Maintenance Manual

VectorStar™ MS4640B Series Microwave Vector Network Analyzer

MS4642B, 10 MHz to 20 GHz, K Connectors

MS4644B, 10 MHz to 40 GHz, K Connectors

MS4645B, 10 MHz to 50 GHz, V Connectors

MS4647B, 10 MHz to 70 GHz, V Connectors

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NOTICE

UPDATES

The latest service and sales contact information, and updated documents can be downloaded from the Anritsu Website at: http://www.anritsu.com

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Chapter 1 — General Information

1-1 Introduction

This manual provides general service and preventive maintenance information for the Anritsu MS4640B models of Vector Network Analyzers. The information includes replaceable parts information, performance verification tests, adjustment procedures, troubleshooting, theory of operation and block diagrams, and assembly/sub-assembly removal and replacement procedures.

Throughout this manual, the terms “MS4640B” and “VNA” will be used interchangeably to refer to all models of the MS4640B series VNA, unless otherwise noted. The individual VNA models are:

- MS4642B, K Connectors, 10 MHz to 20 GHz
- MS4644B, K Connectors, 10 MHz to 40 GHz
- MS4645B, V Connectors, 10 MHz to 50 GHz
- MS4647B, V Connectors, 10 MHz to 70 GHz

This chapter provides a general description of the MS4640B Series VNA, instrument identification numbers, related manuals, options, and required tools for maintenance. Information concerning level of maintenance, replaceable parts, Anritsu exchange assembly program, and preventive maintenance is also included.

1-2 Contacting Anritsu

To contact Anritsu, please visit:

https://www.anritsu.com/contact-us

From here, you can select the latest sales, service and support contact information in your country or region, provide online feedback, complete a “Talk to Anritsu” form to get your questions answered, or obtain other services offered by Anritsu.

Updated product information can be found on your product page:

https://www.anritsu.com/test-measurement/products/ms4640b-series

On this web page, you can select various tabs for more information about your instrument. Included is a “Library” tab which contains links to all the latest technical documentation related to this instrument.

1-3 VectorStar MS4640B VNA Description

The VectorStar™ MS4640B Series Microwave Vector Network Analyzer (VNA) is an instrument system that contains a built-in source, test set, and analyzer. Test results are displayed real time on a front panel touch screen or also to a separate video monitor. Screen captures can easily be printed or saved in common graphic file formats.

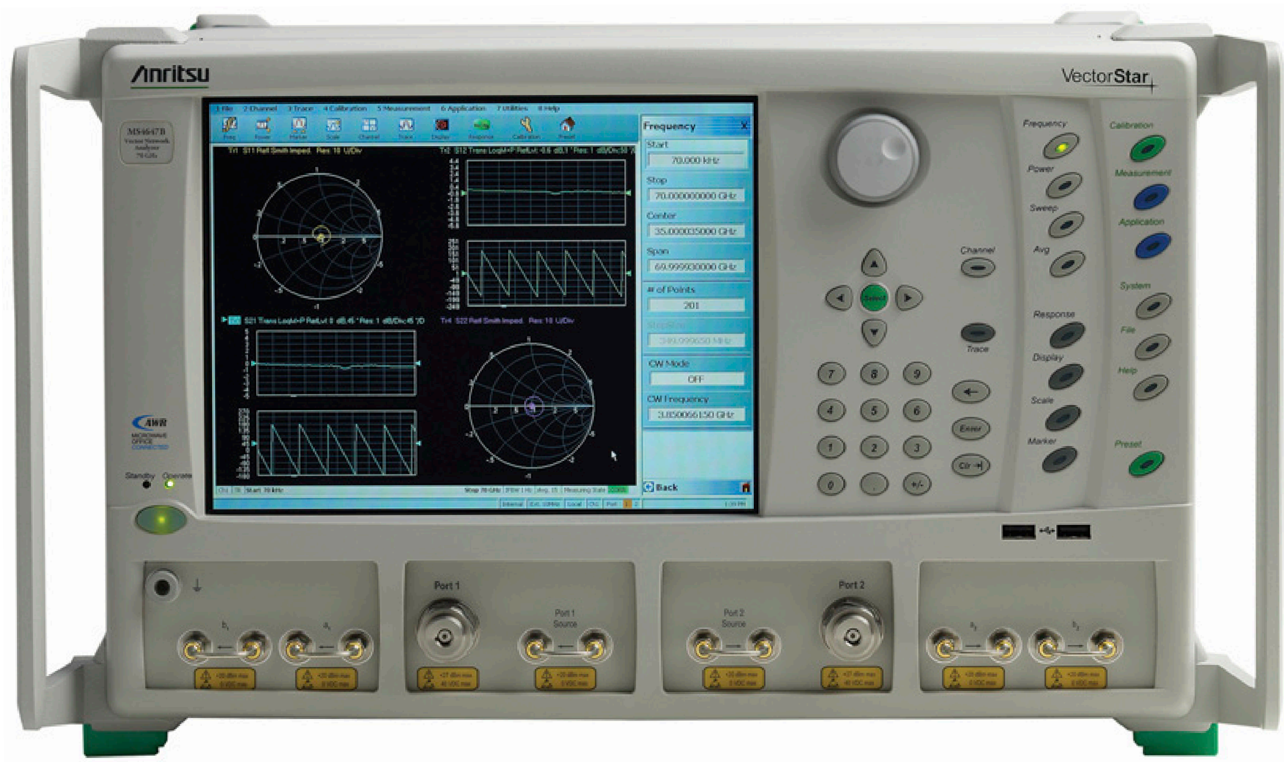


Figure 1-1. VectorStar MS4647B VNA Front Panel – Equipped with Option 62

Depending on the model and installed options, the MS4640B provides a maximum frequency range from 70 kHz to 70 GHz. The instrument can provide either:

- Up to 25,000 total data points in up to 16 channels, and each channel with up to 16 trace displays. Each trace display method can be selected from 17 major display types. Most trace display types can have up to 12 regular markers and one reference marker.
- Up to 100,000 total data points in single channel with up to 16 trace displays. Each trace display method can be selected from 17 major display types. Most trace display types can have up to 12 regular markers and one reference marker.

Figure 1-2. Typical VectorStar VNA Rear Panel

Available Models

The MS4640B Series VNA instrument is available in four models with different frequency range capabilities:

- MS4642B – 10 MHz to 20 GHz – with two K (m) connector test ports
- MS4644B – 10 MHz to 40 GHz – with two K (m) connector test ports
- MS4645B – 10 MHz to 50 GHz – with two V (m) connector test ports
- MS4647B – 10 MHz to 70 GHz – with two V (m) connector test ports

Available Options

The instrument is available with multiple options, calibration kits, performance verification kits, and AutoCal™ modules. The main system options are:

- MS4640B-001 – Rack Mount
- MS4640B-002 – Time Domain Measurements
- MS4640B-004 – Spare Solid State Drive (SSD) with Operating System Software
- MS4640B-007 – Receiver Offset
- MS4640B-021 – Universal Fixture Extraction
- MS464xB-031 – Dual Source Architecture
- MS464xB-032 – Internal Switched RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-036 – Extended Memory
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS46xB-049 – Spectrum Analysis
- MS464xB-051 – Direct Access Loops
- MS4640B-053 – External ALC
- MS464xB-061 – Active Measurements Suite, with 2 Step Attenuators
- MS464xB-062 – Active Measurements Suite, with 4 Step Attenuators
- MS4640B-070 – 70 kHz Low-End Frequency Extension
- MS4647B-080 – MS4647B Broadband/mmWave Connection Capability
- MS4647B-081 – MS4647B Broadband/mmWave Connection Capability
- MS4640B-082 – MS4640B Series Banded mmWave Connection Capability
- MS4640B-083 – MS4640B Series Banded mmWave Connection Capability
- MS4640B-084 – MS4640B Series Banded/Broadband/mmWave Connection Capability
- MS4640B-085 – MS4640B Series Banded/Broadband/mmWave Connection Capability
- MS4640B-086 – MS4640B Series Banded/Broadband/mmWave Connection Capability
- MS4640B-087 – MS4640B Series Banded/Broadband/mmWave Connection Capability
- MS4640B-088 – MS4640B Series Banded/Broadband/mmWave Connection Capability
- MS4640B-089 – MS4640B Series Banded/Broadband/mmWave Connection Capability

For a complete description of available options and their part numbers, refer to the:

- **VectorStar MS4640B Series VNA Configuration Guide and Technical Data Sheet** – 11410-00611.

Identification Number

All Anritsu MS4640B instruments are assigned a seven-digit ID number (Serial Number), such as “1334203”. This number appears on a decal affixed to the rear panel.

When ordering parts or corresponding with Anritsu Customer Service, please use this identification number with reference to the specific instrument model number, installed options, and serial number. For example, a MS4647B, Option 62, Option 70, Serial Number 1234567.

1-4 Additional Documentation

This is one of a six document and manual set that consists of the following:

- Configuration Guide and Technical Data Sheet – 11410-00611
- Operation Manual – 10410-00317
- Programming Manual – 10410-00322
- Programming Manual – Supplement – 10410-00323
- Measurement Guide – 10410-00318

For more information on VNA systems, calibration/verification kits, and other supporting accessories, refer to the Anritsu web site: http://www.anritsu.com.

This and other VectorStar manuals are available for download as PDF files.

Product Information, Compliance, and Safety

Refer to the *VectorStar Product Information, Compliance, and Safety (PICS) – 10100-00063* for applicable product information, compliance statements, and safety information, including links to applicable product web pages.

1-5 Basic Maintenance

Cleaning LCD Display Touch Screen

The touch screen is protected by a plastic display filter. To clean the display filter, dampen a soft cloth with a mild soap and water solution and gently wipe the display filter. Use a soft, clean, lint-free cloth such as those for cleaning computer screens. If liquid cleaner is used, apply it to the cloth and not to the instrument. Do not use abrasive cleaners, tissues, or paper towels. These items can scratch the plastic surface.

Maintaining Operating System Integrity

The Microsoft Windows® operating system on the MS4640B Series VNA is configured for optimum performance when the instrument leaves the factory. To maintain the system’s operating integrity, follow proper Windows shutdown procedure and DO NOT modify the operating system configuration, the firewall settings, the system registry, the solid state drive partitions, or the Anritsu user accounts.

Antivirus Protection

The VectorStar MS4640B Series VNA is tested with most common antivirus software, but stability is not guaranteed with all antivirus software. Anritsu recommends connecting the instrument only to a secure network. The user assumes the responsibility to provide virus protection because this is not supplied with the instrument. Contact your network administrator for information about your network security and antivirus protection policies.

Windows OS Updates

Not all Microsoft updates are compatible with the MS4640B Series VNA and, if installed, may affect the performance of the instrument.

Solid State Drive Data Backup

Anritsu recommends that you make a backup copy of your critical data stored on the VNA solid state drive as often as possible.

Note	Anritsu reserves the right to reformat or replace the VNAs solid state drive as part of the repair. In such incidence, all user data on the drive will be erased.

Troubleshooting and Repair

The VNA modular design, extensive built-in diagnostics, and automated service tools are designed to support fast exchange of functional assembly level repair. Failed assemblies are not field repairable. Once an assembly is found to be faulty, it should be returned to an authorized Anritsu Service Center for exchange. See the description in the section named "Anritsu Exchange Assembly Program" on page 6-1.

The procedures for troubleshooting a failed VNA are described in Chapter 5 — Troubleshooting.

The procedures for replacing failed parts are covered from Chapter 8 through Chapter 19. Refer to the table of contents to find the desired procedure.

Internal Hardware Adjustments and Calibrations

Internal hardware calibrations insure accuracy of system frequency and proper compensation, leveling and flatness of system power at the front panel test ports.

To conduct these calibrations, you need only connect the appropriate test equipment (Frequency Counter or power meter) to the VNA rear panel **Dedicated GPIB** port and initiate the calibration. The VNA will control itself and the externally connected test equipment to perform measurements and store calibration constants in its internal memory.

The procedures for adjusting the VNA are described in Chapter 7 — Adjustment Procedures.

System Test/Certification

Quick operational checkout of the system may be accomplished by the system user or for incoming inspection purposes using the "Operational Checkout procedures" in the MS4640B Operation Manual. Those procedures are useful in quickly verifying that the instrument's primary measurement functions are operational and stable.

Verification of the system's measurement accuracy and full operational testing of the system are detailed in Chapter 3 — Performance Verification.

1-6 Performance Specifications

The performance specifications for all MS4640B models are contained in the following data sheet available online at www.anritsu.com.

- **VectorStar MS4640B Series VNA Configuration Guide and Technical Data Sheet – 11410-00611**

1-7 Electrostatic Discharge Prevention

All electronic devices, components, and instruments can be damaged by electrostatic discharge. It is important to take preventative measures to protect the instrument and its internal subassemblies from electrostatic discharge.

An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-1999 or ANSI/ESD S20.20-2007 is mandatory to avoid ESD damage when handling subassemblies or components found in the MS4640B instruments.

Prior to connecting an extension cable to the VNA test port, take steps to eliminate the static charges built-up on the cable. This can be done by terminating the open-end of the extension cable with the short from the calibration kit and then grounding the outer conductor of the connector on the cable.

1-8 Recommended Test Equipment

Table 1-1 provides a list of recommended test equipment needed for the performance verification, calibration, and troubleshooting procedures presented in this manual.

Table 1-1. Recommended Test Equipment (1 of 2)

Instrument	Critical Specifications	Recommended Manufacturer Model Number	Typical Usage (See Note)
Note Codes for Typical Usage	— “A” = Adjustment/Internal Hardware Calibration — “I” = Instrument Key Parameter Testing — “P” = System Performance Verification — “T” = Troubleshooting		
Frequency Counter	Frequency: 10 MHz Input Impedance: 50 Ohm	Anritsu Model MF2412B or MF2412C	A, I
Frequency Reference	Frequency: 10 MHz	Symmetricom Model RubiSource T&M	A, I
Power Meter	Power Range: –70 to +20 dBm	Anritsu Model ML2438A	A, I
Power Sensor	Frequency: 70 kHz to 70 GHz Connector Type: V	Anritsu Model SC7770	A, I
Adapter	Type: N (m) to K (m)	Anritsu Model 34NK50	A, I
Adapter	Type: N (m) to K (f)	Anritsu Model 34NKF50	A
Adapter	Type: V (f) to K (m) Quantity: 2	Anritsu Model 34VFK50	A
Adapter	Type: V (f) to K (f)	Anritsu Model 34VFKF50	A, I
Adapter	Type: V (f) to V (f) Quantity: 2	Anritsu Model 33VFVF50C	A, I
Adapter	Type: N (m) to V (m)	Pasternack Model PE9718A	A, I
Attenuator	Type: K (m) to K (f) Attenuation: 20 dB	Anritsu Model 43KC-20	A
Attenuator	Type: SMA (m) to SMA (f) Attenuation: 7 dB	Aeroflex/Inmet Model 18B-7	A
Calibration Kit	Connector Type: K	Anritsu Model 3652A or 3652A-1	A, I, P
Calibration Kit	Connector Type: V	Anritsu Model 3654D or 3654D-1	A, I, P
Verification Kit	Connector Type: K	Anritsu Model 3668-1	P
Verification Kit	Connector Type: V	Anritsu Model 3669B-1	P
RF Cable	Frequency: DC to 40 GHz Connector Type: K (m) to K (f) Quantity: 2	Anritsu Model 3670K50-2	A, I, P
RF Cable	Frequency: DC to 70 GHz Connector Type: V (m) to V (f)	Anritsu Model 3670V50A-2	A, I, P

Table 1-1. Recommended Test Equipment (2 of 2)

Instrument	Critical Specifications	Recommended Manufacturer Model Number	Typical Usage (See Note)
Note Codes for Typical Usage	— "A" = Adjustment/Internal Hardware Calibration — "I" = Instrument Key Parameter Testing — "P" = System Performance Verification — "T" = Troubleshooting		
Step Attenuator	With traceable Characterization Data	Anritsu Model SC7974	I
Step Attenuator Controller	—	Anritsu Model SC3796	I
Coaxial Cable	Type: BNC (m) to BNC (m) Impedance: 50 ohm Length: 0.6 meter	Any	A, I
Computer	PC with Windows XP or Windows 7 and National Instruments GPIB hardware and software. **Note:** Only VectorStar software version 2.1.3 and higher runs on Windows 7. The VISA Library must be installed on the hardware.	Any	I, P
GPIB Cable	IEEE 488.2 compliant	Anritsu PN 2100-2	A, I, P
Digital Multimeter	—	Any	T
XGA/VGA Monitor	—	Any	A, I
PC Keyboard	Interface: PS/2 or USB 2.0, US English	Any	A, I
PC Mouse	Interface: PS/2 or USB 2.0	Any	A, I
Oscilloscope	Analog Bandwidth: 100 MHz	Any	I
Adapter	Impedance 50 ohm; SMA (m) to BNC (f)	Pasternack Model PE9074	I

1-9 Recommended Tools and Supplies

The following tools are recommended for servicing the VectorStar MS4640B Series VNA.

Flat Blade Screwdrivers

- Large flat blade screwdriver
- Medium flat blade screwdriver
- Small flat blade screwdriver

Phillips-Head Screwdrivers

- Medium Phillips-head screwdriver
- Small Phillips-head screwdriver

Torque Wrenches

- 4 mm (5/32”) Torque End Wrench set to less than 0.22 N·m (2 lbf·in) – Anritsu 01-511 or equivalent. Used to torque the SSMC connectors on the 3743A mmWave Modules that are a component of the ME7838A Broadband/mmWave System.
- 6 mm Torque End Wrench set to 0.45 N·m (4 lbf·in) – Anritsu 01-504 or equivalent. Used to torque W1 and similar connectors.
- 6 mm / 7 mm Open End Wrench – Anritsu 01-505 or equivalent. Used to back the torque wrench above.
- 8 mm (5/16”) Torque End Wrench set to 0.9 N · m (8 lbf · in) – Anritsu 01-201 or equivalent. For tightening male devices and used to torque the Direct Access Loops, the rear panel loops, and the SMA, 3.5 mm, 2.4 mm, K, and V connectors throughout the chassis and RF Deck.
- 8 mm (5/16”) Torque Socket Wrench set to 20 lbf · in – Mountz TB-06004D or equivalent with 8 mm (5/16”) socket.
- 1/2” Torque End Wrench – 50 lbf · in – Utica TCI-150RA or equivalent with 1/2” socket. Used to torque the RF Deck Sub Panel Connector nuts.
- 1/2” Torque End Wrench – 36 lbf · in – Mountz MTBN10 or equivalent with 1/2” socket. Used to torque the Test Port Adapters.
- 3/4” Torque End Wrench – 12 lbf · in – Anritsu 01-200 or equivalent.
- 13/16” (20.6 mm) Torque End Wrench – 0.9 N · m (8 lbf · in) – Anritsu 01-203 or equivalent. Used to tighten the VNA test ports to female devices.
- 13/16” (20.6 mm) Torque Socket Wrench – 15 lbf · ft – Craftsman 009-44594 or equivalent with 13/16” deep socket on 3/8” drive. Used to torque the Port Connector Nut to 15 lbf · ft.

Nut Drivers, Hex Drivers, Allen Wrenches, and Ratchet Wrenches

- Nut Driver – M3
- Nut Driver – 1/4”
- Nut Driver – 11/32”
- Nut Driver – 3/16”
- Hex Allen Wrench – 8 mm – T-Handle recommended

End Wrenches

- Universal circular end wrench, for SMA, 3.5 mm, 2.4 mm, K, and V connectors – Anritsu 01-204.
- Open End Wrench – 6 mm
- Open End Wrench – 22 mm
- Open End Wrench – 5/16”
- Open End Wrench – 7/16”
- Open End Wrench – 7/32”

Socket Wrenches and Sockets

- Socket Wrench – 5 mm
- Socket Wrench – 7 mm
- Socket Wrench – 8 mm
- Socket – 1/2” Socket (for 50 lbf · in torque wrench)
- Socket – 13/16” socket with 1/2” drive (for 15 lbf · ft torque wrench)
- Socket – 5/16” Socket (for 20 lbf · in torque wrench)

Pliers and Cutters

- Diagonal wire cutters
- Needle-Nose pliers
- Pliers
- Wire Stripper

Cleaning Supplies

- Appropriate commercial cleaner compatible for use on an LCD display, front and rear panels, instrument model identity labels, and instrument external covers. *Do not use alcohol or other solvents*.
- LCD Cleaning Cloth – Use a soft, clean, lint-free cloth to clean the LCD screen. If liquid cleaner is used, apply it to the cloth and not the instrument.

1-10 Recommended T3545 RF Deck Fixture

T3545 RF Deck Fixture is used to hold a removed RF Deck (any model, any combination of options) in order to service deck-mounted modules and PCBs. The fixture protects protruding top and bottom loops and attaches to the deck using four (4) M5 × 8 mm screws. If multiple uses are anticipated, obtain Knob Head M5 × 8 mm screws to speed fixture setup. Refer to Figure A-1, “T3545 – RF Deck Maintenance Fixture – 62036” on page A-2.

Chapter 2 — Theory of Operation

2-1 Introduction

This chapter provides a brief overview of the functional assemblies and major parts that comprise the MS4640B VNA system. It also briefly describes the operation of each major assembly.

2-2 System Overview

MS4640B Series Vector Network Analyzers are ratio measurement systems used to measure complex vector signal characteristics of devices and systems in the 70 kHz to 70 GHz frequency range.

The MS4640B performs complex vector signal measurements by sourcing a stimulus signal to the Device Under Test (DUT) that is connected to the front panel Port 1 and/or Port 2 connectors. It simultaneously measures the DUT response, which consists of reflected and/or transmitted (attenuated or amplified) signals at the connectors of the DUT. The reflected and/or transmitted signals and a sample of the stimulus signal are down converted to intermediate frequency (IF) signals.

These IF signals are then converted into digital information and processed by a Digital Signal Processor (DSP) to determine the real and imaginary vector components of the signal being measured. The information is then normalized for the desired S-parameter and presented to the user via the front panel color LCD display.

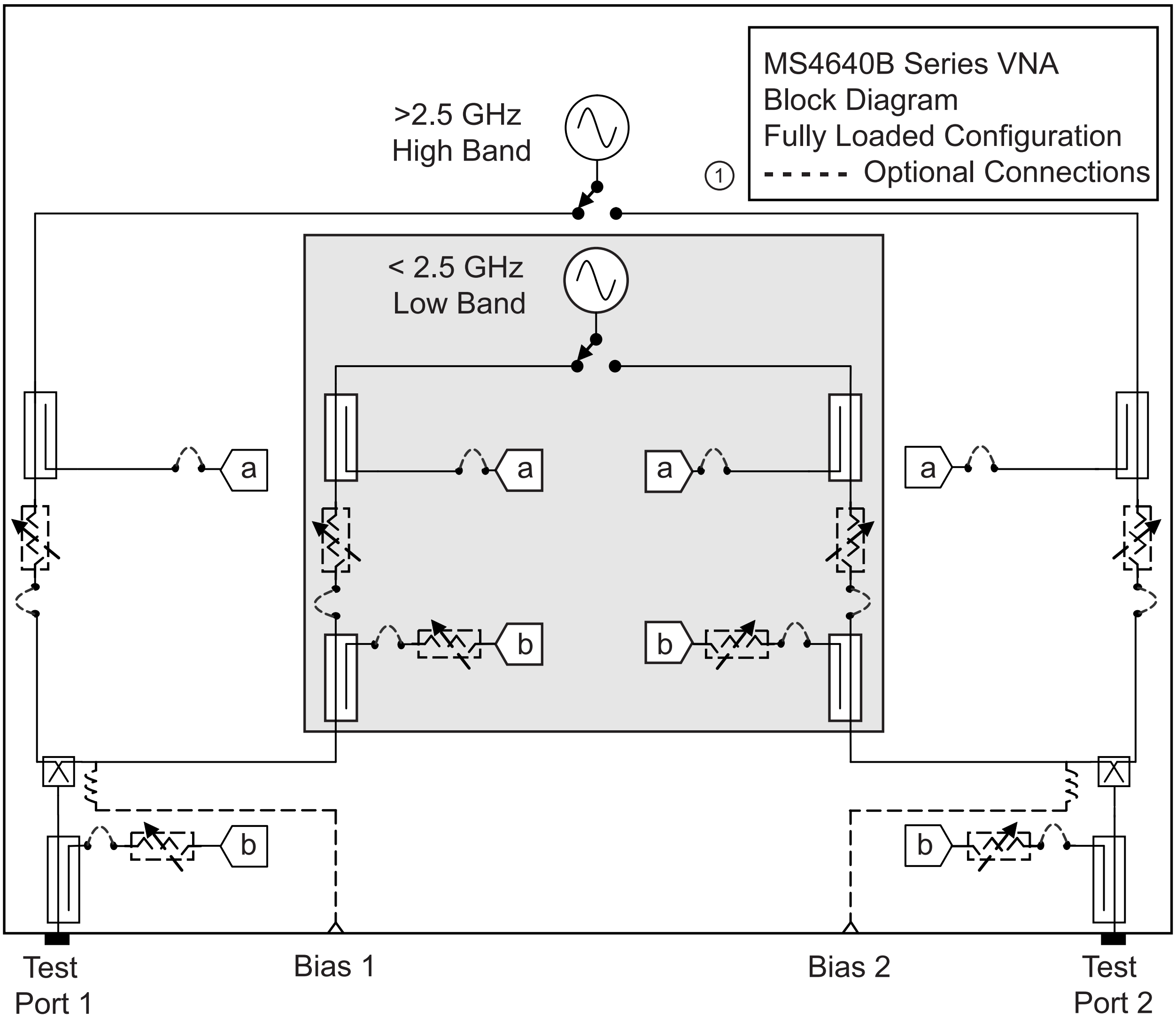
A keypad and a rotary knob on the front panel as well as a touch screen on the LCD display provide user interaction with the MS4640B Single Board Computer. External PC mouse and PC keyboard are also supported via either the PS/2 and USB connectors on the rear panel or the USB connectors on the front panel.

The MS4640B is equipped with a solid state drive for storage and retrieval of data and front panel setup information. The USB connectors on the front and rear panels also allow using a USB memory device (a “USB flash drive”) for data and front panel setup information storage.

The MS4640B implements an IEEE488.2 interface. This interface allows an externally connected GPIB controller to control the MS4640B in the “Remote Only” mode.

2-3 System Description

The MS4640B Vector Network Analyzer essentially incorporates two Vector Network Analyzers in one instrument. It consists of a Low Band section and a High Band section. The frequency break point of these two sections is 2.5 GHz. See Figure 2-1.



1. Items with broken (dashed) lines are optional connections.

Figure 2-1. VectorStar MS4640B Series VNA Simplified Block Diagram

2-4 Functional Description of Major Assemblies

The MS4640B internal assemblies and components can be divided into four major groups depending on their mounting location inside the instrument as shown in Figure 2-2:

- Analog Section
- RF Deck
- Digital Section
- Main Chassis Assemblies

Brief functional descriptions of the major sub-assemblies and components by these major groups are listed in the sections following Figure 2-2.

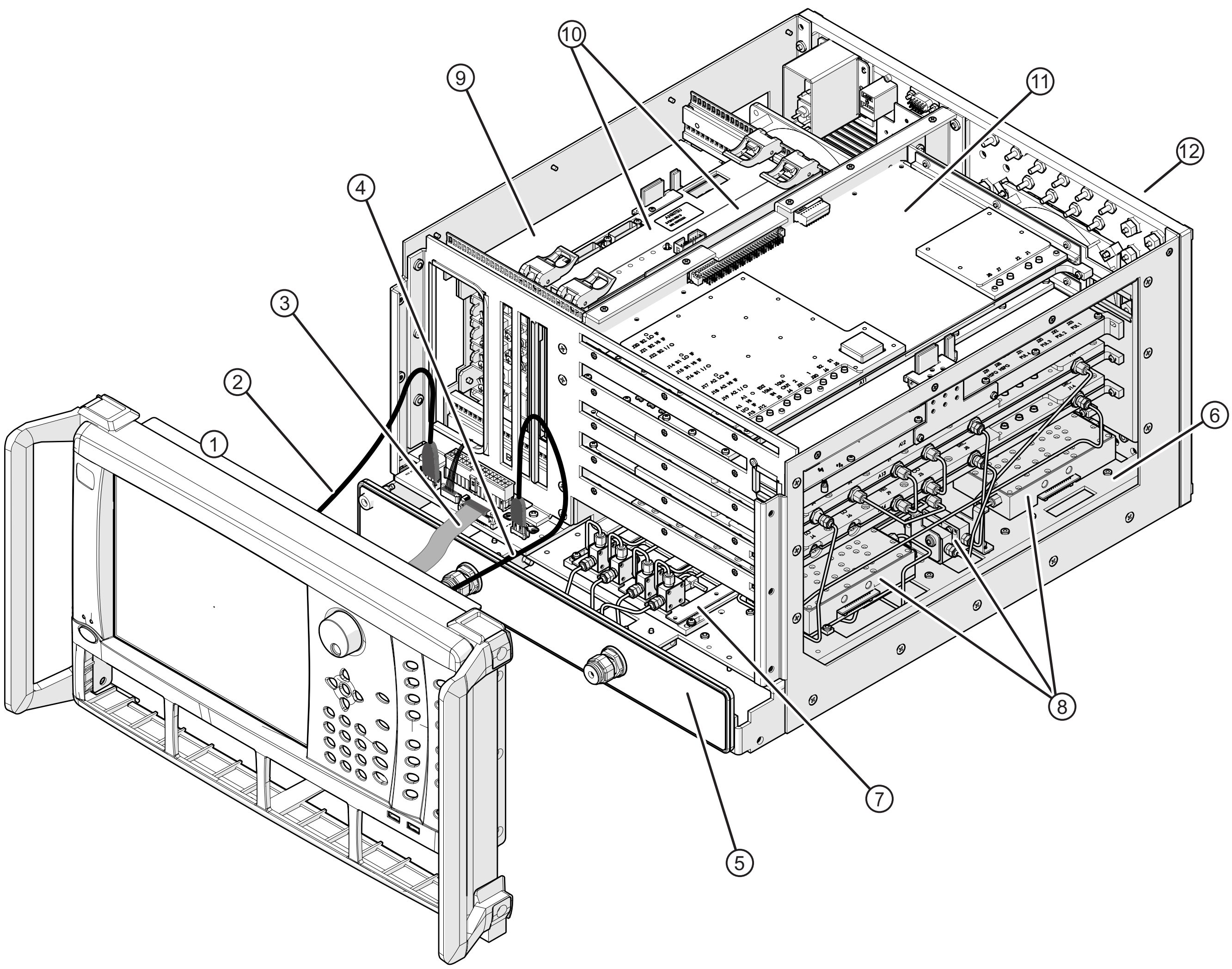


Figure 2-2. MS4640B Series VNA Typical Internal Assemblies and Components (1 of 2)

Front Panel

1. Front Panel Assembly
2. Front Panel USB Cable
3. Front Panel Ribbon Cable
4. Front Panel HDMI Cable

RF Deck

5. RF Deck Front Panel
6. RF Deck inside chassis

Sampler/LO Distribution Module Assembly

7. Sampler/LO Distribution Module Assembly – The exact configuration depends on the instrument equipped options. Typical components consist of:

    A111 LO Distribution Module (bottom)

    A100 Sampler Module (left on top of A111)

    A101 Sampler Module (left center on top of A111)

    A102 Sampler Module (right center on top of A111)

    A103 Sampler Module (right on top of A111)

RF Deck Top Side Modules

8. RF Deck Top Right Side Modules – Consisting of:

    A113 5-20 GHz Doubler Module (rear)

    A213 5-20 GHz Doubler Module (front – with Option 31)

    A116 Low Band Bridge Module (rear)

    A117 Low Band Bridge Module (front)

Top Side Assemblies

9. Power Supply Module
10. Digital PCB Assemblies
11. Analog Module Assemblies

Rear Panel

12. Rear Panel

Figure 2-2. MS4640B Series VNA Typical Internal Assemblies and Components (2 of 2)

2-5 Analog Section

The Analog section is located on the right side of the instrument. It consists of the following module assemblies:

- RF Source Module
- Second Source Module (Optional)
- Low Band Receiver Module
- IF Band Module
- IF Digitizer Module (Optional)

RF Source Module

The RF Source Module generates the primary source and the local oscillator (LO) outputs. The module contains the phase lock circuitry for the oscillators, circuitry to generate different output frequency bands spanning 70 kHz to 5000 MHz, and output amplifiers. Both the source output level and the local oscillator output level are controllable via Auto Level Control (ALC) loops.

The Source and LO RF outputs are both generated by voltage controlled oscillators (Main VCOs) that nominally span 2.5 to 5.0 GHz. The outputs of the Main VCOs are either passed out of the module directly for High Band Mode or are used to mix down to frequencies of 70 kHz to 2.5 GHz for the Source output and ~12 MHz to 2.5 GHz for the LO output for the Low Band Mode.

There are two heterodyne oscillators (HET VCOs), one for the Source and one for the LO. In the Low Band Mode, these two HET VCOs are mixed against the outputs of the Source Main VCO and LO Main VCO to generate frequencies less than 2.5 GHz. Nominally, the HET VCO is set to 5 GHz for output frequencies less than 1.5 GHz and 6 GHz for output frequencies higher than 1.5 GHz. However, the output of the HET VCO can vary by approximately 100 MHz from the nominal values due to spur avoidance. If not operating in the Low Band Mode, the HET VCO is set to 5.5 GHz.

Additionally, the outputs of the Main VCOs are sampled and fed back, in order to allow phase-locking to the system 10 MHz reference. The phase locking circuitry for the Source and LO VCOs are essentially identical in their implementation.

When phase locking the Main VCO, the VCO is mixed with an offset oscillator (Offset VCO) to produce a lower frequency signal. This mixed down signal is fed into a phase detector where it is compared against a signal produced by a Direct Digital Synthesis (DDS) IC.

To improve harmonics and spurious characteristics of the output signals, they are passed through low pass filter sections. A 5000 MHz Low Pass Filter is placed at the High Band LO signal output. Additionally, there is a switched filter section in the LO High Band path that is enabled for outputs less than 3175 MHz. Only fixed 2500 MHz Low Pass Filters exist in the Low Band Source and LO outputs.

The RF Source Module can operate in two modes:

- Common Offset Mode
- Independent Offset Mode

RF Source Module Common Offset Mode

When in this mode of operation, the LO Offset VCO is shared and locks up both the source and LO loops. The Source Offset VCO is disabled in this mode. The DDS outputs for the Source and LO make up the frequency difference between the two outputs. Sharing a common offset VCO allows the two signal sources to more closely track each other. The resulting Intermediate Frequency (IF) has better phase noise because much of the offset VCO noise is ratioed out.

To make accurate measurements, the IF must be settled before the DSP processing is triggered. When operating in common offset mode, the IF settles faster. Even though the common offset VCO (and therefore both main VCOs) may still be slewing in phase, the IF itself may already be settled because the Source and LO are tracking each other. The two main VCOs are able to track the offset VCO settling because of their high bandwidths. Therefore in general, measurements can be made sooner in the common offset mode, and overall system speed is thus faster.

When in Low Band Mode, the LO HET VCO is also shared by both the Source and LO and the Source HET VCO is disabled.

However, the common offset mode can only be used when the Source and LO frequencies are relatively close. The range of the DDS limits the allowable frequency difference. Furthermore, the Source and LO must be operating in the same frequency band. Common offset mode is most beneficial for typical S-parameter measurements where speed is an important parameter.

RF Source Module Independent Offset Mode

When operating in this mode, the Source and LO output signals are generated independently. Each main loop is fed by a separate offset VCO and also Low Band signal generation is performed by two independent HET VCOs. This mode is for measurements that require the Source and LO be far apart in frequency.

Operation in Independent Offset Mode enables the Source and LO to be arbitrarily apart in frequency. One output could be sending out a High Band signal, while the other output is creating a Low Band signal.

Source and LO Signal Output Ports

There are two sets of output ports for both the Source and LO signals. These ports route separately to either the High Band branch of the instrument or the Low Band branch of the instrument. Only one frequency band is active at a given time for either the Source or LO. However, the Source and LO do not necessarily have to be in the same band – one could output a High Band frequency, while the other generates a Low Band frequency.

The High Band Outputs for the Source and LO, respectively, are J14 and J4. The Low Band LO output is at J6 and the Low Band Source output is at J8. The Main VCO output is switched into one or the other of these two paths.

Feedback from a level detector adjusts the level of the RF output for the Source. There are three separate level detectors – two for the High Band path located on the RF Deck and one for the Low Band path located within the RF Source Module. The two high band level detectors provide separate feedback for forward and reverse signal paths. The inputs from these level detectors are switched into the ALC loop, depending on the frequency band of operation.

This module also supplies the External Analog Output that is routed to the rear panel. Based on the user definition this output is generated by a DAC that can vary from –10V to +10V.

Second Source Module

For units equipped with Option 31, the optional Second Source Module generates the source signal for Port 2. The module contains the phase lock circuitry for the oscillators, circuitry to generate different output frequency bands spanning 70 kHz to 5000 MHz, and output amplifiers. The source output level is controllable via Auto Level Control (ALC) loop.

The Source output is generated by voltage controlled oscillator (Main VCOs) that nominally span 2.5 to 5.0 GHz. The output of the Main VCO is either passed out of the module directly for High Band Mode or is used to mix down to frequencies of 70 kHz to 2.5 GHz for the Source output.

In the Low Band Mode, the output of the heterodyne oscillator (HET VCO) is mixed against the output of the Source Main VCO to generate frequencies less than 2.5 GHz. Nominally, the HET VCO is set to 5 GHz for output frequencies less than 1.5 GHz and 6 GHz for output frequencies higher than 1.5 GHz. However, the output of the HET VCO can vary by approximately 100 MHz from the nominal values due to spur avoidance. If not operating in the Low Band Mode, the HET VCO is set to 5.5 GHz.

Additionally, the output of the Main VCO is sampled and fed back, in order to allow phase-locking to the system 10 MHz reference.

When phase locking the Main VCO, the VCO is mixed with an offset oscillator (Offset VCO) to produce a lower frequency signal. This mixed down signal is fed into a phase detector where it is compared against a signal produced by a Direct Digital Synthesis (DDS) IC.

A fixed 2500 MHz Low Pass Filter exists in the Low Band Source output to improve harmonics and spurious characteristics of the output signal.

When in the common offset mode of operation, the LO Offset VCO signal of the RF Source Module is used to lock up the Second Source Main VCO loop. The Second Source Offset VCO is disabled in this mode. When in Low Band Mode, the RF Source LO HET VCO signal is also shared by the Second Source module and the Second Source HET VCO is disabled.

There are two sets of output ports for the Source signals. These ports route separately to either the High Band branch of the instrument or the Low Band branch of the instrument. Only one frequency band is active at a given time.

The High Band Output port is at J14. The Low Band Source output port is at J8. The Main VCO output is switched into one or the other of these two paths.

Feedback from a level detector adjusts the level of the RF output for the Second Source. Two separate level detectors – one for the High Band path located on the RF Deck and one for the Low Band path located within the RF Source Module. The inputs from these level detectors are switched into the ALC loop, depending on the frequency band of operation.

Low Band Receiver Module

The Low Band Receiver Module provides frequency conversion from low band (70 kHz to 2.5 GHz) to IF (5-20 MHz) for ALL measurement channels. It also provides IF signal amplification.

IF Band Module

The primary function of the IF Band Module is to take the system intermediate frequency (IF) signals from both the Low Band branch and High Band branch, perform some analog conditioning on them and then digitize them with the data to be sent on to the Digital Signal Processor (DSP) Module.

In summary, the IF Band Module performs the following tasks:

- IF multiplexing
- Gain ranging
- IF anti-alias filtering
- Analog to Digital conversion
- Formatting data for transmission to the DSP Module

In addition, the IF Band Module handles some infrastructure tasks such as 10 MHz generation, switching and distribution, analog monitor multiplexing (External Analog In included), and clock generation for the A/D converters, and IF calibrations. A simple state machine is also included for handling status line events and measurement triggering.

IF Digitizer Module

For units equipped with Option 35, the optional IF Digitizer Module generates time records of high data rate samples from multiple channels for the purpose of pulse measurements. It also contains the pulse generators and modulation synthesizer for various pulse measurement applications.

Adding Option 36, Extended IF Digitizer Memory to Option 35 provides additional memory for the IF digitizer option to allow for longer record lengths. This option increases the maximum record length from 0.5 seconds to 2.5 seconds at the maximum sampling rate (minimum time resolution) with proportionate increases in record length increases at other sampling rates.

In the S-parameter measurement mode, the module passes the analog IF signals from Low Band Module and Samplers to the IF Band Module for signal processing.

In pulse measurement mode, this module conditions the IF signals, samples the data at a relatively high data rate, stores the data on the internal memory and moves the data directly to the instrument's Single Board Computer via PCIe bus.

2-6 RF Deck

The RF Deck is located on the bottom side of the instrument. It consists of the RF Component Control PCB Assembly and RF/Microwave components for the MS4640B Vector Network Analyzer. These components perform the following:

- Stimulus signal routing from the signal source to the DUT through one of the test ports (Port 1 or Port 2)
- Signal separation of the incident, reflected and transmitted signals
- Down conversion of the incident, reflected and transmitted signals for High Band
- Stimulus signal and test signal attenuation
- Source/LO signal frequency multiplication

RF Component Control PCB Assembly

The RF Component Control PCB Assembly provides bias and control signals for operating the following components:

- 5-20 GHz Doubler Module
- Switched Doubler Module
- Switched Quadrupler Module
- Low Band Transfer Switch
- High Band Transfer Switch
- LO Module
- Low Band Source Attenuator(s)
- Low Band Test Attenuator(s)
- High Band Source Attenuator(s)
- High Band Test Attenuator(s)

This PCB assembly also provides Bias Tee voltage switching control and amplification for the outputs of the High Band ALC Level Detectors.

5-20 GHz Doubler Module

Depending on the frequency of operation, the stimulus signal from the High Band Source Output of the RF Source Module passes into one of the three internal paths in the 5-20 GHz Doubler Module. The 5-20 GHz Doubler Module has three internal paths:

- Through
- Doubler
- Doubler -Doubler

For operation between 2.5 to 5 GHz, the stimulus signal is routed to the “Through” path. For operation between 5 to 10 GHz, the stimulus signal is routed to the “Doubler” path. For operation between 10 GHz to 20 GHz, the stimulus signal is routed to a second internal Doubler after it has passed through the first Doubler.

Switched Doubler Module

Depending on the frequency of operation, the Switched Doubler Module either passes the 2.5 GHz to 20 GHz stimulus signal from the 5 to 20 GHz Doubler Module directly to its output or doubles the frequencies for operation between 20GHz to 40 GHz. For the MS4645B and MS4647B VNA, this module is used for operation between 20 and 38 GHz.

Switched Quadrupler Module

The Switched Quadrupler Module quadruples the stimulus signal for operation between 38 and 70 GHz.

Low Band Transfer Switch

The Low Band Transfer Switch is controlled by the DSP Module to set the direction of the stimulus signal flow for the desired test (Port 1 = S11, S21; Port 2 = S22, S12) for frequencies below 2.5 GHz. This switch is not used on units equipped with Option 31.

High Band Transfer Switch

The High Band Transfer Switch is controlled by the DSP Module to set the direction of the stimulus signal flow for frequencies above 2.5 GHz. The 70 GHz version of Transfer Switch also has an additional integrated switch which multiplexes the stimulus signal from the Switched Doubler Module and Switched Quadrupler Module to the second switch. This switch is not used on units equipped with Option 31.

Level Detectors

The Level Detector provides feedback to the RF Source Module for High Band stimulus signal automatic leveling control (ALC).

Diplexer/Bias Tee Assembly

The Diplexer multiplexes the Low Band stimulus signal and High Band stimulus signal to the VNA Test Port. It also separates and routes the test signal from the VNA Test Port to the Low Band branch. The integrated Bias Tee in this assembly allows a DC supply to be used as a source for supplying bias to the DUT via the test port center conductor along with the stimulus signal.

Low Band Receiver Bridges

The Low Band Receiver Bridge samples the Low Band stimulus signal and routes the sample to the Reference signal input (a1 or a2) of the Low Band Receiver Module.

Low Band Test Bridges

The Low Band Test Bridge separates the Low Band test signal (Reflected or Transmitted) from the stimulus signal and routes the test signal to the Test signal input (b1 or b2) of the Low Band Receiver Module.

High Band Reference Couplers

The High Band Reference Coupler samples the High Band stimulus signal and routes the sample to the Reference Sampler Module (a1 or a2).

Port Couplers – Port 1 and Port 2

The Port Coupler separates the High Band test signal (Reflected or Transmitted) from the stimulus signal and routes the test signal to the Test Sampler Module (b1 or b2). It also allows the Low Band test signal to pass through and is fed to the Diplexer to be routed to the Low Band branch.

Sampler Modules

The Sampler Module uses the LO signal from the LO Distribution Module to convert the Microwave band signal above 2.5 GHz to Intermediate Frequency (IF) signals in the range of 10 to 20 MHz.

LO Module

Depending on the frequency of operation, the LO Module distributes the 2.5 to 5 GHz LO signals from the High Band LO Output of the RF Source Module to the Sampler Modules with frequency either unchanged or doubled to 5 to 10 GHz. The built-in level detector provides feedback to the RF Source Module for high band LO signal automatic leveling control.

Low Band Source Attenuators

The optional Low Band Source Attenuators can be used to attenuate the stimulus signal in 10 dB steps for frequencies below 2.5 GHz. They are in units with Options 61 and 62.

Low Band Test Attenuators

The optional Low Band Test Attenuators can be used to reduce the test signal in 10 dB steps for frequencies below 2.5 GHz. They are in units with Options 61 and 62.

High Band Source Attenuators

The optional High Band Source Attenuators can be used to attenuate the stimulus signal in 10 dB steps for frequencies above 2.5 GHz. They are in units with Options 61 and 62.

High Band Test Attenuators

The optional High Band Test Attenuators can be used to reduce the test signal in 10 dB steps for frequencies above 2.5 GHz. They are in units with Option 61 and 62.

RF Coupler

The optional RF Coupler is used to pick off the stimulus signal and route the signal to the front panel RF Out connector(s) on units equipped with Options 80, 81, 82, 83, 84 and 85.

LO Coupler

The optional LO Couplers are used to pick off the LO signals from a1 and a2 Samplers and route the signals to the front panel LO1 and LO2 connectors on units equipped with Options 80, 81, 82, 83, 84 and 85.

Forward Coupler

On units equipped with Option 31, Forward Couplers are used to multiplex the outputs of the Switched Doubler Module and the Switched Quadrupler Module.

High Band Source 2 Switch

In Broadband configurations on units equipped with Options 84 or 85 and Option 31 and NOT Option 32, an optional High Band RF Switch shuts off the RF power from Port 2 to the millimeter wave module during forward sweep.

In Broadband configurations on units equipped with Option 32, the same optional High Band RF Switch (frequencies equal or above 2.5 GHz) is used to route High Band Source 2 stimulus signal to either the Port 2 output path or to the Port 1 output path (Source 2 stimulus is coupled to the Source 1 stimulus thru the High Band Source 2 to Port 1 Coupler).

Low Band Source 2 Switch

In Broadband configurations on units equipped with Option 32, an optional Low Band RF Switch (frequencies below 2.5 GHz) is used to route Low Band Source 2 stimulus signal to either the Port 2 output path or to the Port 1 output path (Source 2 stimulus is coupled to the Source 1 stimulus thru the Low Band Source 2 to Port 1 Bridge).

High Band Source 2 to Port 1 Coupler

In Broadband configurations on units equipped with Option 32, an optional High Band Coupler (frequencies equal or above 2.5 GHz) is used to multiplex the High Band Source 2 stimulus signal with the High Band Source 1 stimulus signal which then feeds into the Port 1 output path.

Low Band Source 2 to Port 1 Bridge

In Broadband configurations on units equipped with Option 32, an optional Low Band Bridge (frequencies below 2.5 GHz) is used to sample the Low Band Source 2 stimulus signal and route this sampled signal with the Low Band Source 1 stimulus signal which then feeds into the Port 1 output path.

2-7 Digital Section

The Digital Section is located on the left side of the instrument. Table 2-1 shows a summary of the Digital Section PCBs and related assemblies.

Table 2-1. Digital Section PCBs and Assemblies

Assembly
Single Board Computer PCB – ND75953 (For VNA serial numbers below 1546700.) Single Board Computer PCB – ND82106 or 3-ND82106 (For VNA serial numbers 1546700 and above.)
Small Outline Dual-In line Memory PCB – 2 each
A10 Digital Signal Processor PCB
A4 USB Controller PCB
Graphics Processor Unit PCB
A8 GPIB Module PCB
Carrier Board
Solid State Disk Assembly – ND75952 (For VNA serial numbers below 1546700) Solid State Disk Assembly – ND82107 or 3-ND82107 (For VNA serial numbers 1546700 and above)

Single Board Computer

The Single Board Computer (SBC) controls operation of the entire instrument via CompactPCI (cPCI) interface; handles user interaction from the touch screen, front panel keys, external mouse and external keyboard; and performs data processing and formatting for measurement presentation.

It contains 4 Gigabytes of DDR3 DRAM. On-board peripherals include SATA Controller, USB Controller, Ethernet Controller, and PCI Express (PCIe) interface. This SBC is mounted on the Carrier Board.

Digital Signal Processor Module

The Digital Signal Processor Module receives high-speed analog-to-digital data from the IF Band Module, performs signal processing, and makes the results available to the Single Board Computer for further processing and display.

This module plugs into standard CompactPCI (cPCI) connectors on Motherboard 2 PCB Assembly. The module also has other custom connectors that provide an interface to the control bus of the instrument.

This module also handles the I/O Connector signals and Dedicated GPIB Connector signals.

The Single Board Computer communicates with the Digital Signal Processor Module through the cPCI bus.

Graphics Processor Unit Module

The Graphics Module is a high performance dual-display controller with at least 512 MBytes of internal DRAM. Its Transition Minimized Differential Signaling TMDS interface supports the digital flat panel display. Its DVI interface supports the external XVGA interface. Both the digital flat panel display and the external XVGA display can be driven simultaneously. It is mounted on the Carrier Board and interfaces with the Single Board Computer via PCI Express PCIe bus.

GPIB Module

The GPIB Module manages the IEEE-488 General Purpose Interface Bus (GPIB) linked to the System GPIB connector on the rear panel. It also translates the bi-directional data back and forth between the Single Board Computer and the System GPIB bus. In addition, it also supports the Dedicated GPIB Interface.

The GPIB Module is mounted on the Carrier Board.

USB Controller Card

The USB Controller Card adds a second USB controller to the Single Board Computer. It is mounted to the PMC bus connector on the Carrier Board.

Carrier Board

The Carrier Board provides the interfaced for mounting the Single Board Computer, the Graphic Processor Unit, the GPIB Module, and the USB Controller Card. It bridges these devices together as a digital sub-system. Its CompactPCI (cPCI) interface links the Single Board Computer to the DSP Module as well as adding an RS-232C interface to the Single Board Computer.

Solid State Drive Assembly

The Solid State Drive Assembly is a data storage device with an interface conformed to SATA (Serial Advanced Technology Attachment) standards. It is connected directly to the Motherboard 2 PCB Assembly. The Operating System software and VectorStar Application software are stored on this assembly.

2-8 Main Chassis Assemblies

The major assemblies mounted to the basic frame of the VNA are:

- Motherboard 1 PCB Assembly
- Motherboard 2 PCB Assembly
- Power Supply
- Front Panel Assembly
- Rear Panel PCB Assembly

Motherboard 1 PCB Assembly

The Motherboard 1 PCB Assembly provides signal routing and DC power distribution paths for the Low Band Receiver Module, IF Band Module, RF Source Module, Second Source Module and IF Digitizer Module. It also links these modules to the Motherboard 2 PCB Assembly via backplane connectors.

Motherboard 2 PCB Assembly

The Motherboard 2 PCB Assembly provides signal routing and DC power distribution paths for the:

- Single Board Computer
- Digital Signal Processor Module
- The Carrier Board
- Front Panel Assembly
- RF Component Control PCB Assembly
- Motherboard 1 PCB Assembly

The Motherboard 2 PCB also contains the:

- SATA Solid State Drive interface
- Analog Section Fan power source
- Digital Section Fan power source
- Rear Panel PS/2 Mouse and Keyboard interfaces
- Rear Panel USB interface
- Rear Panel Ethernet interface

Power Supply

The total available power of the power supply is rated at 450 Watts. The power supply outputs are divided into three groups of Analog, Digital, and Common. The output voltages are routed throughout the instrument via the Motherboard 2 PCB Assembly.

- The Analog outputs include +12 V, +6 V, +4.1 V.
- The Digital outputs include +12 V, +5 V and +3.3 V
- There is one Common output which is –12 V

Front Panel Assembly

The Front Panel Assembly performs the following functions:

- Display measurement data and status information
- Provide an interface for user input of measurement setup and control information, via a touch screen, keys and a rotary knob
- Acts as a structural member of the instrument enclosure
- Provides RF shielding for the front of the instrument

The front panel consists of the front panel, the front panel rotary knob, the front panel control/interface PCB, the USB A Interface connectors, and a 26 cm (10.4 in) diagonal TFT type XGA Color Liquid Crystal Display with touch screen.

The graphic data from the instrument are sent from the Graphic Processor Unit Module via Transition Minimized Differential Signaling (TMDS) interface to the Motherboard 2 which then sends the data via HDMI interface to the front panel assembly.

Touch screen and key interaction data are communicated to the instrument Single Board Computer via the USB Interface.

The power switch signals the power control logic of the instrument through both the USB interface and the RS-232 interface.

Angular rotational displacement information of the rotary knob is converted into a digital signal which is sent to the Single Board Computer via the RS-232 interface. This rotary knob can also be pushed in, activating a key press that will be sent as key data over the USB interface.

Controls for back-illumination of all keys are sent via the RS-232 interface.

The control, signal, and power connections are through three (3) cables (HDMI, USB, and Power/Signal).

Rear Panel Assembly

The rear panel assembly provides the mechanical support for the A17 Rear Panel PCB Assembly, the Analog Fan Assembly, and the following input and output connectors:

- 10 MHz In
- 10 MHz Out
- Analog In 1 and Analog In 2
- a1 IF, b1 IF, a2 IF, b2 IF
- Ext Analog Out
- Ext Trigger
- Lock Status
- Ready for Trigger
- Trigger Out
- Port 1 Bias Input and Port 2 Bias Input (optional)
- Ext ALC 1 and Ext ALC 2 (optional)
- P Gen 1, P Gen 2, P Gen 3, P Gen 4 (optional)
- Pulse Sync In and Pulse Sync Out (optional)

Rear Panel PCB Assembly

The A17 Rear Panel PCB Assembly contains the:

- RS-232 interface
- System GPIB interface
- Dedicated GPIB interface
- Auxiliary (AUX) I/O interface
- Trigger Out interface
- External Trigger interface

2-9 Overall Operation

Low Band Operation

The 70 kHz to 2.5 GHz stimulus signal from the Low Band Source Out connector of the RF Source Module is switched via the Low Band Transfer Switch between the front panel Port 1 and Port 2 connectors. The Low Band Transfer Switch is controlled by the DSP Module via the RF Component Controller PCB Assembly to set the direction of the signal flow for the desired test. The stimulus signal is then passed through the Low Band Receiver Bridge, Low Band Test Bridge, Diplexer/Bias Tee Assembly and Port Coupler. The stimulus signal is output to the DUT via the Port Couplers mounted directly to the Port 1 and Port 2 front panel connectors.

A sample of the stimulus signal is picked off the Low Band Receiver Bridge and routed to the Reference signal input of the Low Band Receiver Module.

The reflected and transmitted device-under-test (DUT) signals are received simultaneously via the Port 1 and Port 2 Couplers. These signals are then passed via the Diplexer/Bias Tee Assembly to the Low Band Test Bridge.

Due to the directional characteristic of the Low Band Test Bridge, the test signal is separated from the stimulus signal and then routed to the Test Signal Inputs of the Low Band Receiver Module.

In the Low Band Receiver Module, the sampled stimulus signals (Reference) and test signals (Reflected or Transmitted) are then mixed with the 12 MHz to 2.5 GHz LO signal from the Low Band LO Out connector of the RF Source Module to generate IF signals in the range of 5 to 20 MHz.

The IF signals are then multiplexed to the A/D converters in the IF Band Module. The A/D converters digitize the IF signals and send the data to the DSP Module via the high-speed LVDS bus.

The DSP Module performs signal processing, and makes the results available to the Single Board Computer for further processing and display.

High Band Operation

The 2.5 GHz to 5 GHz stimulus signal from the High Band Source Out connector of the RF Source Module is fed to the 5-20 GHz Doubler Module.

- For operation between 2.5 to 5 GHz, the stimulus signal passes through the 5-20 GHz Doubler Module unchanged.
- For operation between 5 and 10 GHz, the frequency of the stimulus signal is doubled by the 5-20 GHz Doubler Module.
- For operation between 10 and 20 GHz, the frequency of the stimulus signal is doubled twice by the 5-20 GHz Doubler Module.
- For Model MS4644B, the output of the 5-20 GHz Doubler Module is fed to the Switched Doubler Module (SDM) which either passes the stimulus signal through unchanged or doubles the frequency of the stimulus signal for operation between 20 and 40 GHz. The stimulus signal is then fed to the High Band Transfer Switch.
- For Models MS4645B and MS4647B, the output of the 5-20 GHz Doubler Module is fed to the Switched Quadrupler Module (SQM). For operation below 38 GHz, an integrated switch in the SQM routes the stimulus signal to the SDM. For operation above 38 GHz, the frequency of the stimulus signal is quadrupled by the SQM. The stimulus signal from either the SDM or SQM is then fed to the High Band Transfer Switch.

The stimulus signal is then switched via the High Band Transfer Switch between the front panel Port 1 and Port 2 connectors. The High Band Transfer Switch is controlled by the DSP Module via the RF Component Controller PCB Assembly to set the direction of the signal flow for the desired test. The stimulus signal is then passed through the High Band Reference Coupler, Diplexer/Bias Tee Assembly and Port Coupler. The stimulus signal is output to the DUT via the Port Couplers mounted directly to the Port 1 and Port 2 front panel connectors.

A sample of the stimulus signal is picked off the High Band Reference Coupler and fed to the Level Detector.

The Level Detector provides feedback to the RF Source Module for High Band stimulus signal automatic leveling control (ALC). The sampled stimulus signal is then fed to the Reference signal Sampler Module.

The reflected and transmitted device-under-test (DUT) signals are received simultaneously via the Port 1 and Port 2 Couplers.

Due to the directional characteristic of the Port Coupler, the test signal is separated from the stimulus signal and then routed to the Test signal Sampler Module.

The 2.5 to 5 GHz LO signal from the High Band LO Out connector of RF Source Module is fed to the LO Module. Depending on the frequency of operation, the LO Module distributes the LO signals to all the Sampler Modules with frequency either unchanged or doubled to 5 to 10 GHz.

The LO Module has an integrated level detector which provides feedback to the RF Source Module for LO signal automatic leveling control (ALC).

The Sampler Module incorporates the Non Linear Transmission Line (NLTL) LO driven harmonic sampler architecture.

The 2.5 to 70 GHz sampled stimulus signals and test signals are converted by the Sampler Modules to Intermediate Frequency (IF) signals in the range of 10 to 20 MHz.

The IF signals are then multiplexed to the A/D converters in the IF Band Module. The A/D converters digitize the IF signals and send the data to the DSP Module via the high-speed LVDS bus.

The DSP Module performs signal processing, and makes the results available to the Single Board Computer for further processing and display.

Second Source Option Operation – Option 31

For units equipped with the Optional Second Source Module (Option 31), the RF Source Module provides the stimulus signal for Port 1 and the Second Source Module provides the stimulus signal for Port 2. The Low Band Transfer Switch and the High Band Transfer Switch are not used.

Second Source Redirection out Port 1 – Option 32

Source 2 Out Redirection out Port 1 pertains to Option 32, a combiner option available in dual source systems with (Option 31 installed) where the source 2 signal can be switched to combine into the source 1/port 1 signal path. This can be combined with Option 44 IMDView™ for making IMD measurements.

Pulse Measurement Option Operation – Option 35

For units equipped with the Optional IF Digitizer Module (Option 35), the IF signals are fed to the IF Digitizer Module first and then route to the IF Band Module for signal processing when in the normal S-parameter measurement mode.

When in Pulse Measurement mode, the IF signals are sampled by the Analog-to-Digital converter in the IF Digitizer Module and the data is stored to on-board DDR2 memory. The data is then later sent to the Single Board Computer via a PCIe interface for data processing.

2-10 Functional Block Diagrams

The figures in this section show the functional block diagrams of the VectorStar VNA.

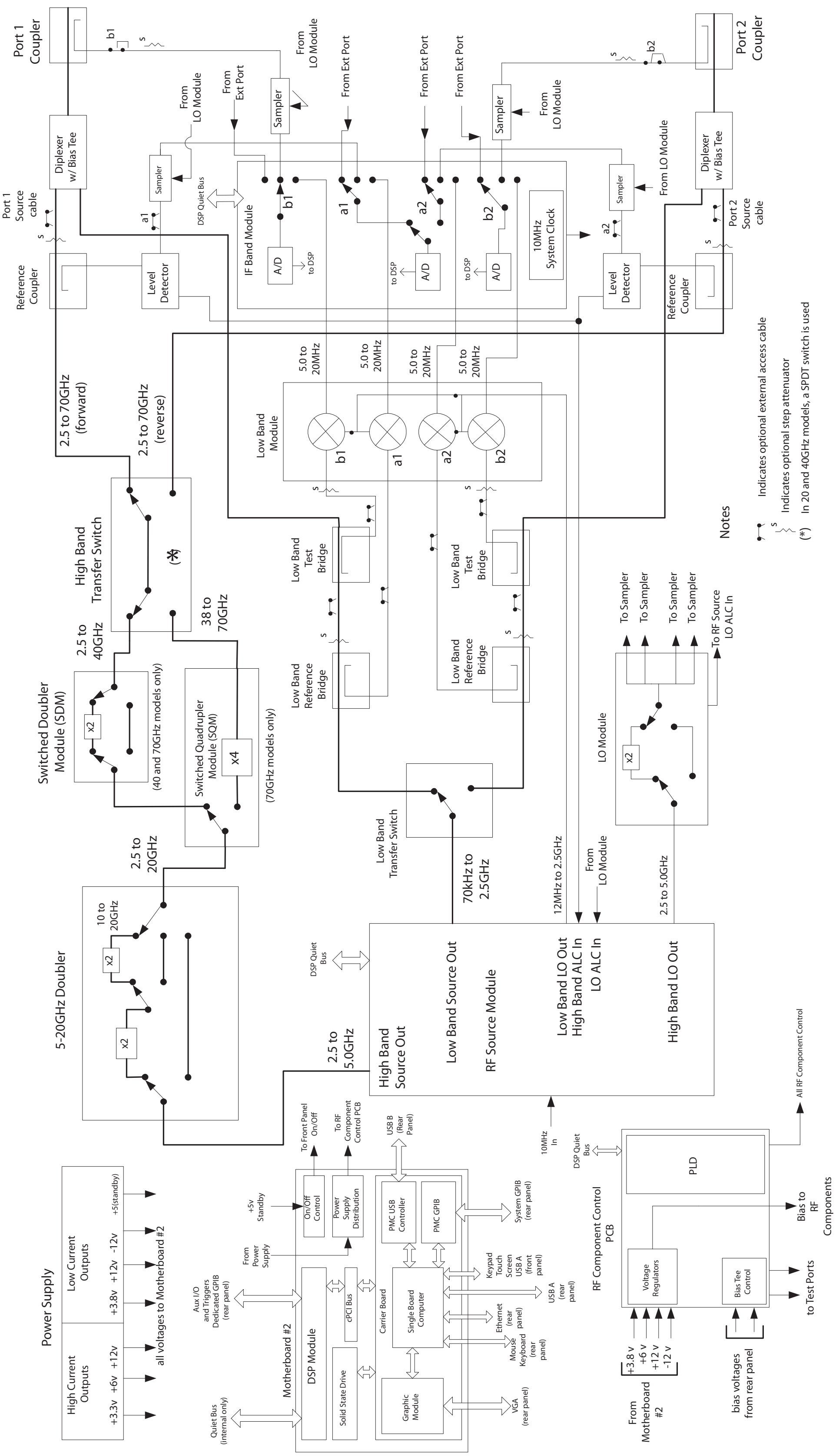


Figure 2-3. Functional Block Diagram – Overview of VectorStar MS4640B VNA

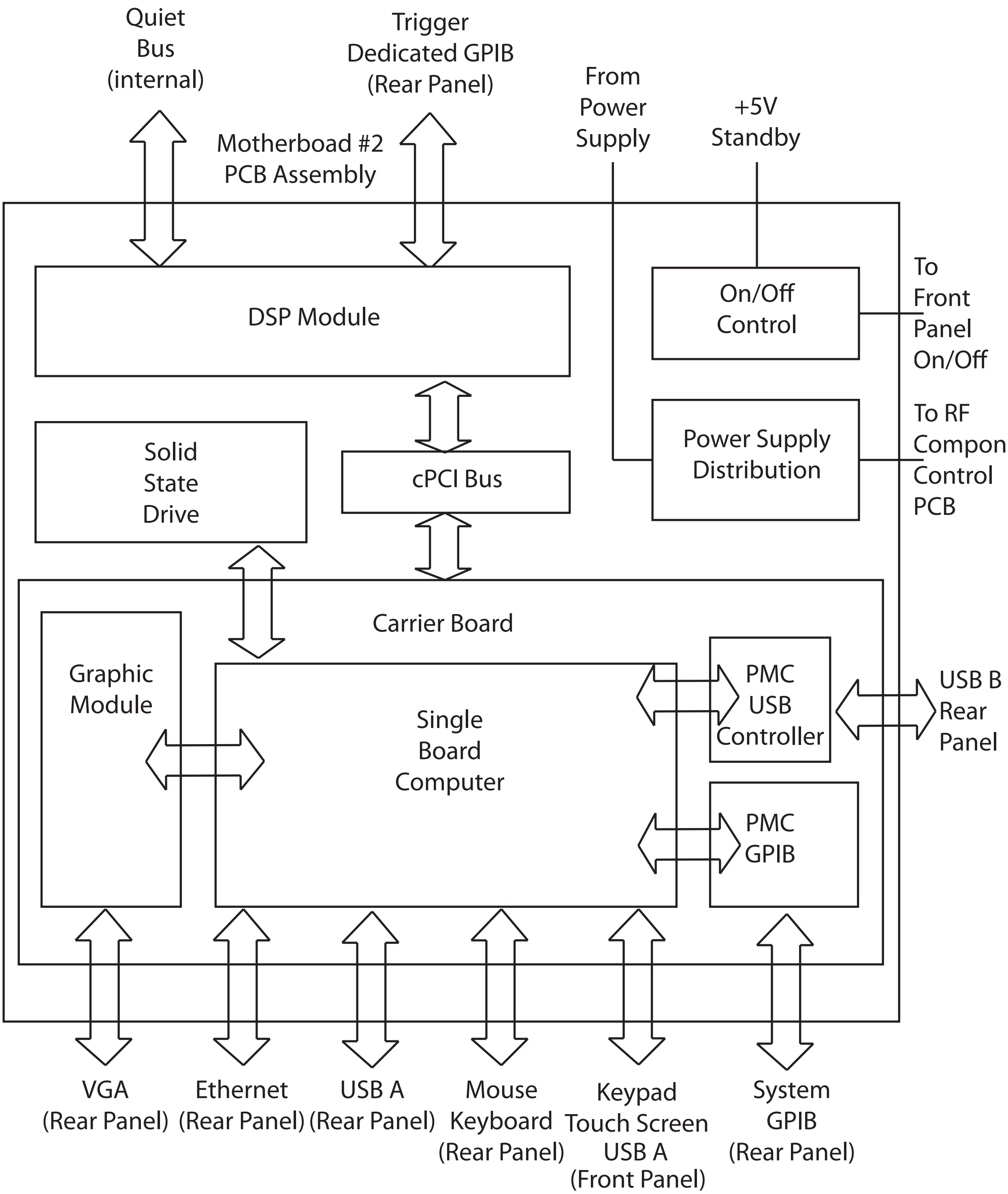


Figure 2-4. Functional Block Diagram – Motherboard 2 PCB

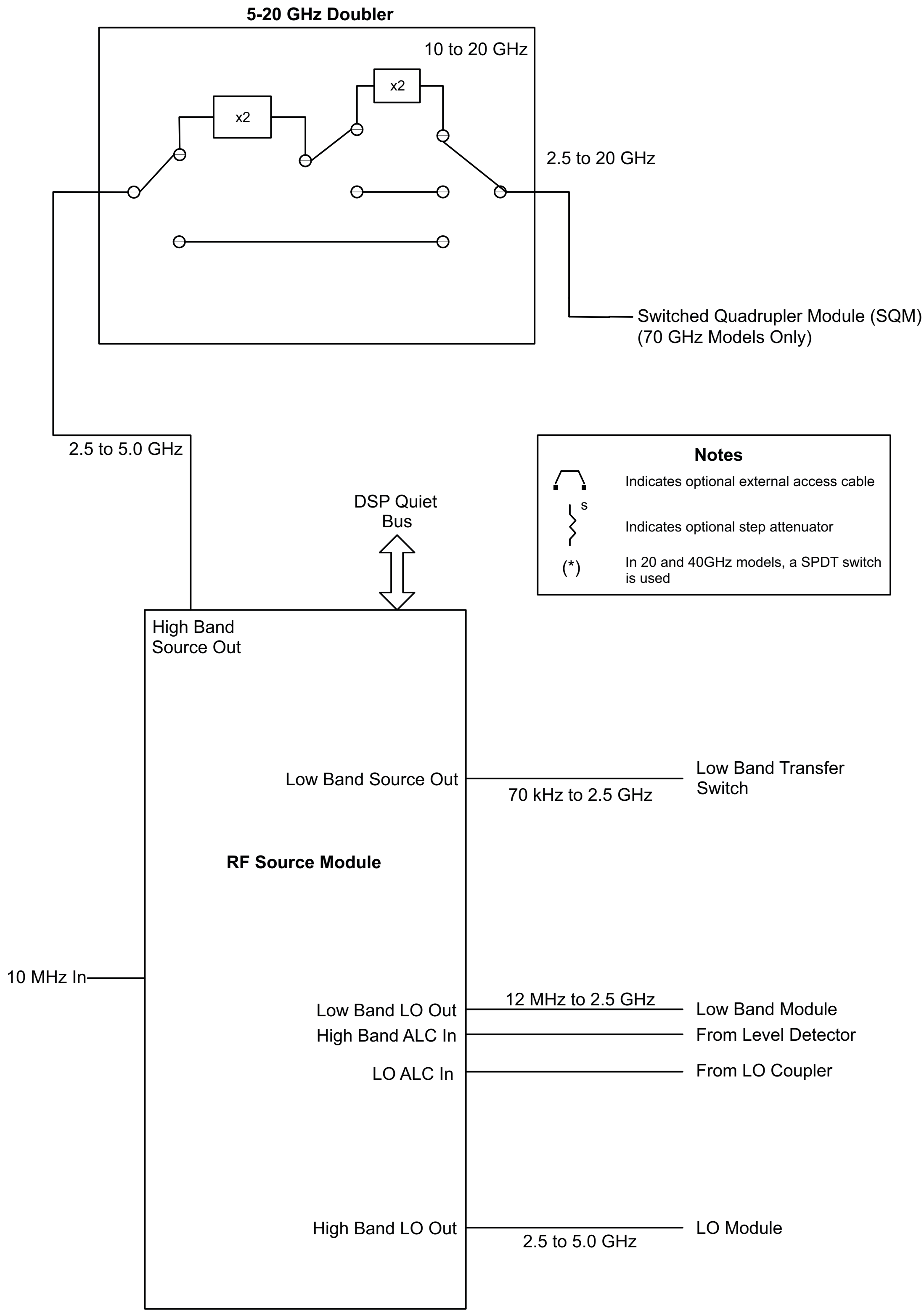


Figure 2-5. Functional Block Diagram – MS4647B – Part 1 of 4

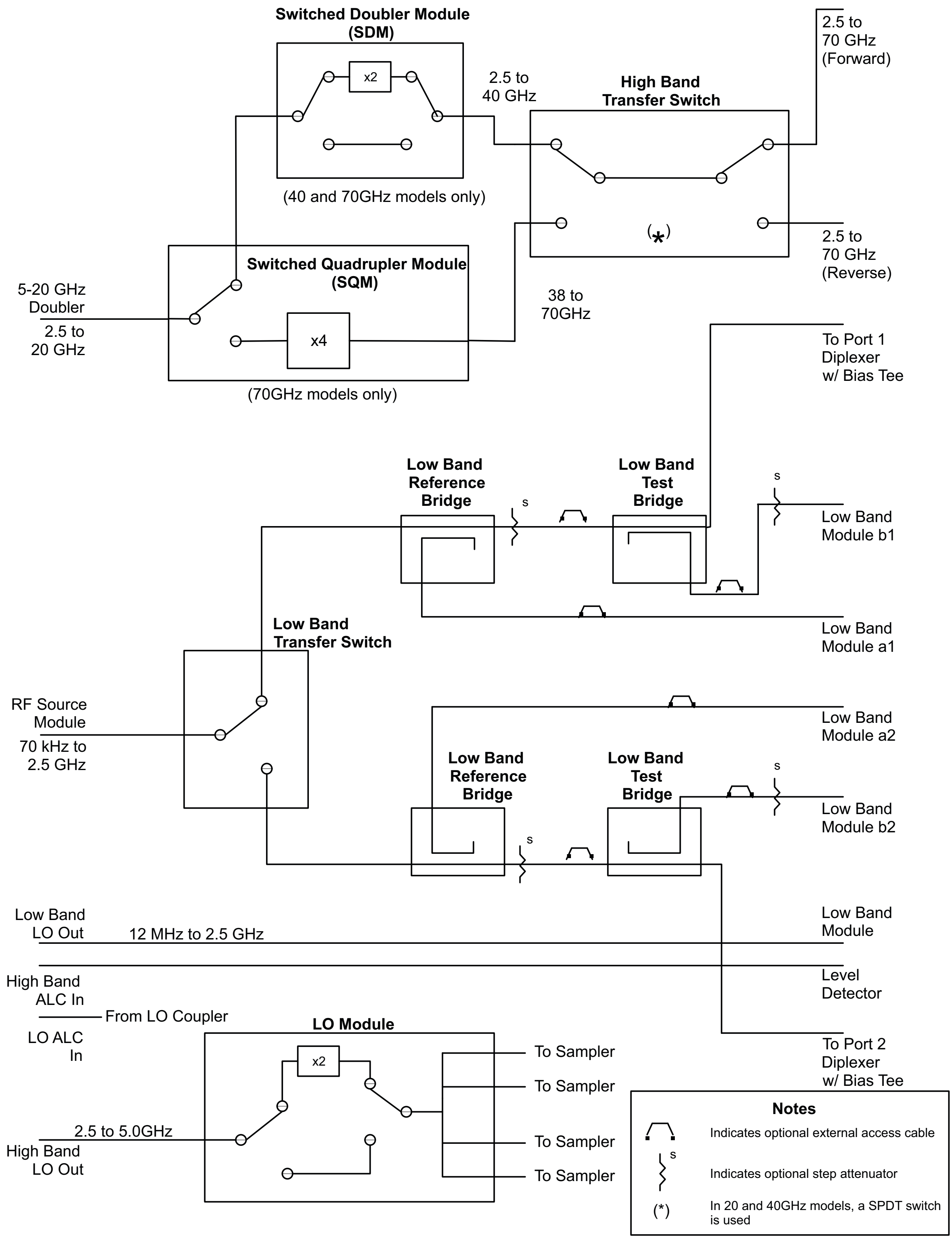


Figure 2-6. Functional Block Diagram – MS4647B – Part 2 of 4

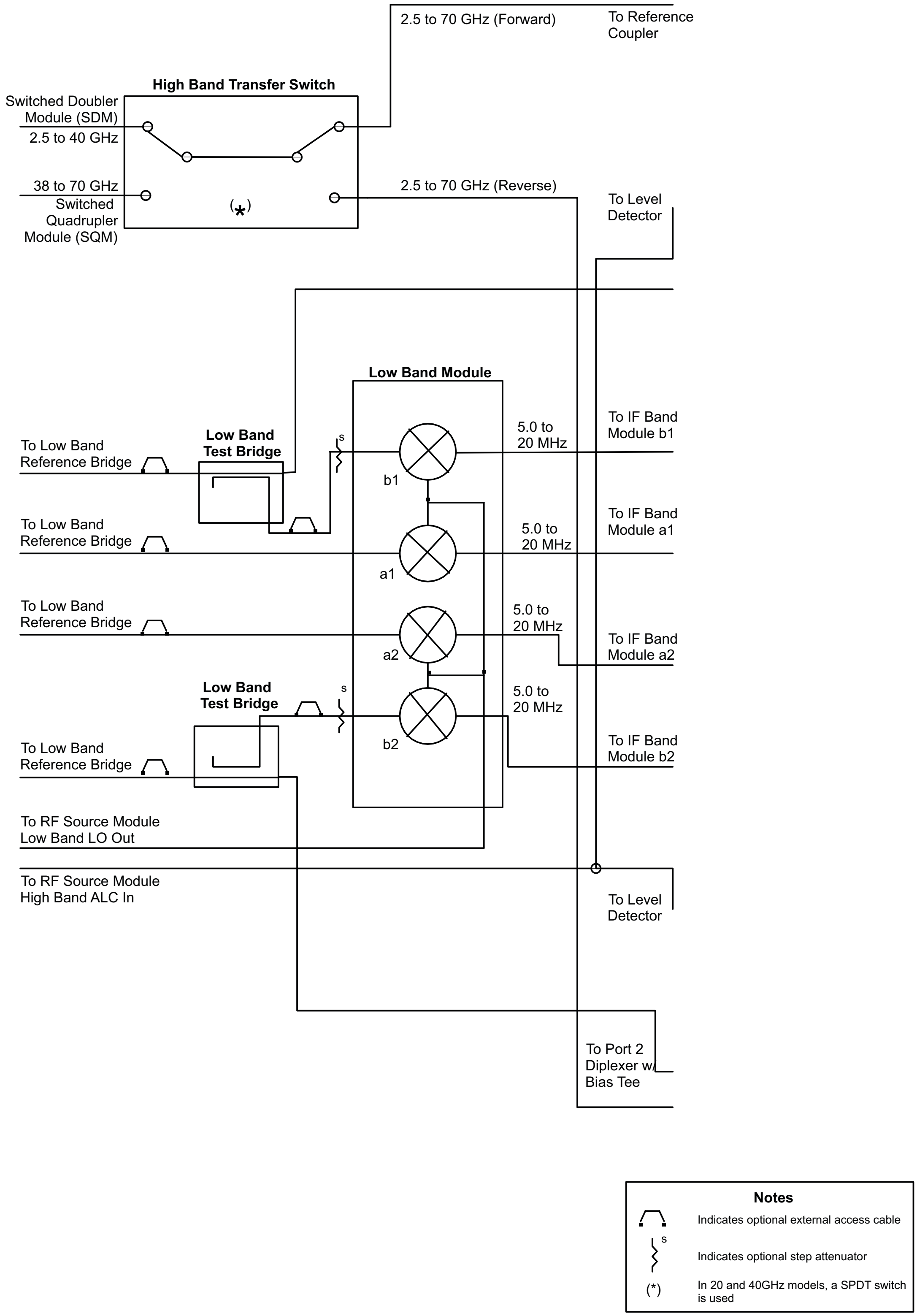


Figure 2-7. Functional Block Diagram – MS4647B – Part 3 of 4

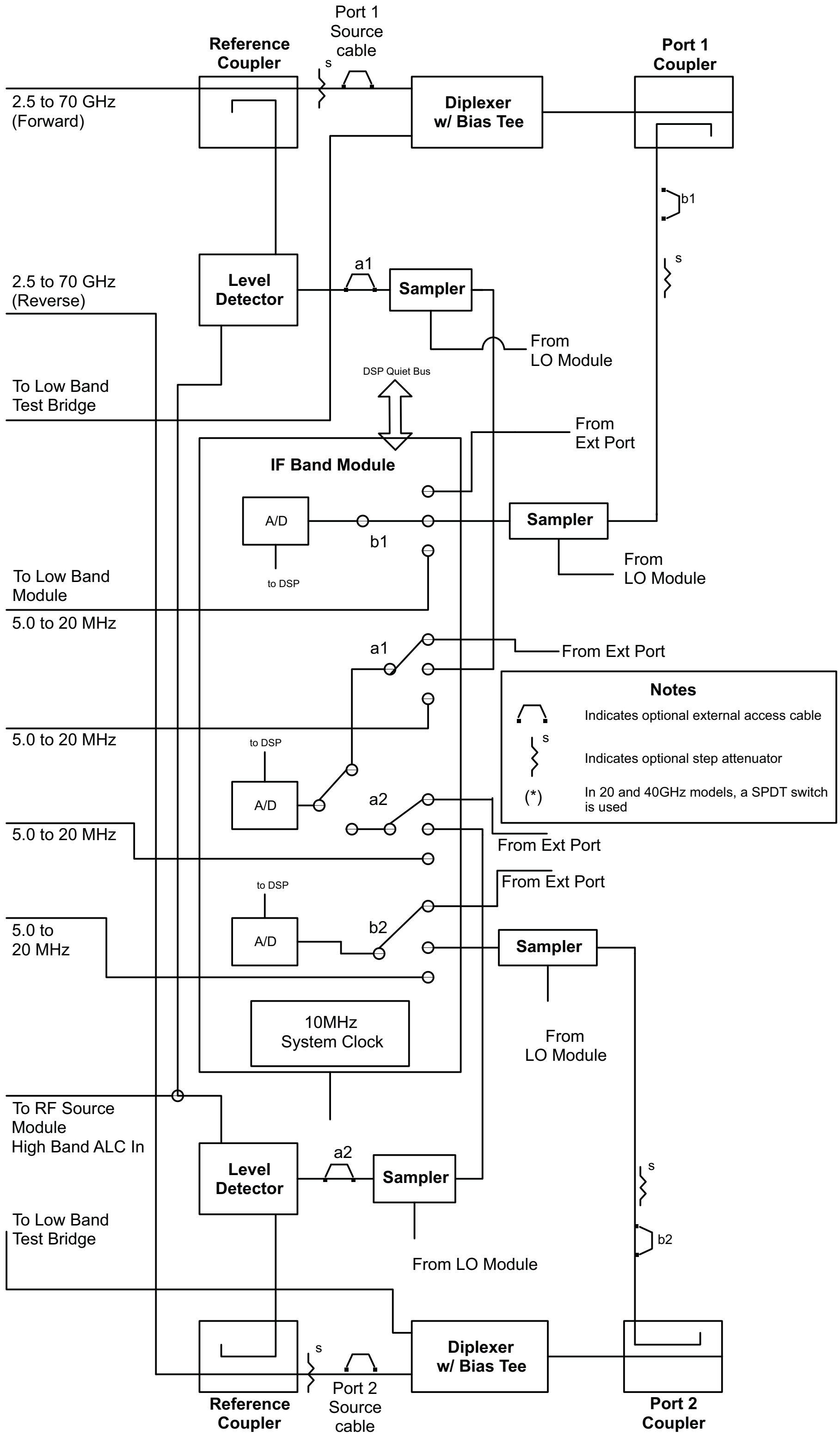


Figure 2-8. Functional Block Diagram – MS4647B – Part 4 of 4

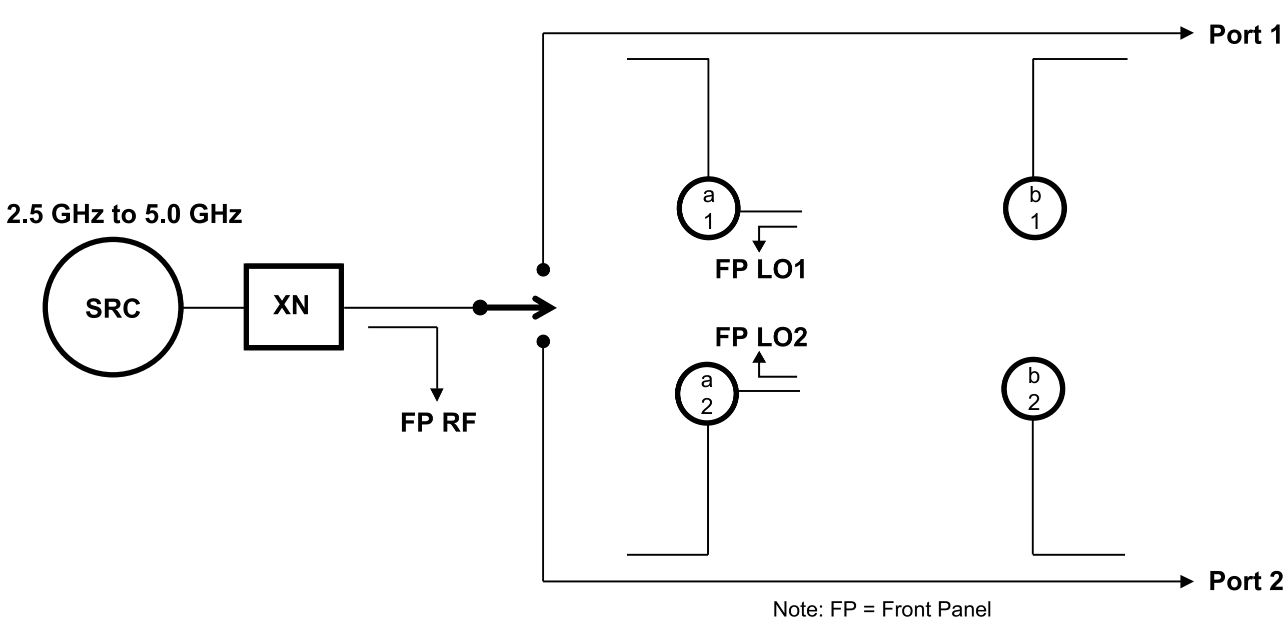


Figure 2-9. Simplified Functional Block Diagram – Options 80, 81, 82, and 83

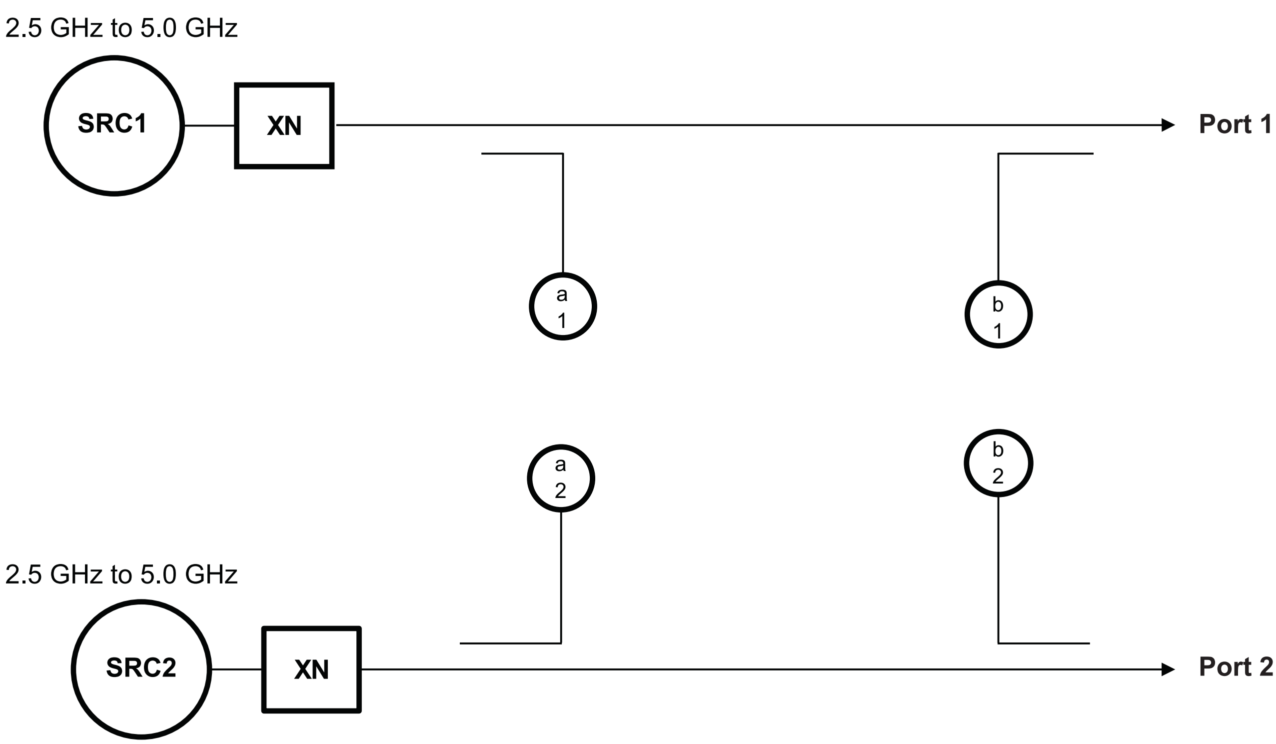


Figure 2-10. Simplified Functional Block Diagram – Option 31 – Second Source

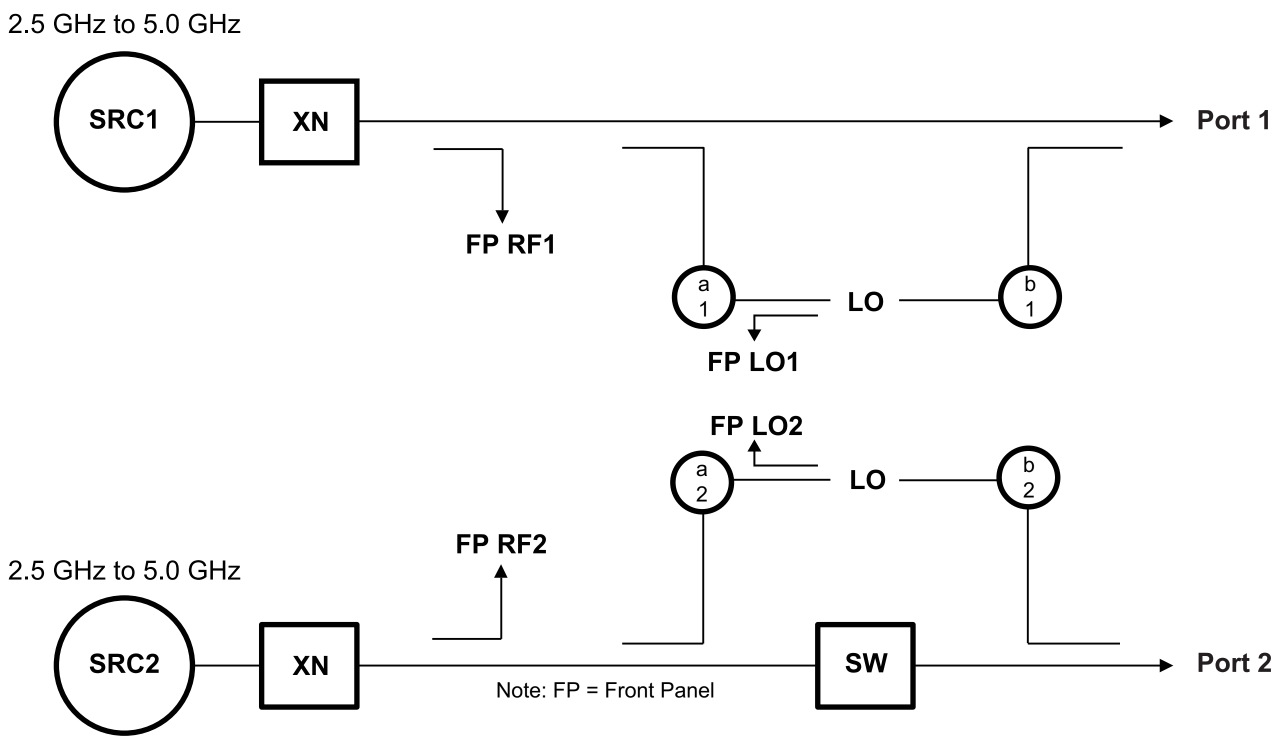


Figure 2-11. Simplified Functional Block Diagram – Options 31, 84, and 85

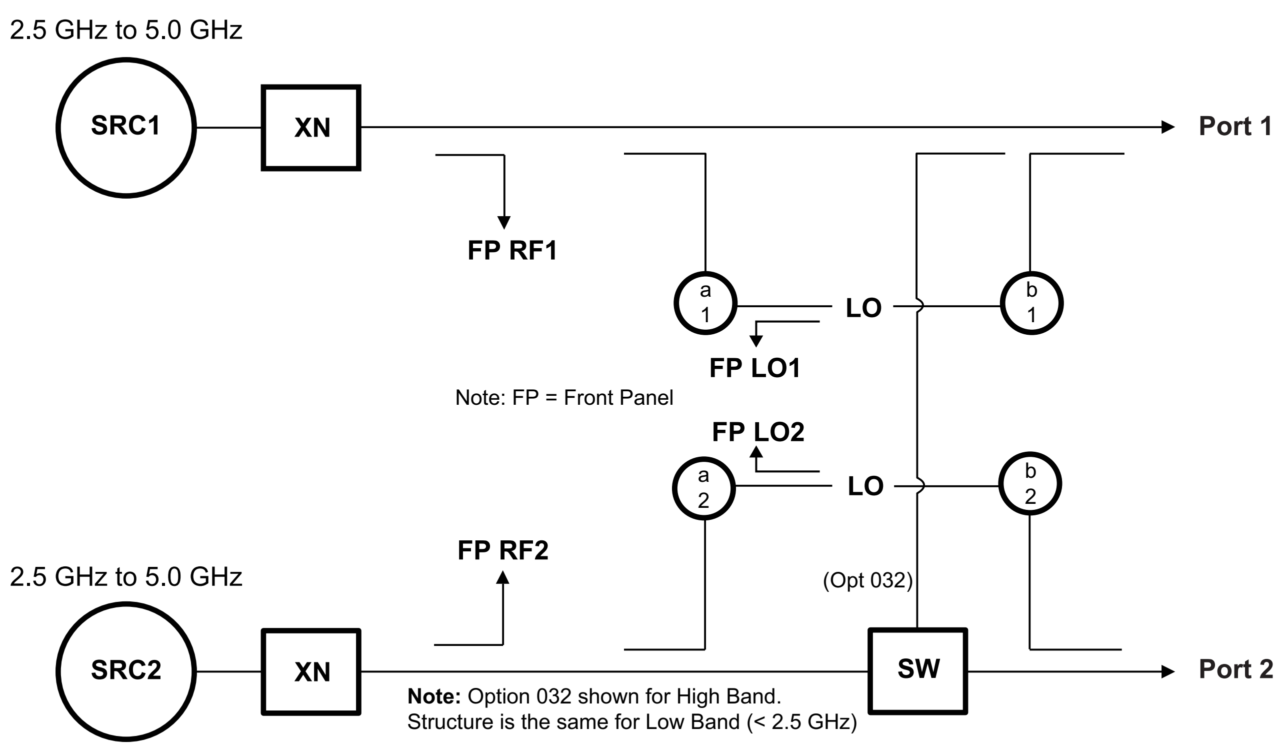


Figure 2-12. Simplified Functional Block Diagram – Options 31, 32, 84, and 85

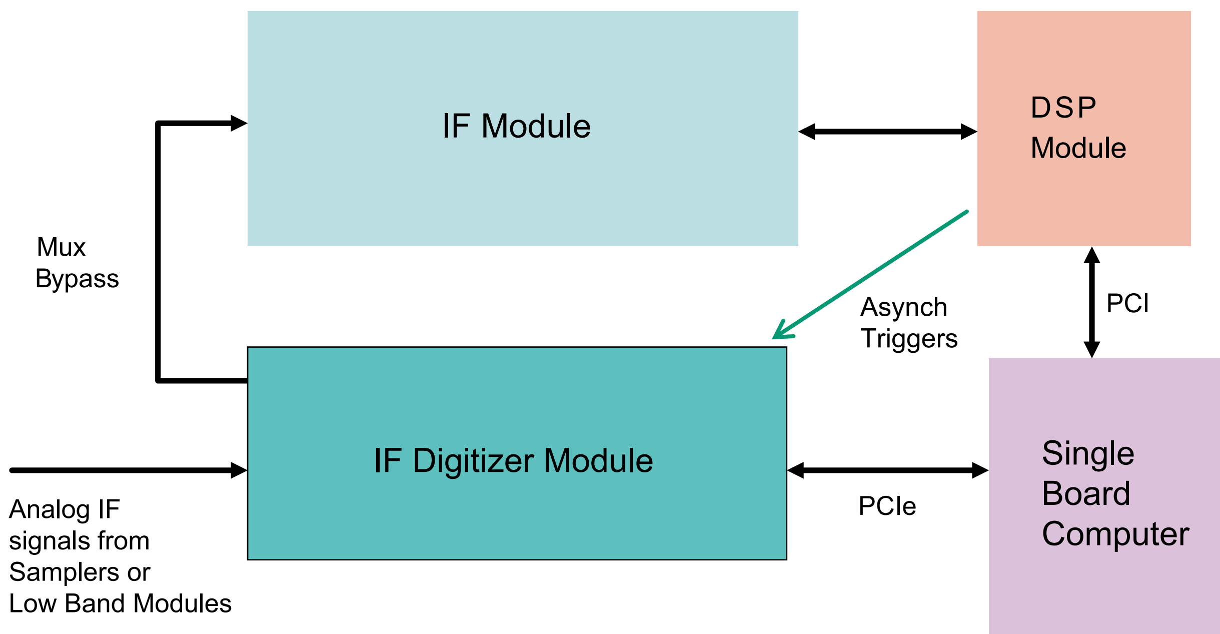


Figure 2-13. Block Diagram – Option 35 or 42 – IF Digitizer / Pulse Measurement (PulseView™)

Chapter 3 — Performance Verification

3-1 Introduction to Performance Verification

This chapter provides procedures to be used to verify the performance of the MS4640B VNA.

There are many levels to the concept of VNA “verification”.

On the explicit VNA hardware level are operational checkout items such as port power and noise levels.

On the calibrated instrument level (which includes the VNA and the calibration kit or AutoCal Automatic Calibrator) are the system residual specifications (corrected directivity, source match, load match, and tracking) which are measured using airlines (traceable impedance standards).

An intermediate level which can look at overall system behavior (VNA, calibration kit, cables, environment) in a traceable fashion is through the use of a verification kit. While not intended for day-to-day use, the verification kit can provide a periodic check on system behavior without going through the rigor needed for full residual analysis (which can usually be done less often).

While there are many ways of verifying VNA performance, sometimes simple procedures are desired. The use of a verification kit, available from Anritsu, is a simple method of verifying the measurement capabilities of the instrument by analyzing the measurement of artifacts that are traceable to International System of Units (SI) via national metrology institutes.

3-2 VNA Traceability and Uncertainty

Vector network analyzers (VNAs) are precision instruments for making high frequency and broadband measurements in devices, components, and instrumentations. The accuracy of these measurements is affirmed by demonstrated and adequate traceability of measurement standards. Metrology traceability, per International vocabulary of metrology, JCGM 200:2012, is property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. For the accuracy of VNAs and quality assurance by users, two standard approaches were created to ensure sound metrology traceability. One is to construct tight uncertainty budget and specifications in three tiers from the ground up, and the other is to develop a calibration hierarchy for systematic verification.

The three-tier process is depicted in the following sections.

First Tier of Uncertainty – The VNA Calibration

A traceable VNA itself for coverage from 70 kHz to 70 GHz requires proper calibration for several key quantities, e.g., frequency, power level, and high level noise, via traceable standards to the SI units. Each contributing uncertainty was evaluated at the time of instrument calibration.

The inception of a precision VNA is accuracy-enhanced 50 ohm impedance, which is characterized in lieu of coaxial transmission lines all with proper propagation properties throughout the whole measurement systems including the device-under-test. A transmission line for VNAs is best represented by a coaxial airline, which was precisely selected and machined based on the electromagnetic properties such as conductivity, skin depth, and so on. Therefore, the dimensional measurement accuracy of the airline gives out the first tier of measurement uncertainty of impedance quantity.

Second Tier of Uncertainty – Systematic Measurement Errors

The second tier of uncertainty, corrected or residual uncertainty, is the result of the accuracy enhancement of VNA calibration to remove systematic errors. Systematic measurement errors are components of measurement error that in replicate measurements remains constant or values in a predictable manner. This accuracy enhancement is usually the function of calibration kits. The choice of calibration kits used will dictate the level of uncertainties for the intended measurements or applications.

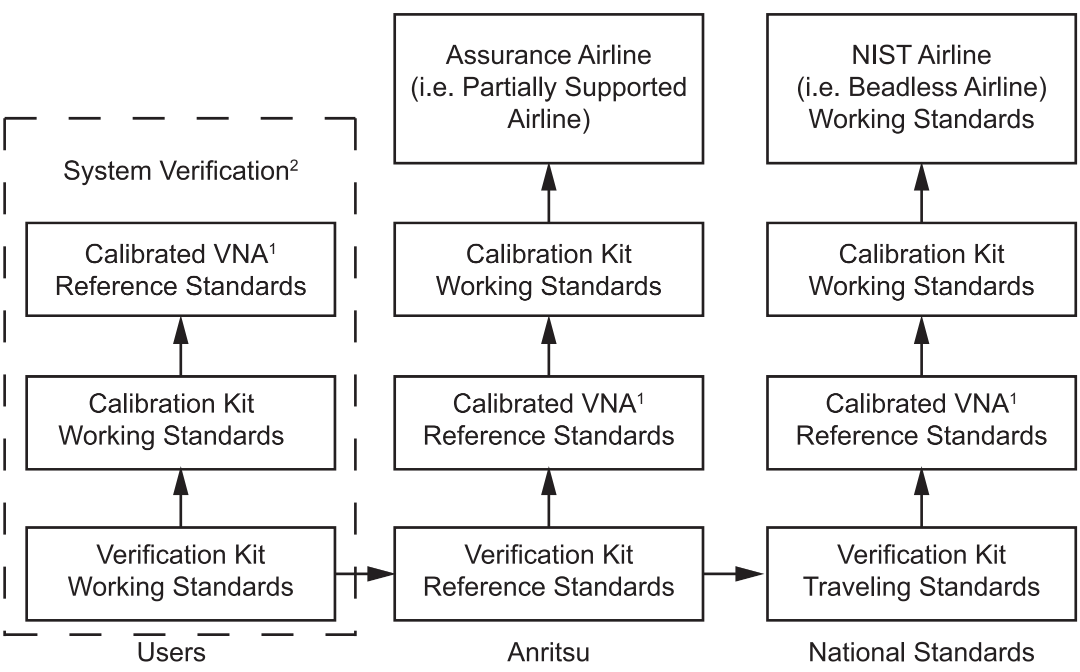
Third Tier of Uncertainty – Random Measurement Error

The third tier of uncertainty is random measurement error that in replicate measurements varies in an unpredictable manner. The examples are connector repeatability, cable stability, and so on. Random measurement error equals measurement error minus systematic measurement error.

Standards and Verification

Most often instrument end users demand system verifications in order to provide quality check or assurance. This is accomplished by utilizing a set of known or characterized devices, e.g., verification kit, for comparison. It can also be done by using devices that are different from the calibration kit. The calibration hierarchy of verification uncertainty is built through unbroken chain comparisons with the national standards, as illustrated in Figure 3-1.

- Physical standards → airline dimensionality → impedance standard → residuals and port parameters
- Basic power standards → power sensors → power accuracy specifications
- Basic time standards → frequency reference source → frequency accuracy



Calibrated VNA[1] - Without error-correction (accuracy enhancement) by calibration kit
System Verification[2] - S-parameter measurements with error-correction

Figure 3-1. Process for Creation and Use of a Verification Kit

3-3 Electrostatic Discharge Prevention

A VNA is a precision electronic instrument consisting of components and/or circuitries that are sensitive to electrostatic discharge (ESD). In order to prevent intrusion of electrostatic charge and mitigate risk of costly ESD damage, it is important to take preventive measures to protect against ESD before and during usage. For example, prior to connecting a test port cable to the VNA test port, take steps to eliminate the static charges built up on the test port cable. This can be done by terminating the open end of the cable with the short from the calibration kit and then grounding the outer conductor of the connector on the cable.

3-4 Calibration and Measurement Conditions

The surrounding environmental conditions and the condition and stability of the test port connectors, through-cable, and calibration kit determine system measurement integrity to a large extent.

These are all user controlled conditions, and as such, should be evaluated periodically for impact on system performance.

The standard conditions specified below must be observed when performing any of the operations in this chapter – both during calibration and during measurement.

- Warm-up Time:
    - 90 minutes
- Environmental Conditions
    - Temperature
        - 23 °C ± 3 °C, with < 1 °C variation from calibration temperature
    - Relative Humidity
        - 20-50% recommended

3-5 Performance Verification

Using best measurement practices and maintaining environmental conditions within specified limits during calibration and measurements are critical requirements for performing system verification that involves reliable high-quality measurements with associated measurement uncertainties. Note that both of these key factors affect the measurement uncertainty.

The Performance of MS464xB VNA can be verified using either verification procedures below:

- System Verification Procedure in "System Verification" on page 3-4.
    - The VNA, calibration kit, test cable, and any required adapter(s) are verified as a system.
- Instrument Key Performance Parameter Verification
    - The VNA is verified as an independent instrument.
    - The Instrument Key Performance Parameter Verification is broken into two separate verification procedures. Choose the procedure that best meets your needs.
        - Semi-Automated Instrument Verification Procedure in "Instrument Key Semi-Automated Performance Tests" on page 3-8.
        - Instrument Key Parameter Performance Tests (used for accredited calibrations) in "Instrument Key Parameter Performance Tests" on page 3-7.

3-6 System Verification

The System Verification procedures verify the measurement capabilities of the VNA, calibration kit, test port cables, and any required adapters as a system by analyzing the measurement of artifacts that are traceable to national standards laboratories. The procedures are automated by using the MS464XX System Verification Software – 2300-579, in conjunction with the appropriate Anritsu Calibration and Verification Kits listed in Table 3-1.

Table 3-1. Required Calibration and Verification Equipment

Model	Calibration Kit	Verification Kit	Test Port Cable
MS4642B	3652A or 3652A-1	3668-1	3670K50-2
MS4644B			
MS4645B	3654D or 3654D-1	3669B-1	3670V50A-2
MS4647B			

Note The use of non-Anritsu calibration kits or verification kits is not supported.

2300-579 Performance Verification Software (PVS)

The MS464XX System 2300-579 Performance Verification Software (PVS) USB memory device is shipped with each Anritsu Verification Kit listed in Table 3-1. Refer to the software installation instructions on the software USB memory device.

The System PVS guides the user to perform a full 12 Term calibration on the VNA using the appropriate calibration kit, measure the S-parameters of the impedance transfer standards in the verification kit, and verify that the measured values are within the specified measurement uncertainty limits.

The impedance transfer standards contained in the verification kit are:

- 20 dB Attenuation Standard
- 40 dB or 50 dB Attenuation Standard (depending on the VNA Model)
- 50 ohm Air Line Standard
- 25 ohm Mismatch (Beatty) Standard

For VectorStar VNA verification kit description and component listing, see:

- **3666-1 (3.5 mm), 3668-1 (K), and 3669B-1 (V) Verification Kit Reference Manual – 10410-00285**

The devices in the verification kit are selected based on their ability to stress the envelope of possible measurement parameters while still providing a very stable and repeatable behavior. The key attribute of the devices is that of long term stability.

Verification Result Determination

The software verification process compares the measured S-parameter data of the impedance transfer standards against the original standard (characterization) data for those devices that was obtained using the Factory Standard MS464XX Vector Network Analyzer (at Anritsu).

The Factory Standard MS464XX system is traceable to International System of Units (SI) through the impedance Standards of the Anritsu Calibration laboratory. These standards are traceable to International System of Units (SI) through precision mechanical measurements, microwave theory impedance derivation methods, and electrical impedance comparison measurements.

At each frequency point, the verification measurement is compared to the characterization measurement in the context of the uncertainties. If the delta between the two measurements is consistent with the uncertainty window, the measurement is considered acceptable at that point.

The metric of comparison, termed *En*, is a check to see if the measurement differences are consistent with the uncertainty windows of both the characterization and the verification measurements. The quantity is shown in the formula below:

$$E_n = \frac{\left|X_{xy}^{char} - X_{xy}^{ver}\right|}{\sqrt{(U_{xy}^{char})^2 + (U_{xy}^{ver})^2}}$$

where:

- The numerator contains the magnitude or phase of S-parameters measured during characterization (by Anritsu) and during verification (by the user).
- The denominator contains the respective uncertainties.

These uncertainties are calculated based on the VNA, the calibration kit, and repeatability. If this quantity *En* is less than 1, then the measurements during the two phases are within the overlap of the uncertainties and one can consider the measurements “equivalent” and, in some sense, verified.

The quality of the verification results is very dependent on the degree of care taken by the user in maintaining, calibrating, and using the system. The most critical factors are:

- The stability and quality of the devices in the calibration kit and verification kit.
- The condition of the VNA test port connectors and test port cables.
- The pin depths of all connectors and the proper torquing of connections. These same factors also affect the VNA measurement quality.

Consult the reference manual supplied with Anritsu Calibration Kits and Verification Kits for proper use, care, and maintenance of the devices contained in these kits.

3-7 System Verification Procedure

This procedure assumes that the System Verification Software has been installed to an External Personal Computer with National Instruments GPIB interface running Microsoft Windows® Operating System.

Note	The **3-2300-579 System Verification Software for VectorStar MS464XX Series VNAs User Guide – 10410-00270** explains in detail the PC requirements and procedures to be used for the operation of the verification software on the Personal Computer.

Equipment Required

Refer to Table 3-1, “Required Calibration and Verification Equipment” on page 3-4

- Personal Computer:
    - With Microsoft Windows XP or Windows 7 Operating System

      Note: Only VectorStar software version 2.1.3 and higher runs on Windows 7.
    - National Instruments GPIB interface and GPIB interface cable
- Anritsu Calibration Kit
- Anritsu Verification Kit
- Anritsu Test Port Cables

Special Precautions

When performing the procedures, observe the following precautions:

- Minimize vibration and movement of the system, attached components, and test cables.

- Clean and check the pin depth and condition of all adapters, test port cables, calibration components, and impedance transfer standards.
- Pre-shape the test cables to minimize their movement during calibration and measurement activities.

Procedure

1. Using the GPIB interface cable to connect the external computer/controller to the VNA rear panel system GPIB connector. It is the upper GPIB port, labeled **IEEE488.2 GPIB**. Do not connect to the lower GPIB port, labeled **Dedicated GPIB**.
2. Install the Test Port Cable to **Port 2** of the VNA and then the male to female phase equal insertable from the calibration kit to the open end of the cable.
3. Install the female to female phase equal insertable from the calibration kit to **Port 1** of the VNA. This converts Port 1 from a male test port to a female test port.
4. Run the MS464XX System Verification software.
5. Insert the USB memory device (also called a "USB flash drive") supplied with the verification kit to an available USB port on the external computer/controller. Set the data location of the verification software to the USB memory device when prompted.
6. Follow the directions displayed on the PC to perform calibration with the appropriate calibration kit.
7. Follow the directions on the computer to perform measurements of impedance transfer standards of the appropriate verification kit.
8. Pass/Fail status of the measurements is displayed on the computer. The software can also provide a hard copy printout of the measured data, measurement uncertainties, and the impedance transfer standards used.
9. If the verification fails, check the connectors of the VNA test ports, calibration kit devices, the impedance transfer standards, and test port cables for damage, cleanliness, and proper connection and torquing. Also check the phase stability of the test port cables. These are common causes for verification failures.

3-8 Instrument Key Parameter Performance Tests

The Instrument Key Parameter Performance tests verify the key performance parameters of the MS4640B Series Vector Network Analyzers.

Note	**Unwarranted Performance Parameters** Unwarranted performance parameters are not verified by the instrument performance tests as these parameters are not covered by product warranty. Examples of unwarranted performance parameters are those that are designated as nominal, typical and characteristic* (e.g. Receiver Dynamic Range, Receiver Compression Level, Noise Floor at a_x and b_x loop, and so on.). **Characteristic Performance** Characteristic performance indicates a performance designed-in and verified during the design phase. Refer to the latest version of the **VectorStar MS4640B VNA Configuration Guide and Technical Data Sheet – 11410-00611** for warranted instrument specifications.

The Instrument Key Performance tests consist of two procedures and an optional verification. Choose the procedure that best meets your needs.

1. Instrument Key Semi-Automated Verification Procedure in “Instrument Key Semi-Automated Performance Tests” on page 3-8
   a. Automated Performance Tests
      i. “Maximum Port Power Output Test” on page 3-10
      ii. “Port Power Accuracy Test” on page 3-11
      iii. “Frequency Accuracy Test” on page 3-12
      iv. “High Level Noise Test” on page 3-13
      v. “Noise Floor Test” on page 3-15
      vi. “Raw Source Match and Raw Directivity Test” on page 3-16 (optional).
   b. Manual Performance – Log Magnitude Dynamic Accuracy Test (optional) in “Manual Performance – Log Magnitude Dynamic Accuracy Test (Optional)” on page 3-69.
2. Instrument Key Parameter Performance Verification (used for accredited calibrations) in “Instrument Key Parameter Performance Verification (Accredited Calibrations)” on page 3-18, which contains the following verifications:
   a. “Maximum Port Power Output Test (for K-connector models MS4642B and MS4644B)” on page 3-21
   b. “Port Power Accuracy Test (for K-connector models MS4642B and MS4644B)” on page 3-39
   c. “Frequency Accuracy Test ” on page 3-57
   d. “High Level Noise Test” on page 3-58
   e. “Noise Floor Test” on page 3-63
   f. Manual Performance Test – Log Magnitude Dynamic Accuracy Test in “Manual Performance – Log Magnitude Dynamic Accuracy Test (Optional)” on page 3-69

Note	The Log Magnitude Dynamic Accuracy Test requires the use of SC3796 step attenuator controller to set the attenuation of the calibrated step attenuator in a manual manner, so the test steps must be performed manually.

3-9 Instrument Key Semi-Automated Performance Tests

The Semi-Automated Instrument Key Performance tests is broken into two parts.

1. The Automated Instrument Key Performance tests consist of the following
    a. "Maximum Port Power Output Test" on page 3-10
    b. "Port Power Accuracy Test" on page 3-11
    c. "Frequency Accuracy Test" on page 3-12
    d. "High Level Noise Test" on page 3-13
    e. "Noise Floor Test" on page 3-15
    f. "Raw Source Match and Raw Directivity Test" on page 3-16 (optional).
2. "Manual Performance – Log Magnitude Dynamic Accuracy Test (Optional)" on page 3-69

The equipment is listed in Table 3-2, "Equipment Required for Semi-Automated Performance Test Procedures".

Note	Refer to the **VectorStar MS464XX 2300-531-R Instrument Test Software Quick Start Guide (QSG) – 10410-00291**. The document is included with the latest release of the MS464XX Instrument Test Software for installation instructions, operation, and updated test equipment requirements.

Equipment Required for Semi-Automated Performance Tests

Table 3-2. Equipment Required for Semi-Automated Performance Test Procedures (1 of 2)

Instrument	Critical Specification	Recommended Manufacturer and Model
Frequency Counter	Frequency: 10 MHz Input Impedance: 50 ohm	Anritsu Model MF2412B
Frequency Reference	Frequency: 10 MHz	Symmetricom Model RubiSource T&M
Power Meter	Power Range: -70 to +20 dBm	Anritsu Model ML2438A
Power Sensor	Frequency: 70 kHz to 70 GHz Connector Type: V	Anritsu Model SC7770
Adapter	Type: N (m) to K (m)	Anritsu Model 34NK50
Adapter	Type: V (f) to K (f)	Anritsu Model 34VFKF50
Adapter	Type: V (f) to V (f)	Anritsu Model 33VFVF50C
Adapter	Type: N (m) to V (m)	Pasternack Model PE9718
Calibration Kit	Connector Type: K	Anritsu Model 3652A or 3652A-1
Calibration Kit	Connector Type: V	Anritsu Model 3654D or 3654D-1
RF Cable	Frequency: DC to 40 GHz Connector Type: K (m) to K (f)	Anritsu Model 3670K50-2
RF Cable	Frequency: DC to 70 GHz Connector Type: V (m) to V (f)	Anritsu Model 3670V50A-2

Table 3-2. Equipment Required for Semi-Automated Performance Test Procedures (2 of 2)

Instrument	Critical Specification	Recommended Manufacturer and Model
Coaxial Cable	Type: BNC (m) to BNC (m) Impedance: 50 ohm Length: 0.6 meter	Any
Computer	PC with Windows XP or Windows 7 and National Instruments GPIB hardware and software **Note:** Only VectorStar software version 2.1.3 and higher runs on Windows 7.	Any
GPIB Cable	IEEE 488.2 compliant	Anritsu Part Number 2100-2
PC Keyboard	Interface: PS/2, US English	Any
PC Mouse	Interface: PS/2	Any

Procedures

1. Use the GPIB interface cable to connect the external computer/controller to the System GPIB connector at the **IEEE488.2 GPIB Interface** port on the VNA rear panel. Also connect other required test equipment to the external controller via one or more GPIB interface cables.
2. Run the MS464xB Instrument Test Software.
3. Follow the directions on the computer to perform each test.
4. Pass/Fail status of the measurements are displayed on the computer. The software can also provide a hard copy printout of the measured data.

Automated Performance Test Descriptions

Note	These automated performance tests are subject to change so the test descriptions provided are for reference only. See the latest release of the MS464XX Instrument Test Software for the latest list.

This section provides a brief description of each automated performance test. The automated tests described in the following sections are:

- “Maximum Port Power Output Test” on page 3-10
- “Port Power Accuracy Test” on page 3-11
- “Frequency Accuracy Test” on page 3-12
- “High Level Noise Test” on page 3-13
- “Noise Floor Test” on page 3-15
- “Raw Source Match and Raw Directivity Test” on page 3-16 (optional).

Maximum Port Power Output Test

This test verifies that the VNA ports are capable of outputting the maximum rated power.

Measurements are made with a power sensor connected to Port 1 and then Port 2. The MS464XX VNA is set to a CW frequency and the port power is stepped above the specified Maximum Rated Port power for each frequency.

Equipment Required

- Power Meter
- Power Sensor
- Adapters

Procedure

Note	The Instrument Test Software supports automated tests. The manual procedure below provides a detailed description of the instrument test steps.

1. Preset the VNA.
2. Configure the VNA for default power and set the VNA source for "CW" mode.
3. Set # of Points to 51 and set Display to S11 Log Magnitude only.
4. Connect power sensor to **Port 1**.
5. Set the VNA to the first frequency in the test list, step the output power up until the level stops increasing, drop the level by 0.5 dB, measure and record the power at the port. Refer to Table 3-3, "Test Frequency List for Maximum Rated Power Test and Level Accuracy Test" on page 3-17 for the test frequency list.
6. Repeat for remaining frequency points on the test frequency list.
7. For MS4640B with Option 31 and Option 84 or 85, the test is complete.
8. Set Display to S22 Log Magnitude only.
9. Connect power sensor to **Port 2**.
10. Repeat Step 5 through Step 6.

If the Test Fails

11. If this test fails, do the following:
    - Perform "Source Auto Leveling Control Adjustment (ALC Cal)" on page 7-28 and the repeat the Maximum Port Power Output Test.
    - Perform the steps in Section 5-13 "Troubleshooting RF Section Power-Related Problems" on page 5-19 in Chapter 5, "Troubleshooting".

Port Power Accuracy Test

This test verifies that the port power level accuracy at default port power.

Power accuracy is determined with an external power meter. Accuracy is evaluated at default power across frequency.

Measurements are made with a power sensor connected to port 1 and then port 2. The MS4640B is set to CW mode and default power. The frequency is then stepped across the entire frequency band of the instrument.

Equipment Required

- Power Meter
- Power Sensor
- Adapters

Procedure

1. Preset the VNA.
2. Configure the VNA for default power and set the VNA source for “CW” mode.
3. Set # of Points to 51 and set Display to S11 Log Magnitude only.
4. Connect power sensor to **Port 1**.
5. Set the VNA to the first frequency in the test frequency list, measure and record the port output power.
   - Refer to Table 3-3, “Test Frequency List for Maximum Rated Power Test and Level Accuracy Test” on page 3-17 for the frequencies list.
6. Repeat for remaining frequency points on the test frequency list.
7. Set Display to S22 Log Magnitude only.
8. Connect power sensor to **Port 2**.
9. Repeat Step 5 through Step 6.

If the Test Fails

10. If this test fails, do the following:
    - Perform “Source Auto Leveling Control Adjustment (ALC Cal)” on page 7-28, and then repeat the Port Power Accuracy Test.
    - Perform the steps in Section 5-13 “Troubleshooting RF Section Power-Related Problems” on page 5-19. The section is located in Chapter 5, “Troubleshooting”.

Frequency Accuracy Test

This test verifies the frequency accuracy of the source in the MS4640B. Frequency accuracy is determined with a Frequency Counter with its external reference linked to a high-precision 10 MHz Timebase.

Equipment Required

- Frequency Counter
- Precision 10 MHz Timebase
- Test Cable
- Adapters

Procedure

1. Preset the VNA.
2. Configure the VNA for default power and set the VNA source for “CW” mode.
3. Set # of Points to 51 and set Display to S11 Log Magnitude Only.
4. Connect **Port 1** to a frequency counter with a test cable and adapter.
5. A series of frequencies in the 1 to 20 GHz band are checked as shown in Table 3-4, “Test Frequency List for Frequency Accuracy Test” on page 3-17.

If the Test Fails

6. If this test fails, do the following:
   - Perform 10 MHz Frequency Reference Adjustment in “10 MHz Frequency Reference Adjustment (10 MHz Cal)” on page 7-12 in Chapter 7, “Adjustment Procedures”, and then repeat the Frequency Accuracy Test.
   - Replace RF Source Module and then repeat the Frequency Accuracy Test.

High Level Noise Test

This test verifies that the high level noise (trace noise) performance of MS4640B meets specifications.

Note	Skip this test if the VectorStar VNA is equipped with Option 51, 61, or 62.

This is a measure of the scatter of data when measuring a high level signal (full reflect or transmission through a short transmission line). The measurement is performed at default power with a 1 kHz IFBW and IFBW Enhancer set to ON.

A minimum of 20 sweeps of data of the desired parameter in linear magnitude and phase are acquired after trace-math normalization. At each frequency point the population-based standard deviation is computed and this forms the RMS high level noise number. For magnitude, this is normally converted back to Log Magnitude.

The results for this test are measured for both Magnitude and Phase in both sweep directions.

Equipment Required

- Adapter
- Thru Cable

Procedure

1. Connect a female to female adapter to **Port 1** and a thru Cable to **Port 2**.
2. Preset the instrument.
3. Configure the instrument for default power and transmission measurements (S21 and S12).
4. Set IFBW to 1 kHz and Display to Linear Magnitude and Phase.
5. Set # of Points to 51 and the first frequency band listed below:
   - **a.** 0.07 to 0.499 MHz
   - **b.** 0.5 to 2499 MHz
   - **c.** 2500 to 5000 MHz
   - **d.** 5001 to 20000 MHz
   - **e.** 20001 to 40000 MHz
   - **f.** 40001 to 67000 MHz
   - **g.** 67001 to 70000 MHz
6. Normalize the trace (data divided by memory).
7. Take trace data 40 times and calculate the RMS value of the band being tested.
8. Repeat Step 5 through Step 7 for the rest of the frequency band listed. The equation for this is:

$$\text{RMS value for each frequency point} = \left\{\frac{(X - Y)^2}{N}\right\}$$

$$\text{where } X = x1, x2, x3 \ldots xn$$

$$Y = \text{mean}$$

$$N = 40 \text{ sweep count}$$

Figure 3-2. Equation: RMS Value for Each Frequency Point

If the Test Fails

9. If the test fails, do each of the following until the test passes:

   a. Repeat the High Level Noise Test.

   b. Replace the thru line and repeat the High Level Noise Test

   c. Verify the Port Power Accuracy Test and then repeat the High Level Noise Test

   d. Perform LO Cal in "Source LO Level Adjustment (Src LO Level Cal)" on page 7-15, and then repeat the High Level Noise Test.

   e. Replace the Source Module and then repeat the High Level Noise Test

   f. Replace the LO Module and then repeat the High Level Noise Test

Noise Floor Test

The test verifies the noise floor performance of the VNA receivers at Port 1 and Port 2. This is a measure in absolute power (dBm) of the noise floor of the system referenced to the test port. This is done by measuring S21 and S12 with a short thru line connected and the port power set to –10 dBm. The cable loss is compensated by performing a Port Power Cal at the end of the cable. The traces are normalized with this through in place and no leakage correction is applied. The ports are then terminated with loads and S21 and S12 measured when in a 10 Hz bandwidth with no averaging. A minimum of 10 sweeps are acquired in linear magnitude mode and the RMS value is computed at each frequency point individually. The results are then converted back to Log magnitude and are expressed in RMS values.

Equipment Required

- Adapters
- Thru Cable
- Loads

Procedure

1. Preset the VNA.
2. Set IFBW to 10 Hz.
3. Connect a thru cable to **Port 1** and then set Display to S21 and Linear Magnitude.
4. Set Port 1 Power to –10 dBm.
5. Set # of Points to 2001.
6. Perform a 2-port transmission-only calibration.
7. Disconnect the cable from **Port 2**. Terminate both the cable and **Port 2** with loads from the calibration kit.
8. Take trace data 20 times and calculate RMS value for each point with sample size 20.
9. Calculate the Noise Floor using the formula:

$$\text{Noise Floor} = \text{RMS per point} + (-10\ \text{dBm})$$
$$\text{since by definition it references to 0 dBm.}$$

Figure 3-3. Equation: Noise Floor

Note	All the calculations are handled in linear form and final result is converted to dBm.

10. Set Display to S12 and Linear Magnitude.
11. Repeat Step 8 through Step 9.

If The Test Fails

12. If this test fails, do the following:
    - Check all RF cable connections in the RF Deck.
    - Check the **Test Port Adapter** connections at the front panel for proper tightness and repeat the Noise Floor Test.

Raw Source Match and Raw Directivity Test

This test verifies the uncorrected (Raw) Port characteristics of the VNA.

Note	Skip this test if the instrument is equipped with Option 51, 61, or 62.

The measurement data for Raw Source Match and Directivity is gathered by the extraction of error correction terms from the Reflection Only Calibration done at the port being measured.

Equipment Required

- Calibration Kit
- PC with GPIB interface
- GPIB Interface cable

Procedure

1. Connect a GPIB interface cable between **IEEE488.2 Port** of the VNA to the PC GPIB interface.
2. Preset the VNA.
3. Set up the VNA for segmented sweep mode for all the specified frequency bands.
4. Perform 2-port Reflection-Only Calibration (Do not include Isolation). This generates six error correction terms (coefficients).
5. Send GPIB commands (`OC1`, `OC2`, `OC3`, `OC4`, `OC5`, and `OC6`) to retrieve the respective values for:
    - Port 1 Directivity (ED1) (GPIB command `OC1`)
    - Port 1 Source Match (EP1S) (GPIB command `OC2`)
    - Port 1 Reflection Tracking (ET11) (GPIB command `OC3`)
    - Port 2 Directivity (ED2) (GPIB command `OC4`)
    - Port 2 Source Match (EP2S) (GPIB command `OC5`)
    - Port 2 Reflection Tracking (ET22) (GPIB command `OC6`)
6. Calculate the Raw Port Match and Raw Directivity as follows:

$$
\begin{aligned}
\text{Port 1 Raw Source Match} &= \text{EP1S} \\
\text{Port 1 Raw Directivity} &= \text{ED1}/\text{ET11} \\
\text{Port 2 Raw Source Match} &= \text{EP2S} \\
\text{Port 2 Raw Directivity} &= \text{ED2}/\text{ET22}
\end{aligned}
$$

Figure 3-4. Equations: Raw Port Match/Directivity

Note	All error correction terms are in real-imaginary format. After the calculation has been done in complex form, convert the result to dB format.

If The Test Fails

7. If this test fails, do the following:
    - Check the **Test Port Adapter** connection at the front panel.
    - Repeat Step 4 through Step 6.
    - Replace Test Port Adapter and repeat Step 4 through Step 6.
    - Replace Test Coupler and repeat Step 4 through Step 6.

Table 3-3. Test Frequency List for Maximum Rated Power Test and Level Accuracy Test

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.07	18000	37000	56000
50	19000	38000	57000
1000	20000	39000	58000
2000	21000	40000	59000
3000	22000	41000	60000
4000	23000	42000	61000
5000	24000	43000	62000
6000	25000	44000	63000
7000	26000	45000	64000
8000	27000	46000	65000
9000	28000	47000	66000
10000	29000	48000	66699
11000	30000	49000	67000
12000	31000	50000	68000
13000	32000	51000	69000
14000	33000	52000	70000
15000	34000	53000	—
16000	35000	54000	—
17000	36000	55000	—

Table 3-4. Test Frequency List for Frequency Accuracy Test

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
1000	17000	5001	10001
1800	3000	36000	15000
2500	4000	7500	55000
2501	5000	10000	20000

3-10 Instrument Key Parameter Performance Verification (Accredited Calibrations)

The Instrument Key Parameter Performance Verification is broken into five parts.

1. “Maximum Port Power Output Test (for K-connector models MS4642B and MS4644B)” on page 3-21
2. “Maximum Port Power Output Test (for V-connector Model MS4647B)” on page 3-23
3. “Port Power Accuracy Test (for K-connector models MS4642B and MS4644B)” on page 3-39
4. “Port Power Accuracy Test (for V-connector Model MS4647B)” on page 3-41
5. “Frequency Accuracy Test ” on page 3-57
6. “High Level Noise Test” on page 3-58
7. “Noise Floor Test” on page 3-63

These tests are manual verification and the equipment is listed in Table 3-5, “Equipment Required for Instrument Key Parameter Performance Verifications for MS4642B and MS4644B” on page 3-20 and Table 3-6, “Equipment Required for Instrument Key Parameter Performance Verifications for MS4647B” on page 3-20.

Note	This procedure supports the MS4642B, MS4644B, and MS4647B. This procedure does not support the MS4645B.

Note	Refer to the **VectorStar MS464XX 2300-531-R Instrument Test Software Quick Start Guide (QSG) – 10410-00291**. The document is included with the latest release of the MS464XX Instrument Test Software for installation instructions, operation, and updated test equipment requirements.

PASS/FAIL Determination for Instrument Key Parameter Performance Tests

Figure 3-5 shows the rule that is used to determine the pass/fail status of test results that are associated with warranted specifications.

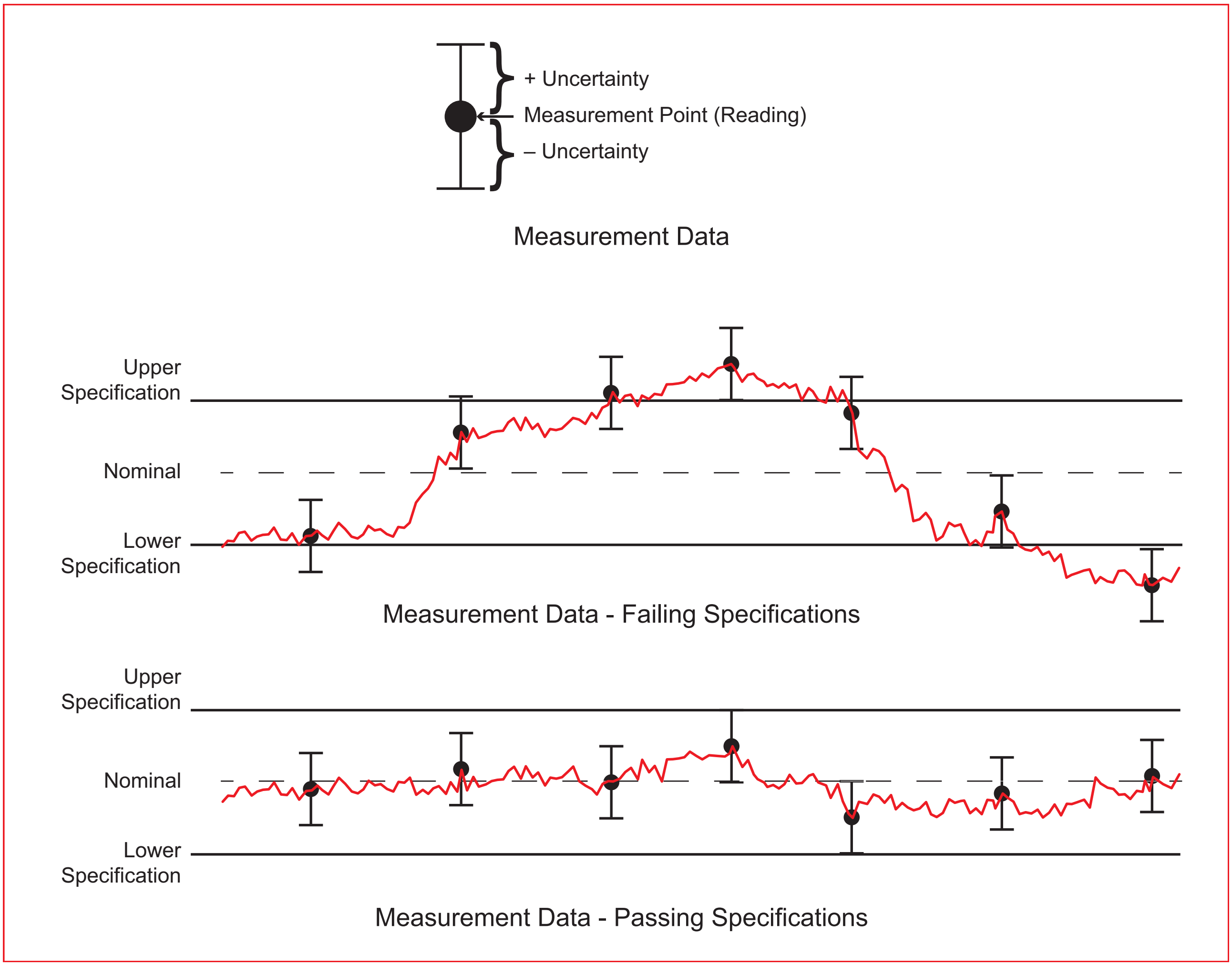


Figure 3-5. Pass/Fail Determination

The measurement uncertainty listed in each test record includes the best estimate of the errors contributed by the measurement, test equipment, standards, and other correction factors (for example, calibration factors and mismatch error) based on the suggested equipment, the equipment setup, and the prescribed test procedure. Most of the uncertainties are type-B per ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM).

Equipment Required for Instrument Key Parameter Performance Verifications

Table 3-5. Equipment Required for Instrument Key Parameter Performance Verifications for MS4642B and MS4644B

Instrument	Critical Specification	Recommended Manufacturer and Model
Power Meter	Power Range: -70 to +20 dBm	Anritsu Model ML2438A or ML2488A
Power Sensor	Frequency: 70 kHz to 70 GHz Connector Type: V	Anritsu Model SC7770
Frequency Counter	Frequency: 10 MHz Input Impedance: 50 ohm	Anritsu Model MF2412C
Frequency Reference	Frequency: 10 MHz	Symmetricom ET6010-RBC
Thru-Line	KF-KF Thru Line 2 ft	Anritsu 3670KF50-2
Precision Adapter	KF-KF Adapter	Anritsu 33KFKF50B
Precision Termination	KF Termination	Anritsu 28KF50
Calibration Kit	Connector Type: K	Anritsu Model 3652A or 3652A-1

Table 3-6. Equipment Required for Instrument Key Parameter Performance Verifications for MS4647B

Instrument	Critical Specification	Recommended Manufacturer and Model
Power Meter	Power Range: -70 to +20 dBm	Anritsu Model ML2438A or ML2488A
Power Sensor	Frequency: 70 kHz to 70 GHz Connector Type: V	Anritsu Model SC7770
Frequency Counter	Frequency: 10 MHz Input Impedance: 50 ohm	Anritsu Model MF2412C
Frequency Reference	Frequency: 10 MHz	Symmetricom ET6010-RBC
Thru-Line	VF-VF Thru Line 2 ft	Anritsu 3670VF50A-2
Precision Adapter	VF-VF Adapter	Anritsu 33VFVF50C
Precision Termination	KF Termination	Anritsu 28VF50D
Calibration Kit	Connector Type: V	Anritsu Model 3654D or 3654D-1

Maximum Port Power Output Test (for K-connector models MS4642B and MS4644B)

This test verifies that the VNA ports are capable of outputting the maximum rated power.

Measurements are made with a power sensor connected to Port 1 and then Port 2. The MS464XX VNA is set to a CW frequency and the port power is stepped above the specified Maximum Rated Port power for each frequency.

Equipment Required

- Power Meter
- Power Sensor
- Adapters

Procedure

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA.
3. Set the VNA Port power.
   a. Click on Power and in the fields Port 1 Power and Port 2 Power enter the power based on Option 31.
      i. If VNA is fitted with Option 31 set port power to +20 dBm.
      ii. If not fitted with Option 31 set port power to + 15 dBm.
4. Set the VNA source for “CW” mode.
   a. Click on Freq and then click on CW Mode.
   b. Click on # of Points and enter 51.
5. Set Display to S11 Log Magnitude only.
   a. Click on Trace.
   b. Click on # of Traces and enter 1.
   c. Select Trace Max.
   d. Double click on TR1.
   e. Click on Display.
   f. Click on Trace Format.
   g. Click on Log Mag
6. Set IFBW 10 Hz
   a. Click on Chanel
   b. Click on Averaging
   c. Click on IFBW and enter 10 then click on Hz.
7. Connect power sensor to Port 1.
8. Set the VNA’s frequency:
   a. Click on Freq.
   b. Click on CW Frequency and enter the first (or minimum frequency) or next frequency in the test list in Section B-2 “Maximum Port Power Output Test Record” on page B-4.
9. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
10. Measure the power at the port subtract 0.2 dB from the measured reading and record this adjusted value in the test records Section B-2 “Maximum Port Power Output Test Record” on page B-4.
11. Repeat Step 8 through Step 10 for remaining frequency points on the test records.

12. For MS4640B with Option 31 and Option 84 or 85, the test is complete.
13. Set Display to S22 Log Magnitude only.
    a. Click on Response.
    b. Click on S22.
14. Connect power sensor to **Port 2**.
15. Repeat Step 8 through Step 11.

If the Test Results are Out of Tolerance

16. If the test results are out of tolerance, do the following:
    - Perform "Source Auto Leveling Control Adjustment (ALC Cal)" on page 7-28 and then repeat the Maximum Port Power Output Test.
    - Perform the steps in "Troubleshooting RF Section Power-Related Problems" on page 5-19 in Chapter 5, "Troubleshooting".

Maximum Port Power Output Test (for V-connector Model MS4647B)

This test verifies the maximum port power.

Measurements are made with a power sensor connected to port 1, and then port 2. The MS4640B is set to CW mode and maximum power. The frequency is then stepped across the entire frequency band of the instrument.

Additionally this method provides instructions on correcting the measurements for VNA (Source) to Power Sensor (Load) Mismatch.

Equipment Required

- Power Meter
- Power Sensor
- Adapter
- V-Type Calibration Kit

Procedure 1-Port Reflection Only Calibration

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA.
3. Configure the instrument; using Frequency Based Segmented Sweep, create a segmented sweep table, as shown in Figure 3-6, appropriate for VNA being tested.
    a. Select Channel, then select Sweep.
    b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
    c. In this new screen, enter the information from the first entry of Figure 3-6.

Note	In Figure 3-6, the default power of -10 dBm is listed in the table. However, the unit’s power should be set to +20 or +15 dBm based on the option configuration.

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	1 MHz	2	930 kHz	1 kHz	-10	-10	1
2	☑	Start & Stop	2 MHz	5 MHz	2	3 MHz	1 kHz	-10	-10	1
3	☑	Start & Stop	7 MHz	9 MHz	2	2 MHz	1 kHz	-10	-10	1
4	☑	Start & Stop	10 MHz	11 MHz	2	1 MHz	1 kHz	-10	-10	1
5	☑	Start & Stop	20 MHz	50 MHz	2	30 MHz	1 kHz	-10	-10	1
6	☑	Start & Stop	100 MHz	300 MHz	3	100 MHz	1 kHz	-10	-10	1
7	☑	Start & Stop	500 MHz	700 MHz	2	200 MHz	1 kHz	-10	-10	1
8	☑	Start & Stop	1 GHz	2 GHz	3	500 MHz	1 kHz	-10	-10	1
9	☑	Start & Stop	2.2 GHz	2.399 GHz	2	199 MHz	1 kHz	-10	-10	1
10	☑	Start & Stop	2.4 GHz	2.499 GHz	2	99 MHz	1 kHz	-10	-10	1
11	☑	Start & Stop	2.5 GHz	2.7 GHz	2	200 MHz	1 kHz	-10	-10	1
12	☑	Start & Stop	2.701 GHz	3 GHz	2	299 MHz	1 kHz	-10	-10	1
13	☑	Start & Stop	3.5 GHz	5 GHz	4	500 MHz	1 kHz	-10	-10	1
14	☑	Start & Stop	5.001 GHz	5.5 GHz	2	499 MHz	1 kHz	-10	-10	1
15	☑	Start & Stop	6 GHz	10 GHz	9	500 MHz	1 kHz	-10	-10	1
16	☑	Start & Stop	10.001 GHz	11 GHz	2	999 MHz	1 kHz	-10	-10	1
17	☑	Start & Stop	12 GHz	20 GHz	9	1 GHz	1 kHz	-10	-10	1
18	☑	Start & Stop	20.001 GHz	21 GHz	2	999 MHz	1 kHz	-10	-10	1
19	☑	Start & Stop	22 GHz	38 GHz	17	1 GHz	1 kHz	-10	-10	1
20	☑	Start & Stop	38.001 GHz	39 GHz	2	999 MHz	1 kHz	-10	-10	1
21	☑	Start & Stop	40 GHz	40.001 GHz	2	1 MHz	1 kHz	-10	-10	1
22	☑	Start & Stop	41 GHz	49 GHz	9	1 GHz	1 kHz	-10	-10	1
23	☑	Start & Stop	49.001 GHz	50 GHz	2	999 MHz	1 kHz	-10	-10	1
24	☑	Start & Stop	50.001 GHz	51 GHz	2	999 MHz	1 kHz	-10	-10	1
25	☑	Start & Stop	52 GHz	65 GHz	14	1 GHz	1 kHz	-10	-10	1
26	☑	Start & Stop	65.001 GHz	66 GHz	2	999 MHz	1 kHz	-10	-10	1
27	☑	Start & Stop	67 GHz	67.001 GHz	2	1 MHz	1 kHz	-10	-10	1
28	☑	Start & Stop	68 GHz	70 GHz	3	1 GHz	1 kHz	-10	-10	1

Figure 3-6. Segmented Sweep Table Example

- **d.** Select Add and repeat until the all segments are entered.
- **e.** Select Back, then select Sweep type, and then select Segmented Sweep (Freq Based).

4. Set VNA for single trace, Real + Imaginary, with S-Parameter response = S11.

- **a.** Select Trace.
- **b.** Select # of Traces and enter 1.
- **c.** Select Trace Max to expand the trace to the full screen.
- **d.** Select Response, select S11.
- **e.** Select Display >> Trace Format >> scroll down and select Real And Imaginary.

5. Load Cal Kit Coefficients

- **a.** Insert Cal Kit USB device to VNA **USB Port**.
- **b.** Select Calibrate.
- **c.** Select Cal Kit/AutoCal Characterization, then Install Kit/Charac.

d. At the INSTALL dialog, select the Cal Kit radio button and then the Browse button (see Figure 3-7).

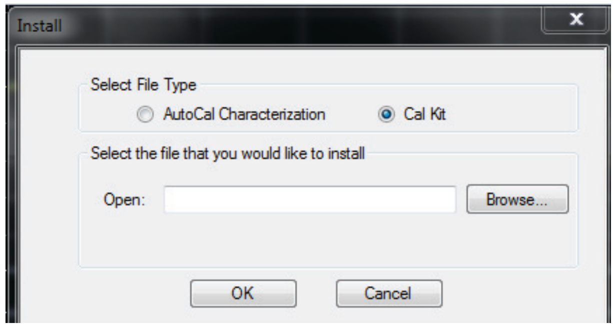


Figure 3-7. INSTALL Dialog

e. Browse to locate the `*.ccf` file on the Cal Kit USB drive (see Figure 3-8).

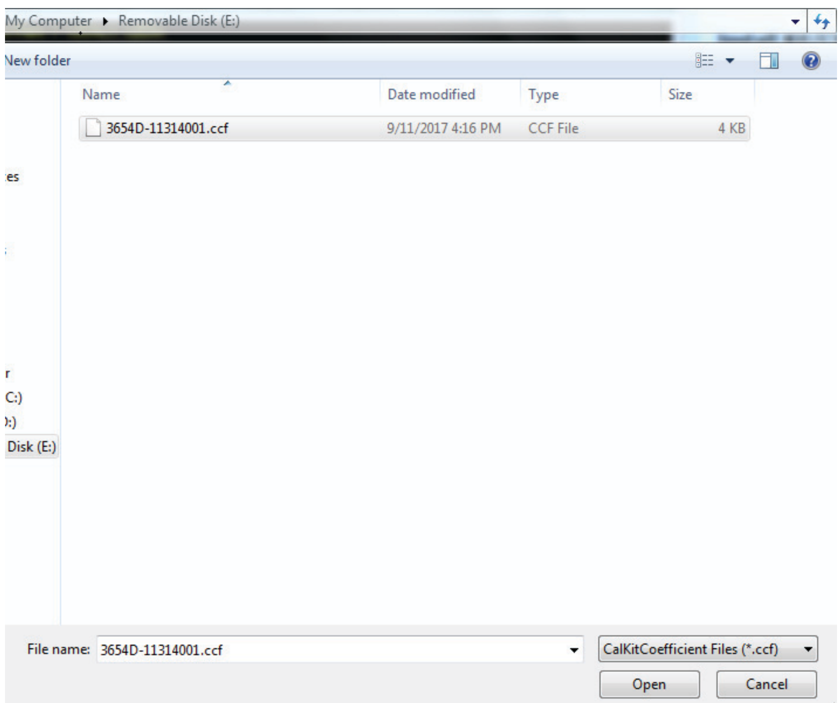


Figure 3-8. Browse CCF File Window

f. Select the file and then select Open.

g. The software returns to the INSTALL dialog with the path populated (see Figure 3-9). Select OK.

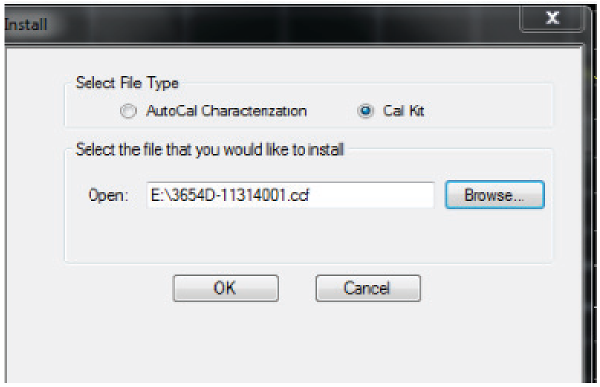


Figure 3-9. INSTALL Cal Kit Dialog

h. Confirm Cal Kit Serial number. Select Install (see Figure 3-10).

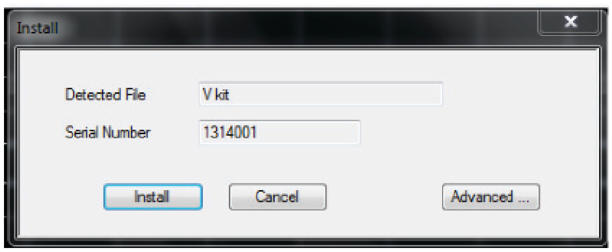


Figure 3-10. INSTALL Cal Kit Serial Number Dialog

6. Define 1-Port Calibration at Port 1.

a. Select Calibrate >> Manual Cal >> 1-Port Cal.

b. Select Modify Cal Setup, then select Edit Cal Params, and new dialog appears (see Figure 3-11).

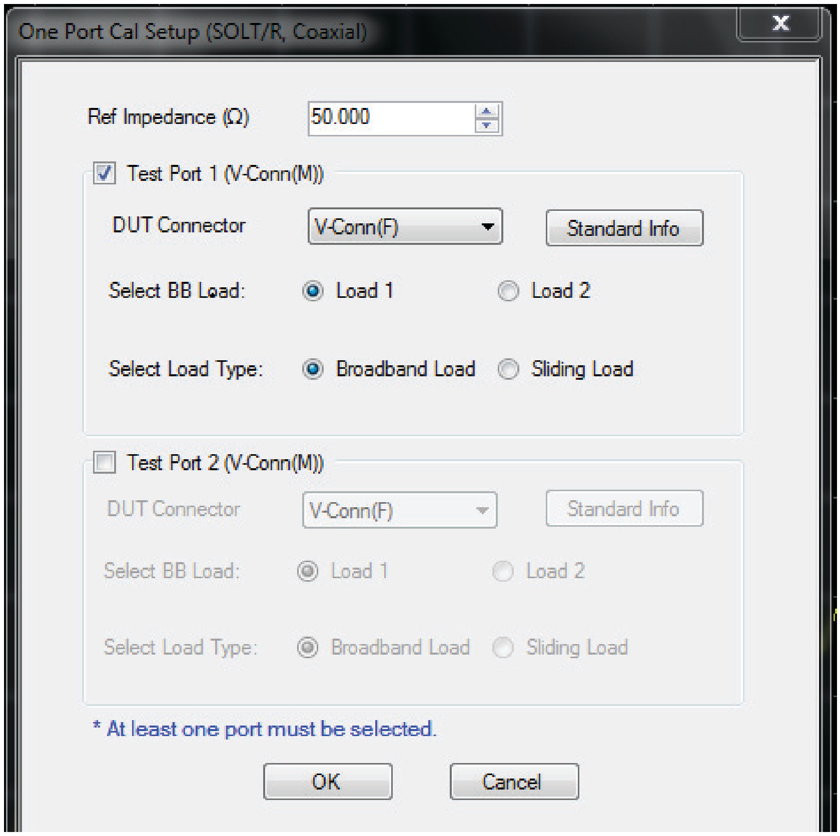


Figure 3-11. ONE PORT CAL SETUP Dialog

c. In the new window, uncheck the Test Port 2 check box.

d. Select Test Port 1 DUT Connector as V-Conn(F).

e. Select OK.

7. Perform 1-Port Reflection-only calibration (S11) at Port 1.

   a. Select Calibrate >> Manual Cal >> 1-Port Cal (see Figure 3-12).

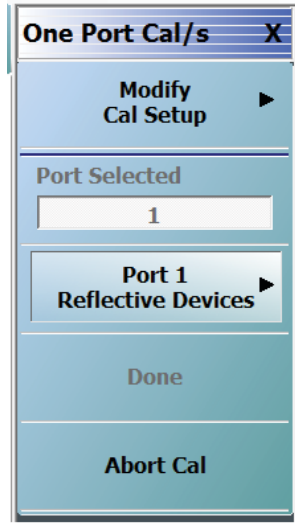


Figure 3-12. ONE PORT CAL/S Menu – Port 1

   b. Select Port 1 Reflective Devices and the new dialog appears (see figure Figure 3-13).

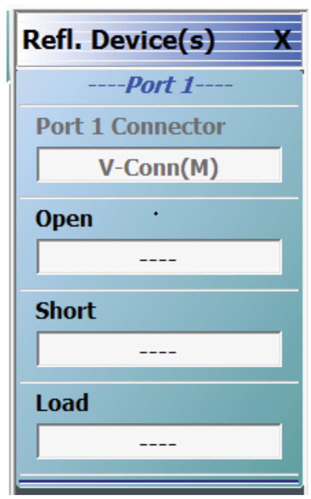


Figure 3-13. REFL. DEVICES Menu – Port 1

   c. Connect to an Open to **Port 1**, then select Open, next connect a Short, then select Short, and finally connect a Load, then select Load.

   d. When finished measuring devices select Back and then Done to complete and apply the calibration.

   e. Save the calibration on SSD to a convenient location, such as `C:\AnritsuVNA`.

      i. Select File and then Save Setup.

      ii. Change the file location or file name to identify target port, for instance `Port_1_Refl_Calibration.chx`.

      iii. Select Save.

8. Set VNA for single trace, Real + Imaginary, with S-Parameter response = S22.
   a. Select Trace TR1.
   b. Select Response >> S22.
   c. Select Display >> Trace Format >> scroll down and select Real And Imaginary.
9. Define 1-Port Calibration at Port 2.
   a. Select Calibrate >> Manual Cal >> 1-Port Cal.
   b. Select Modify Cal Setup, then select Edit Cal Params and un-check the Test Port 1 check box.
   c. Check Test Port 2 check box
   d. Select Test Port 2 DUT Connector as V-Conn(F)
   e. Select OK.
10. Perform 1-Port Reflection-only calibration (S22) at Port 2.
   a. Select Calibrate >> Manual Cal >> 1-Port Cal (see figure Figure 3-14).

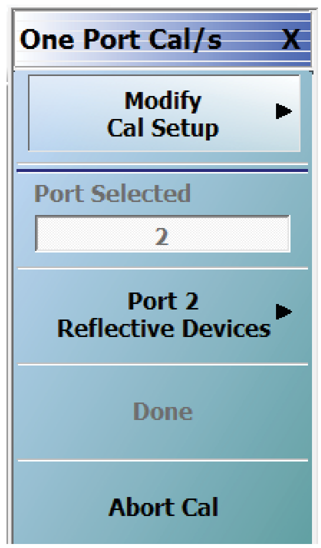


Figure 3-14. ONE PORT CAL/S Menu – Port 2

b. Select the Port 2 Reflective Devices and the new dialog appears (see Figure 3-15).

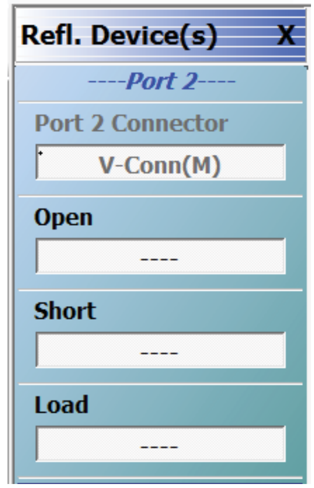


Figure 3-15. REFL. DEVICES Menu – Port 2

c. Connect an Open to **Port 2**, then select Open, next connect a Short, then select Short, and finally connect a Load, then select Load.

d. When finished measuring devices select Back and then Done to complete and apply the calibration

e. Save the calibration on hard disk to a convenient location, such as `C:\AnritsuVNA`.

   i. Select File and then Save Setup.

   ii. Change the file location or file name to identify target port, for instance `Port_2_Refl_Calibration.chx`.

   iii. Select Save.

Measure Sensor Input Match Procedure

1. Recall the saved calibration for Port 1. The file name is `Port_1_Refl_Calibration.chx` (from Step 7, Step e).
2. Connect Power Sensor SC7770 Via 33VFVF50B adapter to VNA **Port 1**.
3. Trace format should be Real And Imaginary.
4. Save measured data. Select File >> Save Data >> data type `*.csv` at a convenient location, for instance `C:\AnritsuVNA`.
5. Name the data file, for instance: `SC7770_Sensor_Input_Match.csv`.

Extract VNA Raw Source Match Term (Port-1) Procedure

1. Setup the VNA in same configuration as in "Measure Sensor Input Match Procedure" on page 3-30.

Note	If this test is done immediately after Measurement Sensor Input Match procedure then no change in setup. Otherwise, recall the same saved calibration.chx file for Port 1 used in "Measure Sensor Input Match Procedure" on page 3-48.

2. Using National Instruments NI-Max communicator tool which is installed on PC as part of NI-VISA, open a communication session with the VNA and click the Query button to validate communication.

a. The VNA will return Mfg, Model, SerNO, SWver (see figure Figure 3-16).

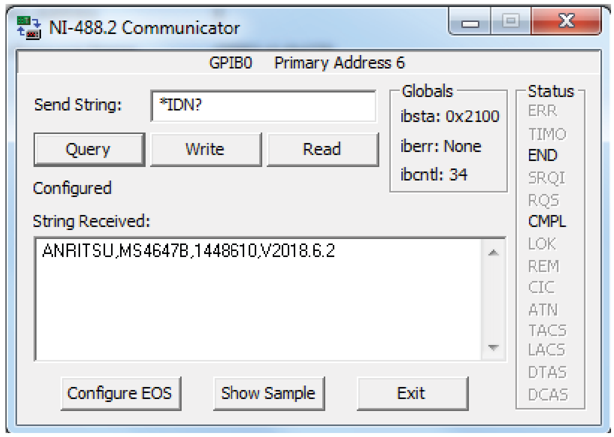


Figure 3-16. NI-488.2 COMMUNICATOR Dialog – *IDN?

3. Retrieve the Frequency Points from the VNA

a. Enter the command `:SENS1:FREQ:DATA?`.

b. Click the Query button to load the frequency points from the current calibration setup.

c. Use the mouse to highlight the data and paste to Windows clipboard (see Figure 3-17).

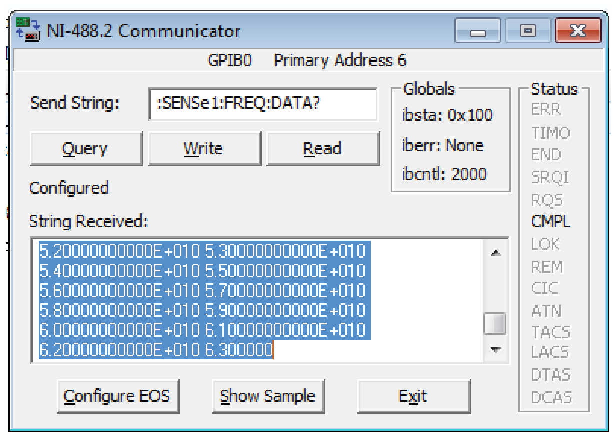


Figure 3-17. NI-488.2 COMMUNICATOR Dialog – :SENSe1:FREQ:DATA? (first screen)

d. Open a standard text editor, such as Notepad, and paste the frequency data to the document

e. Go back to NI-Comm Tool and click the Read button to flush and capture any data that remains in the VNA buffer (see Figure 3-18).

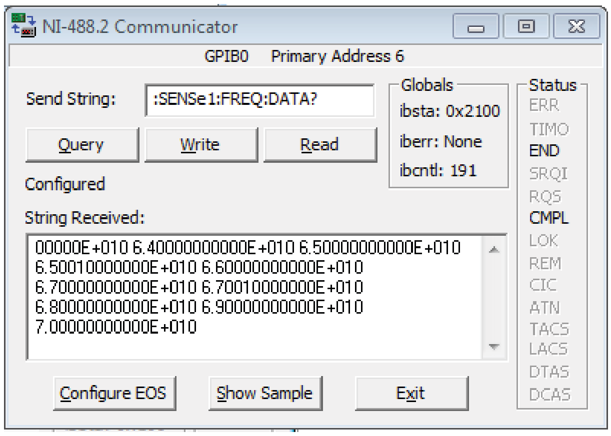


Figure 3-18. NI-488.2 COMMUNICATOR Dialog – :SENSe1:FREQ:DATA? (final screen)

f. As in Step c, again capture the frequency point data and paste on to the end of the data in the text document.

g. Save this text document in a convenient location on Windows PC. Name the text document, for instance: `VNA_Port1_Freq_Points`.

4. Retrieve Port-1 Raw Source Match Data Points from the VNA.

a. Enter the command `:SENS1:CORR:COEF? EP1S`

b. Click the Query button to load the Raw Source Match data points from the current calibration setup.

c. Use the mouse to highlight the data and paste to the Windows clipboard (see figure Figure 3-19).

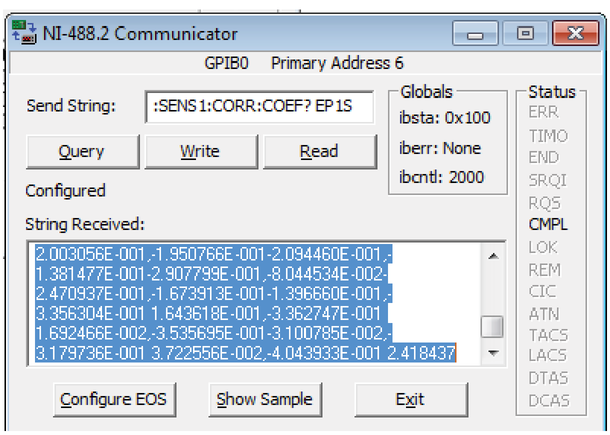


Figure 3-19. NI-488.2 COMMUNICATOR Dialog – :SENS1:CORR:COEF? EP1S (first screen)

d. Open a standard text editor, such as Notepad, and paste the Raw Source Match data to the document.

e. Go back to NI-Comm Tool and click the **Read** button to flush and capture any data that remains in the VNA buffer (see figure Figure 3-20).

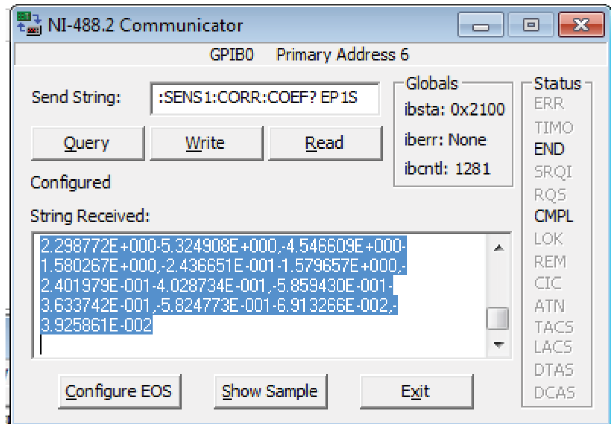


Figure 3-20. NI-488.2 COMMUNICATOR Dialog – :SENS1:CORR:COEF? EP1S (final screen)

f. As in Step c, again highlight and capture the Raw Source Match data and paste on to the end of the data in the text document.

g. Save this text document in a convenient location on Windows PC. Name the text file, for instance: `VNA_Port1_Raw_Source_Match`.

Extract VNA Raw Source Match Term (Port 2) Procedure

1. Recall the saved calibration for Port 2, for instance `PORT_2_REFL_CALIBRATION.chx`.
2. Using National Instruments NI-Max communicator tool which is installed on PC as part of NI-VISA, open a communication session with the VNA and click the **Query** button to validate communication.
   a. The VNA will return Mfg, Model, SerNO, SWver (see Figure 3-21).

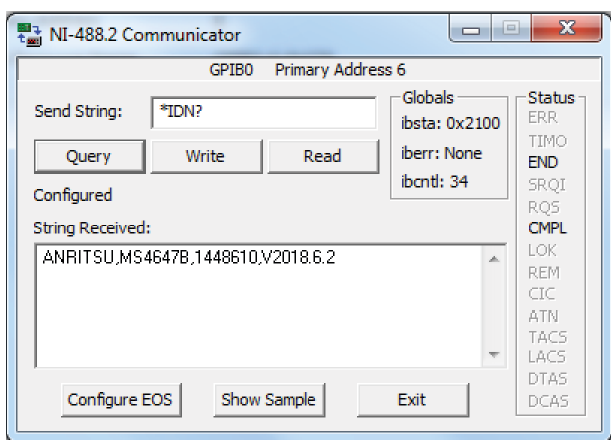


Figure 3-21. NI-488.2 COMMUNICATOR Dialog – *IDN?

3. Retrieve the Frequency Points from the VNA.
   a. Enter the command `:SENS1:FREQ:DATA?`.
   b. Click the **Query** button to load the frequency points from the current calibration setup.

c. Use the mouse to highlight the data and paste to the Windows clipboard (see Figure 3-22).

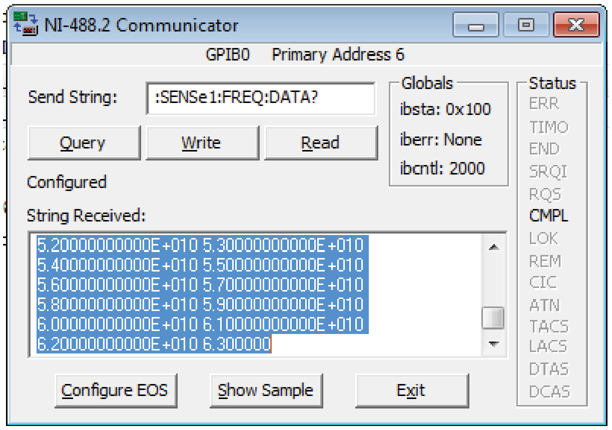


Figure 3-22. NI-488.2 COMMUNICATOR Dialog – :SENSe1::FREQ:DATA?

d. As in Step c, again capture the frequency point data and paste on to the end of the data in the text document.

e. Save this text document in a convenient location on Windows PC. Name the text file, for instance: `VNA_Port2_Freq_Points`.

4. Retrieve Port-1 Raw Source Match Data Points from the VNA.

   a. Enter the command `:SENS1:CORR:COEF? EP2S`.

   b. Click the Query button to load the Raw Source Match data points from the current calibration setup.

   c. Use the mouse and highlight the data and paste to the Windows clipboard.

   d. Open a standard text editor, such as Notepad, and paste the Raw Source Match data to the document.

   e. Go back to the NI-Comm Tool and click the Read button to flush and capture any data that remains in the VNA buffer.

   f. As in Step c, again highlight and capture the Raw Source Match data and paste on to the end of the data in the text document.

   g. Save this text document in a convenient location on Windows PC. Name the test document, for instance: `VNA_Port2_Raw_Source_Match`.

Port Power at Port 1 Procedure

1. If calibration is applied, set to OFF

2. Select Channel, then Sweep, then Sweep Type and set to Freq Sweep (Linear).

   a. Click on Freq and then click on CW mode.

   b. Click on # of Points and enter 51.

3. Set the VNA Port Power.

   a. Click on Power, and in the fields Port 1 Power and Port 2 Power, enter the power based on Option 31.

      i. If VNA is fitted with Option 31, set port power to +20 dBm.

      ii. If not fitted with Option 31, set port power to + 15 dBm.

4. Set Display to S11 Log Magnitude only.
   a. Click on Trace.
   b. Click on # of Traces and enter 1.
   c. Select Trace Max.
   d. Click on Display.
   e. Click on Trace Format.
   f. Click on Log Mag.
5. Set IFBW 10 Hz.
   a. Click on Channel
   b. Click on Averaging
   c. Click on IFBW and enter 10 then click on Hz.
6. Connect power sensor to **Port 1**.
7. Set the VNA's frequency.
   a. Click on Freq.
   b. Click on CW Frequency and enter the first (or minimum frequency) or next frequency in the test list in the "Maximum Port Power Output Test Record" on page B-4.
8. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
9. Measure and record the port output power in the column labeled Measurement (dBm).
10. Repeat for remaining frequency points on the "Maximum Port Power Output Test Record" on page B-4 or until the unit's maximum frequency is reached.

Port Power at Port 2 Procedure

1. Set Display to S22 Log Magnitude only.
   a. Click on Trace.
   b. Click on # of Traces and enter 1.
   c. Select Trace Max.
   d. Click on Display.
   e. Click on Trace Format.
   f. Click on Log Mag.
2. Connect power sensor to **Port 2**.
3. Set the VNA's frequency.
   a. Click on Freq.
   b. Click on CW Frequency and enter the first (or minimum frequency) or next frequency in the test list in the "Maximum Port Power Output Test Record" on page B-4.
4. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
5. Measure and record the port output power in the column labeled Measurement (dBm).
6. Repeat for remaining frequency points on the "Maximum Port Power Output Test Record" on page B-4 or until the unit's maximum frequency is reached.

Compute Source-Load Match Correction Factor at Port 1

1. Rename the suffixes on the files saved to the PC for Port 1 to `.csv`.
2. Open the Frequency point file (`VNA_Port1_Freq_Points.csv`) and the Raw Source Match File (`VNA_Port1_Raw_Source_Match.csv`) and align the data into one file; there should be 106 data points. There should be three columns; label these columns from left to right Freq (Hz), Real Raw Source Match, and Imaginary Raw Source Match.
3. Save this file as an Excel file with a new name (for example: `Port_1_Calculation.xlsx`).
4. Transfer the Power Sensor Input Match data file (`SC7770_Sensor_input_match.csv`) to the PC via a USB drive and open this file, then compare the frequency points against file built in Step 2. They should match. Copy this data into the calculation file. Rename these columns from PNT to Data Point, FREQ1.GHZ to Freq (GHz), REAL1 to Real Power Sensor Input Match, and IMAG1 to Imaginary Power Sensor Input Match.

Note	The column labeled “FREQ1.GHZ” is not used and can be removed if desired.

5. Create five more columns in the Excel spreadsheet with a labels MCF, Measurement (dBm), Measurement (Watts), Adjusted Meas times MCF (Watts), and Adjusted Meas and MCF (dBm)
6. On a point by point basis for all 106 data points, compute the Match-Correction-Factor (MCF) using the formula shown below.

$$\mathrm{MCF} = (|1 - (B \times C)|)^2$$

Figure 3-23. MCF = Mismatch Loss Equation

where B and C are complex values of Raw Source Match and Power Sensor Input Match respectively.

   a. For each frequency point, enter the MCF value in the table for Port 1 into the column labeled MCF.
   b. Typical values will be in the range 0.9 to 1.1 in the lower range and can approach 0.75 to 1.3 at higher frequencies.

Compute Source-Load Match Correction Factor at Port 2

1. Rename the suffixes on the files saved to the PC for Port 2 to `.csv`.
2. Open the Frequency point file (`VNA_Port2_Freq_Points.csv`) and the Raw Source Match File (`VNA_Port2_Raw_Source_Match.csv`) and align the data into one file; there should be 106 data points. There should be three columns; label these columns from left to right Freq (Hz), Real Raw Source Match, and Imaginary Raw Source Match.
3. Save this file as an Excel file with a new name (for example: `Port_2_Calculation.xlsx`).

Note	It is not necessary to re-measure the sensor on Port 2.

4. Transfer the Power Sensor Input Match data file (`SC7770_Sensor_input_match.csv`) to the PC via a USB drive and open this file, then compare the frequency points against file built in Step 2. They should match. Copy this data into the calculation file. Rename these columns from PNT to Data Point, FREQ1.GHZ to Freq (GHz), REAL1 to Real Power Sensor Input Match, and IMAG1 to Imaginary Power Sensor Input Match.

Note	The column labeled “FREQ1.GHZ” is not used and can be removed if desired.

5. Create five more columns in the Excel spreadsheet with a labels MCF, Measurement (dBm), Measurement (Watts), Adjusted Meas times MCF (Watts), and Adjusted Meas and MCF (dBm)

6. On a point by point basis, for all 106 data points, compute the Match-Correction-Factor (MCF) using the formula shown below.

$$\mathrm{MCF} = (|1 - (\mathrm{B} \times \mathrm{C})|)^2$$

Figure 3-24. MCF = Mismatch Loss Equation

where B and C are complex values of Raw Source Match and Power Sensor Input Match respectively.

a. For each frequency point enter the MCF value in the table for Port 1 into the column labeled MCF.

b. Typical values will be in the range 0.9 to 1.1 in the lower range and can approach 0.75 to 1.3 at higher frequencies.

Compute Match Corrected Result for Port-1

1. In the Port 1 data table (file `Port_1_Calculation.xlsx`) Measurement (dBm) column, convert the raw dBm reading to watts using the formula below, and place the values into the Measurement (Watts) column.

$$\text{Watts value} = \left(\frac{10^{(\mathrm{dBm}/10)}}{1000}\right)$$

Figure 3-25. Convert Raw dBm to Watts

$$-9.76\ \mathrm{dBm} = \left(\frac{10^{((-9.76)/10)}}{1000}\right)\mathrm{W} = 0.000106\mathrm{W}$$

Figure 3-26. Convert Raw dBm to Watts Example

a. Enter results in watts for all frequency points into the Measurement (Watts) column.

b. Multiply the Measurement (Watts) value by the MCF value, and enter into the Adjusted Meas times MCF (Watts) column as adjusted value watts.

Example: 0.000106W x 1.075 MCF = .00011395W

c. Convert adjusted Adjusted Meas times MCF (Watts) back to dBm using the formula below.

$$\text{dBm value} = 10\log_{10}(\text{Watts} \times 1000)$$

Figure 3-27. Convert Adjusted Adjusted Mean Times to dBm

Example: dBm = 10 * Log_{10}(.00011395W * 1000) = -9.43 dBm

i. Enter this value into column Adjusted Meas and MCF (dBm) and compare to the specification.

Compute Match Corrected Result for Port 2

1. In the Port 2 data table (file `Port_2_Calculation.xlsx`), Measurement (dBm) column, convert the raw dBm reading to watts using the formula below, and place the values into column Measurement (Watts).

$$\text{Watts value} = \left(\frac{10^{(\text{dBm}/10)}}{1000}\right)$$

Figure 3-28. Convert Raw dB to Watts

$$-9.76\ \text{dBm} = \left(\frac{10^{((-9.76)/10)}}{1000}\right)\text{W} = 0.000106\text{W}$$

Figure 3-29. Convert Raw dB to Watts Example

a. Enter results in watts for all frequency points into the Measurement (Watts) column.

b. Multiply the Measurement (Watts) value by the MCF value and enter into the Adjusted Meas times MCF (Watts) column as adjusted value watts.

   Example: 0.000106W x 1.075 MCF = .00011395W

c. Convert adjusted Adjusted Meas times MCF (Watts) back to dBm using the formula below.

$$\text{dBm value} = 10\log_{10}(\text{Watts} \times 1000)$$

Figure 3-30. Convert Adjusted Adjusted Mean Times to dBm

$$\text{dBm} = 10\log_{10}(0.00011395\text{W} \times 1000) = -9.43\text{dBm}$$

Figure 3-31. Convert Adjusted Adjusted Mean Times to dBm Example

i. Enter this value into the Adjusted Meas and MCF (dBm) column and compare to the specification.

If the Test Results are Out of Tolerance

1. If this test fails, do the following:

- Perform Section 7-9 "Source Auto Leveling Control Adjustment (ALC Cal)" on page 7-28.
- Perform the steps in Section 5-13 "Troubleshooting RF Section Power-Related Problems" on page 5-19 in Chapter 5, "Troubleshooting".

Port Power Accuracy Test (for K-connector models MS4642B and MS4644B)

This test verifies the port power level accuracy at default port power.

Power accuracy is determined with an external power meter. Accuracy is evaluated at default power across frequency.

Measurements are made with a power sensor connected to Port 1 and then Port 2. The MS4640B is set to CW mode and default power. The frequency is then stepped across the entire frequency band of the instrument.

Equipment Required

- Power Meter
- Power Sensor
- Adapters

Procedure

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA.
3. Configure the VNA for default power.
   a. Click on Power and in the fields Port 1 Power and Port 2 Power enter the power based on technical data sheet section “Output Default Power” for the default power values.
4. Set the VNA source for “CW” mode.
   a. Click on Freq and then click on CW mode.
   b. Click on # of Points and enter 51.
5. Set Display to S11 Log Magnitude only.
   a. Click on Trace.
   b. Click on # of Traces and enter 1.
   c. Select Trace Max.
   d. Click on Display.
   e. Click on Trace Format.
   f. Click on Log Mag
6. Set IFBW 10 Hz
   a. Click on Chanel
   b. Click on Averaging
   c. Click on IFBW and enter 10 then click on Hz.
7. Connect power sensor to **Port 1**.
8. Set the VNA’s frequency.
   a. Click on Freq.
   b. Click on CW Frequency and enter the first (or minimum frequency), or next frequency in the test list in the Section B-3 “Port Power Accuracy Test Record” on page B-169, or until the unit’s maximum frequency is reached.
9. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
10. Measure and record the port output power.
11. Repeat for remaining frequency points on the Port Power Accuracy test records in Section B-3 “Port Power Accuracy Test Record” on page B-169 or until the unit’s maximum frequency is reached.

12. Set Display to S22 Log Magnitude only.

- **a.** Click on Trace.
- **b.** Click on # of Traces and enter 1.
- **c.** Select Trace Max.
- **d.** Click on Display.
- **e.** Click on Trace Format.
- **f.** Click on Log Mag

13. Connect power sensor to **Port 2**.

14. Repeat Step 8 through Step 11.

If the Test Results are Out of Tolerance

15. If this test fails, do the following:

- Perform the steps in "Source Auto Leveling Control Adjustment (ALC Cal)" on page 7-28.
- Perform the steps in "Troubleshooting RF Section Power-Related Problems" on page 5-19.

Port Power Accuracy Test (for V-connector Model MS4647B)

This test verifies that the port power level accuracy at default port power. Power accuracy is determined with an external power meter. Accuracy is evaluated at default power across frequency.

Measurements are made with a power sensor connected to port 1, and then port 2. The MS4640B is set to CW mode and default power. The frequency is then stepped across the entire frequency band of the instrument.

Additionally this method provides instructions on correcting the measurements for VNA (Source) to Power Sensor (Load) Mismatch

Equipment Required

- Power Meter
- Power Sensor
- Adapter
- V-Type Calibration Kit

Procedure 1-Port Reflection Only Calibration

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA.

Note	The computations of MCF made previously for maximum power measurements may be reused for correction of power accuracy. Re-performing the port calibrations and extractions of Raw Source Match and Re-measurement of Power Sensor are optional.

3. Set the VNA for default power.
   a. Click on Power, and in the fields Port 1 Power and Port 2 Power, enter the power based on the technical data sheet section *Output Default Power* for the default power values.
4. Configure the instrument; using Frequency Based Segmented Sweep, create a segmented sweep table, as shown in Figure 3-32, appropriate for VNA being tested.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry of Figure 3-32.

Note	In Figure 3-32, the default power of -10 dBm is listed in the table. However, the unit's power should be set to Output Default Power.

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	1 MHz	2	930 kHz	1 kHz	-10	-10	1
2	☑	Start & Stop	2 MHz	5 MHz	2	3 MHz	1 kHz	-10	-10	1
3	☑	Start & Stop	7 MHz	9 MHz	2	2 MHz	1 kHz	-10	-10	1
4	☑	Start & Stop	10 MHz	11 MHz	2	1 MHz	1 kHz	-10	-10	1
5	☑	Start & Stop	20 MHz	50 MHz	2	30 MHz	1 kHz	-10	-10	1
6	☑	Start & Stop	100 MHz	300 MHz	3	100 MHz	1 kHz	-10	-10	1
7	☑	Start & Stop	500 MHz	700 MHz	2	200 MHz	1 kHz	-10	-10	1
8	☑	Start & Stop	1 GHz	2 GHz	3	500 MHz	1 kHz	-10	-10	1
9	☑	Start & Stop	2.2 GHz	2.399 GHz	2	199 MHz	1 kHz	-10	-10	1
10	☑	Start & Stop	2.4 GHz	2.499 GHz	2	99 MHz	1 kHz	-10	-10	1
11	☑	Start & Stop	2.5 GHz	2.7 GHz	2	200 MHz	1 kHz	-10	-10	1
12	☑	Start & Stop	2.701 GHz	3 GHz	2	299 MHz	1 kHz	-10	-10	1
13	☑	Start & Stop	3.5 GHz	5 GHz	4	500 MHz	1 kHz	-10	-10	1
14	☑	Start & Stop	5.001 GHz	5.5 GHz	2	499 MHz	1 kHz	-10	-10	1
15	☑	Start & Stop	6 GHz	10 GHz	9	500 MHz	1 kHz	-10	-10	1
16	☑	Start & Stop	10.001 GHz	11 GHz	2	999 MHz	1 kHz	-10	-10	1
17	☑	Start & Stop	12 GHz	20 GHz	9	1 GHz	1 kHz	-10	-10	1
18	☑	Start & Stop	20.001 GHz	21 GHz	2	999 MHz	1 kHz	-10	-10	1
19	☑	Start & Stop	22 GHz	38 GHz	17	1 GHz	1 kHz	-10	-10	1
20	☑	Start & Stop	38.001 GHz	39 GHz	2	999 MHz	1 kHz	-10	-10	1
21	☑	Start & Stop	40 GHz	40.001 GHz	2	1 MHz	1 kHz	-10	-10	1
22	☑	Start & Stop	41 GHz	49 GHz	9	1 GHz	1 kHz	-10	-10	1
23	☑	Start & Stop	49.001 GHz	50 GHz	2	999 MHz	1 kHz	-10	-10	1
24	☑	Start & Stop	50.001 GHz	51 GHz	2	999 MHz	1 kHz	-10	-10	1
25	☑	Start & Stop	52 GHz	65 GHz	14	1 GHz	1 kHz	-10	-10	1
26	☑	Start & Stop	65.001 GHz	66 GHz	2	999 MHz	1 kHz	-10	-10	1
27	☑	Start & Stop	67 GHz	67.001 GHz	2	1 MHz	1 kHz	-10	-10	1
28	☑	Start & Stop	68 GHz	70 GHz	3	1 GHz	1 kHz	-10	-10	1

Figure 3-32. Segmented Sweep Table Example

- **d.** Select Add and repeat until the all segments are entered.
- **e.** Select Back, then select Sweep type, and then select Segmented Sweep (Freq Based).

5. Set VNA for single trace, Real + Imaginary, with S-Parameter response = S11.

- **a.** Select Trace.
- **b.** Select # of Traces and enter 1.
- **c.** Select Trace Max to expand the trace to the full screen.
- **d.** Select Response, select S11.
- **e.** Select Display >> Trace Format >> scroll down and select Real And Imaginary.

6. Load Cal Kit Coefficients

- **a.** Insert Cal Kit USB device to VNA **USB Port**.
- **b.** Select Calibrate.
- **c.** Select Cal Kit/AutoCal Characterization, then Install Kit/Charac.

d. At the INSTALL dialog, select the Cal Kit radio button and then the Browse button (see Figure 3-33).

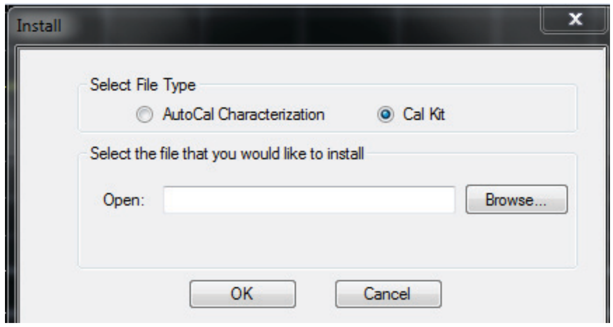


Figure 3-33. INSTALL Dialog

e. Browse to locate the `*.ccf` file on the Cal Kit USB drive (see Figure 3-34).

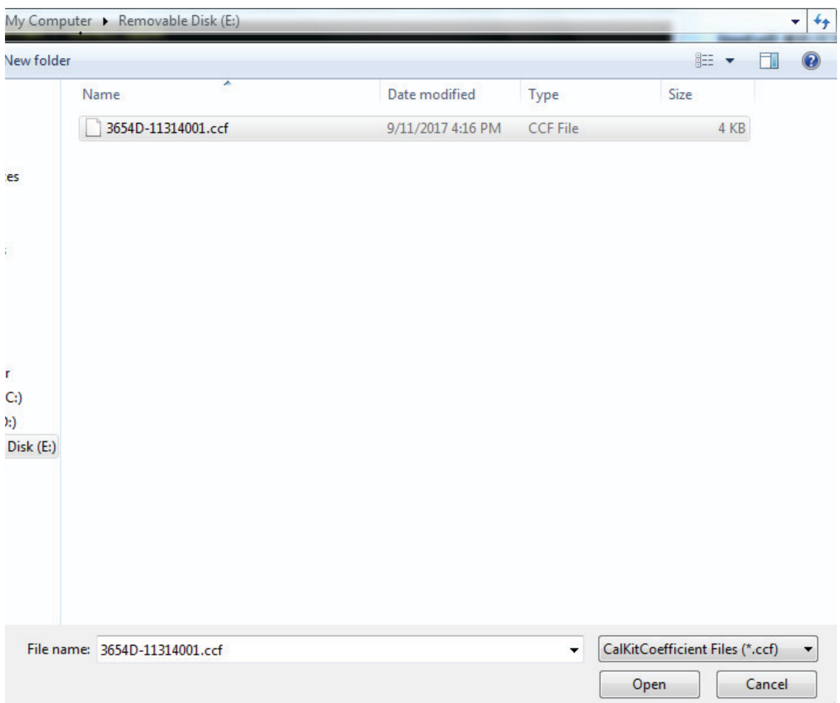


Figure 3-34. Browse CCF File Window

f. Select the file and then select Open.

g. The software returns to the INSTALL dialog with the path populated (see Figure 3-35). Select OK.

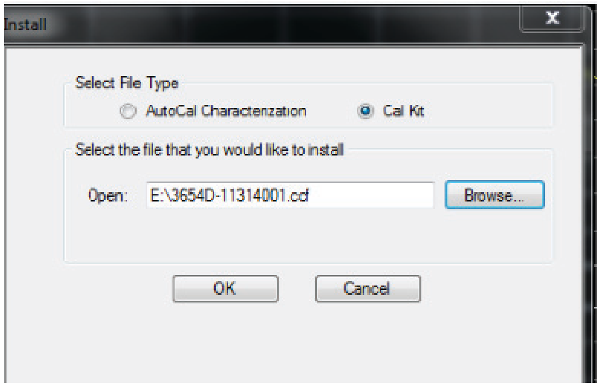


Figure 3-35. INSTALL Cal Kit Dialog

h. Confirm Cal Kit Serial number. Select Install (see Figure 3-36).

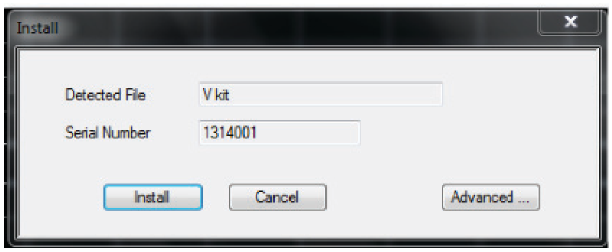


Figure 3-36. INSTALL Cal Kit Serial Number Dialog

7. Define 1-Port Calibration at Port 1.
   a. Select Calibrate >> Manual Cal >> 1-Port Cal.

b. Select Modify Cal Setup, then select Edit Cal Params, and new dialog appears (see Figure 3-37).

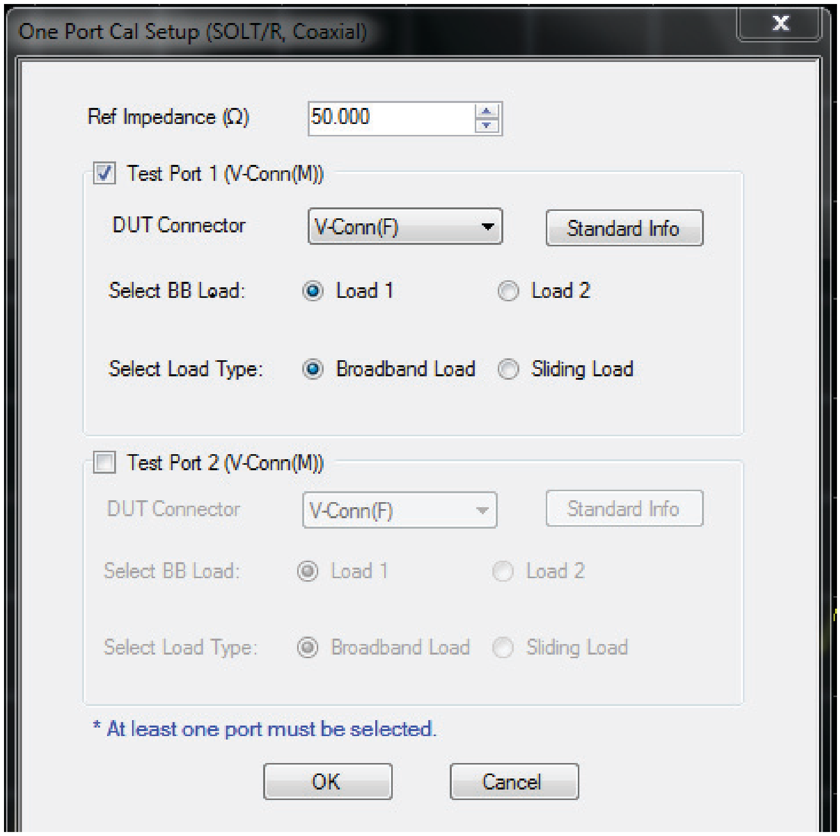


Figure 3-37. ONE PORT CAL SETUP Dialog

c. In the new window, uncheck the Test Port 2 check box.

d. Select Test Port 1 DUT Connector as V-Conn(F).

e. Select OK.

8. Perform 1-Port Reflection-only calibration (S11) at Port 1

   a. Select Calibrate >> Manual Cal >> 1-Port Cal (see Figure 3-38).

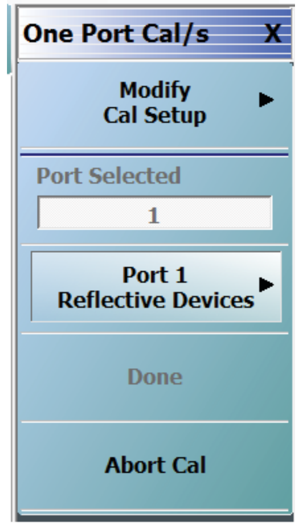


Figure 3-38. ONE PORT CAL/S Menu – Port 1

   b. Select the Port 1 Reflective Devices and the new menu appears (see figure Figure 3-39).

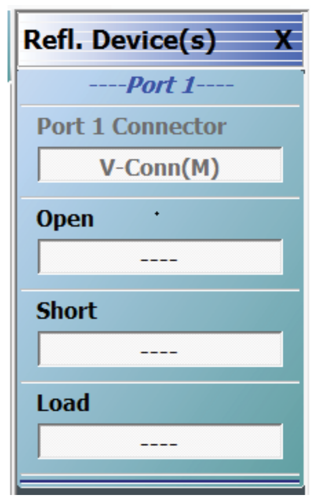


Figure 3-39. REFL. DEVICES Menu – Port 1

   c. Connect to an Open to **Port 1**, then select Open, next connect a Short, then select Short, and finally connect a Load, then select Load.

   d. When finished measuring devices select Back and then Done to complete and apply the calibration.

   e. Save the calibration on SSD to a convenient location, such as `C:\AnritsuVNA`.

      i. Select File and then Save Setup.

      ii. Change the file location or file name to identify target port, for instance `Port_1_Refl_Calibration.chx`.

      iii. Select Save.

9. Set VNA for single trace, Real + Imaginary, with S-Parameter response = S22.
   a. Select Trace TR1.
   b. Select Response >> S22.
   c. Select Display >> Trace Format >> scroll down and select Real And Imaginary.
10. Define 1-Port Calibration at Port 2.
    a. Select Calibrate >> Manual Cal >> 1-Port Cal.
    b. Select Modify Cal Setup, then select Edit Cal Params and un-check the Test Port 1 check box.
    c. Check Test Port 2 check box.
    d. Select Test Port 2 DUT Connector as V-Conn(F).
    e. Select OK.
11. Perform 1-Port Reflection-only calibration (S22) at Port 2.
    a. Select Calibrate >> Manual Cal >> 1-Port Cal (see figure Figure 3-40).

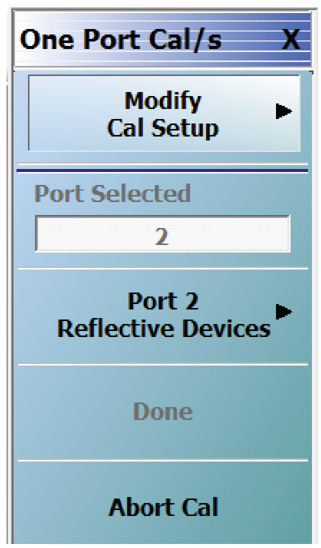


Figure 3-40. ONE PORT CAL/S Menu – Port 2

b. Select the Port 2 Reflective Devices and the new menu appears (see Figure 3-41).

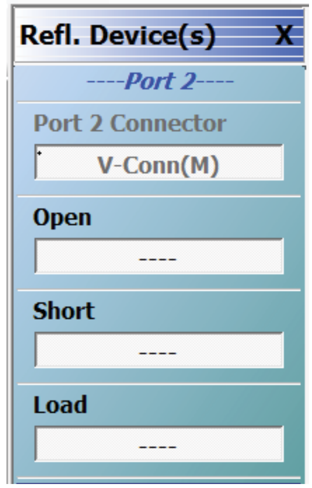


Figure 3-41. REFL. DEVICES Menu – Port 2

c. Connect an Open to **Port 2**, then select Open, next connect a Short, then select Short, and finally connect a Load, then select Load.

d. When finished measuring devices select Back and then Done to complete and apply the calibration

e. Save the calibration on hard disk to a convenient location, such as `C:\AnritsuVNA`.

i. Select File and then Save Setup.

ii. Change the file location or file name to identify target port, for instance `Port_2_Refl_Calibration.chx`.

iii. Select Save.

Measure Sensor Input Match Procedure

1. Recall the saved calibration for Port-1. The file name is `Port_1_Refl_Calibration.chx` (from Step 8, Step e).
2. Connect Power Sensor SC7770 Via 33VFVF50B adapter to VNA **Port 1**.
3. Trace format should be Real And Imaginary.
4. Save measured data. Select File >> Save Data >> data type `*.csv` at a convenient location, for instance `C:\AnritsuVNA`.
5. Name the data file, for instance: `SC7770_Sensor_Input_Match.csv`.

Extract VNA Raw Source Match Term (Port-1) Procedure

1. Set up the VNA in the same configuration as for "Measure Sensor Input Match Procedure" on page 3-48.

Note	If this test is done immediately after Measurement Sensor Input Match procedure then no change in setup. Otherwise, recall the same saved calibration.chx file for Port 1 used in "Measure Sensor Input Match Procedure" on page 3-48.

2. Using National Instruments NI-Max communicator tool which is installed on PC as part of NI-VISA, open a communication session with the VNA and click the Query button to validate communication.
    a. The VNA will return Mfg, Model, SerNO, SWver (see figure Figure 3-42).

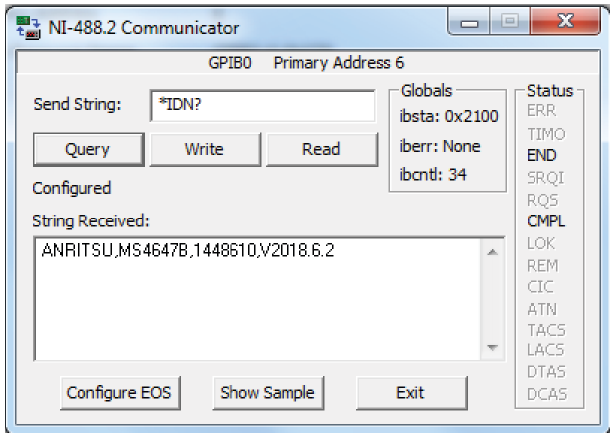


Figure 3-42. NI-488.2 COMMUNICATOR DIALOG – *IDN?

3. Retrieve the Frequency Points from the VNA
    a. Enter the command `:SENS1:FREQ:DATA?`
    b. Click the Query button to load the frequency points from the current calibration setup.
    c. Use the mouse to highlight the data and paste to Windows clipboard (see Figure 3-43).

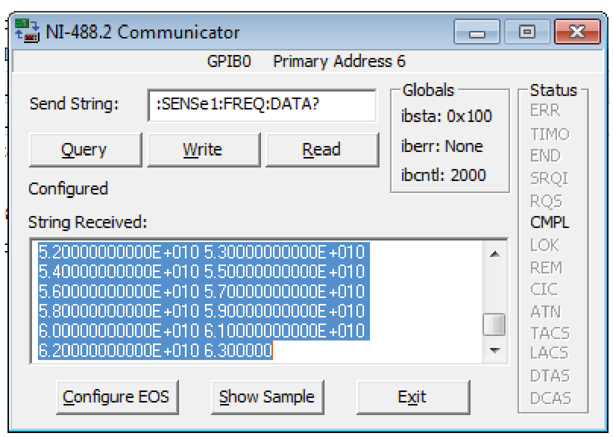


Figure 3-43. NI-488.2 COMMUNICATOR DIALOG – :SENSe1:FREQ:DATA? (first screen)

    d. Open a standard text editor, such as Notepad, and paste the frequency data to the document.

e. Go back to NI-Comm Tool and click the **Read** button to flush and capture any data that remains in the VNA buffer (see Figure 3-44).

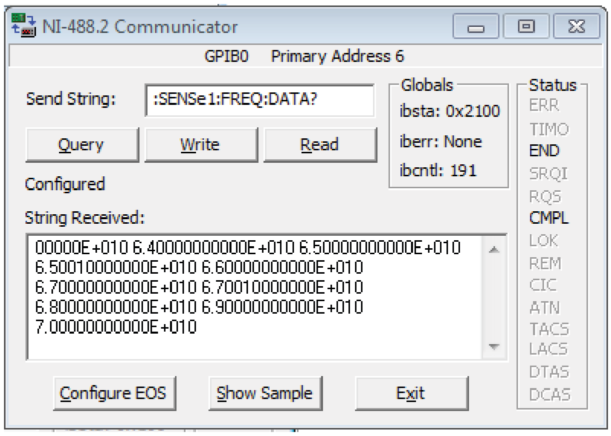


Figure 3-44. NI-488.2 COMMUNICATOR DIALOG – :SENSe1:FREQ:DATA? (final screen)

f. As in Step c, again capture the frequency point data and paste on to the end of the data in the text document.

g. Save this text document in a convenient location on Windows PC. Name the text document, for instance: `VNA_Port1_Freq_Points`.

4. Retrieve Port-1 Raw Source Match Data Points from the VNA.

a. Enter the command `:SENS1:CORR:COEF? EP1S`

b. Click the **Query** button to load the Raw Source Match data points from the current calibration setup.

c. Use the mouse to highlight the data and paste to the Windows clipboard (see figure Figure 3-45).

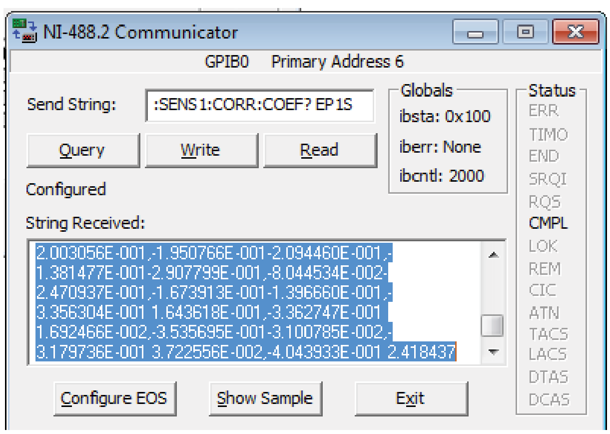


Figure 3-45. NI-488.2 COMMUNICATOR DIALOG – :SENS1:CORR:COEF? EP 1S (first screen)

d. Open a standard text editor, such as Notepad, and paste the Raw Source Match data to the document.

e. Go back to NI-Comm Tool and click the Read button to flush and capture any data that remains in the VNA buffer (see figure Figure 3-46).

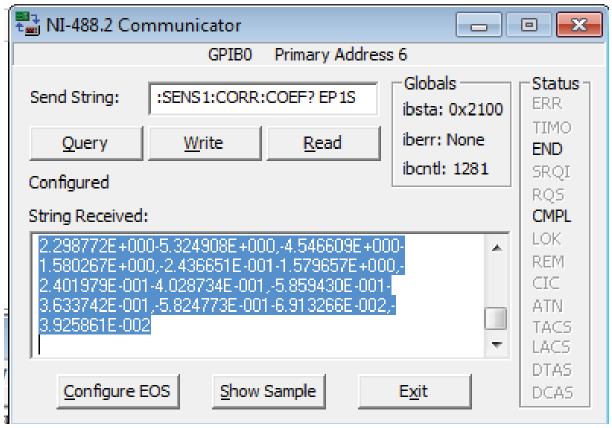


Figure 3-46. NI-488.2 COMMUNICATOR DIALOG – :SENS1:CORR:COEF? EP 1S (final screen)

f. As in Step c, again highlight and capture the Raw Source Match data and paste on to the end of the data in the text document.

g. Save this text document in a convenient location on Windows PC. Name the text file, for instance: `VNA_Port1_Raw_Source_Match`.

Extract VNA Raw Source Match Term (Port 2) Procedure

1. Recall the saved calibration for Port 2, for instance `Port_2_Refl_Calibration.chx`.
2. Using National Instruments NI-Max communicator tool which is installed on PC as part of NI-VISA, open a communication session with the VNA and click the **Query** button to validate communication
   a. The VNA will return Mfg, Model, SerNO, SWver (see figure Figure 3-47).

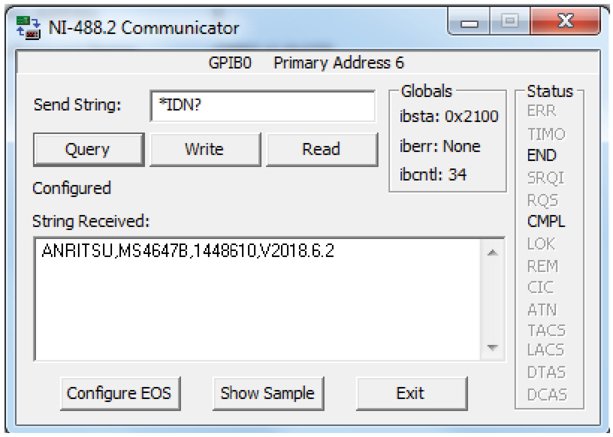


Figure 3-47. NI-488.2 Communicator Dialog – *IDN?

3. Retrieve the Frequency Points from the VNA
   a. Enter the command `:SENS1:FREQ:DATA?`.
   b. Click the **Query** button to load the frequency points from the current calibration setup.
   c. Use the mouse to highlight the data and paste to the Windows clipboard (see Figure 3-48).

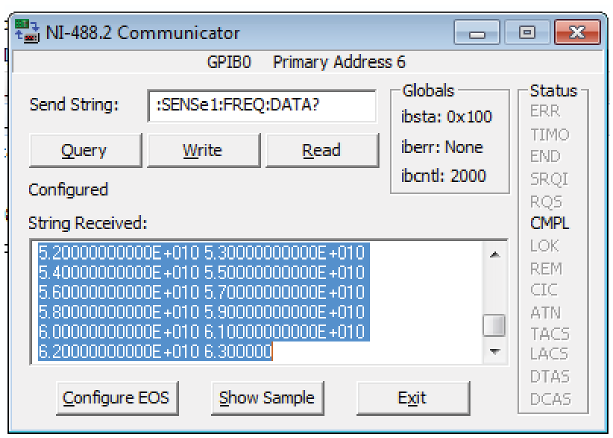


Figure 3-48. NI-488.2 COMMUNICATOR DIALOG – :SENSe1::FREQ:DATA?

   d. As in Step c, again capture the frequency point data and paste on to the end of the data in the text document.
   e. Save this text document in a convenient location on Windows PC. Name the text file, for instance: `VNA_Port2_Freq_Points`.
4. Retrieve Port-1 Raw Source Match Data Points from the VNA.
   a. Enter the command `:SENS1:CORR:COEF? EP2S`

b. Click the Query button to load the Raw Source Match data points from the current calibration setup.

c. Use the mouse and highlight the data and paste to the Windows clipboard.

d. Open a standard text editor, such as Notepad, and paste the Raw Source Match data to the document.

e. Go back to the NI-Comm Tool and click the Read button to flush and capture any data that remains in the VNA buffer.

f. As in Step c, again highlight and capture the Raw Source Match data and paste on to the end of the data in the text document.

g. Save this text document in a convenient location on Windows PC. Name the test document, for instance: `VNA_Port2_Raw_Source_Match`.

Port Power at Port 1 Procedure

1. If calibration is applied, set to OFF
2. Select Channel, then Sweep, then Sweep Type and set to Freq Sweep (Linear).
    a. Click on Freq and then click on CW mode.
    b. Click on # of Points and enter 51.
3. Set Display to S11 Log Magnitude only.
    a. Click on Trace.
    b. Click on # of Traces and enter 1.
    c. Select Trace Max.
    d. Click on Display.
    e. Click on Trace Format.
    f. Click on Log Mag.
4. Set IFBW 10 Hz.
    a. Click on Channel.
    b. Click on Averaging.
    c. Click on IFBW and enter 10 then click on Hz.
5. Connect power sensor to **Port 1**.
6. Set the VNA’s frequency.
    a. Click on Freq.
    b. Click on CW Frequency and enter the first (or minimum frequency) or next frequency in the test list in the “Port Power Accuracy Test Record” on page B-169.
7. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
8. Measure and record the port output power in the column labeled Measurement (dBm).
9. Repeat for remaining frequency points on the “Port Power Accuracy Test Record” on page B-169 or until the unit's maximum frequency is reached.

Port Power at Port 2 Procedure

1. Set Display to S22 Log Magnitude only.
    a. Click on Trace.
    b. Click on # of Traces and enter 1.
    c. Select Trace Max.

   d. Click on Display.
   e. Click on Trace Format.
   f. Click on Log Mag.
2. Connect power sensor to **Port 2**.
3. Set the VNA's frequency.
   a. Click on Freq.
   b. Click on CW Frequency and enter the first (or minimum frequency) or next frequency in the test list in the "Port Power Accuracy Test Record" on page B-169.
4. Set the Power Meter sensor cal-factor frequency to the same frequency as the VNA.
5. Measure and record the port output power in the column labeled Measurement (dBm).
6. Repeat for remaining frequency points on the "Port Power Accuracy Test Record" on page B-169 or until the unit's maximum frequency is reached.

Compute Source-Load Match Correction Factor at Port 1

1. Rename the suffixes on the files saved to the PC for Port 1 to `.csv`.
2. Open the Frequency point file (`VNA_Port1_Freq_Points.csv`) and the Raw Source Match File (`VNA_Port1_Raw_Source_Match.csv`) and align the data into one file; there should be 106 data points. There should be three columns; label these columns from left to right Freq (Hz), Real Raw Source Match, and Imaginary Raw Source Match.
3. Save this file as an Excel file with a new name (for example: `Port_1_Calculation.xlsx`).
4. Transfer the Power Sensor Input Match data file (`SC7770_Sensor_input_match.csv`) to the PC via a USB drive and open this file, then compare the frequency points against file built in Step 2. They should match. Copy this data into the calculation file. Rename these columns from PNT to Data Point, FREQ1.GHZ to Freq (GHz), REAL1 to Real Power Sensor Input Match, and IMAG1 to Imaginary Power Sensor Input Match.

Note	The column labeled "FREQ1.GHZ" is not used and can be removed if desired.

5. Create five more columns in the Excel spreadsheet with labels MCF, Measurement (dBm), Measurement (Watts), Adjusted Meas times MCF (Watts), and Adjusted Meas and MCF (dBm)
6. On a point by point basis for all 106 data points, compute the Match-Correction-Factor (MCF) using the formula shown below.

$$\mathrm{MCF} = (|1 - (\mathrm{B} \times \mathrm{C})|)^2$$

Figure 3-49. MCF = Mismatch Loss Equation

where B and C are complex values of Raw Source Match and Power Sensor Input Match respectively.

   a. For each frequency point, enter the MCF value in the table for Port 1. Enter these values into the column labeled MCF.
   b. Typical values will be in the range 0.9 to 1.1 in the lower range and can approach 0.75 to 1.3 at higher frequencies.

Compute Source-Load Match Correction Factor at Port 2

1. Rename the suffixes on the files saved to the PC for Port 2 to `.csv`.
2. Open the Frequency point file (`VNA_Port2_Freq_Points.csv`) and the Raw Source Match File (`VNA_Port2_Raw_Source_Match.csv`) and align the data into one file; there should be 106 data points.

There should be three columns; label these columns from left to right Freq (Hz), Real Raw Source Match, and Imaginary Raw Source Match.

3. Save this file as an Excel file with a new name (for example: `Port_2_Calculation.xlsx`).

Note	It is not necessary to re-measure the sensor on Port 2.

4. Transfer the Power Sensor Input Match data file (`SC7770_Sensor_input_match.csv`) to the PC via a USB drive and open this file, then compare the frequency points against file built in Step 2. They should match. Copy this data into the calculation file. Rename these columns from PNT to Data Point, FREQ1.GHZ to Freq (GHz), REAL1 to Real Power Sensor Input Match, and IMAG1 to Imaginary Power Sensor Input Match.

Note	The column labeled "FREQ1.GHZ" is not used and can be removed if desired.

5. Create five more columns in the Excel spreadsheet with a labels MCF, Measurement (dBm), Measurement (Watts), Adjusted Meas times MCF (Watts), and Adjusted Meas and MCF (dBm)

6. On a point by point basis, for all 106 data points, compute the Match-Correction-Factor (MCF) using the formula shown below.

$$\text{MCF} = (|1-(B \times C)|)^2$$

Figure 3-50. MCF = Mismatch Loss Equation

where B and C are complex values of Raw Source Match and Power Sensor Input Match respectively.

a. For each frequency point enter the MCF value in the table for Port 1 in the column labeled Measurement (dBm).

b. Typical values will be in the range 0.9 to 1.1 in the lower range and can approach 0.75 to 1.3 at higher frequencies.

Compute Match Corrected Result for Port-1

1. In the Port 1 data table (file `Port_1_Calculation.xlsx`) Measurement (dBm) column, convert the raw dBm reading to watts using the formula below, and place the values into the Measurement (Watts) column.

$$\text{Watts value} = \left(\frac{10^{(\text{dBm}/10)}}{1000}\right)$$

Figure 3-51. Convert Raw dBm to Watts

$$-9.76\ \text{dBm} = \left(\frac{10^{((-9.76)/10)}}{1000}\right)\text{W} = 0.000106\text{W}$$

Figure 3-52. Convert Raw dBm to Watts Example

a. Enter results in watts for all frequency points into the Measurement (Watts) column.

b. Multiply the Measurement (Watts) value by the MCF value, and enter into the Adjusted Meas times MCF (Watts) column as adjusted value watts.

Example: 0.000106W x 1.075 MCF = .00011395W

c. Convert adjusted Adjusted Meas times MCF (Watts) back to dBm using the formula below.

$$\text{dBm value} = 10\log_{10}(\text{Watts} \times 1000)$$

Figure 3-53. Convert Adjusted Adjusted Mean Times to dBm

Example: dBm = 10 * Log_{10}(.00011395W * 1000) = -9.43 dBm

i. Enter this value into column Adjusted Meas and MCF (dBm) and compare to the specification.

Compute Match Corrected Result for Port 2

1. In the Port 2 data table (file `Port_2_Calculation.xlsx`), Measurement (dBm) column, convert the raw dBm reading to watts using the formula below, and place the values into column Measurement (Watts).

$$\text{Watts value} = \left(\frac{10^{(\text{dBm}/10)}}{1000}\right)$$

Figure 3-54. Convert Raw dB to Watts

$$-9.76\text{ dBm} = \left(\frac{10^{((-9.76)/10)}}{1000}\right)\text{W} = 0.000106\text{W}$$

Figure 3-55. Convert Raw dB to Watts Example

a. Enter results in watts for all frequency points into the Measurement (Watts) column.

b. Multiply the Measurement (Watts) value by the MCF value and enter into the Adjusted Meas times MCF (Watts) column as adjusted value watts.

Example: 0.000106W x 1.075 MCF = .00011395W

c. Convert adjusted Adjusted Meas times MCF (Watts) back to dBm using the formula below.

$$\text{dBm value} = 10\log_{10}(\text{Watts} \times 1000)$$

Figure 3-56. Convert Adjusted Adjusted Mean Times to dBm

$$\text{dBm} = 10\log_{10}(0.00011395\text{W} \times 1000) = -9.43\text{dBm}$$

Figure 3-57. Convert Adjusted Adjusted Mean Times to dBm Example

i. Enter this value into the Adjusted Meas and MCF (dBm) column and compare to the specification.

If the Test Results are Out of Tolerance

1. If this test fails, do the following:

- Perform Section 7-9 “Source Auto Leveling Control Adjustment (ALC Cal)” on page 7-28.
- Perform the steps in Section 5-13 “Troubleshooting RF Section Power-Related Problems” on page 5-19 in Chapter 5, “Troubleshooting”.

Frequency Accuracy Test

This test verifies the frequency accuracy of the source in the MS4640B. Frequency accuracy is determined with a Frequency Counter with its external reference linked to a high precision 10 MHz Timebase.

Equipment Required

- Frequency Counter
- Precision 10 MHz Timebase
- Test Cable
- Adapters

Procedure

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA.
3. Configure the VNA for default power.
   a. Click on Power and in the fields Port 1 Power and Port 2 Power enter the power based on technical data sheet section "Output Default Power" for the default power values.
4. Set the VNA source for "CW" mode.
   a. Click on Freq and then click on CW mode.
   b. Click on # of Points and enter 51.
5. Set Display to S11 Log Magnitude only.
   a. Click on Trace.
   b. Click on # of Traces and enter 1.
   c. Select Trace Max.
   d. Click on Display.
   e. Click on Trace Format.
   f. Click on Log Mag
6. Connect **Port 1** to a frequency counter with a test cable and adapter.
7. Set the VNA's frequency.
   a. Click on Freq.
   b. Click on CW Frequency and enter the first or next frequency in the test list in the Frequency Accuracy test records in Table B-45, "Frequency Accuracy Test" on page B-176.
8. Measure and record in Table B-45, "Frequency Accuracy Test" on page B-176.

If the Test Results are Out of Tolerance

9. If this test fails, do the following:
   - Perform 10 MHz Frequency Reference Adjustment
   - Replace RF Source Module

High Level Noise Test

This test verifies that the high level noise (trace noise) performance of MS4640B meets specifications.

Note	Skip this test if the VectorStar VNA is Model MS4647B equipped with Option 51, 61, or 62.

This is a measure of the scatter of data when measuring a high level signal (full reflect or transmission through a short transmission line). The measurement is performed at default power with a 1 kHz IFBW and IFBW Enhancer set to ON.

A minimum of 40 sweeps of data of the desired parameter in linear magnitude and phase are acquired after trace-math normalization. At each frequency point the population-based standard deviation is computed and this forms the RMS high level noise number. For magnitude, this is normally converted back to Log Magnitude.

The results for this test are measured for both Magnitude and Phase in both sweep directions.

Equipment Required

- Adapter
- Thru Cable

Procedure

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.
2. Preset the VNA as follows:
    a. Select Preset button on the Icon bar and then the OK button.
3. Prepare the Thru Cable(s) as follows:
    a. For MS4642B or MS4644B: Install the 34KFKF50 Adapter to the male end of the 3670K50-2 Thru Cable. Use torque wrench to tighten the K connectors to insure that the connections do not work themselves loose during the test.
    b. For MS4647B: Install the 33VFVF50C Adapter to the male end of the 3670V50A-2 Thru Cable. Use torque wrench to tighten the V connectors to insure that the connections do not work themselves loose during the test.
4. Configure the instrument; using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-58, Figure 3-59, Figure 3-60, or Figure 3-61.
    a. Select Channel, then select Sweep.
    b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
    c. In this new screen, enter the information from the first entry in Figure 3-58, Figure 3-59, Figure 3-60, or Figure 3-61 that matches your model and options.
    d. Select Add and repeat until all the segments are entered.
    e. Set Sweep type to Segmented Sweep (Freq Based).

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	499 kHz	51	8.58 kHz	300 Hz	5	5	1
2	☑	Start & Stop	500 kHz	2.499 GHz	51	49.97 MHz	1 kHz	5	5	1
3	☑	Start & Stop	2.5 GHz	5 GHz	51	50 MHz	1 kHz	5	5	1
4	☑	Start & Stop	5.001 GHz	20 GHz	51	299.98 MHz	1 kHz	5	5	1

Figure 3-58. MS4642B All configurations: 4 bands as shown.

Source power = +5 dBm, IFBW = 1 KHz, with exception 300 Hz @ 70 kHz to 499 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	499 kHz	51	8.58 kHz	300 Hz	5	5	1
2	☑	Start & Stop	500 kHz	2.499 GHz	51	49.97 MHz	1 kHz	5	5	1
3	☑	Start & Stop	2.5 GHz	5 GHz	51	50 MHz	1 kHz	5	5	1
4	☑	Start & Stop	5.001 GHz	20 GHz	51	299.98 MHz	1 kHz	5	5	1

Figure 3-59. MS4644B All configurations: 5 bands as shown.

Source power = +5 dBm, IFBW = 1 KHz, with exception 300 Hz @ 70 kHz to 499 KHz

Note For MS4647B, if Option 51, 61, or 62 are fitted, high-level noise is typically specified and need not be measured.

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	499 kHz	51	8.58 kHz	300 Hz	-3	-3	1
2	☑	Start & Stop	500 kHz	2.499 GHz	51	49.97 MHz	1 kHz	-3	-3	1
3	☑	Start & Stop	2.5 GHz	5 GHz	51	50 MHz	1 kHz	-3	-3	1
4	☑	Start & Stop	5.001 GHz	20 GHz	51	299.98 MHz	1 kHz	-3	-3	1
5	☑	Start & Stop	20.001 GHz	40 GHz	51	399.98 MHz	1 kHz	-3	-3	1
6	☑	Start & Stop	40.001 GHz	67 GHz	51	539.98 MHz	1 kHz	-3	-3	1
7	☑	Start & Stop	67.001 GHz	70 GHz	51	59.98 MHz	1 kHz	-3	-3	1

Figure 3-60. MS4647B W/O Option 51, 61 or 62: 7 bands as shown.

Source power = -3 dBm, IFBW = 1 KHz, with exception 300 Hz @ 70 kHz to 499 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	499 kHz	51	8.58 kHz	300 Hz	-5	-5	1
2	☑	Start & Stop	500 kHz	2.499 GHz	51	49.97 MHz	1 kHz	-5	-5	1
3	☑	Start & Stop	2.5 GHz	5 GHz	51	50 MHz	1 kHz	-5	-5	1
4	☑	Start & Stop	5.001 GHz	20 GHz	51	299.98 MHz	1 kHz	-5	-5	1
5	☑	Start & Stop	20.001 GHz	40 GHz	51	399.98 MHz	1 kHz	-5	-5	1
6	☑	Start & Stop	40.001 GHz	67 GHz	51	539.98 MHz	1 kHz	-5	-5	1
7	☑	Start & Stop	67.001 GHz	70 GHz	51	59.98 MHz	1 kHz	-5	-5	1

Figure 3-61. MS4647B W/O Option 51, 61 or 62 with Option 8x: 7 bands as shown.

Source power = -5 dBm, IFBW = 1 KHz, with exception 300 Hz @ 70 kHz to 499 KHz

5. Set VNA for dual trace, Linear Magnitude, with S-Parameter response = S21 and S12
   - **a.** Select Trace.
   - **b.** Select # of Traces and enter 2.
   - **c.** Select Response.
   - **d.** Select S21.
   - **e.** Select Display.

   f. Select Trace Format.
   g. Select Linear Mag and Phase.
   h. Click on TR2.
   i. Select Response.
   j. Select S12.
   k. Select Display.
   l. Select Trace Format.
   m. Select Linear Mag and Phase.

6. Set Mag offset = 1 @ 1mU per division & Phase Offset = 0 deg. @ 0.1 deg. per division.
   a. Select Scale.
   b. Click on TR1.
   c. Select Lin Mag Reference Value and set to 1.
   d. Select Resolution and set to 1mU/Div
   e. Select Phase.
   f. Select Reference Value and set to 0 degrees.
   g. Select Resolution and set to 0.1 degrees/Div.
   h. Click on TR2 and repeat Step a to Step g.

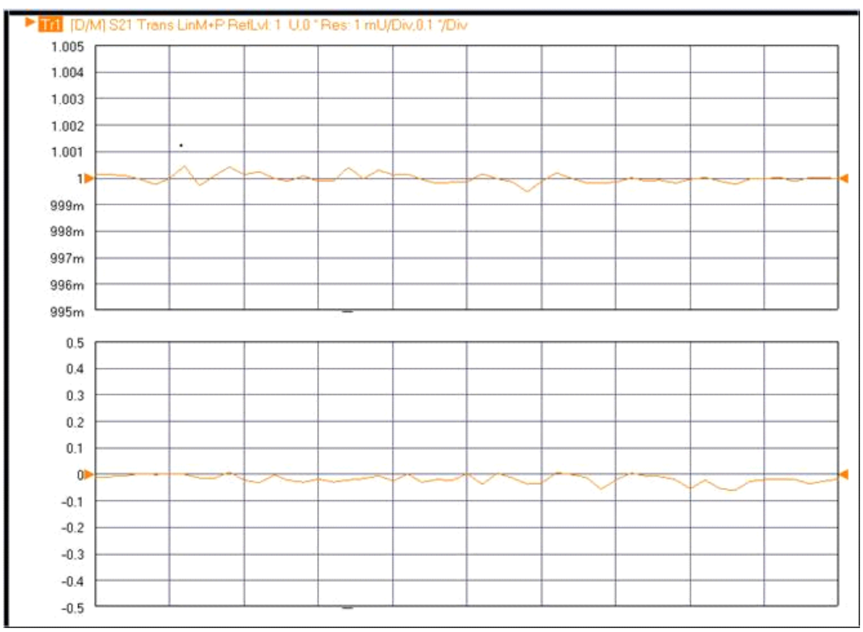


Figure 3-62. Sample of S21 Trace

7. Normalize the trace (data divided by memory).
   a. Select Display.
   b. Select View Trace.
   c. Click on TR2.
   d. Select Store Data to Memory.
   e. Select Data, Memory Math.

f. Click on TR1.

g. Select Store Data to Memory.

h. Select Data, Memory Math.

8. Select Sweep and then Hold Functions. Select Single Sweep & Hold.

9. Select File and then Save Data, file name `HLN#1`, file type .csv.

10. Repeat Step 8 through Step 9 thirty-nine (39) more times. When saving the data, increment the number at the end of the file name by one (e.g. `HLN#2`, `HLN#3` and so on.).

11. Copy the forty (40) saved data files off the MS4652x2B onto a USB flash drive for transferring to a Personal Computer.

12. On a separate Windows Personal Computer, import the saved data from the `HLN#n` files into Microsoft Excel so the RMS values can be calculated.

13. There are many ways one can set up Microsoft Excel for calculating the RMS values. Below is an example:

a. Assume the data are in an Excel worksheet as follows:

i. Row 1 is the header – Freq, Data1 through Data40, RMS Linear Mag (or RMS Deg), RMS Log Mag (or RMS Deg)

ii. Column A – Freq (Imported from the `HLN#n` files)

iii. Column B through Column AO – Data1 through Data40 (Imported from the `HLN#n` files)

b. Set up cell AP2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:

$$= \mathrm{STDEV.P(B2:U2)}$$

Figure 3-63. RMS value in Linear Mag Formula

c. Copy the formula to the next cell on Column V until it reaches the last frequency point.

d. For magnitude measurements only,:

i. Set up cell AQ2 to calculate the RMS value in Log Mag by entering the following formula into the cell:

$$= 20 \times \log(V2 + 1, 10)$$

Figure 3-64. RMS value in Log Mag Formula

ii. Copy the formula to the next cell on Column W until it reaches the last frequency point.

e. Rename Sheet 1 to S21 Magnitude by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

f. Copy the S21 Magnitude sheet by right-clicking on the S21 Magnitude tab, selecting 'Move or Copy...", selecting (move to end), checking the Create a copy check box and then clicking OK.

i. Rename the new sheet as S12 Magnitude.

ii. Use the Move or Copy... of Excel to create as many new sheets as required for both magnitude and phase measurements. Rename the sheets as necessary to indicate which measurement is being computed on the worksheet (e.g. *S21 Phase*, and so on.).

iii. Import the S21 data to the appropriate worksheet for RMS value calculation as required.

14. Record the calculated RMS value of each frequency band listed in "High Level Noise – S21 Magnitude" and "High Level Noise – S12 Phase" worksheets into Table B-46, "High-level Noise Test S21 Magnitude MS4642B" on page B-177 and Table B-49, "High-level Noise Test S12 Phase MS4642B" on page B-178.

If the Test Results are Out of Tolerance

15. If the test fails, do each of the following until the test passes:

- **a.** Repeat the "High Level Noise Test".
- **b.** Replace the thru line and repeat the entire "High Level Noise Test".
- **c.** Verify the "Port Power Accuracy Test (for K-connector models MS4642B and MS4644B)" and then repeat the "High Level Noise Test".
- **d.** Perform LO Cal and then repeat the "High Level Noise Test".
- **e.** Replace the Source Module and then repeat the "High Level Noise Test".
- **f.** Replace the LO Module and then repeat the "High Level Noise Test".

Noise Floor Test

The test verifies the noise floor performance of the VNA receivers at Port 1 and Port 2. This is a measure in absolute power (dBm) of the noise floor of the system referenced to the test port. This is done by measuring S21 and S12 with a short thru line connected and the port power set to default. The traces are normalized with this thru in place and no leakage correction is applied. The ports are then terminated with loads and S21 and S12 measured when in a 10 Hz bandwidth with no averaging. Eight sweeps are acquired in linear magnitude mode and the RMS value is computed at each frequency point individually. The results are then converted back to Log magnitude and are expressed in RMS values.

Equipment Required

- Adapters
- Thru Cable
- Loads

Procedure Frequency Response Thru Calibration

1. Power on the MS464xB and allow the instrument to warm up for 90 minutes.

2. Preset the VNA as follows:

  a. Select Preset button on the Icon bar and then the OK button.

3. Prepare the Thru Cable(s) as follows:

  a. For MS4642B or MS4644B: Install the 34KFKF50 Adapter to the male end of the 3670K50-2 Thru Cable. Use torque wrench to tighten the K connectors to insure that the connections do not work themselves loose during the test.

  b. For MS4647B: Install the 33VFVF50C Adapter to the male end of the 3670V50A-2 Thru Cable. Use torque wrench to tighten the V connectors to insure that the connections do not work themselves loose during the test.

4. Configure the instrument; using Frequency Based Segmented Sweep, create segmented sweep table as shown in Figure 3-65, Figure 3-66, Figure 3-67, or Figure 3-68.

  a. Select Channel, then select Sweep.

  b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.

  c. In this new screen, enter the information from the first entry in Figure 3-65, Figure 3-66, Figure 3-67, or Figure 3-68 that matches your model and options.

  d. Select Add and repeat until all the segments are entered.

  e. Set Sweep type to Segmented Sweep (Freq Based).

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per P Avera
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	1 kHz	5	5	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	1 kHz	5	5	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	1 kHz	5	5	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	1 kHz	5	5	1
5	☑	Start & Stop	1 GHz	2.499 GHz	17	93.6875 MHz	1 kHz	5	5	1
6	☑	Start & Stop	2.5 GHz	5 GHz	21	125 MHz	1 kHz	5	5	1
7	☑	Start & Stop	5.001 GHz	20 GHz	91	166.6555555555...	1 kHz	5	5	1

Figure 3-65. MS4642B All configurations: 7 bands as shown.

Source power = +5 dBm, IFBW = 1 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per P Avera
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	1 kHz	5	5	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	1 kHz	5	5	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	1 kHz	5	5	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	1 kHz	5	5	1
5	☑	Start & Stop	1 GHz	2.499 GHz	17	93.6875 MHz	1 kHz	5	5	1
6	☑	Start & Stop	2.5 GHz	5 GHz	21	125 MHz	1 kHz	5	5	1
7	☑	Start & Stop	5.001 GHz	20 GHz	91	166.6555555555...	1 kHz	5	5	1
8	☑	Start & Stop	20.001 GHz	38 GHz	91	199.9888888888...	1 kHz	5	5	1
9	☑	Start & Stop	38.001 GHz	40 GHz	11	199.9 MHz	1 kHz	5	5	1

Figure 3-66. MS4644B All configurations: 9 bands as shown.

Source power = +5 dBm, IFBW = 1 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per P Avera
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	1 kHz	5	5	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	1 kHz	5	5	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	1 kHz	5	5	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	1 kHz	5	5	1
5	☑	Start & Stop	1 GHz	2.499 GHz	17	93.6875 MHz	1 kHz	5	5	1
6	☑	Start & Stop	2.5 GHz	5 GHz	21	125 MHz	1 kHz	5	5	1
7	☑	Start & Stop	5.001 GHz	20 GHz	91	166.6555555555...	1 kHz	5	5	1
8	☑	Start & Stop	20.001 GHz	38 GHz	91	199.9888888888...	1 kHz	5	5	1
9	☑	Start & Stop	38.001 GHz	40 GHz	11	199.9 MHz	1 kHz	5	5	1

Figure 3-67. MS4647B Configuration Non-Option 51, 61 or 62 or 32: 13 bands as shown.

Source power = -3 dBm, IFBW = 1 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Po Averag
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	10 Hz	-5	-5	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	100 Hz	-5	-5	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	300 Hz	-5	-5	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	1 kHz	-5	-5	1
5	☑	Start & Stop	1 GHz	2.499 GHz	17	93.6875 MHz	1 kHz	-5	-5	1
6	☑	Start & Stop	2.5 GHz	5 GHz	21	125 MHz	1 kHz	-5	-5	1
7	☑	Start & Stop	5.001 GHz	20 GHz	91	166.6555555555...	1 kHz	-5	-5	1
8	☑	Start & Stop	20.001 GHz	38 GHz	91	199.9888888888...	1 kHz	-5	-5	1
9	☑	Start & Stop	38.001 GHz	40 GHz	11	199.9 MHz	1 kHz	-5	-5	1
10	☑	Start & Stop	40.001 GHz	50 GHz	51	199.98 MHz	1 kHz	-5	-5	1
11	☑	Start & Stop	50.001 GHz	65 GHz	51	299.98 MHz	1 kHz	-5	-5	1
12	☑	Start & Stop	65.001 GHz	67 GHz	21	99.95 MHz	1 kHz	-5	-5	1
13	☑	Start & Stop	67.001 GHz	70 GHz	21	149.95 MHz	1 kHz	-5	-5	1

Figure 3-68. MS4647B Configuration Non-Option 51, 61 or 62 or 32, but with Option 8x Installed: 13 bands as shown.

Source power = -5 dBm, IFBW = 1 KHz

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Po Averag
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	10 Hz	-10	-10	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	100 Hz	-10	-10	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	300 Hz	-10	-10	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	1 kHz	-10	-10	1
5	☑	Start & Stop	1 GHz	2.499 GHz	17	93.6875 MHz	1 kHz	-10	-10	1
6	☑	Start & Stop	2.5 GHz	5 GHz	21	125 MHz	1 kHz	-10	-10	1
7	☑	Start & Stop	5.001 GHz	20 GHz	91	166.6555555555...	1 kHz	-10	-10	1
8	☑	Start & Stop	20.001 GHz	38 GHz	91	199.9888888888...	1 kHz	-10	-10	1
9	☑	Start & Stop	38.001 GHz	40 GHz	11	199.9 MHz	1 kHz	-10	-10	1
10	☑	Start & Stop	40.001 GHz	50 GHz	51	199.98 MHz	1 kHz	-10	-10	1
11	☑	Start & Stop	50.001 GHz	65 GHz	51	299.98 MHz	1 kHz	-10	-10	1
12	☑	Start & Stop	65.001 GHz	67 GHz	21	99.95 MHz	1 kHz	-10	-10	1
13	☑	Start & Stop	67.001 GHz	70 GHz	21	149.95 MHz	1 kHz	-10	-10	1

Figure 3-69. MS4647B Configuration with Option 51, 61 or 62 or 32: 13 bands as shown.

Source power = -10 dBm, IFBW = 1 KHz

5. Connect VNA **Port 1** to VNA **Port 2** via high quality RF Anritsu Model 3670K50-2 or 3670V50A-2 depending on connector type.
6. Set VNA for single trace, Linear Magnitude, with S-Parameter response = S21.
   - **a.** Select Trace.
   - **b.** Select # of Traces and enter 1.
   - **c.** Select Trace Max.
   - **d.** Select Response.
   - **e.** Select S21.
   - **f.** Select Display.
   - **g.** Select Trace Format.
   - **h.** Select Linear Mag.
7. Select Calibration.
   - **a.** Select Calibrate.
   - **b.** Select Manual Cal.
   - **c.** Select Transmission Freq. Response.
   - **d.** Select Modify Cal Setup.

e. Select Edit Cal Params (see Figure 3-70).

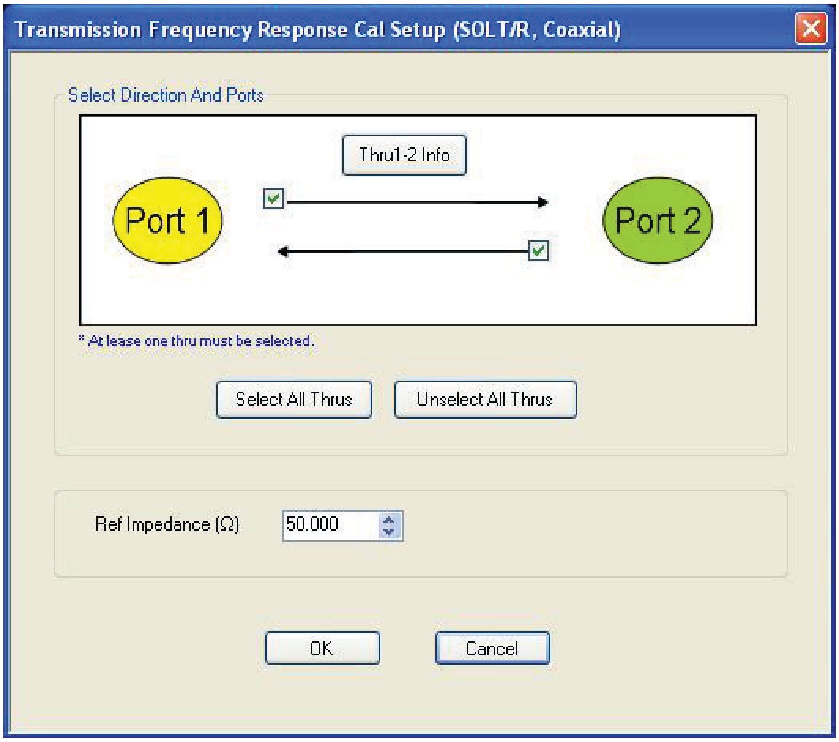


Figure 3-70. TRANSMISSION FREQUENCY RESPONSE CAL SETUP (SOLT/R, Coaxial) Dialog

f. Click on Thru1-2 Info and the screen appears (see Figure 3-71).

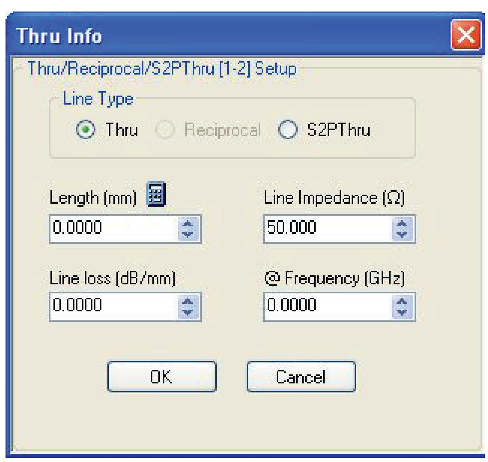


Figure 3-71. THRU INFO Dialog

g. Enter values into the dialog, depending on connector type.

i. K-Type Settings if DUT is MS4642B, or MS4644B using Anritsu 3670KF50-2. Set frequency value to 40 GHz, length to 634 mm, and Line Loss to 0.047.

ii. V-Type Settings if DUT is MS4647B using Anritsu 3670VF50-2. Set frequency value to 70 GHz, length to 634 mm, and Line Loss to 0.067.

iii. Click OK and OK again to close edit calibration parameters dialog.

8. Select Back.
9. Perform a Transmission Frequency Response-only calibration. Select Done and observe that the **Green** Calibration lamp in VNA is on.
    - **a.** Select Thru/Recip.
    - **b.** Select Thru and wait for green check mark to appear.
    - **c.** Select Back.
    - **d.** Select Done.
    - **e.** Verify **Green** Calibration lamp is on.
10. Open Segmented sweep table and set IFBW on all segments to 10 HZ and set all port power levels to -10 dBm
    - **a.** Select Channel then select Sweep.
    - **b.** Select Freq-based Seg. Sweep Setup.
    - **c.** Set IFBW on all segments to 10 HZ and set all port power levels to -10 dBm to all segments at the bottom of the screen, see Figure 3-72.

	Seg. On	Freq Def. for F1 & F2	F1	F2	# of Pts	Step/Stop Freq	IFBW	P1 Src Pwr (Src Atten = 0 dB)	P2 Src Pwr (Src Atten = 0 dB)	Per Point Averaging
1	☑	Start & Stop	70 kHz	200 kHz	11	13 kHz	10 Hz	-10	-10	1
2	☑	Start & Stop	311 kHz	2 MHz	22	80.42857142857...	10 Hz	-10	-10	1
3	☑	Start & Stop	2.35 MHz	9 MHz	20	350 kHz	10 Hz	-10	-10	1
4	☑	Start & Stop	10.001 MHz	998 MHz	17	61.7499375 MHz	10 Hz	-10	-10	1

Figure 3-72. Set IFBW on All Segments to 10 HZ and Set All Port Power Levels to -10 dBm

Procedure Noise Floor Measurement

1. Disconnect the cable from VNA. Terminate both VNA Ports with loads from the calibration kit.
2. Select Trace and then set # of Traces to 2.
3. Select Response and then S21. Verify that Tr1 is displaying S21 response.
4. Select Display and set Trace Format to Linear Mag.
5. Click on Tr2 on the top of the S12 trace on the screen and then set Trace Format to Linear Mag.
6. Select Channel, then Sweep, select Hold Functions and then select Single Sweep & Hold.
7. Select File and then Save Data
8. Change the Type of File to Active Channel CSV File (*.csv)
9. Change the file name to `NF#1.csv` and then click the Save button. Note the location of the data file being saved to.
10. Repeat Step 6 through Step 9 seven (7) more times. When saving the data, increment the number at the end of the file name by one (e.g. `NF#2.csv`, `NF#3.csv` and so on.).
11. There are many ways one can set up Microsoft Excel for calculating the Noise Floor values. Below is an example:
    - **a.** Assume the data are in an Excel worksheet as follows:
        - **i.** Row 1 is the header – Freq (GHz), Data1 through Data8, RMS Linear Mag, RMS Log Mag, Noise Floor.
        - **ii.** Column A – Freq (GHz) (Imported from the `NF#n.csv` files)
        - **iii.** Column B through Column I – Data1 through Data8 (Imported from the `NF#n.csv` files). The data in file `NF12#x.csv` is LINMAG1 is S21 and LINMAG2 is S12.
        - **iv.** Column J – Calculated Linear Mag RMS values

v. Column K – Calculated Log Mag RMS values

vi. Column L – Calculated Noise Floor values

b. Set up cell J2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:

$$= \mathrm{SQRT}(\mathrm{SUMSQ}((B2{:}I2)/8))$$

Figure 3-73. RMS value in Linear Mag Formula

c. Copy the formula to the next cell on Column J until it reaches the last frequency point.

d. Set up cell K2 to calculate the RMS value in Log Mag by entering the following formula into the cell:

$$= 20 \times \log(J2, 10)$$

Figure 3-74. RMS value in Log Mag Formula

e. Copy the formula to the next cell on Column K until it reaches the last frequency point.

f. Set up cell L2 to calculate the Noise Floor in dBm by entering the following formula into the cell:

$$= (-10 - K2)$$

Figure 3-75. Noise Floor in dBm Formula

g. Copy the formula to the next cell on Column L until it reaches the last frequency point.

h. Rename Sheet 1 to NF S21 by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

i. Copy NF S21 sheet by right-clicking on the NF S21 tab, selecting Move or Copy..., selecting (move to end), checking the Create a copy check box and then clicking OK.

j. Rename the new sheet as NF S12.

k. Use the Move or Copy... function of Excel to copy the LINMAG2 information from the NF#x files into the new tab under heading data x.

12. Record the worst case calculated NF value of each frequency band (S21 and S12) in "Noise Floor Test Record" on page B-182.

If The Test Results are Out of Tolerance

1. If this test fails, do the following:
   - Check all RF cable connections in the RF Deck.
   - Check the **Test Port Adapter** connections at the front panel for proper tightness.

3-11 Manual Performance – Log Magnitude Dynamic Accuracy Test (Optional)

This test verifies the measurement accuracy (receiver linearity) of the VNA at power levels that are significantly below 0 dBm.

An external step attenuator that has been accurately characterized for 2 GHz at a calibration lab is required. Measurements are made on each step of the attenuator after a CW 12-Term calibration at 2 GHz with 10 Hz IF Bandwidth has been performed and the VNA has been set to S21 measurement mode. The reference power level is at –10 dBm. Characteristic VNA uncertainty and uncertainty associated with the step attenuator are part of the criteria used in the Pass or Fail determination for each attenuation step.

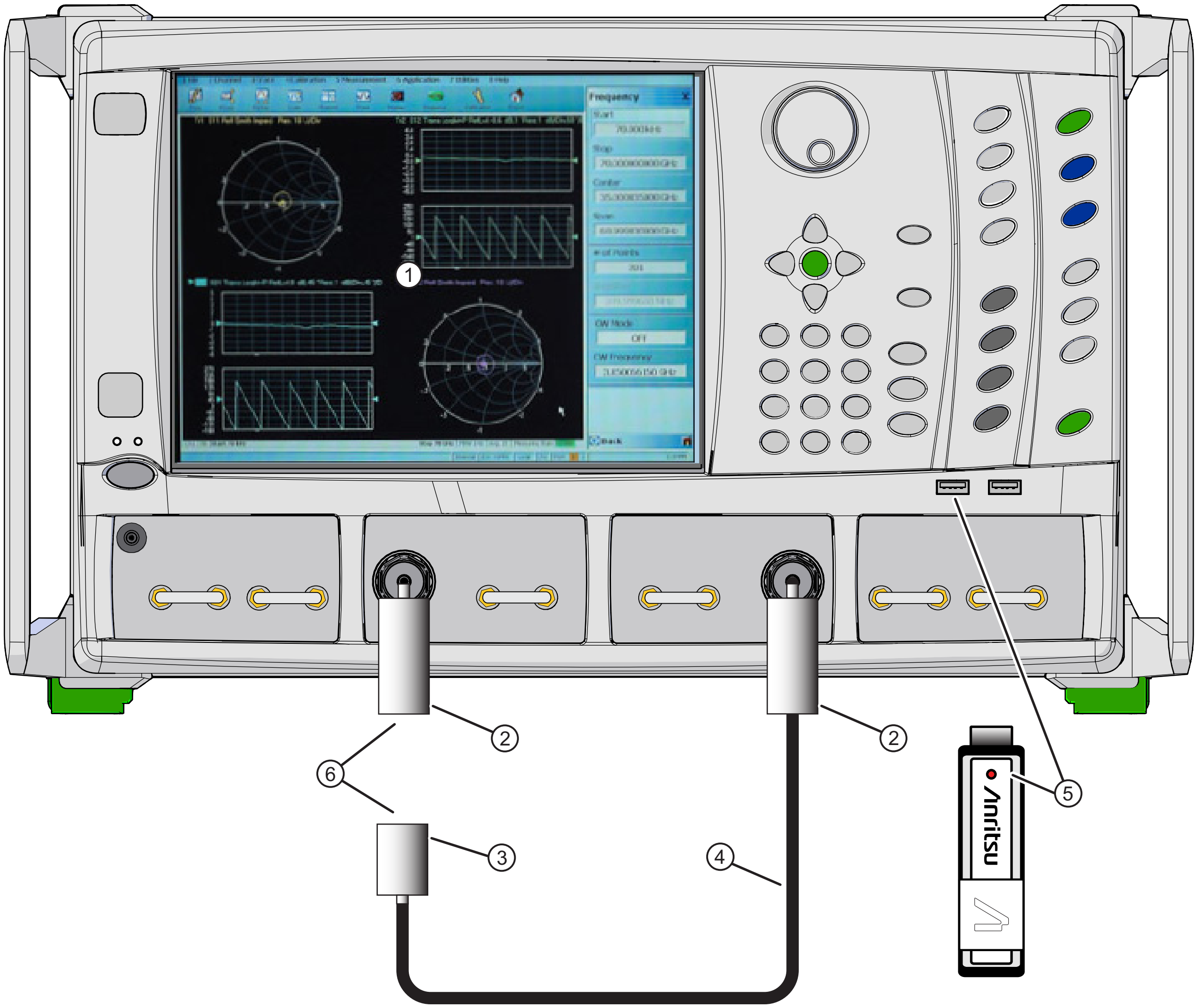
Equipment Required

Table 3-7. Required Equipment for Log Magnitude Dynamic Accuracy Test

Instrument	Critical Specification	Recommended Manufacturer and Model
Adapter Required only for MS4647B VNAs	Type: V (f) to K (f) Quantity: 2	Anritsu Model 34VFKF50
Calibration Kit	Connector Type: K	Anritsu Model 3652A-1
RF Cable	Frequency: DC to 40 GHz Connector Type: K (m) to K (f)	Anritsu Model 3670K50-2
Step Attenuator	With traceable Characterization Data at 2 GHz	Anritsu Model SC7974
Step Attenuator Control Box	—	Anritsu Model SC3796

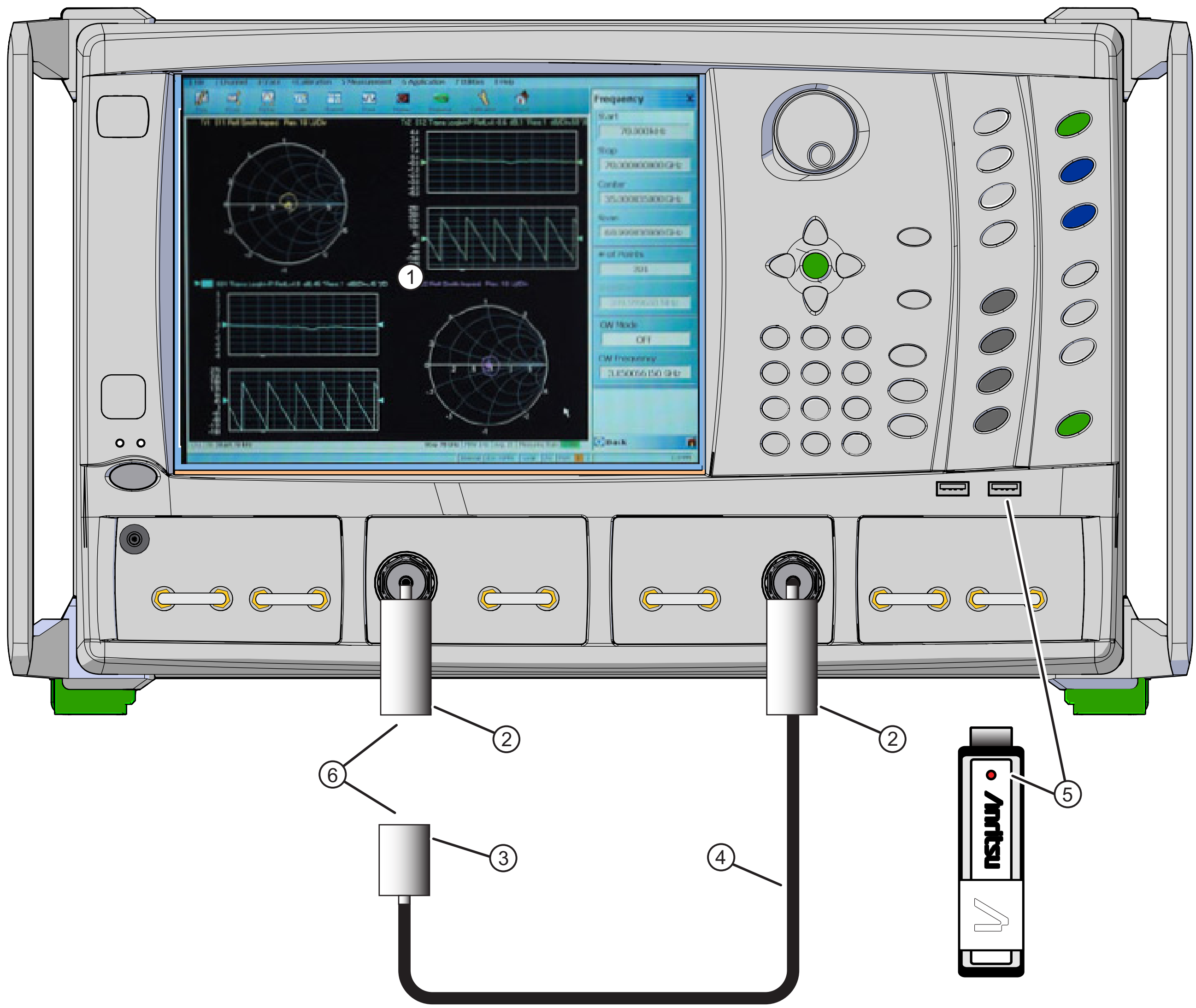
Procedure

1. Warm up the VNA for at least 90 minutes.
2. Connect adapters, cable, and USB Memory Device as shown one of the two figures below.
   - Use the configuration shown in Figure 3-76 on page 3-70 for MS4642B and MS4644B VNAs.
   - Use the configuration shown in Figure 3-77 on page 3-71 for MS4645B and MS4647B VNAs.



1. Anritsu VectorStar MS4642B or MS4644B VNA	4. Anritsu 3670K50-2 Cable
2. Anritsu 33KFKF50 Adapter from 3652A Calibration Kit	5. USB Memory Device from 3652A Calibration Kit
3. Anritsu 33KKF50B Adapter from 3652A Calibration Kit	6. Insert calibration standards here

Figure 3-76. Test Setup for MS4642B and MS4644B VNAs



MS4647B Test Setup	4. Anritsu 3670K50-2 Cable
1. Anritsu VectorStar MS4645B or MS4647B VNA	5. USB Memory Device from 3652A Calibration Kit
2. Anritsu 34VFKF50 Adapter	6. Insert calibration standards here
3. Anritsu 33KK50B Adapter from 3652A Calibration Kit	

Figure 3-77. Test Setup for MS4645B and MS4647B VNAs

3. Press the **Preset** key on the front panel and select the OK button to continue. This resets the VNA to default factory setting.

4. Set up the VNA as follows:

   a. Press the **Frequency** key on the front panel and set Start Frequency to 2 GHz.

   b. Set CW Mode to On.

   c. Set # of Points to 10.

   d. Press the **Avg** key on the front panel

   e. Set IFBW to 10 Hz.

   f. Set Averaging Factor to 1024 and then select Averaging to turn it On.

5. Install the Calibration Kit Component coefficients as follows:

  a. Press the **Calibration** key on the front panel.

  b. Select Cal Kit/AutoCal Characterization.

  c. Select Install Kit/Charac.

  d. Select Cal Kit on the dialog box.

  e. Click on the Browse… button. Browse to the Removable Disk (E:). Select the `.ccf` file and then click on the Open button to load the data.

6. Perform a 12-Term calibration as follows:

  a. Press the **Calibration** key on the front panel.

Manual Calibration Menu

  b. Select Calibrate and then Manual Cal.

  c. Select 2-Port Cal.

  d. Select Modify Cal Setup and then Edit Cal Param.

  e. Change Test Port 1 DUT Connector to the K (m) connector and Test Port 2 DUT Connector to the K (f) connector. Click on the OK button to close the dialog box.

  f. Click on the Back icon on the bottom of the Right Side Menu to return to the previous menu.

Port 1 Reflective Devices

  g. Select Port 1 Reflective Devices.

  h. Connect the **24K50 Open** from the **3652A Calibration Kit** to the female end of the adapter at Port 1. Select Open to measure the calibration standard. A check mark will appear on the Open button when the measurement is complete.

  i. Disconnect the **24K50** and then connect the **23K50 Short** to the female end of the adapter at Port 1. Select Short to measure the calibration standard. A check mark will appear on the Short button when the measurement is complete.

  j. Disconnect the **23K50** and then connect the **28K50A Load** to the female end of the adapter at Port 1. Select Load to measure the calibration standard. A check mark will appear on the Load button when the measurement is complete. Leave the **Load** connected to Port 1.

  k. Click on the Back icon on the bottom of the Right Side Menu to return to the previous menu.

Port 2 Reflective Devices

  l. Select Port 2 Reflective Devices.

  m. Connect the **24KF50 Open** from the **3652A Calibration Kit** to the open end of the adapter on the cable connected to Port 2. Select Open to measure the calibration standard. A check mark will appear on the Open button when the measurement is complete.

  n. Disconnect the **24KF50** and then connect the **23KF50 Short** to the open end of the adapter on the cable connected to Port 2. Select Short to measure the calibration standard. A check mark will appear on the Short button when the measurement is complete.

  o. Disconnect the **23KF50** and then connect the **28KF50A Load** to the open end of the adapter on the cable connected to Port 2. Select Load to measure the calibration standard. A check mark will appear on the Load button when the measurement is complete. Leave the Load connected to the open end of the adapter on the cable connected to Port 2.

  p. Click on the Back icon on the bottom of the Right Side Menu to return to the previous menu.

Isolation (Optional)

q. Select Isolation (Optional).

r. Select Isolation 1-2 to measure both calibration standards. A check mark will appear on the Isolation 1-2 button when the measurements are complete.

s. Click on the Back icon on the bottom of the Right Side Menu to return to the previous menu.

t. Disconnect both **Loads**.

u. Connect the open end of the thru cable at **Port 2** to **Port 1**.

v. Select Thru/Recip and then Thru 1-2 to start the thru measurement. A check mark will appear on the Thru 1-2 button when the measurement is complete.

w. Click on the Back icon on the bottom of the Right Side Menu to return to the previous menu.

x. Select Done to complete the calibration.

Setup Display

7. Set up the Display as follows:

   a. Press the **Trace** key on the front panel.

   b. Select Trace Max to expand the S11 Smith Chart to fill the screen.

   c. Select Trace Next twice so S21 Data is displayed on screen.

   d. Press the **Display** key on the front panel.

   e. Select Trace Format Log Mag+Phase.

   f. Select Log Mag.

   g. Press the **Marker** key on the front panel.

   h. Select Mkr1 [OFF]. This will turn Marker 1 On.

Step Attenuator Control Box

8. Set all four switches on the **SC3796 Step Attenuator Control Box** to 0 dB.

9. Install the ribbon cable connector plug of the step attenuator to the DIP socket of the **SC3796 Step Attenuator Control Box**.

Warning	The white dots and/or beveled connector corners designate Pin 1 on the ribbon cable connector plug of the step attenuator and the DIP socket of the SC3796 Step Attenuator Control Box. The Pin 1 dot or beveled corner MUST be aligned together to prevent damage to the step attenuator.

10. Disconnect the thru cable from Port 1 and then install the step attenuator between **Port 1** and the **Port 2** thru cable.

Set 0 dB Attenuation

11. Record the M1 value on the display to 0 dB row on Table C-1 on page C-2 in Appendix C, “Test Records: Log Magnitude Dynamic Accuracy (Optional)”.

Set 10 dB Attenuation

12. Set the first switch on the most right to 10 dB position to set the step attenuator to 10 dB attenuation. Refer to Figure 3-77, “Test Setup for MS4645B and MS4647B VNAs” on page 3-71 above.

13. Record the M1 value on the display to 10 dB row on Table C-1 on page C-2.

14. Set the switch from 10 dB back to 0 dB position.

Set 20 dB Attenuation

15. Toggle the second switch from the right to 20 dB position to set the step attenuator to 20 dB attenuation.

16. Record the M1 value on the display to 20 dB row on Table C-1 on page C-2.

Set 30 dB Attenuation

17. Toggle the first switch to 10 dB position to set the step attenuator to 30 dB attenuation.
18. Record the M1 value on the display to 30 dB row on Table C-1 on page C-2.
19. Set both switches (10 dB and 20 dB) back to 0 dB position.

Set 40 dB Attenuation

20. Toggle the third switch from the right to 40 dB position to set the step attenuator to 40 dB attenuation.
21. Record the M1 value on the display to 40 dB row on Table C-1 on page C-2.

Set 50 dB

22. Toggle the first switch to 10 dB position to set the step attenuator to 50 dB attenuation.
23. Record the M1 value on the display to 50 dB row on Table C-1 on page C-2.
24. Set the first switch from 10 dB position to 0 dB position.

Set 60 dB

25. Toggle the second switch to 20 dB position to set the step attenuator to 60 dB attenuation.
26. Record the M1 value on the display to 60 dB row on Table C-1 on page C-2.

Set 70 dB

27. Toggle the first switch to 10 dB position to set the step attenuator to 70 dB attenuation.
28. Record the M1 value on the display to 70 dB row on Table C-1 on page C-2.
29. Set both the first and second switches (10 dB and 20 dB) back to 0 dB position.

Set 80 dB

30. Toggle the last switch to 40 dB position to set the step attenuator to 80 dB attenuation.
31. Record the M1 value on the display to 80 dB row on Table C-1 on page C-2.

Set 0 dB

32. Set all switches on the SC3796 Control Box back to 0 dB position.
33. Repeat Step 11 to Step 32 nine more times. Record the M1 value to the next available column on Table C-1 on page C-2.

Calculate Attenuation Values

34. Calculate the attenuation values for the 10, 20, 30, 40, 50, 60, 70, and 80 dB attenuation steps of the Step Attenuator using the following formula:

$$\text{Attenuation (x dB)} = \text{Measured Value (x dB)} - \text{Measured Value (0 dB)}$$
$$\text{Where x} = \text{Attenuation step (e.g. 10 dB, 20 dB, etc.)}$$

35. Calculate the mean values by summing the 10 calculated values in the previous steps and then divide the sum by 10 for each attenuation step of the Step Attenuator using the following formula:

$$\text{Attenuation (x dB)}_{\text{mean}} = \frac{[\text{Attenuation (x dB)}_{\text{pass1}} + \text{Attenuation (x dB)}_{\text{pass2}} + \ldots + \text{Attenuation (x dB)}_{\text{pass10}}]}{10}$$

36. Record the calculated mean values to Table C-1 on page C-2.

Analysis of the Measurement

37. Open the characterization data file (using a text editor program such as Windows™ Notepad) on the Characterization Disk of the step attenuator on a personal computer and copy the eight characterization values to Column B in Table C-2 on page C-3.

Note	The data for each attenuation step is found on the same line as the nominal attenuation value. For example, assume the line reads "–10 = –10.02,0.05". Copy "–10.02" to Column B in Table C-2 on page C-3. Do not record the value of "0.05", which is the uncertainty of that attenuation step.

38. In Table C-2 on page C-3, add the values of Column B to Column C to compute the values for the Upper Limit. Record the computed values in Column D.

- Column B + Column C = Upper Limit = Column D

39. In Table C-2 on page C-3, subtract the values of Column C from Column B to compute the values for Lower Limit. Record the computed values in Column F.

- Column B – Column C = Lower Limit = Column F.

Note	The uncertainty values in Column C of Table C-2 on page C-3 are derived values that are a composite of the uncertainty of the VNA and the uncertainty of the step attenuator.

40. Transfer the mean values of each attenuation step of the step attenuator from the worksheet in Table C-1 on page C-2 to Column E of Table C-2 on page C-3.

Test Pass/Fail

41. If the mean value in Column E falls between the values of Column D (Upper Limit) and Column F (Lower Limit), the test passes. If the mean value in Column E is outside the Upper and Lower limits, the test fails.

If the Test Fails

42. If the test fails, do the following:

- Check connections of adapters, cable and VNA port connectors are tightened with sufficient torque.
- Re-do the test after performing a new 12-Term calibration.
- Check if the S21 Noise Floor is out of specification. If it is outside the specification, correct the Noise Floor issue prior to re-doing this test.
- Replace IF Band module.

Chapter 4 — Option Functional Checks

4-1 Introduction

This chapter provides the procedures for verifying the functionality of various options in the MS4640B VNA. The test procedures consists of the following:

- "Pulse Measurement (Option 35 and 42) Functional Check" on page 4-1
- "Noise Figure Measurement (Option 41) Functional Check" on page 4-4

4-2 Pulse Measurement (Option 35 and 42) Functional Check

If the Pulse Measurement Hardware (Option 35) and PulseView™ Application (Option 42) are installed in the MS4640B, the following test procedures can be used to verify the Pulse Measurement functionality in the MS4640B Vector Network Analyzer. The test procedures are:

- Pulse Measurement Mode Transmission Dynamic Range Test
- Pulse Generator Validation Test

Equipment Required

- Anritsu Model 3652A K connector Calibration Kit (For MS4642B and MS4644B)
- Anritsu Model 3654D V connector Calibration Kit (For MS4645B and MS4647B)
- Anritsu Model 3670K50-2 K connector Through Cable (For MS4642B and MS4644B)
- Anritsu Model 3670V50A-2 V connector Through Cable (For MS4645B and MS4647B)
- Anritsu 3-806-225 RF Coaxial Cable, BNC(m) to BNC(m), 2 ft
- Pasternack PE9074 SMA(m) to BNC(f) Adapter
- 100 MHz Analog Bandwidth Oscilloscope

Procedure

1. Power on the MS4640B VNA and allow it to warm up for at least 30 minutes.
2. Preset the MS4640B to factory default state.
3. Press the front panel **Application** key and select PulseView™.
4. Under the PulseView menu, set up the VNA as follows:
   a. PRI: 10 μs
   b. PRF: 100 kHz
   c. Mode: Point-in-Pulse
   d. Rcvr: B2
   e. Meas Width: 1 μs
   f. Delay: 0 s
5. Press the front panel **Frequency** key and set the Start Frequency to 100 MHz.
6. Press the front panel **Avg** key and set the IFBW to 10 kHz.
7. Press the front panel **Power** key and set both Port 1 Power and Port 2 Power to –10 dBm.
8. Press the front panel **Trace** key and set Number of Trace to 2 and Trace Layout to display Tr1 is above Tr2.
9. Press the front panel **Response** key and set Tr1 to S21.

10. Press the front panel **Display** key, set Trace Format of both Tr1 and Tr2 to Log Mag.
11. Press the front panel **Scale** key, set both Tr1 and Tr2 traces as follows:
    a. Resolution: 10 dB/Div
    b. Reference Value: 0 dB
    c. Reference Position: 9

Pulse Measurement Mode Transmission Dynamic Range Test

12. Install the female to female adapter from the calibration kit to the male connector end of the through cable.
13. Install the through cable between VNA Port 1 and Port 2.
14. Select Tr1 trace.
15. Press the front panel **Display** key and verify that Data Mem. Op. is [Data/Mem].
16. Select Store Data to Memory and then Data, Memory Math.
17. Select Tr2 trace.
18. Select Store Data to Memory and then Data, Memory Math.
19. Remove the through cable between VNA Port 1 and Port 2.
20. Install the terminations from the calibration kit to both VNA Port 1 and Port 2.
21. Verify both S21 and S12 traces are less than –75 dB.
22. Remove the terminations from both VNA Port 1 and Port 2.

Pulse Generator Validation Test

23. Press the front panel **Application** key and select PulseView™ Setup.
24. Select PulseView™ Configuration.
25. On the PulseView Configuration Dialog box (see Figure 4-1 on page 4-3), activate each of the four pulse generators in this order:
    a. On the PG1 tab, select Singlet under Mode and activate Enable Pulse Generator.
    b. On the PG2 tab, select Doublet under Mode and activate Enable Pulse Generator.
    c. On the PG3 tab, select Triplet under Mode and activate Enable Pulse Generator.
    d. On the PG4 tab, select Quadruplet under Mode and activate Enable Pulse Generator.
26. Install the SMA(m) to BNC(f) on one end of the BNC(m) to BNC(m) coaxial cable.
27. Connect the BNC(m) end of the coaxial cable to the input of the Oscilloscope.
28. Connect SMA(m) end of the coaxial cable to P Gen 1 connector on the rear panel of the MS4640B.
29. Adjust the Oscilloscope for a stable display and verify that P Gen 1 outputs singlet signal.
30. Disconnect the cable from P Gen 1 and connect it to P Gen 2.
31. Verify that P Gen 2 outputs doublet signal.
32. Disconnect the cable from P Gen 2 and connect it to P Gen 3.
33. Verify that P Gen 3 outputs triplet signal.
34. Disconnect the cable from P Gen 3 and connect it to P Gen 4.
35. Verify that P Gen 4 outputs quadruplet signal.

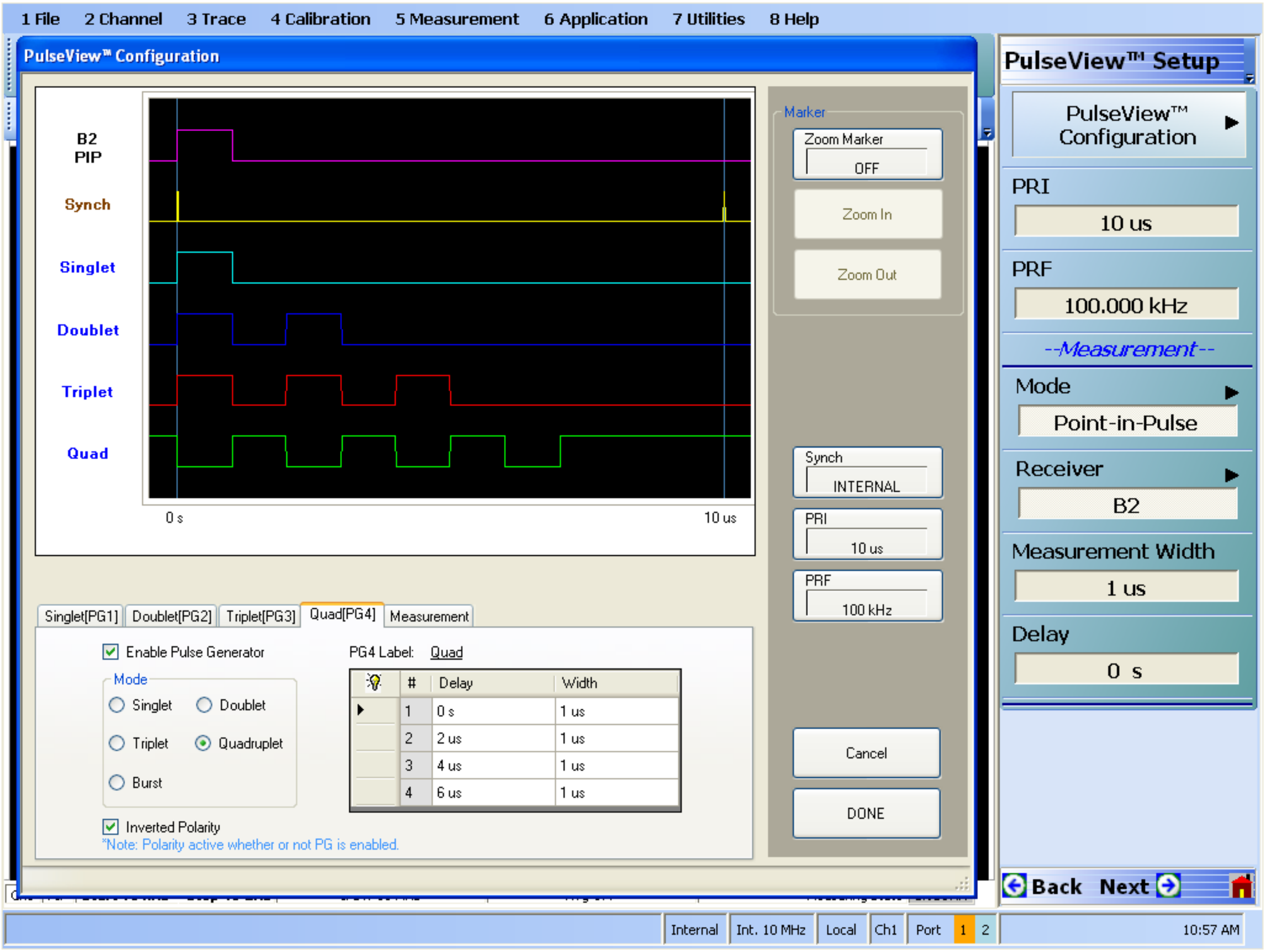


Figure 4-1. PulseView™ Configuration Dialog box

4-3 Noise Figure Measurement (Option 41) Functional Check

If the Noise Figure Measurement Application (Option 41) is installed in the MS4640B, the following test procedure can be used to verify the Noise Figure Measurement functionality in the MS4640B Vector Network Analyzer.

Note	No ports on the VNA are connected for this test. If port b2 is connected to an amplifier for noise figure measurement, the power supply for the amplifier should be turned off.

Procedure

1. Power on the MS4640B VNA and allow it to warm up for at least 30 minutes.
2. Preset the MS4640B to factory default state.
3. Press the front panel **Application** key and select Noise Figure.
4. Click on the Continue button on the Noise Figure Application dialog box.
5. Select Noise Figure Setup and then Noise Figure Configuration.
6. Set Start Frequency to 10 MHz and # of Points to 400.
7. Press the front panel **Response** key.
8. Select Noise Figure and then Noise Power.
9. Press the front panel **System** key and then select Utility.
10. Select Factory Receiver Cal to turn it off.
11. Press the front panel **Scale** key and set the Reference Value to –100 dB.
12. Verify that the noise power over entire frequency sweep to be within –100 dB ± 15 dB.

Chapter 5 — Troubleshooting

5-1 Introduction to Troubleshooting

This chapter provides information about troubleshooting aids, tests and techniques for identifying system failures.

A good understanding of the system and sub-assembly operation is an important aid to troubleshooting instrument failures. Refer to the descriptions of system and sub-assembly operation, and block diagrams located in Chapter 2, "Theory of Operation".

Accurately defining a fault is the most important step in troubleshooting a Vector Network Analyzer instrument. Faults can be categorized as the following:

- Hardware problems
- Software problems
- Measurement problems

5-2 General Safety Warnings

Many of the troubleshooting procedures presented in this chapter require the removal of instrument covers to gain access to sub-assemblies and modules. When using these procedures, please observe the warning and caution notices.

Warning	Hazardous voltages are present inside the instrument when AC line power is connected. Before removing any covers or panels, turn off the instrument via the Main power switch on the rear panel after Windows has completed its shut down process.

Caution	Many assemblies in the MS4640B contain static-sensitive components. Improper handling of these assemblies may result in damage to the assemblies. Always observe the static-sensitive component handling precautions. An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-1999 or ANSI/ESD S20.20-2007 is mandatory to avoid ESD damage when handling sub-assemblies or components found in the instrument.

Caution	Some modules and assemblies such as the 5-20 GHz Doubler module or the Sampler/LO Distribution Assembly can be damaged by applying RF power to their inputs when their outputs are not terminated. Always follow the disassembly procedures closely when working around these components.

5-3 Equipment Damage Warning

Caution	The A10 PCB contains model configuration data which is unique to each instrument. The replacement board is pre-configured at the Factory for the targeted instrument. DO NOT install the A10 PCB on a different instrument. If a VectorStar's A10 DSP Module is removed and installed in any other VectorStar VNA, the data in the module's non-volatile memory will be corrupted.

5-4 Test Equipment

The recommended test equipment for troubleshooting is listed in Table 1-1, "Recommended Test Equipment" on page 1-9, in Chapter 1.

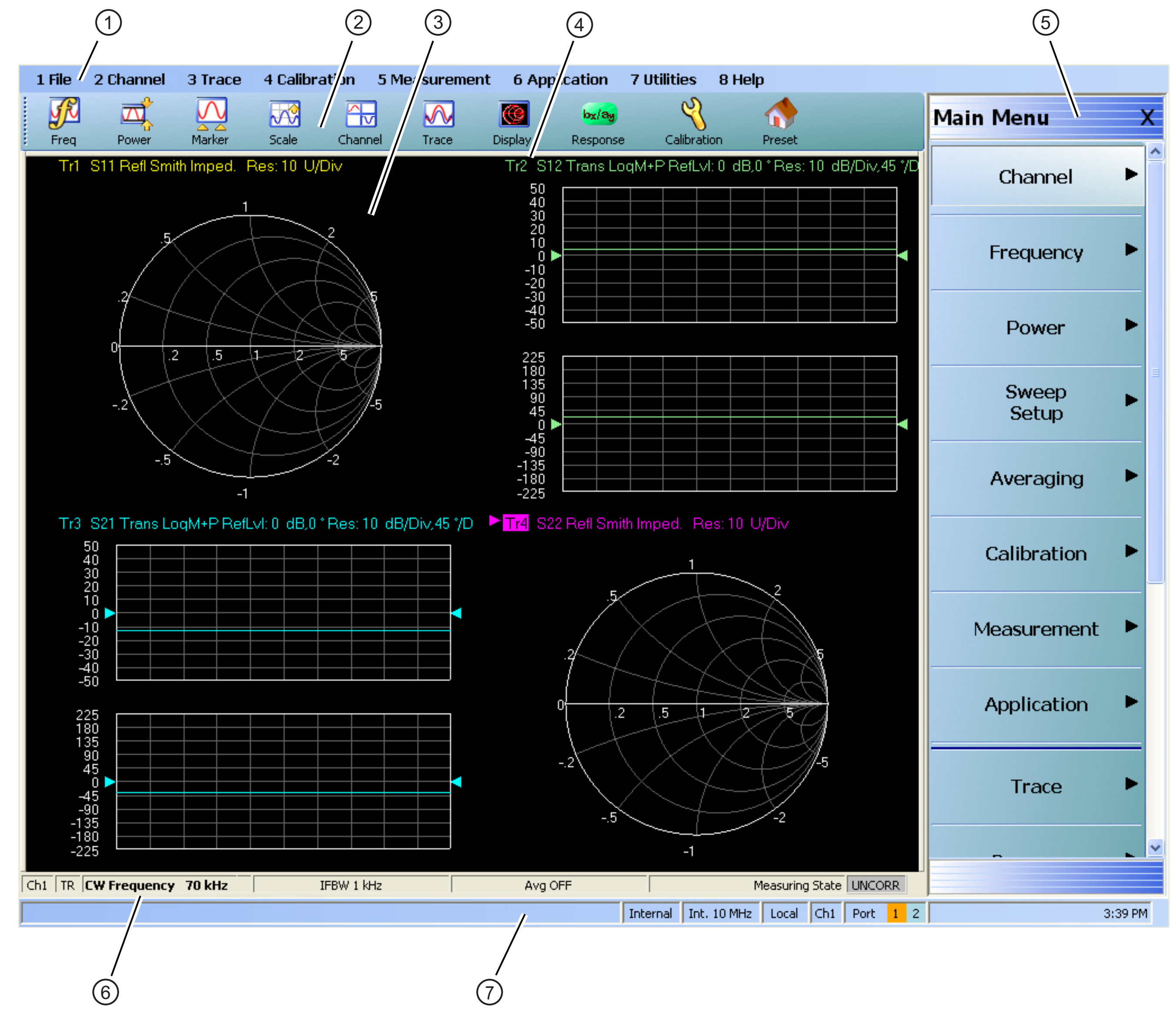
5-5 Troubleshooting Aids and Test Procedures

This section provides information about the aids available in the VectorStar Application software and the troubleshooting test procedures. They include:

- Error Messages
- Self Test
- Power Supply Voltage Check
- Non Ratio Power Level Check

5-6 Troubleshooting with Error Message

Some system malfunctions cause the VectorStar Application software to display a message in the status bar area of the display as shown in Figure 5-1. Typical status bar messages and the possible fault and/or remedy is listed in Table 5-1.



1. Menu Bar Interface
2. User-Defined Icon Bar Interface
3. Main Measurement Display showing One Channel and Four Traces
4. Trace Identification Label for Trace #2 (Tr2)
5. Application Menu Title for MAIN MENU with buttons below
6. Channels status information for Channel #1 (Ch1)
7. Instrument Status Bar at bottom of screen and location of some instrument error messages.

Figure 5-1. Main Display Status Bar Location

Table 5-1. Status Bar Error Messages

Message	Description	Possible Faults/Remedies
Lock Error “A”	Direct Digital Synthesis Reference Unlocked	• Timebase Reference signal lost • RF Source Module failed
Lock Error “B”	Heterodyne Local Oscillator Unlocked	• Timebase Reference signal lost • RF Source Module failed
Lock Error “C”	Offset Local Oscillator Unlocked	• Timebase Reference signal lost • RF Source Module failed
Lock Error “D”	Offset Source Unlocked	• Timebase Reference signal lost • RF Source Module failed
Lock Error “E”	Main Local Oscillator Unlocked	• Timebase Reference signal lost • RF Source Module failed
Lock Error “F”	Main Source Unlocked	• Timebase Reference signal lost • Source Module failed
Lock Error “H”	Heterodyne Source Unlocked	• Timebase Reference signal lost • Source Module failed
RF Power Unlevel	Unleveled RF Power	• Port power set too high; reduce port power • Level Detector failed (High band) • RF Source Module failed
Auto IF Cal Failed	Automatic IF Calibration Failed	• IF Band Module failed
Unknown Lock Error	Lock Error Status flag set but failure could not be identified	• RF Source Module failed • Level Detector failed (High band)
Power-Up Self Test Failed	Self Test Failed	• Run Triggered Self Test

5-7 Troubleshooting with Self Test

The self test performs a series of tests that verify that various internal MS464xB circuits are functional and operating properly. There are two self tests:

- Power-Up Self Test
- Triggered Self Test

Power-Up Self Test

Power-Up Self Test is performed when the instrument is powered on. Triggered Self Test is performed when it is triggered by the user via the front panel. Both Power-Up Self Test and Triggered Self Test verify the following MS464xB circuits:

- Source
- Analog IF
- DSP/PC
- RF deck Control

Triggered Self Test

The Triggered Self Test performs additional tests for the Source and DSP/PC circuits.

Note	Allow the system to warm up for at least 90 minutes prior to performing Triggered Self Test.

To start the Triggered Self Test, do the following:

1. Use the Menu bar at the top of the display.
2. Select MENU BAR | Utilities | UTILITIES Drop-Down Menu | System.
    - Alternatively from the right-side application menus, MAIN MENU | System | SYSTEM.

3. The right side SYSTEM menu appears.

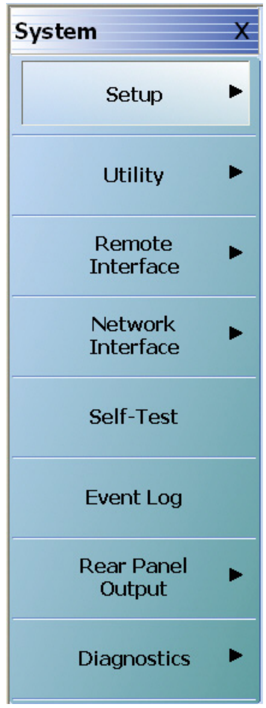
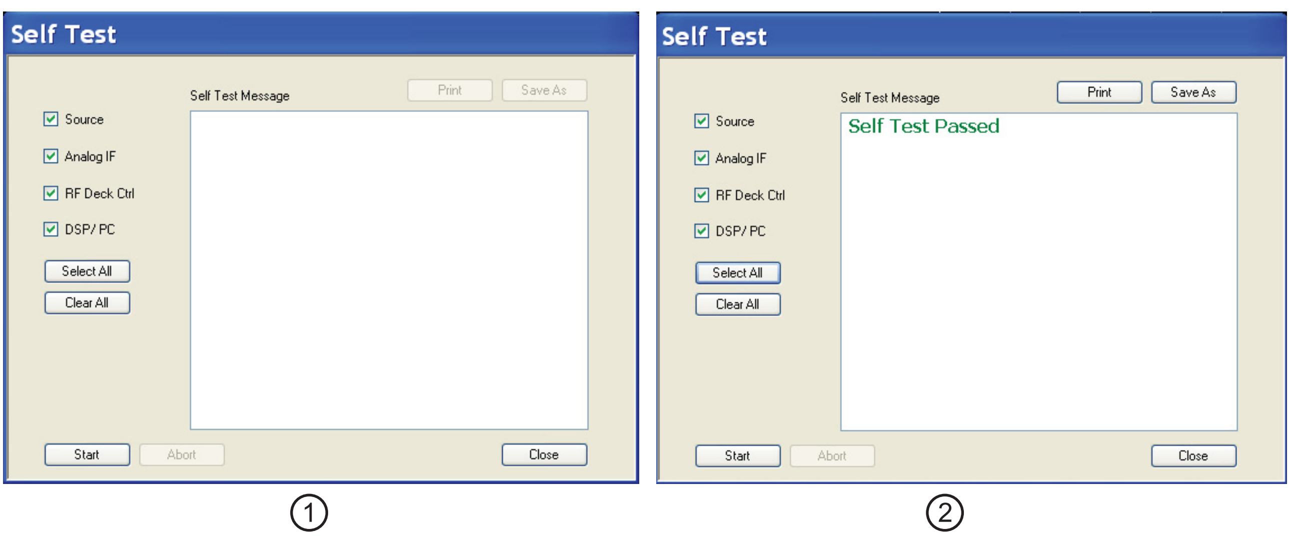


Figure 5-2. SYSTEM Menu

4. Select the Self-Test button. The SELF TEST dialog box appears.



1. SELF TEST dialog box before test at left.	2. SELF TEST dialog box after test at right.

Figure 5-3. SELF TEST Dialog Box Before and After Test

5. Select all check boxes:
   - Source
   - Analog IF
   - RF Deck Ctrl

- DSP/PC

6. Click Start to begin the initial self-test process.
7. If the test is successful, the Self Test Passed message is displayed.
8. If the test fails, detailed test results are displayed. Refer to Table 5-2 for the solutions of the failures.

Table 5-2. Self Test Failure Faults

Self Test Failure Faults	Fault Reason
Source	RF Source Module failed
Analog IF	IF Band Module failed
RF Deck Ctrl	RF Component Control PCB failed
DSP/PC	DSP Module failed

9. Click Close to exit the dialog box.

5-8 Troubleshooting with Power Supply Voltage Check

This procedure verifies whether the correct power supply voltages are present at the Power Control connector and Power Supply input connectors on the Motherboard 2 PCB Assembly.

Note	Connectors are located near the front panel assembly. There are two possible MB2 configurations: ND81312 or 3-ND81312 (which uses ring lug terminals from the power supply), or ND80356 – 3-80124-3 (which uses P94 multipin connector from the power supply).

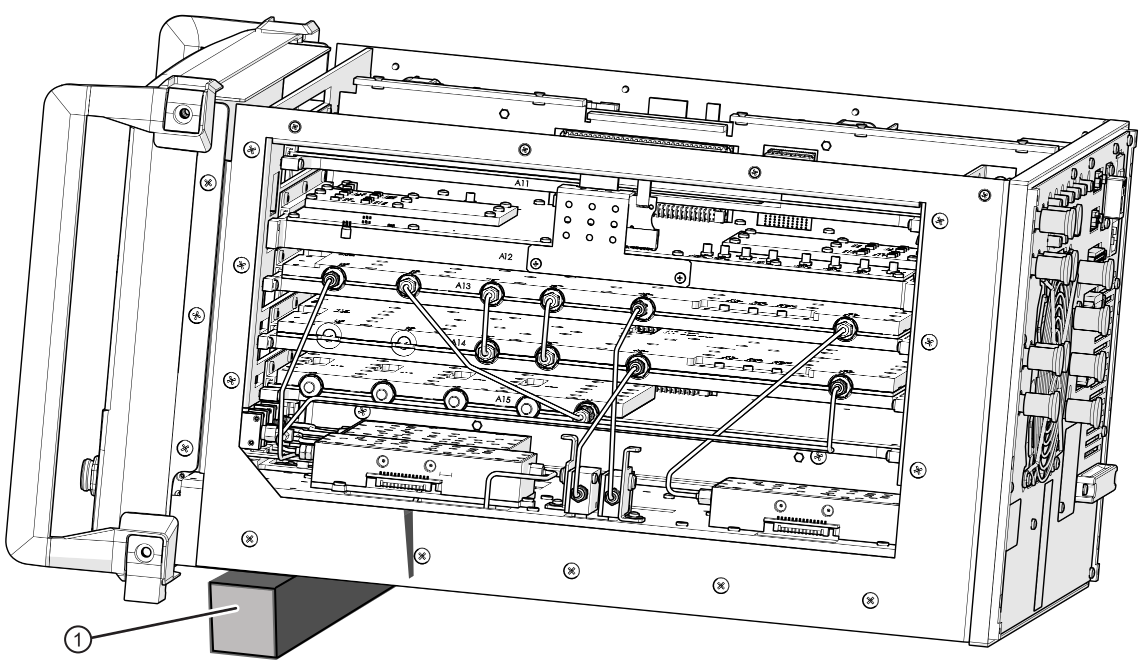
Warning	Hazardous voltages are present inside the instrument when AC line power is connected. Turn off the instrument and remove the line cord before removing covers. Troubleshooting or repair procedures should only be performed by service personnel who are fully aware of the potential hazards.

Procedure

1. Toggle the rear panel **Main AC Switch** to **OFF**. Disconnect the AC line cord from the MS4640B. Ensure that all external connections to the instrument front and rear panel are also disconnected, except the loop cables supplied with Option 51, 61 or 62.

Remove Case and Add Spacer Block

2. Remove the Outer Cover. In Chapter 8, see Section “Remove Outer Cover” on page 8-3.
3. Position the instrument so that it is right-side up, RF deck down.
4. Add a spacer at least 5 cm (~2 in) thick under the front of the unit, approximately 10 cm (~4 in) in from the instrument front as shown in Figure 5-4.
   - The spacer should be at least 50 mm (~20 in) long.
   - The spacer creates clearance for the Direct Access Loops located on the RF Deck.
   - A ~50 cm (~20 in) length of plastic or wood 5 cm x 5 cm (2 in x 2 in) makes an adequate spacer.



1. Spacer Block

Figure 5-4. Spacer Block Under Instrument with Cover and Front Panel Off

Remove Front Panel

5. Remove the Front Panel following the procedure in Section 18-3 “Remove Front Panel” on page 18-1.

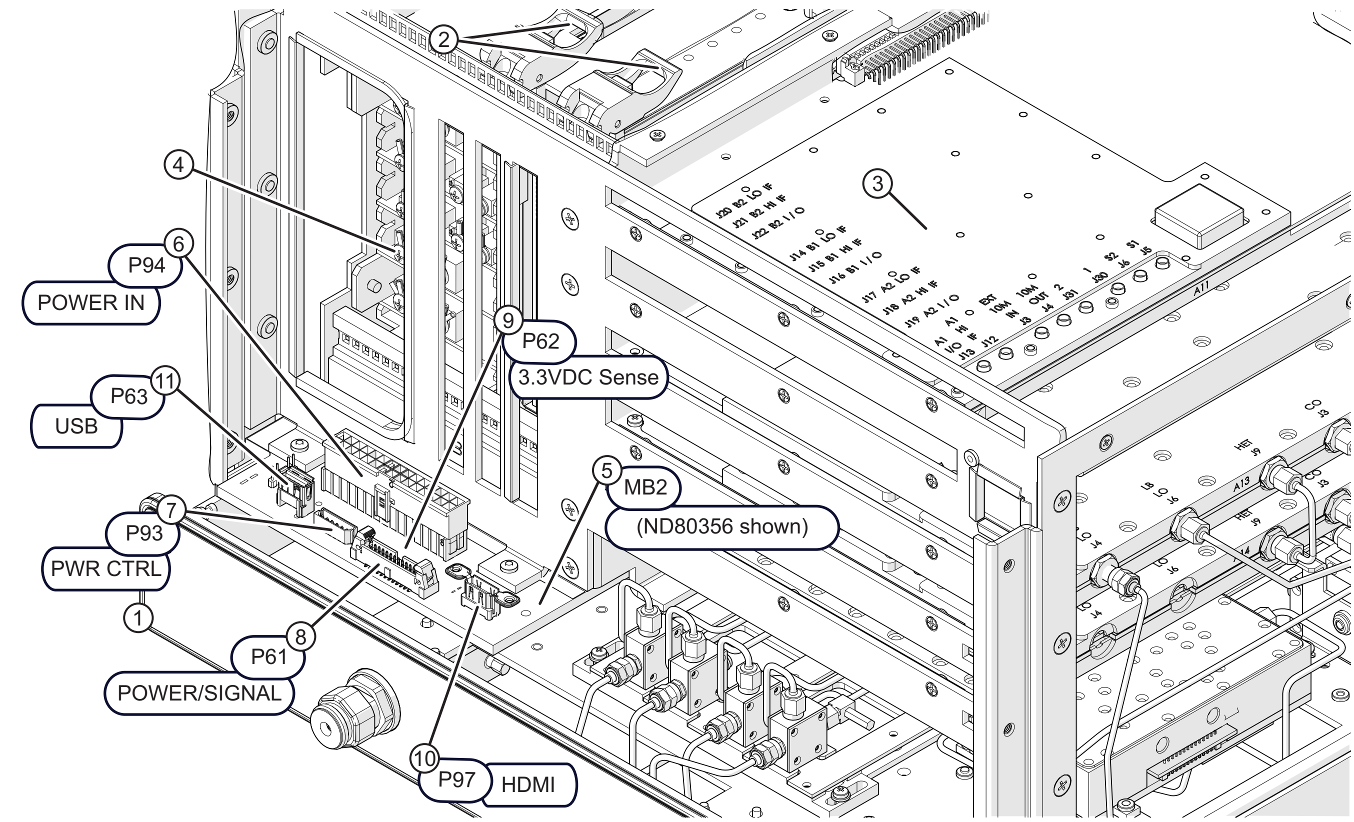
6. After removal from the instrument, carefully lay the Front Panel with the LCD side facing downward.

- Ensure that no stress is put on the front panel cables.
- Keep the Front Panel and Chassis on the same centerline with ±2.5 cm (± 1 inch) of each other.

7. Reconnect the AC line cord to the instrument. Toggle the rear panel **Main AC Switch** to **ON**.

Motherboard 2 PCB Assembly Power Connectors

8. Depending on the MB2 PCB configuration, locate the **P93 Power Supply Control Connector** and the **Power Supply In Connectors** as shown in Figure 5-5, Figure 5-6, or Figure 5-7.



1. Front Panel
2. Top Side Digital PCB Assemblies
3. Right Side Analog Module Assemblies
4. Power Supply Module Front End Power Harness Connectors
5. Motherboard 2 PCB Assembly – Mounted horizontally below the card cages and above RF Deck

   (**NOTE:** shown above is ND80356 MB2 (Figure 5-6) with P94 connection from Power Supply.
   Later VNAs have ND81312 or 3-ND81312 MB2 (Figure 5-7) with ring lug terminal block connections from Power Supply.)

Motherboard 2 PCB Power Connectors

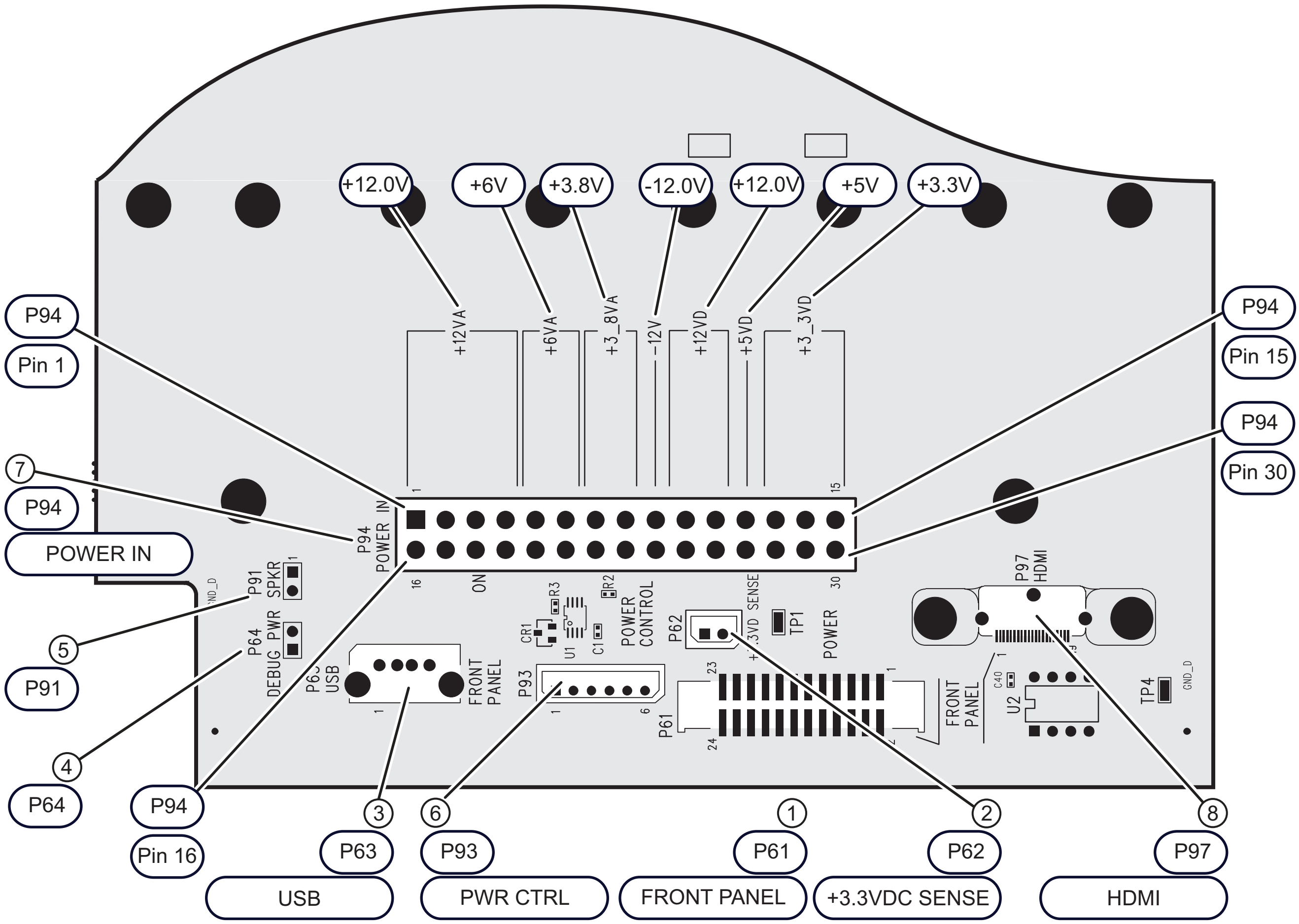
6. P94 Power In Connector – On MB2 PCB (ND80356)
7. P93 Pwr Ctrl (Power Control) Connector – On MB2 PCB (ND80356).

Motherboard 2 PCB Front Panel Connectors

8. P61 Front Panel Power Connector – For gray ribbon cable on Front Panel.
9. P62 Front Panel Signal Connector – For gold Flex PCB cable on Front Panel.
10. P97 HDMI to Front Panel (ND80356)
    P62 HDMI to Front Panel (ND81312 or 3-ND81312)
11. P63 USB to Front Panel

Figure 5-5. Motherboard 2 PCB Assembly Connectors

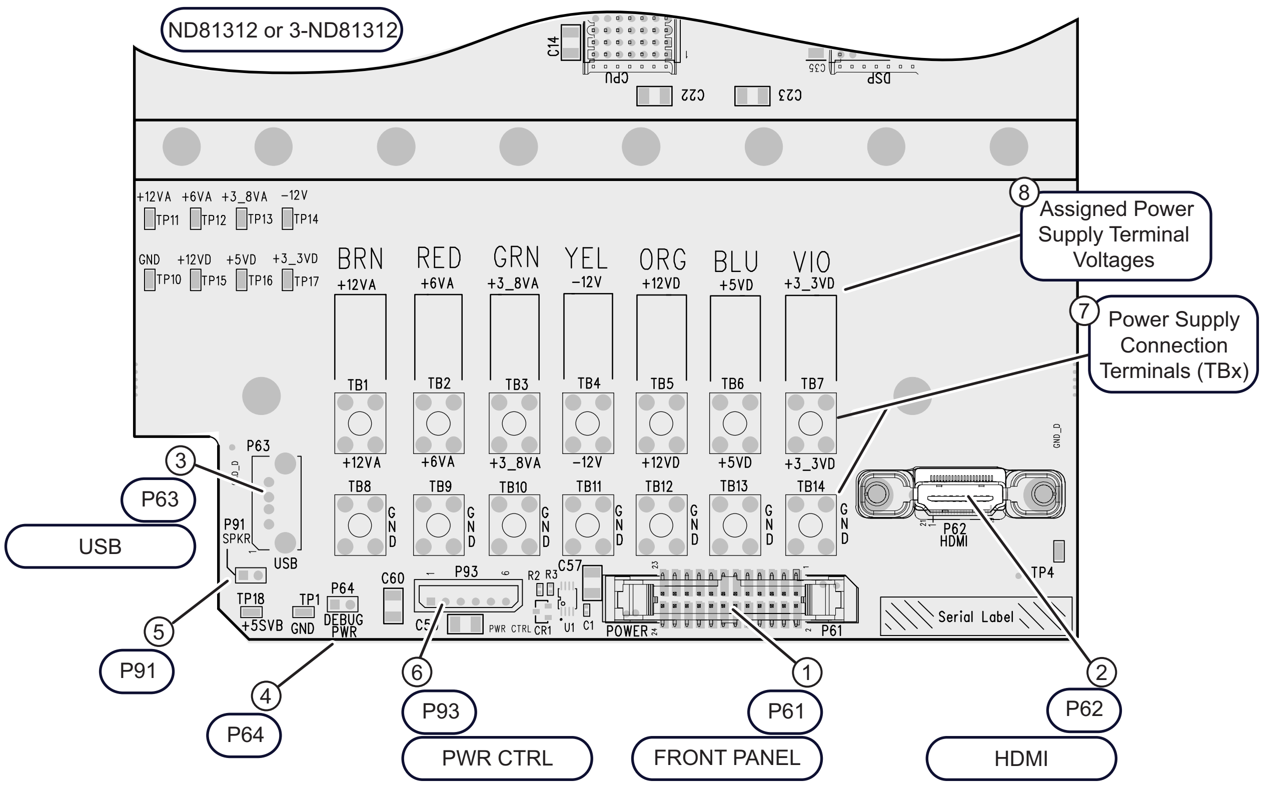
9. Figure 5-6 shows a close up plan view of the ND80356 – 3-80124-3 MB2 P93 and P94 Connectors.



1. P61 – Ribbon Cable Connector to Front Panel	P94 – Connector Pin 1
2. P62 – +3.3 VDC Sense Connector to Power Supply Module	P94 – Connector Pin 15
3. P63 – USB Type A Connector to Front Panel	P94 – Connector Pin 16
4. P64 – Debug Power – Not used	P94 – Connector Pin 30
5. P91 – Speaker – Not used	
6. P93 – Power Control Connector to Power Supply	
7. P94 – Power In Connector to Power Supply	
8. P97 – HDMI Connector to Front Panel	

Figure 5-6. P93 and P94 Power Connectors – ND80356 – 3-80124-3 MB2 PCB Assembly

10. Figure 5-7 shows a close up plan view of the ND81312 or 3-ND81312 MB2 P93 and Power supply connection terminal block connectors.



1. P61 – Ribbon Cable Connector to Front Panel	5. P91 – Speaker – Not used
2. P62 – HDMI Connector to Front Panel	6. P93 – Power Control Connector to Power Supply
3. P63 – USB Type A Connector to Front Panel	7. TBx – Power Supply Connection Terminals
4. P64 – Debug Power – Not used	Assigned Power Supply Voltages

Figure 5-7. Connectors – P/N ND81312 or 3-ND81312 MB2 PCB Assembly

Front Panel Standby Voltage Check

11. Using a DMM or an oscilloscope, measure the **Front Panel Standby Voltage** between **Pin 4** and **Pin 5** on **P93** as shown in Figure 5-8. Verify that **+5 V** is present. The schematic for the P93 Connector is shown below in Figure 5-8.

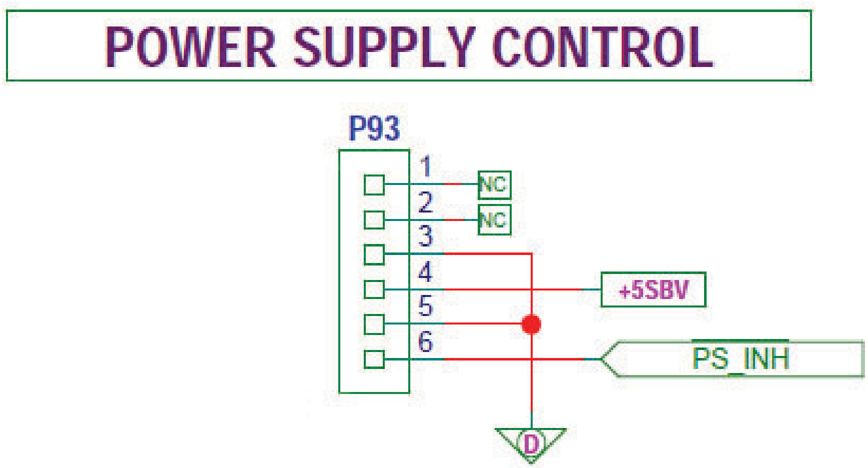


Figure 5-8. Schematic – P93 Power Supply Control Connector – Front Panel Standby Voltage

Power Supply DC Voltage Check

12. Press the front panel On/Off switch until its light changes from yellow to green and then release.
13. At the P4 Connector, using a DMM or an oscilloscope, measure the **DC voltages** listed in Table 5-3.

Table 5-3. Power Supply Voltage Check

P94 Measurement Pin (MB2 P/N – ND80356 – 3-80124-3)	P94 Common Pin	Terminal Block (TB) (MB2 P/N ND81312 or 3-ND81312)	Common Terminal Block	Expected DC Voltage (VDC)
1	18	TB1	TB8	+12.0
5	18	TB2	TB9	+6.0
7	18	TB3	TB10	+4.1
9	18	TB4	TB11	–12.0
10	18	TB5	TB12	+12.0
12	18	TB6	TB13	+5.06
13	18	TB7	TB14	+3.37

5-9 Non-Ratio Power Level Check

This procedure checks the IF power level of each individual receiver. It does not require measurement calibration of the system. It requires that you press specified front panel keys, or use a mouse to make choices from the displayed menus and is valid for all instrument model and option combinations.

Procedure

1. Connect Test Ports 1 and 2 together using a high-quality through line.
2. At the top of the display, select MENU BAR | Utility | UTILITY Drop-Down Menu | System. The right-side SYSTEM menu appears.
3. Click Setup. The SETUP menu appears.
4. Click Preset Setup. The PRESET SETUP menu appears.
5. Select Default.

Note	The default setting associates both the front panel **Preset Key** and the **MENU BAR | Utilities | UTILITIES Drop-Down Menu | Preset** command with the factory-default preset configuration.

Reset the VNA

6. Reset the VNA by pressing the front panel **Preset Key**.
7. The VNA resets to the factory-default as-shipped configuration.
8. The right-side menu returns to the MAIN MENU.
9. At the top of the display, select MENU BAR | Utilities | UTILITIES Drop-Down Menu | System.
10. The right side SYSTEM menu appears.
11. On the right-side, select SYSTEM | Utility | UTILITY | Factory Receiver Cal and toggle the Factory Receiver Cal button to **OFF**.
12. At the top of the display, select MENU BAR | Channel | CHANNEL Drop-Down Menu | Power. The right side POWER menu appears.
13. Click on the Port 1 Power button.
14. In the displayed field toolbar, enter **–10.0000 dBm**.
15. Click the X at the end of the toolbar to close it.

Format Trace #1

16. Select the upper left LCD trace (Trace #1) using the mouse by clicking on Tr1 S11 Refl Smith Imped.

Note	The trace name has additional resolution and unit information appended to the displayed label.

17. On the icon toolbar, select the DISPLAY icon. The right side DISPLAY menu appears.
18. Click the Trace Format button, the TRACE FORMAT menu appears.
19. Select **Log Mag**.
20. On the icon toolbar, select the Response icon. The RESPONSE menu appears.
21. Click on User-Defined, the USER DEFINED menu appears.
22. Click on Numerator and on the NUMERATOR menu, set it to **A1**.
23. Click on Denominator and on the DENOMINATOR menu, set it to **1**.
24. Set Driver Port to **Port 1**.

Format Trace #3

25. Select the lower left trace (Trace #3) by clicking trace label that starts with Tr3 S21 Trans LogM + P Refl.

Note	The trace name has additional resolution and unit information appended to the displayed label.

26. On the icon toolbar, select the DISPLAY icon. The right side DISPLAY menu appears.
27. Click on the Trace Format button, the TRACE FORMAT menu appears.
28. Select **Log Mag**.
29. On the icon toolbar, select the Response icon. The RESPONSE menu appears.
30. Click on User-Defined, the USER DEFINED menu appears.
31. Click on Numerator and on the NUMERATOR menu, set it to **B2**.
32. Click on Denominator and on the DENOMINATOR menu, and set it to **1**.
33. Set Driver Port to **Port 1**.

Format Trace #2

34. Select the upper right LCD channel using the mouse by clicking on Tr2 S12 Trans Log M&P.

Note	The trace name has additional resolution and unit information appended to the displayed label.

35. On the icon toolbar, select the DISPLAY icon. The right side DISPLAY menu appears.
36. Click on the Trace Format button, the TRACE FORMAT menu appears.
37. Select **Log Mag**.
38. On the icon toolbar, select the RESPONSE icon. The right side RESPONSE menu appears.
39. Click on User-Defined, the USER DEFINED menu appears.
40. Click on Numerator and on the NUMERATOR menu, and set it to **A2**.
41. Click on Denominator and on the DENOMINATOR menu, set it to **1**.
42. Set Driver Port to **Port 2**.

Format Trace #4

43. Select the lower right channel by clicking on Tr4 S22 Refl Smith Imped.

Note	The trace name has additional resolution and unit information appended to the displayed label.

44. On the icon toolbar, select the DISPLAY icon. The right side DISPLAY menu appears.
45. Click on the Trace Format button. The TRACE FORMAT menu appears.
46. Select Log Mag.
47. On the icon toolbar, select the RESPONSE icon. The right side RESPONSE menu appears.
48. Click on User-Defined, the USER DEFINED menu appears.
49. Click on Numerator and on the NUMERATOR menu, and set it to **B1**.
50. Click on Denominator and on the DENOMINATOR menu, and set it to **1**.
51. Set Driver Port to Port 2.
52. Observe whether any power level abnormalities appear in the frequency band of interest on the displayed traces. Refer to Table 5-4 for the frequency band of interest for each receiver.

Table 5-4. Frequency Band of Interest for Each VNA Receiver

VNA Model Number	Frequency Band of Interest	A1 (Port 1)	A2 (Port 2)	B1 (Port 1)	B2 (Port 2)
All	≤ 2.5 GHz	**YES**	**YES**	**YES**	**YES**
All	2.5 GHz to 5 GHz	**YES**	**YES**	NO	NO
All	5 GHz to 20 GHz	**YES**	**YES**	NO	NO
MS4642B and MA4644B	20 GHz to 40 GHz	**YES**	**YES**	NO	NO
MS4645B and MS4647B	20 GHz to 38 GHz*	**YES**	**YES**	NO	NO
All	38 GHz to 70 GHz	**YES**	**YES**	NO	NO
All	2.5 GHz to 70 GHz	NO	NO	**YES**	**YES**

53. Refer to Section 5-13 “Troubleshooting RF Section Power-Related Problems” on page 5-19 for further troubleshooting instructions.

5-10 Hardware Problems

This section provides specific procedures to be followed when troubleshooting hardware problems. While performing these procedures, always observe the warnings and cautions in the Introduction section of this chapter.

To use the troubleshooting procedures in this section:

1. Select the paragraph heading that best describes the nature of the MS464xB VNA system fault. The troubleshooting analysis sections below and their flowcharts cover the following topics:

    - Section 5-11 "Troubleshooting Power-Up Problems" on page 5-17
        - Figure 5-9, "Flowchart for Troubleshooting Power-Up Problems" on page 5-17
    - Section 5-12 "Troubleshooting Boot-Up Problems" on page 5-18
        - Figure 5-10, "Flowchart for Troubleshooting Boot-Up Problems" on page 5-18
    - Section 5-13 "Troubleshooting RF Section Power-Related Problems" on page 5-19
        - Figure 5-11, "Flowchart for Troubleshooting RF Section Problems: Start – Part 1 of 7" on page 5-19
        - Figure 5-12, "Flowchart for Troubleshooting RF Section Problems: Link A – Part 2 of 7" on page 5-20
        - Figure 5-13, "Flowchart for Troubleshooting RF Section Problems: Link B – Part 3 of 7" on page 5-21
        - Figure 5-14, "Flowchart for Troubleshooting RF Section Problems: Link C – Part 4 of 7" on page 5-22
        - Figure 5-15, "Flowchart for Troubleshooting RF Section Problems: Link D – Part 5 of 7" on page 5-23
        - Figure 5-16, "Flowchart for Troubleshooting RF Section Problems: Link E – Part 6 of 7" on page 5-24
        - Figure 5-17, "Flowchart for Troubleshooting RF Section Problems: Link F – Part 7 of 7" on page 5-25
    - Section 5-14 "Troubleshooting Frequency-Related Problems" on page 5-26
    - Section 5-16 "Troubleshooting Front Panel Problems" on page 5-26
    - Section 5-17 "Troubleshooting Rear Panel Problems" on page 5-27
    - Section 5-18 "Troubleshooting Software Problems" on page 5-28
    - Section 5-19 "Troubleshooting Measurement Problems" on page 5-29

2. Perform the procedure contained in the selected paragraph. In general, the steps within each procedure should be followed in the order presented.
3. When removing and replacing the various assemblies and components specified by the troubleshooting procedures in this chapter, refer to Chapter 7, Removal and Replacement Procedures, as necessary.
4. If a step cannot be successfully completed, stop, correct the immediate problem, and then continue on to the next step until all the appropriate steps in the procedure are completed.
5. After troubleshooting and correcting a problem, perform the procedures in Chapter 7, "Adjustment Procedures" and Chapter 3, "Performance Verification", as appropriate. This should be done to insure that the VNA system has been fully and correctly restored to proper operation.

5-11 Troubleshooting Power-Up Problems

If the instrument is non-functional when power-up is attempted, refer to Figure 5-9.

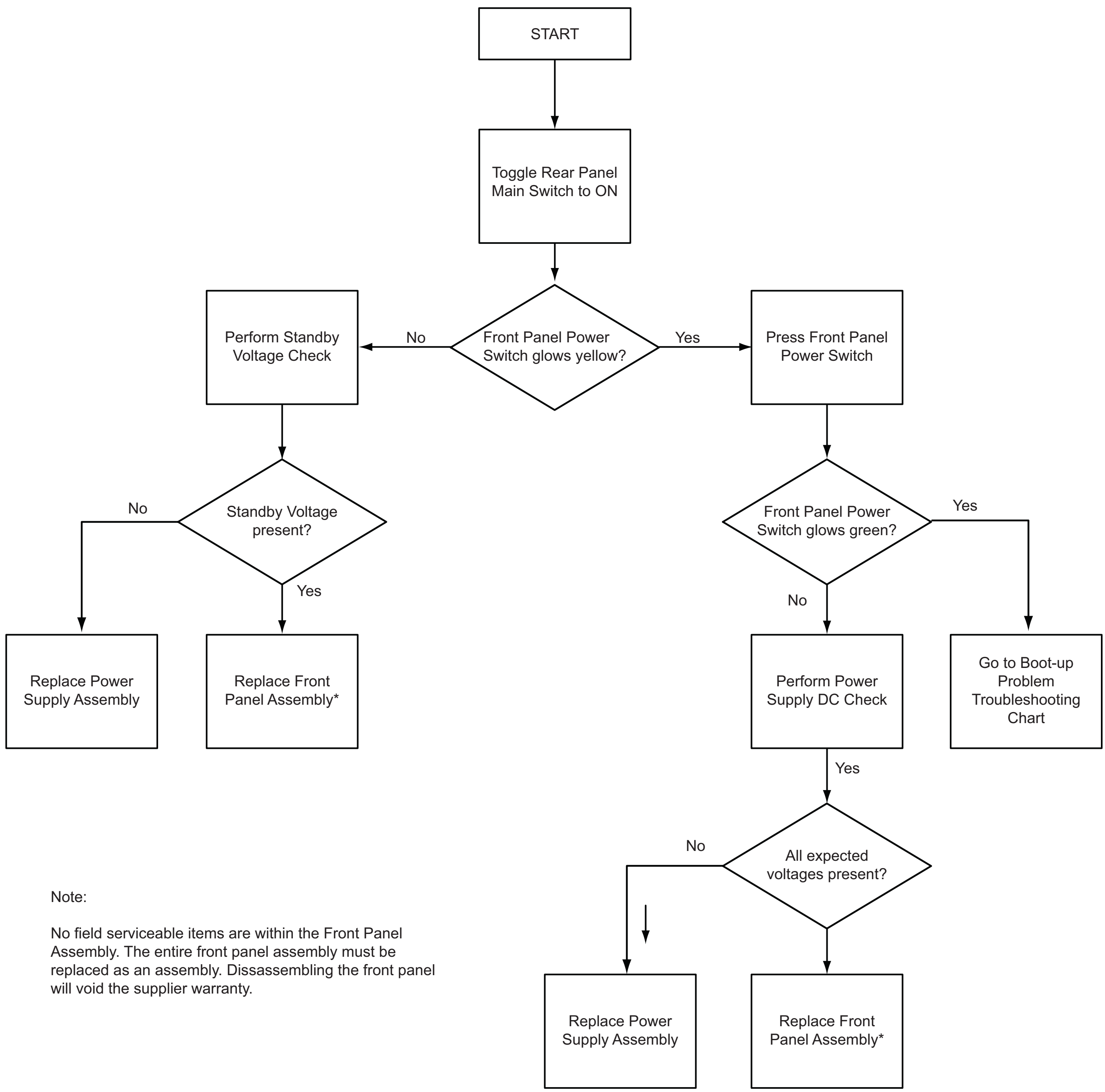
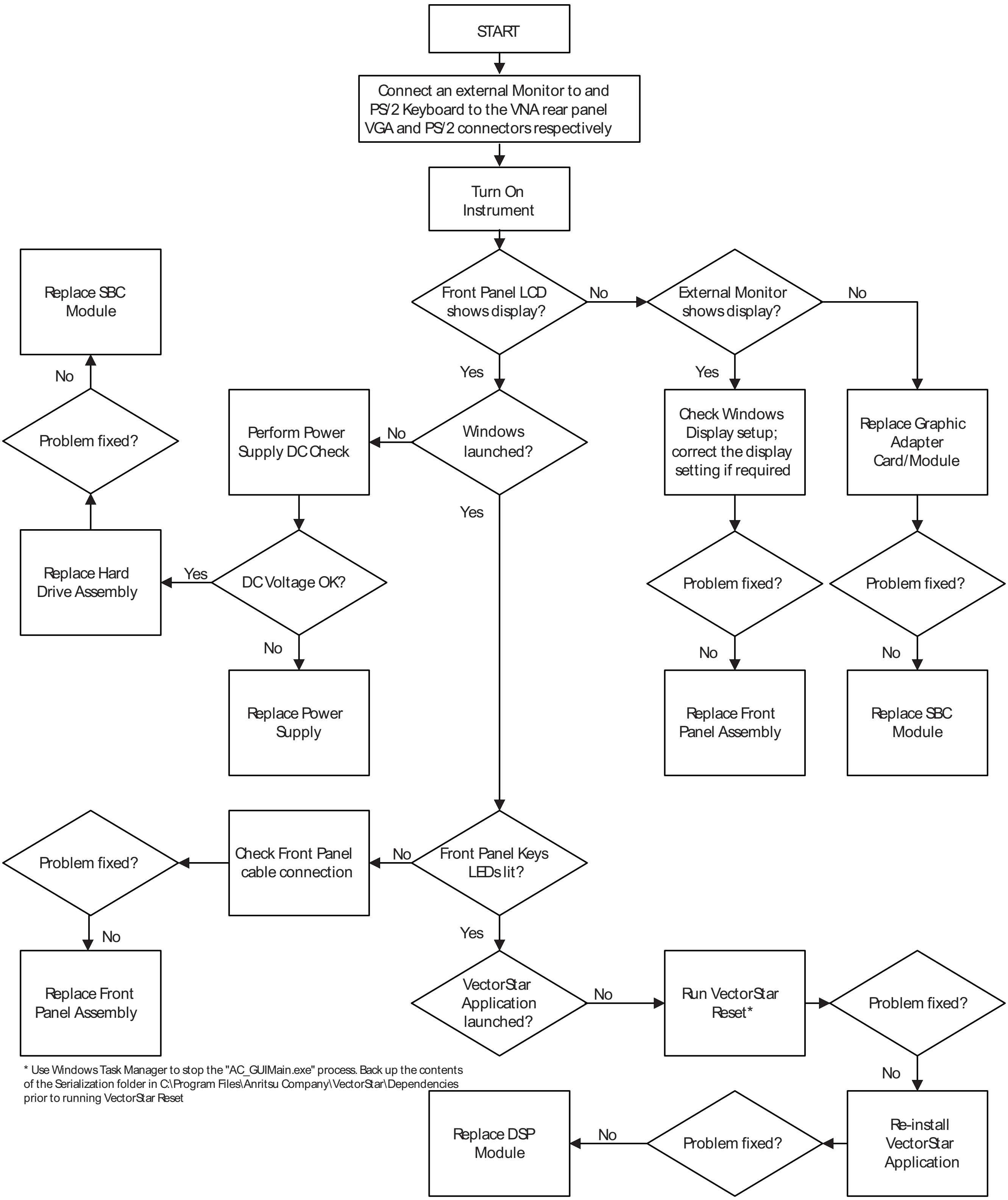


Figure 5-9. Flowchart for Troubleshooting Power-Up Problems

5-12 Troubleshooting Boot-Up Problems

If the instrument is non-functional during the boot-up process, refer to Figure 5-10.

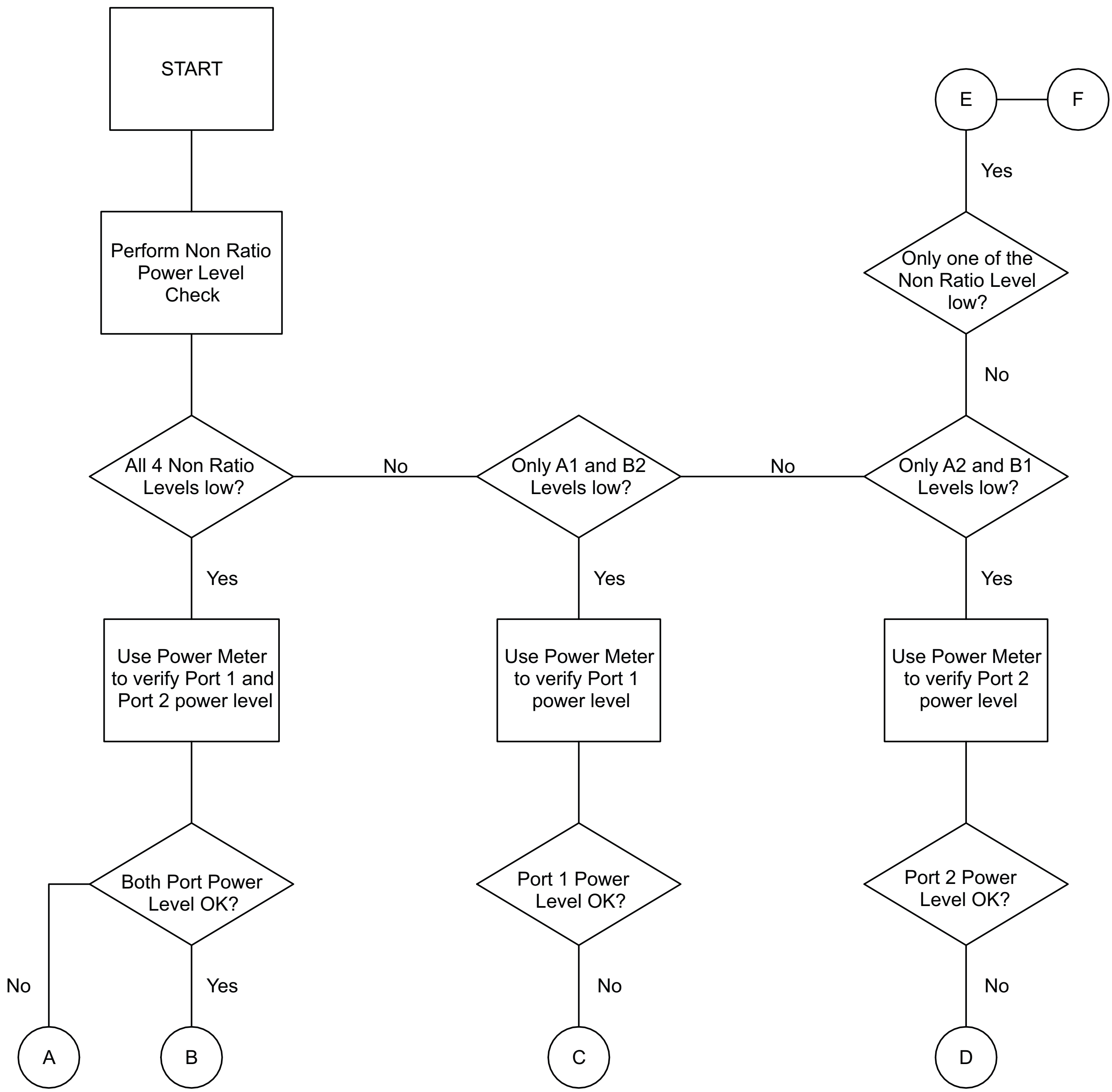


* Use Windows Task Manager to stop the "AC_GUIMain.exe" process. Back up the contents of the Serialization folder in C:\Program Files\Anritsu Company\VectorStar\Dependencies prior to running VectorStar Reset

Figure 5-10. Flowchart for Troubleshooting Boot-Up Problems

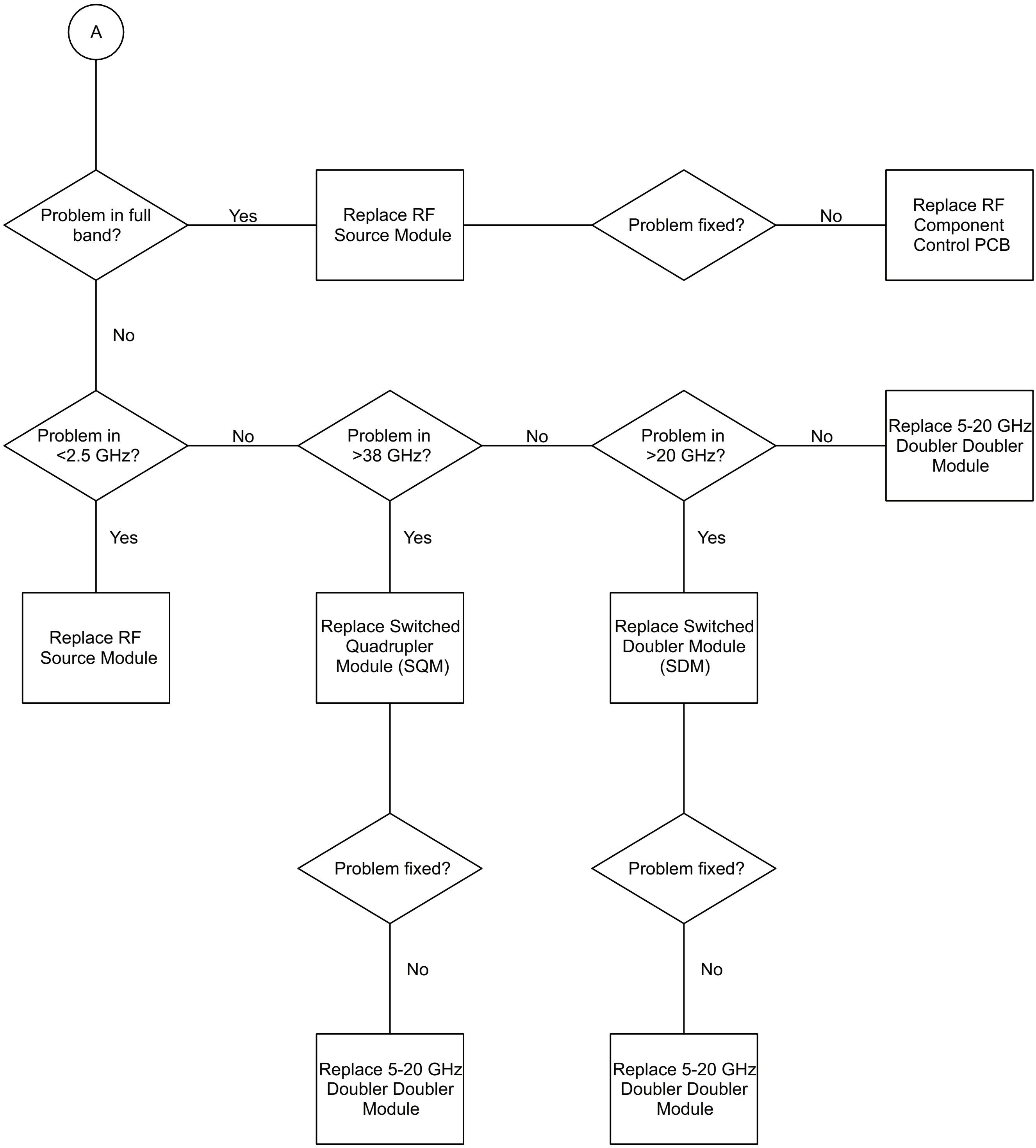
5-13 Troubleshooting RF Section Power-Related Problems

If the instrument exhibits power-related problems, refer to the linked flowcharts in Figure 5-11 through Figure 5-17, which are for troubleshooting RF Section problems.



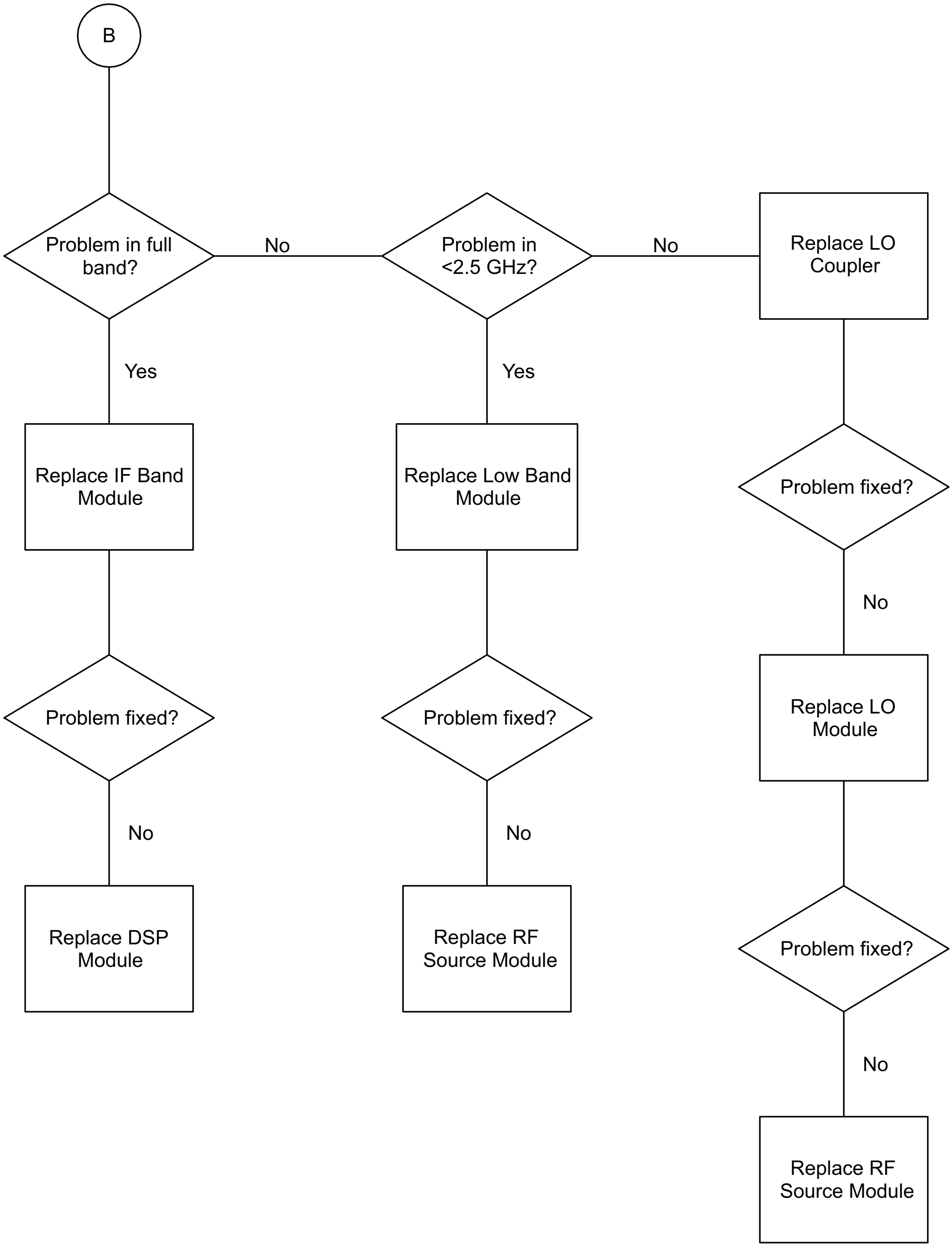
A = Figure 5-12 on page 5-20
B = Figure 5-13 on page 5-21
C = Figure 5-14 on page 5-22
D = Figure 5-15 on page 5-23
E = Figure 5-16 on page 5-24
F = Figure 5-17 on page 5-25

Figure 5-11. Flowchart for Troubleshooting RF Section Problems: Start – Part 1 of 7



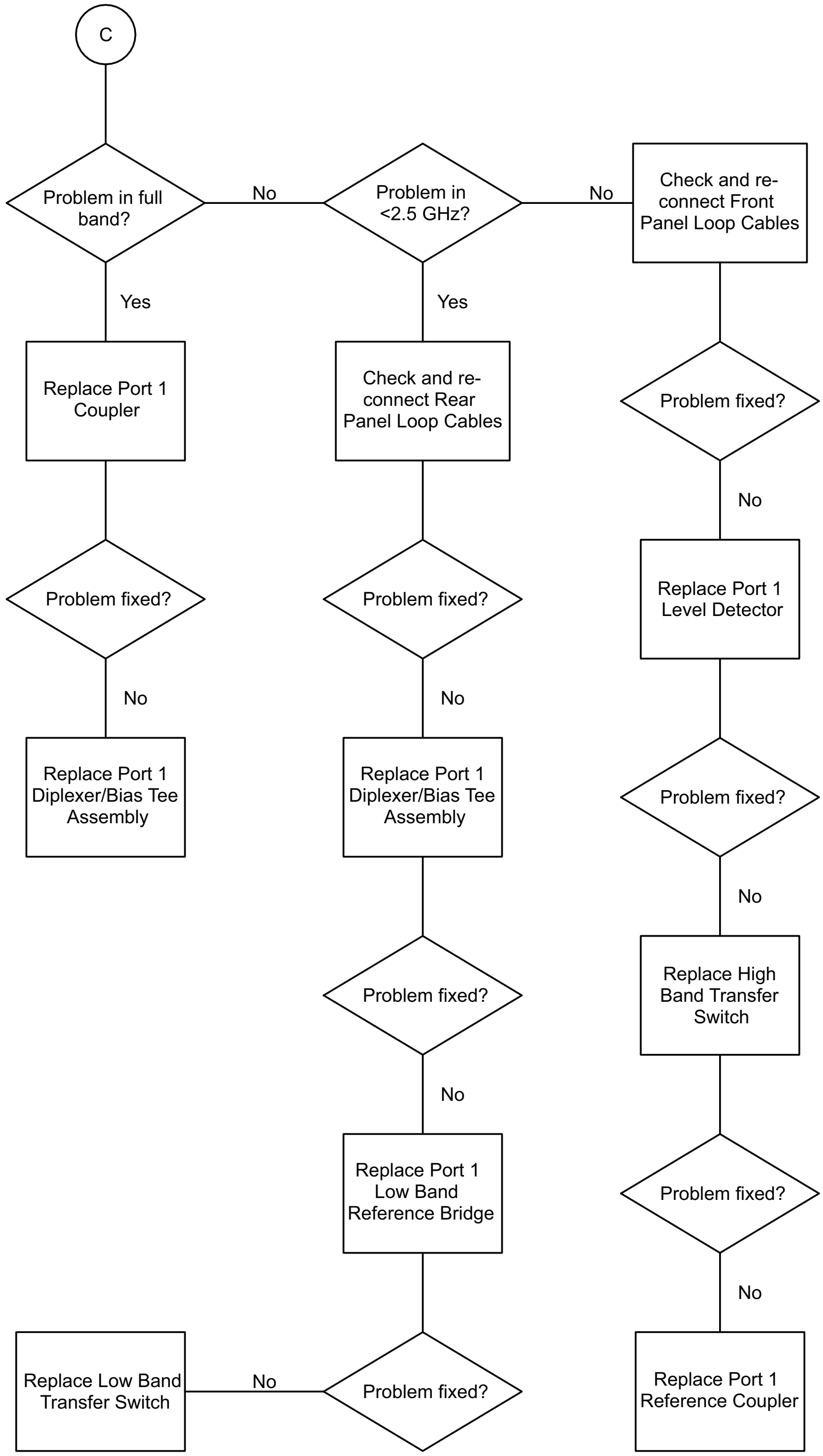
Back to Flowchart Start → (Figure 5-11 on page 5-19)

Figure 5-12. Flowchart for Troubleshooting RF Section Problems: Link A – Part 2 of 7



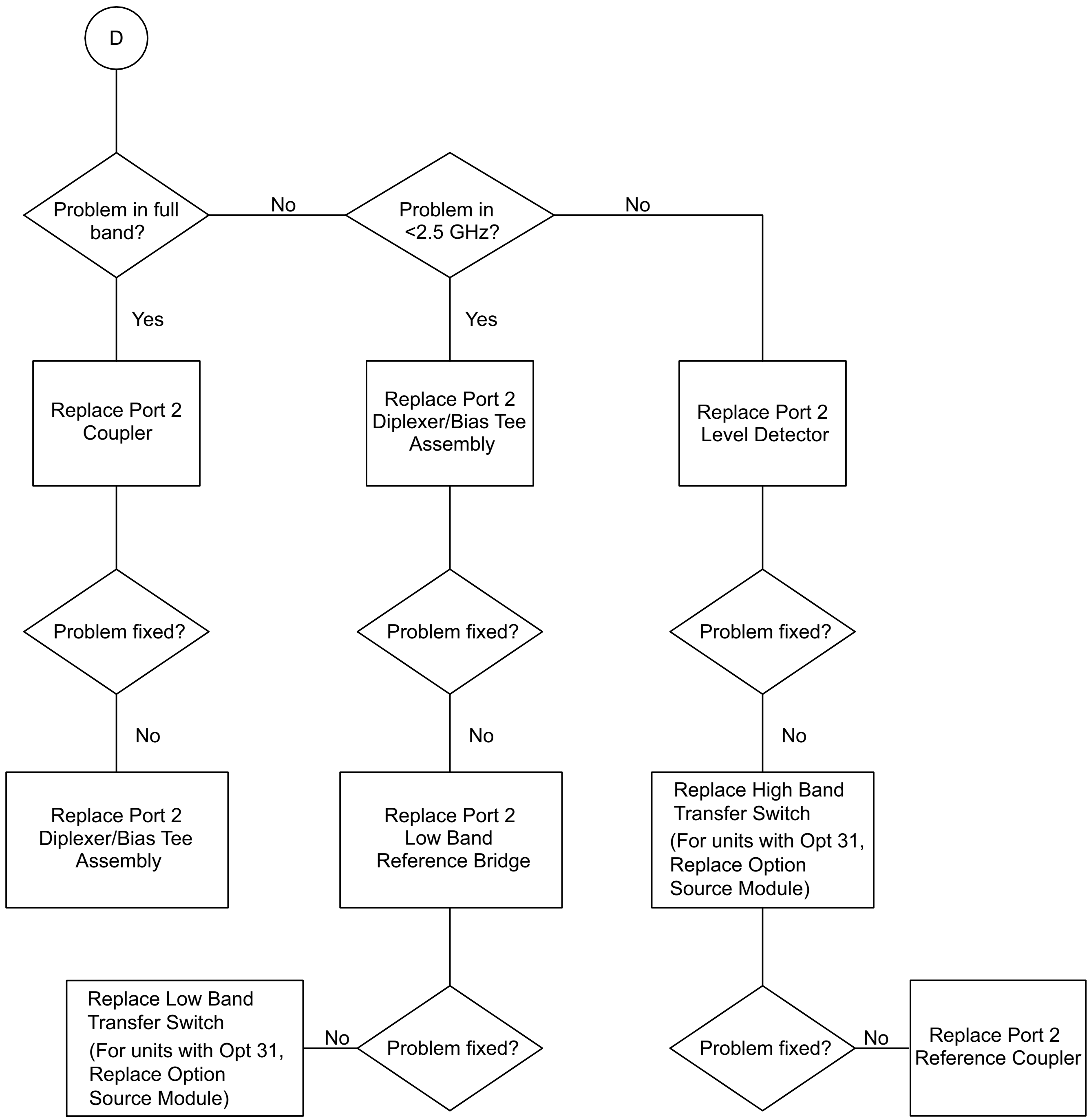
Back to Flowchart Start → (Figure 5-11 on page 5-19)

Figure 5-13. Flowchart for Troubleshooting RF Section Problems: Link B – Part 3 of 7



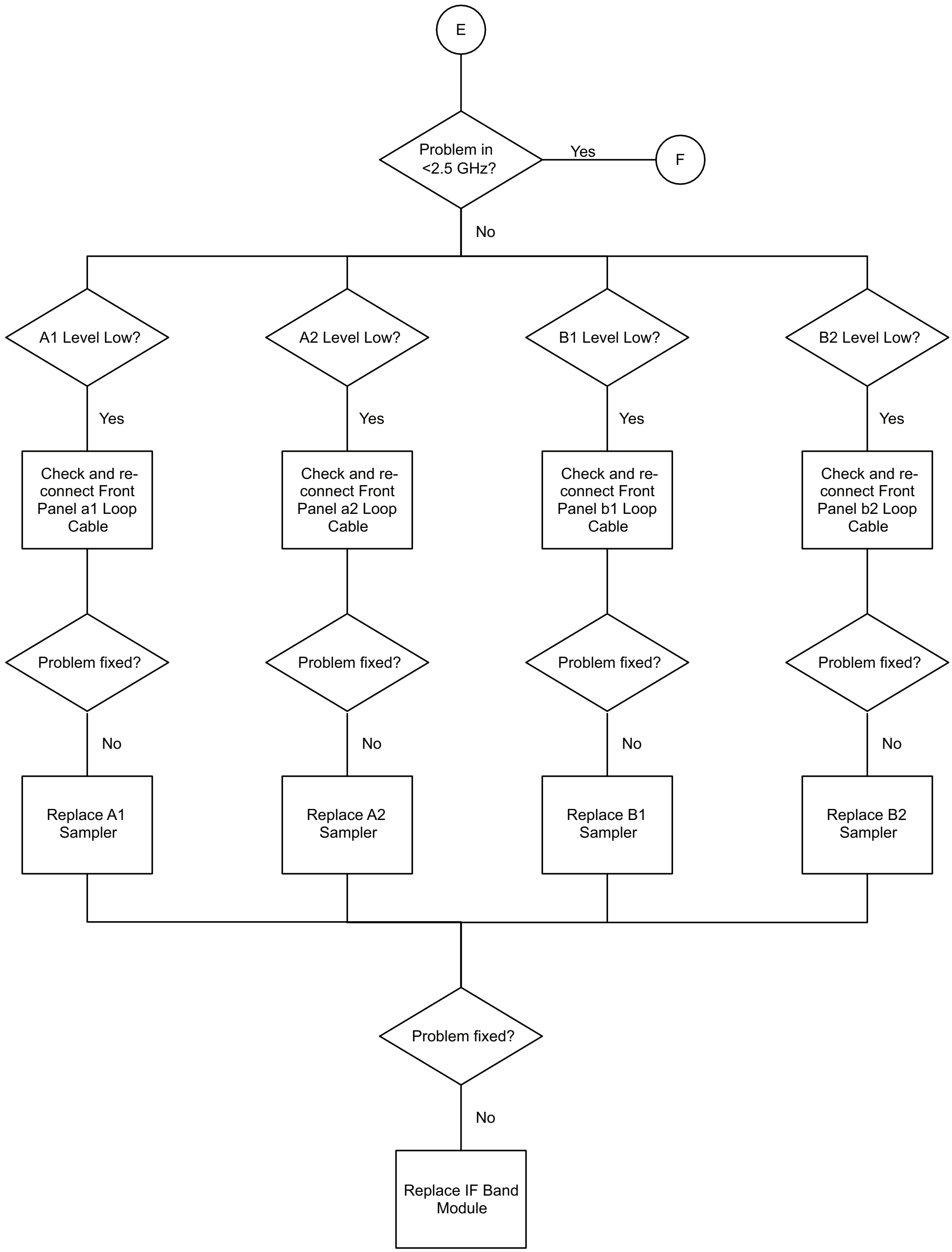
Back to Flowchart Start → (Figure 5-11 on page 5-19)

Figure 5-14. Flowchart for Troubleshooting RF Section Problems: Link C – Part 4 of 7



Back to Flowchart Start → (Figure 5-11 on page 5-19)

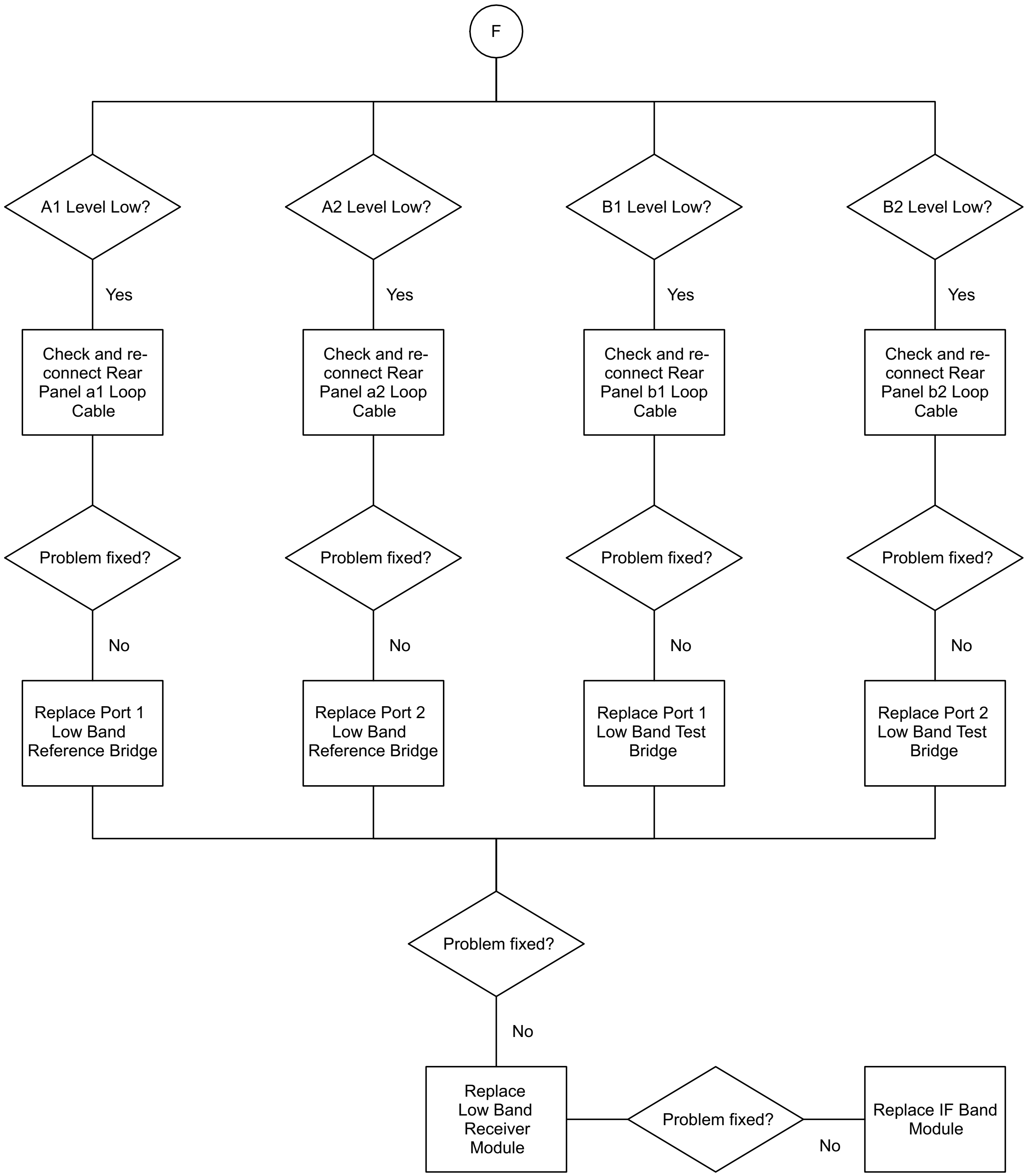
Figure 5-15. Flowchart for Troubleshooting RF Section Problems: Link D – Part 5 of 7



Back to Flowchart Start → (Figure 5-11 on page 5-19)

Continue to Link **F** → (Figure 5-17 on page 5-25)

Figure 5-16. Flowchart for Troubleshooting RF Section Problems: Link E – Part 6 of 7



Back to Flowchart Start → (Figure 5-11 on page 5-19)

Return to Link **E** – Figure 5-16 on page 5-24

Figure 5-17. Flowchart for Troubleshooting RF Section Problems: Link F – Part 7 of 7

5-14 Troubleshooting Frequency-Related Problems

If the instrument exhibits frequency-related problems, do the following:

1. Perform 10 MHz Frequency Adjustment. If it does not help, go to next step.
2. Apply external 10 MHz Reference to the rear panel input and set the instrument to use external reference.
3. If the problem does not show with the external reference, the problem is in the internal reference oscillator. Replace the IF Band Module.
4. If the instrument still exhibits the problem, replace the RF Source Module.
5. For instruments with Option 31, replace the Second Source Module if the problem occurs on Port 2 (S12, S22).

5-15 Troubleshooting Pulse Measurement Problems

If the instrument exhibits pulse-measurement-related problems, do the following:

1. Perform Pulse Measurement Mode Transmission Dynamic Range test.
2. Perform Pulse Generator validation test.
3. If the instrument fails any of the above, replace the IF Digitizer Module.

5-16 Troubleshooting Front Panel Problems

There are no serviceable items within the front panel assembly. Any failures of the front panel assembly require replacing the entire assembly as a whole. Refer to Table 5-5 for a list of possible front panel problems and solutions.

Table 5-5. Front Panel Problems and Solutions

Problems	Solutions
Front Panel LCD touch screen not functioning.	• Perform LCD Touch Panel Adjustment
Front Panel LCD has no display but external monitor does.	• Check Windows Display setting • Replace Front Panel Assembly
Front Panel USB ports not functioning but rear panel USB ports do.	• Replace Front Panel Assembly • Replace SBC (CPU) Module
Front Panel Keys not functioning.	• Replace Front Panel Assembly

5-17 Troubleshooting Rear Panel Problems

The rear panel includes the following connectors:

- PS/2 Mouse Port
- PS/2 Keyboard Port
- USB Ports
- Serial Ports
- Parallel Ports
- LAN Port
- VGA Port
- IEEE488 (GPIB) Port
- Dedicated GPIB Port

To verify if any of these ports are functioning properly, connect a known good device with the appropriate interface and check the operation. If the device performs properly, then the port is functioning correctly. Refer to Table 5-6 for a list of problems and solutions.

Table 5-6. Rear Panel Problems and Solutions

Possible Problem	Solution
PS/2 Mouse Port	• Replace SBC (CPU) Module, Motherboard 2
PS/2 Keyboard Port	• Replace SBC (CPU) Module, Motherboard 2
USB Ports	• Replace SBC (CPU) Module, Motherboard 2
Serial Ports	• Replace SBC (CPU) Module, Motherboard 2
Parallel Ports	• Replace A17 Rear Panel PCB, Motherboard 2, DSP Module
LAN Port	• Replace SBC (CPU) Module
VGA Port	• Replace rear panel video interface cable • Replace Graphic Adapter Card
IEEE488 (GPIB) Port	• Replace SBC (CPU) Module, Motherboard 2, GPIB Interface Card
Dedicated GPIB Port	• Replace SBC (CPU) Module, Motherboard 2, DSP Module

5-18 Troubleshooting Software Problems

The VectorStar MS4640B VectorStar VNA uses an open Microsoft Windows XP Professional operating system. This requires service personnel to be knowledgeable about Windows XP Professional operating system in order to resolve the problems related to the operating system and the VectorStar Application software.

Troubleshooting OS-Related Problems

Refer to Table 5-7 for a list of possible Operating System (OS) software-related problems and solutions.

Table 5-7. Possible Operating System Software-Related Problems

Possible Problem	Solution
A computer peripheral such as a COM port or the rear panel USB port is non-functioning	• Check Windows Device Manager for device conflict
Malicious software infection	• Run malicious software removal tools
VectorStar Application not functioning due to untested Windows Updates applied	• Remove the most recent Windows update using Add/Remove Programs in Windows Control Panel
VectorStar Application not functioning due to Windows Regional and Language Setting modification	• Reset the Windows Regional Setting and Language to English (United States) in Windows Control Panel

Troubleshooting VectorStar Application Software-Related Problems

If the Measurement Graphic User Interface (GUI) is not displayed after the instrument is turned on, check if the VectorStar Application Software is running using Windows Task Manager:

1. With the external keyboard connected, press **Alt-Ctrl-Delete** keys to bring up the Windows Task Manager.
2. Check if AC_GUIMain.exe is listed under the Process tab and if it consumes lots of CPU cycles.
    a. If it is, select the AC_GUIMain.exe and click on the “End Process” button.
        - If the End Process does not solve the problem, replace the **DSP Module**.
    b. If it is not listed, re-install the VectorStar Application Software.

5-19 Troubleshooting Measurement Problems

If the MS4640B measurement quality is suspect, the following paragraphs provide guidelines and hints for determining possible quality problems.

VNA Measurement Quality

The quality of MS4640B VNA measurements is determined by the following test conditions and variables:

1. The condition of the MS4640B.
2. The quality and condition of the interface connections and connectors.
3. The quality and condition of the calibration components, through cables, adapters and fixtures.
4. The surrounding environmental conditions at the time of the measurement.
5. The selection and performance of the calibration for the DUT being measured.

Checking Possible Measurement Problems

When determining possible measurement problems, check the following items:

1. Check the DUT and the calibration conditions:
   - a. Ensure that the Calibration Components Coefficients data has been installed into the system from the Calibration Kit in use.
   - b. Ensure that the proper calibration was done for the device being measured:
     - For high insertion-loss device measurements, the calibration should include isolation, high number of averages, and lower IF Bandwidth settings during the calibration.
     - For high return-loss device measurements, the calibration should also include a sliding load calibration or LRL calibration.
   - c. Check the condition of DUT mating connectors and their pin depth.
   - d. If possible, measure an alternate known good DUT.
   - e. Check if the environment is stable enough for the accuracy required for the DUT measurement.
     - The system should not be subjected to variations in temperature.
     - The system should not be placed in direct sun light or next to a changing cooling source, such as a fan or air conditioning unit.
2. Check the calibration using known good components from the calibration kit. If measurements of these devices do not produce good results, try the following:
   - a. Check through-cable stability including condition and pin depth. Replace with a known good cable, if necessary.
   - b. Check condition and pin depth of calibration kit components. Replace with known good components, if necessary.
   - c. Check condition and pin depth of test port connectors. Replace with known good ones if necessary.
3. Check the system performance as described in Chapter 3, “Performance Verification”.

Chapter 6 — Replaceable Parts

6-1 Introduction

This chapter provides replaceable parts information for all MS4640B models. The major replaceable assemblies and parts are listed and their locations are shown in this chapter.

Anritsu Exchange Assembly Program

Anritsu maintains a module exchange program for selected subassemblies. If a malfunction occurs in one of these subassemblies, the defective item can be exchanged. Upon receiving your request, Anritsu will ship the exchange subassembly to you. You then have 45 days in which to return the defective item. All exchange subassemblies or RF assemblies are warranted for 90 days from the date of shipment, or for the balance of the original equipment warranty, whichever is longer.

Please have the exact model number and serial number of your unit available when requesting this service, as the information about your unit is filed according to the instrument model and serial number. For more information about this program, contact your local Anritsu Service Center.

6-2 Replaceable Parts

Note	**Identification** Most parts are identified by their common “A” Engineering Reference Number (**ERN**), such as “A11” or “A241”. These are useful for identifying the part you need to replace and then using this to find the number you would use to order a replacement. The replaceable parts listing provided is sorted by its ERN.

Note	Instruments shipped to European Union countries after 22nd July, 2017 are compliant with the requirements in the RoHS Directive, officially known as Directive 2011/65/EU. Instruments shipped to European Union countries after 22nd July, 2021 are compliant with the requirements in the RoHS amendment, officially known as Directive 2011/65/EU, Amendment 2015/863/EU. RoHS-compliant replacement parts must be used to repair RoHS-compliant instruments.

Definitions

The following definitions apply to the replacement parts table in the next section (Table 6-2).

Table 6-1. Definitions for Replaceable Parts Table (1 of 2)

Note	Description
Part Quantity Per Instrument	Unless otherwise specified, only one (1) part is required per instrument.
Part Quantity Per Replacement Kit	Unless otherwise specified, each replacement part kit contains only one (1) part.
ERN	Engineering “**A**” Reference Number (for example, A114)
RPN	Replacement Part Number
APN	Anritsu Part Number

Table 6-1. Definitions for Replaceable Parts Table (2 of 2)

Note	Description
Any Model	Applicable to all MS4640B Series VNAs.
Model	**Where only applicable to a single model VNA:** • **MS4642B**, 10 MHz to 20 GHz, K Connectors • **MS4644B**, 10 MHz to 40 GHz, K Connectors • **MS4645B**, 10 MHz to 50 GHz, V Connectors • **MS4647B**, 10 MHz to 70 GHz, V Connectors **Where applicable to pairs of VNA models:** • **MS4642B** and **MS4644B** • **MS4645B** and **MS4647B**
Option	Identifies whether a replaceable item is part of a VNA option: • **Any** – Applicable to Standard No Options or any combination of options. • **No Option(s)** – Applicable to VNAs not equipped with Options listed (e.g. 51, 61, or 62). • **31** – Applicable to VNAs equipped with Option 31 Second Source. • **35** – Applicable to VNAs equipped with Option 35 IF Digitizer Hardware. • **51** – Applicable to VNAs equipped with Option 51 Direct Access Loops. • **61** – Applicable to VNAs equipped with Option 61 Active Measurement Suite with Direct Access Loops and Two Attenuators. • **62** – Applicable to VNAs equipped with Option 62 Active Measurement Suite with Direct Access Loops with Four Attenuators. • **80/ 81** – Applicable to MS4647B equipped with Option 80 or 81 Broadband/Millimeter Wave interface. • **82/ 83** – Applicable to MS4642B, MS4644B and MS4645B equipped with Option 82 or 83 Millimeter Wave interface. • **84/ 85** – Applicable to MS4640B equipped with Option 31 and Option 84 or 85 Broadband/Millimeter Wave interface.
Access and General Location	Summarizes the requirements for accessing the to-be-replaced part, removing it, and installing a replacement part: • **External Part:** Part can be serviced with the instrument covers on. • **Covers Off:** The covers must be removed from the instrument to service the part. • **Remove Front Panel**: This part requires the Front Panel be removed. • **RF Deck In:** The part can be serviced with the covers off and the RF Deck in place. Usually the instrument is positioned upside down. • **RF Deck Out:** The RF Deck must be removed from the instrument to service this part, usually located on the RF Deck Top Side. A T3545 Fixture is recommended. • **Internal Assembly:** This is an internal assembly with additional disassembly requirements.

Ordering Replacement Parts

For the purpose of ordering, most replacement parts are identified by an "**ND**" part number (RPN or RPN RoHS). For example, the USB Controller PCB Assembly is ND70062-RFB or 3-ND70062-RFB.

In some cases, there is no "**ND**" number and a multi-digit Anritsu part number "**APN or APN RoHS**" is used. For example, the 70 GHz High Band Step Attenuator is part number 66050-RFB or 3-66050-RFB.

Replaceable Parts List

Table 6-2 lists the VectorStar VNA replacement parts sorted by the engineering reference number (ERN). Where indicated, a cross-reference to an example figure is provided. The sections following this table provide location and identification drawings of many of the replacement components and assemblies.

ERN = Engineering Reference Number

RPN = Replacement Part Number

APN = Anritsu Part Number

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (1 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
—	Attenuator, 10 dB, Fixed, K Connector • Connects to A110 Port 2 Level Detector	—	—	41KC-10	41KC-10	MS4642B MS4644B 84/85 88/89	Covers Off RF Deck In
—	Attenuator, 10 dB, Fixed, V Connector • Connects to A110 Port 2 Level Detector	—	—	41V-10	41V-10	MS4645B MS4647B 84/85 88/89	Covers Off RF Deck In
—	Coin Battery • Mounts on the front side of the Carrier Board • Figure 6-5 on page 6-22	—	—	3-633-43	3-633-43	Any Model Any Option	Covers Off Digital PCBs
—	Digital PCB Fan Assembly • 165 mm Cable Attached • Figure 6-27 on page 6-52	ND70073	3-ND70073			Any Model Any Option	Covers Off Internal Part Power Supply Digital Fan
—	Front Panel Assembly • Three (3) cable connections to instrument chassis. • Does not include cables USB, Signal/Power, and HDMI. • No user serviceable parts inside Front Panel. • Identity Label 3-60124-XX must be ordered separately • Figure 6-2 on page 6-18 • Figure 6-13 on page 6-30	ND73195-RFB	3-ND73195-RFB	—	—	Any Model Any Option	Covers Off RF Deck In Front Panel Off

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (2 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
—	Front Panel Loop Cable, K Connector, male to male • Six (6) per instrument • Kit contains one (1) loop • Figure 6-17 on page 6-36	—	—	67357-6	3-67357-6	MS4642B MS4644B 51, 61, 62	Covers On External Part
—	Front Panel Loop Cable, V Connector, male to male • Six (6) per instrument • Kit contains one (1) loop • Figure 6-17 on page 6-36	—	—	62109-1	3-62109-1	MS4645B MS4647B 51, 61, 62	Covers On External Part
—	Identity Label – MS4642B Model • Must be ordered separately from replacement Front Panel Assembly • Figure 6-1 on page 6-17	—	—	3-60124-19	3-60124-19	MS4642B Any Option	Covers On External Part
—	Identity Label – MS4644B Model • Must be ordered separately from replacement Front Panel Assembly • Figure 6-1 on page 6-17	—	—	3-60124-20	3-60124-20	MS4644B Any Option	Covers On External Part
—	Identity Label – MS4645B Model • Must be ordered separately from replacement Front Panel Assembly • Figure 6-1 on page 6-17	—	—	3-60124-21	3-60124-21	MS4645B Any Option	Covers On External Part
—	Identity Label – MS4647B Model • Must be ordered separately from replacement Front Panel Assembly • Figure 6-1 on page 6-17	—	—	3-60124-22	3-60124-22	MS4647B Any Option	Covers On External Part
—	Power Supply Module and Harness • For VNA serial numbers 1506634 and above (including 1450614 and 1450617) • ND81463-RFB includes Power Supply Cable – ND81421 • 3-ND81463-RFB includes Power Supply Cable – ND81421 or RoHS P/N 3-ND81421 • Figure 6-30 on page 6-58	ND81463-RFB	3-ND81463-RFB	—	—	Any Model Any Option	Covers Off Internal Part Power Supply
—	Power Supply Module and Harness • For systems with S/N 1506633 and below (excluding 1450614 and 1450617) • Includes Power Supply Cable – 3-71996 • Figure 6-30 on page 6-58	ND75957-RFB	NA	—	—	Any Model Any Option	Covers Off Internal Part Power Supply
—	Rear Panel Fan Assembly • 330 mm Cable Attached • Figure 6-27 on page 6-52	ND70074	3-ND70074	—	—	Any Model Any Option	Covers Off Rear Panel

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (3 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
—	Rear Panel Loop Cable, SMA Connector, male to male • Six (6) per instrument • Kit contains one (1) loop • Figure 6-17 on page 6-36	—	—	62112-1	3-62112-1	All Models 51, 61, 62	Covers On External Part
—	RF Deck Front Panel RF, LO1, and LO2 Panel K Connector, Female to Female • Three (3) per VNA instrument • Four (4) per VNA instrument with Option 84/85 • One (1) per replacement kit • Figure 6-19 on page 6-39	—	—	K232B	K232B	Any Model Option 80/81, 82/83, or 84/85	Covers Off RF Deck In
—	Test Port K Connector • Two (2) per instrument • Kit contains with one (1) connector • Figure 6-17 on page 6-36	—	—	34YK50C	34YK50C	MS4642B MS4644B Any Option	Covers On External Part
—	Test Port V Connector • Two (2) per instrument • Kit contains one (1) connector • Figure 6-19 on page 6-39	—	—	34YV50C	34YV50C	MS4645B MS4647B Any Option	Covers On External Part
A4	A4 USB Controller PCB Assembly • Mounts on the front side of the Carrier Board Assembly • Figure 6-5 on page 6-22	ND70062-RFB	3-ND70062-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
A8	GPIB Module • Mounts on Carrier Board Assembly • Figure 6-5 on page 6-22	ND70065-RFB	3-ND70065-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
A10	Digital Signal Processing (DSP) Module • Figure 6-4 on page 6-21	ND70066-RFB	3-ND70066-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
A11	IF Band Module • Top analog module • Figure 6-7 on page 6-24	ND75362-RFB	3-ND75362-RFB	—	—	Any Model Any Option	Covers Off Analog PCBs
A12	IF Digitizer Module • For systems with Option 35 and S/N 1627751 and below • Mounts below the A11 IF Band Module • Figure 6-7 on page 6-24	ND75344-RFB	NA	—	—	Any Model 35	Covers Off Analog PCBs

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (4 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A12	IF Digitizer Module • For systems with Option 35 and S/N 1627752 and above, and all units with Option 36 • Mounts below the A11 IF Band Module • Requires MS464xB VectorStar application software v2.3.1 or later. • Figure 6-7 on page 6-24	ND82747-RFB	3-ND82747-RFB	—	—	Any Model 35 36	Covers Off Analog PCBs
A13	Source Module Main; Replaced by ND82450 • Middle analog module • Figure 6-7 on page 6-24	ND75867-RFB	NA	—	—	Any Model Any Option	Covers Off Analog PCBs
A13	Source Module • Middle analog module • Figure 6-7 on page 6-24	ND82450-RFB	3-ND82450-RFB	—	—	Any Model Any Option	Covers Off Analog PCBs
A14	Second Source Module (Option 31); Replaced by ND82451 • Middle analog module • Figure 6-7 on page 6-24	ND75341-RFB	NA	—	—	Any Model 31	Covers Off Analog PCBs
A14	Second Source Module (Option 31) • Middle analog module • Figure 6-7 on page 6-24	ND82451-RFB	3-ND82451-RFB	—	—	Any Model 31	Covers Off Analog PCBs
A15	Low Band Receiver Module • Bottom analog module • Figure 6-7 on page 6-24	ND70075-RFB	3-ND70075-RFB	—	—	Any Model Any Option	Covers Off Analog PCBs
A17	Rear Panel PCB Assembly • Figure 6-27 on page 6-52 • Figure 6-28 on page 6-54 • Figure 6-29 on page 6-56	ND70067-RFB	3-ND70067-RFB	—	—	Any Model Any Option	Covers Off Rear Panel
A18	RF Component Control PCB Assembly • Figure 6-19 on page 6-39	ND75342-RFB	3-ND75342-RFB	—	—	Any Model Not 31	Covers Off RF Deck In
A18	RF Component Control PCB Assembly • Figure 6-19 on page 6-39	ND75929-RFB	3-ND75929-RFB	—	—	Any Model 31	Covers Off RF Deck In
A100	Sampler Module; Replaced by ND81610 • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND70082-RFB	NA	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (5 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A100	Sampler Module • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND81610-RFB	3-ND81610-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A101	Sampler Module; Replaced by ND81610 • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND70082-RFB	NA	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A101	Sampler Module • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND81610-RFB	3-ND81610-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A102	Sampler Module; Replaced by ND81610 • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND70082-RFB	NA	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A102	Sampler Module • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND81610-RFB	3-ND81610-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A103	Sampler Module; Replaced by ND81610 • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND70082-RFB	NA	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (6 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A103	Sampler Module • Replacement kit provides one (1) module. • The A100-A103 modules are components of the Sampler/LO Distribution Module Assembly. • Figure 6-25 on page 6-47	ND81610-RFB	3-ND81610-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A104	Test Coupler, 70 GHz • One (1) per replacement kit • Figure 6-20 on page 6-41	66245-RFB	3-66245-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A104	Test Coupler, 40 GHz • One (1) per replacement kit • Figure 6-15 on page 6-33	66480-RFB	3-66480-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A105	Reference Coupler, 70 GHz • Kit contains one (1) coupler • Figure 6-19 on page 6-39	65270-RFB	3-65270-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A105	Reference Coupler, 40 GHz • One (1) per replacement kit • Figure 6-15 on page 6-33	66487-RFB	3-66487-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A106	Test Coupler, 70 GHz • One (1) per replacement kit • Figure 6-19 on page 6-39	66245-RFB	3-66245-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A106	Test Coupler, 40 GHz • One (1) per replacement kit • Figure 6-15 on page 6-33	66480-RFB	3-66480-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A107	Reference Coupler, 70 GHz • Kit contains one (1) coupler • Figure 6-19 on page 6-39	65270-RFB	3-65270-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A107	Reference Coupler, 40 GHz • One (1) per replacement kit • Figure 6-15 on page 6-33	66487-RFB	3-66487-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A108	High Band Transfer Switch (HBTS), 40 GHz • Not used on instruments with Option 31 • One (1) per instruments with Option 84/85 • Figure 6-15 on page 6-33	ND70092-RFB	3-ND70092-RFB	—	—	MS4642B MS4644B Not 31, 84/85	Covers Off RF Deck In

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (7 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A108	V Integrated High Band Transfer Switch (VITS), 70 GHz • Not used on instruments with Option 31 • Figure 6-19 on page 6-39	ND70093-RFB	3-ND70093-RFB	—	—	MS4645B MS4647B Not 31	Covers Off RF Deck In
A109	Port 1 Level Detector, V Connector, 70 GHz • Figure 6-19 on page 6-39	ND72126-RFB	3-ND72126-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A109	Port 1 Level Detector, K Connector, 40 GHz • Figure 6-15 on page 6-33	ND72124-RFB	3-ND72124-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A110	Port 2 Level Detector, V Connector, 70 GHz • Figure 6-19 on page 6-39	ND72127-RFB	3-ND72127-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A110	Port 2 Level Detector, 40 GHz, K Connector • Figure 6-15 on page 6-33	ND72125-RFB	3-ND72125-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A111	LO Distribution Module • A111 is a component of the Sampler/LO Distribution Module Assembly • A111 provides mounting for four (4) A100-A104 Sampler Modules – ND70082 – 64180 • Figure 6-24 on page 6-46	ND73193-RFB	3-ND73193-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out SLODM Assembly
A112	Switched Doubler Module (SDM) • Two (2) per instrument with Option 31 • Figure 6-20 on page 6-41	ND70098-RFB	3-ND70098-RFB	—	—	MS4644B MS4645B MS4647B Any Option	Covers Off RF Deck In
A113	5-20 GHz Doubler Module • Two (2) per instrument with Option 31 • Figure 6-24 on page 6-46	ND70080-RFB	3-64920-1-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out
A114	Switched Quadrupler Module (SQM) • Two (2) per instrument with Option 31 • Figure 6-20 on page 6-41	ND70099-RFB	3-ND70099-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A115	Low Band Transfer Switch • Not used on instrument with Option 31 • Figure 6-23 on page 6-45	ND70079-RFB	3-ND70079-RFB	—	—	Any Model Not 31	Covers Off RF Deck Out

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (8 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A116	Low Band Bridge • Replacement kit contains one (1) bridge • A116 is located on RF Deck Top Side, accessible with RF Deck Out • Figure 6-23 on page 6-45 • Figure 6-24 on page 6-46	ND70078-RFB	3-64016-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out
A117	Low Band Bridge • Replacement kit contains one (1) bridge • A117 is located on RF Deck Top Side, accessible with RF Deck Out • Figure 6-23 on page 6-45 • Figure 6-24 on page 6-46	ND70078-RFB	3-64016-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out
A118	Low Band Bridge • Replacement kit contains one (1) bridge • A118 located on RF Deck Bottom Side, accessible with RF Deck InFigure 6-20 on page 6-41	ND70078-RFB	3-64016-RFB	—	—	Any Model Any Option	Covers Off RF Deck Out
A119	Low Band Bridge • Replacement kit contains one (1) bridge • A119 located on RF Deck Bottom Side, accessible with RF Deck In • Figure 6-20 on page 6-41	ND70078-RFB	3-64016-RFB	—	—	Any Model Any Option	Covers Off RF Deck In
A120	High Band Step Attenuator, Test or Source, 70 GHz • Kit contains one (1) attenuator. • Figure 6-20 on page 6-41	66050-RFB	3-66050-RFB	—	—	MS4645B MS4647B 61, 62	Covers Off RF Deck In
A120	High Band Step Attenuator, Test, 40 GHz • Kit contains one (1) attenuator. • Figure 6-16 on page 6-34	68570-RFB	3-68570-RFB	—	—	MS4642B MS4644B 61, 62	Covers Off RF Deck In
A121	High Band Step Attenuator, Test or Source, 70 GHz • Kit contains one (1) attenuator. • Figure 6-20 on page 6-41	66050-RFB	3-66050-RFB	—	—	MS4645B MS4647B 61, 62	Covers Off RF Deck In
A121	High Band Step Attenuator, Source, 40 GHz • Kit contains one (1) attenuator • Figure 6-16 on page 6-34	66052-RFB	3-66052-RFB	—	—	MS4642B MS4644B 61, 62	Covers Off RF Deck In
A122	High Band Step Attenuator, Test or Source, 70 GHz • Kit contains one (1) attenuator. • Figure 6-20 on page 6-41	66050-RFB	3-66050-RFB	—	—	MS4645B MS4647B 61, 62	Covers Off RF Deck In

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (9 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A122	High Band Step Attenuator, Source, 40 GHz • Kit contains one (1) attenuator • Figure 6-16 on page 6-34	66052-RFB	3-66052-RFB	—	—	MS4642B MS4644B 61, 62	Covers Off RF Deck In
A123	High Band Step Attenuator, Test or Source, 70 GHz • Kit contains one (1) attenuator. • Figure 6-20 on page 6-41	66050-RFB	3-66050-RFB	—	—	MS4645B MS4647B 61, 62	Covers Off RF Deck In
A123	High Band Step Attenuator, Test, 40 GHz • Kit contains one (1) attenuator. • Figure 6-16 on page 6-34	68570-RFB	3-68570-RFB	—	—	MS4642B MS4644B 61, 62	Covers Off RF Deck In
A124	Low Band Test Attenuator, Port 1 • Harness attached • Figure 6-24 on page 6-46	ND70085-RFB	3-ND70085-RFB	—	—	Any Model 62	Covers Off RF Deck Out
A125	Low Band Source Attenuator, Port 1 • Harness attached • Figure 6-24 on page 6-46	ND70084-RFB	3-ND70084-RFB	—	—	Any Model 61 or 62	Covers Off RF Deck Out
A126	Low Band Source Attenuator, Port 2 • Harness attached • Figure 6-24 on page 6-46	ND70086-RFB	3-ND70086-RFB	—	—	Any Model 62	Covers Off RF Deck Out
A127	Low Band Test Attenuator, Port 2 • Harness attached • Figure 6-24 on page 6-46	ND70087-RFB	3-ND70087-RFB	—	—	Any Model 61, 62	Covers Off RF Deck Out
A128	Diplexer/Bias Tee Module, Port 1, 40 GHz • Figure 6-16 on page 6-34	ND73940-RFB	3-ND73940-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A128	Diplexer/Bias Tee Module, Port 1, 70 GHz • Figure 6-20 on page 6-41	ND73942-RFB	3-ND73942-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In
A129	Diplexer/Bias Tee Module, Port 2, 40 GHz • Figure 6-16 on page 6-34	ND73941-RFB	3-ND73941-RFB	—	—	MS4642B MS4644B Any Option	Covers Off RF Deck In
A129	Diplexer/Bias Tee Module, Port 2, 70 GHz • Figure 6-20 on page 6-41	ND73943-RFB	3-ND73943-RFB	—	—	MS4645B MS4647B Any Option	Covers Off RF Deck In

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (10 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A131	LO Coupler Module • One (1) per replacement kit • A131 LO Coupler mounts on top of A101 Sampler Module • The A131 module is part of the Sampler/LO Distribution Module Assembly when the VNA is equipped with Option 8x. • Figure 6-24 on page 6-46	70685-RFB	3-70685-RFB	—	—	Any Model 80/81, 82/83, or 84/85	Covers Off RF Deck Out SLODM Assembly
A132	LO Coupler Module • One (1) per replacement kit • A132 LO Coupler mounts on top of A103 Sampler Module • The A132 module is part of the Sampler/LO Distribution Module Assembly when the VNA is equipped with Option 8x. • Figure 6-24 on page 6-46	70685-RFB	3-70685-RFB	—	—	Any Model 80/81, 82/83, or 84/85	Covers Off RF Deck Out SLODM Assembly
A133 and A233	20-40 GHz RF Coupler Module • One (1) per replacement kit • Two (2) per instrument with Option 84/85 (A133, A233) • Figure 6-24 on page 6-46	72237-RFB	3-72237-RFB	—	—	Any Model 80/81, 82/83, or 84/85	Covers Off RF Deck In
A140	Forward Coupler Module • Two (2) per instrument with Option 31 (A140, A240) • Figure 6-20 on page 6-41	76535-RFB	3-76535-RFB	—	—	MS4645B MS4647B 31	Covers Off RF Deck In
A142	Reference Coupler, 40 GHz • One (1) per replacement kit • With Option 32 • Figure 6-21 on page 6-43	66487-RFB	3-66487-RFB	—	—	MS4642B MS4644B 32	Covers Off RF Deck In
A142	Reference Coupler, 70 GHz • One (1) per replacement kit • With Option 32 • Figure 6-22 on page 6-44	65270-RFB	3-65270-RFB	—	—	MS4645B MS4647B 32	Covers Off RF Deck In
A144	Low Band Bridge • One (1) per replacement kit • With Option 32 • Figure 6-22 on page 6-44	3-76535-RFB	3-76535-RFB	—	—	Any Model 32	Covers Off RF Deck In
A212	Switched Doubler Module (SDM) • Two (2) per instrument with Option 31 (A112. A212) • Figure 6-20 on page 6-41	ND70098-RFB	3-ND70098-RFB	—	—	MS4644B MS4645B MS4647B 31	Covers Off RF Deck In

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (11 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A213	5-20 GHz Doubler Module • One (1) per replacement kit • Two (2) per instrument with Option 31 (A113, A213) • Figure 6-24 on page 6-46	ND70080-RFB	3-64920-1-RFB	—	—	Any Model 31	Covers Off RF Deck Out
A213	5-20 GHz Doubler Module • One (1) per replacement kit • Two (2) per instrument with Option 31 (A113, A213) • Figure 6-24 on page 6-46	3-64920-2-RFB	3-64920-2-RFB	—	—	Any Model 31	Covers Off RF Deck Out
A214	Switched Quadrupler Module (SQM) • One (1) per replacement kit • Two (2) per instrument with Option 31 (A114, A214) • Figure 6-20 on page 6-41	ND70099	3-ND70099	—	—	MS4645B MS4647B 31	Covers Off RF Deck In
A240	Forward Coupler Module • One (1) per replacement kit • Two (2) per instrument with Option 31 (A140, A240) • Figure 6-20 on page 6-41	76535-RFB	3-76535-RFB	—	—	MS4645B MS4647B 31	Covers Off RF Deck In
A241	High Band Transfer Switch (HBTS), 40 GHz • One (1) per replacement kit • With Option 31/32/84/85 • Figure 6-16 on page 6-34 • Figure 6-18 on page 6-37 • Figure 6-21 on page 6-43	ND70092-RFB	3-ND70092-RFB	—	—	MS4642B MS4644B 31/32 84/85	Covers Off RF Deck In
A241	SPDT Switch, 40 GHz • One (1) per replacement kit • With Option 31, 32, 84, 85, 88, 89 • Figure 6-16 on page 6-34 • Figure 6-18 on page 6-37 • Figure 6-21 on page 6-43	—	—	70242-RFB	3-70242-RFB	Any Model 31, 32, 84, 85, 88, 89	Covers Off RF Deck In
A241	High Band Transfer Switch (HBTS), 70 GHz • One (1) per replacement kit • With Option 31/32/84/85 • Figure 6-20 on page 6-41 • Figure 6-22 on page 6-44	—	—	70241-RFB	3-70241-RFB	MS4645B MS4647B 31/32 84/85	Covers Off RF Deck In

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (12 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
A242	SPDT Switch Control PCB Assembly • With Option 31/32/84/85 • Figure 6-16 on page 6-34 • Figure 6-18 on page 6-37 • Figure 6-20 on page 6-41 • Figure 6-21 on page 6-43	ND70926	3-ND70926	—	—	Any Model 31/32 84/85	Covers Off RF Deck In
A243	Low Band Transfer Switch • With Option 32 • Figure 6-21 on page 6-43 • Figure 6-22 on page 6-44	ND70079-RFB	3-ND70079-RFB	—	—	Any Model 32	Covers Off RF Deck In
CB	Carrier Board Assembly • The front-side daughter boards are: SBC, SO-DIMM (2 each), PMC-USB, and A8 GPIB PCBs. • The back-side daughter board is the GPU PCB. • Figure 6-5 on page 6-22	ND73874-RFB	3-ND73874-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
GPU	Graphics Processor Unit (GPU) PCB Assembly • With heatsink • Mounts on back side of the Carrier Board Assembly • Figure 6-6 on page 6-23	ND73876-RFB	—	—	—	Any Model Any Option	Covers Off Digital PCBs
GPU	Graphics Processor Unit (GPU) PCB Assembly • For system with S/N 1426554 and above • With heatsink • Mounts on back side of the Carrier Board Assembly • Figure 6-6 on page 6-23	ND81252-RFB	3-ND81252-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
MB1	Motherboard 1 (MB1) PCB Assembly • Vertically mounted in the digital PCB bay and connectors project into the Analog Module PCB bay. • Figure 6-31 on page 6-60 • Figure 6-36 on page 6-67	ND80355	3-ND80355	—	—	Any Model Any Option	Covers Off Internal Part Motherboa rd
MB2	Motherboard 2 (MB2) PCB Assembly • For VNA serial numbers 1506634 and above (including 1450614 and 1450617). • Figure 6-3 on page 6-19 • Figure 6-32 on page 6-61 • Figure 6-33 on page 6-63	ND81312-RFB	3-ND81312-RFB	—	—	Any Model Any Option	Covers Off Internal Part Motherboa rd

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (13 of 14)

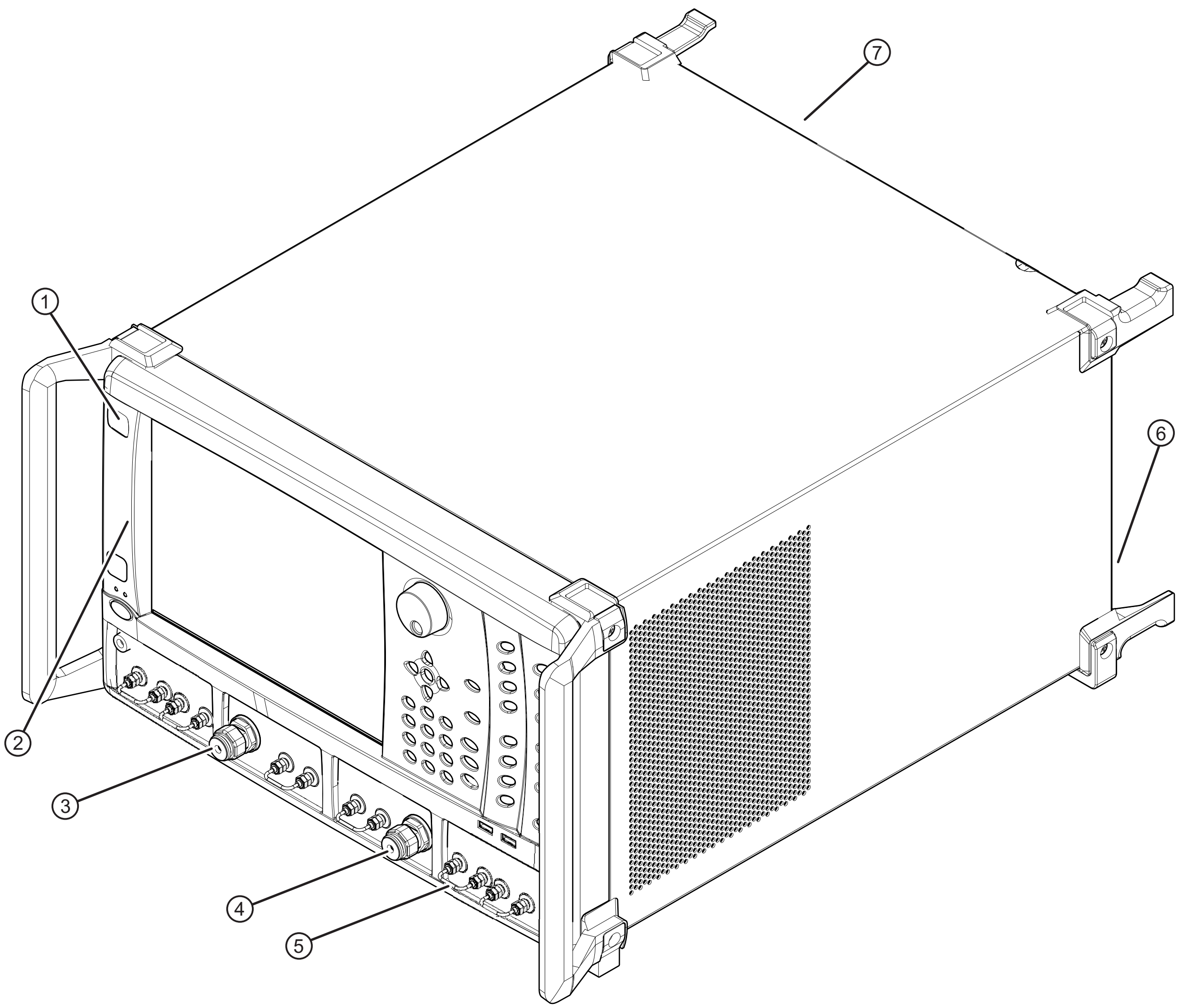
ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
MB2	Motherboard 2 (MB2) PCB Assembly • For VNA serial numbers 1506633 and below (excluding 1450614 and 1450617). • Figure 6-3 on page 6-19 • Figure 6-34 on page 6-64 • Figure 6-35 on page 6-66	ND80356	—	—	—	Any Model Any Option	Covers Off Internal Part Motherboa rd
SBC	Single Board Computer (SBC) • For VNA serial numbers below 1546700 • With heatsink • Mounts on front side of the Carrier Board. • Figure 6-5 on page 6-22	ND75953-RFB	—	—	—	Any Model Any Option	Covers Off Digital PCBs
SBC	Single Board Computer (SBC) • For VNA serial numbers 1546700 and above • With heatsink • Mounts on front side of the Carrier Board. • Figure 6-5 on page 6-22	ND82106-RFB	3-ND82106-RFB	—	—	Any Model Any Option	Covers Off Digital PCBs
SO DIMM	Small Outline Dual In-line Memory Module (SODIMM) • Mounts on the front side of the SBC. • Two (2) per instrument • One (1) per replacement kit • Figure 6-5 on page 6-22	—	—	3-2000-1671	3-2000-1671	Any Model Any Option	Covers Off Digital PCBs
SSD	Solid State Drive Assembly (SSD) • For VNA serial numbers below 1546700 • Plug and play with VectorStar Application Software installed. • For replacement purposes only. • Figure 6-27 on page 6-52	ND75952	—	—	—	Any Model Any Option	Covers On External Part
SSD	Solid State Drive Assembly (SSD) • For VNA serial numbers greater than or equal to 1546700 and less than 1743847 • Plug and play with VectorStar Application Software installed. • For replacement purposes only. • Figure 6-27 on page 6-52	ND82107	3-ND82107	—	—	Any Model Any Option	Covers On External Part

Table 6-2. Replacement Parts – Sorted by Engineering Reference Number (ERN) (14 of 14)

ERN	Name, Description Location, Reference Figure	RPN	RPN (RoHS)	APN	APN (RoHS)	Model/ Option	Access and General Location
SSD	Solid State Drive Assembly (SSD) • For VNA serial numbers greater than 1743846 and less than 2019000 • Plug and play with VectorStar Application Software installed. • For replacement purposes only. • Figure 6-27 on page 6-52		3-ND83689	—	—	Any Model Any Option	Covers On External Part
SSD	Solid State Drive Assembly (SSD) • For VNA serial numbers greater than 2019000 • Plug and play with VectorStar Application Software installed. • For replacement purposes only. • Figure 6-27 on page 6-52		3-ND86792	—	—	Any Model Any Option	Covers On External Part

6-3 External Replaceable Parts

With the exception of the Front Panel assembly, the parts illustrated in Figure 6-1 are replaceable without opening the instrument. The front panel can be replaced by simply removing the outer cover and six mounting screws.

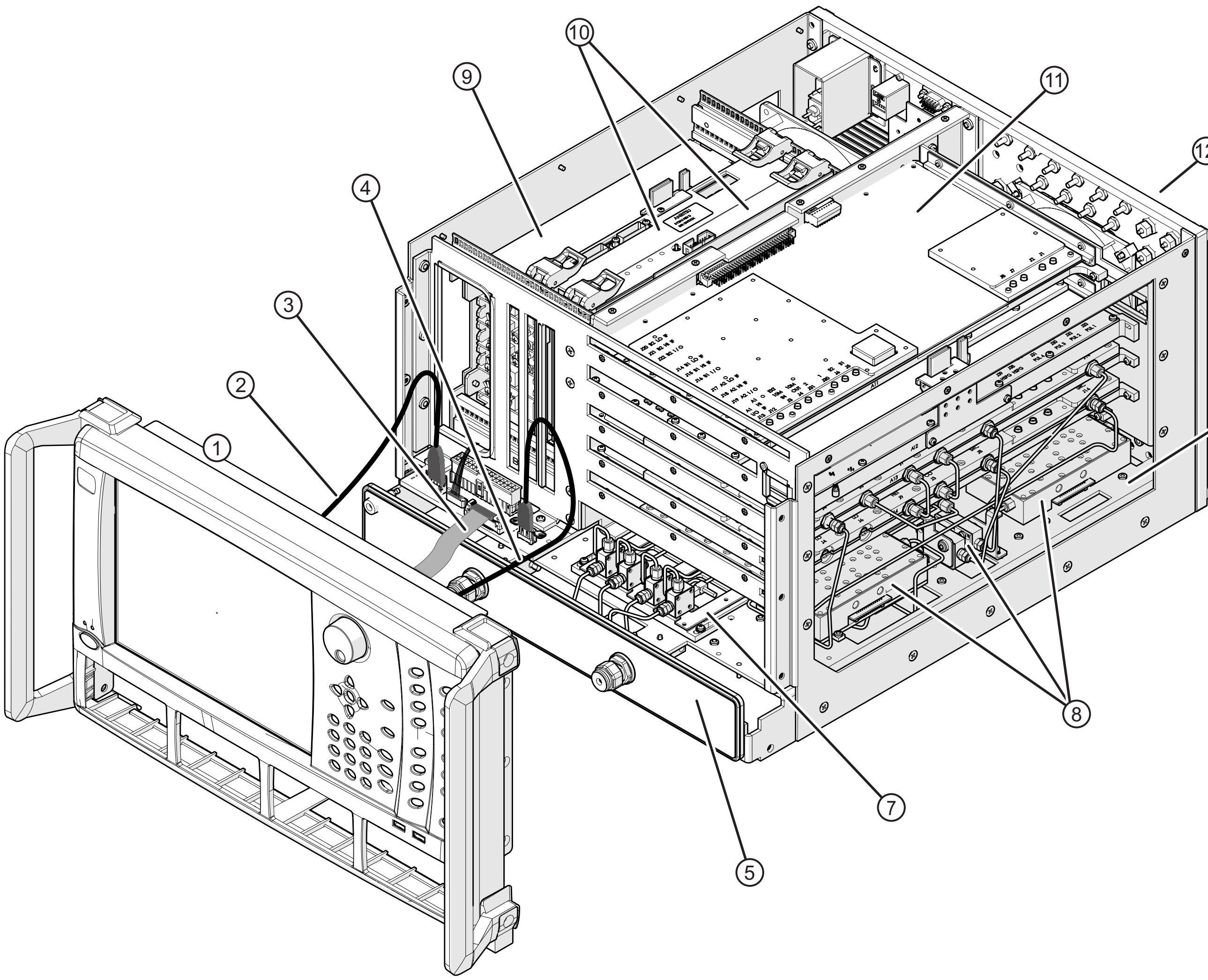


1. Model Identity Label – 3-60124-XX	5. Direct Access Loops
2. Front Panel Assembly	6. Rear Panel Loops – (hidden)
3. Test Port 1 RF Adapter	7. Solid State Drive (SSD) – (hidden)
4. Test Port 2 RF Adapter	

Figure 6-1. External Replaceable Parts

6-4 Chassis View of Internal Assemblies

The drawing in Figure 6-2 shows the location of major components after the covers have been removed and the Front Panel partially detached.



1. Front Panel	**RF Deck (continued)**
Front Panel Cables	7. Sampler/LO Distribution Module Assembly
2. USB cable	8. RF Deck Top Side Modules
3. Ribbon cable	**Top Side Assemblies**
4. HDMI cable	9. Power Supply Module
RF Deck	10. Digital PCB Assemblies
5. RF Deck Front Panel – No options installed	11. Analog Module PCB Assemblies
6. RF Deck inside chassis	12. Rear Panel

Figure 6-2. VNA Major Assemblies

6-5 Digital PCBs

Digital PCB Locations

Figure 6-3 shows the instrument chassis with the covers off and the locations of the Digital PCB Assemblies.

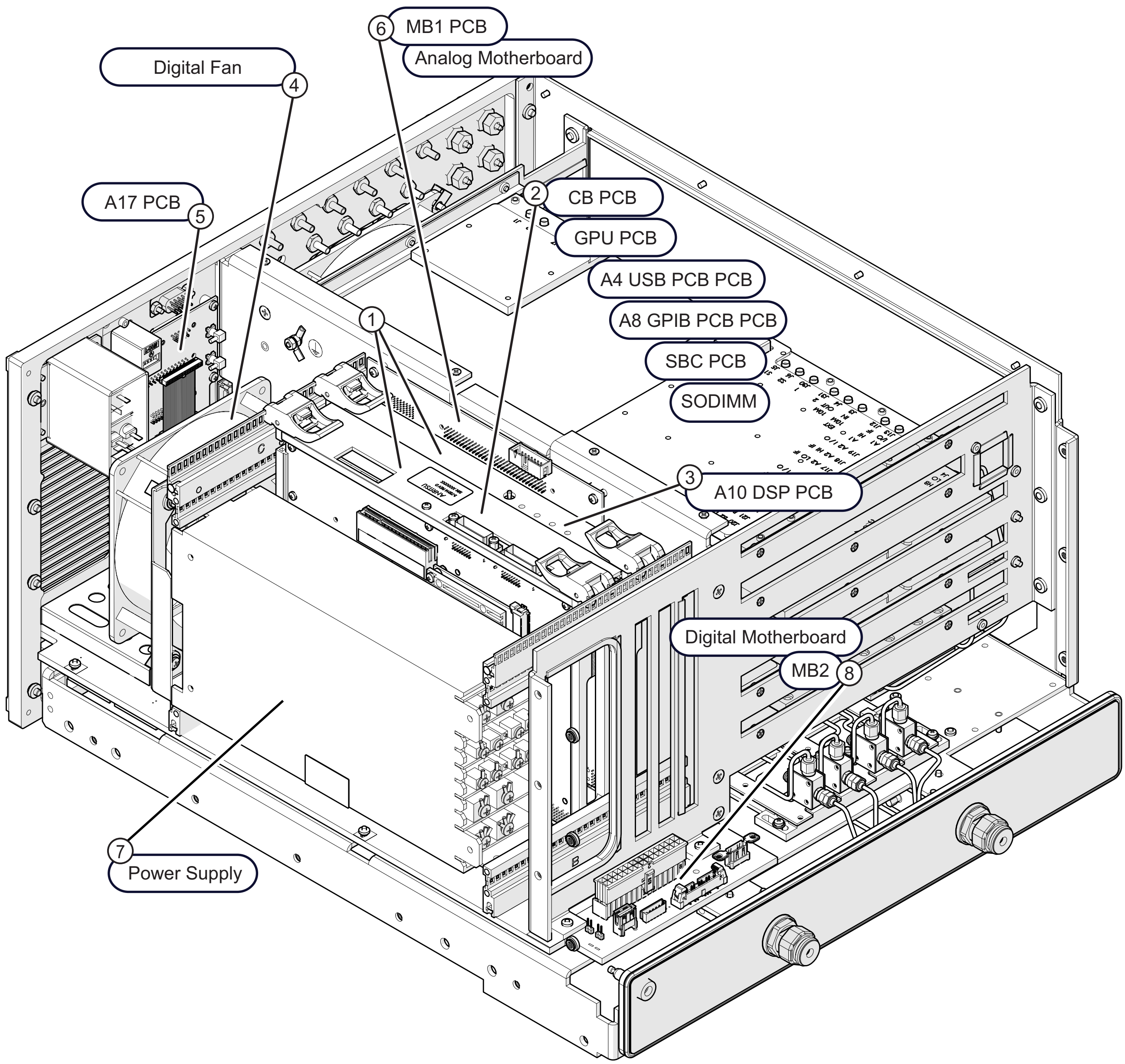


Figure 6-3. Digital PCB Locations (1 of 2)

1. Digital PCBs – PCBs mounted vertically in the left side digital PCB bay to the left of the Power Supply. They seat into the backplane connectors on the horizontally mounted Motherboard 2 PCB Assembly (See number 13) 2. Carrier Board PCB (CB PCB) Assembly Mounted on the CB PCB are: • Graphics Processor Unit (GPU PCB) PCB Assembly – Mounts on back of CB PCB. • A4 USB Controller PCB Assembly – Mounts on front of CB PCB. • A8 GPIB Module PCB Assembly – Mounts on front of CB PCB. • Single Board Computer (SBC PCB) – Mounts on front of CB PCB. • Small Outline Dual In-line Memory Module (SODIMM) – Mounts on the front side of the SBC PCB. Two (2) per instrument. One (1) per replacement kit.	3. A10 Digital Signal Processor PCB Assembly 4. Digital PCB Fan Assembly – With 165 mm cable harness and plug. 5. A17 Rear Panel PCB Assembly – Located inside the Rear Panel Chassis Assembly. Provides connectors for the Serial, External I/O, IEEE 488.2 GPIB, and Dedicated GPIB Ports. 6. Motherboard 1 (MB1) PCB Assembly 7. Power Supply Module and Cable Harnesses 8. MB2 – Motherboard 2 PCB: • ND81312 or 3-ND81312 **or** • ND80356 – 3-80124-3

Figure 6-3. Digital PCB Locations (2 of 2)

On the left side of the instrument in the digital PCB bay are the eight (8) PCB assemblies that can be removed from the top of the unit and comprise the Digital PCB set.

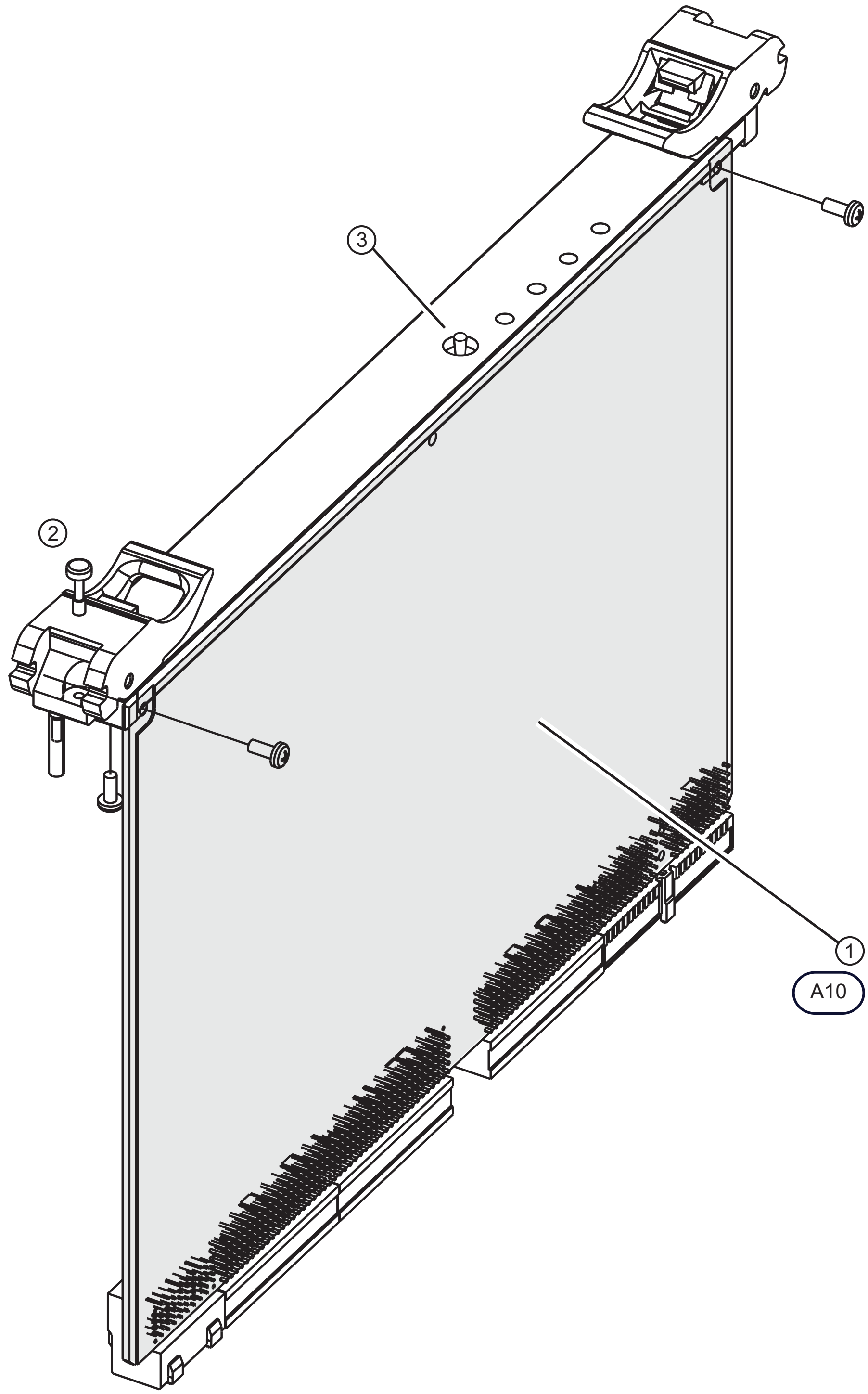
The Digital PCB assemblies are:

- Carrier Board (CB) Assembly
  - Provides front side mounting side for the SBC, A4 USB, A8 GPIB PCBs.
  - Provides back side mounting for the GPU PCB.
- Single Board Computer (SBC) PCB Assembly
  - Mounted on the front side of the CB PCB.
- A4 USB Controller PCB Assembly
  - Mounted on the front side of the CB PCB.
- A8 GPIB Module (A8) PCB Assembly
  - Mounted on the front side of the CB PCB.
- Small Outline Dual Inline Memory Module (SODIMM) PCB – 2 each
  - The two SODIMMs are mounted on the SBC PCB.
- Graphics Processor Unit PCB Assembly
  - Mounted on the back side of the CB PCB.
- A10 Digital Signal Processor (DSP) Module PCB Assembly
  - Described in Section “A10 DSP Module Assembly” on page 6-21 above.

The basic removal and replacement procedures are the same for each PCB.

A10 DSP Module Assembly

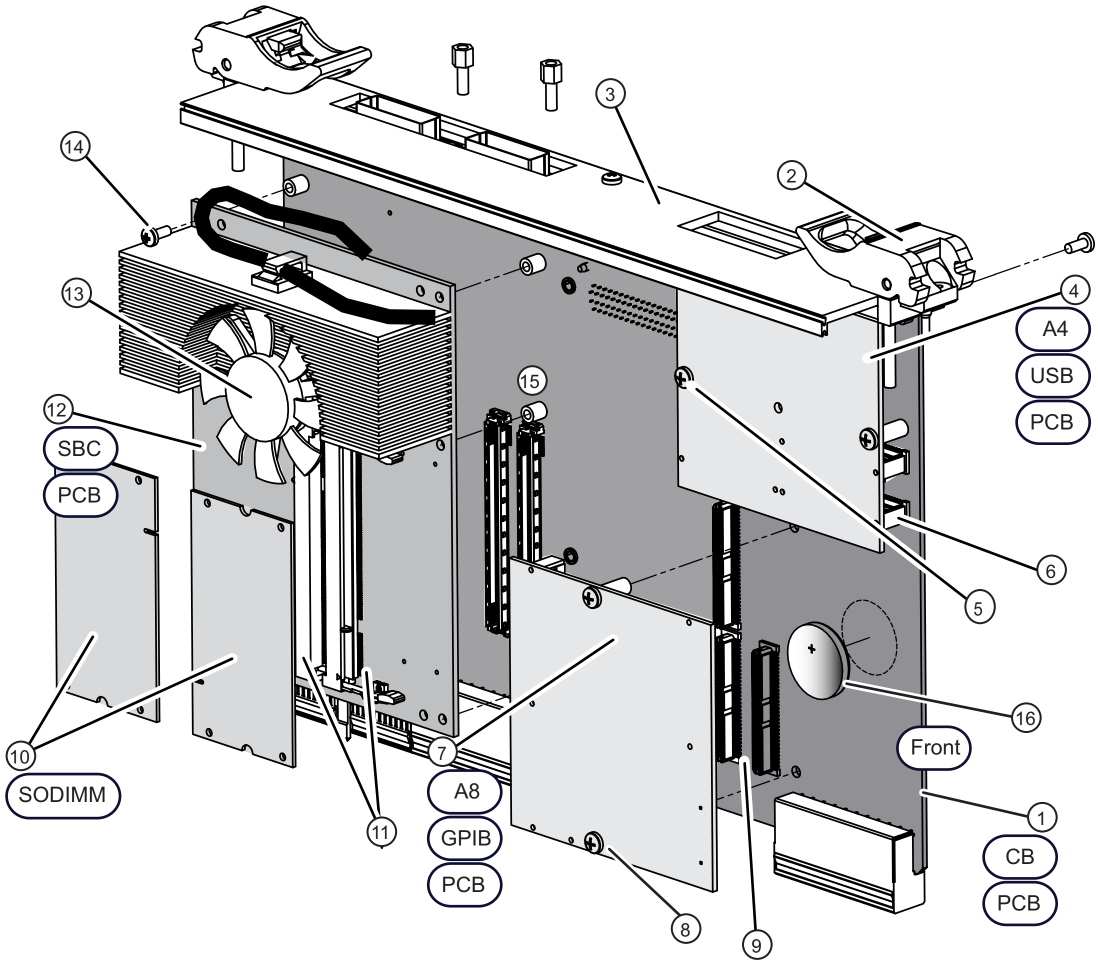
The A10 DSP Module Assembly mounts in the right-side digital bay slot closest to the Motherboard 1 PCB Assembly.



1. A10 Digital Signal Processor (DSP) Module PCB Assembly	2. PCB Ejector Handles and mounting hardware. 3. SW1 Reset Switch

Figure 6-4. A10 DSP Module Assembly

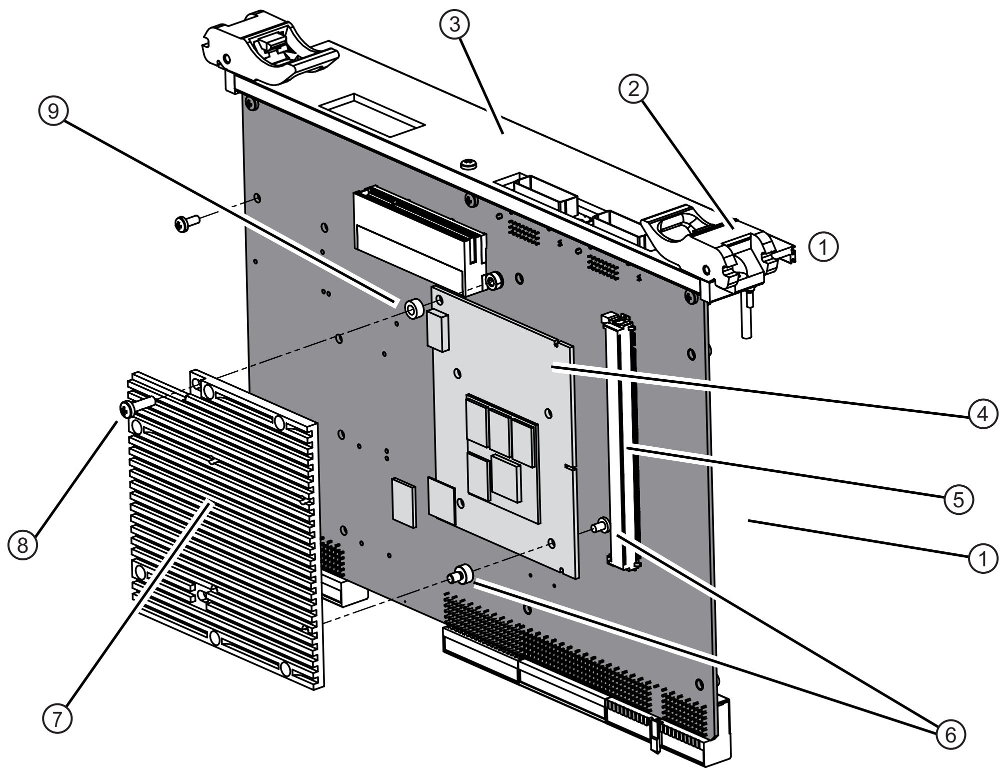
Carrier Board Assembly – Front Side



1. Carrier Board Assembly	10. Small Outline Dual In-line Memory Module (SODIMM)
2. Carrier Board Ejector Handles	• Two (2) SODIMMs per instrument
3. Carrier Board Front Panel Connectors and LEDs	11. Connectors for SODIMMs on SBC PCB, one (1) per SODIMM, two (2) per SBC PCB
4. A4 USB Controller PCB Assembly	12. Single Board Computer (SBC)
5. USB Controller PCB mounting screws, 2 each	13. SBC heatsink, fan, and fan cable
6. Connectors for USB Controller PCB Assembly on Carrier Board, 2 each	14. SBC mounting screws, 5 each
7. A8 GPIB Module – Mounts on the Carrier Board.	15. Connectors for SBC on Carrier Board, 2 each
8. GPIB Module mounting screws, 2 each	16. Coin Battery 3-633-43
9. Connectors for USB Controller PCB Assembly on Carrier Board, 3 each	

Figure 6-5. A8 Carrier Board Assembly – PCB Front Side

Carrier Board Assembly – Back Side



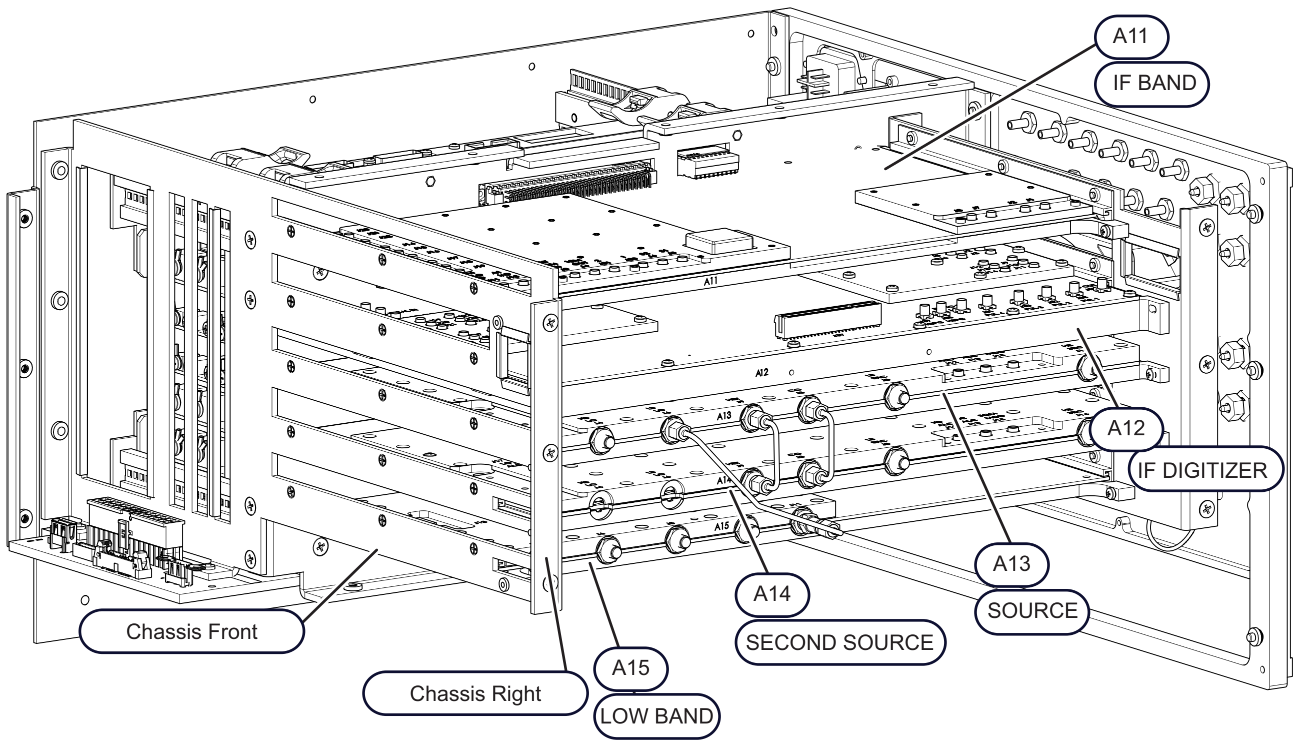
1. Carrier Board Assembly 2. Carrier Board Ejector Handles 3. Carrier Board Front Panel Connectors and LEDs 4. Graphics Processor Unit (GPU) PCB 5. Connector for GPU PCB	6. Heatsink mounting screws and standoffs, from back of GPU PCB to threaded holes in heatsink, 4 each 7. GPU PCB Heatsink – 3-71973 • An included component of the GPU PCB replacement kit. 8. Mounting screws holding Heatsink/GPU PCB assembly to Carrier Board, 2 each 9. Standoff washers between GPU PCB and Heatsink, 2 each

Figure 6-6. Carrier Board Assembly – PCB Back Side

6-6 Analog Module PCBs

This section describes the following analog module assemblies:

- A11 IF Band Module
- A12 Pulse/IF Digitizer (Option 35)
- A13 Source Module
- A14 Second Source Module (Option 31)
- A15 Low Band Receiver Module

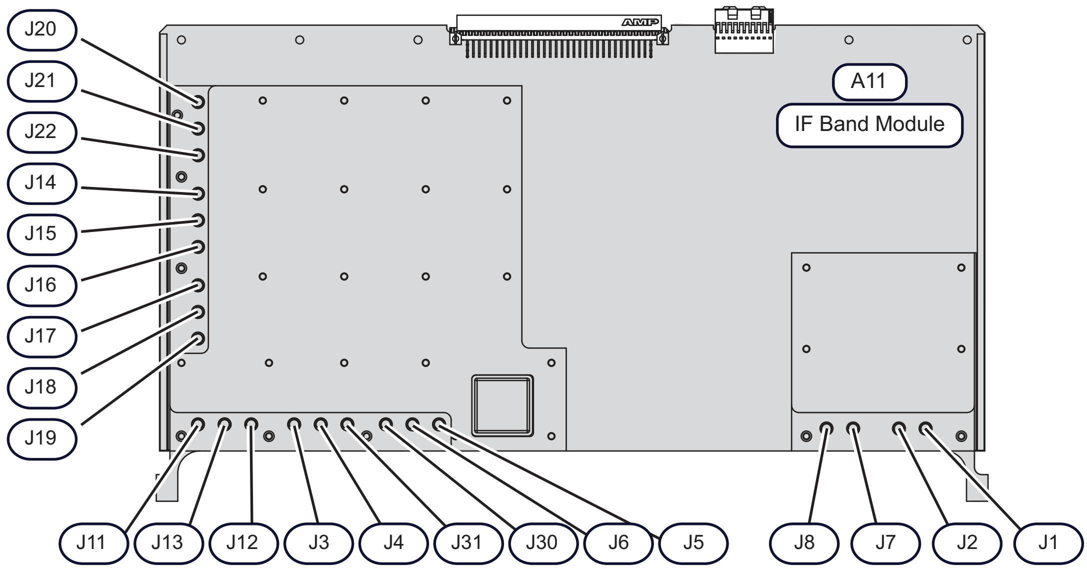


Orientation • Chassis Right – Side panel and some cables removed for clarity. • Chassis Front – Front panel removed for clarity. **Analog Modules** • A11 – IF Band Module	• A12 – IF Digitizer Module (with Option 36, Extended IF Digitizer Memory) • A13 – Source Module • A14 – Second Source Module • A15 – Low Band Receiver Module

Figure 6-7. Analog PCB Assemblies

A11 IF Band Module

Figure 6-8 shows the port and connector locations for the A11 module.



All A11 module cable connectors are MCX.

Left Side Connectors (top to bottom)

1. J20 – B2 LO IF – Low Band b2 IF In
   Connects to A15 module J22.
2. J21 – B2 HI IF – High Band b2 IF In
   Connects to the A102 Sampler Module rear facing J3. Note that the A100, A101, A102, A103, and A130 modules are located on the RF Deck Top Side and are part of the Sampler/LO Distribution Module Assembly.
3. J22 – B2 I/O – b2 IF In/Out.
   Connects to rear panel IF I/O b2.
4. J14 – B1 LO IF – Low Band b1 IF In.
   Connects to A15 module J16.
5. J15 – B1 HI IF – High Band b1 IF In.
   Connects to A100 Sampler Module rear facing J3.
6. J16 – B1 I/O – b1 IF In/Out.
   Connects to rear panel IF I/O b1.
7. J17 – A2 LO IF – Low Band a2 IF In.
   Connects to A15 module J20.
8. J18 – A2 HI IF – High Band a2 IF In.
   Connects to A103 Sampler Module rear facing J3.
9. J19 – A2 I/O – a2 IF In/Out.
   Connects to rear panel IF I/O a2.

Bottom Left Connectors (left to right)

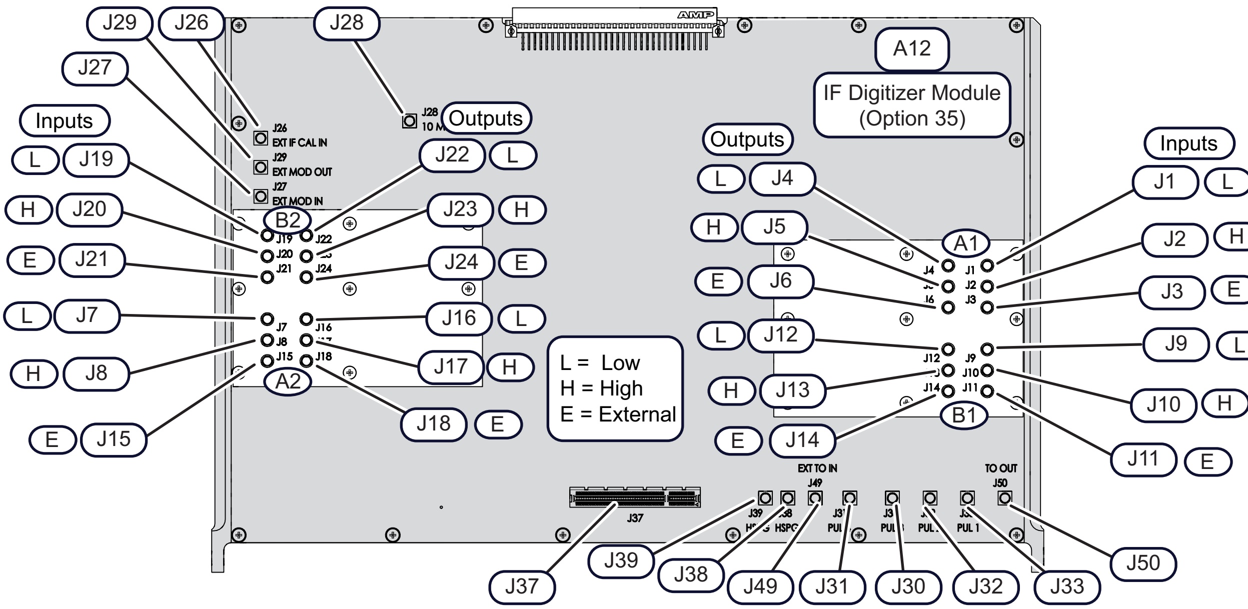
10. J11 – A1 LO IF – Low Band a1 IF In.
    Connects to A15 module J13.
11. J13 – A1 I/O – a1 IF In/Out.
    Connects to rear panel IF I/O a1.
12. J12 – A1 HI IF – High Band a1 IF In.
    Connects to the A101 Sampler Module rear facing J3.
13. J3 – EXT 10M IN – External 10 MHz Reference In.
    Connects to rear panel External 10 MHz Input.
14. J4 – EXT 10M OUT – External 10 MHz Reference Out.
    Connects to rear panel External 10 MHz Output.
15. J31 – REF 2 – 10 MHz Reference Out.
    Not used.
16. J30 – REF 1 – 10 MHz Reference Out.
    Connects to A12 module connector J28.
17. J6 – REF S2 – 10 MHz Reference Out.
    Connects to A14 module connector J10.
18. J5 – REF S1 – 10 MHz Reference Out.
    Connects to A13 module connector J10.

Bottom Right Connectors (left to right)

19. J8 – External A/D Clock Out. Not used.
20. J7 – External A/D Clock In. Not used.
21. J2 – External Analog In 2.
    Connects to rear panel External Analog Input 2.
22. J1 – External Analog In 1.
    Connects to rear panel External Analog Input 1.

Figure 6-8. A11 IF Band Module – Connectors

A12 IF Digitizer Module (Option 35)



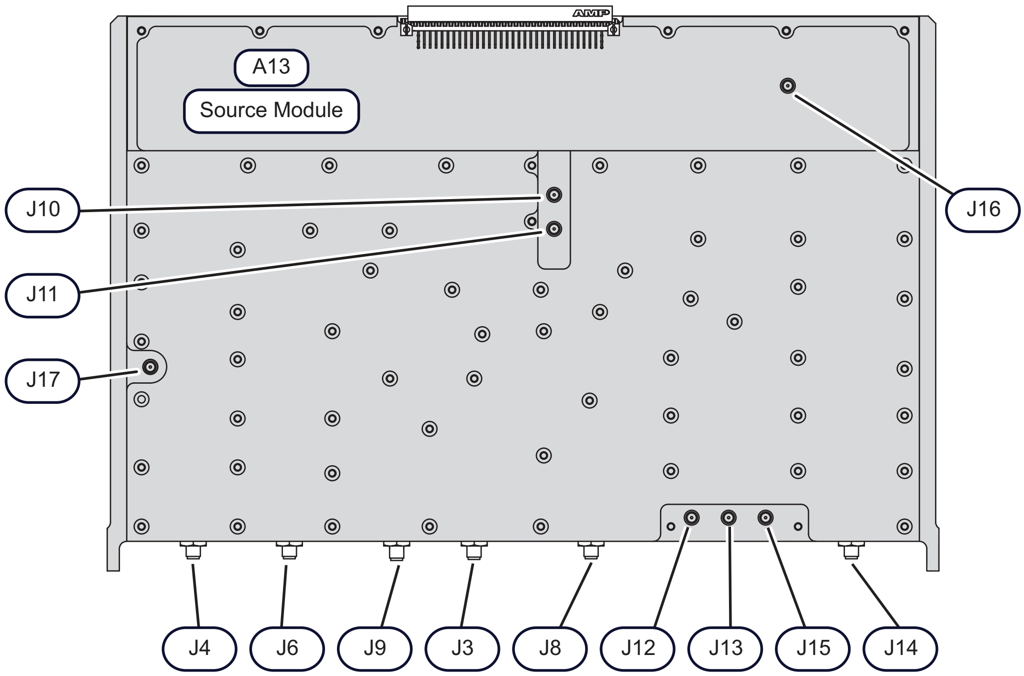
All A12 module cable connectors are MCX except for J37.

Left Side Connectors (top to bottom)		**Right Side Connectors (top to bottom)**	
J28	10 MHz REF – To A11 module J30	J4	Low A1 Output – To A11 module J11
J26	EXT IF CAL IN – (Unused)	J5	High A1 Output – To A11 module J12
J29	EXT MOD OUT – (Unused)	J6	External A1 Output – To A11 module J13
J27	EXT MOD IN – (Unused)	J12	Low B1 Output – To A11 module J14
J19	Low B2 Input – To A15 module J22	J13	High B1 Output – To A11 module J15
J20	High B2 Input – To A102 module J3	J14	External B1 Output – To A11 module J16
J21	External B2 Input – To Rear Panel External B2.	J1	Low A1 Input – To A15 module J3
J7	Low A2 Input – To A15 module J20	J2	High A1 Input – To A101 module J3
J8	High A2 Input – To A103 module J3	J3	External A1 Input – To Rear Panel External A1.
J15	External A2 Input – To Rear Panel External A2.	J9	Low B1 Input – To A15 module J16
J22	Low B2 Output – To A11 module J20	J10	High B1 Input – To A100 module J3
J23	High B2 Output – To A11 module J21	J11	External B1 Input – To Rear Panel External B1.
J24	External B2 Output – To A11 module J24	**Top Front Connectors (left to right)**	
J16	Low A2 Output – To A11 module J17	J37	PCIe Cable Connector – To Carrier Board J25
J17	High A2 Output – To A11 module J18	J39	HSPG – (Unused)
J18	External A2 Output – To A11 module J19	J38	HSPG – (Unused)
		J49	EXT TO IN – To Rear Panel Pulse Sync In.
		J31	PUL 4 – To Rear Panel Pulse Gen 4.
		J30	PUL 3 – To Rear Panel Pulse Gen 3.
		J32	PUL 2 – To Rear Panel Pulse Gen 2.
		J33	PUL 1 – To Rear Panel Pulse Gen 1.
		J50	TO OUT – To Rear Panel Pulse Sync Out.

Figure 6-9. A12 IF Digitizer Module (Option 35) – Connectors

A13 Source Module

Figure 6-10 shows the port and connector locations for the A13 module.



A13 Source Module Connectors

J3 – Common Offset Out – Only used with Option 31; Terminated when unused.

J4 – High Band LO Out, to A111 LO Distribution Module

J6 – Low Band LO Out, to A11 IF Band Module

J8 – Low Band Source Out, to A115 Low Band Transfer Switch

J9 – HET Out – Only used with Option 31; terminated when unused.

J10 – 10 MHz Reference In, from A11 IF Band Module

J11 – DDS Clock Out – Only used with Option 31; To A14 Second Source Module

J12 – High Band ALC Detector In, from A18 RF Component Control PCB

J13 – External ALC Detector – Only used with Option 8x or 53.

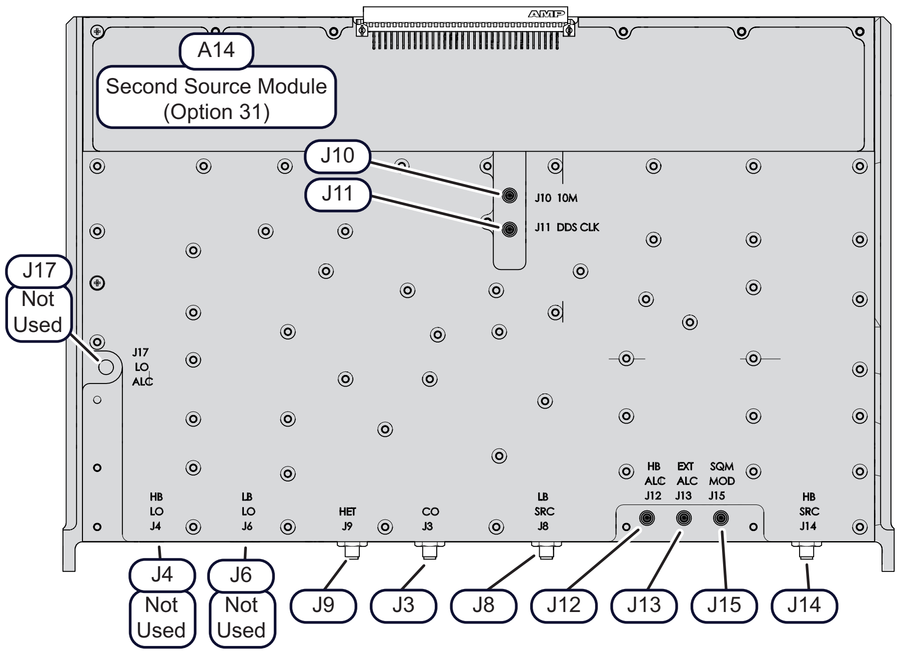
J14 – High Band Source Out, to A113 5-20 GHz Doubler Module

J15 – SQM Modulator Drive Out, to A114 SQM

J17 – High Band LO ALC Detector In, from A111 LO Module

Figure 6-10. A13 Source Module

A14 Second Source Module (Option 31)

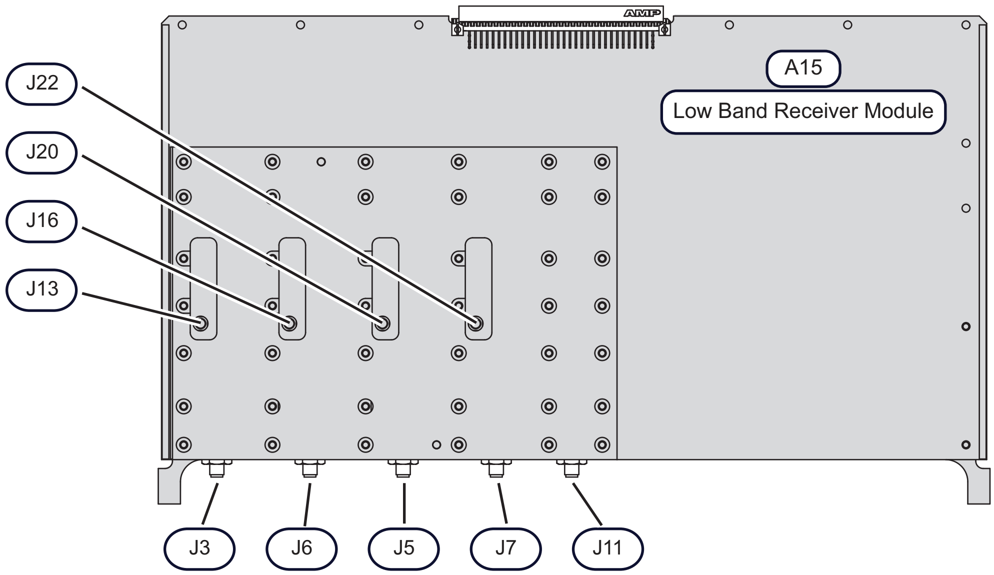


Bottom Connectors (left to right)		Left Side and Upper Connectors	
J4	High Band LO1 Output – Not used	J10	10 MHz Reference Input Connects to A11 module J6
J6	Low band LO1 Output – Not used	J11	DDS Clock Input From A13 Source Module, J11
J9	Common Het Input From A13 Source Module, J9	J17	HB LO ALC Input – Not used
J3	Common Offset Input From A13 Source Module, J3		
J8	Low Band Source Output Connects to A115 Low Band Transfer Switch Module J1 on RF Deck Top Side.		
J12	HB Src ALC Input Connects to A18 PCB J7 on RF Deck Bottom Side.		
J13	External ALC Input Only used with Option 80/81 or 53. Connects to Rear Panel External ALC connector.		
J15	J15 – SQM Modulator Drive Output Only used on MS4645B / MS4647B VNAs. Connects to A18 PCB J12.		
J14	High Band Source Output Connects to A113 5-20 GHz Doubler Module J1 on RF Deck Top Side.		

Figure 6-11. A14 Second Source Module (Option 31) – Connectors

A15 Low Band Receiver Module

Figure 6-12 shows the port and connector locations for the A15 PCB.

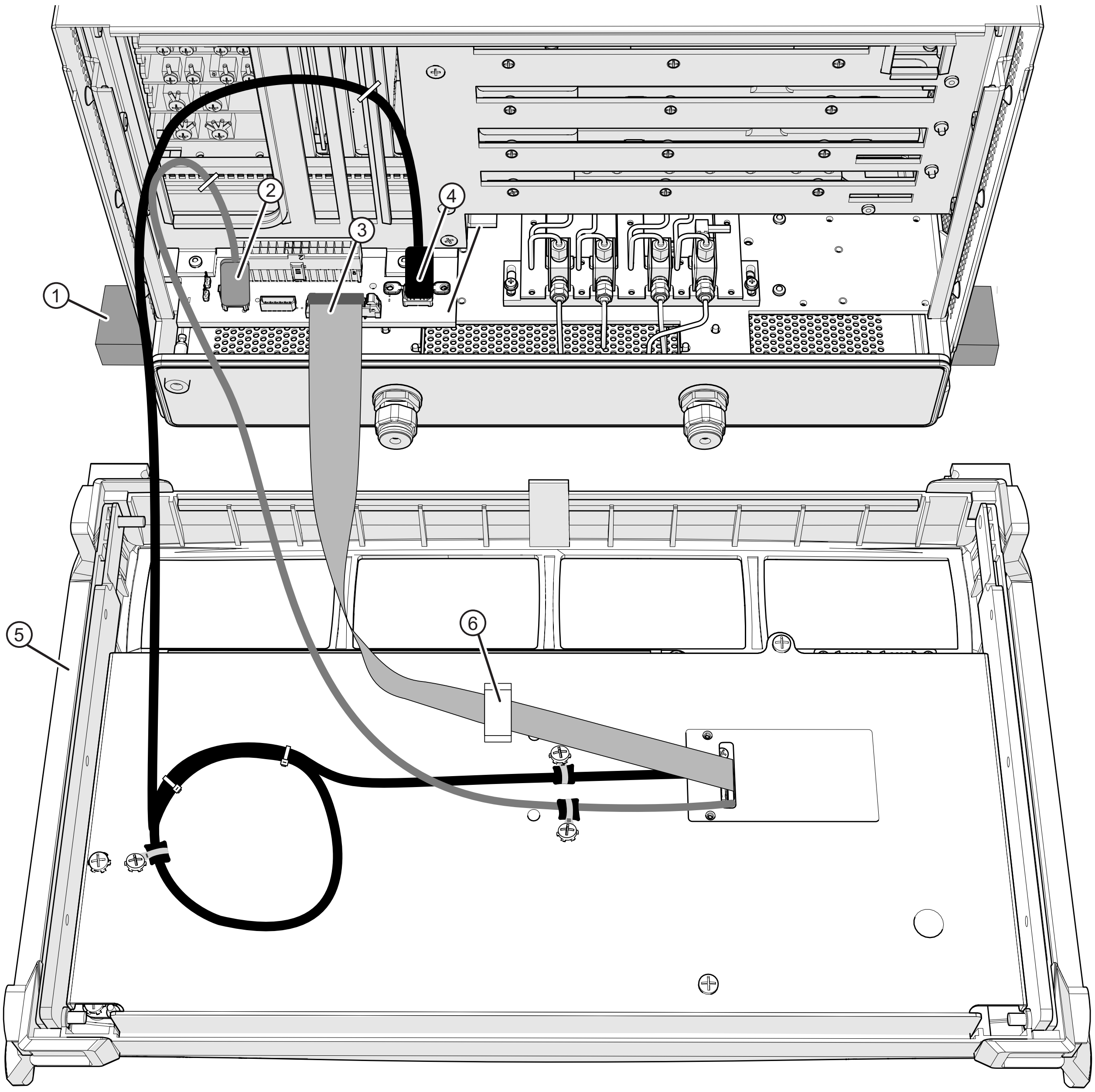


Center Connectors (left to right)	Bottom Connectors (left to right)
1. J13 – Connects to A11 module, J11 (Without Option 35) (Connects to A12 module J1 with Option 35).	5. J3 – Connects to rear panel.
2. J16 – Connects to A11 module, J14 (Without Option 35) (Connects to A12 module J9 with Option 35)	6. J6 – Connects to rear panel.
3. J20 – Connects to A11 module, J17 (Without Option 35) (Connects to A12 module J7 with Option 35)	7. J5 – Connects to rear panel.
4. J22 – Connects to A11 module, J20 (Without Option 35) (Connects to A12 module J19 with Option 35)	8. J7 – Connects to rear panel.
	9. J11 – Connects to A13 module, J6.

Figure 6-12. A15 Low Band Receiver Module – Connectors

6-7 Front Panel and Connections

Front Panel Assembly



1. Spacer (plastic or wood) provides clearance for RF Deck underside modules, loops, and connectors. **Note:** Connector locations on MB2 vary depending on whether MB2 has ring lug power supply connections or a P94 power supply connection. 2. MB2 PCB P63 USB Type A connector with USB cable to Front Panel USB Type B J22 connector. 3. MB2 PCB P61 Power/Signal Ribbon Connector with ribbon cable to Front Panel J6 connector.	4. MB2 PCB HDMI connector with flexible-head HDMI cable to Front Panel HDMI connector. (**Note:** Connector is labeled P62 on MB2 with ring lug power supply connections. It is labeled P97 on MB2 with P94 power supply connector.) 5. Front Panel Assembly – Face down with rear connectors 6. Adhesive-mount ribbon cable clamp. Lift clamp latch to release cable.

Figure 6-13. Front Panel Assembly: Cable Connections to MB2 PCB

6-8 RF Deck – Overview

Servicing RF Deck components requires removing the External Cover and the Internal Top Cover, and usually the Front Panel. The RF Deck has different configurations depending on the VNA model and the installed options. Each configuration changes the installed modules, connectors, and cables. The combinations are:

- MS4642B 20 GHz VNA – Standard No Options, Option 51, Option 61, Option 62 Option 82/83/84/85
- MS4644B 40 GHz VNA – Standard No Options, Option 51, Option 61, Option 62 Option 82/83/84/85
- MS4645B 50 GHz VNA – Standard No Options, Option 51, Option 61, Option 62 Option 82/83/84/85
- MS4647B 70 GHz VNA – Standard No Options, Option 51, Option 61, Option 62, Option 80/81/84/85

Option Definitions

- Standard No Options – No loops or attenuators. The instrument only has Test Port 1 and Test Port 2.
- Option 31 – Second Source
- Option 51 – MS464xB-051 – Direct Access Loops
- Option 61 – MS464xB-061 – Active Measurements Suite, with 2 Step Attenuators and Direct Access Loops
- Option 62 – MS464xB-062 – Active Measurements Suite, with 4 Step Attenuators and Direct Access Loops
- Option 82 – MS464xB-082 – Broadband/mmWave option for MS4642B, 44B, and 45B VNAs without Option 51, 61, or 62.
- Option 83 – MS464xB-083 – Broadband/mmWave for MS4642B, 44B, and 45B VNAs with Option 51, 61, or 62
- Option 80 – MS4647B-080 – Broadband/mmWave for MS4647B VNAs without Option 51, 61, or 62.
- Option 81 – MS4647B-081 – Broadband/mmWave for MS4647B VNAs with Option 51, 61, or 62
- Option 84 – MS464xB-084 – Broadband/mmWave for MS4642B, 44B, 45B, and 47B VNAs with Option 31 but without Option 51, 61, or 62
- Option 85 – MS464xB-085 – Broadband/mmWave for MS4642B, 44B, 45B, and 47B VNAs with Option 31 and with Option 51, 61, or 62

Note	To determine the instrument model number, its serial number, and its installed options, consult the Rear Panel label on the Rear Panel left side at center.

Caution	Some of the RF Deck modules form module groups where care must be taken to disassemble the group in the correct sequence until the to-be-replaced module is accessed. Once replaced, the reassembly process must observe strict sequencing to assure the RF connections are correct and that no modules or interconnecting semi-rigid coaxial cables are damaged.

Note	The RF Deck components can be divided into Top Side and Bottom Side components. All Bottom Side components can be replaced while the RF Deck remains in the chassis. All Top Side components can only be accessed if the RF Deck is removed from the chassis.

RF Deck Removal

The RF Deck must be removed from the chassis to service the RF Deck Top Side modules, the Power Supply Module, the Motherboard 2 PCB Assembly, or the Motherboard 1 PCB Assembly. Once removed, it is recommended that the T3545 Test Fixture be installed on the deck to protect the loops and modules. The fixture is described in Section A-2 "T3545 RF Deck Fixture" on page A-1.

If the RF Deck is to be removed, the Front Panel Assembly must be removed.

Note	Some module part numbers vary depending on instrument model number and equipped options. For example, A120 for a MS4642B has a different part number than an A120 for a MS4647B (higher operating frequency). For simplicity of replaceable part identification, not all model/option permutations are illustrated. Only the necessary model/option combinations which identify all possible modules are shown.

6-9 RF Deck – Bottom Side Replaceable Parts

Module Division on the Bottom Side RF Deck

Figure 6-14 shows the division between the front "Port Modules" and the "Rear Modules". Two chapters provide procedures for replacing the modules. Replacement for the Rear Modules are described in Chapter 13, "RF Deck Module Replacement – Rear Modules" Replacement of the Port Modules are described in Chapter 14, "RF Deck Module Replacement – Port Modules".

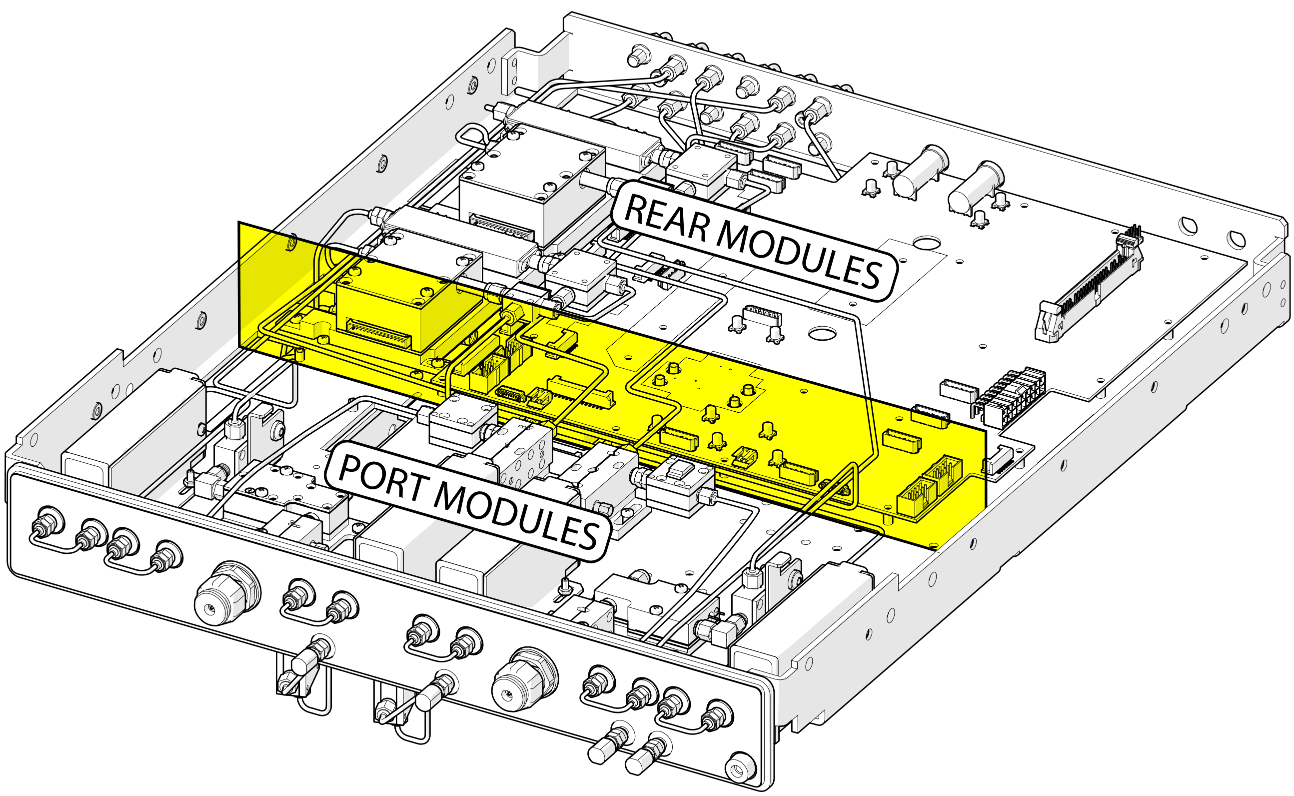
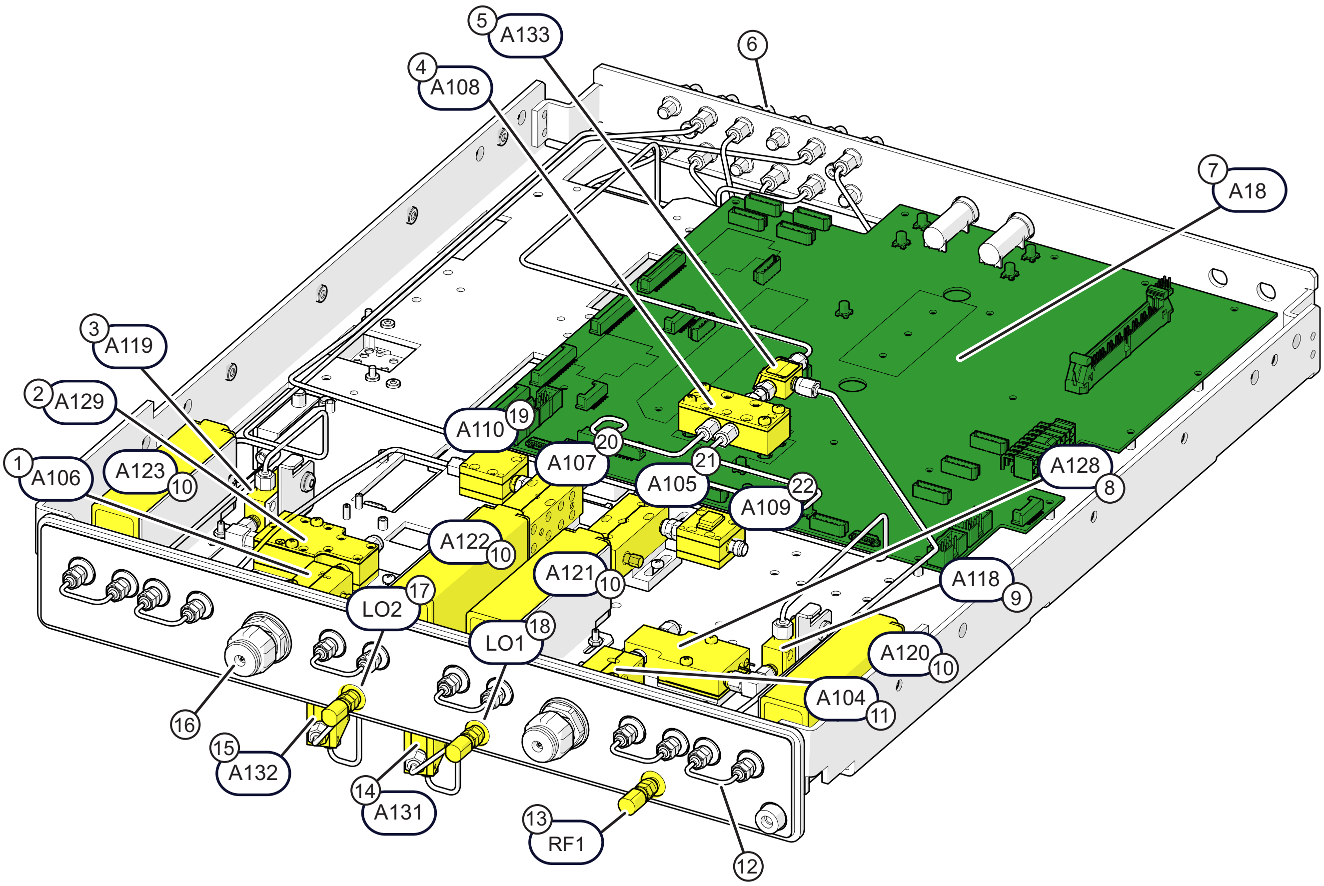


Figure 6-14. RF Deck Division: Port Modules and Rear Modules

Module Identification – Standard Configuration MS4642B

Figure 6-15 shows an MS4642B with Option 62 (Access Loops and Step Attenuators) and Option 83 mmWave Interface. This identifies all possible parts for this model in a standard configuration (no Option 31). For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3



1. **A106** – Test Coupler, 40 GHz	11. **A104** – Test Coupler, 40 GHz
2. **A129** – Diplexer/Bias Tee Module, Port 2, 40 GHz	12. **Front Panel Loop** Cable, K(m) to K(m)
3. **A119** – Low Band Bridge	13. **RF1 Port** for mmWave System
4. **A108** High Band Transfer Switch, 40 GHz	14. **A131** LO Coupler Module
5. **A133** 20-40 GHz RF Coupler Module (Option 83)	15. **A132** LO Coupler Module
6. **Rear Panel Loop** Cable, SMA(m) to SMA(m)	16. **Test Port Adapter** – K Connector
7. **A18** RF Control PCB Assembly	17. **LO2 Port** for mmWave System
8. **A128** – Diplexer/Bias Tee Module, Port 1, 40 GHz	18. **LO1 Port** for mmWave System
9. **A118** – Low Band Bridge	19. **A110** – Port 2 Level Detector, 40 GHz, K Connector
10. **A120** High Band Step Attenuator, Port 1 b1, 40 GHz **A121** High Band Step Attenuator, Port 1 Src, 40 GHz **A122** High Band Step Attenuator, Port 2 Src, 40 GHz **A123** High Band Step Attenuator, Port 2 b2, 40 GHz	20. **A107** – Reference Coupler, 40 GHz 21. **A105** – Reference Coupler, 40 GHz 22. **A109** Port 1 Level Detector, 40 GHz, K Connector

Figure 6-15. MS4642B 20 GHz VNA: Standard Configuration with Option 83

Module Identification – Option 31 Configuration – MS4642B

Figure 6-16 shows an MS4642B with Option 31 (Second Source), Option 62 (Access Loops and Step Attenuators), and Option 85 mmWave Interface. This identifies all possible parts for this model in an Option 31 configuration. For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3

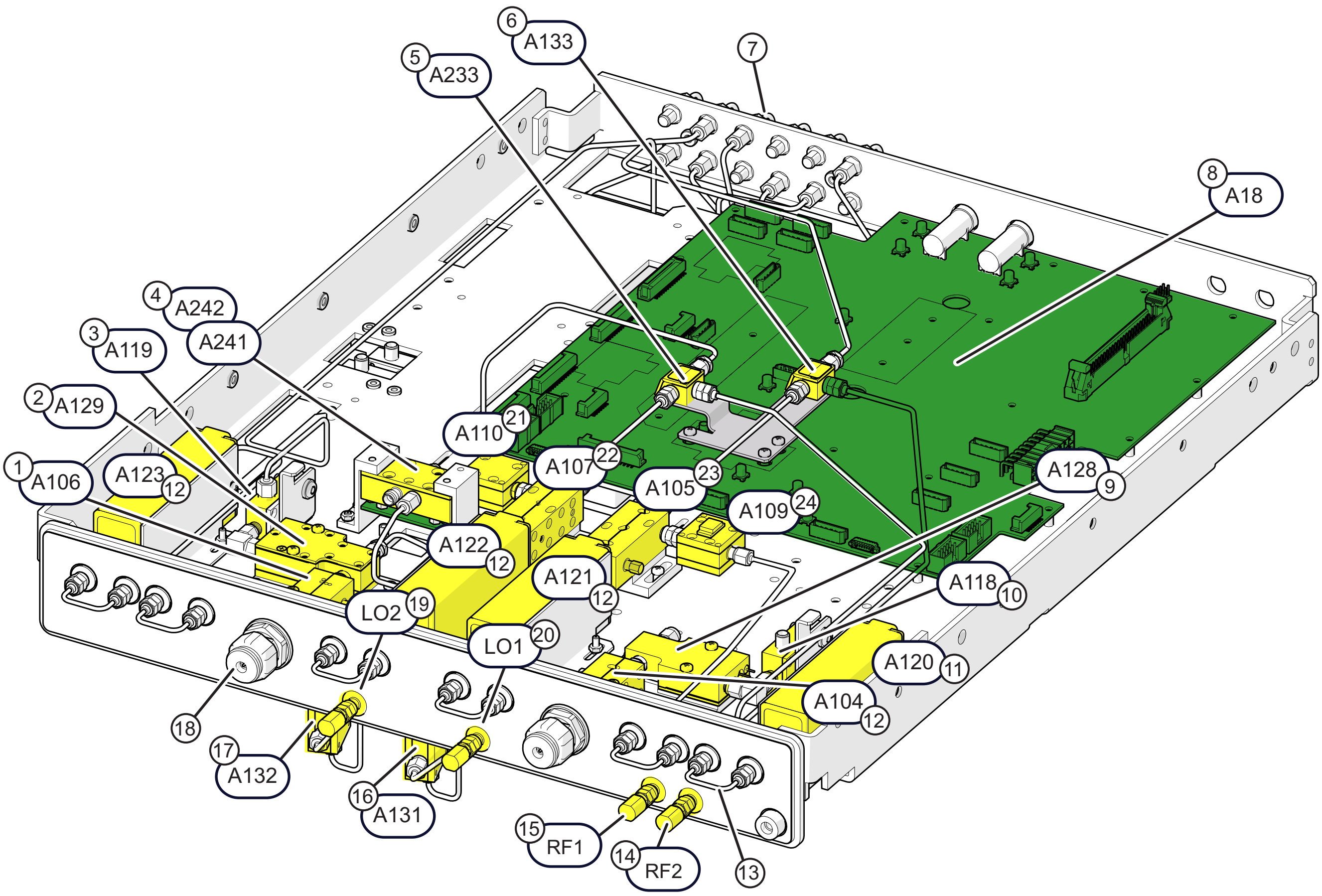


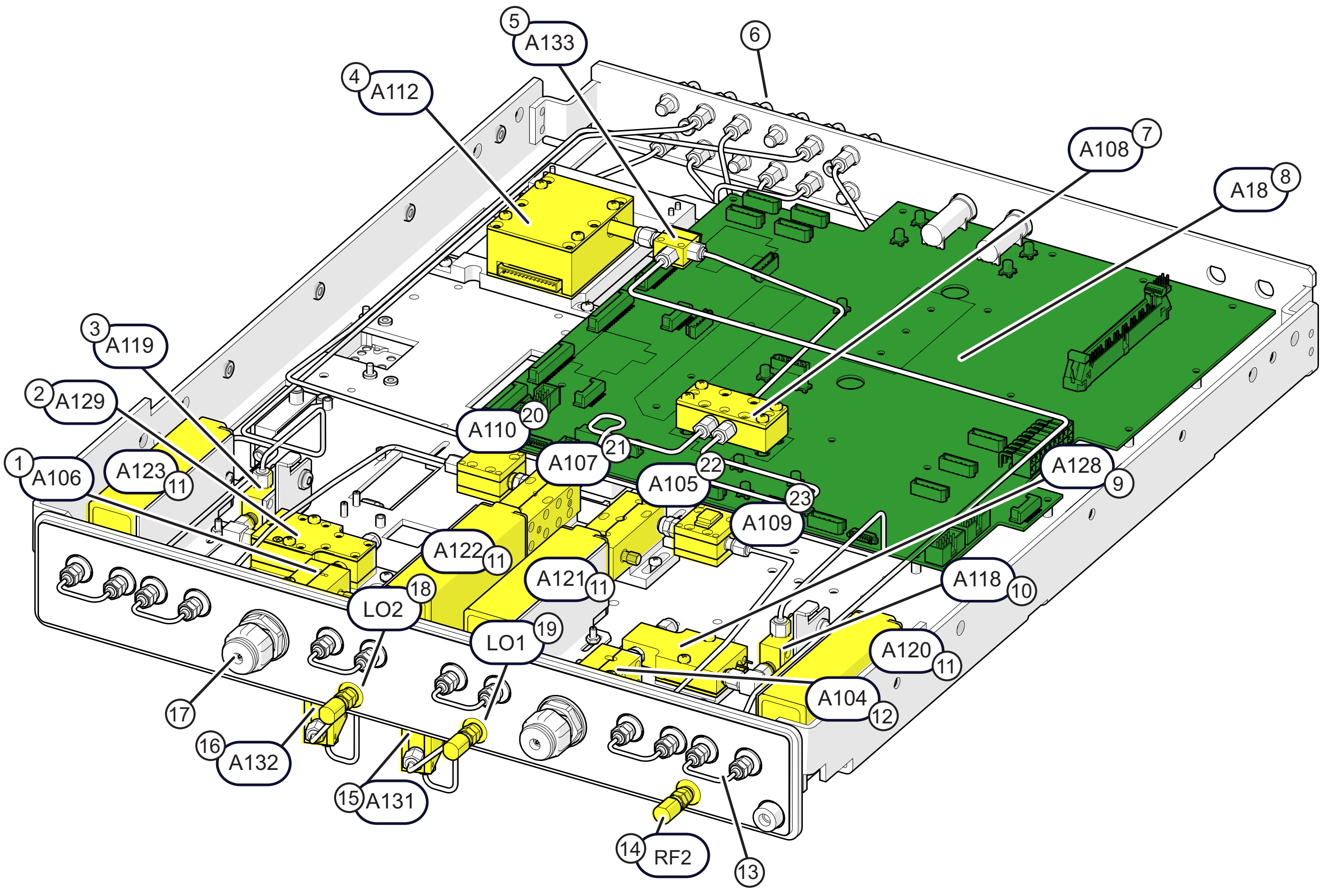
Figure 6-16. MS4642B 20 GHz VNA: Option 31 Configuration with Option 85 (1 of 2)

1. **A106** – Test Coupler, 40 GHz	12. **A104** – Test Coupler, 40 GHz
2. **A129** – Diplexer/Bias Tee Module, Port 2, 40 GHz	13. **Front Panel Loop** Cable, K(m) to K(m)
3. **A119** – Low Band Bridge	14. **RF2 Port** for mmWave System (Option 8x)
4. **A241** High Band Transfer Switch (HBTS), 40 GHz **A242** (Under A241) SPDT Switch Control Assy	15. **RF1 Port** for mmWave System (Option 8x) 16. **A131** LO Coupler Module
5. **A233** 20-40 GHz RF Coupler Module (Option 83)	17. **A132** LO Coupler Module
6. **A133** 20-40 GHz RF Coupler Module (Option 83)	18. **Test Port Adapter** – K Connector
7. **Rear Panel Loop** Cable, SMA(m) to SMA(m)	19. **LO2 Port** for mmWave System
8. **A18** RF Control PCB Assembly	20. **LO1 Port** for mmWave System
9. **A128** – Diplexer/Bias Tee Module, Port 1, 40 GHz	21. **A110** – Port 2 Level Detector, 40 GHz, K Connector
10. **A118** – Low Band Bridge	22. **A107** – Reference Coupler, 40 GHz
11. **A120** High Band Step Attenuator, Port 1 b1, 40 GHz **A121** High Band Step Attenuator, Port 1 Src, 40 GHz **A122** High Band Step Attenuator, Port 2 Src, 40 GHz **A123** High Band Step Attenuator, Port 2 b2, 40 GHz	23. **A105** – Reference Coupler, 40 GHz 24. **A109** Port 1 Level Detector, 40 GHz, K Connector

Figure 6-16. MS4642B 20 GHz VNA: Option 31 Configuration with Option 85 (2 of 2)

Module Identification – Standard Configuration MS4644B

Figure 6-17 shows an MS4644B with Option 62 (Access Loops and Step Attenuators) and Option 83 mmWave Interface. This identifies all possible parts for this model in a standard configuration (no Option 31). For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3



1. **A106** – Test Coupler, 40 GHz
2. **A129** – Diplexer/Bias Tee Module, Port 2, 40 GHz
3. **A119** – Low Band Bridge
4. **A112** Switched Doubler Module (A112 SDM)
5. **A133** 20-40 GHz RF Coupler Module (Option 83)
6. **Rear Panel Loop** Cable, SMA(m) to SMA(m)
7. **A108** High Band Transfer Switch, 40 GHz
8. **A18** RF Control PCB Assembly
9. **A128** – Diplexer/Bias Tee Module, Port 1, 40 GHz
10. **A118** – Low Band Bridge
11. **A120** High Band Step Attenuator, Port 1 b1, 40 GHz
    A121 High Band Step Attenuator, Port 1 Src, 40 GHz
    A122 High Band Step Attenuator, Port 2 Src, 40 GHz
    A123 High Band Step Attenuator, Port 2 b2, 40 GHz
12. **A104** – Test Coupler, 40 GHz
13. **Front Panel Loop** Cable, K(m) to K(m)
14. **RF1 Port** for mmWave System (Option 8x)
15. **A131** LO Coupler Module
16. **A132** LO Coupler Module
17. **Test Port Adapter** – K Connector
18. **LO2 Port** for mmWave System
19. **LO1 Port** for mmWave System
20. **A110** – Port 2 Level Detector, 40 GHz, K Connector
21. **A107** – Reference Coupler, 40 GHz
22. **A105** – Reference Coupler, 40 GHz
23. **A109** Port 1 Level Detector, 40 GHz, K Connector

Figure 6-17. MS4644B 40 GHz VNA: Standard Configuration with Option 83

Module Identification – Option 31 Configuration – MS4644B

Figure 6-18 shows an MS4644B with Option 31 (Second Source), Option 62 (Access Loops and Step Attenuators), and Option 85 mmWave Interface. This identifies all possible parts for this model in an Option 31 configuration. For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3

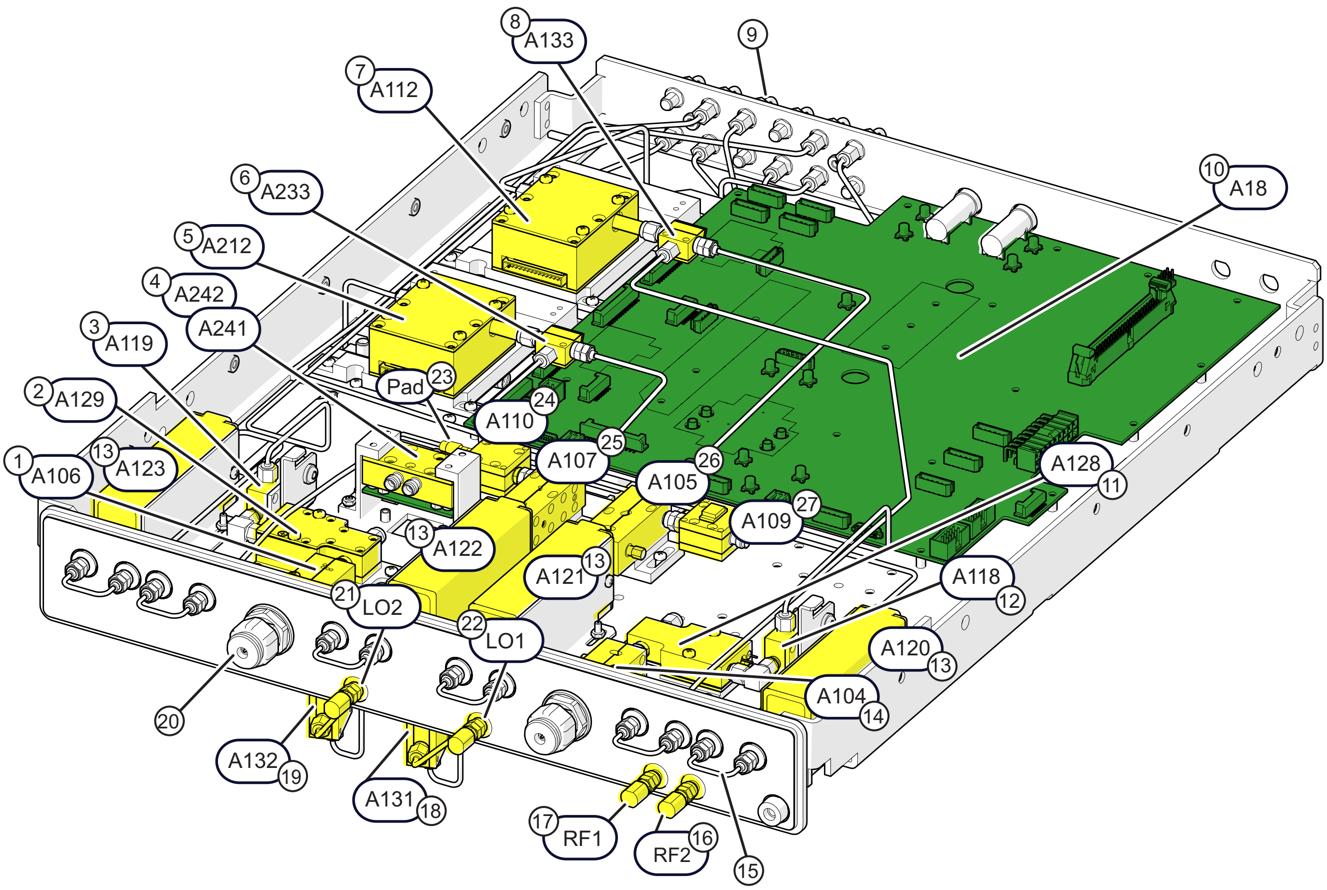


Figure 6-18. MS4644B 40 GHz VNA: Option 31 Configuration with Option 85 (1 of 2)

1. **A106** – Test Coupler, 40 GHz	14. **A104** – Test Coupler, 40 GHz
2. **A129** – Diplexer/Bias Tee Module, Port 2, 40 GHz	15. **Front Panel Loop** Cable, K(m) to K(m)
3. **A119** – Low Band Bridge	16. **RF2 Port** for mmWave System (Option 8x)
4. **A241** High Band Transfer Switch (HBTS), 40 GHz or **A242** (Under A241) SPDT Switch Control Assy	17. **RF1 Port** for mmWave System (Option 8x)
5. **A212** Switched Doubler Module (A112 SDM)	18. **A131** LO Coupler Module
6. **A233** 20-40 GHz RF Coupler Module (Option 83)	19. **A132** LO Coupler Module
7. **A112** Switched Doubler Module (A112 SDM)	20. **Test Port Adapter** – K Connector
8. **A133** 20-40 GHz RF Coupler Module (Option 83)	21. **LO2 Port** for mmWave System
9. **Rear Panel Loop** Cable, SMA(m) to SMA(m)	22. **LO1 Port** for mmWave System
10. **A18** RF Control PCB Assembly	23. **Attenuator for A110:** 10 dB K-Connector *(For MS4644B with Option 84/85/88/89 only)*
11. **A128** – Diplexer/Bias Tee Module, Port 1, 40 GHz	24. **A110** – Port 2 Level Detector, 40 GHz, K Connector
12. **A118** – Low Band Bridge	25. **A107** – Reference Coupler, 40 GHz
13. **A120** High Band Step Attenuator, Port 1 b1, 40 GHz **A121** High Band Step Attenuator, Port 1 Src, 40 GHz **A122** High Band Step Attenuator, Port 2 Src, 40 GHz **A123** High Band Step Attenuator, Port 2 b2, 40 GHz	26. **A105** – Reference Coupler, 40 GHz 27. **A109** Port 1 Level Detector, 40 GHz, K Connector

Figure 6-18. MS4644B 40 GHz VNA: Option 31 Configuration with Option 85 (2 of 2)

Module Identification – Standard Configuration – MS4645B/MS4647B

Figure 6-19 shows an MS4645B/MS4647B with Option 62 (Access Loops and Step Attenuators) and Option 83, mmWave Interface. This identifies all possible parts for these models in a standard configuration (no Option 31). For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3

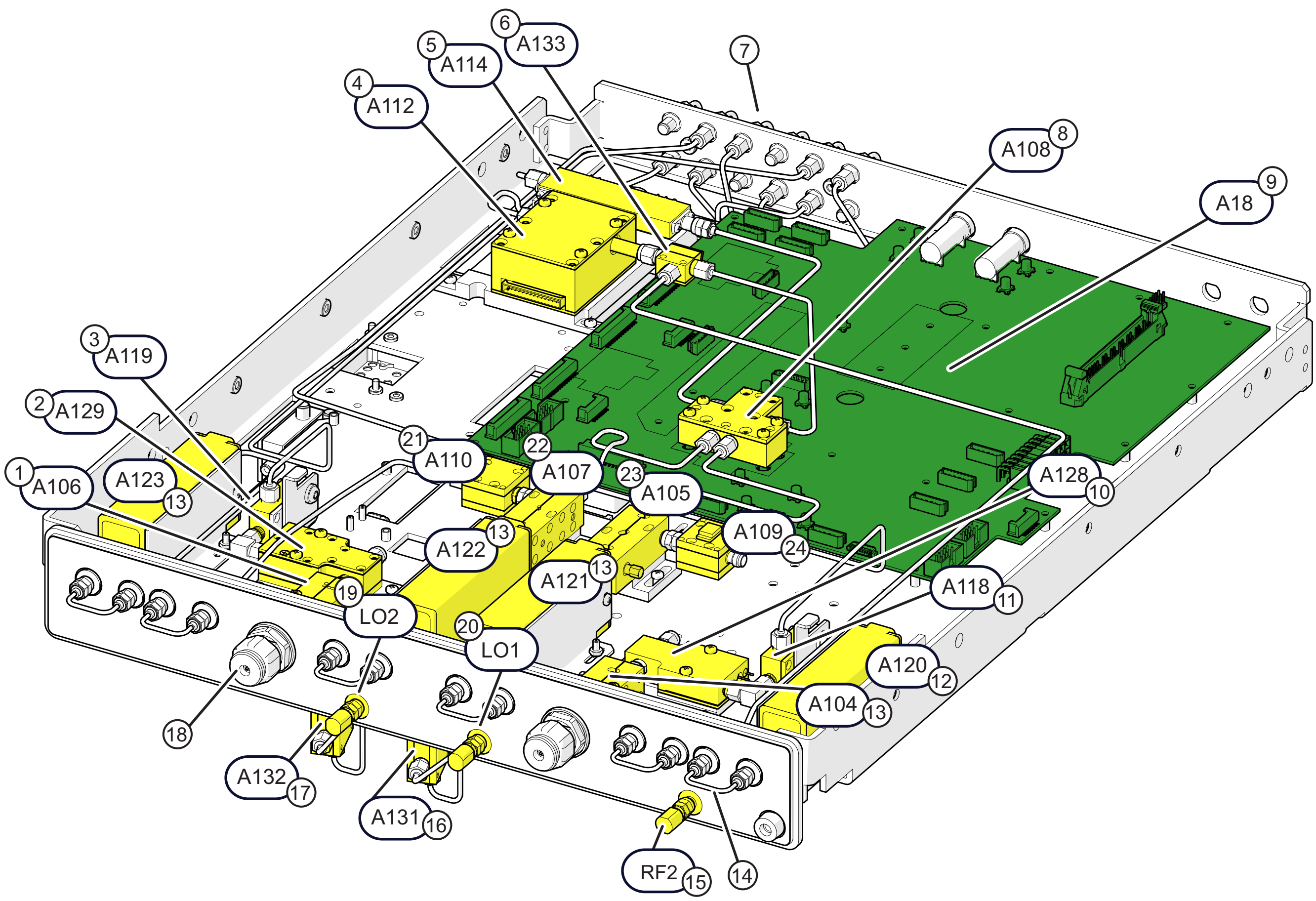


Figure 6-19. MS4645B (50 GHz) / MS4647B (70 GHz): Standard Config. with Option 81 or 83 (1 of 2)

1. **A106** – Test Coupler, 70 GHz	13. **A104** – Test Coupler, 70 GHz
2. **A129** – Diplexer/Bias Tee Module, Port 2, 70 GHz	14. **Front Panel Loop** Cable, V(m) to V(m)
3. **A119** – Low Band Bridge	15. **RF Port** for mmWave System (Option 8x)
4. **A112** Switched Doubler Module	16. **A131** LO Coupler Module
5. **A114** – A114 Switched Quadrupler Module	17. **A132** LO Coupler Module
6. **A133** 20-40 GHz RF Coupler Module (Option 83)	18. **Test Port Adapter** V Connector 34YV50C
7. **Rear Panel Loop** Cable, SMA(m) to SMA(m)	
8. **A108** V Integrated High Band Transfer Switch (VITS), 70 GHz, 40 GHz	19. **LO2 Port** for mmWave System
	20. **LO1 Port** for mmWave System
9. **A18** RF Control PCB Assembly	21. **A110** – Port 2 Level Detector, 70 GHz, V Connector
10. **A128** – Diplexer/Bias Tee Module, Port 1, 70 GHz	22. **A107** – Reference Coupler, 70 GHz
11. **A118** – Low Band Bridge	23. **A105** – Reference Coupler, 70 GHz
12. **A120** High Band Step Attenuator, Port 1 b1, 70 GHz **A121** High Band Step Attenuator, Port 1 Src, 40 GHz **A122** High Band Step Attenuator, Port 2 Src, 40 GHz **A123** High Band Step Attenuator, Port 2 b2, 40 GHz	24. **A109** Port 1 Level Detector, 70 GHz, V Connector

Figure 6-19. MS4645B (50 GHz) / MS4647B (70 GHz): Standard Config. with Option 81 or 83 (2 of 2)

Module Identification – Option 31 Configuration – MS4645B/MS4647B

Figure 6-20 shows an MS4645B/MS4647B with Option 31 (Second Source), Option 62 (Access Loops and Step Attenuators), and Option 85 mmWave Interface. This identifies all possible parts for these models with Option 31. For more comprehensive parts ID covering each model and option, see Section 13-2 “Rear Module Parts Identification” on page 13-2, and Section 14-2 “Port Module Parts Identification” on page 14-3.

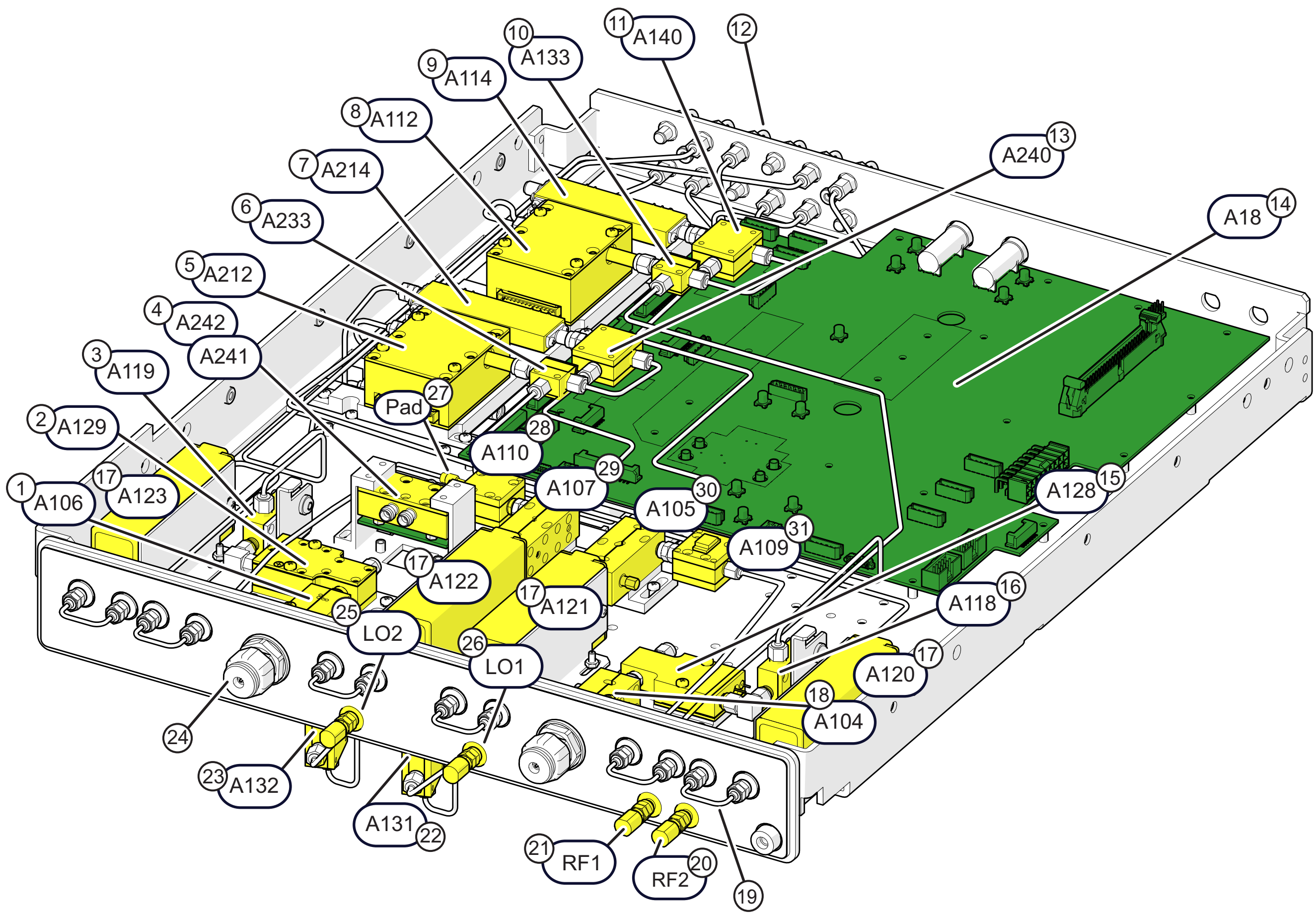


Figure 6-20. MS4645B (50 GHz) / MS4647B (70 GHz): Option 31 with Option 84 or 85 (1 of 2)

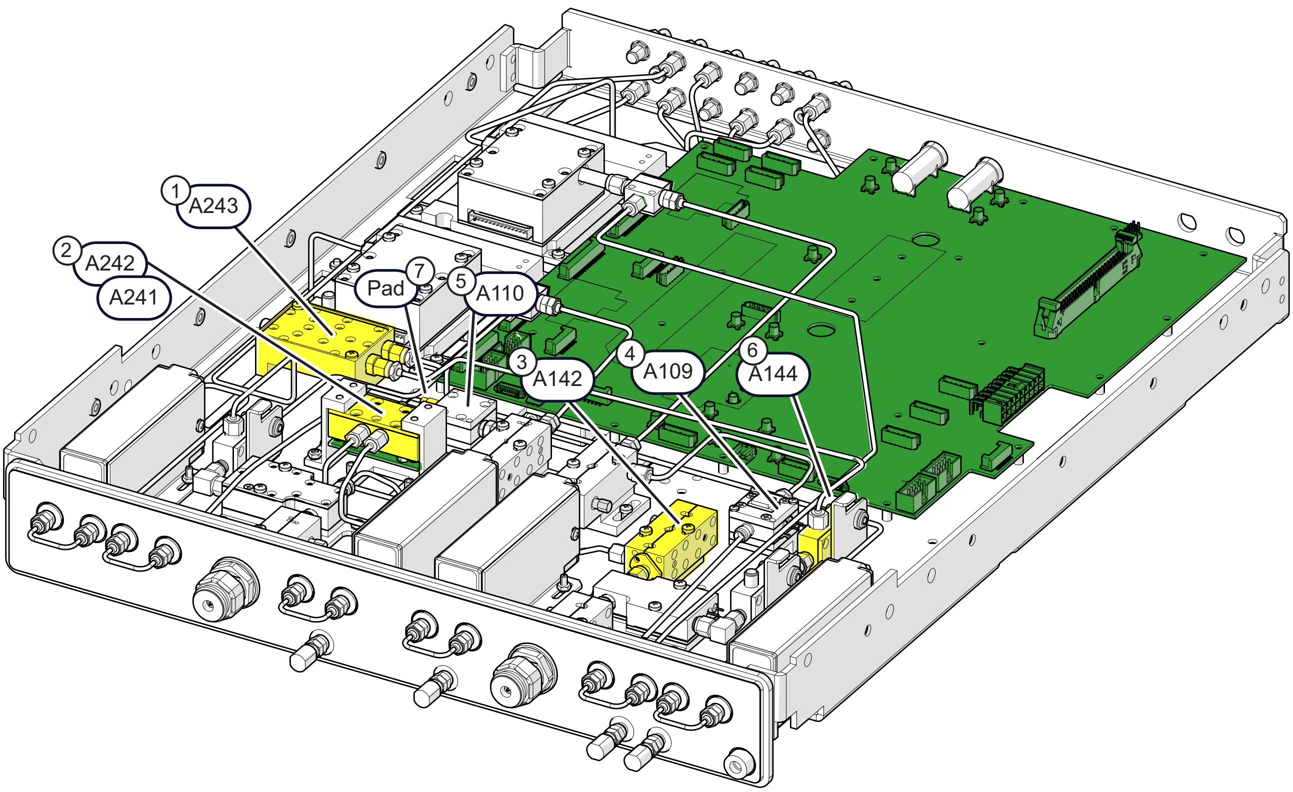
1. **A106** – Test Coupler, 70 GHz 2. **A129** – Diplexer/Bias Tee Module, Port 2, 70 GHz 3. **A119** – Low Band Bridge 4. **A241** High Band Transfer Switch (HBTS), 70 GHz **A242** (Under A241) SPDT Switch Control Assy 5. **A212** Switched Doubler Module (A212 SDM) 6. **A233** 20-40 GHz RF Coupler Module (Option 83) 7. **A214** – Switched Quadrupler Module (A214 SQM) 8. **A112** Switched Doubler Module (A112 SDM) 9. **A114** – Switched Quadrupler Module (A114 SQM) 10. **A133** 20-40 GHz RF Coupler Module (Option 83) 11. **A140** – 70 GHz Forward Coupler 12. **Rear Panel Loop** Cable, SMA(m) to SMA(m) 13. **A240** – 70 GHz Forward Coupler – 14. **A18** RF Control PCB Assembly 15. **A128** – Diplexer/Bias Tee Module, Port 1, 70 GHz 16. **A118** – Low Band Bridge	17. **A120** High Band Step Attenuator, Port 1 b1, 70 GHz **A121** High Band Step Attenuator, Port 1 Src, 40 GHz **A122** High Band Step Attenuator, Port 2 Src, 40 GHz **A123** High Band Step Attenuator, Port 2 b2, 40 GHz 18. **A104** – Test Coupler, 70 GHz 19. **Front Panel Loop** Cable, V(m) to V(m) 20. **RF2 Port** for mmWave System (Option 8x) 21. **RF1 Port** for mmWave System (Option 8x) 22. **A131** LO Coupler Module 23. **A132** LO Coupler Module 24. **Test Port Adapter** – V Connector 34YV50C 25. **LO2 Port** for mmWave System 26. **LO1 Port** for mmWave System 27. **Attenuator for A110:**10 dB V-Connector (*For MS4647B with Option 84/85/88/89 only)* 28. **A110** – Port 2 Level Detector, 70 GHz, V Connector 29. **A107** – Reference Coupler, 70 GHz 30. **A105** – Reference Coupler, 70 GHz 31. **A109** Port 1 Level Detector, 70 GHz, V Connector

Figure 6-20. MS4645B (50 GHz) / MS4647B (70 GHz): Option 31 with Option 84 or 85 (2 of 2)

Module Identification – Option 32 Configuration – MS4642B/MS4644B

Figure 6-21 identifies the parts for models MS4642B/MS4644B with Option 32 configuration. Note that an MS4644B is shown in the figure but the Option 32 configuration is the same for an MS4642B.

Option 31 (Second Source) must be installed to have Option 32. Note that MS4645B and MS4647B models can have Option 32 as well. For more comprehensive parts ID covering each model and option, see Section 13-2 "Rear Module Parts Identification" on page 13-2, and Section 14-2 "Port Module Parts Identification" on page 14-3



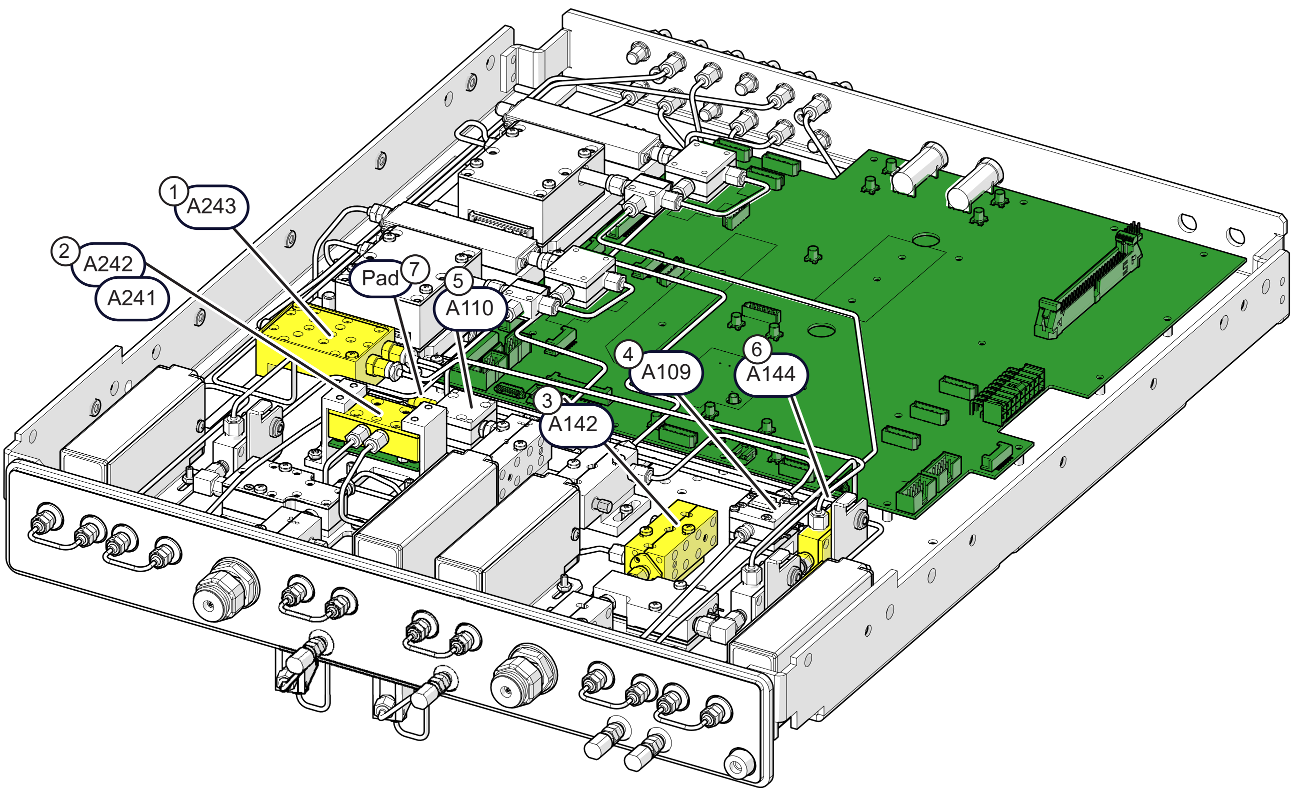
1. **A243** – Low Band Transfer Switch
2. **A241 –** High Band Transfer Switch (HBTS), 40 GHz
   A242 (Under A241) SPDT Switch Control Assy
3. **A142** – Reference Coupler, 70 GHz
4. **A109** Is relocated to accommodate the addition of A142 with Option 32.
5. **A110** Port 2 Level Detector
6. **A144** – Low Band Bridge
7. **Attenuator for A110:** 10 dB K-Connector 41KC-10
   (For MS4644B with Option 84/85/88/89 only)

Figure 6-21. MS4642B (20GHz) / MS4644B (40 GHz): Option 31 or 32 with Option 84 or 85

Module Identification – Option 32 Configuration – MS4645B/MS4647B

Figure 6-22 identifies the parts for models MS4645B/MS4647B with Option 32 configuration (IMD). Note that an MS4647B is shown in the figure but the Option 32 configuration is the same for an MS4645B.

Option 31 (Second Source) must be installed to have Option 32. MS4642B and MS4644B models can have Option 32 as well. For more comprehensive parts ID covering each model and option, see Section 13-2 "Rear Module Parts Identification" on page 13-2, and Section 14-2 "Port Module Parts Identification" on page 14-3



1. **A243** – Low Band Transfer Switch	5. **A110** Port 2 Level Detector
2. **A241 –** High Band Transfer Switch (HBTS), 70 GHz **A242** (Under A241) SPDT Switch Control Assy	6. **A144** – Low Band Bridge
3. **A142** – Reference Coupler, 70 GHz	7. **Attenuator for A110:** 10 dB V-Connector 41V-10 *(For MS4647B with Option 84/85/88/89 only)*
4. **A109** Is relocated to accommodate the addition of A142 with Option 32.	

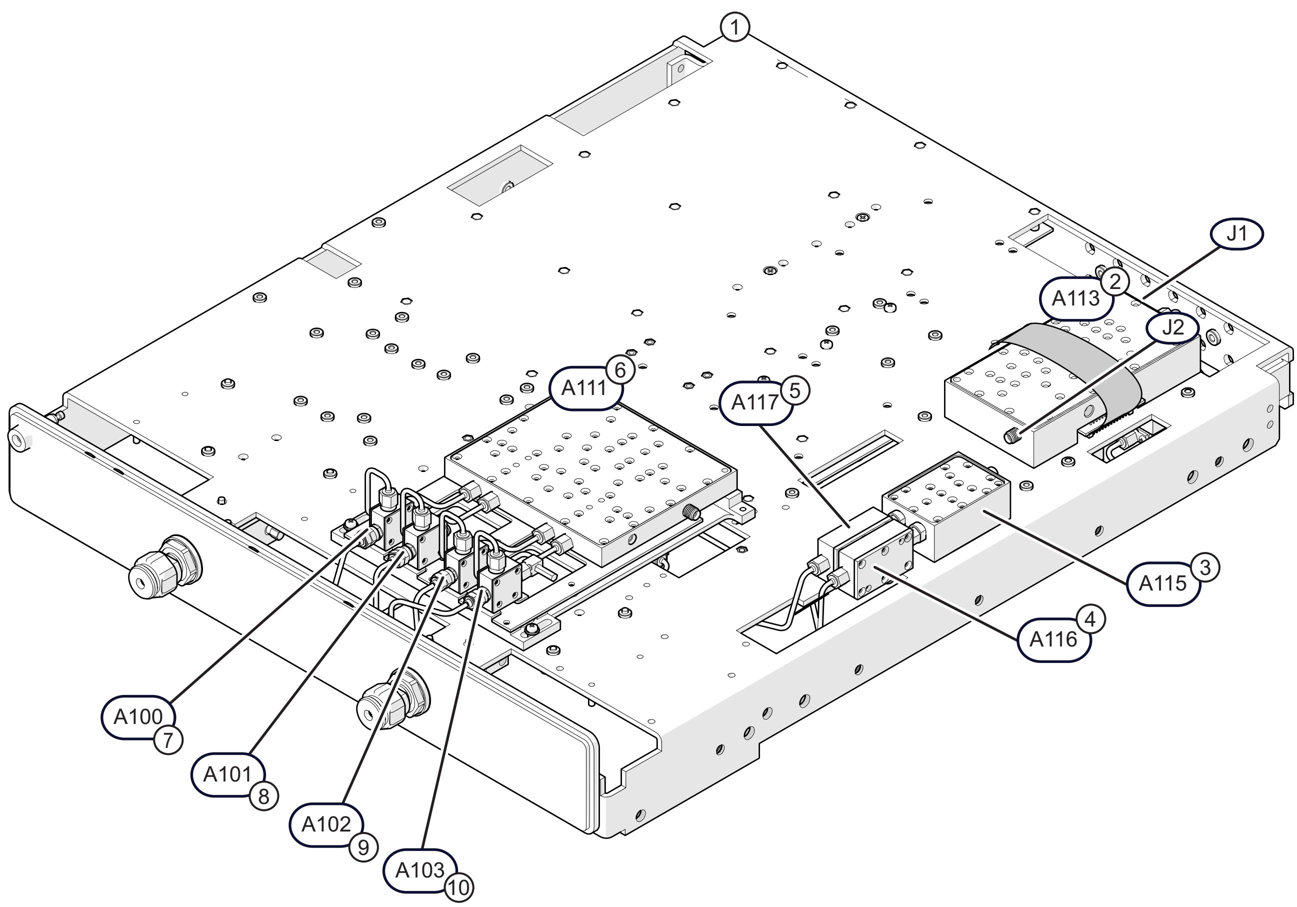
Figure 6-22. MS4645B (50 GHz) / MS4647B (70 GHz): Option 31 or 32 with Option 84 or 85

6-10 RF Deck – Top Side Replaceable Parts

The RF Deck Top Side modules vary depending on whether it is Standard Configuration or Option 31 Configuration. They also vary according to the access loop/attenuator options (Option 51, 61, or 62), or Option 8x (mmWave Interface). The module part numbers and engineering reference numbers are the same for all instrument models. Each top side variant is described in the Figure 6-23 and Figure 6-24.

Standard Configuration – No Options

This section shows a standard RF Deck top side configuration with no options installed. Notice that A115 is used in this configuration but is *not* used when Option 31 is installed. Also notice that A116 and A117 are oriented differently as shown in Figure 6-24 on page 6-46, than when Option 31 Second Source is installed.

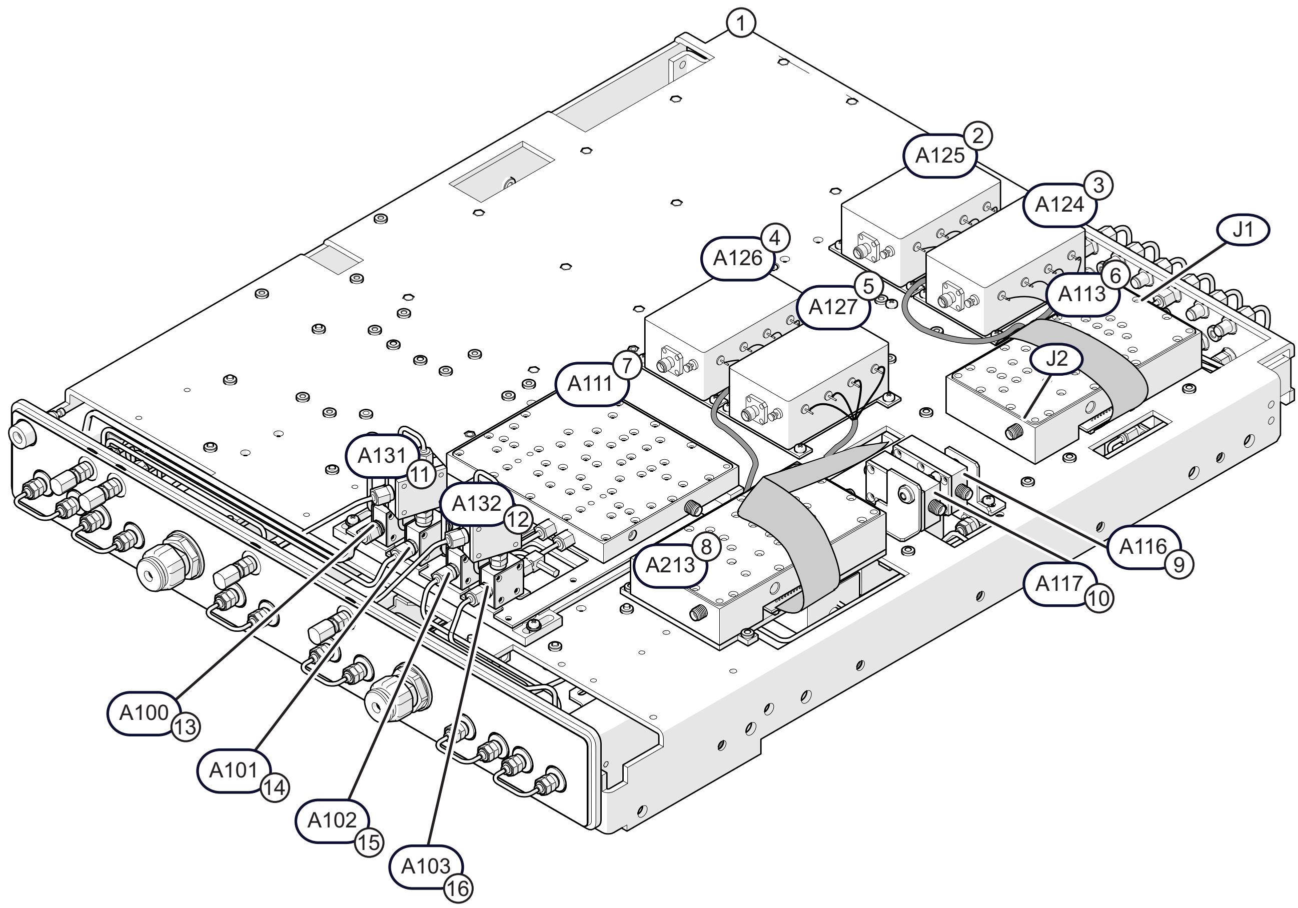


RF Deck Top Replaceable Components	
1. RF Deck Top Side as removed from chassis.	6. A111 LO Coupler Distribution Module
2. A113 5-20 GHz Doubler Module (All Models)	7. A100 Sampler Module
3. A115 Low Band Transfer Switch Module	8. A101 Sampler Module
4. A116 – Low Band Bridge Module	9. A102 Sampler Module
5. A117 – Low Band Bridge Module	10.A103 Sampler Module

Figure 6-23. RF Deck Top – Replaceable Components: Standard System – No Options

Option 31 Configuration – With all Applicable Options

This section shows an RF Deck top side with Option 31 Dual Source Configuration and with all applicable options installed. Notice that A131 and A132 are used when Option 8x is installed.



1. RF Deck Top Side as removed from chassis.	9. A116 – Low Band Bridge Module
2. A125 Low Band Source Attenuator, Port 1, (Option 61 or 62)	10. A117 – Low Band Bridge Module
3. A124 Low Band Test Attenuator, Port 1, (Option 62)	11. A131 LO Coupler Module – Mounts on top of A101 (Option 8x)
4. A126 Low Band Source Attenuator, Port 2, (Option 62)	12. A132 LO Coupler Module – Mounts on top of A103 (Option 8x)
5. A127 Low Band Test Attenuator, Port 2, (Option 61 or 62)	13. A100 Sampler Module
6. A113 5-20 GHz Doubler Module (All Models)	14. A101 Sampler Module
7. A111 LO Coupler Distribution Module	15. A102 Sampler Module
8. A213 5-20 GHz Doubler Module (Option 31, Second Source)	16. A103 Sampler Module

Figure 6-24. RF Deck Top – Replaceable Components: System with All Options

Sampler/LO Distribution Module Assembly

The SLODM Assembly varies depending on the instrument equipped options.

SLODM Assembly – Components

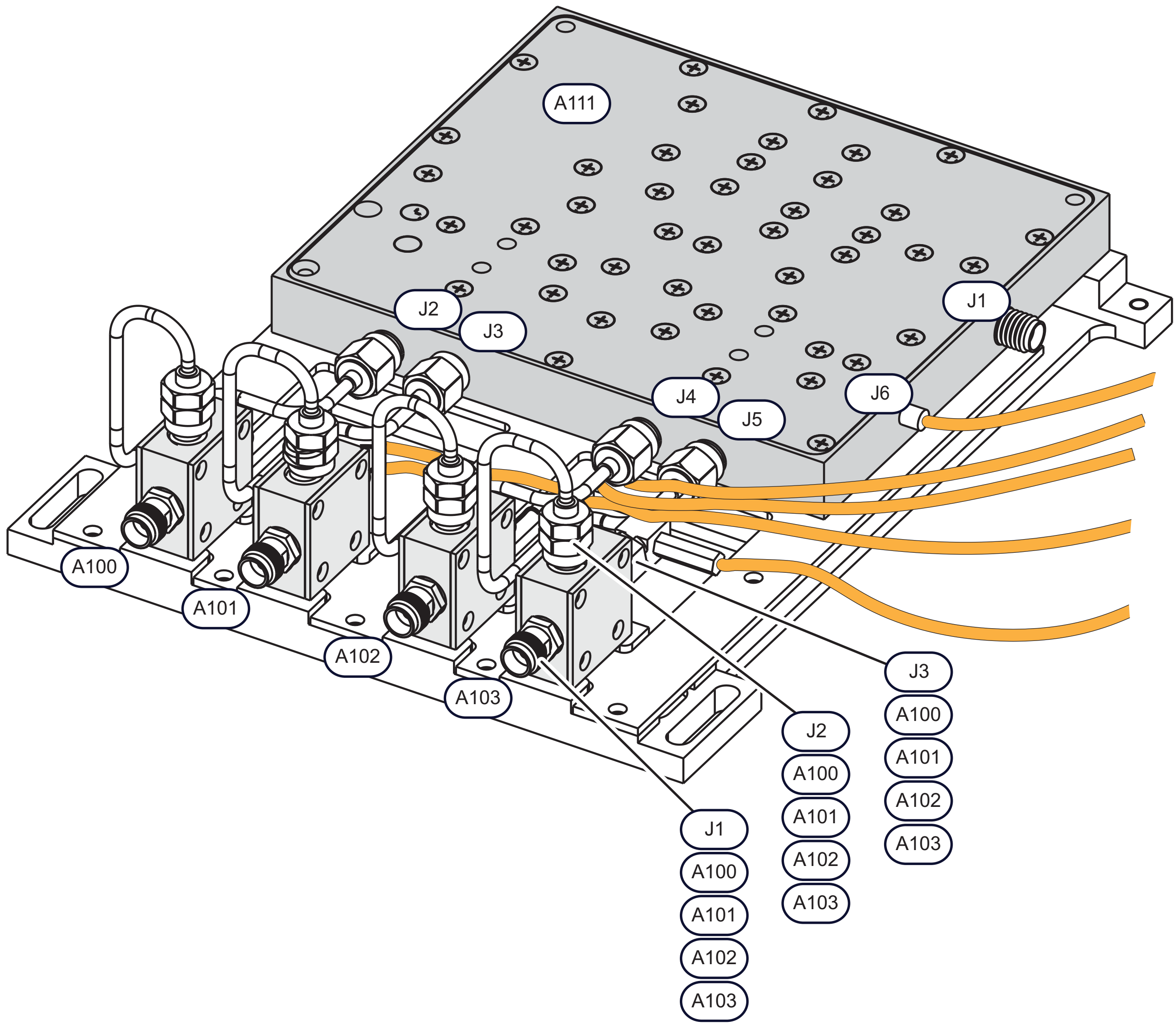


Figure 6-25. SLODM Assembly – Components (1 of 2)

SLODM Assembly	A111 LO Distribution Module Assembly
The SLODM assembly consists of the following five (5) components: • A111 LO Distribution Module • A100 Sampler Module • A101 Sampler Module • A102 Sampler Module • A103 Sampler Module **A100-A103 Sampler Module Connectors** • J1 – Front • J2 – Top • J3 – Rear • -5V Pin – Bottom Rear • +5v Pin – Bottom Front • Each Sampler Module is held to the A111 with two (2) pan head Phillips M2.5 × 10 mm screws.	**The following connectors are located on the A111 LO Distribution Module Assembly:** • J1 – Right side towards rear • J2 – Front facing left • J3 – Front facing left center • J4 – Front facing right center • J5 – Front facing right • J6 – Right side towards front • Position 1 – 2-Pin Socket for A100 – At left • Position 2 – 2-Pin Socket for A101 – At left center • Position 3 – 2-Pin Socket for A102 – At right center • Position 4 – 2-Pin Socket for A103 – At right

Figure 6-25. SLODM Assembly – Components (2 of 2)

SLODM Assembly – Components

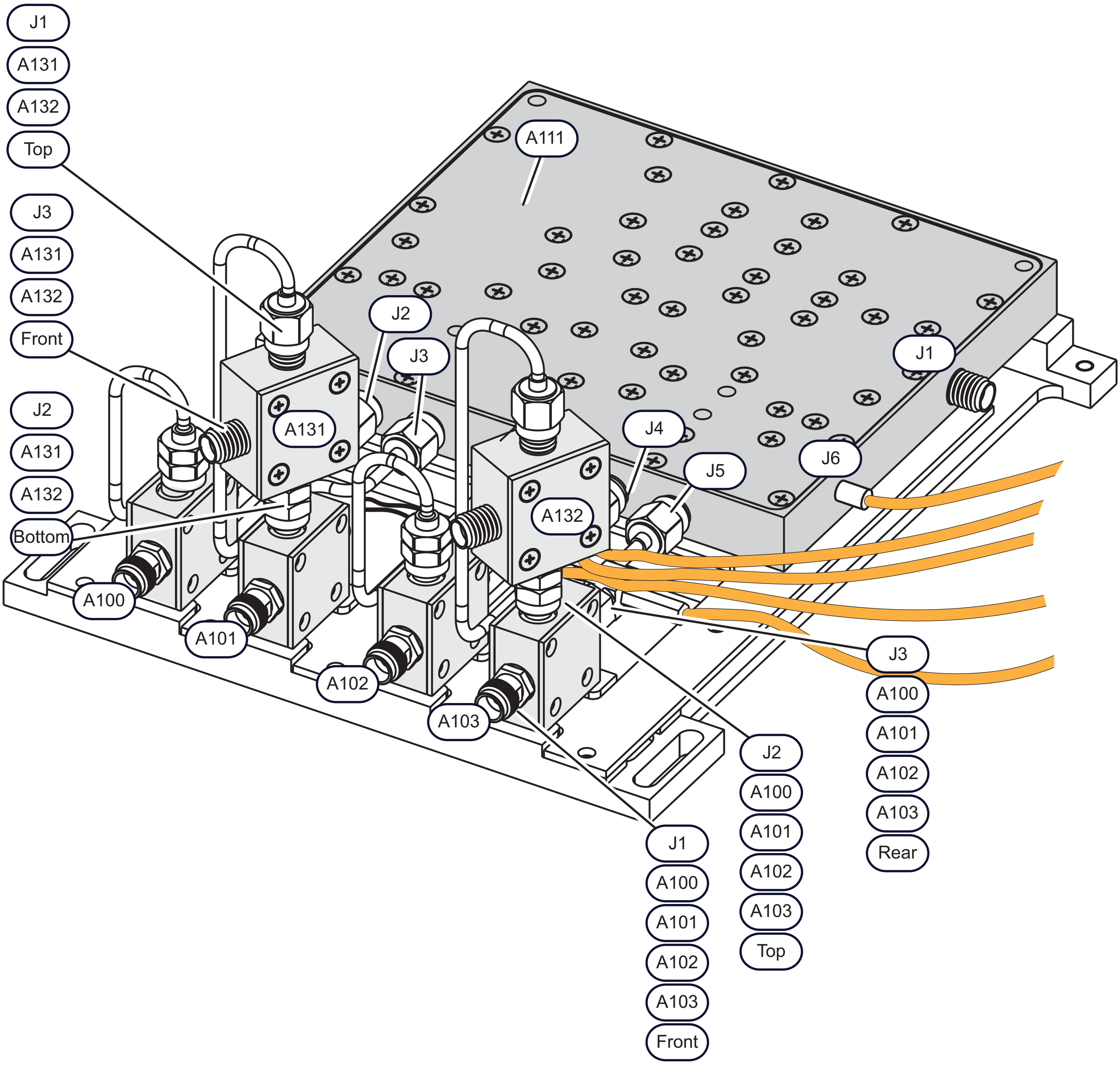


Figure 6-26. SLODM Assembly – Components: MS4640B with Option 8x (1 of 2)

SLODM Assembly For MS4640B VNAs equipped with Option 8x. The SLODM assembly consists of the following eight (8) components: • A111 LO Distribution Module • A100 Sampler Module • A101 Sampler Module • A102 Sampler Module • A103 Sampler Module • A131 LO Coupler Module – Mounts on top of the A101. • A132 LO Coupler Module – Mounts on top of the A103. **A100-A103 Sampler Module Connectors** • J1 – Front • J2 – Top • J3 – Rear • -5V Pin – Bottom Rear • +5v Pin – Bottom Front • Each Sampler Module is held to the A111 with two (2) pan head Phillips M2.5 × 10 mm screws.	**A131-A132 LO Coupler Module Connectors** • J1 – Top • J2 – Bottom • J3 – Front **A111 LO Distribution Module Assembly** • J1 – Right side towards rear • J2 – Front facing left • J3 – Front facing left center • J4 – Front facing right center • J5 – Front facing right • J6 – Right side towards front • Position 1 – 2-Pin Socket for A100 – At left • Position 2 – 2-Pin Socket for A101 – At left center • Position 3 – 2-Pin Socket for A102 – At right center • Position 4 – 2-Pin Socket for A103 – At right

Figure 6-26. SLODM Assembly – Components: MS4640B with Option 8x (2 of 2)

6-11 Rear Panel

Rear Panel Assemblies

The following Rear Panel components can be removed without removing the Rear Panel:

- Solid State Drive Assembly (SSD) – ND75952 – 67861
- Rear Panel Loops

The Rear Panel is not a replaceable part but its removal provides access to two of its mounted components:

- A17 Rear Panel PCB Assembly
- Rear Panel Analog Section Fan Assembly

Partial or full removal of the Rear Panel also provides access for the following internal components:

- Motherboard 1 PCB Assembly
- Motherboard 2 PCB Assembly
- Power Supply Module and related cables and harnesses
- Digital PCB Fan Assembly, 165 mm Cable Attached

Rear Panel Overview

The Rear Panel and its components are shown in Figure 6-27.

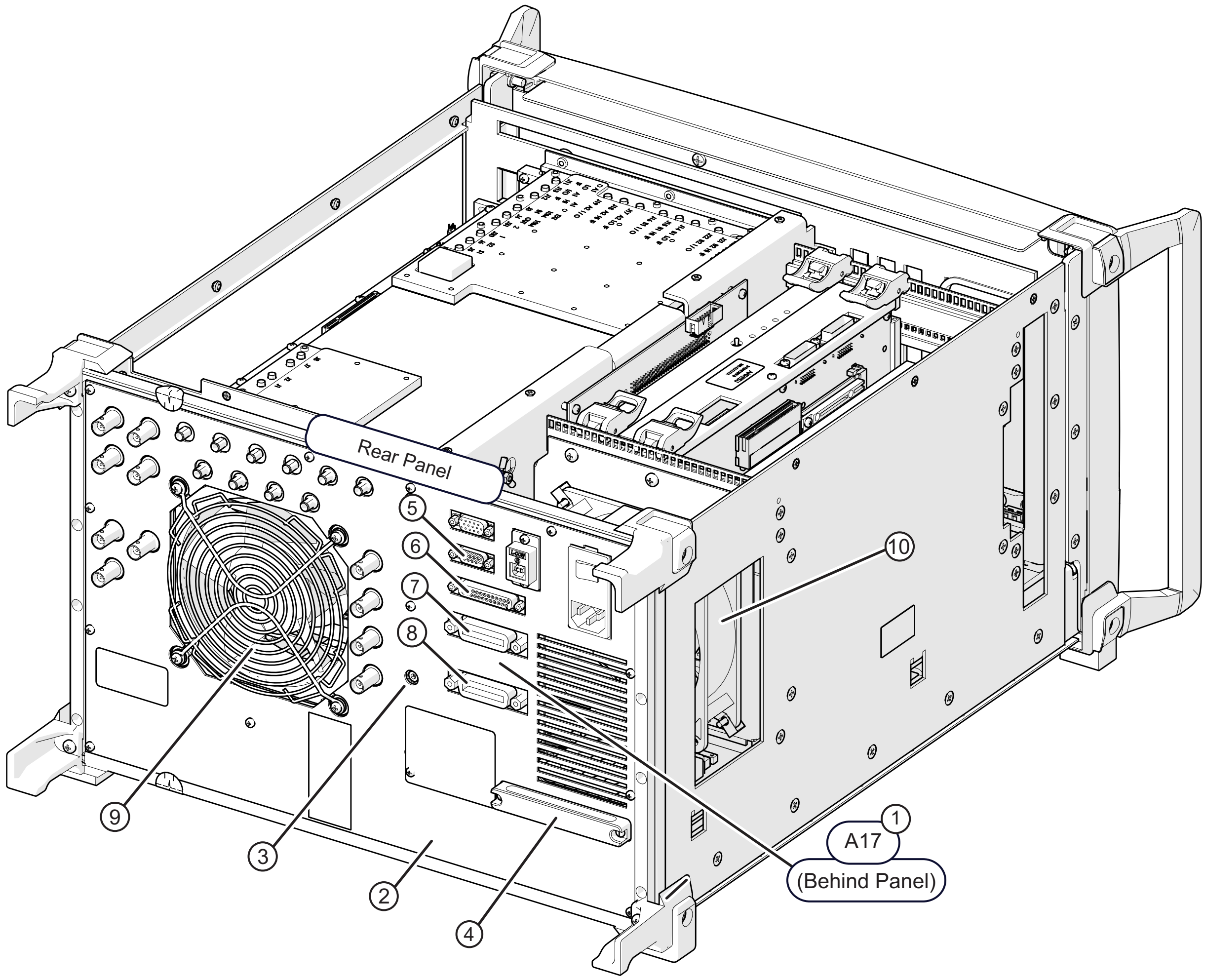


Figure 6-27. Rear Panel Assembly: Chassis Covers Off (1 of 2)

Orientation	A17 Rear Panel PCB Assembly Connectors
The instrument chassis viewed from the Rear Panel with the covers off. **Rear Panel** 1. A17 Rear Panel PCB located here on inside of Rear Panel. 2. Rear Panel Silk-Screened Sub Plate – The sub plate is fastened in place using 14 pan head Phillips M3 × 6 mm screws and it can be removed with the covers on or off. 3. Rear Panel Fastening Screws – The rear panel is held to the instrument chassis using 12 socket head Allen M4 × 20 mm screws. There are three rows of four screws each at the left, center, and right. 4. Solid State Drive (SSD)	5. Serial Connector port with two (2) 4-40 × 0.187 M-F connector mounting studs. 6. External I/O Control port with two (2) 4-40 × 0.187 M-F connector mounting studs. – The connector mounting studs here and above thread to standard DB connectors. The studs must be removed to service the A17 PCB. 7. IEEE 488.2 GPIB port with two (2) 4-40 × 0.650 connector mounting studs. 8. Dedicated GPIB port with two (2) 4 -40 × 0.650 connector mounting studs. – The GPIB connector mounting studs thread into standard stack able GPIB Test Cable Connectors. **Fan Assemblies** 9. Rear Panel Analog Section Fan Assembly. The Rear Panel must be removed to service this fan. 10. Digital PCB Fan Assembly. The Rear Panel and instrument chassis plates must be removed to service this fan.

Figure 6-27. Rear Panel Assembly: Chassis Covers Off (2 of 2)

A17 Rear Panel PCB Assembly

The connections to the A17 Rear Panel PCB Assembly are shown in Figure 6-28. The left chassis side plate has been removed for clarity.,

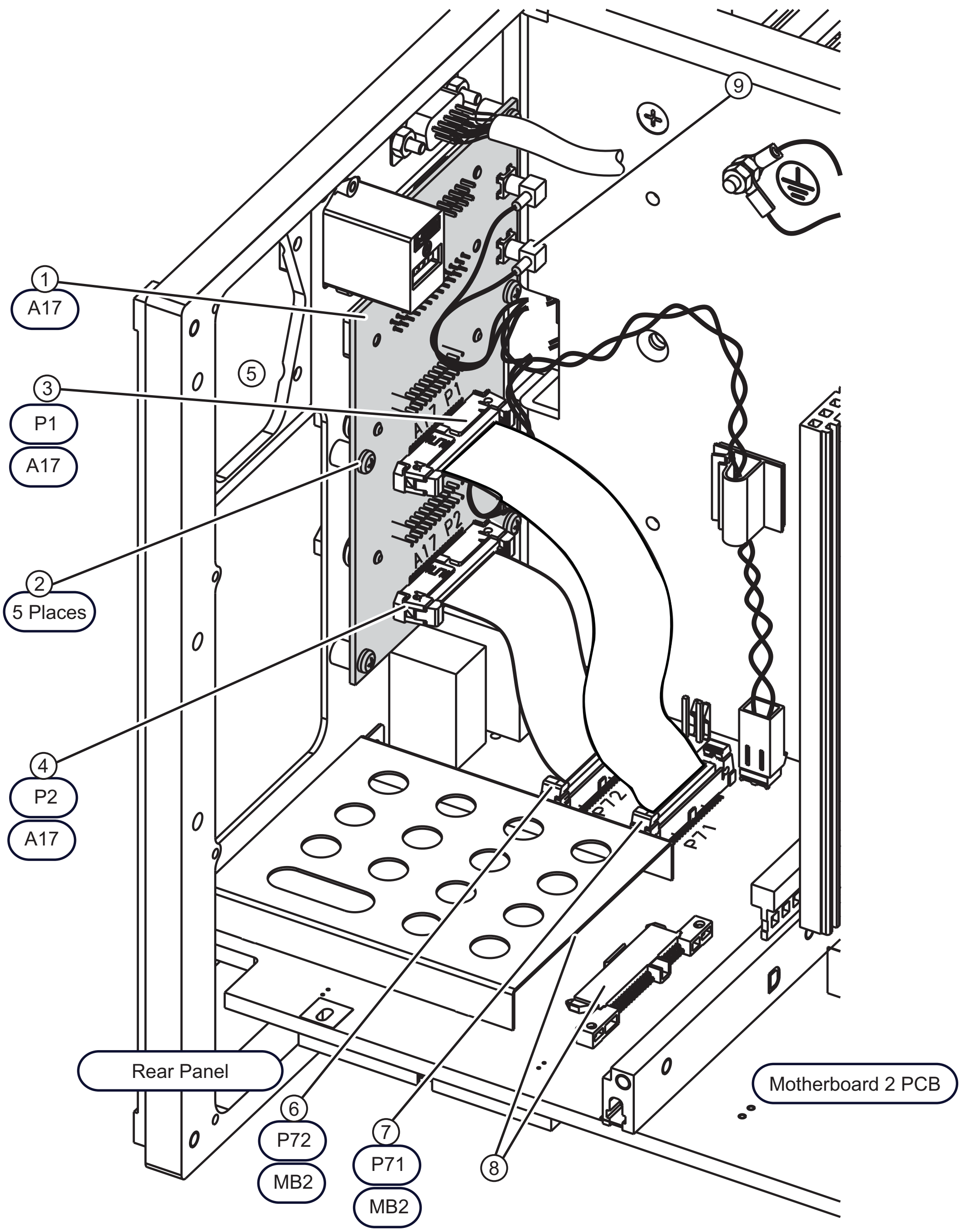


Figure 6-28. Rear Panel – A17 Rear Panel PCB Assembly (1 of 2)

Orientation	A17 PCB Cable Connections
The instrument is viewed from the left side with the side plate removed for clarity. The rear panel is to the left. **A17 PCB** 1. A17 Rear Panel PCB • Provides support for the Serial I/O, External I/O, IEEE 488.2 GPIB, and Dedicated GPIB rear panel ports. • The Serial I/O and External I/O connectors are fastened to the Rear Panel Plate. • Each I/O connector uses two (2) 4 × 40 × 0.187 hex M-F threaded connector mounting studs. • The IEEE 488.2 GPIB Port and the Dedicated GPIB Port are also fastened to the Rear Panel Plate. • Each GPIB connector uses two (2) 4-40 × 0.650 M-F connector mounting studs supporting stackable GPIB Test Cable Connectors. • The eight (8) connector mounting studs must be removed to service the A17 PCB. 2. Five (5) pan head Phillips M3 × 6 mm mounting screws holding the A17 PCB to swaged-in standoffs on the Rear Panel Plate.	3. A17 PCB P1 connector – For ribbon cable to MB2 PCB connector P71. 4. A17 PCB P2 connector – For ribbon cable to MB2 PCB connector P72. 5. Chassis opening for the AC Power Module and Switch (not shown here for clarity). 6. MB2 PCB P72 ribbon cable connector. 7. MB2 PCB P71 ribbon cable connector. 8. Enclosure and connector for the SATA Solid State Drive. 9. A17 PCB MCX coaxial connectors P8, P9, P10, and P11 – Connect to the Rear Panel BNC trigger ports.

Figure 6-28. Rear Panel – A17 Rear Panel PCB Assembly (2 of 2)

Rear Panel Inside Components

Figure 6-29 shows the internal components attached to the Rear Panel.

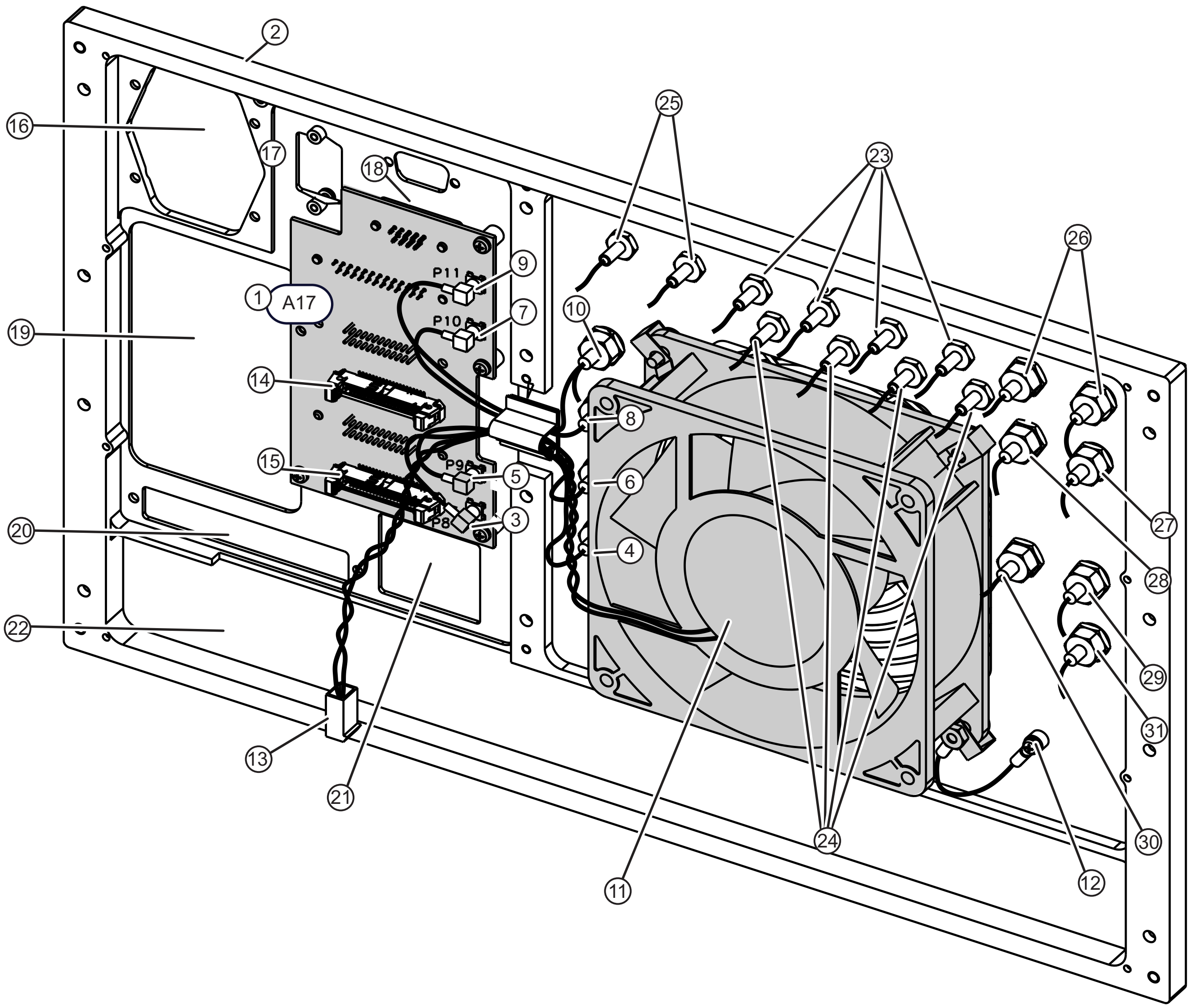


Figure 6-29. Rear Panel: Inside Connections and Assemblies (1 of 2)

A17 PCB

1. A17 Rear Panel PCB Assembly
2. Rear Panel Chassis Plate

A17 PCB Cable Connections

The A17 PCB MCX cables connect to the four trigger control BNC ports on the Rear Panel. The two ribbon cables connect to the MB2 PCB.

Trigger Out

3. A17 PCB P8 MCX Connector – Connects to the Trigger Out BNC
4. Trigger Out BNC Connector (partially hidden by fan)

Ready for Trigger

5. A17 PCB P9 MCX Connector – Connects to the Ready for Trigger BNC
6. Trigger BNC Connector (partially hidden by fan)

Lock Status

7. A17 PCB P10 MCX Connector – Connects to the Lock Status BNC
8. Lock Status BNC Connector (partially hidden by fan)

External Trigger

9. A17 PCB P11 MCX Connector – Connects to the External Trigger BNC
10. External Trigger BNC Connector

Rear Panel Fan

11. Rear Panel Fan Assembly
12. Rear Panel Fan Ground Connection to Rear Panel
13. Fan Power Connection – Twisted-pair cable and 2-pin header connects to MB2 PCB connector P95.

Ribbon Cables

14. A17 PCB connector P1 – Ribbon cable connects to MB2 PCB connector P71.
15. A17 PCB connector P2 – Ribbon cable connects to MB2 PCB connector P72.

Chassis Openings

16. Opening for AC Power Module (not shown)
17. Opening for USB A connector (not shown)
18. Opening for XGA/VGA connector (not shown)
19. Opening for fan cooling
20. Opening for the SATA Solid State Drive
21. Opening for USB and PS/2 connectors (not shown)
22. Opening for RF Deck Rear Panel (not shown)
23. IF Inputs/Outputs
24. Pulse Generator Outputs (Option 35)
25. Pulse Synch In and Pulse Synch Out (Option 35)
26. 10 MHz In/ 10 MHz Out
27. Analog In 1 and Analog In 2
28. External ALC In 1, External ALC In 2, and External Analog Out

Figure 6-29. Rear Panel: Inside Connections and Assemblies (2 of 2)

6-12 Power Supply Modules

Power Supply Module and Cable Harnesses

The Power Supply Module Assembly and its four major cable harnesses is shown in Figure 6-30. It is mounted in the Digital PCB Section. The cable harnesses go to connectors on the Motherboard 2 PCB Assembly.

Replacement part ND75957-RFB includes Power Supply Cable Assembly.

Replacement part ND81463-RFB – RoHS 3-ND81463-RFB includes Power Supply Cable Assembly.

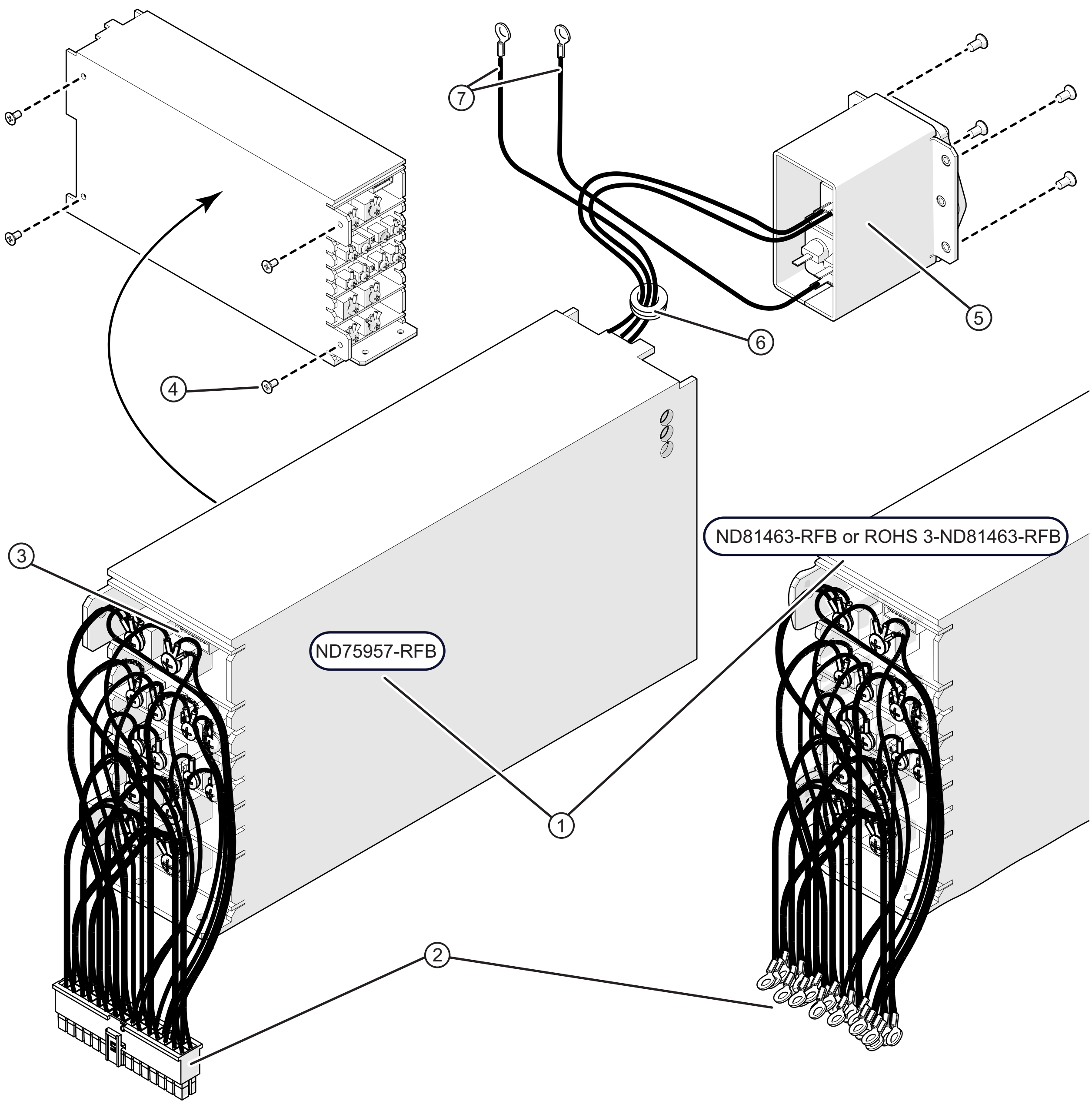


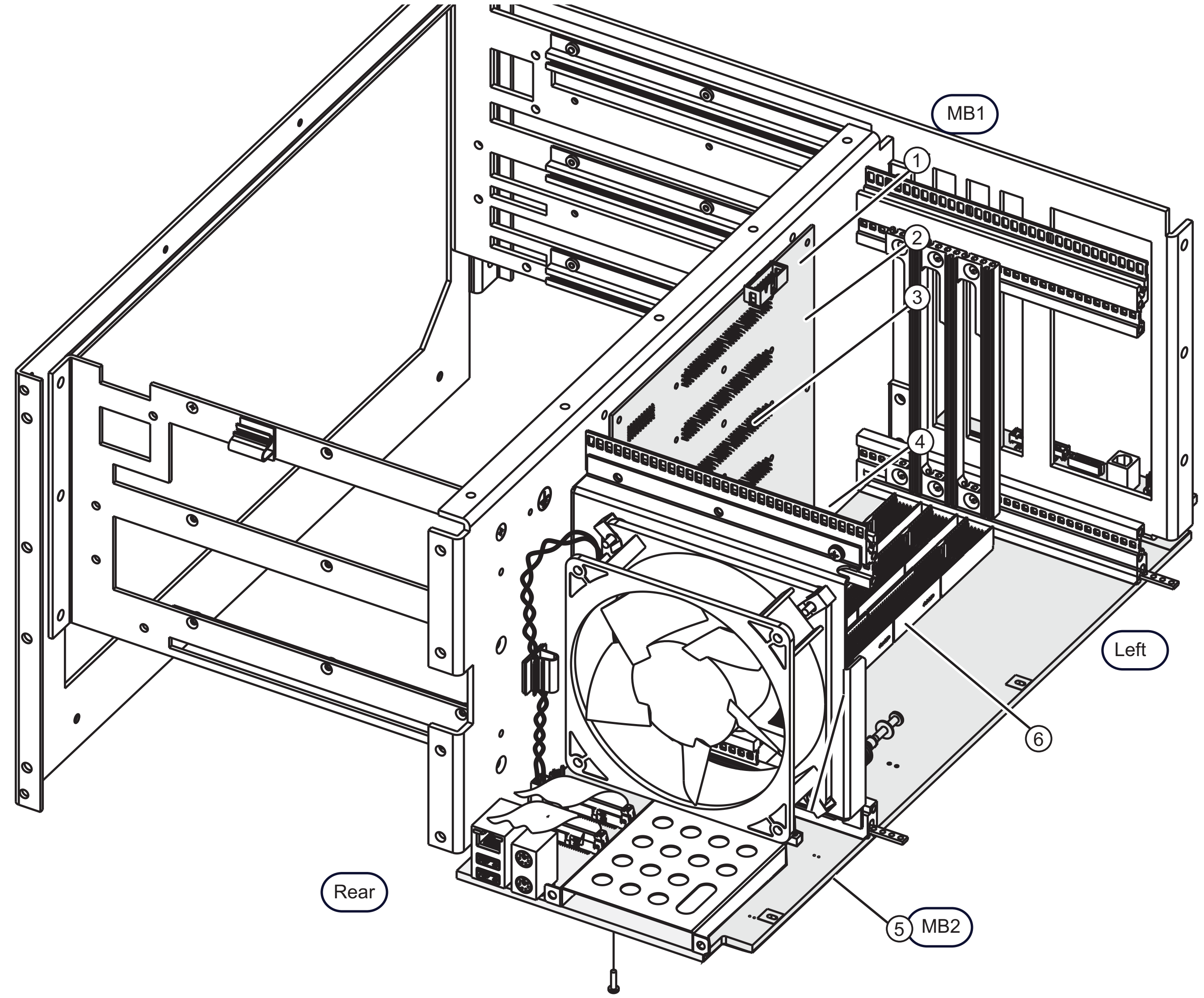
Figure 6-30. Power Supply Modules (1 of 2)

1. Power Supply Module 2. Power Supply Cable Assembly 3. Power control wiring harness (not shown, plugs into receptacle shown here) from MB2 PCB connector **Pwr Ctrl P93. (**Not a replacement part).	4. Four (4) flat head Phillips M4 × 8 mm screws for mounting the Power Supply Assembly to the chassis. 5. AC Input Module 6. Grommet holding harness wires. 7. Green Wire with Yellow Stripe – Terminated in ring lugs for connection to chassis ground post.

Figure 6-30. Power Supply Modules (2 of 2)

6-13 Motherboard PCB Assemblies

Two motherboard (MB1, MB2) locations are shown in Figure 6-31.



Orientation

Viewing the instrument chassis from the Rear Panel.

MB1 PCB

1. MB1 – Motherboard 1 PCB Assembly
2. Mounted vertically and fastened in Digital PCB Bay to the Chassis Center Plate.
3. The MB1 PCB backplane connectors protrude through plate openings into the Analog PCB Bay for (from top to bottom) the A11 IF Band Module, A13 Source Module, and A15 Low Band Receiver Module.
4. The MB1 PCB connects via a backplane connector into the MB2 PCB. The MB1 PCB can only be removed after the MB2 PCB has been removed.

MB2 PCB

5. MB2 – Motherboard 2 PCB – ND81312 or 3-ND81312 or ND80356
6. The MB2 backplane connectors viewed from rear, from left to right are:
   - MB1 PCB
   - A10 DSP Module PCB
   - CB PCB with SBC, SODIMM on SBC, GPIB, USB, and GPU PCBs

Figure 6-31. Motherboard 1 (MB1) PCB Assembly

MB2 PCB Assembly – ND81312 or 3-ND81312

This MB2 assembly appears in systems with Serial Number 1506634 and above.

The following modules connect to MB2:

- CB PCB – Carrier Board PCB Assembly
- SBC PCB – Single Board Computer PCB Assembly – Mounted on the CB PCB.
- SODIMM – Small-Outline Dual Inline Memory Module – Mounted on the SBC PCB, two (2) per instrument.
- GPU PCB – Graphics Processor Unit – Mounted on the back of the CB PCB.
- Power Supply Module and Harness – Includes Power Supply Cable Assembly

In Figure 6-32, the MB2 connector locations are shown. In Figure 6-33 on page 6-63, a detailed view of the MB2 front connectors is shown.

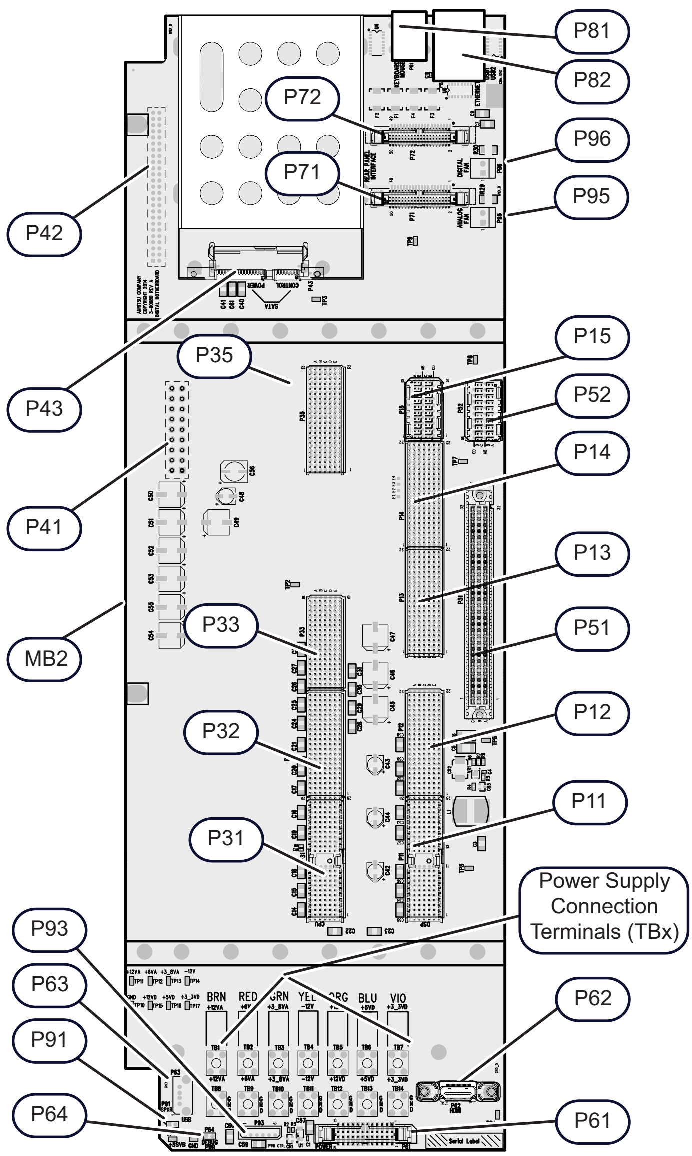
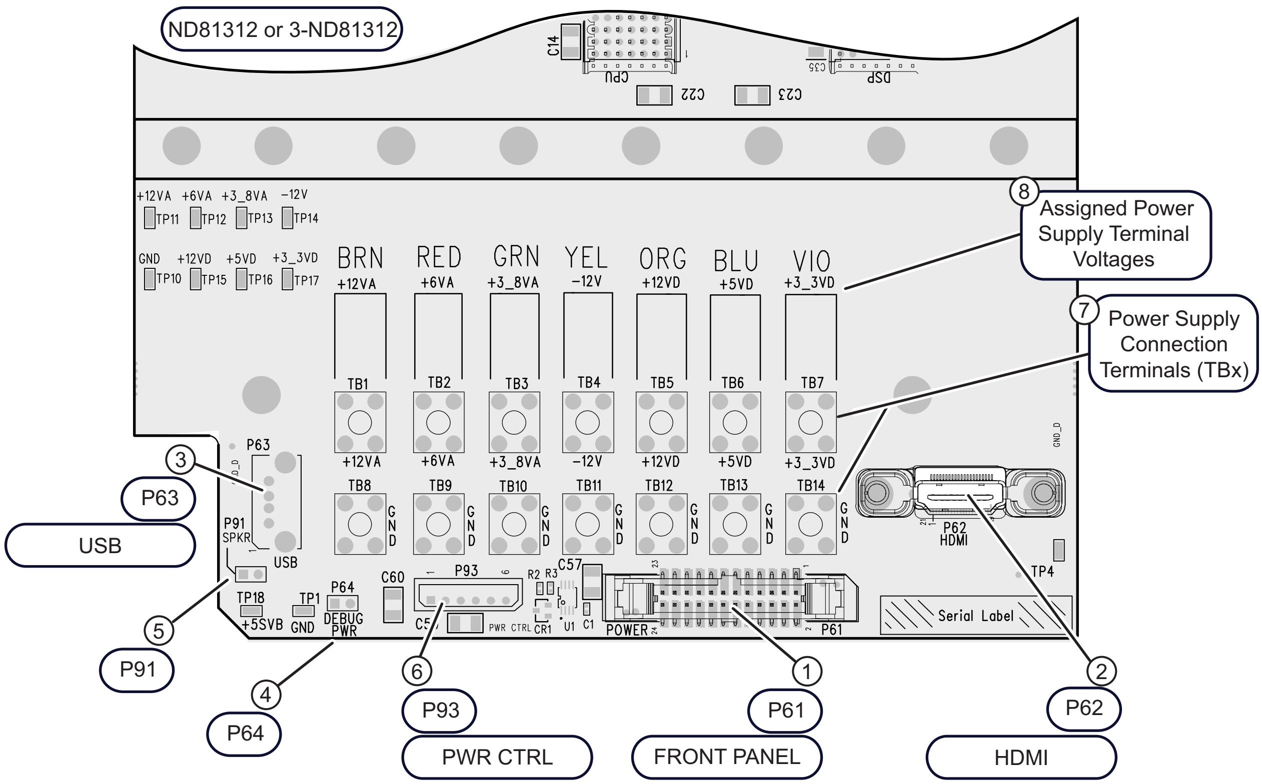


Figure 6-32. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 Connectors (1 of 2)

Power Supply Connection Terminals	**Carrier Board PCB Edge Connectors**
TB1: +12VA	P31
TB2: +6VA	P32
TB3: +3_8VA	P33
TB4: -12VA	P35
TB5: +12VD	**A10 Digital Signal Processing PCB Edge Connectors**
TB6: +5VD	P11
TB7: +3_3VD	P12
TB8 through TB14: GND (Ground)	P13
P93 – Power Control Cable	P14
Front Panel Connectors	P15
P61 – Power/Signal Ribbon Cable	**Motherboard 1 PCB Edge Connectors**
P62 – HDMI Cable	P51
P63 – USB Cable	P52
MB2 Front Connectors	**Reverse Side Connectors**
P64 – Debug Power – Not used	P41 – RF Power In
P91 – Speaker – Not used	P42 – RF Control In
MB2 Rear Connectors	
P43 – Solid State Drive Control and Signal Connector	
P71 – Rear Panel Interface Connector	
P72 – Rear Panel Interface Connector	
P95 – Analog Section Fan Power	
P81 – PS/2 Keyboard and Mouse Connector Stack	
P82 – RJ45 Ethernet and USB Connector Stack	
P96 – Digital Section Rear Panel Fan Power	

Figure 6-32. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 Connectors (2 of 2)



1. P61 – Ribbon Cable Connector to Front Panel	5. P91 – Speaker – Not used
2. P62 – HDMI Connector to Front Panel	6. P93 – Power Control Connector to Power Supply
3. P63 – USB Type A Connector to Front Panel	7. TBx – Power Supply Connection Terminals
4. P64 – Debug Power – Not used	Assigned Power Supply Voltages

Figure 6-33. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 – Front

MB2 PCB Assembly – ND80356

This MB2 assembly appears in systems with S/N 1505633 and below:

The following modules connect to MB2:

- CB PCB – Carrier Board PCB Assembly
- SBC PCB – Single Board Computer PCB Assembly – Mounted on the CB PCB.
- SODIMM – Small-Outline Dual Inline Memory Module – Mounted on the SBC PCB, two (2) per instrument.
- GPU PCB – Graphics Processor Unit – Mounted on the back of the CB PCB.
- Power Supply Module and Harness

In Figure 6-34, the MB2 connector locations are shown. In Figure 6-35 on page 6-66, a detailed view of the MB2 front connectors is shown.

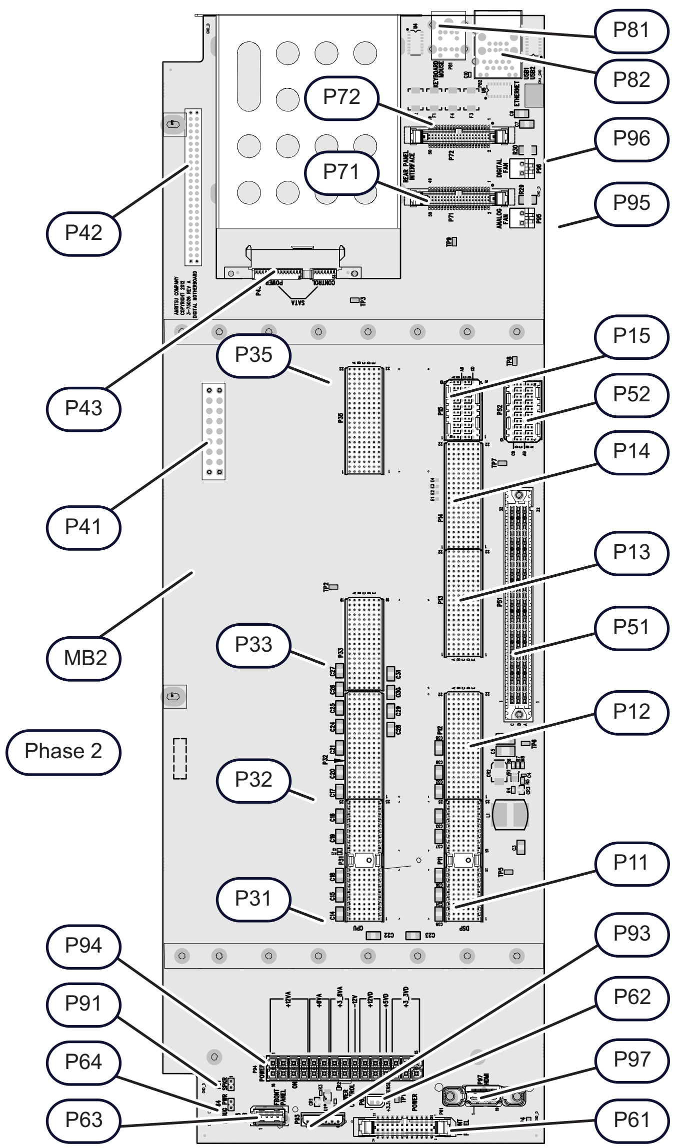
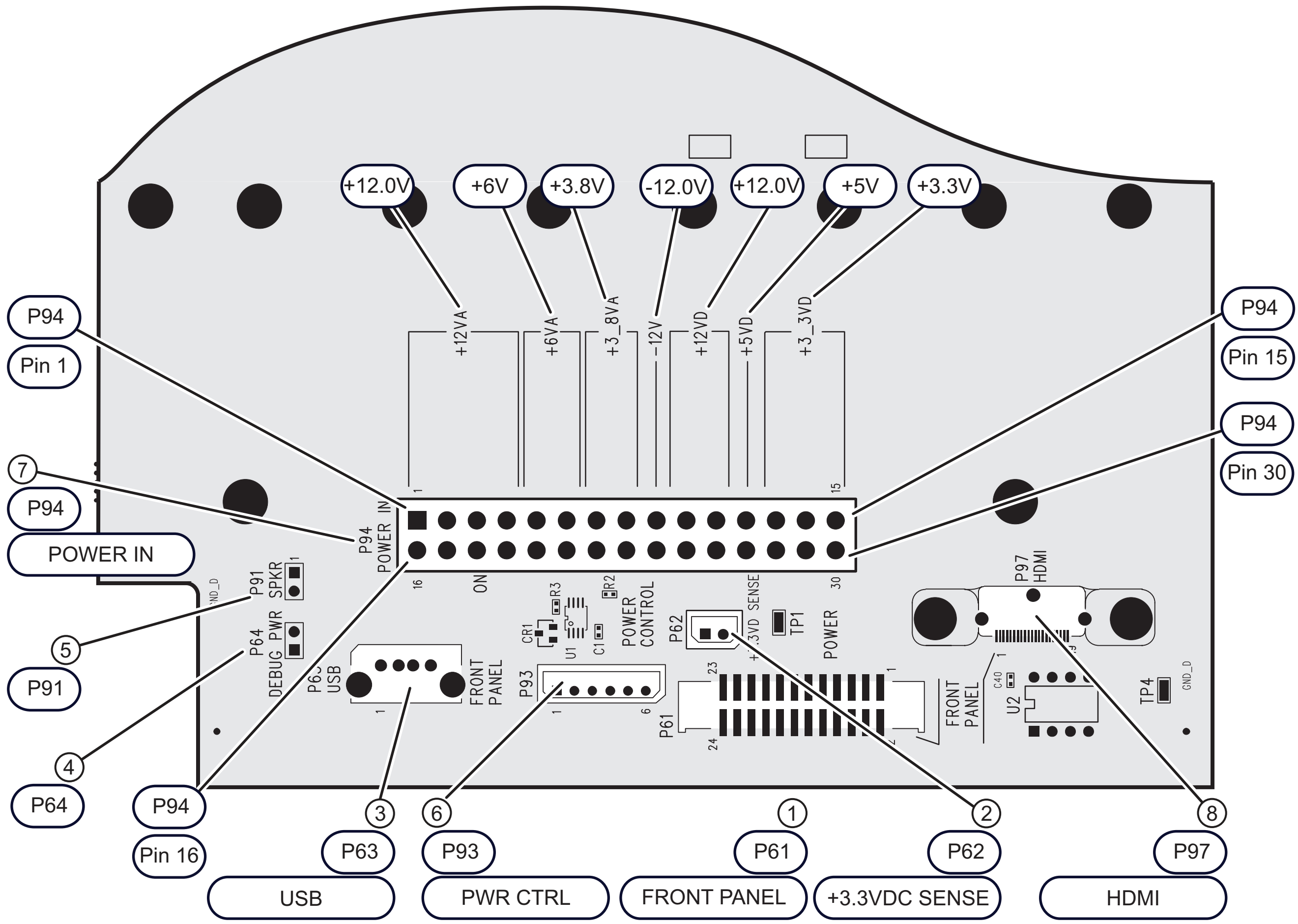


Figure 6-34. Motherboard 2 PCB Assembly – ND80356: Connectors (1 of 2)

Power Supply Connectors	**Carrier Board PCB Edge Connectors**
P94 – Main Cable Harness from Power Supply	P31
P93 – Power Control Cable	P32
P62 – +3.3 VDC Sense – Not used	P33
Front Panel Connectors	P35
P61 – Power/Signal Ribbon Cable	**A10 Digital Signal Processing PCB Edge Connectors**
P63 – USB Cable	P11
P97 – HDMI Cable	P12
MB2 Front Connectors	P13
P54 – Debug Power – Not used	P14
P91 – Speaker – Not used	P15
MB2 Rear Connectors	**Motherboard 1 PCB Edge Connectors**
P43 – Solid State Drive Control and Signal Connector	P51
P71 – Rear Panel Interface Connector	P52
P72 – Rear Panel Interface Connector	**Reverse Side Connectors**
P95 – Analog Section Fan Power	P41 – RF Power In
P81 – PS/2 Keyboard and Mouse Connector Stack	P42 – RF Control In
P82 – RJ45 Ethernet and USB Connector Stack	
P96 – Digital Section Rear Panel Fan Power	

Figure 6-34. Motherboard 2 PCB Assembly – ND80356: Connectors (2 of 2)



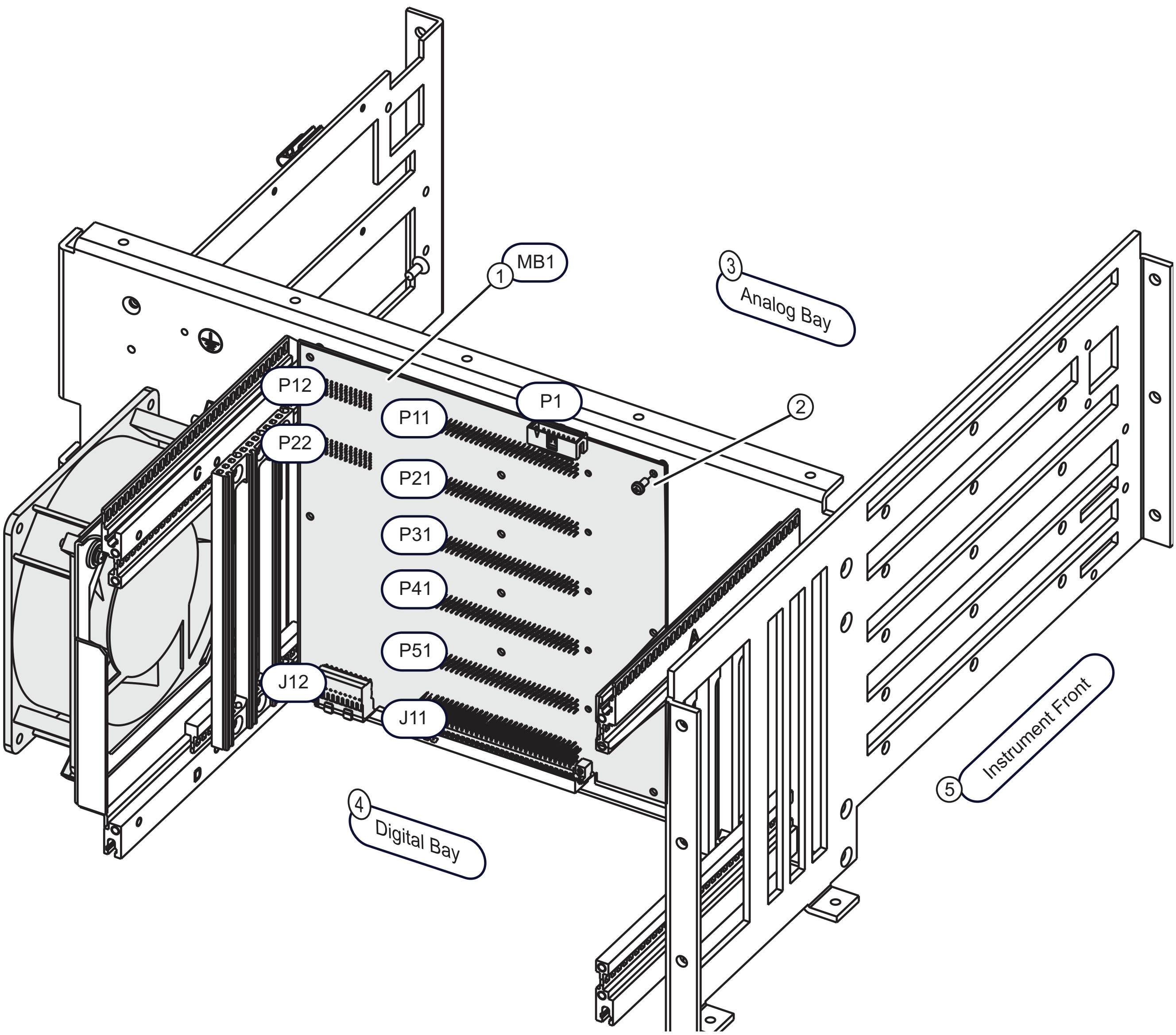
1. P61 – Ribbon Cable Connector to Front Panel	P94 – Connector Pin 1
2. P62 – +3.3 VDC Sense – Not used	P94 – Connector Pin 15
3. P63 – USB Type A Connector to Front Panel	P94 – Connector Pin 16
4. P64 – Debug Power – Not used	P94 – Connector Pin 30
5. P91 – Speaker – Not used	
6. P93 – Power Control Connector to Power Supply	
7. P94 – Power In Connector to Power Supply	
8. P97 – HDMI Connector to Front Panel	

Figure 6-35. Motherboard 2 PCB Assembly – ND80356: Front

Motherboard 1 PCB Assembly

Functionally, the Motherboard 1 PCB Assembly (MB1 PCB) provides signal routing and DC power distribution paths for the Analog Section PCB assemblies:

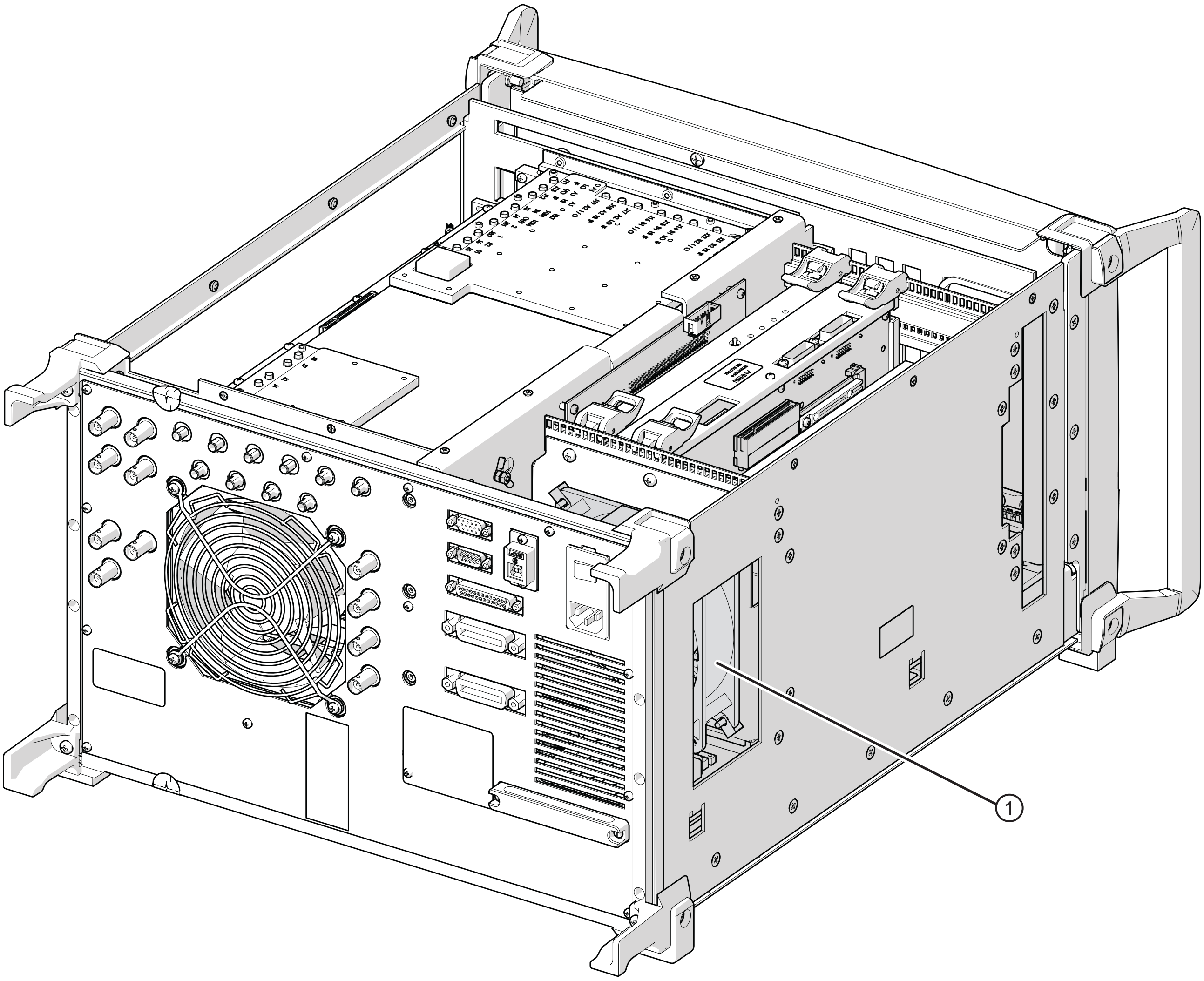
Mechanically, the Motherboard 1 PCB Assembly is mounted vertically on the chassis center plate in the Digital PCB Bay where its backplane connectors protrude through the chassis center plate into the Analog PCB Bay. The MB1 PCB edge connectors mate with backplane connectors on the horizontally-mounted Motherboard 2 (MB2) PCB Assembly located below the PCB Bays and above the RF Deck assembly.



1. MB1 – Motherboard 1 PCB Assembly – Mounted vertically.
2. Mounting Screws
3. Analog Bay
4. Digital Bay
5. Instrument Front

Figure 6-36. Motherboard 1 PCB Assembly – ND80355 – 3-80125-3

6-14 Digital Section Fan



1. Digital Section Fan

Figure 6-37. Digital PCB Fan Assembly

Chapter 7 — Adjustment Procedures

7-1 Introduction

This chapter provides information about adjustments required for the MS4640B Series Vector Network Analyzers. Most of these adjustments are typically driven by the VectorStar Application software on the VNA to fine-tune the system hardware for optimum performance.

The adjustments are typically performed as a result of replacement of sub-assemblies or RF components or because out-of-tolerance conditions have been noted during instrument key performance parameter testing (see Chapter 3, “Performance Verification”).

Note	Ensure that the instrument has warmed up for at least 90 minutes before proceeding.

These adjustments include:

- 10 MHz Frequency Reference Adjustment
- Source Pre-tune DAC Adjustment
- Source LO Level Adjustment
- SQM Power Adjustment (For Models MS4645B and MS4647B only)
- Source Auto Leveling Control Adjustment
- Analog In Adjustment
- Factory RF Calibration
- Factory Receiver Calibration
- Factory Phase Calibration
- LCD Touch Panel Calibration Adjustment

With the exception of the LCD Touch Panel Calibration Adjustment, perform these adjustments in the order listed if multiple adjustments are required.

Caution	Do not apply RF power to 5-20 GHz Doubler module or the Sampler/LO Distribution Assembly at any time when their outputs are not terminated as this will damage the components. Always disconnect the active component’s input cable first before disconnecting its output cable. Always connect the active component’s output cable first before re-connecting its input cable.

7-2 Recommended Test Equipment

Table 7-1 provides a list of recommended test equipment needed for the performance verification, calibration, and troubleshooting procedures presented in this manual.

Table 7-1. Recommended Test Equipment (1 of 2)

Instrument	Critical Specifications	Recommended Manufacturer Model Number
Frequency Counter	Frequency: 10 MHz Input Impedance: 50 Ohm	Anritsu Model MF2412B or MF2412C
Frequency Reference	Frequency: 10 MHz	Symmetricom Model RubiSource T&M
Power Meter	Power Range: –70 to +20 dBm	Anritsu Model ML2438A
Power Sensor	Frequency: 70 kHz to 70 GHz Connector Type: V	Anritsu Model SC7770 • The SC7770 70 kHz to 70 GHz Power Sensor is required for supporting MS4647B and other models with Option 70. A standard thermal power sensor with 10 MHz starting frequency (such as the MA24004A or MA24005A) can be used for adjusting non-Option 70 units as long as it covers the top frequency of the instrument. Quantity: 2 • Using two SC7770 power sensors for power leveling-related adjustment provides a more convenient way to adjust both Port 1 and Port 2 without physically moving the power sensor from Port 1 to Port 2. The VectorStar application software also supports the use of only one power sensor for hardware adjustment.
Adapter	Type: N (m) to K (f)	Anritsu Model 34NKF50
Adapter	Type: V (f) to K (m)	Anritsu Model 34VFK50 Quantity: 2
Adapter	Type: V (f) to K (f)	Anritsu Model 34VFKF50 Quantity: 2
Adapter	Type: V (f) to V (f)	Anritsu Model 34VFVF50C Quantity: 2
Adapter	Type: N (m) to V (m)	Pasternack Model PE9718
Attenuator	Type: K (m) to K (f) Attenuation: 20 dB	Anritsu Model 43KC-20
Attenuator	Type: SMA (m) to SMA (f) Attenuation: 7 dB	Aeroflex/Inmet Model 18B-7
Calibration Kit	Connector Type: K	Anritsu Model 3652A K Connector or Anritsu Model 3652A-1 K Connector with Sliding Loads

Table 7-1. Recommended Test Equipment (2 of 2)

Instrument	Critical Specifications	Recommended Manufacturer Model Number
Calibration Kit	Connector Type: V	Anritsu Model 3654D V Connector or Anritsu Model 3654D-1 V Connector with Sliding Loads
Coaxial Cable	Frequency: DC to 40 GHz Connector Type: K (m) to K (f)	Anritsu Model 3670K50-2
Coaxial Cable	Frequency: DC to 70 GHz Connector Type: V (m) to V (f)	Anritsu Model 3670V50A-2
PC Keyboard	Interface: PS/2 or USB 2.0, US English	Any
PC Mouse	Interface: PS/2 or USB 2.0	Any

7-3 Recommended Adjustment Procedures

Table 7-2 lists the adjustments that should be performed following the replacement of many MS464xB sub-assemblies or RF components.

Table 7-2. Required Replacement Assembly Adjustments (1 of 4)

Sub-Assembly or RF Component Replaced	Perform the Following Adjustment(s)	Procedure Sections
***Note 1*: Perform all adjustment procedures if original Cal Data files are not available.**		
Front Panel Assembly	LCD Touch Panel Adjustment	7-14
SBC (CPU) PCB Assembly	None	–
USB Controller PCB Assembly	None	–
Graphics Processor Unit (GPU) PCB Assembly	None	–
GPIB Module	None	–
Carrier Board (CB) PCB Assembly	None	–
Digital Signal Processor (DSP) PCB Assembly	All (See Note 1 above)	–
Solid State Drive (SSD) Assembly	None	–
Power Supply	None	–
RF Component Control PCB Assembly	High Band Source Auto-Leveling Control Adjustment	7-9
Low Band Receiver Module PCB Assembly	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
IF Band Module	10 MHz Frequency Reference Adjustment	7-5
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
RF Source Module	Source Pre-tune DAC Adjustment	7-6
	Source LO Level Adjustment	7-7
	SQM Power Adjustment (MS4645B and MS4647B only)	7-8
	Source Auto Leveling Control (Source ALC) Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Second Source Module	Source Pre-tune DAC Adjustment	7-6
	SQM Power Adjustment (MS4645B and MS4647B only)	7-8
	Port 2 Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration	7-13
Low Band Bridge, Reference or Test	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13

Table 7-2. Required Replacement Assembly Adjustments (2 of 4)

Sub-Assembly or RF Component Replaced	Perform the Following Adjustment(s)	Procedure Sections
***Note 1*: Perform all adjustment procedures if original Cal Data files are not available.**		
High Band Coupler, Reference or Test	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Low Band Transfer Switch	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
High Band Transfer Switch	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
5-20 GHz Doubler Module	SQM Power Adjustment (MS4645B and MS4647B only)	7-8
	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Switched Doubler Module	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Switched Quadrupler Module	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Level Detector, Port 1 or Port 2	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
Diplexer/Bias Tee Module	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Port 1 Source Step Attenuator, Low Band or High Band	Port 1 Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Port 1 Test Step Attenuator, Low Band or High Band	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13

Table 7-2. Required Replacement Assembly Adjustments (3 of 4)

Sub-Assembly or RF Component Replaced	Perform the Following Adjustment(s)	Procedure Sections
***Note 1*: Perform all adjustment procedures if original Cal Data files are not available.**		
Port 2 Source Step Attenuator, Low Band or High Band	Port 2 Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Port 2 Test Step Attenuator, Low Band or High Band	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
LO Distribution Module	Source LO Level Adjustment	7-7
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
Sampler Module	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
LO Coupler (Unit with Option 8x)	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
RF Coupler (Unit with Option 8x)	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration (Unit with Option 31 only)	7-13
Forward Coupler (Unit with Option 31)	Source Auto Leveling Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration	7-13
Port 2 Switch (Unit with Option 84/85)	Port 2 Source Auto Level Control Adjustment	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration	7-13
Port 2 Switch (Unit with Option 32)	Port 2 Source Auto Level Control Adjustment	7-9
	Source 2 Redirected Out Port 1 ALC Calibration	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration	7-13
Source 2 to Port 1 Coupler (Unit with Option 32)	Port 1 Source Auto Level Control Adjustment	7-9
	Source 2 Redirected Out Port 1 ALC Calibration	7-9
	Factory RF Calibration	7-11
	Factory Receiver Calibration	7-12
	Factory Phase Calibration	7-13

Table 7-2. Required Replacement Assembly Adjustments (4 of 4)

Sub-Assembly or RF Component Replaced	Perform the Following Adjustment(s)	Procedure Sections
***Note 1*: Perform all adjustment procedures if original Cal Data files are not available.**		
Front Panel Direct Access Loops (Systems with Option 51, 61, or 62)	Factory RF Calibration	7-11
Switch Control PCB Assembly (Systems with Option 84/85)	None	–

7-4 Adjustment Setup

With the exception of the LCD Touch Panel Calibration Adjustment, the hardware adjustment functions are accessed by selecting the Diagnostics button under the System Menu. The Diagnostics Menu is password-protected to prevent a casual VNA user from changing the correction coefficients inadvertently.

Procedure

To access the DIAGNOSTICS menu, do the following:

1. Plug in the PC keyboard and PC Mouse to the rear panel of the VNA.
2. Power on the VNA and wait until the VectorStar application is running.
3. Press the **System** key on the front panel.
4. Select the Diagnostics button on the right-side menu.
5. The DIAGNOSTICS ACCESS dialog box appears providing an entry field to enter the diagnostics access password as shown in Figure 7-1.

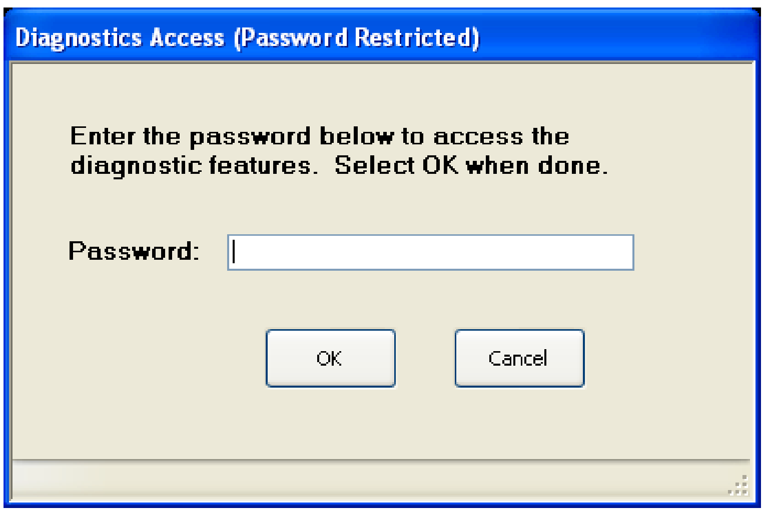


Figure 7-1. Password to Enter Diagnostics

6. Enter the password CajaNueva in the Password field and click OK.
7. The DIAGNOSTICS menu appears as shown in Figure 7-2 on page 7-9.
8. Select Hardware Cal to access the HARDWARE CAL menu as shown in Figure 7-3 on page 7-10.

Figure 7-2. DIAGNOSTICS Menu

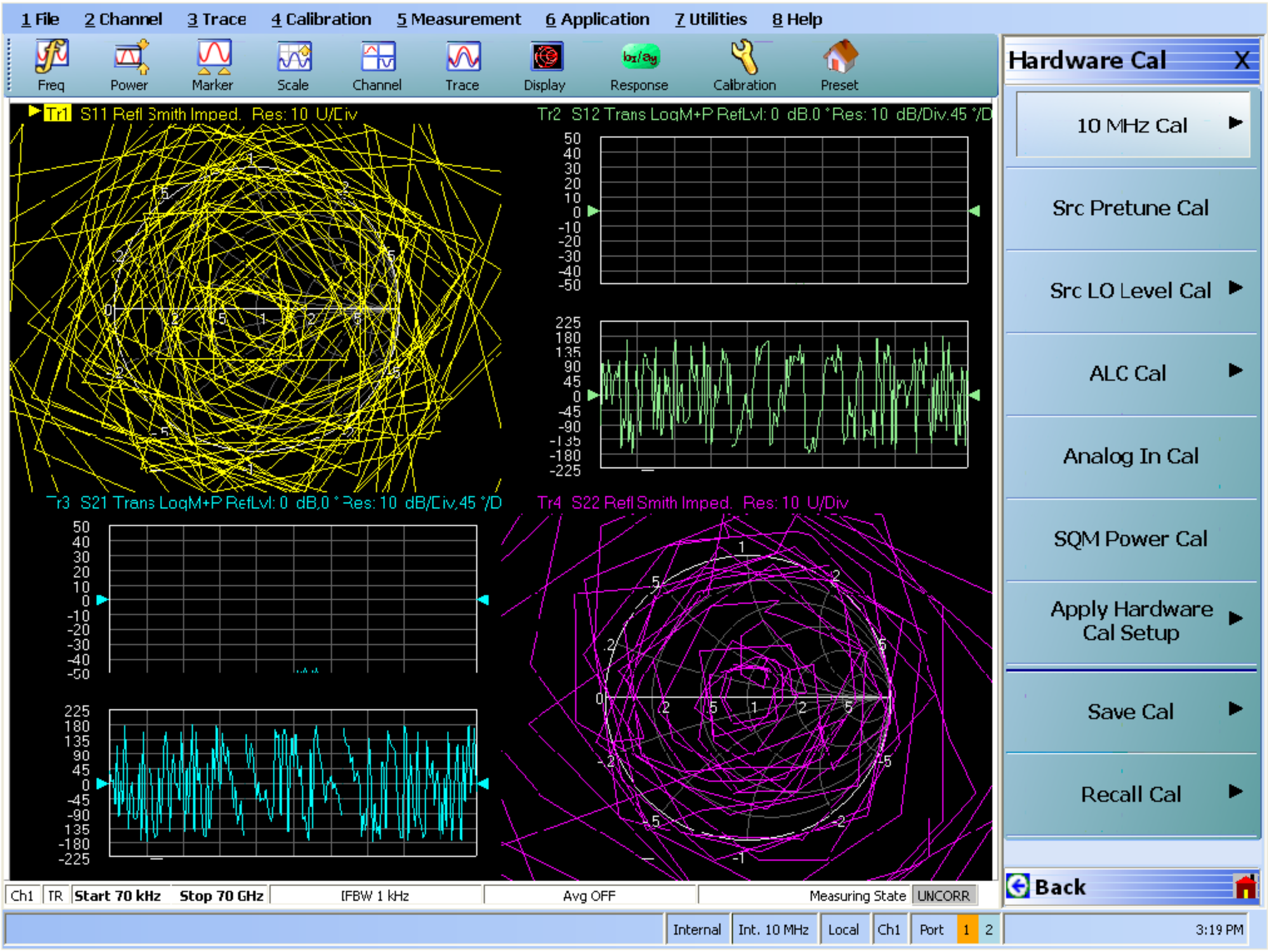


Figure 7-3. HARDWARE CAL Menu

9. Select Factory Cal to access the FACTORY CAL menu with its RF Cal, Rcvr Cal, and Phase Cal sections as shown in Figure 7-4.

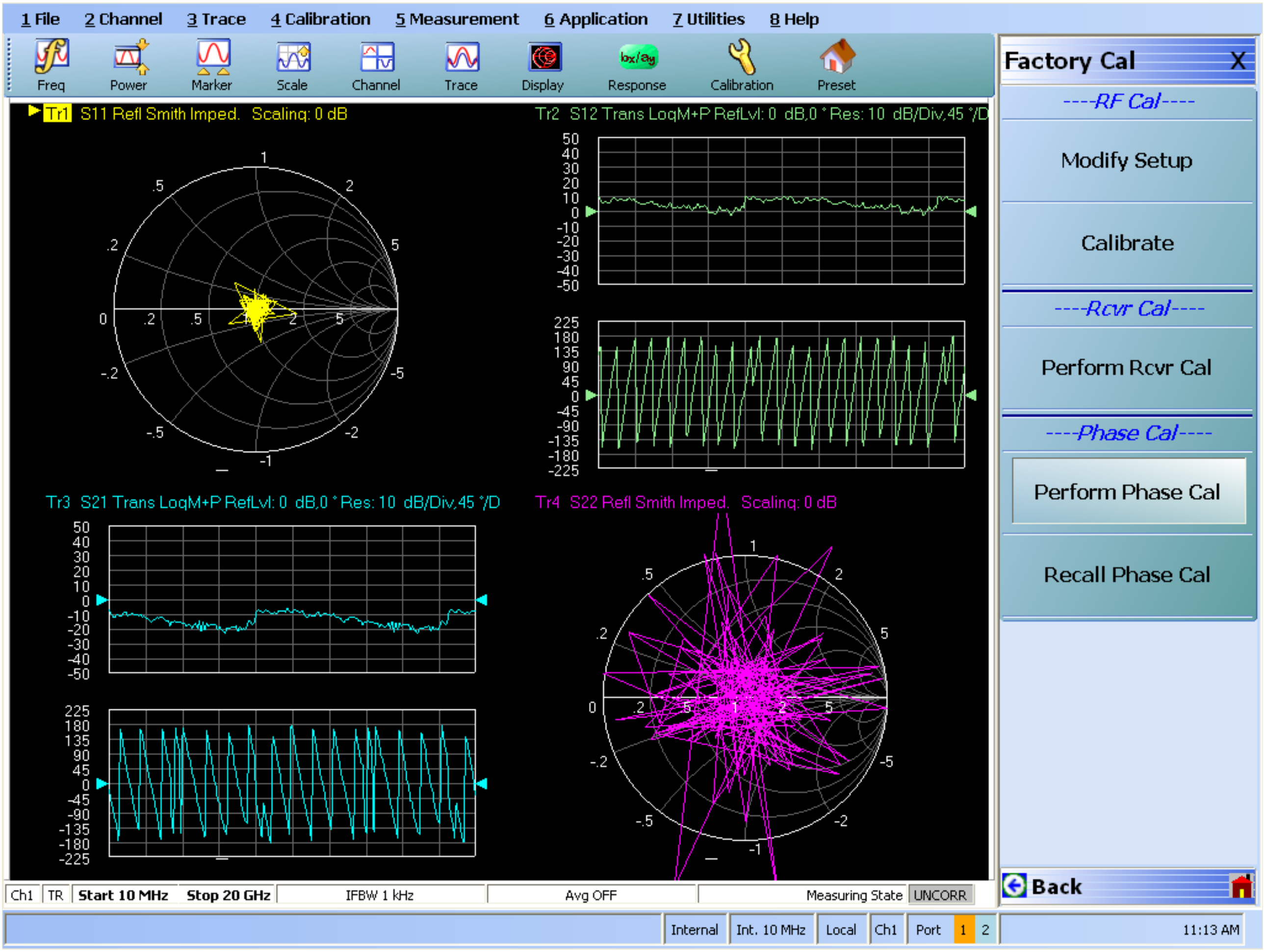


Figure 7-4. FACTORY CAL Menu

7-5 10 MHz Frequency Reference Adjustment (10 MHz Cal)

The 10 MHz calibration adjusts the frequency accuracy of the 10 MHz Reference Oscillator of the MS4640B. Two methods, Automatic or Manual, can be used for this adjustment.

Automatic Method Required Equipment

- Anritsu Model MF2412B or MF2412C Frequency Counter
- 10 MHz Reference Timebase
- GPIB Interface Cable
- RF Coaxial Cable, K(m) to K (f)
- Adapter, V (f) to K(m)
    - Only for MS4645B and MS4647B VNAs

Automatic Procedure

1. Connect the Frequency Counter 10 MHz Reference In to the 10 MHz Reference Timebase.
2. Connect the GPIB Interface Cable between the VNA Dedicated GPIB port and the Frequency Counter GPIB port.
3. Warm up both the Frequency Counter and the VNA for at least 90 minutes.
4. Access the HARDWARE CAL menu as described above in Section 7-4, “Adjustment Setup” on page 7-8.
5. Select the 10 MHz Cal button and the 10 MHz CALIBRATION (AUTOMATIC) dialog box appears as shown in Figure 7-5.
6. Connect a coaxial cable between the frequency counter input port and VNA port 1.
7. Click the Start Cal button to begin the adjustment.
8. Click the Close button when the calibration is complete

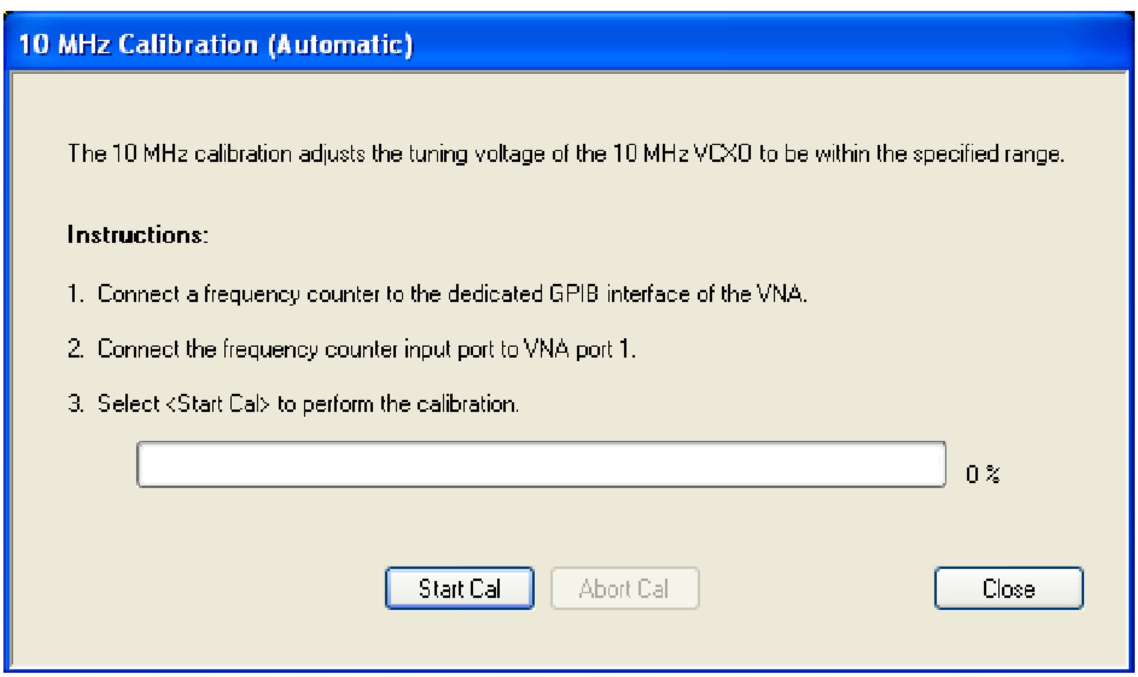


Figure 7-5. 10 MHz Calibration: Automatic

Manual Method Required Equipment

- Any Frequency Counter with top frequency coverage > 17 GHz
- 10 MHz Reference Timebase
- RF Coaxial Cable, K(m) to K (f)
- Adapter, V (f) to K(m)
    - Only for MS4645B and MS4647B VNAs

Manual Method Procedure

1. Connect the Frequency Counter 10 MHz Reference In to the 10 MHz Reference Timebase.
2. Warm up both the Frequency Counter and the VNA for at least 90 minutes.
3. Access the HARDWARE CAL menu as described above in Section 7-4, “Adjustment Setup” on page 7-8.
4. Select the 10 MHz Cal button and the 10 MHz CALIBRATION (MANUAL) dialog box appears as shown in Figure 7-6.
5. Connect a coaxial cable between the frequency counter input port and VNA port 1.
6. Change the DAC Number by clicking the up or down arrow button until the frequency counter reads 17 GHz ± 700 Hz.
7. Click the Save Change button to save the DAC value.
8. Click the Close button to complete the adjustment.

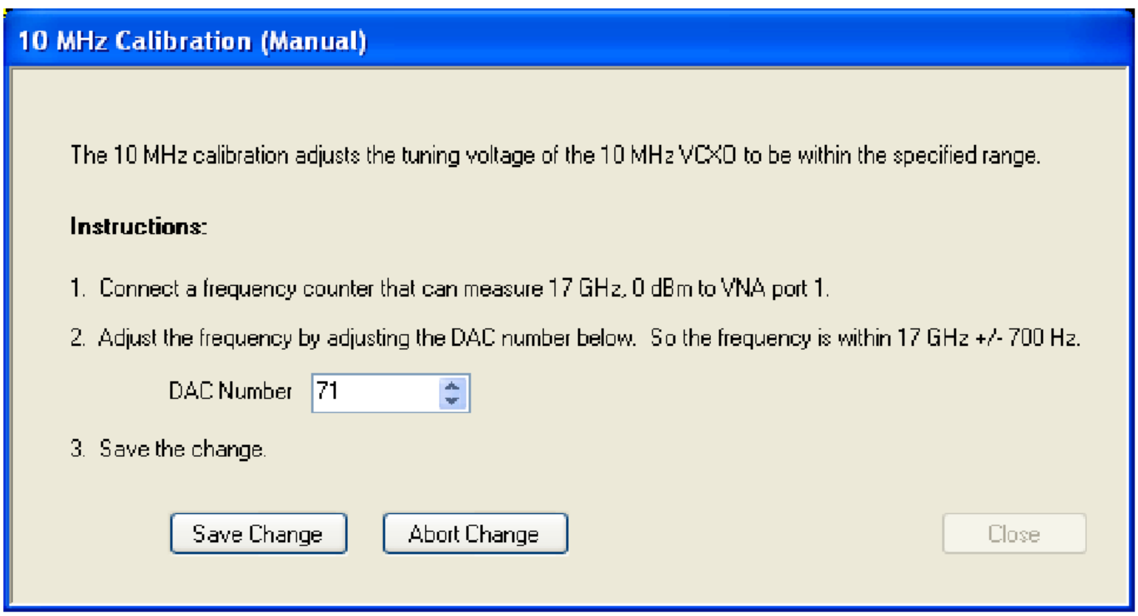


Figure 7-6. 10 MHz CALIBRATION: MANUAL METHOD Dialog

7-6 Source Pretune DAC Adjustment (Src Pretune Cal)

This calibration adjusts the pre-tune DAC values for the RF Source Module.

Equipment Required

- None

Procedure

1. Warm up the VNA for at least 90 minutes.
2. Access the HARDWARE CAL menu as described above in Section 7-4, "Adjustment Setup" on page 7-8.
3. Select Src Pretune Cal button and the CALIBRATION PROGRESS dialog box appears as shown in Figure 7-7.
4. The dialog box will close by itself when the calibration is completed successfully.

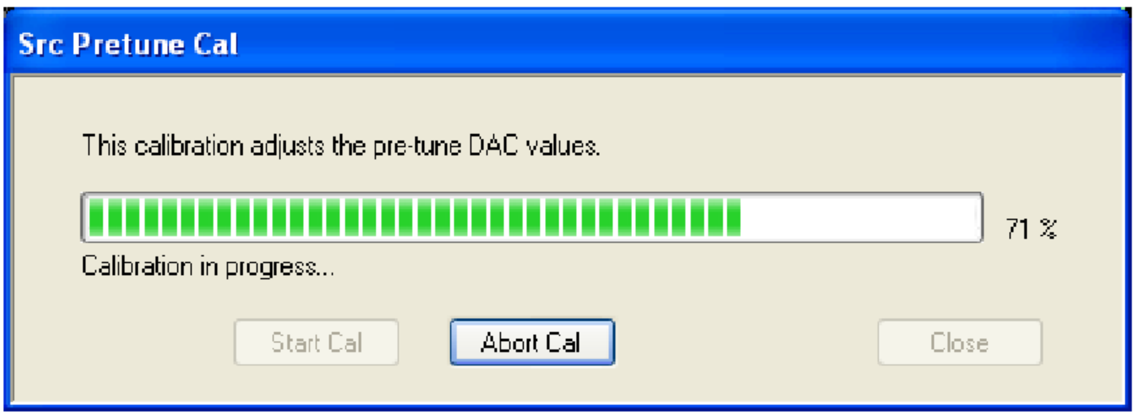


Figure 7-7. SRC (SOURCE) PRETUNE CALIBRATION PROGRESS Dialog Box

7-7 Source LO Level Adjustment (Src LO Level Cal)

This adjustment optimizes the Source LO level into the samplers. It is required after the A111 LO Module has been replaced. Removal of the instrument external cover is required.

Equipment Required

- Anritsu ML2438A Power Meter
- Anritsu SC7770 Power Sensor or MA244xD Power Sensor
- Anritsu 34NKF50 N (m) to K (f) Adapter
- Anritsu 34VFK50 V (f) to K (m) Adapter
- Anritsu 34VFKF50 V (f) to K (f) Adapter
- Anritsu 43KC-20 20 dB Fixed Attenuator
- Anritsu 3670K50-2 or 3670V50A-2 Through cable
- Aeroflex/Inmet 18B-7 7 dB Fixed Attenuator
- GPIB Interface cable

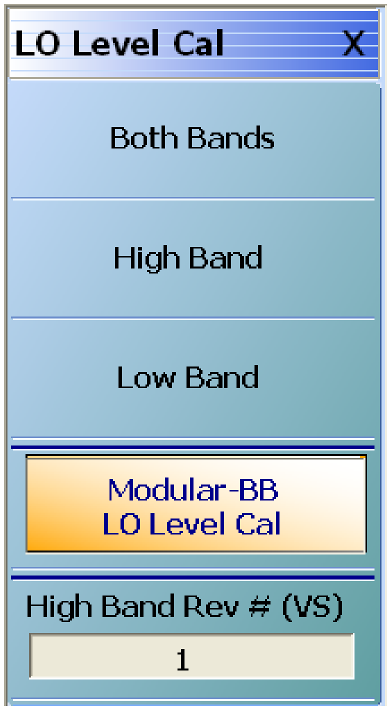
Procedure

Caution	The RF output level from the instrument component exceeds the damage level of the power sensor. Follow the procedure steps below closely, especially where a protective fixed attenuator is attached to the power sensor.

1. Remove the outer cover and lay the VNA with its left side down on an anti-static safe workstation.
2. Connect a GPIB Interface cable between the Power Meter GPIB port and the VNA Dedicated GPIB port.
3. Warm up the VNA and power meter for at least 90 minutes.

Low Band LO Level Adjustment

4. Connect the **34VFK50 Adapter** to the power sensor.
5. Connect the **34NKF50 Adapter** to the power meter Calibrator port.
6. Connect the power sensor with adapter to the Calibrator port of the power meter and then perform a Zero/Cal on the power sensor.
7. Disconnect the power sensor with the **34VFK50 Adapter** attached to its input.
8. Access the HARDWARE CAL menu as described above in Section 7-4, “Adjustment Setup” on page 7-8.
9. Select the Src LO Level Cal button. The LO CAL menu appears as shown in Figure 7-8.



• Set the **High Band Rev # (VS)** to 1 (one).

Figure 7-8. LO LEVEL CAL Menu and High Band Rev (VS) Setting

10. Select the Low Band button. The SRC LO LEVEL CAL (LOW BAND) CALIBRATION dialog box appears as shown in Figure 7-9. Do not start the calibration yet.

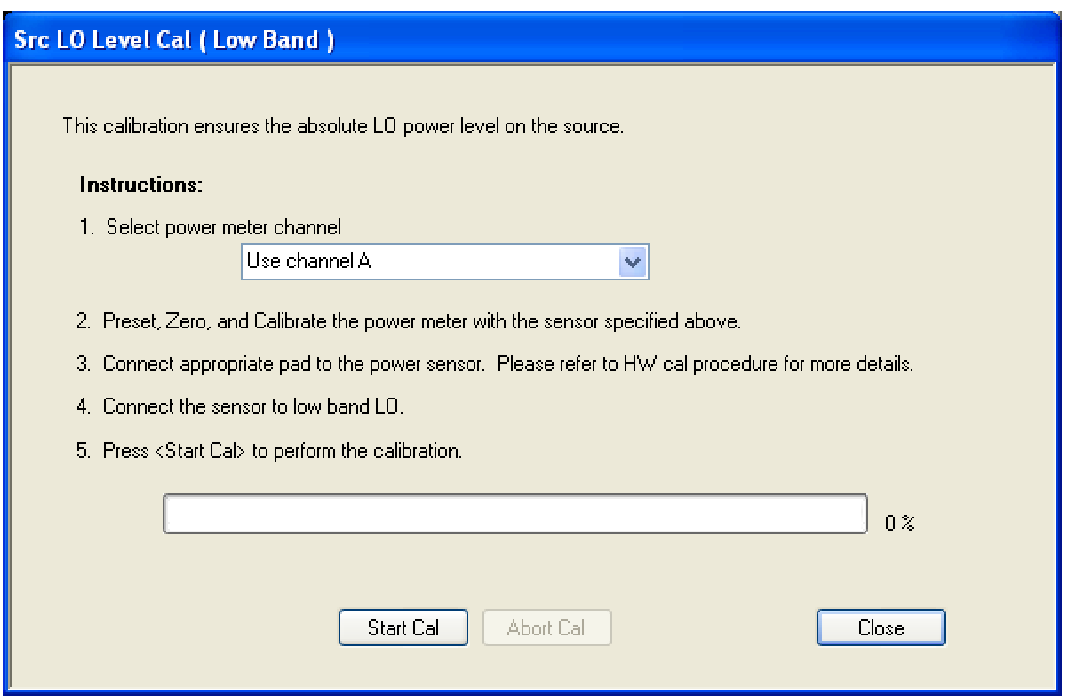
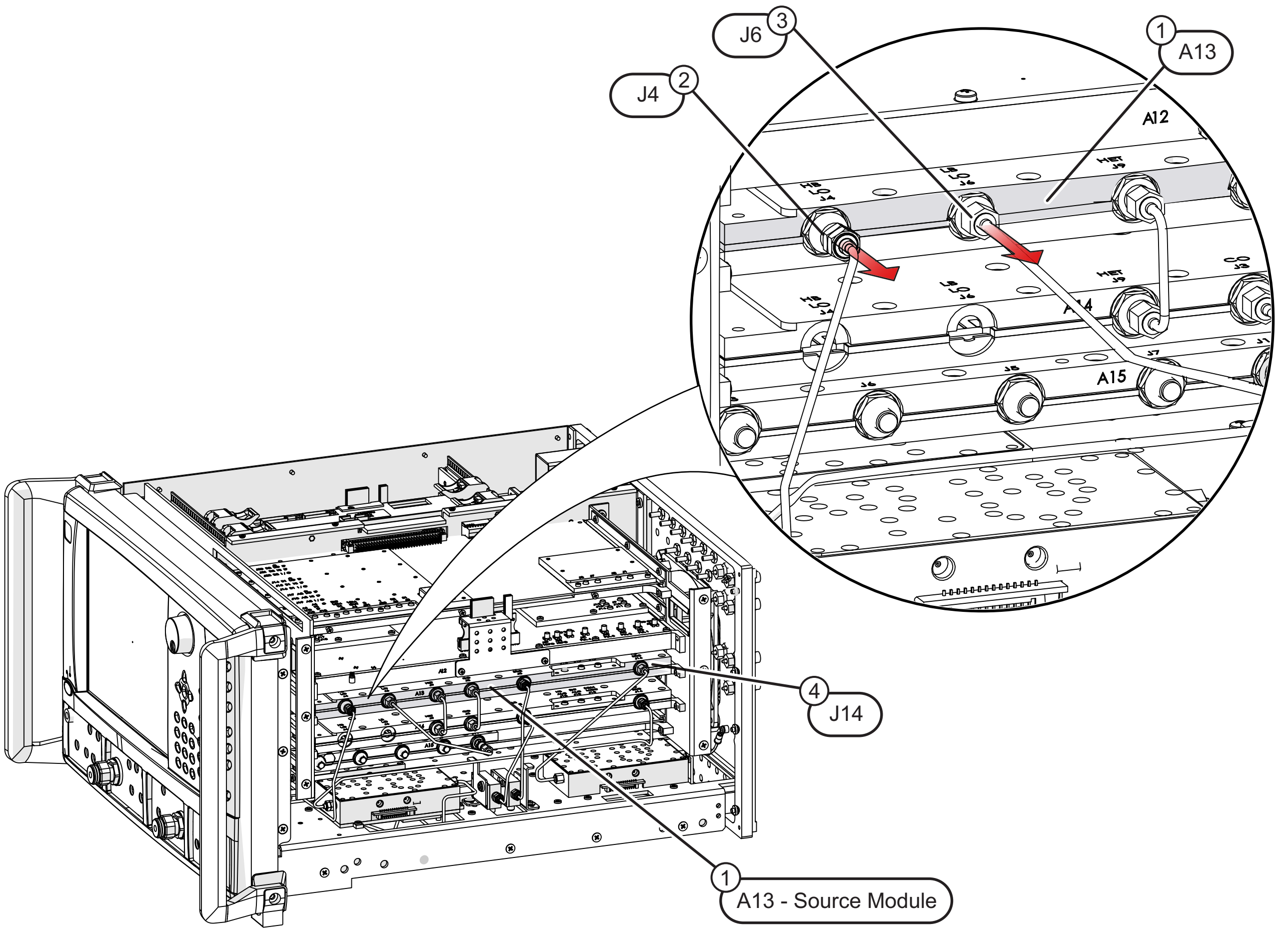


Figure 7-9. SRC LO LEVEL CAL (LOW BAND) CALIBRATION Dialog Box

11. Disconnect the **Low Band LO Output** cable from **J6 LB LO1 OUT** on the middle A13 RF Source Module as shown in Figure 7-10.



1. A13 Source Module 2. A13 J4 HB LO1 OUT – High Band Local Oscillator 1 Output	3. A13 J6 LB LO1 OUT – Low Band Local Oscillator 1 Output 4. A13 J14 HB OUT – High Band Output

Figure 7-10. J4, J6, and J14 Connector Locations – A13 RF Source Module

12. Connect the 7 dB fixed attenuator to the K connector end of 34VFK50 Adapter that is attached to the power sensor. Then connect the power sensor with Adapter and Attenuator to J6 LO1 OUT connector of the RF Source.
13. On the MS4640B, click on the Start Cal button to start the calibration.
14. When calibration is complete, close the dialog box.
15. Disconnect the power sensor and reconnect **Low Band LO Output** cable to **J6 LB LO1 OUT** of the RF Source Module. Re-torque the connection using 5/16” 8 lbf · in (8 mm 0.9 N · m) torque wrench.

High Band LO Level Adjustment

Caution	Do not apply RF power to the Sampler/LO Distribution Assembly at any time when their outputs are not terminated as this will damage the components. Always disconnect the active component's input cable first before disconnecting its output cable. Always connect the active component's output cable first before re-connecting its input cable. It is very important to perform the next two steps in the order presented.

16. At the A13 RF Source Module, disconnect the **High Band LO Output** cable from **J4 HB LO1 OUT** connector as shown in Figure 7-10 on page 7-17. This is done to prevent damage to the Sampler/LO Distribution Assembly.

Power Sensor Attachment – Standard Configuration

17. If Option 8x is *not* installed, follow these steps to attach a power sensor.

a. Disconnect the semi-rigid cable from the J2 LO Input of the A103 Sampler. Gently bend the cable out towards the front of the instrument. See Figure 7-11 on page 7-19.

b. On the power sensor, replace the **7 dB Fixed Attenuator** with a **20 dB Fixed Attenuator**. Connect the **34VFKF50 Adapter** to the end of the 20 dB Fixed Attenuator.

c. Connect the power sensor with the Attenuator and Adapter to the free end of the semi-rigid cable that was disconnected from A103 J2.

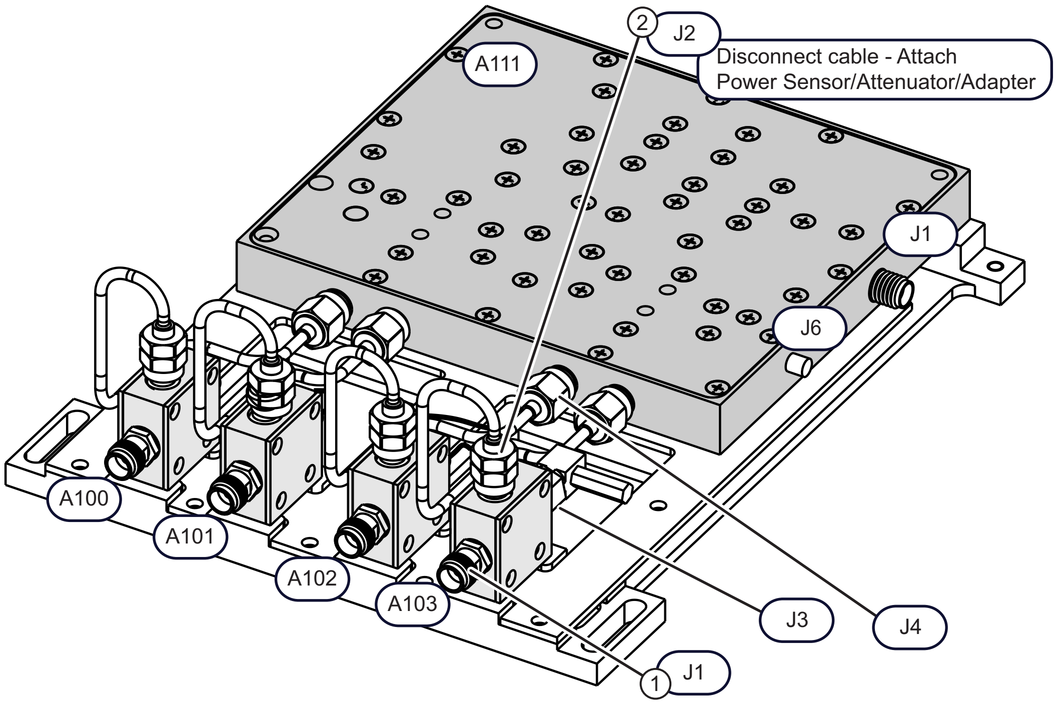
Power Sensor Attachment – Option 8x Configuration

18. If Option 8x is installed, follow these steps to attach a power sensor.

a. Disconnect the semi-rigid cable from the J1 port of the A132 LO Coupler Module. Gently bend the cable out towards the front of the instrument. See Figure 7-12 on page 7-19.

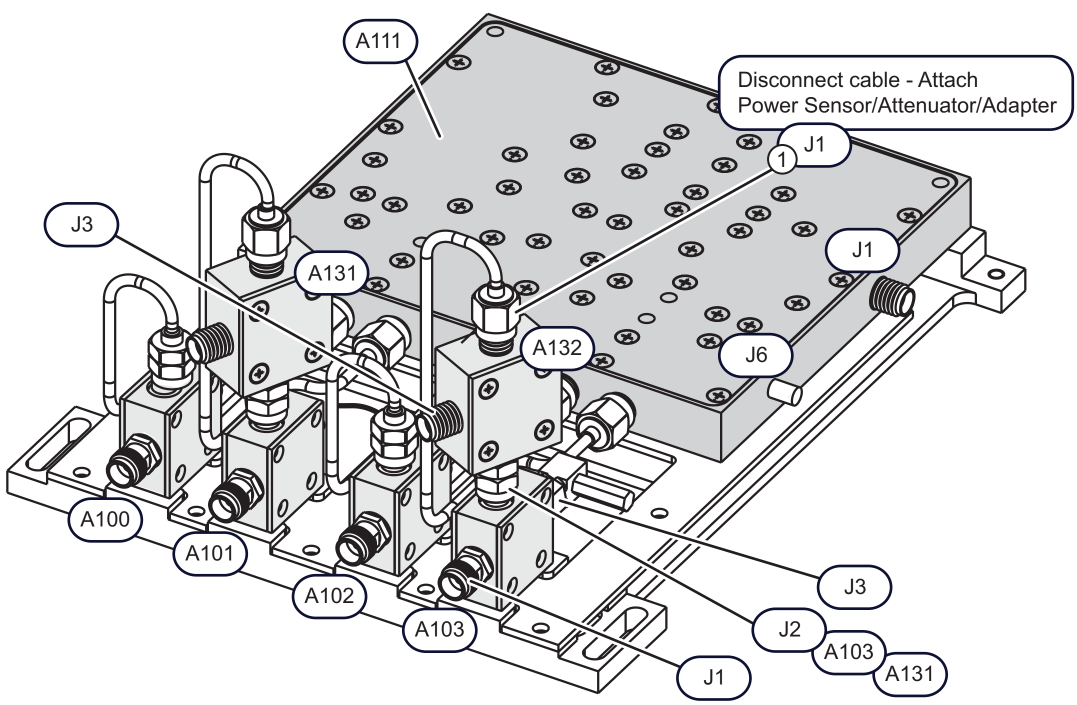
b. On the power sensor, replace the **7 dB Fixed Attenuator** with a **20 dB Fixed Attenuator**. Connect the **34VFKF50 Adapter** to the end of the 20 dB Fixed Attenuator.

c. Connect the power sensor with the Attenuator and Adapter to the free end of the semi-rigid cable that was disconnected from A132 J1.



1. J2 of A103 Sampler Module – Disconnected to attach power sensor with attenuator and adapter to cable end.

Figure 7-11. Standard Configuration – High Band LO Cal Point for a2 on J2 of A103



1. J1 of A131 LO Coupler Module – Disconnected to attach power sensor with attenuator and adapter to cable end.

Figure 7-12. Option 8x High Band LO Cal Point for a2 on J1 of A132

Adjustment Steps

19. Re-connect the **High Band LO Output** cable to **J4 HB LO1 OUT** connector of A13 RF Source Module. See Figure 7-10 on page 7-17.
20. On the MS4640B user interface, set the High Band Rev # (VS) to 1 (one).
21. On the MS4640B, click on the High Band button and the SRC LO LEVEL CAL (HIGH BAND) CALIBRATION dialog box appears as shown in Figure 7-13 on page 7-20.

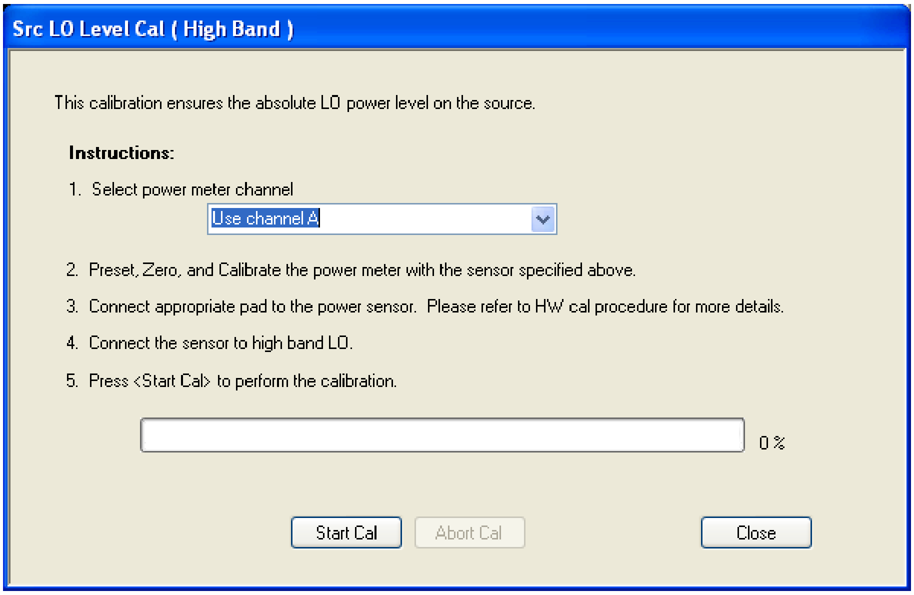


Figure 7-13. Src LO LEVEL CAL (HIGH BAND) CALIBRATION Dialog Box

22. Click on the Start Cal button to start the calibration.
23. When complete, close the dialog box.
24. Disconnect the **High Band LO Output** cable from **J4 HB LO1 OUT** connector of RF Source Module as shown in Figure 7-11 on page 7-19 above. This is done to prevent damage to the Sampler/LO Distribution Assembly.

Disconnect Power Sensor – Standard Configuration

25. Disconnect the power sensor with the Attenuator and Adapter from the free end of the semi-rigid cable that was disconnected from A103 J2 and carefully reconnect the cable to J2 of A103 as shown in Figure 7-11 on page 7-19.
26. Reconnect the **High Band LO Output** cable from **J4 HB LO1 OUT** connector of RF Module as shown in Figure 7-11 on page 7-19 above.

Disconnect Power Sensor – Option 8x Configuration

27. Disconnect the power sensor with the Attenuator and Adapter from the free end of the semi-rigid cable that was disconnected from J1 of A132 and carefully reconnect the cable to J1 as shown in Figure 7-11 on page 7-19.
28. Reconnect the **High Band LO Output** cable from **J4 HB LO1 OUT** connector of RF Module as shown in Figure 7-11 on page 7-19 above.

Final Steps

29. Re-torque all connections that were loosened in this procedure using a 5/16” 8 lbf · in (8 mm 0.9 N · m) torque wrench.
30. Re-install the outer cover.

Low Band LO Level Optimization

The following steps are used to improve the Low Band Noise Floor performance.

31. Verify that the Noise Floor below 2.5 GHz is within specifications by performing the Noise Floor Test as described in Chapter 3, "Performance Verification". If the Noise Floor below 2.5 GHz meets specifications, skip this procedure.

32. Select Save Cal and then Src LO Level Cal to save the LO Cal Table data file ("`LOCal.slc`") to the default `Data` folder.

33. Open Windows Explorer and navigate to the `C:\AnritsuVNA\Data` folder.

34. Open the "`LOCal.slc`" file with Windows Notepad.

35. Locate the `<LowBand>` section and decrease the DAC values of `Point_8` through `Point_12` (500 MHz to 800 MHz) by 2000 as shown in the code listing in Figure 7-14, "Location of Low Band DAC Values that Require Modification" on page 7-22.

36. Save the file as "`LOCal_new.slc`."

Note	When using Notepad, add quotation marks (") around the new file name; otherwise, Notepad will append ".txt" to the file name.

37. Select Recall Cal and then Src LO Level Cal to load the new modified data from "`LOCal_new.slc`" back to the internal memory of the instrument.

38. Verify if the instrument passes the Noise Floor test in the low band (<2.5 GHz).

39. If the instrument still fails the Noise Floor test in the low band, repeat steps 12 through 16 until the instrument passes (decreasing the DAC values by 500 counts each attempt).

```
<LowBand>
   <CalVersion>1</CalVersion>
   <CheckSum>320</CheckSum>
   <TimeStamp>
      <Year>2008</Year>
      <Month>11</Month>
      <Day>5</Day>
      <Hour>15</Hour>
      <Minute>15</Minute>
      <Second>51</Second>
   </TimeStamp>
   <DacPts>30</DacPts>
   <!--freq;dacNum-->
   <Coefficients>
      <Point_0>12420000;5632</Point_0>
      <Point_1>13000000;5632</Point_1>
      <Point_2>21300000;5760</Point_2>
      <Point_3>50000000;5760</Point_3>
      <Point_4>100000000;4864</Point_4>
      <Point_5>200000000;4608</Point_5>
      <Point_6>300000000;4480</Point_6>
      <Point_7>400000000;4480</Point_7>
      <Point_8>500000000;4480</Point_8>
      <Point_9>600000000;5248</Point_9>
      <Point_10>700000000;5248</Point_10>
      <Point_11>750000000;5376</Point_11>
      <Point_12>800000000;5376</Point_12>
      <Point_13>900000000;4992</Point_13>
      <Point_14>1000000000;5376</Point_14>
      <Point_15>1125000000;5504</Point_15>
      <Point_16>1250000000;5760</Point_16>
      <Point_17>1375000000;6016</Point_17>
      <Point_18>1499000000;6144</Point_18>
      <Point_19>1499001000;5376</Point_19>
      <Point_20>1625000000;2048</Point_20>
      <Point_21>1750000000;2112</Point_21>
      <Point_22>1875000000;2304</Point_22>`
      <Point_23>2000000000;448</Point_23>
      <Point_24>2100000000;512</Point_24>
      <Point_25>2200000000;640</Point_25>
      <Point_26>2250000000;704</Point_26>
      <Point_27>2300000000;704</Point_27>
      <Point_28>2400000000;704</Point_28>
      <Point_29>2512349999;512</Point_29>
   </Coefficients>
</LowBand>
```


Changed values are highlighted in larger **bold** face font.

Figure 7-14. Location of Low Band DAC Values that Require Modification

7-8 SQM Power Adjustment (SQM Power Cal)

The adjustment insures that the SQM drive signal is at optimum level. This adjustment is required only for MS4645B and MS4647B models when the 5 GHz – 20 GHz Doubler, the A13 RF Source Module or the A14 Second Source Module (for units with Option 31) has been replaced.

Equipment Required

- Anritsu ML2438A Power Meter
- Anritsu SC7770 Power Sensor or Anritsu MA24005A Power Sensor
- Anritsu 34NK50 N(m) to K(m) Adapter
- Anritsu 34VFKF50 V(f) to K(f) Adapter
- Anritsu 43KC-20 20 dB Fixed Attenuator

Caution	Do not disconnect the output cable of the A113 5-20 GHz Doubler Module from the input of the A114 SQM at any time that RF power is applied to the 5-20 GHz Doubler Module. This will damage the 5-20 GHz Doubler Module. For units with Option 31, do not disconnect the output cable of the A213 5-20 GHz Doubler Module from the input of the A214 SQM at any time that RF power is applied to the 5-20 GHz Doubler Module. This will damage the 5-20 GHz Module. Follow the steps in the adjustment procedure closely to prevent damage to the 5-20 GHz Doubler Module.

Procedure

1. Remove the outer cover and lay the VNA with its left side down on an anti-static safe workstation.
2. Connect a **GPIB Interface cable** between the Power Meter GPIB port and the VNA Dedicated GPIB port.
3. Warm up the VNA and Power Meter for at least 90 minutes.
4. On the power meter, connect the **34NK50 Adapter** to the Calibrator output and connect the **34VFKF50 Adapter** to the power sensor input. Then, perform a ZERO/CAL on the power sensor.
5. Disconnect the Power Sensor with the **34VFKF50 Adapter** from the Power Meter Calibrator output.
6. On the MS4640B Series VNA, access the HARDWARE CAL menu as described above in Section 7-4, "Adjustment Setup" on page 7-8.
7. Select the SQM Power Cal button and the SQM CALIBRATION dialog box appears as shown in Figure 7-15, "SQM Power Cal Dialog Box" on page 7-24. Do not start the calibration yet.

Note	For units with Option 31, skip to Step 16 if only the Second Source Module or the A214 5-20 GHz Doubler Module has been replaced.

Note	For units with Option 31, select SQM Power Cal and then Port 1 SQM Cal. See Figure 7-16 on page 7-24. The SQM Power Cal – Source 1 dialog box appears as shown in Figure 7-17 on page 7-25.

8. Disconnect the RF semi-rigid cable from the J14 HB OUT connector of the A13 RF Source Module as shown in Figure 7-10, "J4, J6, and J14 Connector Locations – A13 RF Source Module" on page 7-17 above. This is done to prevent damage to the A113 5-20 GHz Double Module.
9. Disconnect the A113 5-20 GHz Doubler Module output RF semi-rigid cable from J1 Input connector of the A114 SQM as shown in Figure 7-19 on page 7-27.

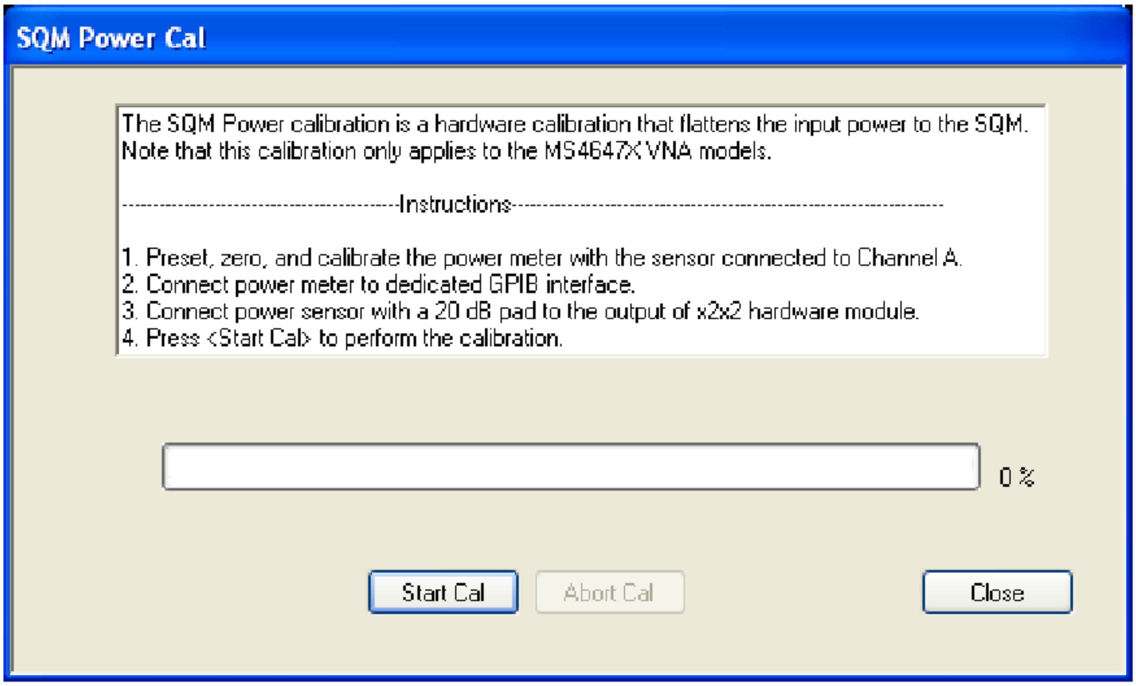


Figure 7-15. SQM Power Cal Dialog Box

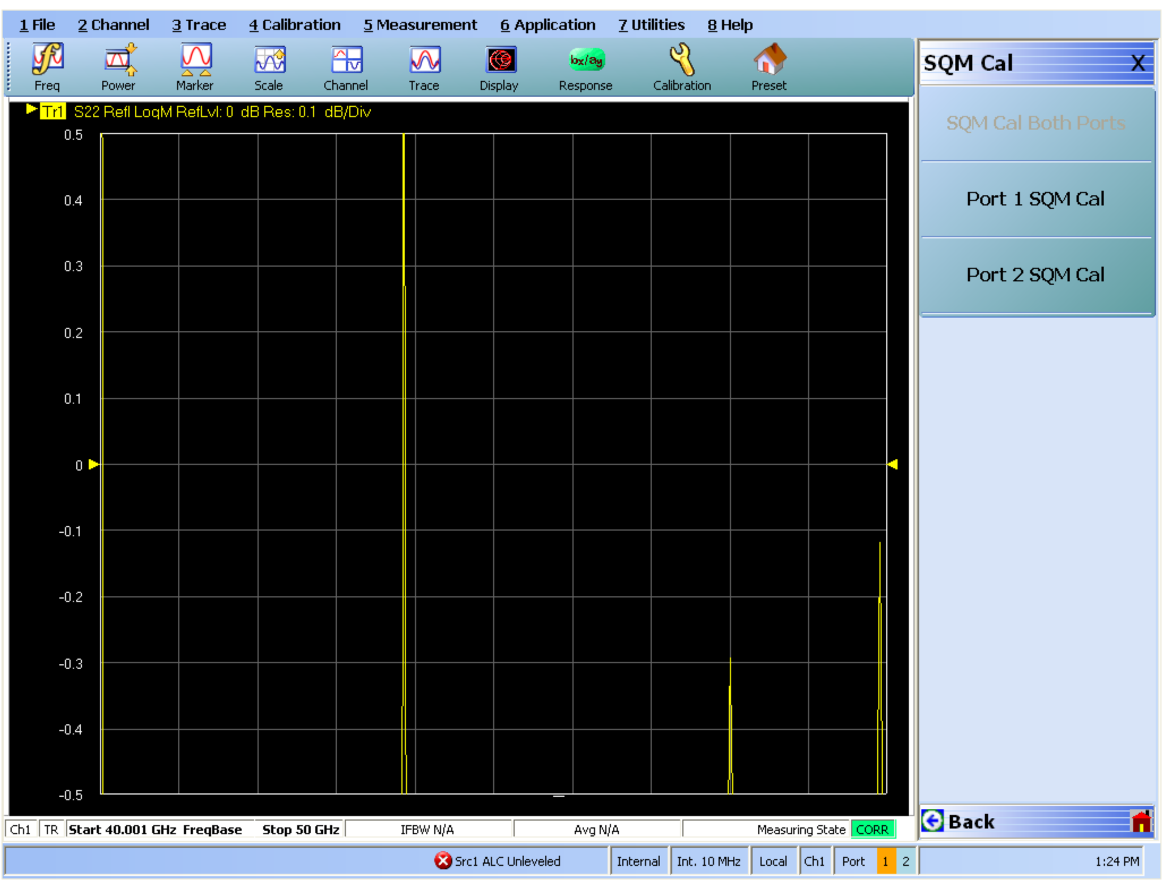


Figure 7-16. SQM Cal Menu (with Option 31)

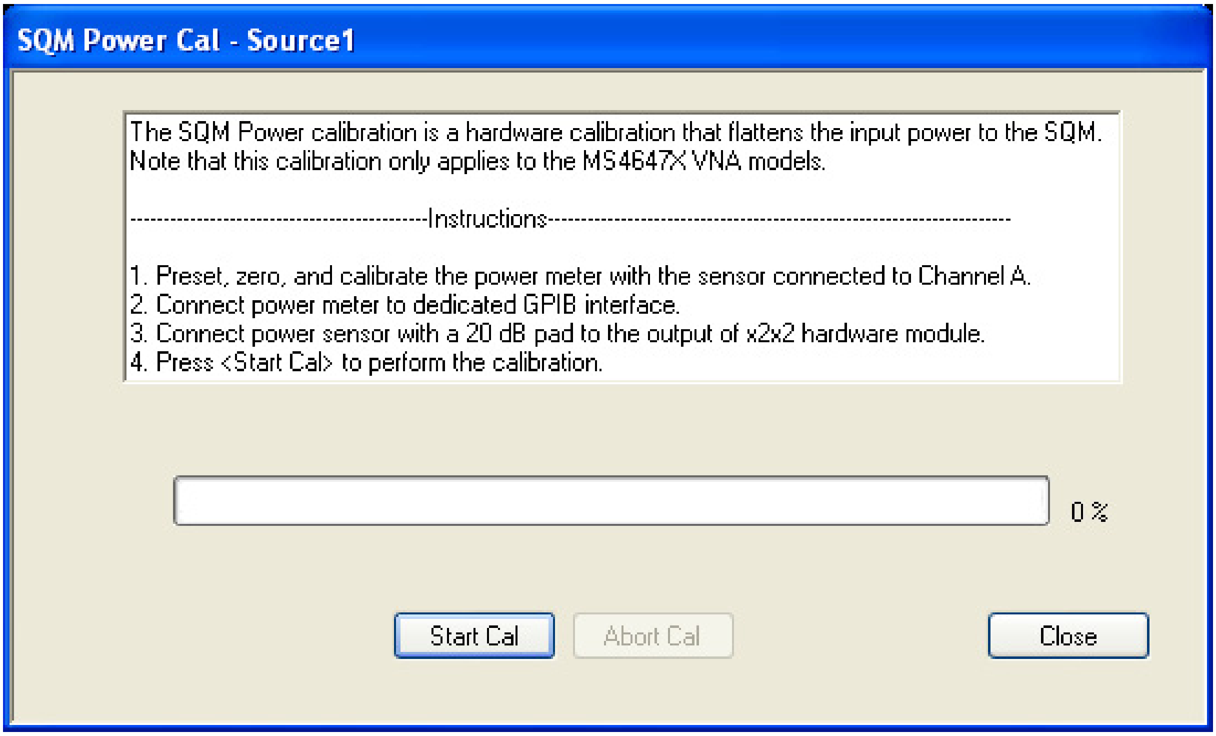


Figure 7-17. SQM Pwr Cal Src 1 Dialog (with Option 35)

10. Connect the **20 dB attenuator** to the adapter at the power sensor input and then connect the power sensor to the open end of A113 5-20 GHz Doubler Module output RF semi-rigid cable.
11. Re-connect the RF semi-rigid cable to the J14 HB OUT connector of the A13 RF Source Module.
    - See Figure 7-11 on page 7-19 above.
12. Click on Start Cal to begin calibration. When the calibration is complete at 100%, click the Close button to close the SQM Calibration dialog.
13. Disconnect the RF semi-rigid cable from the J14 HB OUT connector of the RF Source Module. This is done to prevent damage to the 5-20 GHz Double Module.
    - See Figure 7-11 on page 7-19 above.
14. Disconnect the power sensor with the 20 dB attenuator from the 5-20 GHz Doubler Module Output RF semi-rigid cable.
15. Re-connect the RF semi-rigid cable to J1 Input connector of the SQM and then re-connect the RF semi-rigid cable to J14 HB OUT connector of the RF Source Module.
    - See Figure 7-11 on page 7-19 above.
16. For units with Option 31, perform SQM calibration for the second source as follows:
    a. Disconnect the RF semi-rigid cable from the J14 HB OUT connector of the A14 Second Source module. This is done to prevent damage to the 5-20 GHz Doubler Module. See Figure 7-18 on page 7-26.
    b. Disconnect the A213 5-20 GHz Doubler Module output RF semi-rigid cable from J1 Input connector of the A214 SQM as shown in Figure 7-19 on page 7-27.
    c. Connect the power sensor with the 20 dB attenuator to the open end of A213 5-20 GHz Doubler output RF semi-rigid cable.
    d. Re-connect the RF semi-rigid cable to the J14 HB OUT connector of the A14 Second Source Module.

e. On the MS4640B, select Port 2 SQM Cal and the SQM Power Cal – Source 2 dialog box appears as shown in Figure x (SQMPwrCalSrc2DialogBox.bmp).

f. Click on Start Cal to begin calibration. Click on Close when the calibration is done.

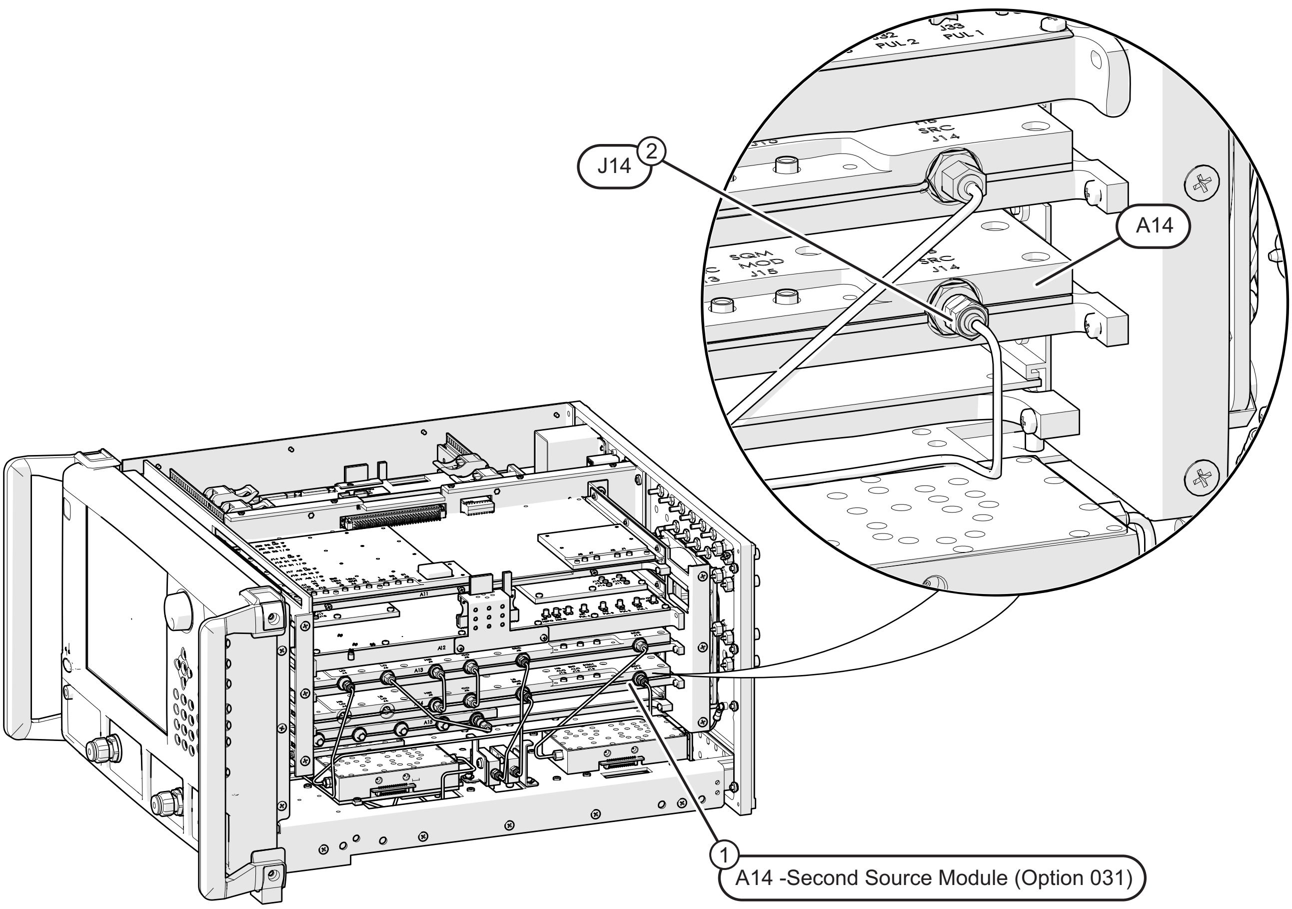
g. Disconnect the RF semi-rigid cable from the J14 HB OUT connector of the A14 Second Source Module. This is done to prevent damage to the 5-20 GHz Doubler Module.

h. Disconnect the power sensor with the 20 dB attenuator from the A213 5-20 GHz Doubler Module Output RF semi-rigid cable.

i. Re-connect the RF semi-rigid cable to J1 Input connector of the A214 SQM and then re-connect the RF semi-rigid cable to J14 HB OUT connector of the Second Source Module.

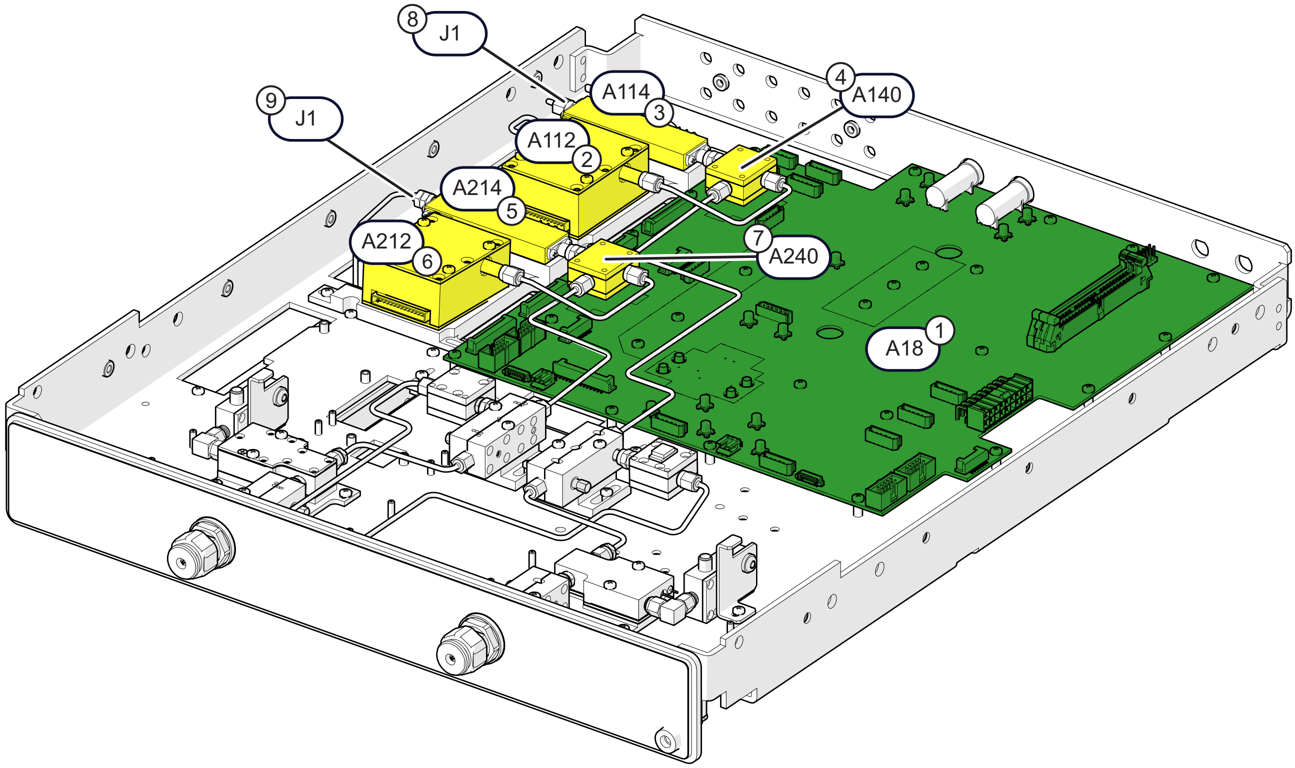
17. SQM calibration is now complete.

18. Power off the VNA and re-install the outer cover.



1. A14 Second Source Module A13 J4 HB LO1 OUT	2. J14 HB OUT

Figure 7-18. J14 HB OUT Connector Location – A14 RF Second Source Module (Option 31)



MS4645B / MS4647B VNA equipped with Option 31	5. A214 – Switched Quadrupler Module
1. A18 RF Component Control PCB Assembly	6. A212 – Switched Doubler Module
2. A112 Switched Doubler Module (SDM)	7. A240 – Forward Coupler
3. A114 Switched Quadrupler Module (SQM)	8. A114 SQM J1 – J1 Input Connector
4. A140 – Forward Coupler	9. A214 SQM J1 – J1 Input Connector

Figure 7-19. Location of SQM J1 Input Connectors on A114 and A214

7-9 Source Auto Leveling Control Adjustment (ALC Cal)

The Source ALC adjustment insures that the overall system power levels at Port 1 and Port 2 are flat across the full frequency band of the VNA.

There are three adjustments:

- "ALC Offset Cal" on page 7-30
- "Port 1 ALC Cal" on page 7-31
- "Port 2 ALC Cal" on page 7-32
- "Source 2 Redirected Out Port 1 ALC Cal (Option 32)" on page 7-33

Note	After the RF Source Module or Second Source Module has been replaced, perform ALC Offset Cal prior to doing other ALC Calibrations

Equipment Required

- Anritsu ML2438A Power Meter
- Anritsu SC7770 Power Sensor
- For Models MS4645B and MS4647B:
  - Anritsu 33VFVF50C V(f) to V(f) Adapter
  - Pasternack PE9718 N(m) to V(m) Adapter
- For Models MS4642B and MS4644B:
  - Anritsu 34NK50 N(m) to K(m) Adapter
  - Anritsu 34VFKF50 V(f) to K(f) Adapter
- GPIB Interface Cable

Procedure

1. Connect the GPIB interface cable between the VNA Dedicated GPIB port and the Power Meter GPIB port.
2. Warm up the VNA and Power Meter for at least 90 minutes.
3. Preset the VNA.
4. On the MS4640B Series VNA, access the HARDWARE CAL menu:

   Main | System | Diagnostics | Hardware Cal | ALC Cal | ALC Level Cal | ALC Cal
5. Select the ALC Cal button and the ALC CAL menu appears as shown in Figure 7-20 on page 7-29.

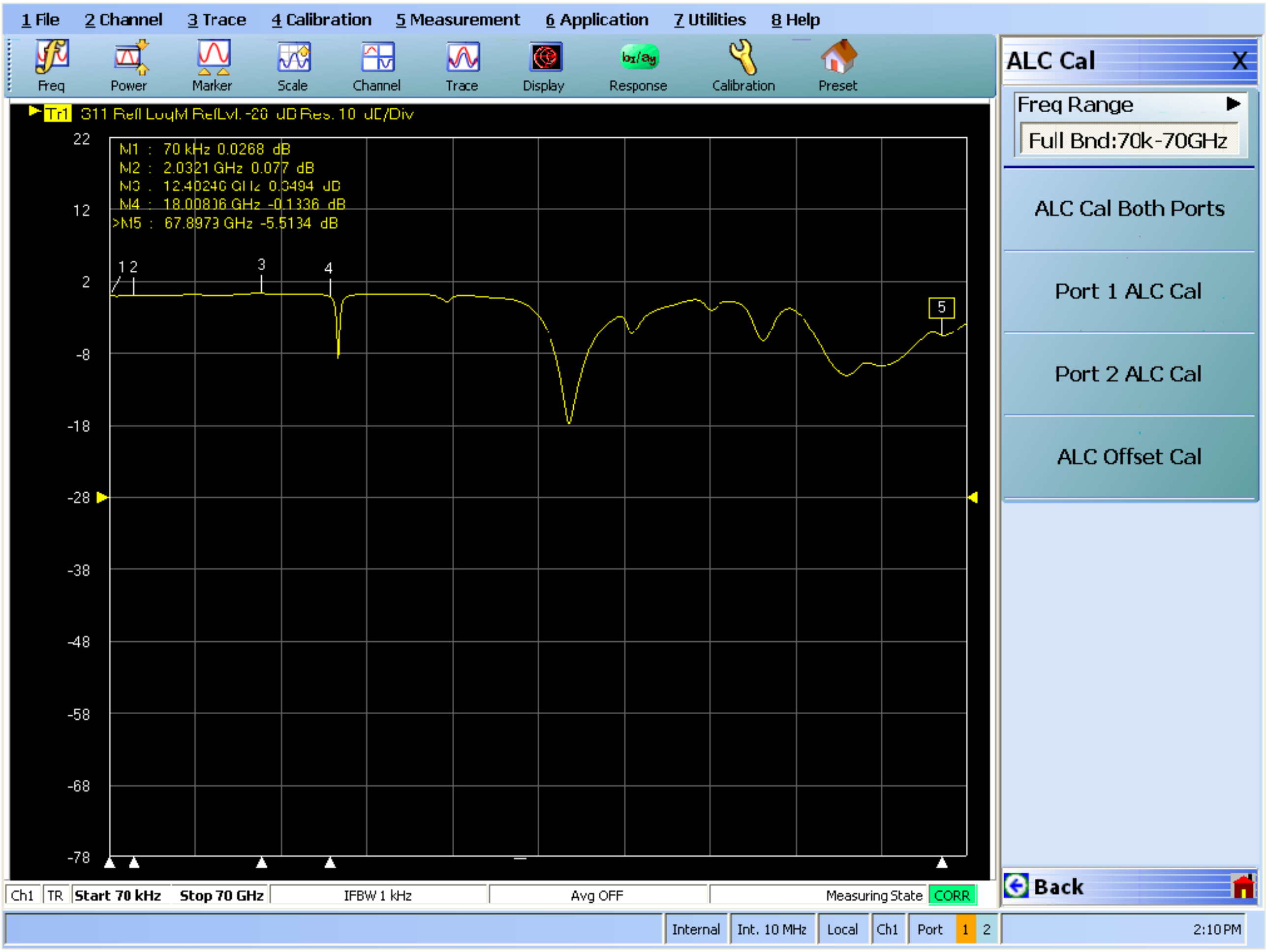


Figure 7-20. ALC CAL Menu

ALC Offset Cal

6. Select the ALC Offset Cal button and the ALC OFFSET CAL dialog box appears (Figure 7-21).
   Main | System | Diagnostics | Hardware Cal | ALC Cal | ALC Level Cal | ALC Cal | ALC Offset Cal
7. Select the Start Cal button to begin the calibration. Click on the Close button when done.

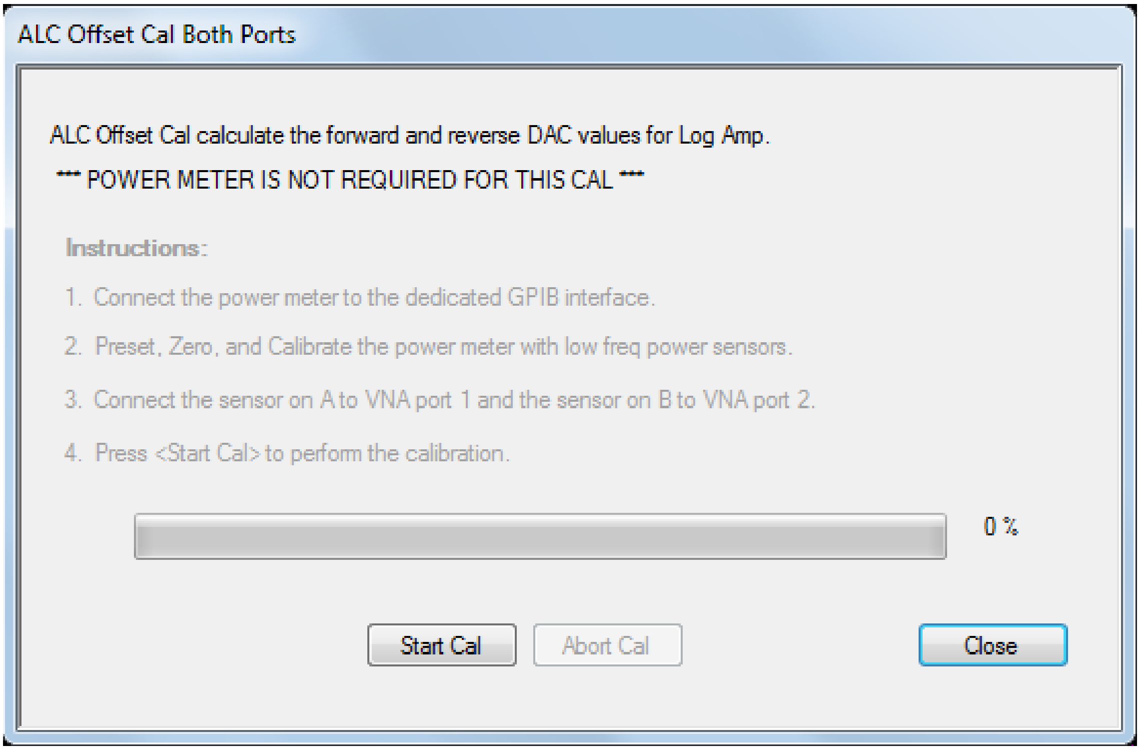


Figure 7-21. ALC OFFSET CAL Dialog Box

Port 1 ALC Cal

8. Zero and calibrate the Power Sensor with the Power Meter.

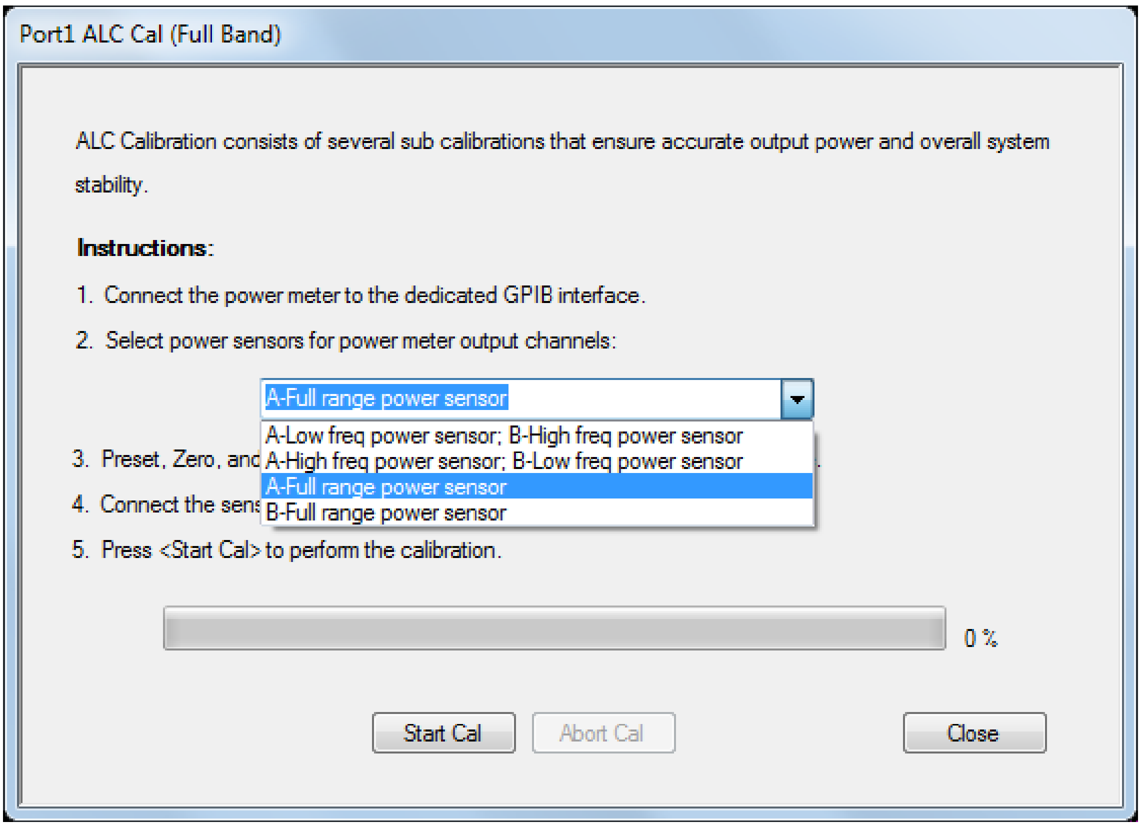
9. On the VNA, select the Port 1 ALC Cal button:

Main | System | Diagnostics | Hardware Cal | ALC Cal | ALC Level Cal | ALC Cal | Port 1 ALC Cal

10. When the Port 1 ALC Cal dialog box appears, select the appropriate power sensors for power meter output channels (Figure 7-22, “PORT 1 ALC CAL (FULL BAND) Dialog Box” on page 7-31). Be sure to select A – Full Range Power Sensor.

11. Connect the Power Sensor to VNA Port 1.

12. Select the Start Cal button to perform calibration. Click on the Close button when done.



Select “**A-Full range power Sensor**” for instruction step #2.

Figure 7-22. PORT 1 ALC CAL (FULL BAND) Dialog Box

Port 2 ALC Cal

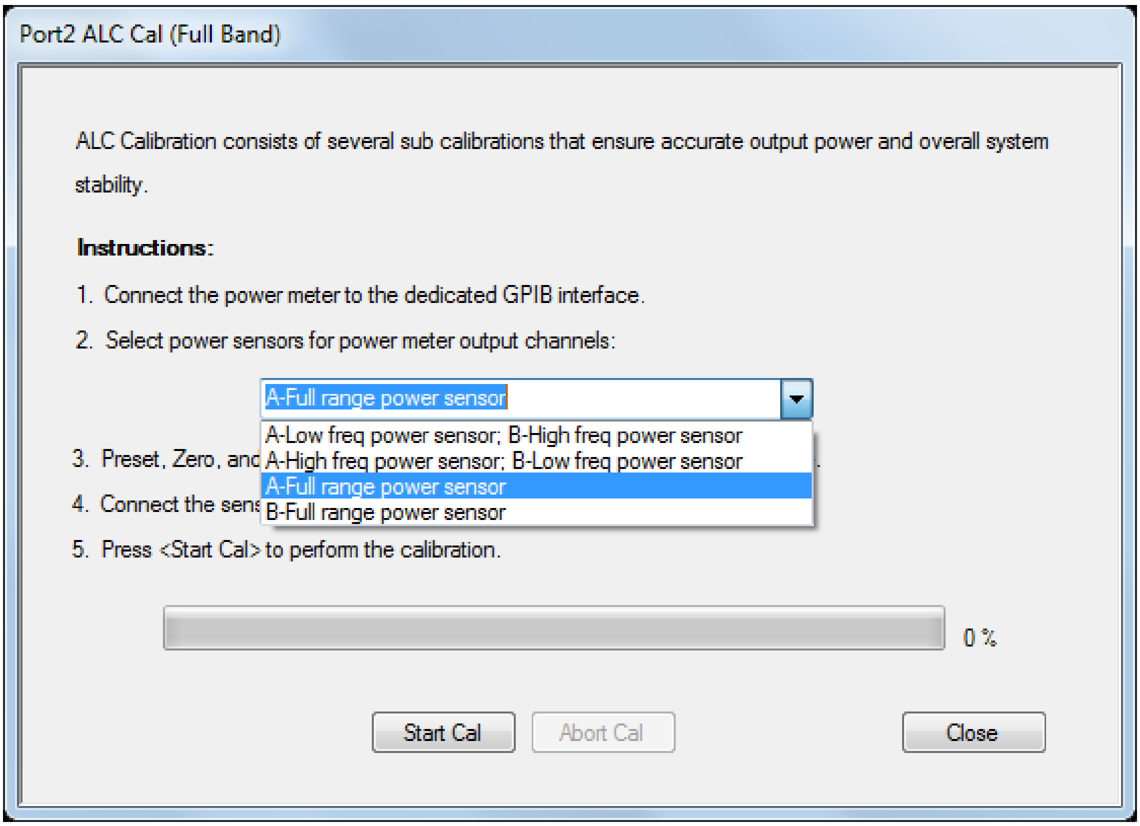
13. Zero and calibrate the Power Sensor with the Power Meter.

14. On the VNA, select the Port 2 ALC Cal button:

Main | System | Diagnostics | Hardware Cal | ALC Cal | ALC Level Cal | ALC Cal | Port 2 ALC Cal

15. When the PORT 2 ALC CAL dialog box appears, select the appropriate power sensors for power meter output channels (Figure 7-23). For example, Select A – Full Range Power Sensor and connect the Power Sensor to VNA Port 2.

16. Select the Start Cal button to perform calibration. Click on the Close button when done.



Select "**A-Full range power Sensor**" for instruction step #2.

Figure 7-23. PORT 2 ALC CALIBRATION Dialog

Source 2 Redirected Out Port 1 ALC Cal (Option 32)

Note Before performing this procedure, ensure "Port 2 ALC Cal" on page 7-32 has been completed first.

With Option 32 enabled, Source 2 is redirected out of Port 1. These steps provide ALC Cal in this configuration.

1. Ensure Option 32 is installed and enabled. To verify, navigate:

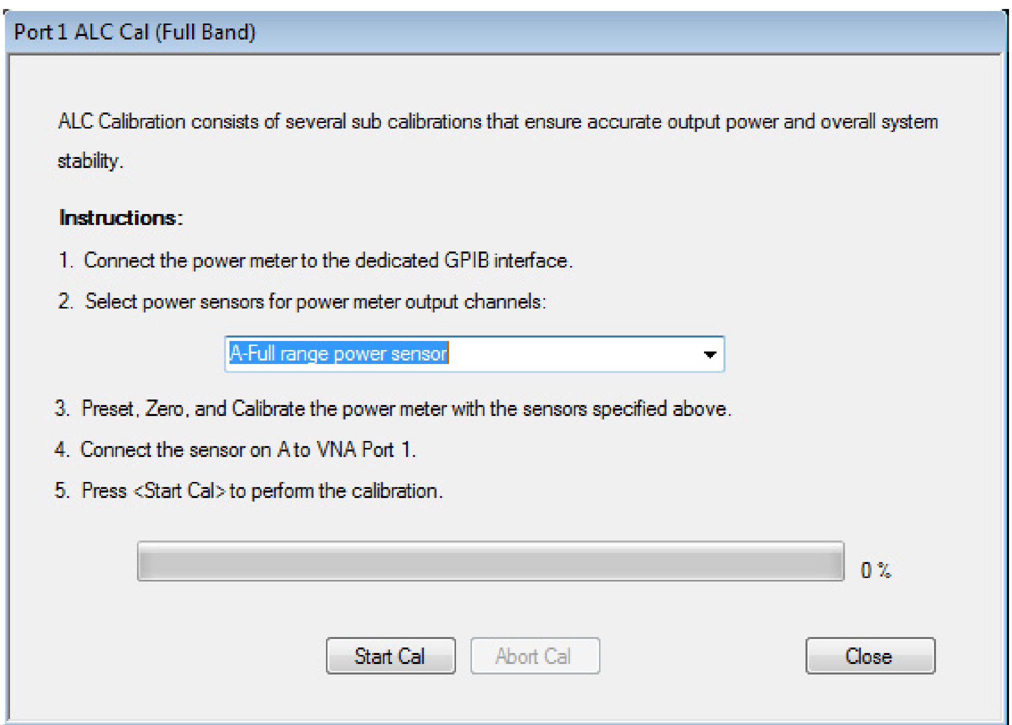
   MAIN | System | SYSTEM | Setup | SETUP | Misc. Setup | MISC. SETUP

   Select Installed Options and verify RF Combiner (Option 32) is enabled.

2. On the VNA, navigate to ALC LEVEL CAL:

   Main | System | Diagnostics | Hardware Cal | ALC Cal | ALC LEVEL CAL

3. On the ALC LEVEL CAL menu Select Src 2 out Port 1. The Src 2 out Port 1 menu appears.
4. On the menu, select the Freq Range button and then select a frequency range.
5. Return to the Src 2 out Port 1 menu and select the Port 1 ALC Cal button.
6. When the Port 1 ALC CAL dialog box appears, select the appropriate power sensors for power meter output channels (Figure 7-24). Be sure to select A – Full Range Power Sensor.
7. Zero and calibrate the Power Sensor with the Power Meter.
8. Connect the Power Sensor to VNA Port 1.
9. Select the Start Cal button to perform calibration. Click on the Close button when done.



Select "**A-Full range power Sensor**" for instruction step #2.

Figure 7-24. Source 2 Redirected – PORT 1 ALC CAL (FULL BAND) Dialog Box

7-10 Analog In Adjustment (Analog In Cal)

This calibration adjusts the offset and gain range of the analog inputs.

Equipment Required

- None

Procedure

1. Warm up the VNA for at least 90 minutes.
2. On the MS4640B Series VNA, access the HARDWARE CAL menu as described above in Section 7-4, "Adjustment Setup" on page 7-8.
3. Select Analog In Cal button and the CALIBRATION PROGRESS dialog box appears as shown in Figure 7-25.
4. The dialog box will close by itself when the calibration is complete successfully.

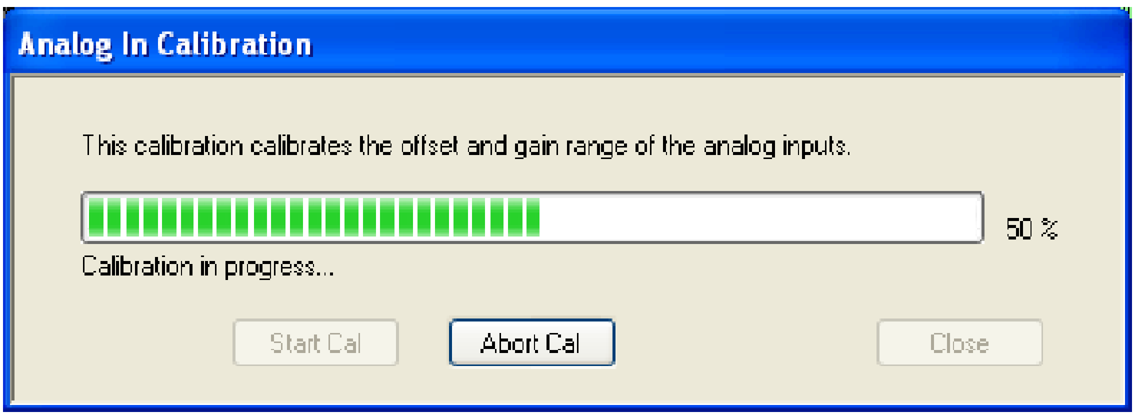


Figure 7-25. Analog In Calibration Progress Dialog Box

7-11 Factory RF Calibration (RF Cal)

The Factory RF Calibration represents a subset of a 12 term calibration so that simple reflection and transmission standards will read somewhat close to their true value even without a User Measurement Calibration.

Equipment Required

- Anritsu 3652A K Connector Calibration Kit (For MS4642B and MS4644B)
- Anritsu 3654D V Connector Calibration Kit (For MS4645B and MS4647B)
- Coaxial Through Line Cable, male to female
- Adapter, female to female

Procedure

1. Warm up the VNA for at least 90 minutes.
2. If the length of the through line cable is not known, perform the Length Determination Procedure described in Section 7-15, "Through Line Length Determination Procedure" on page 7-47.
3. Preset the VNA and then access the FACTORY CAL menu as described above in Section 7-4, "Adjustment Setup" on page 7-8.

4. Select Modify Setup button under RF Cal and the FACTORY RF CAL SETUP dialog box appears (Figure 7-26).

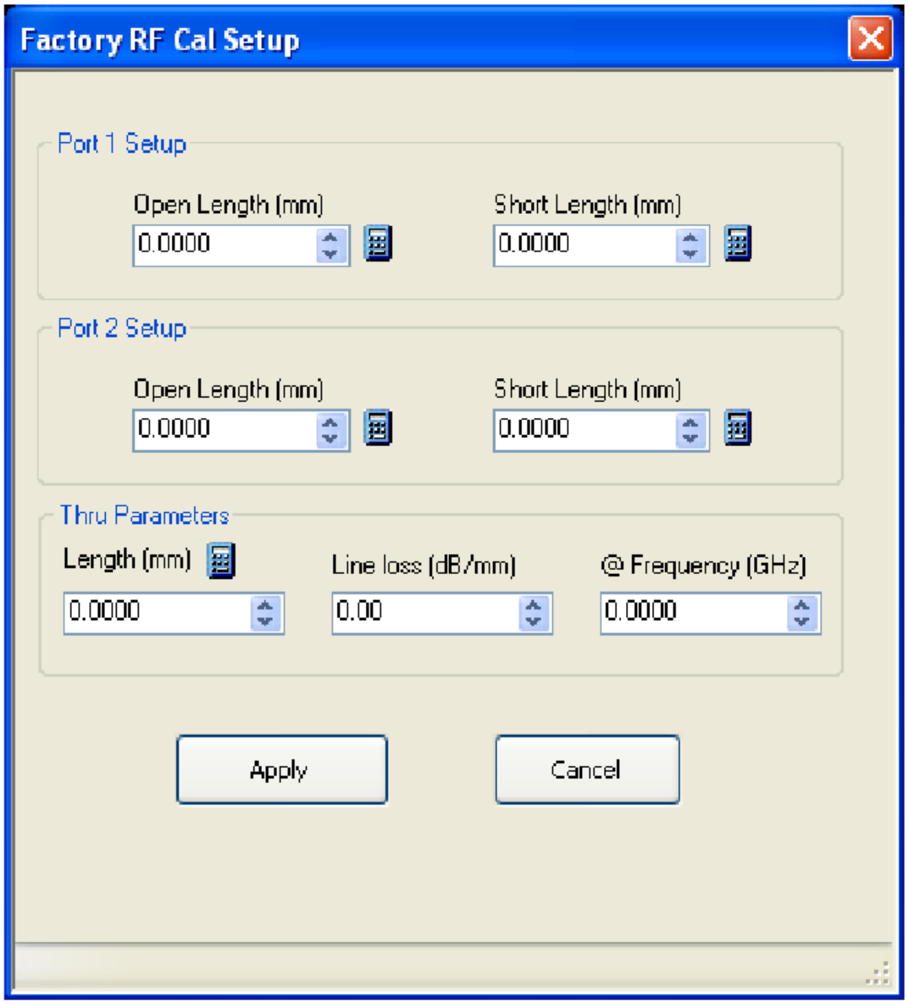


Figure 7-26. Factory RF Cal Setup Dialog Box

5. Change the parameters in the dialog box as shown in Table 7-3. Click the Apply button when done.

Table 7-3. Parameter Changes for Factory RF Calibration

For Model(s)	MS4642B / MS4644B VNAs	MS4645B/MS4647B VNAs
Open Length (mm)	5.00	4.75
Short Length (mm)	5.00	5.10
Thru Length (mm)	Actual length of through including adapters, if used.	Actual length of through including adapters, if used.
Line Loss (dB)	0.009 After the value above is entered, it will round up to 0.01.	0.009 After the value above is entered, it will round up to 0.01.
@ Frequency (GHz)	70 (not 40)	70

6. Select the Calibrate button and the FACTORY RF CAL dialog box appears (Figure 7-27).

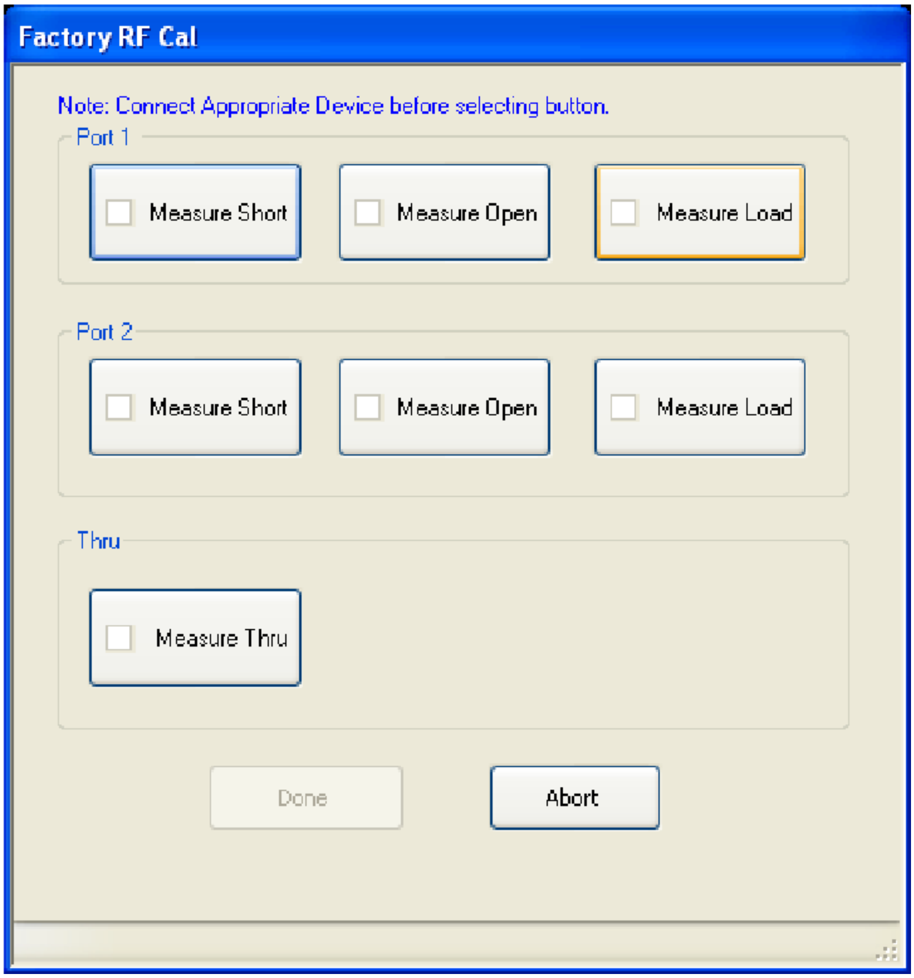


Figure 7-27. FACTORY RF CAL Dialog Box

7. Connect each calibration standard from the calibration kit in sequence to the appropriate port. Click the appropriate button when ready.
8. When all seven (7) calibration standards have been measured, click the Done button to complete.

7-12 Factory Receiver Calibration (Rcvr Cal)

The Factory Receiver Calibration is intended to allow the non-ratioed parameters to read out closer to absolute power levels without a user receiver calibration.

Equipment Required

- Coaxial Cable, male to female
- Adapter, female to female

Procedure

1. Warm up the VNA for at least 90 minutes.
2. Install the adapter to the male end of the coaxial cable.
3. Connect the coaxial cable between VNA Port 1 and VNA Port 2.
4. Access the FACTORY CAL menu as described above in Section 7-4, "Adjustment Setup" on page 7-8.
5. Select the Perform Rcvr Cal button.
6. When the FACTORY RECEIVER CAL dialog box appears (Figure 7-28), click on the Perform Measurement button to begin the calibration.
7. Click on the Done button when the calibration is done.

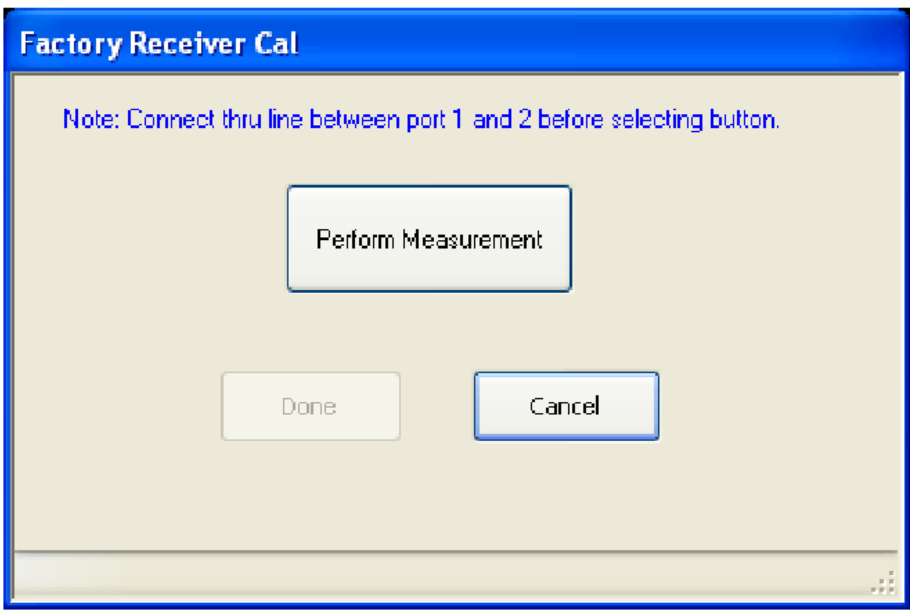


Figure 7-28. FACTORY RECEIVER CALIBRATION Dialog Box

7-13 Factory Phase Calibration

This calibration is required when Option 31 is installed.

Equipment Required

- Anritsu 3652A K Calibration Kit (for MS4642B and MS4644B)
- Anritsu 3670K50-2 cable (for MS4642B and MS4644B)
- Anritsu 33KFKF50B adapter that is included with 3652A (For MS4642B and MS4644B)
- Anritsu 3654D V Calibration Kit (For MS4645B and MS4647B)
- Anritsu 3670V50A-2 cable (for MS4645B and MS4647B)
- Anritsu 33VFVF50C adapter that is included with 3654D (For MS4645B and MS4647B)

Procedure for MS4640B

Note	Prior to performing this procedure, perform the Through Line Length Determination Procedure to determine the length of the through line cable (including adapter).

1. Warm up the VNA for at least 90 minutes.
2. Press the **Preset** button on the VNA.
3. Press the **Avg** key and set the IFBW to 1 kHz.
4. Press the **Frequency** key and set # of Points according to the model, as shown below:
    a. MS4642B – 2001
    b. MS4644B – 4001
    c. MS4645B – 5001
    d. MS4647B – 7001
5. Insert the USB memory device from the calibration kit into the **USB port** on the front panel.
6. Press the **Calibration** key.
7. Select Cal Kit/AutoCal Characterization and then select Install Kit/Charac.
8. Select the Cal Kit radio button and then click the Browse button.
9. Locate the Removable Disk (x:), where x is the drive letter designated to the USB drive by Windows Operating System software.
10. Select the Removable Disk (x:).
11. Select the "xxxxxxxx.ccf" file and click on the Open button.
12. On the Install dialog box, click the OK button to load the coefficients.
13. Click on the Back icon to return to the CALIBRATION [TR] menu.
14. Select Calibrate and then select Manual Cal.
15. Select 2-Port Cal.
16. Select Modify Cal Setup and then select Edit Cal Params.
17. On the Two Port Cal Setup (SOLT/R, Coaxial) dialog box, edit the parameters as follows:
    a. Cal Type – Full 2 Port
    b. Load Type – Broadband Load
    c. Test Port 1 DUT Connector – K-Conn(F)
    d. Test Port 1 BB Load – Load 1

  e. Test Port 2 DUT Connector – K-Conn(F)
  f. Test Port 2 BB Load – Load 1
  g. Length – Enter the length value in mm determined using the procedure in Section 7-15 “Through Line Length Determination Procedure”.
  h. Line Loss – 0.0090
  i. @ Frequency – 70

18. Click on the OK button to continue.
19. Click on the Back icon to return to the TWO PORT CAL menu.
20. Select Port 1 Reflective Devices.
21. Connect the female Open calibration standard to VNA **Port 1** and then select Open to measure. When done, a check mark appears on the Open button to indicate the existence of calibration data.
22. Remove the Open standard. Connect the female Short calibration standard to VNA **Port 1** and then select Short to measure.
23. Remove the Short standard. Connect the female Load calibration standard to VNA **Port 1** and then select Load to measure.
24. Remove the Load standard.
25. Click on the Back icon to return to the TWO PORT CAL menu.
26. Select Port 2 Reflective Devices.
27. Connect the female Open calibration standard to VNA Port 2 and then select Open to measure.
28. Remove the Open standard. Connect the female Short calibration standard to VNA Port 2 and then select Short to measure.
29. Remove the Short standard. Connect the female Load calibration standard to VNA Port 2 and then select Load to measure.
30. Remove the Load standard.
31. Click on the Back icon to return to the TWO PORT CAL menu.
32. Connect the through line cable with adapter between VNA **Port 1** and VNA **Port 2**.
33. Select Thru/Recip and then Thru to measure.
34. Click on the Back icon to return to the TWO PORT CAL menu.
35. Select Done.
36. Install female Load standards from the calibration kit to both VNA **Port 1** and VNA **Port 2**.
37. Access the FACTORY CAL menu as described in Section 7-4 “Adjustment Setup”.
38. Select Perform Phase Cal.
39. The FACTORY PHASE CAL dialog box appears as shown in Figure 7-29 on page 7-41. Click on Perform Calibration button to begin the measurements.
40. Click on Save button when the measurements are complete.

Calibration for MS4640B operating with the MN4690B Multiport Test Set

41. Power off the VNA and then assemble the MS4640B and MN4690B together as a 4-port VNA system.
42. Power on the VNA and test set. Warm up the system for at least 90 minutes.
43. Perform a 2-Port Cal using the test set ports 1 and 3.

Note	Refer to step 3 thru step 35. Choose Test Port 3 instead of Test Port 2 while in the Two Port Cal Setup (SOLT/R, Coaxial) dialog box and install calibration standards to Test Set Port 3 instead of Port 2.

44. Install female Load standards from the calibration kit to Test Set Ports 1 and 3.
45. Access the FACTORY CAL menu as described in Section 7-4 "Adjustment Setup".
46. Select Perform Phase Cal
47. The Factory Phase Cal dialog box appears as shown in Figure 7-29. Click on Perform Calibration button to begin the measurements.
48. Click on Save button when the measurements are complete. This saves the additional calibration files for a 4-port system.

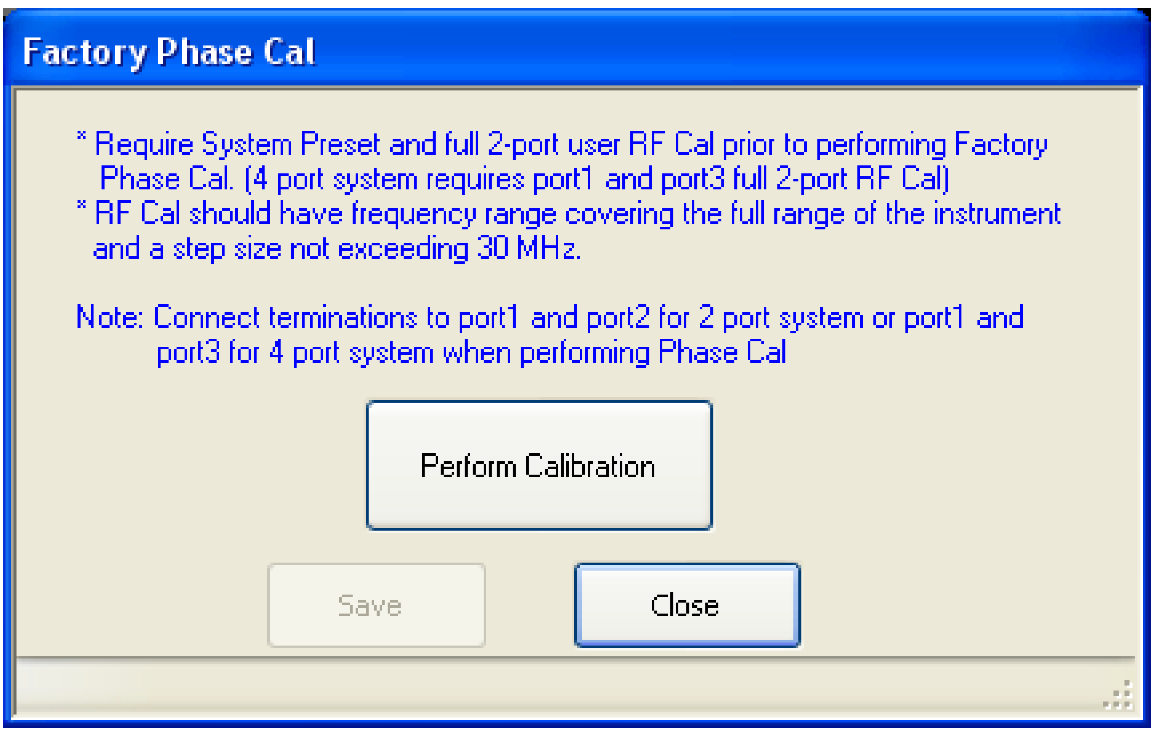


Figure 7-29. Factory Phase Cal Dialog Box

7-14 LCD Touch Panel Calibration Adjustments

The LCD touch panel calibration is used to align the touch screen coordinates with those of the LCD display.

Equipment Required

- None

Procedure

1. Exit the VectorStar application by selecting File from the Icon Tool Bar and then Exit from the drop down menu.
2. Do one of the following to start the LCD touch panel calibration dialog.
   - On the Windows Desktop of the VNA, click:
     Start | All Programs | Hampshire TSHARC Control Panel
   - On the VectorStar GUI, select:
     MAIN | System | SYSTEM | Utility | UTILITY | Calibrate Touch Screen | HAMPSHIRE TSHARC (TOUCHSCREEN) CONTROL PANEL Dialog Box
3. The HAMPSHIRE TSHARC CONTROL PANEL tabbed dialog box appears (Figure 7-31).

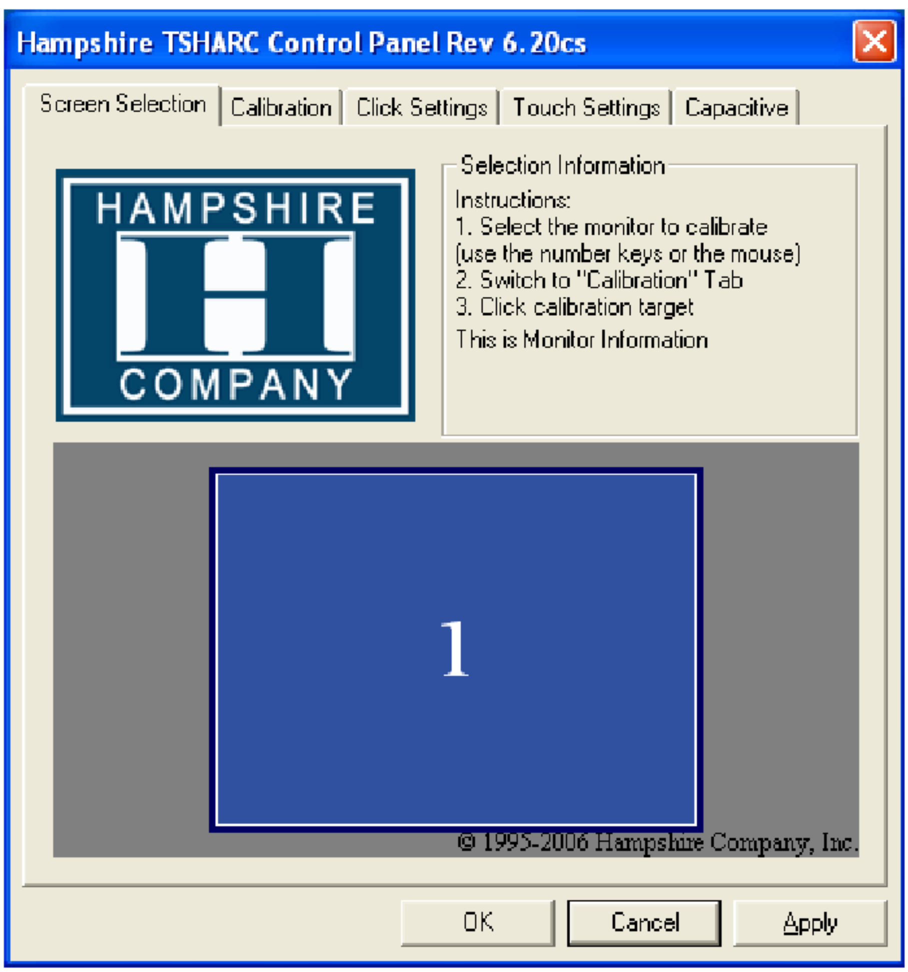


Figure 7-30. HAMPSHIRE TSHARC CONTROL PANEL Dialog

4. Select the Calibration tab and then click on the Configure button.

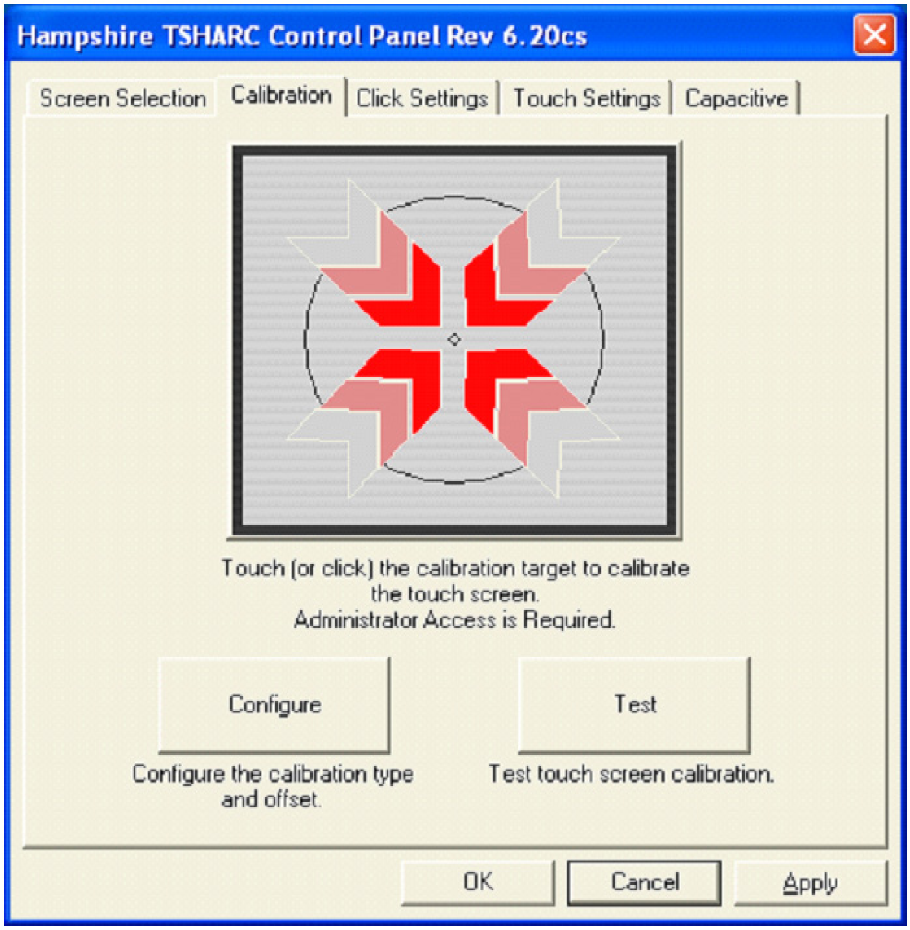


Figure 7-31. Hampshire TSHARC Control Panel – Calibration Tab

5. On the CALIBRATION OPTIONS dialog box, select 20 point calibration and 10% offset. Also click on the Inset Calibration Targets check box to enable the option (Figure 7-32).

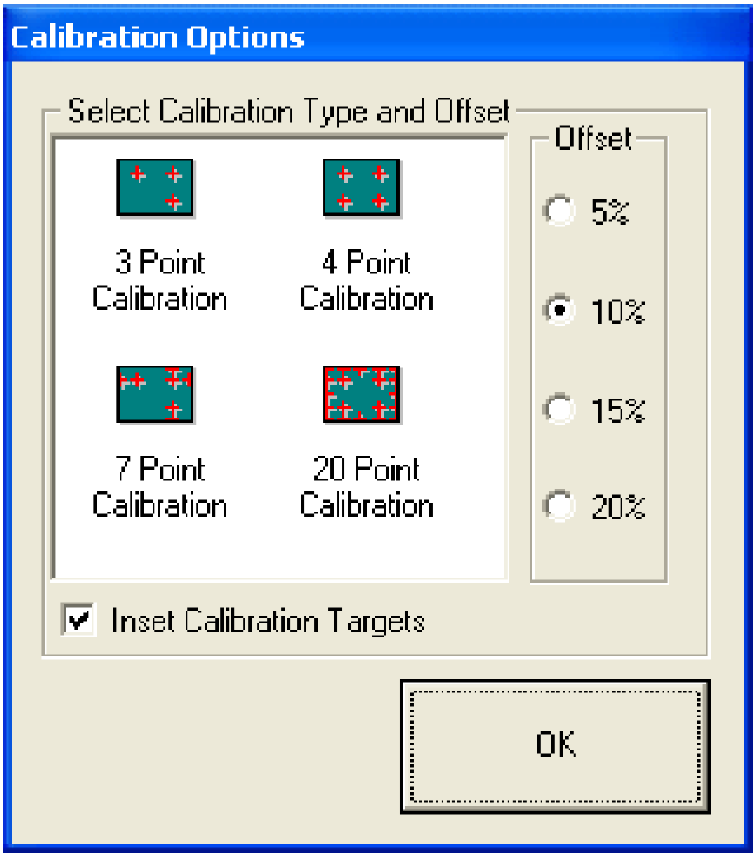


Figure 7-32. Hampshire TSHARC Control Panel – Calibration Options

6. Click the OK button to close the CALIBRATION OPTIONS window.

7. On Calibration tab window, use your finger to touch the red target symbol and the Calibration screen will appear (Figure 7-33).

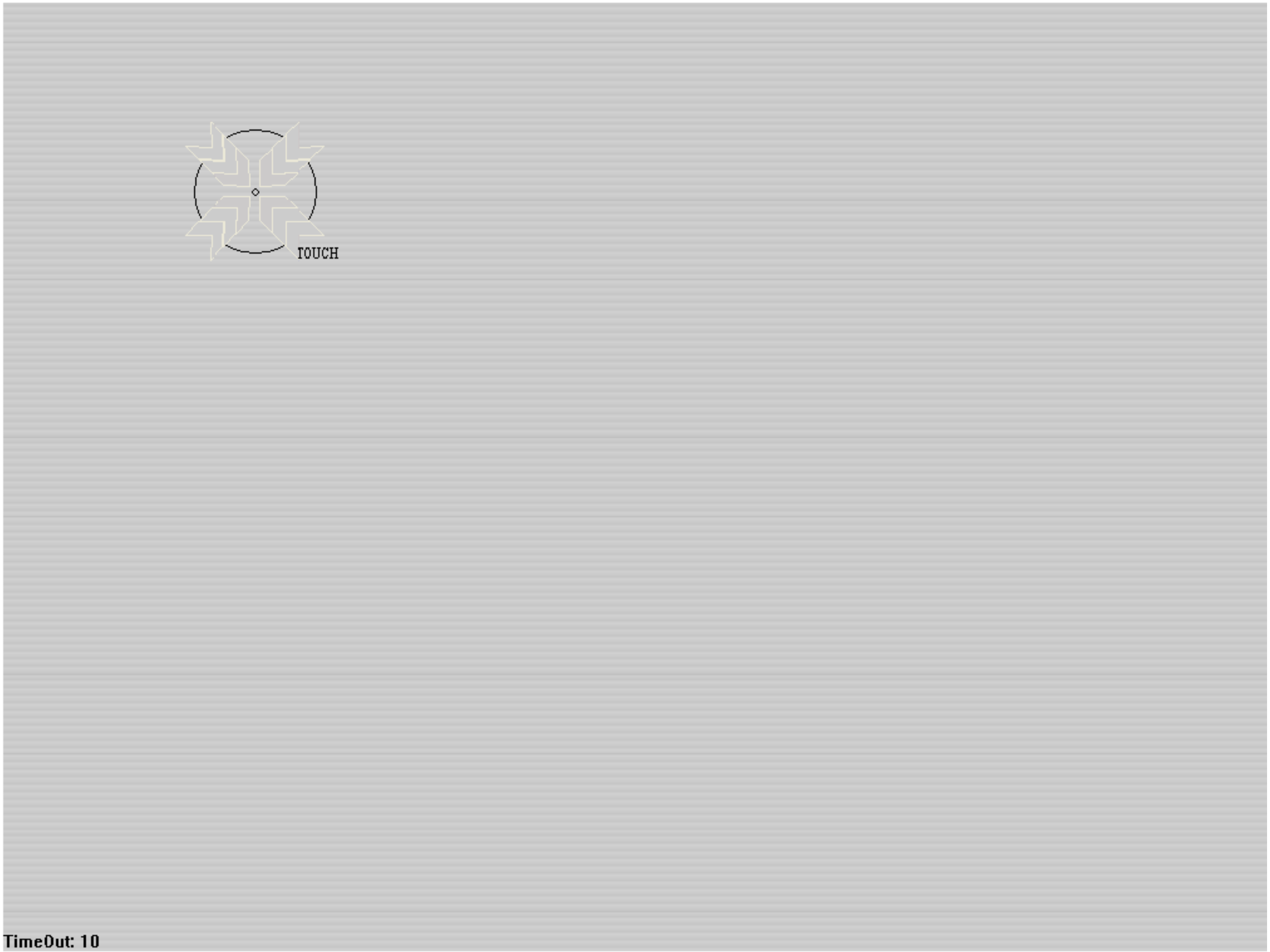


Figure 7-33. Calibration Screen with Target Symbol

8. Touch the target symbol with your finger and hold until the displayed word changes from TOUCH to HOLD to RELEASE. Then release your finger from the target symbol. Repeat until no more target symbols are displayed.

9. Next, the touch target movement verification screen will then appear (Figure 7-34). Use your finger to touch the screen and a target symbol will appear where your finger touches the screen.

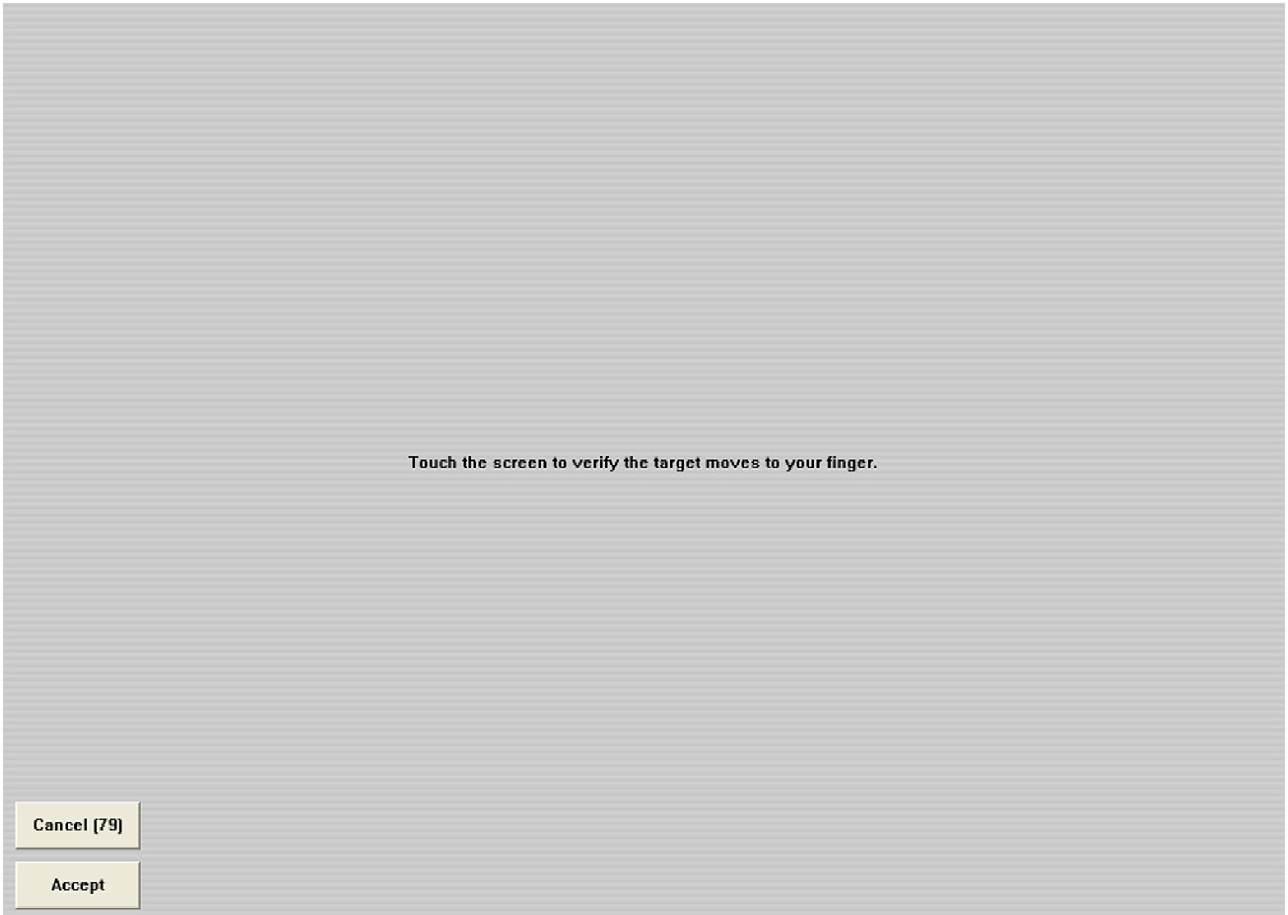


Figure 7-34. Touch Target Movement Verification Screen

10. Drag the target symbol across the screen and observe if the target symbol moves to the direction to which you have dragged.
11. Use the external mouse to click on the Accept button when done.
12. When the Hampshire TSHARC Control Panel re-appears, click the Apply button to apply the new calibration.
13. This completes the LCD Touch Panel Calibration adjustment.

7-15 Through Line Length Determination Procedure

This procedure is used to determine the length of the through line cable (including adapters) that is used for Factory RF Calibration and Factory Phase Calibration.

Equipment Required

- Anritsu 3652A K connector Calibration Kit (For K connector cable)
- Anritsu 3654D V connector Calibration Kit (For V connector cable)

Procedure

1. Preset the VNA.
2. Press the **Frequency** key and set points to 801.
3. Press the **Calibration** key.
4. Insert the USB memory device from the calibration kit into the **USB port** on the front panel. The red indicator LED on the USB memory device will flash and then light constantly.
5. Select Cal Kit/AutoCal Characterization.
6. Select Install Kit/Charac.
7. The INSTALL dialog box appears (Figure 7-35). Then, select the Cal Kit radio button, and click the Browse button.

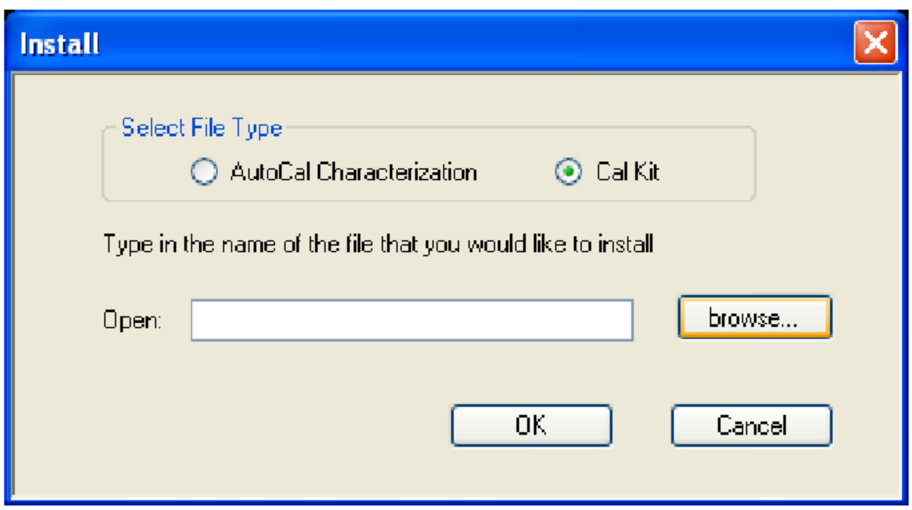


Figure 7-35. INSTALL Dialog Box

8. Locate Removable Disk (x:), where x is the drive letter designated to the USB drive by Windows (Figure 7-36).

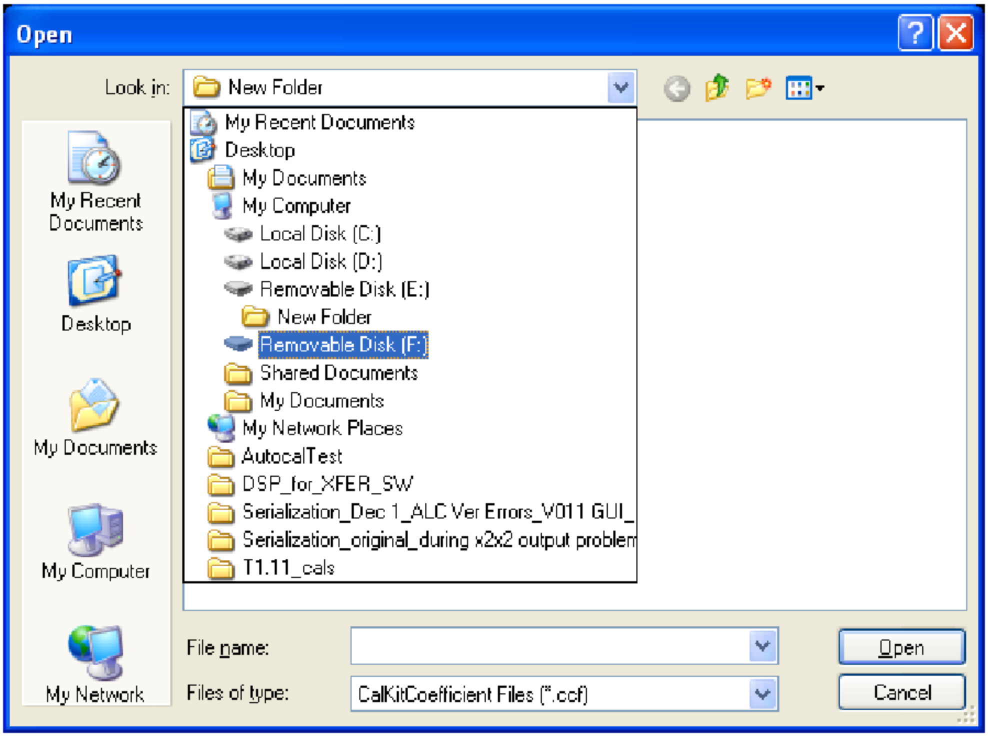


Figure 7-36. OPEN Dialog Box

9. Double-click on “Removable Disk (x:). Select the xxxxxxxxx.ccf file and then click the Open button.
10. Back to the INSTALL dialog box, click OK to load the coefficients.
11. Touch the Back icon to return to the CALIBRATION [TR] Menu.
12. Select the Calibrate button and then the Manual Cal button.
13. Select 1-Port Cal button and then Edit Cal Params. Uncheck Test Port 2 and change Test Port 1 DUT Connector to K-Conn(F). Click on the OK button when done. Click on the Back icon to return to the previous menu. Select Port 1 Reflective Devices.
14. Connect the female Open calibration standard to VNA **Port 1** and then select the Open button to measure. When done, a check mark appears on the Open button to indicate the existence of a calibration.
15. Remove the Open, connect the female Short calibration standard to VNA **Port 1** and then select the Short button to measure.
16. Remove the Short, connect the female Load calibration standard to VNA **Port 1** and then select the Load button to measure.
17. Remove the Load calibration standard.
18. Select the Done button.
19. Connect a short to one end of the through cable (DUT).
20. If the through cable is a male to female, connect a female to female adapter to the other end of the cable and then connect the open end of the adapter to VNA **Port 1**. If not, connect the open end of the through cable to VNA **Port 1**.
21. Press the **Measurement** key and then select the Reference Plane button.
22. Select the Auto button. Subtract 5 mm for K connector (5.1 mm for V connector) from the displayed Distance value. This is the Length of the through cable used for Factory RF Calibration.

Chapter 8 — Work Area Preparation and Cover Removal

8-1 Introduction

This chapter provides instructions for work area preparation, and chassis outer cover and inner cover removal and installation.

8-2 Preparation of Work Area and Safety Instructions

1. Make sure that antistatic procedures are followed throughout every step of every procedure.
2. An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-1999 or ANSI/ESD S20.20-2007 is mandatory to avoid ESD damage when handling subassemblies or components found in the instrument.
3. The work surface must prevent scratching the instrument and be free of debris.
4. The cart or bench must be able to support the weight of the instrument.

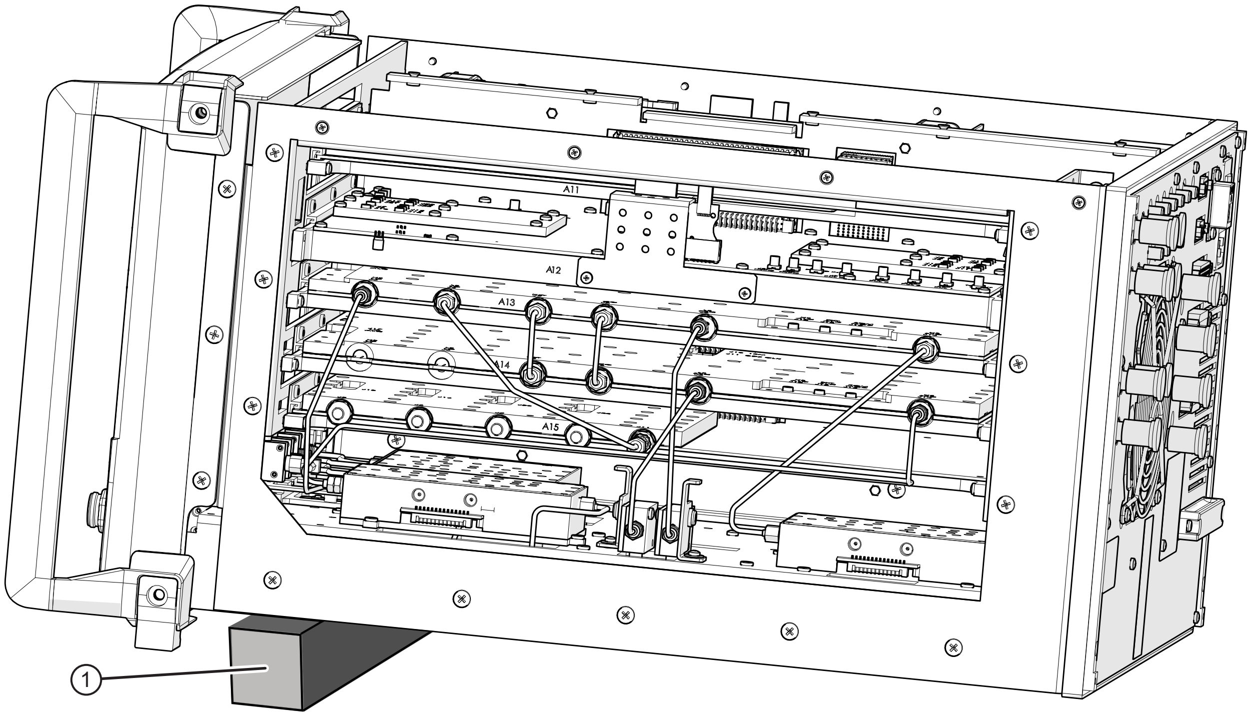
Caution ⚠ CAUTION >18 kg HEAVY WEIGHT	The weight of the MS4640B VNA is greater than 18 kg (39.6 pounds). The weight of a fully equipped MS4647B VNA is greater than 26 kg (> 57.3 pounds). Use two or more people to lift and move the MS4640B Series Vector Network Analyzer. There is a risk of a back injury if this equipment is lifted by one person. Make sure that any equipment carts can safely carry the instrument weight.

5. If the RF Deck is removed for servicing, a pair of T3545 RF Deck Fixtures should be attached to protect the loops and modules.
   - See Appendix A, “T3545 Maintenance Fixture” for a description of the T3545 Fixture. It is available from Anritsu or can easily be fabricated locally.

Caution	When working around the Front Panel or the RF Deck, a spacer block device is essential to keep the loops and other components from being damaged.

6. Before removing the Front Panel, add a spacer at least 5 cm (~2 in) thick under the front of the unit, approximately 10 cm (~4 in) in from the instrument front as shown in Figure 8-1 on page 8-2.
   - The spacer should be at least 50 mm (~20 in) long.
   - The spacer creates clearance for the Direct Access Loops located on the RF Deck.
   - A ~50 cm (~20 in) length of plastic or wood 5 cm x 5 cm (2 in x 2 in) makes a good spacer.

Danger	Before starting any disassembly procedures, ensure that the instrument is disconnected from AC mains supply and has cooled to room temperature.



1. Block for raising front of chassis

Figure 8-1. Spacer Block Under Front of Chassis

Remove Outer Cover

Applicability

Applicable for all MS4640B models.

Procedure

1. Observe work area, work surface, and safety preparations.
    - See "Preparation of Work Area and Safety Instructions" on page 8-1.

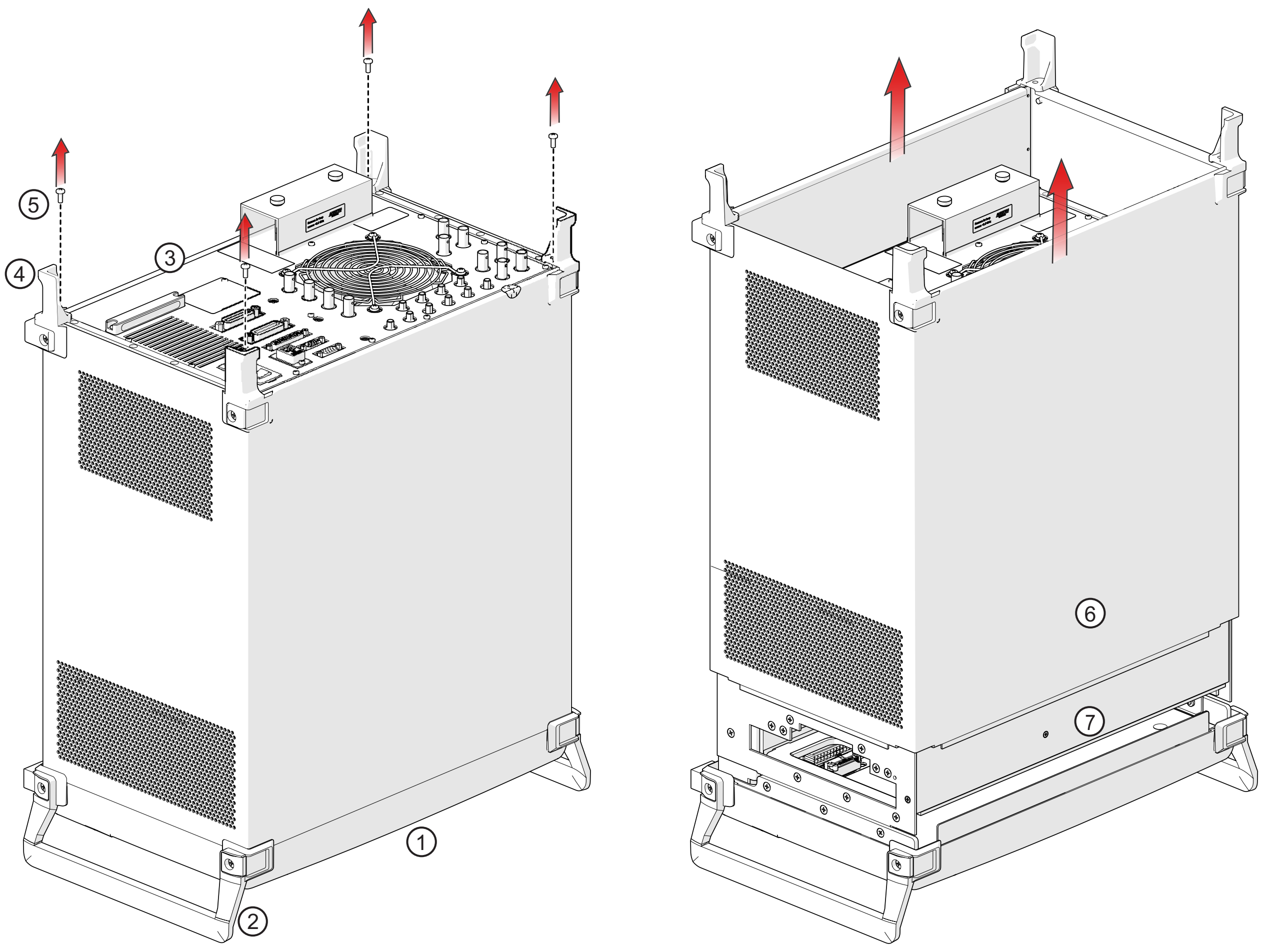
Caution ⚠ CAUTION >18 kg HEAVY WEIGHT	The weight of the MS4640B VNA is greater than 18 kg (39.6 pounds). The weight of a fully equipped MS4647B VNA is greater than 26 kg (> 57.3 pounds). Use two or more people to lift and move the MS4640B Series Vector Network Analyzer. There is a risk of a back injury if this equipment is lifted by one person. Make sure that any equipment carts can safely carry the instrument weight.

2. If using an equipment cart, secure the cart so it will not move.

Caution	If the instrument handles or rack mount ears/handles are removed, one type MUST be reinstalled before proceeding. The handles must be in place to remove the Front Panel and to remove the RF Deck. The handles protect the Front Panel Keys, Rotary Knob, Test Ports, and if installed, the Direct Access Loops. Do not attempt removing the Outer Cover without one of the handle types in place. In most cases, the instrument is always equipped with regular handles or with combination rack mount ears/handles.

Note	The Rear Feet can stay fastened to the Outer Cover and do not need to be removed.

3. Using two people, tilt the VNA up so that it is vertical and resting on its Front Handles as shown in Figure 8-2. Make sure the instrument is stable before letting go.
4. Remove the four (4) pan head Phillips M4 × 10 mm screws holding the Outer Cover at the Rear Panel. the screws go through the Rear Feet into the inner chassis.
5. Again using two people, one person holds the instrument while the other slides the Outer Cover up and off the instrument.
6. Again using two people, tilt the instrument back down so it is oriented right-side up.
7. If removing the front panel, insert the spacer block under the chassis near the front of the unit. (See Figure 8-1 on page 8-2

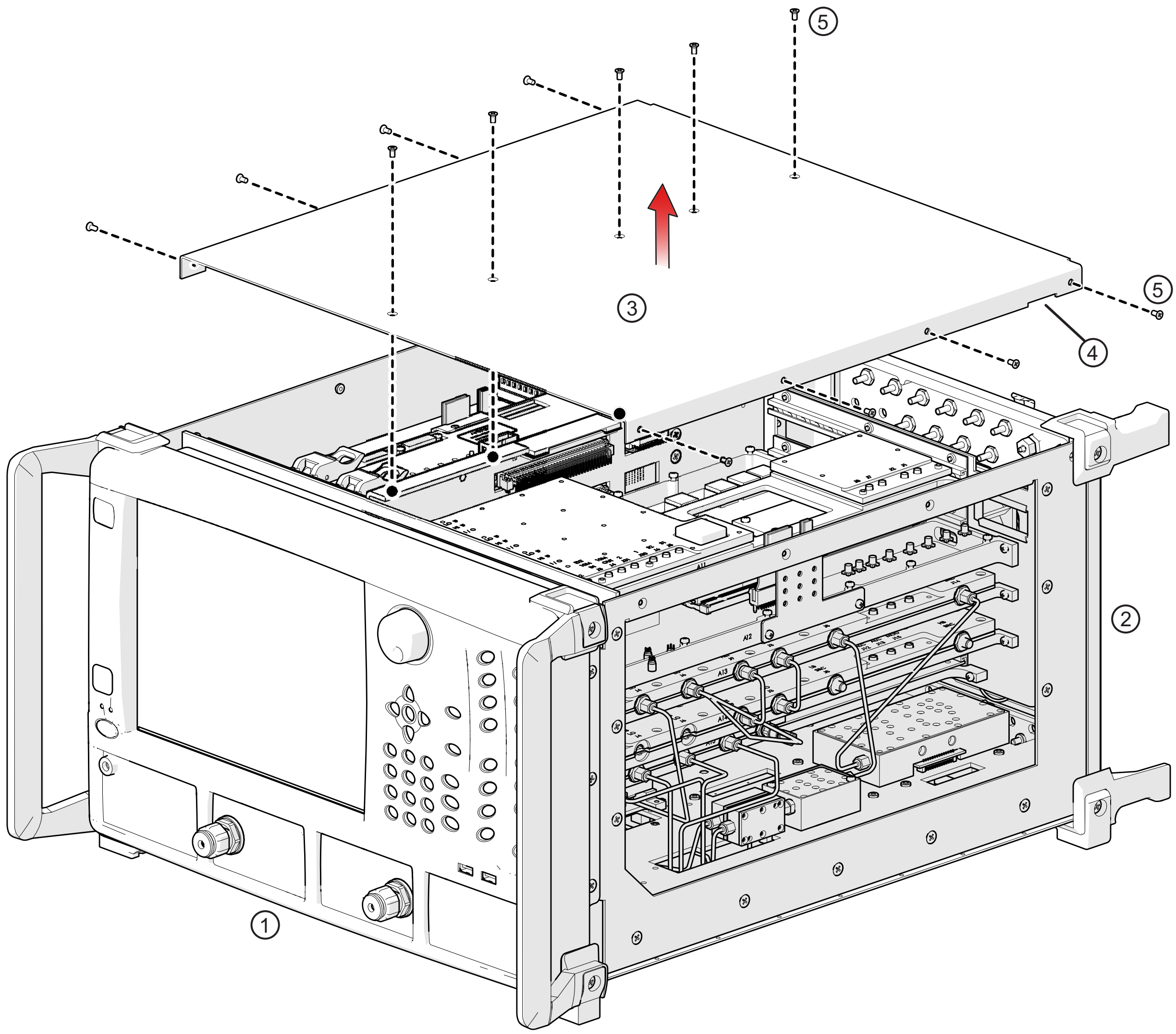


1. Front Panel	4. Rear Panel Feet
2. Front Panel Handles – Two each. Must be installed before doing this procedure.	5. Outer Cover Screws – Pan head Phillips M4 × 10 mm
3. Rear Panel and Bottom of Instrument	6. Outer Cover and Top of Instrument
	7. Inner Cover

Figure 8-2. Outer Cover Assembly

Remove Inner Cover

Use this common procedure to remove the Inner Top Cover after removing the Outer Cover.



Instrument with Outer Cover removed.	5. Mounting Screws
1. Front Panel 2. Rear Panel 3. Inner Top Cover 4. Inner Top Cover Orientation – Note the orientation with the notches toward the Rear Panel.	• 13 screws total, five (5) screws on top and four (4) on each side • All mounting screws are flat head Phillips Head M3 × 6 mm. • The top center screw is covered by a Calibration Seal – 3-48371.

Figure 8-3. Inner Cover – Front/Rear Orientation – Location of Screws

1. From the top of the Inner Cover, remove the five (5) flat-head Phillips M3 × 6 screws. The center screw is covered by a Calibration Seal.
2. On the right and left chassis sides, remove the eight (8) flat head screws.
3. Lift up, remove, and set the Inner Cover aside.
4. For installation, note that the panel notches go towards the Rear Panel.

8-3 Chassis Reassembly

Install Inner Cover

Use this procedure to install the Inner Cover.

1. Inspect the chassis to make sure all connections are complete, correctly torqued, and all PCBs correctly seated.
2. Place the Inner Cover loosely in position. The small protruding lip and notched end on the cover goes toward the rear panel.
3. Loosely insert the flathead Phillips M3 × 6 mm screws. Do not tighten. On top, insert five (5) screws; on each side, insert four (4) screws on each side; 13 screws total.
4. When the screws are in place, working from the top center, tighten all screws. Then at each side, again working from the center, tighten all screws.
5. If appropriate, apply a Calibration Seal over the top center mounting screw.

Install Outer Cover

This procedure installs the Outer Cover while the instrument is standing on its Front Panel Handles.

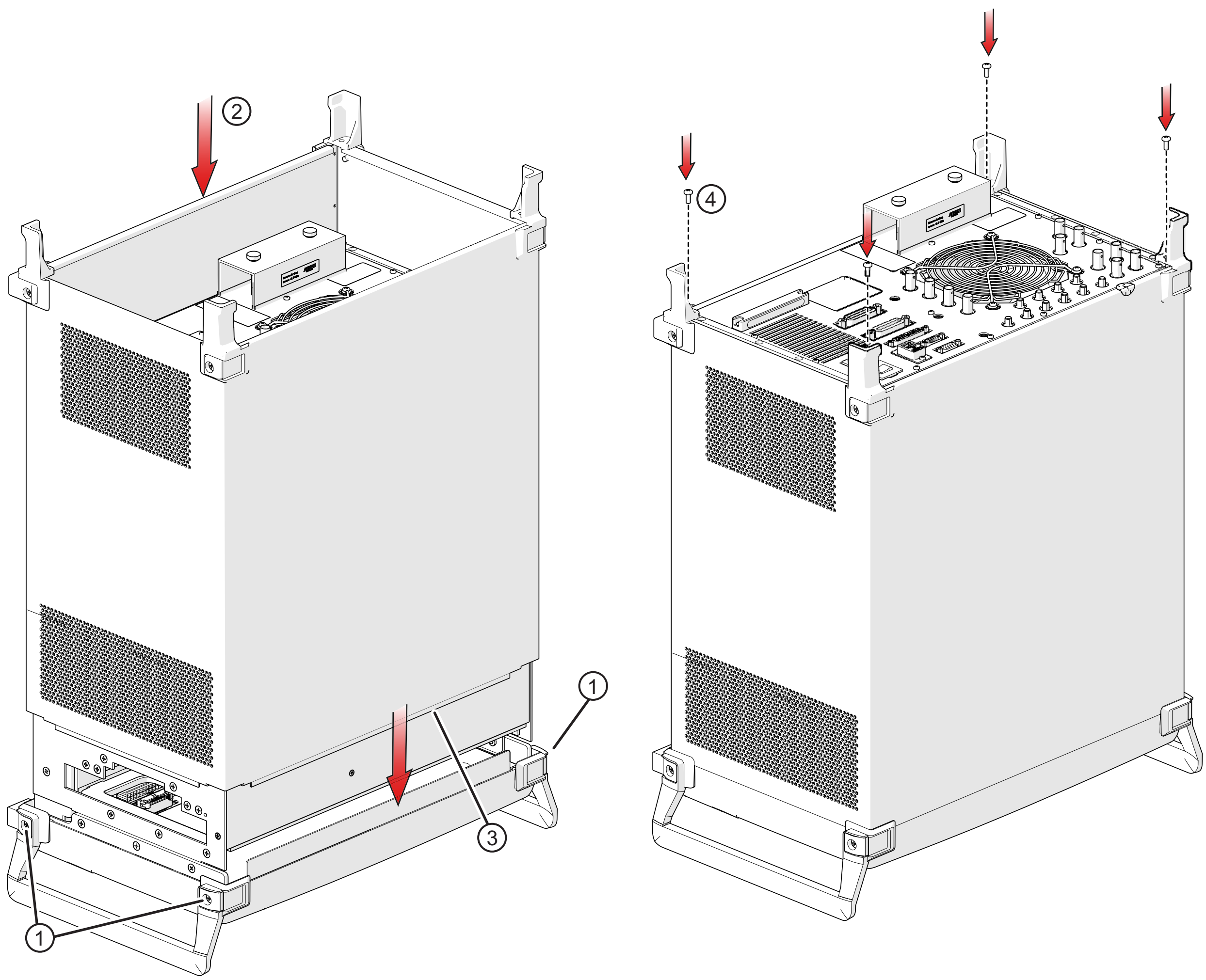
The procedure is shown in Figure 8-4 on page 8-7.

1. Observe work area and work surface preparations.
   - See "Preparation of Work Area and Safety Instructions" on page 8-1.

Warning

The weight of the MS4640B VNA is greater than 18 kg (39.6 pounds). The weight of a fully equipped MS4647B 70 GHz VNA is greater than 26 kg (> 57.3 pounds). Use two or more people to lift and move the MS4640B Series Vector Network Analyzer. There is a risk of a back injury if this equipment is lifted by one person. Make sure that any equipment carts can safely carry the instrument weight.

2. If using an equipment cart, secure the cart so it will not move.
3. Loosen the handle screws slightly to provide more clearance for the cover flange lip. There are four (4) screws total, two (2) on each side.
4. Using two people, tilt the VNA up so that it is vertical on its Front Panel until it is resting on its Front Handles. Make sure the instrument is stable before letting go.
5. When viewing the Outer Cover, observe the following orientation:
   - The edge with the lip goes towards the front and the feet towards chassis rear.
   - The side with the single block of ventilation holes goes on chassis right side.
   - The side with two blocks of ventilation holes go on chassis left side.
   - The riveted edges go toward chassis bottom.
6. Using two people, one person should slide on the Outer Cover over the unit. The other person should hold the instrument.
7. Loosely set the Outer Cover flange under the handles.
8. Insert the four (4) pan head Phillips M4 × 10 mm screws into the outer cover through the sides of the feet.
9. When the Outer Cover is correctly positioned, tighten the four (4) cover retaining screws.
10. Tighten the four (4) handle screws.
11. Again using two people, tilt the instrument down until it is right-side up.



1. Loosen handle screws slightly to provide installation clearance. 2. Sliding cover down	3. Cover flange goes under handles and front panel 4. Cover Fastening Screws (into Inner Chassis)

Figure 8-4. Front Cover Orientation

Chapter 9 — External Component Replacement

9-1 Introduction

Use this procedure to remove and replace the front panel test ports, the front panel access loops, the rear panel access loops, and the rear panel SATA Solid State Drive (SSD). The procedures covered here are:

Note

The instrument Model Identity Label – 3-60124-X must be ordered separately and can be applied at the end of the Front Panel installation procedure or with the covers on if just replacing the label. The label part number varies depending on the instrument model. Each label is valid for any combination of options for that model:

- MS4642B Model Identity Label – 3-60124-19
- MS4644B Model Identity Label – 3-60124-20
- MS4645B Model Identity Label – 3-60124-21
- MS4647B Model Identity Label – 3-60124-22

The identity label replacement instructions are covered in Chapter 18, "Front Panel Assembly Replacement" in Section 18-4 "Prepare New Front Panel" on page 18-7.

9-2 Replace Front Panel Test Ports

Use this procedure to replace a Front Panel Test Port for any combination of options or no options. Also use this procedure to remove and later replace the same Test Port to access RF Deck Bottom Side modules, typically the Test Port Couplers. See Figure 9-1 on page 9-2.

Parts and Applicability

The Front Panel Test Ports are available on all instruments and are usually the same type as the K (m) or V (m) Test Port connectors. It is possible to install a K Test Port on a V instrument and vice versa. There are two (2) Front Panel Test Ports per instrument. The replacement part kit comes with one (1) Test Port.

- MS4642B / MS4644B: Test Port K Connector – 34YK50C
- MS4645B / MS4647B: Test Port V Connector – 34YV50C

Procedure

1. Make sure you have the correct front panel Test Port Adapter connector depending on your instrument model.

Remove the Test Port Adapter

2. Using a 1/2" torque end wrench set to 36 lbf · in, loosen the Test Port Adapter then remove by hand.

3. Carefully remove the Test Port Adapter from the underlying threaded coupler, taking care to protect the Test Port Center Pin. The test port coupler is held in place with a nut and thrust washer which need not be removed in this procedure.

Install the Test Port Adapter

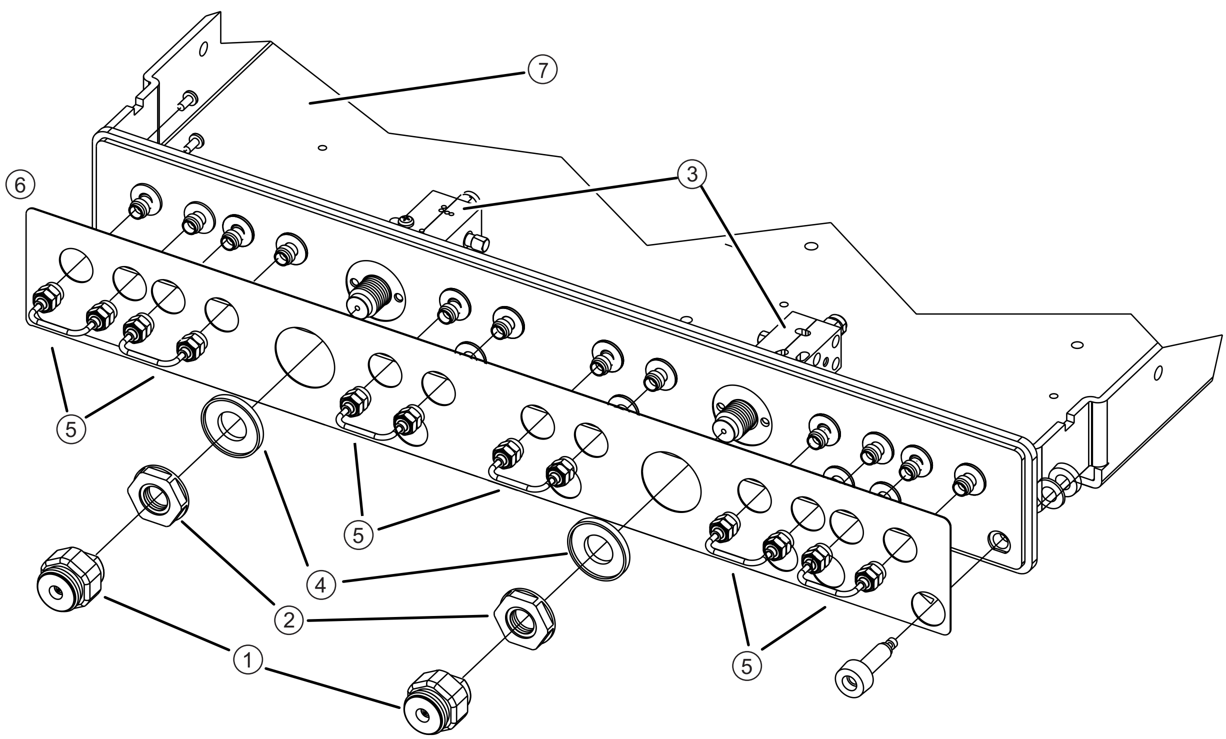
Warning	To avoid issues with measurement repeatability, ensure the test port adapters are properly torqued to 36 lbf · in. Do not over-torque.

4. Carefully place the Test Port Adapter on the threaded coupler shaft, making sure the Test Port Center Pin is correctly aligned.

5. Thread the replacement on by hand, making sure the threads are correctly engaged and not cross threaded.

6. When fully threaded on, tighten to finger tight.

7. Torque the Test Port Adapter using a 1/2” torque end wrench set to 36 lbf · in.



Orientation: The RF Deck Front Panel upside down with the bottom of the RF Deck visible. 1. Test Port Adapter 2. Test Port Nut 3. Test Port Couplers • Located inside the RF Deck and not visible with the instrument covers on. • Only the protruding and threaded Coupler connector is visible with the covers on.	4. Test Port Thrust Washer 5. Front Panel Loop Cables • Only with Option 51, 61, or 62. • Connector types (K or V) match the Test Port Connector type. 6. RF Deck Overlay Panel. 7. RF Deck Chassis.

Figure 9-1. Test Port Connectors and Related Hardware

9-3 Replace Front Panel Direct Access Loops

The Direct Access Loops are available if the instrument is equipped with Option 51, 61, or 62. The K (m) or V (m) loop connectors are the same as the instrument Test Port connector type. There are six (6) Direct Access Loops per instrument. The replacement part kit comes with one (1) loop.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 “Factory RF Calibration (RF Cal)” for instructions on performing a new RF calibration.

Parts and Applicability

- MS4642B / MS4644B: Direct Access Loops, K Connectors
- MS4645B / MS4647B: Direct Access Loops, V Connectors
    - There are six (6) Direct Access Loops per instrument.
    - The replacement part kit comes with one (1) loop.
    - For instruments equipped with Option 51, 61, or 62.

Procedure

1. Make sure you have the correct Front Panel Loop connector for your instrument model.
2. Loosen the Front Panel Loop using a 5/16” torque end wrench set to 8 lbf · in.
    - Recommended is a 5/16” Torque End Wrench – 8 lbf · in (8 mm 0.9 N · m) – Anritsu 01-201 or equivalent.
3. Once loose, remove the loop connector by hand.
4. Replace the loop, making sure both connectors are correctly seated, aligned, and threaded. Tighten both connectors finger tight.
    - “Walk the replacement loop on” gently to make sure it is in place with the center pins aligned.
5. When both connectors are finger tight, use a 5/16” torque wrench and torque to 8 lbf · in.

9-4 Replace Rear Panel Direct Access Loops

The Direct Access Loops are available if the instrument is equipped with Option 51, 61, or 62. The loop connectors are all SMA (m-m). There are six (6) Rear Panel Loops per instrument. The replacement part kit comes with one (1) loop.

Parts and Applicability

- Rear Panel Loop, SMA (m-m)
    - For all instrument models with Option 51, 61, or 62.
    - The instrument is equipped six (6) loops.
    - The replacement kit comes with one (1) loop.

Procedure

1. Loosen the to-be-replaced Rear Panel Loop using a 5/16” torque end wrench set to 8 lbf · in.
    - Recommended is a 5/16” Torque End Wrench – 8 lbf · in (8 mm 0.9 N · m) – Anritsu 01-201 or equivalent.
2. Once loose, remove the loop connector by hand.
3. Replace the loop, making sure both connectors are correctly seated, aligned, and threaded. Tighten both connectors finger tight.
    - “Walk the replacement loop on” gently to make sure it is in place with the center pins aligned.
4. When both connectors are finger tight, use a 5/16” torque wrench and torque to 8 lbf · in.

9-5 Replace the Solid State Drive Assembly

Use this procedure to replace the SATA Solid State Drive (SSD) Assembly. Note that these replacement parts can only be used to replace a defective SSD and no additional operating system license is provided with this replacement unit.

If additional SSDs are required with separate licenses for environments such as high security operations, order instead the SSD Option MS4640B-004.

Parts and Applicability

- Solid State Drive – ND75952 – 67861

Procedure

1. Using a flat head screwdriver, loosen and remove the two (2) captive screws holding the SSD assembly into the chassis.
2. Pulling gently, remove the SATA SSD assembly from the chassis.
3. Insert the replacement SSD into the slot.
4. Press the SSD into its mating socket on the Motherboard 2 PCB and gradually tighten the two (2) flat head screws.

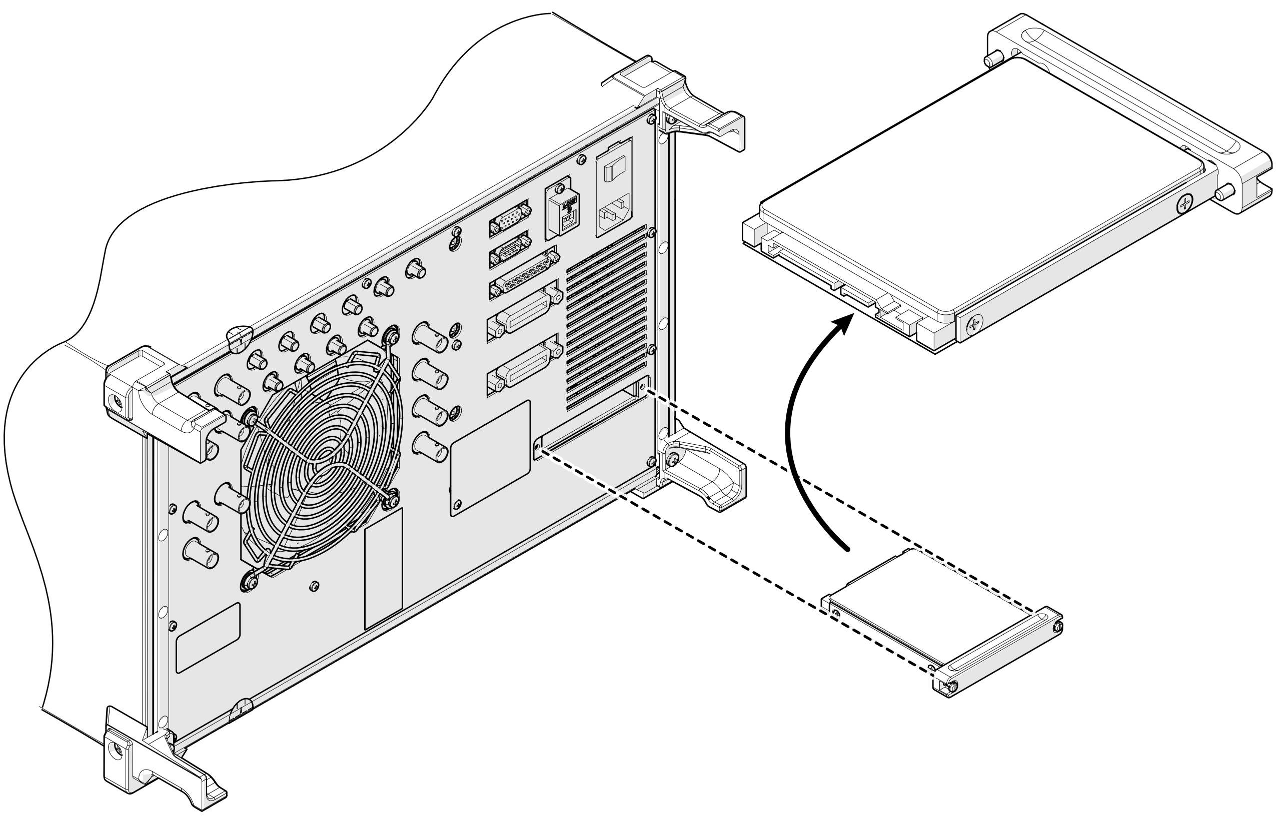


Figure 9-2. Solid State Drive

Chapter 10 — Digital and Analog PCB Replacement

10-1 Introduction

This chapter describes how to replace the following digital and analog printed circuit board (PCB) assemblies.

10-2 Digital PCB Overview

Parts and Applicability

A10 Digital PCB Assembly

- A10 Digital Signal Processing (DSP) PCB Assembly
- The A10 PCB is used on any VNA model with any combination of options.

Caution	The A10 PCB contains model configuration data which is unique to each instrument. The replacement board is pre-configured at the Factory for the targeted instrument. DO NOT install the A10 PCB on a different instrument. If a VectorStar's A10 DSP Module is removed and installed in any other VectorStar VNA, the data in the module's non-volatile memory will be corrupted.

Carrier Board PCB (CB PCB) Assembly

The CB PCB front-side daughter boards are: SBC, SODIMM (2 each), A4 USB Controller PCB, and A8 GPIB PCBs.

The CB PCB back-side daughter board is the GPU PCB.

- Graphics Processor Unit (GPU PCB) PCB Assembly
  - Includes heatsink
  - Mounts on back side of the CB PCB.
- A4 USB Controller PCB Assembly
  - Mounts on the front side of the CB PCB.
- A8 GPIB PCB Assembly
  - Mounts on the front side of the CB PCB.
- Single Board Computer (SBC PCB)
  - Includes heatsink
  - Mounts on front side of the CB PCB.
- Small Outline Dual In-line Memory Module (SODIMM)
  - Mounts on the front side of the SBC PCB.
  - Two (2) per instrument
  - One (1) per replacement kit
- Coin Battery – 3-633-43
  - Mounts on the front side of the CV PCB, behind the A8 GPIB Module PCB Assembly.

Digital PCB Locations

Figure 10-1 on page 10-3 shows the instrument chassis with the covers off and the locations of the Digital PCB Assemblies.

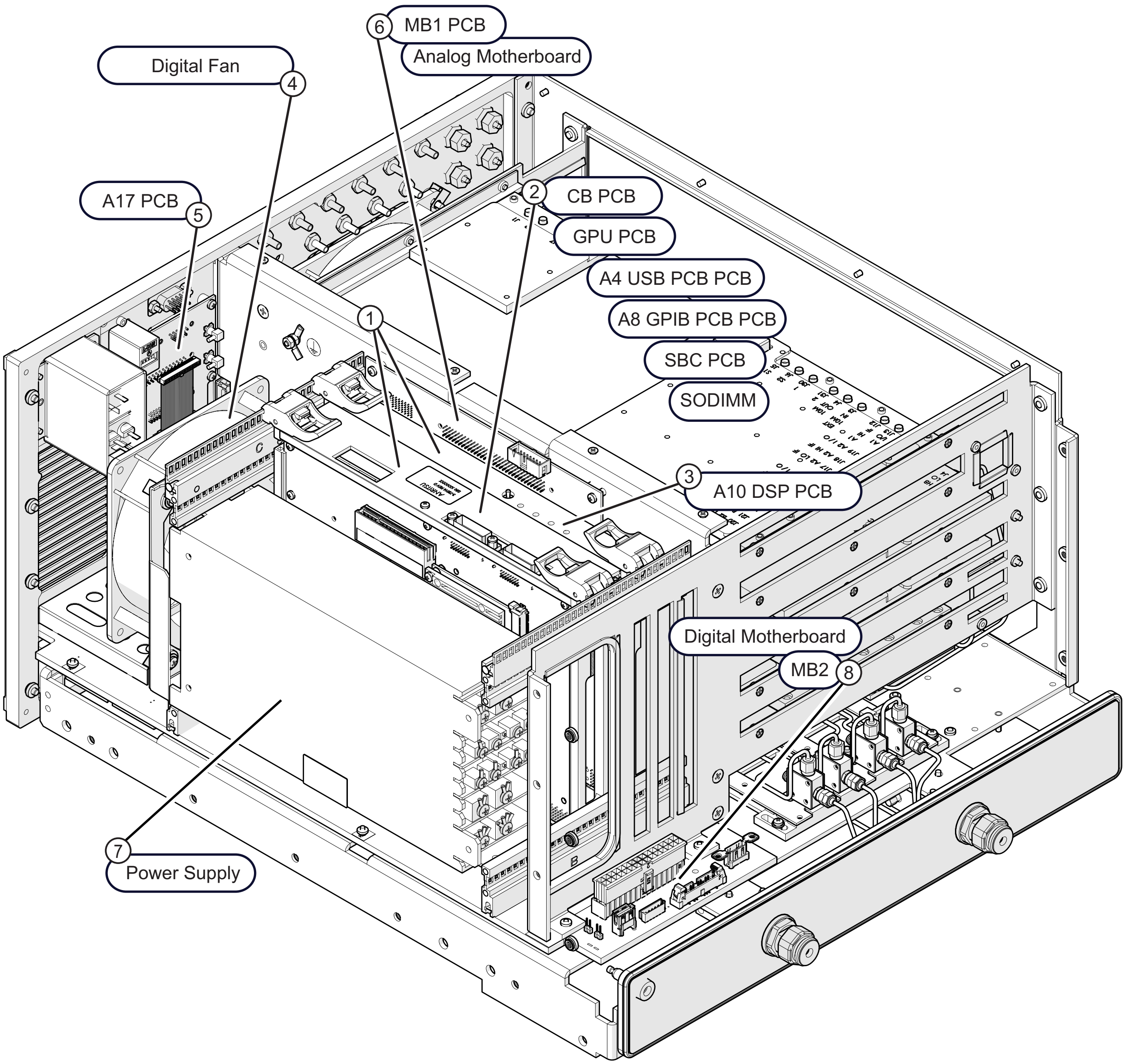


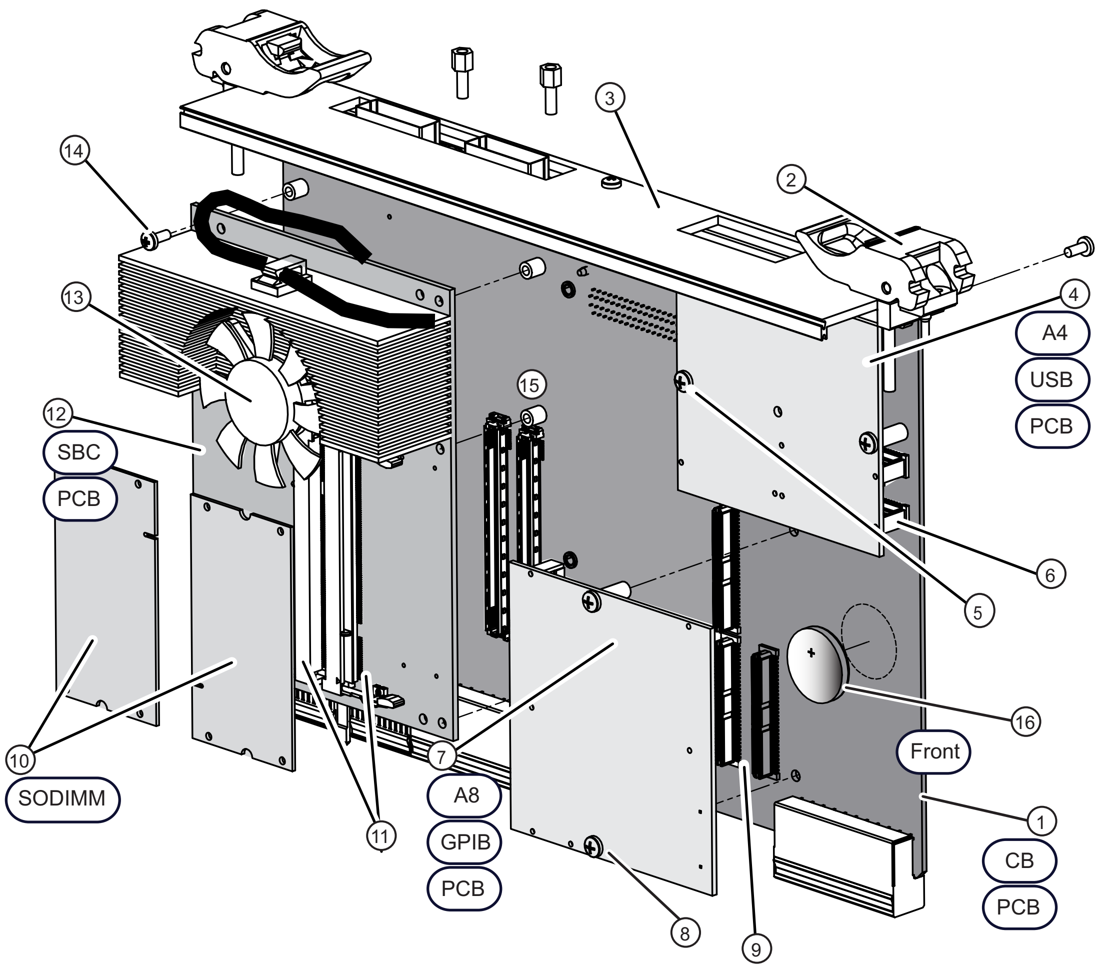
Figure 10-1. Digital Bay Components

1. Digital PCBs – PCBs mounted vertically in the left side digital PCB bay to the right of the Power Supply. They seat into the backplane connectors on the horizontally mounted Motherboard 2 PCB Assembly (See number 13) 2. Carrier Board PCB (CB PCB) Assembly Mounted on the CB PCB are: • Graphics Processor Unit (GPU) PCB Assembly Mounts on back of CB PCB. • A4 USB Controller PCB Assembly Mounts on front of CB PCB. • A8 GPIB Module PCB Assembly Mounts on front of CB PCB. • Single Board Computer (SBC PCB) Mounts on front of CB PCB. • Small Outline Dual In-line Memory Module (SODIMM) Mounts on the front side of the SBC PCB. Two (2) per instrument. One (1) per replacement kit.	3. A10 Digital Signal Processor PCB Assembly 4. Digital PCB Fan Assembly With 165 mm cable harness and plug. 5. A17 Rear Panel PCB Assembly Located inside the Rear Panel Chassis Assembly. Provides connectors for the Serial, External I/O, IEEE 488.2 GPIB, and Dedicated GPIB Ports. 6. Motherboard 1 (MB1) PCB Assembly 7. Power Supply Module and Cable Harnesses: 8. MB2 – Motherboard 2 PCB: ND81312 or 3-ND81312 or ND80356

Figure 10-1. Digital Bay Components

Identification – Carrier Board – Front Side Assemblies

Shown in Figure 10-2 are the front side components of the Carrier Board.

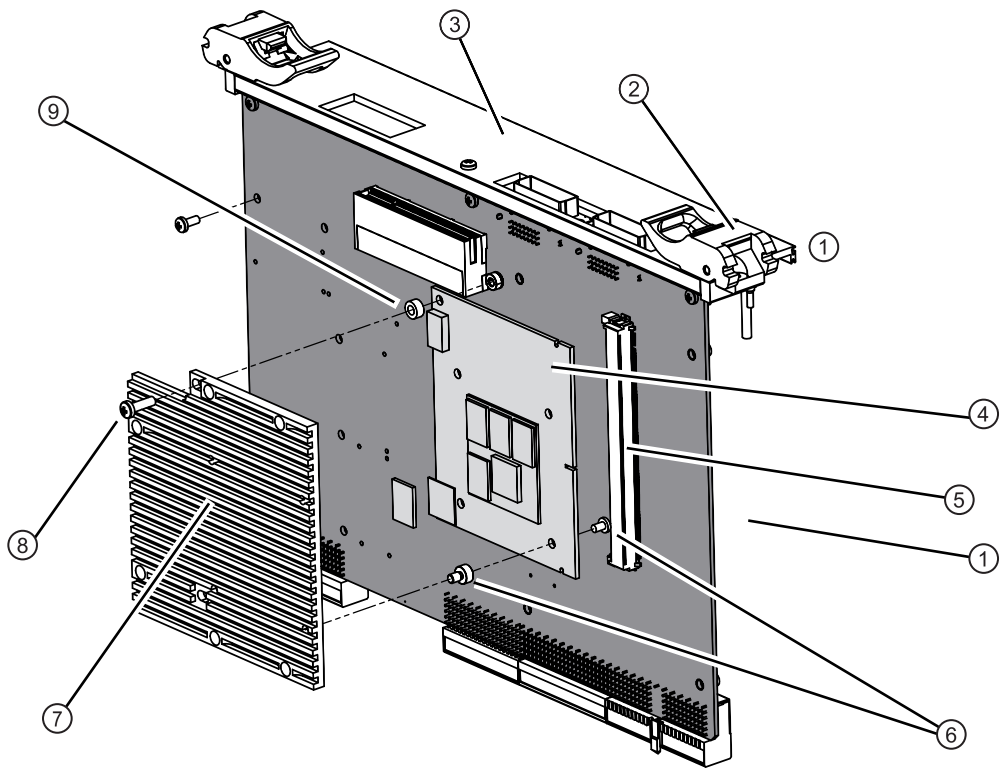


1. Carrier Board (CB) PCB Assembly	8. GPIB PCB mounting screws, 2 each
2. CB PCB Ejector Handles	9. Connectors for PMC-USB PCB on CB-PCB, 3 each
3. CB PCB Front Panel Connectors and LEDs	10. Small Outline Dual In-line Memory Module (SODIMM) – Two (2) SODIMMs per instrument
4. A4 USB Controller PCB Assembly	11. Connectors for SODIMMs on SBC PCB, one (1) per SODIMM, two (2) per SBC PCB
5. USB PCB mounting screws, 2 each	12. Single Board Computer (SBC) PCB Assembly
6. Connectors for USB PCB on CB PCB, 2 each	13. SBC PCB heatsink, fan, and fan cable
7. A8 GPIB PCB Assembly Mounts on the Carrier Board.	14. SBC PCB mounting screws, 5 each
	15. Connectors for SBC PCB on CB PCB, 2 each
	16. Coin Battery, Part Number 3-633-43

Figure 10-2. A8 Carrier Board PCB Assembly – Front

Identification – Carrier Board – Back Side Assemblies

Shown in Figure 10-3 are the rear side components of the Carrier Board.



1. Carrier Board PCB (CB-PCB) Assembly 2. CB-PCB Ejector Handles 3. CB-PCB Front Panel Connectors and LEDs 4. Graphics Processor Unit (GPU) PCB 5. Connector for GPU PCB 6. Heatsink mounting screws and standoffs, from back of GPU to threaded holes in heatsink, 4 each	7. GPU PCB Heatsink – 3-71973 • An included component of the GPU PCB replacement kit. 8. Mounting screws holding Heatsink/GPU PCB assembly to CB-PCB, 2 each 9. Standoff washers between GPU PCB and Heatsink, 2 each

Figure 10-3. Carrier Board PCB Assembly – Back

10-3 Digital PCB Replacement

Common Preparation and Access Procedures

Follow the instructions in Section 8-2 “Preparation of Work Area and Safety Instructions” on page 8-1.

PCIe Cable (Option 35) – Removal for Access

First remove the following cables connected to the Digital section PCBs.

XGA/VGA Cable: From Carrier Board PCB J23 to Rear Panel XGA/VAG 15-pin D-Sub Connector.

1. Disconnect the cable from the J23 connector.

Carrier Board USB Cable: Connects the Carrier Board PCB USB connector to Rear Panel USB connector.

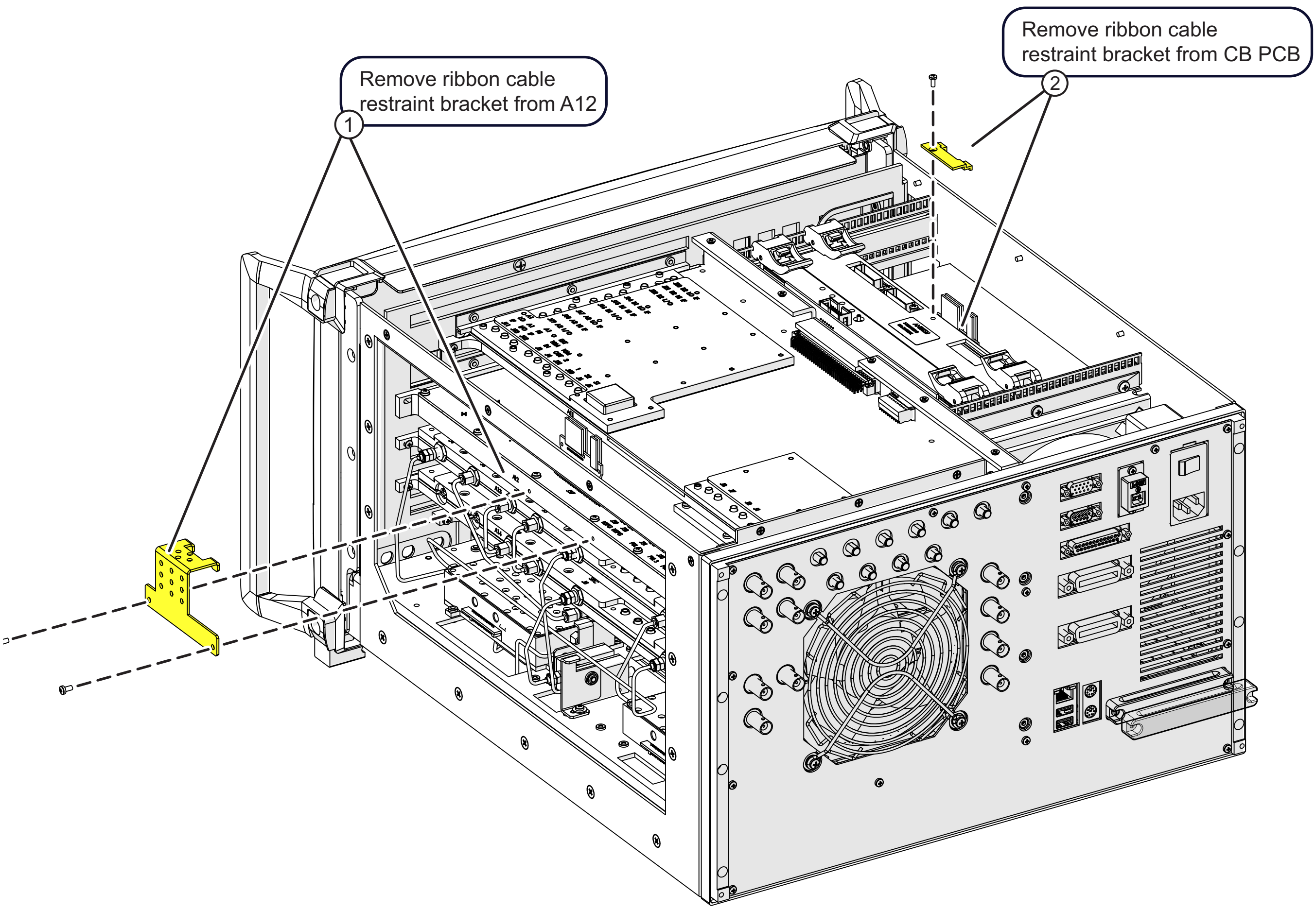
2. Disconnect the USB cable from the Carrier Board PCB.

Option 35 IF Digitizer Board PCIe Cable

Note	If your VNA does not have Option 35, IF Digitizer Module, skip to the next applicable section.

Caution	It is important to handle the PCIe Cable carefully when removing it. Use the following procedure. Always disconnect both ends to move the cable. Disconnecting only one end and flexing the cable to gain access to the boards can degrade its performance.

3. Following the illustrations in Figure 10-4 and Figure 10-5 on page 10-8, first remove the cable restraint brackets at each end of the cable assembly.



1	Ribbon cable restraint bracket removed from A122 (two screws, M3 x 6 mm)
2	Ribbon cable restraint bracket removed from CB PCB. (one screw, M2.5 x 6 mm)

Figure 10-4. PCIe Cable Restraint Bracket Removal (for digital PCB access)

4. Carefully disconnect each cable end from their receptacles.

5. Slide the cable out of the way to allow removal of the Digital PCBs.

Note	Avoid lifting the middle adhesive cable restraint to move the cable. If the restraint must be moved, peel up only one end of the restraint to ensure it will remain in place after reassembly.

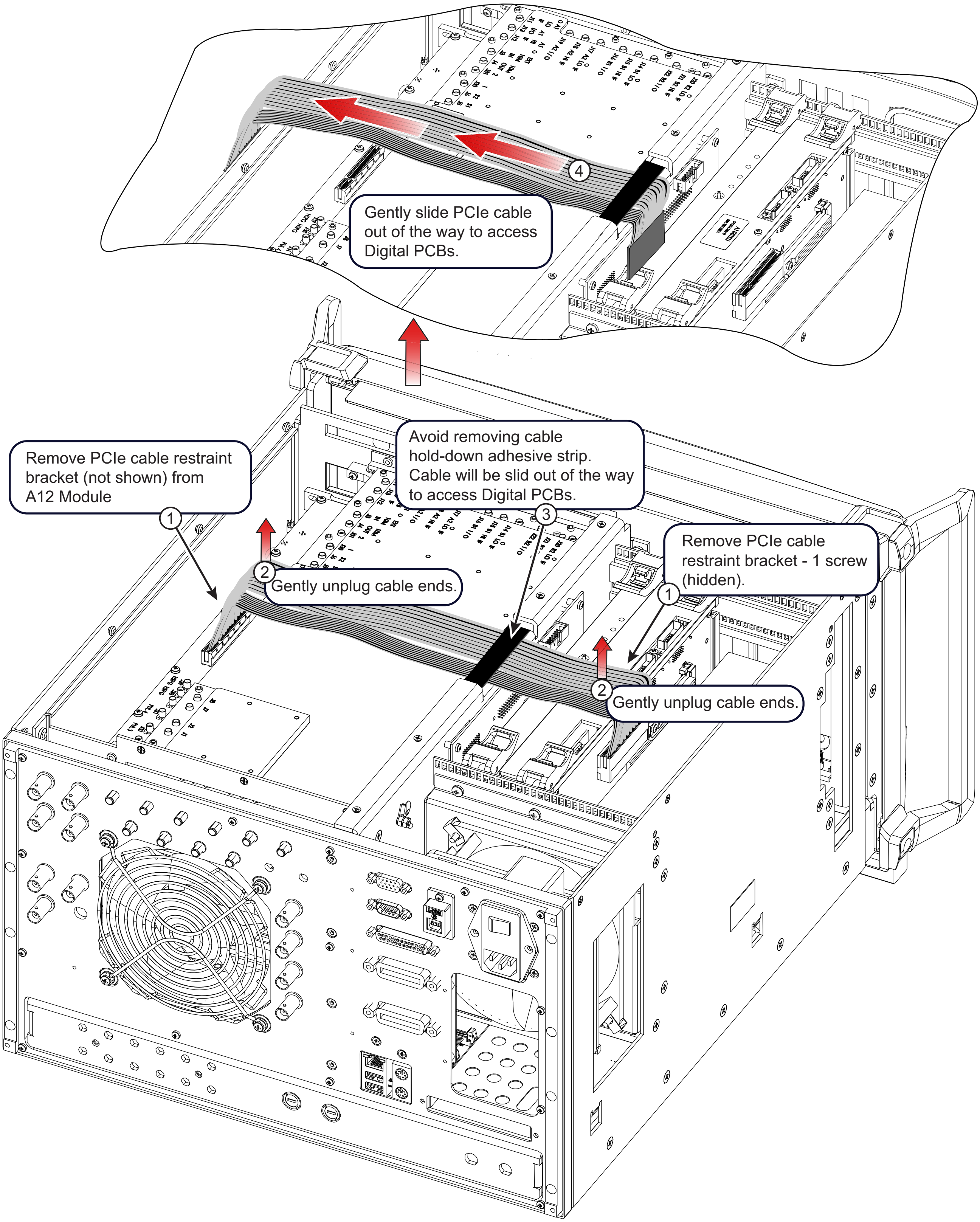


Figure 10-5. PCIe Cable Removal (for digital PCB access) (1 of 2)

Index	Description/Instruction
1	Remove PCIe cable restraint bracket (not shown) from A12 Module. Remove PCIe cable restraint bracket from the Carrier Board PCB – 1 screw (hidden).
2	Carefully unplug the cable ends.
3	Avoid removing cable hold-down adhesive strip. Cable will be slid out of the way to access Digital PCBs.
4	Gently slide the cable out of the way to access the Digital PCBs.

Figure 10-5. PCIe Cable Removal (for digital PCB access) (2 of 2)

A10 DSP Module PCB Replacement

Use this procedure to replace the A10 DSP Module PCB Assembly or to remove it to access deeper dwelling components.

Caution	The A10 PCB contains model configuration data which is unique to each instrument. The replacement board is pre-configured at the Factory for the targeted instrument. DO NOT install the A10 PCB on a different instrument. If a VectorStar's A10 DSP Module is removed and installed in any other VectorStar VNA, the data in the module's non-volatile memory will be corrupted.

Procedure

1. If your VNA has Option 35, A12 IF Digitizer Board, ensure the PCIe Cable that runs from A12 to the Carrier PCB assembly has been moved as described in Section "PCIe Cable (Option 35) – Removal for Access" on page 10-6.
2. Remove the screws holding the PCB assembly in place, pull up the latches, and then pull up straight up until the PCB assembly is clear of the chassis.
3. If the PCBs are being removed to access another part, set aside in a static-free environment and repeat until all PCBs are out. Then proceed with other removal procedures as required.
4. There are no field replaceable components on the A10 DSP Module PCB Assembly.
5. When ready, slide the A10 DSP Module PCB Assembly into its card cage slots until the latches click. Fasten it in place using the two (2) captive screws.

Carrier Board Replacement

Use this procedure to replace the Carrier (CB) PCB Assembly. The CB PCB and its daughter-boards are used on any model VNA with any combination of options.

Warning	The CB PCB must be handled carefully to avoid damaging the components on the front or back of the PCB, especially during replacement of the Single Board Computer.

Carrier Board PCB Removal

1. If your VNA has Option 35, A12 IF Digitizer Board, ensure the PCIe Cable that runs from A12 to the Carrier PCB assembly has been moved as described in Section "PCIe Cable (Option 35) – Removal for Access" on page 10-6.
2. Remove the screws holding the PCB assembly in place, pull up the latches, and then pull up straight up until the PCB assembly is clear of the chassis.
3. If the PCBs are being removed to access another part, set aside in a static-free environment and repeat until all PCBs are out. Then proceed with other removal procedures as required.
4. Avoid putting pressure on the Graphics Processor Module PCB Assembly (GPU PCB) on the back of the CB PCB.

5. Hold the CB PCB in a vertical position with one hand and use the other hand to remove the required daughter-board mounting screws as required using a Phillips-head screwdriver.

Caution	**Static Sensitivity:** If replacing the CB PCB, all daughter boards must be transferred to the replacement CB PCB. In this case, as each daughter board is removed, set it aside in a static-free environment until it is ready to be installed on the new CB PCB.

6. If replacing an individual daughter-board, go to Section 10-4 "Daughter Board Replacements on Carrier Board" on page 10-10.
7. If replacing the Carrier Board PCB, use all the instructions in Section 10-4 to transfer the daughter boards onto the new carrier board.

Carrier Board PCB Installation

8. Check that all the connections and mounting hardware on the CB PCB are correct and tight.
9. Make sure the Single Board Computer Heatsink Fan has been connected to its connector on the back side of the SBC PCB.
10. Slide the CB PCB into the chassis, making sure to clear both the Power Supply Module on the left (when viewed from the front) and the A10 Digital Signal Processor PCB on the right.
11. Connect the cable between the CB PCB J23 XGA/VGA connector and the rear panel XGA/VGA connector.
12. Connect the USB cable from the rear panel to its location on the CB PCB.
13. If your VNA has Option 35, A12 IF Digitizer Board, install the PCIe Cable that runs from A12 to the Carrier PCB assembly. Refer to Section "PCIe Cable (Option 35) – Removal for Access" on page 10-6 and reverse the process.

10-4 Daughter Board Replacements on Carrier Board

GPU PCB Replacement

GPU PCB Removal

1. Note that the Graphics Processor Unit (GPU PCB) PCB Assembly is mounted on the Carrier Board PCB back side. Keep the Carrier Board vertically oriented while servicing the GPU PCB.
   - Figure 10-3, "Carrier Board PCB Assembly – Back" on page 10-6.
2. Partially remove the two (2) screws holding the PCB/Heatsink assembly onto the Carrier Board PCB. The goal is to disengage the screw threads from the Carrier Board PCB standoffs, but not loose the spacer standoffs between the heatsink and the GPU PCB.
   - Note that the PCB heatsink is part of the replacement PCB.
3. Lift the non-connector edge of the GPU PCB up 45 degrees and then remove from the Carrier Board PCB.
4. Be careful with the GPU PCB orientation so that the screw spacers are not lost or misaligned.

GPU PCB Installation

5. Position the CB PCB so that it is vertical. Do not lay the CB PCB flat on its heat sink side.
6. Install the Graphics Processor Unit (GPU PCB) PCB Assembly with its attached heatsink on the rear of the CB PCB.
   - For orientation, Figure 10-3, "Carrier Board PCB Assembly – Back" on page 10-6.
7. Make sure the GPU PCB mounting screw spacers are correctly centered over their mounting holes.
8. Holding the GPU PCB at a 45 degree angle, insert the connector edge of the PCB into the connector.
9. Gently push the GPU PCB flat until the connector tabs click into place.

10. Making sure the spacers between the heatsink and the PCB are still correctly aligned and in place, insert and tighten the two (2) machine screws to hold the GPU PCB in place.
11. The Carrier Board PCB is now ready to install in the chassis using the instructions in "Carrier Board Replacement" on page 10-9.

SODIMM Replacement

SODIMM Removal

1. The Small Outline Dual In-line Memory Modules (SODIMMs) do not have any fastening hardware and are mounted on the SBC PCB.
2. Lift the SODIMM connector latches out, disengaging from the module and then lift the front edge of the SODIMM up 45 degrees, and then remove from the SBC PCB.
3. If required, repeat for the second SODIMM.

SODIMM Installation

4. Position the first Small Outline Dual In-line Memory Module (SODIMM) over its mounting connector on the SBC PCB.
5. Holding the SODIMM at a 45 degrees angle, insert the connector edge of the SODIMM into its connector on the SBC PCB.
6. Gently press the SODIMM flat until the connector tabs click into place. There are no mounting screws required for the SODIMMs.
7. Repeat the step above to the second SODIMM.

A4 USB PCB Replacement

A4 USB PCB Removal

1. Remove the two (2) screws holding the A4 USB Controller PCB Assembly (A4 USB PCB) onto the Carrier Board PCB.
2. Lift the A4 USB PCB straight up from its two (2) connectors on the CB PCB.
3. If replacing just the A4 USB PCB, installation is the reverse.
4. If replacing the CB PCB, set the A4 USB PCB aside in a static-free environment and continue with Step 5.

A4 USB PCB Installation

5. Install the A4 USB Controller PCB (A4 USB PCB) Assembly on the front of the CB PCB.
6. Position the A4 USB PCB over its two (2) CB PCB connectors and press into place, making sure the connectors are fully seated.
7. Fasten in place with two (2) machine screws.

A8 GPIB PCB Replacement

A8 GPIB PCB Removal

1. Remove the two (2) screws holding the A8 GPIB Module PCB Assembly (A8 GPIB PCB) onto the CB PCB.
2. Lift the A8 GPIB PCB straight up from its three (3) connectors on the CB PCB.
3. If replacing just the A8 GPIB PCB, installation is the reverse.
4. If replacing the CB PCB, set the A8 GPIB PCB aside in a static-free environment and continue with Step 5.

A8 GPIB PCB Installation

5. Install the A8 GPIB Module PCB (A8 GPIB PCB) Assembly on the front of the CB PCB.
6. Position the A8 GPIB PCB over its three (3) CB PCB connectors and press into place, making sure the connectors are fully seated.
7. Fasten in place with two (2) machine screws.

SBC PCB Replacement

Use this procedure to replace the Single Board Computer (SBC PCB) onto the Carrier Board PCB (CB PCB) Assembly or if you are replacing the CB PCB.

SBC PCB Removal

Note	If removing just the Single Board Computer PCB Assembly (SBC PCB) for replacement, the disassembly sequence is: 1. Remove the GPU PCB from the back side of the CB PCB. 2. Remove the two SODIMMs from the SBC. 3. Remove the SBC PCB.

1. The SODIMMs must be removed before the Single Board Computer (SBC PCB) can be removed.
   - Do Step 1 through Step 3 of the "SODIMM Replacement" procedure above first.
2. Remove the seven (7) screws holding the SBC PCB in place on the CB PCB.
3. Using even lifting force, lift the SBC PCB straight up from its two (2) connectors on the Carrier Board PCB.
   - Note that the PCB main heatsink and fan are part of the replacement part.
   - The fan cable plugs into a socket on the back of the SBC PCB.

SBC PCB Installation.

Note	If installing just the Single Board Computer PCB Assembly (SBC PCB) the reassembly sequence is: 1. Place the SBC PCB in position on the front side of the CB PCB and press the connectors into place. Fasten in place with seven (7) machine screws. 2. Replace the two SODIMMs on the SBC. 3. Keeping the CB PCB vertical, replace the GPU PCB on the back side of the CB PCB.

4. Be sure that the Graphics Processor Unit PBC (GPU PCB) Assembly and its heatsink have been removed from the back of the CB PCB.

   If the GPU PCB has been removed, the CB PCB can be laid flat on a table for the SBC assembly below.

   If the GPU PCB is still attached, the CB PCB must remain upright during the assembly procedure
5. Ensure the heat sink fan cable is attached to its connector on the back of the SBC PCB.
6. Install the SBC PCB by aligning it with the two (2) connectors on the CB PCB.
7. Use firm pressure to press the SBC PCB into its connectors so they are fully seated taking care not to pinch the fan power cable.
8. Fasten in place with seven (7) machine screws.

Real Time Clock Coin Battery Replacement

Battery replacement part number is 3-633-43.

1. Remove the Carrier Board PCB Assembly from the instrument.

2. Remove the A8 GPIB Module PCB Assembly. See Figure 10-2 on page 10-5.

  a. Remove the two (2) screws holding the A8 GPIB Module PCB Assembly onto the CB PCB.

  b. Lift the A8 GPIB PCB straight up from its three (3) connectors on the CB PCB.

3. Replace the coin battery.

4. Install the A8 GPIB Module PCB Assembly.

5. Install the Carrier Board PCB Assembly in the instrument.

Completion Common Procedures

6. If removed, install the Front Panel.

- See Section 18-5 “Install Front Panel” on page 18-8.

7. Install the Inner Top Cover.

- See Section “Install Inner Cover” on page 8-6.

8. Install the Outer Cover.

- See Section “Install Outer Cover” on page 8-6.

10-5 Analog Module Overview

Use this procedure to remove the right side analog section module assemblies. After removal, follow-up procedures may be to replace an analog module assembly, access other chassis-mounted components, or access RF Deck hardware, components, and cables.

Note	The Motherboard 1 PCB Assembly (MB1 PCB) provides the backplane connectors for the analog module assemblies. The MB1 PCB backplane connectors protrude through the chassis center plate into the analog section PCB bay. The MB1 PCB plugs into a backplane connector on MB2.

Parts and Applicability

- A11 IF Band Module
- A12 Pulse/IF Digitizer Module (Option 35)
- A13 Source Module
- A14 Second Source Module (Option 31)
- A15 Low Band Receiver Module

Note	The A11, A13, A15 analog module assemblies are used in all instrument models with any combination of options.

Analog Module Locations

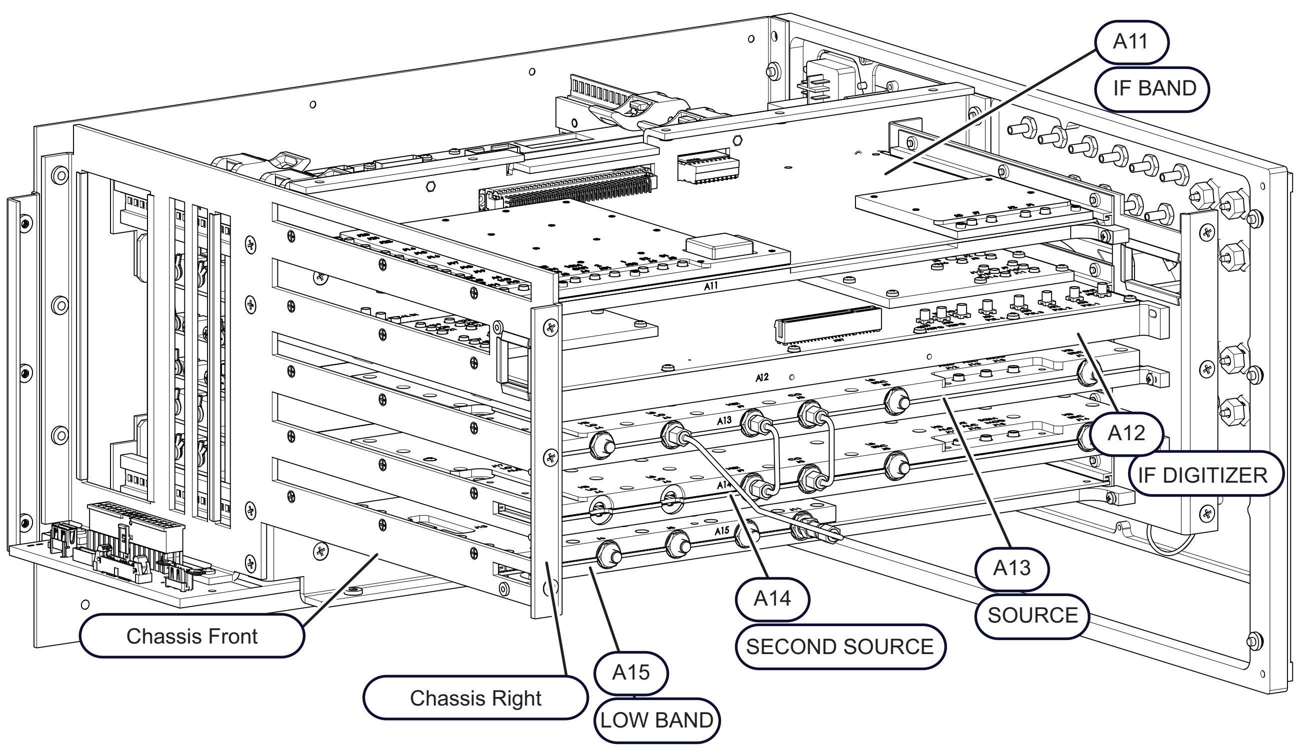


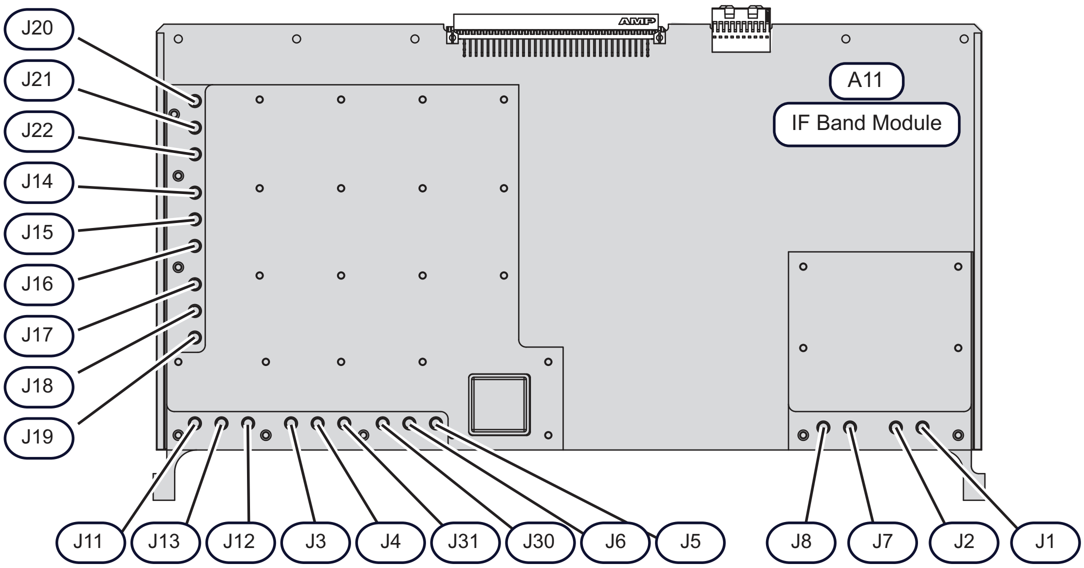
Figure 10-6. A11 IF Band, A13 Source, and A15 Low Band Receiver Module PCB Assemblies (1 of 2)

• A11 – IF Band Module	• A14 – Second Source Module
• A12 – IF Digitizer Module	• A15 – Low Band Receiver Module
• A13 – Source Module	

Figure 10-6. A11 IF Band, A13 Source, and A15 Low Band Receiver Module PCB Assemblies (2 of 2)

Module Identification

The five figures below (Figure 10-7, Figure 10-8 on page 10-17, Figure 10-9 on page 10-18, Figure 10-10 on page 10-19, and Figure 10-11 on page 10-20) describe each analog module assembly and show their connector locations. The call outs in each figure summarize the MCX and semi-rigid coaxial cable connections for each PCB.



All A11 module cable connectors are MCX.

Top Left Side Connectors (top to bottom)

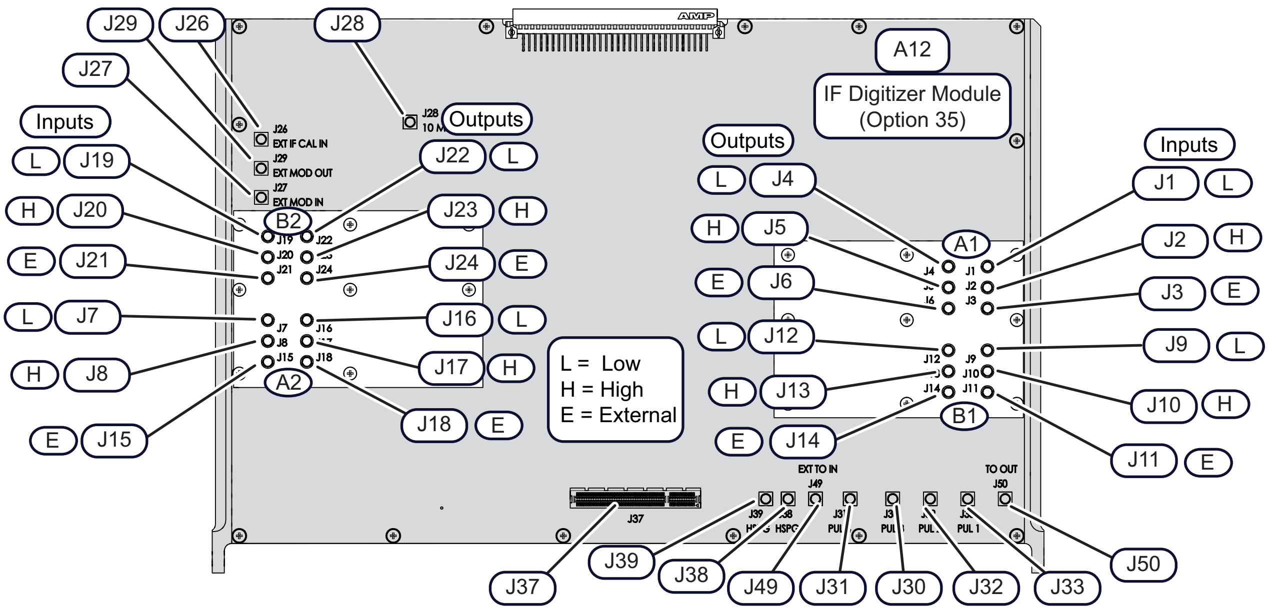
1. J20 – B2 LO IF – Low Band b2 IF In
   Connects to A15 module J22.
2. J21 – B2 HI IF – High Band b2 IF In
   Connects to the A102 Sampler Module rear facing J3. Note that the A100, A101, A102, A103, and A130 modules are located on the RF Deck Top Side and are part of the Sampler/LO Distribution Module Assembly.
3. J22 – B2 I/O – b2 IF In/Out
   Connects to rear panel IF I/O b2.
4. J14 – B1 LO IF – Low Band b1 IF In
   Connects to A15 module J16.
5. J15 – B1 HI IF – High Band b1 IF In
   Connects to A100 Sampler Module rear facing J3.
6. J16 – B1 I/O – b1 IF In/Out
   Connects to rear panel IF I/O b1.
7. J17 – A2 LO IF – Low Band a2 IF In
   Connects to A15 module J20.
8. J18 – A2 HI IF – High Band a2 IF In
   Connects to A103 Sampler Module rear facing J3.
9. J19 – A2 I/O – a2 IF In/Out
   Connects to rear panel IF I/O a2.

Front Connectors (left to right)

10. J11 – A1 LO IF – Low Band a1 IF In
    Connects to A15 module J13.
11. J13 – A1 I/O – a1 IF In/Out
    Connects to rear panel IF I/O a1.
12. J12 – A1 HI IF – High Band a1 IF In
    Connects to the A101 Sampler Module rear facing J3.
13. J3 – EXT 10M IN – External 10 MHz Reference In
    Connects to rear panel External 10 MHz Input.
14. J4 – EXT 10M OUT – External 10 MHz Reference Out
    Connects to rear panel External 10 MHz Output.
15. J31 – REF 2 – 10 MHz Reference Out
16. J30 – REF 1 – 10 MHz Reference Out
    Connects to A12 module connector J28.
17. J6 – REF S2 – 10 MHz Reference Out
    Connects to A14 Module connector J10.
18. J5 – REF S1 – 10 MHz Reference Out
    Connects to A13 module connector J10.
19. J8 – External A/D Clock Out – Not used.
20. J7 – External A/D Clock In – Not used.
21. J2 – External Analog In 2
    Connects to rear panel External Analog Input 2.
22. J1 – External Analog In 1
    Connects to rear panel External Analog Input 1.

Figure 10-7. A11 IF Band Module – Connectors

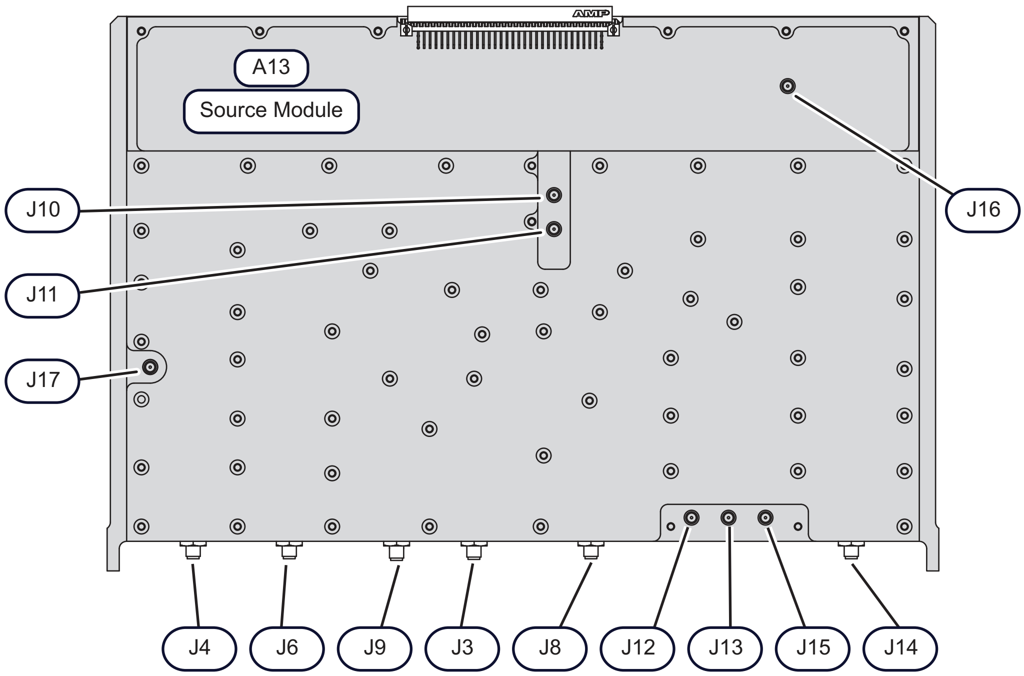
.A12 IF Digitizer Module (Option 35)



All A12 module cable connectors are MCX except for J37.			
Top Left Side Connectors (top to bottom)		**Top Right Side Connectors (top to bottom)**	
J28	10 MHz REF – To A11 module J30	J4	Low A1 Output – To A11 module J11
J26	EXT IF CAL IN – (Unused)	J5	High A1 Output – To A11 module J12
J29	EXT MOD OUT – (Unused)	J6	External A1 Output – To A11 module J13
J27	EXT MOD IN – (Unused)	J12	Low B1 Output – To A11 module J14
J19	Low B2 Input – To A15 module J22	J13	High B1 Output – To A11 module J15
J20	High B2 Input – To A102 module J3	J14	External B1 Output – To A11 module J16
J21	External B2 Input – To Rear Panel External B2.	J1	Low A1 Input – To A15 module J3
J7	Low A2 Input – To A15 module J20	J2	High A1 Input – To A101 module J3
J8	High A2 Input – To A103 module J3	J3	External A1 Input – To Rear Panel External A1.
J15	External A2 Input – To Rear Panel External A2.	J9	Low B1 Input – To A15 module J16
J22	Low B2 Output – To A11 module J20	J10	High B1 Input – To A100 module J3
J23	High B2 Output – To A11 module J21	J11	External B1 Input – To Rear Panel External B1.
J24	External B2 Output – To A11 module J24	**Top Front Connectors (left to right)**	
J16	Low A2 Output – To A11 module J17	J37	PCIe Cable Connector – To Carrier Board J25
J17	High A2 Output – To A11 module J18	J39	HSPG – (Unused)
J18	External A2 Output – To A11 module J19	J38	HSPG – (Unused)
		J49	EXT TO IN – To Rear Panel Pulse Sync In.
		J31	PUL 4 – To Rear Panel Pulse Gen 4.
		J30	PUL 3 – To Rear Panel Pulse Gen 3.
		J32	PUL 2 – To Rear Panel Pulse Gen 2.
		J33	PUL 1 – To Rear Panel Pulse Gen 1.
		J50	TO OUT – To Rear Panel Pulse Sync Out.

Figure 10-8. A12 IF Digitizer Module (Option 35) – Connectors

A13 Source Module



Top Left Side Connector

1. **J17** – HB LO ALC Input
   Connects to A130 LO Coupler Module and its forward facing J3/J4 pins (on RF Deck Top Side Center).

Top Rear Connectors

2. **J10** – 10 MHz Reference Input
   Connects to A11 module J5.
3. **J11** – DDS Clock Output
   Connects to J11 on A14 Second Source Module (Option 31). Otherwise, not used.
4. **J16** – External Analog Output
   Connects to rear panel External Analog Output.

Front Connectors (left to right)

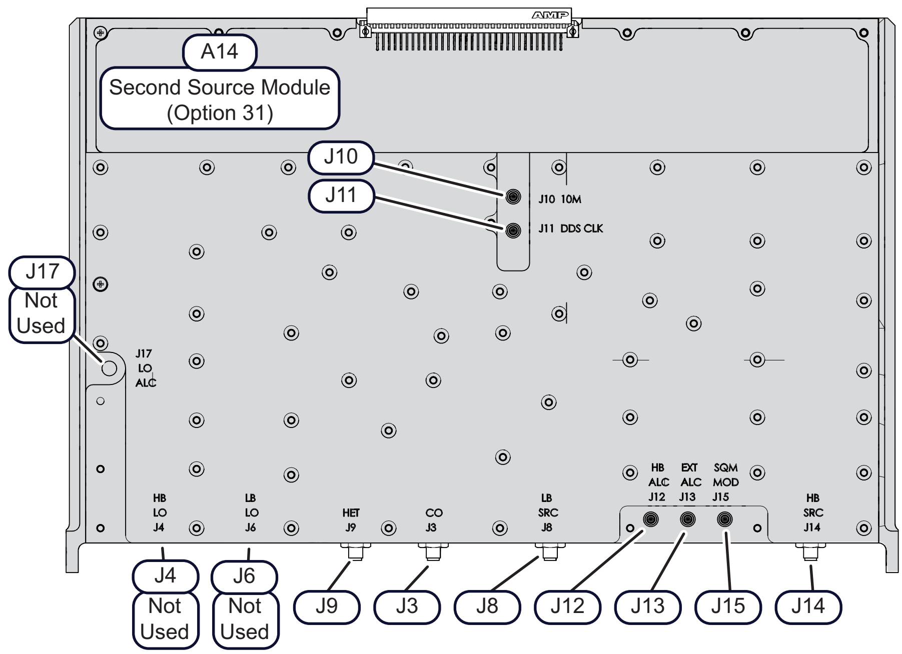
5. J4 – Highband LO1 Output
   Connects to A111 LO Distribution Module right facing J1 on RF Deck Top Side.
6. J6 – Low band LO1 Output
   Connects to A15 module J11.

Front Connectors (continued)

7. J9 – Common Het Output
   Connects to A14 Second Source Module, J9
8. J3 – Common Offset Output
   Connects to A14 Second Source Module, J3
9. J8 – Low band Source Output
   Connects to A115 Low Band Transfer Switch Module J1 on RF Deck Top Side.
10. J12 – HB Src ALC Input
    Connects to A18 PCB J7 on RF Deck Bottom Side.
11. J13 – External ALC Input
    Only used with Option 80/81 or 53 only. Connects to Rear Panel External ALC connector.
12. J15 – SQM Modulator Drive Output
    Only used on MS4645B / MS4647B VNAs. Connects to A18 PCB J12.
13. J14 – Highband Source Output
    Connects to A113 5-20 GHz Doubler Module J1 on RF Deck Top Side.

Figure 10-9. A13 Source Module – Connectors

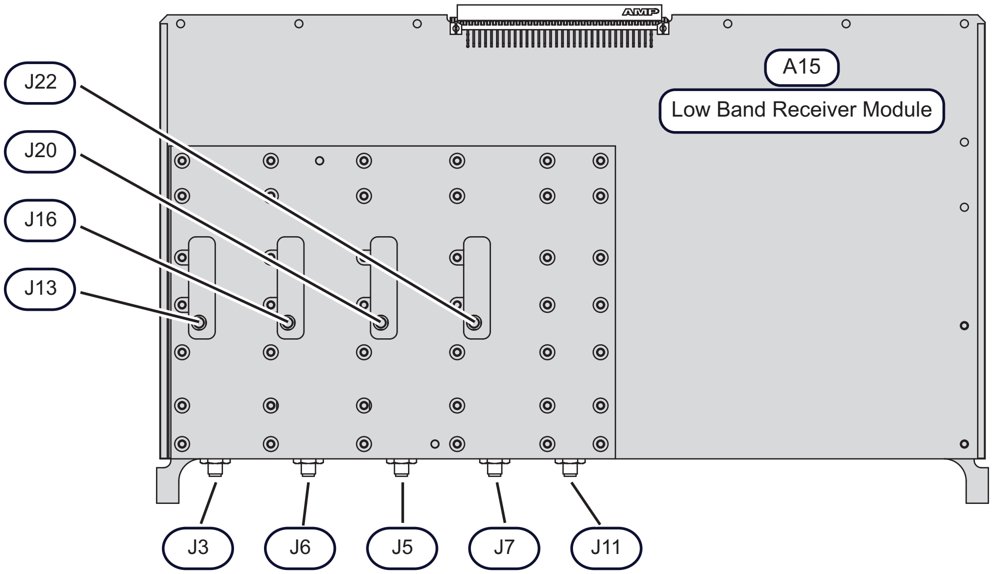
A14 Second Source Module (Option 31)



Front Connectors (left to right)		Top Left Side and Rear Connectors	
J4	Highband LO1 Output – Not used	J10	10 MHz Reference Input Connects to A11 module J6
J6	Low band LO1 Output – Not used	J11	DDS Clock Connects to A13 Source Module J11
J9	Common Het Input From A13 Source Module, J9	J17	HB LO ALC Input – Not used
J3	Common Offset Input From A13 Source Module, J3		
J8	Low band Source Output Connects to A115 Low Band Transfer Switch Module J1 on RF Deck Top Side.		
J12	HB Src ALC Input Connects to A18 PCB J7 on RF Deck Bottom Side.		
J13	External ALC Input Only used with Option 80/81 or 53. Connects to Rear Panel External ALC connector.		
J15	J15 – SQM Modulator Drive Output Only used on MS4645B / MS4647B VNAs. Connects to A18 PCB J12.		
J14	Highband Source Output Connects to A113 5-20 GHz Doubler Module J1 on RF Deck Top Side.		

Figure 10-10. A14 Second Source Module (Option 31) – Connectors

A15 Low Band Receiver Module



Top Connectors (left to right)	Front Connectors (left to right)
1. J13 – Connects to A11 module, J11 (Without Option 35) (Connects to A12 module J1 with Option 35).	5. J3 – Connects to rear panel.
2. J16 – Connects to A11 module, J14 (Without Option 35) (Connects to A12 module J9 with Option 35).	6. J6 – Connects to rear panel.
3. J20 – Connects to A11 module, J17 (Without Option 35) (Connects to A12 module J7 with Option 35).	7. J5 – Connects to rear panel.
4. J22 – Connects to A11 module, J20 (Without Option 35) (Connects to A12 module J19 with Option 35).	8. J7 – Connects to rear panel.
	9. J11 – Connects to A13 module, J6.

Figure 10-11. A15 Low Band Receiver Module – Connectors

10-6 Analog Module Replacement

Common Removal Procedures

1. Prepare work area, work surface, and observe safety issues.

- See “Preparation of Work Area and Safety Instructions” on page 8-1.

2. Remove Outer Cover.

- See Section “Remove Outer Cover” on page 8-3.

3. Position the instrument so that it is right-side up, RF deck down.

4. Remove Inner Top Cover.

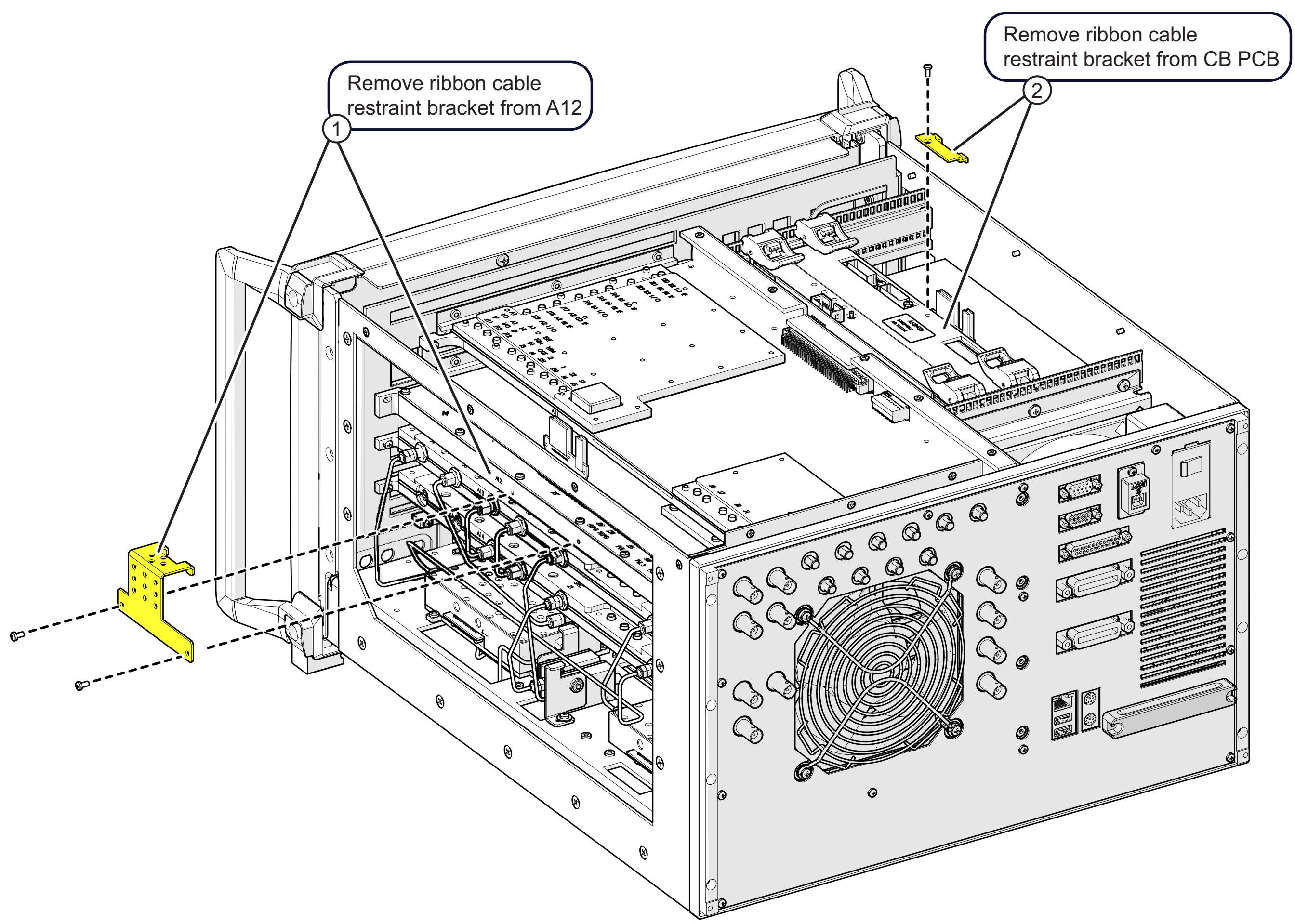
- See Section “Remove Inner Cover” on page 8-5.

PCIe Cable (Option 35) Removal for Access

Note	If your VNA does not have Option 35 IF Digitizer Module, skip to the next section, "A11 IF Band Module Replacement".

Caution	It is important to handle the PCIe Cable carefully when removing it. Use the following procedure. Always disconnect both ends to move the cable. Disconnecting only one end and flexing the cable to gain access to the boards can degrade its performance.

5. Following the illustrations in Figure 10-4 and Figure 10-5 on page 10-8, first remove the cable restraint brackets at each end of the cable assembly.



1	Ribbon cable restraint bracket removed from A122 (two screws, M3 x 6 mm)
2	Ribbon cable restraint bracket removed from CB PCB. (one screw, M2.5 x 6 mm)

Figure 10-12. A12 Cable Restraint Bracket Removal (for analog module access)

6. Carefully disconnect each cable end from their receptacles.

7. Slide the cable out of the way to allow removal of the Digital PCBs.

Note	Avoid lifting the middle adhesive cable restraint to move the cable. If the restraint must be moved, peel up only one end of the restraint to ensure it will remain in place after reassembly.

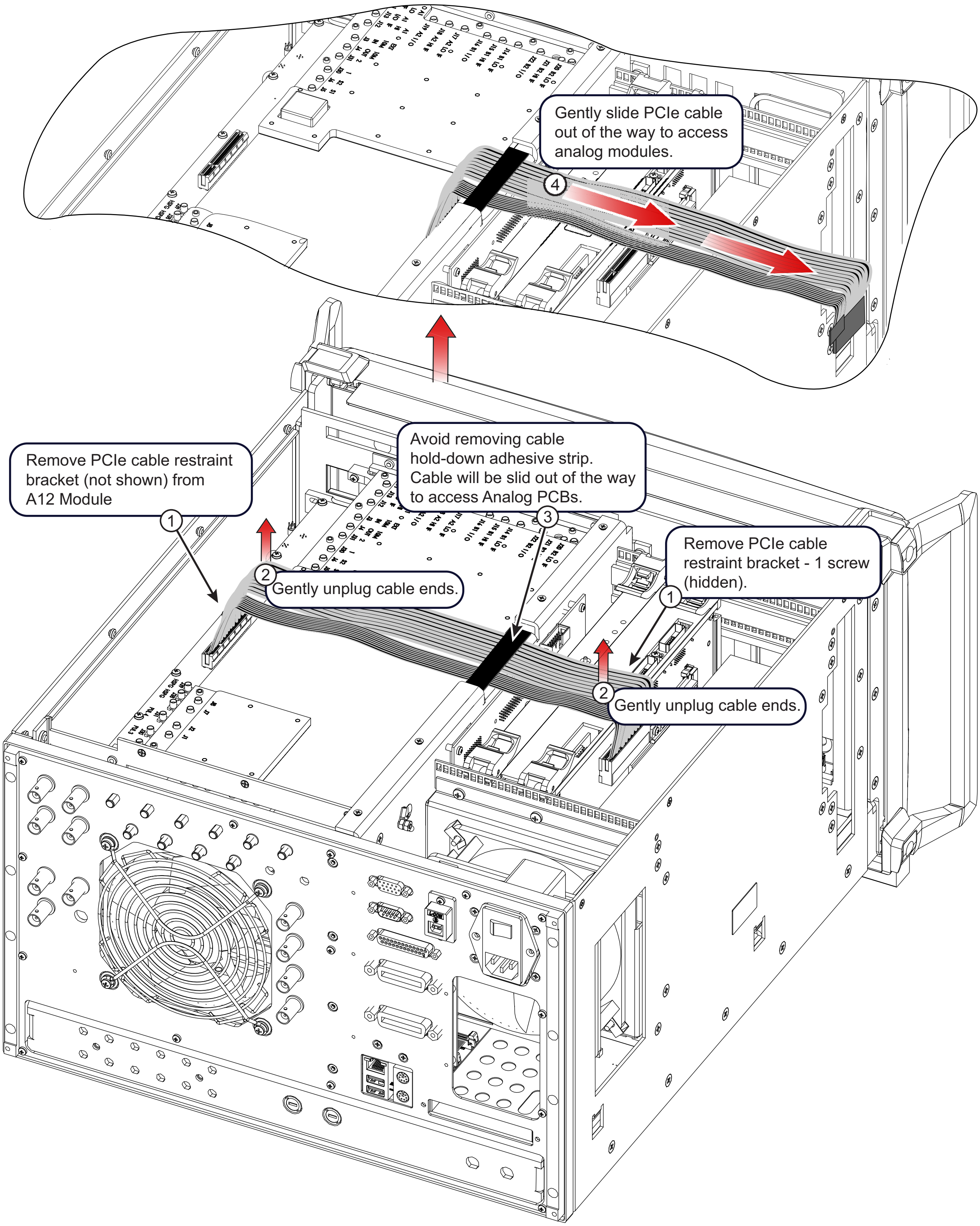


Figure 10-13. PCIe Cable Removal (for analog module access) (1 of 2)

Index	Description/Instruction
1	Remove PCIe cable restraint bracket (not shown) from A12 Module. Remove PCIe cable restraint bracket at the Carrier Board PCB – 1 screw (hidden).
2	Carefully unplug cable ends.
3	Avoid removing cable hold-down adhesive strip. Cable will be slid out of the way to access Digital PCBs.
4	Gently slide the cable out of the way to access the Analog PCBs.

Figure 10-13. PCIe Cable Removal (for analog module access) (2 of 2)

A11 IF Band Module Replacement

A11 Removal

This is the top analog module.

1. If Option 35, A12 IF Digitizer Module is installed, ensure the PCIe Cable that runs from A12 up to the Carrier Board PCB is removed per the instructions above (“PCIe Cable (Option 35) Removal for Access” on page 10-21).
2. Disconnect all MCX cables as listed in Figure 10-7 on page 10-16.
3. Remove the two (2) outer screws that hold the module in its card guide.
4. Remove the A11 module and set aside.

A11 Installation

5. This is the upper analog module.
6. Press the A11 module into its backplane connector on the MB1 PCB.
7. Insert two (2) screws to hold the module in place and then tighten.
8. If A12 (Option 31) is installed, route the output cables from A12 and reconnect them to their respective ports on A11.
9. Connect the remaining MCX cables as listed in Figure 10-7, “A11 IF Band Module – Connectors” on page 10-16.
10. If A12 Option 35 is installed, reconnect the PCIe cable. Refer to the section “PCIe Cable (Option 35) Removal for Access” on page 10-21. Installation is the reverse of removal.

A12 IF Digitizer Module (Option 35) Replacement

A12 Removal

Before the IF Digitizer module can be removed, the A11 module must be removed from the bay.

1. With A11 removed, disconnect the remaining **Input** MCX cables from A12 as listed in Figure 10-8 on page 10-17.

Note	Leave the Output MCX cables connected to the A12 module. If replacing the A12 module, these cables will be transferred to the same locations on the new module. If removing A12 for access to other modules, the Output cables will remain connected to A12 for reinstallation to the chassis.

2. Remove the A12 module and set aside.

A12 Installation

3. If replacing A12, remove the output cables from the other module and install them in the same positions on the new module. The other ends of these cables will attach to All IF Band Module after it is installed.
4. Press the A12 module into its backplane connector on the MB1 PCB.

   Leave the output cables that connect to A11 module loose for now until after A11 is installed.
5. Insert two (2) screws to hold the module in place and then tighten.
6. Connect the remaining MCX and semi-rigid coaxial cables as listed in Figure 10-8, “A12 IF Digitizer Module (Option 35) – Connectors” on page 10-17.

A13 Source Module Replacement

A13 Removal

This module can be removed without having to remove other modules.

1. Disconnect the attached MCX and semi-rigid coaxial cables as listed in Figure 10-9 on page 10-18.
2. At the A11 IF Band Module, disconnect the MCX cable from J5. The other end connects to J10 10MHz Reference on A13 which is not accessible until the module is removed.
3. Remove the two (2) outer screws that hold the module in its card guide.
4. Remove the A13 module and set aside.

A13 Installation

5. Press the A13 module into its backplane connector on the MB1 PCB.
6. Insert two (2) screws to hold the module in place and then tighten.
7. Connect the MCX and semi-rigid coaxial cables as listed in Figure 10-9, “A13 Source Module – Connectors” on page 10-18.

A14 Second Source Module (Option 31) Replacement

A14 Removal

This module can be removed without having to remove other modules.

1. Disconnect the attached MCX and semi-rigid coaxial cables as listed in Figure 10-10 on page 10-19.
2. At the A11 IF Band Module, disconnect the MCX cable from J6. The other end connects to J10 10MHz Reference on A14 which is not accessible until the module is removed.
3. Remove the two (2) outer screws that hold the module in its card guide.
4. Remove the A14 module and set aside.

A14 Installation

5. Press the A14 module into its backplane connector on the MB1 PCB.
6. Insert two (2) screws to hold the module in place and then tighten.
7. Connect the MCX and semi-rigid coaxial cables as listed in Figure 10-10, “A14 Second Source Module (Option 31) – Connectors” on page 10-19.

A15 Low Band Receiver Module Replacement

A15 Removal

This is the bottom analog module. This module can be removed without having to remove other modules.

1. Disconnect the attached MCX and semi-rigid coaxial cables as listed in Figure 10-11 on page 10-20.
2. Remove the two (2) outer screws that hold the module in its card guide.
3. Remove the A15 module and set aside.

A15 Low Band Receiver Module Installation

4. Press the A15 module into its backplane connector on the MB1 PCB Assembly.
5. Insert two (2) screws to hold the module in place and then tighten.
6. Connect the MCX and semi-rigid coaxial cables as listed in Figure 10-11, “A15 Low Band Receiver Module – Connectors” on page 10-20.

Completion Procedures and Calibration

1. If it was removed, install the Front Panel.
    - See Section 18-5 “Install Front Panel” on page 18-8.
2. Install the Inner Top Cover.
    - See Section “Install Inner Cover” on page 8-6.
3. Install the Outer Cover.
    - See Section “Install Outer Cover” on page 8-6.

Calibration and Adjustment

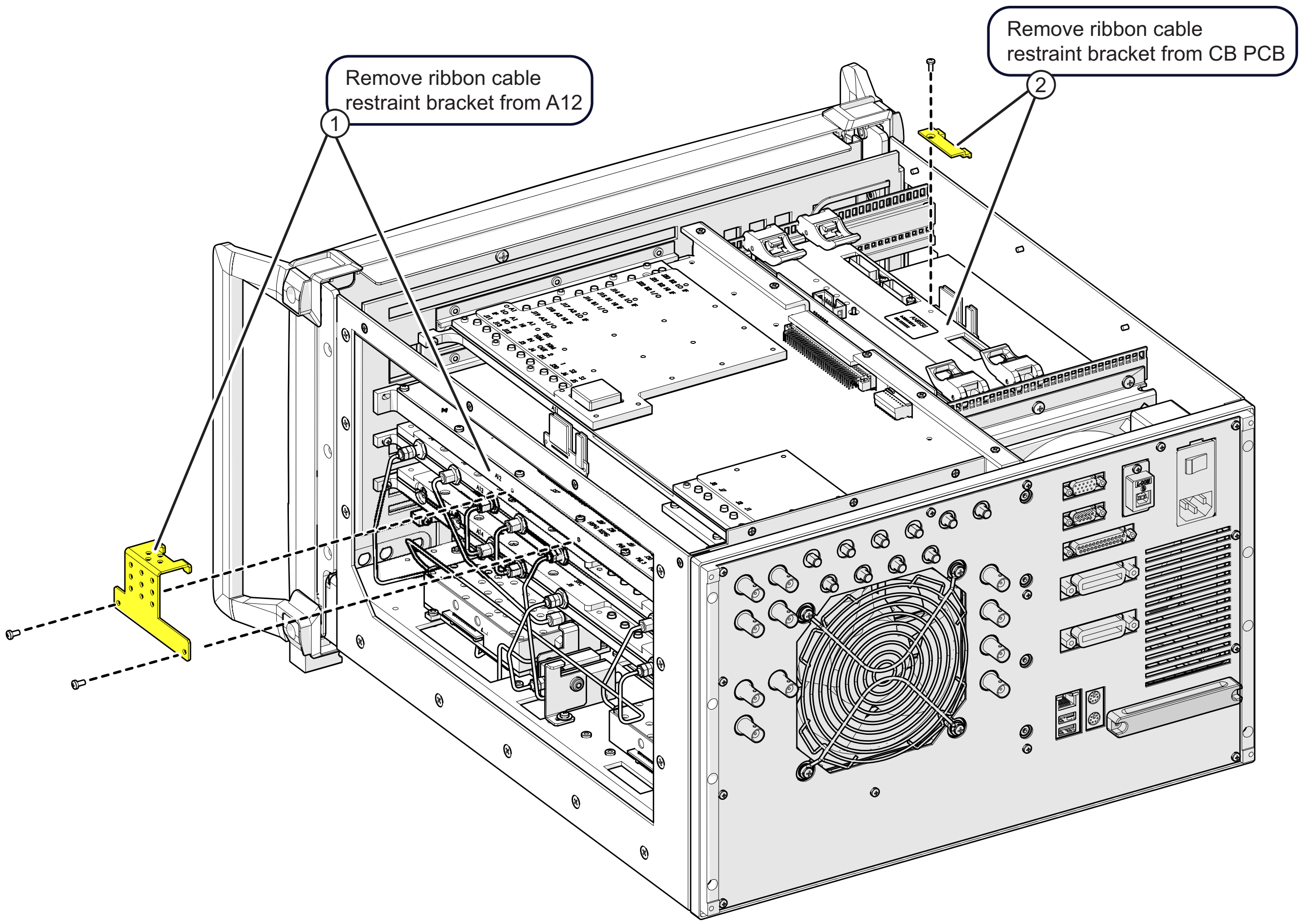
4. If any of the analog modules were replaced, refer to both of the following chapters for completion calibration procedures:
    - Chapter 3, “Performance Verification”
    - Chapter 7, “Adjustment Procedures”

10-7 PCIe Cable Replacement (Option 35)

Cable Restraint Removal

Caution	It is important to handle the PCIe Cable carefully when removing it. Use the following procedure. Always disconnect both ends to move the cable. Disconnecting only one end and flexing the cable to gain access to the boards can degrade its performance.

1. Following Figure 10-14, remove the cable restraint brackets at each end of the cable assembly.



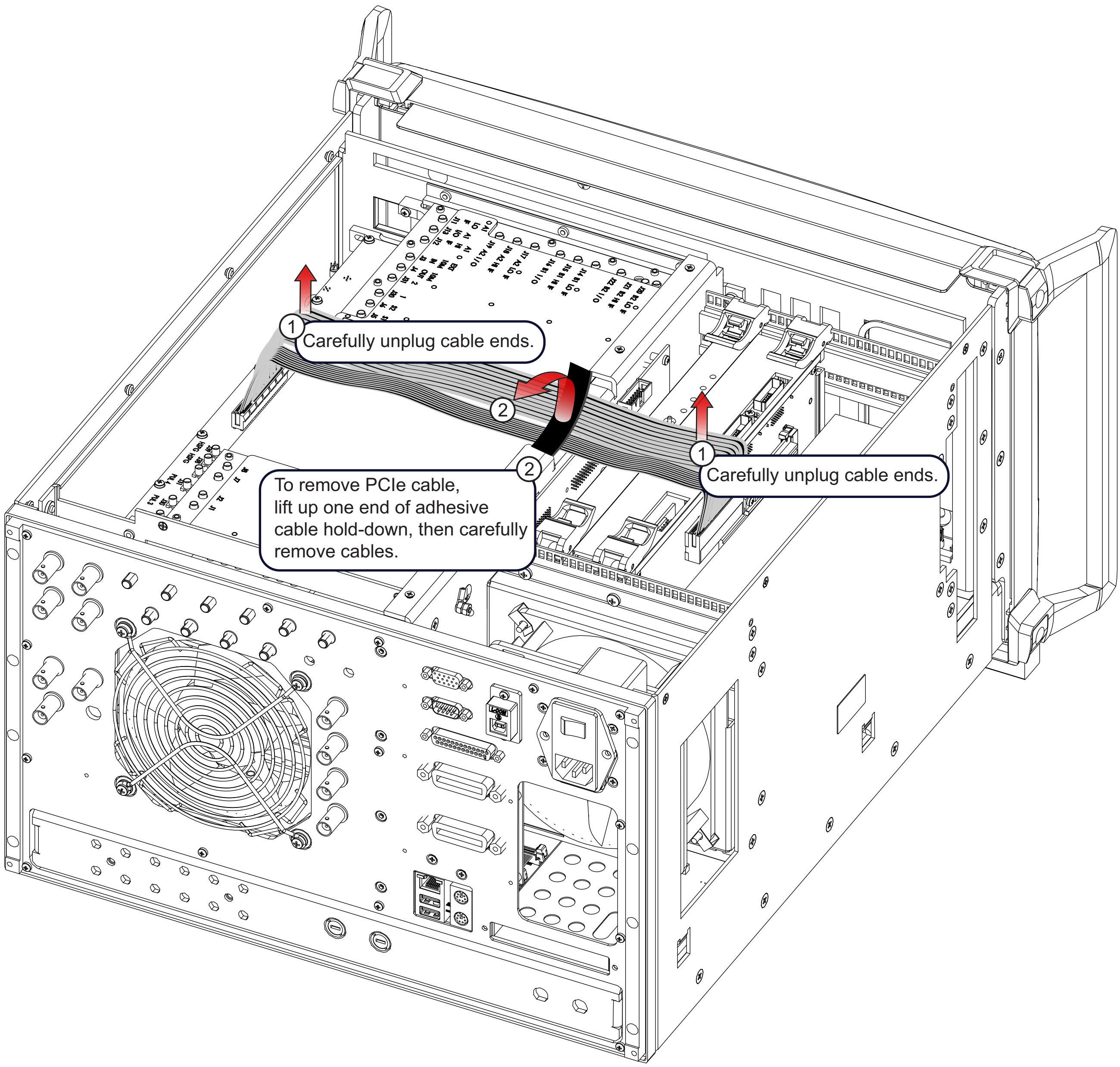
1	Ribbon cable restraint bracket removed from A122 (two screws, M3 x 6 mm)
2	Ribbon cable restraint bracket removed from CB PCB. (one screw, M2.5 x 6 mm)

Figure 10-14. A12 Cable Restraint Bracket Removal (for PCIe cable replacement)

Cable Replacement

See Figure 10-15 on page 10-27 when replacing the PCIe cable.

1. Carefully unplug cable ends.
2. To remove the PCIe cable assembly, peel up one end of the adhesive cable hold-down, then gently remove cable.
3. Installation is reverse of removal.



Index	Description/Instruction
1	Disconnecting cable ends
2	Peeling up one end of the adhesive cable hold-down

Figure 10-15. PCIe Cable Removal (for replacement)

Chapter 11 — RF Deck Removal and Installation

11-1 Introduction

The RF Deck itself is not a replaceable component. This procedure describes how to remove the RF Deck from the instrument chassis in order to service RF Deck Top Side components or to access deeper dwelling assemblies. The chapter concludes with RF Deck installation into the chassis.

When to Remove the RF Deck

The RF Deck must be removed to provide access for servicing the following components. Each set of components is covered in separate chapters:

- **RF Deck Top Side Modules** – The RF Deck must be removed to replace the top side modules, which is covered in Chapter 12, “RF Deck Module Replacement – Top Modules”.
- **Digital PCB Fan Assembly** – The RF Deck must be removed to replace the cooling fan in the Digital PCB Fan Assembly. The assembly consists of multiple brackets and mounting hardware that must be removed in sequence. The procedure is described in Chapter 16 — Digital PCB Fan Replacement.
- **Motherboard PCB Assemblies** – The RF Deck must be removed to gain access to the Motherboard 2 PCB Assembly and the Motherboard 1 PCB Assembly. Removing the Motherboard PCBs is described in Chapter 17, “MB1 and MB2 PCB Replacement”.

11-2 Typical RF Deck Assembly

The exact components on the RF Deck vary depending on the instrument serial number, model, and equipped options. Shown in Figure 11-1 is a typical RF Deck equipped with Option 31 Second Source, Option 61 Front and Rear Panel Access Loops and two Step Attenuators, and Option 85 mm-Wave Interface.

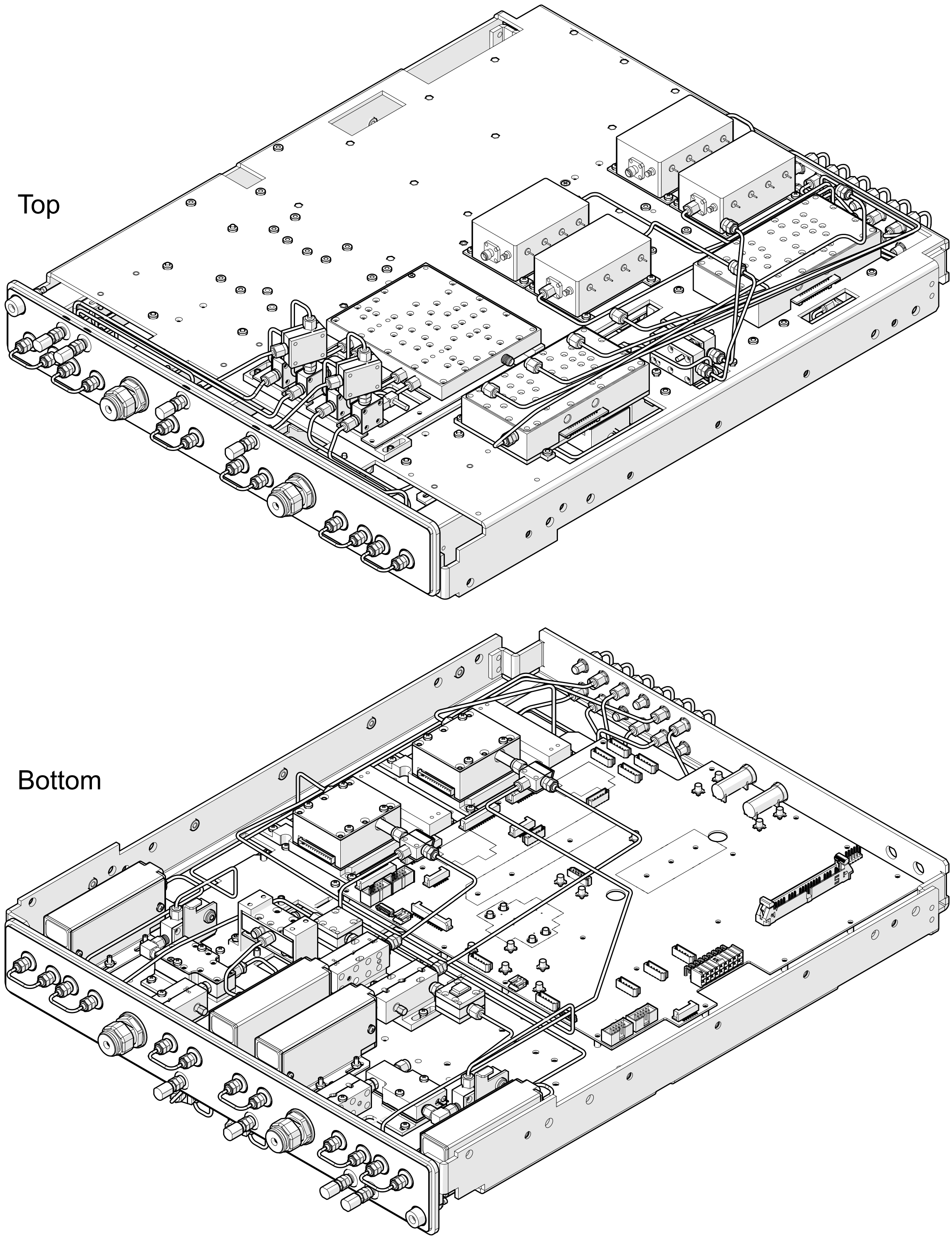


Figure 11-1. Typical RF Deck Removed – MS4645B with Option 31, 61, and 85

11-3 RF Deck Removal

Use this procedure to remove the RF Deck. The deck itself is not a replaceable part.

Applicability

- This procedure is for all models with any combination of options.
- The specifics for some model number and/or option combinations are noted as required in the procedure.

Recommended Fixture

- T3545 – RF Deck Fixture
- Refer to Section A-2 "T3545 RF Deck Fixture" on page A-1 for specifications.

Common Procedures

Refer to Section 8-2 "Preparation of Work Area and Safety Instructions" on page 8-1.

1. Prepare work area, work surface, and observe safety issues.
    - Refer to "Preparation of Work Area and Safety Instructions" on page 8-1
2. Remove Outer Cover.
    - Refer to "Remove Outer Cover" on page 8-3.
3. Position the instrument so that it is right-side up, RF deck down.
4. Remove Inner Top Cover.
    - Refer to "Remove Inner Cover" on page 8-5.
5. Position the instrument so that it is upside down, with the bottom of the RF Deck facing up.

Deck Removal

Remove Front Panel

1. Make sure that Front Panel has its handles or rack mount ears installed.
2. Place a block under the front of the instrument.
3. Remove the Front Panel.
    - To remove it, see:
        - Section 18-3 "Remove Front Panel" on page 18-1

Caution	Do not lift the RF Deck by the Front or Rear Panel Loops.

Remove RF Deck Front and Rear Panel Loops

4. If equipped with Option 51, 61, or 62, Remove the Direct Access Loops and set aside.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 "Factory RF Calibration (RF Cal)" for instructions on performing a new RF calibration.

5. Remove the Rear Panel Loops and set aside.

Remove Analog Module Semi-rigid and MCX Cables

6. Disconnect the semi-rigid and MCX cables as indicated in Figure 11-2 on page 11-4.

   Leave the cables connected at the RF deck.

7. Carefully move the semi-rigid cables so the connectors will clear the analog modules as the RF deck is removed.

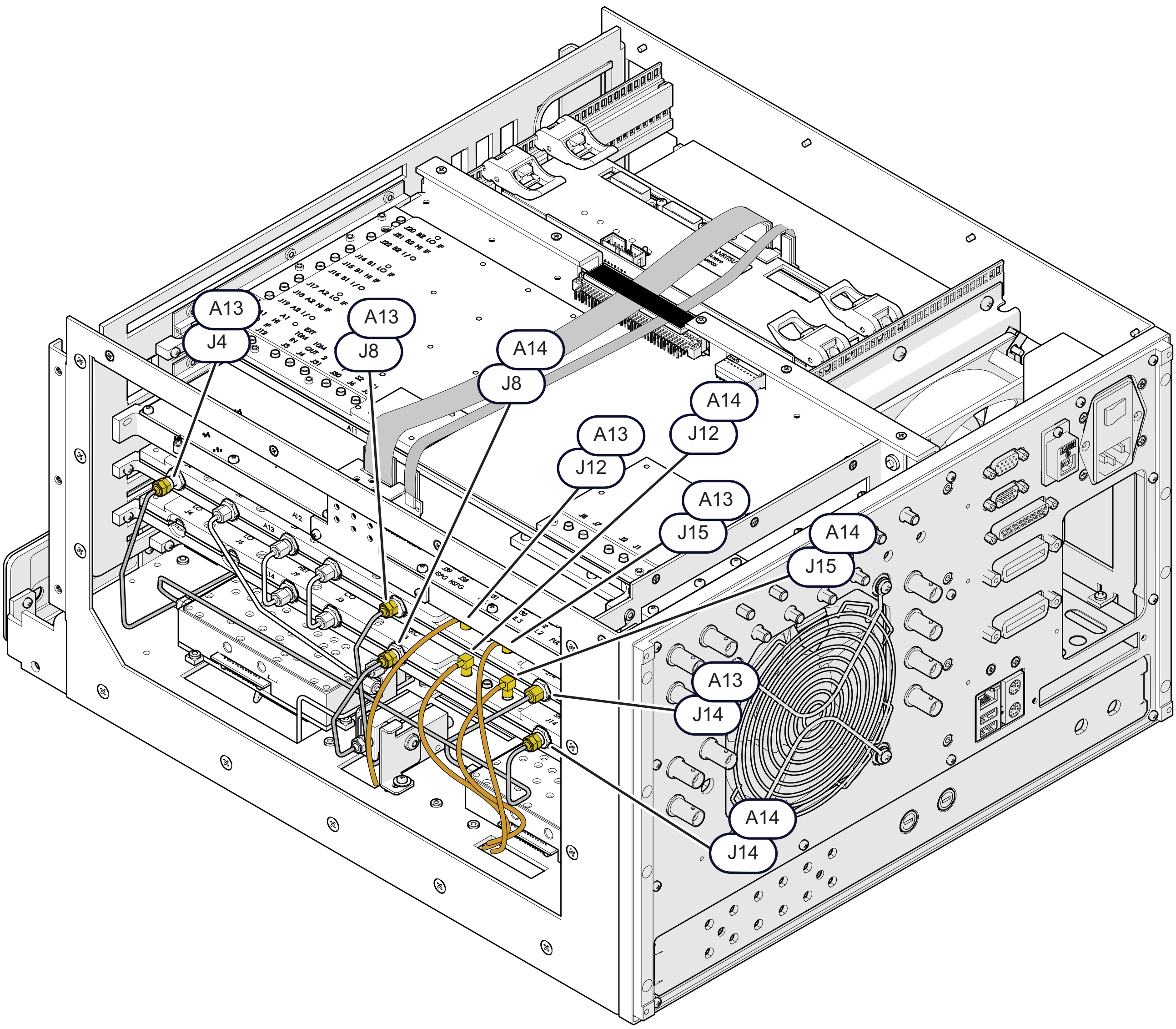


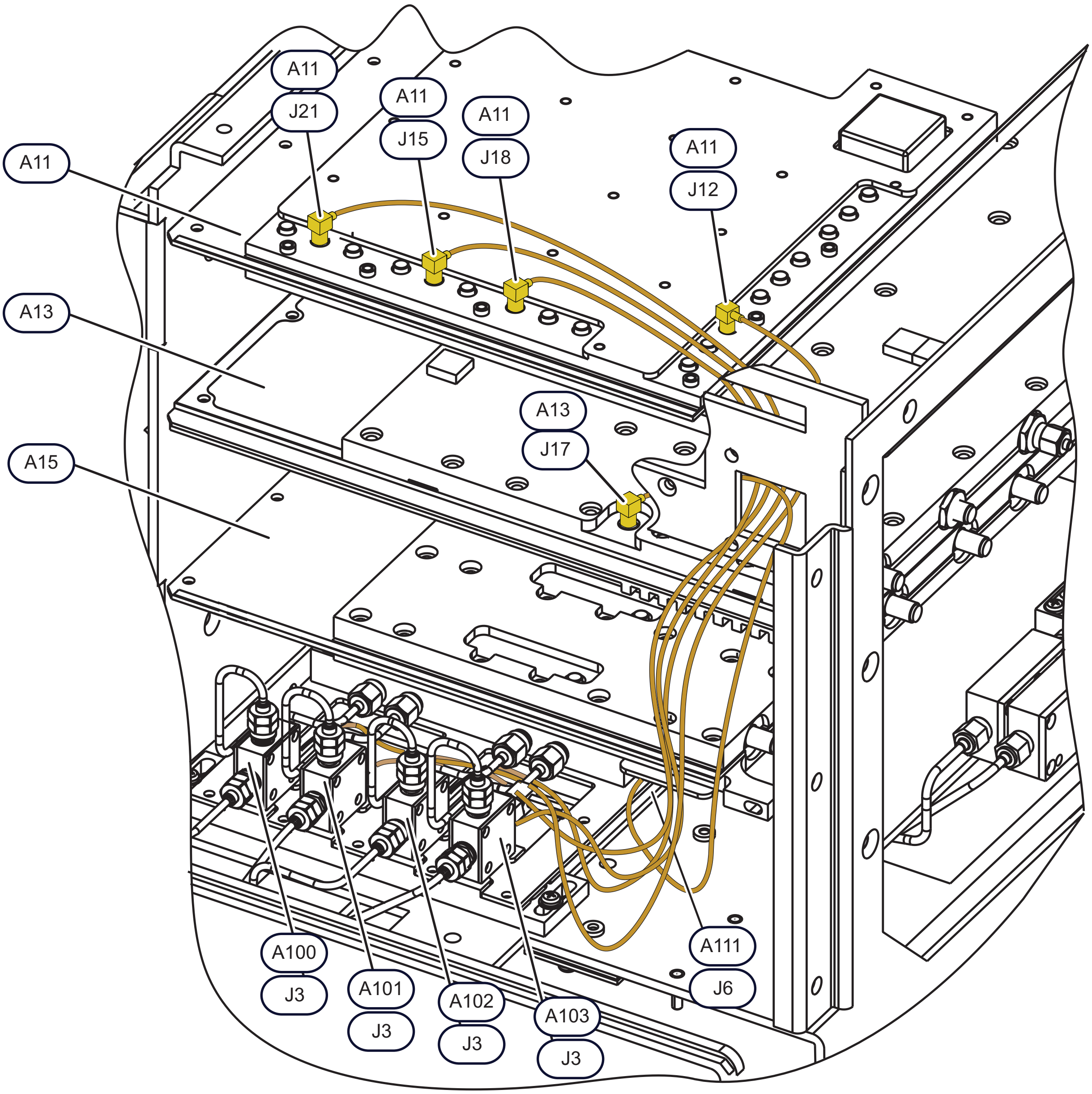
Figure 11-2. RF Deck Removal/Installation – Analog Modules and Semi-Rigid Coaxial Cables (1 of 2)

A13 Cables to Disconnect	**A14 Cables to Disconnect (If Option 31 Second Source is installed)**
Left to right, from instrument front to rear: • J4 – Semi-rigid coaxial cable (HB LO) Routes to A111 connector J1. • J8 – LB SRC Routes to A116 connector J1. • J12 – MCX coaxial cable Routes to RF Deck Bottom Side. • J15 – MCX coaxial cable to RF Deck Bottom Side. (Only used on MS4645B / MS4647B.) • J14 – Semi-rigid coaxial cable HB SRC Routes to A113 5-20 GHz Doubler Module J1.	Left to right, from instrument front to rear: • J8 – LB SRC to A117 connector J1. • J12 – MCX coaxial cable to RF Deck Bottom Side. • J15 – MCX coaxial cable to RF Deck Bottom Side. (Only used on MS4645B / MS4647B.) • J14 – HB SRC to A213 5-20 GHz Doubler Module connector J1.

Figure 11-2. RF Deck Removal/Installation – Analog Modules and Semi-Rigid Coaxial Cables (2 of 2)

Disconnect A11 and A13 MCX Cables (Standard Configuration)

8. At the top of the A11 module, disconnect MCX coaxial cables from J21, J15, J18, and J12 as shown in Figure 11-3. These route from the Sampler/LO Distribution Assembly to the top A11 IF Band Module assembly
9. Disconnect the MCX coaxial cable that routes from A111 J6 to the A13 module connector J17.
10. Route the disconnected MCX cables through the chassis so that they are loose, cutting cable ties as needed.



Note: For RF Deck removal, it is easiest to disconnect the MCX coaxial cables from the analog module assemblies and then remove the cables with the RF Deck.	1. Disconnect MCX cables at J21, J15, J18, and J12. 2. Disconnect the MCX cable from J17 located on A13. 3. Carefully pull the cables out of the analog bay, through the pass-through hole as shown. The cables will remain attached at the RF Deck.

Figure 11-3. MCX Coaxial Cable Removal from A11 (Standard Configuration)

Disconnect A12 MCX Cables (Option 35 Configuration Only)

If Option 35 – A12 IF Digitizer Module is part of your configuration, the MCX coaxial cables route from the A12 module to the RF Deck instead of from the A11 module. The A11 module must be removed before disconnecting the MCX cables from A12.

Remove the A11 Module

Caution	To avoid damage, use care when moving the PCIe cable out of the way to allow removal of the All Module. The PCIe cable is not completely removed; it is slid out of the way for All access. For detailed instructions, see Figure 10-13 on page 10-22 and Figure 10-15 on page 10-27.

11. Remove the two PCIe cable restraint brackets.

Avoid removing the adhesive middle restraint strip.

12. Carefully slide the PCIe cable under the restraint strip toward the digital bay so it is out of the way.

13. Disconnect the MCX connectors to allow A11 module to be removed from the bay.

14. Remove the two (2) outer screws that hold the module in its card guide.

15. Remove the A11 module and set it aside on an ESD protected area.

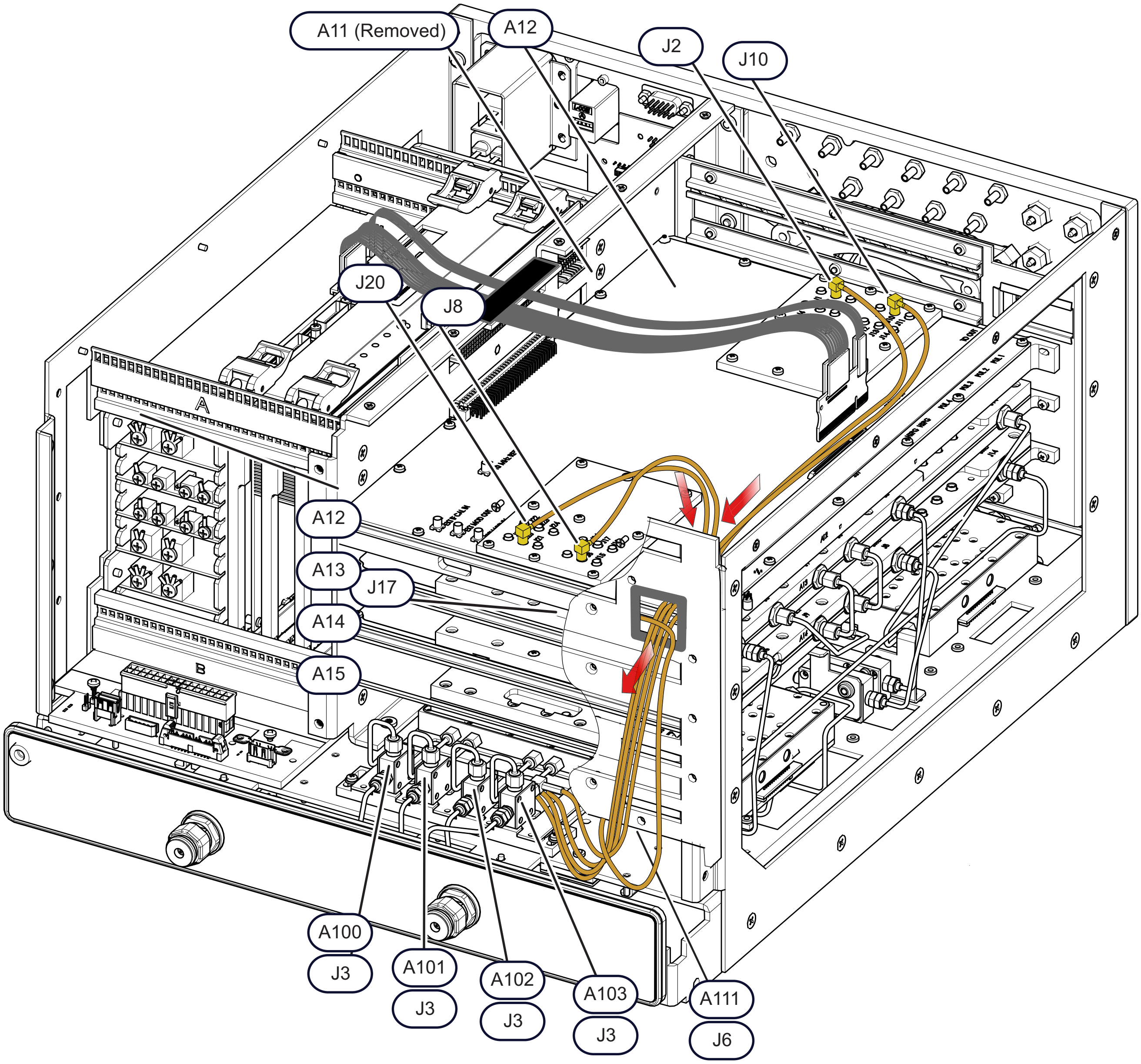
Disconnect MCX Cables

16. Disconnect the MCX Cables from the following A12 receptacles (see Figure 11-4 on page 11-8):

- J2 and J10 on A12 right side
- J8 and J20 from A12 left side.

17. Disconnect the MCX Cable from the A13 – J17. receptacle.

18. Route the disconnected MCX cables through the chassis opening so that they are loose, cutting cable ties as needed. The cables will remain attached at the RF Deck.

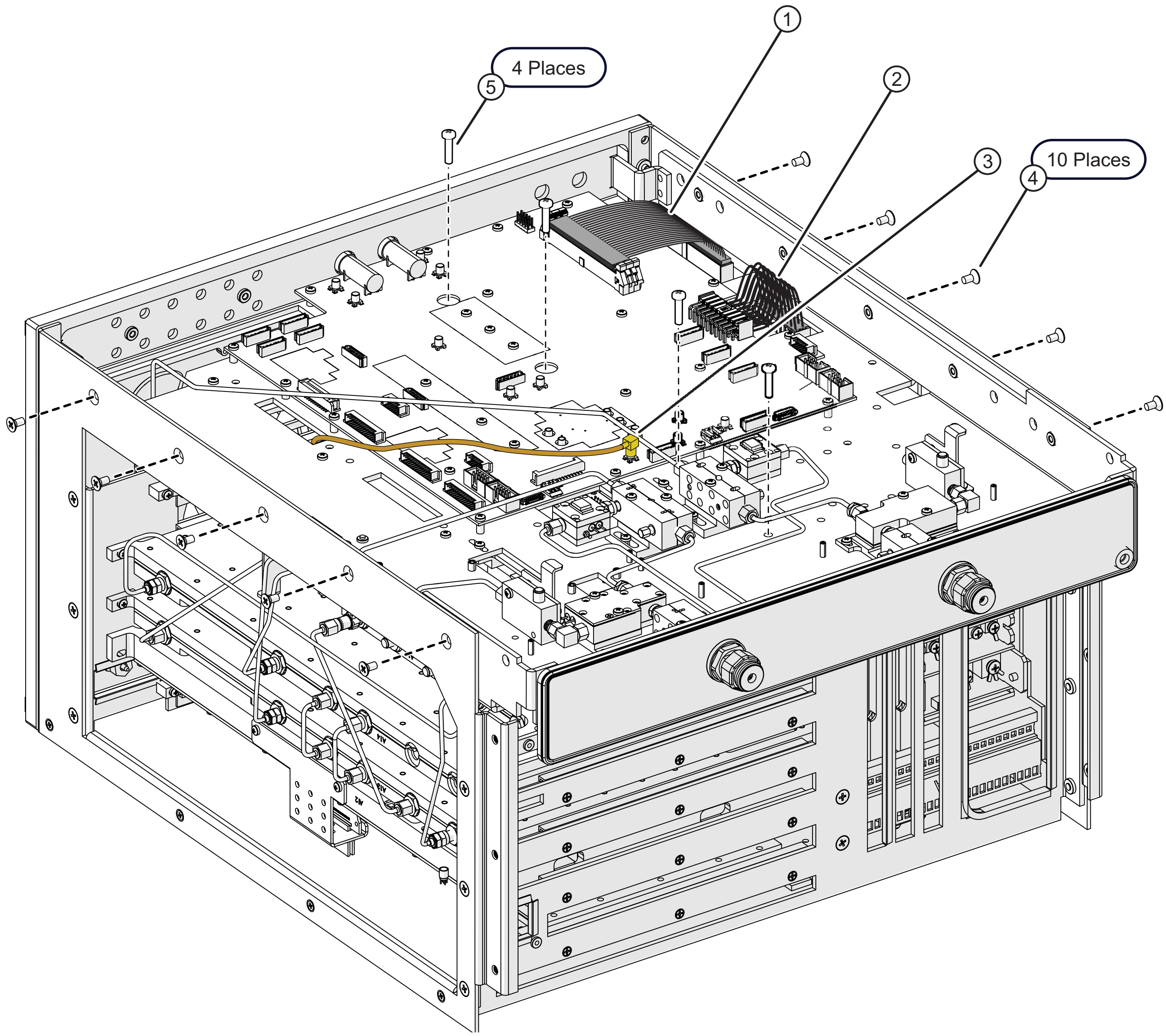


Notes:
A11 IF Module must be removed to access the cables on A12.
Other MCX cables to and from the A12 Module are hidden for clarity.

Figure 11-4. MCX Coaxial Cable Removal from A12 (When Option 35 installed)

Turn Instrument Over – Disconnect Signal/Power Cables, Remove Screws

19. Position the instrument topside down. See Figure 11-5.



Typical MS4647B, Standard No Options shown.	**Mounting Hardware**
Cables 1. Disconnect ribbon cable from A18 PCB connector J18. Cable routes to MB2 PCB connector P42. 2. Disconnect cable harness from A18 PCB connector P3. Cable routes to MB2 2 PCB connector P41. Both P41 and P42 are located on the bottom side of the MB2 PCB. 3. Disconnect all MCX coaxial cables coming through from Analog Bay. (one shown only for illustration – cable quantity and locations vary depending on VNA configuration.	4. Five (5) flat head Phillips M4 × 8 mm screws on each side, 10 total. 5. Four (4) pan head Phillips M4 × 10 mm screws across middle of RF Deck chassis

Figure 11-5. RF Deck Bottom Side – Cables and Mounting Hardware

20. Disconnect the Power Supply Module main power cable from the Motherboard 2 (MB2) PCB Assembly at connector P42. This connector and P41 below are the only two downward facing connectors on the MB2 PCB.
21. Disconnect the Power Supply Module signal cable from the MB2 PCB at connector P41.
22. Disconnect all MCX coaxial cables coming through from Analog Bay. (Only one is shown for illustration – cable quantity and locations vary depending on VNA configuration.

Remove RF Deck Hardware

23. See Figure 11-5 on page 11-9 above for orientation and references.
24. On each side of the RF Deck, remove the five (5) flat head Phillips M4 × 8 mm screws; 10 screws total.
25. Position the instrument upside down with the bottom side of the RF Deck visible.
26. Along the left-to-right centerline of the RF Deck, remove the four (4) pan head Phillips M4 × 10 mm screws.

Remove RF Deck

27. Proceed with caution to avoid damaging cables, modules, or loops.
28. Lift the front of the RF Deck up slightly, slide the deck towards the front about 1 cm (~ 1/2 in) and lift out of the chassis. Take care to protect any connected cables and harnesses that come out with the RF Deck.

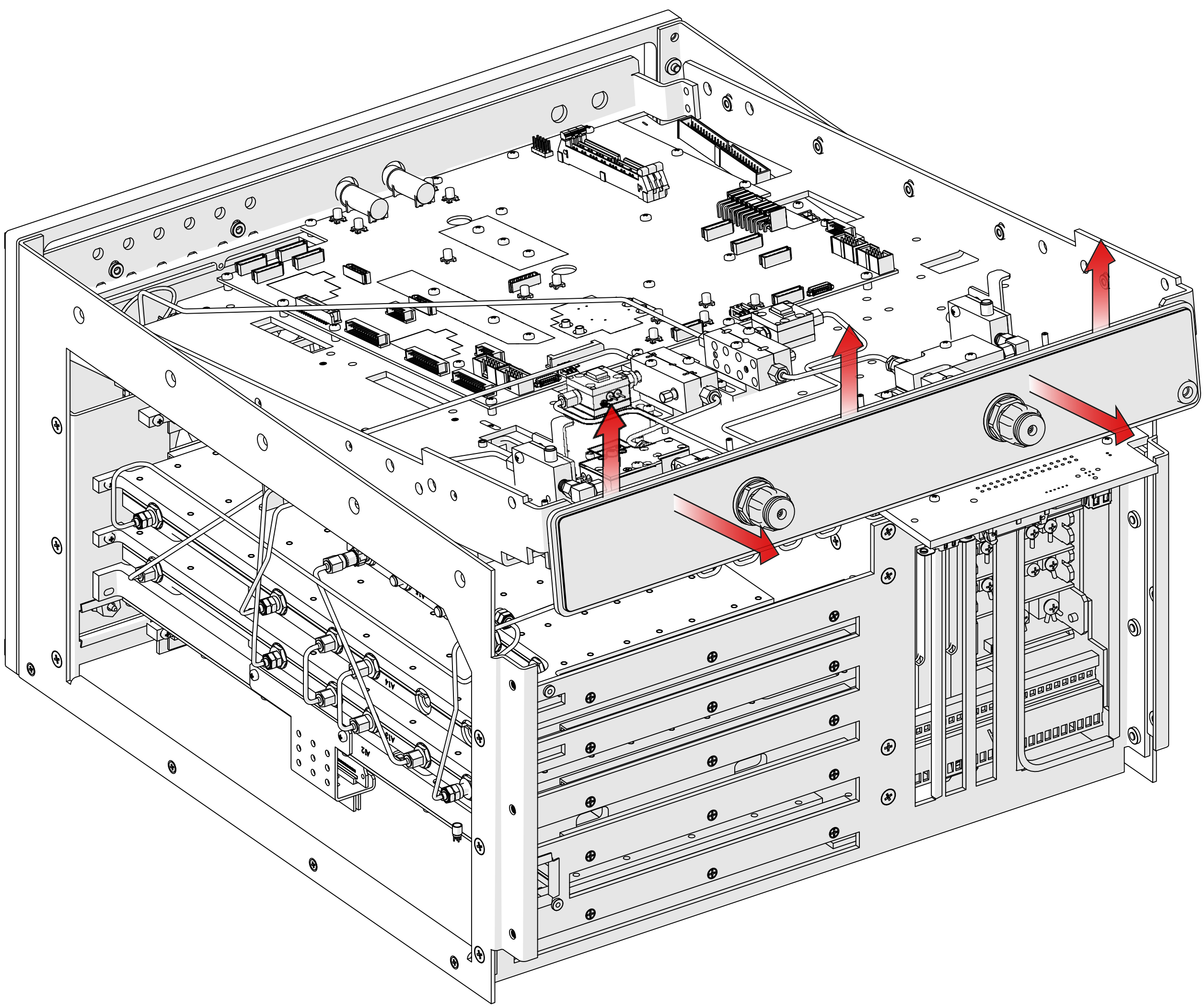


Figure 11-6. Removing RF Deck From Chassis – 1

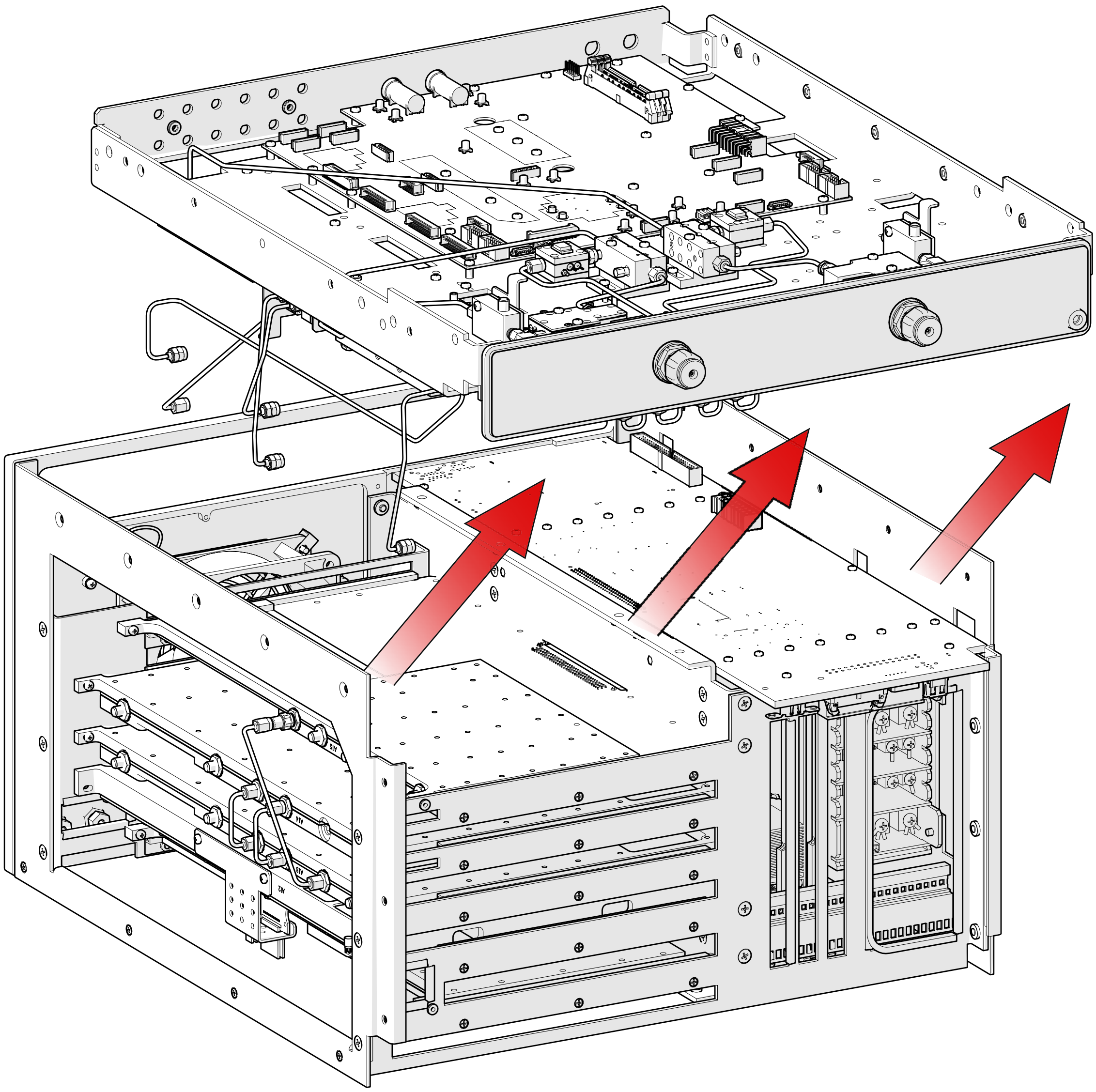


Figure 11-7. Removing Deck from Chassis – 2

Attach T3545 RF Deck Fixture

29. If servicing modules on the RF Deck, attach two (2) T-3545 fixtures to the RF Deck using the four (4) pan head Phillips M4 × 10 mm screws removed above.

- The orientation can be with either end of the fixture towards the front.
- The top of the fixture should be higher than the loops on the Sampler/LO Distribution Module Assembly.
- If multiple uses of the fixtures are anticipated, best practices recommend obtaining knob-head M4 fasteners to speed fixture installation.

30. The RF Deck Top Side Loops and modules should be protected by the fixture plates.

Service Modules

The RF Deck is ready for servicing the top side modules or to provide access to deeper dwelling components in the chassis.

11-4 RF Deck Installation

Use this procedure to install the RF Deck after either replacing an RF Module or accessing another deeper dwelling component.

Applicability and Recommended Fixture

- This procedure is for all models with all option combinations.
- Specifics for some model and/or option combinations are noted as required in the procedure.
- T3545 – RF Deck Fixture
  - See Section A-2 “T3545 RF Deck Fixture” on page A-1 for specifications.

Procedure

Prerequisites

1. The RF Deck has been removed from the chassis and the T3545 Fixture has been added.
2. The Front Panel assembly has been removed from the instrument chassis.
3. Position the instrument chassis top side down, so the bottom side of the Motherboard 2 PCB Assembly is visible. The orientation below is with the front panel location towards the technician.
4. Each MCX Sampler Module coaxial cable should still be attached to its Sampler Module on the RF deck. If the cables were not removed, skip ahead to Step 5. If any were removed, reattach the each cable to its module, observing the cable labeling to ensure it is connected to the correct module. Tighten all connections using the 5/16” torque end wrench set to 8 lbf · in.

Install RF Deck

5. Remove the fixtures from the RF Deck, saving the screws for the deck installation below, taking care to protect the top side loops, and if equipped, the Direct Access Loops.
   - Best practices recommend removing both the front and rear panel loops before removing or installing the RF Deck.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 “Factory RF Calibration (RF Cal)” for instructions on performing a new RF calibration.

6. Position the RF Deck topside down over the instrument chassis with the test ports and loops towards the front, and the two black Bias Tee fuses (on the A18 PCB) towards the Rear Panel.
7. Insert the RF Deck rear panel in first, sliding the deck back and then down in the front.

Caution	As the deck is inserted, ensure the still-attached semi-rigid cables clear any obstructions in the analog bay as the deck is moved into place Ensure that the connector on the Motherboard 2 PCB is clear of the rear cutout of the RF Deck before laying the Deck into the chassis.

8. Along the left-to-right center of the deck, insert the four (4) pan head Phillips M4 × 10 mm screws. Do not tighten yet.
9. On each side, insert the five (5) flat head Phillips M4 × 8 mm screws; 10 screws total. Do not tighten yet.
10. When all screws are correctly inserted and the RF Deck is correctly positioned, tighten all 14 screws.

Connect Motherboard 2 Signal and Power Cables

11. Plug in the main ribbon cable between A18 PCB P3 and MB2 connector P42.
12. Plug in the cable between A18 PCB P3 and MB2 PCB connector P41.
13. Plug in the MCX coaxial cable into A18 PCB J7.
14. Plug in the MCX coaxial cable into A18 PCB J12 (only used on the MS4645B / MS4647). The other end of this cable will be connected in Step 23 or Step 25 below.

Connect A11 Module MCX Coaxial Cables (Standard Configuration)

Note	If your VNA has Option 35 installed, skip to Step 18.

15. Turn the instrument so that it is top side up.
16. At the A111 LO Distribution Module Assembly at the front of the RF Deck, route the MCX coaxial cable from the right side of A11 Module towards the right and then up to the middle A13 module and connect the end to the J17 connector.
17. Route the four (4) Sampler Module MCX coaxial cables through the access hole in the chassis plate to the A11 IF Band Module. Connect them to their respective A11 connectors as designated on each cable label.
    - J21 – from A102 Sampler Module connector J3.
    - J15 – from A100 Sampler Module connector J3.
    - J18 – from A103 Sampler Module connector J3.
    - J12 – from A101 Sampler Module connector J3.

Connect MCX Cables from Sampler Modules to A12 (Option 35 Configuration Only)

Route the four (4) Sampler Module MCX coaxial cables through the access hole in the chassis plate to the A12 IF Digitizer Module. Connect them to their respective A12 connectors as designated on each cable label. (If Option 35 is *not* installed, ignore this step.)

- J20 – from A102 Sampler Module connector J3.
- J8 – from A100 Sampler Module connector J3.
- J2 – from A103 Sampler Module connector J3.
- J10 – from A101 Sampler Module connector J3.

Install the A11 Module (If Option 35 is installed)

Caution	To avoid damage to the PCIe cable, use care by holding it out of the way when installing the A11 Module. For details, see Figure 10-13 on page 10-22 and Figure 10-15 on page 10-27.

18. Slide the A11 module into its place in the analog bay and press it into its connector on MB1.
19. Install the two (2) outer screws that hold the module in its card guide.
20. Reconnect the MCX connectors from A12 to A11:
    - J20 – from A12 IF Digitizer Module connector J22
    - J21 – from A12 IF Digitizer Module connector J23
    - J22 – from A12 IF Digitizer Module connector J24
    - J14 – from A12 IF Digitizer Module connector J12
    - J15 – from A12 IF Digitizer Module connector J13
    - J16 – from A12 IF Digitizer Module connector J14
    - J17 – from A12 IF Digitizer Module connector J16
    - J18 – from A12 IF Digitizer Module connector J17
    - J19 – from A12 IF Digitizer Module connector J18

- J11 – from A12 IF Digitizer Module connector J4
- J13 – from A12 IF Digitizer Module connector J6
- J12 – from A12 IF Digitizer Module connector J5

21. Carefully reconnect the PCIe cable to its receptacle on J12.

22. Install the two PCIe cable restraint brackets.

Connect A13 Module Semi-Rigid Coaxial Cables and MCX Cables

23. While observing the connector labels, reconnect these cables to their respective locations on A13:

- J4 – Semi-rigid coaxial cable HB LO from A111 connector J1.
- J8 – LB SRC from A116 connector J1.
- J12 – MCX coaxial cable from RF Deck Bottom Side.
- J15 – MCX coaxial cable from RF Deck Bottom Side. (Only used on MS4645B / MS4647B.)
- J14 – Semi-rigid coaxial cable HB SRC from A113 Doubler Module J1.

24. Tighten all connections using the 5/16” torque end wrench set to 8 lbf · in.

Connect A14 Module Semi-Rigid Coaxial Cables and MCX Cables (Option 31 Second Source)

25. While observing the connector labels, reconnect these cables to their respective locations on A14:

- J8 – Semi-rigid cable – LB SRC from A117 connector J1.
- J12 – MCX coaxial cable from RF Deck Bottom Side.
- J15 – MCX coaxial cable from RF Deck Bottom Side. (Only used on MS4645B / MS4647B.)
- J14 – Semi-rigid cable – HB SRC from A213 Doubler Module connector J1.

26. Tighten all connections using the 5/16” torque end wrench set to 8 lbf · in.

Install the Front Panel

27. Position the chassis so that it is top side up.

28. Place a block under the front of the instrument chassis.

29. Install the Front Panel.

- See Section 18-5 “Install Front Panel” on page 18-8

Completion

30. Replace the Inner Cover and Outer Cover.

- See Section 8-3 “Chassis Reassembly” on page 8-6

Chapter 12 — RF Deck Module Replacement – Top Modules

12-1 Introduction

This chapter provides procedures to replace modules located on the top side of the RF Deck. The RF deck is removed to service top side modules.

Note	These procedures must be performed with the RF Deck removed from the instrument chassis. Refer to Chapter 11, "RF Deck Removal and Installation" for instructions. To protect the RF Deck underside components and cables, Anritsu recommends that the protective T3545 Fixture be installed on the deck prior to servicing.

12-2 Applicability

The procedures in this chapter are applicable to all MS4640B models with any combination of options.

12-3 Chapter Organization

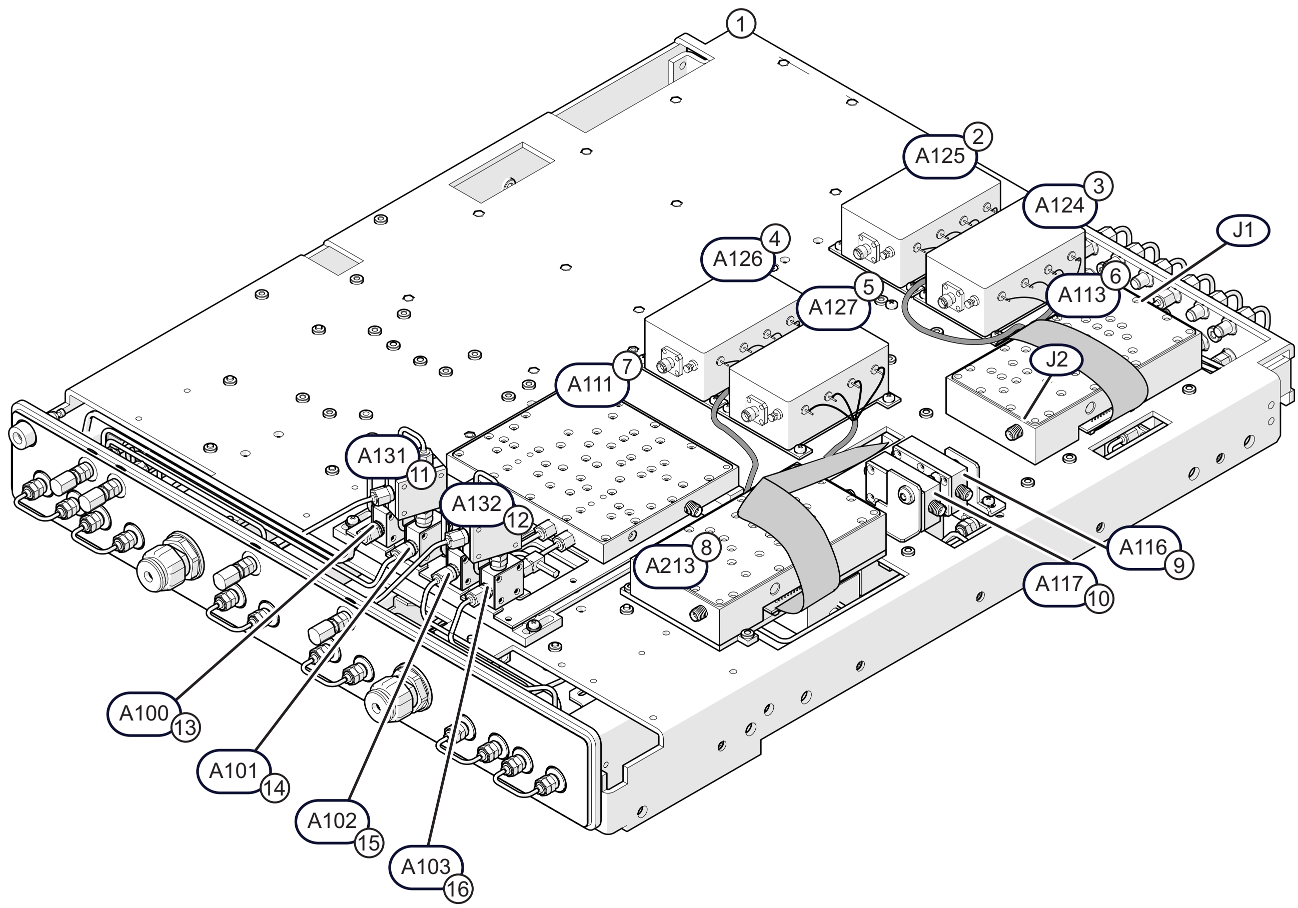
This chapter contains the following sections:

12-4 RF Deck Removal

Refer to Chapter 11, "RF Deck Removal and Installation" for system disassembly steps to remove the RF Deck.

12-5 RF Deck Top Side Module ID – With Options

This section describes the RF Deck top side configuration with all options installed. Depending on the VNA options, your system may or may not have all the components shown.

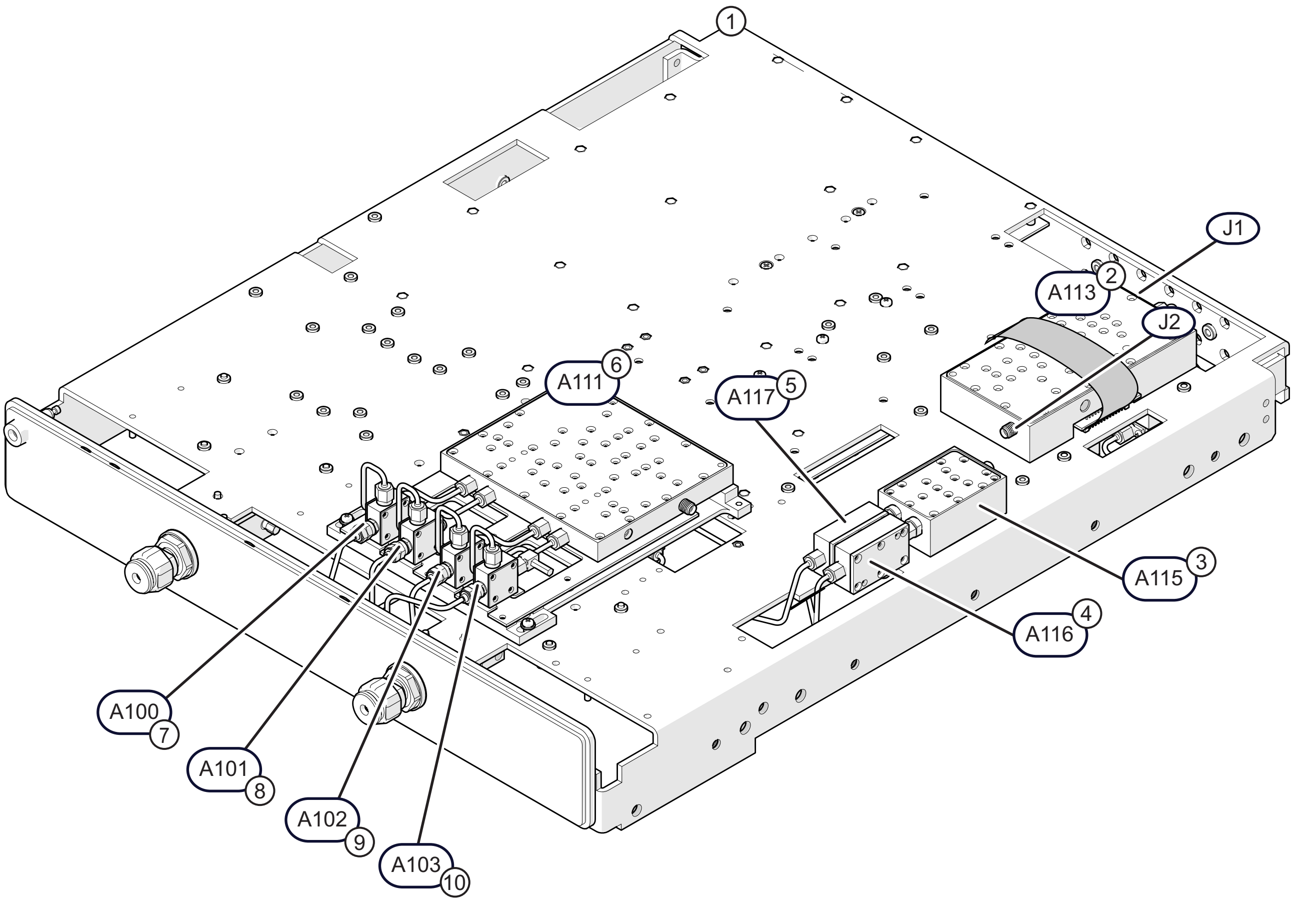


1. RF Deck Top Side as removed from chassis.
2. A125 Low Band Source Attenuator, Port 1 (Option 61 or 62)
3. A124 Low Band Test Attenuator, Port 1 (Option 62)
4. A126 Low Band Source Attenuator, Port 2 (Option 62)
5. A127 Low Band Test Attenuator, Port 2 (Option 61 or 62)
6. A113 5-20 GHz Doubler Module (All Models)
7. A111 LO Coupler Distribution Module
8. A213 5-20 GHz Doubler Module (Option 31, Second Source)
9. A116 – Low Band Bridge Module
10. A117 – Low Band Bridge Module
11. A131 LO Coupler Module – Mounts on top of A101 (Option 8x)
12. A132 LO Coupler Module – Mounts on top of A103 (Option 8x)
13. A100 Sampler Module
14. A101 Sampler Module
15. A102 Sampler Module
16. A103 Sampler Module

Figure 12-1. RF Deck Top Replaceable Components: System with All Options

12-6 RF Deck Top Side Module ID (Standard Config.)

This section shows a standard RF Deck top side configuration with no options installed. Note that A115 is used in this configuration but is *not* used when Option 31 is installed. Also notice that A116 and A117 are oriented differently as shown in Figure 12-2, than when Option 31 Second Source is installed. To see the difference in orientation, see Figure 12-1 on page 12-2.



RF Deck Top Replaceable Components	
1. RF Deck Top Side as removed from chassis.	6. A111 LO Coupler Distribution Module
2. A113 5-20 GHz Doubler Module (All Models)	7. A100 Sampler Module
3. A115 Low Band Transfer Switch Module	8. A101 Sampler Module
4. A116 Low Band Bridge Module	9. A102 Sampler Module
5. A117 Low Band Bridge Module	10.A103 Sampler Module

Figure 12-2. RF Deck Top – Replaceable Components: Standard System – No Options

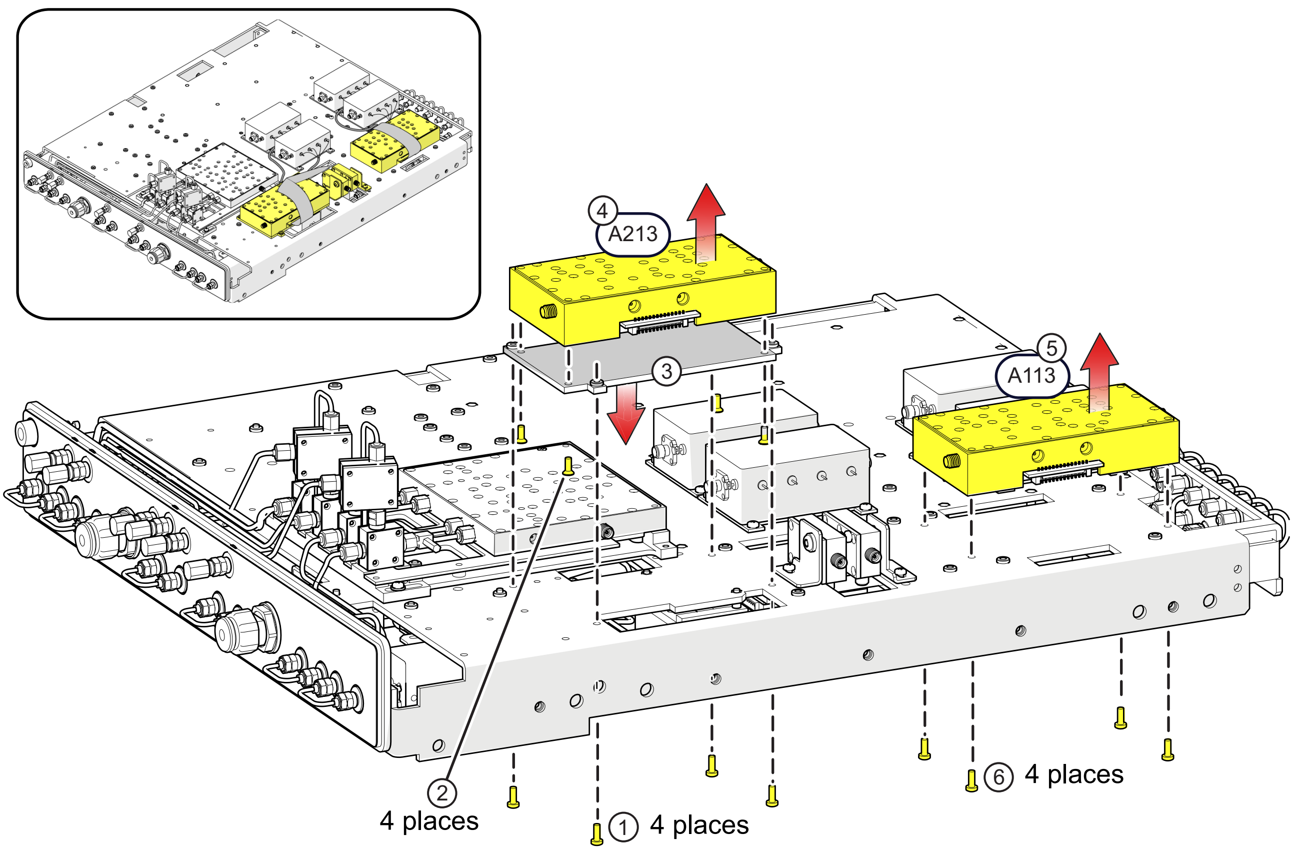
12-7 RF Deck Top Module Replacement (System with Options)

This section provides instructions for replacing top side modules when all options applicable to the RF Deck top side are included.

A113 or A213 (Option 31) Replacement

To replace either module A113 or A213:

1. Disconnect the Signal ribbon cable from the module.
2. Disconnect any semi-rigid cables.
3. Remove and replace the module as shown in Figure 12-3.
4. For Module A213, remove the mounting plate and install on the new module, then install the assembly to the RF Deck as shown.
5. Reconnect the semi-rigid cables before tightening the mounting screws.
6. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connectors.
7. Tighten the mounting screws.



1. Four (4) pan head Phillips M3 × 8 mm mounting screws	4. A213 5-20 GHz Doubler Module
2. Four (4) flat head M3 x 8mm Phillips mounting screws for A213 Doubler Mounting Plate	5. A113 5-20 GHz Doubler Module
3. A213 Mounting Plate	6. Four (4) pan head Phillips M3 × 8 mm mounting screws

Figure 12-3. A113 or A213 (Option 31) 5–20 GHz Doubler Replacement

A124, A125, A126, or A127 (Option 61, Option 62) Low Band Attenuator Replacement

The bracket and related hardware is transferred to the replacement attenuator. The replacement attenuator comes equipped with a soldered-on harness. For instructions on Option 61/62 High Band Attenuator replacement, see Chapter 14, “RF Deck Module Replacement – Port Modules”.

1. Tilt the RF Deck up on one side and disconnect the Control Cable from its receptacle on the A18 board.
2. Disconnect any semi-rigid coaxial cables from the module.
3. Remove and replace the attenuator module as shown in Figure 12-4.
4. Reconnect the semi-rigid cables before tightening the mounting screws.
5. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connectors.
6. Tighten the mounting screws.

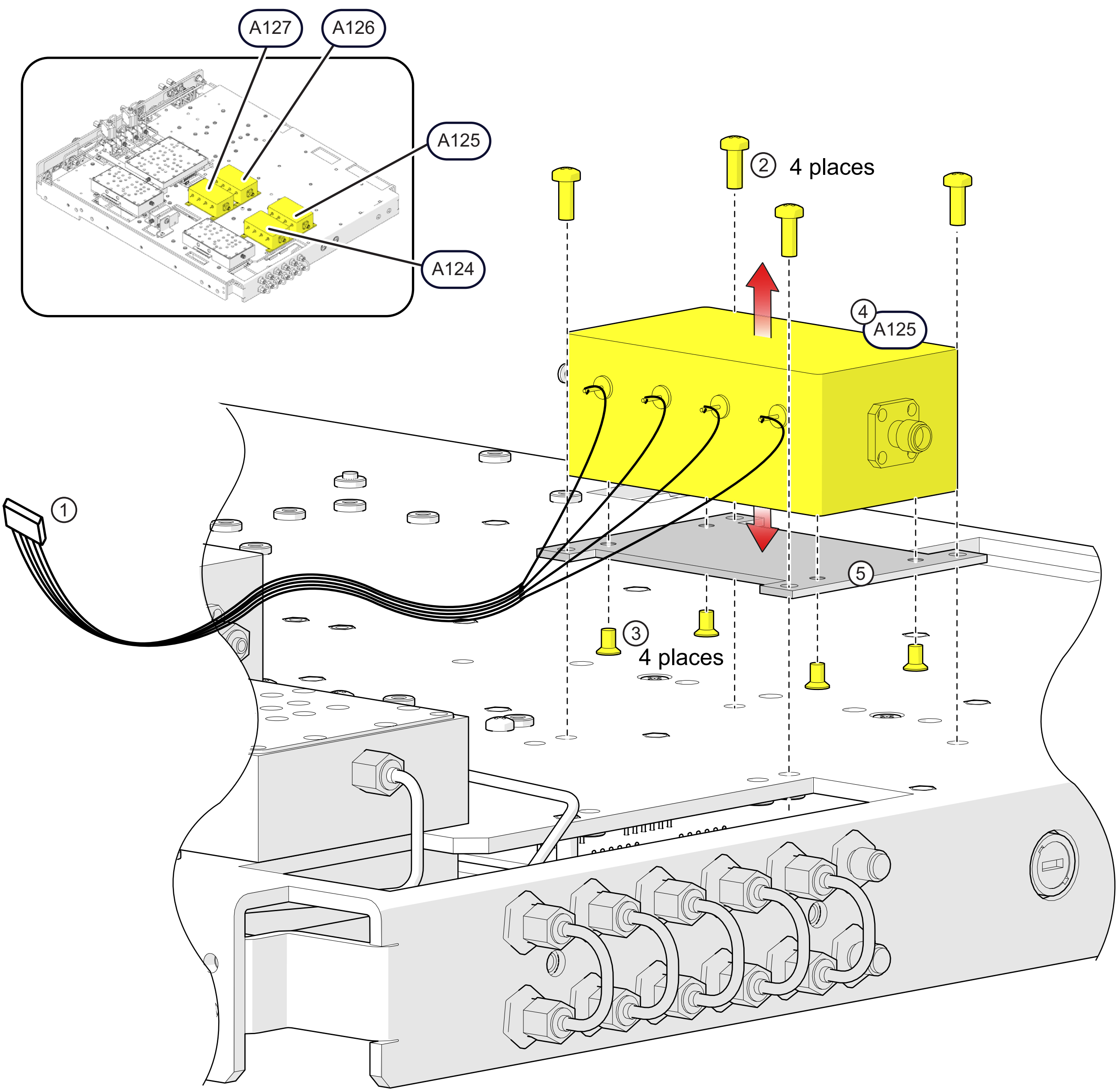


Figure 12-4. Replacing A124, A125, A126, or A127 (1 of 2)

1. Control cable from A18 Control Board (under chassis – see attenuators listed below for connection point)
2. Four (4) pan head Phillips M3 × 8 mm screws
3. Four (4) flat head M3 x 8mm Phillips screws
4. Low Band Step Attenuator:

   A124 Attenuator – Port 1 Test
   Option 62
   Connects to A18 PCB J14

   A125 Attenuator – Port 1 Source
   Option 61/62
   Connects to A18 PCB J13

   A126 Attenuator – Port 2 Source
   Option 62
   Connects to A18 PCB J15

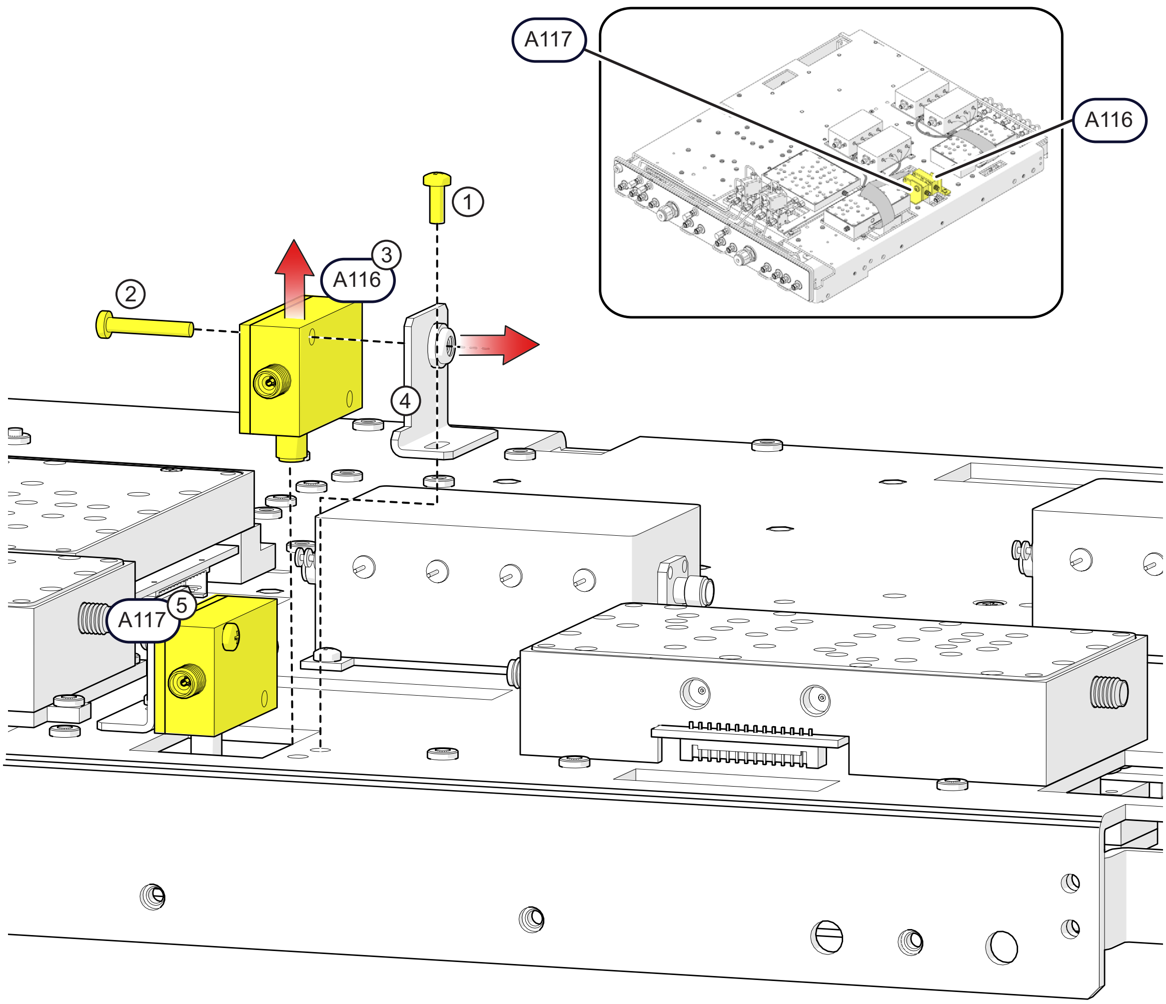
   A127 Attenuator – Port 2 Test
   Option 61, 62
   Connects to A18 PCB J16
5. Attenuator mounting bracket PN 3-61954. Not a component of the replacement part.

Figure 12-4. Replacing A124, A125, A126, or A127 (2 of 2)

A116 or A117 Low Band Bridge Module Replacement (Option 31 Configuration)

This section covers the A116/A117 replacement for systems with Option 31 configuration (with or without Option 52). The removal and installation procedure for each module is the same. The bracket and related hardware is transferred to the replacement module.

1. Disconnect any semi-rigid cables attached to the module.
2. Remove and replace the module as shown in Figure 12-5.
3. Reconnect the semi-rigid cable before tightening the mounting screws.
4. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connector.
5. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connector.
6. Tighten the mounting screws.



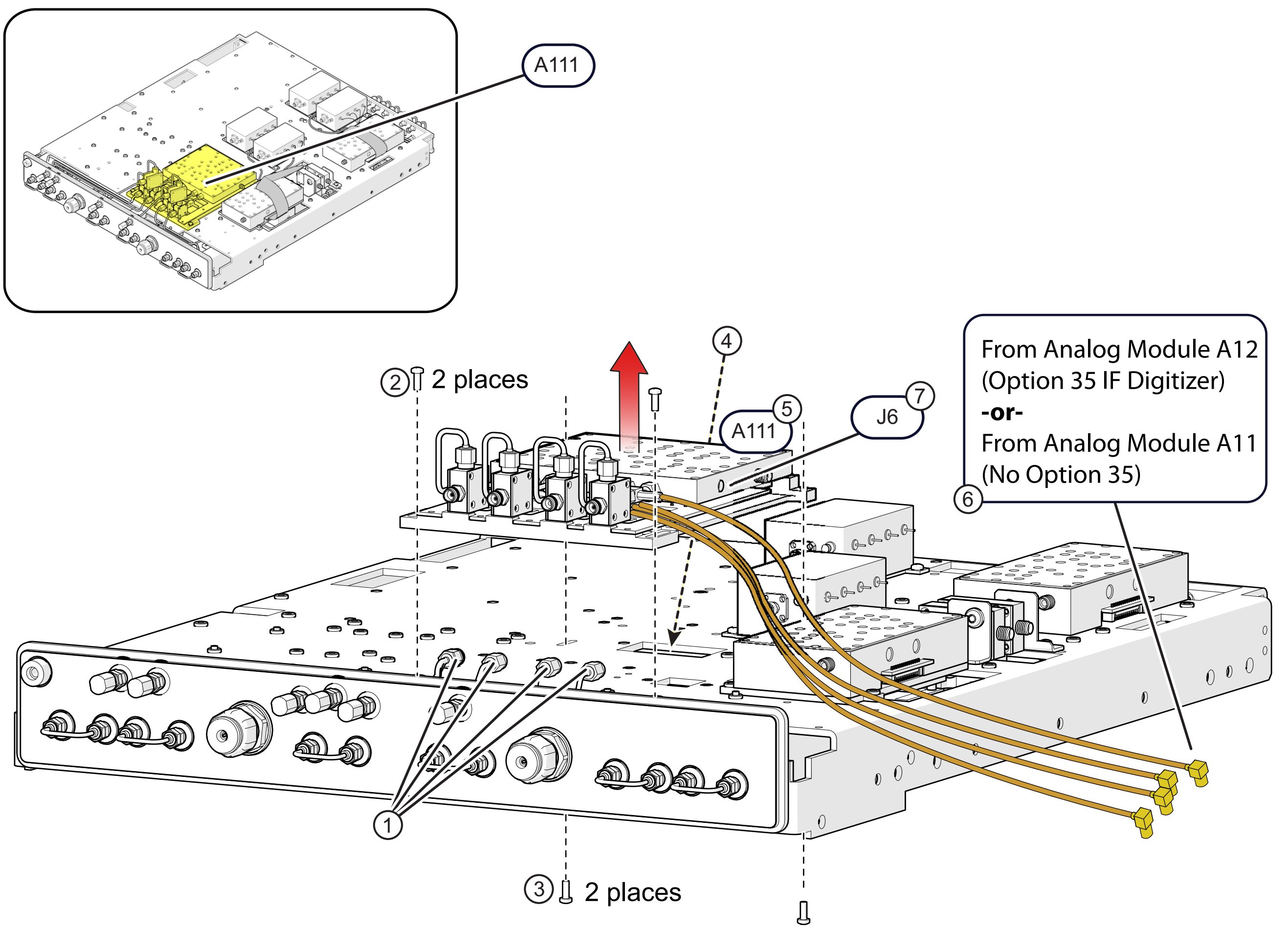
1. Pan head Phillips M3 × 8 mm screw	4. Module Mounting Bracket
2. Pan head Phillips M3 × 18 mm screw	5. A117 Low Band Bridge Module
3. A116 Low Band Bridge Module	

Figure 12-5. Replacing A116 or A117: Option 31 Configuration

12-8 Removing A111 SLODM Assembly for Module Replacement

The Sampler/LO Distribution Module (SLODM) assembly itself is not a replaceable part, but consists of multiple components which are replaceable parts.

1. Disconnect the semi-rigid cables from the sampler modules.
2. Disconnect the semi-rigid cable from J1 and the MCX cable from J6 on A111.
3. Disconnect the SLODM ribbon cable from J4 on A18 board (located at chassis underside).
4. Remove the four (4) mounting screws, to release A11 assembly.
5. When installing the SLODM, reconnect the semi-rigid cables before tightening the mounting screws.
6. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connectors.
7. Tighten the mounting screws.



1. Sampler module semi-rigid cables	5. A111 LO Distribution Module Assembly
2. Two (2) pan head Phillips M3 × 8 mm screws and two (2) flat #6 washers under the screws.	6. MCX Cables From Analog Module A12 (Option 35 IF Digitizer) or From Analog Module All (No Option 35)
3. Two (2) pan head Phillips M3 × 8 mm screws access from chassis underside.	7. MCX Connector J6 – MCX cable connects from J6 on A111 to J17 on A13.
4. Disconnect Signal Ribbon Cable from J4 on A18 under chassis.	

Figure 12-6. Removing A111 SLODM Assembly

12-9 SLODM Module Replacement

This section covers replacement of the modules that are part of the SLODM assembly.

Overview

The Sampler/LO Distribution Module (SLODM) Assembly Part Number is for configuration purposes only and is not a replacement part.

The only reason to remove and disassemble the SLODM is to replace one or more of its modules. Other than differing cable connections, the removal and replace procedure for each variant is the same. For disassembly and assembly procedures, the procedures are similar but vary with module sequence and cable connections. The general procedure consists of the following steps:

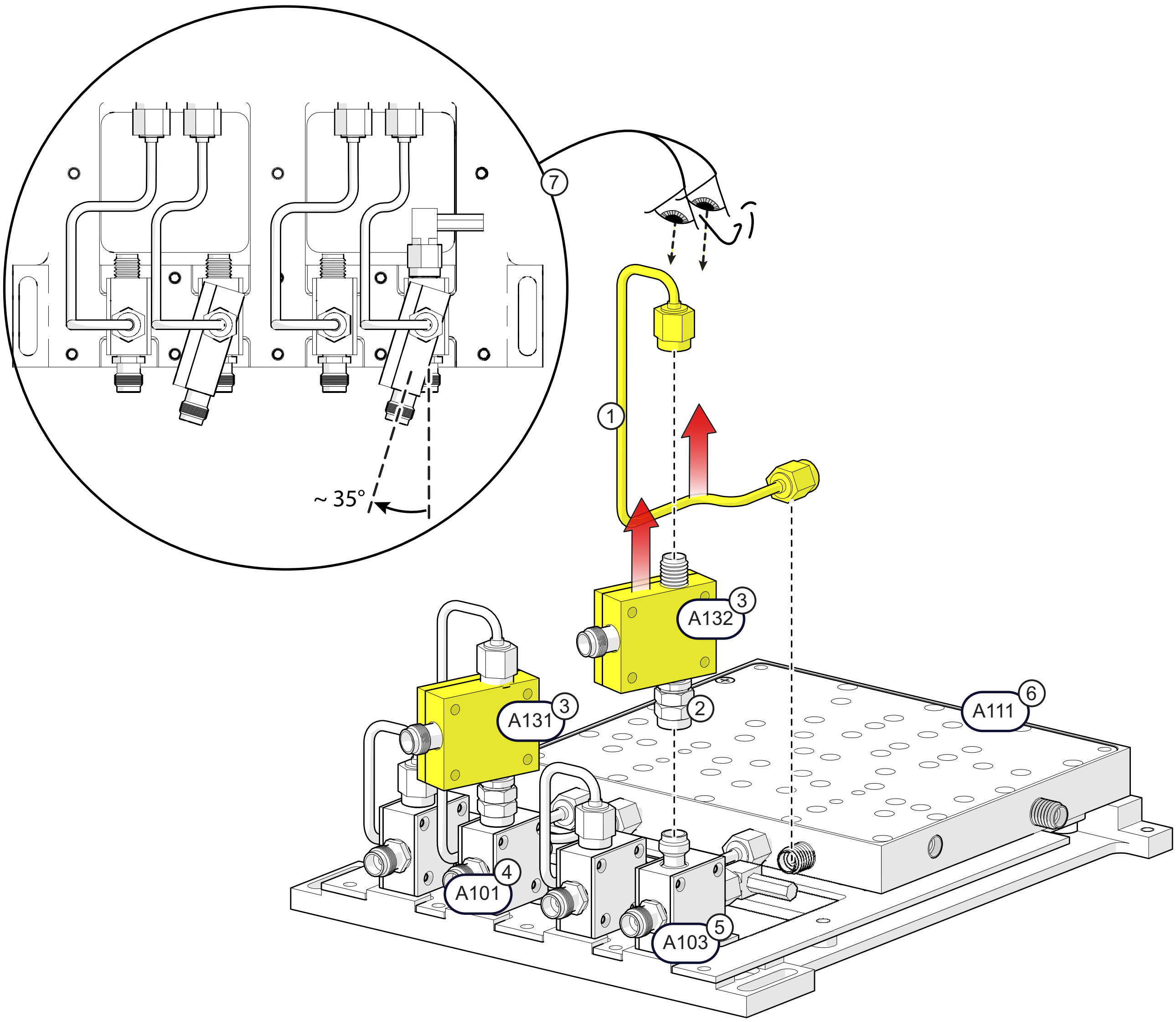
- Removal
    - Remove any cables between the SLODM assembly and other components.
    - Remove the SLODM assembly from the RF Deck Top Side.
- Disassembly
    - If required to access a component, remove the appropriate SLODM semi-rigid coaxial cables.
    - If required to access a component, remove any modules mounted on top of the A100, A101, or A103 Sampler Modules.
    - If required to access the foundation A111 LO Distribution Module, remove all mounted components, and all connected semi-rigid coaxial cables.
    - Remove any mounting hardware as required to remove modules.
- Assembly
    - Install the replacement module.
    - If required, install the component mounting hardware and cables.
    - Make sure all SLODM assembly cables are correctly tightened and torqued.
- Installation
    - Install the SLODM assembly on the RF Deck Top Side.
    - Connect all cables between the SLODM, the RF Deck, and the Analog PCB assemblies.

A131 or A132 LO Coupler Module Replacement (Option 8x)

A131 and A132 LO Coupler modules are used for Option 80, 81, 82, 83, 84, or 85. A131 is mounted to A101 Sampler Module and A132 is mounted to A103 Sampler Module. A131 and A132 can be removed without removing the SLODM Assembly from the RF deck.

Note	When the A131-A132 modules are installed, ensure they are oriented about 35 degrees towards the left.

1. Remove the semi-rigid cable from the module.
2. Disconnect the connector between the coupler module and the sampler module below it.
3. Remove the coupler module.
4. Install the new module, ensuring it is rotated approximately 35° to the left as shown in Figure 12-7 on page 12-10
5. Reconnect the semi-rigid cable between the module and its respective A111 port.
6. Use a 5/16” torque end wrench set to 8 lbf · in to torque the cable connector.



1. Semi-rigid cable between A131 or A132 and A111.	5. A103 Sampler Module
2. A132 Coupler Module	6. A111 LO Distribution
3. A131 and A132 LO Coupler Modules	7. When installing, rotate the module about 35° before tightening connector.
4. A101 Sampler Module	

Figure 12-7. Replacing A131 or A132 LO Coupler Modules

A101 and A103 Sampler Module Replacement (with Option 8x)

When Option 8x is installed, follow this instruction to replace A101 or A103.

1. Remove the semi-rigid cable from the LO Coupler Module.
2. Remove A131 or A132 LO Coupler Module from its respective sampler module.
3. Remove the two screws holding the sampler module to the SLODM foundation, then remove the module.
4. Remove the MCX cable from the sampler module and install the cable on the new module.
5. Install the new module, then reattach the LO coupler module as shown in Figure 12-8. Before tightening the coupler module, ensure it is angled about 35° to the left as shown in Figure 12-7 on page 12-10.
6. Reconnect the semi-rigid cable between the module and its respective A111 port.
7. Use a 5/16” torque end wrench set to 8 lbf · in to torque all cable connectors.

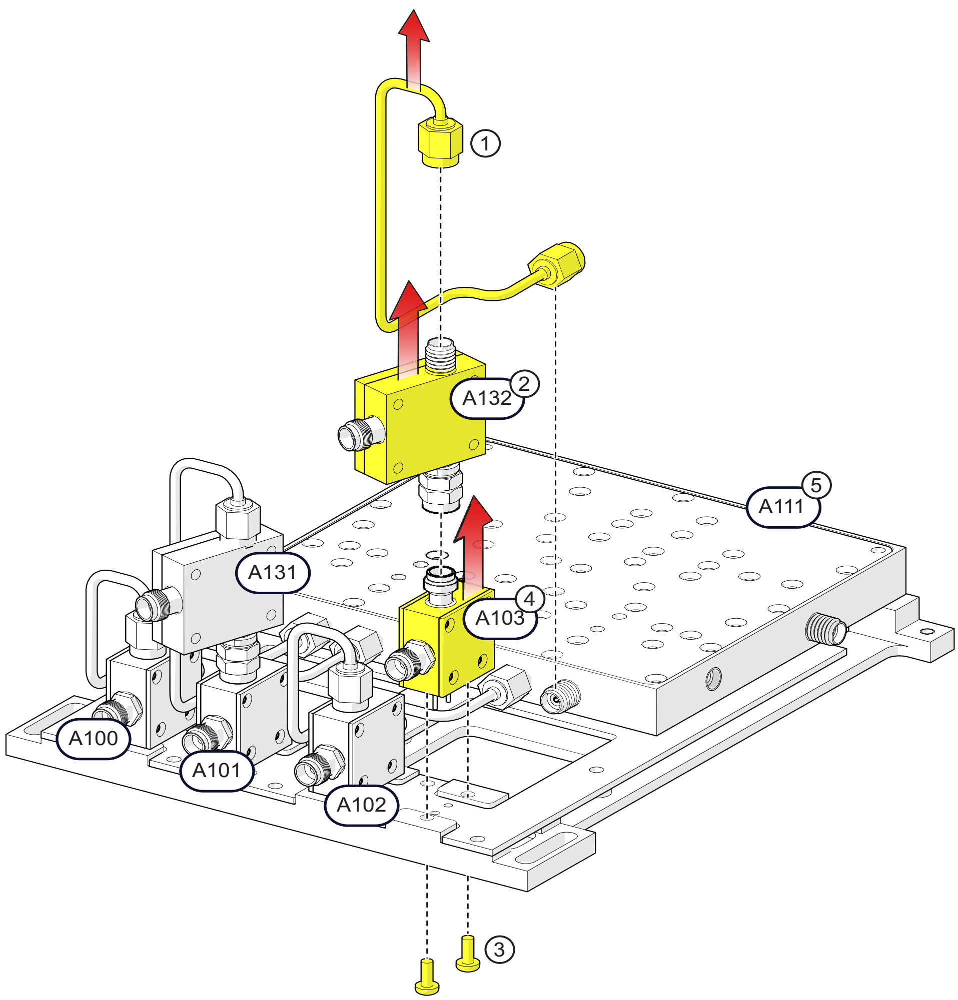


Figure 12-8. Replacing A101 or A103 Sampler Modules

A100 or A102 Sampler Module Replacement (with Option 8x)

When Option 8x is installed, follow this instruction to replace A100 or A102.

1. Remove the semi-rigid cable from the module.
2. Remove the two screws holding the module to the SLODM foundation, then remove the module.
3. Remove the MCX cable from the sampler module and install on the replacement module.
4. Install the new module, then reattach the LO coupler module as shown in Figure 12-8.
5. Reconnect the semi-rigid cable between the module and its respective A111 port.
6. Use a 5/16" torque end wrench set to 8 lbf · in to torque the cable connector.

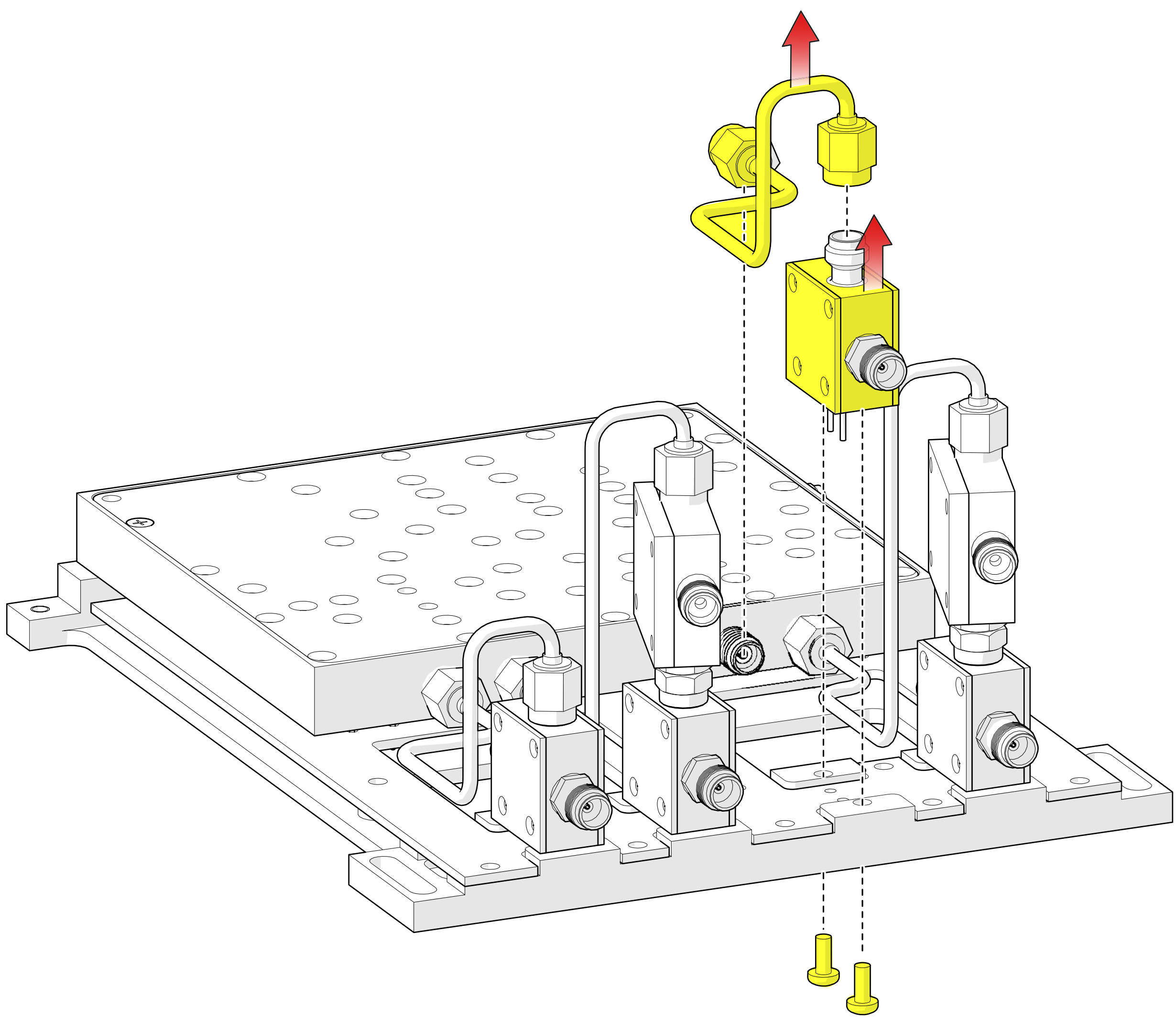


Figure 12-9. Replacing A100 or A102 Sampler Modules

A100 to A103 Sampler Module Replacement (Standard System, no Option 8x)

Follow this instruction to replace A100 to A103 on a standard system.

1. Remove the semi-rigid cable from the module.
2. Remove the two screws holding the module to the SLODM foundation, then remove the module.
3. Remove the MCX cable from the sampler module and install on the replacement module.
4. Install the new module on the SLODM foundation, securing it with the mounting screws.
5. Reconnect the semi-rigid cable between the module and its respective A111 port.
6. Use a 5/16" torque end wrench set to 8 lbf · in to torque the cable connector.

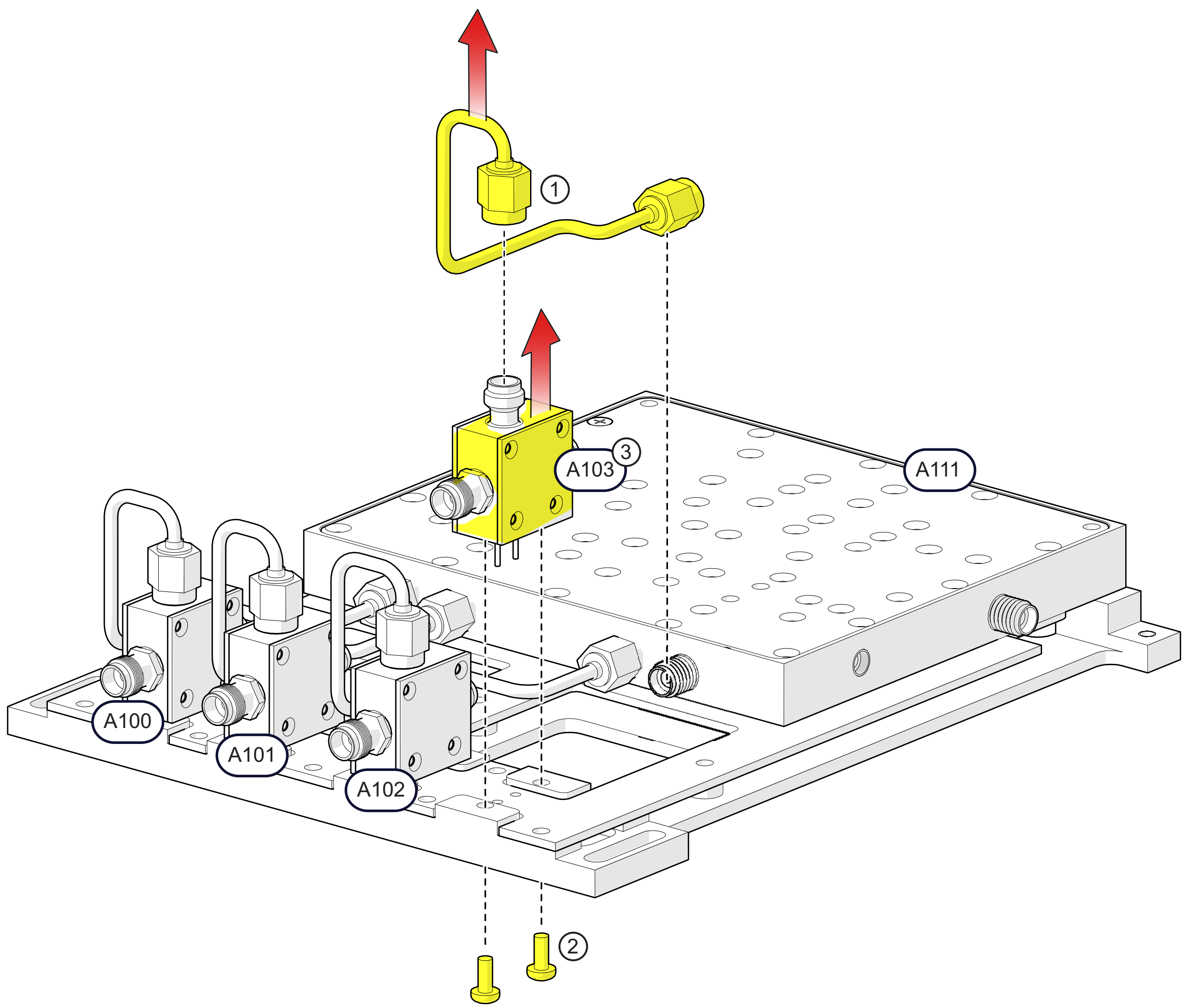


Figure 12-10. Replacing A100 to A103 Sampler Modules (No Option 8x)

A111 LO Distribution Module Replacement

Follow this instruction to replace the base A111 assembly.

1. Remove the semi-rigid cables from the two sampler modules and the two LO coupler modules.
2. Remove the two screws holding each sampler module to the SLODM foundation, then remove the modules.
3. Leave the MCX cables attached to the sampler modules.
4. Install the sampler modules on the new A111 module, securing them with the mounting screws.
5. Reconnect the semi-rigid cables between each module and its respective A111 port.
6. Use a 5/16" torque end wrench set to 8 lbf · in to torque the cable connectors.

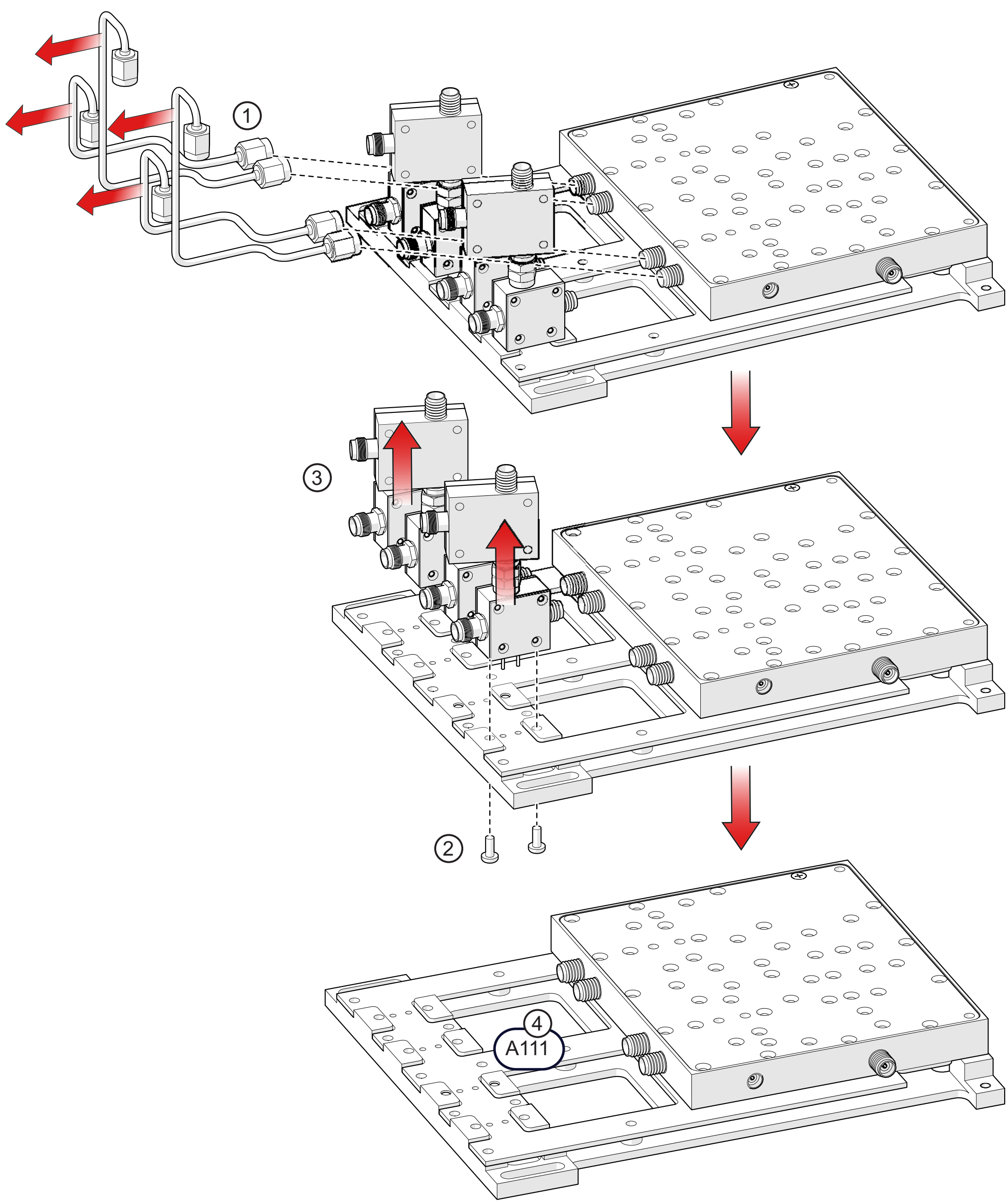


Figure 12-11. Replacing A100 to A103 Sampler Modules (No Option 8x)

12-10 RF Deck Top Module Replacement (No Options)

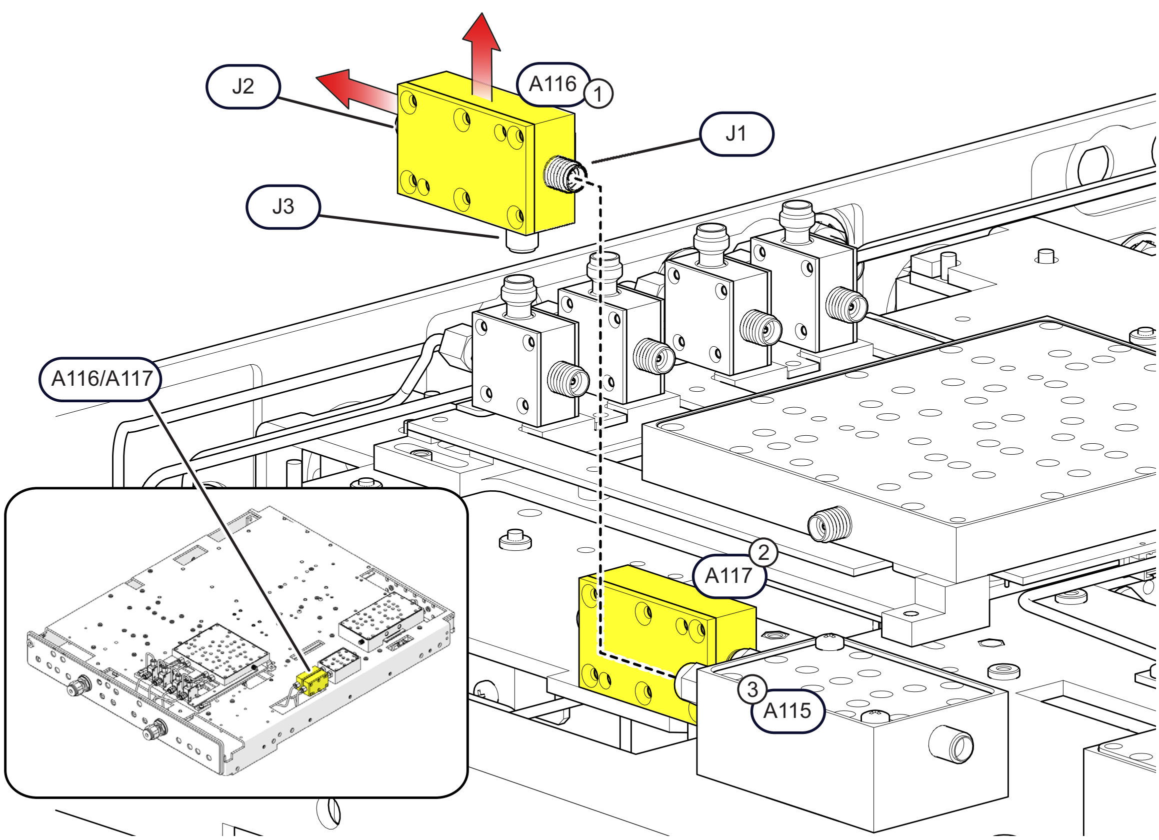
This section covers the replacement of the modules on a standard RF Deck top side configuration with no options installed. Notice that A115 is used in this configuration but is *not* used when Option 31 is installed. Also notice that A116 and A117 are oriented differently as shown in Figure 12-12, than when Option 31 Second Source is installed. To see the difference in orientation, see Figure 12-1 on page 12-2.

Since replacement of all other modules common to both standard systems and optioned systems is covered in Section 12-7, Section 12-8, and Section 12-9, this section need only cover the replacement of A115, A116, and A117 modules as shown in their orientation in Figure 12-12.

A116 or A117 Low Band Bridge Module Replacement (No Option 31)

A115 does not need to be removed to replace A116 or A117. See Figure 12-12

1. Disconnect the semi-rigid cables from the A116 or A117 J2 connector.
2. Position the RF Deck upside down.
3. Disconnect the semi-rigid coaxial cable connected to A116 or A117 J3 connector.
4. Loosen the A115 J2 or J3 connector to module J1 connection.
5. Remove the A116 or A117 module.
6. Attach the new module to the A115 J2 or J3. Finger tight for now.
7. Reconnect the semi-rigid cables to the new bridge module J2 and J3 connectors.
8. Torque all three RF connections to 8 lbf · in.



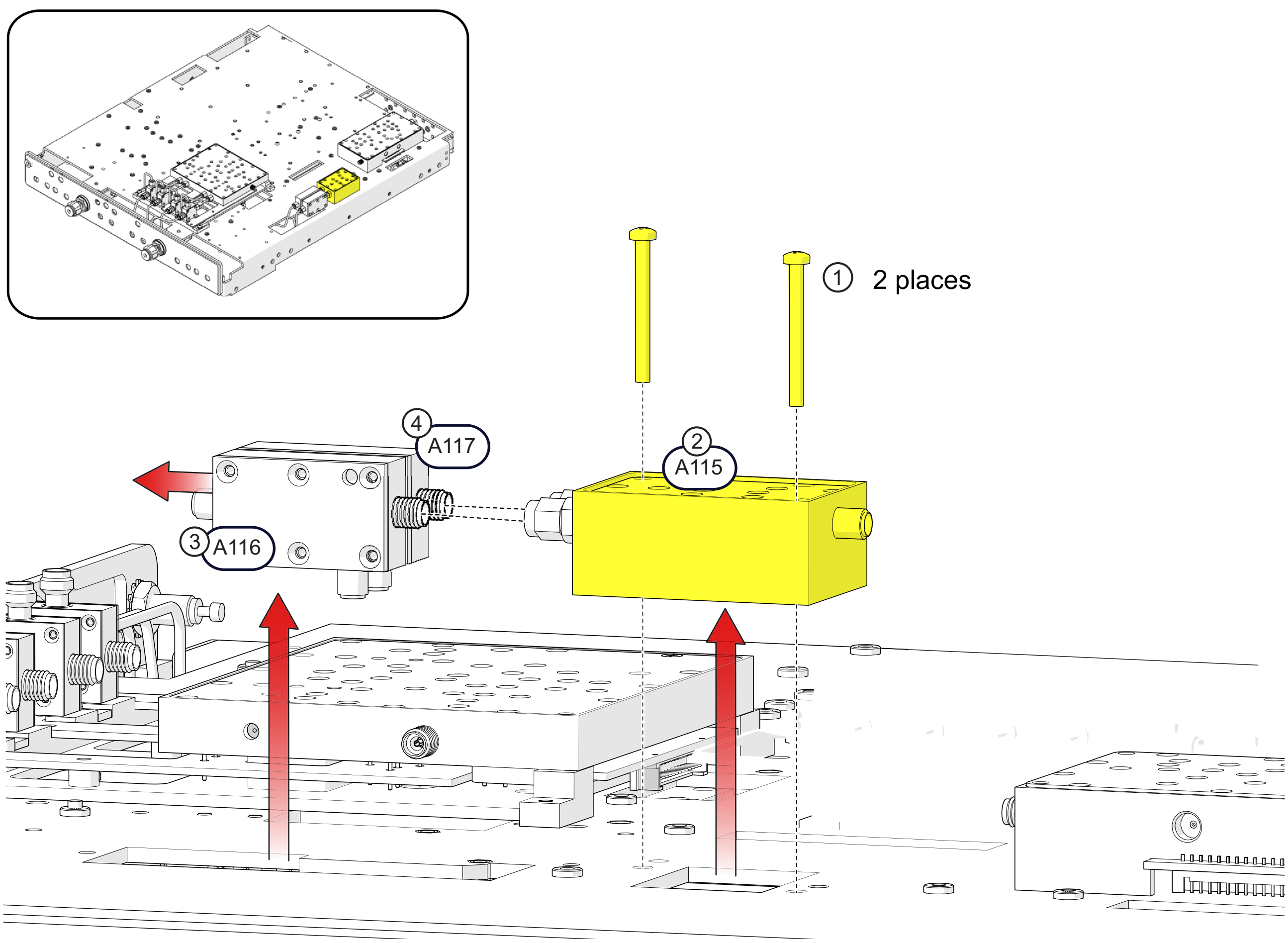
1. A116 Low Band Bridge Module	3. A115 Low Band Transfer Switch Module
2. A117 Low Band Bridge Module	

Figure 12-12. Replacing A115, A116 or A117: Standard Configuration – No Option 31

A115 Low Band Transfer Switch Module Replacement (No Option 31)

To replace A115:

1. Remove two (2) pan head Phillips M3 × 30 mm screws.
2. Loosen the two RF connectors at J1 of both A116 and A117
3. Slide the A115 module slightly to the left until the RF connectors are clear of obstruction, then lift A115 slightly upward.
4. Disconnect the P1 Connector from A115. This ribbon cable routes to the RF Deck Bottom Side A18 PCB and connects to connector P1. Leave attached at the P1 end.
5. On the replacement A115 module, reattach the ribbon cable to the module connector.
6. Feed the excess ribbon cable through the RF deck opening while setting the module into place on the deck. Ensure the cable is not pinched under A115.
7. Slide the module up to the A116 and A117 input connectors and thread them together finger tight.
8. Install the two mounting screws snug but not tight.
9. Using 5/16” plain backing wrench and a torque end wrench, torque each RF connection to 8 lbf · in.
10. Tighten the mounting screws.



1. Two (2) pan head Phillips M3 × 30 mm screws.	3. A116 Low Band Bridge Module
2. A115 Low Band Transfer Switch Module	4. A117 Low Band Bridge Module

Figure 12-13. Replacing A115: Standard Configuration – No Option 31

Chapter 13 — RF Deck Module Replacement – Rear Modules

13-1 Introduction

This procedure describes how to replace the modules mounted toward the rear of the RF Deck or those mounted on the A18 RF Control PCB. These components are located in the bottom side of the RF Deck. Replacement procedures for each module depends on the instrument model and its installed options.

Note	All of the modules and the A18 PCB itself can be serviced while the RF Deck is mounted in the instrument chassis with the instrument positioned upside down.

Module Division on the RF Deck

Figure 13-1 shows the division between the front “Port Modules” and the “Rear Modules”. This chapter provides procedures for replacing the rear modules and A18 RF Control PCB only. Replacement of the Port Modules are described in Chapter 14, “RF Deck Module Replacement – Port Modules”

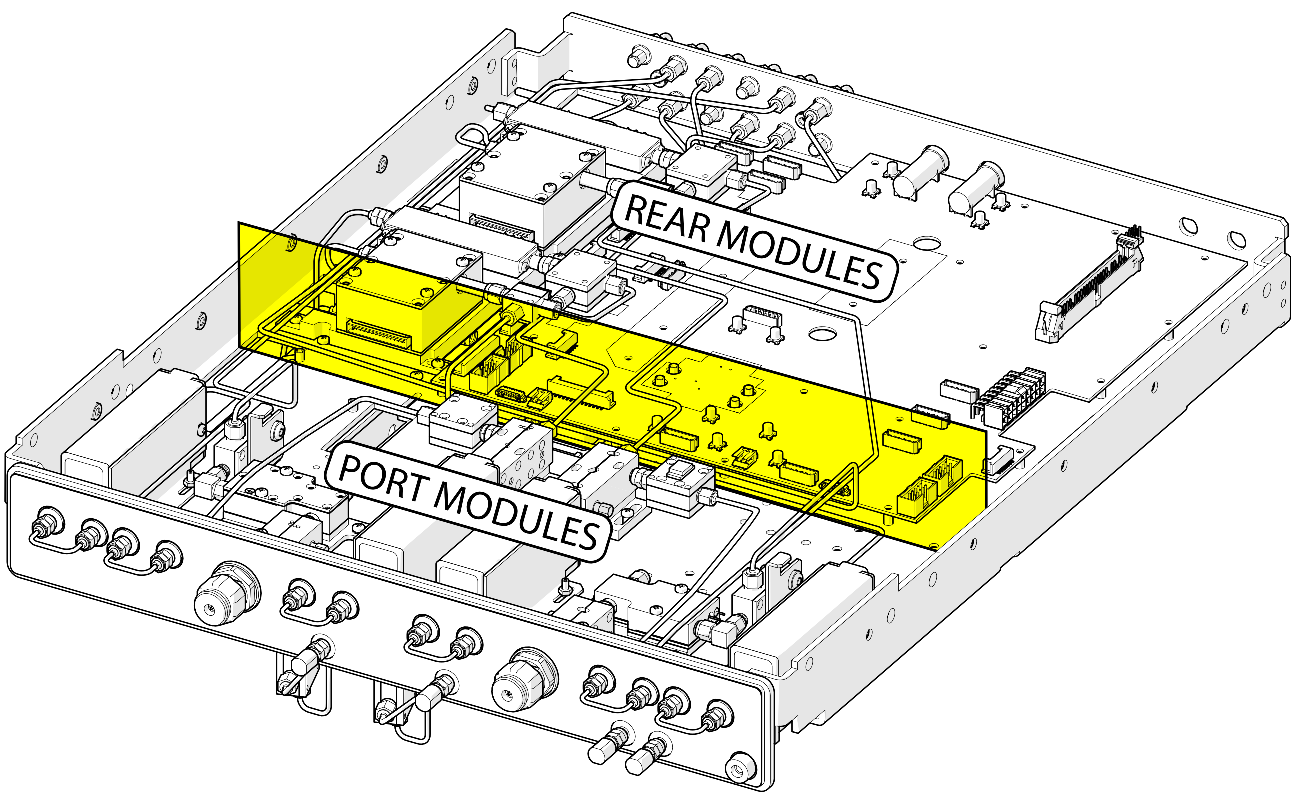


Figure 13-1. RF Deck Division – Front and Rear Modules

Chapter Organization

The chapter is organized as shown below.

13-2 Rear Module Parts Identification

The A18 RF Control PCB Assembly and the modules on or within it are located towards the rear of the RF Deck. These modules and the PCB can be removed while the RF Deck remains mounted in the instrument chassis.

Caution	Do not perform any RF Deck procedures unless the instrument is turned off and disconnected from AC Power. Damage to RF components may occur if certain inputs/outputs are removed with live RF power.

Component List and Applicability

The modules in the rear area vary depending on the instrument model as shown in Table 13-1. The A112 SDM and A212 SDM, and the A114 SQM and A214 SQM all have an attached signal/power harness for connection to the A18 PCB.

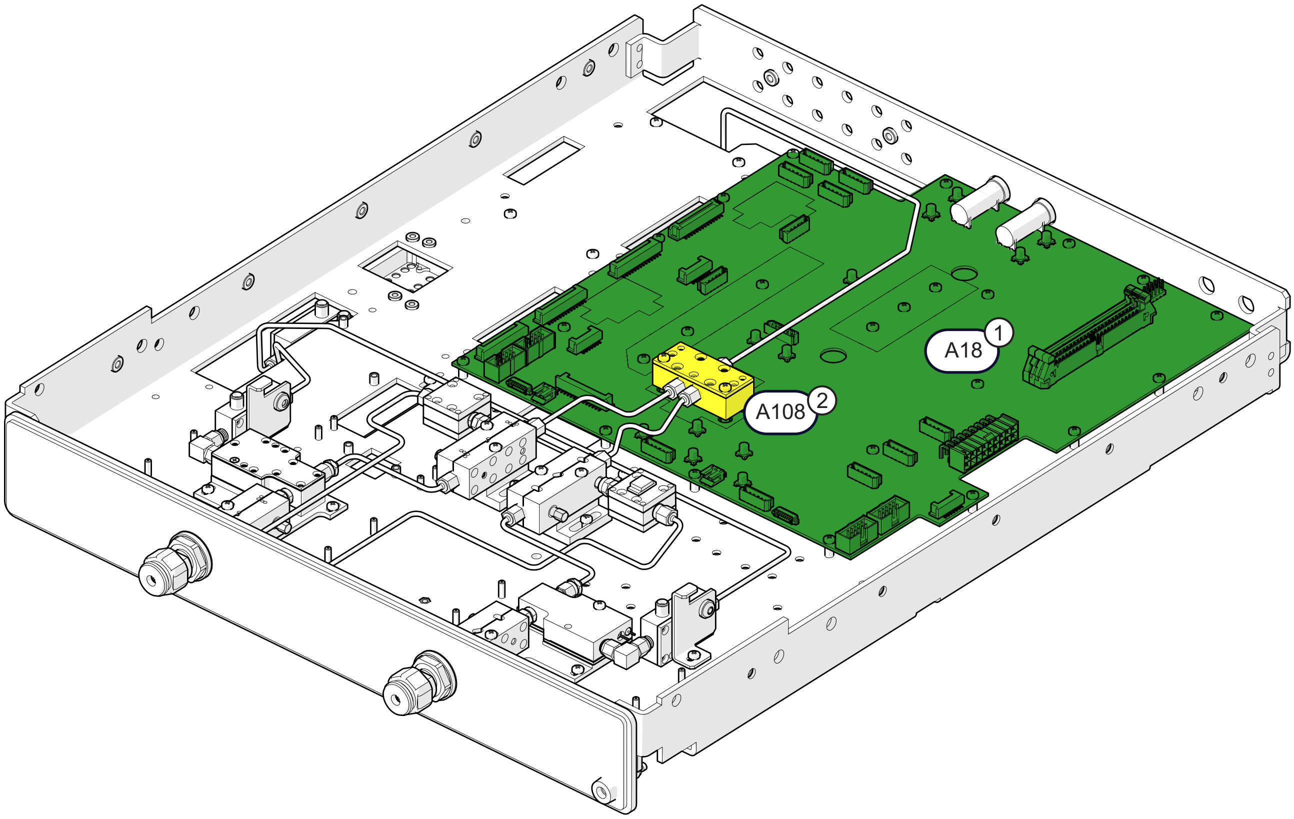
Table 13-1. RF Deck A18 Modules by Instrument Model Number (1 of 2)

Engineering Reference Number	Module Name Replacement and Anritsu Part Numbers	Equipped in this VectorStar Model?			
		MS4642B 20 GHz VNA	**MS4644B 40 GHz VNA**	**MS4645B 50 GHz VNA**	**MS4647B 70 GHz VNA**
A18 PCB	A18 RF Control PCB Assembly (A18 PCB)	**YES**	**YES**	**YES**	**YES**
A18 PCB (with Option 31)	A18 RF Control PCB Assembly (A18 PCB)	**YES with Option 31**	**YES with Option 31**	**YES with Option 31**	**YES with Option 31**
A108 HBTS	A108 High Band Transfer Switch (A108 HBTS), 40 GHz If referring to both the HBTS above and the VITS below, the designator reads "A108 HBTS/VITS.	**YES**	**YES**	NO	NO
A108 VITS	A108 V Integrated High Band Transfer Switch (A108 VITS), 70 GHz	NO	NO	**YES**	**YES**
A112 SDM	A112 Switched Doubler Module (A112 SDM)	NO	**YES**	**YES**	**YES**

Table 13-1. RF Deck A18 Modules by Instrument Model Number (2 of 2)

Engineering Reference Number	Module Name Replacement and Anritsu Part Numbers	Equipped in this VectorStar Model? MS4642B 20 GHz VNA	MS4644B 40 GHz VNA	MS4645B 50 GHz VNA	MS4647B 70 GHz VNA
A212 SDM (with Option 31)	A212 Switched Doubler Module (A212 SDM)	NO	**YES with Option 31**	**YES with Option 31**	**YES with Option 31**
A114 SQM	A114 Switched Quadrupler Module (A114 SQM)	NO	NO	**YES**	**YES**
A214 SQM (with Option 31)	A214 Switched Quadrupler Module (A214 SQM)	NO	NO	**YES with Option 31**	**YES with Option 31**
A133 RCM	A133 20-40 GHz RF Coupler Module (A133 RCM)	**YES with Option 82/83/ 84/85**	**YES with Option 82/83/ 84/85**	**YES with Option 82/83/ 84/85**	**YES with Option 80/81/ 84/85**
A233 RCM (with Option 31)	A233 20-40 GHz RF Coupler Module (A233 RCM)	**YES with Option 84/85**	**YES with Option 84/85**	**YES with Option 84/85**	**YES with Option 84/85**
A140 (with Option 31)	A140 – Forward Coupler	NO	NO	**YES with Option 31**	**YES with Option 31**
A240 (with Option 31)	A240 – Forward Coupler	NO	NO	**YES with Option 31**	**YES with Option 31**

MS4642B – Standard Configuration

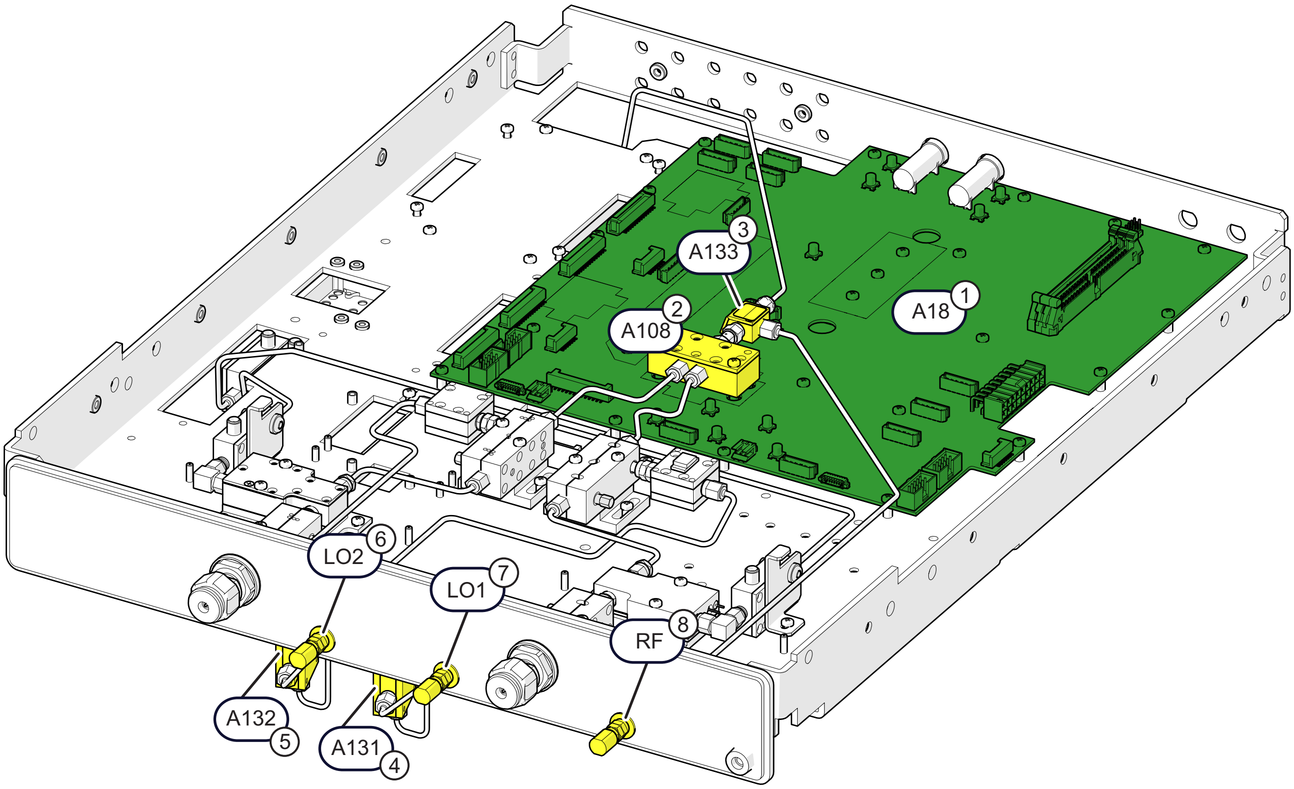


1. A18 RF Control PCB Assembly	2. A108 High Band Transfer Switch, 40 GHz

Figure 13-2. MS4642B – 20 GHz – Standard Configuration – No Options

MS4642B – Standard Configuration with Option 82

Option 82 provides a mmWave interface.

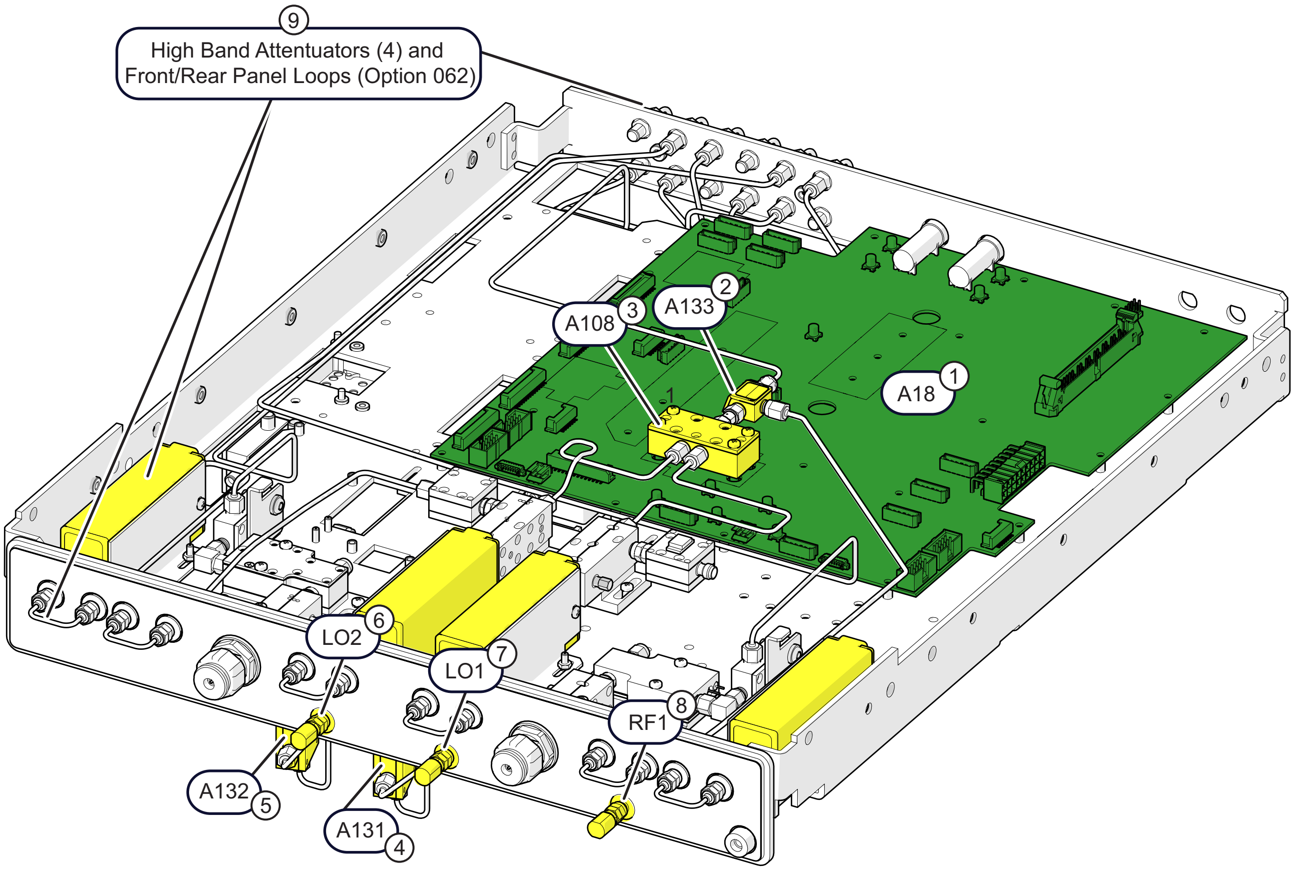


1. A18 RF Control PCB Assembly	5. A132 LO Coupler Module
2. A108 High Band Transfer Switch, 40 GHz	6. LO2 Port for mmWave System
3. A133 20-40 GHz RF Coupler Module (A133 RCM)	7. LO1 Port for mmWave System
4. A131 LO Coupler Module	8. RF Port for mmWave System

Figure 13-3. MS4642B – 20 GHz – Standard Configuration with Option 82

MS4642B – Standard Configuration with Option 83

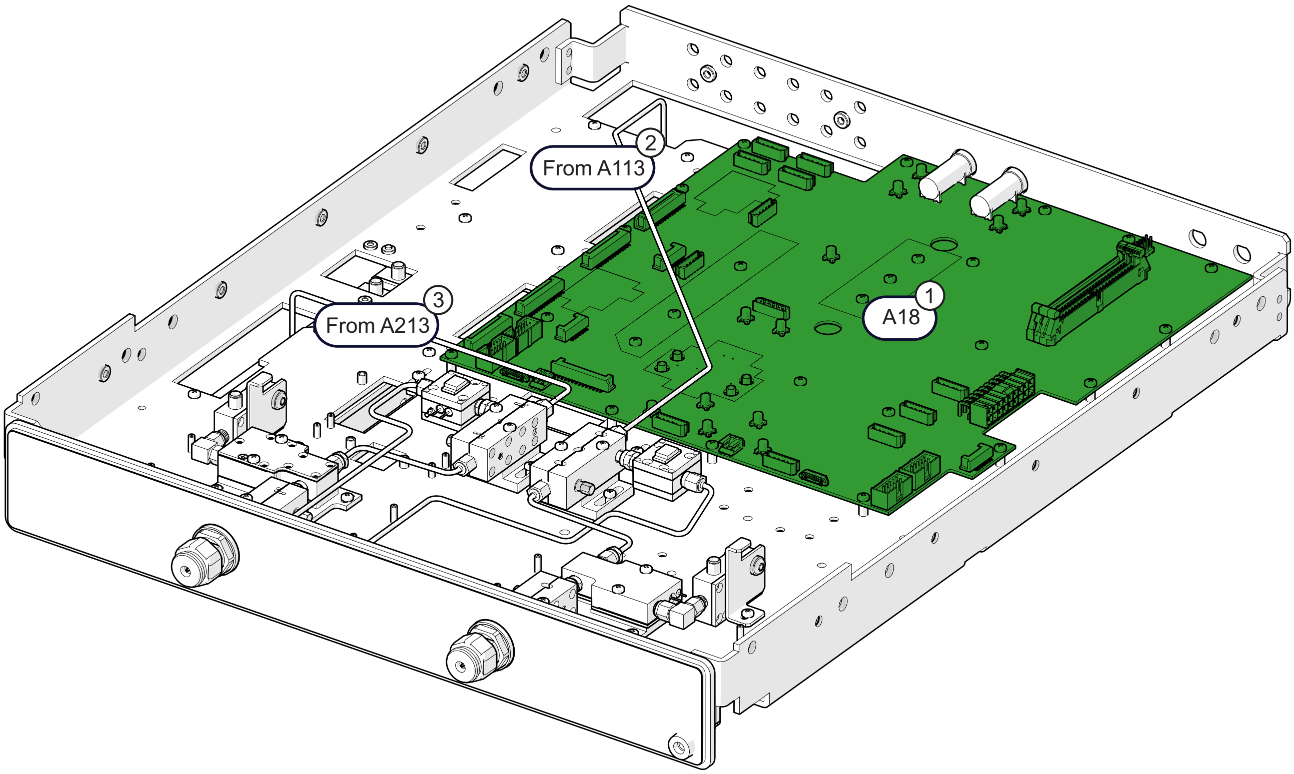
Option 83 provides a mmWave interface and front/rear panel access loops.



Option 51, 61, or 62 is required with Option 83. The illustration above includes Option 62. 1. A18 RF Control PCB Assembly 2. A108 High Band Transfer Switch, 40 GHz 3. A133 20-40 GHz RF Coupler Module (A133 RCM) 4. A131 LO Coupler Module (for reference only)	5. A132 LO Coupler Module (for reference only) 6. LO2 Port for mmWave System 7. LO1 Port for mmWave System 8. RF Port for mmWave System 9. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – High Band Step Attenuator, K Connector

Figure 13-4. MS4642B – 20 GHz – Standard Configuration with Option 83

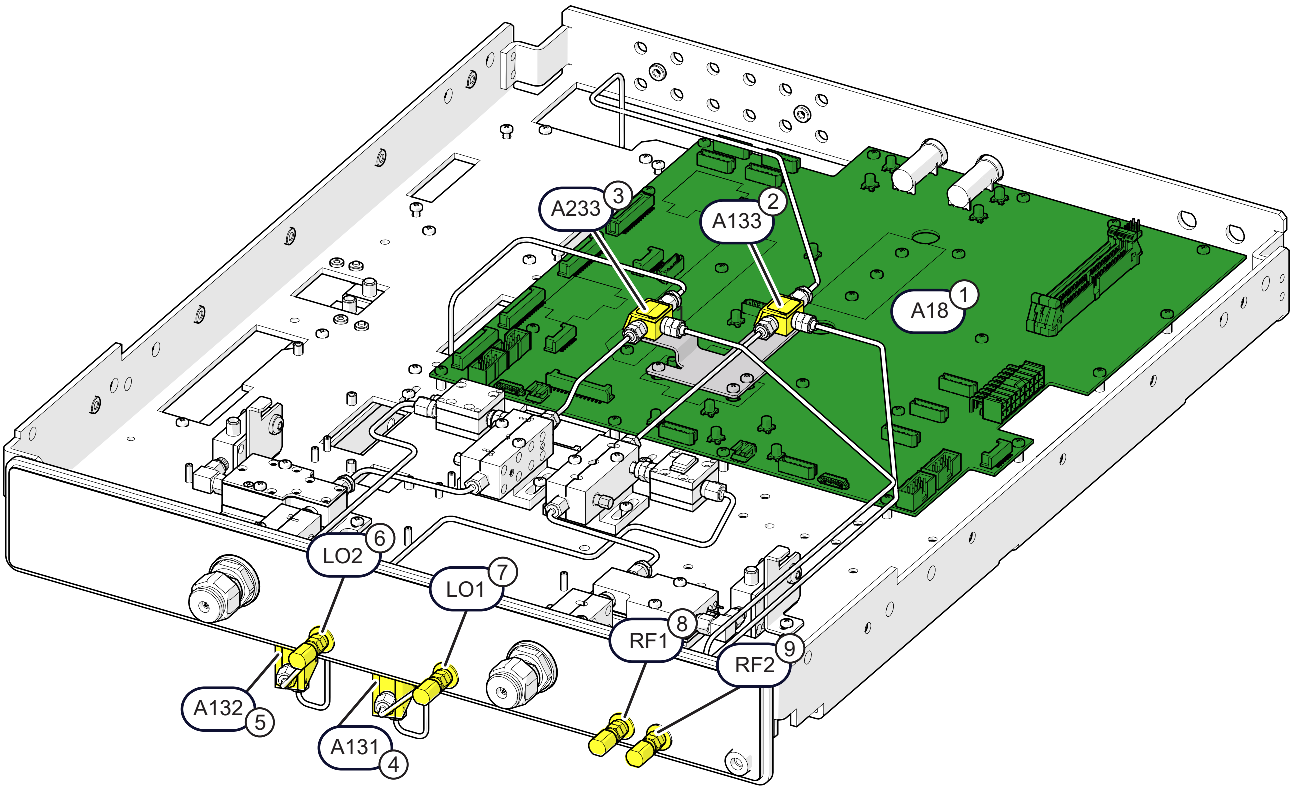
MS4642B – Option 31 Configuration



1. A18 RF Control PCB Assembly 2. From A113 – 5-20 GHz Doubler Module For Port 1	3. From A213 – 5-20 GHz Doubler Module For Port 2 (Option 31)

Figure 13-5. MS4642B – 20 GHz – Option 31 Configuration – Second Source

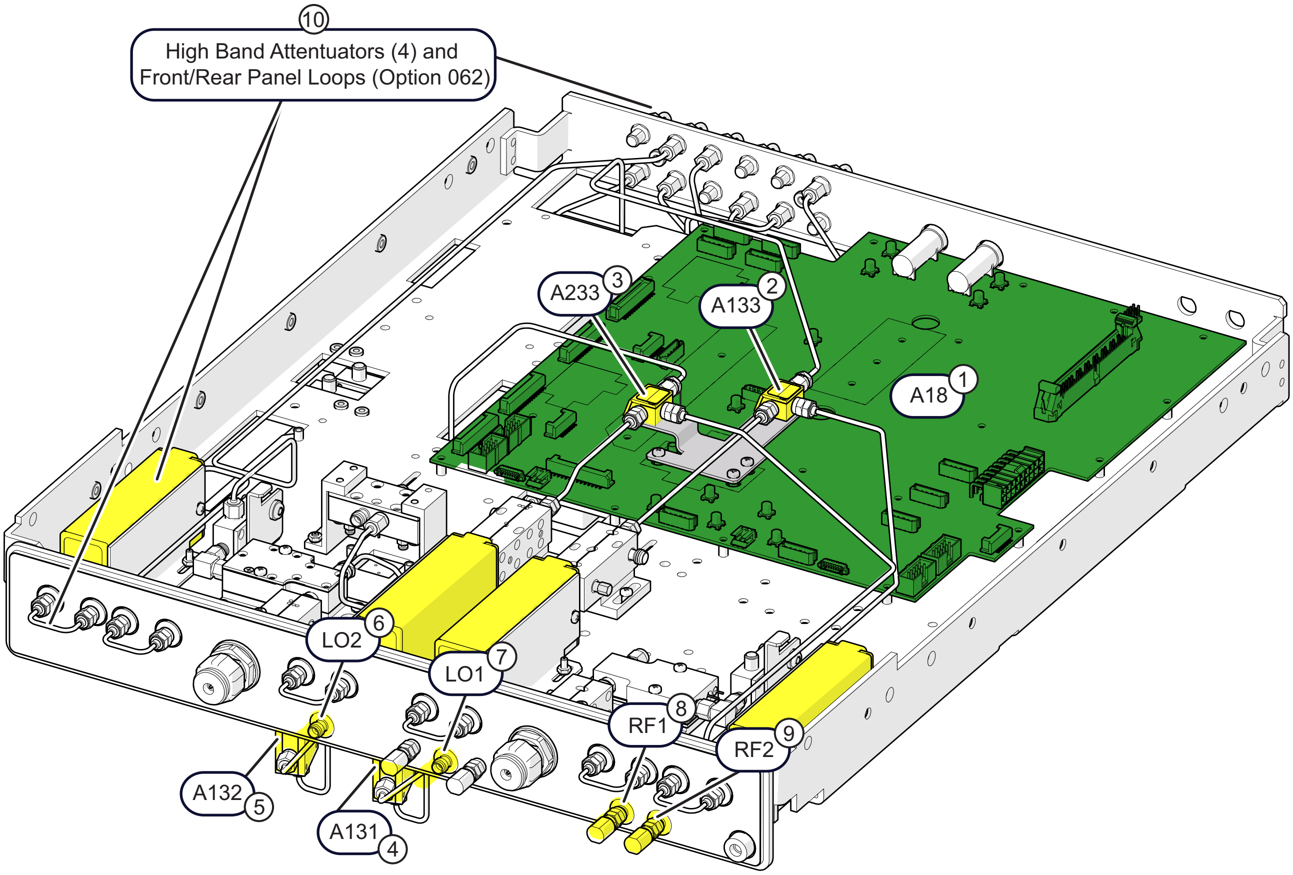
MS4642B – Option 31 Configuration – with Option 84



1. A18 RF Control PCB Assembly	6. LO2 Port for mmWave System
2. A133 20-40 GHz RF Coupler Module (A133 RCM)	7. LO1 Port for mmWave System
3. A233 20-40 GHz RF Coupler Module (A233 RCM)	8. RF2 Port for mmWave System
4. A131 LO Coupler Module	9. RF1 Port for mmWave System
5. A132 LO Coupler Module	

Figure 13-6. MS4642B – 20 GHz – Option 31 Configuration – with Option 84

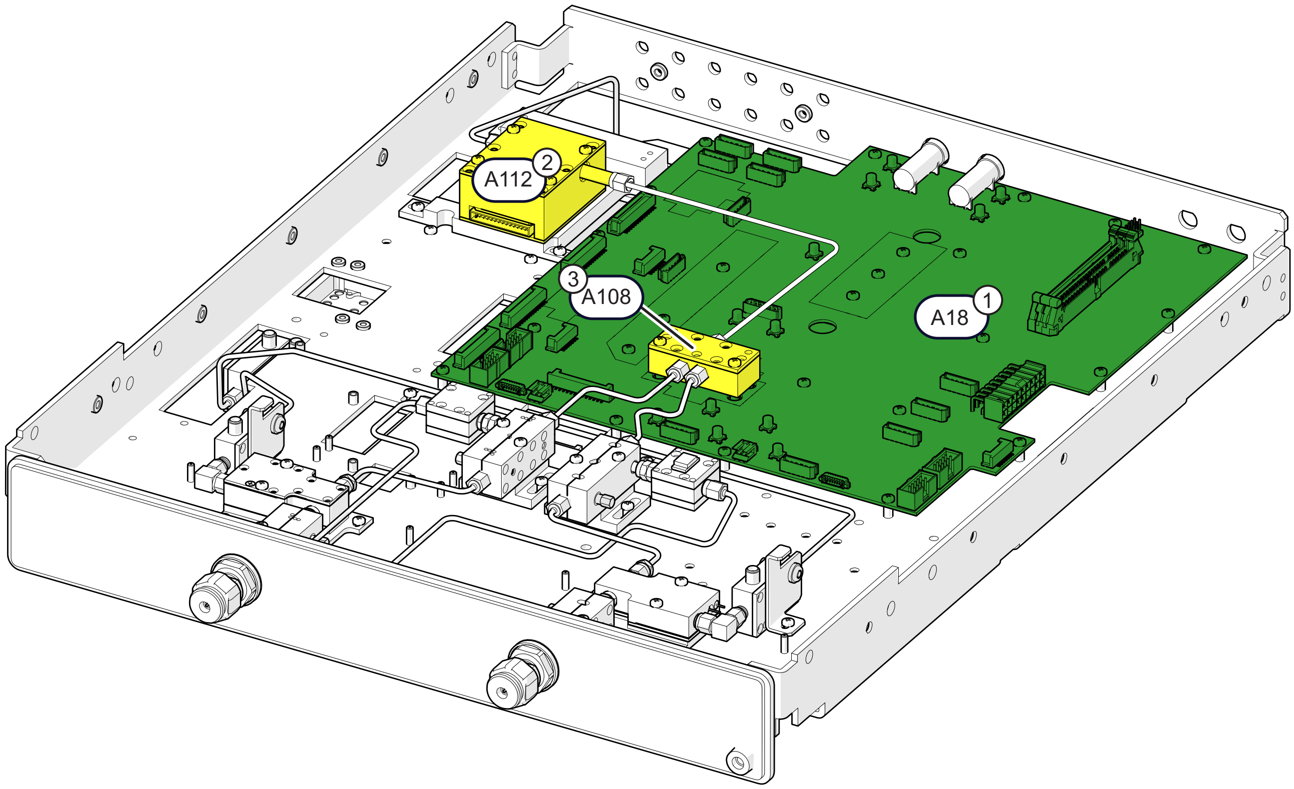
MS4642B – Option 31 Configuration – with Option 85



Option 51, 61, or 62 is required with Option 85. The illustration above includes Option 62. A131 and A132 are accessible only from the RF Deck top side and are shown for reference only. 1. A18 RF Control PCB Assembly 2. A133 20-40 GHz RF Coupler Module (A133 RCM) 3. A233 20-40 GHz RF Coupler Module (A233 RCM) 4. A131 LO Coupler Module (for reference only)	5. A132 LO Coupler Module (for reference only) 6. LO2 Port for mmWave System 7. LO1 Port for mmWave System 8. RF2 Port for mmWave System 9. RF1 Port for mmWave System 10. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – High Band Step Attenuator, K Connector

Figure 13-7. MS4642B – 20 GHz – Option 31 Configuration – with Option 85 and Option 62

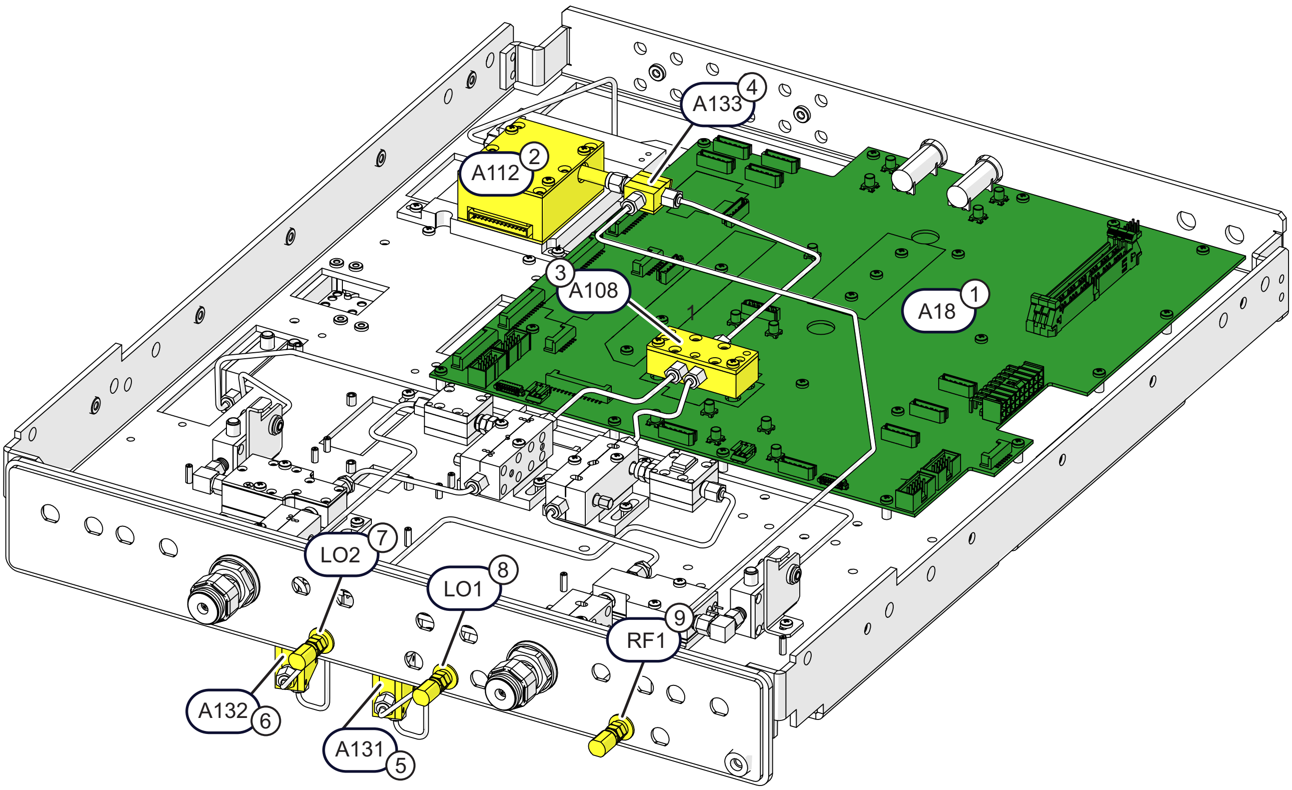
MS4644B – Standard Configuration



1. A18 RF Control PCB Assembly	3. A108 High Band Transfer Switch, 40 GHz
2. A112 Switched Doubler Module (A112 SDM)	

Figure 13-8. MS4644B – 40 GHz – Standard Configuration

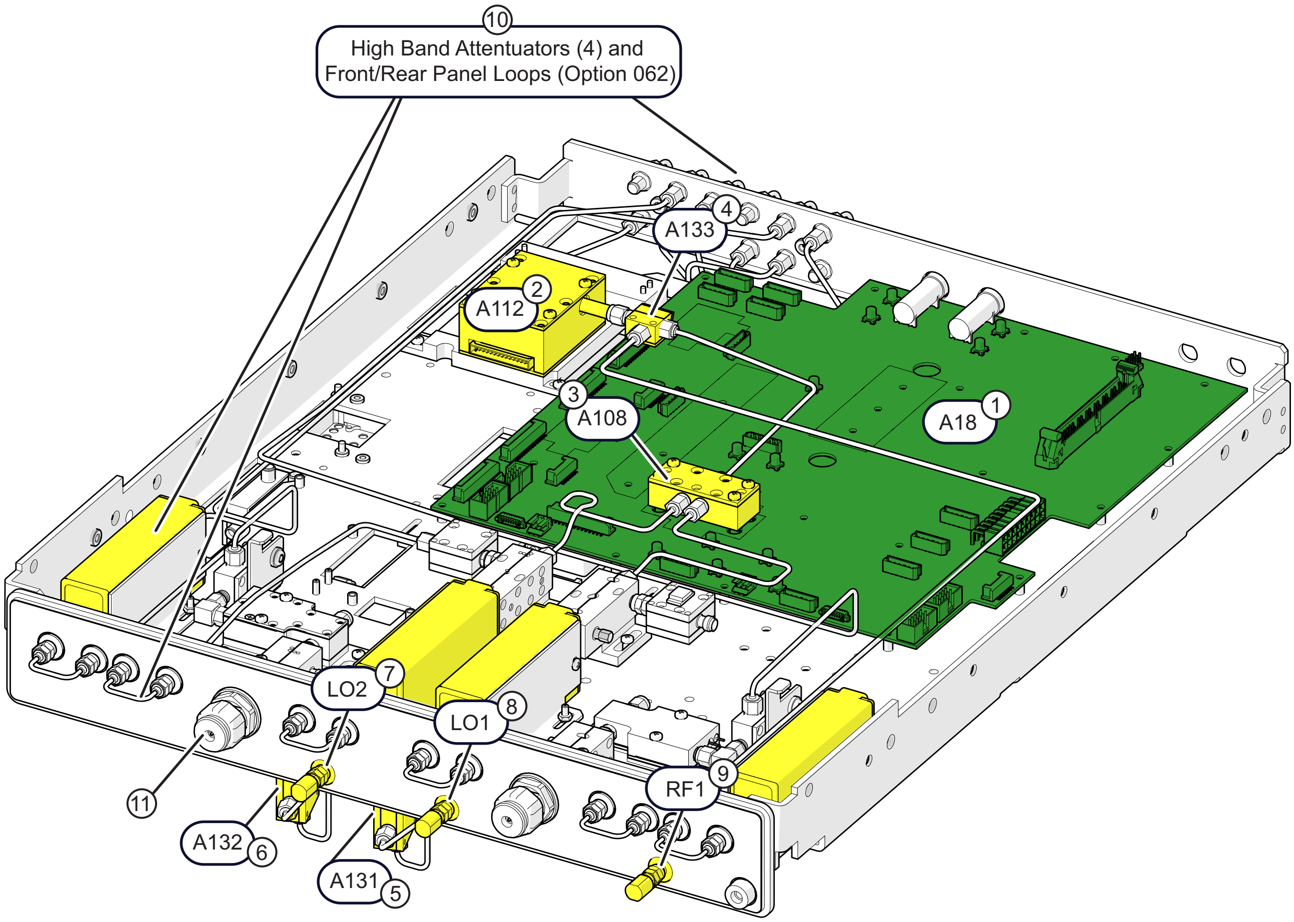
MS4644B – Standard Configuration with Option 82



1. A18 RF Control PCB Assembly	5. A131 LO Coupler Module (for reference only)
2. A112 Switched Doubler Module (A112 SDM)	6. A132 LO Coupler Module (for reference only)
3. A108 High Band Transfer Switch, 40 GHz	7. LO2 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM)	8. LO1 Port for mmWave System
	9. RF1 Port for mmWave System

Figure 13-9. MS4644B – 40 GHz – Standard Configuration – with Option 82

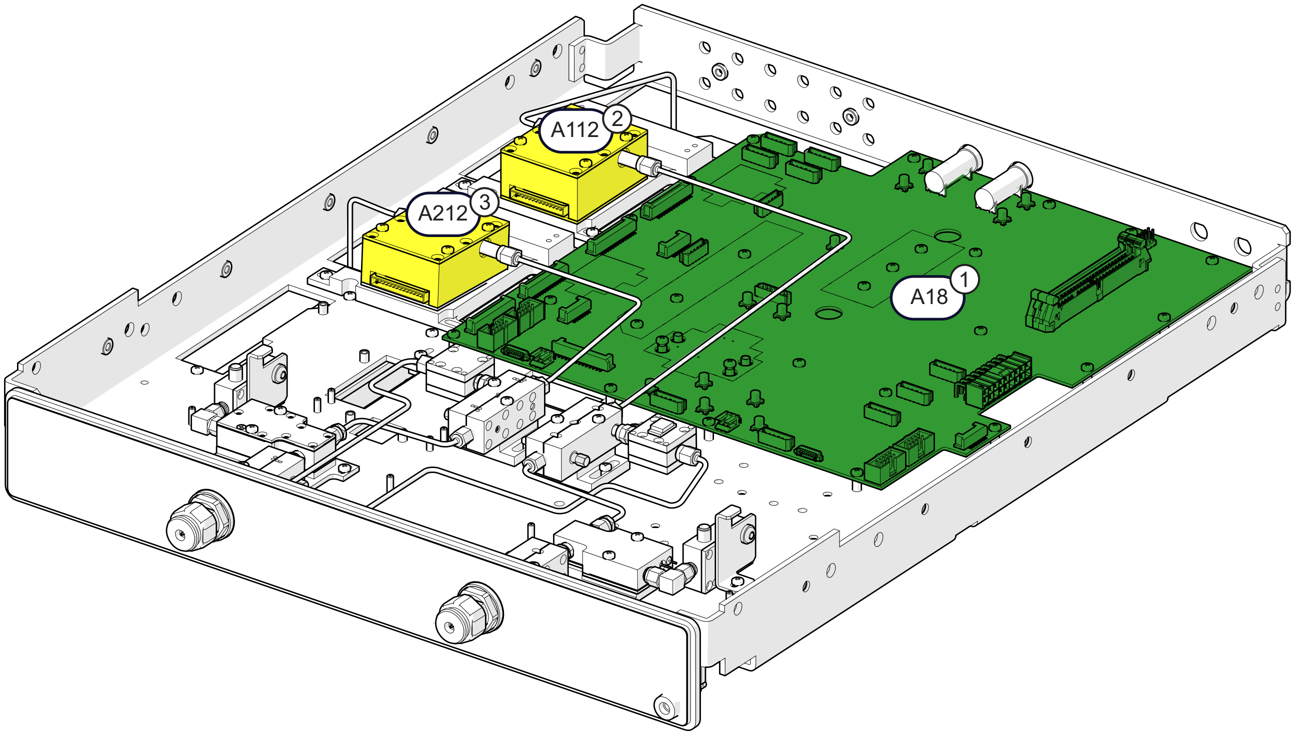
MS4644B – Standard Configuration with Option 83



1. A18 RF Control PCB Assembly	6. A132 LO Coupler Module (for reference only)
2. A112 Switched Doubler Module (A112 SDM)	7. LO2 Port for mmWave System
3. A108 High Band Transfer Switch, 40 GHz	8. LO1 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM) (Option 83)	9. RF1 Port for mmWave System
5. A131 LO Coupler Module (for reference only)	10. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – High Band Step Attenuator, K Connector

Figure 13-10. MS4644B – 40 GHz VNA – Standard Configuration with Option 83

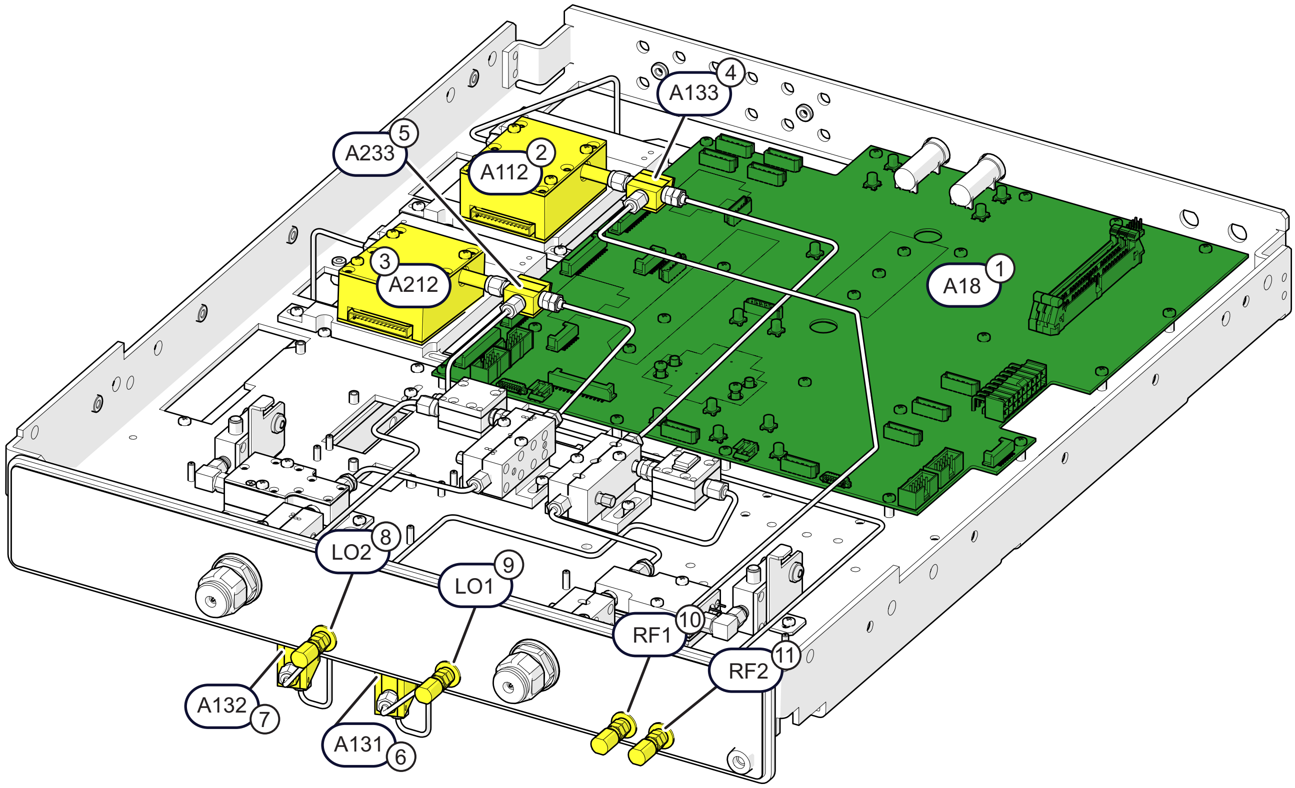
MS4644B – Option 31 Configuration



1. A18 RF Control PCB Assembly	3. A212 Switched Doubler Module (A212 SDM)
2. A112 Switched Doubler Module (A112 SDM)	

Figure 13-11. MS4644B – 40 GHz VNA – With Option 31 Second Source

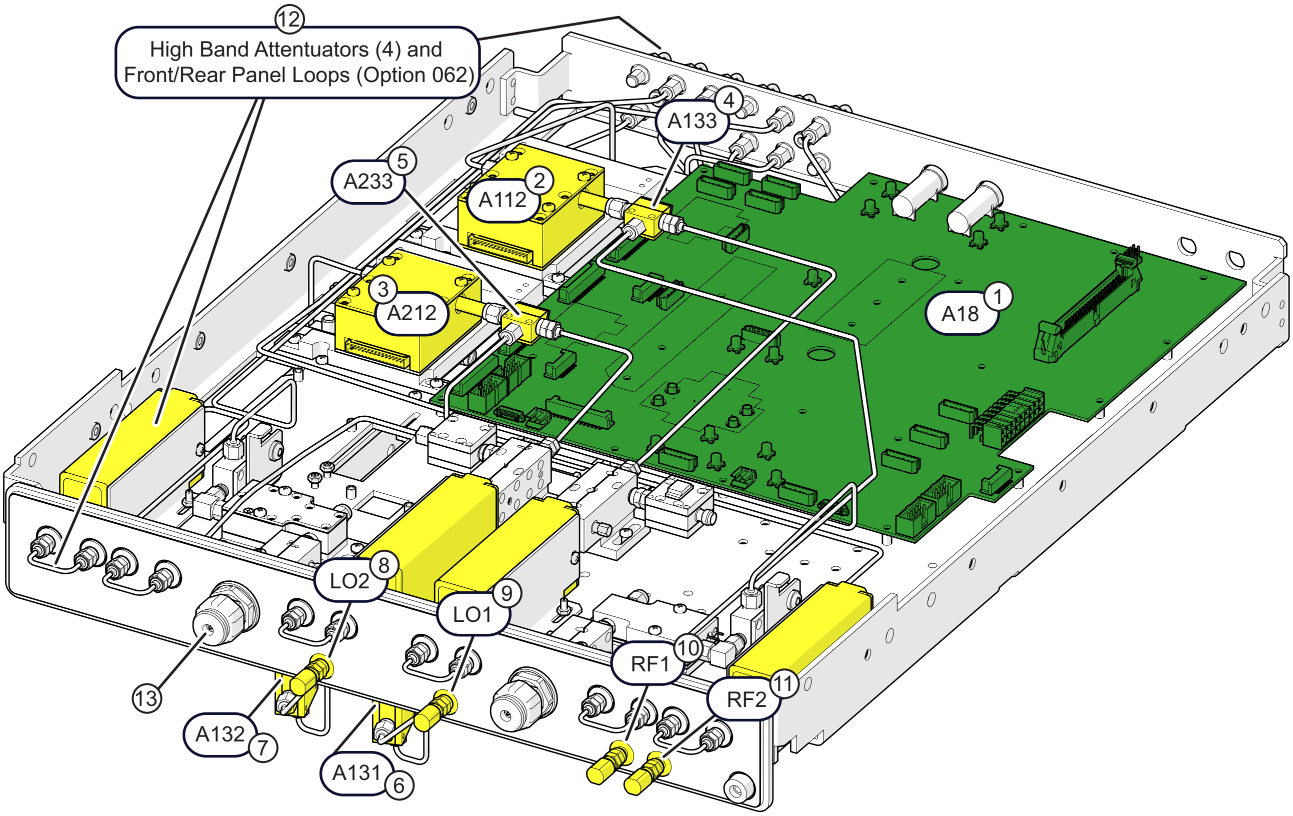
MS4644B – Option 31 Configuration – with Option 84



1. A18 RF Control PCB Assembly	7. A132 LO Coupler Module (reference only)
2. A112 Switched Doubler Module (A112 SDM)	8. LO2 Port for mmWave System
3. A212 Switched Doubler Module (A212 SDM)	9. LO1 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM)	10. RF2 Port for mmWave System
5. A233 20-40 GHz RF Coupler Module (A233 RCM)	11. RF1 Port for mmWave System
6. A131 LO Coupler Module (reference only)	

Figure 13-12. MS4644B – 40 GHz VNA – Option 31 Configuration with Option 84

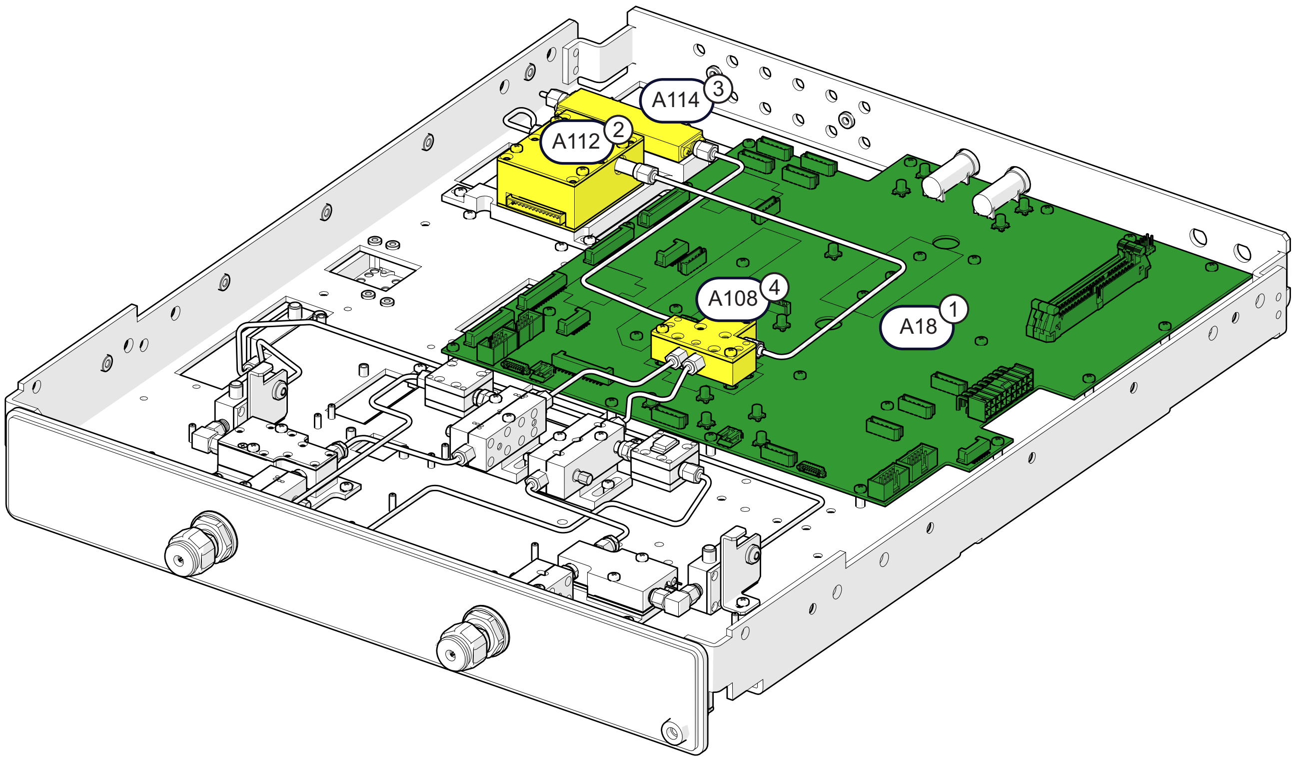
MS4644B – Option 31 Configuration – with Option 85



1. A18 RF Control PCB Assembly	7. A132 LO Coupler Module (reference only)
2. A112 Switched Doubler Module (A112 SDM)	8. LO2 Port for mmWave System
3. A212 Switched Doubler Module (A212 SDM)	9. LO1 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM)	10. RF2 Port for mmWave System
5. A233 20-40 GHz RF Coupler Module (A233 RCM)	11. RF1 Port for mmWave System
6. A131 LO Coupler Module (reference only)	12. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – K Connector

Figure 13-13. MS4644B – 40 GHz VNA – Option 31 Configuration – with Option 85

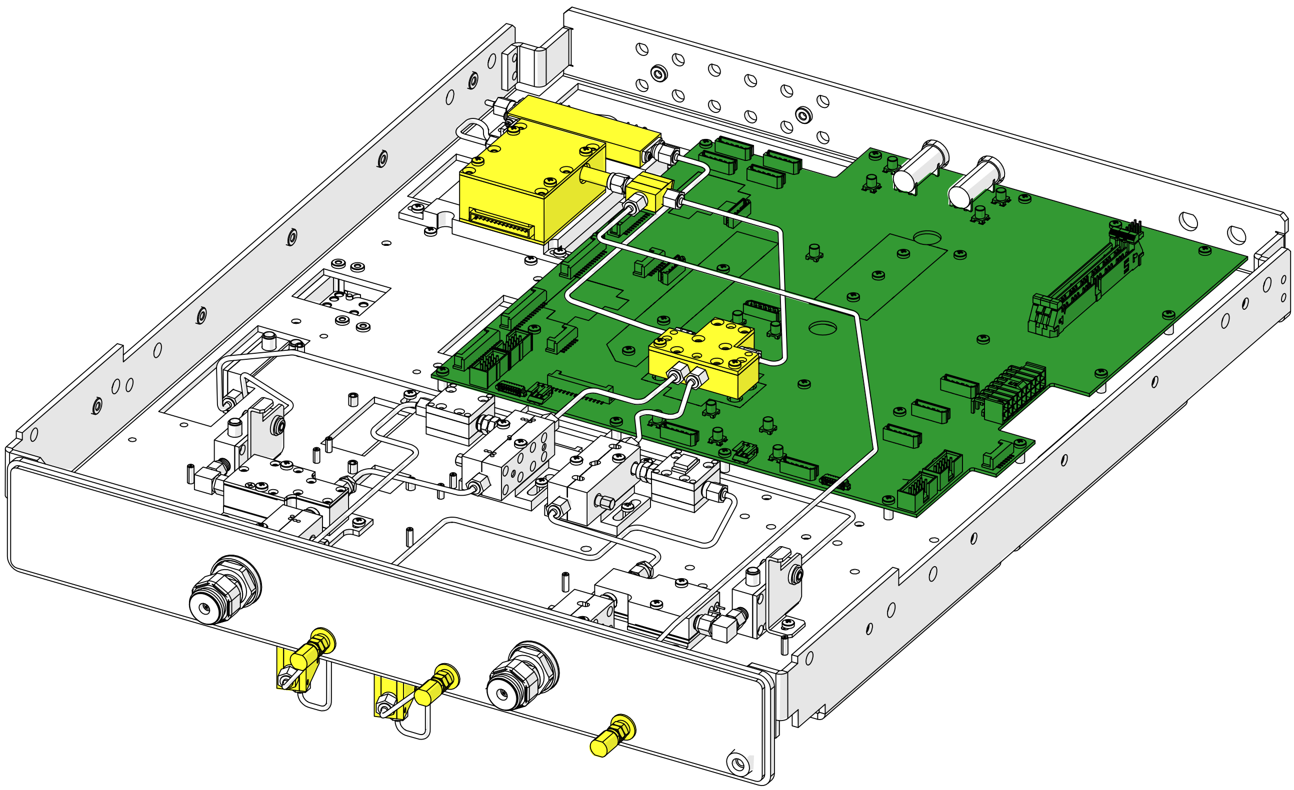
MS4645B or MS4647B – Standard Configuration



1. A18 RF Control PCB Assembly (A18 PCB)	3. A114 Switched Quadrupler Module (A114 SQM)
2. A112 Switched Doubler Module (A112 SDM)	4. A108 V Integrated High Band Transfer Switch (A108 VITS), 70 GHz

Figure 13-14. MS4645B (50 GHz) / MS4647B (70 GHz) – Standard Configuration

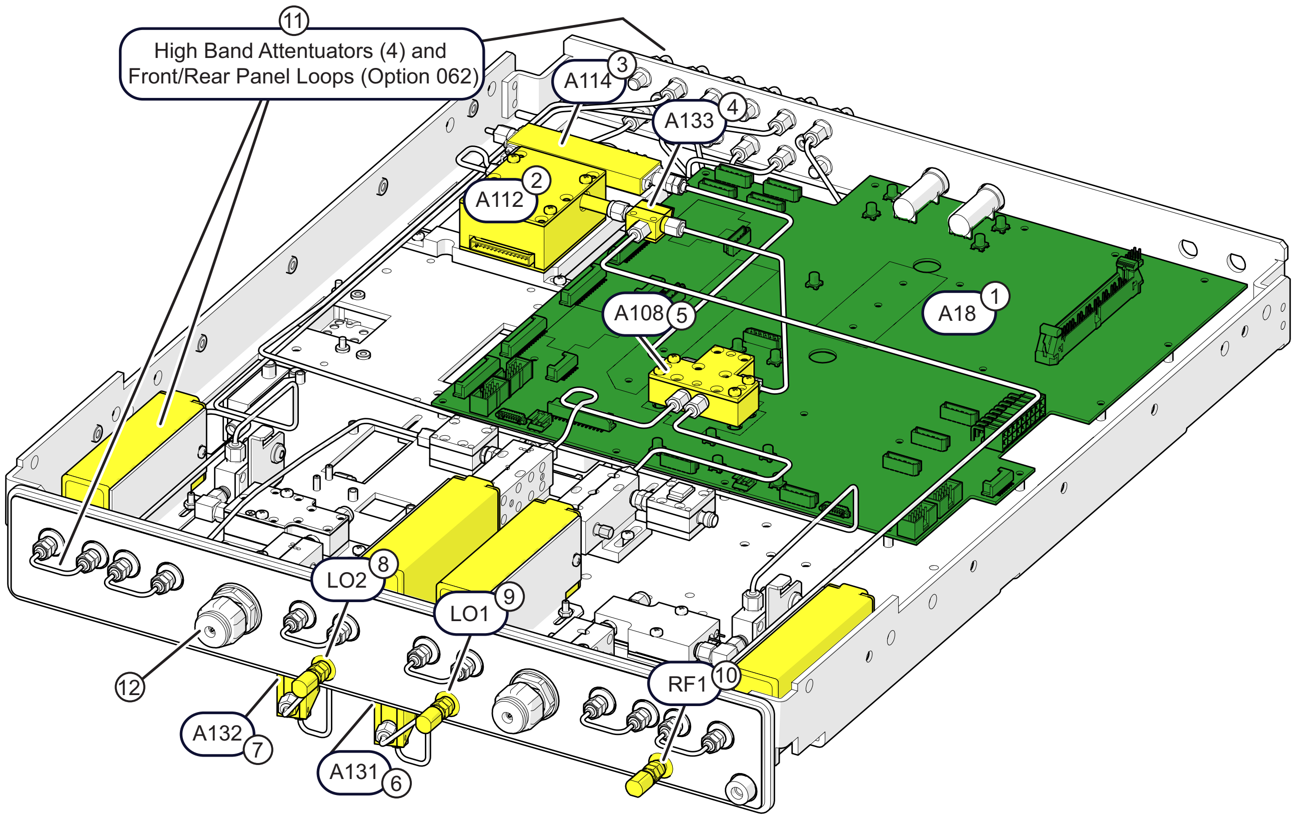
MS4645B or MS4647B – Standard Configuration with Option 80 or 82



1. A18 RF Control PCB Assembly (A18 PCB)	6. A131 LO Coupler Module (reference only)
2. A112 Switched Doubler Module (A112 SDM)	7. A132 LO Coupler Module (reference only)
3. A114 Switched Quadrupler Module (A114 SQM)	8. LO2 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM)	9. LO1 Port for mmWave System
5. A108 V Integrated High Band Transfer Switch (A108 VITS), 70 GHz	10.RF1 Port for mmWave System

Figure 13-15. MS4645B (50 GHz) / MS4647B (70 GHz) – Standard Config.+ Option 80 or 82

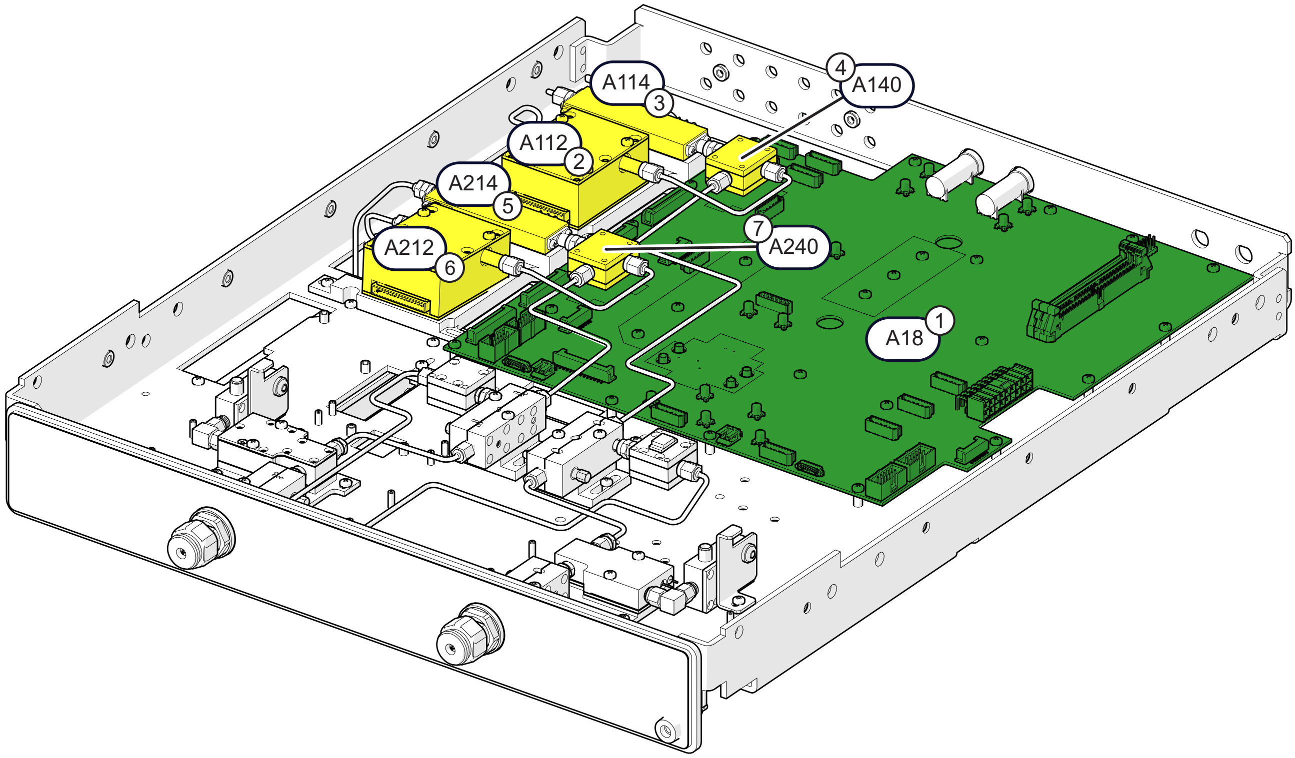
MS4645B or MS4647B – Standard Configuration with Option 81 or 83



1. A18 RF Control PCB Assembly (A18 PCB)	7. A132 LO Coupler Module (reference only)
2. A112 Switched Doubler Module (A112 SDM)	8. LO2 Port for mmWave System
3. A114 Switched Quadrupler Module (A114 SQM)	9. LO1 Port for mmWave System
4. A133 20-40 GHz RF Coupler Module (A133 RCM)	10. RF1 Port for mmWave System
5. A108 V Integrated High Band Transfer Switch (A108 VITS), 70 GHz	11. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – V Connector
6. A131 LO Coupler Module (reference only)	

Figure 13-16. MS4645B (50 GHz) or MS4647B (70 GHz) – Standard Config.+ Option 81 or 83

MS4645B or MS4647B – Option 31 Configuration

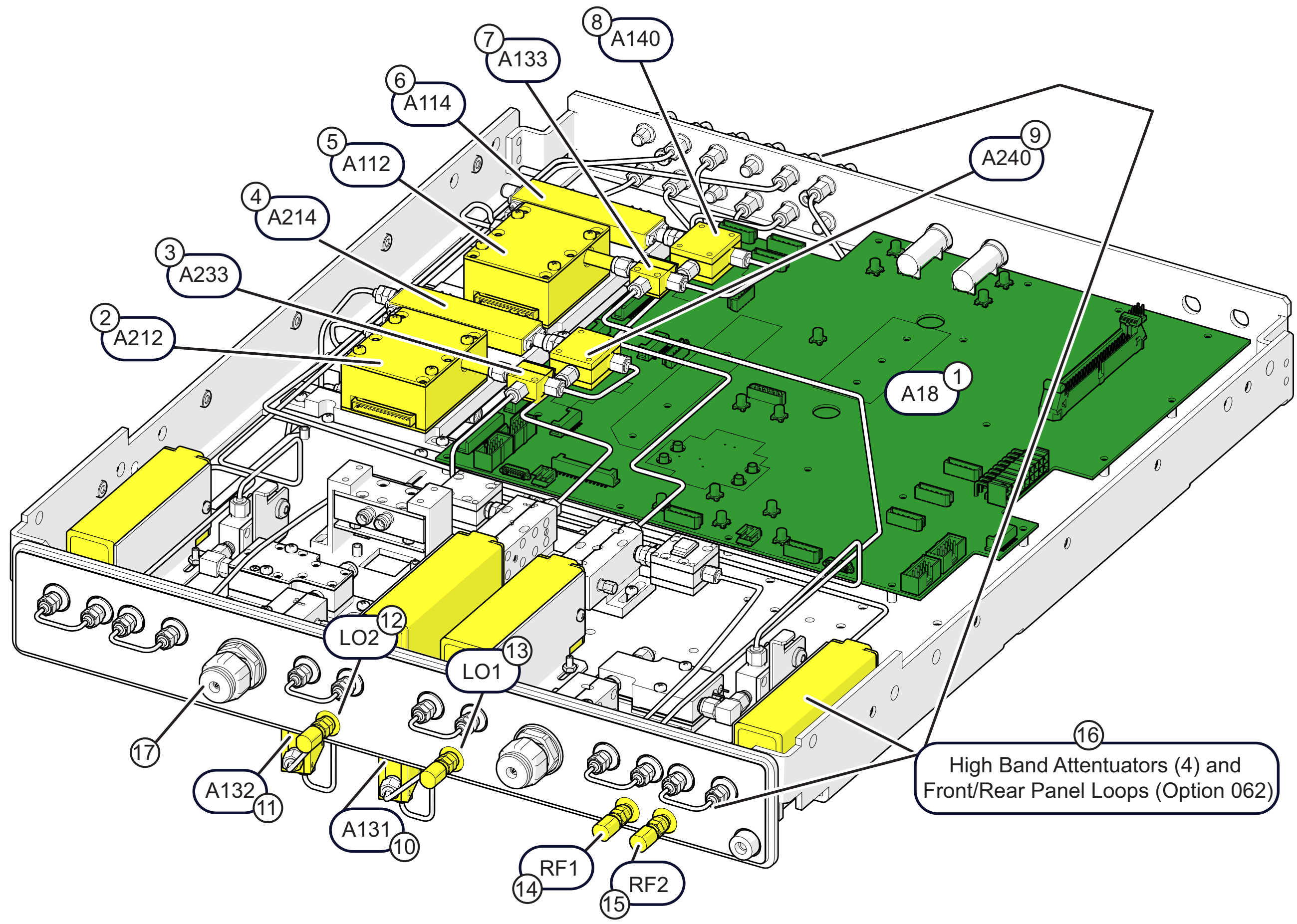


1. A18 RF Control PCB Assembly (A18 PCB)	5. A212 Switched Doubler Module (A212 SDM)
2. A112 Switched Doubler Module (A112 SDM)	6. A214Switched Quadrupler Module (A214 SQM)
3. A114 Switched Quadrupler Module (A114 SQM)	7. A240 Forward Coupler
4. A140 Forward Coupler	

Figure 13-17. MS4645B (50 GHz) / MS4647B (70 GHz) – Option 31 Configuration

MS4645B or MS4647B – Option 31 Configuration with Option 84 or 85

Shown in Figure 13-18 is an MS4645B or MS4647B with Option 85. The same system with Option 84 would have no direct access loops.



1. A18 RF Control PCB Assembly (A18 PCB)	9. A240 Forward Coupler
2. A212 Switched Doubler Module (A212 SDM)	10. A131 LO Coupler Module (reference only)
3. A233 20-40 GHz RF Coupler Module (A233 RCM)	11. A132 LO Coupler Module (reference only)
4. A214 Switched Quadrupler Module (A214 SQM)	12. LO2 Port for mmWave System
5. A112 Switched Doubler Module (A112 SDM)	13. LO1 Port for mmWave System
6. A114 Switched Quadrupler Module (A114 SQM)	14. RF1 Port for mmWave System
7. A133 20-40 GHz RF Coupler Module (A133 RCM)	15. RF2 Port for mmWave System
8. A140 Forward Coupler	16. Option 62 – Front/Rear Panel loops and Four High Band Attenuators A122 – V Connector

Figure 13-18. MS4645B (50 GHz) / MS4647B (70 GHz) – Option 31 Config.+ Option 85

13-3 System Disassembly for RF Deck Component Removal

Caution	Do not perform any RF Deck procedures unless the instrument is turned off and disconnected from AC Power. Damage to RF components may occur if certain inputs/outputs are removed with live RF power.

Refer to Section 8-2 "Preparation of Work Area and Safety Instructions" on page 8-1.

1. Prepare work area, work surface, and observe safety issues.
    - Refer to "Preparation of Work Area and Safety Instructions" on page 8-1
2. Remove Outer Cover.
    - Refer to "Remove Outer Cover" on page 8-3.
3. Position the instrument so that it is right-side up, RF deck down.
4. Remove Inner Top Cover.
    - Refer to "Remove Inner Cover" on page 8-5.
5. The Front Panel can stay in place.
6. Position the instrument so that it is topside down, with the RF Deck facing up.

13-4 A112 or A212 SDM Module Replacement

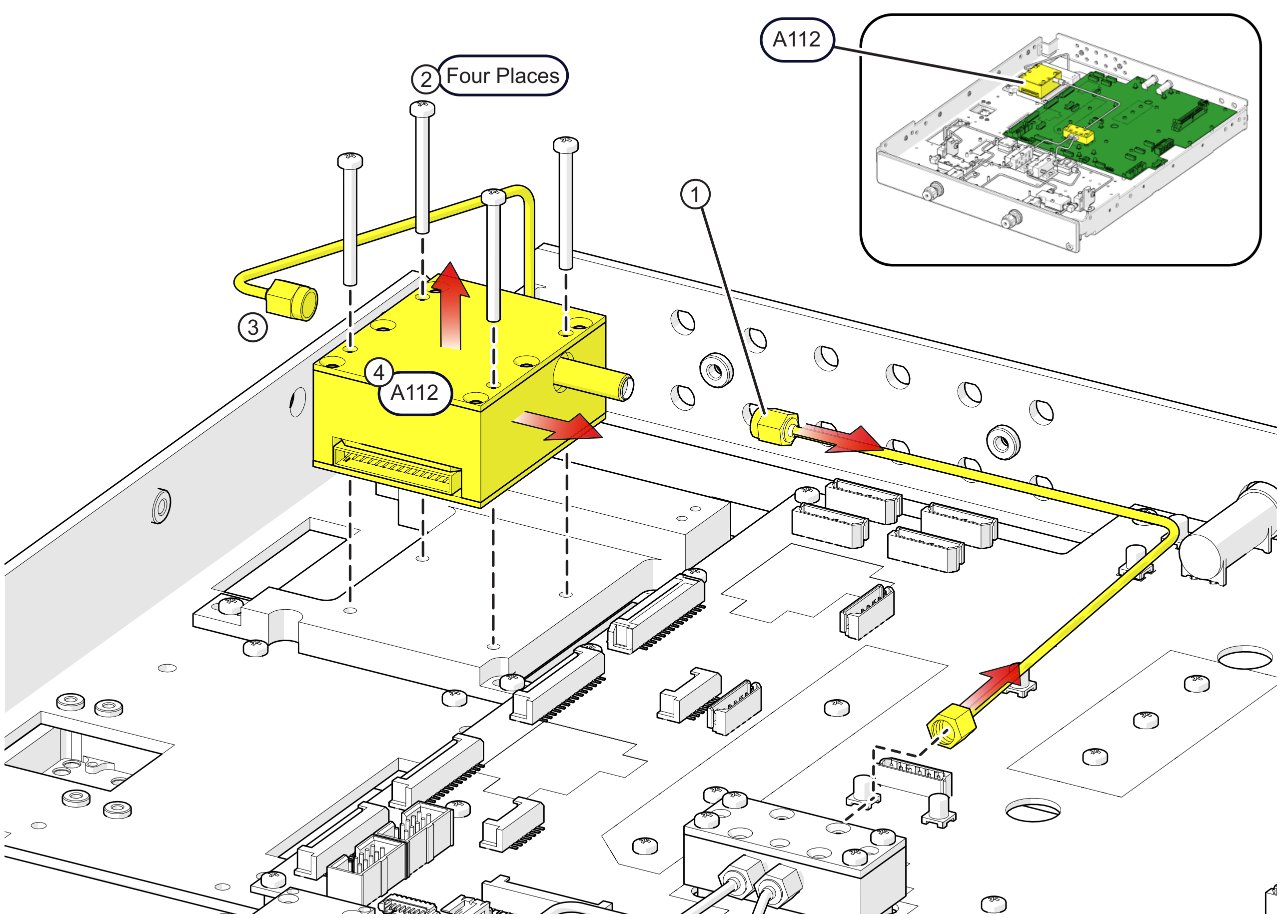
Parts and Applicability

- A112 Switched Doubler Module (A112 SDM)
- A212 Switched Doubler Module (A212 SDM) (Used when Option 31 installed)
- These modules are used in the MS4644B, MS4645B, or MS4647B models.

MS4644B – Standard Configuration with No Options

Use Figure 13-19 with instructions to replace the module.

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – A112 SDM to A108 Switch	3. Semi-rigid Cable – A113 Doubler Module to A112 SDM Loosen at A112 but do not remove.
2. M3 x 30 mm Pan Head Screws (four (4) places)	4. A112 Switched Doubler Module (A112 SDM)

Figure 13-19. A112 Replacement: MS4644B – Standard Configuration with No Options

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

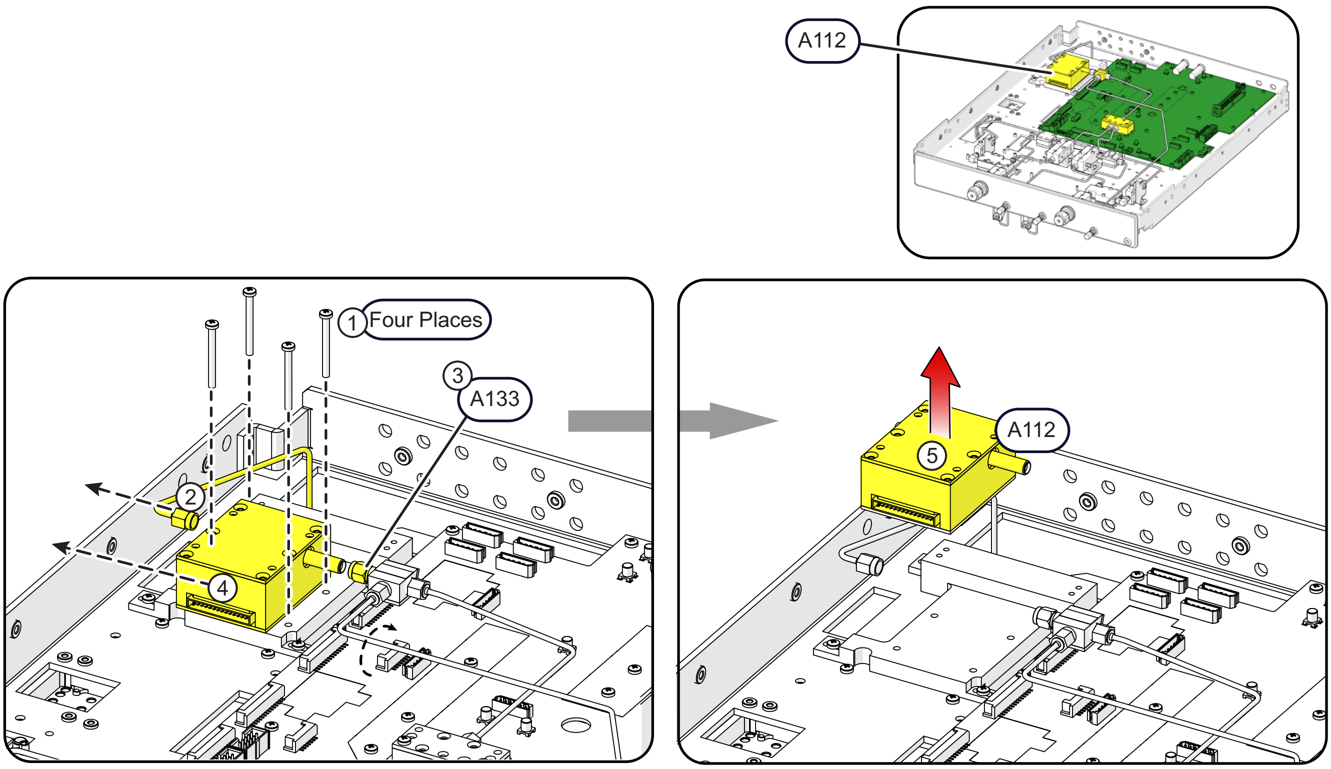
1. Disconnect the semi-rigid cable from A112 J2 and from J1 of A108.
2. Remove the four A112 mounting screws.
3. Loosen the semi-rigid coax nut at A112 J1 input.
4. Disconnect the Power/Signal ribbon cable (not shown) from P4 on PCB A18 and then remove A112.
5. Transfer the control cable to the new module.
6. Installation is reverse of removal.
7. Torque all semi-rigid connections to 8 lbf · in.

MS4644B – Standard Configuration – with Option 82 or 83

See Figure 13-20 for parts ID and use with instructions to replace the module.

Replacement Part: A112 Switched Doubler Module (A112 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. M3 x 30 mm Pan Head Screws (four (4) places)	3. A133 20-40 GHz RF Coupler Module (A133 RCM)
2. Semi-rigid Cable – A113 Doubler Module to A112 SDM Loosen at A112, but do not remove.	4. A112 Switched Doubler Module (A112 SDM)

Figure 13-20. A112 Replacement: MS4644B – Std. or Option 31 Config.+ Option 82, 83, 84, or 85

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

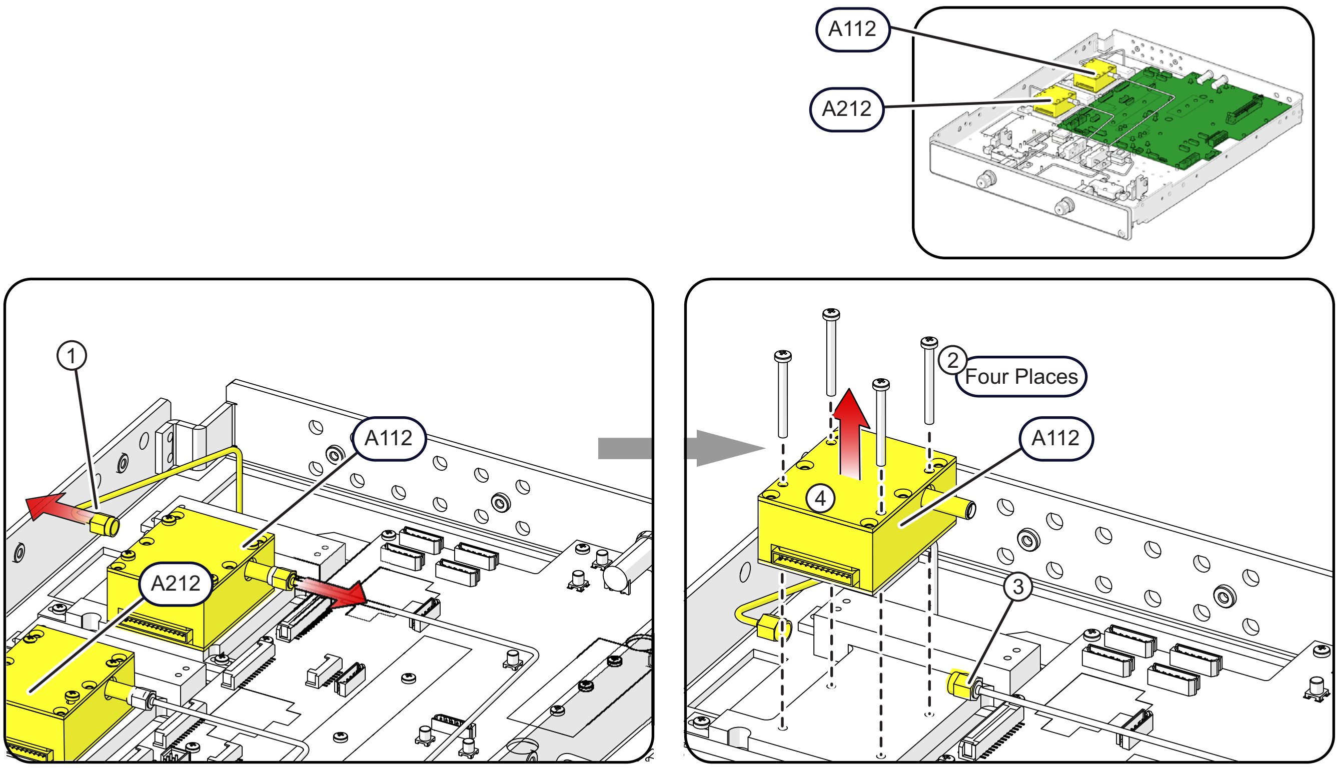
1. Remove the four A112 mounting screws.
2. Disconnect the semi-rigid coax nut from A112 J1 input and carefully move the cable to the left.
3. Disconnect semi-rigid coax nut at A133.
4. Disconnect the Power/Signal ribbon cable (not shown) from P4 on PCB A18.
5. Slide A112 to the left, away from A133 and lift it out of deck.
6. Transfer the control cable to the new A112 module.
7. Installation is reverse of removal.
8. Torque all semi-rigid connections to 8 lbf · in.

MS4644B – Option 31 Configuration

See Figure 13-21 for parts ID and instructions to replace the module.

Replacement Part: A112 or A212 Switched Doubler Module (A112 or A212 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – A113 Doubler Module to A112 SDM	3. Semi-rigid Cable – A112 SDM to A105
2. M3 x 30 mm Pan Head Screws (four (4) places)	4. A112 (or A212) Switched Doubler Module (A112 or A212 SDM)

Figure 13-21. A112 Replacement: MS4644B – Option 31 Configuration

Replacement Steps (Applies to A112 or A212)

The following steps match the index numbers in the illustration where applicable.

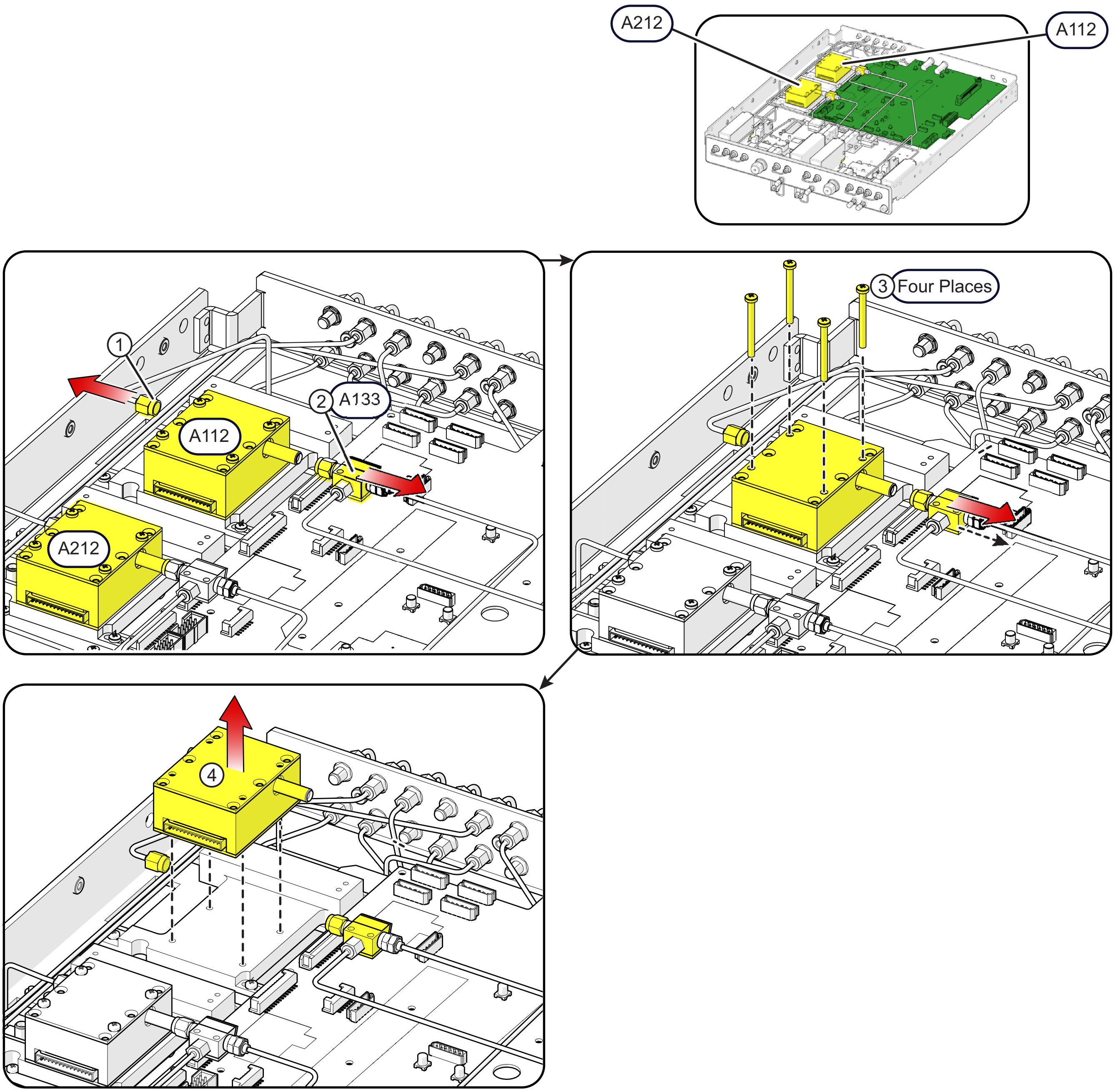
1. Disconnect the semi-rigid coax nut at J1 of A112 (or A212) and gently move it far enough to clear the RF input connector.
2. Remove the four mounting screws.
3. Disconnect semi-rigid coax nut at J2 on A112 (or A212) and move the cable to the right.
4. Lift A112 (or A212) out of the deck.
5. Disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18. If removing A212, disconnect ribbon cable from P9 on A18.
6. Transfer the control cable to the new A112 (or A212) module.
7. Installation is reverse of removal.
8. Torque all semi-rigid connections to 8 lbf · in.

MS4644B – Option 31 Configuration – With Option 84 or 85

See Figure 13-22 for parts ID and instructions to replace the module.

Replacement Part: A112 or A212 Switched Doubler Module (A112 or A212 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – A113 Doubler Module to A112 SDM (or from A213 Doubler to A212 SDM)
2. A133 20-40 GHz RF Coupler Module
3. M3 x 30 mm Pan Head Screws (four (4) places)
4. A112 (or A212) Switched Doubler Module

Figure 13-22. A112 or A212 Replacement: MS4644B – Option 31 Config.+ Option 84 or 85

Replacement Steps (Applies to A112 or A212)

The following steps match the index numbers in the illustration where applicable.

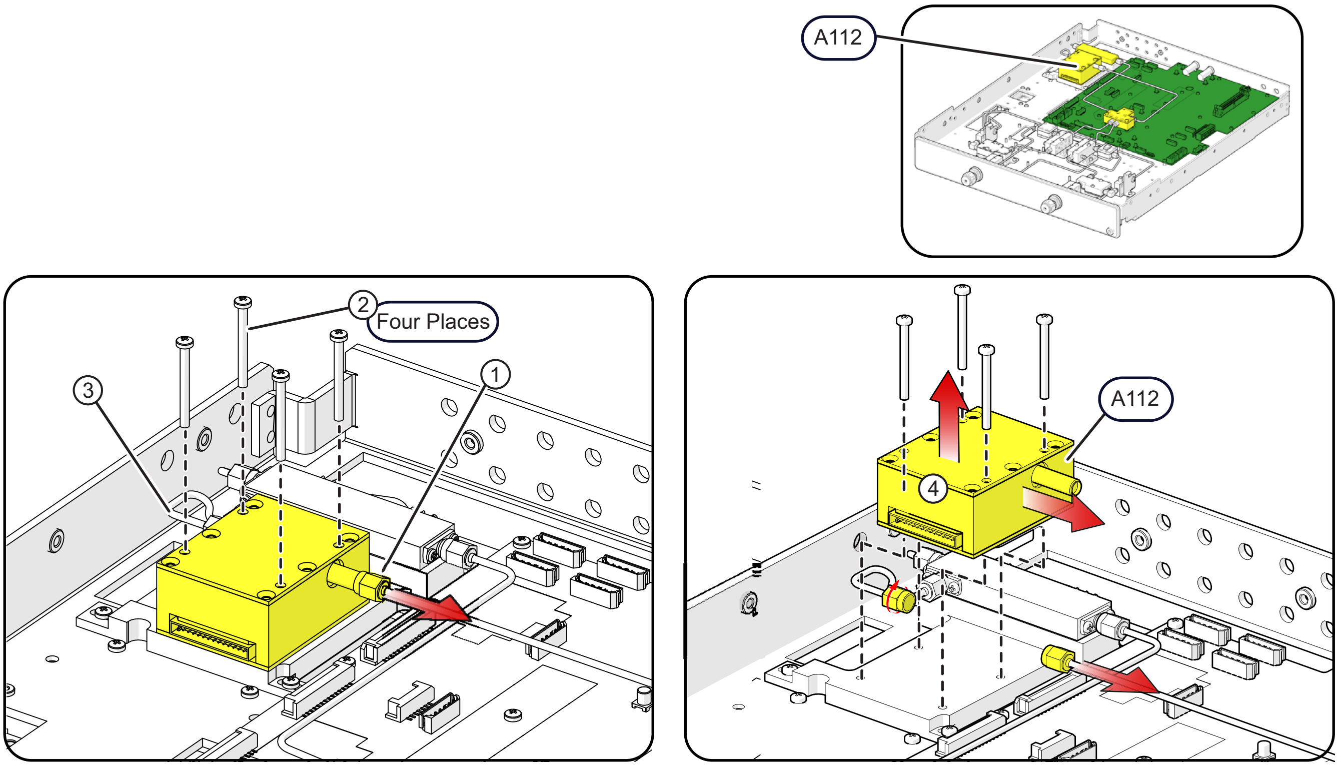
1. Disconnect the semi-rigid cable at J1 of A112 (or A212) and move it slightly to the left to clear the connector.
2. Disconnect the semi-rigid cable at J2 on A112 (or A212) and move A133 (or A233) assembly slightly to the right.
3. Remove the four mounting screws.
4. Lift A112 (or A212) out of the deck.
5. Disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18. If removing A212, disconnect ribbon cable from P9.
6. Transfer the control cable to the new A112 (or A212) module.
7. Installation is reverse of removal.
8. Torque semi-rigid connections to 8 lbf · in.

MS4645B / MS4647B – Standard Configuration

See Figure 13-23 for parts ID and instructions to replace the module.

Replacement Part: A112 Switched Doubler Module (A112 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – A113 Doubler Module to A105	3. Semi-rigid Cable – A112 SDM to A114 Switched Quadrupler Module
2. M3 x 30 mm Pan Head Screws (four (4) places)	4. A112 Switched Doubler Module (A112 SDM)

Figure 13-23. A112 Replacement: MS4645B / MS4647B – Standard Configuration

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

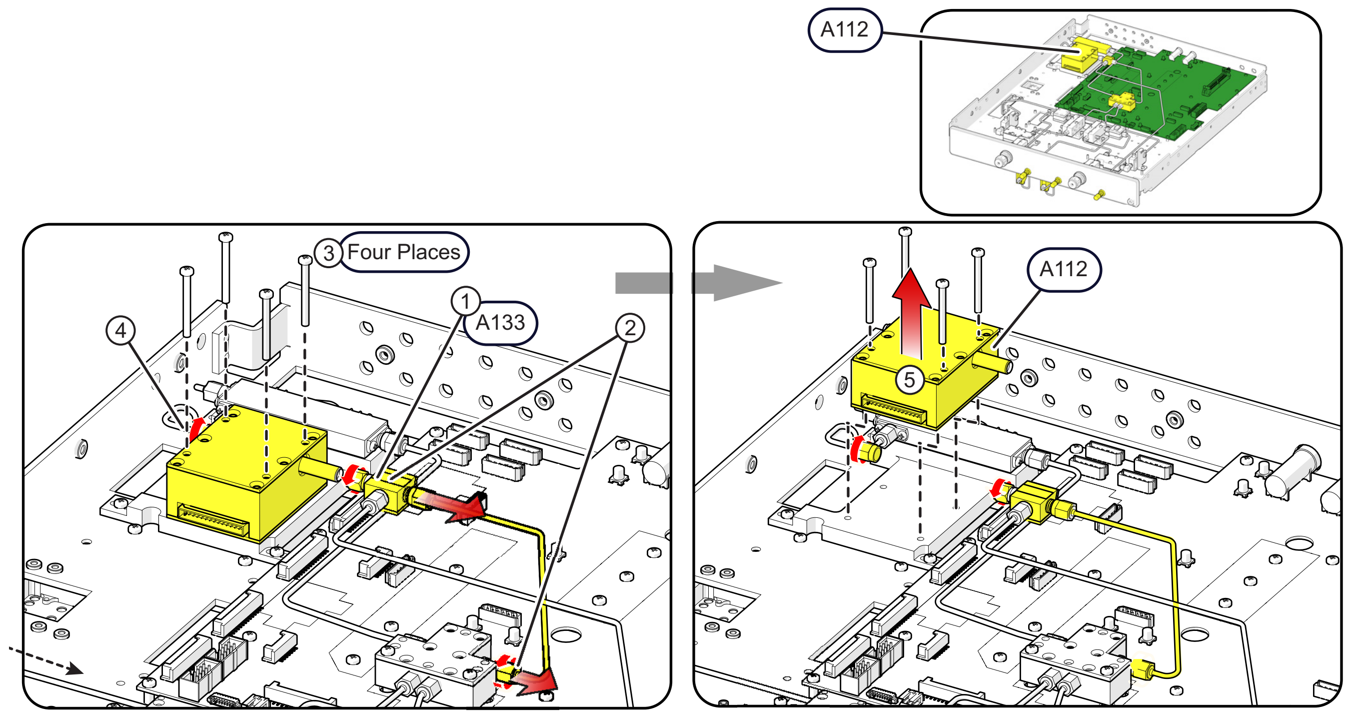
1. Disconnect the semi-rigid coax nut from J2 on A112, and gently move the cable to the right.
2. Remove the four mounting screws.
3. Loosen the semi-rigid coax nut at J1 on A112. Do not move the cable.
4. While sliding A112 to the right, finish disconnecting the semi-rigid coax nut from J1 on A112.
5. While lifting A112 out of the deck, disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18.
6. Transfer the ribbon cable from A112 to the new module.
7. Installation is reverse of removal.
8. Torque semi-rigid connections to 8 lbf · in.

MS4645B / MS4647B – Standard Configuration with Option 80, 81, 82, or 83

See Figure 13-24 for parts ID and instructions to replace the module.

Replacement Part: A112 Switched Doubler Module (A112 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. A133 J1 Coaxial Nut	4. Semi-rigid Cable – A112 J1 SDM to A114 Switched Quadrupler Module
2. A133 Semi-rigid Cable – J2 output to A108	5. A112 Switched Doubler Module (A112 SDM)
3. M3 x 30 mm Pan Head Screws (four (4) places)	

Figure 13-24. A112 Replacement: MS4645B / MS4647B – Std Config.+ Option 80, 81, 82, 83

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

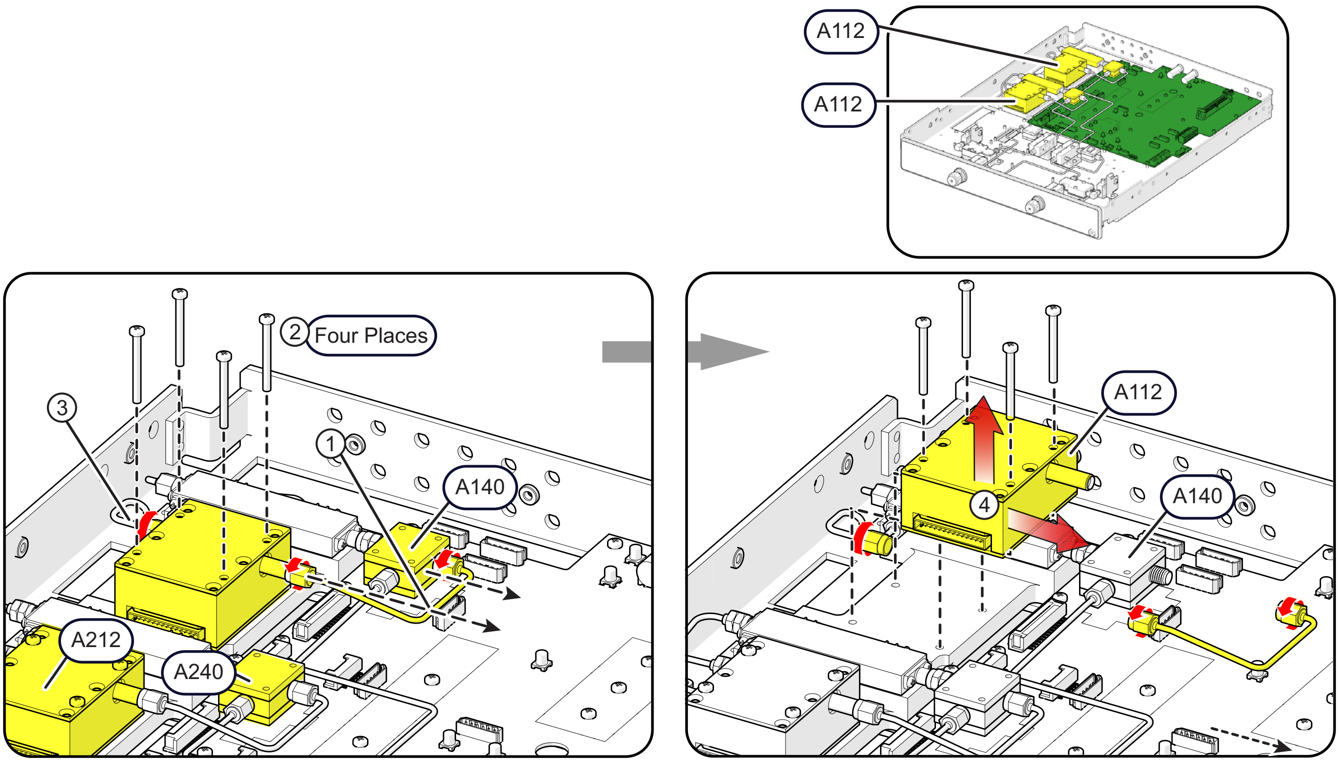
1. At A133, disconnect the semi-rigid coax nut from J2 at A112.
2. Disconnect the semi-rigid cable from A108 (leave the other end attached to A133 J2), then move A133 and the cable to the right.
3. Remove the four A112 mounting screws.
4. Loosen the semi-rigid coax nut at J1 on A112. Do not move the cable.
5. While sliding A112 to the right, finish disconnecting the semi-rigid coax nut from J1 on A112.
6. While lifting A112 out of the deck, disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18.
7. Transfer the ribbon cable from A112 to the new module.
8. Installation is reverse of removal.
9. Torque semi-rigid connections to 8 lbf · in.

MS4645B / MS4647B – Option 31 Configuration

See Figure 13-25 for parts ID and instructions to replace the module.

Replacement Part: A112 or A212 Switched Doubler Module (A112 SDM or A212 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – From J2; A112 SDM to J2; A140	3. Semi-rigid Cable – J1; A112 SDM to J2; A114 SQM
2. M3 x 30 mm Pan Head Screws (four (4) places)	4. A112 Switched Doubler Module (A112 SDM)

Figure 13-25. A112 Replacement: MS4645B / MS4647B – Option 31 Config.+ No Other Options

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

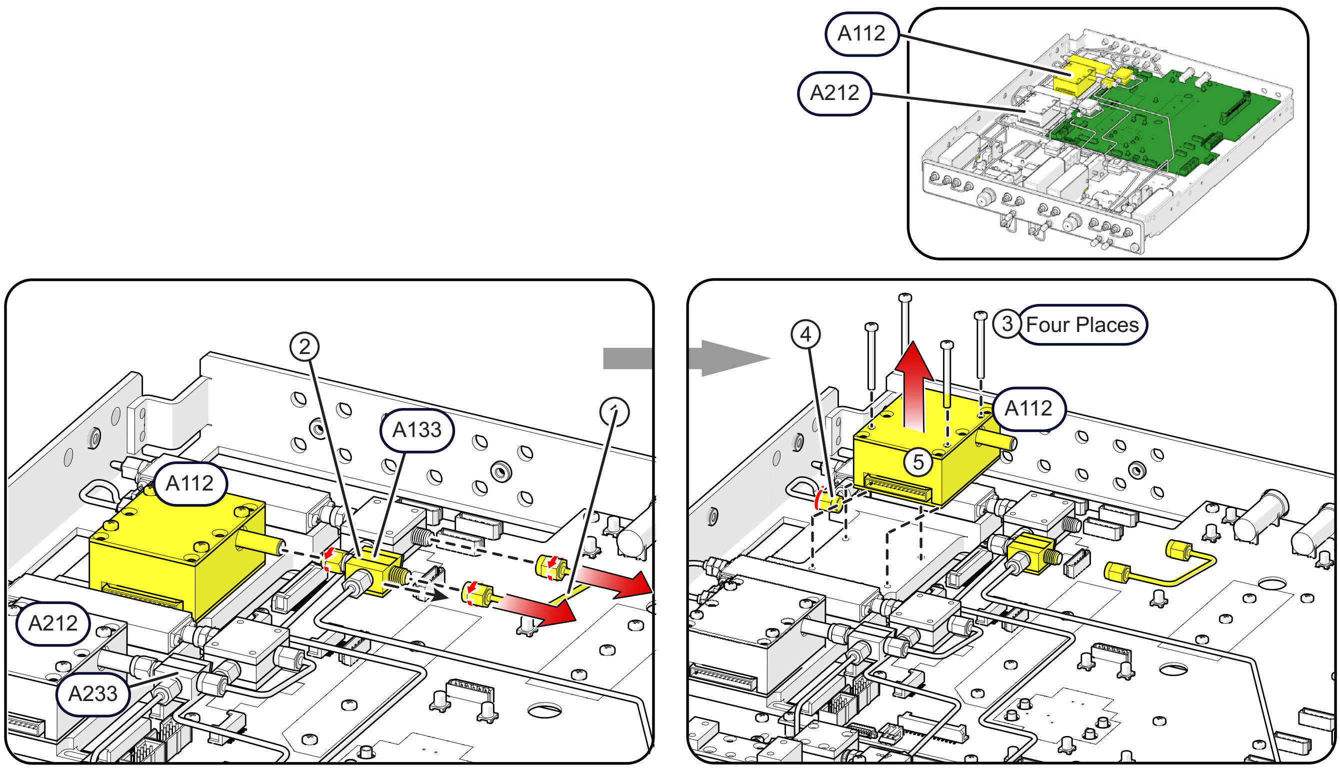
1. Remove the semi-rigid cable from A112 J2 and A140 J2 (or A212 J2 and A240 J2).
2. Remove the four mounting screws.
3. Loosen the semi-rigid coax nut at J1 on A112 (or J1 at A212). Do not move the cable.
4. While sliding A112 (or A212) to the right, finish disconnecting the semi-rigid coax nut from J1.
5. While lifting A112 out of the deck, disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18. If removing A212, disconnect the Power/Signal ribbon cable from P9 on PCB A18.
6. Transfer the ribbon cable from A112 (or A212) to the new module.
7. Installation is reverse of removal.
8. Torque all semi-rigid connections to 8 lbf · in.

MS4645B / MS4647B – Option 31 Configuration with Option 84 or 85

See Figure 13-26 for parts ID and instructions to replace the module.

Replacement Part: A112 or A212 Switched Doubler Module (A112 SDM or A212 SDM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid Cable – From J2; A133 RCM to J2; A140
2. A133 Coupler
3. M3 x 30 mm Pan Head Screws (four (4) places)
4. Semi-rigid Cable – J1; A112 SDM to J2; A114 SQM
5. A112 Switched Doubler Module (A112 SDM)

Figure 13-26. A112 Replacement: MS4645B / MS4647B – Option 31 Config.+ Option 84 or 85

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Remove the semi-rigid cable from A133 J2 and A140 J2 (or A233 J2 and A240 J2)
2. Disconnect A133 from A112 J2 (or A233 from A212 J2)
3. Remove the four A112 (or A212) mounting screws.
4. Loosen the semi-rigid coax nut on J1 at A112 (or J1 at A212).
5. While sliding A112 (orA212) to the right, finish disconnecting the coax nut from J1 on A112 (or A212).
6. While lifting A112 out of the deck, disconnect the A112 Power/Signal ribbon cable (not shown) from P4 on PCB A18. If removing A212, disconnect the A112 Power/Signal ribbon cable from P9 on PCB A18.
7. Transfer the ribbon cable from A112 (or A212) to the new module.
8. Installation is reverse of removal.
9. Torque semi-rigid connections to 8 lbf · in.

13-5 A114 or A214 SQM Module Replacement

Parts and Applicability

- A114 Switched Quadrupler Module (A114 SQM)
- A214 Switched Quadrupler Module (A214 SQM) (Used with Option 31)
- These modules are used in the MS4645B or MS4647B models.

MS4645B / MS4647B – Option 31 Configuration

See Figure 13-27 for parts ID and instructions to replace the module. This procedure is applicable to both A114 and A214.

Replacement Part: A114 or A214 Switched Quadrupler Module (A114 SQM or A214 SQM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

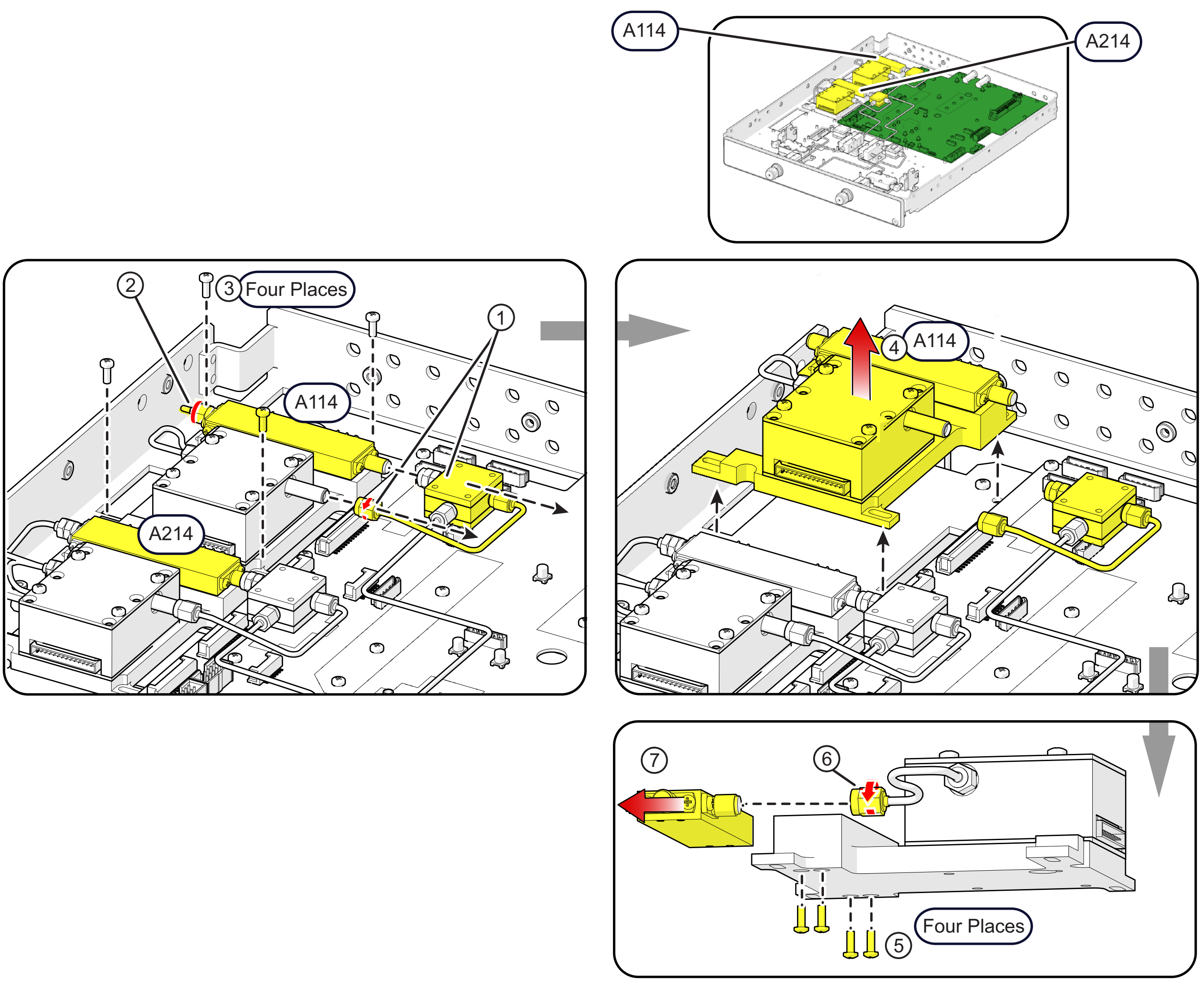


Figure 13-27. A114 or A214 Replacement: MS4645B / MS4647B – Option 31 Config. (1 of 2)

1. A140 and Semi-rigid Cable	4. A114 Switched Quadrupler Module (A114 SQM)
2. Semi-rigid Cable – J2; A113 Doubler Module to J1; A114 SQM	5. 0.86-56 x 0.25 x 0.25 Pan Head Screws (four (4) places)
3. M3 x 8 mm Pan Head Screws (four (4) places)	6. Semi-rigid Cable – J2; A114 SQM to J1; A112 SDM

Figure 13-27. A114 or A214 Replacement: MS4645B / MS4647B – Option 31 Config. (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable. This procedure applies to A214 as well.

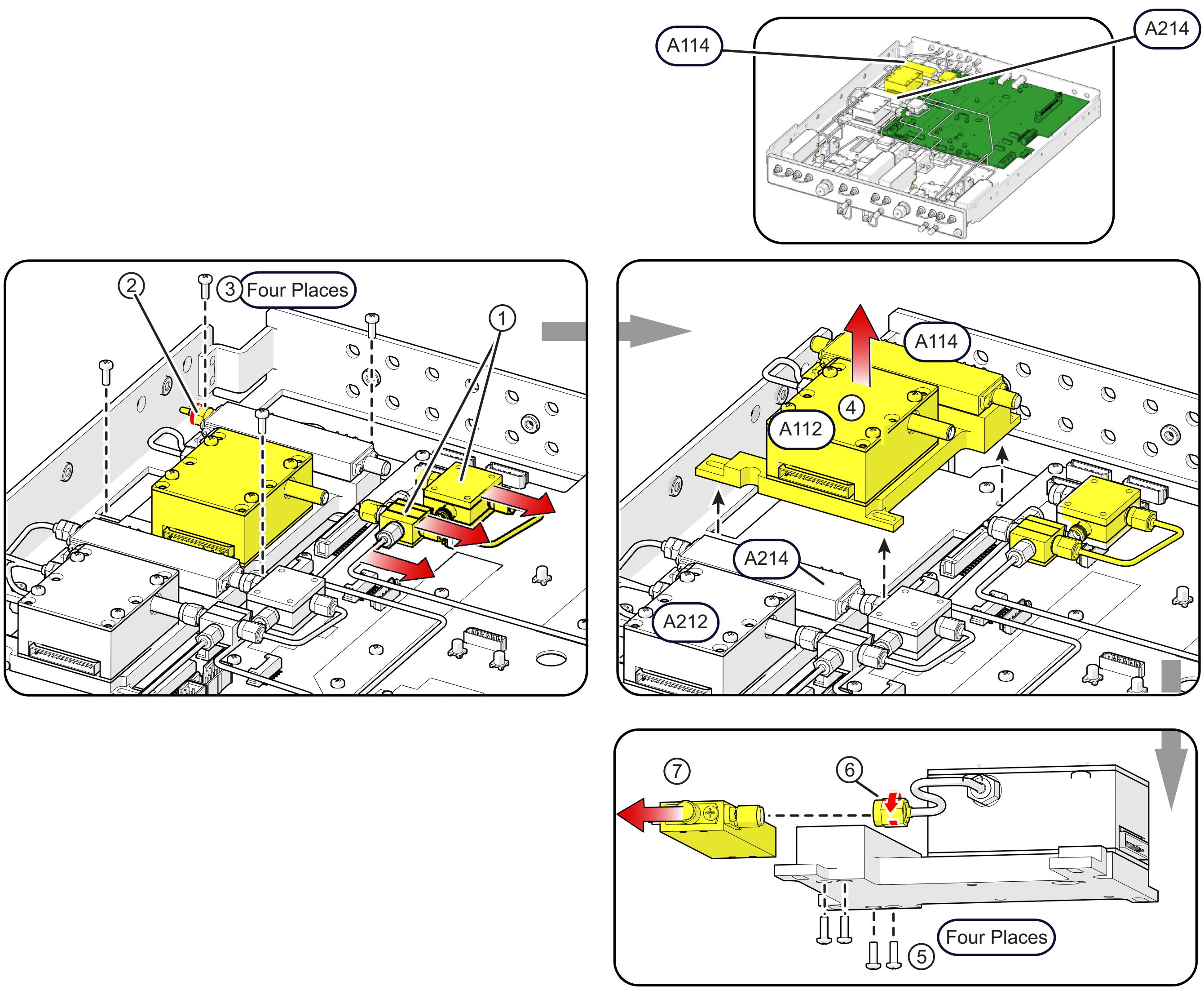
1. Disconnect the semi-rigid cable from J2 of A112 and A140 from J3 of A114 (or J2 of A212 and A240 from J3 of A214). Move them out of the way to the right.
2. Disconnect the semi-rigid Cable from J1 of A114 SQM (or J1 of A214 SQM) and gently move it to the left
3. Remove the four mounting plate screws.
4. While lifting the assembly from the deck, disconnect the A112 Power/Signal ribbon cable from P4 on PCB A18, and the A114 cable from J17 on PCB A18 (not shown). If removing A214, disconnect the A212 Power/Signal ribbon cable from P9 on PCB A18, and the A214 cable from J27 on PCB A18.
5. Remove the four mounting screws that secure A114 (or A214) to the mounting plate.
6. Disconnect the semi-rigid cable from J2 of A214 to release the module.
7. Remove A114 (or A214) and install the new SQM. The replacement SQM comes with a new cable attached.
8. Reassembly is reverse of removal.
9. Torque the semi-rigid cable connections to 8 lbf · in.

MS4645B / MS4647B – Option 31 Configuration with Option 84 or 85

See Figure 13-28 for parts ID and instructions to replace the module. This procedure is applicable to both A114 or A214.

Replacement Part: A114 or A214 Switched Quadrupler Module (A114 SQM or A214 SQM)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. A140 and A133	4. A114 Switched Quadrupler Module (A114 SQM)
2. Semi-rigid Cable – J2; A113 SDM to J1; A114 SQM	5. 0.86-56 x 0.25 x 0.25 Pan Head Screws (four (4) places)
3. M3 x 8 mm Pan Head Screws (four (4) places)	6. Semi-rigid Cable – J2; A114 SQM to J1; A112 SDM

Figure 13-28. A114 Replacement: MS4645B / MS4647B – Option 31 Config.+ Option 84 or 85

Replacement Steps

The following steps match the index numbers in the illustration where applicable. This procedure applies to A214 as well.

1. Disconnect A133 from J2 of A112 and A140 from J3 of A114 (or A233 from J2 of A212 and A240 from J3 of A214.). Move them a short distance to the right.
2. Disconnect the semi-rigid cable from J1 of A114 SQM (or J1 of A214 SQM) and move it to the left.
3. Remove the four mounting plate screws.
4. While lifting the assembly from the deck, disconnect the A112 Power/Signal ribbon cable from P4 on PCB A18, and the A114 cable from J17 on PCB A18. If removing A214, disconnect the A212 Power/Signal ribbon cable from P9 on PCB A18, and the A214 cable from J27 on PCB A18.
5. Remove the four screws that secure A114 (or A214) to the mounting plate.
6. Disconnect the semi-rigid cable from J2 of A114 (or J2 of A114) to release the module.
7. Remove the SQM and install the new SQM. The replacement SQM comes with a new cable attached.
8. Reassembly is reverse of removal.
9. Torque the semi-rigid cable connections to 8 lbf · in.

13-6 A108 HBTS/VITS Module Replacement

Note	Although the HBTS and the VITS share the same A108 Engineering Reference Number, the two modules are different components. The HBTS (**A108 High Band Transfer Switch**) is only used with model MS4642B and MS4644B VNAs. The VITS (**A108 V Integrated High Band Transfer Switch**) is only used with model MS4645B and MS4647B VNAs. In the procedures below: A108 HBTS refers to the ND70092 or 3-ND70092 component. A108 VITS refers to the ND70093 or 3-ND70093 component. A108 HBTS/VITS refers to either component.

Caution	Do not perform any RF Deck procedures unless the instrument is turned off and disconnected from AC Power. Damage to RF components may occur if certain inputs/outputs are removed with live RF power. To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

Critical Removal Concepts

Both the A108 HBTS and the A108 VITS have connector pins that mate with sockets on the A18 RF Control PCB Assembly. Removing the A108 module requires that it be lifted straight up from the A18 RF Control PCB as shown in Figure 13-29.

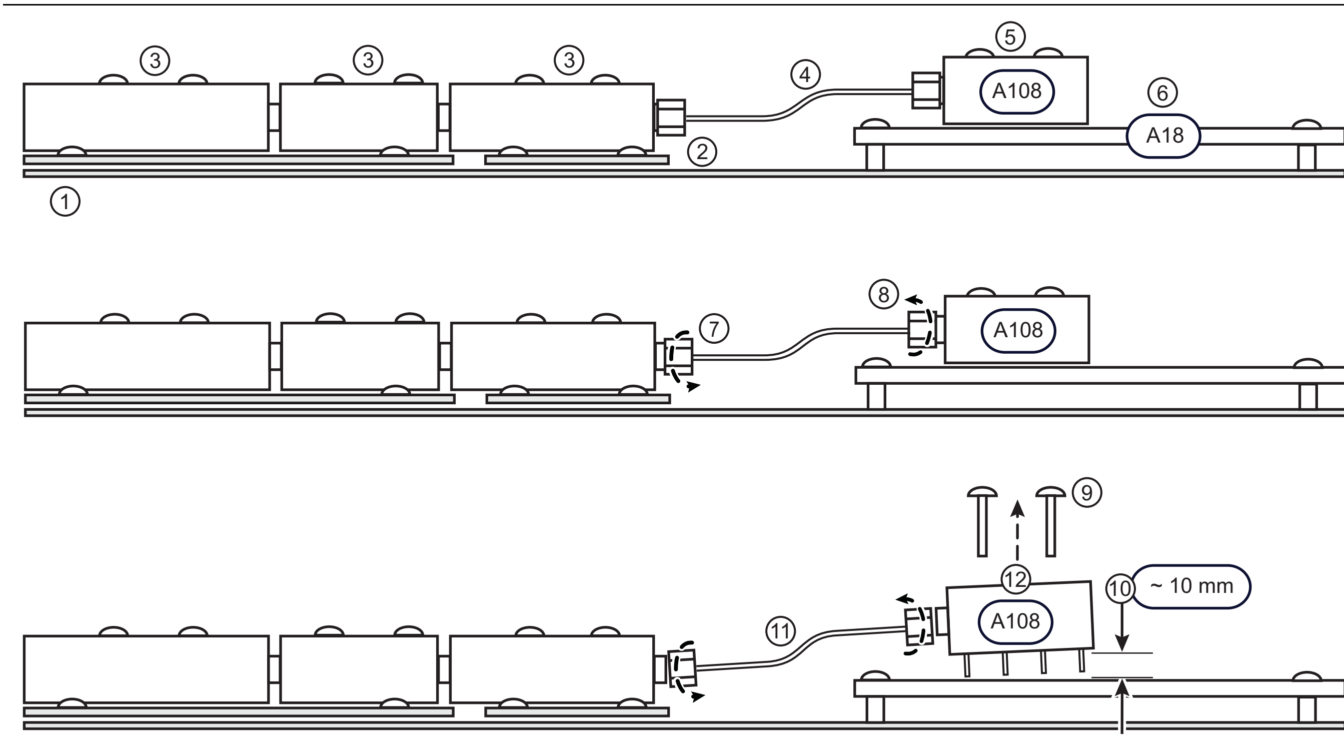


Figure 13-29. General Removal Procedure: A108 HBTS/VITS (1 of 2)

Parts ID	A108 Replacement Steps
1. RF Deck chassis. 2. Mounting plates, under some port components, fastened to the RF Deck Chassis. 3. Mounting screws holding the port components to the mounting plates. 4. Semi-rigid coaxial cable between the final port module component and the A108 HBTS/VITS. There are two cables between the A108 and the central port groups. 5. A108 High Band Transfer Switch (HBTS) or A108 V Integrated High Band Transfer Switch (VITS). On the bottom side of the module, pins connect to sockets in the A18 PCB. The module is fastened to the A18 PCB with four (4) mounting screws. 6. A18 RF Control PCB Assembly	7. Loosen the two connectors holding the semi-rigid coaxial cables to the port group modules. 8. Loosen the two connectors holding the semi-rigid coaxial cables to the A108 HBTS/VITS output ports. 9. Remove the four (4) mounting screws holding the A108 HBTS/VITS to the A18 PCB. 10. Pull the A108 HBTS/VITS straight up about 10 mm (~3/8") until the pins clear the A18 PCB sockets. 11. Finish disconnecting the two coaxial cables from the port modules and the output ports of A108 and set the cables aside. 12. Remove the A108 HBTS/VITS module. 13. Reassembly is reverse of removal. 14. Torque the semi-rigid cable connections to 8 lbf· in.

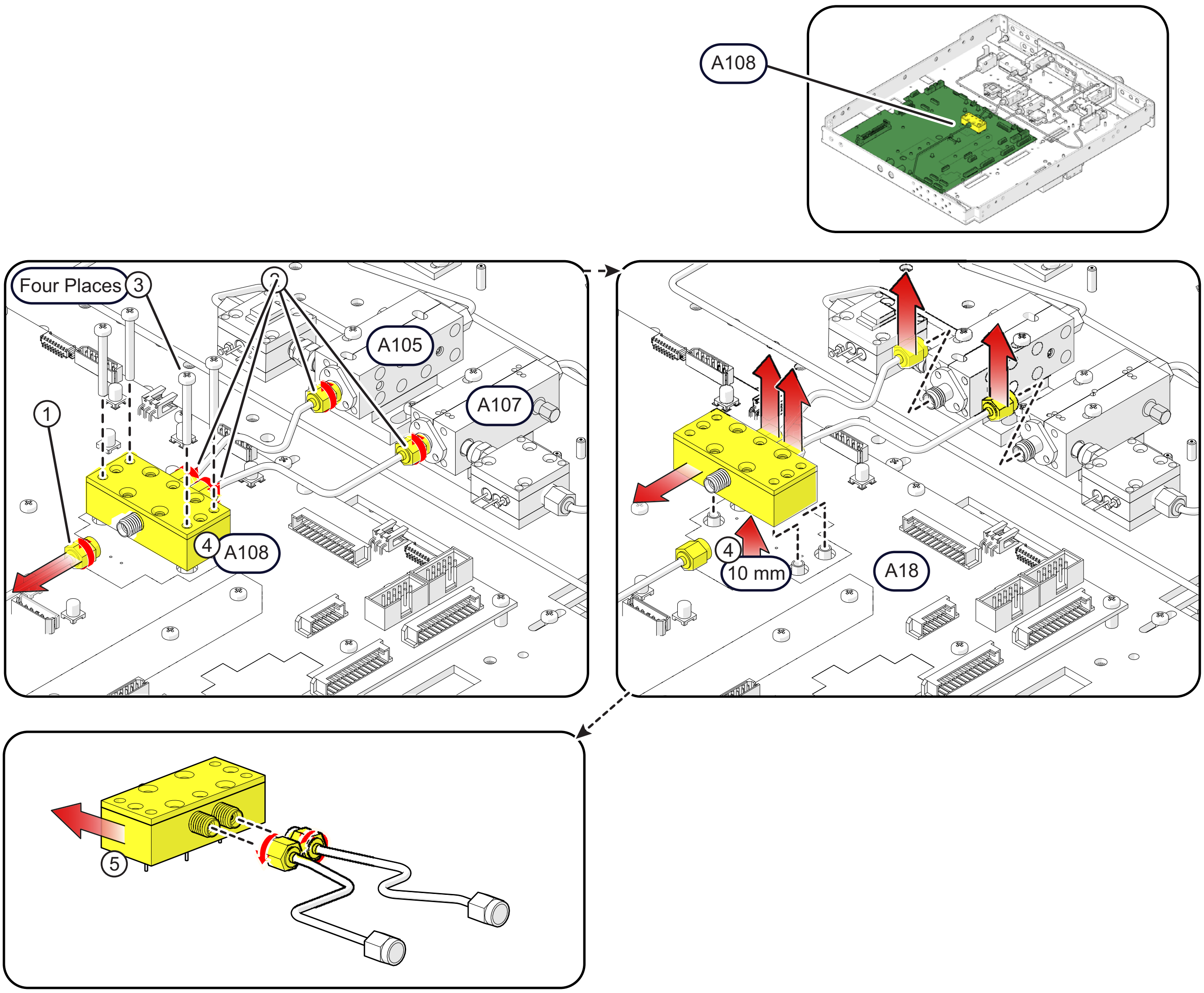
Figure 13-29. General Removal Procedure: A108 HBTS/VITS (2 of 2)

A108 HBTS – MS4642B or MS4644B with No Options

See Figure 13-30 for parts ID and instructions to replace the A108 module.

Replacement Part: A108 HBTS (High Band Transfer Switch)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Two semi-rigid cables between A108 switch output ports and A107 and A105 Reference Module input ports. 2. Semi-rigid cable from J2 of A113 to J1 of A108 (MS4642B) or Semi-rigid cable from J2 of A112 to J1 of A108 (MS4644B)	3. **S**M3 x 25 mm Pan Head Screws (four (4) places) 4. A108 HBTS (High Band Transfer Switch)

Figure 13-30. A108 HBTS Replacement: MS4642B / MS4644B – Std Config./ No Options

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J1of A108 and gently move it to the left.
2. Loosen (but do not remove) the four (4) semi-rigid cable connections between A108 output ports and the A107 and A105 Reference Module input ports.
3. Remove the four (4) screws from A108.
4. Referring to Figure 13-29 on page 13-36, gently lift A108 straight up about 10 mm (~3/8 in) until the A108 pins are free from their sockets.
5. Finish removing the four connectors holding the two semi-rigid coaxial cables in place. Set the two cables aside.
6. Reassembly with the replacement A108 module is reverse of removal.
7. Torque the semi-rigid cable connections to 8 lbf · in.

A108 HBTS – MS4642B with Option 82 or 83

See Figure 13-31 for parts ID and instructions to replace the A108 module.

Replacement Part: A108 HBTS (High Band Transfer Switch)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

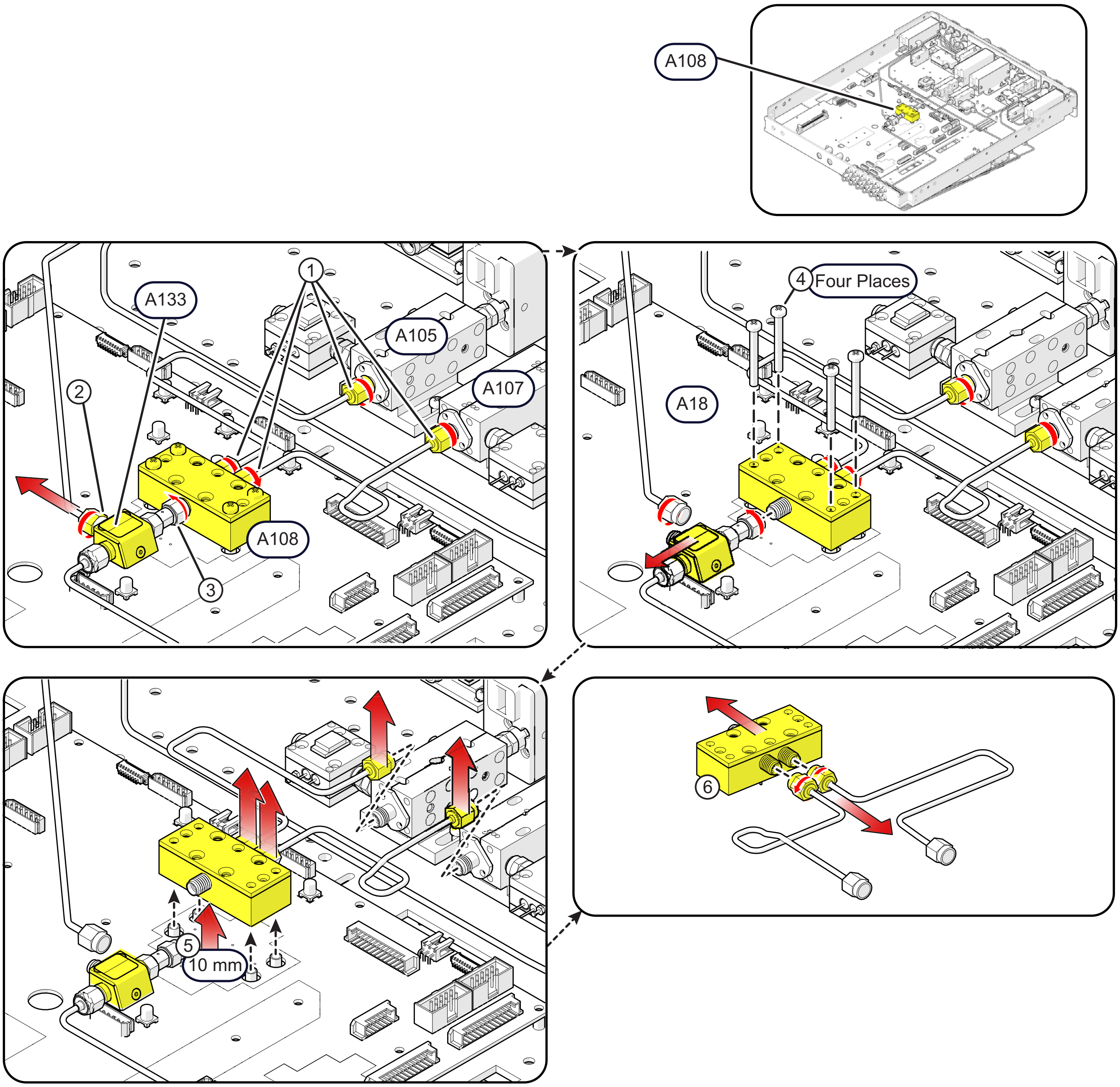


Figure 13-31. A108 HBTS Replacement: MS4642B – Std Config.+ Option 82 or 83 (1 of 2)

1. Two semi-rigid cables between A108 switch output ports and A107 and A105 Reference Module input ports. 2. Semi-rigid cable from J3 of A133 RF coupler to the front panel. (Option 82 or 83)	3. Coax coupler between A133 – J2 and A108 J1 4. M3 x 25 mm Pan Head Screws (four (4) places) 5. A108 HBTS (High Band Transfer Switch)

Figure 13-31. A108 HBTS Replacement: MS4642B – Std Config.+ Option 82 or 83 (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

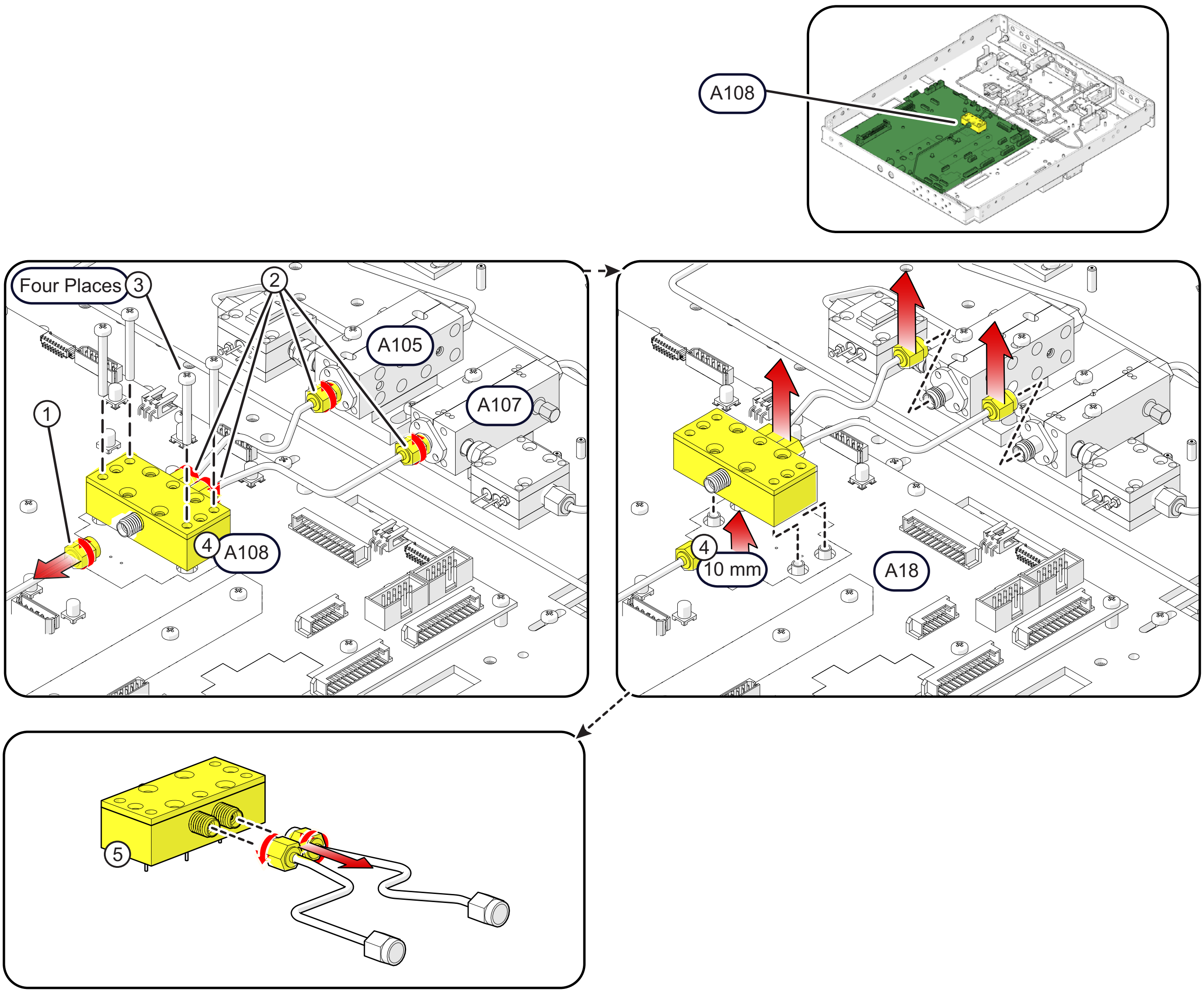
1. Loosen (but do not remove) the four (4) semi-rigid cable connections between A108 output ports and the A107 and A105 Reference Module input ports.
2. Disconnect the semi-rigid cable from J3 of A133 Coupler and move it to the left.
3. Disconnect the coax coupler from input port J1 of A108 and move A133 and its input cable away from switch.
4. Remove the four (4) screws from A108.
5. Referring to Figure 13-29 on page 13-36, gently lift A108 straight up about 10 mm (~3/8 in) until the A108 pins are free from their sockets.
6. Finish removing the four connectors that hold the two semi-rigid coaxial cables in place. Set the two cables aside.
7. Reassembly with the new A108 module is the reverse of removal.
8. Torque the semi-rigid cable connections to 8 lbf · in.

A108 HBTS – MS4644B with Option 82 or 83

See Figure 13-32 for parts ID and instructions to replace the A108 module.

Replacement Part: A108 HBTS (High Band Transfer Switch)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Two semi-rigid cables between A108 switch output ports and A107 and A105 Reference Module input ports.	3. M3 x 25 mm Pan Head Screws (four (4) places)
2. Semi-rigid cable from J2 of A133 to J1 of A108	4. A108 HBTS (High Band Transfer Switch)

Figure 13-32. A108 HBTS Replacement: MS4644B – Std Config.+ Option 82 or 83

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

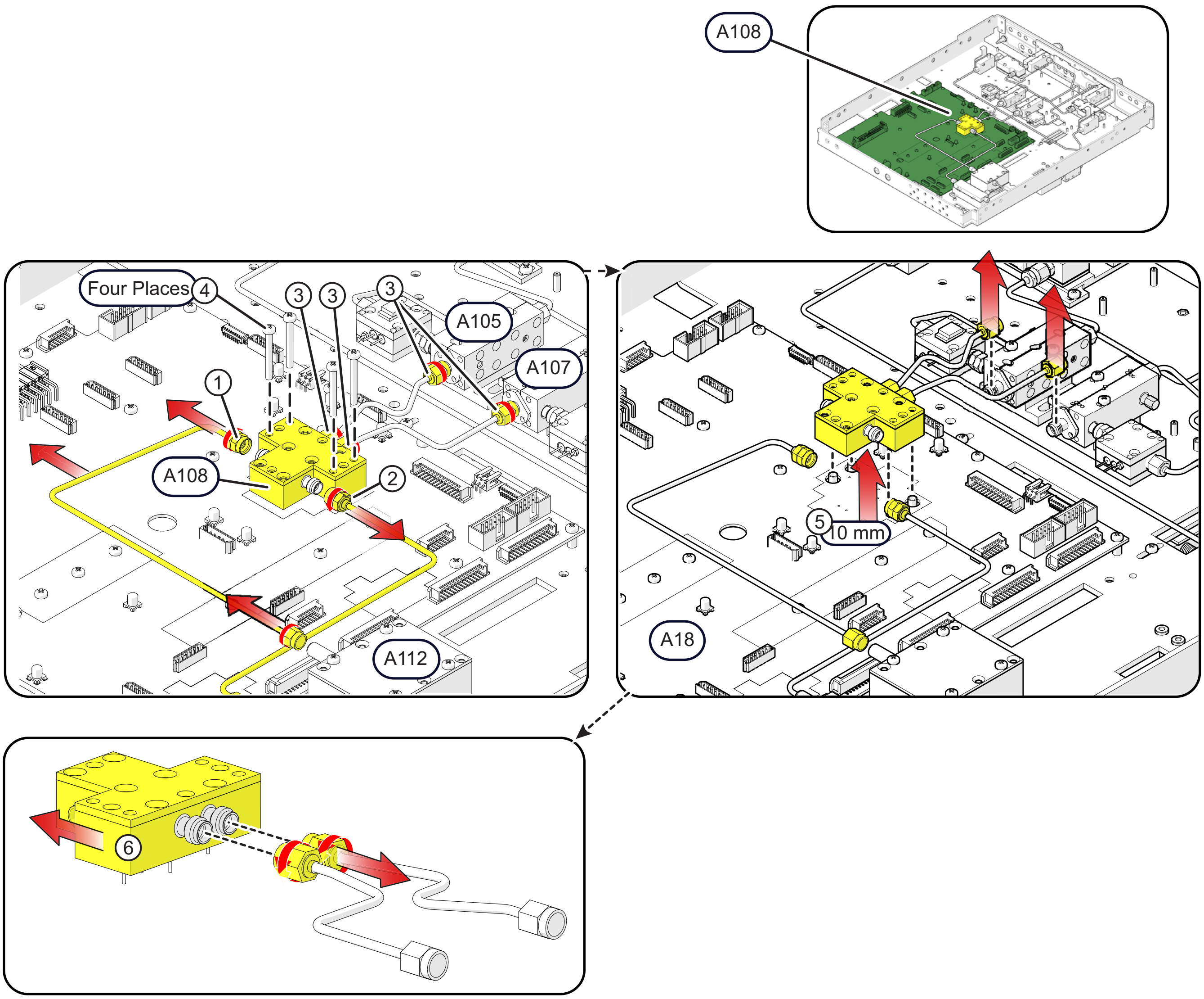
1. Disconnect the semi-rigid cable from J1of A108 and move it to the left.
2. Loosen (but do not remove) the four (4) semi-rigid cable connections between A108 output ports and the A107 and A105 Reference Module input ports.
3. Remove the four (4) screws from A108.
4. Referring to Figure 13-29 on page 13-36, gently lift A108 straight up about 10 mm (~3/8 in) until the A108 pins are free from their sockets.
5. Finish removing the four connectors holding the two semi-rigid coaxial cables in place. Set the two cables aside.
6. Reassembly with the new A108 module is the reverse of removal.
7. Torque the semi-rigid cable connections to 8 lbf · in.

A108 VITS – MS4645B or MS4647B – Standard Configuration – No Options

See Figure 13-33 for parts ID and instructions to replace the A108 VITS module.

Replacement Part: A108 VITS (V Integrated High Band Transfer Switch)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A112 to J2 of A108	4. M3 x 25 mm Pan Head Screws (four (4) places)
2. Semi-rigid cable from J3 of A114 to J1 of A108	5. A108 VITS (V Integrated High Band Transfer Switch)
3. Two semi-rigid cables between A108 switch output ports and A107 and A105 Reference Module input ports.	

Figure 13-33. A108 VITS Replacement: MS4645B / 47B – Std Config.+ No Options

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

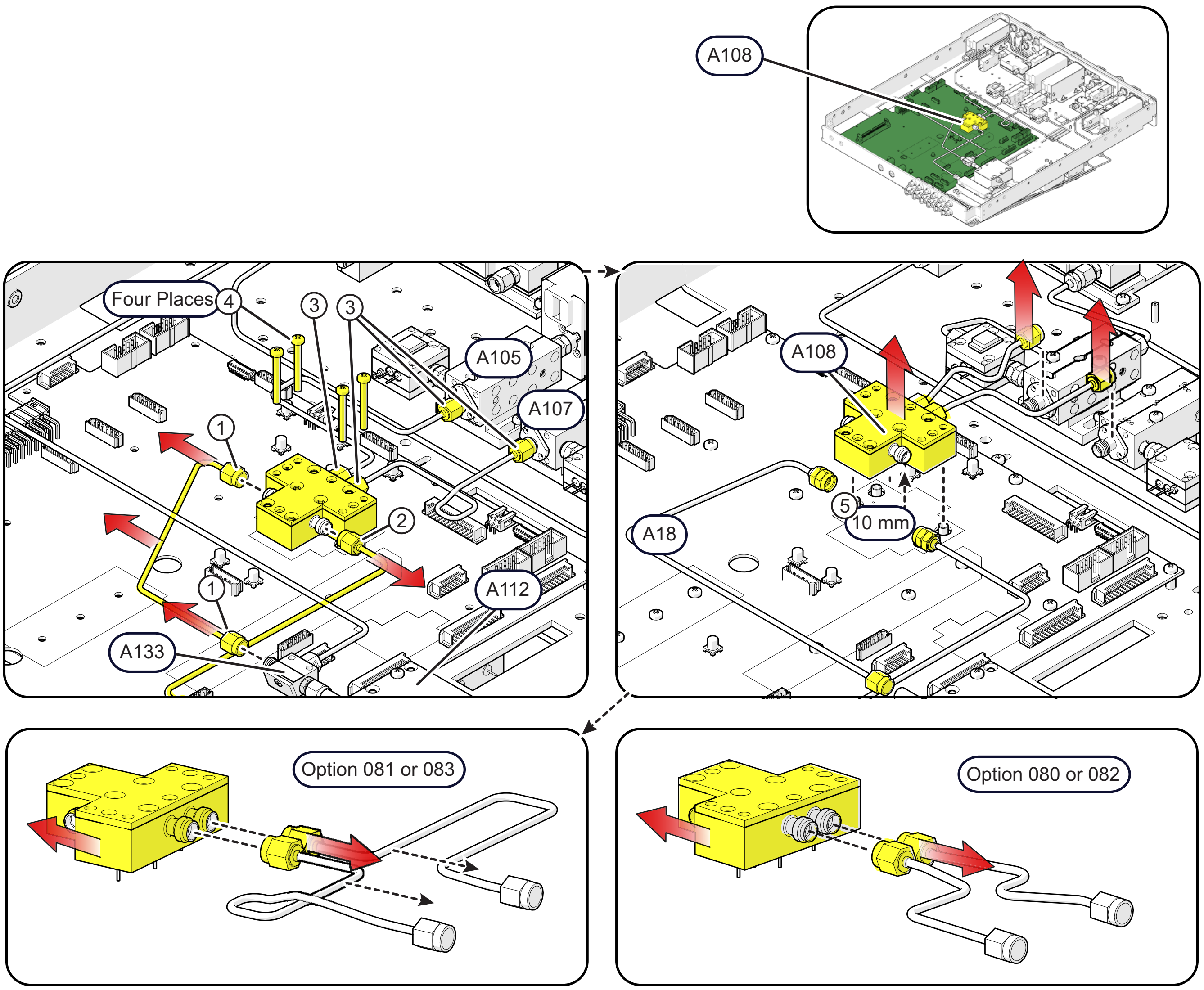
1. Disconnect the semi-rigid cable from J2 of A108 and J2 of A112 and set it aside.
2. Disconnect the semi-rigid cable from J1 of A108 and move it to the right.
3. Loosen (but do not remove) the four (4) semi-rigid cable connections between A108 output ports and the A107 and A105 Reference Module input ports.
4. Remove the four (4) mounting screws from A108.
5. Referring to Figure 13-29 on page 13-36, gently lift A108 straight up about 10 mm (~3/8 in) until the A108 pins are free from their sockets.
6. Finish removing the four connectors holding the two semi-rigid coaxial cables in place. Set the two cables aside.
7. Reassembly is reverse of removal.
8. Torque the semi-rigid cable connections to 8 lbf · in.

A108 VITS – MS4645/47B – Standard Configuration with Option 80, 81, 82, or 83

See Figure 13-34 for parts ID and instructions to replace the A108 VITS module.

Replacement Part: A108 VITS (V Integrated High Band Transfer Switch)

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A133 to J2 of A108
2. Semi-rigid cable from J3 of A114 to J1 of A108
3. Two semi-rigid cables between A108 switch output ports and A107 and A105 Reference Module input ports.
4. M3 x 25 mm Pan Head Screws (four (4) places)
5. A108 VITS (V Integrated High Band Transfer Switch)

Figure 13-34. A108 VITS Replacement: MS4645B / 47B – Std Config.+ Option 80, 81, 82, or 83

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J2 of A108 and J2 of A133 and set it aside.
2. Disconnect the semi-rigid cable from J1 of A108 and move it to the right.
3. Loosen (but do not remove) the four (4) semi-rigid cable connections between A108 output ports and the A107 and A105 Reference Module input ports.
4. Remove the four (4) mounting screws from A108.
5. Referring to Figure 13-29 on page 13-36, gently lift A108 straight up about 10 mm (~3/8 in) until the A108 pins are free from their sockets.
6. Finish removing the four connectors holding the two semi-rigid coaxial cables in place. Set the two cables aside.
7. Reassembly with the new A108 module is the reverse of removal.
8. Torque the semi-rigid cable connections to 8 lbf · in.

13-7 A133 or A233 Module Replacement

MS4642B – Standard Configuration with Option 82 or 83

See Figure 13-35 for parts ID and instructions to replace the A133 RF Coupler module.

Replacement Part: A133 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

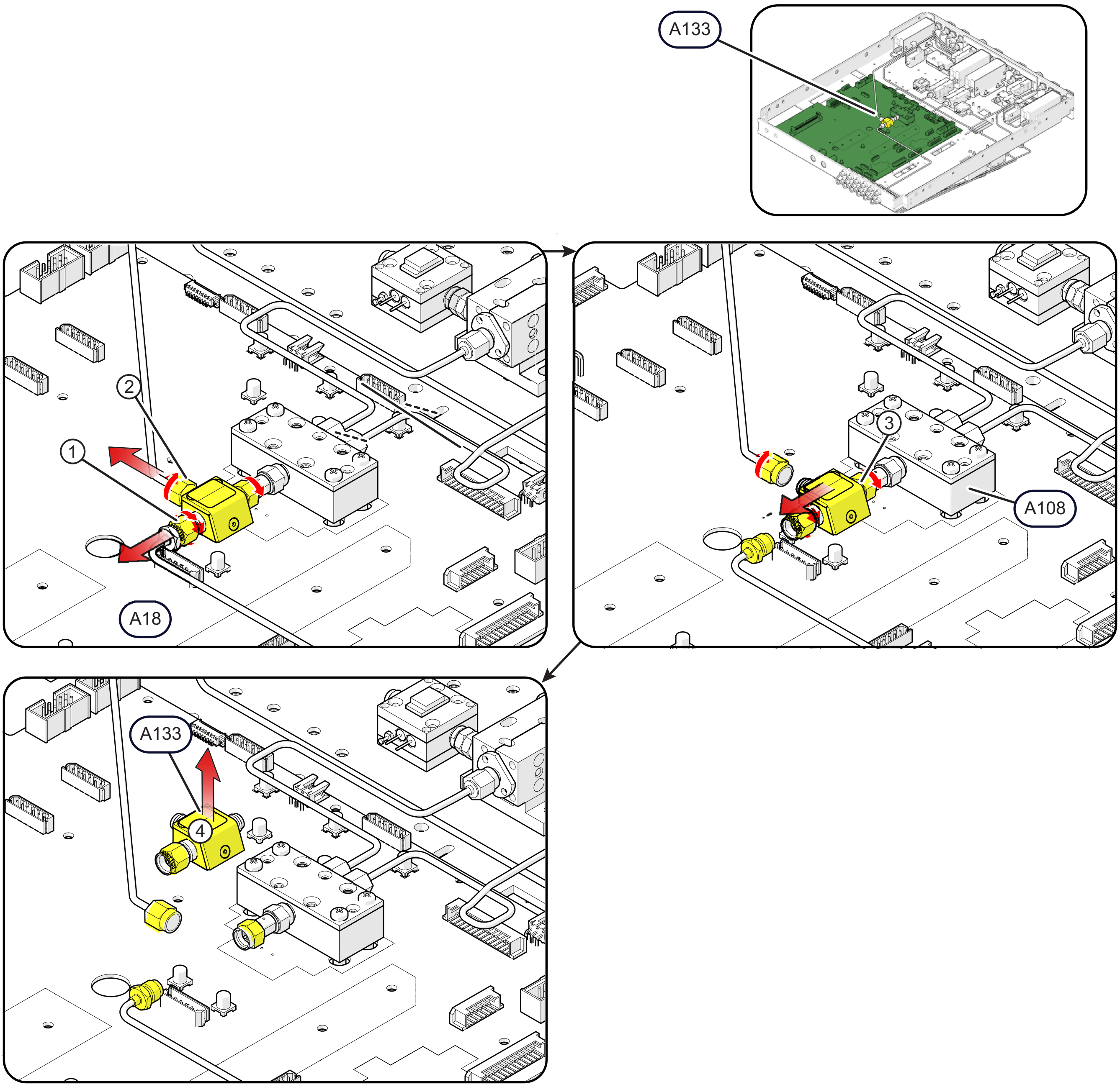


Figure 13-35. A133 Replacement: MS4642B – Std Config.+ Option 82 or 83 (1 of 2)

1. Semi-rigid cable from J2 of A113 to J1 of A133 2. Semi-rigid cable from J3 of A133 to front panel RF1	3. Coaxial connector from J2 of A133 to J1 of A108 switch. 4. A133 20-40 GHz RF Coupler Module (A133 RCM)

Figure 13-35. A133 Replacement: MS4642B – Std Config.+ Option 82 or 83 (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J1 of A133 and move it slightly toward the rear.
2. Disconnect the semi-rigid cable from J3 of A133 and move it slightly to the left.
3. Disconnect the A133 to A108 coaxial adapter from J2 of A133.
4. Remove the A133 module.
5. Reassembly with the new A133 module is the reverse of removal.
6. Torque the semi-rigid cable connections to 8 lbf · in.

MS4642B – Option 31 Configuration with Option 84 or 85

See Figure 13-36 for parts ID and instructions to replace the A133 or A233 RF Coupler module.

Replacement Part: A133 or A233 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

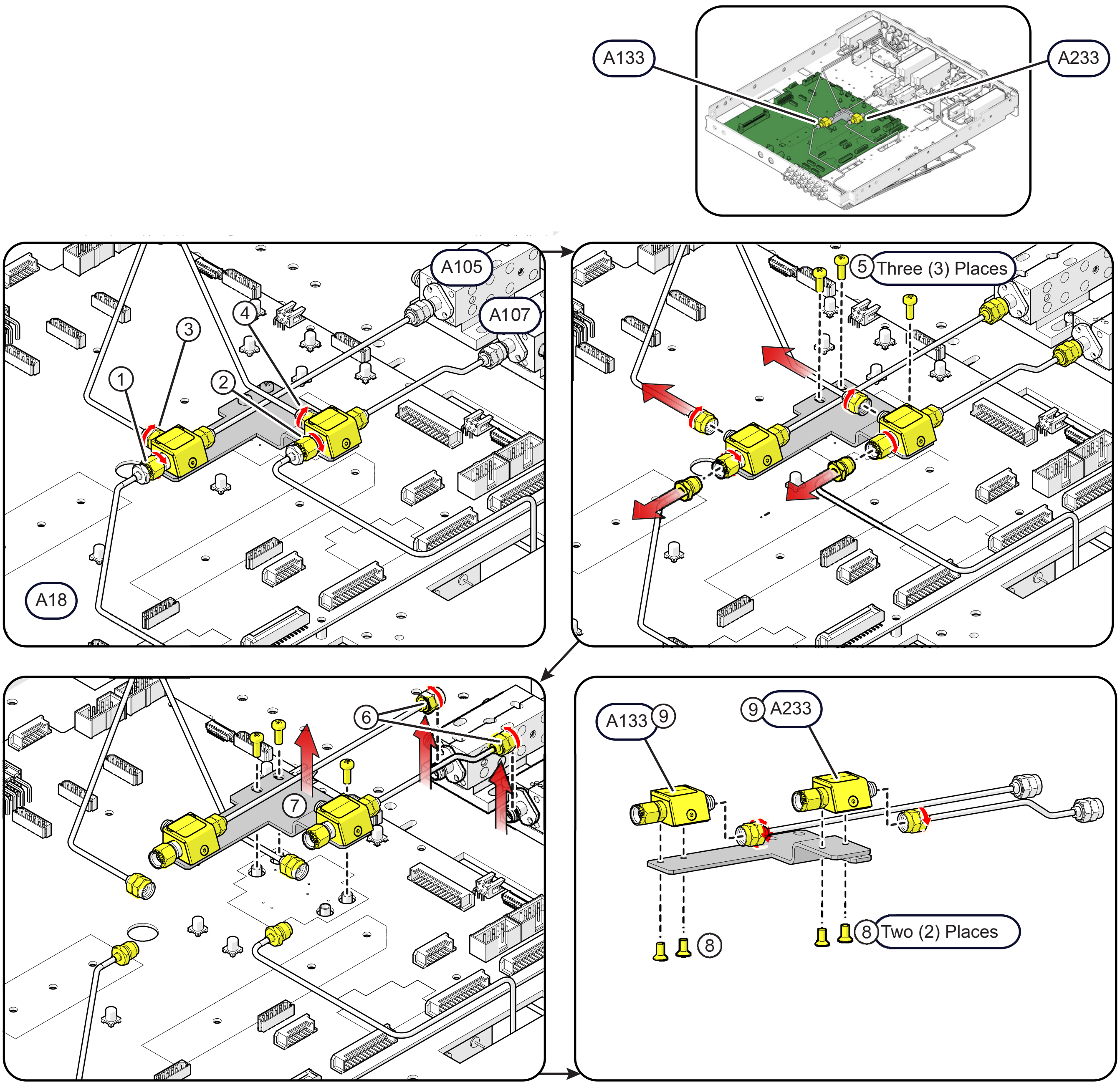


Figure 13-36. A133 / A233 Replacement: MS4642B – Option 31 Config.+ Option 84 or 85 (1 of 2)

1. Semi-rigid cable from J2 of A113 to J1 of A133 2. Semi-rigid cable from J2 of A213 to J1 of A233 3. Semi-rigid cable from J3 of A133 to front panel RF1 4. Semi-rigid cable from J3 of A233 to front panel RF2 5. M3 x 8 mm Phillips Pan Head screws (three (3) places)	6. Semi-rigid cable from J2 of A113 to J1 of A105 Semi-rigid cable from J2 of A213 to J1 of A107 7. Mounting Plate 8. A133 (or A233) – 20-40 GHz RF Coupler Module (A133 RCM or A233 RCM) 9. M3 x 6 mm Phillips Flat Head screws (two (2) places)

Figure 13-36. A133 / A233 Replacement: MS4642B – Option 31 Config.+ Option 84 or 85 (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

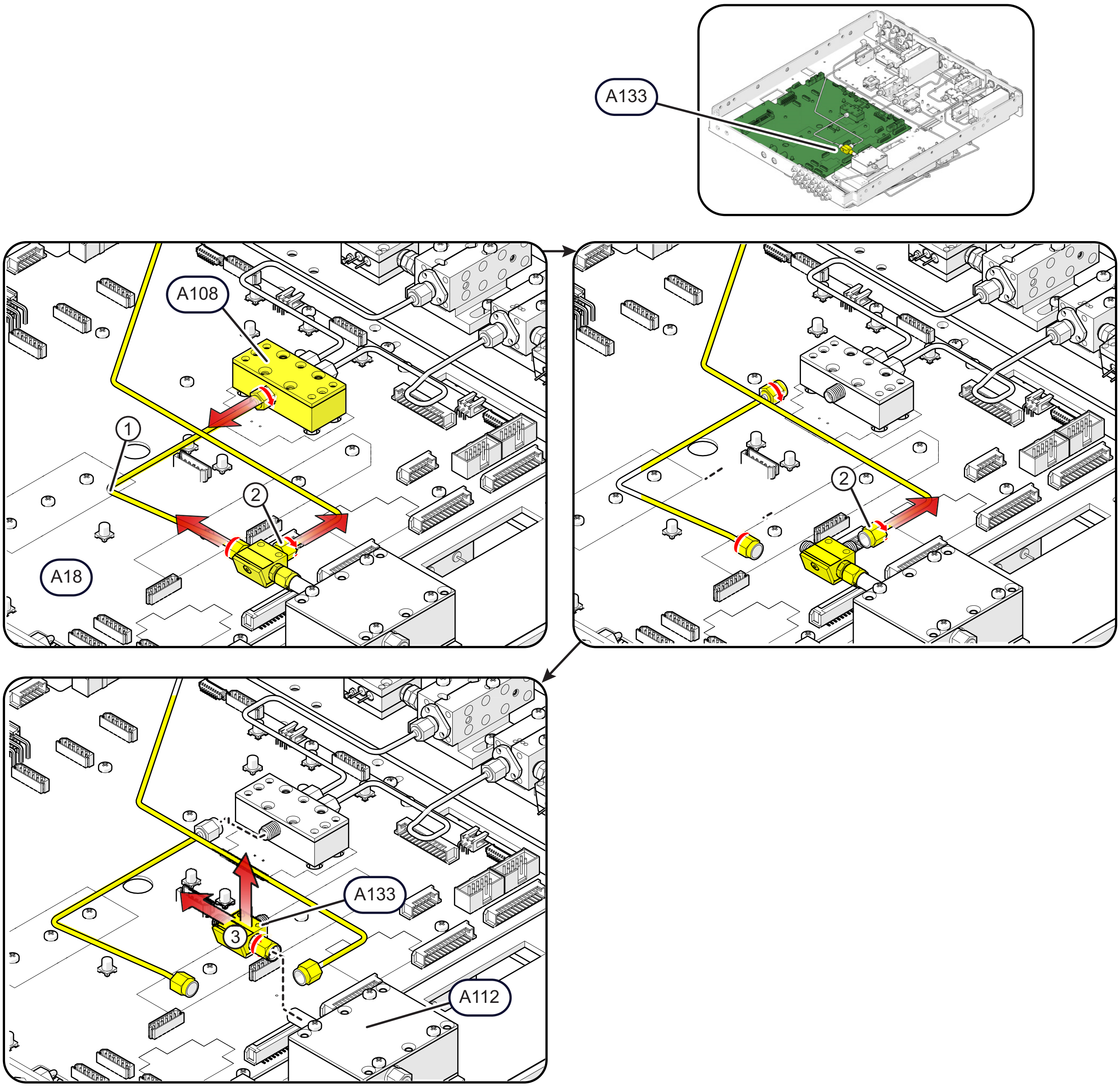
1. Disconnect the cable from J1 of A133 and move it slightly toward the rear.
2. Disconnect the cable from J1 of A233 and move it slightly toward the rear.
3. Disconnect the semi-rigid cable from J3 of A133 and move it slightly to the left.
4. Disconnect the semi-rigid cable from J3 of A233 and move it slightly to the left.
5. Remove the three (3) pan head screws from the mounting plate.
6. Disconnect the semi-rigid cables from J1 of A105 and from J1 of A107.
7. Lift the mounting plate and coupler/cable assembly out of the chassis.
8. Remove the two (2) flat head screws holding A122 (or A233) to the mounting plate
9. Remove the A133 (or A233) module.
10. Reassembly is reverse of removal.
11. Torque the semi-rigid cable connections to 8 lbf · in.

MS4644B – Standard Configuration with Option 82 or 83

See Figure 13-37 for parts ID and instructions to replace the A133 RF Coupler module.

Replacement Part: A133 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A133 to J1 of A108	3. A133 20-40 GHz RF Coupler Module (A133 RCM)
2. Semi-rigid cable from J3 of A133 to front panel RF1	

Figure 13-37. A133 Replacement: MS4644B – Std Config.+ Option 82 or 83

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

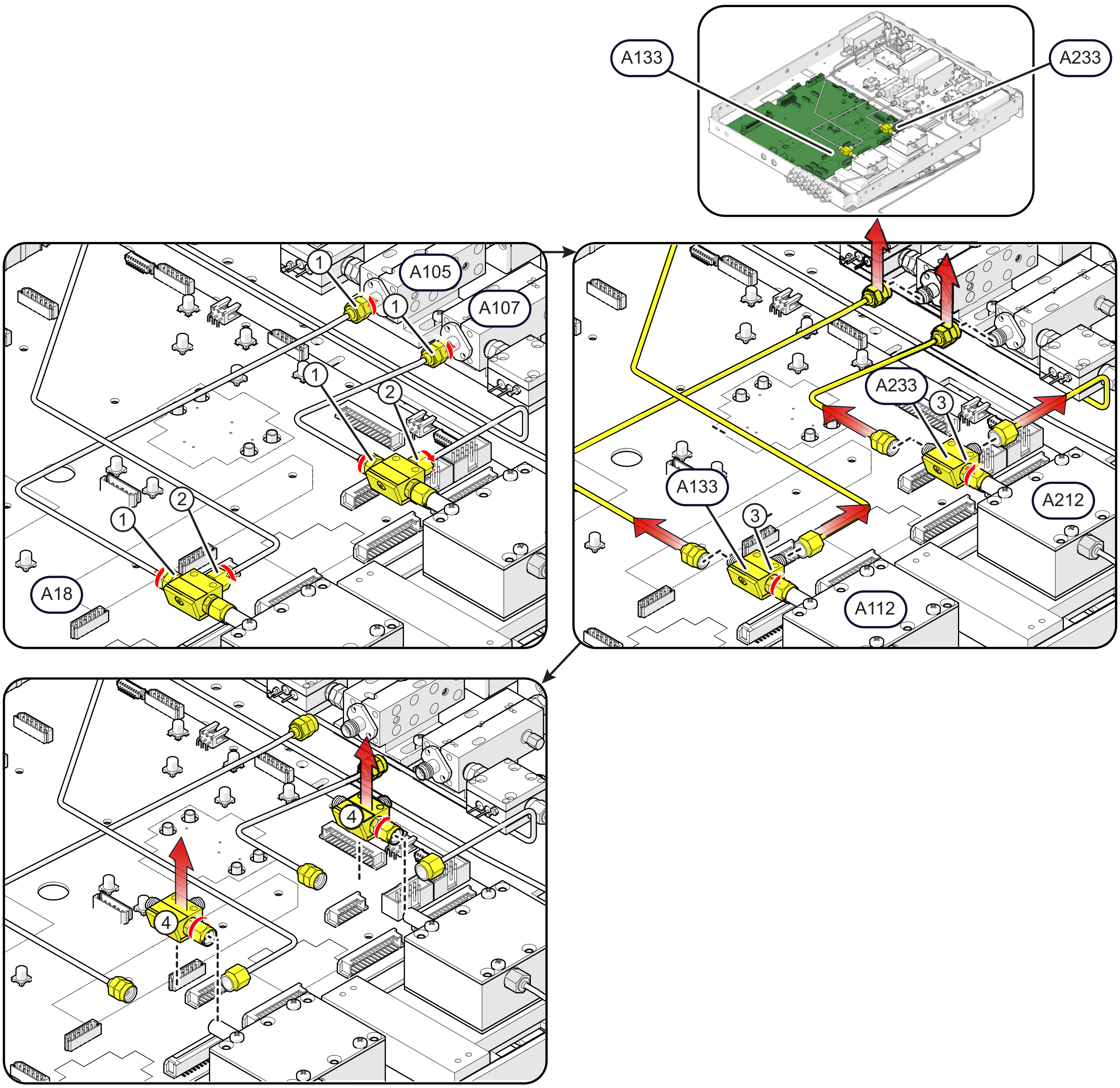
1. Disconnect the cable from J2 of A133 and J1 of A108 and set it aside.
2. Disconnect the cable from J3 of A133 and move it slightly toward the front.
3. Disconnect A133 J1 connector from A112 J2 and then remove A133.
4. Reassembly is reverse of removal.
5. Torque the semi-rigid cable connections to 8 lbf · in.

MS4644B – Option 31 Configuration with Option 84 or 85

See Figure 13-38 for parts ID and instructions to replace the A133 or A233 RF Coupler module.

Replacement Part: A133 or A233 – 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A133 to J1 of A108	3. A133 20-40 GHz RF Coupler Module (A133 RCM)
2. Semi-rigid cable from J3 of A133 to front panel RF1	

Figure 13-38. A133 / A233 Replacement: MS4644B – Option 31 Config.+ Option 84 or 85

Replacement Steps – A133

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the cable from J2 of A133 and move it slightly out of the way. If necessary, disconnect the other end from A105.
2. Disconnect the cable from J3 of A133 and move it slightly toward chassis front.
3. Disconnect A133 J1 connector from the A112 module.
4. Remove A133.
5. Reassembly is reverse of removal.
6. Torque the semi-rigid cable connections to 8 lbf · in.

Replacement Steps – A233

The following steps match the index numbers in the illustration where applicable.

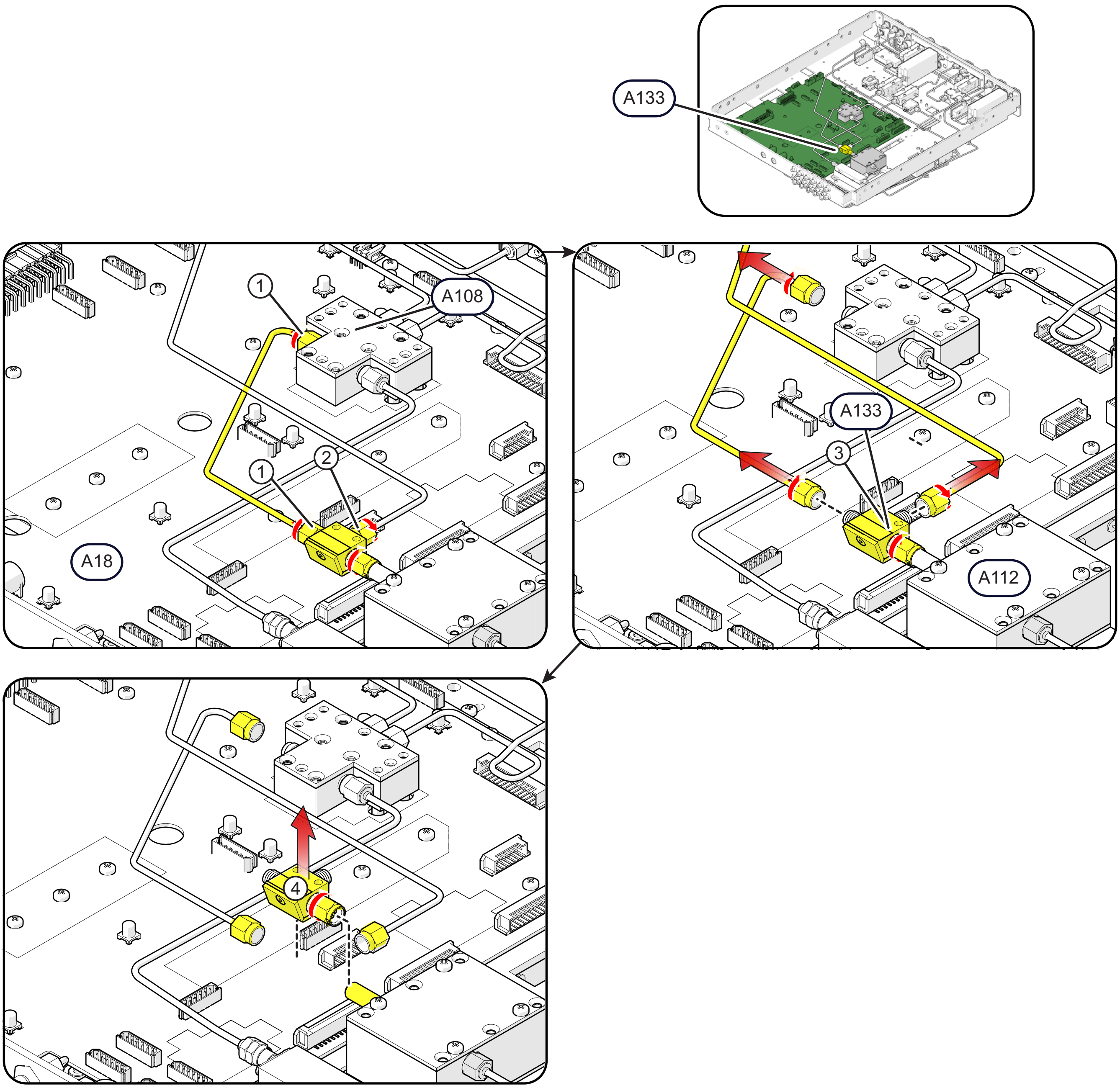
1. Disconnect the cable from J2 of A233 and the other end from A107. Set it aside.
2. Disconnect the cable from J3 of A233 and move it slightly toward chassis front.
3. Disconnect A233 J1 connector from the A212 module.
4. Remove A233.
5. Reassembly is reverse of removal.
6. Torque the semi-rigid cable connections to 8 lbf · in.

MS4645B – Standard Configuration with Option 82 or 83

See Figure 13-39 for parts ID and instructions to replace the A133 RF Coupler module.

Replacement Part: A133 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A133 to J1 of A108	3. A133 20-40 GHz RF Coupler Module (A133 RCM)
2. Semi-rigid cable from J3 of A133 to front panel RF1	

Figure 13-39. A133 Replacement: MS4645B + Option 82 or 83 – MS4547B + Option 80 or 81

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the cable from J2 of A133 and J1 of A108 and set it aside.
2. Disconnect the cable from J3 of A233 and move it slightly toward chassis front.
3. Disconnect A133 J1 connector from the A112 module.
4. Remove A133.
5. Reassembly is reverse of removal.
6. Torque the semi-rigid cable connections to 8 lbf · in.

MS4647B – Standard Configuration with Option 80 or 81

See Figure 13-41 for parts ID and instructions to replace the A133 RF Coupler module.

Replacement Part: A133 – 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

1. Semi-rigid cable from J2 of A133 to J2 of A108	3. A133 20-40 GHz RF Coupler Module (A133 RCM)
2. Semi-rigid cable from J3 of A133 to front panel RF1	

Figure 13-40. A133 Replacement: MS4647B – Std Config.+ Option 80 or 81

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J2 of A133 and J2 of A108 and set it aside.
2. Disconnect the semi-rigid cable from J3 of A133 and gently move it toward chassis front, far enough to clear the J3 RF connector.
3. Disconnect A133 from J2 of A112 and remove the module.
4. Reassembly is reverse of removal.
5. Torque the semi-rigid cable connections to 8 lbf · in.

MS4645B or MS4647B – Option 31 Configuration with Option 84 or 85

See Figure 13-41 for parts ID and instructions to replace the A133 or A233 RF Coupler module. The instructions below are for replacing A133 but can also be applied to the replacement of A233.

Replacement Part: A133 or A233 – 20-40 GHz RF Coupler Module

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

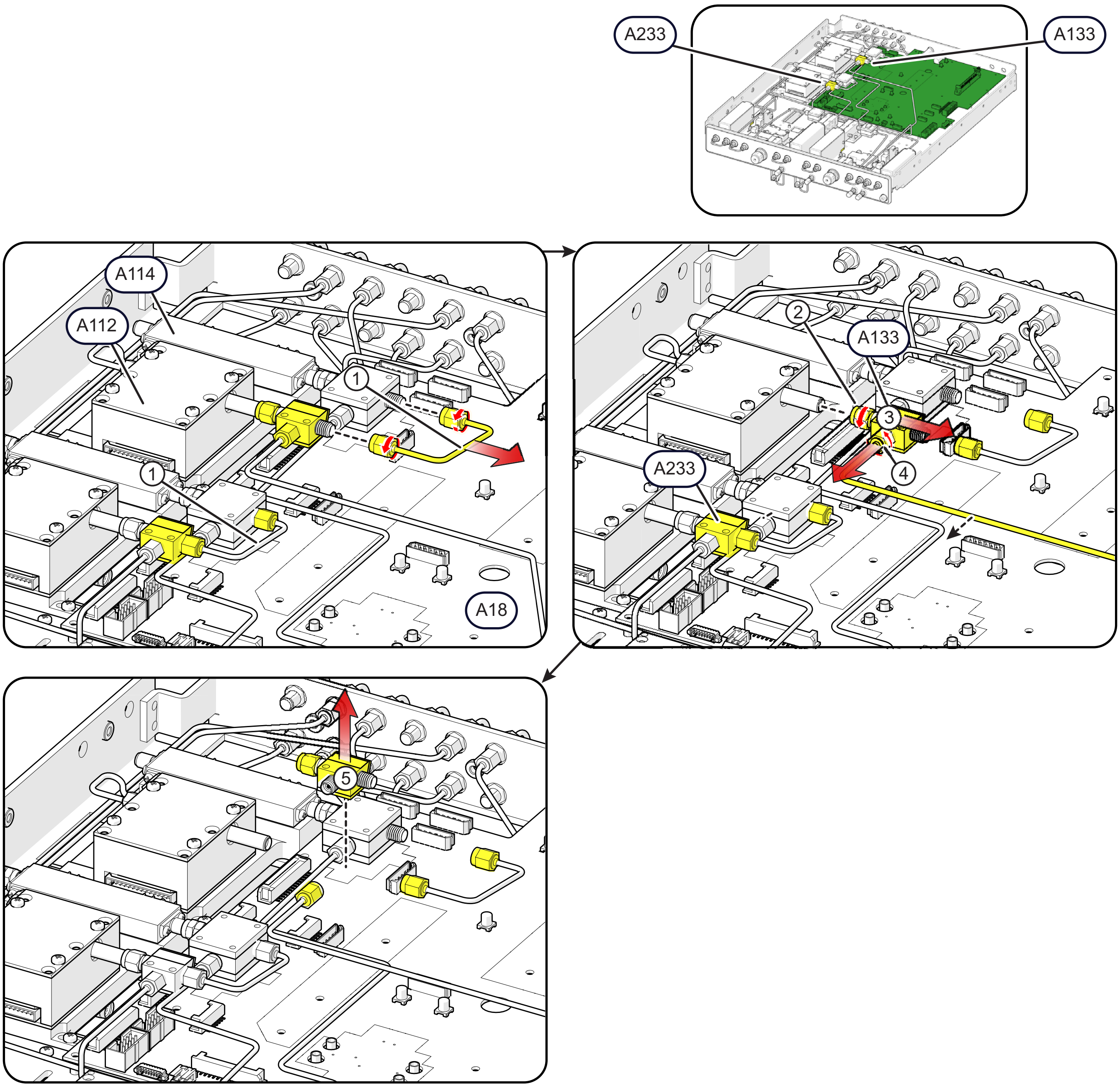


Figure 13-41. A133 or A233 Replacement: MS4645B/47B – Option 31 Config.+ Option 84 or 85 (1 of 2)

1. Semi-rigid cable from J2 of A133 (or A233) to J2 of A140 (or A240) 2. A133 (or A233) J1 input	3. A133 20-40 GHz RF Coupler Module (A133 RCM) 4. Semi-rigid cable from J3 of A133 (or A233) to front panel RF1 (or RF2)

Figure 13-41. A133 or A233 Replacement: MS4645B/47B – Option 31 Config.+ Option 84 or 85 (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J2 of A133 (or A233) and J2 of A140 (or A240), and set it aside.
2. Disconnect A133 (or A233) from J2 of A112 (or A212)
3. Move A133 (or A233) to the right.
4. Disconnect the semi-rigid cable from J3 of A133 (or A233) and gently move it far enough to clear the J3 connector.
5. Remove the A133 (or A233) module.
6. Reassembly is reverse of removal.
7. Torque the semi-rigid cable connections to 8 lbf · in.

13-8 A140 or A240 Forward Coupler Replacement

MS4645B or MS4647B – Option 31 Configuration (without Option 84 or 85)

See Figure 13-31 for parts ID and instructions to replace the A140 or A240 Forward Coupler module.

Replacement Part: A140 or A240 – Forward Coupler

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.

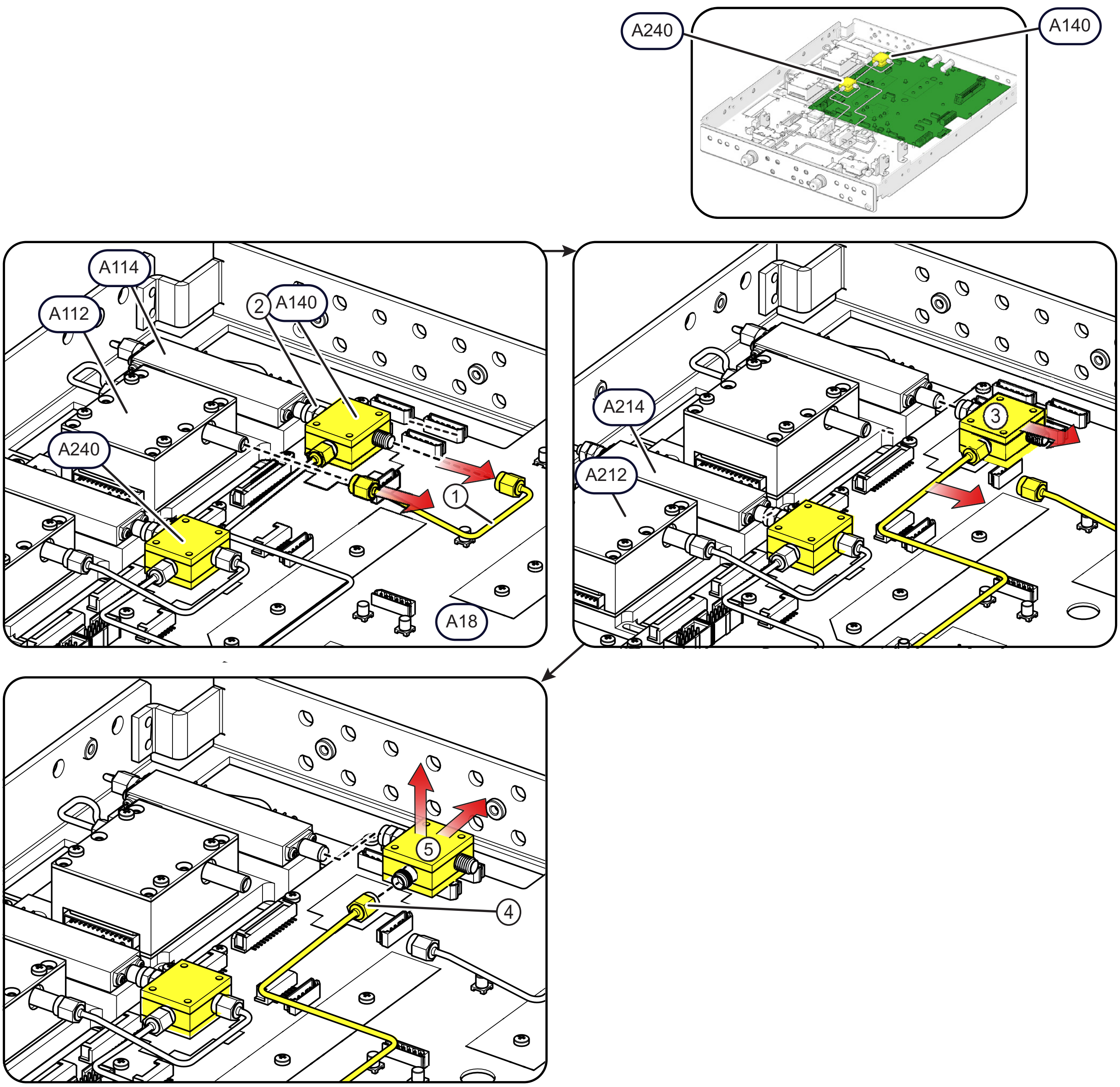


Figure 13-42. A140 or A240 Replacement: MS4645B/47B – Option 31 Config.– No Option 84 or 85 (1 of 2)

1. Semi-rigid cable from J2 of A140 (or A240) to J2 of A112 (or A212) 2. A140 (or A240) J1 input	3. A140 Forward Coupler 4. Semi-rigid cable from J3 of A140 (or A240) to J1 of A105 (or A107)

Figure 13-42. A140 or A240 Replacement: MS4645B/47B – Option 31 Config.– No Option 84 or 85 (2 of 2)

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

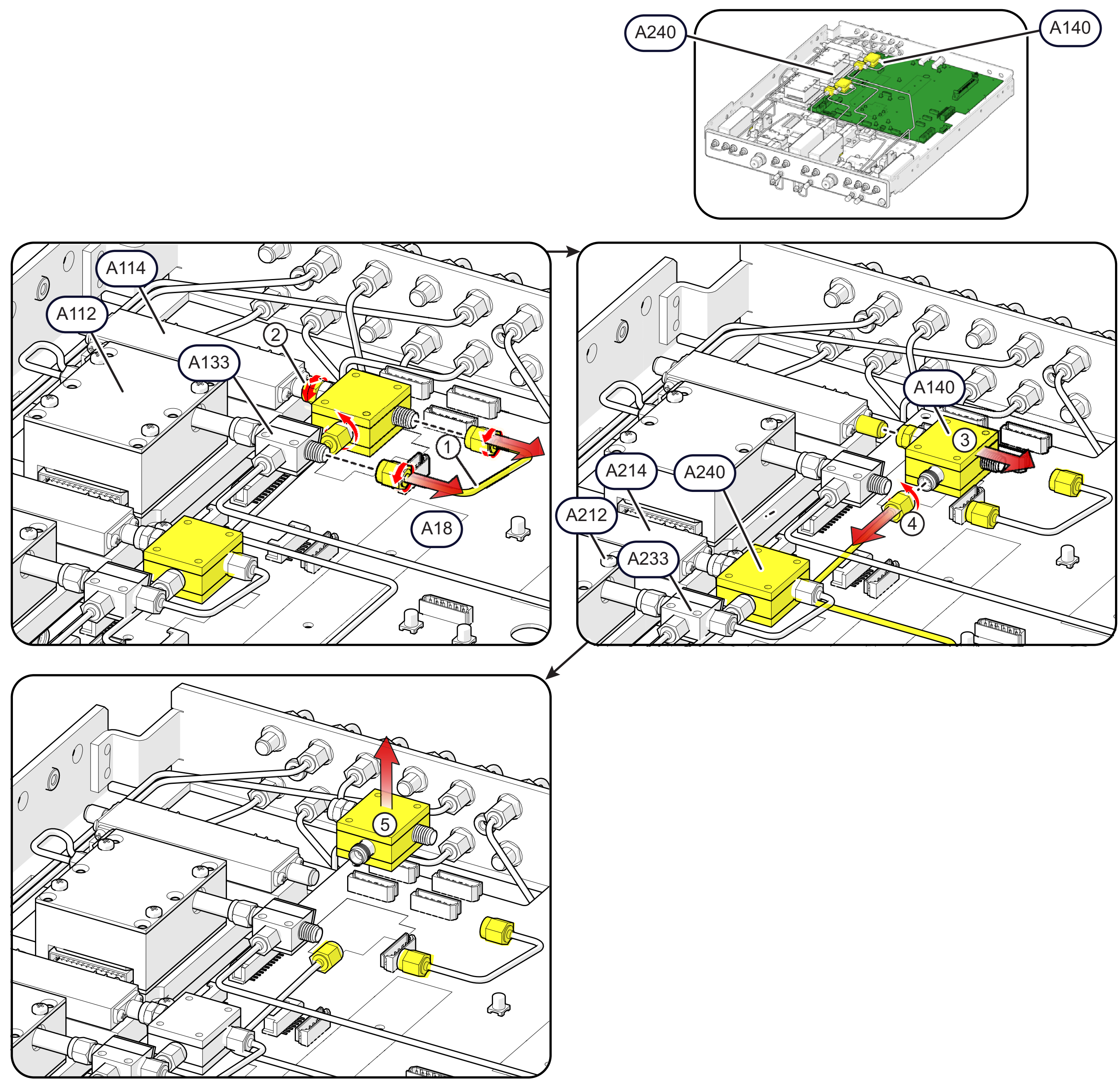
1. Disconnect the semi-rigid cable from J2 of A140 (or A240) and J2 of A112 (or A212), and set it aside.
2. Disconnect A140 (or A240) from J3 of A114 (or A214)
3. Move A140 (or A240) to the right.
4. Disconnect the semi-rigid cable from J3 of A140 (or A240).
5. Remove the A140 (or A240) module.
6. Reassembly is reverse of removal.
7. Torque the semi-rigid cable connections to 8 lbf · in.

MS4645B or MS4647B – Option 31 Configuration with Option 84 or 85

See Figure 13-31 for parts ID and instructions to replace the A140 or A240 Forward Coupler module.

Replacement Part: A140 – Forward Coupler

Caution	To avoid damage when disconnecting and reconnecting semi-rigid coaxial cables, ensure each connector is properly aligned before attaching to its mating connector. When remaking connections, align, thread, finger tighten the nut, then torque to 8 lbf· in.



1. Semi-rigid cable from J2 of A140 (or A240) to J2 of A133 (or A233)
2. A140 (or A240) J1 input
3. A140 Forward Coupler
4. Semi-rigid cable from J3 of A140 (or A240) to J1 of A105 (or A107)

Figure 13-43. A140 or A240 Replacement: MS4645B/47B – Option 31 Config.+ Option 84 or 85

Replacement Steps

The following steps match the index numbers in the illustration where applicable.

1. Disconnect the semi-rigid cable from J2 of A140 (or A240) and J2 of A133 (or A233), and set it aside.
2. Disconnect A140 (or A2240) from J3 of A114 (or A214).
3. Move A140 (or A240) to the right.
4. Disconnect the semi-rigid cable from J3 of A140 (or A240).
5. Remove the A140 (or A240) module.
6. Reassembly is reverse of removal.
7. Torque the semi-rigid cable connections to 8 lbf · in.

13-9 A18 RF Control PCB Replacement

If the A18 PCB is to be removed, all the modules mounted on it must be removed, as well as all semi-rigid coaxial cables, coaxial cables, and signal/power cables. See Figure 13-44 for a map of connectors.

Parts and Applicability

- A18 RF Control PCB Assembly (A18 PCB)
- A18 RF Control PCB Assembly (A18 PCB) for units Option 31

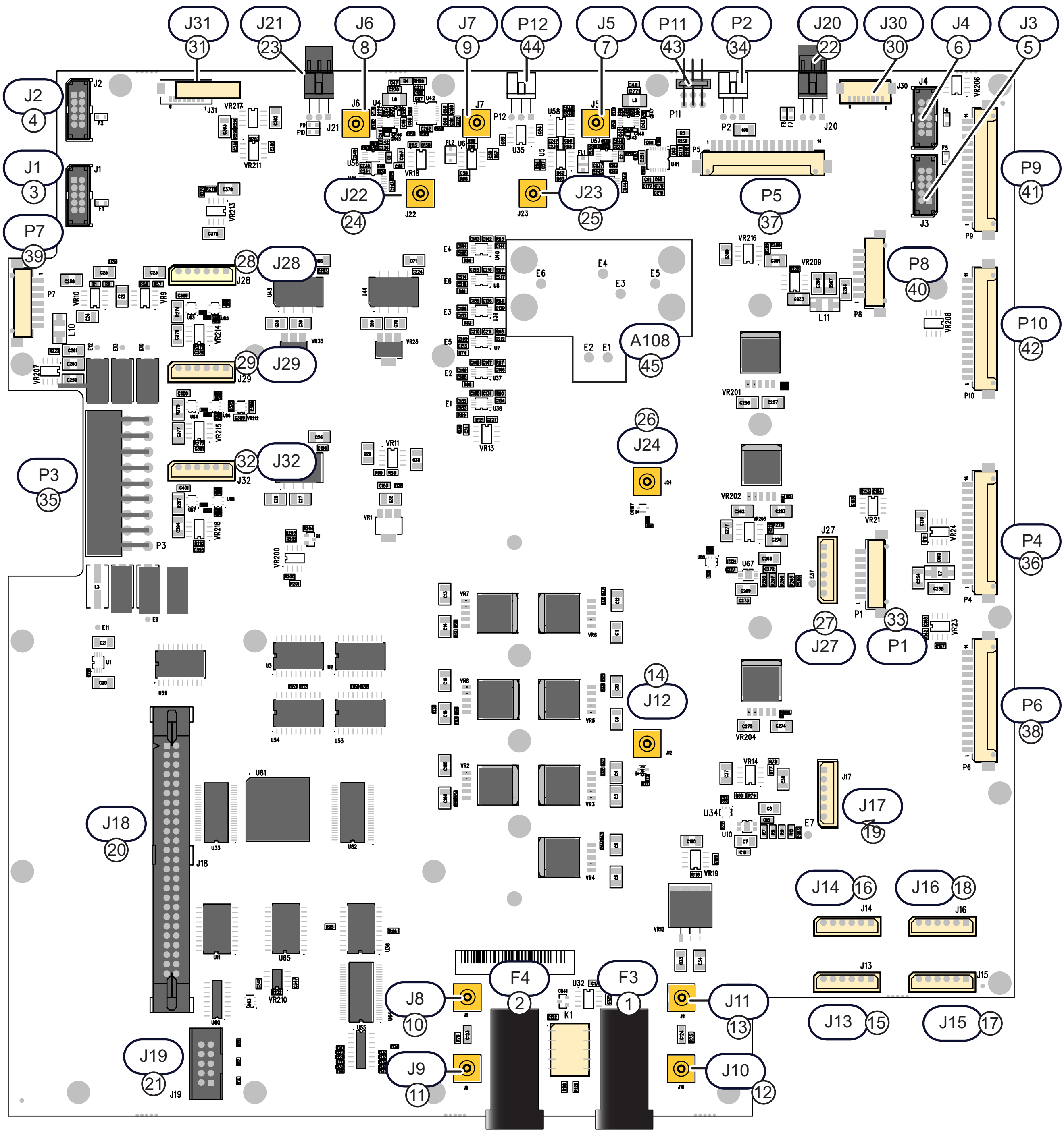


Figure 13-44. A18 RF Control PCB Assembly (1 of 2)

Orientation

The figure above is oriented as viewed from above with the front panel located toward the figure top, and the rear panel located at the bottom.

Fuses

1. F3 – Bias Fuse Holder. No cable.
2. F4 – Bias Fuse Holder. No cable.

Connectors

3. J1 – Option 61 or 62 only. Ribbon cable to the A121 High Band Step Attenuator Module.
4. J2 – Option 62 only. Ribbon cable to the A120 High Band Step Attenuator Module.
5. J3 – Option 62 only. Ribbon cable to the A122 High Band Step Attenuator Module.
6. J4 – Option 61 or 62 only. Ribbon cable to the A123 High Band Step Attenuator Module.
7. J5 – MCX coaxial cable to pins on the A110 Port 2 Level Detector Module.
8. J6 – MCX coaxial cable to pins on the A109 Port 1 Level Detector.
9. J7 – Non-Option 31 only – MCX Coaxial cable to A13 module connector J12
10. J8 – MCX coaxial cable to rear panel BNC P1.
11. J9 – MCX coaxial cable to pins on the A128 Diplexer/Bias Tee Module.
12. J10 – MCX coaxial cable to pins on the A129 Diplexer/Bias Tee Module.
13. J11 – MCX coaxial cable to the rear panel BNC P2.
14. J12 – MCX coaxial cable to A13 module connector J15.
15. J13 – Option 62 only. Ribbon cable to pins on the A126 Low Band Attenuator Module.
16. J14 – Option 61 or 62 only. Ribbon cable to pins on the A127 Low Band Attenuator Module.
17. J15 – Option 61 or 62 only. Ribbon cable to pins on the A125 Low Band Attenuator Module.
18. J16 – Option 62 only. Ribbon cable to pins on the A124 Low Band Attenuator Module.
19. J17 – SQM Bias and Control Cable.
20. J18 – Cable harness to Motherboard 2 PCB bottom side P42 RF Control connector.
21. J19 – Unused.
22. J20 – 3-pin header connector harness to heater chip for the A110 Port 2 Level Detector Module
23. J21 – 3-pin header connector harness to heater chip for the A109 Port 1 Level Detector Module
24. J22 – Option 31 only – MCX Coaxial Cable to A13 J12
25. J23 – Option 31 only – MCX Coaxial Cable to A14 J12
26. J24 – 50 GHz and 70 GHz models with Option 31 MCX Coaxial Cable to A14 J15
27. J27 – SQM 2 Bias and Control Cable (Option 31)
28. J28 – Not used
29. J29 – Not used
30. J30 – Option 84/85 Only. Ribbon cable to A241/A242 Port 2 Switch
31. J31 – Not used
32. J32 – Not used

Plugs

33. P1 – Ribbon cable to the A115 Low Band Switch Module J3 connector
34. Not used
35. P3 – Multi-pin connector cable to Motherboard 2 PCB bottom side RF Power P41 connector
36. P4 – Ribbon cable to the A112 Switched Doubler Module.
37. P5 – Ribbon cable to the A111 LO Distribution Module
38. P6 – Ribbon cable to the A113 5-20 GHz Doubler Module J3 connector.
39. P7 – Not used
40. P8 – Not used
41. P9 – Ribbon cable to the A212 Switched Doubler Module. (Option 31)
42. P10 – Ribbon cable to the A213 5-20 GHz Doubler Module J3 connector (Option 31)
43. P11 – Not used
44. P12 – Not used
45. A108 – Sockets and mounting holes for A108 HBTS/VITS

Figure 13-44. A18 RF Control PCB Assembly (2 of 2)

Replacing A18 in MS4642B or MS4644B Models

1. Remove any semi-rigid cables and modules that may impede removal of A18. Depending on the system options, refer to one of the following sections and find the procedure for your VNA configuration.
   - Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36
   - Section 13-7 “A133 or A233 Module Replacement” on page 13-48
2. Disconnect the A18 PCB cables.
3. Disconnect the remaining power and signal cables from A18. See Figure 13-44 on page 13-66 for connector locations.
4. Remove the 25 pan head Phillips M3 × 8 mm screws holding A18 PCB in place as shown in Figure 13-45.

   The PCB standoffs remain attached to the RF Deck chassis.
5. Taking care to not damage the rear panel semi-rigid coaxial cables, lift the PCB up by the front edge, and then out of the chassis and set aside.
6. See Section “A18 Installation” on page 13-69 for instructions for installing the new A18 PCB.

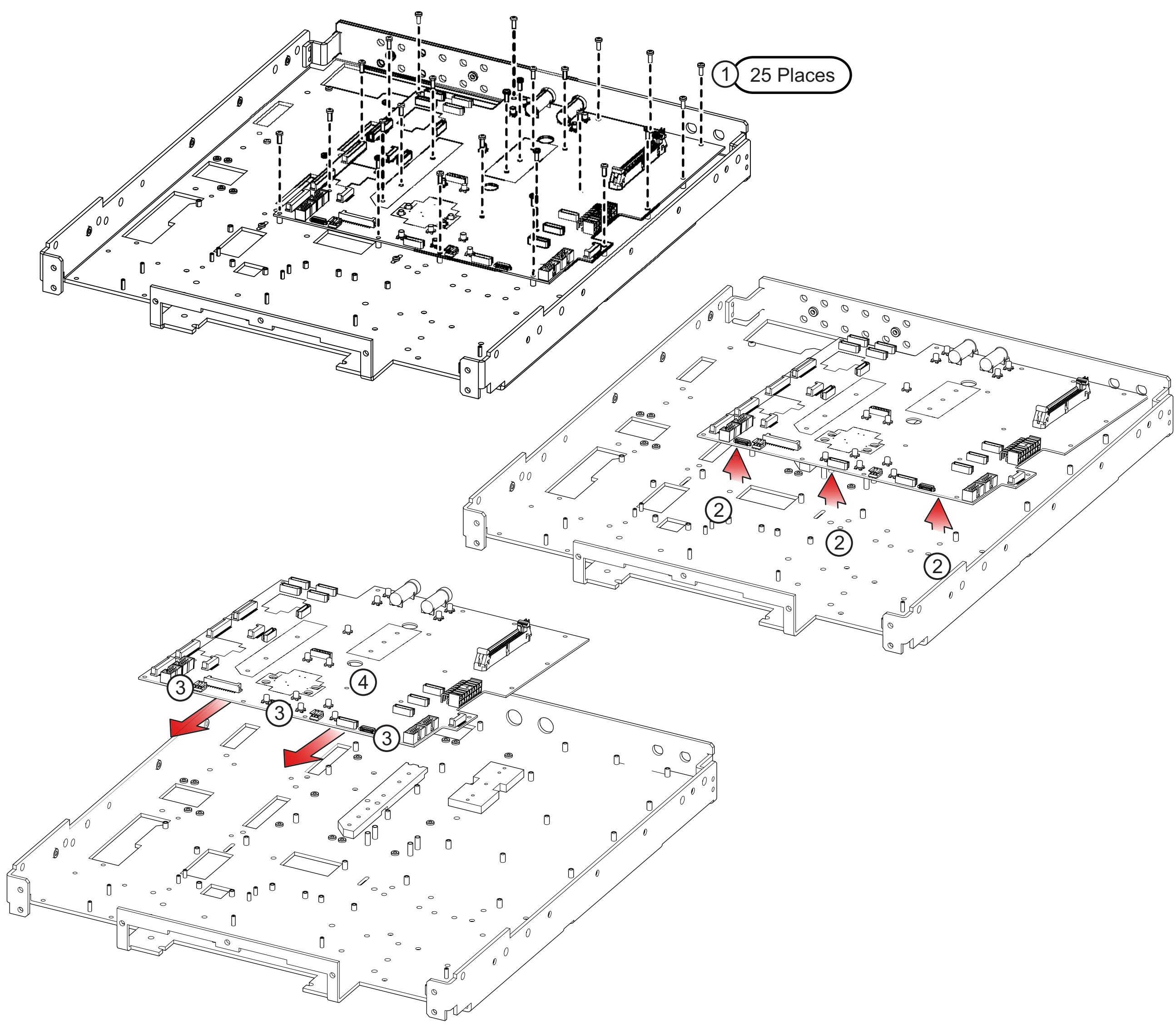


Figure 13-45. A18 PCB Board Replacement (1 of 2)

Parts ID	Steps
1. 25 Pan Head Phillips M3 × 8 mm screws	1. Remove 25 screws.
2. A18 RF Control PCB	2. Lift up slightly the front edge of the PCB.
	3. Pull the board up and out
	4. Reassembly is reverse of removal.
	5. Torque all semi-rigid cable connections to 8 lbf· in.

Figure 13-45. A18 PCB Board Replacement (2 of 2)

Replacing A18 in MS4645B or MS4647B Models

1. Remove any semi-rigid cables and modules that may impede removal of A18. Depending on the system options, refer to one of the following sections and find the procedure for your VNA configuration.
    - Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36
    - Section 13-7 “A133 or A233 Module Replacement” on page 13-48
    - Section 13-8 “A140 or A240 Forward Coupler Replacement” on page 13-62
2. Disconnect all A18 PCB cables.
3. Disconnect the remaining power and signal cables from A18.

    See Figure 13-44, “A18 RF Control PCB Assembly” on page 13-66 for connector locations.
4. Remove the 25 pan head Phillips M3 × 8 mm screws holding A18 PCB in place as shown in Figure 13-45 on page 13-68.

    The PCB standoffs remain attached to the RF Deck chassis.
5. Taking care to not damage the rear panel semi-rigid coaxial cables, lift the PCB up by the front edge, and then out of the chassis and set aside. See Figure 13-45.
6. See Section “A18 Installation” below for instructions for installing the new A18 PCB.

A18 Installation

This procedure applies to all models.

Assumptions

1. This procedure assumes the A18 PCB has been removed, and the instrument chassis is positioned upside down with the RF Deck Bottom Side accessible.

Place the A18 PCB

2. Place the A18 PCB into the chassis by first inserting the rear side identified by the two black Bias Fuse holders.
3. Taking care to not damage the rear panel loops, move the PCB into position and then lower the front edge onto the chassis-mounted standoffs.
4. Insert and carefully thread the 20 pan head Phillips M3 × 8 mm screws holding the A18 PCB in place. Do not tighten.
5. Once all screws are inserted, tighten to specifications. Best practices recommend working from the A18 PCB center out towards the edges, tightening in two passes.
6. Connect the power and signal cables.
    - See Figure 13-44, “A18 RF Control PCB Assembly” on page 13-66 above for connector locations.

13-10 System Reassembly

1. Position the instrument so that it is top side up.
2. If removed, install the Front Panel.
    - See Section 18-5 "Install Front Panel" on page 18-8.
3. Install the Inner Top Cover.
    - See "Install Inner Cover" on page 8-6.
4. Install the Outer Cover.
    - See "Install Outer Cover" on page 8-6.

Chapter 14 — RF Deck Module Replacement – Port Modules

14-1 Introduction

This chapter describes how to remove and replace the port group modules on the RF Deck Bottom Side. The port group modules can be serviced while the instrument Front Panel and the RF Deck remain in the instrument chassis. The port groups vary mechanically and electrically depending on the instrument model and equipped options.

Module Division on the RF Deck

Figure 14-1 shows the division between the front “Port Modules” and the “Rear Modules”. This chapter provides procedures for replacing the port modules only. Replacement of the Rear Modules are described in Chapter 13, “RF Deck Module Replacement – Rear Modules”

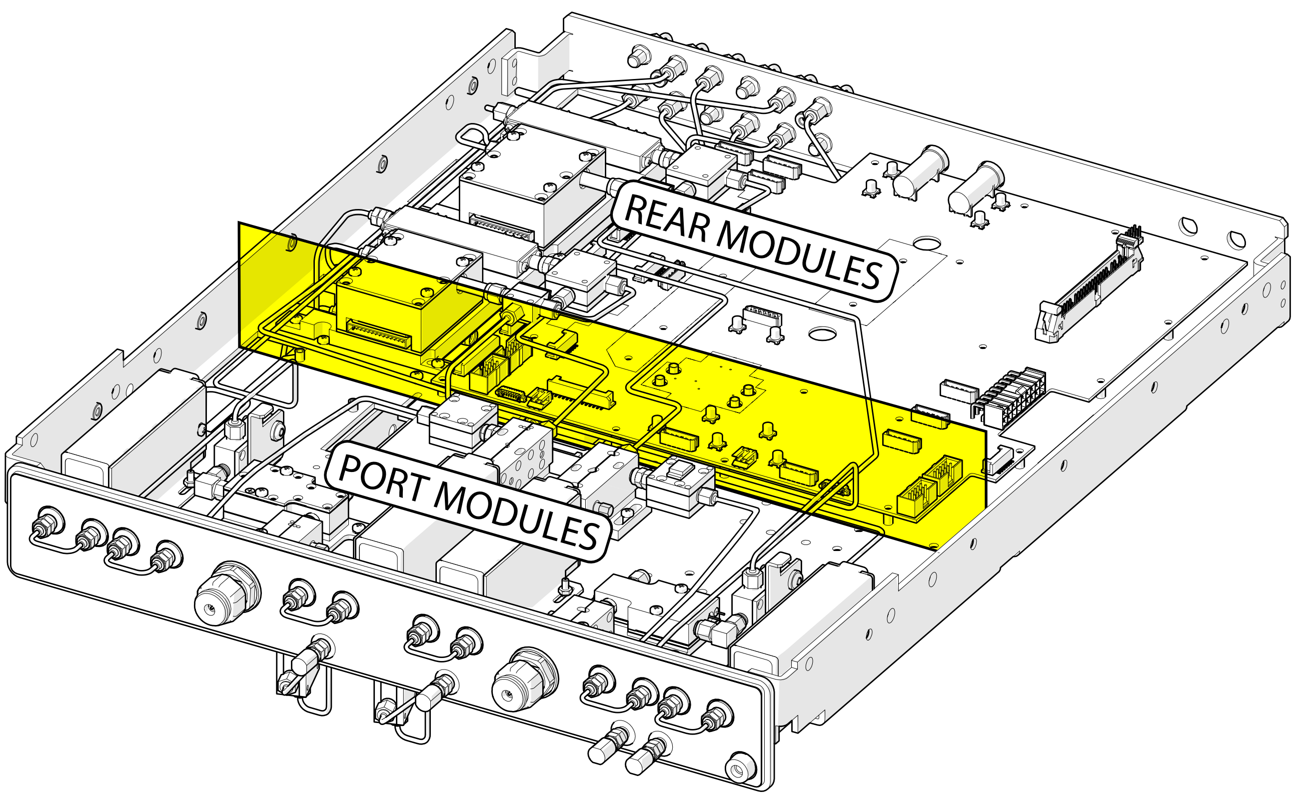


Figure 14-1. RF Deck Division – Port and Rear Modules

Port Groups

In general, when viewing the RF Deck upside down from the front panel, the left side Port 2 module groups are mirror opposites of the right side Port 1 module groups. The number of modules in a port group varies depending on the model number and installed options. A port group can have from one to seven modules and components. Some modules can be removed without disassembling the other group modules.

A108 Module

Although A108 HBTS/VITS is considered a port group module, its removal and installation is covered in detail in Section 13-6, "A108 HBTS/VITS Module Replacement" on page 13-36 because it is mounted in the rear module area.

Test Port Adapters

For purposes of this chapter, the Test Port Adapter is also considered a member of the Test Port 2 and the Test Port 1 port groups.

- MS4642B / MS4644B: Test Port Adapter K Connector – 34YK50C
- MS4645B / MS4647B: Test Port Adapter V Connector – 34YV50C

In all cases, the adapters must be removed to service the underlying Test Port Couplers:

- MS4642B / MS4644B: A104 Test Coupler, 40 GHz
- MS4645B / MS4647B: A104 Test Coupler, 70 GHz
- MS4642B / MS4644B: A106 Test Coupler, 40 GHz
- MS4645B / MS4647B: A106 Test Coupler, 70 GHz

Part Numbers as Related to Model Numbers and Options

Part numbers of the modules in the port groups change depending on the instrument model number.

Note

The removal, and installation procedures for the RF Deck Port Group Modules depend on three factors:

- **VNA Model Number**: MS4642B, MS4644B, MS4645B, and MS4647B
- **RF Deck Port Number** as described below
- **Installed Option**:

  Standard Configuration with No Options or with Option 51 Direct Access Loops, Option 61 Loops and Two Attenuators, and Option 62 Loops and Four Attenuators, and Option 80, 81, 82, or 83 mm-Wave Interface.

  Option 31 Configuration (Second Source) with No Options, or with Option 51 Direct Access Loops, Option 61 Loops and Two Attenuators, or Option 62 Loops and Four Attenuators, and Option 84 or 85 mm-Wave Interface.

Depending on the installed option, there can be up to twelve possible port groups. With the RF Deck upside down and Option 62 installed, viewed from the Front Panel, the port groups from left to right are:

- Port 2 Test Receiver b2 – P2 b2
- Port 2 Reference Receiver a2 – P2 a2
- Test Port 2 – TP2
- Port 2 Source – P2 Src
- Port 1 Source – P1 Src
- Test Port 1 – TP1
- Port 1 Reference Receiver a1 – P1 a1
- Port 1 Test Receiver b1 – P1 b1
- LO1 (mm-Wave Interface Option – 8x)
- LO2 (mm-Wave Interface Option – 8x)
- RF1 (mm-Wave Interface Option – 8x)
- RF2 (mm-Wave Interface Option – 84 or 85)

Note that Port 2 – a2 and Port 1 – a1 do not have any directly connected modules. They are connected to other locations within the instrument chassis through the use of semi-rigid coaxial cables.

14-2 Port Module Parts Identification

Note	The engineering reference numbers ("A" numbers) for the modules are the same for all modules on both the MS4642B / MS4644B, and the MS4645B / MS4647B VNAs even though the replacement part numbers may vary.

MS4642B / MS4644B – Standard Configuration – No Options

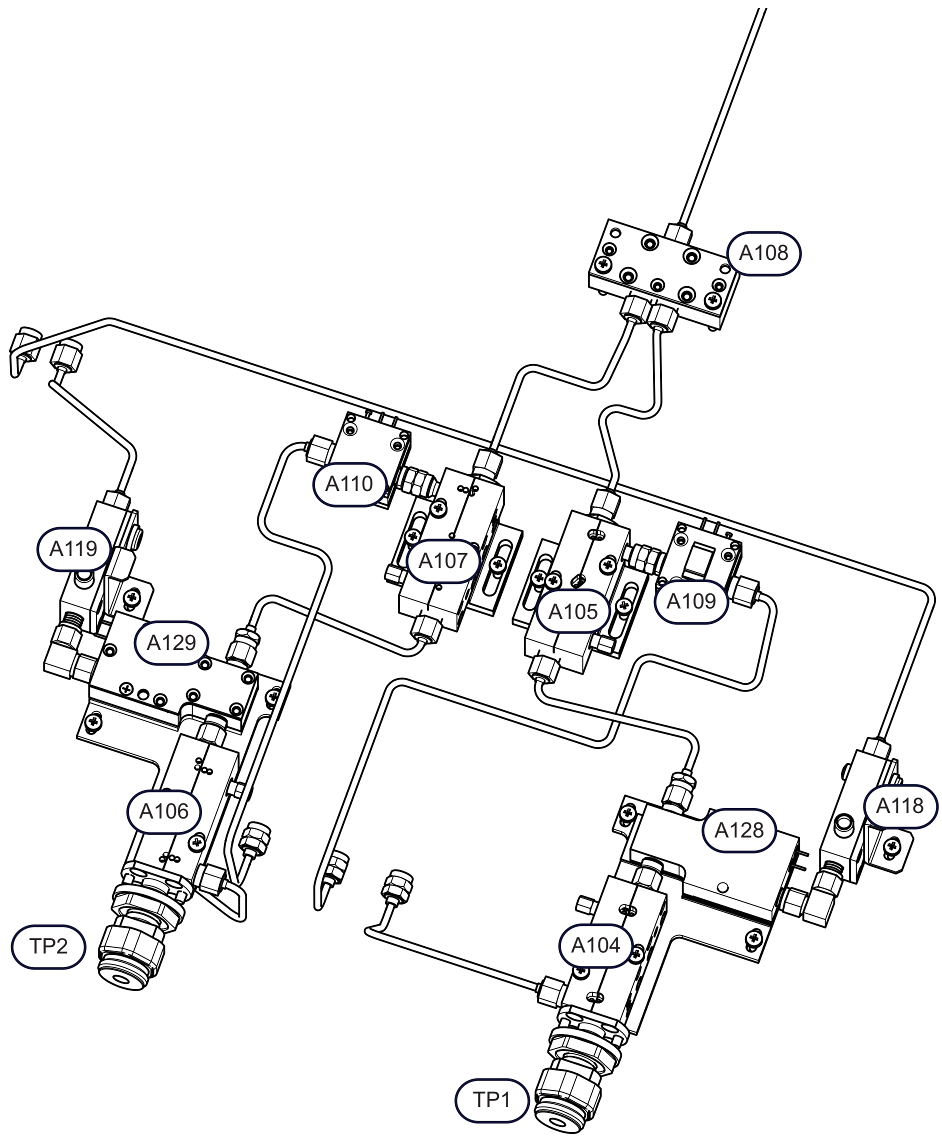


Figure 14-2. MS4642B / MS4644B Standard No Options: Test Port Group Modules (1 of 2)

Test Ports (from left to right) • TP2 – Test Port 2 • TP1 – Test Port 1 **RF Control Module** Mounted on A18 RF Control PCB Assembly: • A108 High Band Transfer Switch, 40 GHz **Test Port 2** • A107 Reference Coupler, 40 GHz • A110 Port 2 Level Detector, 40 GHz, K Connector • A129 Diplexer/Bias Tee Module, Port 2, 40 GHz • A119 Low Band Bridge • A106 Test Coupler, 40 GHz • TP2 Test Port Adapter K Connector – 34YK50C	**Test Port 1** • A105 – Reference Coupler, 40 GHz • A109 – Port 1 Level Detector, 40 GHz, K Connector • A128 – Diplexer/Bias Tee Module, Port 1, 40 GHz • A118 – Low Band Bridge • A104 – Test Coupler, 40 GHz • TP1 – Test Port Adapter K Connector – 34YK50C

Figure 14-2. MS4642B / MS4644B Standard No Options: Test Port Group Modules (2 of 2)

MS4642B – Option 31 Configuration – with Option 62 and Option 85

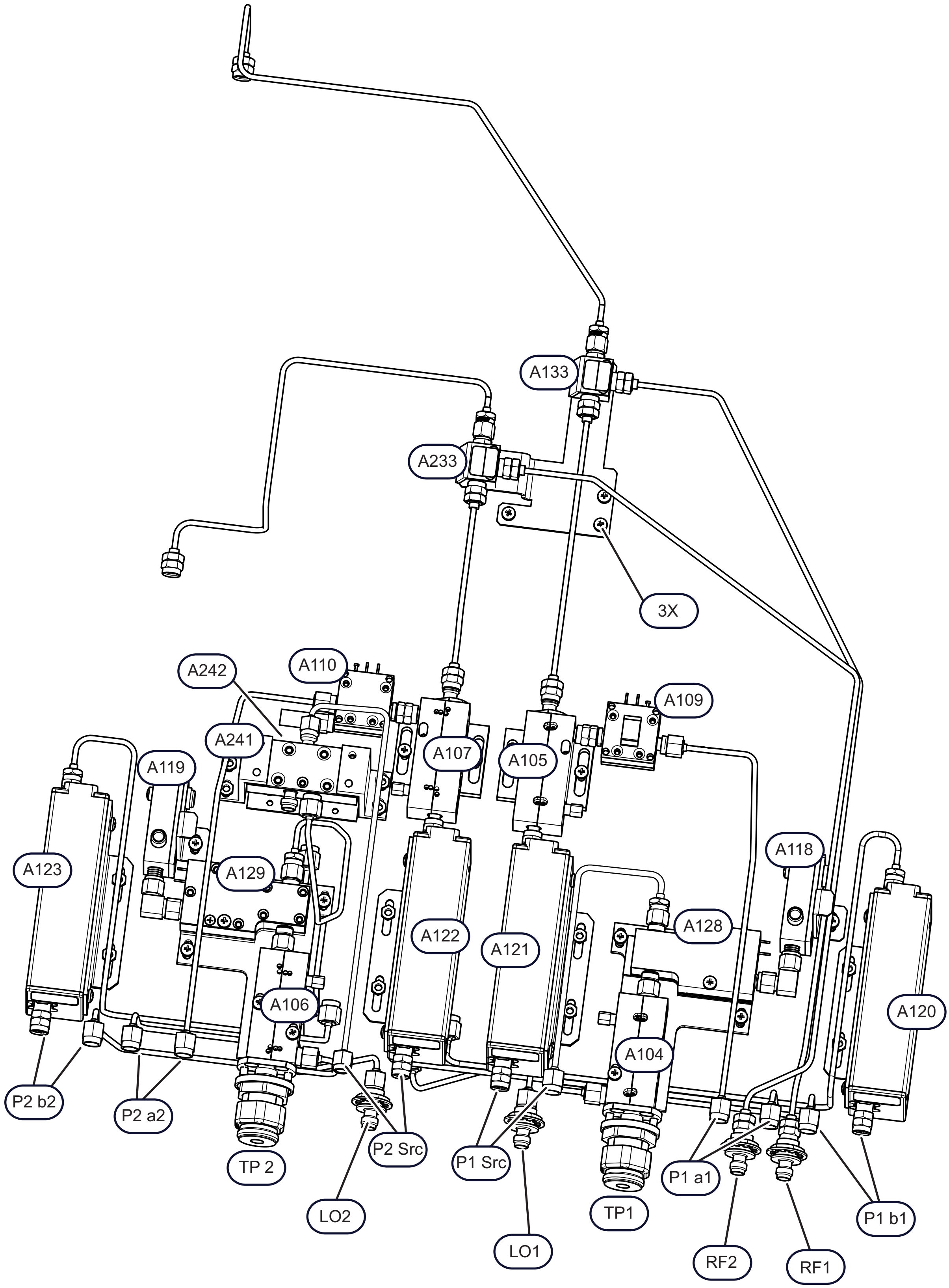


Figure 14-3. MS4642B – Option 31 Configuration – with Option 62 and Option 85 (1 of 2)

Test Ports (from left to right)

- P2 b2 – Port 2 Test Receiver b2
- P2 a2 – Port 2 Reference Receiver a2 – There are no modules connected directly to Port 2 a2.
- TP2 – Test Port 2
- P2 Src – Port 2 Source
- P1 Src – Port 1 Source
- TP1 – Test Port 1
- P1 a1 – Port 1 Reference Receiver a1 – There are no modules connected directly to Port 1 a1.
- P1 b1 – Port 1 Test Receiver b1

Option 84 or 85 Modules and Ports

- A241 High Band Transfer Switch (HBTS), 40 GHz
- A242 (Under A241) SPDT Switch Control Assy
- A133 20-40 GHz RF Coupler Module (A133 RCM)
- A233 20-40 GHz RF Coupler Module (A233 RCM)
- LO2 Port
- LO1 Port
- RF2 Port
- RF1 Port

Port 2 Test Receiver b2

- A123 – High Band Step Attenuator, Port 2 b2, 40 GHz

Test Port 2

- A107 – Reference Coupler, 40 GHz
- A110 – Port 2 Level Detector, 40 GHz, K Connector
- A129 – Diplexer/Bias Tee Module, Port 2, 40 GHz
- A119 – Low Band Bridge
- A106 – Test Coupler, 40 GHz
- TP2 – Test Port Adapter K Connector – 34YK50C
- A122 High Band Step Attenuator, Port 2 Src, 40 GHz

Test Port 1

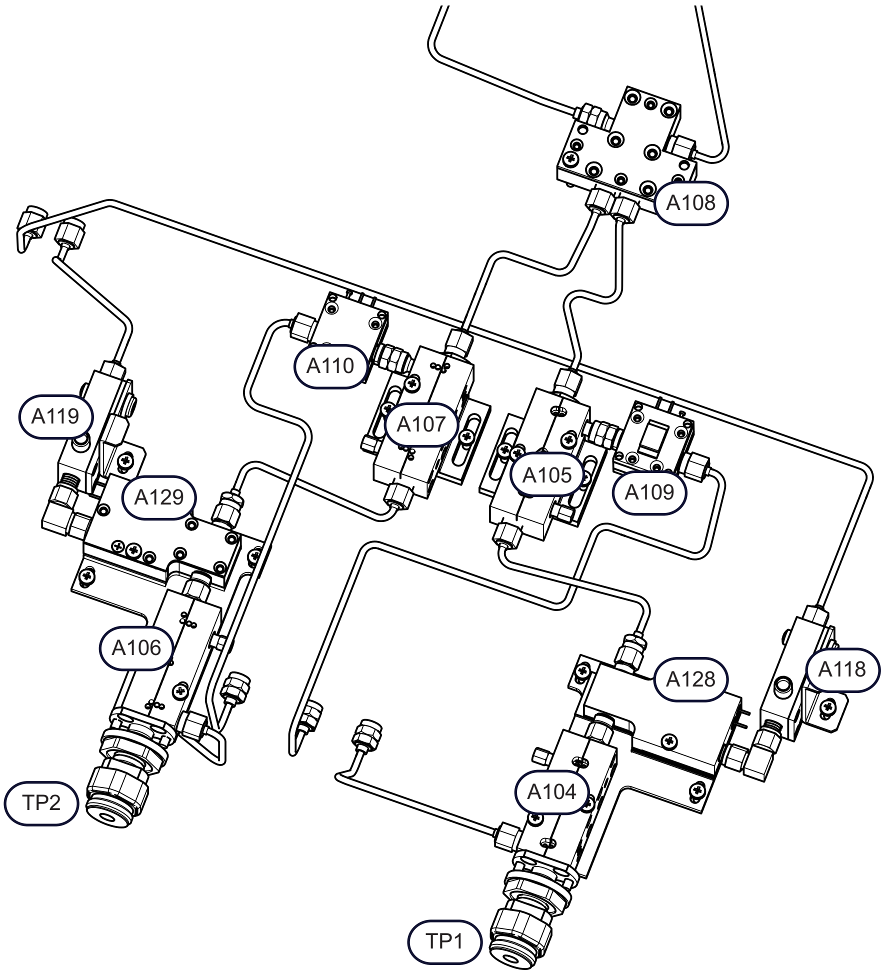
- A105 – Reference Coupler, 40 GHz
- A109 – Port 1 Level Detector, 40 GHz, K Connector
- A128 – Diplexer/Bias Tee Module, Port 1, 40 GHz
- A118 – Low Band Bridge
- A104 – Test Coupler, 40 GHz
- TP1 – Test Port Adapter K Connector – 34YK50C
- A121 – High Band Step Attenuator, Port 1 Src, 40 GHz

Port 1 Test Receiver b1

- A120 – High Band Step Attenuator, Test, Port 1 b1, 40 GHz

Figure 14-3. MS4642B – Option 31 Configuration – with Option 62 and Option 85 (2 of 2)

MS4645B / MS4647B – Standard Configuration – No Options



Test Ports (from left to right)	Test Port 1
• TP2 – Test Port 2 • TP1 – Test Port 1 **RF Control Modules** • A108 – V Integrated Switch **Test Port 2** • A107 – Reference Coupler, 70 GHz – • A110 – Port 2 Level Detector, V Connector, 70 GHz • A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz • A119 – Low Band Bridge • A106 – Test Coupler, V Connector, 70 GHz • TP2 – Test Port Adapter V Connector – 34YV50C	• A105 – Reference Coupler 70 GHz • A109 – Port 1 Level Detector, V Connector, 70 GHz • A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz • A118 – Low Band Bridge • A104 – Test Coupler, V Connector, 70 GHz • TP1 – Test Port Adapter V Connector – 34YV50C

Figure 14-4. MS4645B / MS4647B – Standard No Options: Test Port Group Modules

MS4645B / MS4647B – Standard Configuration with Option 51

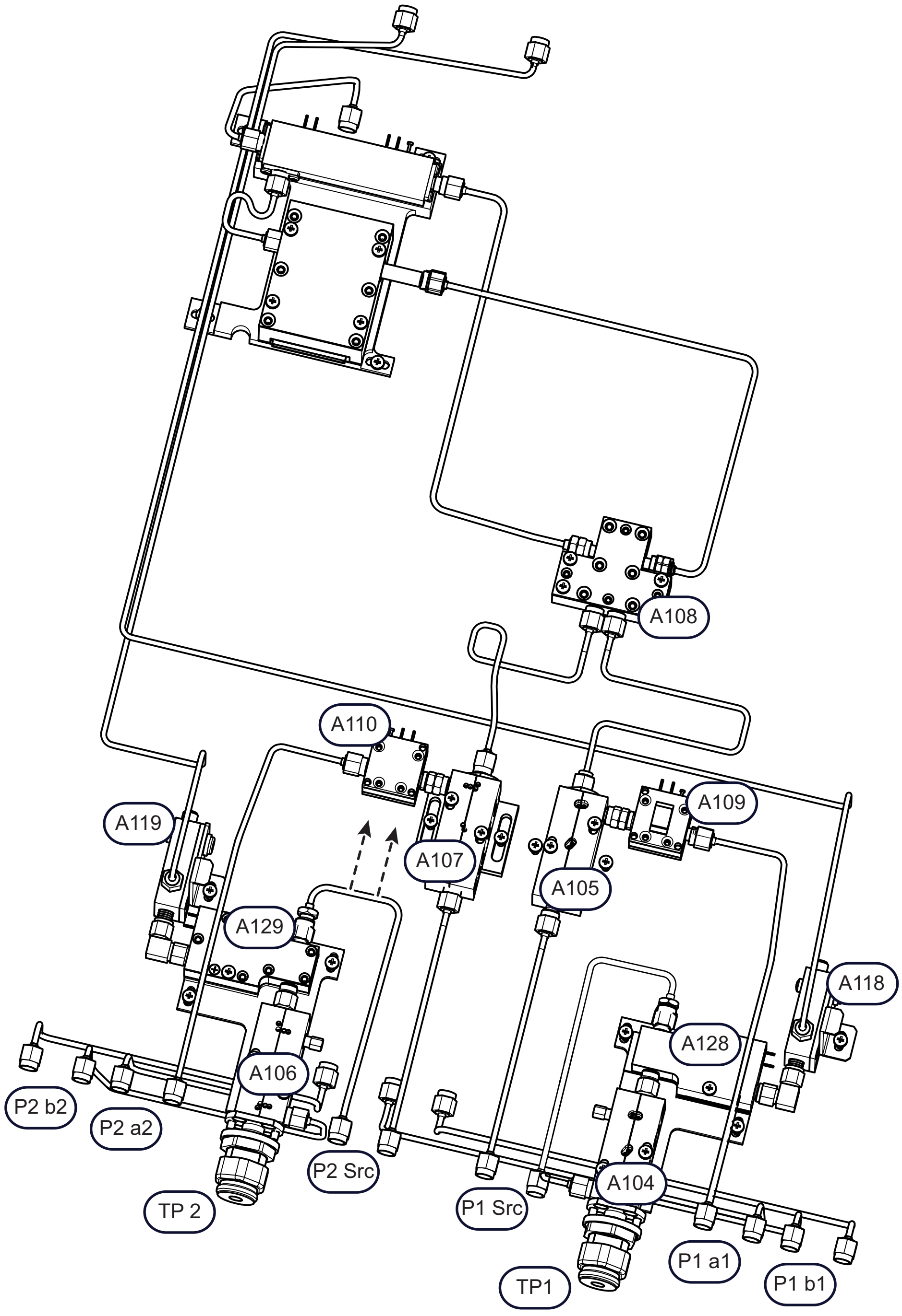


Figure 14-5. MS4645B / MS4647B – Standard Configuration – Option 51: Direct Access Loops (1 of 2)

Test Ports (from left to right)

- P2 b2 – Port 2 Test Receiver b2 –
  There are no modules connected directly to Port 2 b2.
- P2 a2 – Port 2 Reference Receiver a2 –
  There are no modules connected directly to Port 2 a2.
- TP2 – Test Port 2
- P2 Src – Port 2 Source
- P1 Src – Port 1 Source
- TP1 – Test Port 1
- P1 a1 – Port 1 Reference Receiver a1 –
  There are no modules connected directly to Port 1 a1.
- P1 b1 – Port 1 Test Receiver b1 –
  There are no modules connected directly to Port 2 b1.

RF Control Modules

- A108 – V Integrated Switch

Test Port 2

- A119 – Low Band Bridge
- A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz
- A106 – Test Coupler, V Connector, 70 GHz
- TP2 – Test Port Adapter V Connector –
  34YV50C

Port 2 Source

- A107 – Reference Coupler, 70 GHz
- A110 – Port 2 Level Detector, V Connector, 70 GHz

Port 1 Source

- A105 – Reference Coupler 70 GHz
- A109 – Port 1 Level Detector, V Connector, 70 GHz

Test Port 1

- A118 – Low Band Bridge
- A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz
- A104 – Test Coupler, V Connector, 70 GHz
- TP1 – Test Port Adapter V Connector –
  34YV50C

Figure 14-5. MS4645B / MS4647B – Standard Configuration – Option 51: Direct Access Loops (2 of 2)

MS4645B / MS4647B – Standard Configuration with Option 61

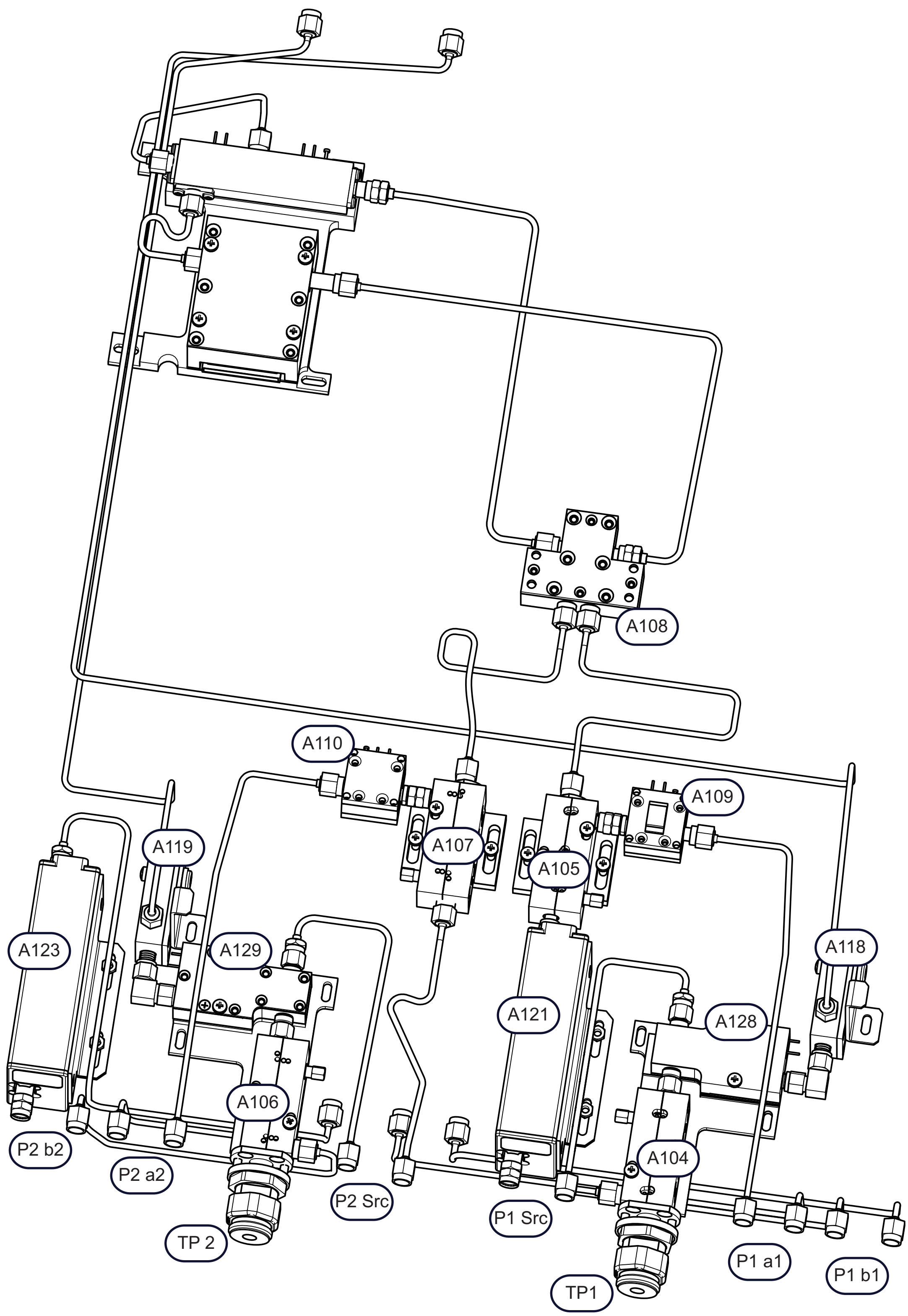


Figure 14-6. MS4645B / MS4647B – Standard Configuration with Option 61

Test Ports (from left to right)	Test Port 2
• P2 b2 – Port 2 Test Receiver b2 • P2 a2 – Port 2 Reference Receiver a2 – There are no modules connected directly to Port 2 a2. • TP2 – Test Port 2 • P2 Src – Port 2 Source • P1 Src – Port 1 Source • TP1 – Test Port 1 • P1 a1 – Port 1 Reference Receiver a1 – There are no modules connected directly to Port 1 a1. • P1 b1 – Port 1 Test Receiver b1 **RF Control Modules** • A108 – V Integrated Switch **Port 2 Test Receiver b2** • A123 – High Band Step Attenuator, V Connector	• A119 – Low Band Bridge • A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz • A106 – Test Coupler, V Connector, 70 GHz **Port 2 Source** • A107 – Reference Coupler 70 GHz • A110 – Port 2 Level Detector, V Connector, 70 GHz **Port 1 Source** • A105 – Reference Coupler 70 GHz • A109 – Port 1 Level Detector, V Connector, 70 GHz • A121 – High Band Step Attenuator, V Connector **Test Port 1** • A118 – Low Band Bridge • A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz • A104 – Test Coupler, V Connector, 70 GHz

Figure 14-6. MS4645B / MS4647B – Standard Configuration with Option 61

MS4645B / MS4647B – Standard Configuration with Option 62 s

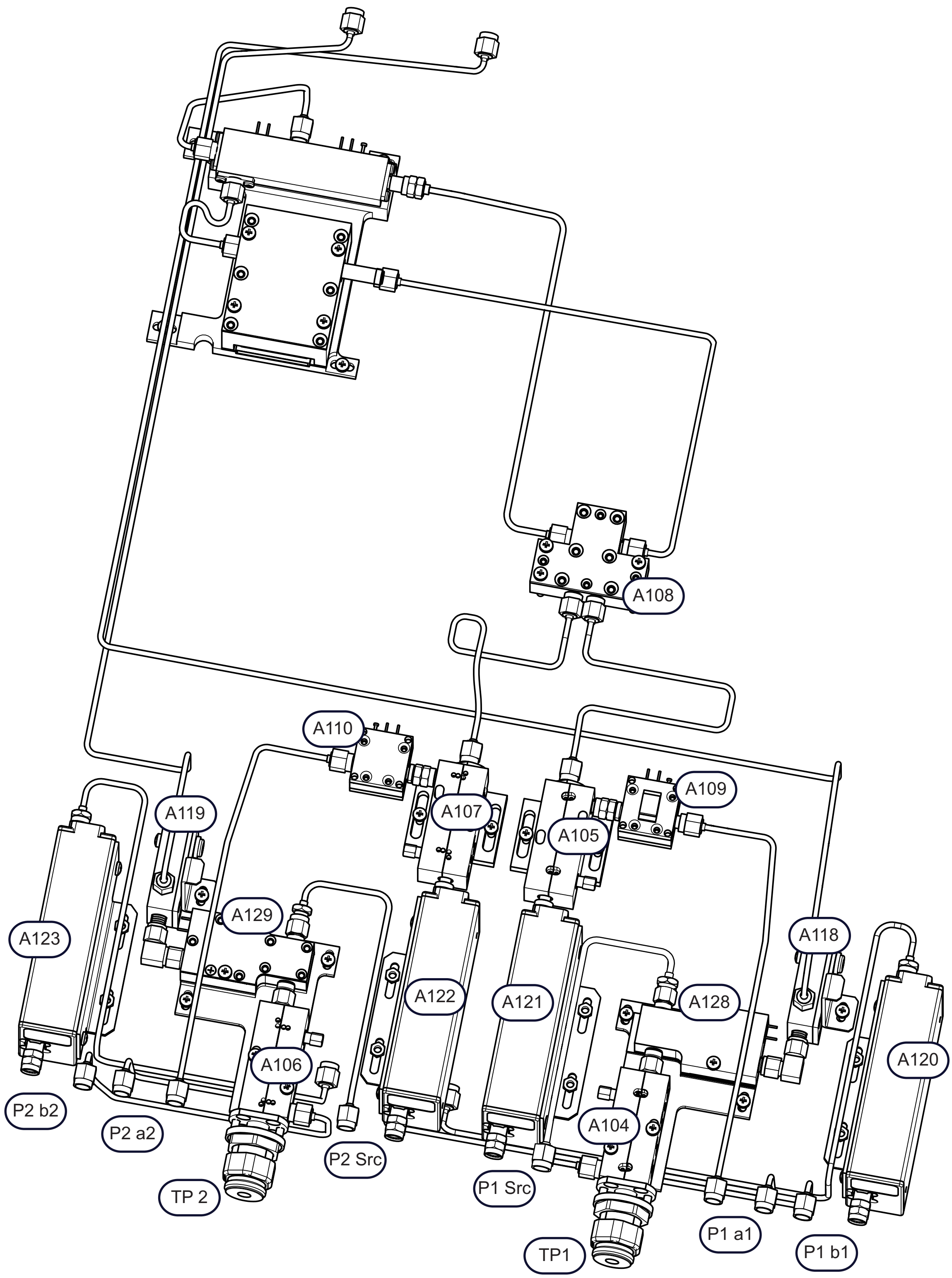


Figure 14-7. MS4645B / MS4647B – Option 62: Loops and Four Attenuators (1 of 2)

Test Ports (from left to right)

- P2 b2 – Port 2 Test Receiver b2
- P2 a2 – Port 2 Reference Receiver a2 – There are no modules connected directly to Port 2 a2.
- TP2 – Test Port 2
- P2 Src – Port 2 Source
- P1 Src – Port 1 Source
- TP1 – Test Port 1
- P1 a1 – Port 1 Reference Receiver a1 – There are no modules connected directly to Port 1 a1.
- P1 b1 – Port 1 Test Receiver b1

RF Control Modules

- A108 – V Integrated Switch

Port 2 Test Receiver b2

- A123 – High Band Step Attenuator, V Connector

Test Port 2

- A119 – Low Band Bridge
- A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz
- A106 – Test Coupler, V Connector, 70 GHz

Port 2 Source

- A107 – Reference Coupler 70 GHz
- A110 – Port 2 Level Detector, V Connector, 70 GHz
- A122 – High Band Step Attenuator, V Connector

Port 1 Source

- A105 – Reference Coupler 70 GHz
- A109 – Port 1 Level Detector, V Connector, 70 GHz
- A121 – High Band Step Attenuator, V Connector

Test Port 1

- A118 – Low Band Bridge
- A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz
- A104 – Test Coupler, V Connector, 70 GHz

Port 1 Test Receiver b1

- A120 – High Band Step Attenuator, V Connector

Figure 14-7. MS4645B / MS4647B – Option 62: Loops and Four Attenuators (2 of 2)

MS4645B / MS4647B – Option 31 Configuration with Option 62 and 85

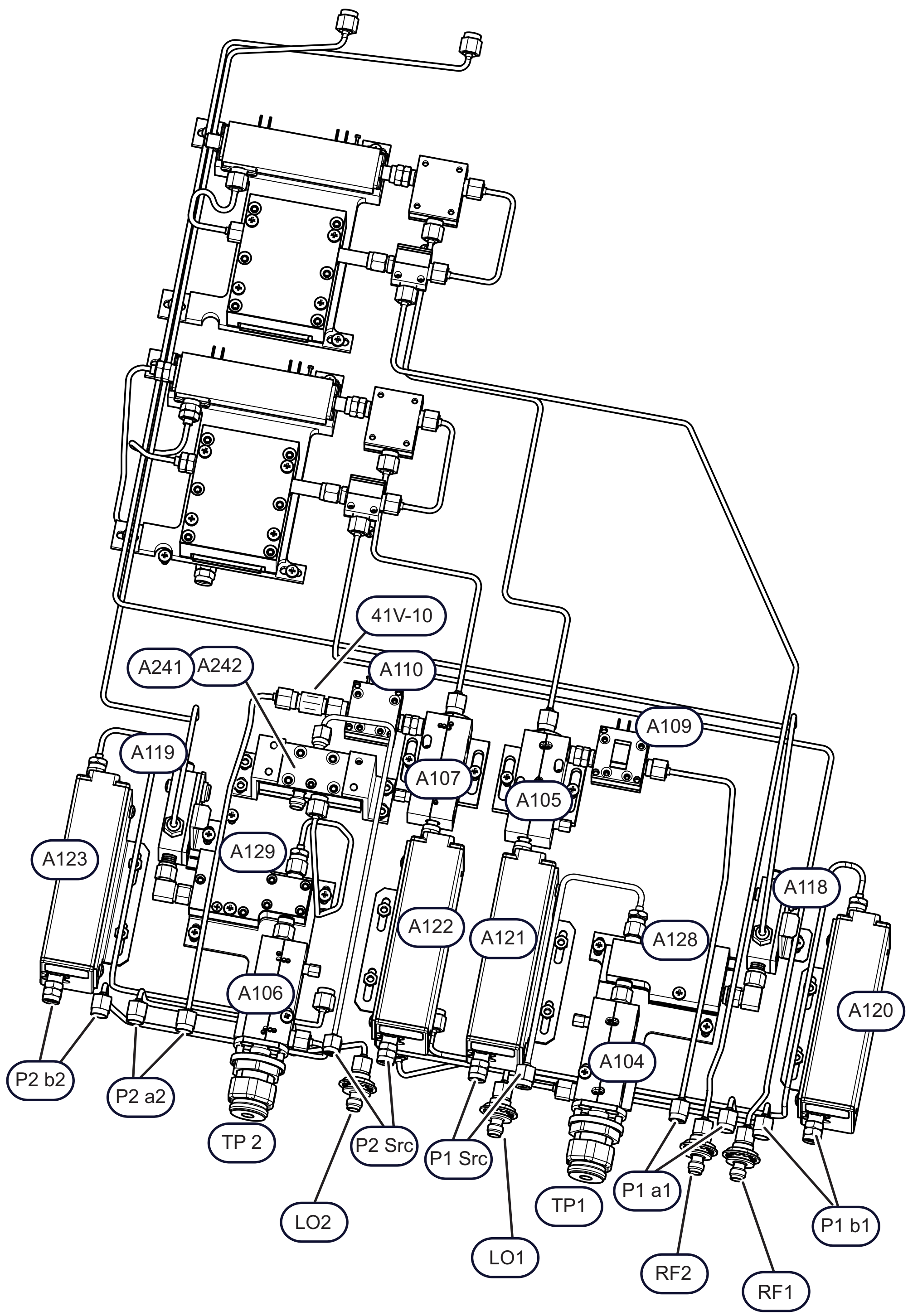


Figure 14-8. MS4645B / MS4647B – Option 31 Configuration with Option 62 and Option 85

Test Ports (from left to right)

- P2 b2 – Port 2 Test Receiver b2
- P2 a2 – Port 2 Reference Receiver a2
- TP2 – Test Port 2
- P2 Src – Port 2 Source
- P1 Src – Port 1 Source
- TP1 – Test Port 1
- P1 a1 – Port 1 Reference Receiver a1
- P1 b1 – Port 1 Test Receiver b1

Option 84 or 85 Modules and Ports

- A241 High Band Transfer Switch (HBTS), 70 GHz
- A242 (Under A241) SPDT Switch Control Assy
- LO2 Port
- LO1 Port
- RF2 Port
- RF1 Port

Port 2 Test Receiver b2

- A123 – High Band Step Attenuator, V Connector

Test Port 2

- A119 – Low Band Bridge
- A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz
- A106 – Test Coupler, V Connector, 70 GHz

Port 2 Source

- A107 – Reference Coupler 70 GHz
- **Attenuator for A110:** 10 dB V-Connector 41V-10 *(Used for MS4645B/47B with Option 84, 85, 88, or 89 only)*
- A110 – Port 2 Level Detector, V Connector, 70 GHz
- A122 – High Band Step Attenuator, V Connector

Port 1 Source

- A105 – Reference Coupler 70 GHz
- A109 – Port 1 Level Detector, V Connector, 70 GHz
- A121 – High Band Step Attenuator, V Connector

Test Port 1

- A118 – Low Band Bridge
- A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz
- A104 – Test Coupler, V Connector, 70 GHz

Port 1 Test Receiver b1

- A120 – High Band Step Attenuator, V Connector

Figure 14-8. MS4645B / MS4647B – Option 31 Configuration with Option 62 and Option 85

MS464xB – Option 32 Configuration

Option 32 is applicable to all VectorStar models that have Option 31. Option 32 configuration utilizes A241/242, A243, A142, and A144 modules in the Port Source path for instruments equipped with Option 31.

Shown in Figure 14-9 is the configuration for an MS4647B with Option 31, 32, Option 62, and Option 85. Cable configurations in the path may vary depending on model and options but the removal process is still the same.

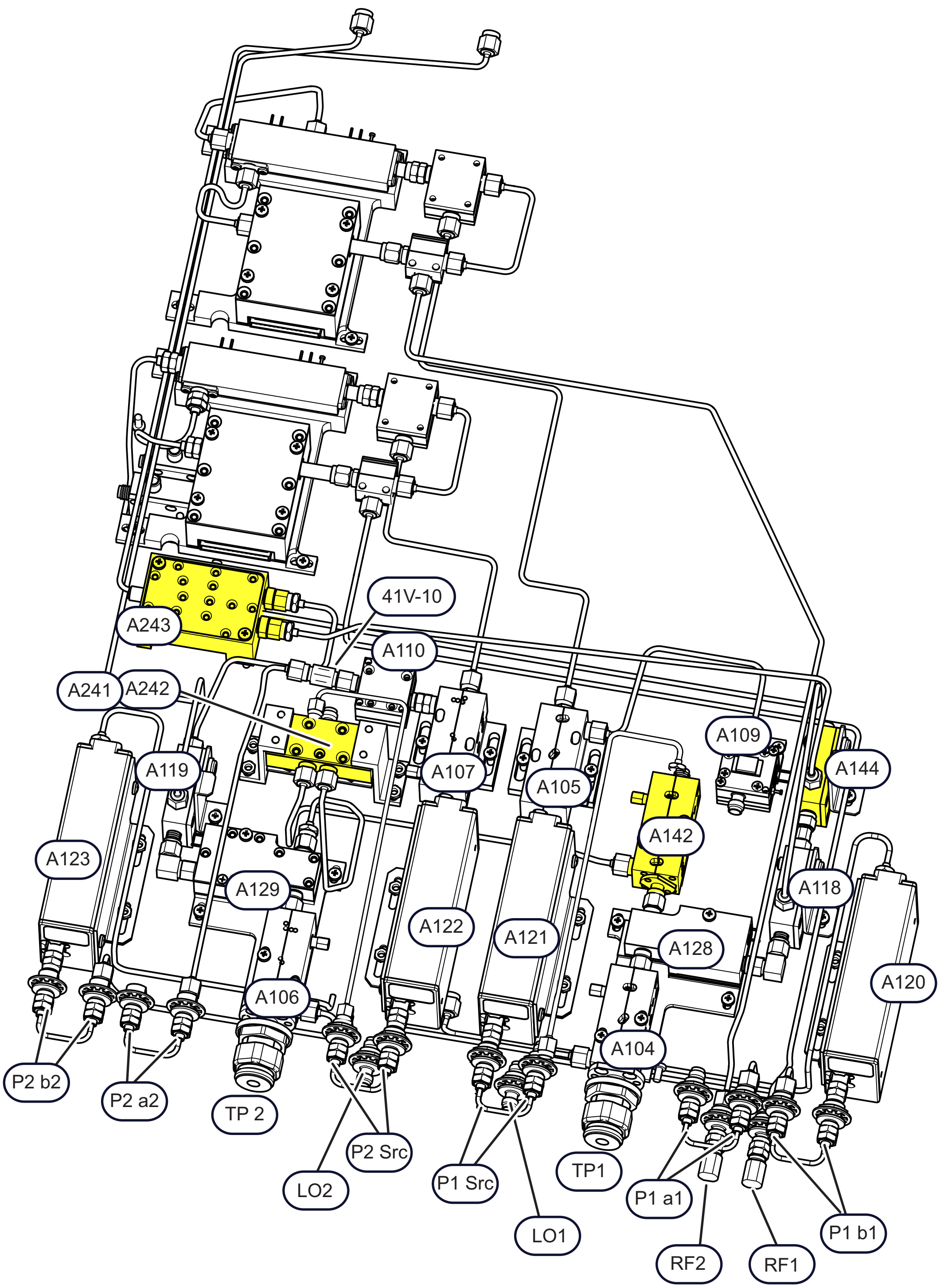


Figure 14-9. MS464xB – Option 32 Configuration (MS4647B Shown) (1 of 2)

Test Ports (from left to right)

- P2 b2 – Port 2 Test Receiver b2
- P2 a2 – Port 2 Reference Receiver a2
- TP2 – Test Port 2
- P2 Src – Port 2 Source
- LO2 Port
- P1 Src – Port 1 Source
- LO1 Port
- TP1 – Test Port 1
- P1 a1 – Port 1 Reference Receiver a1
- RF2 Port
- RF1 Port
- P1 b1 – Port 1 Test Receiver b1

Option 32 and Option 84 or 85 Modules and Ports

- A243 – Low Band Transfer Switch
- A241 – High Band Transfer Switch (HBTS), 70 GHz (for MS4645B or MS4647B)
- A241 – High Band Transfer Switch (HBTS), 40 GHz (for MS4642B or MS4644B)
- A242 (Under A241) SPDT Switch Control Assy (All Models)
- A142 – Reference Coupler, 70 GHz (for MS4645B or MS4647B)
- A142 – Reference Coupler, 40 GHz (for MS4642B or MS4644B)
- A144 – Low Band Bridge

Port 2 Test Receiver b2

- A123 – High Band Step Attenuator, V Connector

Test Port 2

- A119 – Low Band Bridge
- A129 – Diplexer/Bias Tee Module, Port 2, 70 GHz
- A106 – Test Coupler, V Connector, 70 GHz

Port 2 Source

- A107 – Reference Coupler 70 GHz
- **Attenuator for A110:** 10 dB V-Connector 41V-10 *(Used for MS4647B with Option 84, 85, 88, or 89 only)*
- A110 – Port 2 Level Detector, V Connector, 70 GHz
- A122 – High Band Step Attenuator, V Connector

Port 1 Source

- A105 – Reference Coupler 70 GHz
- A109 – Port 1 Level Detector, V Connector, 70 GHz (Relocated with Option 32)
- A121 – High Band Step Attenuator, V Connector

Test Port 1

- A118 – Low Band Bridge
- A128 – Diplexer/Bias Tee Module, Port 1, 70 GHz
- A104 – Test Coupler, V Connector, 70 GHz

Port 1 Test Receiver b1

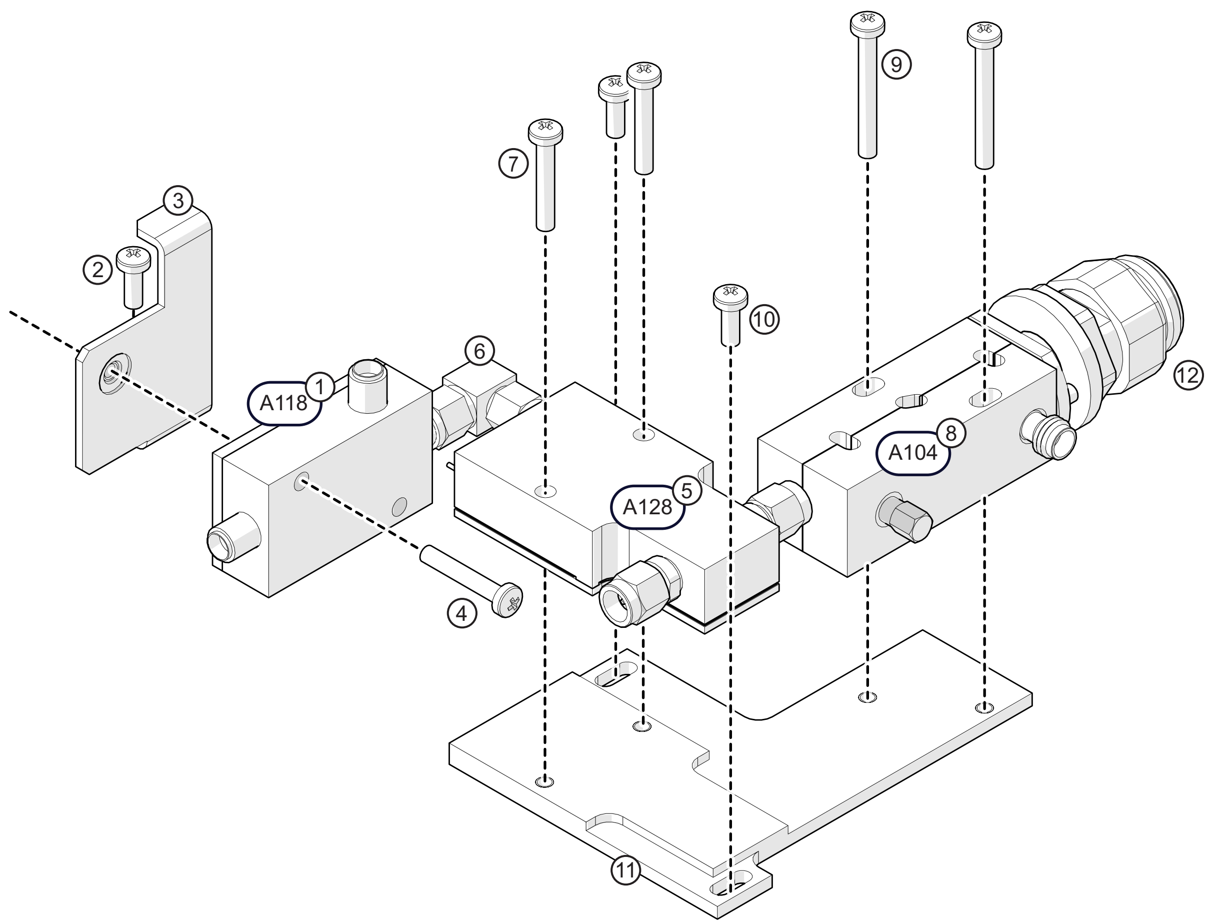
- A120 – High Band Step Attenuator, V Connector

Figure 14-9. MS464xB – Option 32 Configuration (MS4647B Shown) (2 of 2)

14-3 Port Module Subassembly Parts Identification

Test Port 1 Module Group

Figure 14-10 shows the basic port group assembly for Test Port 1. The modules shown are common to all instrument models.

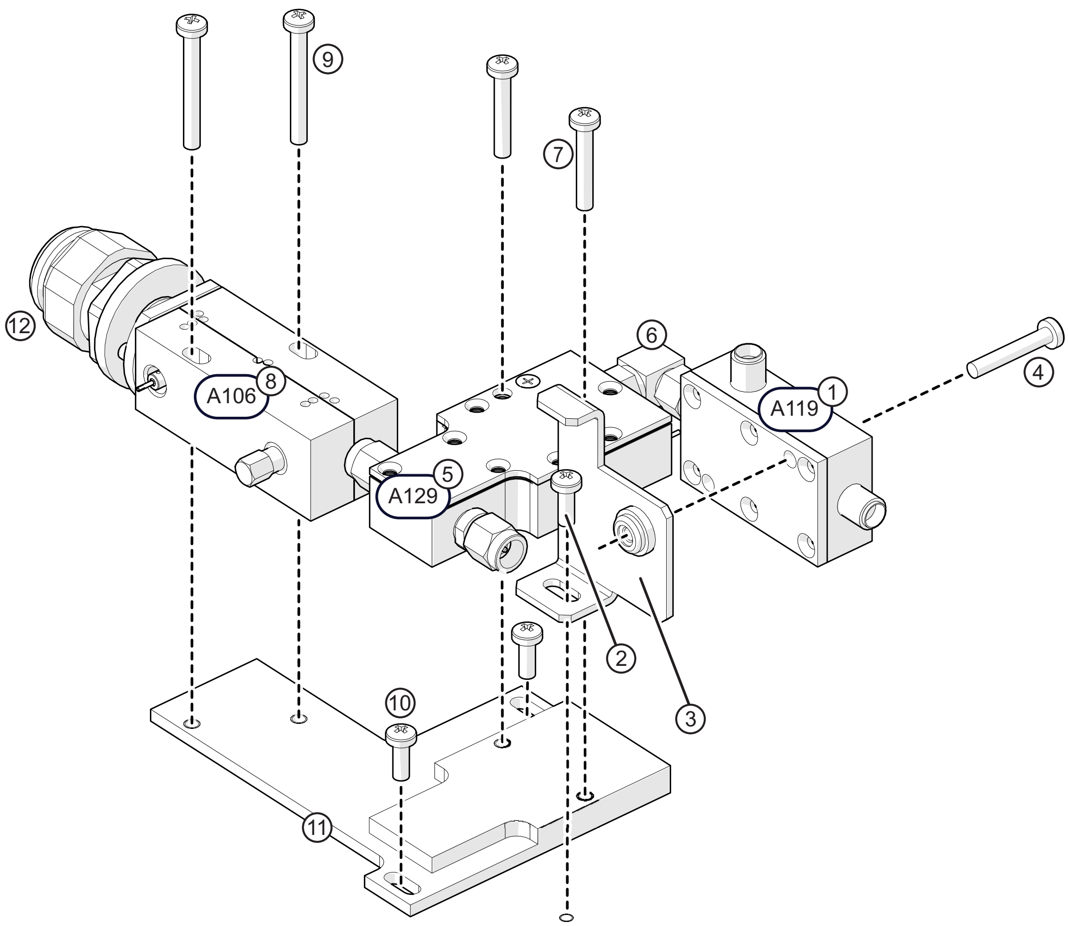


1. A118 Low Band Bridge • MS4642B / MS4644B: A118 Low Band Bridge • MS4645B / MS4647B: A118 Low Band Bridge 2. Pan head Phillips M3 × 8 mm bracket screws 3. A118 mounting bracket 4. Pan head Phillips M3 × 18 mm A118 module-to-bracket screws 5. A128 Diplexer/Bias Tee Module • MS4642B / MS4644B: A128 Diplexer/Bias Tee Module, Port 1, 40 GHz • MS4645B / MS4647B: A128 Diplexer/Bias Tee Module, Port 1, 70 GHz	6. RF Elbow Connector (m-m) A118 to A128 7. Two (2) pan head Phillips M3 × 18 mm module-to-bracket screws 8. A104 Test Port Coupler • MS4642B / MS4644B: A104 Test Coupler, 40 GHz • MS4645B / MS4647B: A104 Test Coupler, 70 GHz 9. Two (2) pan head Phillips M3 × 25 mm module-to-bracket screws 10. Two (2) pan head Phillips M3 × 8 mm bracket screws 11. A104 / A128 combination mounting bracket. 12. Test Port 1

Figure 14-10. Test Port 1 Module Group – A118, A128, and A104

Test Port 2 Module Group

Figure 14-11 shows the basic port group assembly for Test Port 2. The modules as shown are common to all instrument models.

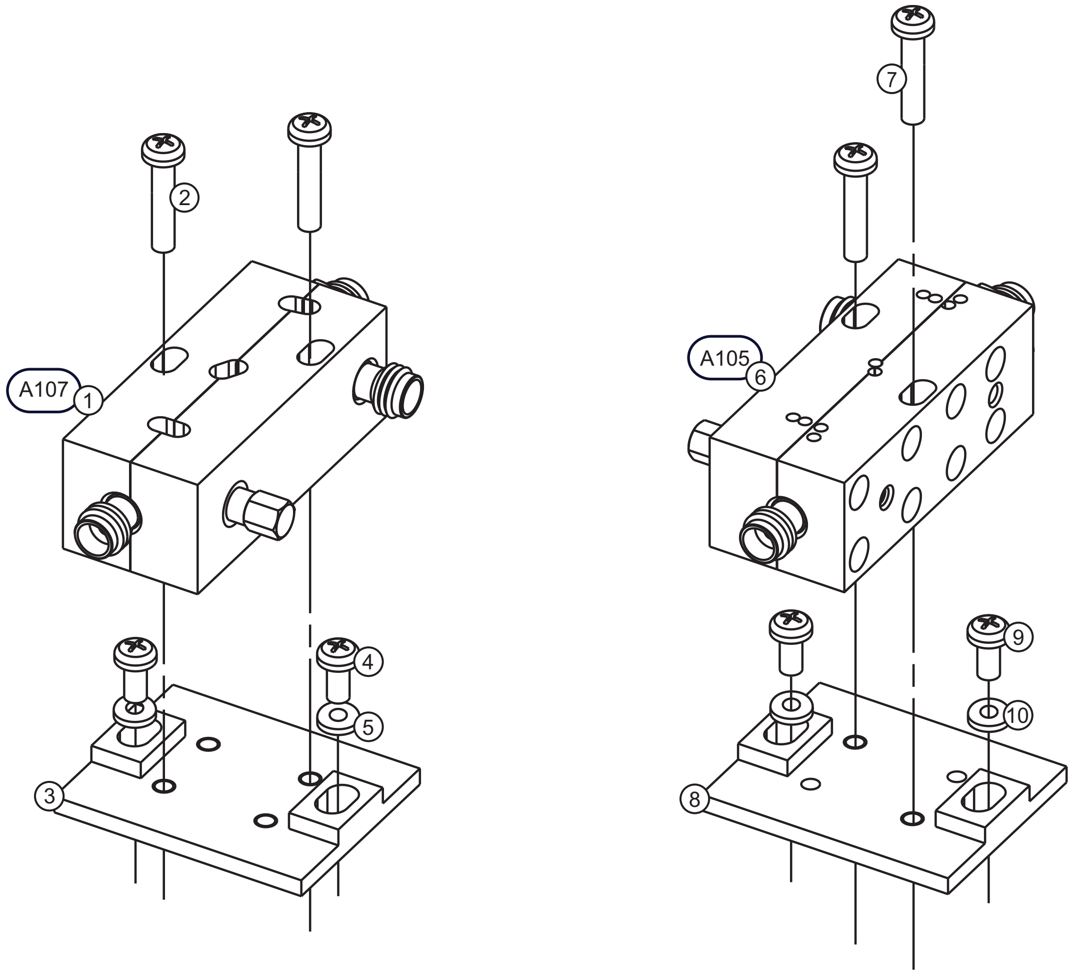


1. A119 Low Band Bridge • MS4642B / MS4644B: A119 Low Band Bridge • MS4645B / MS4647B: A119 Low Band Bridge	6. RF Elbow Connector (m-m) between A119 and A129
2. Pan head Phillips M3 × 8 mm bracket-to-chassis screws	7. Two (2) pan head Phillips M3 × 18 mm module-to-bracket screws
3. A119 mounting bracket	8. A106 Test Port Coupler • MS4642B / MS4644B: A106 Test Coupler, 40 GHz • MS4645B / MS4647B: A106 Test Coupler, 70 GHz
4. Pan head Phillips M3 × 18 mm A118 module-to-bracket screws	9. Two (2) pan head Phillips M3 × 25 mm module-to-bracket screws
5. A129 Diplexer/Bias Tee Module • MS4642B / MS4644B: A129 Diplexer/Bias Tee Module, Port 2, 40 GHz • MS4645B / MS4647B: A129 Diplexer/Bias Tee Module, Port 2, 70 GHz	10. Two (2) pan head Phillips M3 × 8 mm bracket-to-chassis screws 11. A106 / A129 combo mounting bracket 12. Test Port 2

Figure 14-11. Test Port 2 Module Group Assembly – A119, A129, and A106

A105 Port 1 and A107 Port 2 Reference Modules

Figure 14-12 shows A105/A107 Reference Coupler module and bracket assembly.

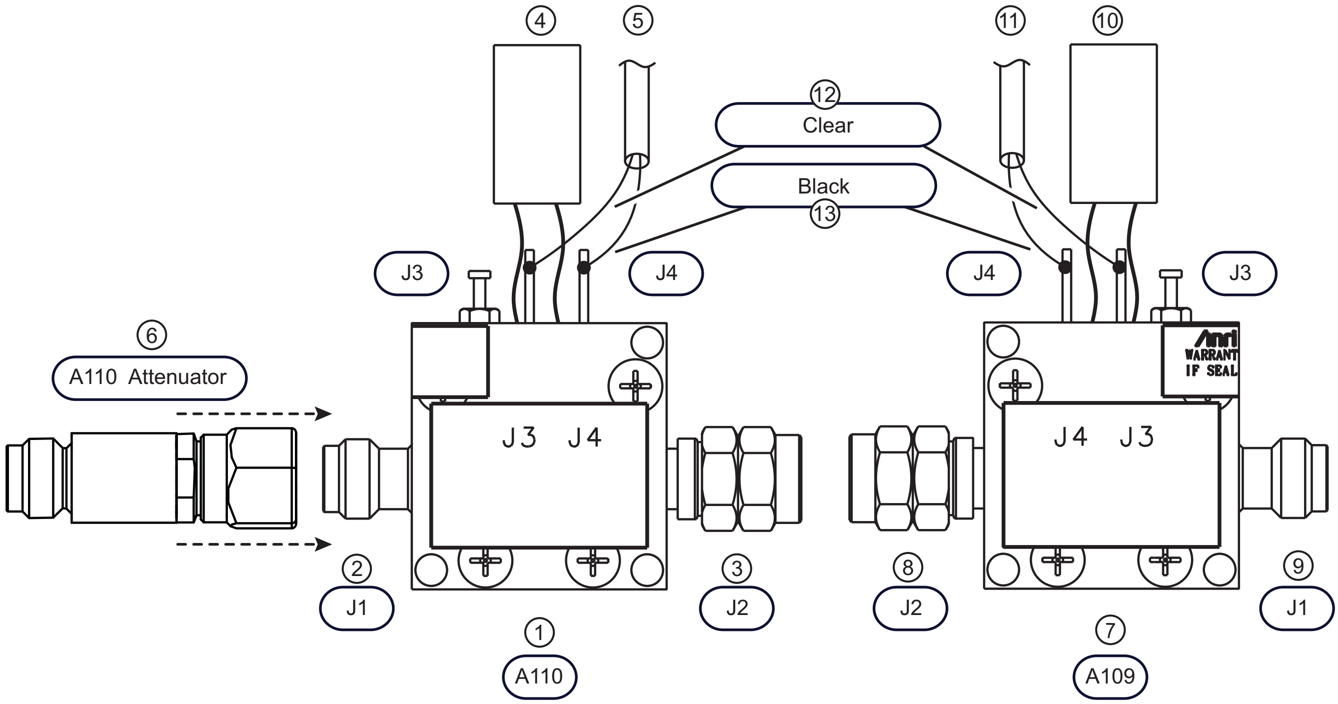


A107 – Reference Coupler	A105 – Reference Coupler
1. A107 Reference Coupler • MS4642B / MS4644B: A107 Reference Coupler, 40 GHz • MS4645B / MS4647B: A107 Reference Coupler, 70 GHz	6. A105 Reference Coupler • MS4642B / MS4644B: A105 Reference Coupler, 40 GHz • MS4645B / MS4647B: A105 Reference Coupler, 70 GHz
2. Two (2) pan head Phillips M3 × 20 mm module to bracket screws.	7. Two (2) pan head Phillips M3 × 20 mm module to bracket screws.
3. Module mounting bracket	8. Module mounting bracket
4. Two (2) pan head Phillips M3 × 8 mm screws	9. Two (2) pan head Phillips M3 × 8 mm screws
5. Two (2) #6 flat washers	10.Two (2) #6 flat washers

Figure 14-12. A105 and A107 Reference Coupler Modules and Mounting Brackets

A109 Port 1 and A110 Port 2 Level Detector Modules

Figure 14-13 shows A110 Port 2 Level Detector Module (at left) and A109 Port 1 Level Detector Module (at right). Mechanically, the MS4642B / MS4644B modules are the same as the MS4645B / MS4647B modules.

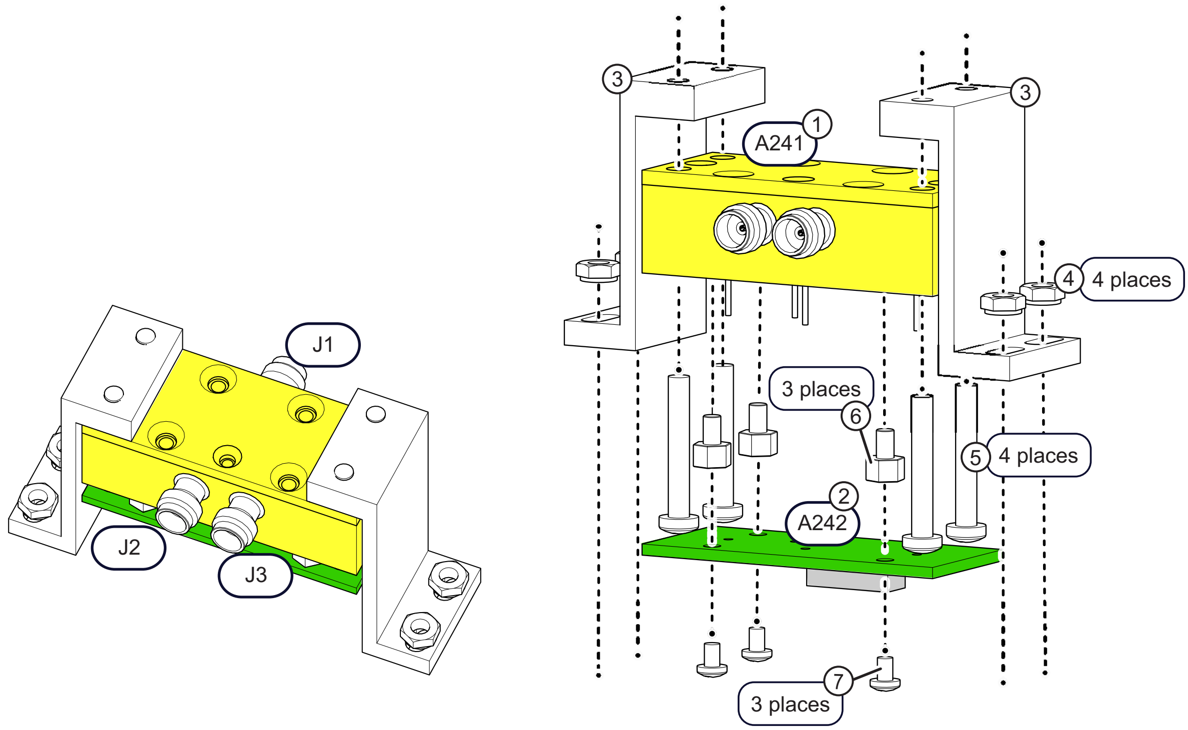


A110 Port 2 Level Detector	A109 Port 1 Level Detector
1. A110 Port 2 Level Detector • MS4642B / MS4644B (Option 51, 61 or 62) – A110 Port 2 Level Detector, K Connector, 40 GHz • MS4645B / MS4647B (Option 51, 61 or 62) – A110 Port 2 Level Detector, V Connector, 70 GHz	7. A109 Port 1 Level Detector • MS4642B / MS4644B (Option 51, 61 or 62) A109 Port 1 Level Detector, K Connector, 40 GHz • MS4645B / MS4647B (Option 51, 61 or 62) A109 Port 1 Level Detector, V Connector, 70 GHz
2. A110 port J1	8. A109 port J2
3. A110 port J2	9. A109 port J1
4. Twisted pair cable from level detector heater to A18 RF Control PCB Assembly connector J20.	10. Twisted pair cable from level detector heater to A18 PCB connector J21.
5. Coaxial cable to A18 PCB connector J5	11. Coaxial cable to A18 PCB connector J6.
A110 Attenuator (Option 84/85/88/89)	12. Clear wire
6. MS4642B/44B: Attenuator:10 dB K-Connector 41KC-10 *(Only used with Option 84,85, 88, or 89)* MS4645B/47B: Attenuator:10 dB V-Connector 41V-10 *(Only used with Option 84, 85, 88, or 89)*	13. Black wire

Figure 14-13. A110 Port 2 Level Detector and A109 Port 1 Level Detector Modules

A241 / A242 – Option 84 and Option 85 Switch Assembly

A switch/controller assembly is added to the Port 2 path when Option 84 or 85, and/or Option 32 are included.



A241/A242 Switch Assembly	
1. A241 SPDT Switch • MS4642B / 44B – A241 SPDT Switch – 40 GHz • MS4645B / 47B – A241 SPDT Switch – 70 GHz	4. KEP Nut – M3 x 0.5905 – 4 places
2. A242 – SPDT Switch Control Assembly	5. Screw – M3 x 20 mm PHMS Phillips (cross recessed) – 4 places
3. Switch Bracket – 2 places	6. Standoffs – 3 each
	7. Screw – 0.086-56 x 0.125 x 0.125-N – 3 places

Figure 14-14. A241/A242 Assembly (Option 84 or 85 and/or Option 32)

14-4 System Disassembly

Caution	Do not perform any RF Deck procedures unless the instrument is turned off and disconnected from AC Power. Damage to RF components may occur if certain inputs/outputs are removed with live RF power.

Refer to Section 8-2 “Preparation of Work Area and Safety Instructions” on page 8-1.

1. Prepare work area, work surface, and observe safety issues.
   - Refer to “Preparation of Work Area and Safety Instructions” on page 8-1
2. Remove Outer Cover.
   - Refer to “Remove Outer Cover” on page 8-3.
3. Position the instrument so that it is right-side up, RF deck down.
4. Remove Inner Top Cover.
   - Refer to “Remove Inner Cover” on page 8-5.
5. The Front Panel can stay in place.
6. Position the instrument so that it is topside down, with the RF Deck facing up.

14-5 Module Replacement Procedures

This section provides instructions to replace the modules listed below The basic procedure is to remove A108 switch and then disassemble the port group module-by-module until the module targeted for replacement is removed.

Note	For systems equipped with Option 31 Second Source, A108 is not used. In this case, the cables connected to A107 or A105 are simply disconnected to access the module path. Because of the widely varied model and option configurations, the illustrations in this section are for reference only and may not precisely reflect the RF deck in your system. However, the procedures are still applicable for all configurations with a few exceptions. Procedures for these exceptions are also included in this section

MS4642B / MS4644B

- A106 Test Coupler, 40 GHz
- A104 Test Coupler, 40 GHz
- A107 Reference Coupler, 40 GHz
- A105 Reference Coupler, 40 GHz
- A110 Port 2 Level Detector, 40 GHz, K Connector
- A109 Port 1 Level Detector, 40 GHz, K Connector
- A241/A242 Switch Assembly (Option 84 or Option 85)
  - A241 SPDT Switch – 40 GHz
  - A242 Switch Controller
- A119 Low Band Bridge
- A118 Low Band Bridge
- A129 Diplexer/Bias Tee Module, Port 2, 40 GHz
- A128 Diplexer/Bias Tee Module, Port 1, 40 GHz
- Test Port Adapter K Connector, Port 2 – 34YK50C

- Test Port Adapter K Connector, Port 1 – 34YK50C
- A120 / A123 High Band Step Attenuator (Port 1 b1 and Port 2 b2), 40 GHz
- A121 / A122 High Band Step Attenuator (Port 1 Source and Port 2 Source), 40 GHz

MS4645B / MS4647B

- A106 Test Coupler, V Connector, 70 GHz
- A104 Test Coupler, V Connector, 70 GHz
- A107 Reference Coupler, Port 2, 70 GHz
- A105 Reference Coupler, Port 1, 70 GHz
- A110 Port 2 Level Detector, V Connector, 70 GHz
- A109 Port 1 Level Detector, V Connector, 70 GHz
- A119 Low Band Bridge
- A118 Low Band Bridge
- A129 Diplexer/Bias Tee Module, Port 2, 70 GHz
- A128 Diplexer/Bias Tee Module, Port 1, 70 GHz
- Test Port Adapter V Connector, Port 2 – 34YV50C
- Test Port Adapter V Connector, Port 1 – 4YV50C
- A241/A242 Switch Assembly (Option 84 or Option 85)
    - A241 SPDT Switch – 70 GHz
    - A242 Switch Controller – ND
- A120 / A121 / A122 / A123 High Band Step Attenuator, (Port 1 b1, Port 2 b2, Port 1 Source, Port 2 Source), 70 GHz

Test Port Module Replacement – Standard Configuration with No Options

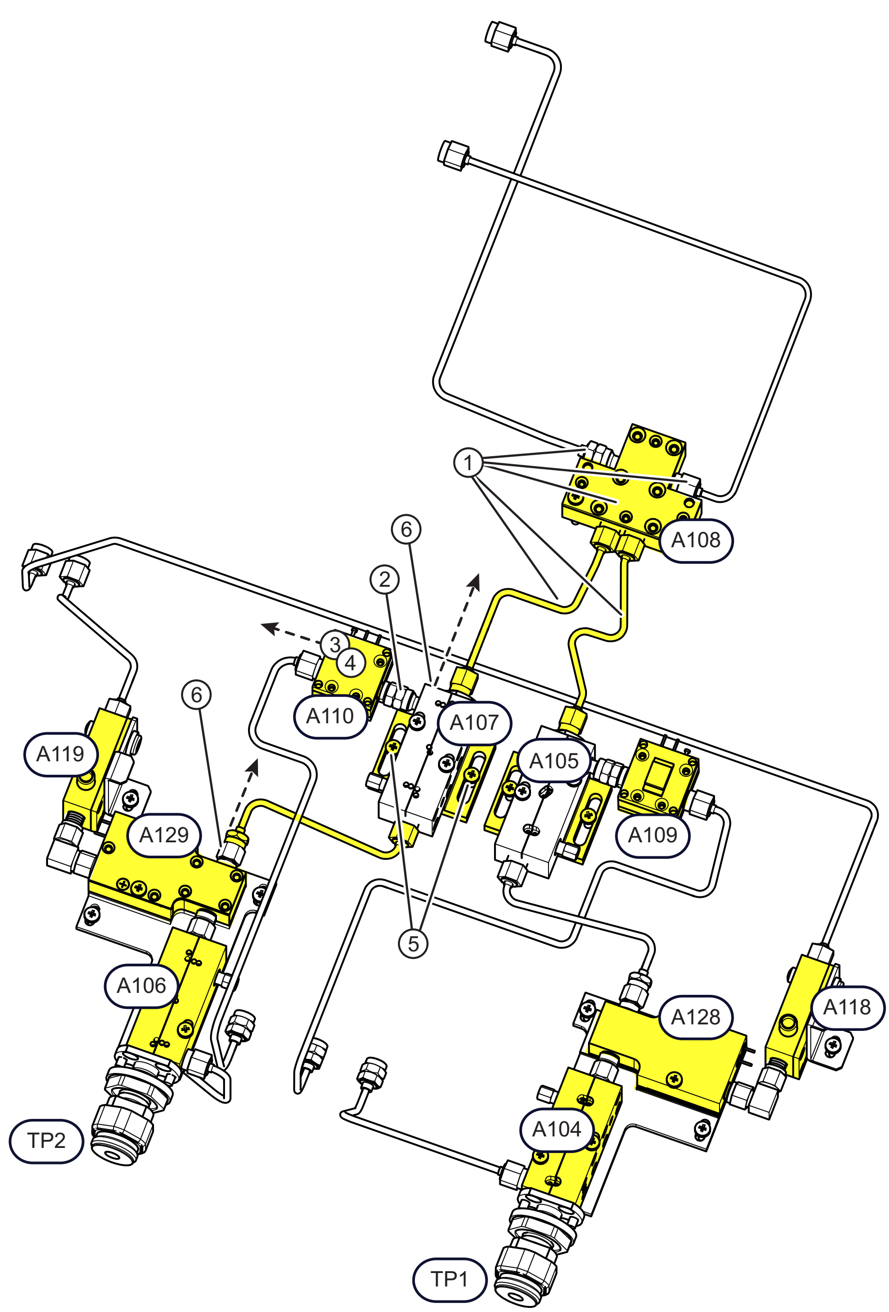


Figure 14-15. Test Port Module Replacement: Standard Configuration with No Options

Remove A108 HBTS/VITS

1. Remove A108 HBTS/VITS and cables following the procedure steps in Section 13-6 "A108 HBTS/VITS Module Replacement" on page 13-36.

Note	This replacement procedure provides step by step instructions for Port 2 modules. The same procedure applies to the port 1 modules.

Disconnect A110 (or A109)

2. Use a 5/16” 8 lbf · in torque end wrench to loosen and then remove the RF connection between A107 and A110.
3. Move A110 slightly out of the way.
4. If replacing A110 or A109, disconnect the semi-rigid cable from its J1 port and the signal cable from its connection on A18, making note of its connector number.

Loosen A107 (or A105) Chassis Mounting Bracket

5. Loosen the bracket-to-chassis mounting hardware on the A107 bracket. Do not remove.
6. Using a 5/16” torque end wrench set to 8 lbf · in loosen and disconnect the semi-rigid cable from J2 on A129. As you are disconnecting the cable, slide A107 toward chassis rear until the connector nut is clear of J2 on A129
7. If replacing A107 (or A105), remove the screws holding the module to the mounting plate and install the new module.

Disconnect A119 (or A118)

8. Remove A119 bracket-to-chassis hardware. The bracket stays attached to A119.
9. Use an 8 lbf · in torque end wrench and a plain end wrench to loosen the elbow RF connection between A119 and A129. Remove the elbow RF connector from A129 and leave it on A119.
10. Move A119 slightly out of the way.
11. If replacing A119 (or A118), transfer the mounting bracket to the new module and install.

Remove A129 (or A128)

12. Loosen the A129/A106 shared bracket-to-chassis hardware but do not remove.
13. Remove the module-to-bracket hardware holding A129 to the bracket.
14. Remove the module-to-bracket hardware holding A106 to the bracket.
15. Use a 5/16” torque end wrench set to 8 lbf · in to loosen the RF Connection between A129 and A106 and then remove the connection.
16. Remove A129 from the bracket.
17. If replacing A129 (or A128), install to the bracket according to the reassembly instructions below.

Remove Test Port 1 (or Test Port 2) Adapter

18. Use a 1/2” torque end wrench set to 36 lbf · in to loosen the Test Port Adapter on the Test Port. Once loose, use finger pressure to carefully remove the Test Port Adapter, taking care not to damage the center pin.
    - The detailed removal/installation procedure is in Section 9-2, “Replace Front Panel Test Ports” on page 9-1.

Remove A106 (or A104) Test Port Mounting Hardware

19. Use a 13/16” torque socket wrench set to 15 lbf · ft to loosen the Test Port nut.
    - Recommended is a torque wrench set to 15 lbf · ft with a 13/16” deep socket on a 3/8” drive.
20. When loose, use finger pressure to remove the Test Port Nut and then remove the Test Port Thrust washer.

Remove A106 (or A104)

21. If not already done, remove the module-to-bracket hardware holding A106 to the bracket.
22. Remove A106 from the chassis. Leave the mounting bracket in place on the chassis.
23. If replacing A106 (or A104), follow the reassembly instructions below.

Caution	**When installing a series of interconnected RF modules, the general hardware installation sequence is:** 1. Place the first module into its position in the chassis. 2. Carefully align, thread, and finger tighten the RF connector to its receiving connector, but do *not torque yet.* 3. Loosely install the module mounting plate-to-chassis mounting screws or nuts but *do not tighten yet*. 4. Torque the RF connection to 8 lbf· in. 5. Place the next module into its position in the chassis. 6. Carefully align, thread, and finger tighten the RF connector to the module previously installed but *do not torque yet.* 7. Loosely install the module mounting plate-to-chassis mounting screws or nuts but *do not tighten yet*. 8. Torque the RF connection to 8 lbf· in. 9. Continue this sequence until all modules are installed. 10. Once all modules are installed and the RF interconnects are torqued, tighten all chassis mounting hardware. 11. After all chassis mounting hardware is tight, perform a final torquing of all RF connections to 8 lbf · in.

Install A106 (or A104)

24. Place A106 into position with its threaded end through the front panel.

25. Loosely insert the two module-to-bracket screws *but do not yet tighten*.

Note	Before tightening the module-to-bracket mounting screws, ensure the threaded test port is in full contact with the front panel.

Install A106 (or A104) Test Port Mounting Hardware

26. From the front panel, add the test port thrust washer and then the test port nut.

27. Use a 13/16” torque socket wrench set to 15 lbf · ft to tighten the Test Port nut.

28. Tighten the module-to-bracket screws.

Install Test Port 2 (or Test Port 1) Adapter

29. Install the Test Port Adapter on the Test Port.

Carefully align the adapter with the center pin of the test port connector, and make sure it is correctly threaded. Tighten finger tight and then use a 1/2” torque end wrench to torque to 36 lbf · in.

Install A129 (or A128)

30. Place A129 into position next to A106. Carefully align their RF connectors and make sure they are correctly threaded. Tighten the connection finger tight.

31. Torque the RF connection between A106 and A129 to 8 lbf · in.

32. Insert the two module-to-bracket screws and then tighten.

Install A107 (or A105)

33. Place A107 bracket into the chassis. Loosely insert two bracket-to-chassis screws.

34. Make sure A107 RF connector is correctly aligned and threaded with A129 RF connector. Tighten the connection finger tight.

Install A108

35. Install A108 HBTS/VITS back into its socket on A18 PCB by carefully following the procedure in Section 13-6, “A108 HBTS/VITS Module Replacement” on page 13-36.

Connect A119 (or A118)

36. Bend the semi-rigid coaxial cables attached to A119 so that the elbow RF connector between A119 and A129 is correctly aligned and A119 bracket is aligned with its chassis mounting hole.

37. Loosely insert the bracket-to-chassis screws.

38. Make sure both of the RF elbow connectors are correctly aligned, threaded and then tighten finger tight.

Tighten and Torque A119 and A129 (or A118 and A128)

39. Using two end wrenches (a 5/16” plain end wrench and a 5/16” torque end wrench set to 8 lbf · in), torque the two elbow RF connections.

40. Tighten A119 bracket-to-chassis screws.

41. Tighten A129 module-to-chassis screws.

Connect A110 (or A109)

42. Connect the side-attached A110.

43. Move the semi-rigid coaxial cables attached to A110 so that the RF connectors between A110 and A107 are correctly aligned and threaded. Tighten the RF connection finger tight.

44. Make sure A110 harnesses are correctly and fully inserted into their sockets on A18 RF Control PCB Assembly.

45. Torque the RF connection between A110 and A107 to 8 lbf · in.

Final Checks

46. Check that all cables are correctly routed and firmly seated in their connectors.

47. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued to 8 lbf · in.

48. Ensure all chassis mounting hardware is tightened.

Test Port Module Replacement – Option 51, 61, 62

Use this procedure to replace one or more modules within the Test Port 2 or Test Port 1 port module groups on instruments equipped with:

- Option 51 Direct Access Loops
- Option 61 Direct Access Loops and Two Attenuators
- Option 62 Direct Access Loops and Four Attenuators

The basic procedure is to remove the port group components until the to-be-replaced module is removed from the instrument.

Note	With Option 51, 61, and 62, each Test Port module group is not attached to the A108 HBTS/VITS, Therefore A108 does not need to be removed to service the port module groups.

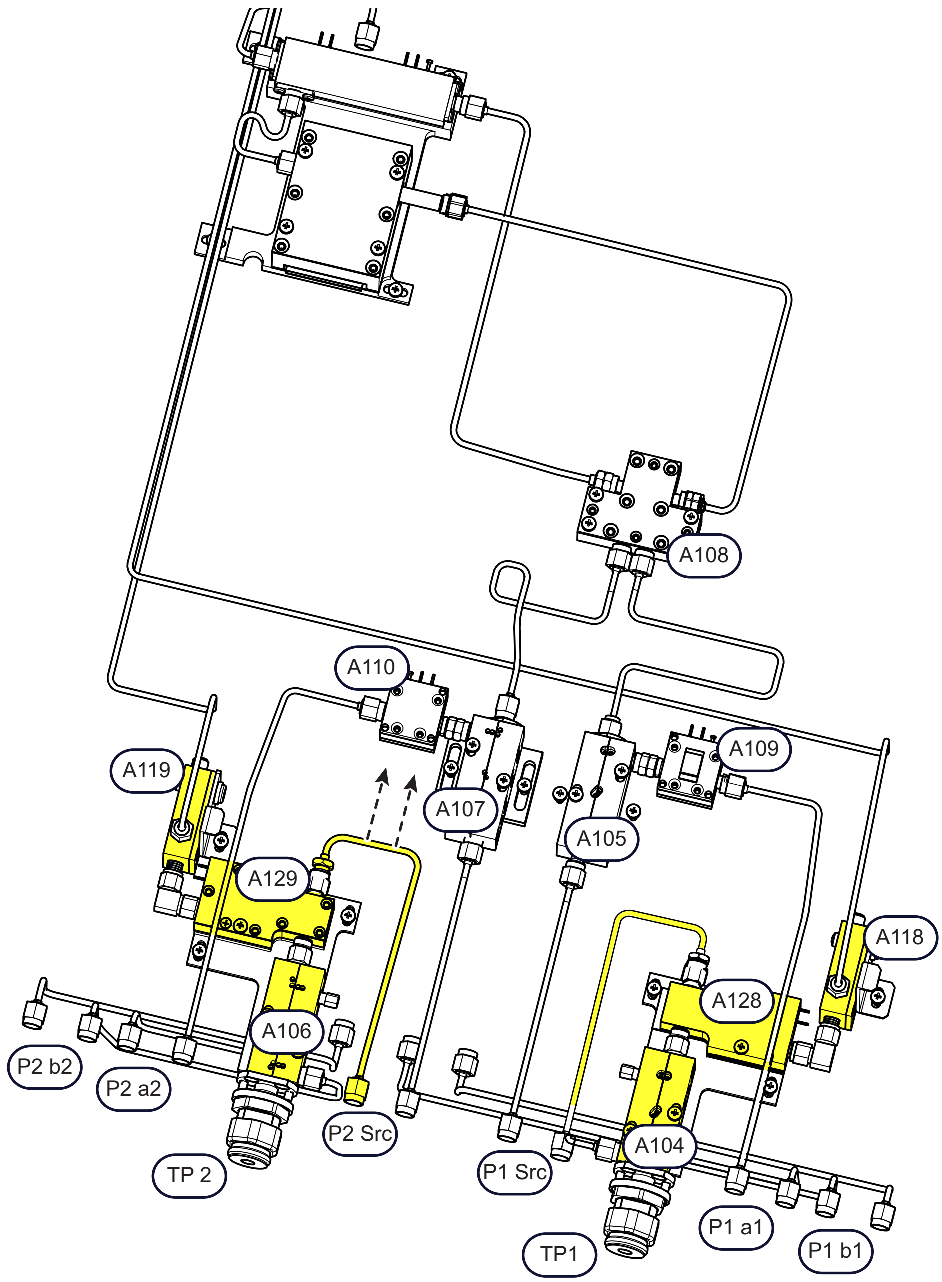


Figure 14-16. Test Port Module Replacement: Option 51, 61, 62 (Showing Option 51) (1 of 2)

Test Port Module Configuration – Systems with Option 51

- Illustration shows MS4645B / MS4647B with Option 51 (no Step Attenuators)
- Mechanical configuration is the same for MS4642B / MS4644B.
- Shaded modules and cables are either disconnected or removed.

Test Port Modules

- MS4642B / MS4644B: A119 or A118 – Low Band Bridge
- MS4645B / MS4647B: A119 or A118 – Low Band Bridge
- MS4642B / MS4644B: A129 or A128 – Diplexer/Bias Tee Module, 40 GHz
- MS4645B / MS4647B: A129 or A128 – Diplexer/Bias Tee Module, 70 GHz
- MS4642B / MS4644B: A106 or A104 – Test Coupler, 40 GHz
- MS4645B / MS4647B: A106 or A104 – Test Coupler, 70 GHz
- MS4642B / MS4644B: Test Port Adapter K Connector 34YK50C
- MS4645B / MS4647B: Test Port Adapter V Connector – 34YV50C

Figure 14-16. Test Port Module Replacement: Option 51, 61, 62 (Showing Option 51) (2 of 2)

Note	The port module groups in this configuration are not attached to A108 HBTS/VITS. Therefore, A108 does not need to be removed to service the modules in these port groups. This procedure specifies the steps for replacing the modules for Port 2. The same procedure can be used to replace the modules for Port 1.

Disconnect A119 (or A118)

1. Remove the A119 bracket-to-chassis hardware. The bracket stays attached to A119.
2. Use a 5/16” torque end wrench set to 8 lbf · in and a plain end wrench to loosen the elbow RF connection between A119 and A129. Remove the elbow RF connector from A129 and leave it on A119.
3. Gently move the semi-rigid coaxial cables connected to A119 so that it is out of the way.
4. If replacing A119 or A118, disconnect the semi-rigid cables, transfer the mounting bracket to the new module and reinstall if no other modules in the path need to be replaced.

Remove A129 (or A128)

5. Disconnect and remove the semi-rigid cable between J2 on A129 and the front panel (or A107).
6. Loosen but do not remove the chassis mounting hardware holding A129, A106, and their shared bracket to the chassis.
7. Remove the hardware holding A129 to the bracket.
8. Remove the hardware holding A106 to the bracket.
9. Use a 5/16” torque end wrench set to 8 lbf · in to loosen the RF Connection between A129 and A106 and then remove the connection.
10. Remove A129 from the chassis.
11. If replacing A129, install the new module according to the reassembly instructions below.

Remove Test Port 1 or Test Port 2 Adapter

12. Use a 1/2” torque end wrench set to 36 lbf · in to loosen the Test Port Adapter on the Test Port. Once loose, use finger pressure to carefully remove the Test Port Adapter, taking care not to damage the center pin.
    - The detailed removal/installation procedure is in Section 9-2, “Replace Front Panel Test Ports” on page 9-1.

Remove A106 (or A104) Test Port Hardware

13. Use a 13/16” torque socket wrench set to 15 lbf · ft to loosen the Test Port nut.
    - Recommended is a torque wrench set to 15 lbf · ft with a 13/16” deep socket on a 3/8” drive.
14. When loose, use finger pressure to remove the Test Port Nut and then remove the Test Port Thrust washer.

Remove A106 (or A104)

15. If not already done, remove the module-to-bracket hardware holding A106 to the bracket.
16. Remove A106 from the chassis. Remove the mounting bracket from the chassis.

Install A106 (or A104)

17. Place A106 into position with its threaded end through the front panel. Loosely insert the two module-to-bracket screws.

Note	Before tightening the bracket-to-chassis or the module-to-bracket mounting screws, ensure the threaded port is in full contact with the front panel.

18. Tighten the module-to-bracket screws.
19. From the front panel, add the test port thrust washer and then the test port nut.
20. Use a 13/16” torque socket wrench set to 15 lbf · ft to tighten the Test Port nut.

Install the Test Port 2 (or Test Port 1) Test Port Adapter

21. Install the Test Port Adapter on the Test Port.
22. Carefully align the center pin of the test port connector, and make sure it is correctly threaded. Tighten finger tight and then use a 1/2” torque end wrench to torque to 36 lbf · in.

Install A129 (or A128)

23. Place A129 into position next to A106. Carefully align their RF connectors and make sure they are correctly threaded. Tighten the connection finger tight.
24. Insert the two module-to-bracket screws and then tighten.
25. Torque the RF connection between A106 and A129 to 8 lbf · in.

Connect A119 (or A118)

26. Connect the side-attached A119.
27. Gently move the semi-rigid coaxial cables attached to A119 so that the elbow RF connector between A119 and A129 is correctly aligned and A119 bracket is aligned with its chassis mounting hole.
28. Make sure both of the RF elbow connectors are correctly aligned, threaded and then tighten finger tight.
29. Loosely insert the bracket-to-chassis mounting screws.

Tighten and Torque A119 and A129 (or A118 and A128)

30. Tighten the A119 bracket-to-chassis screw.
31. Tighten A129 module-to-chassis screws.
32. Using two end wrenches (a 5/16” plain end wrench and a 5/16” torque end wrench set to 8 lbf · in), torque the two elbow RF connections.
33. Tighten the bracket-to-chassis screws on the A129/A106 mounting bracket.

Final Checks

34. Check that all cables are correctly routed and firmly seated in their connectors.
35. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued.

A105 or A107 Replacement – Standard Configuration with Option 51

Use this procedure to remove and replace A107 or A105 module in the Port Source (P2 Src or P1 Src) port module groups for instruments equipped with Option 51.

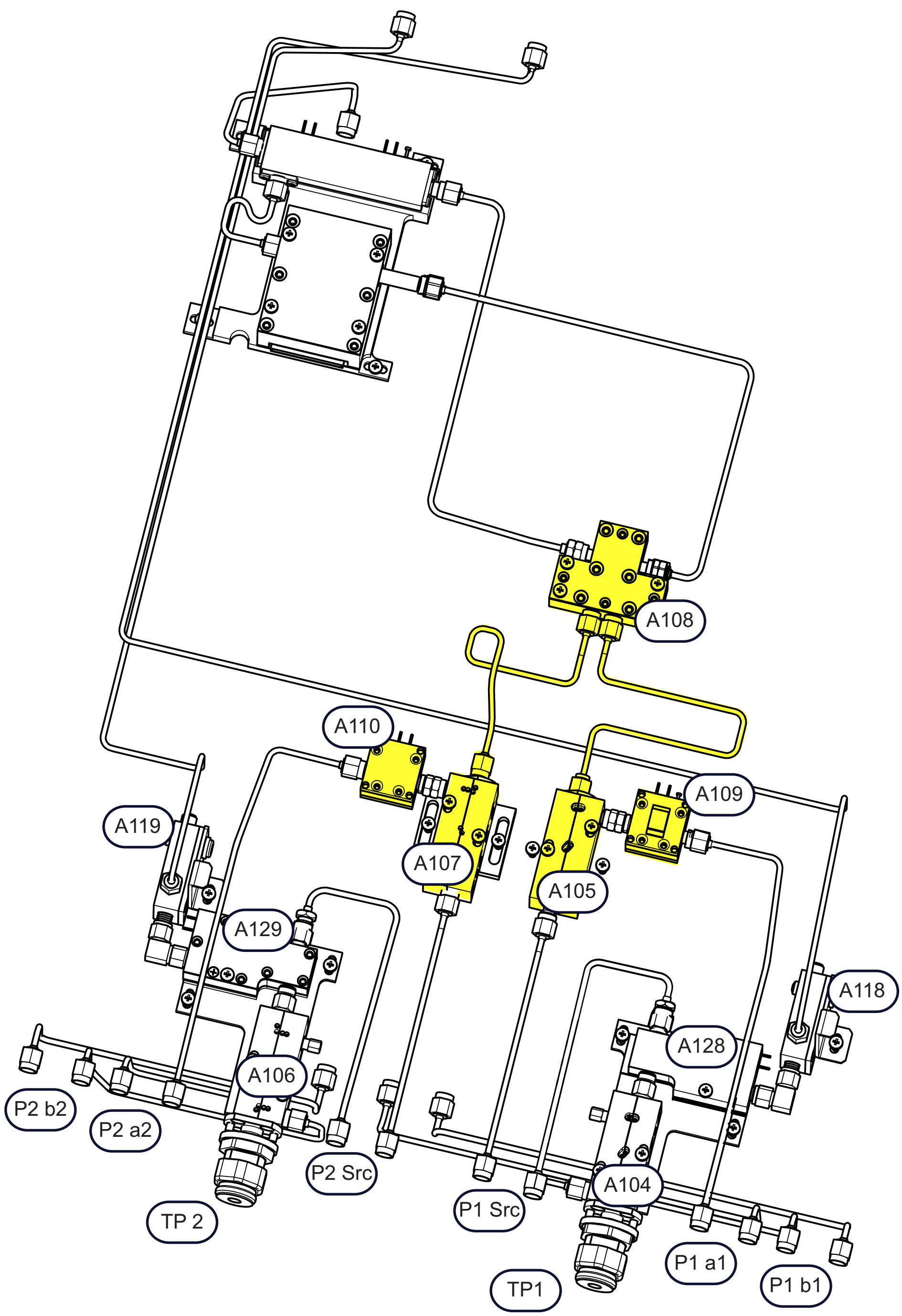


Figure 14-17. A105 or A107 Replacement: Option 51: Port Source Modules (1 of 2)

• Shown is MS4645B/MS4647B with Option 51. • Mechanical configuration is the same for MS4642B / MS4644B. • Shaded modules are either disconnected or removed in this procedure.	**Port Source Modules** • MS4642B / MS4644B: A108 High Band Transfer Switch, 40 GHz • MS4645B / MS4647B: A108 V Integrated High Band Transfer Switch, 70 GHz • MS4642B / MS4644B: A105 or A107 Reference Coupler, 40 GHz • MS4645B / MS4647B: A105 or A107 Reference Coupler, 70 GHz • MS4642B / MS4644B: A109 or A110 Port Level Detector, K Connector, 40 GHz • MS4645B / MS4647B: A109 or A110 Port Level Detector, V Connector, 70 GHz

Figure 14-17. A105 or A107 Replacement: Option 51: Port Source Modules (2 of 2)

Parts and Applicability

Use this procedure to remove and replace the following Port Source modules:

- MS4642B / MS4644B: A107 or A105 Reference Coupler, 40 GHz
- MS4645B / MS4647B: A107 or A105 Reference Coupler, 70 GHz

Note	This procedure specifies the steps for replacing the modules for Port 2. The same procedure can be used to replace the modules for Port 1.

Remove A108 HBTS/VITS

1. Remove A108 HBTS/VITS, following the steps in Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36.

Disconnect A110 (or A109)

2. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and then remove the RF connection between A107 and A110.
3. Gently move A110 and its attached semi-rigid coaxial cables slightly out of the way.

Remove A107 (or A105)

4. Loosen A107 bracket-to-chassis mounting hardware.
5. Loosen and then remove the semi-rigid coaxial cable between A107 and the front panel Port Source port.
6. Remove A107 bracket-to-chassis hardware. Remove the module-to-bracket hardware.
7. Remove A107 and its bracket from the chassis.

Install A107 (or A105)

1. Place A107 mounting bracket in the chassis.
2. Loosely insert the bracket-to-chassis mounting screws. Do not tighten.
3. Place A107 module in the chassis and connect the semi-rigid coaxial cable between the module and the front panel Port Source port.
4. Carefully align and thread the RF connectors between the coaxial cable and A107 module. Do not tighten.
5. Torque the RF cable connection to the front panel to 8 lbf · in.
6. Insert and thread the module-to-bracket mounting hardware.
7. Tighten the module-to-bracket mounting hardware.

8. Do not yet tighten the bracket-to-chassis mounting hardware.

Install A108

9. Install A108 HBTS/VITS back into its socket on A18 PCB by carefully following the procedure in Section 13-6, "A108 HBTS/VITS Module Replacement" on page 13-36.
10. Check that A108 HBTS/VITS module-to-PCB mounting hardware is tight.
11. Check that all RF connections between A108 HBTS/VITS and A107 and A108 are correctly torqued.
12. Check that the bracket-to-chassis and module-to-bracket mounting hardware for A107 is tight.

Connect A110 (or A109)

13. Gently move the semi-rigid coaxial cables connected to A110 back into place until the RF connectors between A110 and A107 are lined up.
14. Carefully align and thread the RF connection between the two modules.
15. When correctly threaded, tighten using finger pressure and then torque the connection to 8 lbf · in.
16. Tighten A107 module-to-bracket mounting hardware.
17. Tighten the bracket-to-chassis mounting hardware.

Final Checks

18. Check that all cables are correctly routed and firmly seated in their connectors.
19. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued.

A105 or A107 Replacement – Standard Configuration with Option 61

Use this procedure to remove and replace A107 or A105 modules in the Port Source (P2 Src or P1 Src) port module groups for instruments equipped with Option 61.

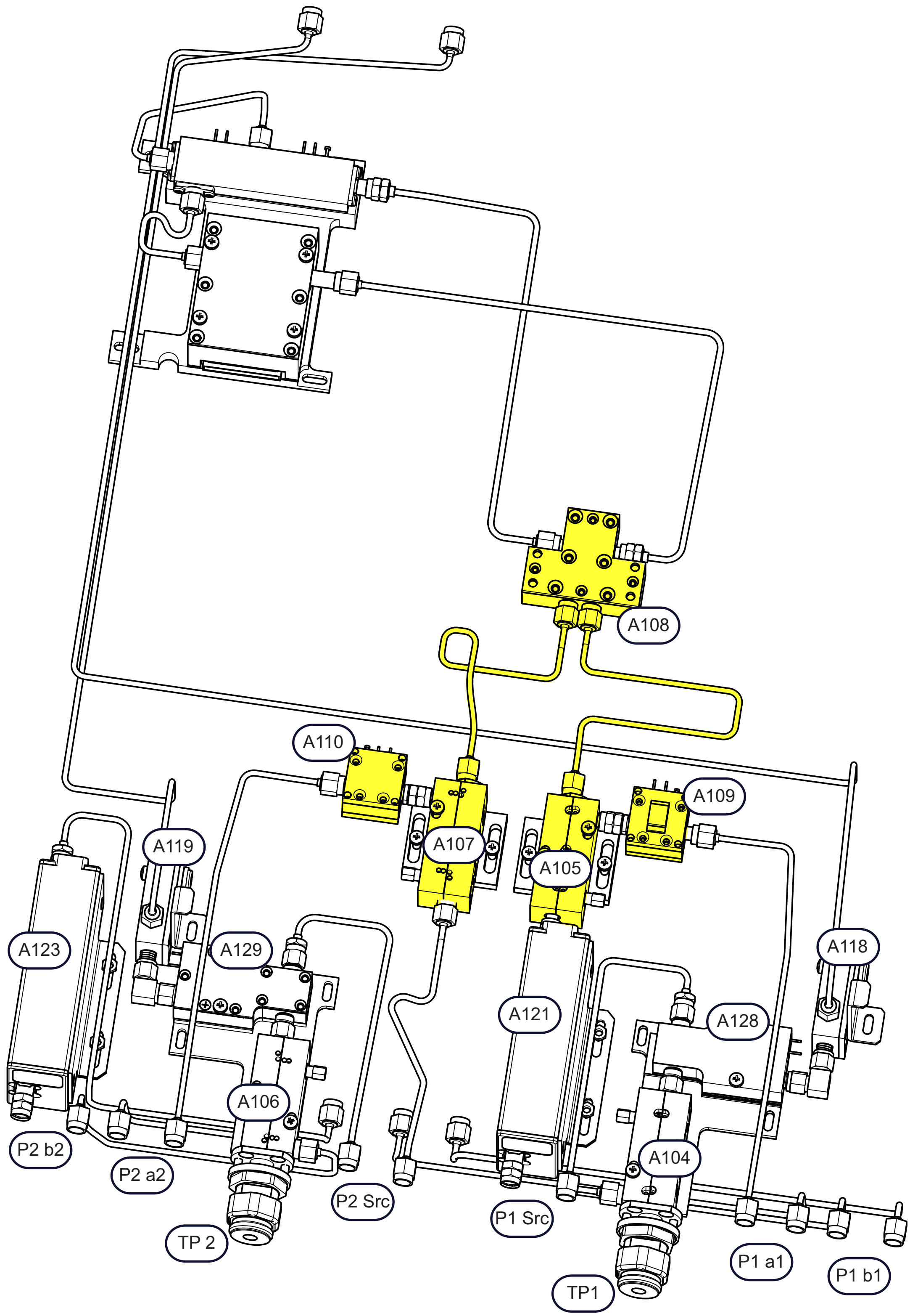


Figure 14-18. A105 or A107 Replacement: Option 61: Port Source Modules (1 of 2)

Port Source Modules – Option 61	Port Source Modules
• Model shown is MS4645B / MS4647B with Option 61. • Mechanical configuration is the same for MS4642B / MS4644B. • Shaded modules are either disconnected or removed in this procedure.	• MS4642B / MS4644B: A108 High Band Transfer Switch, 40 GHz • MS4645B / MS4647B: A108 V Integrated High Band Transfer Switch, 70 GHz • MS4642B / MS4644B: A107 or A105 Reference Coupler, 40 GHz • MS4645B / MS4647B: A105 Reference Coupler, 70 GHz • MS4642B / MS4644B: A109 Port 1 Level Detector, K Connector, 40 GHz • MS4645B / MS4647B: A109 Port 1 Level Detector, V Connector, 70 GHz

Figure 14-18. A105 or A107 Replacement: Option 61: Port Source Modules (2 of 2)

Parts and Applicability

Use this procedure to remove and replace the following Port Source modules:

- MS4642B / MS4644B: A107 or A105 Reference Coupler, 40 GHz
- MS4645B / MS4647B: A107 or A105 Reference Coupler, 70 GHz

Note	This procedure specifies the steps for replacing the modules for Port 1. The same procedure can be used to replace the modules for Port 2.

Remove A108 HBTS/VITS

1. Remove A108 HBTS/VITS, following the steps in Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36.

Disconnect A109 (or A110)

2. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and then remove the RF connection between A105 and A109.
3. Gently move A109 and its attached semi-rigid coaxial cable slightly out of the way.

Remove A105 (or A107)

4. Loosen A105 bracket-to-chassis mounting hardware but do not remove.
5. Loosen the connection between J3 of A105 and J2 of A121. (If removing A107, disconnect it from the semi-rigid coaxial cable attached between J3 and the front panel.)
6. Remove A105 module-to-bracket hardware.
7. Remove A105 from the chassis.

Install A105 (or A107)

1. Place A105 mounting bracket in the chassis.
2. Loosely insert the bracket-to-chassis mounting screws. Do not tighten.
3. Place A105 module in the chassis and connect it to A121.
4. Carefully align and thread the RF connector between A121 and A105 module. Do not yet tighten.
5. Insert and thread the module-to-bracket mounting hardware.
6. Tighten the module-to-bracket mounting hardware.
7. Do not yet tighten the bracket-to-chassis mounting hardware.

Install A108

8. Install A108 HBTS/VITS back into its socket on A18 PCB by carefully following the procedure in Section 13-6, “A108 HBTS/VITS Module Replacement” on page 13-36.
9. Check that A108 HBTS/VITS module-to-PCB mounting hardware is tight.
10. Check that the RF connections between A108 HBTS/VITS and A105 and A107 are correctly torqued.

Connect A109 (or A110)

11. Gently move the semi-rigid coaxial cables connected to A109 back into place until the RF connectors between A109 and A105 are lined up.
12. Carefully align and thread the RF connection between the two modules.
13. When correctly threaded, tighten using finger pressure and then torque the connection to 8 lbf · in.
14. Tighten the bracket-to-chassis mounting hardware.

Final Checks

15. Check that all cables are correctly routed and firmly seated in their connectors.
16. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued.

A105 or A107 Replacement – Standard Configuration with Option 62

Use this procedure to remove and replace A107 or A105 modules in the Port Source (P2 Src or P1 Src) port module groups for instruments equipped with Option 62.

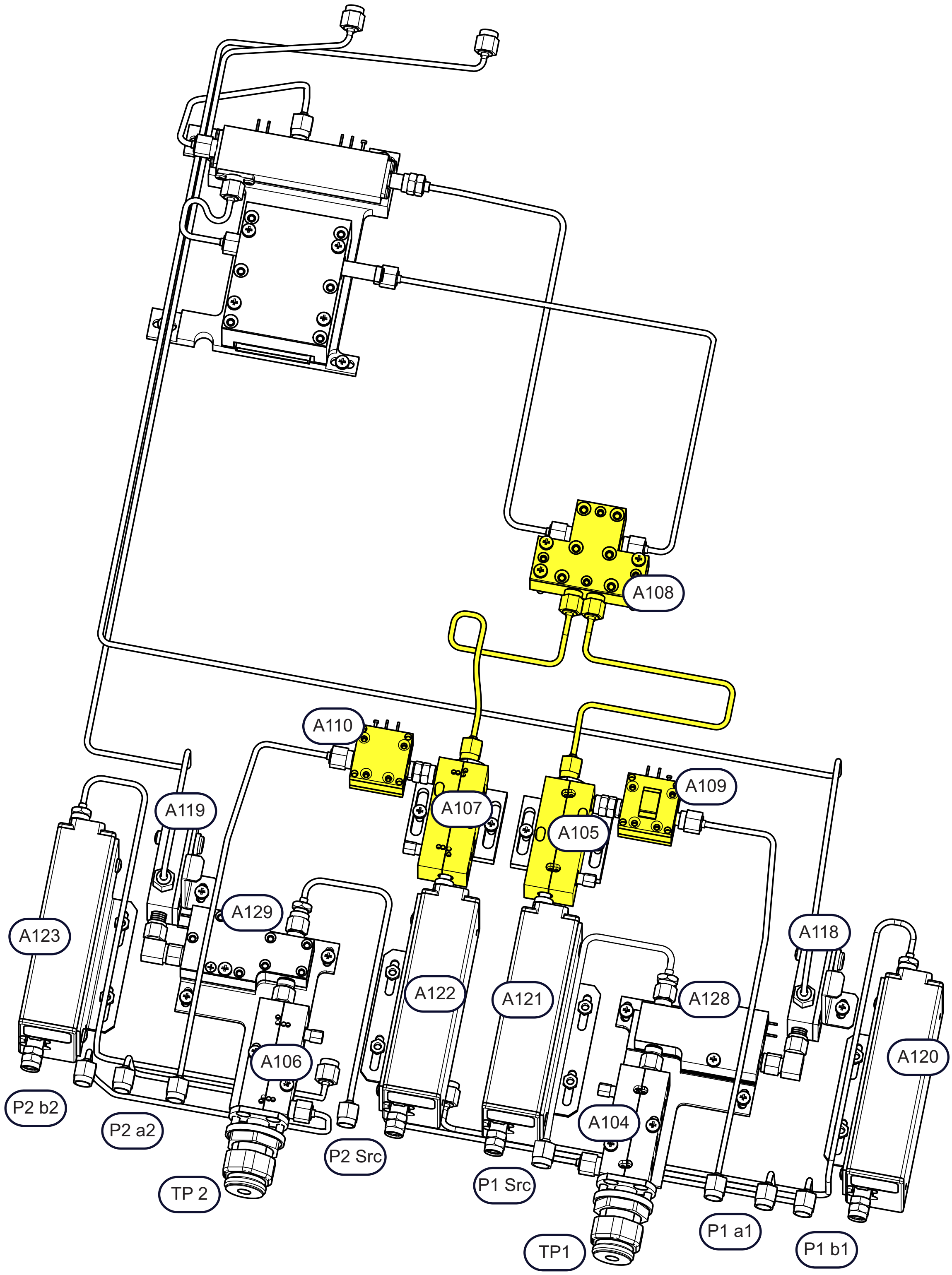


Figure 14-19. A105 or A107 Replacement: Option 62: Port Source Modules (1 of 2)

Port Source Modules – Option 62	Port Source Modules
• Model shown is MS4645B / MS4647B with Option 62. • Mechanical configuration is the same for MS4642B / MS4644B. • Shaded modules are either disconnected or removed in this procedure.	• MS4642B / MS4644B: A108 High Band Transfer Switch, 40 GHz • MS4645B / MS4647B: A108 V Integrated High Band Transfer Switch, 70 GHz • MS4642B / MS4644B: A107 or A105 Reference Coupler, 40 GHz • MS4645B / MS4647B: A105 Reference Coupler, 70 GHz • MS4642B / MS4644B: A109 Port 1 Level Detector, K Connector, 40 GHz • MS4645B / MS4647B: A109 Port 1 Level Detector, V Connector, 70 GHz

Figure 14-19. A105 or A107 Replacement: Option 62: Port Source Modules (2 of 2)

Parts and Applicability

Use this procedure to remove and replace the following Port Source modules:

- MS4642B / MS4644B: A107 or A105 Reference Coupler, 40 GHz
- MS4645B / MS4647B: A107 or A105 Reference Coupler, 70 GHz

Note	This procedure specifies the steps for replacing the modules for Port 1. The same procedure can be used to replace the modules for Port 2.

Remove A108 HBTS/VITS

1. Remove A108 HBTS/VITS, following the steps in Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36.

Disconnect A109 (or A110)

2. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and then remove the RF connection between A105 and A109.
3. Gently move A109 and its attached semi-rigid coaxial cables slightly out of the way.

Remove A105 (or A107)

4. Loosen A105 bracket-to-chassis mounting hardware.
5. Loosen the connection between A105 and A121.
6. Remove A105 bracket-to-chassis hardware. Remove the module-to-bracket hardware.
7. Remove A105 and its bracket from the chassis.

Install A105 (or A107)

8. Place A105 mounting bracket in the chassis.
9. Loosely insert the bracket-to-chassis mounting screws. Do not tighten.
10. Place A105 module in the chassis and connect it to A121.
11. Carefully align and thread the RF connector between A121 and A105 module. Do not yet tighten.
12. Insert and thread the module-to-bracket mounting hardware.
13. Tighten the module-to-bracket mounting hardware.
14. Do not yet tighten the bracket-to-chassis mounting hardware.

Install A108

15. Install A108 HBTS/VITS back into its socket on A18 PCB by carefully following the procedure in Section 13-6, “A108 HBTS/VITS Module Replacement” on page 13-36.
16. Check that A108 HBTS/VITS module-to-PCB mounting hardware is tight.
17. Check that the RF connections between A108 HBTS/VITS and A105 and A107 are correctly torqued.

Connect A109 (or A110)

18. Gently move the semi-rigid coaxial cables connected to A109 back into place until the RF connectors between A109 and A105 are lined up.
19. Carefully align and thread the RF connection between the two modules.
20. When correctly threaded, tighten using finger pressure and then torque the connection to 8 lbf · in.
21. Tighten the bracket-to-chassis mounting hardware.

Final Checks

22. Check that all cables are correctly routed and firmly seated in their connectors.
23. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued.

A105 or A107 Replacement – Option 31 Configuration – with Option 62 and 85

Use this procedure to remove and replace A107 or A105 modules in the Port Source (P2 Src or P1 Src) port module groups for MS4642B instruments equipped with Option 62 and Option 85.

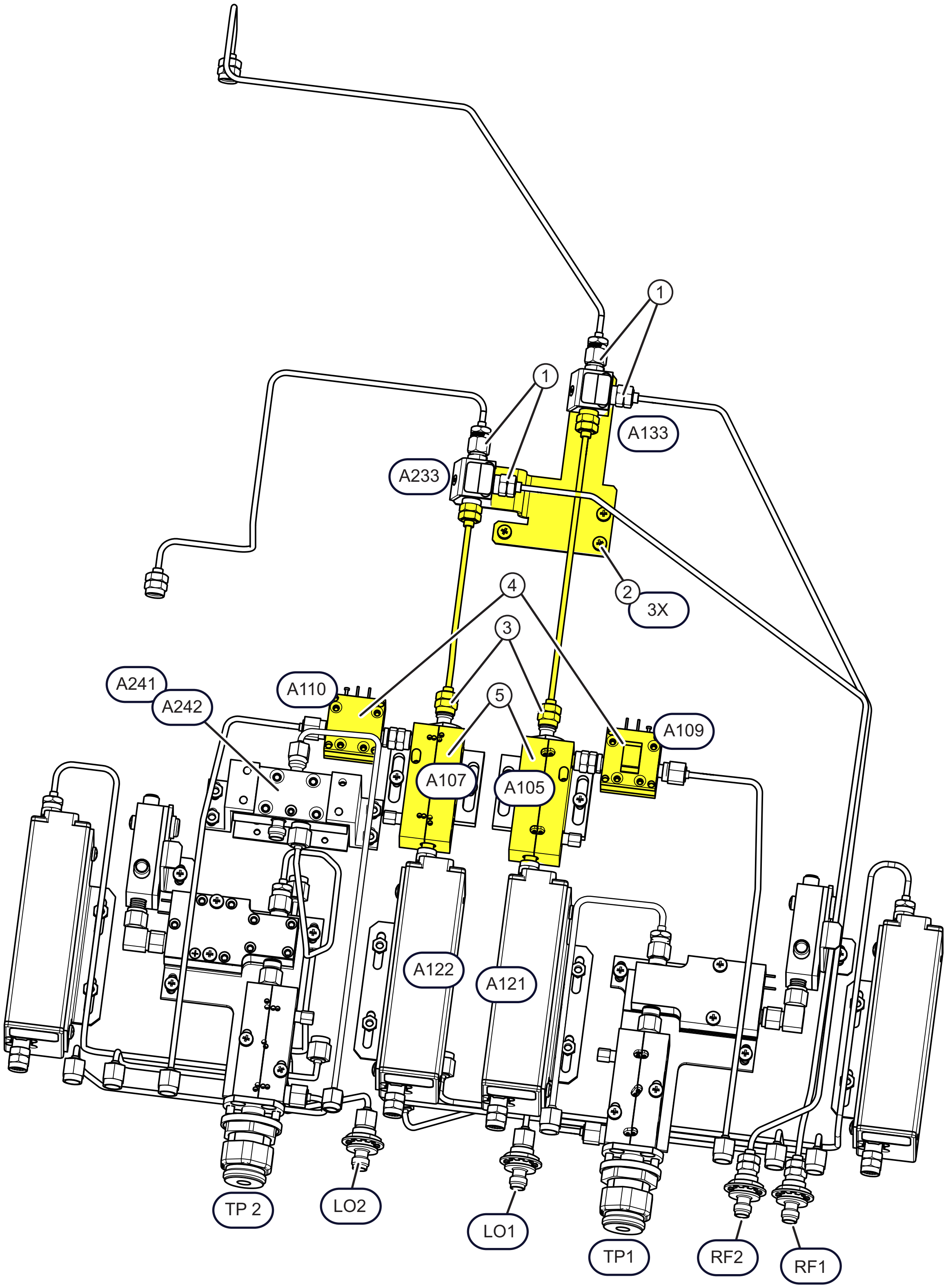


Figure 14-20. A105 or A107 Replacement: MS4642B – Option 31 Configuration – with Option 62 or 85 (1 of 2)

Option 84 or 85 Modules and Ports	Test Port 2
• A241 SPDT Switch • A242 (Under A241) SPDT Switch Control Assy • A133 20-40 GHz RF Coupler Module (A133 RCM) • A233 20-40 GHz RF Coupler Module (A233 RCM) • LO2 Port • LO1 Port • RF2 Port • RF1 Port	• A107 – Reference Coupler, 40 GHz • A110 – Port 2 Level Detector, 40 GHz, K Connector • TP2 – Test Port Adapter K Connector – 34YK50C • A122 High Band Step Attenuator, Port 2 Src, 40 GHz **Test Port 1** • A105 – Reference Coupler, 40 GHz • A109 Port 1 Level Detector, 40 GHz, K Connector • TP1 – Test Port Adapter K Connector – 34YK50C • A121 High Band Step Attenuator, Port 1 Src, 40 GHz

Figure 14-20. A105 or A107 Replacement: MS4642B – Option 31 Configuration – with Option 62 or 85 (2 of 2)

Remove A133 and A233 Assembly from A18

1. Disconnect the semi-rigid cables from J1 and J3 of both A133 and A233.
2. Remove the three screws from the bracket that holds the assembly to A18.
3. Disconnect the semi-rigid cables from J1 of A107 and J1 of the A105 Module. Leave them attached to the coupler module on A118. Remove the assembly and set it aside.

Disconnect A110 or A109

4. Disconnect A110 from A107 (or A109 from A105) and move it far enough to allow removal of the reference coupler.

Remove A107 (or A105)

5. Loosen (but do not remove) the module bracket to chassis mounting screws. This allows movement of components while the RF connectors are tightened during reinstallation.
6. Remove the two A107 (or A105) module-to-bracket mounting screws.
7. Disconnect the RF connector at the module J3 connector to release the module.

Install Replacement Module

8. Place the new module on its mounting bracket and carefully align and thread its J3 RF connector onto its mating connector and finger tighten. Do not torque the connection yet.
9. Install the two A107 (or A105) module-to-bracket mounting screws but do not tighten them yet. Ensure they are just tight enough to keep the module flat against the bracket.
10. Insert, thread, and tighten the A107 (or A105) module-to-bracket mounting hardware.

Reconnect A110 (or A109)

11. Gently move the semi-rigid coaxial cables connected to A110 back into place until the RF connectors between A110 and A1107 are lined up.
12. Carefully align and thread the RF connection between the two modules.
13. When correctly threaded, tighten using finger pressure and then torque the connection to 8 lbf · in.

Reattach A133 and A233 Assembly to A18

14. Place the A133 /A233 assembly onto A18.

15. Thread and finger tighten the A133 and A233 semi-rigid cables to J1 of A107 and J1 of the A105 Module.

16. Install the three A133/A233 bracket mounting screws that holds the assembly to A18. Do not yet tighten.

17. Reconnect the semi-rigid cables to J1 and J3 of both A133 and A233.

Tighten Connectors and Brackets

18. Ensure that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued to 8 lbf · in.

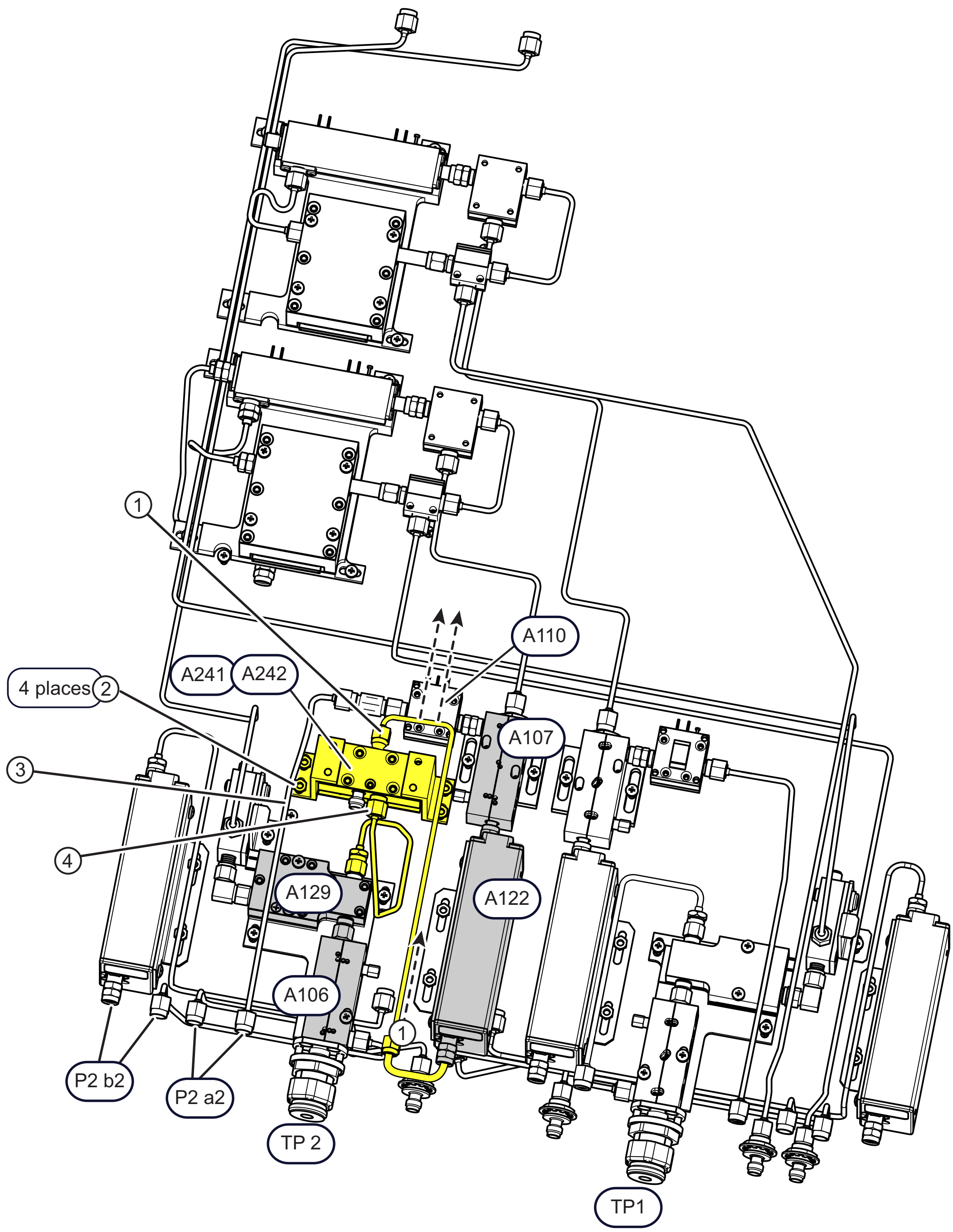
19. Tighten the A107 (or A105) bracket-to-chassis mounting hardware.

20. Tighten the A133/A233 bracket-to-A18 mounting hardware.

21. Perform a final torquing to all RF connections to 8 lbf · in.

A241 and A242 – Switch Replacement – Option 31/32, and 84 or 85

Use this procedure to remove and replace A241 or A242 modules in the Port Source path for instruments equipped with Option 31 and Option 84 or Option 85, and/or Option 32. Shown in Figure 14-21 is the configuration for an MS4647B Option 31 Configuration equipped with Option 62 and Option 85. Cable configurations in the path may vary depending on model and options but the removal process is still the same.



- Model shown is MS4645B / MS4647B with Option 62 and Option 85.
- Mechanical configuration of the switch is the same for MS4642B or an MS4644B.
- Shaded modules illustrate the signal path through the switch.

Figure 14-21. A241/A242 Replacement: Option 31 with Option 84/85 Switch Assembly

Parts and Applicability

Use this procedure to remove and replace the following modules:

- MS4642B / MS4644B: A241 Switch, 40 GHz
- MS4645B / MS4647B: A241 Switch, 70 GHz
- MS4642B / MS4644B / MS4645B / MS4647B: A242 – Switch Control Assy

Remove Semi-rigid Cable from A241 J1 Input

1. Using a 5/16” torque end wrench set to 8 lbf · in, remove the semi-rigid switch input cable. Cable configurations may vary depending on system options.

Remove KEP Nuts

2. Remove the four KEP nuts that hold the switch assembly to the chassis.

3. If necessary, disconnect the semi-rigid cable from A110 pad at the J1 port to access the KEP nuts on that side.

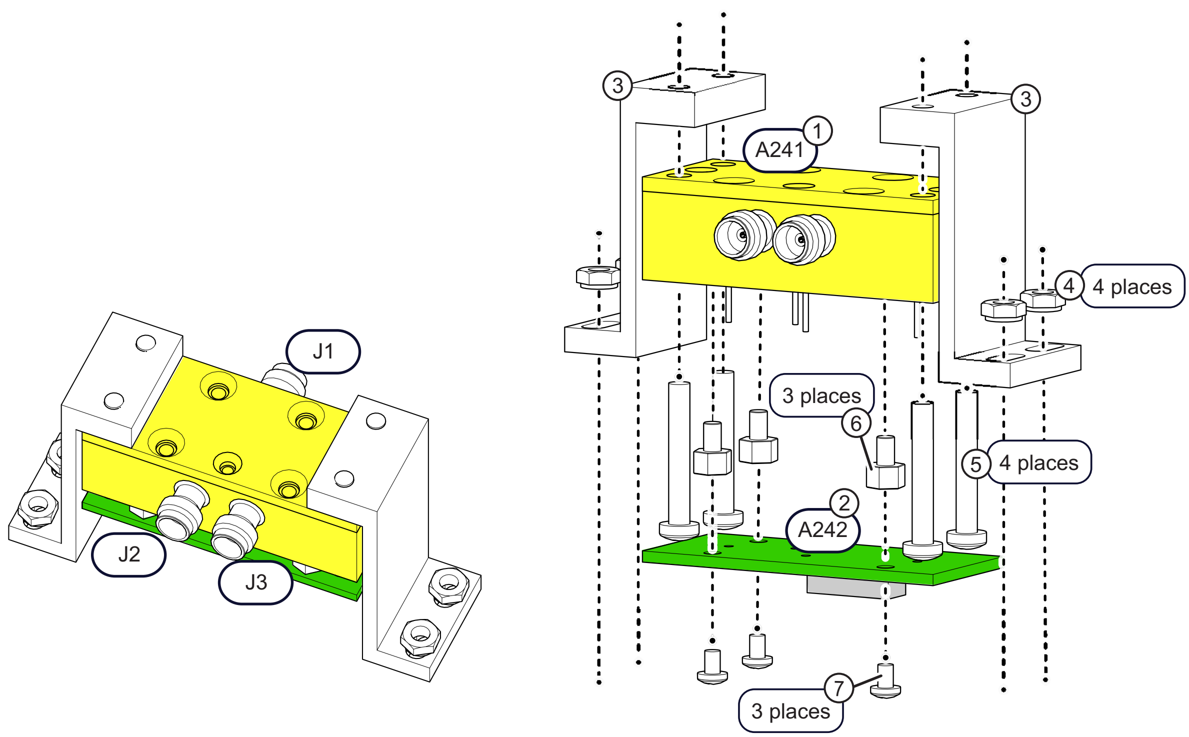
4. Disconnect the cable between A241 J3 and the input to A129.

5. Disconnect the control cable from A18 – J30.

Replace Switch or Control PCB

6. Remove the switch assembly.

7. Disassemble the switch assembly as shown in Figure 14-22 to replace either A241 or a 242.



1. A241 Switch, 40 GHz (For MS4642B and MS4644B) or A241 Switch, 70 Ghz (For MS4645B and MS4647B)	4. M3 x 0.5905 KEP Nuts – (four (4) places)
2. A242 – SPDT Switch Control PCB Assembly	5. M3 x 20 mm Pan Head Screws, (four (4) places)
3. Switch Mounting Brackets	6. Control Board Standoffs (three (3) places)
	7. 0.086-56 x 0.125 Board Mounting Screws (three (3) places)

Figure 14-22. A241/A242 Replacement Sequence

8. Reassemble the switch assembly with the new component.
9. Insert the switch assembly into the chassis.
10. Reconnect the control cable to A18 – J30.
11. Carefully align, thread, and finger tighten the semi-rigid cable from A129 to A241 J3 port. Do not torque yet.
12. Install the four KEP nuts that hold the switch assembly to the chassis. Do not tighten yet.
13. Carefully align, thread, and finger tighten the semi-rigid input cable to switch A241 – J1 port and the other port from which it was removed. Do not torque yet.
14. Using a 5/16” torque end wrench set to 8 lbf · in, now tighten the semi-rigid cables.
15. Tighten the four KEP nuts that hold the bracket to the chassis.

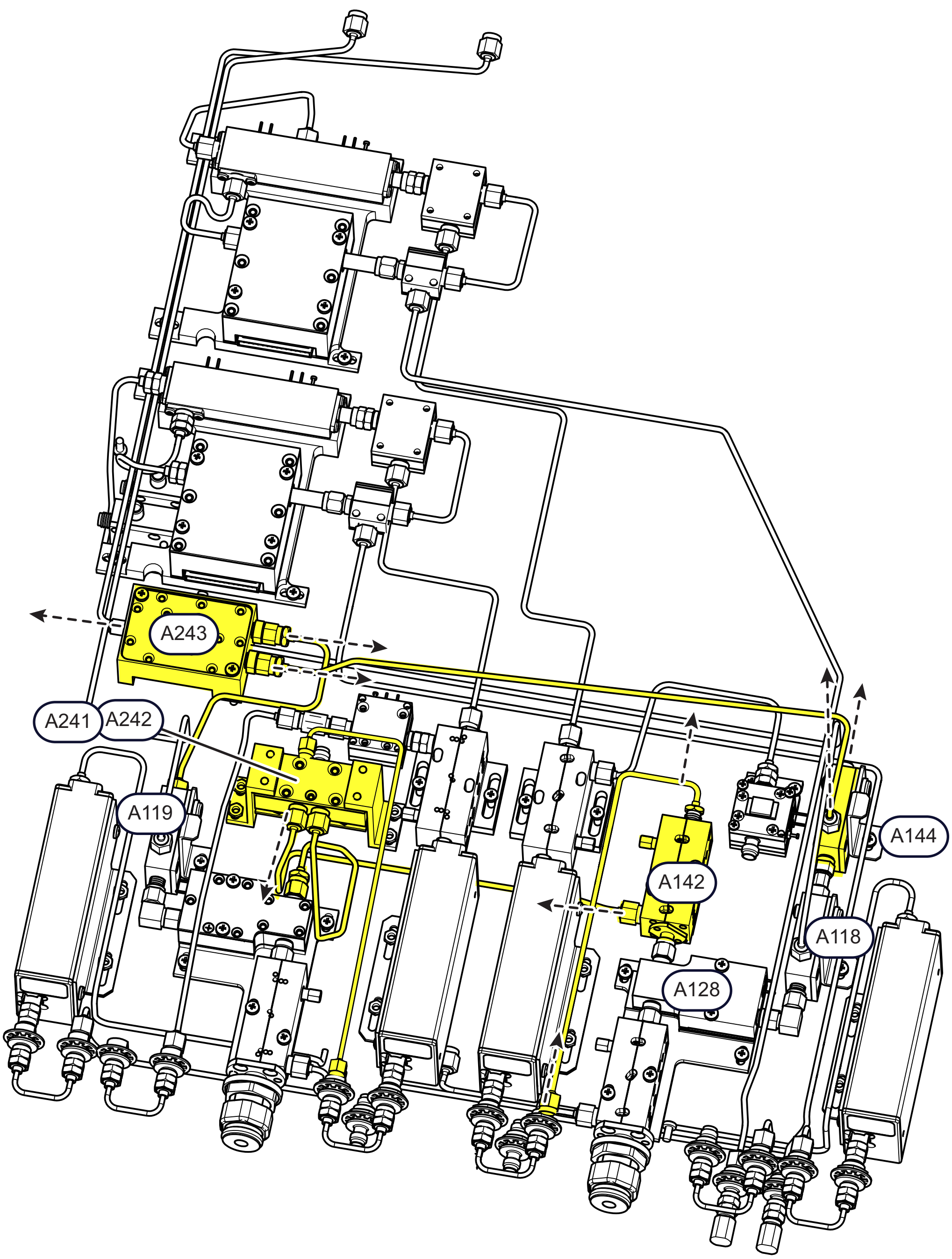
Final Checks

16. Check that all control cables are correctly routed and firmly seated in their connectors.
17. Check that all semi-rigid coaxial cables are correctly aligned, threaded.
18. Perform a final torquing of the semi-rigid cable connectors to 8 lbf · in.

A243, A142, or A144 Replacement – Option 32

Use this procedure to remove and replace A243, A142, or A144 modules in the Port Source path for instruments equipped with Option 31 and Option 32.

Shown in Figure 14-23 is the configuration for an MS4645B/47B Option 31 Configuration equipped with Option 32, Option 62 and Option 85. Cable configurations in the path may vary depending on model and options but the removal process is still the same.



- Model shown is MS4645B / MS4647B with Option 31/32/62/85.
- Mechanical configuration of the modules in Option 32 are the same for all VectorStar models.
- For A242/A241 switch replacement details see “A241 and A242 – Switch Replacement – Option 31/32, and 84 or 85” on page 14-44

Figure 14-23. A243/A142/A144 Replacement: Option 32 with Option 31, 84, or 85

Parts and Applicability

- A243 – Low Band Transfer Switch
- A142 – Reference Coupler, 70 GHz
- A144 – Low Band Bridge
- MS4642B / MS4644B: A241 Switch, 40 GHz
- MS4645B / MS4647B: A241 Switch, 70 GHz
- MS4642B / MS4644B / MS4645B / MS4647B: A242 – Switch Control Assy

A243 Replacement

1. Remove the two (2) A243 module mounting screws.
2. Using a 5/16” end wrench, disconnect the semi-rigid switch input cable and the two output cables.
3. Remove the module and place the new one into position.
4. Carefully align, thread, and finger tighten the semi-rigid cables to the module. Do not torque yet.
5. Install the two (2) module mounting screws and tighten.
6. Using a 5/16” torque end wrench set to 8 lbf · in, now tighten the semi-rigid cables.

A142 Replacement

1. Remove the two (2) A142 module mounting screws.
2. Using a 5/16” end wrench, remove the semi-rigid switch input cable from the input port and the front panel.
3. Disconnect the coupled port cable first from the port on the A242 switch and then the coupled port of A142.
4. Disconnect the A128 coupling nut and remove the A142 module.
5. Place the new module into position then thread and finger tighten the A128 coupling nut to the module.
6. Carefully align, thread, and finger tighten the semi-rigid cables to the module. Do not torque yet.
7. Install the two (2) module mounting screws and tighten.
8. Using a 5/16” torque end wrench set to 8 lbf · in, now tighten the semi-rigid cables at the A142 module, the A242 switch module, and the A128 coupling nut.

A144 Replacement

1. Remove the A144 module bracket mounting screw.
2. Using a 5/16” end wrench, disconnect the semi-rigid switch input cable from input port.
3. Disconnect the A144 coupled port cable from its port.
4. Disconnect the coupling nut between A144 and A118 and remove the module.
5. Transfer the mounting bracket to the new module.
6. Place the new module/bracket into position then thread and finger tighten the A118 coupling nut to the module.
7. Carefully align, thread, and finger tighten the semi-rigid cables to the module. Do not torque yet.
8. Install the bracket mounting screw and tighten.
9. Using a 5/16” torque end wrench set to 8 lbf · in, now tighten the semi-rigid cables at the A144 module and the A118 coupling nut.

Final Checks

10. Check that all control cables are correctly routed and firmly seated in their connectors.
11. Check that all semi-rigid coaxial cables are correctly aligned, threaded.
12. Perform a final torquing of the semi-rigid cable connectors to 8 lbf · in.

A123 or A120 Replacement – Option 61 or 62

In general, the only reason to remove an attenuator module is to replace it. In all cases, the High Band Step Attenuators are encountered only in instruments equipped with Option 61 or Option 62.

A120 appears only in Option 62.

Part Numbers

- MS4642B / MS4644B: A123 High Band Step Attenuator, Port 2 b2, 40 GHz
- MS4645B / MS4647B: A123 High Band Step Attenuator, Port 2 b2, 70 GHz
- MS4642B / MS4644B: A120 High Band Step Attenuator, Test, Port 1 b1, 40 GHz
- MS4645B / MS4647B: A120 High Band Step Attenuator, Test, Port 1 b1, 70 GHz

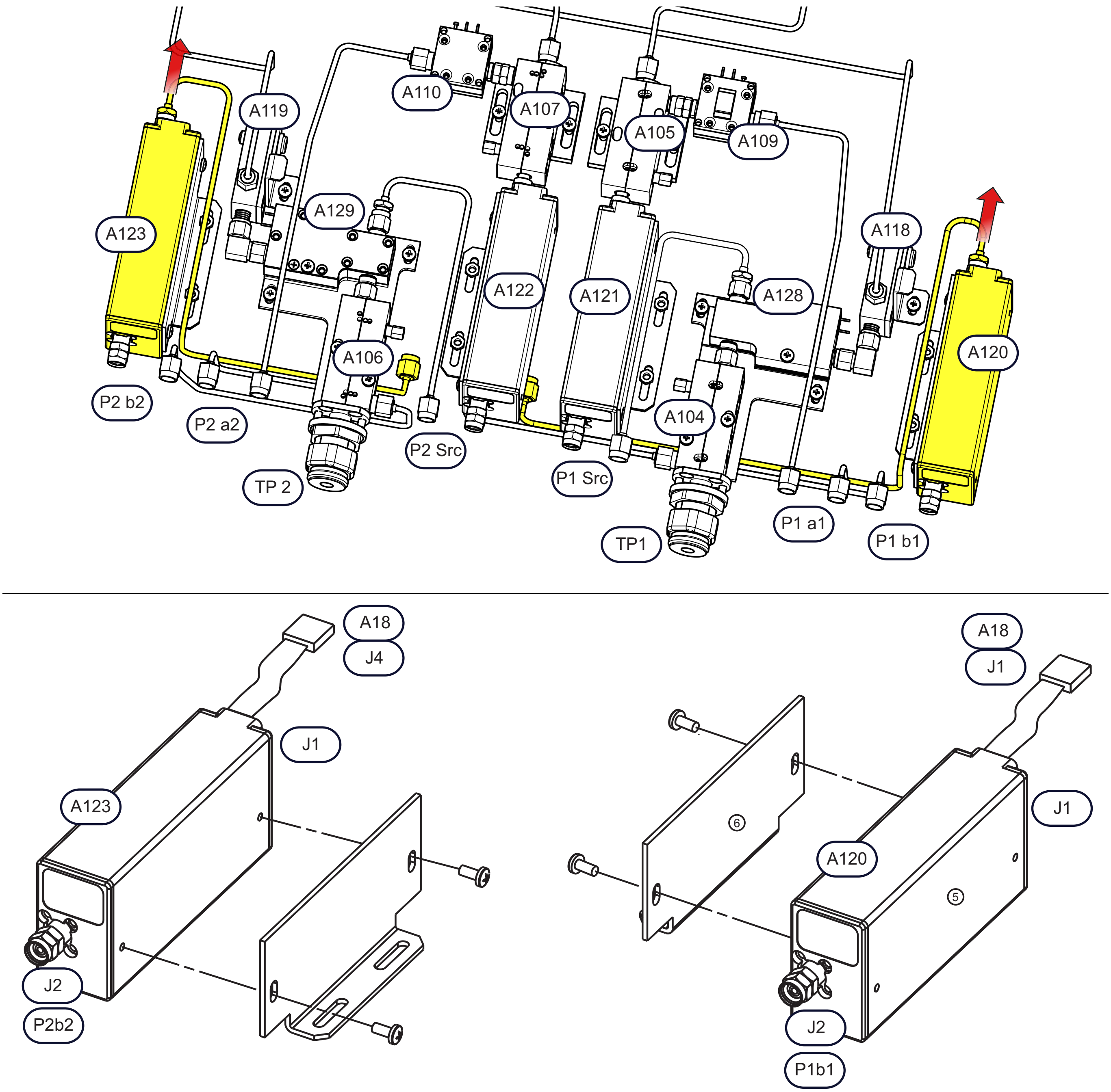


Figure 14-24. A123 or A120 Attenuator Replacement: Option 61 or 62

A123 or A120 Removal

1. Disconnect the semi-rigid coaxial cable from the attenuator module and move it slightly out of the way.
2. Remove the attached signal/power ribbon cable from the attenuator connector. Leave the cable attached to A18 RF Control PCB Assembly.
3. Remove the two M3 × 0.5 mm kep nuts holding attenuator bracket to the RF Deck chassis.
4. Using an 8 lbf · in torque end wrench, disconnect attenuator output (J2) from the front panel connector.
5. Lift attenuator/bracket assembly out of the chassis.
6. Note the orientation of the bracket to the attenuator J1 and J2 ports.
7. Remove the two (2) pan head Phillips 4-40 × 0.187” attenuator-to-bracket screws.
8. Set attenuator aside.

A123 or A120 Installation

9. Install the replacement attenuator module onto the mounting bracket, again observing the orientation mentioned during removal.
10. Install the two (2) pan head Phillips 4-40 × 0.187” mounting screws, finger tighten, and position each screw in the center of the bracket slot. When correctly positioned, tighten the two screws.
11. Position Attenuator Module/Bracket Assembly in the RF Deck with its ribbon cable connector facing the rear panel.
12. If replacing A123, attach the attenuator ribbon cable to J4 on A18.
13. If replacing A120, attach the attenuator ribbon cable to J1 on A18.
14. Place the attenuator/bracket assembly over the threaded chassis studs and loosely thread on the two (2) M3 × 0.5 mm kep nuts.
15. Carefully align, thread and finger tighten the attenuator module J2 RF connector with its matching front panel connector. Tighten the connector finger tight and then reverse for one-half turn.

Torque RF Connectors

16. Torque the attenuator J2 RF connector to 8 lbf · in.
17. Attach the semi-rigid coaxial cable to the attenuator J1 RF connector. Make sure it is correctly aligned and threaded. Tighten finger tight and then torque to 8 lbf · in.
18. Tighten the two chassis mounting kep nuts.

Final Checks

19. Check that all cables are correctly routed and firmly seated in their connectors.
20. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued to 8 lbf · in.
21. Ensure all chassis mounting hardware is tightened.

Warning	Before reassembling the VNA, ensure all electrical connectors are secure in their receptacles, all mounting hardware is properly tightened, and all RF connections have been torqued to 8 lbf· in.

A121 or A122 Replacement – Option 61 or 62

When replacing A121 or A122, the shaded modules shown in Figure 14-25 must be removed. Note that A121 appears only in Option 62.

Part Numbers

- MS4642B / MS4644B: A122 High Band Step Attenuator, Port 2 Source, 40 GHz
- MS4645B / MS4647B: A122 High Band Step Attenuator, Port 2 Source, 70 GHz
- MS4642B / MS4644B: A121 High Band Step Attenuator, Port 1 Source, 40 GHz
- MS4645B / MS4647B: A121 High Band Step Attenuator, Port 1 Source, 70 GHz

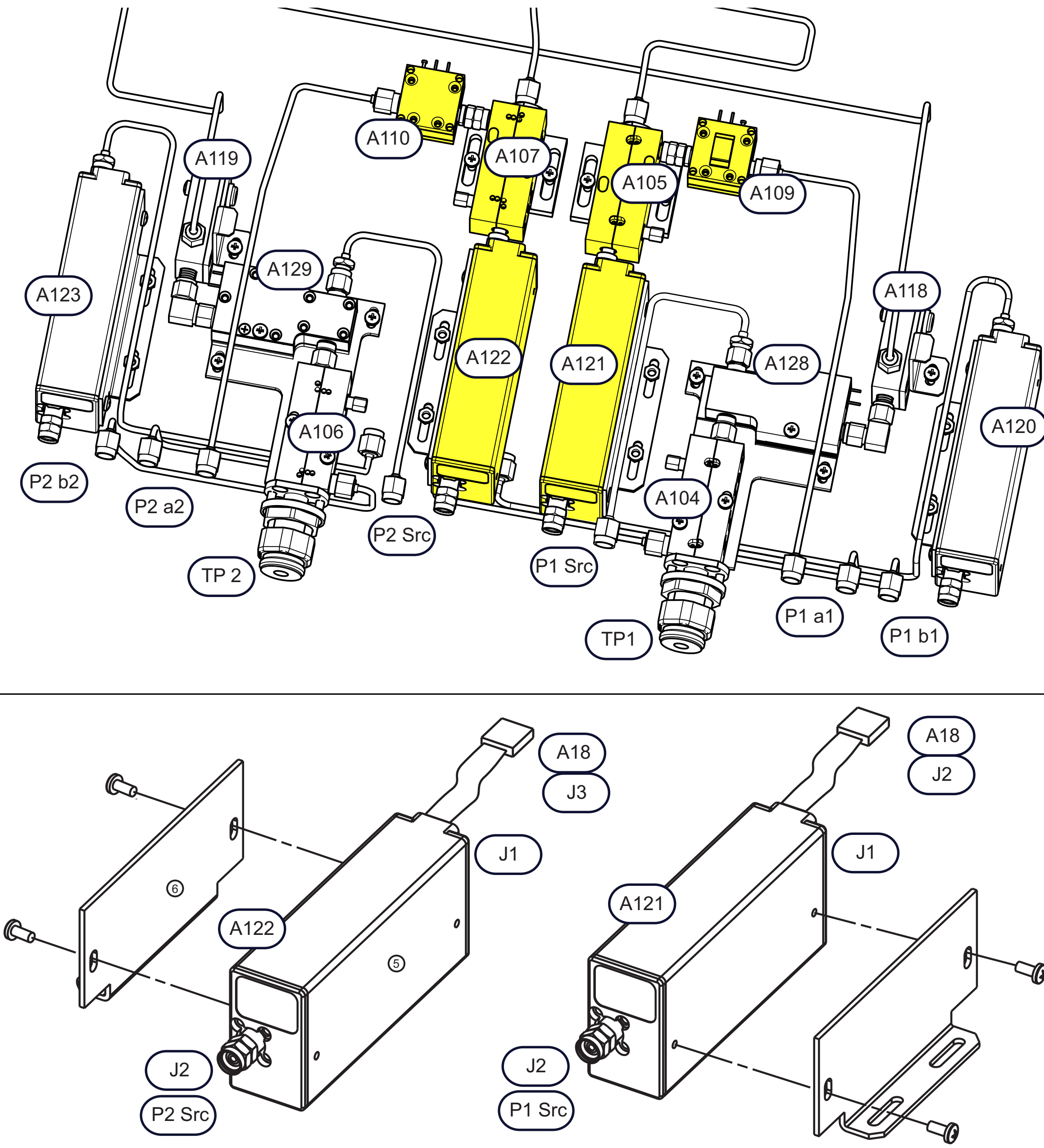


Figure 14-25. A121 or A122 Attenuator Replacement: Option 61 or 62

Remove A108

1. If A108 is installed, remove it and the two coaxial cables attached to A105 and A107. Use the procedure in Section 13-6 “A108 HBTS/VITS Module Replacement” on page 13-36.

Disconnect A109 or A110

2. If replacing A121, disconnect A109 from A105 and move it and its attached semi-rigid coaxial cable slightly out of the way. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and then remove the RF connection.
3. If replacing A122, disconnect A110 from A107 and move it and its attached semi-rigid coaxial cable slightly out of the way. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and then remove the RF connection.

Remove A105 or A107

4. If replacing A121, loosen the RF connection between A105 and A121 using a 5/16” torque end wrench set to 8 lbf · in.
5. If replacing A122, loosen the RF connection between A107 and A122 using a 5/16” torque end wrench set to 8 lbf · in.
6. Loosen and remove the bracket-to-chassis mounting hardware.
7. Finish disconnecting the RF connection between the modules.
8. Remove A105 or A107 module and bracket from the chassis.

Remove A121 or A122

9. If replacing A121, disconnect the ribbon cable from A18 PCB J2 connector. For the moment, the ribbon cable can stay attached to the attenuator.
10. If replacing A122, disconnect the ribbon cable from A18 PCB J3 connector. For the moment, the ribbon cable can stay attached to the attenuator.
11. Loosen and remove the two (2) M3 × 0.5 mm kep nuts holding the module bracket to the chassis.
12. Using two 5/16” end wrenches (a plain and a torque wrench set to 8 lbf · in), loosen the RF connection between the attenuator module and the front panel.
13. When loose, use finger pressure to remove the RF connection and carefully remove the attenuator module from the chassis.

Caution	**When installing a series of interconnected RF modules, the general hardware installation sequence is:** 1. Place the first module into its position in the chassis. 2. Carefully align, thread, and finger tighten the RF connector to its receiving connector, but do *not torque yet.* 3. Loosely install the module mounting plate-to-chassis mounting screws or nuts and *do not tighten yet*. 4. Torque the RF connection to 8 lbf· in. 5. Place the next module into its position in the chassis. 6. Carefully align, thread, and finger tighten the RF connector to the module previously installed but *do not torque yet.* 7. Loosely install the module mounting plate-to-chassis mounting screws or nuts and *do not tighten yet*. 8. Torque the RF connection to 8 lbf· in. 9. Continue this sequence until all modules are installed. 10. Once all modules are installed and the RF interconnects are torqued, tighten all chassis mounting hardware. 11. After all chassis mounting hardware is tight, perform a final torquing of all RF connections to 8 lbf · in.

Install A121 or A122

14. Install the replacement attenuator module onto its bracket, again observing the orientation is the same.

Install the two (2) pan head Phillips 4-40 × 0.187” mounting screws, finger tighten, and position each screw in the center of the bracket slot. When correctly positioned, tighten the two screws.

15. Place the module/bracket assembly into the chassis over its threaded mounting studs.

16. Loosely attach the two (2) M3 × 0.5 mm kep nuts *but do not tighten yet*.

17. Carefully align and thread the RF connector between the attenuator front connector and the front panel connector.

18. When correctly threaded, tighten finger tight.

19. Torque the connection to 8 lbf · in.

20. *Do not tighten the chassis mounting hardware yet.*

Install A105 or A107

21. Place A105 or A107 module/bracket assembly into the chassis over its two threaded mounting studs.

22. Carefully align and thread the RF connection between A105 and A121, or between A017 and A122.

23. When correctly threaded, tighten finger tight but do not torque the connection yet.

24. Loosely attach the two (2) M3 × 0.5 mm kep nuts *but do not tighten yet*.

25. Torque the RF connection to 8 lbf · in.

26. Now tighten all mounting bracket-to-chassis hardware.

Reconnect A109 or A110

27. If replacing A121,move A109 and its attached semi-rigid coaxial cable slightly back into place and carefully thread the RF connector to A105 and finger tighten. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and tighten the RF connection.

28. If replacing A122,move A110 and its attached semi-rigid coaxial cable slightly back into place and carefully thread the RF connector to A107 and finger tighten. Use a 5/16” torque end wrench set to 8 lbf · in to loosen and tighten the RF connection.

Install A108

29. Install A108 HBTS/VITS back into its socket on A18 PCB and reconnect its cables by carefully following the procedure in Section 13-6, “A108 HBTS/VITS Module Replacement” on page 13-36.

Final Checks

30. Check that all cables are correctly routed and firmly seated in their connectors.

31. Check that all semi-rigid coaxial cables are correctly aligned, threaded, and torqued to 8 lbf · in.

32. Ensure all chassis mounting hardware is tightened.

System Reassembly

Follow the instructions in Section 14-6 “System Reassembly” on page 14-55.

Warning	Before reassembling the VNA, ensure all electrical connectors are secure in their receptacles, all mounting hardware is properly tightened, and all RF connections have been torqued to 8 lbf· in.

14-6 System Reassembly

Use this procedure to complete the port module replacement and installation used in the procedures above.

Signal/Power Cables

1. Check that all signal/power cable connections are correctly positioned and fully seated in their connectors.
2. Where required, add cable ties to keep the signal/power cables in their required location and out of chassis fasteners and fans.

Coaxial Cables

3. Make sure that all semi-rigid coaxial cables are correctly routed, aligned, threaded, and torqued.
4. Where required, add cable ties to keep the semi-rigid coaxial cables in their required position.

Intra-Module RF Connections

5. Make sure that all RF connections between modules are correctly aligned, threaded, and torqued.

Fastening Hardware

6. Check the tightness for all bracket-to-chassis mounting hardware.
7. Check the tightness for all module-to-bracket mounting hardware.

Install the Front Panel (if removed)

8. Position the instrument top side up.
9. If removed, install the Front Panel Assembly.

Install Covers

10. Install the Inner Cover.
    - See Section “Install Inner Cover” on page 8-6.
11. Install the Outer Cover.
    - See Section “Install Outer Cover” on page 8-6.
12. Tighten the four handle screws.

Final Tests

13. Perform any final tests as required.

Chapter 15 — Power Supply Module Replacement

15-1 Introduction

This procedure describes how to remove the Power Supply Module from the instrument chassis. Use this procedure to either replace the module, or to remove it from the chassis in order to service the following deeper dwelling components:

- Digital PCB Fan Assembly
- Motherboard 1 PCB Assembly

15-2 Power Supply Module Overview

Parts and Applicability

- Power Supply Module
    - See Table 6-2, “Replacement Parts – Sorted by Engineering Reference Number (ERN)” on page 6-3.
    - Compatible with all instrument models with any combination of options.

Parts Identification

Identification – Power Supply Module – ND81463-RFB, RoHS 3-ND81463-RFB, or ND75957-RFB

The Power Supply Module has three (3) attached cable harnesses for power, power control and the AC Line Input modules.

The power harness, control harness (not shown in Figure 15-1) go to the Motherboard 2 PCB Assembly. The fourth harness goes to the Rear Panel and the AC Input Module Assembly.

Note	All harnesses are supplied with the replacement power supply and do not need to be exchanged between old and new units.

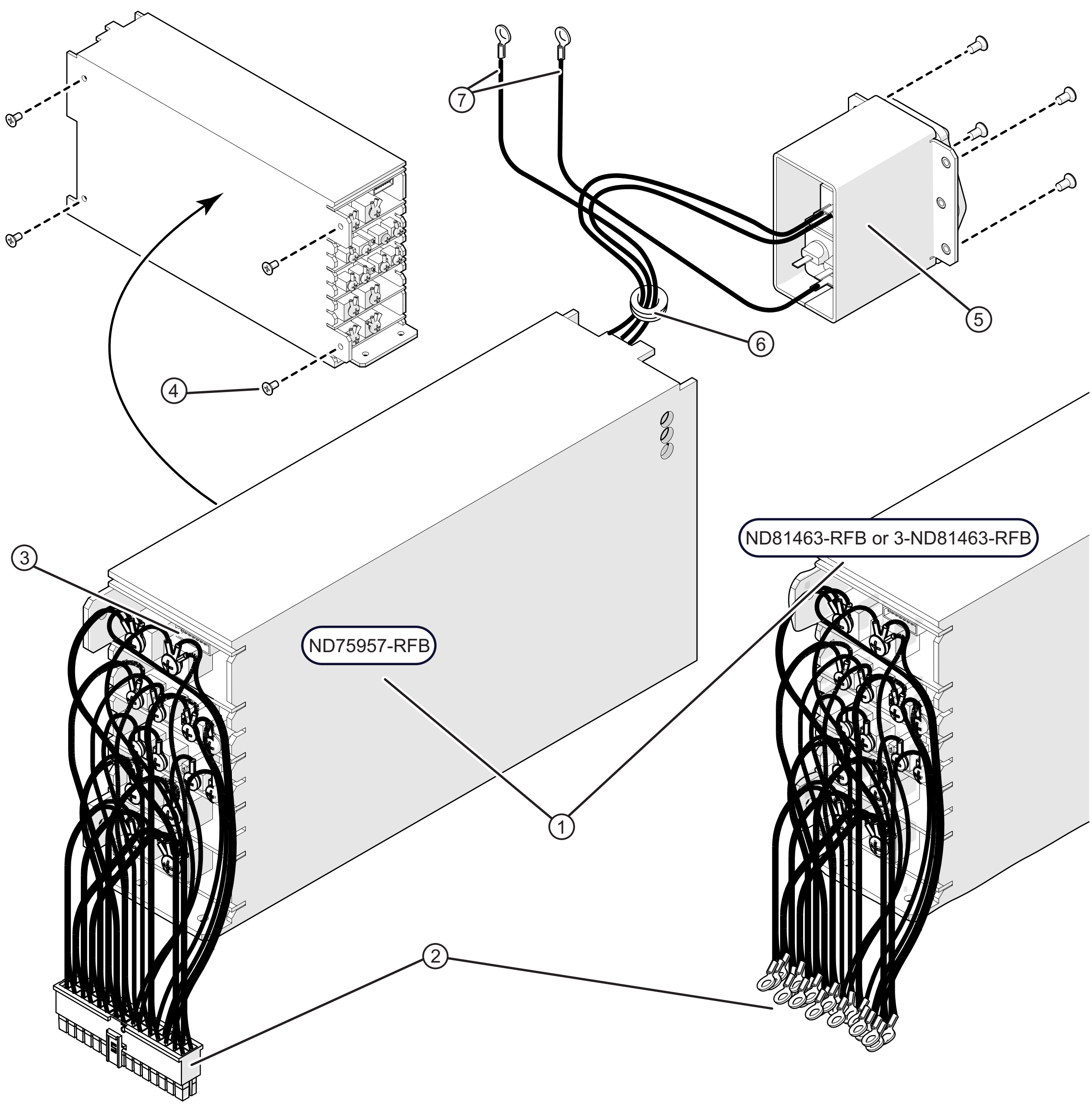


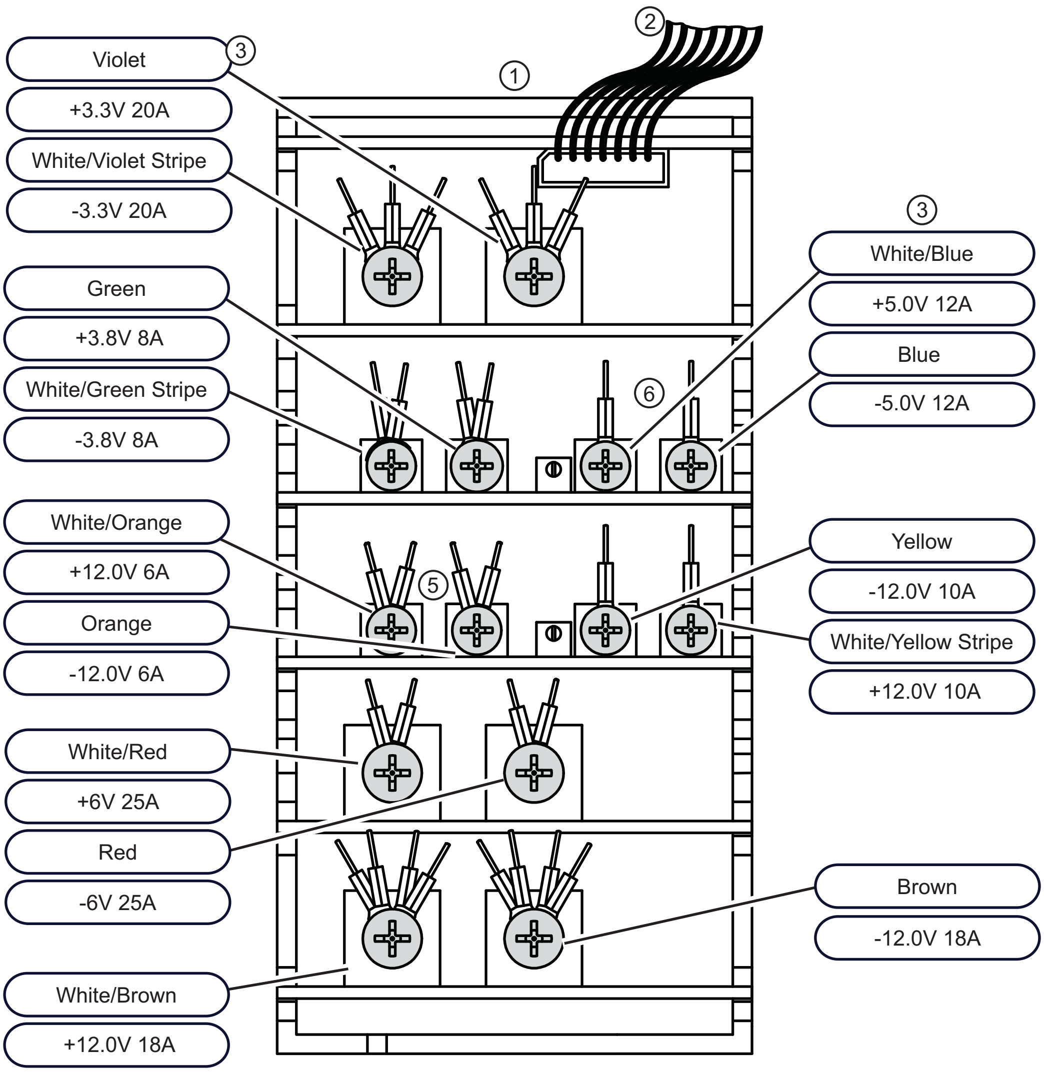
Figure 15-1. Power Supply Module Assembly – ND81463-RFB (RoHS 3-ND81463-RFB) or ND73933-RFB (1 of 2)

1. **Power Supply Module** ***In systems with S/N 1506634 and above:*** **ND81463-RFB or 3-ND81463-RFB** – For systems with Motherboard MB2 P/N ND81312 or 3-ND81312– Includes Power Supply Cable Assembly (Item 2) ***In systems with S/N 1505633 and below:*** **ND75957-RFB** – For systems with Motherboard MB2 P/N ND80356. Includes Power Supply Cable Assembly (Item 2)	3. Power control wiring harness (not shown, plugs into receptacle shown here) from MB2 PCB connector **Pwr Ctrl P93.** (Not a replacement part.) 4. Four (4) flat head Phillips M4 x 8 mm screws. • These screws attach to the corners of the AC Module where they hold the AC Module onto the chassis side plate. 5. AC Input Power Supply Module (inside housing). • Connections to the Power Supply Module are shown in Figure 15-3.
2. **Power Supply Cable Assembly**	6. Grommet holding harness wires. 7. Green/Yellow Stripe wires for connection to chassis ground.

Figure 15-1. Power Supply Module Assembly – ND81463-RFB (RoHS 3-ND81463-RFB) or ND73933-RFB (2 of 2)

Identification – Power Supply Module Wiring Harness

The main harness connections are to the front end of the Power Supply Module and are connected via pan head Phillips screws that hold the 30 color-coded harness wires with ring lugs. The replacement module comes with the wiring harness installed.

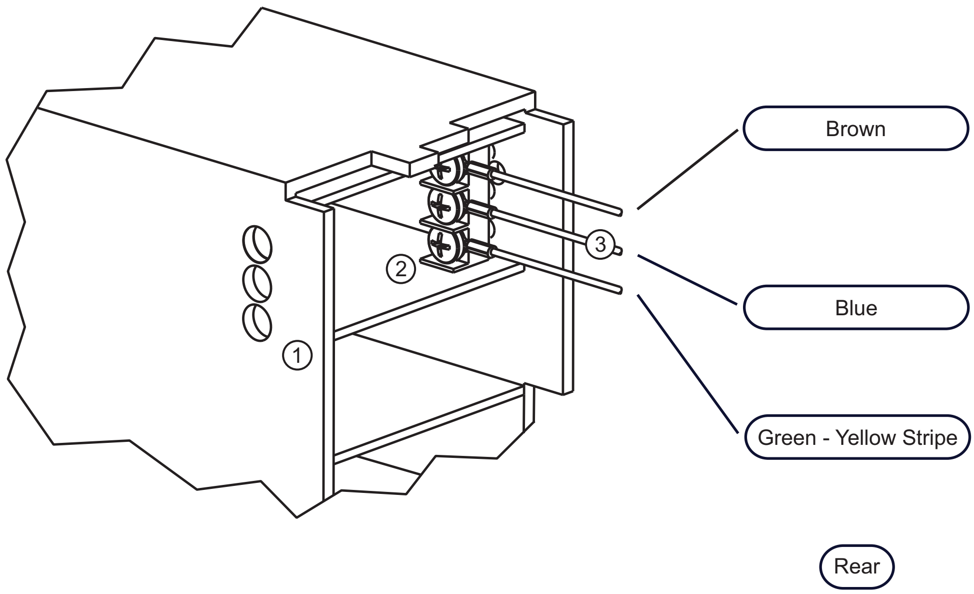


1. Power Supply Module Assembly
2. The 7-pin cable harness at the top front of the Power Supply Module.
   - Connects to the P93 Power Control connector on the front of the MB2 PCB.
   - Not part of the power supply replacement module.
3. Individual ring-lug terminated cables that connect to Motherboard 2 (MB2) PCB Assembly.
4. Note that Orange and White/Orange Stripe terminals have two (2) ring lug connections.
5. Note that Blue and White/Blue Stripe terminals have one (1) ring lug connections.
6. All other ring-lug connections are identical to connections.

Figure 15-2. Power Supply Module Wiring Harness Connections

Identification – AC Line Input Module Connections

The AC Line Input Module connects via three (3) color coded wires with ring lugs to a barrier strip connector on the rear of the Power Supply Module. The AC Line Input Module, the AC Module Mounting Bracket, and the AC Module Harness comes with the replacement Power Supply Module



Orientation	Components
Rear view of Power Supply Module and the cable connection detail between the Power Supply Module and the AC Line Input Module.	1. Power Supply Module 2. Cable harness barrier strip. 3. Cable harness between the Power Supply Module and the AC Line Input Module. The replacement Power Supply Module comes equipped with the necessary harnesses so the harness do not need to be exchanged.

Figure 15-3. Power Supply Module Assembly – AC Line Module Connections

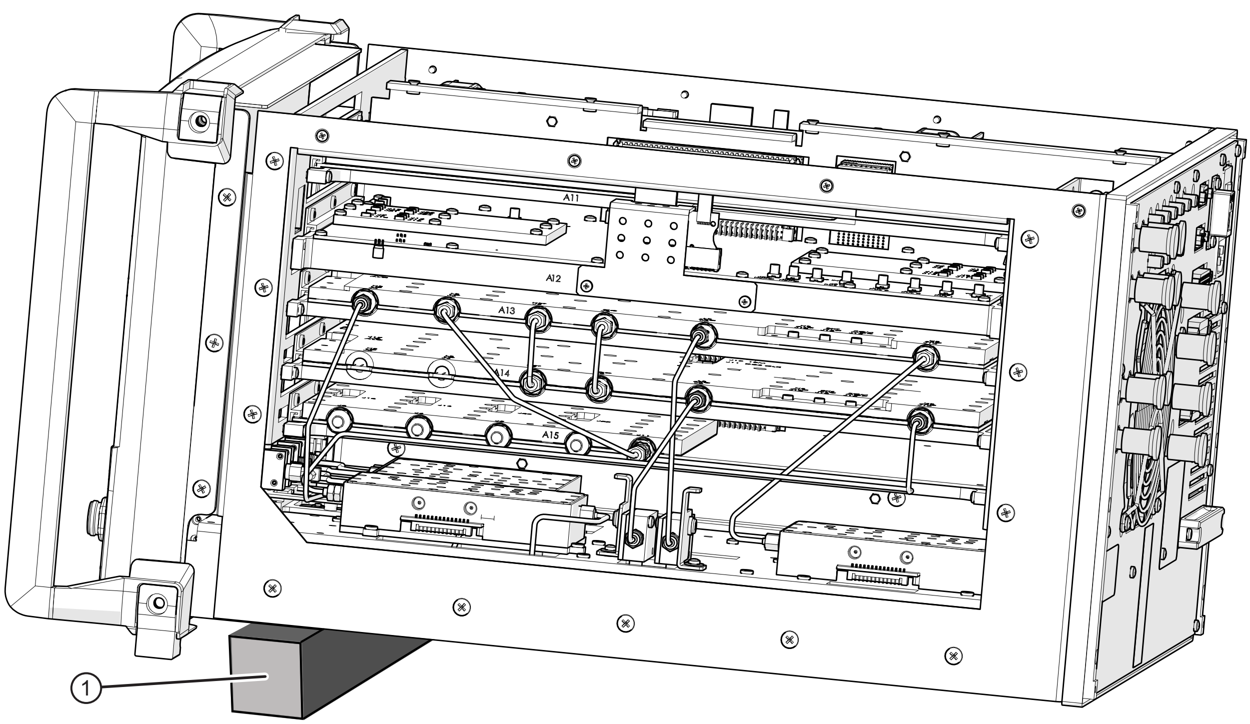
15-3 Power Supply Module Replacement

Power Supply Module

- Includes Power Supply Cable Assembly
- Compatible with all instrument models with any combination of options.

Common Disassembly Procedures

1. For instructions on preparation of work area, removing outer and inner covers, refer to Section 8-2 "Preparation of Work Area and Safety Instructions" on page 8-1.
2. Add a spacer at least 5 cm (~2 in) thick under the front of the unit, approximately 10 cm (~4 in) in from the instrument front as shown in Figure 15-4.
    - The spacer should be at least 50 mm (~20 in) long.
    - The spacer provides clearance for the Direct Access Loops located on the underside of the RF Deck.
    - A ~50 cm (~20 in) length of plastic or wood 5 cm x 5 cm (2 in x 2 in) makes a good spacer.



1. Block for raising front of chassis

Figure 15-4. Spacer Block Front of Chassis

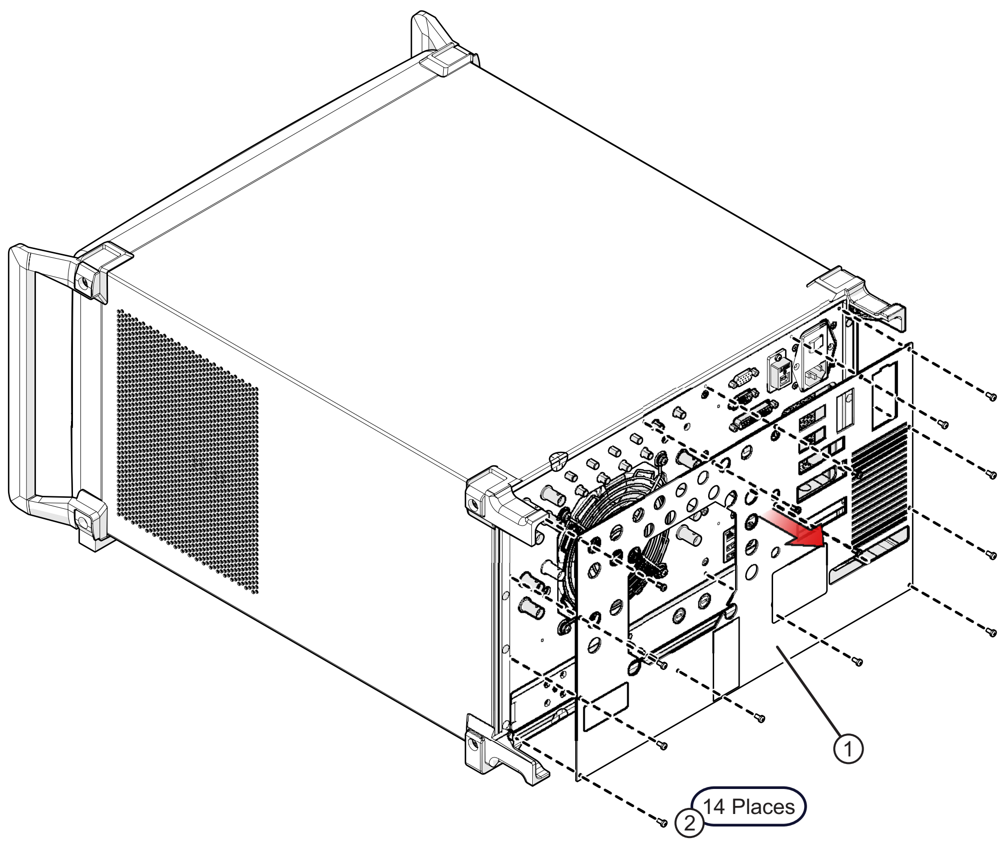
3. Remove and set aside the Front Panel.
    - See Section 18-3 "Remove Front Panel" on page 18-1.
4. Remove and set aside the Digital PCB Assemblies.
    - See Chapter 10, "Digital and Analog PCB Replacement".
5. The RF Deck remains in the instrument.

Power Supply Removal

Remove the Rear Panel Sub Plate

6. From the Rear Panel, remove and set aside the 14 pan head Phillips M3 × 6 mm screws holding the silk-screened Rear Panel Sub Plate in place. Work carefully to avoid scratching the sub plate.

7. Gently pull off the Rear Panel Sub Plate and set aside.



1. Rear Panel Sub Plate, Silk-screened	2. Sub Plate Screws: 14 pan head Phillips M3 × 6 mm, 14 Places

Figure 15-5. Rear Panel Sub Plate Removal

Disconnect Power Cables from Motherboard 2 PCB Assembly

8. At the instrument front, disconnect the Power Supply Module cables.

- In systems with S/N 1506634 and above, disconnect the ring lugs from their respective terminals on Motherboard 2 (MB2) PCB Assembly
- In systems with S/N 1505633 and below, disconnect the power supply harness 30-pin connector from the Motherboard 2 (MB2) PCB Assembly P94 connector. Lift the lock tab to remove the connector.

9. Disconnect the power supply control harness 6-pin connector from the MB2 PCB P93 connector. The connector pulls straight up.

Remove Power Supply Mounting Screws

10. Remove the four (4) flat head Phillips M4 × 8 mm screws holding the Power Supply Module Assembly in place on the chassis side plate.

Remove the Left Side Chassis Plate

11. Remove the chassis left side plate mounting screws as shown in Figure 15-6.
12. On the Rear Panel, on its right side, remove four (4) cap socket Allen head M4 × 10 mm screws using an 8 mm hex driver. The Rear Panel center and left side screws stay in place.
13. On the instrument left side, remove the three (3) flat head Phillips M4 × 8 mm screws holding the Side Plate to the front section of the instrument chassis.
14. On the instrument left side, remove the seven (7) flat head Phillips M4 × 10 mm screws that hold the side plate to the Digital PCB Fan Bracket Assembly.
15. On the instrument bottom, remove the two (2) pan head Phillips M2.5 × 6 mm screws holding the side plate to the chassis.
16. If the RF deck is in place, remove the five (5) flat head Phillips M4 × 8 mm screws at the bottom of the side plate. Disconnect AC Module from Rear Panel.
17. Remove the side plate and set aside.

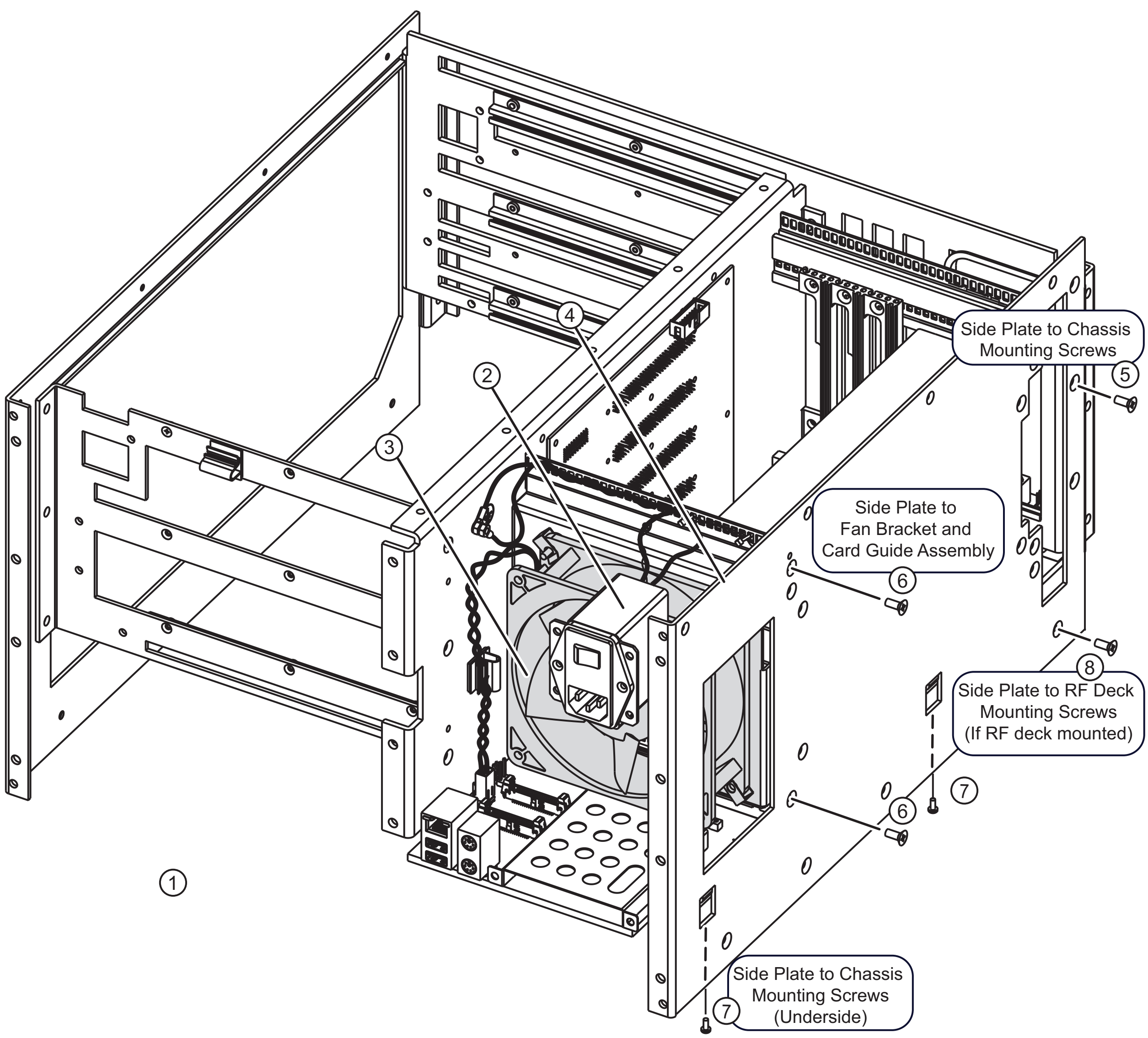


Figure 15-6. Location of Left Side Screw and Rear Panel Screws (1 of 2)

1. Rear Panel, removed here for clarity. 2. AC Input Module, removed from Rear Panel and left connected to Power Supply Module 3. Digital Section Fan assembly 4. Left side outer chassis plate, viewed from rear of instrument. 5. On side plate, three (3) flat head Phillips M4 × 8 mm screws holding the Side Plate to the front section of the instrument chassis and four (4) flat head Phillips M4 x 8 mm screws securing the Power Supply Module onto the side plate.	6. On side plate, seven (7) flat head Phillips M4 × 10 mm Digital PCB Fan Bracket Assembly. 7. On instrument bottom, two (2) pan head Phillips M2.5 × 6 mm screws holding the side plate to the chassis. 8. Side Plate to RF Deck Mounting Screws five (5) flat head Phillips M4 × 8 mm screws

Figure 15-6. Location of Left Side Screw and Rear Panel Screws (2 of 2)

Disconnect AC Module from Rear Panel

18. At the Rear Panel, remove the two (2) center flat head Phillips M4 × 8 mm screws holding the AC Module Bracket Assembly to the Rear Panel.

- The outer four (4) screws hold the AC Module to the AC Module Bracket and can be left in place.
- The AC Module assembly is permanently wired to the Power Supply Module Assembly.
- Make sure the AC Module Bracket Assembly is loose.

19. Remove the two (2) M3 × 0.5 locking kep nuts holding the two (2) ring lugs to the chassis center plate. Each ring lug is attached to a Green wire with a Yellow Stripe.

Remove the Power Supply Assembly

20. 25. Remove the Power Supply Module Assembly and attached harnesses out the side of the Digital PCB Bay. Take care to route the attached harnesses and AC Module through the chassis openings.

Note	The replacement Power Supply Module comes with the necessary harnesses to connect directly to the MB2 PCB, the AC Line Input Module Assembly, and its AC Module harness. There is no need to transfer the Power Supply Module harnesses from the to-be-replaced assembly to the new assembly.

Power Supply Installation

1. Insert and tighten the screws into the Power Supply Module so the module is securely mounted onto the side plate.
2. Mount the Power Supply Module with side plate to the chassis, positioning the cable harnesses and the AC Module as it slides in. Make sure the front power harnesses are fed through the chassis openings.

Rear Panel and AC Line Module

3. Position the AC Line Module Assembly in the Rear Panel. Then insert and tighten the two (2) center flat head Phillips M4 × 8 mm mounting screws.

Chassis Side Plate and Rear Panel

4. Position the Chassis Left Side Plate and then insert and thread the three (3) flat head Phillips M4 × 8 mm screws and seven (7) flat head Phillips M4 x 10 mm screws. Do not tighten.
5. At the right side of the Rear Panel, insert and thread the (4) cap socket Allen head M4 × 10 mm screws. Do not tighten.
6. At the instrument bottom, insert and thread the two (2) pan head Phillips M2.5 × 6 mm screws. When correctly threaded, tighten.
7. At the Chassis Left Side Plate, tighten the ten (10) screws.
8. At the Rear Panel, tighten the four (4) cap socket Allen head M4 × 10 mm screws. Then tighten the Digital Fan Assembly mounting screws.

Motherboard 2 PCB and Ground Connections

9. Position the main power harness on the Motherboard 2 P94 connector and then push it in to connect until the latch clicks into place.
10. Position the power control harness on the Motherboard 2 P93 connector and then push it in to connect.
11. Check all connections and mounting hardware.
12. Position the two (2) ring lugs (green wire with yellow stripes) over the chassis center plate threaded mounting stud. Add the two (2) M3 × 0.5 locking kep nuts and tighten.

Rear Panel Sub Plate

13. Install the Rear Panel Sub Plate and loosely thread the 14 each M3 x 6 mm pan head Phillips screws that hold the Rear Panel Sub Plate to the Rear Panel.
14. Starting at the center and working towards the panel edges, tighten the screws in two passes.

Common Reassembly Procedures

15. Add spacer block under the front of the instrument.
16. Install the Front Panel Assembly.

    Refer to Section 18-5 “Install Front Panel” on page 18-8.
17. If removed, install the digital PCBs.

    Refer to Chapter 10, “Digital and Analog PCB Replacement”.
18. Install the Inner Top Cover.

    Refer to “Install Inner Cover” on page 8-6.
19. Install the Outer Cover.

    Refer to “Install Outer Cover” on page 8-6.

Chapter 16 — Digital PCB Fan Replacement

16-1 Introduction

This chapter describes how to remove and replace the fan that cools the Digital PCB Bay. This fan is termed the "Digital PCB Fan Bracket and Card Guide Assembly" and consists of the fan, brackets, card guides, and related mounting hardware. The fan airflow is from the rear of the instrument, through the Digital PCB Bay, and out through the front or sides of the instrument.

Remove the complete Digital PCB Fan Bracket Card Guide Assembly in order to replace the fan or to provide access for removing the Motherboard 1 PCB Assembly.

Digital PCB Fan Assembly Removal Process

The general fan removal procedure involves removing most major instrument components including the RF Deck, removing the instrument chassis left side plate, and finally removing the Digital PCB Fan Bracket and Card Guide Assembly. Once the Digital PCB Fan Bracket and Card Guide Assembly has been removed, it can be disassembled for fan replacement.

Digital PCB Fan Assembly Power Connection

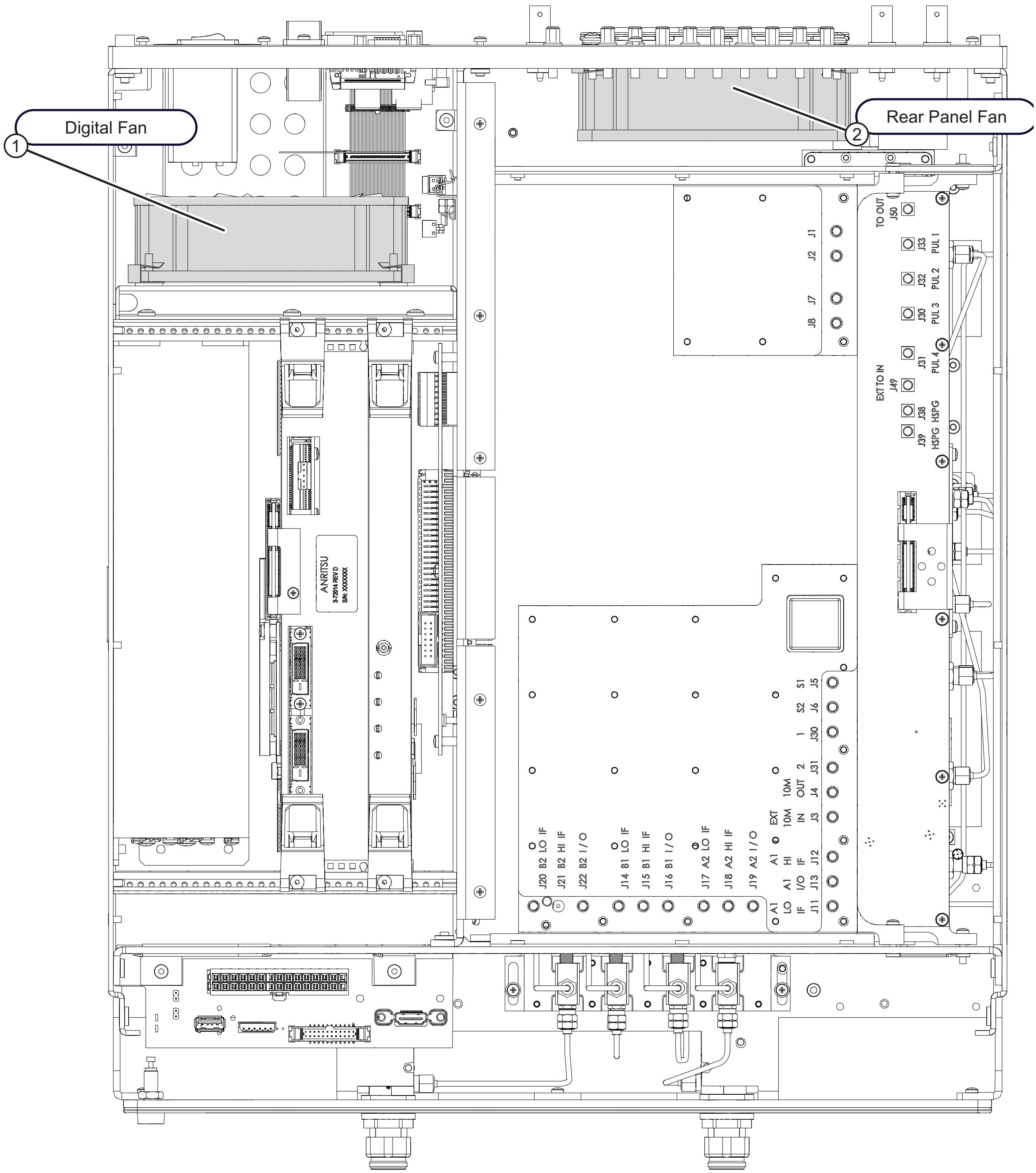
The fan power harness plugs into the Motherboard 2 PCB Assembly P96 Digital Fan header connector near the rear edge of the PCB.

16-2 Parts and Applicability

- Digital PCB Fan Assembly
- This assembly is used on all instrument models with any combination of options.
- The replacement part comes with a permanently attached 165 mm two-wire harness terminated in a 2-pin header connector.
- The fan airflow direction must be observed during installation so that it pushes air from the rear panel into the Digital PCB Bay towards the front.
- The replacement part does not include any mounting brackets or hardware. The brackets and hardware must be installed on the replacement fan.
- The Digital PCB Fan is electrically and form-factor identical to the Rear Panel Fan. However, note that the Rear Panel Fan has a longer 330 mm power cord.

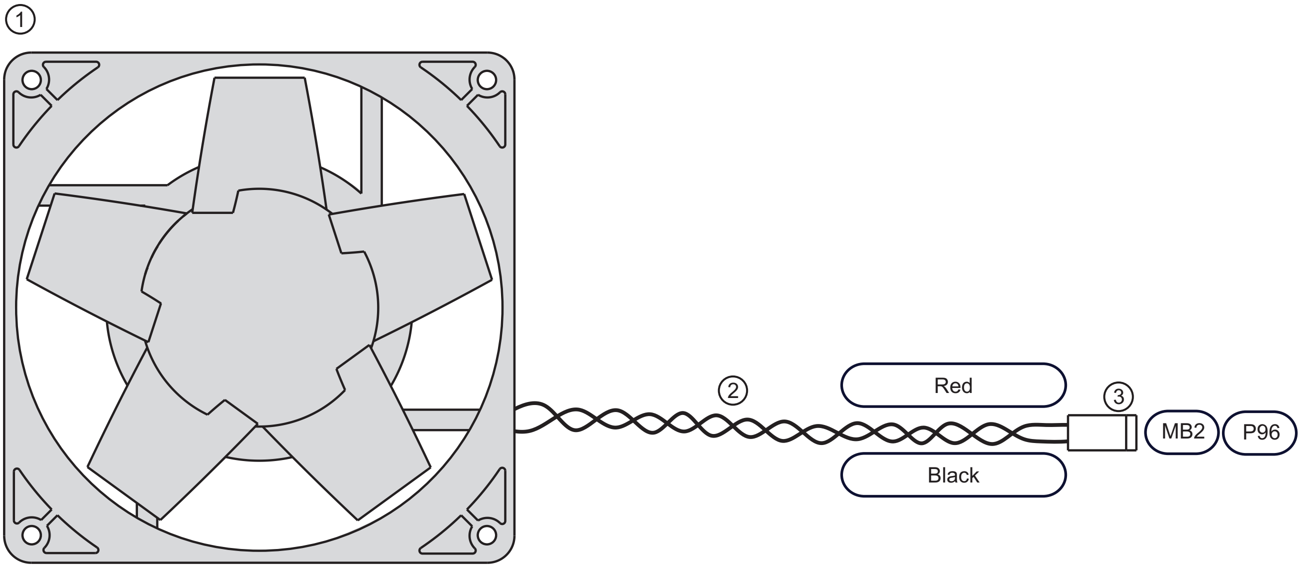
Fan Location and Replacement Identification

Figure 16-2 shows the fan location in the chassis and Figure 16-1 shows the replacement fan and harness.



1. Digital PCB Fan Assembly – Mounted in the Digital Section, with 165 mm cable harness and plug.	2. Rear Panel (Analog) Fan Assembly – with 330 mm cable harness and plug. For rear panel fan removal, refer to Section 19-4 “Rear Panel Removal”.

Figure 16-1. Digital PCB Fan Assembly – Chassis Location



1. Digital PCB Fan Assembly 2. Permanently attached 185 mm long 2-wire red/black twisted pair power harness.	3. Attached harness 2-pin header connector. • Connects to the Motherboard 2 PCB Assembly connector P96 located near the rear of the PCB. The Rear Panel Analog Fan is the same part with a 330 mm long 2-wire red/black twisted pair power harness and connector.

Figure 16-2. Digital PCB Fan Assembly – Detail

16-3 Disassembly for Fan Removal

Common Disassembly Procedures

1. Refer to Section 8-2 “Preparation of Work Area and Safety Instructions” on page 8-1.

2. Add Spacer Block under rear of instrument.

3. Remove and set aside the Front Panel.

- Refer to Section 18-3 “Remove Front Panel” on page 18-1.

Remove Digital PCBs

4. From the instrument top side, disconnect, remove, and set aside the digital PCB assemblies.

- Refer to Chapter 10, “Digital and Analog PCB Replacement” for detailed instructions.

Caution	If Option 35 (IF Digitizer Module) is installed, carefully follow the PCIe cable removal the instructions located in the section: “PCIe Cable (Option 35) – Removal for Access” on page 10-6.

Remove Analog Modules

Caution	If Option 35 (IF Digitizer Module) is installed, carefully follow the PCIe cable removal the instructions located in the section: “PCIe Cable (Option 35) Removal for Access” on page 10-21.

5. From the instrument right side, disconnect, pull out, and set aside the analog module assemblies.
    - Refer to Section 10-5, “Analog Module Overview” on page 10-14.

Remove RF Deck

For detailed instructions, refer to Section 11-3, “RF Deck Removal” on page 11-3.

6. With the instrument chassis top side up, disconnect any remaining cables between the chassis components and the RF Deck components.
7. Best practices recommend removing any Direct Access Loops (if equipped) and the rear panel loops.

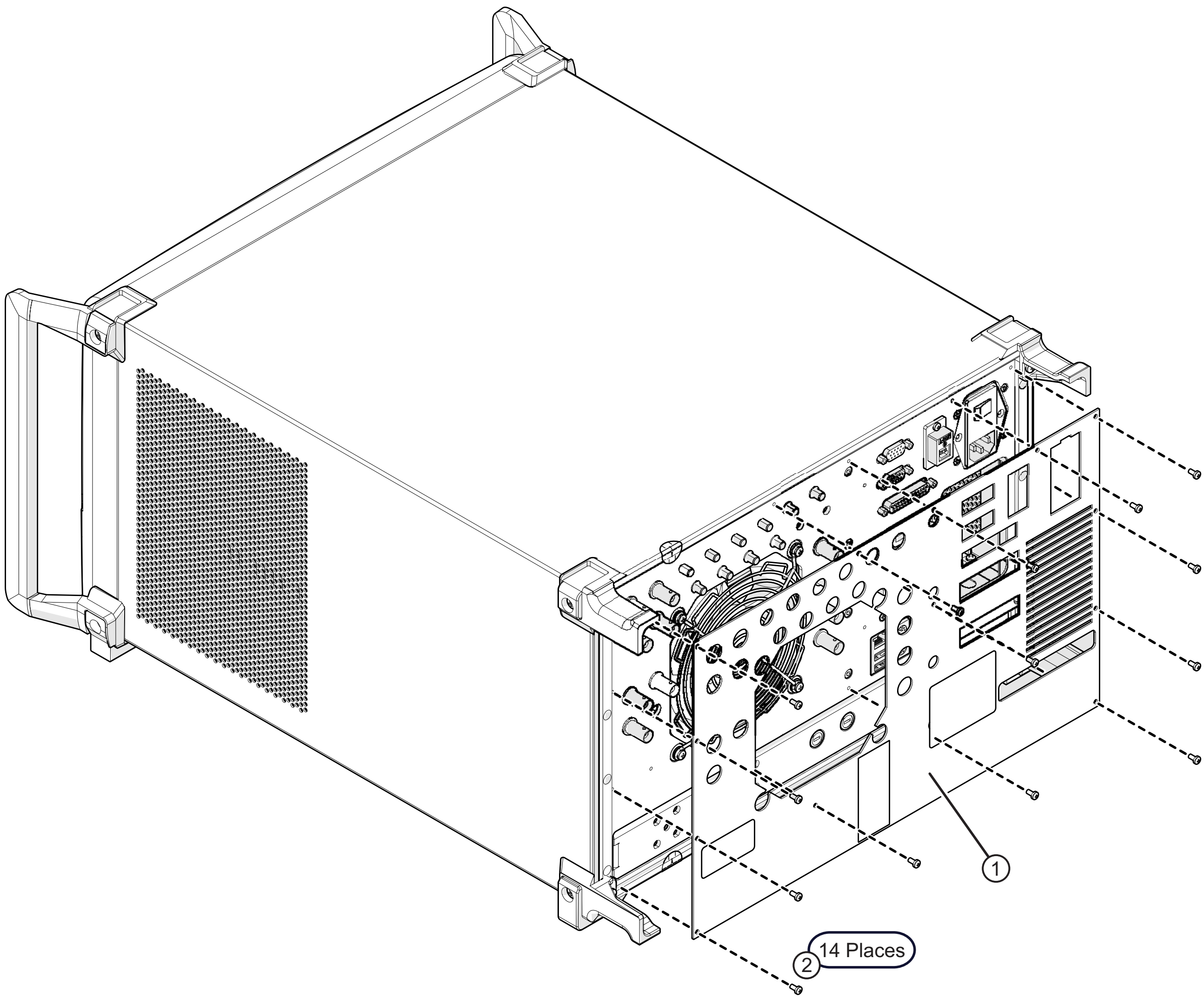
Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 “Factory RF Calibration (RF Cal)” for instructions on performing a new RF calibration.

8. Position the instrument upside down.
9. Remove the RF Deck by removing the hardware along its Bottom Side Center and on each side.
10. Lift the RF Deck up from the front, and then carefully slide out of the chassis.
11. Best practices recommend attaching a pair of T3545 RF Deck Fixtures to the deck to protect the RF Deck underside loops and components. See Appendix A — T3545 Maintenance Fixture.

Remove Rear Panel Sub Plate

The Sub Plate is the outer rear panel with the silk-screened port information.

12. Remove 14 screws, then remove the sub plate.



1. Silk-screened Rear Panel Sub Plate	2. Rear Panel Sub Plate fastening hardware of 14 pan head Phillips M3 × 6 mm screws.

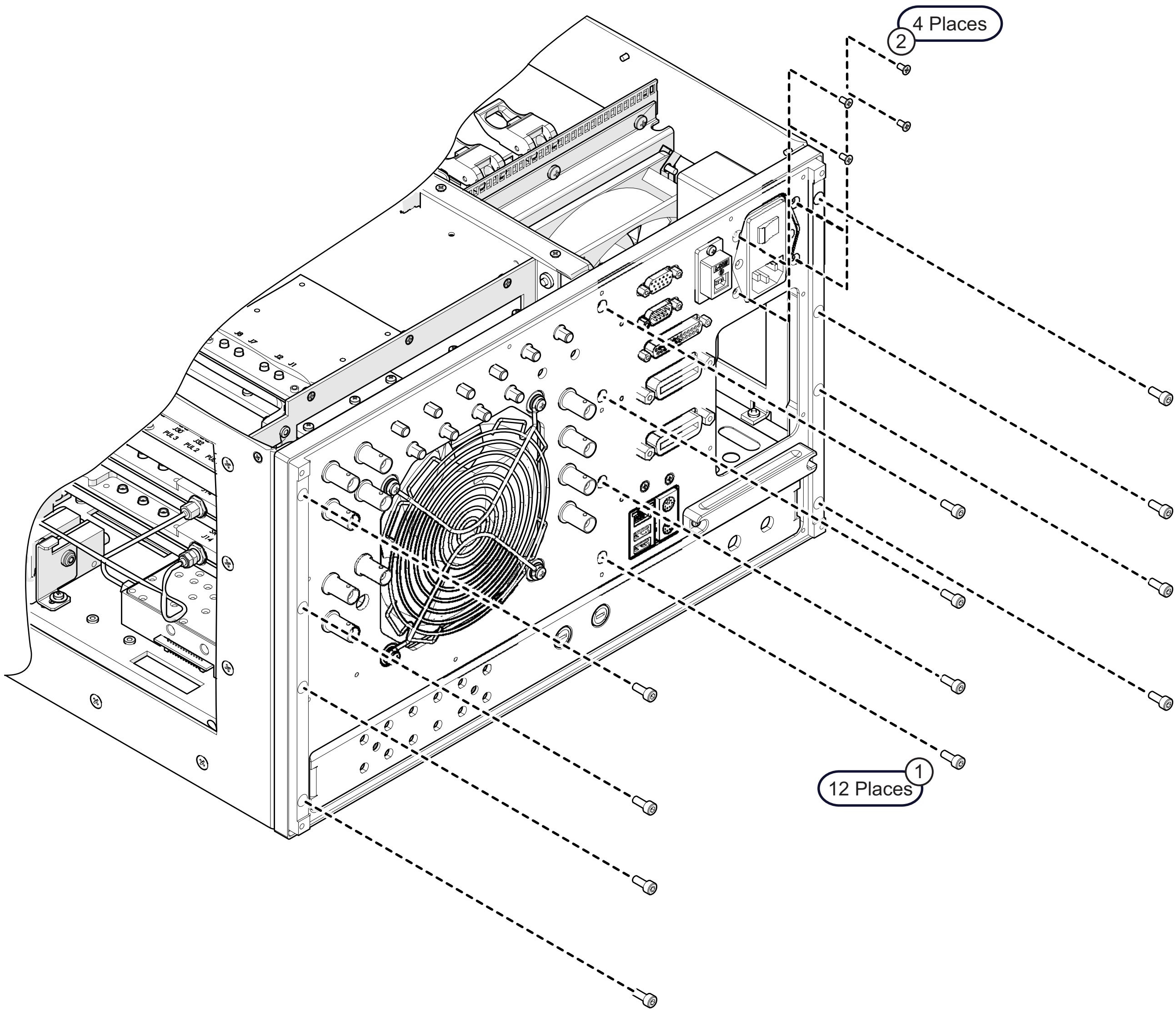
Figure 16-3. Digital PCB Fan Assembly – Removing Rear Panel Sub Plate

Remove Rear Panel Assembly

13. Remove the four (4) outer flat head Phillips M3 × 6 mm screws that hold the AC Module Housing to the Rear Panel. As the Rear Panel is removed, the AC Module Housing stays attached through its cable harness to the Power Supply Module.

14. Using an 8 mm hex Allen driver, remove the 12 cap socket Allen-head M4 × 10 mm screws that hold the Rear Panel Assembly to the instrument chassis

15. Pull the Rear Panel gently straight out, checking to make sure all of the Rear Panel cables have been disconnected.



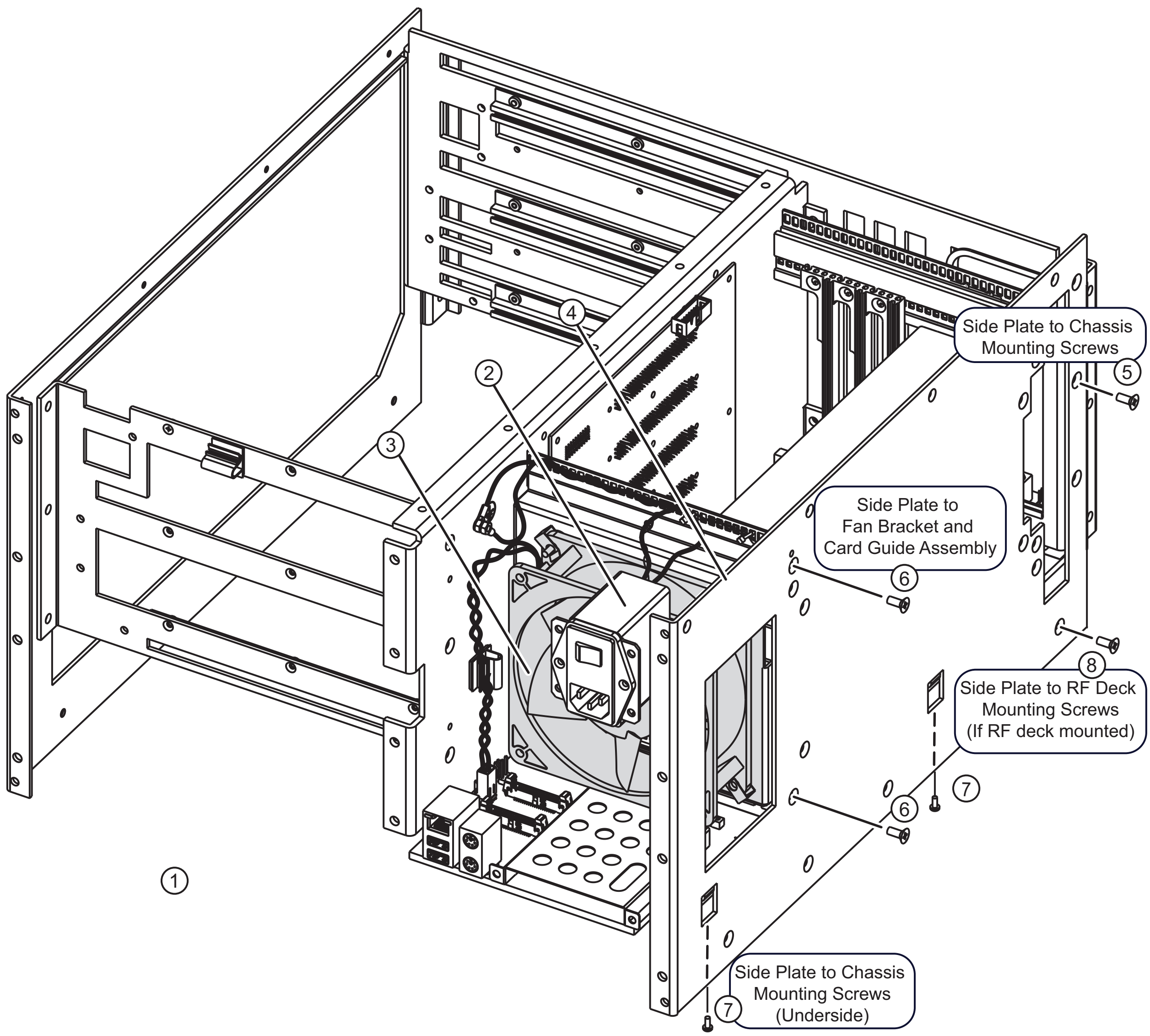
1. Rear Panel Mounting Screws – Twelve (12) cap socket Allen-head M4 × 10 mm screws	2. AC Input Module Mounting Screws – Four (4) flat head Phillips M3 × 6 mm screws

Figure 16-4. Remove or Install the Rear Panel Assembly

Remove Chassis Left Side Plate and Power Supply

The left side plate, power supply and power supply AC module housing is removed as a single unit.

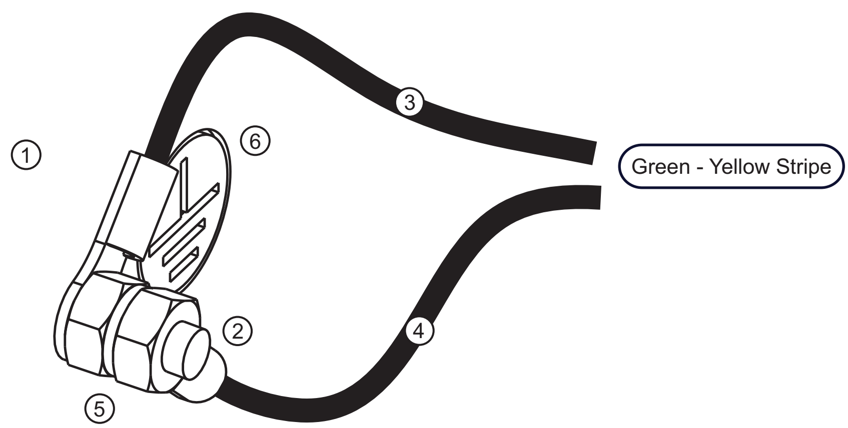
16. See Figure 16-5 for orientation on the removing the instrument chassis left side plate.



1. Rear Panel (removed)	6. Seven (7) flat head Phillips M4 × 10 mm screws holding Side Plate to front and rear Card Guide Assembly.
2. Power Supply AC Module Housing	7. Center two (2) pan head Phillips M2.5 × 6 mm screws holding the Side Plate to the instrument chassis. (Underside, through MB2 motherboard.)
3. Digital PCB Fan Assembly	8. Five (5) flat head Phillips M4 × 8 mm screws (if RF Deck is mounted)
4. Instrument Chassis Left Side Plate	
5. Three (3) flat head Phillips M4 × 8 mm screws holding the Side Plate to the instrument chassis.	

Figure 16-5. Left Side Plate, Power Supply Module and AC Module Housing Removal

17. At the front of the instrument, disconnect the main power supply cable from the Motherboard 2 PCB Assembly P94 31-pin connector.
18. At the front of the instrument, disconnect the power supply control cable from the Motherboard 2 PCB Assembly P93 header connector.
19. Remove the two (2) M3 × 0.5 kep nuts holding the power supply and AC module ground ring lugs in place on the chassis as shown in Figure 16-6.
20. Remove the side panel screws as indicated in Figure 16-5 on page 16-7.
21. Remove the left side plate, power supply and power supply ac module housing together.

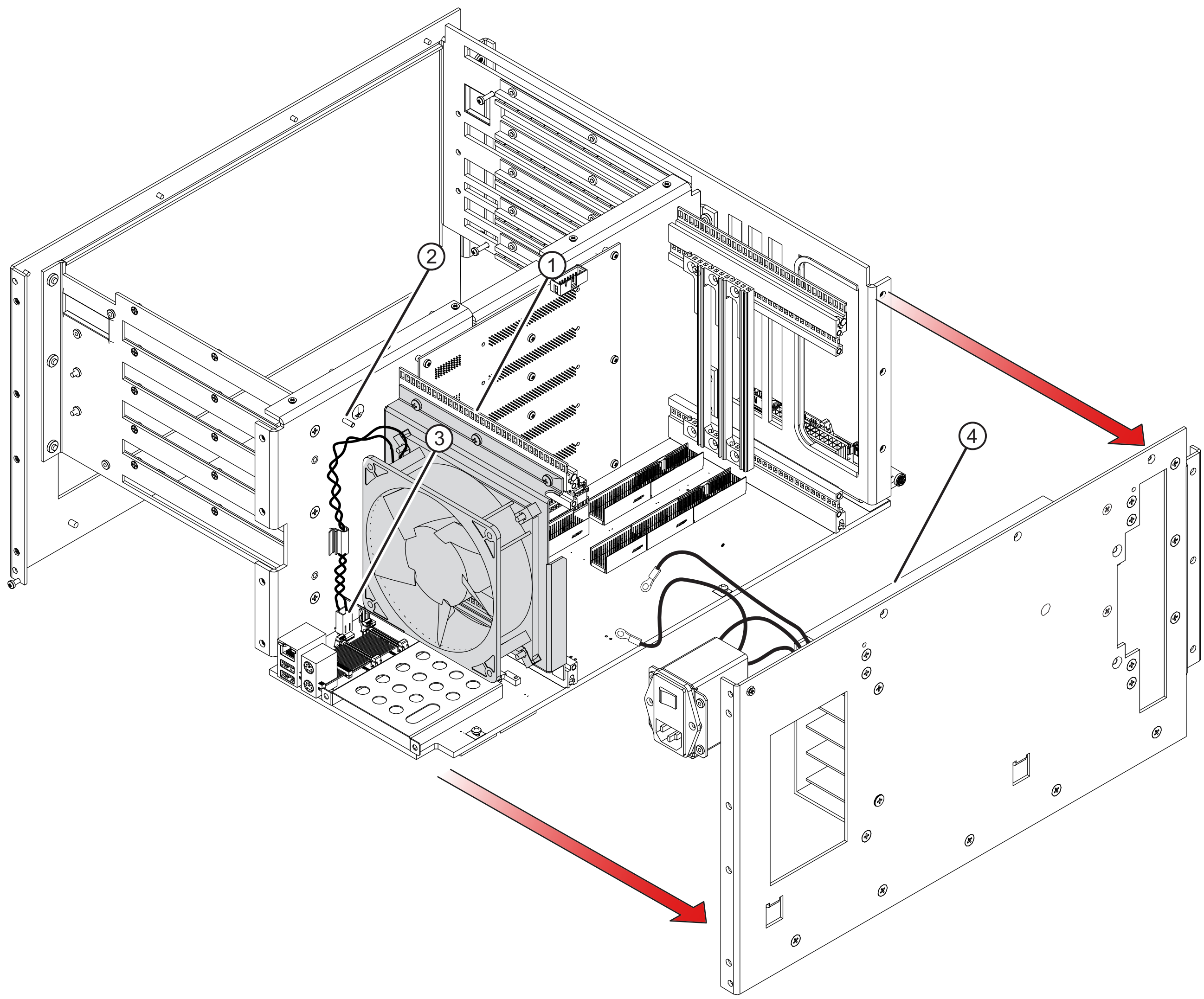


See Figure 16-5 above for orientation and position. 1. Chassis center plate. 2. Threaded stud mounted on chassis center plate. 3. Ring lug on green wire with yellow stripe from AC Line Module.	4. Ring lug on green wire with yellow stripe from Power Supply Module. 5. Two (2) M3 × 0.5 kep nuts. 6. Note that ring lugs and wires are dressed so that the ground symbol is clearly visible.

Figure 16-6. Disconnect or Connect the Power Supply Module Ground Cables

Side Plate and Power Supply Module Removed

Figure 16-7 shows side plate/power supply/AC input module after removal.



See Figure 16-5 above for orientation and position. 1. Fan attached to mounting bracket and card guide assembly. 2. Threaded chassis ground stud mounted on chassis center plate.	3. Fan power wires attached to MB2, P96. 4. Power Supply with AC Module still attached to side plate.

Figure 16-7. Left Side Plate, Power Supply Module and AC Module Housing Removed

Remove DC Fan Bracket/Card Guide Assembly

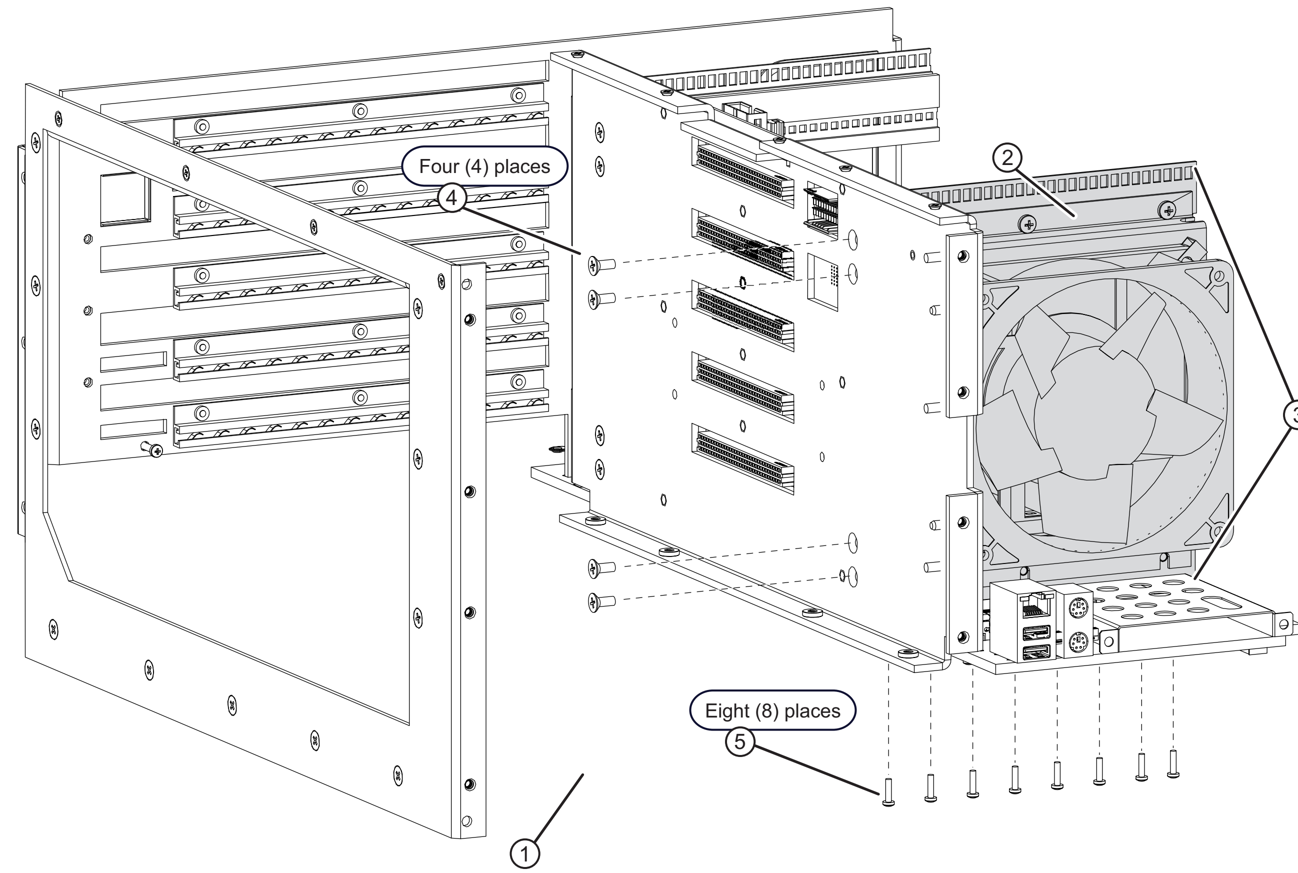
22. Disconnect the DC Fan Power cable from the Motherboard 2 PCB Assembly P96 connector

See Figure 16-7 on page 16-9 above for location of cable and MB2 connector.

23. From the Analog PCB Bay, remove the four (4) flat head Phillips M4 × 10 mm screws.

24. Turn the chassis over and remove the eight (8) M2.5 x 10 mm screws holding the bottom of the card guide assembly to the MB2 motherboard.

25. Remove the assembly from the chassis.



1. Instrument rear (chassis panel removed for clarity) 2. Fan/Bracket Assembly 3. Rear PCB Card Guide Assembly	4. Four (4) flat head Phillips M4 × 10 mm screws holding the Digital PCB Fan Bracket Assembly with the attached PCB Card Guide Assembly in place. 5. Eight (8) M2.5 x 10 mm screws holding bottom of PCB Card Guide Assembly to the MB2 motherboard.

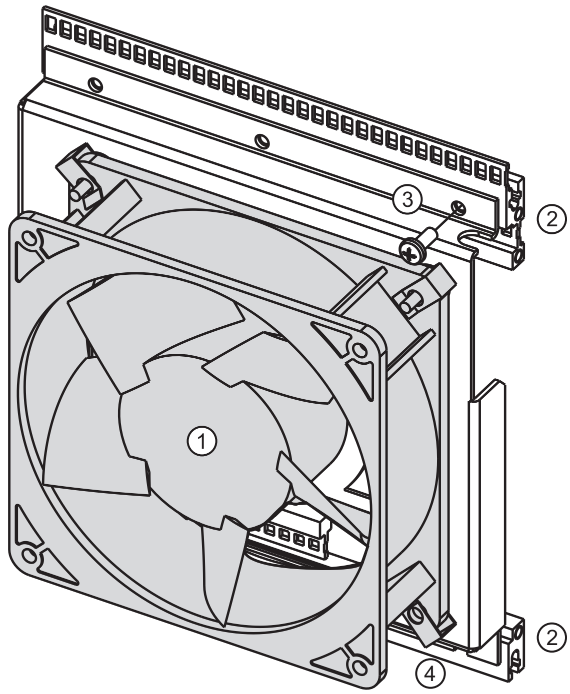
Figure 16-8. Remove or Install the DC Fan Bracket/Card Guide Assembly

16-4 Replacing the Fan

1. Remove the Digital PCB Fan Bracket Assembly from the Card Guide Assembly by removing the six (6) pan head Phillips M4 × 10 mm screws.

   Set the Card Guide Assembly aside.

2. Remove the Digital PCB Fan from the Digital Fan Bracket as shown in Figure 16-10 on page 16-12.

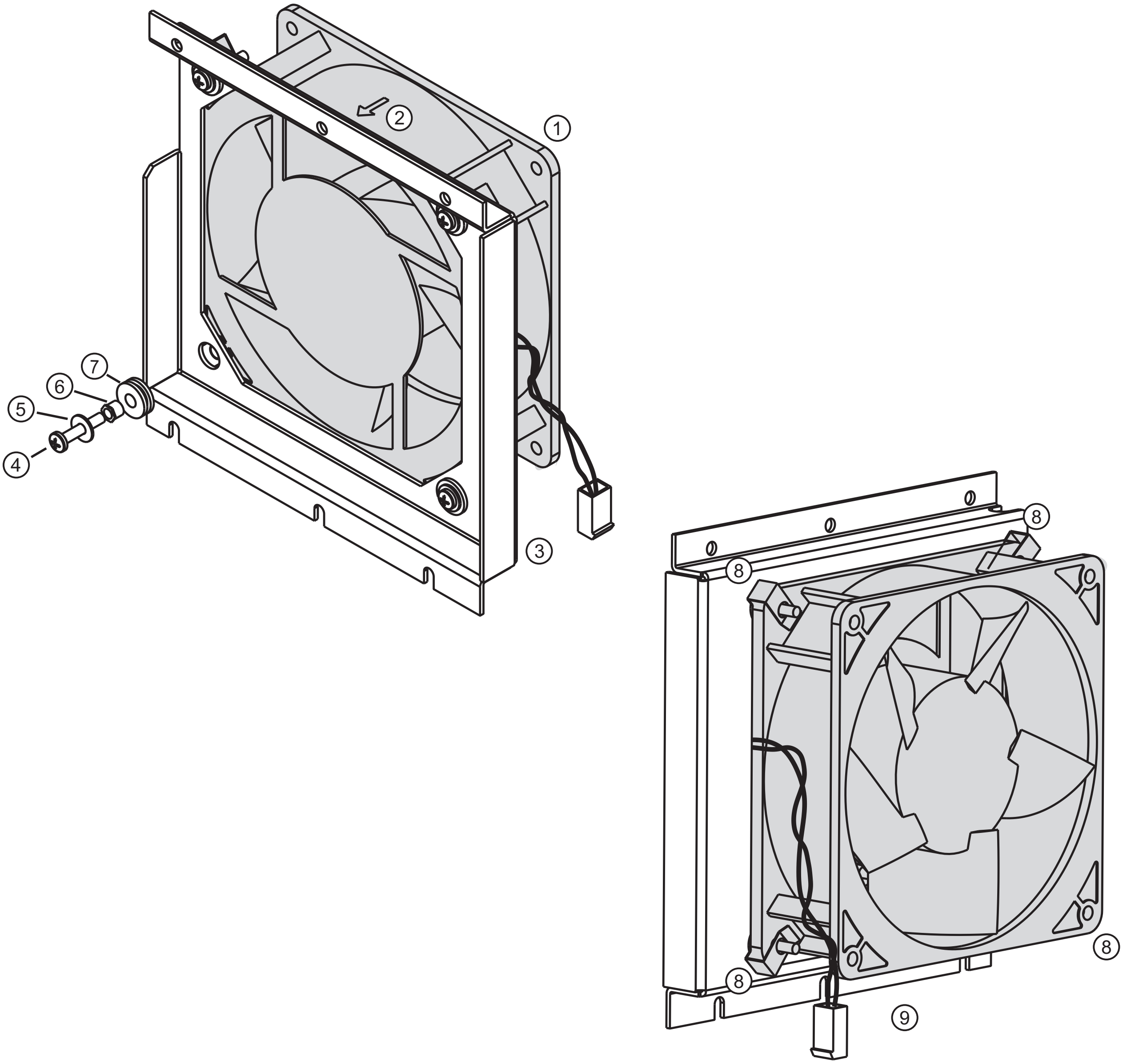


1. Digital PCB Fan Assembly 2. Rear Digital PCB Card Guide Assembly	3. Six (6) pan head Phillips M4 × 10 mm screws holding the Fan/Bracket Assembly to the Card Guide Assembly.

Figure 16-9. Digital PCB Fan Bracket/Card Guide Assembly

3. Remove the four (4) pan head Phillips 6 × 32 × 0.750” mounting screws that hold the fan to the fan bracket. The fan bracket appears as shown in Figure 16-10.

Note	All mounting hardware must be removed from the to-be-replaced fan to use with the replacement fan.



Fan, Airflow, and Bracket 1. Digital PCB Fan and Harness 2. Note that the fan airflow must be into the Digital PCB Bay towards the front of the instrument. 3. Digital Fan Bracket **Fastening Hardware** The fan is held to its mounting bracket with the following hardware in four (4) places: 4. Pan head Phillips 6 × 32 × 0.750” mounting screws. 5. #6 flat washers.	6. Standoff #6 clearance × 0.187” High 7. Isolation Vibration Grommet 8. Threaded Spring Clip, 0.31” × 0.25” (on the fan). 9. Power connector – 2-wire twisted pair header connector – Connects to Motherboard 2 PCB Assembly P96 connector

Figure 16-10. Remove or Install the Digital PCB Fan on the Fan Bracket

Attach the Replacement Fan to the Fan Bracket

Note	The fan airflow direction must be towards the front of the instrument.

4. Attach the four (4) threaded spring clips to the "airflow out" side of the fan.

5. Install the four (4) isolation vibration grommets into the Digital PCB Fan Bracket mounting holes.

6. The assembly sequence for the mounting hardware is shown above in Figure 16-10 on page 16-12.

7. Working from the front side of the Fan Bracket, insert each screw through the washer, and then through the standoff (with the standoff flange facing the screw head), through the vibration isolation grommet, and finally thread into the spring clip mounted on the fan.

8. Tighten all screws.

Attach the Digital Fan Bracket Assembly to the Card Guide Assembly

9. Attach the Digital Fan Bracket Assembly to the Card Guide Assembly by inserting six pan head Phillips M4 × 10 mm screws from the Digital Fan Bracket Assembly into the threaded holes in the Card Guide Assembly.

10. When all screws are correctly threaded, tighten.

11. The Digital PCB Fan Assembly with the attached PCB Card Guide Assembly is ready for installation to the chassis.

16-5 System Reassembly

Use this procedure to install the Digital Fan Bracket Card Guide Assembly into the chassis after removal. This procedure is used after removing the assembly to replace the fan, or to access the Motherboard 1 PCB Assembly.

Preliminary Checks

1. Make sure all hardware has been transferred to the replacement fan assembly.
2. Ensure the fan airflow is from the rear panel towards the front panel.
3. Ensure the four (4) isolation vibration grommets were placed in the correct sequence.
4. Ensure all fastening hardware is tightened.

Install Fan/Card Guide Assembly

5. See Figure 16-8, "Remove or Install the DC Fan Bracket/Card Guide Assembly" on page 16-10 above.
6. Install the Fan Bracket and Card Guide Assembly with eight screws to the MB2 motherboard.
7. Install the four screws to
8. When all screws are correctly threaded, tighten.

Connect the Digital PCB Fan Power and Ground Cables

9. Connect the Fan power cable and header connector to the Motherboard 2 PCB Assembly P96 connector.

Install Left Side Plate with Power Supply Module

The power supply module was removed still attached to the side plate. See Figure 16-5 on page 16-7 for orientation.

Attach the Left Side Plate with Power Supply to Chassis

10. Install the Power Supply Module attached to the Side Plate into the Digital PCB Bay while routing the main and control power supply harnesses toward the front of the instrument through the chassis openings.
11. Insert the three (3) flat head M4 × 8 mm screws that hold the Left Side Plate to the instrument chassis.
12. Insert the seven (7) flat head M4 × 10 mm screws into the Digital Fan Bracket and Card Guide Assembly.
13. When all screws are inserted and correctly threaded, tighten.
14. Connect the main power supply harness connector to the Motherboard 2 PCB Assembly P41 connector near the front of the PCB.
15. Connect the power supply control harness connector to the Motherboard 2 PCB Assembly P42 connector near the front of the PCB.

Connect AC Module Ground Lugs

16. Connect the AC Module Ground ring lugs to the chassis center plate.
    - See Figure 16-7, "Left Side Plate, Power Supply Module and AC Module Housing Removed" on page 16-9 for general location.
    - See Figure 16-6, "Disconnect or Connect the Power Supply Module Ground Cables" on page 16-8 for installation detail.
17. Place the two ring-lug ground cables over the threaded stud. Thread on two (2) M3 × 0.5 kep nuts and make sure the two ground lugs are dressed so that the ground symbol is readable.

Install Rear Panel Assembly

18. Refer to Figure 16-4, "Remove or Install the Rear Panel Assembly" on page 16-6 above for the following steps.

    For detailed instructions, refer to Section 19-7 "Rear Panel Installation".

19. Position the Rear Panel Chassis Plate, making sure all cables are correctly routed.
20. Attach all previously disconnected cables to their respective connectors.
21. Using an 8 mm hex driver bit, insert and thread the 12 cap socket Allen-head M4 × 10 mm screws into the Rear Panel Plate. There are three (3) rows of four (4) screws each.
22. When all are correctly threaded, tighten in two passes, working from the center of the panel out to the edges.

Install Rear Panel Sub Plate

23. Carefully position the Rear Panel Sub Plate into position and thread in the 14 pan head Phillips M3 × 6 mm screws.
24. When all are correctly threaded, tighten in two passes, working from the center of the panel out to the edges.

Install RF Deck

25. To install the RF deck, refer to Section 11-4, "RF Deck Installation" on page 11-12.

Install Analog Module Assemblies

26. Install the Analog Module Assemblies.
    - Refer to Section , "A15 Low Band Receiver Module Installation" on page 10-25.

Install Digital PCB Assemblies

27. Install the Digital PCB Assemblies.
    - Refer to "A10 DSP Module PCB Replacement" on page 10-9.
    - Refer to "Carrier Board Replacement" on page 10-9.

Option 35 – PCIe Cable

28. If the VNA has Option 35 (IF Digitizer Module) installed, reconnect the PCIe cable between A12 and the Carrier PCB using the instructions in Section , "PCIe Cable (Option 35) – Removal for Access" on page 10-6

Common Reassembly Procedures

Install Front Panel

29. Install the Front Panel Assembly.
    - Refer to Section 18-5 "Install Front Panel" on page 18-8.

- Install the Direct Access Loops if applicable.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 “Factory RF Calibration (RF Cal)” for instructions on performing a new RF calibration.

Install Covers

30. Install the Inner Top Cover.

- Section “Install Inner Cover” on page 8-6

31. Install the Outer Cover.

- Section “Install Outer Cover” on page 8-6

Chapter 17 — MB1 and MB2 PCB Replacement

17-1 Introduction

This chapter describes the procedures to remove the Motherboard 1 PCB and the Motherboard 2 PCB Assemblies.

The Motherboard 2 PCB Assembly must be first removed to replace the Motherboard 1 PCB Assembly. This PCB provides the backplane connectors for the Digital Section PCBs and the Motherboard 1 PCB Assembly. Each instrument is equipped with one MB2 PCB.

The Motherboard 1 PCB Assembly is vertically mounted in the Digital PCB Bay, where its backplane connectors protrude through openings in the chassis center plate and provides backplane connectors for the Analog Module Assemblies. Each instrument is equipped with one MB1 PCB.

17-2 Motherboard Identification

Figure 17-1 shows the general orientation of the MB1 and the MB2 PCBs.

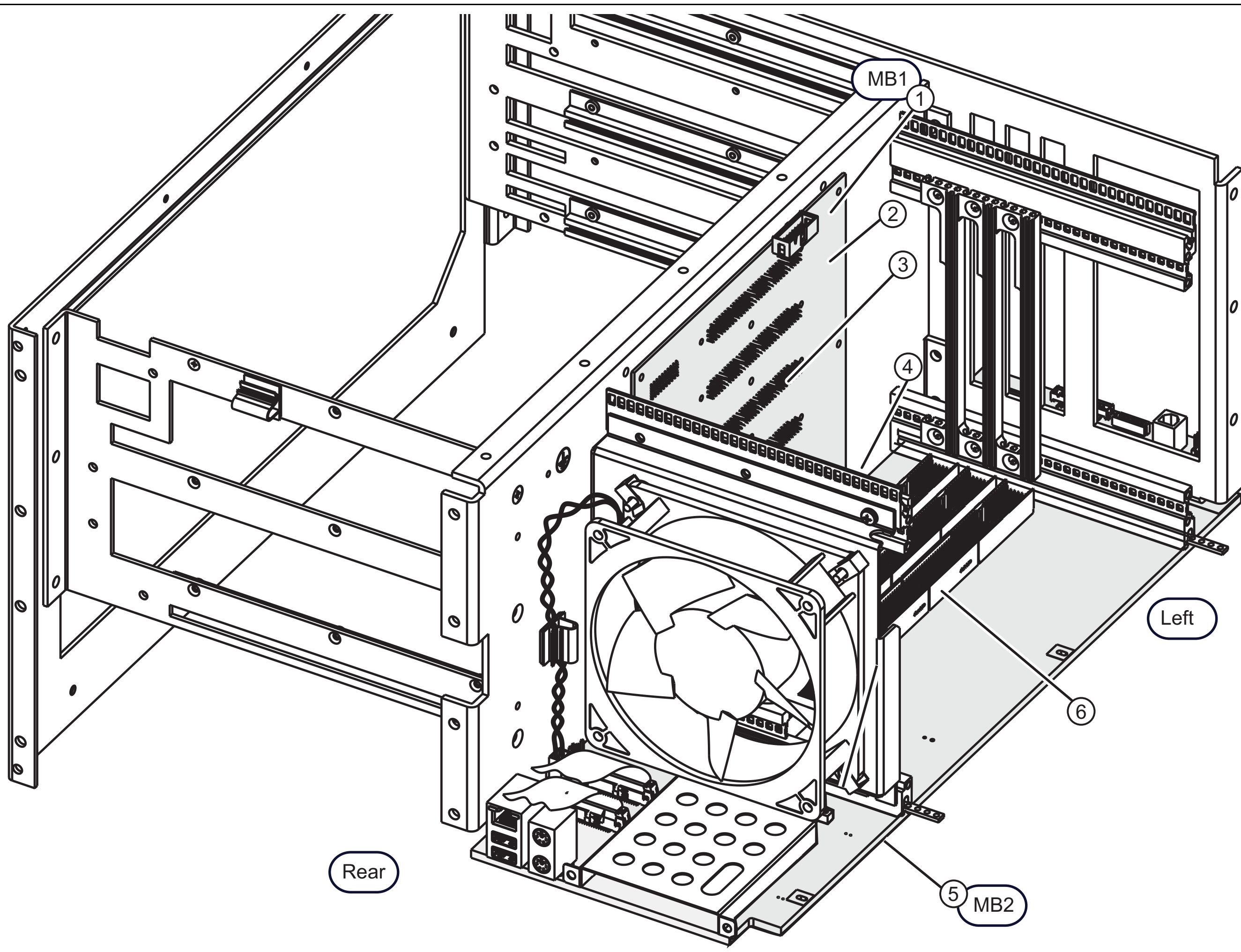


Figure 17-1. Motherboard 1 (MB1) and MB2 PCB Assemblies (1 of 2)

The Left Side Chassis Plate, the Rear Panel Plate, the Front Panel Assembly, the RF Deck, the Digital PCBs, and the Analog PCBs have been removed for clarity. 1. MB1 – Motherboard 1 PCB Assembly 2. Mounted vertically and fastened in Digital PCB Bay to the Chassis Center Plate.	3. The MB1 PCB backplane connectors protrude through plate openings into the Analog PCB Bay for the Analog Modules to plug in. 4. The MB1 PCB connects via a backplane connector into the MB2 PCB. The MB1 PCB can only be removed after the MB2 PCB has been removed. 5. MB2 – Motherboard 2 PCB: ND81312 – ND80356 or ND80356 – 3-80124-3

Figure 17-1. Motherboard 1 (MB1) and MB2 PCB Assemblies (2 of 2)

MB2 PCB Assembly Identification – ND81312 or 3-ND81312

This MB2 assembly appears in systems with Serial Number 1506634 and above.

In Figure 17-2, the MB2 connector locations are shown. In Figure 17-3 on page 17-5, a detailed view of the MB2 front connectors is shown.

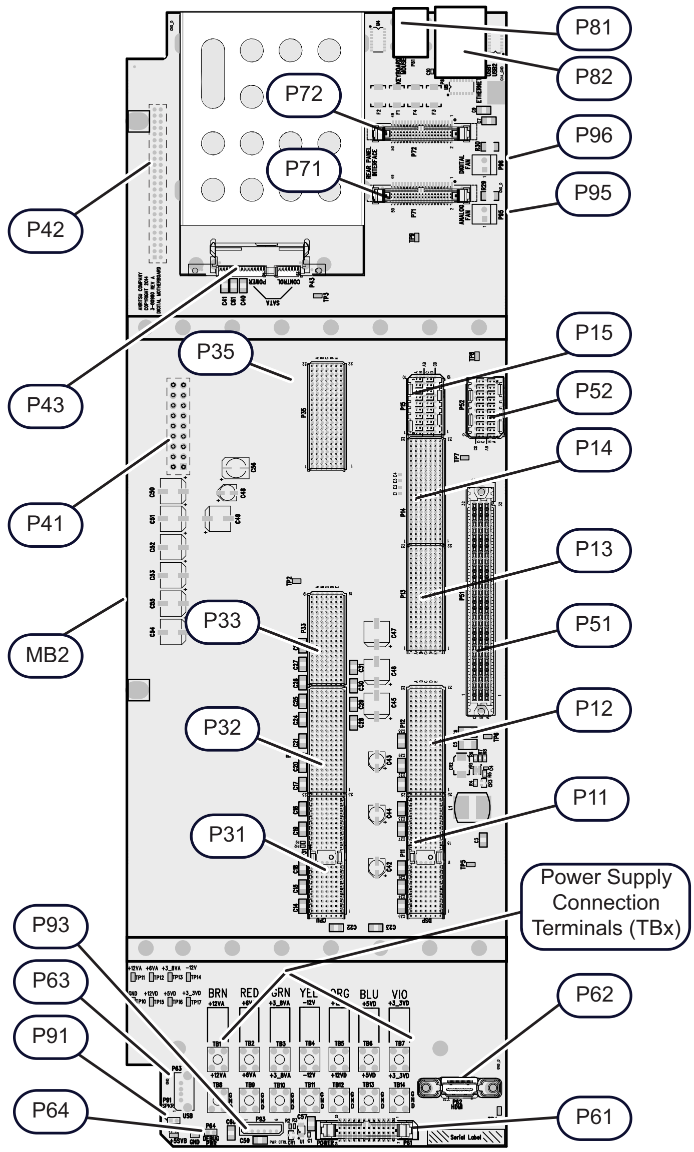
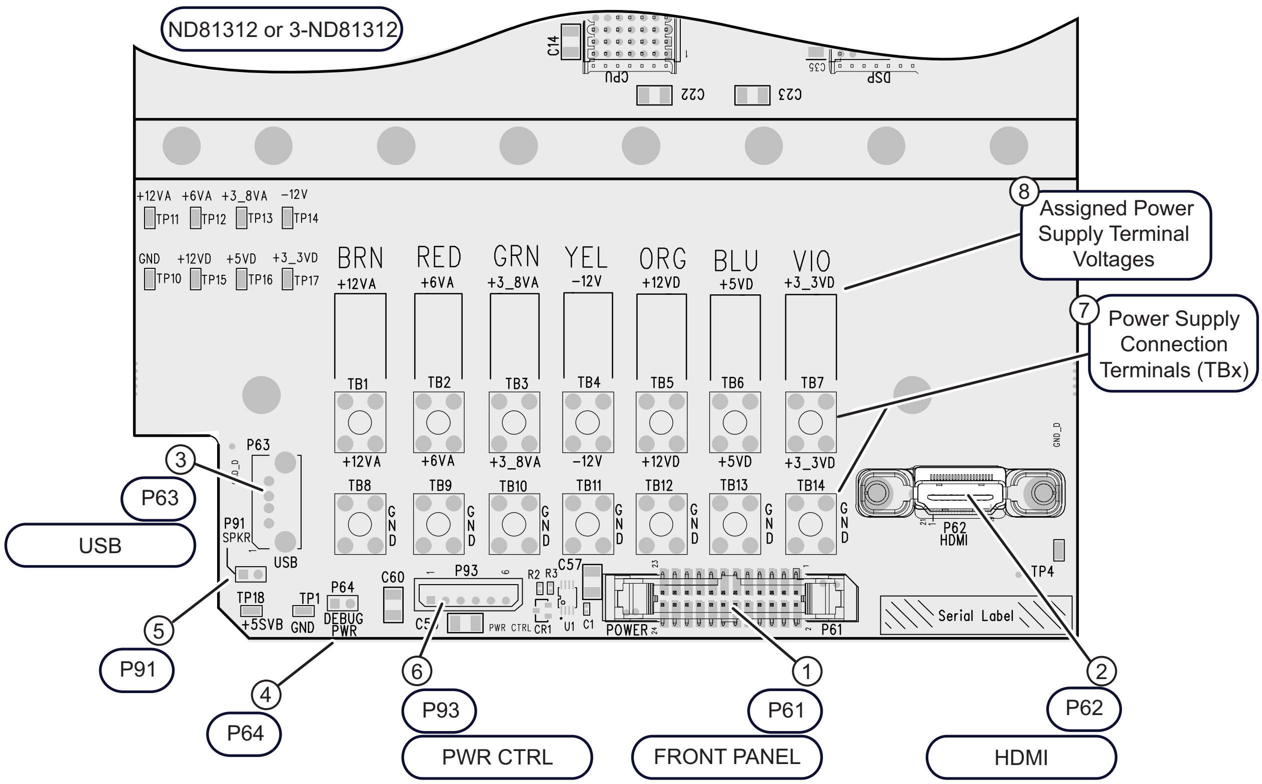


Figure 17-2. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 – Connectors (1 of 2)

Power Supply Connection Terminals	**Carrier Board PCB Edge Connectors**
TB1: +12VA	P31
TB2: +6VA	P32
TB3: +3_8VA	P33
TB4: -12VA	P35
TB5: +12VD	**A10 Digital Signal Processing PCB Edge Connectors**
TB6: +5VD	P11
TB7: +3_3VD	P12
TB8 through TB14: GND (Ground)	P13
P93 – Power Control Cable	P14
Front Panel Connectors	P15
P61 – Power/Signal ribbon cable	**Motherboard 1 PCB Edge Connectors**
P62 – HDMI Cable	P51
P63 – USB Cable	P52
MB2 Front Connectors	**Reverse Side Connectors**
P64 – Debug Power – Not used	P41 – RF Power In
P91 – Speaker – Not used	P42 – RF Control In
MB2 Rear Connectors	
P43 – Solid State Drive Control and Signal Connector	
P71 – Rear Panel Interface Connector	
P72 – Rear Panel Interface Connector	
P95 – Analog Section Fan Power	
P81 – PS/2 Keyboard and Mouse Connector Stack	
P82 – RJ45 Ethernet and USB Connector Stack	
P96 – Digital Section Rear Panel Fan Power	

Figure 17-2. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 – Connectors (2 of 2)



1. P61 – ribbon cable Connector to Front Panel	5. P91 – Speaker – Not used
2. P62 – HDMI Connector to Front Panel	6. P93 – Power Control Connector to Power Supply
3. P63 – USB Type A Connector to Front Panel	7. TBx – Power Supply Connection Terminals
4. P64 – Debug Power – Not used	Assigned Power Supply Voltages

Figure 17-3. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 – Front

MB2 PCB Assembly Identification – ND80356 – 3-80124-3

This MB2 assembly appears in systems with S/N 1505633 and below:

In Figure 17-4, the MB2 connector locations are shown. In Figure 17-5 on page 17-8, a detailed view of the MB2 front connectors is shown.

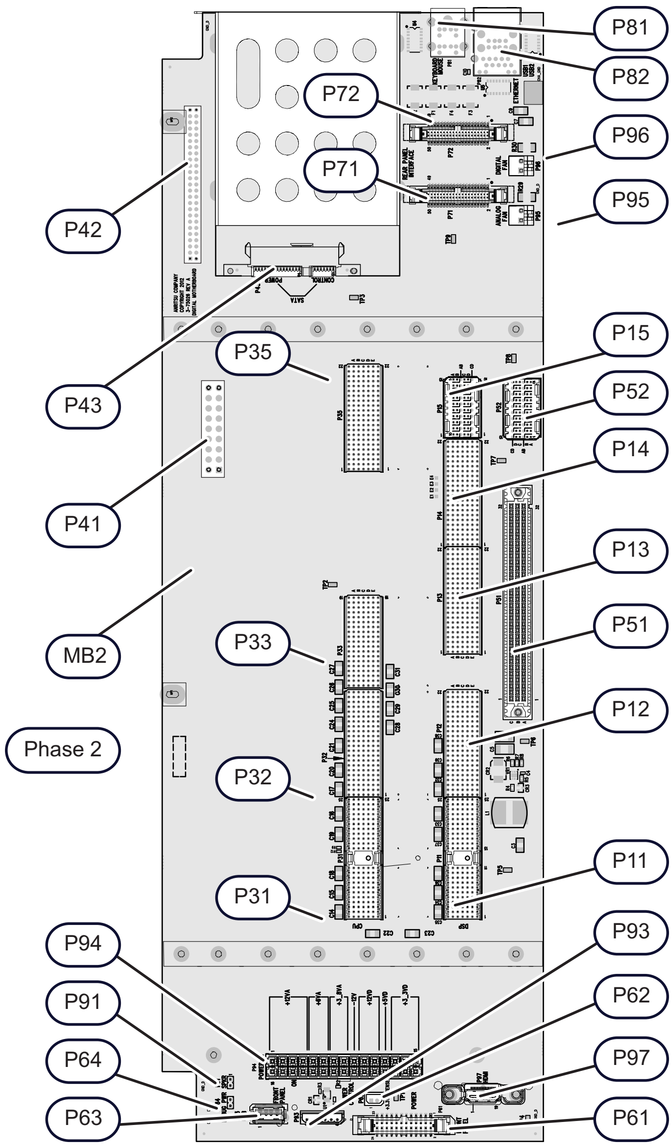
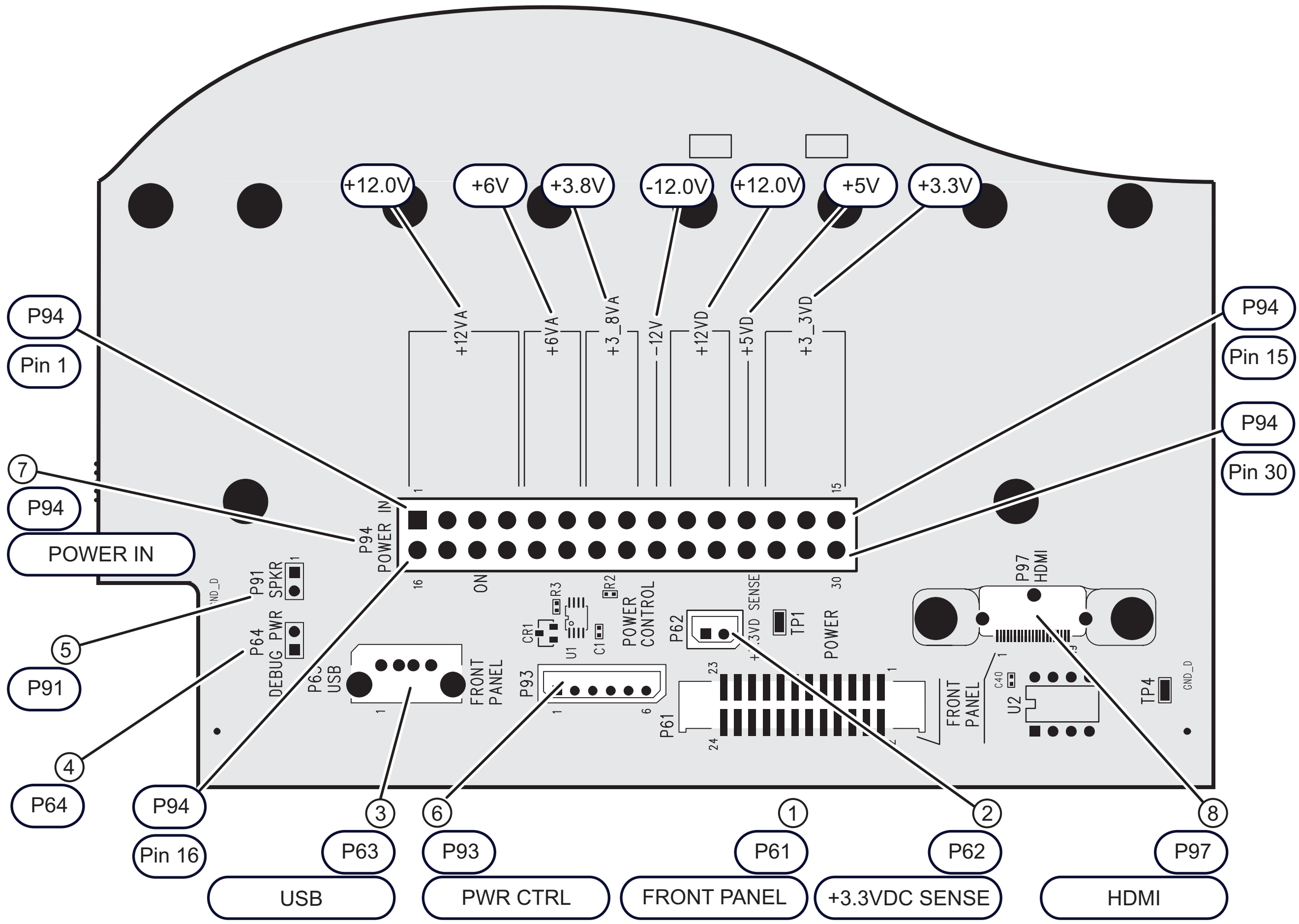


Figure 17-4. Motherboard 2 PCB Assembly – ND80356 – 3-80124-3 – Connectors (1 of 2)

Power Supply Connectors	**Carrier Board PCB Edge Connectors**
P94 – Main Cable Harness from Power Supply	P31
P93 – Power Control Cable	P32
P62 – +3.3 VDC Sense Cable	P33
Front Panel Connectors	P35
P61 – Power/Signal ribbon cable	**A10 Digital Signal Processing PCB Edge Connectors**
P63 – USB Cable	P11
P97 – HDMI Cable	P12
MB2 Front Connectors	P13
P54 – Debug Power – Not used	P14
P91 – Speaker – Not used	P15
MB2 Rear Connectors	**Motherboard 1 PCB Edge Connectors**
P43 – Solid State Drive Control and Signal Connector	P51
P71 – Rear Panel Interface Connector	P52
P72 – Rear Panel Interface Connector	**Reverse Side Connectors**
P95 – Analog Section Fan Power	P41 – RF Power In
P81 – PS/2 Keyboard and Mouse Connector Stack	P42 – RF Control In
P82 – RJ45 Ethernet and USB Connector Stack	
P96 – Digital Section Rear Panel Fan Power	

Figure 17-4. Motherboard 2 PCB Assembly – ND80356 – 3-80124-3 – Connectors (2 of 2)



1. P61 – ribbon cable Connector to Front Panel	P94 – Connector Pin 1
2. P62 – +3.3 VDC Sense Connector to Power Supply Module	P94 – Connector Pin 15
3. P63 – USB Type A Connector to Front Panel	P94 – Connector Pin 16
4. P64 – Debug Power – Not used	P94 – Connector Pin 30
5. P91 – Speaker – Not used	
6. P93 – Power Control Connector to Power Supply	
7. P94 – Power In Connector to Power Supply	
8. P97 – HDMI Connector to Front Panel	

Figure 17-5. Motherboard 2 PCB Assembly – ND80356 – 3-80124-3 – Front

17-3 Motherboard 2 PCB Replacement

Use this removal procedure for MB2 PCBs.

Common Disassembly Procedures

1. Prepare work area, work surface, and observe safety issues.
    - Refer to “Preparation of Work Area and Safety Instructions” on page 8-1.
2. Remove Outer Cover.
    - Refer to Section “Remove Outer Cover” on page 8-3.
3. Position the instrument so that it is right-side up, RF deck down.
4. Remove Inner Top Cover.
    - Refer to Section “Remove Inner Cover” on page 8-5.

Motherboard 2 PCB Removal

Remove PCIe, USB, and XGA/VGA Cables

- Refer to Section “PCIe Cable (Option 35) – Removal for Access” on page 10-6

Remove Digital PCB Assemblies

5. Remove digital section top side PCBs.
    - Refer to Chapter 10, “Digital and Analog PCB Replacement”.

Remove Front Panel

Refer to Section 18-3 “Remove Front Panel” on page 18-1 for detailed instructions.

6. Position the instrument top side up.
7. Install spacer block near the front edge of the chassis.
8. If equipped, remove the Direct Access Loops from RF Deck Front Panel.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 “Factory RF Calibration (RF Cal)” for instructions on performing a new RF calibration.

9. Remove the Front Panel Assembly.

RF Deck Top Side Coaxial Cable Connections

10. Loosen and then remove the semi-rigid coaxial cable from the A111 LO Distribution Module Assembly and its right side J1 connector. The other end of the cable should already be disconnected from the previously removed middle A13 Source Module and its J9 connector.
11. Remove the four MCX cables from the A100-A103 Sampler Modules and their rear facing J3 connectors. These cables route to the previously removed top A11 IF Band Module. The cables can stay fastened to the chassis with cable ties.

Remove RF Deck

For detailed instructions, refer to Section 11-3, “RF Deck Removal” on page 11-3.

12. Position the chassis upside down.
13. Disconnect the cable harness connected to the P42 RF Control connector located near the front of the MB2 PCB.

14. Disconnect the cable harness connected to the P41 RF Power connector located near the front of the MB2 PCB.
15. Remove the RF Deck.

Remove Rear Panel Sub Plate

16. Position the instrument top side up.
17. Be careful not to scratch the silk-screened Rear Sub Plate when working on it.
18. Remove the Rear Sub Plate by removing 14 pan head Phillips M3 × 6 mm screws.
19. Carefully set the sub-plate aside.

Remove Rear Panel Cables

20. Cut the cable ties holding two ribbon cables from the A17 Rear Panel PCB Assembly. The cables route to connectors on the MB2 PCB.
21. Remove the four (4) outer screws holding the AC Power Module Assembly to the Rear Panel. The AC Module is permanently connected via a multi-wire harness to the Power Supply Module. Leave it in place but out of the way for the steps below.
22. The three (3) Analog Module Assemblies should have been removed in a step above. Disconnect any remaining MCX to BNC coaxial cables from their destination. The cables are permanently attached to the Rear Panel BNC connectors.

Remove A17 Rear Panel PCB ribbon cables

23. Remove the ribbon cable from the A17 Rear Panel PCB (A17 PCB) Assembly at the top P1 connector.
24. Remove the ribbon cable from the A17 PCB at the bottom P2 connector.

Remove Rear Panel

25. If not already completed, remove the Rear Panel Loops if the VNA is fitted with Option 51, 61, or 62.
26. Remove the Rear Panel.
    - Refer to Section 19-4 “Rear Panel Removal”
27. Pull the Rear Panel straight out slowly, making sure that all cables have been disconnected.
28. Once clear of the chassis, set the Rear Panel aside.

Remove Motherboard 2 PCB Cables

29. Remove the USB cable from the MB2 PCB P63 connector.
30. Depending on the MB2 configuration in your system, remove the Power Supply Power cable ring lug connectors from their respective terminals on MB2 or the remove the Power Supply Power cable from the MB2 PCB P94 connector.
31. Remove the Power Supply Control cable from the MB2 PCB P93 connector.
32. Remove the two ribbon cables formerly attached to the A17 PCB from the MB2 PCB P71 and P72 connectors.
33. Remove the two fan power cables from the MB2 PCB P95 and P96 connectors.

Remove Motherboard 2 PCB Screws

See Figure 17-6 on page 17-11.

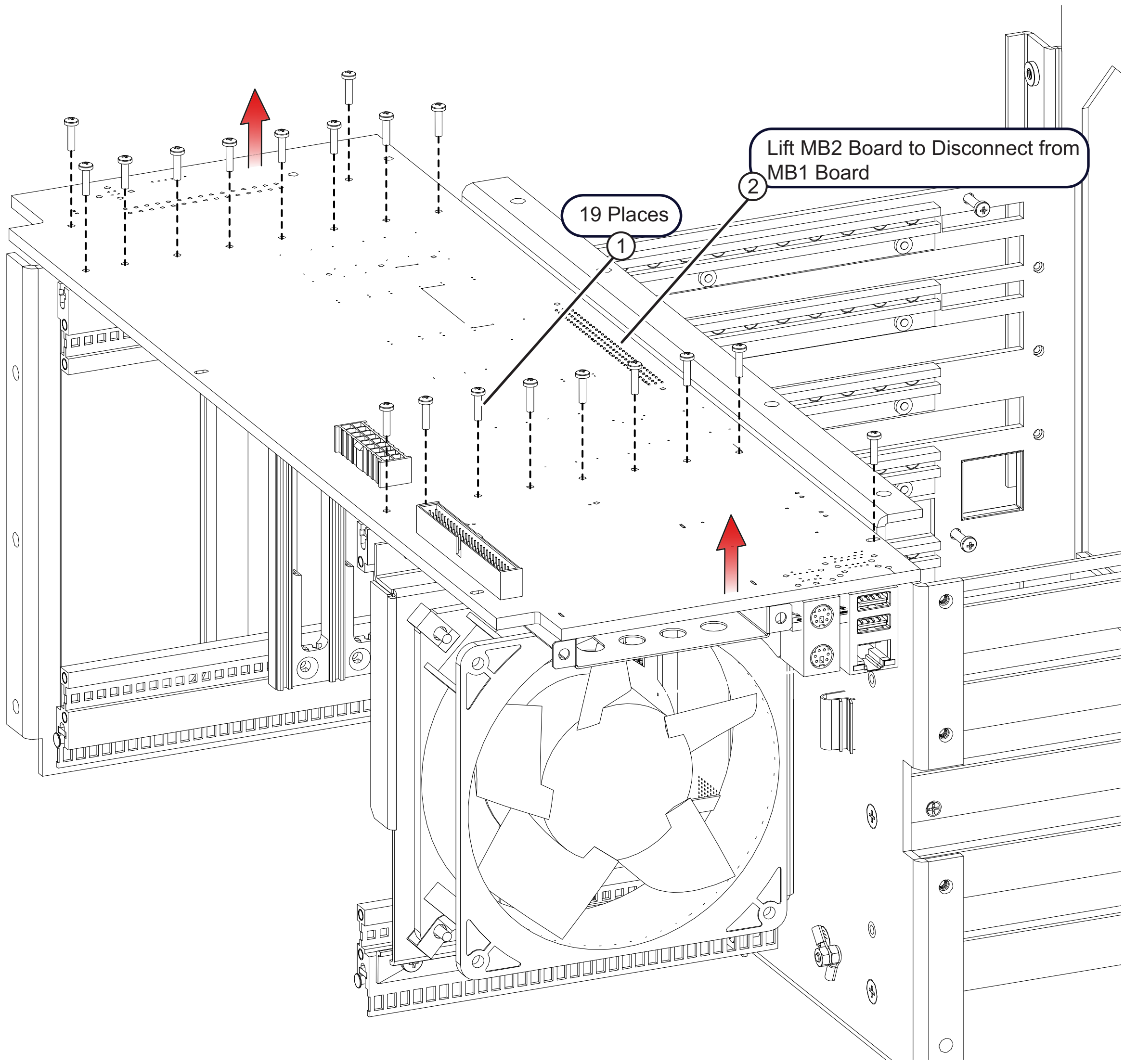
34. Position the chassis upside down.
35. Remove the 19 pan head Phillips M2.5 × 10 mm screws from bottom side of MB2 PCB.

Disconnect MB2 from MB1 PCB Backplane Connector

36. At this point, the MB2 PCB Assembly is still attached to the MB1 PCB through the MB2 backplane connector.

37. Gently lift the MB2 PCB straight up so that the backplane socket on the MB1 PCB disconnects from the backplane pins on the MB2 PCB.

38. Remove the MB2 PCB



1. Remove 19 each, Pan head Phillips M2.5 × 10 mm screws.	2. Lift MB2 Motherboard to disconnect from MB1 Board.

Figure 17-6. Motherboard 2 PCB Assembly – ND80356 – 3-80124-3 – Front

Motherboard 2 PCB Installation

Preparation

There are no replaceable parts located on the MB2 PCB and its replacement is ready to go direct from the factory.

If any of the disconnected cables were left on the to-be-replaced MB2 PCB, transfer them to the replacement PCB.

Prerequisite

1. The MB1 PCB must be installed and fastened in place to perform this procedure.

Install Motherboard 2 PCB Assembly

2. If installing a replacement MB2, make sure that all cable harnesses on the removed PCB are transferred to the replacement unit.
3. Carefully position the MB2 PCB Assembly in place.
4. Make sure the MB2 PCB P51 backplane connector socket correctly engages with the MB1 PCB backplane pins.
5. Gently press the MB2 PCB backplane connector into place so that the pins on the MB1 PCB fully seat in the MB2 PCB connector.

   Check from the side to make sure the MB1 PCB pins are fully seated into the MB2 PCB connector.

Install Motherboard 2 PCB Assembly Hardware and Cables

6. Loosely insert the 19 pan head Phillips M2.5 × 10 mm mounting screws holding the MB2 PCB in place
7. When correctly positioned and threaded, tighten all screws using two passes, each time working from the center outward.
8. Position the instrument chassis so it is top side up.
9. Reconnect all Motherboard 2 PCB Assembly cables at their connectors.

Install the Rear Panel

10. Install the Rear Panel.
    - Refer to Section 19-7 “Rear Panel Installation” on page 19-17.

Install RF Deck

11. Position the instrument upside down.
12. Install the RF Deck.
    - Refer to Section 11-4, “RF Deck Installation” on page 11-12.

Install Analog Module Assemblies

13. Position the instrument top side up.
14. Install the analog module assemblies and connect the MCX and semi-rigid coaxial cables.
    - Refer to “A15 Low Band Receiver Module Installation” on page 10-25.

Install Digital PCB Assemblies

15. Install the digital PCB assemblies and connect the Rear Panel and other cables.
    - Refer to Section 10-3 “Digital PCB Replacement” on page 10-6.

Install Front Panel

16. Position a block under the front of the instrument chassis.
17. Install the Front Panel Assembly.
    - Section 18-5 “Install Front Panel” on page 18-8.

Common Reassembly Procedures

Install Covers

18. Install the Inner Top Cover.

- Refer to Section "Install Inner Cover" on page 8-6.

19. Install the Outer Cover.

- Refer to Section "Install Outer Cover" on page 8-6.

Check Connections

20. Make sure all cables and harnesses are correctly connected and fully seated in their connectors.

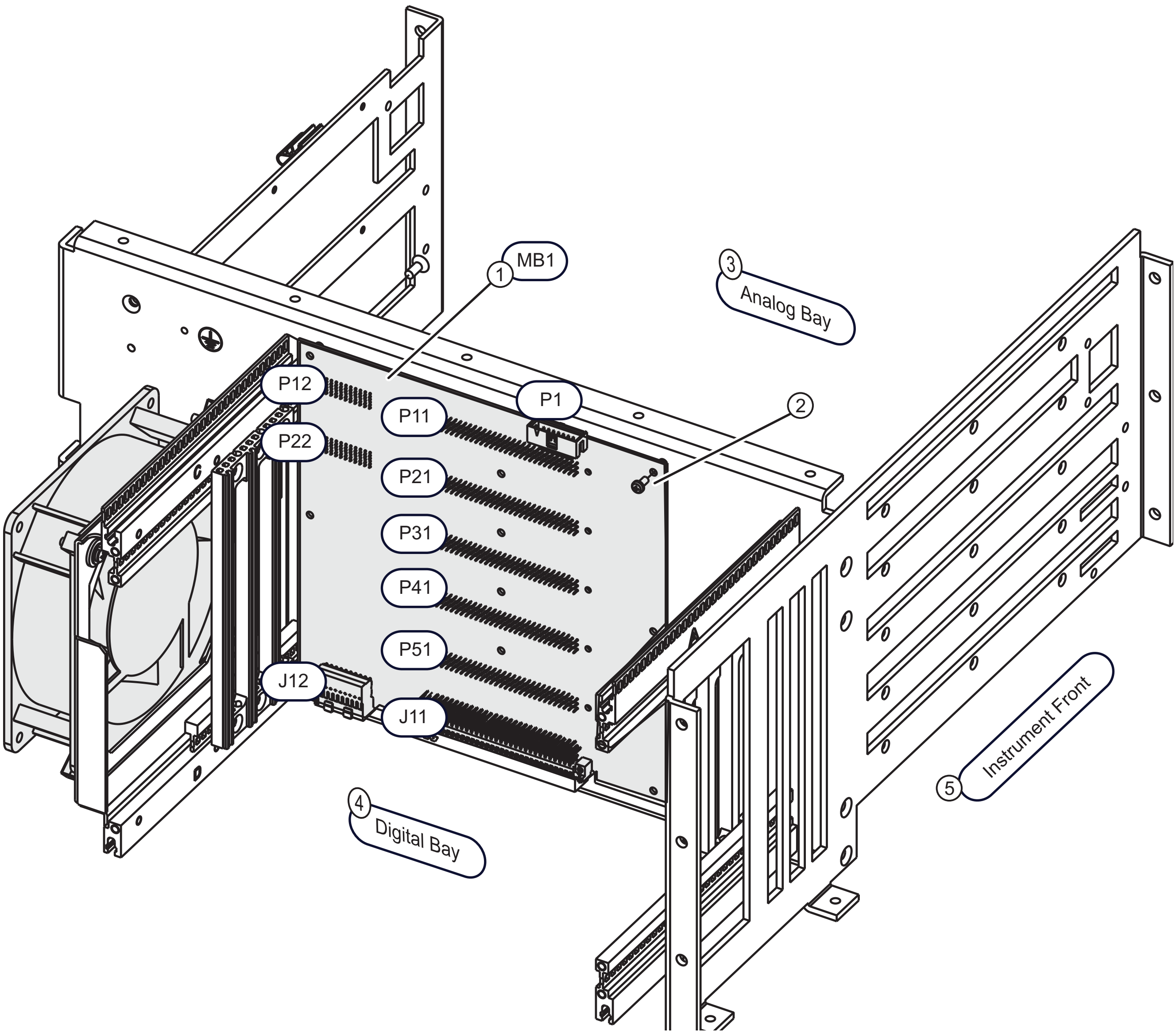
21. Make sure all RF semi-rigid and MCX coaxial cables are correctly aligned, threaded, and torqued.

17-4 Motherboard 1 PCB Replacement

MB1 Replacement requires that MB2 be removed first.

Parts and Applicability

- MB1 – Motherboard 1 PCB Assembly
- Applicable to all MS4640B models with any combination of options.
- Each instrument is equipped with one (1) MB1 PCB.
- Figure 17-7 shows the connector locations for the MB1 PCB.



1. MB1 – Motherboard 1 PCB Assembly	3. Analog PBC Bay
2. 10 each pan head Phillips M3 × 6 mm mounting screws.	4. Digital PCB Bay

Figure 17-7. Motherboard 1 PCB Assembly – Replacement

Common Disassembly Procedures

Refer to Section 8-2 “Preparation of Work Area and Safety Instructions” on page 8-1.

1. Prepare work area, work surface, and observe safety issues.
   - Refer to “Preparation of Work Area and Safety Instructions” on page 8-1

2. Remove Outer Cover.
   - Refer to “Remove Outer Cover” on page 8-3.

3. Position the instrument so that it is right-side up, RF deck down.

4. Remove Inner Top Cover.
   - Refer to “Remove Inner Cover” on page 8-5.

Motherboard 1 PCB Removal

Remove PCIe, USB, and XGA/VGA Cables

- Refer to Section “PCIe Cable (Option 35) – Removal for Access” on page 10-6

Remove Digital PCB Assemblies

5. Remove digital section top side PCBs.
   - Refer to Chapter 10, “Digital and Analog PCB Replacement”.

Remove Analog Module Assemblies

6. Remove analog section right side module assemblies.
   - Refer to Section 10-5 “Analog Module Overview” on page 10-14.

Remove Front Panel

7. Move block near front of instrument.

8. Remove the Front Panel Assembly.
   - To remove it, see:
     - Section 18-3 “Remove Front Panel” on page 18-1

Remove the RF Deck

9. For detailed instructions refer to Section 11-3, “RF Deck Removal” on page 11-3.

10. Make sure all the RF Deck to other assembly semi-rigid and MCX coaxial cables have been removed.

11. Position the chassis upside down.

12. Remove any remaining cables between the chassis components and the RF Deck, then remove the deck.

Remove Motherboard 2 PCB Assembly

13. Remove all connecting cables to the Motherboard 2 PCB Assembly.

14. Position the chassis upside down.

15. Remove the Motherboard 2 PCB assembly.
   - Refer to Section 17-3 “Motherboard 2 PCB Replacement” on page 17-9.
   - During the removal process, the Motherboard 2 PCB backplane connector disengages from the Motherboard 1 PCB Assembly edge contacts.

Remove Digital PCB Fan, Bracket, and Card Guide Assembly

16. Remove the Digital PCB Fan Bracket and Card Guide Assembly.
   - Refer to Section 16-3 “Disassembly for Fan Removal” on page 16-3.

17. During the fan procedure, the left chassis side plate is removed.

18. Remove the Digital PCB Fan Bracket and Card Guide Assembly.

- Refer to Section 16-3, “Disassembly for Fan Removal” on page 16-3.
- This provides access to the Motherboard 1 PCB Assembly mounting screws.

19. Once removed, set the Digital PCB Fan, Bracket, and Card Guide Assembly aside.

Remove Motherboard 1 PCB Assembly

20. Working from the Digital PCB Bay, remove the 10 pan head Phillips M3 × 6 mm mounting screws holding the Motherboard 1 PCB Assembly in place. The swaged standoffs stay on the chassis center plate.
21. Remove the Motherboard 1 PCB Assembly by pulling it into the Digital PCB bay and then up and out.

Motherboard 1 PCB Installation

Prerequisites

1. The Digital PCB Fan Bracket and Card Guide Assembly has been removed.
2. The Motherboard 2 PCB Assembly has been removed.

Install the Motherboard 1 PCB Assembly

1. Position the Motherboard 1 PCB Assembly in the Digital PCB Bay section of the chassis, with the Motherboard 1 PCB Assembly backplane connectors protruding through the chassis center plate openings into the Analog PCB Bay.
2. Loosely insert 10 pan head Phillips M3 × 6 mm mounting screws.
3. When the PCB is correctly positioned, and all screws are correctly inserted and threaded, tighten.

Install the Digital PCB Fan Bracket and Card Guide Assembly

4. Position the Card Guide/Digital Fan Assembly in the Digital PCB Bay and loosely insert the eight (8) flat head Phillips M4 x 10 mm screws from the right side Analog PCB Bay.
   - Refer to Section 16-5, “System Reassembly” on page 16-14.
5. When the assembly is correctly positioned and all screws inserted and threaded, tighten.

Motherboard 2 PCB Assembly

6. Position the instrument upside down.
7. Install the Motherboard 2 PCB Assembly.
8. Carefully position the Motherboard 2 PCB Assembly and engage the backplane socket on the Motherboard 2 PCB Assembly into the Motherboard 1 PCB Assembly backplane pins.
9. When fully engaged, press the Motherboard 2 PCB Assembly into place.
10. Loosely insert the 19 pan head Phillips M2.5 × 10 mm mounting screws holding the PCB to the chassis.
11. When correctly positioned and threaded, tighten all screws.
12. Position the instrument chassis so it is top side up.
13. Connect the Motherboard 2 PCB Assembly cables.
    - Refer to Section “Motherboard 2 PCB Installation” on page 17-12
14. Check that all cables are correctly connected and fully seated in their connectors.

RF Deck Installation

15. Install the RF Deck and connect its cables.
    - Refer to Section 11-4, “RF Deck Installation” on page 11-12
    - Check that all cables are correctly connected and that all connectors are torqued.

Analog Module Assemblies

16. Position the instrument top side up.

17. Install the analog section module assemblies and connect their cables.

- Refer to Section "A15 Low Band Receiver Module Installation" on page 10-25.

Digital PCB Assemblies

18. Install the digital section PCBs and connect their cables.

- Refer to Section 10-3 "Digital PCB Replacement" on page 10-6.

Front Panel

19. Add spacer block under the front of the instrument.

20. Install the Front Panel Assembly

- Refer to Section 18-5 "Install Front Panel" on page 18-8

Common Reassembly Procedures

Install Covers

21. Install the Inner Top Cover.

- Refer to Section "Install Inner Cover" on page 8-6.

22. Install the Outer Cover.

- Refer to Section "Install Outer Cover" on page 8-6.

Check Connections

23. Make sure all cables and harnesses are correctly connected and fully seated in their connectors.

24. Make sure all RF semi-rigid and MCX coaxial cables are correctly aligned, threaded, and torqued.

Chapter 18 — Front Panel Assembly Replacement

18-1 Introduction

Use this procedure to remove the original front panel, and if necessary, exchange it with a replacement unit.

- Section 18-3 "Remove Front Panel" on page 18-1
- Section 18-4 "Prepare New Front Panel" on page 18-7
- Section 18-5 "Install Front Panel" on page 18-8

18-2 Access for Other Components

The removal procedures above are also used to provide access for other replacement parts covered in the chapters listed below:

- Chapter 11, "RF Deck Removal and Installation"
- Chapter 19, "Rear Panel Component Replacement"
- Chapter 12, "RF Deck Module Replacement – Top Modules"
- Chapter 15, "Power Supply Module Replacement"
- Chapter 17, "MB1 and MB2 PCB Replacement"

18-3 Remove Front Panel

The external Front Panel user controls are identical on all MS4640B VNAs. The removal and replacement procedure changes depending on whether the Front Panel cables are permanently attached or can be removed.

Use this procedure to remove the Front Panel Assembly to either replace it or to provide access to other deeper dwelling components. Front Panel Assembly has three (3) removable cables.

Parts and Applicability

- MS4640B Front Panel Assembly
    - There are no user serviceable parts inside the Front Panel.
    - Front Panels do not come with the detachable HDMI, USB, or Power/Signal ribbon cables.
    - Front Panels do not come with the Model Identity Label – 3-60124-XX. It must be ordered separately.

Note

The instrument Model Identity Label must be ordered separately and can be applied at the end of the Front Panel installation procedure. The label part number varies depending on the instrument model. Each label is valid for any combination of options for that model:

- MS4642B Model Identity Label – 3-60124-19
- MS4644B Model Identity Label – 3-60124-20
- MS4645B Model Identity Label – 3-60124-21
- MS4647B Model Identity Label – 3-60124-22

For replacement instructions, see Section 18-4 "Prepare New Front Panel".

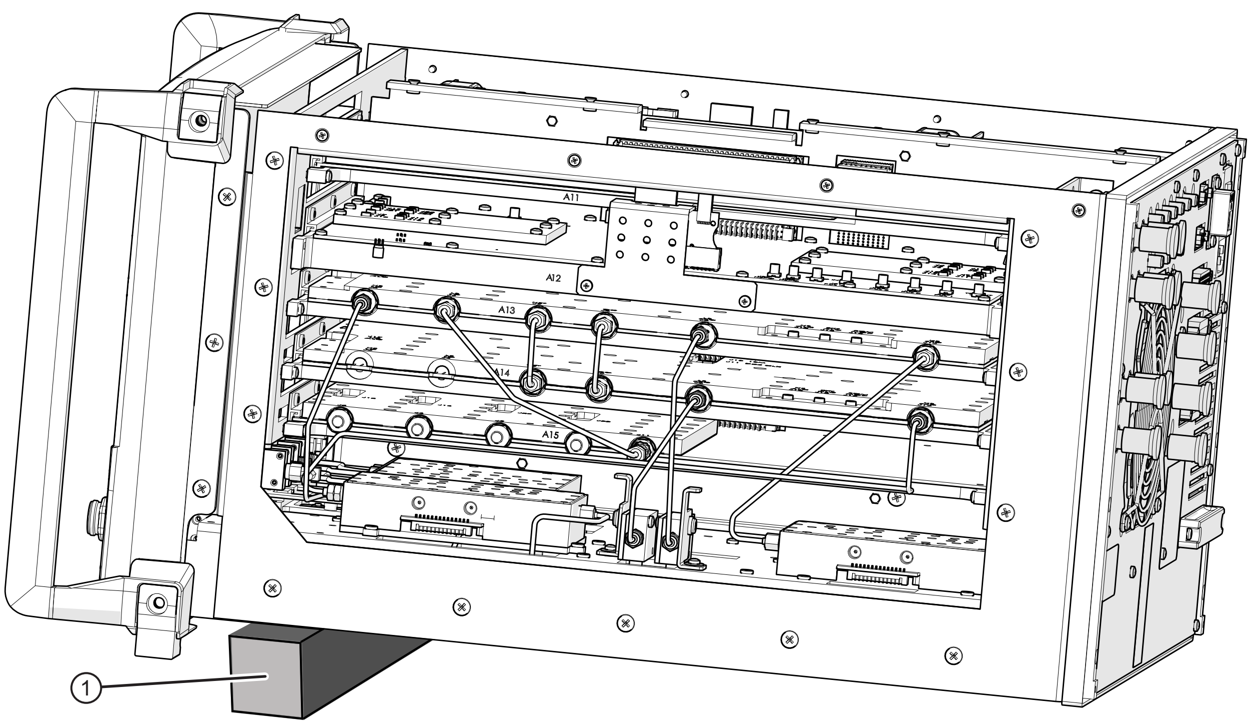
Removal

1. Prepare work area, work surface, and observe safety issues.
   - See the section “Preparation of Work Area and Safety Instructions” on page 8-1.
2. Remove Outer Cover.
   - See the section “Remove Outer Cover” on page 8-3.
3. Remove Inner Cover.
   - See the section “Remove Inner Cover” on page 8-5.
4. Position the instrument so that it is right-side up, RF deck down.

Note	When working around the Front Panel or the RF Deck, a spacer block device is essential to keep the loops and other components from being damaged.

Raise Chassis with Block

5. Before removing the Front Panel, add a spacer at least 5 cm (~2 in) thick under the front of the unit, approximately 10 cm (~4 in) in from the instrument front as shown in Figure 18-1.
   - The spacer should be at least 50 mm (~20 in) long.
   - The spacer provides clearance for the Direct Access Loops located on the underside of the RF Deck.
   - A ~50 cm (~20 in) length of plastic or wood 5 cm x 5 cm (2 in x 2 in) makes a good spacer.



1. Block for raising front of chassis

Figure 18-1. Spacer Block Front of Chassis

Remove the Front Panel

6. Remove the three (3) flat head Phillips M4 × 10 mm screws on each side of the Front Panel, six (6) total as shown in Figure 18-2.
7. Remove the bottom green colored M5 x 25 mm screw on each side of the Front Panel (located at the bottom of the handle).

Caution	When pulling the Front Panel out, be extra careful not to pull it out too far. Recommended is to use two people to gently "walk" the front panel off the chassis, and, when clear, set it down, protecting the cables. If the VNA is equipped with Option 51, 61, or 62, be very careful not to bend the RF Deck Direct Access Loops.

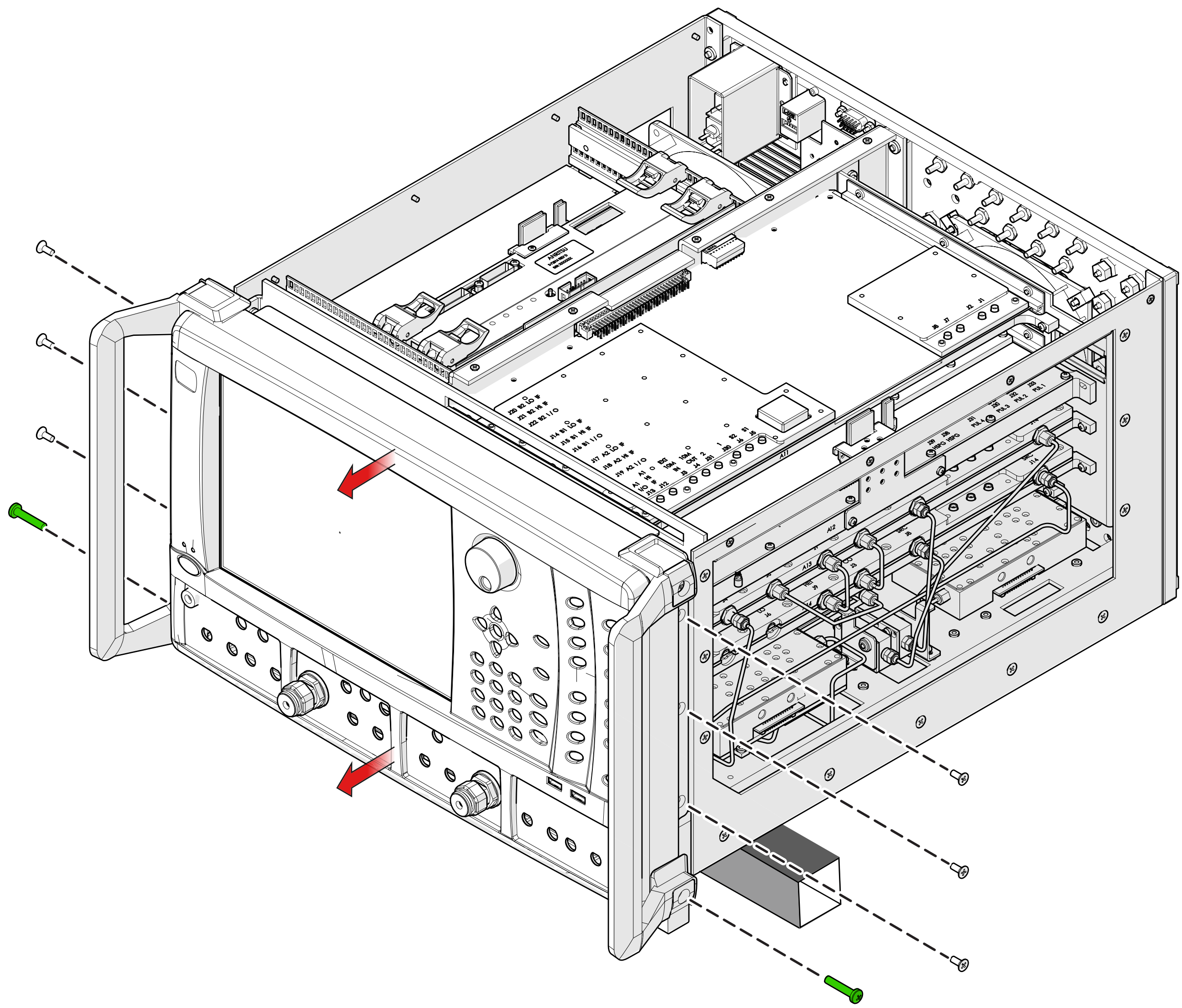
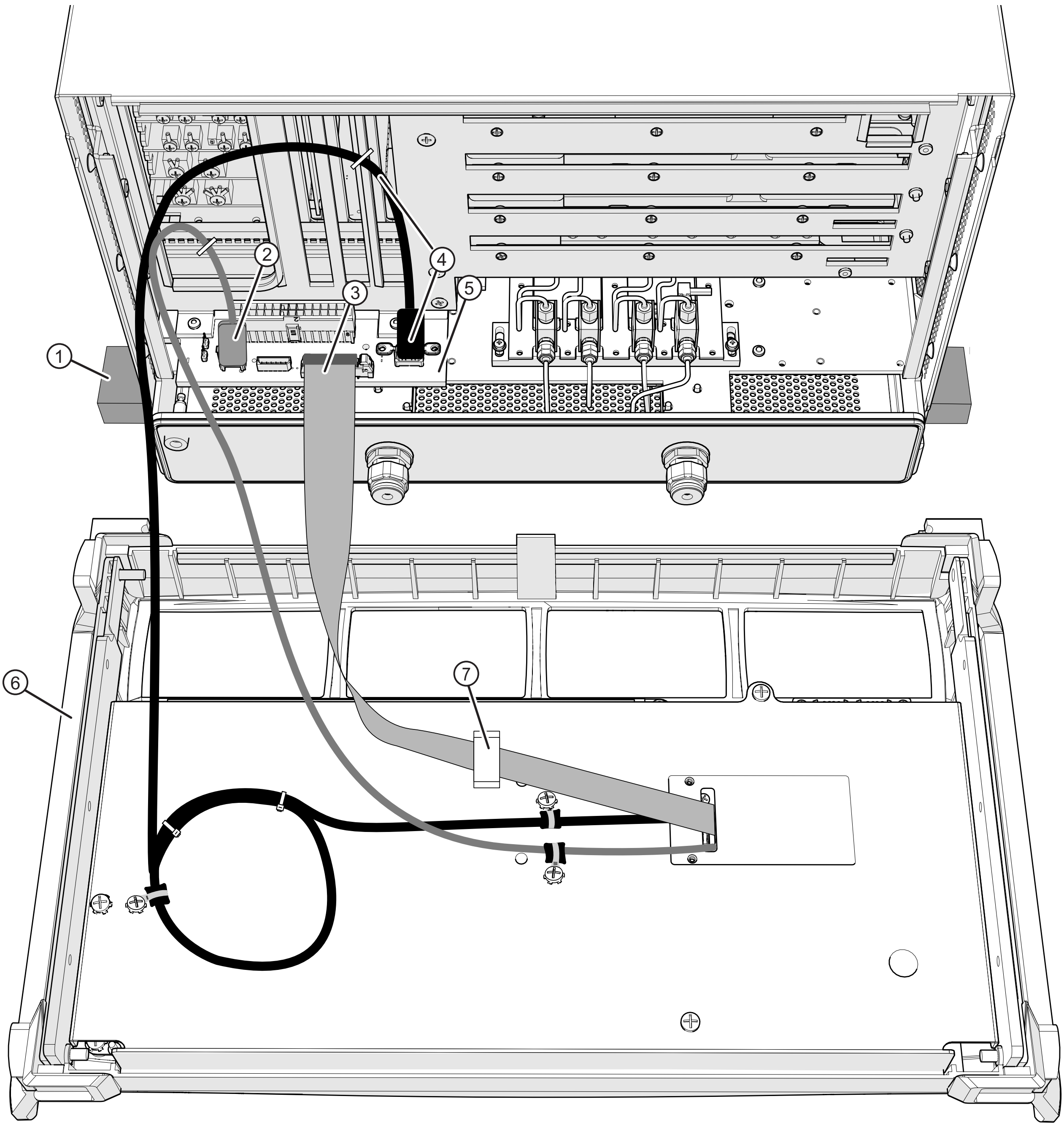


Figure 18-2. Front Panel Removal

8. Gently pull the Front Panel straight off and lay it flat on a non-scratch surface, with the buttons down, resting on the handles or rack mount ears. Slide the panel under the front panel ports a bit to obtain slack in the three (3) Front Panel Cables as shown in Figure 18-3 on page 18-4.



1. Spacer (plastic or wood) provides clearance for RF Deck underside modules, loops, and connectors.	4. MB2 PCB HDMI connector with flexible-head HDMI cable to Front Panel HDMI connector.
Note: Connector locations on MB2 vary depending on whether MB2 has ring lug power supply connections or a P94 power supply connection.	(**Note:** Connector is labeled P62 on MB2 with ring lug power supply connections. It is labeled P97 on MB2 with P94 power supply connector.)
2. MB2 PCB P63 USB Type A connector with USB cable to Front Panel USB Type B J22 connector.	5. Front Panel Assembly – Face down with rear connectors
3. MB2 PCB P61 Power/Signal Ribbon Connector with ribbon cable to Front Panel J6 connector.	6. Adhesive-mount ribbon cable clamp. Lift clamp latch to release cable.

Figure 18-3. Front Panel Assembly – Removed Showing Cable Connections

Remove or Replace the Front Panel Assembly

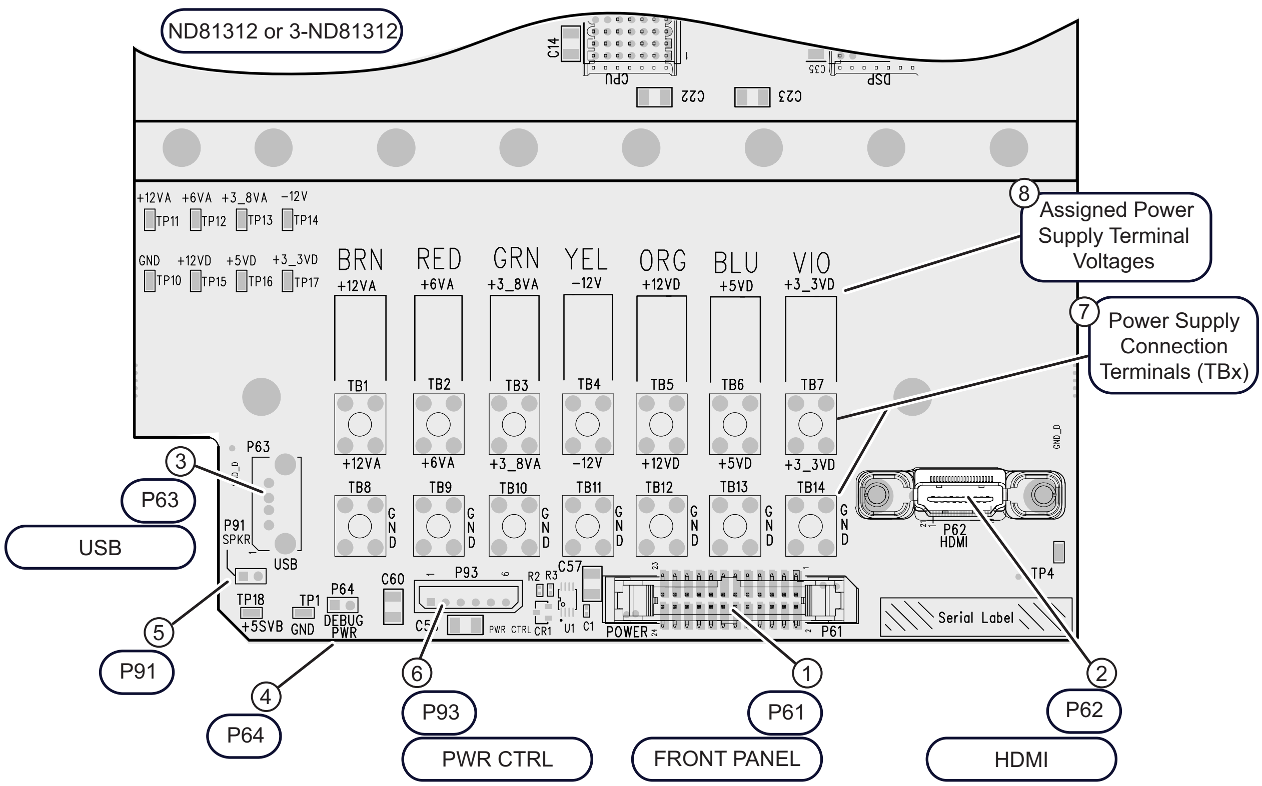
9. The next steps depend on whether the Front Panel is removed to access a deeper dwelling component or to replace it.

- To remove the Front Panel, do Step 10 through Step 15.
- To replace the Front Panel, do Step 16 through Step 18-4.

Remove the Front Panel Assembly

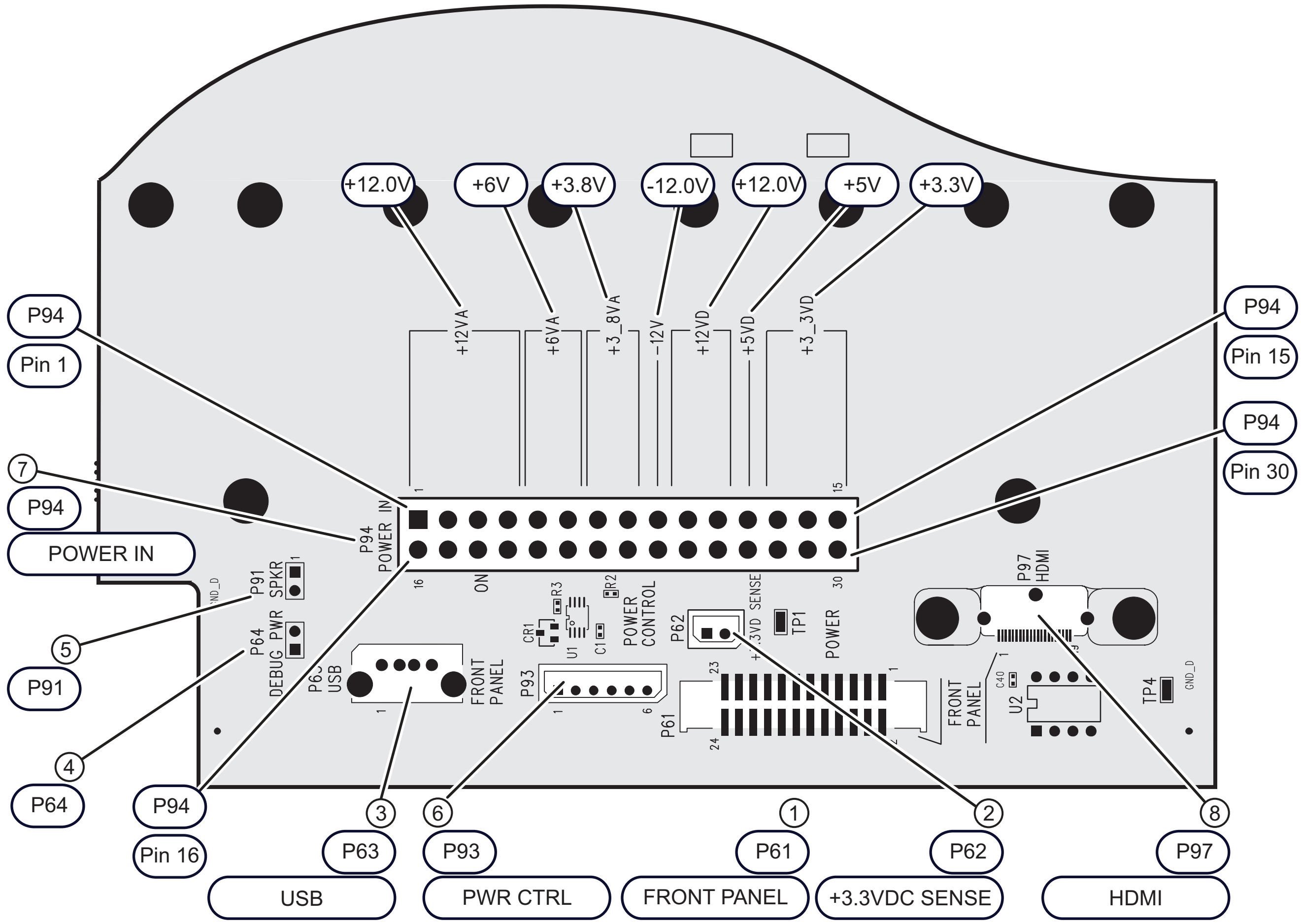
10. Remove the Front Panel cables from the Motherboard 2 PCB (MB2 PCB) Assembly, leaving the cables attached to the Front Panel.

Use Figure 18-4 or Figure 18-5 to identify the MB 2 PCB front connectors.



1. P61 – Ribbon Cable Connector to Front Panel	5. P91 – Speaker – Not used
2. P62 – HDMI Connector to Front Panel	6. P93 – Power Control Connector to Power Supply
3. P63 – USB Type A Connector to Front Panel	7. TBx – Power Supply Connection Terminals
4. P64 – Debug Power – Not used	Assigned Power Supply Voltages

Figure 18-4. Motherboard 2 PCB Assembly – ND81312 or 3-ND81312 – Front



1. P61 – Ribbon Cable Connector to Front Panel	P94 – Connector Pin 1
2. P62 – +3.3 VDC Sense Connector to Power Supply Module	P94 – Connector Pin 15
3. P63 – USB Type A Connector to Front Panel	P94 – Connector Pin 16
4. P64 – Debug Power – Not used	P94 – Connector Pin 30
5. P91 – Speaker – Not used	
6. P93 – Power Control Connector to Power Supply	
7. P94 – Power In Connector to Power Supply	
8. P97 – HDMI Connector to Front Panel	

Figure 18-5. Motherboard 2 PCB Assembly – ND80356 – 3-80124-3 – Front Detail

11. Remove the USB Cable with the Type A connector from the MB2 PCB P63 connector.
12. Remove the Power/Signal ribbon cable from the MB2 PCB P61 connector.
13. Cut the cable tie holding the HDMI Cable to the instrument chassis.

Note	Do not cut the cable ties holding the HDMI Cable excess length loop.

14. Remove the HDMI Cable from the MB2 PCB connector to Front Panel leaving the loop cable ties in place.
15. Set the Front Panel Assembly aside.

Replace the Front Panel Assembly

16. Remove the Front Panel cables from the Front Panel, leaving them attached to the MB2 PCB. Refer to Figure 18-3, “Front Panel Assembly – Removed Showing Cable Connections” on page 18-4 above.
17. Remove the USB Type B Plug from the Front Panel J22 USB connector.
18. Remove the cable clamp screw holding the USB cable to the Front Panel chassis.
19. Remove the Power/Signal Ribbon Plug from the Front Panel J6 connector.
20. Unlatch the ribbon cable clamp to free Power/Signal Ribbon cable.
21. Remove the two (2) cable clamp screws holding the HDMI cable to the Front Panel chassis.
22. Remove the HDMI Plug from the Front Panel HDMI connector.

18-4 Prepare New Front Panel

Use this procedure to prepare a replacement Front Panel Assembly and apply the appropriate Model Identity Label.

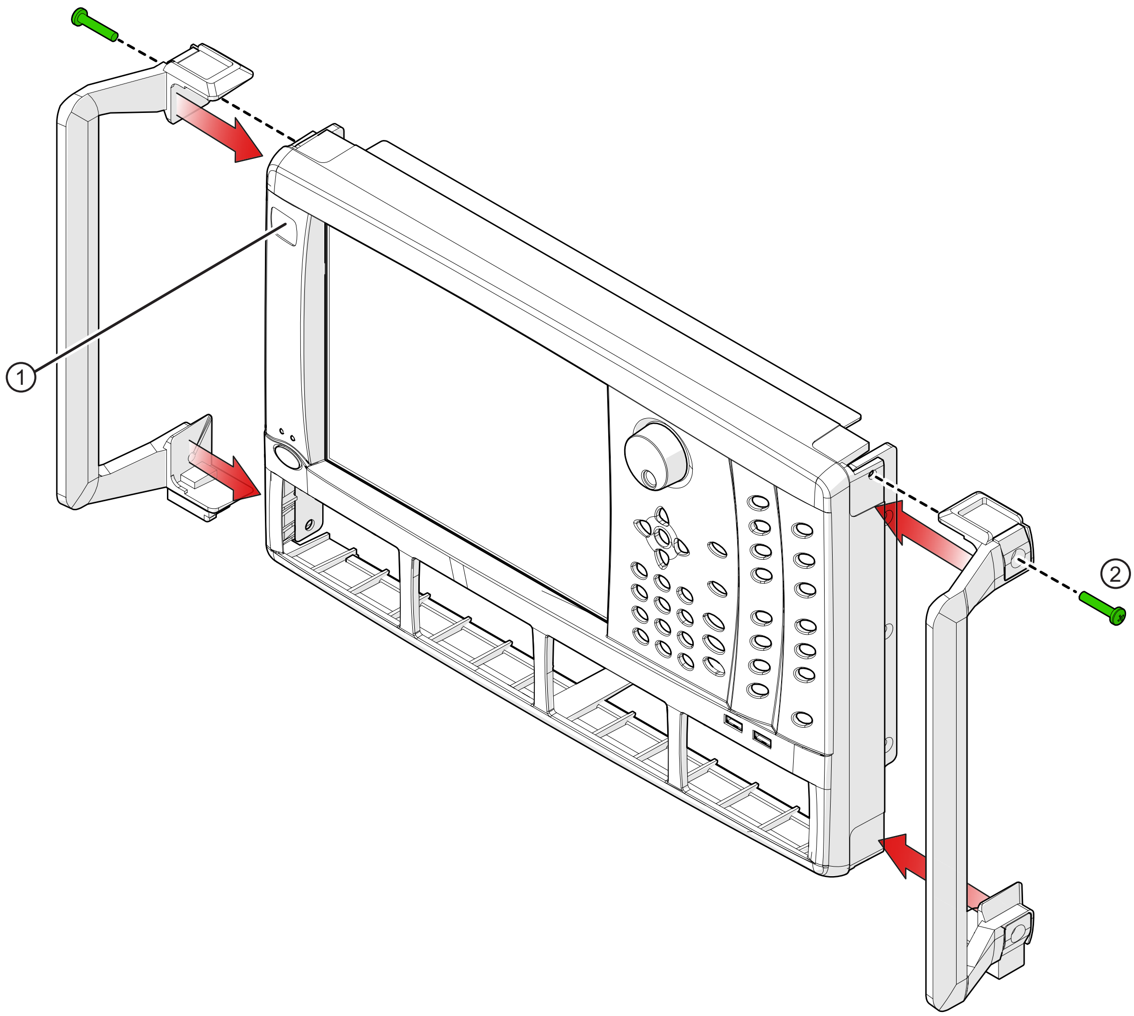
1. Leave the LCD protective covering in place until the instrument is fully assembled.
2. The two (2) handles or two (2) rack mount ears must be exchanged between the to-be-replaced Front Panel and the new Front Panel.
3. Remove the Phillips-head – M5 x 25 mm screw holding the top of each handle or ear in place from the to-be-replaced Front Panel. The bottom screw on each handle was removed to release the front panel from the chassis.
4. Once removed, attach each handle or ear to the new Front Panel. See Figure 18-6 on page 18-8.

Note	The bottom screw for each handle cannot be installed until the front panel is in place on the chassis.

5. Make sure the screws are correctly threaded in a few turns but do not tighten the handle/ear screws until the Outer Cover has been added.
6. Add the appropriate Model Identity Label to the new Front Panel.

Note	If the replacement Front Panel Assembly has been ordered and/or installed, the instrument-model matching Model Identity Label must be ordered separately. The Front Panel Assembly does not come with a Model Identity Label.

7. Clean the label holder recess on the Front Panel with appropriate cleaner and make sure it is dry before proceeding.
8. Peel off the label backing and apply the label in the label recess.



1. Model Identity Label – 3-60124-xx
2. M5 x 25 mm Phillips-head screw, one (1) for each handle

Figure 18-6. Attaching Handles and Model Identity Label – 3-60124-XX

18-5 Install Front Panel

Use this procedure to install the existing or replacement Front Panel Assembly on the instrument. The Front Panel is also replaced using this procedure after the installation procedures listed above in Section 18-2 "Access for Other Components" on page 18-1.

Caution	Either the handles or rack mount ears must be installed on the Front Panel in order to protect the Direct Access Loops and controls when the VNA covers are reinstalled.

Preliminary

1. Ensure the two (2) top handle/rack mount ear mounting screws have been inserted and threaded, but not tightened. They will be tightened after the Outer Cover is in place.

2. Ensure a new model identity label has been applied to the new Panel.
3. Position the instrument so that it is right-side up, RF deck down.

Add Spacer Block

4. If not already done, add the spacer block under the chassis to prevent damage to the underside components. This was described in "Removal" on page 18-2.
5. Align the Front Panel so that the panel and chassis centerlines are within ~2.5 cm (~1") of each other. Position the Front Panel so there is less than ~5 cm (~2") between the Panel and the chassis.

Add the Front Panel Cables

6. Refer to Figure 18-3 on page 18-4.
7. Position the cables loosely in position in the Front Panel chassis.

HDMI Cable

8. Connect the HDMI Cable and Plug to the Front Panel HDMI connector. Note that two (2) excess length cable ties should still be in place.
9. Position the two (2) cable clamps for the HDMI cable and fasten the mounting screws in place.

Power/Signal Ribbon Cable

10. Unlatch the ribbon cable clamp mounted on the Front Panel chassis, insert the Power/Signal ribbon cable, and then re-latch the clamp.
11. Connect the keyed Power/Signal Ribbon Plug to the Front Panel J6 connector.

USB Cable

12. Connect the USB Type B Cable and Plug to the Front Panel J22 USB connector.
13. Position the USB Cable cable clamp screw for the USB Cable and fasten the mounting screw in place.

Install the Front Panel

14. Swing the Front Panel up, making sure the cables are correctly positioned, and slide the Panel ears into the INSIDE of the chassis flanges.
15. Loosely insert the three (3) flat head Phillips M4 × 10 mm screws on each side of the Front Panel, six (6) screws total. Make sure each screw is in several turns *but do not yet tighten*.
16. When all are seated, adjust Front Panel positioning as required, and then tighten all six screws.

Note	Do not tighten the four (4) M5 x 25 mm handle attachment screws until the covers are installed.

17. Loosely insert and thread into the chassis the M5 x 25 mm screw at the bottom of each handle but *do not tighten* until the covers are in place and tightened down. (See Figure 18-2 on page 18-3.

Install Covers

18. Install the Inner Cover.

- See Section “Install Inner Cover” on page 8-6.

19. Install the Outer Cover.

- See Section “Install Outer Cover” on page 8-6.

20. Tighten the four handle screws.

21. If a new Front Panel was installed, and not already done, install the Model Identity Label.

- See Section 18-4 “Prepare New Front Panel” on page 18-7.

22. Remove the LCD protective covering.

Final Tests

23. Perform any final tests as required.

Chapter 19 — Rear Panel Component Replacement

19-1 Introduction

This chapter describes removing the Rear Panel and then servicing the underlying A17 Rear Panel PCB Assembly and the Rear Panel (Analog) Fan Assembly. It also describes removing the Rear Panel to provide access to other internal components. The Rear Panel Assembly and the attached outer silk-screened connector identification Rear Panel Sub Plate are not replacement parts. This chapter covers the following procedures:

- Rear Panel Parts ID
  - Section 19-3, "Rear Panel Parts Identification" on page 19-2
- Rear Panel Removal
  - Section 19-4 "Rear Panel Removal" on page 19-6
- A17 Rear Panel PCB Assembly Replacement
  - Section 19-5, "A17 PCB Replacement" on page 19-10
    - "A17 PCB Removal"
    - "A17 Replacement PCB Preparation"
    - "A17 PCB Installation"
- Rear Panel Fan Assembly Replacement
  - Section 19-6, "Rear Panel Fan Replacement" on page 19-15
    - "Fan Removal"
    - "Replacement Fan Preparation"
    - "Fan Installation"
- Rear Panel Installation
  - Section 19-7, "Rear Panel Installation" on page 19-17

19-2 Parts and Applicability

This procedure covers removing, preparing, and installing these parts.

- A17 Rear Panel PCB
- Rear Panel Fan Assembly, 330 mm Cable Attached
- Digital Section Fan Assembly
- These parts are used on all instrument models with any combination of options.

This procedure covers removing the rear panel and other assemblies to provide access for these parts:

- Power Supply Module
- Digital PCB Fan Assembly, 165 mm Cable Attached
- Motherboard 1 PCB Assembly

19-3 Rear Panel Parts Identification

The figures below identify the relevant rear panel parts and components.

- Figure 19-1, "Rear Panel Assembly – Outside – Panel Attached with Covers Off" on page 19-2 shows the general location of components with the rear panel installed.
- Figure 19-2, "Rear Panel Assembly – Inside View" on page 19-4 shows a view of the A17 PCB cabling connections with the rear panel removed
- Figure 19-5, "Rear Panel Assembly – A17 Standoff Removal" on page 19-11 shows a view of the A17 PCB cabling connections with the rear panel removed.
- Figure 19-6, "A17 PCB Cable Connections" on page 19-12 shows the cable connections between the A17 PCB and the Rear Panel and the Motherboard 2 PCB Assembly.

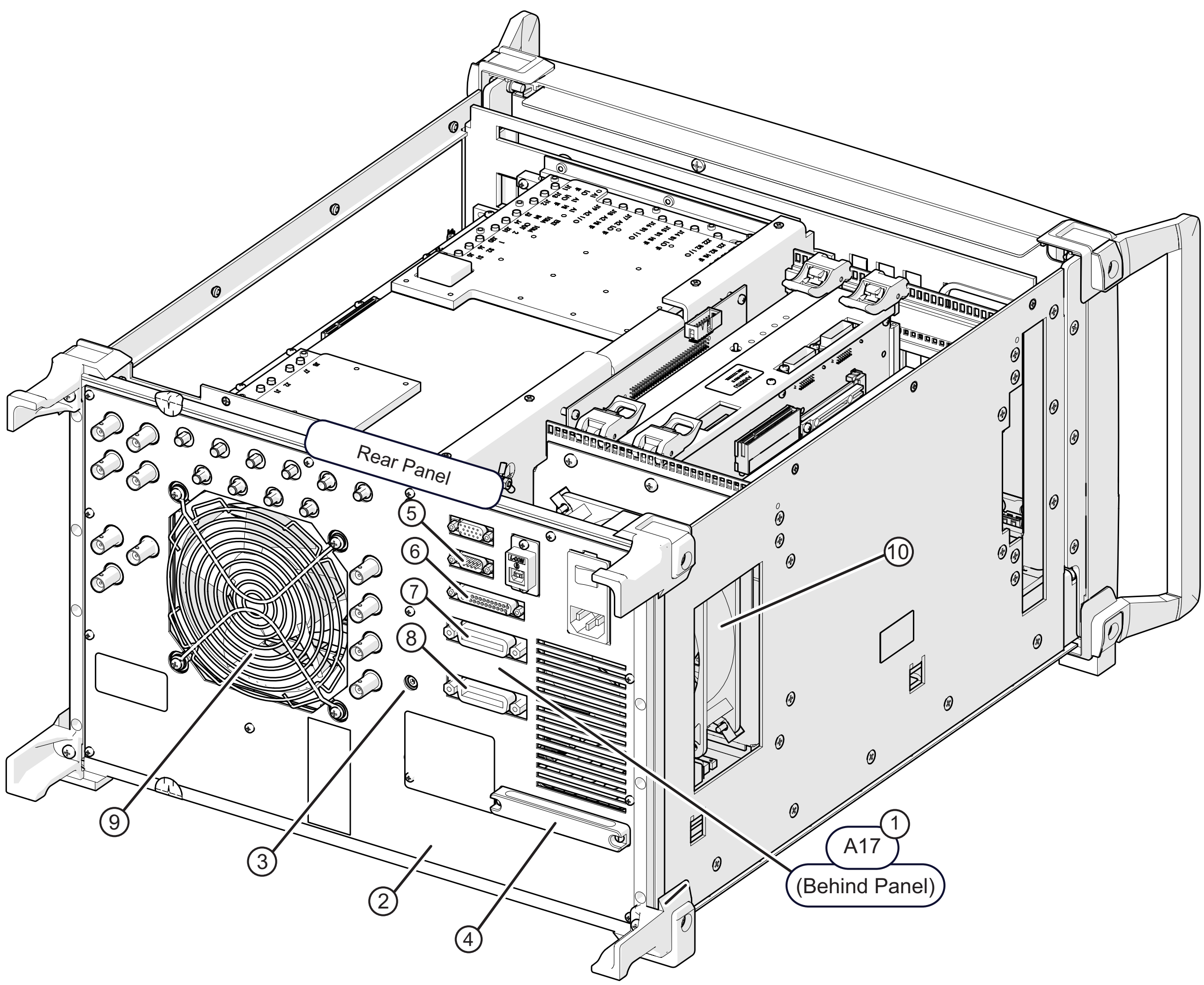


Figure 19-1. Rear Panel Assembly – Outside – Panel Attached with Covers Off (1 of 2)

Orientation

The instrument chassis viewed from the Rear Panel with the covers off.

Rear Panel

1. A17 Rear Panel PCB located here on inside of Rear Panel (hidden from view).
2. Rear Panel Logo Sub Plate removed. The sub plate is fastened using 14 pan head Phillips M3 × 6 mm screws. It can be removed with the chassis covers on or off.
3. Rear Panel Fastening Screws. The rear panel chassis is held to the rest of the instrument chassis using 12 socket head Allen M4 × 20 mm screws. There are three vertical rows of four screws each at the left, center, and right.

Rear Panel Connectors

4. Serial Connector port with two (2) 4-40 × 0.187 connector mounting standoffs.
5. External I/O Control port with two (2) 4-40 × 0.187 connector mounting standoffs. The connector mounting standoffs here and above thread to standard DB connectors. The standoffs must be removed to service the A17 PCB.
6. IEEE 488.2 GPIB Port with two (2) 4-40 × 0.650 connector mounting standoffs.
7. Dedicated GPIB Port with two (2) 4-40 × 0.650 connector mounting standoffs. The connector mounting standoffs here and above thread into standard stackable GPIB Test Cable Connectors.

Fans

8. Rear Panel (Analog) Fan Assembly. The Rear Panel must be removed to service the fan.
9. Digital PCB Fan Assembly. The Rear Panel must be removed to service the fan.

Figure 19-1. Rear Panel Assembly – Outside – Panel Attached with Covers Off (2 of 2)

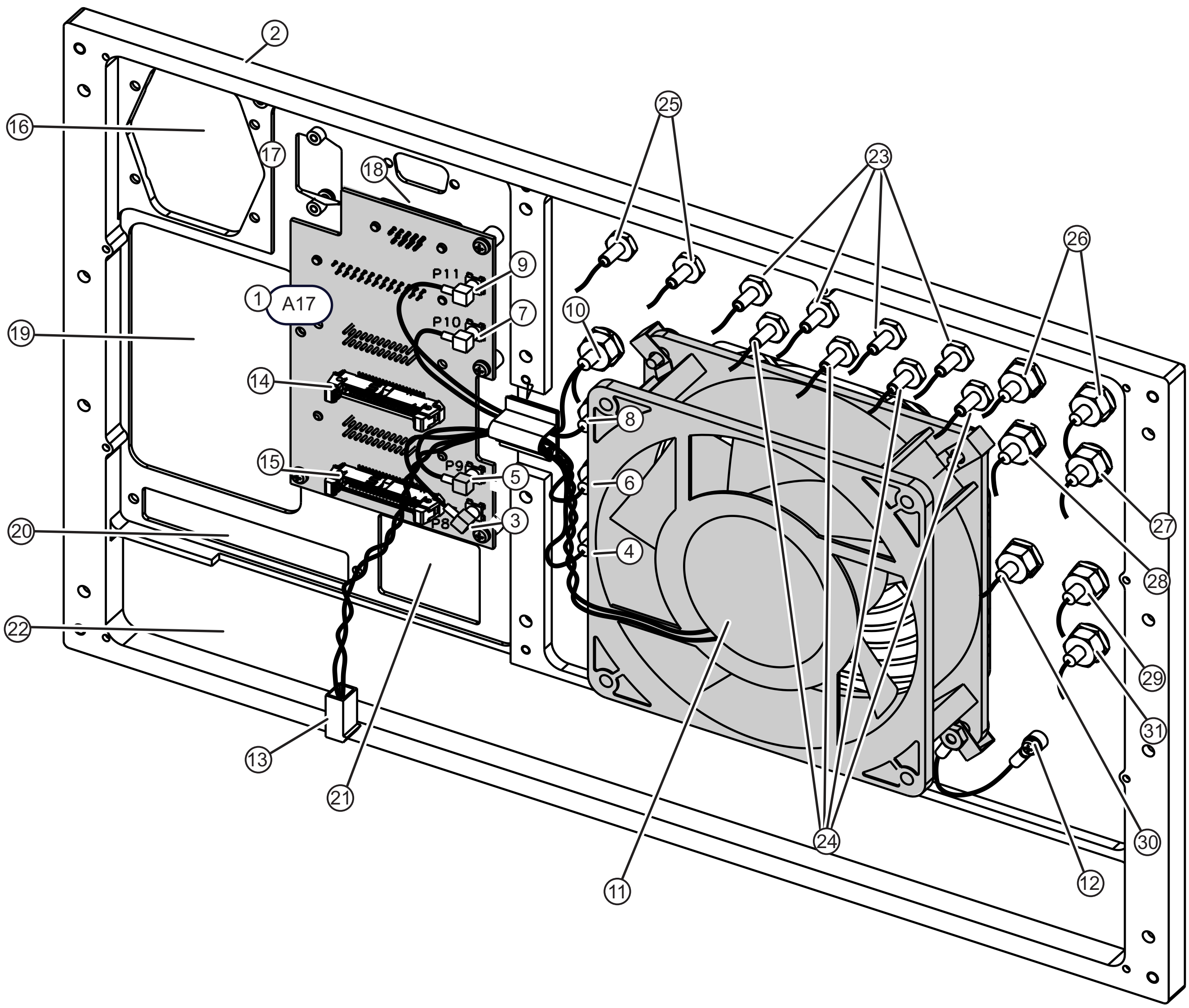


Figure 19-2. Rear Panel Assembly – Inside View (1 of 2)

1. A17 Rear Panel PCB Assembly
2. Rear Panel Chassis Plate

A17 PCB – MCX to BNC Connections

3. A17 Rear Panel PCB Assembly P8 MCX Connector – Connects to Trigger Out BNC
4. Rear Panel Trigger Out BNC Connector (partially hidden by fan)
5. A17 Rear Panel PCB Assembly P9 MCX Connector – Connects to Ready for Trigger BNC
6. Rear Panel Ready for Trigger BNC Connector (partially hidden by fan)
7. A17 Rear Panel PCB Assembly P10 MCX Connector – Connects to Lock Status BNC
8. Rear Panel Lock Status BNC Connector (partially hidden by fan)
9. A17 Rear Panel PCB Assembly P11 MCX Connector – Connects to External Trigger BNC
10. Rear Panel External Trigger BNC Connector

Rear Panel Fan Assembly

11. Rear Panel Fan Assembly
12. Rear Panel Fan Ground Connection to Rear Panel Chassis Plate.
13. Rear Panel Fan Power Connection – Connects to Motherboard 2 PCB Assembly P95 connector.

A17 PCB – Motherboard 2 PCB Ribbon Cables

14. A17 Rear Panel PCB Assembly P1 (upper) connector – Ribbon cable to MB 2 PCB Assembly P71 connector.
15. A17 Rear Panel PCB Assembly P2 (lower) connector – Ribbon cable to MB 2 PCB Assembly P72 connector.

Rear Panel Chassis Plate Openings

16. Opening for AC Power Module
17. Opening for USB Control Port.
18. Opening for VGA/XGA Video Port
19. Opening Digital PCB Fan air entry.
20. Opening for SATA Solid State Drive.
21. Opening for Ethernet Network Port, USB Ports, and PS/2 ports.
22. Opening for RF Deck Rear Panel

Rear Panel SMA Female Connectors

23. a1, b1, a2, b2 IF Inputs/Outputs
24. Pulse Outputs: Pulse 1, Pulse 2, Pulse 3, Pulse 4 (Option 35 only)
25. Pulse Sync In and Out (Option 35 only)

BNC Connections

26. 10 MHz In, 10 MHz Out
27. Analog In 1
28. Analog In 2 (Option 31 only)
29. Ext ALC 1 In (Option 80, 81, 82, and 83)
30. Ext ALC 2 In (Option 84 and 85)
31. Analog Out

Figure 19-2. Rear Panel Assembly – Inside View (2 of 2)

19-4 Rear Panel Removal

The rear panel is not a replaceable part. Following are procedures for panel removal, component replacement, and finally panel installation.

Common Disassembly Procedures

1. Refer to Section 8-2 "Preparation of Work Area and Safety Instructions" on page 8-1 or instructions on cover removal. The Front Panel can stay attached to the instrument chassis. Remove the Direct Access Loops if equipped.

Note	When front panel loops on a VectorStar MS464xB are removed and then reinstalled for any reason, ensure they are returned to their original locations. If they are reconnected to locations other than their original, this can affect the VNA calibration. If the loop locations are forgotten and the calibration has been compromised, refer to the Section 7-11 "Factory RF Calibration (RF Cal)" for instructions on performing a new RF calibration.

Rear Panel Removal Procedure

Remove Rear Panel Sub Plate

2. Remove and set aside the 14 pan head Phillips M3 × 6 mm screw holding the silk-screened Rear Panel Sub Plate in place.
3. Gently pull off the Rear Panel Sub Plate and set aside.

Note	Handle the Sub Plate carefully to avoid scratching its surface.

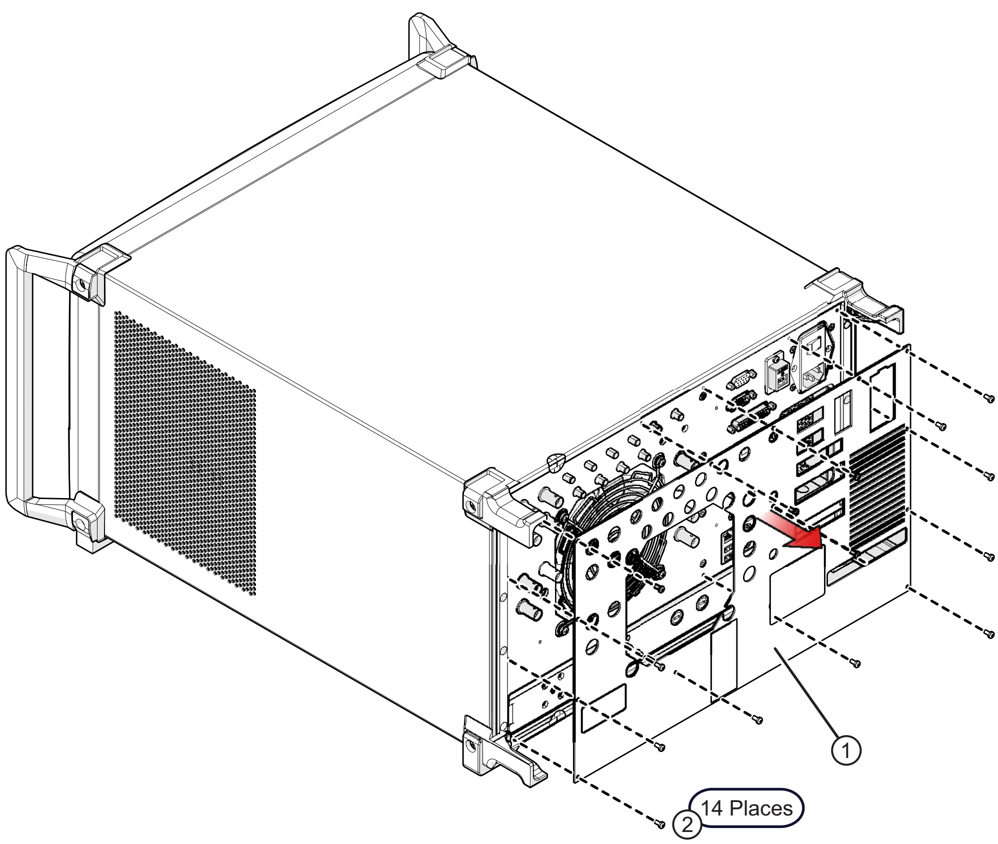


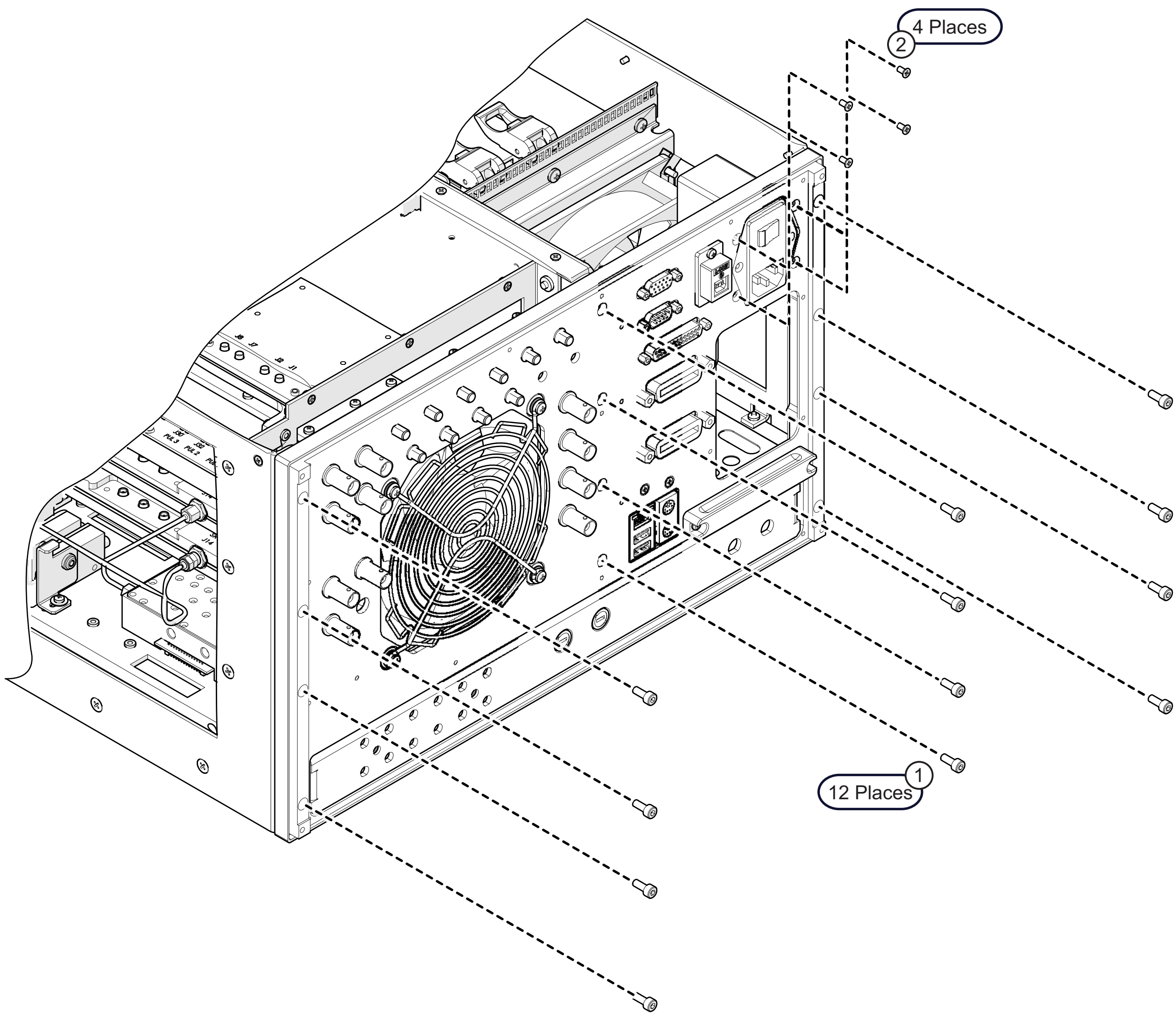
Figure 19-3. Rear Panel Sub Plate Removal

1. Rear Panel Sub Plate, Silk-screened (with port labels)	2. Sub Plate Screws: (14 pan head Phillips M3 × 6 mm)

Figure 19-3. Rear Panel Sub Plate Removal

Remove the Rear Panel Assembly

4. Remove the Rear Panel Loops and set aside.
5. Remove the four (4) outer flat head Phillips M3 × 6 mm screws that hold the AC Module Housing to the Rear Panel. As the Rear Panel is removed, the AC Module Housing stays attached through its cable harness to the Power Supply Module.
6. Using an 8 mm hex Allen driver, remove the 12 cap socket Allen-head M4 × 10 mm screws that hold the Rear Panel Assembly to the instrument chassis.



1. Rear Panel Chassis Plate fastening hardware of 12 cap socket Allen-head M4 × 10 mm screws arranged in three (3) rows of four (4) screws each.
2. Four (4) M3 x 6 mm Type I Cross Recessed FHMS screws hold the AC Input Module Assembly to the Rear Panel Chassis Plate.

Figure 19-4. Remove or Install the Rear Panel Assembly

Disconnect Motherboard 2 PCB Ribbon Cables

7. Gently pull the Rear Panel partially out, so as to gain access to the right side (when viewed from the chassis rear) ribbon cables between the A17 PCB and the Motherboard 2 PCB.
8. Cut any securing cable tie. It is probably easier to disconnect the cables from the Motherboard 2 PCB.
   - A17 PCB P1 connector for ribbon cable to MB2 PCB connector P71.
   - A17 PCB P2 connector for ribbon cable to MB2 PCB connector P72.
9. If the ribbon cables stay on the A17 PCB, they should be installed on the replacement A17 PCB as required during reassembly.

Decision Steps for Replacing Rear Panel Components

The next steps depend on the removal purpose.

10. To replace the A17 Rear Panel PCB Assembly, go to Section 19-5, "A17 PCB Replacement" on page 19-10.
11. To replace the Rear Panel Fan Assembly, go to Section 19-6, "Rear Panel Fan Replacement" on page 19-15.
12. To replace another assembly, skip to any of the following chapters:
    - Chapter 15 — Power Supply Module Replacement
    - Chapter 16 — Digital PCB Fan Replacement
    - Chapter 17 — MB1 and MB2 PCB Replacement
13. To re-install the Rear Panel, go to Section 19-7, "Rear Panel Installation" on page 19-17.

19-5 A17 PCB Replacement

In general, the only reason to remove the A17 PCB is to replace it.

Parts and Applicability

- A17 Rear Panel PCB Assembly
- This PCB is used on all VNA models with any combination of options.

Prerequisites

1. The Rear Panel Assembly must have been removed from the instrument chassis.
   - Refer to Section 19-4 "Rear Panel Removal" on page 19-6 above.

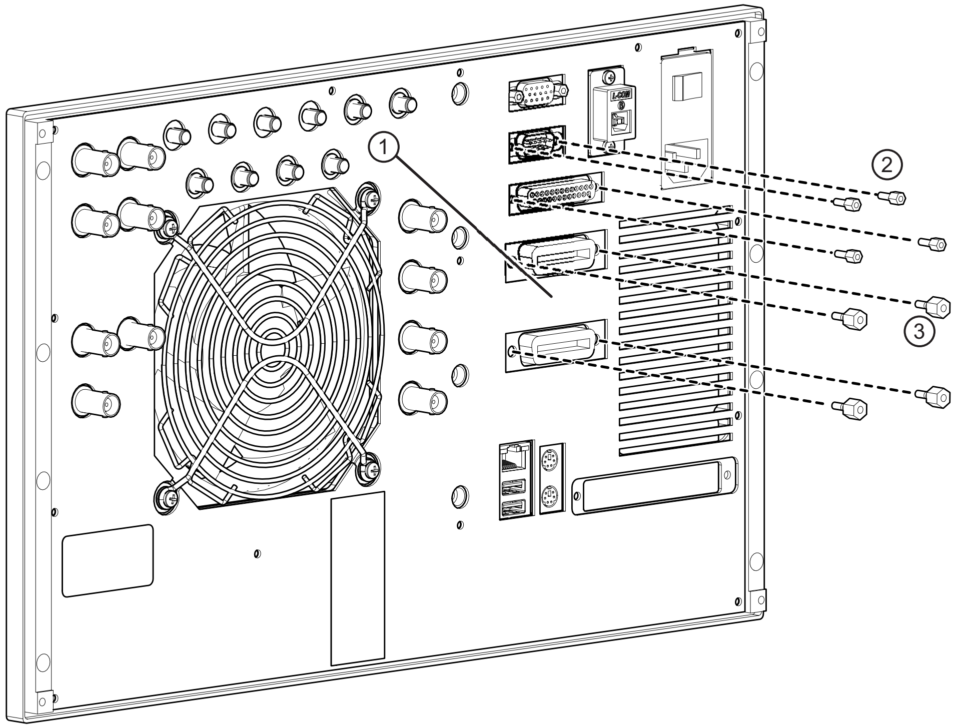
A17 PCB Removal

See Figure 19-5 on page 19-11, and Figure 19-6 on page 19-12.

Remove Connector Hex M-F Standoffs

2. On the outside of the rear panel, use hex drivers to remove the M-F hex connector standoffs from four (4) connectors mounted on the A17 PCB. There are eight (8) total connector standoffs to be removed.
3. Use a 7 mm hex driver to remove the hex M-F connector standoffs from the Serial I/O (top) and the External I/O connectors.
   - Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.187 hex M-F threaded connector mounting standoffs.
4. Use a 3/16" hex driver to remove the M-F connector standoffs from the IEEE 488.2 GPIB connector and the Dedicated GPIB connector.

- Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.650 hex M-F connector mounting standoffs that support stackable GPIB Test Cable Connectors.



1. A17 Rear Panel PCB Assembly (hidden – mounted on inside of Rear Panel Assembly)
2. M-F Hex Connector Standoffs for Serial I/O and External I/O connectors. Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.187 hex M-F threaded connector mounting standoffs.
3. M-F Hex Connector Standoffs for IEEE 488.2 GPIB Port and the Dedicated GPIB Port connectors. Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.650 hex M-F connector mounting standoffs that support stackable GPIB Test Cable Connectors.

Figure 19-5. Rear Panel Assembly – A17 Standoff Removal

Remove A17 PCB MCX Connectors and Coaxial Cables

5. Working from the top to the bottom of the PCB, remove the four (4) MCX coaxial cables from the A17 PCB. These cables route to Rear Panel BNC connectors for triggering functions. The coaxial cables are permanently attached to the rear panel BNC connectors.

6. Remove the coaxial cable from the top A17 PCB P11 MCX Connector.

- Connects to the External Trigger BNC.

7. Remove the coaxial cable from the A17 PCB P10 MCX Connector.

- Connects to the Lock Status BNC.

8. Remove the coaxial cable from the A17 PCB P9 MCX Connector.

- Connects to the Ready for Trigger BNC.

9. Remove the coaxial cable from the bottom A17 PCB P8 MCX Connector.

- Connects to the Trigger Out BNC.

Remove A17 PCB Mounting Hardware

10. Remove the five (5) pan head Phillips M3 × 6 mm mounting screws holding the A17 PCB to the swaged-in standoffs on the Rear Panel Plate.

11. Remove the A17 PCB and set aside.

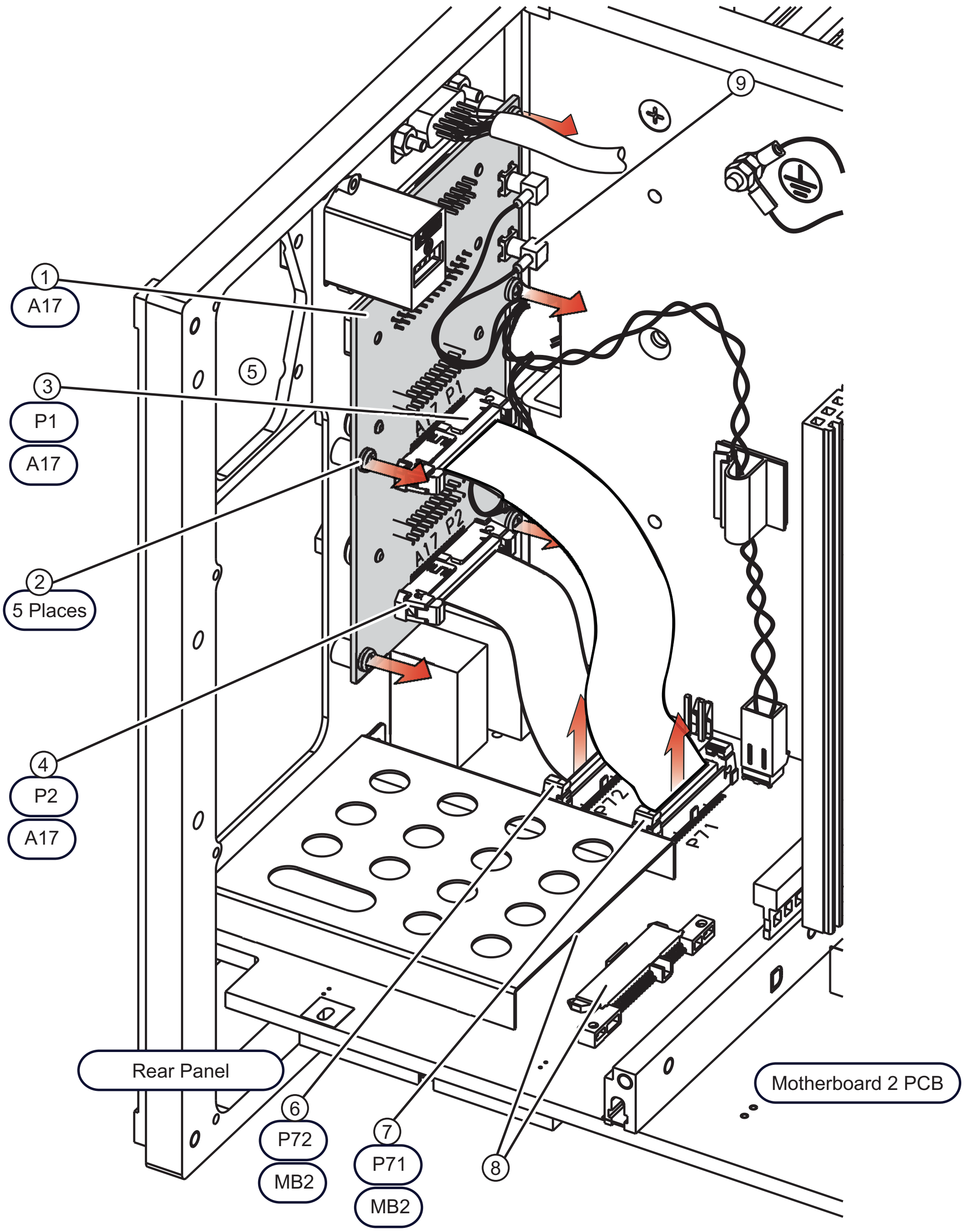


Figure 19-6. A17 PCB Cable Connections (1 of 2)

Orientation

The instrument is viewed from the left side with the side plate removed for clarity. The rear panel is to the left.

A17 Rear Panel PCB Assembly

1. 1 – A17 Rear Panel PCB
   - The Serial I/O and External I/O connectors are each fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.187 hex M-F threaded connector mounting standoffs.
   - The IEEE 488.2 GPIB Port and the Dedicated GPIB Port are each fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.650 hex M-F connector mounting standoffs that support stackable GPIB Test Cable Connectors.
   - The eight (8) connector mounting standoffs described above must be removed from the outside of the Rear Panel to service the A17 Rear Panel PCB Assembly.
2. Five (5) pan head Phillips M3 × 6 mm mounting screws holding the A17 PCB to swaged-in standoffs on the Rear Panel Plate. The screws are removed from the inside of the Rear Panel.
3. A17 PCB P1 connector – For ribbon cable to Motherboard 2 PCB Assembly connector P71.
4. A17 PCB P2 connector – For ribbon cable to Motherboard 2 PCB connector P72.

Chassis Openings

5. Chassis opening for the AC Power Module and Switch (not shown here for clarity).
6. Motherboard 2 PCB P72 ribbon cable connector.
7. Motherboard 2 PCB P71 ribbon cable connector.
8. Enclosure and connector for the SATA Solid State Drive (drive not shown for clarity).
9. A17 PCB MCX coaxial connectors P8, P9, P10, and P11 which connect to the Rear Panel BNC trigger ports.

Figure 19-6. A17 PCB Cable Connections (2 of 2)

A17 Replacement PCB Preparation

There are no replaceable components on the A17 PCB. If any of the ribbon cables came out with the to-be-replaced PCB, remove them and install on the replacement A17 PCB. After installing out the ribbon cables, skip ahead to Section , “A17 PCB Installation” on page 19-13.

A17 PCB Installation

Use this procedure to install the replacement A17 Rear Panel PCB Assembly.

Prerequisites

1. The A17 Rear Panel PCB Assembly has been removed from the Rear Panel.
   - See Section 19-5 “A17 PCB Replacement” on page 19-10 above.

Install the A17 PCB

2. On the inside of the Rear Panel, place the A17 PCB into position and loosely insert the five (5) pan head Phillips M3 × 6 mm mounting screws.
3. When all screws are in place and correctly threaded, check the alignment of the connectors from the outside of the Rear Panel and adjust the PCB positioning as required.
   - Serial I/O connector (second connector from top on outside of Rear Panel)
   - External I/O connector
   - IEEE 488.2 GPIB connector
   - Dedicated GPIB connector.
4. When correctly positioned, tighten the five (5) screws.

Connect the MCX Coaxial Cables

5. Working from the bottom to the top of the PCB, connect the four (4) triggering MCX coaxial cables to the A17 PCB.
6. Connect the Trigger Out coaxial cable to the bottom A17 PCB P8 MCX Connector.
7. Connect the Ready for Trigger coaxial cable to the A17 PCB P9 MCX Connector.
8. Connect the Lock Status coaxial cable to the A17 PCB P10 MCX Connector.
9. Connect the External Trigger coaxial cable to the top A17 PCB P11 MCX Connector.

Connect the Ribbon Cables to the A17 PCB

10. Attach the longer ribbon cable to the upper A17 PCB P1 connector. This cable will route to Motherboard 2 PCB connector P17 when the Rear Panel is installed.
11. Attach the shorter ribbon cable to the lower A17 P2 connector. This cable will route to Motherboard 2 PCB connector P72 when the Rear Panel is installed.

Connector M-F Hex Standoffs

12. On the outside of the rear panel, use hex drivers to install the M-F hex standoffs onto the four (4) connectors mounted on the A17 PCB. There are eight (8) total connector standoffs to be added.
13. Use a 7 mm hex driver to add the hex M-F connector standoffs to the Serial I/O (top) and the External I/O connectors. Do not tighten.
    - Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.187 hex M-F threaded connector mounting standoffs.
14. Use a 3/16” hex driver to add the hex M-F connector standoffs to the IEEE 488.2 GPIB connector and the Dedicated GPIB connector. Do not tighten.
    - Each connector is fastened to the Rear Panel Chassis Plate with two (2) 4-40 × 0.650 hex M-F connector mounting standoffs that support stackable GPIB Test Cable Connectors.
15. When all standoffs are correctly threaded, tighten.

19-6 Rear Panel Fan Replacement

Parts and Applicability

- Rear Panel Fan Assembly, 330 mm Cable Attached
- This fan is used on all VNA models with any combination of options.

Fan Removal

Prerequisites

1. The Rear Panel Assembly must be removed from the instrument chassis.

- See Section 19-4 “Rear Panel Removal” on page 19-6 above.

Disconnect Cables

2. The fan power cable is already disconnected from the Motherboard 2 PCB.

3. Route the power cable through the cable clip on the inside center of the Rear Panel.

4. On the inside of the Rear Panel, remove the #6 nut holding the ground strap in place. Bend the ground cable out of the way.

Remove the Fan Mounting Hardware

See Figure 19-5 on page 19-11.

5. Hold the Rear Panel vertical, and from the outside, remove the four (4) pan head Phillips 6-32 × 0.750 in screws holding the fan grill and fan onto the Rear Panel Assembly.

6. As the screws come out, be careful not to lose the flat washer, standoff, and vibration isolation grommet that goes under each screw.

7. As the last screw comes out, the fan assembly can be removed.

Replacement Fan Preparation

Use this procedure to install the threaded spring clips and ground cable to the replacement fan.

1. At each corner of the fan, remove the four (4) threaded spring clips.

2. Note the orientation of the threaded side of the clip.

3. Install the spring clips on the replacement fan, taking care to observe the correct airflow. The fan should pull air in from the Rear Panel and blow it towards the front panel.

Fan Installation

1. Place the fan loosely in position and route the power cable through the center cable clip.

Hardware Sequence

2. Make sure a vibration isolation grommet is in position in the Rear Panel at each corner of the fan.

3. Insert the screw through the grill, flat washer, standoff, vibration isolation grommet, and finally into the threaded spring clip mounted on the fan.

4. Ensure the fan alignment is centered and that the airflow is from the rear towards the front.

5. Tighten all screws.

Ground Cable

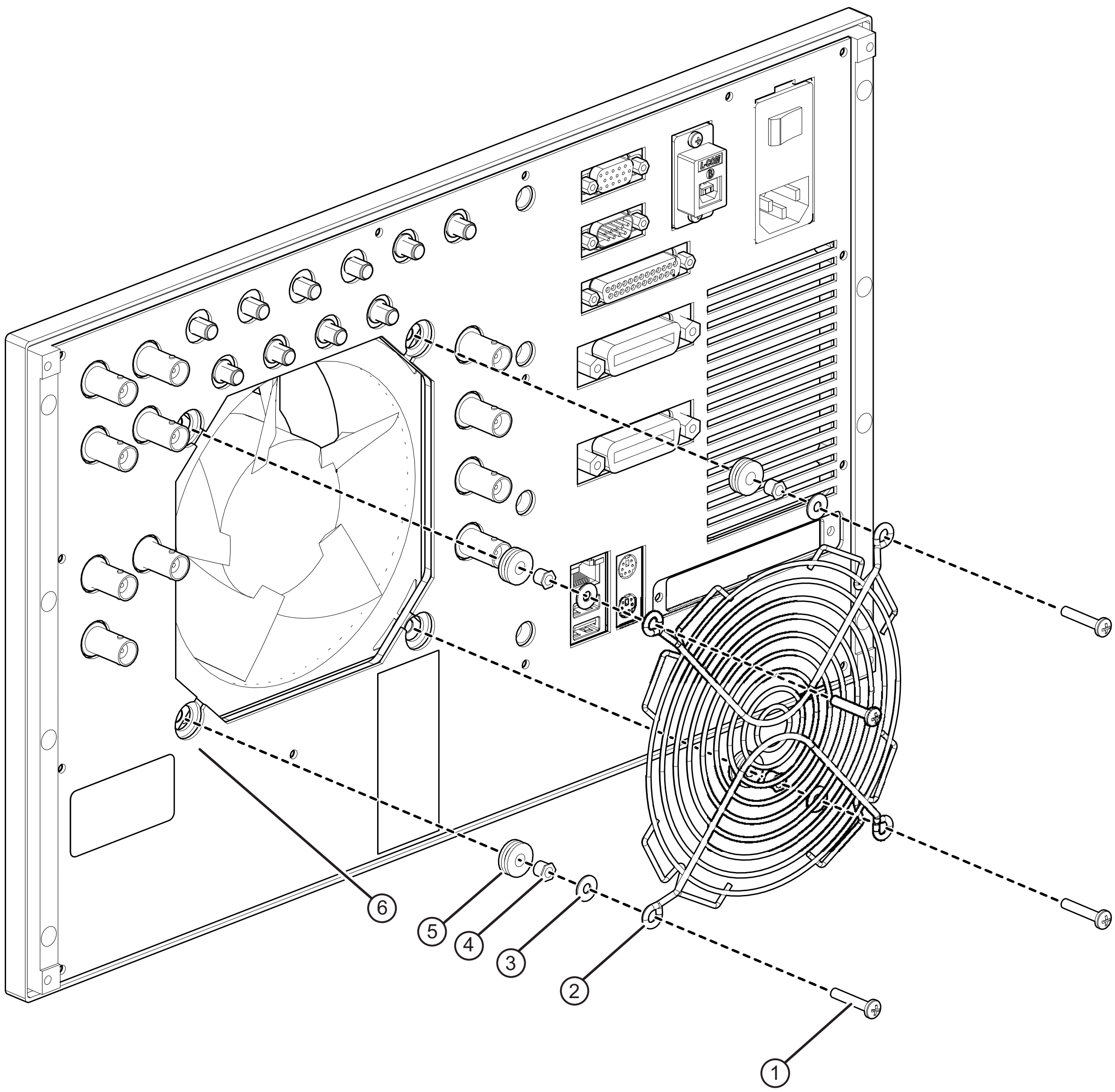
6. On the inside of the Rear Panel, slide the ground cable ring lug over the screw and add the #6 nut and then tighten.

Next Steps

7. If there are other internal components to replace, go to the appropriate procedure below.

   To replace another assembly, skip to any of the following chapters:

   - Chapter 15, "Power Supply Module Replacement"
   - Chapter 16, "Digital PCB Fan Replacement"
   - Chapter 17, "MB1 and MB2 PCB Replacement"



1. Protective Fan Guard
2. Four (4) pan head Phillips 6-32 × 0.750" screws
3. Four (4) #6 flat washers
4. Four (4) self-clinch standoffs #6 clearance × 0.187"
5. Four (4) vibration isolation grommets
6. Four (4) 6-32 Spring Clip Nut Fastener (on inside of chassis, not shown here).

Figure 19-7. Replacing Rear Fan Assembly

19-7 Rear Panel Installation

Use this procedure to install the Rear Panel Assembly after either replacing the Rear Panel Fan, the A17 Rear Panel PCB Assembly, or after replacing an internal component.

Installation Procedures

Position the Rear Panel

1. Position the Rear Panel in approximate position against the instrument chassis.

Make Ribbon Cable Connections

2. Connect the lower A17 PCB P2 connector ribbon cable to the Motherboard 2 PCB P72 connector.
3. Connect the upper A17 PCB P1 connector ribbon cable to the Motherboard 2 PCB P71 connector.
4. Apply a tie wrap to the two ribbon cables to keep them in place.

Install the Rear Panel

5. Position the AC Module in place. Add the (4) outer flat head Phillips M3 × 6 mm screws that hold the AC Module Housing to the Rear Panel. When all are correctly threaded, tighten.
6. Position the Rear Panel Assembly against the chassis and using an 8 mm hex Allen driver, thread in the 12 cap socket Allen-head M4 ×10 mm screws that hold the Rear Panel Assembly to the instrument chassis.
7. Make sure all are correctly threaded.
8. Tighten in two passes, working each time from the center out.
9. Apply as required a cable tie to the AC Power Module cable harness.

Install the Rear Sub Plate

10. Place the Rear Panel Sub Plate in place against the Rear Panel Assembly and insert the 14 pan head Phillips M3 × 6 mm screw. Do not tighten.
11. Make sure all are correctly threaded.
12. Tighten in two passes, working each time from the center out.

Common Reassembly Procedures

13. Install the Inner Cover.
    - See “Install Inner Cover” on page 8-6.
14. Install the Outer Cover.
    - See “Install Outer Cover” on page 8-6.
15. Tighten the four handle screws.

Appendix A — T3545 Maintenance Fixture

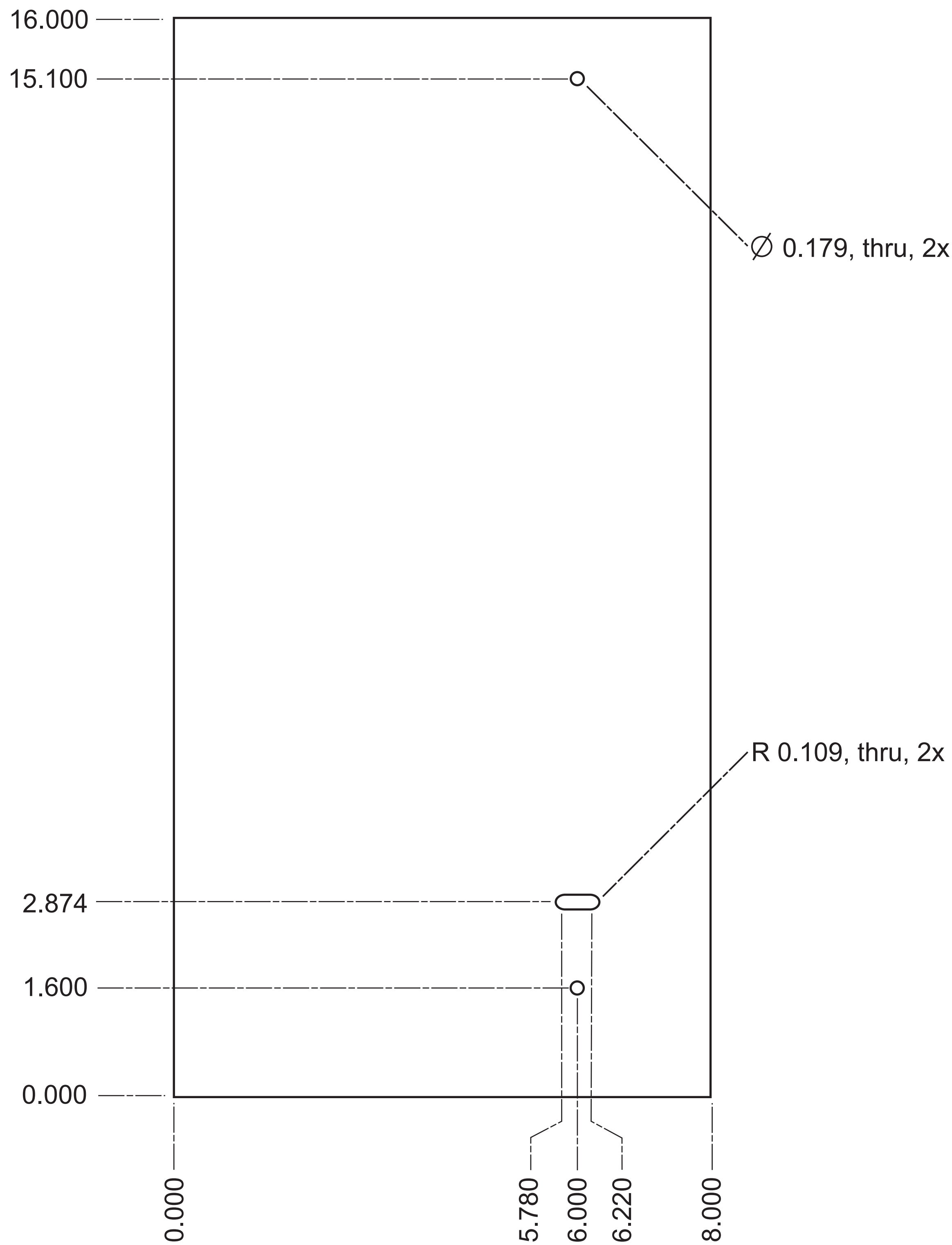
A-1 Introduction to Fixtures

This chapter provides information for recommended assembly and maintenance fixtures for servicing the VectorStar VNA.

A-2 T3545 RF Deck Fixture

The T3545 RF Deck Fixtures attaches to a removed RF Deck (any model with any combination of options) in order to service deck mounted modules and PCBs. The fixture protects protruding top and bottom loops. It attaches to any RF Deck using four (4) M5 x 8 mm screws that originally mounted the RF Deck in the MS4640B main chassis. If multiple uses are anticipated, obtain Knurled Head M5 x 8 mm screws to speed fixture setup.

If required by the customer, the T3545 Fixture can be purchased from Anritsu or easily manufactured locally using the specifications in Figure A-1 on page A-2.



Dimensions in inches, Aluminum, 0.090" Thick, Break Corners and Edges

Figure A-1. T3545 – RF Deck Maintenance Fixture – 62036

The RF Deck Fixture above can be ordered from Anritsu or manufactured locally.

Appendix B — Test Records for Instrument Key Parameter Performance Verification: Accredited Calibrations

B-1 Introduction

Use this appendix to print out and record test, calibration, and verification information. The following test records are available:

- Section B-2 "Maximum Port Power Output Test Record" on page B-4
  - "MS4642B Test Records"
    - Table B-1, "MS4642B (no Option 31 or Option 9) Maximum Port Power Output Test"
    - Table B-2, "MS4642B (no Option 31, with Option 8) Maximum Port Power Output Test"
    - Table B-3, "MS4642B (with Option 31, 9) Maximum Port Power Output Test"
    - Table B-4, "MS4642B (with Option 31, 8) Maximum Port Power Output Test"
    - Table B-5, "MS4642B (with Option 31, 32, and Option 8 or 9) Maximum Port Power Output Test"
  - "MS4644B Test Records"
    - Table B-6, "MS4644B (no Option 31, 51, 61, or 62) Maximum Port Power Output Test"
    - Table B-7, "MS4644B (with Option 51, no Option 31, 61, or 62) Maximum Port Power Output Test"
    - Table B-8, "MS4644B (with Option 61, no Option 31, 51, or 62) Maximum Port Power Output Test"
    - Table B-9, "MS4644B (with Option 62, no Option 31, 51, or 61) Maximum Port Power Output Test"
    - Table B-10, "MS4644B (with Option 31, no Option 51, 61, 62, or 8x) Maximum Port Power Output Test"
    - Table B-11, "MS4644B (with Option 31, 51, no Option 61, 62, or 8x) Maximum Port Power Output Test"
    - Table B-12, "MS4644B (with Option 31, 61, no Option 51, 62, or 8x) Maximum Port Power Output Test"
    - Table B-13, "MS4644B (with Option 31, 62, no Option 51, 61 or 8x) Maximum Port Power Output Test"
    - Table B-14, "MS4644B (with Option 31, 8x, no Option 51, 61, or 62) Maximum Port Power Output Test"
    - Table B-15, "MS4644B (with Option 31, 51, 8x, no Option 61, or 62) Maximum Port Power Output Test"
    - Table B-16, "MS4644B (with Option 31, 61, 8x, no Option 51, or 62) Maximum Port Power Output Test"
    - Table B-17, "MS4644B (with Option 31, 62, 8x, no Option 51, or 61) Maximum Port Power Output Test"
    - Table B-18, "MS4644B (with Option 31, 32, no Option 51, 61, or 62) Maximum Port Power Output Test"
    - Table B-19, "MS4644B (with Option 31, 32, 51, no Option 61 or 62) Maximum Port Power Output Test"

B-2 Maximum Port Power Output Test Record

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

MS4642B Test Records

Table B-1. MS4642B (no Option 31 or Option 9) Maximum Port Power Output Test (1 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)	
0.070000			8	0.34	
1.000000			8	0.34	
2.000000			8	0.34	
5.000000			8	0.34	
7.000000			8	0.34	
9.000000			8	0.34	
10.000000			8	0.34	
11.000000			10	0.25	
20.000000			10	0.25	
50.000000			10	0.25	
100.000000			10	0.25	
200.000000			10	0.25	
300.000000			10	0.25	
500.000000			10	0.25	
700.000000			10	0.25	
1000.000000			10	0.25	
1500.000000			10	0.25	
2000.000000			10	0.25	
2200.000000			10	0.25	
2399.000000			10	0.25	
2400.000000			TYP	TYP	
2499.000000			TYP	TYP	
2500.000000			TYP	TYP	
2700.000000			TYP	TYP	
2701.000000			11	0.58	
3000.000000			11	0.58	

Table B-1. MS4642B (no Option 31 or Option 9) Maximum Port Power Output Test (2 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)	
3500.000000			11	0.58	
4000.000000			11	0.58	
4500.000000			11	0.58	
5000.000000			11	0.58	
5001.000000			11	0.58	
5500.000000			11	0.58	
6000.000000			11	0.58	
6500.000000			11	0.58	
7000.000000			11	0.58	
7500.000000			11	0.58	
8000.000000			11	0.58	
8500.000000			11	0.58	
9000.000000			11	0.58	
9500.000000			11	0.58	
10000.000000			11	0.58	
10001.000000			11	0.58	
11000.000000			11	0.58	
12000.000000			11	0.58	
13000.000000			11	0.58	
14000.000000			11	0.58	
15000.000000			11	0.58	
16000.000000			11	0.58	
17000.000000			11	0.58	
18000.000000			11	0.58	
19000.000000			11	0.58	
20000.000000			11	0.58	

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-2. MS4642B (no Option 31, with Option 8) Maximum Port Power Output Test (1 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		8		9	0.34
1.000000		8		9	0.34
2.000000		8		9	0.34
5.000000		8		9	0.34
7.000000		8		9	0.34
9.000000		8		9	0.34
10.000000		8		9	0.34
11.000000		10		11	0.25
20.000000		10		11	0.25
50.000000		10		11	0.25
100.000000		10		11	0.25
200.000000		10		11	0.25
300.000000		10		11	0.25
500.000000		10		11	0.25
700.000000		10		11	0.25
1000.000000		10		11	0.25
1500.000000		10		11	0.25
2000.000000		10		11	0.25
2200.000000		10		11	0.25
2399.000000		10		11	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		11		12	0.58
3000.000000		11		12	0.58
3500.000000		11		12	0.58
4000.000000		11		12	0.58
4500.000000		11		12	0.58

Table B-2. MS4642B (no Option 31, with Option 8) Maximum Port Power Output Test (2 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		11		12	0.58
5001.000000		11		12	0.58
5500.000000		11		12	0.58
6000.000000		11		12	0.58
6500.000000		11		12	0.58
7000.000000		11		12	0.58
7500.000000		11		12	0.58
8000.000000		11		12	0.58
8500.000000		11		12	0.58
9000.000000		11		12	0.58
9500.000000		11		12	0.58
10000.000000		11		12	0.58
10001.000000		11		12	0.58
11000.000000		11		12	0.58
12000.000000		11		12	0.58
13000.000000		11		12	0.58
14000.000000		11		12	0.58
15000.000000		11		12	0.58
16000.000000		11		12	0.58
17000.000000		11		12	0.58
18000.000000		11		12	0.58
19000.000000		11		12	0.58
20000.000000		11		12	0.58

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-3. MS4642B (with Option 31, 9) Maximum Port Power Output Test (1 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)	
0.070000			10	0.34	
1.000000			10	0.34	
2.000000			10	0.34	
5.000000			10	0.34	
7.000000			10	0.34	
9.000000			10	0.34	
10.000000			10	0.34	
11.000000			12	0.25	
20.000000			12	0.25	
50.000000			12	0.25	
100.000000			12	0.25	
200.000000			12	0.25	
300.000000			12	0.25	
500.000000			12	0.25	
700.000000			12	0.25	
1000.000000			12	0.25	
1500.000000			12	0.25	
2000.000000			12	0.25	
2200.000000			12	0.25	
2399.000000			12	0.25	
2400.000000			TYP	TYP	
2499.000000			TYP	TYP	
2500.000000			TYP	TYP	
2700.000000			TYP	TYP	
2701.000000			12	0.58	
3000.000000			12	0.58	
3500.000000			12	0.58	
4000.000000			12	0.58	
4500.000000			12	0.58	

Table B-3. MS4642B (with Option 31, 9) Maximum Port Power Output Test (2 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)	
5000.000000			12	0.58	
5001.000000			12	0.58	
5500.000000			12	0.58	
6000.000000			12	0.58	
6500.000000			12	0.58	
7000.000000			12	0.58	
7500.000000			12	0.58	
8000.000000			12	0.58	
8500.000000			12	0.58	
9000.000000			12	0.58	
9500.000000			12	0.58	
10000.000000			12	0.58	
10001.000000			12	0.58	
11000.000000			12	0.58	
12000.000000			12	0.58	
13000.000000			12	0.58	
14000.000000			12	0.58	
15000.000000			12	0.58	
16000.000000			12	0.58	
17000.000000			12	0.58	
18000.000000			12	0.58	
19000.000000			12	0.58	
20000.000000			12	0.58	

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-4. MS4642B (with Option 31, 8) Maximum Port Power Output Test (1 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		10		11	0.34
1.000000		10		11	0.34
2.000000		10		11	0.34
5.000000		10		11	0.34
7.000000		10		11	0.34
9.000000		10		11	0.34
10.000000		10		11	0.34
11.000000		12		13	0.25
20.000000		12		13	0.25
50.000000		12		13	0.25
100.000000		12		13	0.25
200.000000		12		13	0.25
300.000000		12		13	0.25
500.000000		12		13	0.25
700.000000		12		13	0.25
1000.000000		12		13	0.25
1500.000000		12		13	0.25
2000.000000		12		13	0.25
2200.000000		12		13	0.25
2399.000000		12		13	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		12		13	0.58
3000.000000		12		13	0.58
3500.000000		12		13	0.58
4000.000000		12		13	0.58
4500.000000		12		13	0.58

Table B-4. MS4642B (with Option 31, 8) Maximum Port Power Output Test (2 of 2)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		12		13	0.58
5001.000000		12		13	0.58
5500.000000		12		13	0.58
6000.000000		12		13	0.58
6500.000000		12		13	0.58
7000.000000		12		13	0.58
7500.000000		12		13	0.58
8000.000000		12		13	0.58
8500.000000		12		13	0.58
9000.000000		12		13	0.58
9500.000000		12		13	0.58
10000.000000		12		13	0.58
10001.000000		12		13	0.58
11000.000000		12		13	0.58
12000.000000		12		13	0.58
13000.000000		12		13	0.58
14000.000000		12		13	0.58
15000.000000		12		13	0.58
16000.000000		12		13	0.58
17000.000000		12		13	0.58
18000.000000		12		13	0.58
19000.000000		12		13	0.58
20000.000000		12		13	0.58

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-5. MS4642B (with Option 31, 32, and Option 8 or 9) Maximum Port Power Output Test (1 of 2)

Frequency (MHz)	Port 1 Source 1 Measured Value (dBm)	Port 1 Source 1 Minimum Value (dBm)	Port 2 Source 2 Measured Value (dBm)	Port 2 Source 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		8		6	0.34
1.000000		8		6	0.34
2.000000		8		6	0.34
5.000000		8		6	0.34
7.000000		8		6	0.34
9.000000		8		6	0.34
10.000000		8		6	0.34
11.000000		10		8	0.25
20.000000		10		8	0.25
50.000000		10		8	0.25
100.000000		10		8	0.25
200.000000		10		8	0.25
300.000000		10		8	0.25
500.000000		10		8	0.25
700.000000		10		8	0.25
1000.000000		10		8	0.25
1500.000000		10		8	0.25
2000.000000		10		8	0.25
2200.000000		10		8	0.25
2399.000000		10		8	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		10		9	0.58
3000.000000		10		9	0.58
3500.000000		10		9	0.58
4000.000000		10		9	0.58
4500.000000		10		9	0.58

Table B-5. MS4642B (with Option 31, 32, and Option 8 or 9) Maximum Port Power Output Test (2 of 2)

Frequency (MHz)	Port 1 Source 1 Measured Value (dBm)	Port 1 Source 1 Minimum Value (dBm)	Port 2 Source 2 Measured Value (dBm)	Port 2 Source 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		10		9	0.58
5001.000000		10		9	0.58
5500.000000		10		9	0.58
6000.000000		10		9	0.58
6500.000000		10		9	0.58
7000.000000		10		9	0.58
7500.000000		10		9	0.58
8000.000000		10		9	0.58
8500.000000		10		9	0.58
9000.000000		10		9	0.58
9500.000000		10		9	0.58
10000.000000		10		9	0.58
10001.000000		10		9	0.58
11000.000000		10		9	0.58
12000.000000		10		9	0.58
13000.000000		10		9	0.58
14000.000000		10		9	0.58
15000.000000		10		9	0.58
16000.000000		10		9	0.58
17000.000000		10		9	0.58
18000.000000		10		9	0.58
19000.000000		10		9	0.58
20000.000000		10		9	0.58

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		Serial Number:	
Options:			
Comments:			
Operator:		Date:	

MS4644B Test Records

Table B-6. MS4644B (no Option 31, 51, 61, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			10	0.34
1.000000			10	0.34
2.000000			10	0.34
5.000000			10	0.34
7.000000			10	0.34
9.000000			10	0.34
10.000000			10	0.34
11.000000			12	0.25
20.000000			12	0.25
50.000000			12	0.25
100.000000			12	0.25
200.000000			12	0.25
300.000000			12	0.25
500.000000			12	0.25
700.000000			12	0.25
1000.000000			12	0.25
1500.000000			12	0.25
2000.000000			12	0.25
2200.000000			12	0.25
2399.000000			12	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			9	0.58
3000.000000			9	0.58
3500.000000			9	0.58
4000.000000			9	0.58

Table B-6. MS4644B (no Option 31, 51, 61, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
4500.000000			9	0.58
5000.000000			9	0.58
5001.000000			9	0.58
5500.000000			9	0.58
6000.000000			9	0.58
6500.000000			9	0.58
7000.000000			9	0.58
7500.000000			9	0.58
8000.000000			9	0.58
8500.000000			9	0.58
9000.000000			9	0.58
9500.000000			9	0.58
10000.000000			9	0.58
10001.000000			9	0.58
11000.000000			9	0.58
12000.000000			9	0.58
13000.000000			9	0.58
14000.000000			9	0.58
15000.000000			9	0.58
16000.000000			9	0.58
17000.000000			9	0.58
18000.000000			9	0.58
19000.000000			9	0.58
20000.000000			9	0.58
20001.000000			9	0.82
21000.000000			9	0.82
22000.000000			9	0.82
23000.000000			9	0.82
24000.000000			9	0.82
25000.000000			9	0.82
26000.000000			9	0.82
27000.000000			9	0.82
28000.000000			9	0.82
29000.000000			9	0.82
30000.000000			9	0.82
31000.000000			9	0.82
32000.000000			9	0.82
33000.000000			9	0.82

Table B-6. MS4644B (no Option 31, 51, 61, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
34000.000000			9	0.82
35000.000000			9	0.82
36000.000000			9	0.82
37000.000000			9	0.82
38000.000000			9	0.82
38001.000000			9	0.82
39000.000000			9	0.82
40000.000000			9	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-7. MS4644B (with Option 51, no Option 31, 61, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			9	0.34
1.000000			9	0.34
2.000000			9	0.34
5.000000			9	0.34
7.000000			9	0.34
9.000000			9	0.34
10.000000			9	0.34
11.000000			11	0.25
20.000000			11	0.25
50.000000			11	0.25
100.000000			11	0.25
200.000000			11	0.25
300.000000			11	0.25
500.000000			11	0.25
700.000000			11	0.25
1000.000000			11	0.25
1500.000000			11	0.25
2000.000000			11	0.25
2200.000000			11	0.25
2399.000000			11	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			8	0.58
3000.000000			8	0.58
3500.000000			8	0.58
4000.000000			8	0.58
4500.000000			8	0.58

Table B-7. MS4644B (with Option 51, no Option 31, 61, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000			8	0.58
5001.000000			8	0.58
5500.000000			8	0.58
6000.000000			8	0.58
6500.000000			8	0.58
7000.000000			8	0.58
7500.000000			8	0.58
8000.000000			8	0.58
8500.000000			8	0.58
9000.000000			8	0.58
9500.000000			8	0.58
10000.000000			8	0.58
10001.000000			8	0.58
11000.000000			8	0.58
12000.000000			8	0.58
13000.000000			8	0.58
14000.000000			8	0.58
15000.000000			8	0.58
16000.000000			8	0.58
17000.000000			8	0.58
18000.000000			8	0.58
19000.000000			8	0.58
20000.000000			8	0.58
20001.000000			8	0.82
21000.000000			8	0.82
22000.000000			8	0.82
23000.000000			8	0.82
24000.000000			8	0.82
25000.000000			8	0.82
26000.000000			8	0.82
27000.000000			8	0.82
28000.000000			8	0.82
29000.000000			8	0.82
30000.000000			8	0.82
31000.000000			8	0.82
32000.000000			8	0.82
33000.000000			8	0.82
34000.000000			8	0.82

Table B-7. MS4644B (with Option 51, no Option 31, 61, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000			8	0.82
36000.000000			8	0.82
37000.000000			8	0.82
38000.000000			8	0.82
38001.000000			8	0.82
39000.000000			8	0.82
40000.000000			8	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-8. MS4644B (with Option 61, no Option 31, 51, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		8.000		9	0.34
1.000000		8.000		9	0.34
2.000000		8.000		9	0.34
5.000000		8.000		9	0.34
7.000000		8.000		9	0.34
9.000000		8.000		9	0.34
10.000000		8.000		9	0.34
11.000000		10.000		11	0.25
20.000000		10.000		11	0.25
50.000000		10.000		11	0.25
100.000000		10.000		11	0.25
200.000000		10.000		11	0.25
300.000000		10.000		11	0.25
500.000000		10.000		11	0.25
700.000000		10.000		11	0.25
1000.000000		10.000		11	0.25
1500.000000		10.000		11	0.25
2000.000000		10.000		11	0.25
2200.000000		10.000		11	0.25
2399.000000		10.000		11	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		7.000		8	0.58
3000.000000		7.000		8	0.58
3500.000000		7.000		8	0.58
4000.000000		7.000		8	0.58
4500.000000		7.000		8	0.58

Table B-8. MS4644B (with Option 61, no Option 31, 51, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		7.000		8	0.58
5001.000000		7.000		8	0.58
5500.000000		7.000		8	0.58
6000.000000		7.000		8	0.58
6500.000000		7.000		8	0.58
7000.000000		7.000		8	0.58
7500.000000		7.000		8	0.58
8000.000000		7.000		8	0.58
8500.000000		7.000		8	0.58
9000.000000		7.000		8	0.58
9500.000000		7.000		8	0.58
10000.000000		7.000		8	0.58
10001.000000		7.000		8	0.58
11000.000000		7.000		8	0.58
12000.000000		7.000		8	0.58
13000.000000		7.000		8	0.58
14000.000000		7.000		8	0.58
15000.000000		7.000		8	0.58
16000.000000		7.000		8	0.58
17000.000000		7.000		8	0.58
18000.000000		7.000		8	0.58
19000.000000		7.000		8	0.58
20000.000000		7.000		8	0.58
20001.000000		7.000		8	0.82
21000.000000		7.000		8	0.82
22000.000000		7.000		8	0.82
23000.000000		7.000		8	0.82
24000.000000		7.000		8	0.82
25000.000000		7.000		8	0.82
26000.000000		7.000		8	0.82
27000.000000		7.000		8	0.82
28000.000000		7.000		8	0.82
29000.000000		7.000		8	0.82
30000.000000		7.000		8	0.82
31000.000000		7.000		8	0.82
32000.000000		7.000		8	0.82
33000.000000		7.000		8	0.82
34000.000000		7.000		8	0.82

Table B-8. MS4644B (with Option 61, no Option 31, 51, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000		7.000		8	0.82
36000.000000		7.000		8	0.82
37000.000000		7.000		8	0.82
38000.000000		7.000		8	0.82
38001.000000		7.000		8	0.82
39000.000000		7.000		8	0.82
40000.000000		7.000		8	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-9. MS4644B (with Option 62, no Option 31, 51, or 61) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			8	0.34
1.000000			8	0.34
2.000000			8	0.34
5.000000			8	0.34
7.000000			8	0.34
9.000000			8	0.34
10.000000			8	0.34
11.000000			10	0.25
20.000000			10	0.25
50.000000			10	0.25
100.000000			10	0.25
200.000000			10	0.25
300.000000			10	0.25
500.000000			10	0.25
700.000000			10	0.25
1000.000000			10	0.25
1500.000000			10	0.25
2000.000000			10	0.25
2200.000000			10	0.25
2399.000000			10	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			7	0.58
3000.000000			7	0.58
3500.000000			7	0.58
4000.000000			7	0.58
4500.000000			7	0.58

Table B-9. MS4644B (with Option 62, no Option 31, 51, or 61) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000			7	0.58
5001.000000			7	0.58
5500.000000			7	0.58
6000.000000			7	0.58
6500.000000			7	0.58
7000.000000			7	0.58
7500.000000			7	0.58
8000.000000			7	0.58
8500.000000			7	0.58
9000.000000			7	0.58
9500.000000			7	0.58
10000.000000			7	0.58
10001.000000			7	0.58
11000.000000			7	0.58
12000.000000			7	0.58
13000.000000			7	0.58
14000.000000			7	0.58
15000.000000			7	0.58
16000.000000			7	0.58
17000.000000			7	0.58
18000.000000			7	0.58
19000.000000			7	0.58
20000.000000			7	0.58
20001.000000			7	0.82
21000.000000			7	0.82
22000.000000			7	0.82
23000.000000			7	0.82
24000.000000			7	0.82
25000.000000			7	0.82
26000.000000			7	0.82
27000.000000			7	0.82
28000.000000			7	0.82
29000.000000			7	0.82
30000.000000			7	0.82
31000.000000			7	0.82
32000.000000			7	0.82
33000.000000			7	0.82
34000.000000			7	0.82

Table B-9. MS4644B (with Option 62, no Option 31, 51, or 61) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000			7	0.82
36000.000000			7	0.82
37000.000000			7	0.82
38000.000000			7	0.82
38001.000000			7	0.82
39000.000000			7	0.82
40000.000000			7	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-10. MS4644B (with Option 31, no Option 51, 61, 62, or 8x) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			12	0.34
1.000000			12	0.34
2.000000			12	0.34
5.000000			12	0.34
7.000000			12	0.34
9.000000			12	0.34
10.000000			12	0.34
11.000000			14	0.25
20.000000			14	0.25
50.000000			14	0.25
100.000000			14	0.25
200.000000			14	0.25
300.000000			14	0.25
500.000000			14	0.25
700.000000			14	0.25
1000.000000			14	0.25
1500.000000			14	0.25
2000.000000			14	0.25
2200.000000			14	0.25
2399.000000			14	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			12	0.58
3000.000000			12	0.58
3500.000000			12	0.58
4000.000000			12	0.58
4500.000000			12	0.58

Table B-10. MS4644B (with Option 31, no Option 51, 61, 62, or 8x) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000			12	0.58
5001.000000			12	0.58
5500.000000			12	0.58
6000.000000			12	0.58
6500.000000			12	0.58
7000.000000			12	0.58
7500.000000			12	0.58
8000.000000			12	0.58
8500.000000			12	0.58
9000.000000			12	0.58
9500.000000			12	0.58
10000.000000			12	0.58
10001.000000			12	0.58
11000.000000			12	0.58
12000.000000			12	0.58
13000.000000			12	0.58
14000.000000			12	0.58
15000.000000			12	0.58
16000.000000			12	0.58
17000.000000			12	0.58
18000.000000			12	0.58
19000.000000			12	0.58
20000.000000			12	0.58
20001.000000			12	0.82
21000.000000			12	0.82
22000.000000			12	0.82
23000.000000			12	0.82
24000.000000			12	0.82
25000.000000			12	0.82
26000.000000			12	0.82
27000.000000			12	0.82
28000.000000			12	0.82
29000.000000			12	0.82
30000.000000			12	0.82
31000.000000			12	0.82
32000.000000			12	0.82
33000.000000			12	0.82
34000.000000			12	0.82

Table B-10. MS4644B (with Option 31, no Option 51, 61, 62, or 8x) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000			12	0.82
36000.000000			12	0.82
37000.000000			12	0.82
38000.000000			12	0.82
38001.000000			12	0.82
39000.000000			12	0.82
40000.000000			12	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-11. MS4644B (with Option 31, 51, no Option 61, 62, or 8x) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			11	0.34
1.000000			11	0.34
2.000000			11	0.34
5.000000			11	0.34
7.000000			11	0.34
9.000000			11	0.34
10.000000			11	0.34
11.000000			13	0.25
20.000000			13	0.25
50.000000			13	0.25
100.000000			13	0.25
200.000000			13	0.25
300.000000			13	0.25
500.000000			13	0.25
700.000000			13	0.25
1000.000000			13	0.25
1500.000000			13	0.25
2000.000000			13	0.25
2200.000000			13	0.25
2399.000000			13	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			11	0.58
3000.000000			11	0.58
3500.000000			11	0.58
4000.000000			11	0.58
4500.000000			11	0.58

Table B-11. MS4644B (with Option 31, 51, no Option 61, 62, or 8x) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000			11	0.58
5001.000000			11	0.58
5500.000000			11	0.58
6000.000000			11	0.58
6500.000000			11	0.58
7000.000000			11	0.58
7500.000000			11	0.58
8000.000000			11	0.58
8500.000000			11	0.58
9000.000000			11	0.58
9500.000000			11	0.58
10000.000000			11	0.58
10001.000000			11	0.58
11000.000000			11	0.58
12000.000000			11	0.58
13000.000000			11	0.58
14000.000000			11	0.58
15000.000000			11	0.58
16000.000000			11	0.58
17000.000000			11	0.58
18000.000000			11	0.58
19000.000000			11	0.58
20000.000000			11	0.58
20001.000000			11	0.82
21000.000000			11	0.82
22000.000000			11	0.82
23000.000000			11	0.82
24000.000000			11	0.82
25000.000000			11	0.82
26000.000000			11	0.82
27000.000000			11	0.82
28000.000000			11	0.82
29000.000000			11	0.82
30000.000000			11	0.82
31000.000000			11	0.82
32000.000000			11	0.82
33000.000000			11	0.82
34000.000000			11	0.82

Table B-11. MS4644B (with Option 31, 51, no Option 61, 62, or 8x) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000			11	0.82
36000.000000			11	0.82
37000.000000			11	0.82
38000.000000			11	0.82
38001.000000			11	0.82
39000.000000			11	0.82
40000.000000			11	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-12. MS4644B (with Option 31, 61, no Option 51, 62, or 8x) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		10		11	0.34
1.000000		10		11	0.34
2.000000		10		11	0.34
5.000000		10		11	0.34
7.000000		10		11	0.34
9.000000		10		11	0.34
10.000000		10		11	0.34
11.000000		12		13	0.25
20.000000		12		13	0.25
50.000000		12		13	0.25
100.000000		12		13	0.25
200.000000		12		13	0.25
300.000000		12		13	0.25
500.000000		12		13	0.25
700.000000		12		13	0.25
1000.000000		12		13	0.25
1500.000000		12		13	0.25
2000.000000		12		13	0.25
2200.000000		12		13	0.25
2399.000000		12		13	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		10		11	0.58
3000.000000		10		11	0.58
3500.000000		10		11	0.58
4000.000000		10		11	0.58
4500.000000		10		11	0.58

Table B-12. MS4644B (with Option 31, 61, no Option 51, 62, or 8x) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		10		11	0.58
5001.000000		10		11	0.58
5500.000000		10		11	0.58
6000.000000		10		11	0.58
6500.000000		10		11	0.58
7000.000000		10		11	0.58
7500.000000		10		11	0.58
8000.000000		10		11	0.58
8500.000000		10		11	0.58
9000.000000		10		11	0.58
9500.000000		10		11	0.58
10000.000000		10		11	0.58
10001.000000		10		11	0.58
11000.000000		10		11	0.58
12000.000000		10		11	0.58
13000.000000		10		11	0.58
14000.000000		10		11	0.58
15000.000000		10		11	0.58
16000.000000		10		11	0.58
17000.000000		10		11	0.58
18000.000000		10		11	0.58
19000.000000		10		11	0.58
20000.000000		10		11	0.58
20001.000000		10		11	0.82
21000.000000		10		11	0.82
22000.000000		10		11	0.82
23000.000000		10		11	0.82
24000.000000		10		11	0.82
25000.000000		10		11	0.82
26000.000000		10		11	0.82
27000.000000		10		11	0.82
28000.000000		10		11	0.82
29000.000000		10		11	0.82
30000.000000		10		11	0.82
31000.000000		10		11	0.82
32000.000000		10		11	0.82
33000.000000		10		11	0.82
34000.000000		10		11	0.82

Table B-12. MS4644B (with Option 31, 61, no Option 51, 62, or 8x) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000		10		11	0.82
36000.000000		10		11	0.82
37000.000000		10		11	0.82
38000.000000		10		11	0.82
38001.000000		10		11	0.82
39000.000000		10		11	0.82
40000.000000		10		11	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-13. MS4644B (with Option 31, 62, no Option 51, 61 or 8x) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000			10	0.34
1.000000			10	0.34
2.000000			10	0.34
5.000000			10	0.34
7.000000			10	0.34
9.000000			10	0.34
10.000000			10	0.34
11.000000			12	0.25
20.000000			12	0.25
50.000000			12	0.25
100.000000			12	0.25
200.000000			12	0.25
300.000000			12	0.25
500.000000			12	0.25
700.000000			12	0.25
1000.000000			12	0.25
1500.000000			12	0.25
2000.000000			12	0.25
2200.000000			12	0.25
2399.000000			12	0.25
2400.000000			TYP	TYP
2499.000000			TYP	TYP
2500.000000			TYP	TYP
2700.000000			TYP	TYP
2701.000000			10	0.58
3000.000000			10	0.58
3500.000000			10	0.58
4000.000000			10	0.58
4500.000000			10	0.58

Table B-13. MS4644B (with Option 31, 62, no Option 51, 61 or 8x) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000			10	0.58
5001.000000			10	0.58
5500.000000			10	0.58
6000.000000			10	0.58
6500.000000			10	0.58
7000.000000			10	0.58
7500.000000			10	0.58
8000.000000			10	0.58
8500.000000			10	0.58
9000.000000			10	0.58
9500.000000			10	0.58
10000.000000			10	0.58
10001.000000			10	0.58
11000.000000			10	0.58
12000.000000			10	0.58
13000.000000			10	0.58
14000.000000			10	0.58
15000.000000			10	0.58
16000.000000			10	0.58
17000.000000			10	0.58
18000.000000			10	0.58
19000.000000			10	0.58
20000.000000			10	0.58
20001.000000			10	0.82
21000.000000			10	0.82
22000.000000			10	0.82
23000.000000			10	0.82
24000.000000			10	0.82
25000.000000			10	0.82
26000.000000			10	0.82
27000.000000			10	0.82
28000.000000			10	0.82
29000.000000			10	0.82
30000.000000			10	0.82
31000.000000			10	0.82
32000.000000			10	0.82
33000.000000			10	0.82
34000.000000			10	0.82

Table B-13. MS4644B (with Option 31, 62, no Option 51, 61 or 8x) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000			10	0.82
36000.000000			10	0.82
37000.000000			10	0.82
38000.000000			10	0.82
38001.000000			10	0.82
39000.000000			10	0.82
40000.000000			10	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-14. MS4644B (with Option 31, 8x, no Option 51, 61, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
0.070000		12	N/A	10 (Typical)	0.34
1.000000		12	N/A	10 (Typical)	0.34
2.000000		12	N/A	10 (Typical)	0.34
5.000000		12	N/A	10 (Typical)	0.34
7.000000		12	N/A	10 (Typical)	0.34
9.000000		12	N/A	10 (Typical)	0.34
10.000000		12	N/A	10 (Typical)	0.34
11.000000		14	N/A	12 (Typical)	0.25
20.000000		14	N/A	12 (Typical)	0.25
50.000000		14	N/A	12 (Typical)	0.25
100.000000		14	N/A	12 (Typical)	0.25
200.000000		14	N/A	12 (Typical)	0.25
300.000000		14	N/A	12 (Typical)	0.25
500.000000		14	N/A	12 (Typical)	0.25
700.000000		14	N/A	12 (Typical)	0.25
1000.000000		14	N/A	12 (Typical)	0.25
1500.000000		14	N/A	12 (Typical)	0.25
2000.000000		14	N/A	12 (Typical)	0.25
2200.000000		14	N/A	12 (Typical)	0.25
2399.000000		14	N/A	12 (Typical)	0.25
2400.000000		TYP	N/A	TYP	TYP
2499.000000		TYP	N/A	TYP	TYP
2500.000000		TYP	N/A	TYP	TYP
2700.000000		TYP	N/A	TYP	TYP
2701.000000		12	N/A	9 (Typical)	0.58
3000.000000		12	N/A	9 (Typical)	0.58
3500.000000		12	N/A	9 (Typical)	0.58
4000.000000		12	N/A	9 (Typical)	0.58
4500.000000		12	N/A	9 (Typical)	0.58

Table B-14. MS4644B (with Option 31, 8x, no Option 51, 61, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
5000.000000		12	N/A	9 (Typical)	0.58
5001.000000		12	N/A	9 (Typical)	0.58
5500.000000		12	N/A	9 (Typical)	0.58
6000.000000		12	N/A	9 (Typical)	0.58
6500.000000		12	N/A	9 (Typical)	0.58
7000.000000		12	N/A	9 (Typical)	0.58
7500.000000		12	N/A	9 (Typical)	0.58
8000.000000		12	N/A	9 (Typical)	0.58
8500.000000		12	N/A	9 (Typical)	0.58
9000.000000		12	N/A	9 (Typical)	0.58
9500.000000		12	N/A	9 (Typical)	0.58
10000.000000		12	N/A	9 (Typical)	0.58
10001.000000		12	N/A	9 (Typical)	0.58
11000.000000		12	N/A	9 (Typical)	0.58
12000.000000		12	N/A	9 (Typical)	0.58
13000.000000		12	N/A	9 (Typical)	0.58
14000.000000		12	N/A	9 (Typical)	0.58
15000.000000		12	N/A	9 (Typical)	0.58
16000.000000		12	N/A	9 (Typical)	0.58
17000.000000		12	N/A	9 (Typical)	0.58
18000.000000		12	N/A	9 (Typical)	0.58
19000.000000		12	N/A	9 (Typical)	0.58
20000.000000		12	N/A	9 (Typical)	0.58
20001.000000		12	N/A	9 (Typical)	0.82
21000.000000		12	N/A	9 (Typical)	0.82
22000.000000		12	N/A	9 (Typical)	0.82
23000.000000		12	N/A	9 (Typical)	0.82
24000.000000		12	N/A	9 (Typical)	0.82
25000.000000		12	N/A	9 (Typical)	0.82
26000.000000		12	N/A	9 (Typical)	0.82
27000.000000		12	N/A	9 (Typical)	0.82
28000.000000		12	N/A	9 (Typical)	0.82
29000.000000		12	N/A	9 (Typical)	0.82
30000.000000		12	N/A	9 (Typical)	0.82
31000.000000		12	N/A	9 (Typical)	0.82
32000.000000		12	N/A	9 (Typical)	0.82
33000.000000		12	N/A	9 (Typical)	0.82
34000.000000		12	N/A	9 (Typical)	0.82

Table B-14. MS4644B (with Option 31, 8x, no Option 51, 61, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
35000.000000		12	N/A	9 (Typical)	0.82
36000.000000		12	N/A	9 (Typical)	0.82
37000.000000		12	N/A	9 (Typical)	0.82
38000.000000		12	N/A	9 (Typical)	0.82
38001.000000		12	N/A	9 (Typical)	0.82
39000.000000		12	N/A	9 (Typical)	0.82
40000.000000		12	N/A	9 (Typical)	0.82

a.With Option 8x, Test Port 2 maximum power is equivalent to the non-Option 31 range (typical).

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-15. MS4644B (with Option 31, 51, 8x, no Option 61, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
0.070000		11	N/A	9 (Typical)	0.34
1.000000		11	N/A	9 (Typical)	0.34
2.000000		11	N/A	9 (Typical)	0.34
5.000000		11	N/A	9 (Typical)	0.34
7.000000		11	N/A	9 (Typical)	0.34
9.000000		11	N/A	9 (Typical)	0.34
10.000000		11	N/A	9 (Typical)	0.34
11.000000		13	N/A	11 (Typical)	0.25
20.000000		13	N/A	11 (Typical)	0.25
50.000000		13	N/A	11 (Typical)	0.25
100.000000		13	N/A	11 (Typical)	0.25
200.000000		13	N/A	11 (Typical)	0.25
300.000000		13	N/A	11 (Typical)	0.25
500.000000		13	N/A	11 (Typical)	0.25
700.000000		13	N/A	11 (Typical)	0.25
1000.000000		13	N/A	11 (Typical)	0.25
1500.000000		13	N/A	11 (Typical)	0.25
2000.000000		13	N/A	11 (Typical)	0.25
2200.000000		13	N/A	11 (Typical)	0.25
2399.000000		13	N/A	11 (Typical)	0.25
2400.000000		TYP	N/A	TYP	TYP
2499.000000		TYP	N/A	TYP	TYP
2500.000000		TYP	N/A	TYP	TYP
2700.000000		TYP	N/A	TYP	TYP
2701.000000		11	N/A	8 (Typical)	0.58
3000.000000		11	N/A	8 (Typical)	0.58
3500.000000		11	N/A	8 (Typical)	0.58
4000.000000		11	N/A	8 (Typical)	0.58
4500.000000		11	N/A	8 (Typical)	0.58

Table B-15. MS4644B (with Option 31, 51, 8x, no Option 61, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
5000.000000		11	N/A	8 (Typical)	0.58
5001.000000		11	N/A	8 (Typical)	0.58
5500.000000		11	N/A	8 (Typical)	0.58
6000.000000		11	N/A	8 (Typical)	0.58
6500.000000		11	N/A	8 (Typical)	0.58
7000.000000		11	N/A	8 (Typical)	0.58
7500.000000		11	N/A	8 (Typical)	0.58
8000.000000		11	N/A	8 (Typical)	0.58
8500.000000		11	N/A	8 (Typical)	0.58
9000.000000		11	N/A	8 (Typical)	0.58
9500.000000		11	N/A	8 (Typical)	0.58
10000.000000		11	N/A	8 (Typical)	0.58
10001.000000		11	N/A	8 (Typical)	0.58
11000.000000		11	N/A	8 (Typical)	0.58
12000.000000		11	N/A	8 (Typical)	0.58
13000.000000		11	N/A	8 (Typical)	0.58
14000.000000		11	N/A	8 (Typical)	0.58
15000.000000		11	N/A	8 (Typical)	0.58
16000.000000		11	N/A	8 (Typical)	0.58
17000.000000		11	N/A	8 (Typical)	0.58
18000.000000		11	N/A	8 (Typical)	0.58
19000.000000		11	N/A	8 (Typical)	0.58
20000.000000		11	N/A	8 (Typical)	0.58
20001.000000		11	N/A	8 (Typical)	0.82
21000.000000		11	N/A	8 (Typical)	0.82
22000.000000		11	N/A	8 (Typical)	0.82
23000.000000		11	N/A	8 (Typical)	0.82
24000.000000		11	N/A	8 (Typical)	0.82
25000.000000		11	N/A	8 (Typical)	0.82
26000.000000		11	N/A	8 (Typical)	0.82
27000.000000		11	N/A	8 (Typical)	0.82
28000.000000		11	N/A	8 (Typical)	0.82
29000.000000		11	N/A	8 (Typical)	0.82
30000.000000		11	N/A	8 (Typical)	0.82
31000.000000		11	N/A	8 (Typical)	0.82
32000.000000		11	N/A	8 (Typical)	0.82
33000.000000		11	N/A	8 (Typical)	0.82
34000.000000		11	N/A	8 (Typical)	0.82

Table B-15. MS4644B (with Option 31, 51, 8x, no Option 61, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
35000.000000		11	N/A	8 (Typical)	0.82
36000.000000		11	N/A	8 (Typical)	0.82
37000.000000		11	N/A	8 (Typical)	0.82
38000.000000		11	N/A	8 (Typical)	0.82
38001.000000		11	N/A	8 (Typical)	0.82
39000.000000		11	N/A	8 (Typical)	0.82
40000.000000		11	N/A	8 (Typical)	0.82

a.With Option 8x, Test Port 2 maximum power is equivalent to the non-Option 31 range (typical).

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-16. MS4644B (with Option 31, 61, 8x, no Option 51, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
0.070000		10	N/A	9 (Typical)	0.34
1.000000		10	N/A	9 (Typical)	0.34
2.000000		10	N/A	9 (Typical)	0.34
5.000000		10	N/A	9 (Typical)	0.34
7.000000		10	N/A	9 (Typical)	0.34
9.000000		10	N/A	9 (Typical)	0.34
10.000000		10	N/A	9 (Typical)	0.34
11.000000		12	N/A	11 (Typical)	0.25
20.000000		12	N/A	11 (Typical)	0.25
50.000000		12	N/A	11 (Typical)	0.25
100.000000		12	N/A	11 (Typical)	0.25
200.000000		12	N/A	11 (Typical)	0.25
300.000000		12	N/A	11 (Typical)	0.25
500.000000		12	N/A	11 (Typical)	0.25
700.000000		12	N/A	11 (Typical)	0.25
1000.000000		12	N/A	11 (Typical)	0.25
1500.000000		12	N/A	11 (Typical)	0.25
2000.000000		12	N/A	11 (Typical)	0.25
2200.000000		12	N/A	11 (Typical)	0.25
2399.000000		12	N/A	11 (Typical)	0.25
2400.000000		TYP	N/A	TYP	TYP
2499.000000		TYP	N/A	TYP	TYP
2500.000000		TYP	N/A	TYP	TYP
2700.000000		TYP	N/A	TYP	TYP
2701.000000		10	N/A	8 (Typical)	0.58
3000.000000		10	N/A	8 (Typical)	0.58
3500.000000		10	N/A	8 (Typical)	0.58
4000.000000		10	N/A	8 (Typical)	0.58
4500.000000		10	N/A	8 (Typical)	0.58

Table B-16. MS4644B (with Option 31, 61, 8x, no Option 51, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
5000.000000		10	N/A	8 (Typical)	0.58
5001.000000		10	N/A	8 (Typical)	0.58
5500.000000		10	N/A	8 (Typical)	0.58
6000.000000		10	N/A	8 (Typical)	0.58
6500.000000		10	N/A	8 (Typical)	0.58
7000.000000		10	N/A	8 (Typical)	0.58
7500.000000		10	N/A	8 (Typical)	0.58
8000.000000		10	N/A	8 (Typical)	0.58
8500.000000		10	N/A	8 (Typical)	0.58
9000.000000		10	N/A	8 (Typical)	0.58
9500.000000		10	N/A	8 (Typical)	0.58
10000.000000		10	N/A	8 (Typical)	0.58
10001.000000		10	N/A	8 (Typical)	0.58
11000.000000		10	N/A	8 (Typical)	0.58
12000.000000		10	N/A	8 (Typical)	0.58
13000.000000		10	N/A	8 (Typical)	0.58
14000.000000		10	N/A	8 (Typical)	0.58
15000.000000		10	N/A	8 (Typical)	0.58
16000.000000		10	N/A	8 (Typical)	0.58
17000.000000		10	N/A	8 (Typical)	0.58
18000.000000		10	N/A	8 (Typical)	0.58
19000.000000		10	N/A	8 (Typical)	0.58
20000.000000		10	N/A	8 (Typical)	0.58
20001.000000		10	N/A	8 (Typical)	0.82
21000.000000		10	N/A	8 (Typical)	0.82
22000.000000		10	N/A	8 (Typical)	0.82
23000.000000		10	N/A	8 (Typical)	0.82
24000.000000		10	N/A	8 (Typical)	0.82
25000.000000		10	N/A	8 (Typical)	0.82
26000.000000		10	N/A	8 (Typical)	0.82
27000.000000		10	N/A	8 (Typical)	0.82
28000.000000		10	N/A	8 (Typical)	0.82
29000.000000		10	N/A	8 (Typical)	0.82
30000.000000		10	N/A	8 (Typical)	0.82
31000.000000		10	N/A	8 (Typical)	0.82
32000.000000		10	N/A	8 (Typical)	0.82
33000.000000		10	N/A	8 (Typical)	0.82
34000.000000		10	N/A	8 (Typical)	0.82

Table B-16. MS4644B (with Option 31, 61, 8x, no Option 51, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
35000.000000		10	N/A	8 (Typical)	0.82
36000.000000		10	N/A	8 (Typical)	0.82
37000.000000		10	N/A	8 (Typical)	0.82
38000.000000		10	N/A	8 (Typical)	0.82
38001.000000		10	N/A	8 (Typical)	0.82
39000.000000		10	N/A	8 (Typical)	0.82
40000.000000		10	N/A	8 (Typical)	0.82

a.With Option 8x, Test Port 2 maximum power is equivalent to the non-Option 31 range (typical).

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-17. MS4644B (with Option 31, 62, 8x, no Option 51, or 61) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
0.070000		10	N/A	8 (Typical)	0.34
1.000000		10	N/A	8 (Typical)	0.34
2.000000		10	N/A	8 (Typical)	0.34
5.000000		10	N/A	8 (Typical)	0.34
7.000000		10	N/A	8 (Typical)	0.34
9.000000		10	N/A	8 (Typical)	0.34
10.000000		10	N/A	8 (Typical)	0.34
11.000000		12	N/A	10 (Typical)	0.25
20.000000		12	N/A	10 (Typical)	0.25
50.000000		12	N/A	10 (Typical)	0.25
100.000000		12	N/A	10 (Typical)	0.25
200.000000		12	N/A	10 (Typical)	0.25
300.000000		12	N/A	10 (Typical)	0.25
500.000000		12	N/A	10 (Typical)	0.25
700.000000		12	N/A	10 (Typical)	0.25
1000.000000		12	N/A	10 (Typical)	0.25
1500.000000		12	N/A	10 (Typical)	0.25
2000.000000		12	N/A	10 (Typical)	0.25
2200.000000		12	N/A	10 (Typical)	0.25
2399.000000		12	N/A	10 (Typical)	0.25
2400.000000		TYP	N/A	TYP	TYP
2499.000000		TYP	N/A	TYP	TYP
2500.000000		TYP	N/A	TYP	TYP
2700.000000		TYP	N/A	TYP	TYP
2701.000000		10	N/A	7 (Typical)	0.58
3000.000000		10	N/A	7 (Typical)	0.58
3500.000000		10	N/A	7 (Typical)	0.58
4000.000000		10	N/A	7 (Typical)	0.58
4500.000000		10	N/A	7 (Typical)	0.58

Table B-17. MS4644B (with Option 31, 62, 8x, no Option 51, or 61) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
5000.000000		10	N/A	7 (Typical)	0.58
5001.000000		10	N/A	7 (Typical)	0.58
5500.000000		10	N/A	7 (Typical)	0.58
6000.000000		10	N/A	7 (Typical)	0.58
6500.000000		10	N/A	7 (Typical)	0.58
7000.000000		10	N/A	7 (Typical)	0.58
7500.000000		10	N/A	7 (Typical)	0.58
8000.000000		10	N/A	7 (Typical)	0.58
8500.000000		10	N/A	7 (Typical)	0.58
9000.000000		10	N/A	7 (Typical)	0.58
9500.000000		10	N/A	7 (Typical)	0.58
10000.000000		10	N/A	7 (Typical)	0.58
10001.000000		10	N/A	7 (Typical)	0.58
11000.000000		10	N/A	7 (Typical)	0.58
12000.000000		10	N/A	7 (Typical)	0.58
13000.000000		10	N/A	7 (Typical)	0.58
14000.000000		10	N/A	7 (Typical)	0.58
15000.000000		10	N/A	7 (Typical)	0.58
16000.000000		10	N/A	7 (Typical)	0.58
17000.000000		10	N/A	7 (Typical)	0.58
18000.000000		10	N/A	7 (Typical)	0.58
19000.000000		10	N/A	7 (Typical)	0.58
20000.000000		10	N/A	7 (Typical)	0.58
20001.000000		10	N/A	7 (Typical)	0.82
21000.000000		10	N/A	7 (Typical)	0.82
22000.000000		10	N/A	7 (Typical)	0.82
23000.000000		10	N/A	7 (Typical)	0.82
24000.000000		10	N/A	7 (Typical)	0.82
25000.000000		10	N/A	7 (Typical)	0.82
26000.000000		10	N/A	7 (Typical)	0.82
27000.000000		10	N/A	7 (Typical)	0.82
28000.000000		10	N/A	7 (Typical)	0.82
29000.000000		10	N/A	7 (Typical)	0.82
30000.000000		10	N/A	7 (Typical)	0.82
31000.000000		10	N/A	7 (Typical)	0.82
32000.000000		10	N/A	7 (Typical)	0.82
33000.000000		10	N/A	7 (Typical)	0.82
34000.000000		10	N/A	7 (Typical)	0.82

Table B-17. MS4644B (with Option 31, 62, 8x, no Option 51, or 61) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm) [a]	Uncertainty (dB)
35000.000000		10	N/A	7 (Typical)	0.82
36000.000000		10	N/A	7 (Typical)	0.82
37000.000000		10	N/A	7 (Typical)	0.82
38000.000000		10	N/A	7 (Typical)	0.82
38001.000000		10	N/A	7 (Typical)	0.82
39000.000000		10	N/A	7 (Typical)	0.82
40000.000000		10	N/A	7 (Typical)	0.82

a.With Option 8x, Test Port 2 maximum power is equivalent to the non-Option 31 range (typical).

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-18. MS4644B (with Option 31, 32, no Option 51, 61, or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		10		8	0.34
1.000000		10		8	0.34
2.000000		10		8	0.34
5.000000		10		8	0.34
7.000000		10		8	0.34
9.000000		10		8	0.34
10.000000		10		8	0.34
11.000000		12		10	0.25
20.000000		12		10	0.25
50.000000		12		10	0.25
100.000000		12		10	0.25
200.000000		12		10	0.25
300.000000		12		10	0.25
500.000000		12		10	0.25
700.000000		12		10	0.25
1000.000000		12		10	0.25
1500.000000		12		10	0.25
2000.000000		12		10	0.25
2200.000000		12		10	0.25
2399.000000		12		10	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		10		7	0.58
3000.000000		10		7	0.58
3500.000000		10		7	0.58
4000.000000		10		7	0.58
4500.000000		10		7	0.58

Table B-18. MS4644B (with Option 31, 32, no Option 51, 61, or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		10		7	0.58
5001.000000		10		7	0.58
5500.000000		10		7	0.58
6000.000000		10		7	0.58
6500.000000		10		7	0.58
7000.000000		10		7	0.58
7500.000000		10		7	0.58
8000.000000		10		7	0.58
8500.000000		10		7	0.58
9000.000000		10		7	0.58
9500.000000		10		7	0.58
10000.000000		10		7	0.58
10001.000000		10		7	0.58
11000.000000		10		7	0.58
12000.000000		10		7	0.58
13000.000000		10		7	0.58
14000.000000		10		7	0.58
15000.000000		10		7	0.58
16000.000000		10		7	0.58
17000.000000		10		7	0.58
18000.000000		10		7	0.58
19000.000000		10		7	0.58
20000.000000		10		7	0.58
20001.000000		10		7	0.82
21000.000000		10		7	0.82
22000.000000		10		7	0.82
23000.000000		10		7	0.82
24000.000000		10		7	0.82
25000.000000		10		7	0.82
26000.000000		10		7	0.82
27000.000000		10		7	0.82
28000.000000		10		7	0.82
29000.000000		10		7	0.82
30000.000000		10		7	0.82
31000.000000		10		7	0.82
32000.000000		10		7	0.82
33000.000000		10		7	0.82
34000.000000		10		7	0.82

Table B-18. MS4644B (with Option 31, 32, no Option 51, 61, or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000		10		7	0.82
36000.000000		10		7	0.82
37000.000000		10		7	0.82
38000.000000		10		7	0.82
38001.000000		10		7	0.82
39000.000000		10		7	0.82
40000.000000		10		7	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-19. MS4644B (with Option 31, 32, 51, no Option 61 or 62) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		9		7	0.34
1.000000		9		7	0.34
2.000000		9		7	0.34
5.000000		9		7	0.34
7.000000		9		7	0.34
9.000000		9		7	0.34
10.000000		9		7	0.34
11.000000		11		9	0.25
20.000000		11		9	0.25
50.000000		11		9	0.25
100.000000		11		9	0.25
200.000000		11		9	0.25
300.000000		11		9	0.25
500.000000		11		9	0.25
700.000000		11		9	0.25
1000.000000		11		9	0.25
1500.000000		11		9	0.25
2000.000000		11		9	0.25
2200.000000		11		9	0.25
2399.000000		11		9	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		9		6	0.58
3000.000000		9		6	0.58
3500.000000		9		6	0.58
4000.000000		9		6	0.58
4500.000000		9		6	0.58

Table B-19. MS4644B (with Option 31, 32, 51, no Option 61 or 62) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		9		6	0.58
5001.000000		9		6	0.58
5500.000000		9		6	0.58
6000.000000		9		6	0.58
6500.000000		9		6	0.58
7000.000000		9		6	0.58
7500.000000		9		6	0.58
8000.000000		9		6	0.58
8500.000000		9		6	0.58
9000.000000		9		6	0.58
9500.000000		9		6	0.58
10000.000000		9		6	0.58
10001.000000		9		6	0.58
11000.000000		9		6	0.58
12000.000000		9		6	0.58
13000.000000		9		6	0.58
14000.000000		9		6	0.58
15000.000000		9		6	0.58
16000.000000		9		6	0.58
17000.000000		9		6	0.58
18000.000000		9		6	0.58
19000.000000		9		6	0.58
20000.000000		9		6	0.58
20001.000000		9		6	0.82
21000.000000		9		6	0.82
22000.000000		9		6	0.82
23000.000000		9		6	0.82
24000.000000		9		6	0.82
25000.000000		9		6	0.82
26000.000000		9		6	0.82
27000.000000		9		6	0.82
28000.000000		9		6	0.82
29000.000000		9		6	0.82
30000.000000		9		6	0.82
31000.000000		9		6	0.82
32000.000000		9		6	0.82
33000.000000		9		6	0.82
34000.000000		9		6	0.82

Table B-19. MS4644B (with Option 31, 32, 51, no Option 61 or 62) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000		9		6	0.82
36000.000000		9		6	0.82
37000.000000		9		6	0.82
38000.000000		9		6	0.82
38001.000000		9		6	0.82
39000.000000		9		6	0.82
40000.000000		9		6	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-20. MS4644B (with Option 31, 32, and 61 or 62, no Option 51) Maximum Port Power Output Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
0.070000		8		6	0.34
1.000000		8		6	0.34
2.000000		8		6	0.34
5.000000		8		6	0.34
7.000000		8		6	0.34
9.000000		8		6	0.34
10.000000		8		6	0.34
11.000000		10		8	0.25
20.000000		10		8	0.25
50.000000		10		8	0.25
100.000000		10		8	0.25
200.000000		10		8	0.25
300.000000		10		8	0.25
500.000000		10		8	0.25
700.000000		10		8	0.25
1000.000000		10		8	0.25
1500.000000		10		8	0.25
2000.000000		10		8	0.25
2200.000000		10		8	0.25
2399.000000		10		8	0.25
2400.000000		TYP		TYP	TYP
2499.000000		TYP		TYP	TYP
2500.000000		TYP		TYP	TYP
2700.000000		TYP		TYP	TYP
2701.000000		8		5	0.58
3000.000000		8		5	0.58
3500.000000		8		5	0.58
4000.000000		8		5	0.58
4500.000000		8		5	0.58

Table B-20. MS4644B (with Option 31, 32, and 61 or 62, no Option 51) Maximum Port Power Output Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
5000.000000		8		5	0.58
5001.000000		8		5	0.58
5500.000000		8		5	0.58
6000.000000		8		5	0.58
6500.000000		8		5	0.58
7000.000000		8		5	0.58
7500.000000		8		5	0.58
8000.000000		8		5	0.58
8500.000000		8		5	0.58
9000.000000		8		5	0.58
9500.000000		8		5	0.58
10000.000000		8		5	0.58
10001.000000		8		5	0.58
11000.000000		8		5	0.58
12000.000000		8		5	0.58
13000.000000		8		5	0.58
14000.000000		8		5	0.58
15000.000000		8		5	0.58
16000.000000		8		5	0.58
17000.000000		8		5	0.58
18000.000000		8		5	0.58
19000.000000		8		5	0.58
20000.000000		8		5	0.58
20001.000000		8		5	0.82
21000.000000		8		5	0.82
22000.000000		8		5	0.82
23000.000000		8		5	0.82
24000.000000		8		5	0.82
25000.000000		8		5	0.82
26000.000000		8		5	0.82
27000.000000		8		5	0.82
28000.000000		8		5	0.82
29000.000000		8		5	0.82
30000.000000		8		5	0.82
31000.000000		8		5	0.82
32000.000000		8		5	0.82
33000.000000		8		5	0.82
34000.000000		8		5	0.82

Table B-20. MS4644B (with Option 31, 32, and 61 or 62, no Option 51) Maximum Port Power Output Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 1 Minimum Value (dBm)	Port 2 Measured Value (dBm)	Port 2 Minimum Value (dBm)	Uncertainty (dB)
35000.000000		8		5	0.82
36000.000000		8		5	0.82
37000.000000		8		5	0.82
38000.000000		8		5	0.82
38001.000000		8		5	0.82
39000.000000		8		5	0.82
40000.000000		8		5	0.82

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

MS4647B Test Records

Table B-21. MS4647B (no Option 31, 32, 51, 61, or 62) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25

Table B-21. MS4647B (no Option 31, 32, 51, 61, or 62) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2000.00											12	0.25
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											6	0.41
3000.00											6	0.41
3500.00											6	0.41
4000.00											6	0.41
4500.00											6	0.41
5000.00											6	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46

Table B-21. MS4647B (no Option 31, 32, 51, 61, or 62) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											5	0.46
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67
39000.00											5	0.67

Table B-21. MS4647B (no Option 31, 32, 51, 61, or 62) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
40000.00											5	0.67
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											Typ	Typ
50000.00											Typ	Typ
50001.00											0	0.8
51000.00											0	0.8
52000.00											0	0.8
53000.00											0	0.8
54000.00											0	0.8
55000.00											0	0.8
56000.00											0	0.8
57000.00											0	0.8
58000.00											0	0.8
59000.00											0	0.8
60000.00											0	0.8
61000.00											0	0.8
62000.00											0	0.8
63000.00											0	0.8
64000.00											0	0.8
65000.00											0	0.82

Table B-21. MS4647B (no Option 31, 32, 51, 61, or 62) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
65001.00											-2	0.82
66000.00											-2	0.82
67000.00											-2	0.82
67001.00											-3	1.2
68000.00											-3	1.2
69000.00											-3	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-22. MS4647B (no Option 31, 32, 51, 61, or 62) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-22. MS4647B (no Option 31, 32, 51, 61, or 62) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											6	0.41
3000.00											6	0.41
3500.00											6	0.41
4000.00											6	0.41
4500.00											6	0.41
5000.00											6	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46
14000.00											5	0.46

Table B-22. MS4647B (no Option 31, 32, 51, 61, or 62) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67
39000.00											5	0.67
40000.00											5	0.67

Table B-22. MS4647B (no Option 31, 32, 51, 61, or 62) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											Typ	Typ
50000.00											Typ	Typ
50001.00											0	0.8
51000.00											0	0.8
52000.00											0	0.8
53000.00											0	0.8
54000.00											0	0.8
55000.00											0	0.8
56000.00											0	0.8
57000.00											0	0.8
58000.00											0	0.8
59000.00											0	0.8
60000.00											0	0.8
61000.00											0	0.8
62000.00											0	0.8
63000.00											0	0.8
64000.00											0	0.8
65000.00											0	0.82
65001.00											-2	0.82

Table B-22. MS4647B (no Option 31, 32, 51, 61, or 62) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
66000.00											-2	0.82
67000.00											-2	0.82
67001.00											-3	1.2
68000.00											-3	1.2
69000.00											-3	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-23. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-23. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											4	0.46
5500.00											4	0.46
6000.00											4	0.46
6500.00											4	0.46
7000.00											4	0.46
7500.00											4	0.46
8000.00											4	0.46
8500.00											4	0.46
9000.00											4	0.46
9500.00											4	0.46
10000.00											4	0.46
10001.00											4	0.46
11000.00											4	0.46
12000.00											4	0.46
13000.00											4	0.46

Table B-23. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											4	0.46
15000.00											4	0.46
16000.00											4	0.46
17000.00											4	0.46
18000.00											4	0.46
19000.00											4	0.46
20000.00											4	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-23. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
50000.00											Typ	Typ
50001.00											-2	0.8
51000.00											-2	0.8
52000.00											-2	0.8
53000.00											-2	0.8
54000.00											-2	0.8
55000.00											-2	0.8
56000.00											-2	0.8
57000.00											-2	0.8
58000.00											-2	0.8
59000.00											-2	0.8
60000.00											-2	0.8
61000.00											-2	0.8
62000.00											-2	0.8
63000.00											-2	0.8

Table B-23. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-2	0.8
65000.00											-2	0.82
65001.00											-3	0.82
66000.00											-3	0.82
67000.00											-3	0.82
67001.00											-6	1.2
68000.00											-6	1.2
69000.00											-6	1.2
70000.00											-6	1.2

a. This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-24. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-24. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											4	0.46
5500.00											4	0.46
6000.00											4	0.46
6500.00											4	0.46
7000.00											4	0.46
7500.00											4	0.46
8000.00											4	0.46
8500.00											4	0.46
9000.00											4	0.46
9500.00											4	0.46
10000.00											4	0.46
10001.00											4	0.46
11000.00											4	0.46
12000.00											4	0.46
13000.00											4	0.46

Table B-24. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											4	0.46
15000.00											4	0.46
16000.00											4	0.46
17000.00											4	0.46
18000.00											4	0.46
19000.00											4	0.46
20000.00											4	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-24. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
50000.00											Typ	Typ
50001.00											-2	0.8
51000.00											-2	0.8
52000.00											-2	0.8
53000.00											-2	0.8
54000.00											-2	0.8
55000.00											-2	0.8
56000.00											-2	0.8
57000.00											-2	0.8
58000.00											-2	0.8
59000.00											-2	0.8
60000.00											-2	0.8
61000.00											-2	0.8
62000.00											-2	0.8
63000.00											-2	0.8

Table B-24. MS4647B (with Option 51, no Option 31, 32, 61, or 62) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-2	0.8
65000.00											-2	0.82
65001.00											-3	0.82
66000.00											-3	0.82
67000.00											-3	0.82
67001.00											-6	1.2
68000.00											-6	1.2
69000.00											-6	1.2
70000.00											-6	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-25. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											9	0.33
1.00											9	0.33
2.00											9	0.33
5.00											9	0.33
7.00											9	0.33
9.00											9	0.33
10.00											9	0.33
11.00											11	0.25
20.00											11	0.25
50.00											11	0.25
100.00											11	0.25
200.00											11	0.25
300.00											11	0.25
500.00											11	0.25
700.00											11	0.25
1000.00											11	0.25
1500.00											11	0.25
2000.00											11	0.25

Table B-25. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											11	0.25
2399.00											11	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											4	0.46
5500.00											4	0.46
6000.00											4	0.46
6500.00											4	0.46
7000.00											4	0.46
7500.00											4	0.46
8000.00											4	0.46
8500.00											4	0.46
9000.00											4	0.46
9500.00											4	0.46
10000.00											4	0.46
10001.00											4	0.46
11000.00											4	0.46
12000.00											4	0.46
13000.00											4	0.46

Table B-25. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											4	0.46
15000.00											4	0.46
16000.00											4	0.46
17000.00											4	0.46
18000.00											4	0.46
19000.00											4	0.46
20000.00											4	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-25. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
50000.00											Typ	Typ
50001.00											-2	0.67
51000.00											-2	0.8
52000.00											-2	0.8
53000.00											-2	0.8
54000.00											-2	0.8
55000.00											-2	0.8
56000.00											-2	0.8
57000.00											-2	0.8
58000.00											-2	0.8
59000.00											-2	0.8
60000.00											-2	0.8
61000.00											-2	0.8
62000.00											-2	0.8
63000.00											-2	0.8

Table B-25. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-2	0.8
65000.00											-2	0.82
65001.00											-3	0.82
66000.00											-3	0.82
67000.00											-3	0.82
67001.00											-6	1.2
68000.00											-6	1.2
69000.00											-6	1.2
70000.00											-6	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-26. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											8	0.33
1.00											8	0.33
2.00											8	0.33
5.00											8	0.33
7.00											8	0.33
9.00											8	0.33
10.00											8	0.33
11.00											10	0.25
20.00											10	0.25
50.00											10	0.25
100.00											10	0.25
200.00											10	0.25
300.00											10	0.25
500.00											10	0.25
700.00											10	0.25
1000.00											10	0.25
1500.00											10	0.25
2000.00											10	0.25

Table B-26. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											10	0.25
2399.00											10	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											3	0.41
3000.00											3	0.41
3500.00											3	0.41
4000.00											3	0.41
4500.00											3	0.41
5000.00											3	0.41
5001.00											2	0.46
5500.00											2	0.46
6000.00											2	0.46
6500.00											2	0.46
7000.00											2	0.46
7500.00											2	0.46
8000.00											2	0.46
8500.00											2	0.46
9000.00											2	0.46
9500.00											2	0.46
10000.00											2	0.46
10001.00											2	0.46
11000.00											2	0.46
12000.00											2	0.46
13000.00											2	0.46

Table B-26. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											2	0.46
15000.00											2	0.46
16000.00											2	0.46
17000.00											2	0.46
18000.00											2	0.46
19000.00											2	0.46
20000.00											2	0.46
20001.00											2	0.61
21000.00											2	0.61
22000.00											2	0.61
23000.00											2	0.61
24000.00											2	0.61
25000.00											2	0.61
26000.00											2	0.61
27000.00											2	0.61
28000.00											2	0.61
29000.00											2	0.61
30000.00											2	0.61
31000.00											2	0.61
32000.00											2	0.61
33000.00											2	0.61
34000.00											2	0.61
35000.00											2	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											1	0.67

Table B-26. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											1	0.67
40000.00											1	0.67
40001.00											1	0.67
41000.00											1	0.67
42000.00											1	0.67
43000.00											1	0.67
44000.00											1	0.67
45000.00											1	0.67
46000.00											1	0.67
47000.00											1	0.67
48000.00											1	0.67
49000.00											1	0.67
50000.00											Typ	Typ
50001.00											-4	0.67
51000.00											-4	0.8
52000.00											-4	0.8
53000.00											-4	0.8
54000.00											-4	0.8
55000.00											-4	0.8
56000.00											-4	0.8
57000.00											-4	0.8
58000.00											-4	0.8
59000.00											-4	0.8
60000.00											-4	0.8
61000.00											-4	0.8
62000.00											-4	0.8
63000.00											-4	0.8

Table B-26. MS4647B (with Option 61, no Option 31, 32, 51, or 62) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-4	0.8
65000.00											-4	0.82
65001.00											-5	0.82
66000.00											-5	0.82
67000.00											-5	0.82
67001.00											-10	1.2
68000.00											-10	1.2
69000.00											-10	1.2
70000.00											-10	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-27. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											8	0.33
1.00											8	0.33
2.00											8	0.33
5.00											8	0.33
7.00											8	0.33
9.00											8	0.33
10.00											8	0.33
11.00											10	0.25
20.00											10	0.25
50.00											10	0.25
100.00											10	0.25
200.00											10	0.25
300.00											10	0.25
500.00											10	0.25
700.00											10	0.25
1000.00											10	0.25
1500.00											10	0.25
2000.00											10	0.25

Table B-27. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											10	0.25
2399.00											10	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											3	0.41
3000.00											3	0.41
3500.00											3	0.41
4000.00											3	0.41
4500.00											3	0.41
5000.00											3	0.41
5001.00											2	0.46
5500.00											2	0.46
6000.00											2	0.46
6500.00											2	0.46
7000.00											2	0.46
7500.00											2	0.46
8000.00											2	0.46
8500.00											2	0.46
9000.00											2	0.46
9500.00											2	0.46
10000.00											2	0.46
10001.00											2	0.46
11000.00											2	0.46
12000.00											2	0.46
13000.00											2	0.46

Table B-27. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											2	0.46
15000.00											2	0.46
16000.00											2	0.46
17000.00											2	0.46
18000.00											2	0.46
19000.00											2	0.46
20000.00											2	0.46
20001.00											2	0.61
21000.00											2	0.61
22000.00											2	0.61
23000.00											2	0.61
24000.00											2	0.61
25000.00											2	0.61
26000.00											2	0.61
27000.00											2	0.61
28000.00											2	0.61
29000.00											2	0.61
30000.00											2	0.61
31000.00											2	0.61
32000.00											2	0.61
33000.00											2	0.61
34000.00											2	0.61
35000.00											2	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											1	0.67

Table B-27. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											1	0.67
40000.00											1	0.67
40001.00											1	0.67
41000.00											1	0.67
42000.00											1	0.67
43000.00											1	0.67
44000.00											1	0.67
45000.00											1	0.67
46000.00											1	0.67
47000.00											1	0.67
48000.00											1	0.67
49000.00											1	0.67
50000.00											Typ	Typ
50001.00											-4	0.8
51000.00											-4	0.8
52000.00											-4	0.8
53000.00											-4	0.8
54000.00											-4	0.8
55000.00											-4	0.8
56000.00											-4	0.8
57000.00											-4	0.8
58000.00											-4	0.8
59000.00											-4	0.8
60000.00											-4	0.8
61000.00											-4	0.8
62000.00											-4	0.8
63000.00											-4	0.8

Table B-27. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-4	0.8
65000.00											-4	0.82
65001.00											-5	0.82
66000.00											-5	0.82
67000.00											-5	0.82
67001.00											-10	1.2
68000.00											-10	1.2
69000.00											-10	1.2
70000.00											-10	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-28. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											8	0.33
1.00											8	0.33
2.00											8	0.33
5.00											8	0.33
7.00											8	0.33
9.00											8	0.33
10.00											8	0.33
11.00											10	0.25
20.00											10	0.25
50.00											10	0.25
100.00											10	0.25
200.00											10	0.25
300.00											10	0.25
500.00											10	0.25
700.00											10	0.25
1000.00											10	0.25
1500.00											10	0.25
2000.00											10	0.25

Table B-28. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											10	0.25
2399.00											10	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											3	0.41
3000.00											3	0.41
3500.00											3	0.41
4000.00											3	0.41
4500.00											3	0.41
5000.00											3	0.41
5001.00											2	0.46
5500.00											2	0.46
6000.00											2	0.46
6500.00											2	0.46
7000.00											2	0.46
7500.00											2	0.46
8000.00											2	0.46
8500.00											2	0.46
9000.00											2	0.46
9500.00											2	0.46
10000.00											2	0.46
10001.00											2	0.46
11000.00											2	0.46
12000.00											2	0.46
13000.00											2	0.46

Table B-28. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											2	0.46
15000.00											2	0.46
16000.00											2	0.46
17000.00											2	0.46
18000.00											2	0.46
19000.00											2	0.46
20000.00											2	0.46
20001.00											2	0.61
21000.00											2	0.61
22000.00											2	0.61
23000.00											2	0.61
24000.00											2	0.61
25000.00											2	0.61
26000.00											2	0.61
27000.00											2	0.61
28000.00											2	0.61
29000.00											2	0.61
30000.00											2	0.61
31000.00											2	0.61
32000.00											2	0.61
33000.00											2	0.61
34000.00											2	0.61
35000.00											2	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											1	0.67

Table B-28. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											1	0.67
40000.00											1	0.67
40001.00											1	0.67
41000.00											1	0.67
42000.00											1	0.67
43000.00											1	0.67
44000.00											1	0.67
45000.00											1	0.67
46000.00											1	0.67
47000.00											1	0.67
48000.00											1	0.67
49000.00											1	0.67
50000.00											Typ	Typ
50001.00											-4	0.8
51000.00											-4	0.8
52000.00											-4	0.8
53000.00											-4	0.8
54000.00											-4	0.8
55000.00											-4	0.8
56000.00											-4	0.8
57000.00											-4	0.8
58000.00											-4	0.8
59000.00											-4	0.8
60000.00											-4	0.8
61000.00											-4	0.8
62000.00											-4	0.8
63000.00											-4	0.8

Table B-28. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
64000.00											-4	0.8
65000.00											-4	0.82
65001.00											-5	0.82
66000.00											-5	0.82
67000.00											-5	0.82
67001.00											-10	1.2
68000.00											-10	1.2
69000.00											-10	1.2
70000.00											-10	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-29. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											12	0.33
1.00											12	0.33
2.00											12	0.33
5.00											12	0.33
7.00											12	0.33
9.00											12	0.33
10.00											12	0.33
11.00											14	0.25
20.00											14	0.25
50.00											14	0.25
100.00											14	0.25
200.00											14	0.25
300.00											14	0.25
500.00											14	0.25
700.00											14	0.25
1000.00											14	0.25
1500.00											14	0.25
2000.00											14	0.25

Table B-29. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											14	0.25
2399.00											14	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											8	0.41
3000.00											8	0.41
3500.00											8	0.41
4000.00											8	0.41
4500.00											8	0.41
5000.00											8	0.41
5001.00											8	0.46
5500.00											8	0.46
6000.00											8	0.46
6500.00											8	0.46
7000.00											8	0.46
7500.00											8	0.46
8000.00											8	0.46
8500.00											8	0.46
9000.00											8	0.46
9500.00											8	0.46
10000.00											8	0.46
10001.00											8	0.46
11000.00											8	0.46
12000.00											8	0.46
13000.00											8	0.46

Table B-29. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											8	0.46
15000.00											8	0.46
16000.00											8	0.46
17000.00											8	0.46
18000.00											8	0.46
19000.00											8	0.46
20000.00											8	0.46
20001.00											8	0.61
21000.00											8	0.61
22000.00											8	0.61
23000.00											8	0.61
24000.00											8	0.61
25000.00											8	0.61
26000.00											8	0.61
27000.00											8	0.61
28000.00											8	0.61
29000.00											8	0.61
30000.00											8	0.61
31000.00											8	0.61
32000.00											8	0.61
33000.00											8	0.61
34000.00											8	0.61
35000.00											8	0.61
36000.00											8	0.61
37000.00											8	0.61
38000.00											8	0.61
38001.00											7	0.67

Table B-29. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											7	0.67
40000.00											7	0.67
40001.00											7	0.67
41000.00											7	0.67
42000.00											7	0.67
43000.00											7	0.67
44000.00											7	0.67
45000.00											7	0.67
46000.00											7	0.67
47000.00											7	0.67
48000.00											7	0.67
49000.00											7	0.67
49001.00											7	0.67
50000.00											7	0.67
50001.00											7	0.8
51000.00											7	0.8
52000.00											7	0.8
53000.00											7	0.8
54000.00											7	0.8
55000.00											7	0.8
56000.00											7	0.8
57000.00											7	0.8
58000.00											7	0.8
59000.00											7	0.8
60000.00											7	0.8
61000.00											7	0.8
62000.00											7	0.8

Table B-29. MS4647B (with Option 62, no Option 31, 32, 51, or 61) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											7	0.8
64000.00											7	0.8
65000.00											7	0.82
65001.00											6	0.82
66000.00											6	0.82
67000.00											6	0.82
67001.00											4	1.2
68000.00											4	1.2
69000.00											4	1.2
70000.00											4	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-30. MS4647B (with Option 31, no Option 32, 51, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											12	0.33
1.00											12	0.33
2.00											12	0.33
5.00											12	0.33
7.00											12	0.33
9.00											12	0.33
10.00											12	0.33
11.00											14	0.25
20.00											14	0.25
50.00											14	0.25
100.00											14	0.25
200.00											14	0.25
300.00											14	0.25
500.00											14	0.25
700.00											14	0.25
1000.00											14	0.25
1500.00											14	0.25
2000.00											14	0.25

Table B-30. MS4647B (with Option 31, no Option 32, 51, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											14	0.25
2399.00											14	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											8	0.41
3000.00											8	0.41
3500.00											8	0.41
4000.00											8	0.41
4500.00											8	0.41
5000.00											8	0.41
5001.00											8	0.46
5500.00											8	0.46
6000.00											8	0.46
6500.00											8	0.46
7000.00											8	0.46
7500.00											8	0.46
8000.00											8	0.46
8500.00											8	0.46
9000.00											8	0.46
9500.00											8	0.46
10000.00											8	0.46
10001.00											8	0.46
11000.00											8	0.46
12000.00											8	0.46
13000.00											8	0.46

Table B-30. MS4647B (with Option 31, no Option 32, 51, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											8	0.46
15000.00											8	0.46
16000.00											8	0.46
17000.00											8	0.46
18000.00											8	0.46
19000.00											8	0.46
20000.00											8	0.46
20001.00											8	0.61
21000.00											8	0.61
22000.00											8	0.61
23000.00											8	0.61
24000.00											8	0.61
25000.00											8	0.61
26000.00											8	0.61
27000.00											8	0.61
28000.00											8	0.61
29000.00											8	0.61
30000.00											8	0.61
31000.00											8	0.61
32000.00											8	0.61
33000.00											8	0.61
34000.00											8	0.61
35000.00											8	0.61
36000.00											8	0.61
37000.00											8	0.61
38000.00											8	0.61
38001.00											7	0.67

Table B-30. MS4647B (with Option 31, no Option 32, 51, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											7	0.67
40000.00											7	0.67
40001.00											7	0.67
41000.00											7	0.67
42000.00											7	0.67
43000.00											7	0.67
44000.00											7	0.67
45000.00											7	0.67
46000.00											7	0.67
47000.00											7	0.67
48000.00											7	0.67
49000.00											7	0.67
49001.00											7	0.67
50000.00											7	0.67
50001.00											7	0.8
51000.00											7	0.8
52000.00											7	0.8
53000.00											7	0.8
54000.00											7	0.8
55000.00											7	0.8
56000.00											7	0.8
57000.00											7	0.8
58000.00											7	0.8
59000.00											7	0.8
60000.00											7	0.8
61000.00											7	0.8
62000.00											7	0.8

Table B-30. MS4647B (with Option 31, no Option 32, 51, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											7	0.8
64000.00											7	0.8
65000.00											7	0.82
65001.00											6	0.82
66000.00											6	0.82
67000.00											6	0.82
67001.00											4	1.2
68000.00											4	1.2
69000.00											4	1.2
70000.00											4	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-31. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											11	0.33
1.00											11	0.33
2.00											11	0.33
5.00											11	0.33
7.00											11	0.33
9.00											11	0.33
10.00											11	0.33
11.00											13	0.25
20.00											13	0.25
50.00											13	0.25
100.00											13	0.25
200.00											13	0.25
300.00											13	0.25
500.00											13	0.25
700.00											13	0.25
1000.00											13	0.25
1500.00											13	0.25
2000.00											13	0.25

Table B-31. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											13	0.25
2399.00											13	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											7	0.41
3000.00											7	0.41
3500.00											7	0.41
4000.00											7	0.41
4500.00											7	0.41
5000.00											7	0.41
5001.00											7	0.46
5500.00											7	0.46
6000.00											7	0.46
6500.00											7	0.46
7000.00											7	0.46
7500.00											7	0.46
8000.00											7	0.46
8500.00											7	0.46
9000.00											7	0.46
9500.00											7	0.46
10000.00											7	0.46
10001.00											7	0.46
11000.00											7	0.46
12000.00											7	0.46
13000.00											7	0.46

Table B-31. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											7	0.46
15000.00											7	0.46
16000.00											7	0.46
17000.00											7	0.46
18000.00											7	0.46
19000.00											7	0.46
20000.00											7	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67

Table B-31. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											5	0.67
40000.00											5	0.67
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											5	0.67
49001.00											5	0.67
50000.00											5	0.67
50001.00											5	0.8
51000.00											5	0.8
52000.00											5	0.8
53000.00											5	0.8
54000.00											5	0.8
55000.00											5	0.8
56000.00											5	0.8
57000.00											5	0.8
58000.00											5	0.8
59000.00											5	0.8
60000.00											5	0.8
61000.00											5	0.8
62000.00											5	0.8

Table B-31. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											5	0.8
64000.00											5	0.8
65000.00											5	0.82
65001.00											4	0.82
66000.00											4	0.82
67000.00											4	0.82
67001.00											1	1.2
68000.00											1	1.2
69000.00											1	1.2
70000.00											1	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-32. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											11	0.33
1.00											11	0.33
2.00											11	0.33
5.00											11	0.33
7.00											11	0.33
9.00											11	0.33
10.00											11	0.33
11.00											13	0.25
20.00											13	0.25
50.00											13	0.25
100.00											13	0.25
200.00											13	0.25
300.00											13	0.25
500.00											13	0.25
700.00											13	0.25
1000.00											13	0.25
1500.00											13	0.25
2000.00											13	0.25

Table B-32. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											13	0.25
2399.00											13	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											7	0.41
3000.00											7	0.41
3500.00											7	0.41
4000.00											7	0.41
4500.00											7	0.41
5000.00											7	0.41
5001.00											7	0.46
5500.00											7	0.46
6000.00											7	0.46
6500.00											7	0.46
7000.00											7	0.46
7500.00											7	0.46
8000.00											7	0.46
8500.00											7	0.46
9000.00											7	0.46
9500.00											7	0.46
10000.00											7	0.46
10001.00											7	0.46
11000.00											7	0.46
12000.00											7	0.46
13000.00											7	0.46

Table B-32. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											7	0.46
15000.00											7	0.46
16000.00											7	0.46
17000.00											7	0.46
18000.00											7	0.46
19000.00											7	0.46
20000.00											7	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67

Table B-32. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											5	0.67
40000.00											5	0.67
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											5	0.67
49001.00											5	0.67
50000.00											5	0.67
50001.00											5	0.8
51000.00											5	0.8
52000.00											5	0.8
53000.00											5	0.8
54000.00											5	0.8
55000.00											5	0.8
56000.00											5	0.8
57000.00											5	0.8
58000.00											5	0.8
59000.00											5	0.8
60000.00											5	0.8
61000.00											5	0.8
62000.00											5	0.8

Table B-32. MS4647B (with Option 31 and 51, no Option 32, 61, 62, or 8x) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											5	0.8
64000.00											5	0.8
65000.00											5	0.82
65001.00											4	0.82
66000.00											4	0.82
67000.00											4	0.82
67001.00											1	1.2
68000.00											1	1.2
69000.00											1	1.2
70000.00											1	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-33. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-33. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46

Table B-33. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											5	0.46
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-33. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
49001.00											3	0.67
50000.00											3	0.67
50001.00											3	0.8
51000.00											3	0.8
52000.00											3	0.8
53000.00											3	0.8
54000.00											3	0.8
55000.00											3	0.8
56000.00											3	0.8
57000.00											3	0.8
58000.00											3	0.8
59000.00											3	0.8
60000.00											3	0.8
61000.00											3	0.8
62000.00											3	0.8

Table B-33. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											3	0.8
64000.00											3	0.8
65000.00											3	0.82
65001.00											2	0.82
66000.00											2	0.82
67000.00											2	0.82
67001.00											-3	1.2
68000.00											-3	1.2
69000.00											-3	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-34. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											11	0.33
1.00											11	0.33
2.00											11	0.33
5.00											11	0.33
7.00											11	0.33
9.00											11	0.33
10.00											11	0.33
11.00											13	0.25
20.00											13	0.25
50.00											13	0.25
100.00											13	0.25
200.00											13	0.25
300.00											13	0.25
500.00											13	0.25
700.00											13	0.25
1000.00											13	0.25
1500.00											13	0.25
2000.00											13	0.25

Table B-34. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											13	0.25
2399.00											13	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											7	0.41
3000.00											7	0.41
3500.00											7	0.41
4000.00											7	0.41
4500.00											7	0.41
5000.00											7	0.41
5001.00											7	0.46
5500.00											7	0.46
6000.00											7	0.46
6500.00											7	0.46
7000.00											7	0.46
7500.00											7	0.46
8000.00											7	0.46
8500.00											7	0.46
9000.00											7	0.46
9500.00											7	0.46
10000.00											7	0.46
10001.00											7	0.46
11000.00											7	0.46
12000.00											7	0.46
13000.00											7	0.46

Table B-34. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											7	0.46
15000.00											7	0.46
16000.00											7	0.46
17000.00											7	0.46
18000.00											7	0.46
19000.00											7	0.46
20000.00											7	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67

Table B-34. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											5	0.67
40000.00											5	0.67
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											5	0.67
49001.00											5	0.67
50000.00											5	0.67
50001.00											5	0.8
51000.00											5	0.8
52000.00											5	0.8
53000.00											5	0.8
54000.00											5	0.8
55000.00											5	0.8
56000.00											5	0.8
57000.00											5	0.8
58000.00											5	0.8
59000.00											5	0.8
60000.00											5	0.8
61000.00											5	0.8
62000.00											5	0.8

Table B-34. MS4647B (with Option 31 and 61, no Option 32, 51, 62, or 8x) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											5	0.8
64000.00											5	0.8
65000.00											5	0.82
65001.00											4	0.82
66000.00											4	0.82
67000.00											4	0.82
67001.00											1	1.2
68000.00											1	1.2
69000.00											1	1.2
70000.00											1	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-35. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-35. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46

Table B-35. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											5	0.46
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-35. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
49001.00											3	0.67
50000.00											3	0.67
50001.00											3	0.8
51000.00											3	0.8
52000.00											3	0.8
53000.00											3	0.8
54000.00											3	0.8
55000.00											3	0.8
56000.00											3	0.8
57000.00											3	0.8
58000.00											3	0.8
59000.00											3	0.8
60000.00											3	0.8
61000.00											3	0.8
62000.00											3	0.8

Table B-35. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											3	0.8
64000.00											3	0.8
65000.00											3	0.82
65001.00											2	0.82
66000.00											2	0.82
67000.00											2	0.82
67001.00											-3	1.2
68000.00											-3	1.2
69000.00											-3	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-36. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-36. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46

Table B-36. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											5	0.46
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-36. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
49001.00											3	0.67
50000.00											3	0.67
50001.00											3	0.8
51000.00											3	0.8
52000.00											3	0.8
53000.00											3	0.8
54000.00											3	0.8
55000.00											3	0.8
56000.00											3	0.8
57000.00											3	0.8
58000.00											3	0.8
59000.00											3	0.8
60000.00											3	0.8
61000.00											3	0.8
62000.00											3	0.8

Table B-36. MS4647B (with Option 31 and 62, no Option 32, 51, 61, or 8x) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											3	0.8
64000.00											3	0.8
65000.00											3	0.82
65001.00											2	0.82
66000.00											2	0.82
67000.00											2	0.82
67001.00											-3	1.2
68000.00											-3	1.2
69000.00											-3	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-37. MS4647B (with Option 31 and 32, no Option 51, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											10	0.33
1.00											10	0.33
2.00											10	0.33
5.00											10	0.33
7.00											10	0.33
9.00											10	0.33
10.00											10	0.33
11.00											12	0.25
20.00											12	0.25
50.00											12	0.25
100.00											12	0.25
200.00											12	0.25
300.00											12	0.25
500.00											12	0.25
700.00											12	0.25
1000.00											12	0.25
1500.00											12	0.25
2000.00											12	0.25

Table B-37. MS4647B (with Option 31 and 32, no Option 51, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											12	0.25
2399.00											12	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											6	0.41
3000.00											6	0.41
3500.00											6	0.41
4000.00											6	0.41
4500.00											6	0.41
5000.00											6	0.41
5001.00											6	0.46
5500.00											6	0.46
6000.00											6	0.46
6500.00											6	0.46
7000.00											6	0.46
7500.00											6	0.46
8000.00											6	0.46
8500.00											6	0.46
9000.00											6	0.46
9500.00											6	0.46
10000.00											6	0.46
10001.00											6	0.46
11000.00											6	0.46
12000.00											6	0.46
13000.00											6	0.46

Table B-37. MS4647B (with Option 31 and 32, no Option 51, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											6	0.46
15000.00											6	0.46
16000.00											6	0.46
17000.00											6	0.46
18000.00											6	0.46
19000.00											6	0.46
20000.00											6	0.46
20001.00											6	0.61
21000.00											6	0.61
22000.00											6	0.61
23000.00											6	0.61
24000.00											6	0.61
25000.00											6	0.61
26000.00											6	0.61
27000.00											6	0.61
28000.00											6	0.61
29000.00											6	0.61
30000.00											6	0.61
31000.00											6	0.61
32000.00											6	0.61
33000.00											6	0.61
34000.00											6	0.61
35000.00											6	0.61
36000.00											6	0.61
37000.00											6	0.61
38000.00											6	0.61
38001.00											5	0.67

Table B-37. MS4647B (with Option 31 and 32, no Option 51, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											5	0.67
40001.00											5	0.67
41000.00											5	0.67
42000.00											5	0.67
43000.00											5	0.67
44000.00											5	0.67
45000.00											5	0.67
46000.00											5	0.67
47000.00											5	0.67
48000.00											5	0.67
49000.00											5	0.67
49001.00											5	0.67
50000.00											5	0.67
50001.00											5	0.8
51000.00											5	0.8
52000.00											5	0.8
53000.00											5	0.8
54000.00											5	0.8
55000.00											5	0.8
56000.00											5	0.8
57000.00											5	0.8
58000.00											5	0.8
59000.00											5	0.8
60000.00											5	0.8
61000.00											5	0.8
62000.00											5	0.8

Table B-37. MS4647B (with Option 31 and 32, no Option 51, 61, 62, or 8x) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											5	0.8
64000.00											5	0.8
65000.00											5	0.82
65001.00											3	0.82
66000.00											3	0.82
67000.00											3	0.82
67001.00											2	1.2
68000.00											2	1.2
69000.00											2	1.2
70000.00											2	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-38. MS4647B (with Option 31, and 32, no Option 51, 61, or 62) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											8	0.33
1.00											8	0.33
2.00											8	0.33
5.00											8	0.33
7.00											8	0.33
9.00											8	0.33
10.00											8	0.33
11.00											10	0.25
20.00											10	0.25
50.00											10	0.25
100.00											10	0.25
200.00											10	0.25
300.00											10	0.25
500.00											10	0.25
700.00											10	0.25
1000.00											10	0.25
1500.00											10	0.25
2000.00											10	0.25

Table B-38. MS4647B (with Option 31, and 32, no Option 51, 61, or 62) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											10	0.25
2399.00											10	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											4	0.41
3000.00											4	0.41
3500.00											4	0.41
4000.00											4	0.41
4500.00											4	0.41
5000.00											4	0.41
5001.00											3	0.46
5500.00											3	0.46
6000.00											3	0.46
6500.00											3	0.46
7000.00											3	0.46
7500.00											3	0.46
8000.00											3	0.46
8500.00											3	0.46
9000.00											3	0.46
9500.00											3	0.46
10000.00											3	0.46
10001.00											3	0.46
11000.00											3	0.46
12000.00											3	0.46
13000.00											3	0.46

Table B-38. MS4647B (with Option 31, and 32, no Option 51, 61, or 62) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											3	0.46
15000.00											3	0.46
16000.00											3	0.46
17000.00											3	0.46
18000.00											3	0.46
19000.00											3	0.46
20000.00											3	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-38. MS4647B (with Option 31, and 32, no Option 51, 61, or 62) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											Typ	Typ
49001.00											Typ	Typ
50000.00											Typ	Typ
50001.00											-2	0.8
51000.00											-2	0.8
52000.00											-2	0.8
53000.00											-2	0.8
54000.00											-2	0.8
55000.00											-2	0.8
56000.00											-2	0.8
57000.00											-2	0.8
58000.00											-2	0.8
59000.00											-2	0.8
60000.00											-2	0.8
61000.00											-2	0.8
62000.00											-2	0.8

Table B-38. MS4647B (with Option 31, and 32, no Option 51, 61, or 62) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											-2	0.8
64000.00											-2	0.8
65000.00											-4	0.82
65001.00											-4	0.82
66000.00											-4	0.82
67000.00											-4	0.82
67001.00											-5	1.2
68000.00											-5	1.2
69000.00											-5	1.2
70000.00											-5	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-39. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											9	0.33
1.00											9	0.33
2.00											9	0.33
5.00											9	0.33
7.00											9	0.33
9.00											9	0.33
10.00											9	0.33
11.00											11	0.25
20.00											11	0.25
50.00											11	0.25
100.00											11	0.25
200.00											11	0.25
300.00											11	0.25
500.00											11	0.25
700.00											11	0.25
1000.00											11	0.25
1500.00											11	0.25
2000.00											11	0.25

Table B-39. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											11	0.25
2399.00											11	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											5	0.41
3000.00											5	0.41
3500.00											5	0.41
4000.00											5	0.41
4500.00											5	0.41
5000.00											5	0.41
5001.00											5	0.46
5500.00											5	0.46
6000.00											5	0.46
6500.00											5	0.46
7000.00											5	0.46
7500.00											5	0.46
8000.00											5	0.46
8500.00											5	0.46
9000.00											5	0.46
9500.00											5	0.46
10000.00											5	0.46
10001.00											5	0.46
11000.00											5	0.46
12000.00											5	0.46
13000.00											5	0.46

Table B-39. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											5	0.46
15000.00											5	0.46
16000.00											5	0.46
17000.00											5	0.46
18000.00											5	0.46
19000.00											5	0.46
20000.00											5	0.46
20001.00											4	0.61
21000.00											4	0.61
22000.00											4	0.61
23000.00											4	0.61
24000.00											4	0.61
25000.00											4	0.61
26000.00											4	0.61
27000.00											4	0.61
28000.00											4	0.61
29000.00											4	0.61
30000.00											4	0.61
31000.00											4	0.61
32000.00											4	0.61
33000.00											4	0.61
34000.00											4	0.61
35000.00											4	0.61
36000.00											4	0.61
37000.00											4	0.61
38000.00											4	0.61
38001.00											3	0.67

Table B-39. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											3	0.67
40000.00											3	0.67
40001.00											3	0.67
41000.00											3	0.67
42000.00											3	0.67
43000.00											3	0.67
44000.00											3	0.67
45000.00											3	0.67
46000.00											3	0.67
47000.00											3	0.67
48000.00											3	0.67
49000.00											3	0.67
49001.00											3	0.67
50000.00											3	0.8
50001.00											3	0.8
51000.00											3	0.8
52000.00											3	0.8
53000.00											3	0.8
54000.00											3	0.8
55000.00											3	0.8
56000.00											3	0.8
57000.00											3	0.8
58000.00											3	0.8
59000.00											3	0.8
60000.00											3	0.8
61000.00											3	0.8
62000.00											3	0.8

Table B-39. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											3	0.8
64000.00											3	0.8
65000.00											3	0.82
65001.00											1	0.82
66000.00											1	0.82
67000.00											1	0.82
67001.00											-1	1.2
68000.00											-1	1.2
69000.00											-1	1.2
70000.00											-3	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-40. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											7	0.33
1.00											7	0.33
2.00											7	0.33
5.00											7	0.33
7.00											7	0.33
9.00											7	0.33
10.00											7	0.33
11.00											9	0.25
20.00											9	0.25
50.00											9	0.25
100.00											9	0.25
200.00											9	0.25
300.00											9	0.25
500.00											9	0.25
700.00											9	0.25
1000.00											9	0.25
1500.00											9	0.25
2000.00											9	0.25

Table B-40. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											9	0.25
2399.00											9	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											3	0.41
3000.00											3	0.41
3500.00											3	0.41
4000.00											3	0.41
4500.00											3	0.41
5000.00											3	0.41
5001.00											2	0.46
5500.00											2	0.46
6000.00											2	0.46
6500.00											2	0.46
7000.00											2	0.46
7500.00											2	0.46
8000.00											2	0.46
8500.00											2	0.46
9000.00											2	0.46
9500.00											2	0.46
10000.00											2	0.46
10001.00											2	0.46
11000.00											2	0.46
12000.00											2	0.46
13000.00											2	0.46

Table B-40. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											2	0.46
15000.00											2	0.46
16000.00											2	0.46
17000.00											2	0.46
18000.00											2	0.46
19000.00											2	0.46
20000.00											2	0.46
20001.00											2	0.61
21000.00											2	0.61
22000.00											2	0.61
23000.00											2	0.61
24000.00											2	0.61
25000.00											2	0.61
26000.00											2	0.61
27000.00											2	0.61
28000.00											2	0.61
29000.00											2	0.61
30000.00											2	0.61
31000.00											2	0.61
32000.00											2	0.61
33000.00											2	0.61
34000.00											2	0.61
35000.00											2	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											1	0.67

Table B-40. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											1	0.67
40000.00											1	0.67
40001.00											1	0.67
41000.00											1	0.67
42000.00											1	0.67
43000.00											1	0.67
44000.00											1	0.67
45000.00											1	0.67
46000.00											1	0.67
47000.00											1	0.67
48000.00											1	0.67
49000.00											Typ	Typ
49001.00											Typ	Typ
50000.00											Typ	Typ
50001.00											-4	0.8
51000.00											-4	0.8
52000.00											-4	0.8
53000.00											-4	0.8
54000.00											-4	0.8
55000.00											-4	0.8
56000.00											-4	0.8
57000.00											-4	0.8
58000.00											-4	0.8
59000.00											-4	0.8
60000.00											-4	0.8
61000.00											-4	0.8
62000.00											-4	0.8

Table B-40. MS4647B (with Option 31, 32, and 51, no Option 61 or 62) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											-4	0.8
64000.00											-4	0.8
65000.00											-5	0.82
65001.00											-5	0.82
66000.00											-5	0.82
67000.00											-5	0.82
67001.00											-8	1.2
68000.00											-8	1.2
69000.00											-8	1.2
70000.00											-8	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-41. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 1 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											8	0.33
1.00											8	0.33
2.00											8	0.33
5.00											8	0.33
7.00											8	0.33
9.00											8	0.33
10.00											8	0.33
11.00											10	0.25
20.00											10	0.25
50.00											10	0.25
100.00											10	0.25
200.00											10	0.25
300.00											10	0.25
500.00											10	0.25
700.00											10	0.25
1000.00											10	0.25
1500.00											10	0.25
2000.00											10	0.25

Table B-41. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 1 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											10	0.25
2399.00											10	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											3	0.41
3000.00											3	0.41
3500.00											3	0.41
4000.00											3	0.41
4500.00											3	0.41
5000.00											3	0.41
5001.00											3	0.46
5500.00											3	0.46
6000.00											3	0.46
6500.00											3	0.46
7000.00											3	0.46
7500.00											3	0.46
8000.00											3	0.46
8500.00											3	0.46
9000.00											3	0.46
9500.00											3	0.46
10000.00											3	0.46
10001.00											3	0.46
11000.00											3	0.46
12000.00											3	0.46
13000.00											3	0.46

Table B-41. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 1 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											3	0.46
15000.00											3	0.46
16000.00											3	0.46
17000.00											3	0.46
18000.00											3	0.46
19000.00											3	0.46
20000.00											3	0.46
20001.00											2	0.61
21000.00											2	0.61
22000.00											2	0.61
23000.00											2	0.61
24000.00											2	0.61
25000.00											2	0.61
26000.00											2	0.61
27000.00											2	0.61
28000.00											2	0.61
29000.00											2	0.61
30000.00											2	0.61
31000.00											2	0.61
32000.00											2	0.61
33000.00											2	0.61
34000.00											2	0.61
35000.00											2	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											1	0.67

Table B-41. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 1 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											1	0.67
40000.00											1	0.67
40001.00											1	0.67
41000.00											1	0.67
42000.00											1	0.67
43000.00											1	0.67
44000.00											1	0.67
45000.00											1	0.67
46000.00											1	0.67
47000.00											1	0.67
48000.00											1	0.67
49000.00											1	0.67
49001.00											1	0.67
50000.00											1	0.8
50001.00											1	0.8
51000.00											1	0.8
52000.00											1	0.8
53000.00											1	0.8
54000.00											1	0.8
55000.00											1	0.8
56000.00											1	0.8
57000.00											1	0.8
58000.00											1	0.8
59000.00											1	0.8
60000.00											1	0.8
61000.00											1	0.8
62000.00											1	0.8

Table B-41. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 1 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											1	0.8
64000.00											1	0.8
65000.00											-1	0.82
65001.00											-1	0.82
66000.00											-1	0.82
67000.00											-1	0.82
67001.00											-5	1.2
68000.00											-5	1.2
69000.00											-5	1.2
70000.00											-5	1.2

a.This formula includes the complex numbers.

Maximum Port Power Output Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-42. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 2 Maximum Port Power Output Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
0.07											6	0.33
1.00											6	0.33
2.00											6	0.33
5.00											6	0.33
7.00											6	0.33
9.00											6	0.33
10.00											6	0.33
11.00											8	0.25
20.00											8	0.25
50.00											8	0.25
100.00											8	0.25
200.00											8	0.25
300.00											8	0.25
500.00											8	0.25
700.00											8	0.25
1000.00											8	0.25
1500.00											8	0.25
2000.00											8	0.25

Table B-42. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 2 Maximum Port Power Output Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
2200.00											8	0.25
2399.00											8	0.25
2400.00											Typ	Typ
2499.00											Typ	Typ
2500.00											Typ	Typ
2700.00											Typ	Typ
2701.00											1	0.41
3000.00											1	0.41
3500.00											1	0.41
4000.00											1	0.41
4500.00											1	0.41
5000.00											1	0.41
5001.00											0	0.46
5500.00											0	0.46
6000.00											0	0.46
6500.00											0	0.46
7000.00											0	0.46
7500.00											0	0.46
8000.00											0	0.46
8500.00											0	0.46
9000.00											0	0.46
9500.00											0	0.46
10000.00											0	0.46
10001.00											0	0.46
11000.00											0	0.46
12000.00											0	0.46
13000.00											0	0.46

Table B-42. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 2 Maximum Port Power Output Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
14000.00											0	0.46
15000.00											0	0.46
16000.00											0	0.46
17000.00											0	0.46
18000.00											0	0.46
19000.00											0	0.46
20000.00											0	0.46
20001.00											0	0.61
21000.00											0	0.61
22000.00											0	0.61
23000.00											0	0.61
24000.00											0	0.61
25000.00											0	0.61
26000.00											0	0.61
27000.00											0	0.61
28000.00											0	0.61
29000.00											0	0.61
30000.00											0	0.61
31000.00											0	0.61
32000.00											0	0.61
33000.00											0	0.61
34000.00											0	0.61
35000.00											0	0.61
36000.00											2	0.61
37000.00											2	0.61
38000.00											2	0.61
38001.00											-1	0.67

Table B-42. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 2 Maximum Port Power Output Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
39000.00											-1	0.67
40000.00											-1	0.67
40001.00											-1	0.67
41000.00											-1	0.67
42000.00											-1	0.67
43000.00											-1	0.67
44000.00											-1	0.67
45000.00											-1	0.67
46000.00											-1	0.67
47000.00											-1	0.67
48000.00											-1	0.67
49000.00											Typ	Typ
49001.00											Typ	Typ
50000.00											Typ	Typ
50001.00											-6	0.8
51000.00											-6	0.8
52000.00											-6	0.8
53000.00											-6	0.8
54000.00											-6	0.8
55000.00											-6	0.8
56000.00											-6	0.8
57000.00											-6	0.8
58000.00											-6	0.8
59000.00											-6	0.8
60000.00											-6	0.8
61000.00											-6	0.8
62000.00											-6	0.8

Table B-42. MS4647B (with Option 31, 32, and 61 or 62, no Option 51) Port 2 Maximum Port Power Output Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Specification	Uncertainty
63000.00											-6	0.8
64000.00											-6	0.8
65000.00											-7	0.82
65001.00											-7	0.82
66000.00											-7	0.82
67000.00											-7	0.82
67001.00											-12	1.2
68000.00											-12	1.2
69000.00											-12	1.2
70000.00											-12	1.2

a.This formula includes the complex numbers.

B-3 Port Power Accuracy Test Record

Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-43. MS4642B and MS4644B (K Connector Units) Port Power Accuracy Test (1 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Lower specification (dBm)	Port 1 and 2 Upper specification (dBm)	Uncertainty (dBm)
0.07			1.5	-1.5	0.34
1.00			1.5	-1.5	0.34
2.00			1.5	-1.5	0.34
5.00			1.5	-1.5	0.34
7.00			1.5	-1.5	0.34
9.00			1.5	-1.5	0.34
10.00			1.5	-1.5	0.34
11.00			1.5	-1.5	0.26
20.00			1.5	-1.5	0.26
50.00			1.5	-1.5	0.26
100.00			1.5	-1.5	0.26
200.00			1.5	-1.5	0.26
300.00			1.5	-1.5	0.26
500.00			1.5	-1.5	0.26
700.00			1.5	-1.5	0.26
1000.00			1.5	-1.5	0.26
1500.00			1.5	-1.5	0.26
2000.00			1.5	-1.5	0.26
2200.00			1.5	-1.5	0.26
2400.00			1.5	-1.5	0.26
2499.00			1.5	-1.5	0.26
2500.00			1.5	-1.5	0.44
2700.00			1.5	-1.5	0.44
2701.00			1.5	-1.5	0.44
3000.00			1.5	-1.5	0.44
3500.00			1.5	-1.5	0.44

B-3 Port Power Accuracy Test RecordTest Records for Instrument Key Parameter Performance Verification:

Table B-43. MS4642B and MS4644B (K Connector Units) Port Power Accuracy Test (2 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Lower specification (dBm)	Port 1 and 2 Upper specification (dBm)	Uncertainty (dBm)
4000.00			1.5	-1.5	0.44
4500.00			1.5	-1.5	0.44
5000.00			1.5	-1.5	0.44
5001.00			1.5	-1.5	0.44
5500.00			1.5	-1.5	0.44
6000.00			1.5	-1.5	0.44
6500.00			1.5	-1.5	0.44
7000.00			1.5	-1.5	0.44
7500.00			1.5	-1.5	0.44
8000.00			1.5	-1.5	0.44
8500.00			1.5	-1.5	0.44
9000.00			1.5	-1.5	0.44
9500.00			1.5	-1.5	0.44
10000.00			1.5	-1.5	0.44
10001.00			1.5	-1.5	0.44
11000.00			1.5	-1.5	0.44
12000.00			1.5	-1.5	0.44
13000.00			1.5	-1.5	0.44
14000.00			1.5	-1.5	0.44
15000.00			1.5	-1.5	0.44
16000.00			1.5	-1.5	0.44
17000.00			1.5	-1.5	0.44
18000.00			1.5	-1.5	0.44
19000.00			1.5	-1.5	0.44
20000.00			1.5	-1.5	0.44
20001.00			1.5	-1.5	0.71
21000.00			1.5	-1.5	0.71
22000.00			1.5	-1.5	0.71
23000.00			1.5	-1.5	0.71
24000.00			1.5	-1.5	0.71
25000.00			1.5	-1.5	0.71
26000.00			1.5	-1.5	0.71
27000.00			1.5	-1.5	0.71
28000.00			1.5	-1.5	0.71
29000.00			1.5	-1.5	0.71
30000.00			1.5	-1.5	0.71
31000.00			1.5	-1.5	0.71

Table B-43. MS4642B and MS4644B (K Connector Units) Port Power Accuracy Test (3 of 3)

Frequency (MHz)	Port 1 Measured Value (dBm)	Port 2 Measured Value (dBm)	Port 1 and 2 Lower specification (dBm)	Port 1 and 2 Upper specification (dBm)	Uncertainty (dBm)
32000.00			1.5	-1.5	0.71
33000.00			1.5	-1.5	0.71
34000.00			1.5	-1.5	0.71
35000.00			1.5	-1.5	0.71
36000.00			1.5	-1.5	0.71
37000.00			1.5	-1.5	0.71
38000.00			1.5	-1.5	0.71
38001.00			1.5	-1.5	0.71
39000.00			1.5	-1.5	0.71
40000.00			1.5	-1.5	0.71

Port Power Accuracy Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-44. MS4647B (V Connector Units) Port 1 Port Power Accuracy Test (1 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Upper Specification	Lower Specification	Uncertainty
0.07											1.5	-1.5	0.32
1.00											1.5	-1.5	0.33
2.00											1.5	-1.5	0.34

Table B-44. MS4647B (V Connector Units) Port 1 Port Power Accuracy Test (2 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Upper Specification	Lower Specification	Uncertainty
5.00											1.5	-1.5	0.35
7.00											1.5	-1.5	0.36
9.00											1.5	-1.5	0.37
10.00											1.5	-1.5	0.38
11.00											1.5	-1.5	0.26
20.00											1.5	-1.5	0.26
50.00											1.5	-1.5	0.26
100.00											1.5	-1.5	0.26
200.00											1.5	-1.5	0.26
300.00											1.5	-1.5	0.26
500.00											1.5	-1.5	0.26
700.00											1.5	-1.5	0.26
1000.00											1.5	-1.5	0.26
1500.00											1.5	-1.5	0.26
2000.00											1.5	-1.5	0.26
2200.00											1.5	-1.5	0.26
2399.00											1.5	-1.5	0.26
2400.00											1.5	-1.5	0.26
2499.00											1.5	-1.5	0.26
2500.00											1.5	-1.5	0.24
2700.00											1.5	-1.5	0.24
2701.00											1.5	-1.5	0.24
3000.00											1.5	-1.5	0.24
3500.00											1.5	-1.5	0.24
4000.00											1.5	-1.5	0.24
4500.00											1.5	-1.5	0.24
5000.00											1.5	-1.5	0.24
5001.00											1.5	-1.5	0.24

Table B-44. MS4647B (V Connector Units) Port 1 Port Power Accuracy Test (3 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Upper Specification	Lower Specification	Uncertainty
5500.00											1.5	-1.5	0.24
6000.00											1.5	-1.5	0.24
6500.00											1.5	-1.5	0.24
7000.00											1.5	-1.5	0.24
7500.00											1.5	-1.5	0.24
8000.00											1.5	-1.5	0.24
8500.00											1.5	-1.5	0.24
9000.00											1.5	-1.5	0.24
9500.00											1.5	-1.5	0.24
10000.00											1.5	-1.5	0.24
10001.00											1.5	-1.5	0.24
11000.00											1.5	-1.5	0.24
12000.00											1.5	-1.5	0.24
13000.00											1.5	-1.5	0.24
14000.00											1.5	-1.5	0.24
15000.00											1.5	-1.5	0.24
16000.00											1.5	-1.5	0.24
17000.00											1.5	-1.5	0.24
18000.00											1.5	-1.5	0.24
19000.00											1.5	-1.5	0.24
20000.00											1.5	-1.5	0.24
20001.00											1.5	-1.5	0.43
21000.00											1.5	-1.5	0.43
22000.00											1.5	-1.5	0.43
23000.00											1.5	-1.5	0.43
24000.00											1.5	-1.5	0.43
25000.00											1.5	-1.5	0.43
26000.00											1.5	-1.5	0.43

Table B-44. MS4647B (V Connector Units) Port 1 Port Power Accuracy Test (4 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Upper Specification	Lower Specification	Uncertainty
27000.00											1.5	-1.5	0.43
28000.00											1.5	-1.5	0.43
29000.00											1.5	-1.5	0.43
30000.00											1.5	-1.5	0.43
31000.00											1.5	-1.5	0.43
32000.00											1.5	-1.5	0.43
33000.00											1.5	-1.5	0.43
34000.00											1.5	-1.5	0.43
35000.00											1.5	-1.5	0.43
36000.00											1.5	-1.5	0.43
37000.00											1.5	-1.5	0.43
38000.00											1.5	-1.5	0.43
38001.00											1.5	-1.5	0.43
39000.00											1.5	-1.5	0.43
40000.00											1.5	-1.5	0.43
40001.00											3	-3	0.62
41000.00											3	-3	0.62
42000.00											3	-3	0.62
43000.00											3	-3	0.62
44000.00											3	-3	0.62
45000.00											3	-3	0.62
46000.00											3	-3	0.62
47000.00											3	-3	0.62
48000.00											3	-3	0.62
49000.00											3	-3	0.62
49001.00											3	-3	0.62
50000.00											3	-3	0.62
50001.00											3	-3	0.8

Table B-44. MS4647B (V Connector Units) Port 1 Port Power Accuracy Test (5 of 5)

Freq (MHz)	Real Raw Source Match	Imaginary Raw Source Match	Freq (GHz)	Real Power Sensor Input Match	Imaginary Power Sensor Input Match	MCF[a]	Measurement (dBm)	Measurement (Watts)	Adjusted Measurement Times MCF (Watts)	Adjusted Measurement and MCF (dBm)	Upper Specification	Lower Specification	Uncertainty
51000.00											3	-3	0.8
52000.00											3	-3	0.8
53000.00											3	-3	0.8
54000.00											3	-3	0.8
55000.00											3	-3	0.8
56000.00											3	-3	0.8
57000.00											3	-3	0.8
58000.00											3	-3	0.8
59000.00											3	-3	0.8
60000.00											3	-3	0.8
61000.00											3	-3	0.8
62000.00											3	-3	0.8
63000.00											3	-3	0.8
64000.00											3	-3	0.8
65000.00											3	-3	0.8
65001.00											3	-3	0.8
66000.00											3	-3	0.8
67000.00											3	-3	0.8
67001.00											4	-4	1.2
68000.00											4	-4	1.2
69000.00											4	-4	1.2
70000.00											4	-4	1.2

a.This formula includes the complex numbers.

B-4 Frequency Accuracy Test Record

Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table B-45. Frequency Accuracy Test

		At Time of Calibration		With Aging (1 year [a]) and Temperature Change		
Frequency (MHz)	**Measured Value (MHz)**	**Lower Specification (Hz) [b]**	**Upper Specification (Hz) [b]**	**Lower Specification (Hz) [b]**	**Upper Specification (Hz) [b]**	**Uncertainty**
1000		500	-500	870	-870	
3000		1500	-1500	2610	-2610	
5000		2500	-2500	4350	-4350	
7000		3500	-3500	6090	-6090	
10000		5000	-5000	8700	-8700	
15000		7500	-7500	13050	-13050	
18000		9000	-9000	15660	-15660	

a.Based on 1 year (365 days) of aging. If the time is different, calculate the number of days times 1 e-9 plus 5 e-9. See technical data sheet for more information.

b.At time of calibration.

B-5 High-level Noise Test Record

Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

MS4642B Test Records

Table B-46. High-level Noise Test S21 Magnitude MS4642B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**			
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045			

Table B-47. High-level Noise Test S21 Phase MS4642B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**			
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05			

Table B-48. High-level Noise Test S12 Magnitude MS4642B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**			
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045			

Table B-49. High-level Noise Test S12 Phase MS4642B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**			
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05			

MS4644B Test Records

Table B-50. High-level Noise Test S21 Magnitude MS4644B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**		
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045	<0.006		

Table B-51. High-level Noise Test S21 Phase MS4644B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**		
Caclulated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05	<0.06		

Table B-52. High-level Noise Test S12 Magnitude MS4644B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**		
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045	<0.006		

Table B-53. High-level Noise Test S12 Phase MS4644B

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**		
Caclulated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05	<0.06		

MS4647B Test Records

Table B-54. High-level Noise Test S21 Magnitude MS4647B and no Option 51, 61, or 62[a]

	Test Frequency					
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**	**40001 to 67000 MHz**	**67001 to 70000 MHz**
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045	<0.006	<0.006	<0.008

a. MS4647B with Option 51, 61, or 62 are characteristic or typical.

Table B-55. High-level Noise Test S21 Phase MS4647B and no Option 51, 61, or 62[a]

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**	**40001 to 67000 MHz**	**67001 to 70000 MHz**
Caclulated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05	<0.06	<0.08	<0.08

a. MS4647B with Option 51, 61, or 62 are characteristic or typical.

Table B-56. High-level Noise Test S12 Magnitude MS4647B and no Option 51, 61, or 62[a]

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**	**40001 to 67000 MHz**	**67001 to 70000 MHz**
Calculated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.0045	<0.0045	<0.0045	<0.006	<0.006	<0.008

a. MS4647B with Option 51, 61, or 62 are characteristic or typical.

Table B-57. High-level Noise Test S12 Phase MS4647B and no Option 51, 61, or 62[a]

	Test Frequency						
Measurement (dBrms)	**0.07 to 0.500 MHz**	**0.501 to 2.5 MHz**	**2501 to 5000 MHz**	**5001 to 20000 MHz**	**20001 to 40000 MHz**	**40001 to 67000 MHz**	**67001 to 70000 MHz**
Caclulated High-level Noise (dBrms)							
Uncertainty (dB)							
Specification (dBrms)	< 0.04	<0.05	<0.05	<0.05	<0.06	<0.08	<0.08

a. MS4647B with Option 51, 61, or 62 are characteristic or typical.

B-6 Noise Floor Test Record

Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

MS4642B Test Records

Table B-58. Noise Floor (S12 port 1) MS4642B with Option 8 or 9

Measured Value	**0.07 to 0.3 MHz**	**> 0.3 to 2 MHz**	**> 2 to 10 MHz**	**> 0.01 to 2.5 GHz**	**> 2.5 to 20 GHz**				
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55				
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A				
Upper Limit (dBmrms)	-74	-91	-104	-105	-104				

Table B-59. Noise Floor (S21 port 2) MS4642B with Option 8 or 9

Measured Value	**0.07 to 0.3 MHz**	**> 0.3 to 2 MHz**	**> 2 to 10 MHz**	**> 0.01 to 2.5 GHz**	**> 2.5 to 20 GHz**				
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55				
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A				
Upper Limit (dBmrms)	-73	-90	-103	-104	-103				

Table B-60. Noise Floor (S12 port 1) MS4644B with no options

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-75	-92	-105	-110	-110	-110			

Table B-61. Noise Floor (S21 port 2) MS4644B with no options

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-75	-92	-105	-110	-110	-110			

MS4644B Test Records

Table B-62. Noise Floor (S12 port 1) MS4644B with Option 51

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-74	-91	-104	-108	-107	-107			

Table B-63. Noise Floor (S21 port 2) MS4644B with Option 51

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-74	-91	-104	-108	-107	-107			

Table B-64. Noise Floor (S12 port 1) MS4644B with Option 61

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-73	-90	-104	-108	-107	-107			

Table B-65. Noise Floor (S21 port 2) MS4644B with Option 61

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-73	-90	-103	-104	-103	-103			

Table B-66. Noise Floor (S12 port 1) MS4644B with Option 62

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-73	-90	-103	-104	-103	-103			

Table B-67. Noise Floor (S21 port 2) MS4644B with Option 62

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 40 GHz			
Noise Floor (Calculated result)									
Uncertainty (dB)	0.46	0.47	0.46	0.45	0.55	0.78			
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A			
Upper Limit (dBmrms)	-73	-90	-103	-104	-103	-103			

MS4647B Test Records

Table B-68. Noise Floor (S12 port 1) MS4647B with no options

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-75	-92	-105	-110	-110	-110	-110	-110	-110	-110

Table B-69. Noise Floor (S21 port 2) MS4647B with no options

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-75	-92	-105	-110	-110	-110	-110	-110	-110	-110

Table B-70. Noise Floor (S12 port 1) MS4647B with Option 51

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-74	-91	-104	-108	-107	-107	-106	-106	-106	-106

Table B-71. Noise Floor (S21 port 2) MS4647B with Option 51

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-74	-91	-104	-108	-107	-107	-106	-106	-106	-106

Table B-72. Noise Floor (S12 port 1) MS4647B with Option 61

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-74	-91	-104	-108	-107	-107	-106	-106	-106	-106

Table B-73. Noise Floor (S21 port 2) MS4647B with Option 61

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dB)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBmrms)	-73	-90	-103	-104	-103	-103	-100	-100	-100	-100

Table B-74. Noise Floor (S12 port 1) MS4647B with Option 62

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dBm)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBm)	-73	-90	-103	-104	-103	-103	-103	-100	-100	-100

Table B-75. Noise Floor (S21 port 2) MS4647B with Option 62

Measured Value	0.07 to 0.3 MHz	> 0.3 to 2 MHz	> 2 to 10 MHz	> 0.01 to 2.5 GHz	> 2.5 to 20 GHz	> 20 to 38 GHz	> 38 to 50 GHz	> 50 to 65 GHz	> 65 to 67 GHz	> 67 to 70 GHz
Noise Floor (Calculated result)										
Uncertainty (dBm)	0.37	0.44	0.37	0.53	0.41	0.53	0.76	0.89	0.85	1.27
Lower limit (dBm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Limit (dBm)	-73	-90	-103	-104	-103	-103	-103	-103	-100	-100

Appendix C — Test Records: Log Magnitude Dynamic Accuracy (Optional)

C-1 Introduction

Use this appendix to print out and record test, calibration, and verification information. The following test records are available:

C-2 Log Magnitude Dynamic Accuracy Test Record (Optional)

This appendix section provides the test record that can be used to record the result of the Log Magnitude Dynamic Accuracy Test. Make a copy of the following Test Record pages and document the test results each time the Log Magnitude Dynamic Accuracy Test is performed.

MS4640B Log Magnitude Dynamic Accuracy Test

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table C-1. Measured S21 Values and Calculated Step Attenuator Attenuation Values

Measured S21 Values											
Step Attenuator Setting (dB)	**Pass #1**	**Pass #2**	**Pass #3**	**Pass #4**	**Pass #5**	**Pass #6**	**Pass #7**	**Pass #8**	**Pass #9**	**Pass #10**	
0											
10											
20											
30											
40											
50											
60											
70											
80											
	Calculated Step Attenuator Attenuation Values										**Mean Value**
10											
20											
30											
40											
50											
60											
70											
80											

C-3 MS4640B Log Magnitude Dynamic Accuracy Test Record (Optional)

MS4640B Log Magnitude Dynamic Accuracy Test Worksheet

Instrument Information			
Model:		**Serial Number:**	
Options:			
Comments:			
Operator:		**Date:**	

Table C-2. Attenuation Calculated Upper Limits, Mean Values, Lower Limits, and Pass/Fail

A	B	C	D	E	F	
Attenuation Device Nominal Value (dB)	**Attenuation Device Characterized (or Traceable) Value**	**Composite Uncertainty**	**Upper Limit (Col. B + Col. C)**	**Mean Value**	**Lower Limit (Col. B – Col. C)**	**Pass or Fail**
– 10		0.15				
– 20		0.15				
– 30		0.15				
– 40		0.20				
– 50		0.25				
– 60		0.28				
– 70		0.50				
– 80		1.20				

Appendix D — Cable Identification Lists

D-1 Introduction

This chapter provides information about the VNA cables and their connections between major assemblies, PCBs, and modules. Cables are not provided as part of the replacement assembly and module kits but can be ordered from Anritsu Customer Service.

Identification Labels on Cables

Most VectorStar VNA internal cables are identified with three labels providing the following information:

- The cable or harness Anritsu part number.
- The assembly and connector where they originate.
- The assembly and connector where they terminate.

Table Organization

The cable lists are organized in sections by VectorStar model Number. In each section, the first table lists cables by origin (where its first connection originates). The second table lists cables by their part number.

Notes About the Identification Tables

The notes in Table D-1 apply to all the cable lists.

Table D-1. Notes about Cable Lists Tables

Note	Description
1	Unless otherwise described, all origin and destination assemblies are standalone modules.
2	Printed circuit board assemblies are identified as "PCBs". (For example A18 PCB)
3	FP = Front Panel of the RF Deck RP = Rear Panel
4	Analog modules are assemblies that mount in the Analog PCB Bay and include the A11, A12, A13, A14, and A15 modules.
Models	• MS4642B – Used on the MS4642B VNA, 10 MHz to 20 GHz VNA, K connectors. • MS4644B – Used on the MS4644B VNA, 10 MHz to 40 GHz VNA, K connectors. • MS4645B – Used on the MS4645B VNA, 10 MHz to 50 GHz VNA, V connectors • MS4647B – Used on the MS4647B VNA, 10 MHz to 70 GHz VNA, V connectors.
Option	• **Standard** – No options installed • **51** – Option 51 Direct Access Loops are installed. • **61** – Option 61 Direct Access Loops and Two Attenuators are installed. • **62** – Option 62 Direct Access Loops and Four Attenuator are installed. • **80** – Option 80 Broadband/Millimeter Wave for MS4647B with No Options installed. • **81** – Option 81 Broadband/Millimeter Wave for MS4647B with Option 51, 61, or 62 installed. • **82** – Option 82 Broadband/Millimeter Wave for MS4642B, MS4644B, MS4645B with No Options installed. • **83** – Option 83 Broadband/Millimeter Wave for MS4642B, MS4644B, MS4645B with Option 51, 61, or 62 installed. • **84** – Option 84 Broadband/Millimeter Wave for MS4642B, MS4644B, MS4645B, MS4647B with Option 31 installed. • **85** – Option 85 Broadband/Millimeter Wave for MS4642B, MS4644B, MS4645B, MS4647B with Option 31 and Option 51, 61, or 62 installed.

D-2 MS4642B Cable ID Lists

MS4642B Cables – Sorted by Origin Connection Point

FP = Front Panel

RP = Rear Panel

Table D-2. MS4642B – Origin Connection Point Sort (1 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62111-3		A100 J1	A104 J2	Standard
62111-10		A100 J1	FP b1 IN	Option 51
62111-10		A100 J1	FP b1 IN	Option 61
62111-1		A100 J2	A111 J2	All Models without Option 8x
62111-1		A100 J2	A111 J2	All Models with Option 8x
62111-11		A101 J1	FP a1 IN	Option 51
62111-11		A101 J1	FP a1 IN	Option 61
62111-11		A101 J1	FP a1 IN	Option 62
62111-8		A101 J2	A111 J3	All Models without Option 8x
62111-5		A102 J1	A106 J2	Standard
62111-13		A102 J1	FP b2 IN	Option 51
62111-9		A102 J2	A111 J4	All Models without Option 8x
62111-9		A102 J2	A111 J4	All Models with Option 8x
62111-12		A103 J1	FP a2 IN	Option 51
62111-12		A103 J1	FP a2 IN	Option 61
62111-12		A103 J1	FP a2 IN	Option 62
62111-2		A103 J2	A111 J5	All Models without Option 8x
57989-23		A104 J2	FP b1 OUT	Option 51
57989-23		A104 J2	FP b1 OUT	Option 61
57989-23		A104 J2	FP b1 OUT	Option 62
62104-230		A105 J2	A109 J1	Standard
62104-230		A105 J2	A109 J1	Option 32/51
62104-230		A105 J2	A109 J1	Option 32/61
62104-230		A105 J2	A109 J1	Option 32/62
57989-33		A105 J3	A142 J2	Option 32/Standard
62104-231		A105 J3	A128 J2	Standard
67357-11		A105 J3	FP S1 OUT	Option 51
67357-10		A106 J2	FP b2 OUT	Option 51
67357-10		A106 J2	FP b2 OUT	Option 61
67357-10		A106 J2	FP b2 OUT	Option 62
57989-24		A107 J3	A241 J1	Option 32/Standard
62104-232		A107 J3	A129 J2	Standard
67357-12		A107 J3	FP S2 OUT	Option 51

Table D-2. MS4642B – Origin Connection Point Sort (2 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67357-12		A107 J3	FP S2 OUT	Option 61
67357-5		A108 J2	A107 J1	Standard
67357-5		A108 J2	A107 J1	Option 51
67357-5		A108 J2	A107 J1	Option 61
67357-5		A108 J2	A107 J1	Option 62
67357-4		A108 J3	A105 J1	Standard
67357-4		A108 J3	A105 J1	Option 51
67357-4		A108 J3	A105 J1	Option 61
67357-4		A108 J3	A105 J1	Option 62
57989-21		A109 J2	FP a1 OUT	Option 32/51
57989-21		A109 J2	FP a1 OUT	Option 32/61
57989-21		A109 J2	FP a1 OUT	Option 32/62
62111-40		A109 J2	A101 J1	Standard
62111-42		A109 J2	A101 J1	Option 32/Standard
67357-7		A109 J2	FP a1 OUT	Option 51
67357-7		A109 J2	FP a1 OUT	Option 61
67357-7		A109 J2	FP a1 OUT	Option 62
67354-4		A11 J12	A101 J3	All Models without Option 8x
67354-4		A11 J12	A101 J3	All Models with Option 8x
67354-3		A11 J15	A100 J3	All Models without Option 8x
67354-3		A11 J15	A100 J3	All Models with Option 8x
67354-2		A11 J18	A103 J3	All Models without Option 8x
67354-2		A11 J18	A103 J3	All Models with Option 8x
67354-1		A11 J21	A102 J3	All Models without Option 8x
67354-1		A11 J21	A102 J3	All Models with Option 8x
62111-41		A110 J2	A103 J1	Standard
67357-8		A110 J2	FP a2 OUT	Option 51
67357-8		A110 J2	FP a2 OUT	Option 61
67357-8		A110 J2	FP a2 OUT	Option 62
3-62111-47		A110 Pad at J2	A103 J1	Option 84/88
3-67357-238		A110 Pad at J2	FP a2 OUT	Option 85/89
3-803-104		A111 P1	A18 P5	All MS4642B
57989-34		A113 J2	A105 J1	Option 31
59744-8		A113 J2	A133 J1	Option 82
59744-8		A113 J2	A133 J1	Option 83
62112-14		A113 J2	A108 J1	Standard
62112-14		A113 J2	A108 J1	Option 51
62112-14		A113 J2	A108 J1	Option 61
62112-14		A113 J2	A108 J1	Option 62

Table D-2. MS4642B – Origin Connection Point Sort (3 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
B37391-154		A113 J2	A133 J1	Option 84
B37391-154		A113 J2	A133 J1	Option 85
3-803-104		A113 P1	A18 P6	All MS4642B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 62
62112-20		A116 J2	A118 J2	Standard
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-36		A116 J2	RP S1 OUT	Option 51
62112-5		A116 J2	A125 J1	Option 61
62112-53		A116 J2	A125 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-27		A116 J3	A15 J3	Standard
62112-40		A116 J3	RP a1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 62
62112-51		A116 J3	RP a1 OUT	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-21		A117 J2	A119 J2	Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-34		A117 J2	RP S2 OUT	Option 51
62112-34		A117 J2	RP S2 OUT	Option 61
62112-11		A117 J2	A126 J1	Option 62
62112-54		A117 J2	A126 J1	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-28		A117 J3	A15 J5	Standard
62112-41		A117 J3	RP a2 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 62
62112-52		A117 J3	RP a2 OUT	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-29		A118 J3	A15 J6	Standard
62112-45		A118 J3	RP b1 OUT	Option 51
62112-45		A118 J3	RP b1 OUT	Option 61
62112-72		A118 J3	A15 J6	Option 31
62112-30		A119 J3	A15 J7	Standard
62112-43		A119 J3	RP b2 OUT	Option 51

Table D-2. MS4642B – Origin Connection Point Sort (4 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-43		A119 J3	RP b2 OUT	Option 61
62112-43		A119 J3	RP b2 OUT	Option 62
62112-73		A119 J3	A15 J7	Option 31
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
62111-14		A120 J2	A100 J1	Option 62
62111-15		A123 J2	A102 J1	Option 61
62111-15		A123 J2	A102 J1	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-12		A125 J2	RP S1 OUT	Option 61
62112-12		A125 J2	RP S1 OUT	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-26		A127 J2	A15 J7	Option 61
62112-26		A127 J2	A15 J7	Option 62
67355-13	ND71748	A13 J10	A11 J5	All MS4642B
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-15	ND71746	A13 J12	A18 J7	All MS4642B
67355-16	ND80050	A13 J12	A18 J22	Option 31
62112-19		A13 J14	A113 J1	All MS4642B
67355-37		A13 J17	A111 J6	All Models without Option 8x
67355-37		A13 J17	A111 J6	All Models with Option 8x
62112-46		A13 J3	A14 J3	Option 31

Table D-2. MS4642B – Origin Connection Point Sort (5 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-58		A13 J4	A111 J1	All MS4642B
62112-59		A13 J6	A15 J11 W/PAD	All MS4642B
62112-16		A13 J8	A115 J1	All MS4642B
62112-48		A13 J8	A116 J1	Option 31
62112-47		A13 J9	A14 J9	Option 31
57989-5		A131 J1	A111 J3	All Models with Option 8x
57989-7		A131 J3	FP LO1	Option 82
57989-7		A131 J3	FP LO1	Option 83
57989-7		A131 J3	FP LO1	Option 84
57989-7		A131 J3	FP LO1	Option 85
57989-6		A132 J1	A111 J5	All Models with Option 8x
57989-8		A132 J3	FP LO2	Option 82
57989-8		A132 J3	FP LO2	Option 83
57989-8		A132 J3	FP LO2	Option 84
57989-8		A132 J3	FP LO2	Option 85
57989-36		A133 J2	A105 J1	Option 84
57989-36		A133 J2	A105 J1	Option 85
57989-22		A133 J3	FP RF	Option 82
57989-22		A133 J3	FP RF	Option 83
57989-31		A133 J3	FP RF1	Option 84
57989-31		A133 J3	FP RF1	Option 85
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
67355-7	ND80053	A15 J13	A11 J11	All MS4642B
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-8	ND71750	A15 J16	A11 J14	All MS4642B
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-9	ND71751	A15 J20	A11 J17	All MS4642B
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-10	ND71752	A15 J22	A11 J20	All MS4642B
67355-36	ND80057	A15 J22	A12 J19	Option 35
57989-35		A213 J2	A107 J1	Option 31
B37391-155		A213 J2	A233 J1	Option 84
B37391-155		A213 J2	A233 J1	Option 85
3-803-132		A213 P1	A18 P10	Option 31
57989-37		A233 J2	A107 J1	Option 84
57989-37		A233 J2	A107 J1	Option 85

Table D-2. MS4642B – Origin Connection Point Sort (6 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
57989-32		A233 J3	FP RF2	Option 84
57989-32		A233 J3	FP RF2	Option 85
3-57989-16		A241 J2	A142 J3	Option 32/Standard
3-57989-16		A241 J2	A142 J3	Option 32/51
3-57989-16		A241 J2	A142 J3	Option 32/61
3-57989-16		A241 J2	A142 J3	Option 32/62
62104-229		A241 J3	A129 J2	Option 32/Standard
62104-229		A241 J3	A129 J2	Option 32/51
62104-229		A241 J3	A129 J2	Option 32/61
62104-229		A241 J3	A129 J2	Option 32/62
62104-229		A241 J3	A129 J2	Option 84
62104-229		A241 J3	A129 J2	Option 85
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4642B
57989-17		FP P1S IN	A142 J2	Option 32/51
57989-17		FP P1S IN	A142 J2	Option 32/61
57989-17		FP P1S IN	A142 J2	Option 32/62
57989-15		FP P1S IN	A241 J1	Option 32/51
57989-15		FP P1S IN	A241 J1	Option 32/61
57989-15		FP P1S IN	A241 J1	Option 32/62
57989-15		FP P2S IN	A241 J1	Option 85
62104-2		FP S1 IN	A128 J2	Option 51
62104-2		FP S1 IN	A128 J2	Option 61
62104-2		FP S1 IN	A128 J2	Option 62
62104-3		FP S2 IN	A129 J2	Option 51
62104-3		FP S2 IN	A129 J2	Option 61
62104-3		FP S2 IN	A129 J2	Option 62
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 61

Table D-2. MS4642B – Origin Connection Point Sort (7 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 62
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 51
3-806-175		MB2 P41	A18 P3	All MS4642B
3-806-185		MB2 P42	A18 J18	All MS4642B
3-803-107		MB2 P71	A17 P1	All MS4642B
3-803-107		MB2 P72	A17 P2	All MS4642B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 62
62112-24		RP a1 IN	A15 J3	Option 51
62112-24		RP a1 IN	A15 J3	Option 61
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 51
62112-25		RP a2 IN	A15 J5	Option 61
62112-25		RP a2 IN	A15 J5	Option 62
62112-33		RP b1 IN	A15 J6	Option 51
62112-33		RP b1 IN	A15 J6	Option 61
62112-10		RP b1 IN	A124 J1	Option 62
62112-35		RP b2 IN	A15 J7	Option 51
62112-9		RP b2 IN	A127 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 62
67356-4		RP EXT 10M IN	A11 J3	All MS4642B
67356-5		RP EXT 10M OUT	A11 J4	All MS4642B
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-13	ND73939	RP EXT ALC	A13 J13	Option 83
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
67356-6		RP EXT AN IN1	A11 J1	All MS4642B
67356-7		RP EXT AN IN2	A11 J2	All MS4642B
67356-8		RP EXT AN OUT	A13 J16	All MS4642B
67356-9		RP EXT TRIG	A17 P11	All MS4642B
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
62105-3	ND73937	RP IF A1	A11 J13	All MS4642B
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35

Table D-2. MS4642B – Origin Connection Point Sort (8 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62105-4	ND73938	RP IF A2	A11 J19	All MS4642B
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
62105-2	ND73935	RP IF B1	A11 J16	All MS4642B
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
62105-1	ND73936	RP IF B2	A11 J22	All MS4642B
67356-10		RP LOCK STATUS	A17 P10	All MS4642B
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
62112-44		RP SRC1 IN	A118 J2	Option 62
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 62
67356-12		RP TRIG OUT	A17 P8	All MS4642B
67356-11		RP TRIG RDY	A17 P9	All MS4642B

MS4642B Cables – Sorted by Part Number

FP = Front Panel

RP = Rear Panel

Table D-3. MS4642B – Part Number Sort (1 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
3-806-185		MB2 P42	A18 J18	All MS4642B
3-803-107		MB2 P71	A17 P1	All MS4642B
3-803-107		MB2 P72	A17 P2	All MS4642B
3-803-104		A113 P1	A18 P6	All MS4642B
3-803-104		A111 P1	A18 P5	All MS4642B
3-806-175		MB2 P41	A18 P3	All MS4642B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 62
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-803-132		A213 P1	A18 P10	Option 31
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
3-62111-47		A110 Pad at J2	A103 J1	Option 84/88
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
3-57989-16		A241 J2	A142 J3	Option 32/Standard
3-57989-16		A241 J2	A142 J3	Option 32/51
3-57989-16		A241 J2	A142 J3	Option 32/61
3-57989-16		A241 J2	A142 J3	Option 32/62
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62

Table D-3. MS4642B – Part Number Sort (2 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
3-67357-238		A110 Pad at J2	FP a2 OUT	Option 85/89
57989-23		A104 J2	FP b1 OUT	Option 51
57989-23		A104 J2	FP b1 OUT	Option 61
57989-23		A104 J2	FP b1 OUT	Option 62
57989-22		A133 J3	FP RF	Option 82
57989-7		A131 J3	FP LO1	Option 82
57989-8		A132 J3	FP LO2	Option 82
57989-22		A133 J3	FP RF	Option 83
57989-7		A131 J3	FP LO1	Option 83
57989-8		A132 J3	FP LO2	Option 83
57989-31		A133 J3	FP RF1	Option 84
57989-32		A233 J3	FP RF2	Option 84
57989-36		A133 J2	A105 J1	Option 84
57989-37		A233 J2	A107 J1	Option 84
57989-7		A131 J3	FP LO1	Option 84
57989-8		A132 J3	FP LO2	Option 84
57989-15		FP P2S IN	A241 J1	Option 85
57989-31		A133 J3	FP RF1	Option 85
57989-32		A233 J3	FP RF2	Option 85
57989-36		A133 J2	A105 J1	Option 85
57989-37		A233 J2	A107 J1	Option 85
57989-7		A131 J3	FP LO1	Option 85
57989-8		A132 J3	FP LO2	Option 85
57989-34		A113 J2	A105 J1	Option 31
57989-35		A213 J2	A107 J1	Option 31
57989-5		A131 J1	A111 J3	All Models with Option 8x
57989-6		A132 J1	A111 J5	All Models with Option 8x
57989-15		FP P1S IN	A241 J1	Option 32/51
57989-15		FP P1S IN	A241 J1	Option 32/61
57989-15		FP P1S IN	A241 J1	Option 32/62
57989-17		FP P1S IN	A142 J2	Option 32/51
57989-17		FP P1S IN	A142 J2	Option 32/61
57989-17		FP P1S IN	A142 J2	Option 32/62
57989-21		A109 J2	FP a1 OUT	Option 32/51
57989-21		A109 J2	FP a1 OUT	Option 32/61
57989-21		A109 J2	FP a1 OUT	Option 32/62
57989-33		A105 J3	A142 J2	Option 32/Standard
59744-8		A113 J2	A133 J1	Option 82
59744-8		A113 J2	A133 J1	Option 83

Table D-3. MS4642B – Part Number Sort (3 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62104-231		A105 J3	A128 J2	Standard
62104-232		A107 J3	A129 J2	Standard
62104-2		FP S1 IN	A128 J2	Option 51
62104-3		FP S2 IN	A129 J2	Option 51
62104-2		FP S1 IN	A128 J2	Option 61
62104-3		FP S2 IN	A129 J2	Option 61
62104-2		FP S1 IN	A128 J2	Option 62
62104-3		FP S2 IN	A129 J2	Option 62
62104-229		A241 J3	A129 J2	Option 84
62104-229		A241 J3	A129 J2	Option 85
62104-229		A241 J3	A129 J2	Option 32/Standard
62104-229		A241 J3	A129 J2	Option 32/51
62104-229		A241 J3	A129 J2	Option 32/61
62104-229		A241 J3	A129 J2	Option 32/62
62104-230		A105 J2	A109 J1	Standard
62104-230		A105 J2	A109 J1	Option 32/51
62104-230		A105 J2	A109 J1	Option 32/61
62104-230		A105 J2	A109 J1	Option 32/62
62105-1	ND73936	RP IF B2	A11 J22	All MS4642B
62105-2	ND73935	RP IF B1	A11 J16	All MS4642B
62105-3	ND73937	RP IF A1	A11 J13	All MS4642B
62105-4	ND73938	RP IF A2	A11 J19	All MS4642B
62111-3		A100 J1	A104 J2	Standard
62111-40		A109 J2	A101 J1	Standard
62111-41		A110 J2	A103 J1	Standard
62111-5		A102 J1	A106 J2	Standard
62111-10		A100 J1	FP b1 IN	Option 51
62111-11		A101 J1	FP a1 IN	Option 51
62111-12		A103 J1	FP a2 IN	Option 51
62111-13		A102 J1	FP b2 IN	Option 51
62111-10		A100 J1	FP b1 IN	Option 61
62111-11		A101 J1	FP a1 IN	Option 61
62111-12		A103 J1	FP a2 IN	Option 61
62111-15		A123 J2	A102 J1	Option 61
62111-11		A101 J1	FP a1 IN	Option 62
62111-12		A103 J1	FP a2 IN	Option 62
62111-14		A120 J2	A100 J1	Option 62
62111-15		A123 J2	A102 J1	Option 62
62111-1		A100 J2	A111 J2	All Models without Option 8x

Table D-3. MS4642B – Part Number Sort (4 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62111-2		A103 J2	A111 J5	All Models without Option 8x
62111-8		A101 J2	A111 J3	All Models without Option 8x
62111-9		A102 J2	A111 J4	All Models without Option 8x
62111-1		A100 J2	A111 J2	All Models with Option 8x
62111-9		A102 J2	A111 J4	All Models with Option 8x
62111-42		A109 J2	A101 J1	Option 32/Standard
62112-16		A13 J8	A115 J1	All MS4642B
62112-19		A13 J14	A113 J1	All MS4642B
62112-58		A13 J4	A111 J1	All MS4642B
62112-59		A13 J6	A15 J11 W/PAD	All MS4642B
62112-14		A113 J2	A108 J1	Standard
62112-20		A116 J2	A118 J2	Standard
62112-21		A117 J2	A119 J2	Standard
62112-27		A116 J3	A15 J3	Standard
62112-28		A117 J3	A15 J5	Standard
62112-29		A118 J3	A15 J6	Standard
62112-30		A119 J3	A15 J7	Standard
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-14		A113 J2	A108 J1	Option 51
62112-24		RP a1 IN	A15 J3	Option 51
62112-25		RP a2 IN	A15 J5	Option 51
62112-33		RP b1 IN	A15 J6	Option 51
62112-34		A117 J2	RP S2 OUT	Option 51
62112-35		RP b2 IN	A15 J7	Option 51
62112-36		A116 J2	RP S1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-43		A119 J3	RP b2 OUT	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-45		A118 J3	RP b1 OUT	Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-12		A125 J2	RP S1 OUT	Option 61
62112-14		A113 J2	A108 J1	Option 61
62112-24		RP a1 IN	A15 J3	Option 61
62112-25		RP a2 IN	A15 J5	Option 61
62112-26		A127 J2	A15 J7	Option 61

Table D-3. MS4642B – Part Number Sort (5 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-33		RP b1 IN	A15 J6	Option 61
62112-34		A117 J2	RP S2 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-43		A119 J3	RP b2 OUT	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-45		A118 J3	RP b1 OUT	Option 61
62112-5		A116 J2	A125 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-10		RP b1 IN	A124 J1	Option 62
62112-11		A117 J2	A126 J1	Option 62
62112-12		A125 J2	RP S1 OUT	Option 62
62112-14		A113 J2	A108 J1	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 62
62112-26		A127 J2	A15 J7	Option 62
62112-40		A116 J3	RP a1 OUT	Option 62
62112-41		A117 J3	RP a2 OUT	Option 62
62112-42		RP SRC2 IN	A119 J2	Option 62
62112-43		A119 J3	RP b2 OUT	Option 62
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-9		RP b2 IN	A127 J1	Option 62
62112-46		A13 J3	A14 J3	Option 31
62112-47		A13 J9	A14 J9	Option 31
62112-48		A13 J8	A116 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-51		A116 J3	RP a1 OUT	Option 31
62112-52		A117 J3	RP a2 OUT	Option 31
62112-53		A116 J2	A125 J1	Option 31
62112-54		A117 J2	A126 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-70		A116 J3	A15 J3	Option 31

Table D-3. MS4642B – Part Number Sort (6 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-71		A117 J3	A15 J5	Option 31
62112-72		A118 J3	A15 J6	Option 31
62112-73		A119 J3	A15 J7	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
67354-1		A11 J21	A102 J3	All Models without Option 8x
67354-2		A11 J18	A103 J3	All Models without Option 8x
67354-3		A11 J15	A100 J3	All Models without Option 8x
67354-4		A11 J12	A101 J3	All Models without Option 8x
67354-1		A11 J21	A102 J3	All Models with Option 8x
67354-2		A11 J18	A103 J3	All Models with Option 8x
67354-3		A11 J15	A100 J3	All Models with Option 8x
67354-4		A11 J12	A101 J3	All Models with Option 8x
67355-15	ND71746	A13 J12	A18 J7	All MS4642B
67355-10	ND71752	A15 J22	A11 J20	All MS4642B
67355-13	ND71748	A13 J10	A11 J5	All MS4642B
67355-7	ND80053	A15 J13	A11 J11	All MS4642B
67355-8	ND71750	A15 J16	A11 J14	All MS4642B
67355-9	ND71751	A15 J20	A11 J17	All MS4642B
67355-16	ND80050	A13 J12	A18 J22	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35

Table D-3. MS4642B – Part Number Sort (7 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-36	ND80057	A15 J22	A12 J19	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
67355-37		A13 J17	A111 J6	All Models without Option 8x
67355-37		A13 J17	A111 J6	All Models with Option 8x
67356-10		RP LOCK STATUS	A17 P10	All MS4642B
67356-11		RP TRIG RDY	A17 P9	All MS4642B
67356-12		RP TRIG OUT	A17 P8	All MS4642B
67356-4		RP EXT 10M IN	A11 J3	All MS4642B
67356-5		RP EXT 10M OUT	A11 J4	All MS4642B
67356-6		RP EXT AN IN1	A11 J1	All MS4642B
67356-7		RP EXT AN IN2	A11 J2	All MS4642B
67356-8		RP EXT AN OUT	A13 J16	All MS4642B
67356-9		RP EXT TRIG	A17 P11	All MS4642B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-13	ND73939	RP EXT ALC	A13 J13	Option 83
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
67357-4		A108 J3	A105 J1	Standard
67357-5		A108 J2	A107 J1	Standard
67357-10		A106 J2	FP b2 OUT	Option 51
67357-11		A105 J3	FP S1 OUT	Option 51
67357-12		A107 J3	FP S2 OUT	Option 51
67357-4		A108 J3	A105 J1	Option 51
67357-5		A108 J2	A107 J1	Option 51
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 51
67357-7		A109 J2	FP a1 OUT	Option 51
67357-8		A110 J2	FP a2 OUT	Option 51
67357-10		A106 J2	FP b2 OUT	Option 61

Table D-3. MS4642B – Part Number Sort (8 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67357-12		A107 J3	FP S2 OUT	Option 61
67357-4		A108 J3	A105 J1	Option 61
67357-5		A108 J2	A107 J1	Option 61
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 61
67357-7		A109 J2	FP a1 OUT	Option 61
67357-8		A110 J2	FP a2 OUT	Option 61
67357-10		A106 J2	FP b2 OUT	Option 62
67357-4		A108 J3	A105 J1	Option 62
67357-5		A108 J2	A107 J1	Option 62
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 62
67357-7		A109 J2	FP a1 OUT	Option 62
67357-8		A110 J2	FP a2 OUT	Option 62
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B37391-154		A113 J2	A133 J1	Option 84
B37391-154		A113 J2	A133 J1	Option 85
B37391-155		A213 J2	A233 J1	Option 84
B37391-155		A213 J2	A233 J1	Option 85
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4642B

D-3 MS4644B Cable ID Lists

MS4644B – Sorted by Origin Connection Point

FP = Front Panel

RP = Rear Panel

Table D-4. MS4644B – Origin Connection Point Sort (1 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62111-10		A100 J1	FP b1 IN	Option 51
62111-10		A100 J1	FP b1 IN	Option 61
62111-3		A100 J1	A104 J2	Standard
62111-1		A100 J2	A111 J2	All MS4644B with Option 8x
62111-1		A100 J2	A111 J2	All MS4644B without Option 8x
62111-11		A101 J1	FP a1 IN	Option 51
62111-11		A101 J1	FP a1 IN	Option 61
62111-11		A101 J1	FP a1 IN	Option 62
62111-8		A101 J2	A111 J3	All MS4644B without Option 8x
62111-13		A102 J1	FP b2 IN	Option 51
62111-5		A102 J1	A106 J2	Standard
62111-9		A102 J2	A111 J4	All MS4644B with Option 8x
62111-9		A102 J2	A111 J4	All MS4644B without Option 8x
62111-12		A103 J1	FP a2 IN	Option 51
62111-12		A103 J1	FP a2 IN	Option 61
62111-12		A103 J1	FP a2 IN	Option 62
62111-2		A103 J2	A111 J5	All MS4644B without Option 8x
57989-23		A104 J2	FP b1 OUT	Option 51
57989-23		A104 J2	FP b1 OUT	Option 61
57989-23		A104 J2	FP b1 OUT	Option 62
62104-230		A105 J2	A109 J1	Option 32/Standard
62104-230		A105 J2	A109 J1	Option 32/51
62104-230		A105 J2	A109 J1	Option 32/61
62104-230		A105 J2	A109 J1	Option 32/62
62104-231		A105 J3	A128 J2	Standard
67357-11		A105 J3	FP S1 OUT	Option 51
57989-33		A105 J3	A142 J2	Option 32/Standard
67357-10		A106 J2	FP b2 OUT	Option 51
67357-10		A106 J2	FP b2 OUT	Option 61
67357-10		A106 J2	FP b2 OUT	Option 62
62104-232		A107 J3	A129 J2	Standard
67357-12		A107 J3	FP S2 OUT	Option 51
67357-12		A107 J3	FP S2 OUT	Option 61

Table D-4. MS4644B – Origin Connection Point Sort (2 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
57989-24		A107 J3	A241 J1	Option 32/Standard
67357-5		A108 J2	A107 J1	Option 51
67357-5		A108 J2	A107 J1	Option 61
67357-5		A108 J2	A107 J1	Option 62
67357-5		A108 J2	A107 J1	Standard
67357-4		A108 J3	A105 J1	Option 51
67357-4		A108 J3	A105 J1	Option 61
67357-4		A108 J3	A105 J1	Option 62
67357-4		A108 J3	A105 J1	Standard
62111-40		A109 J2	A101 J1	Standard
67357-7		A109 J2	FP a1 OUT	Option 51
67357-7		A109 J2	FP a1 OUT	Option 61
67357-7		A109 J2	FP a1 OUT	Option 62
62111-42		A109 J2	A101 J1	Option 32/Standard
57989-21		A109 J2	FP a1 OUT	Option 32/51
57989-21		A109 J2	FP a1 OUT	Option 32/61
57989-21		A109 J2	FP a1 OUT	Option 32/62
67354-4		A11 J12	A101 J3	All MS4644B with Option 8x
67354-4		A11 J12	A101 J3	All MS4644B without Option 8x
67354-3		A11 J15	A100 J3	All MS4644B with Option 8x
67354-3		A11 J15	A100 J3	All MS4644B without Option 8x
67354-2		A11 J18	A103 J3	All MS4644B with Option 8x
67354-2		A11 J18	A103 J3	All MS4644B without Option 8x
67354-1		A11 J21	A102 J3	All MS4644B with Option 8x
67354-1		A11 J21	A102 J3	All MS4644B without Option 8x
62111-41		A110 J2	A103 J1	Standard
67357-8		A110 J2	FP a2 OUT	Option 51
67357-8		A110 J2	FP a2 OUT	Option 61
67357-8		A110 J2	FP a2 OUT	Option 62
3-62111-47		A110 Pad at J2	A103 J1	Option 84/88
3-67357-238		A110 Pad at J2	FP a2 OUT	Option 85/89
3-803-104		A111 P1	A18 P5	All MS4644B
3-803-104		A111 P1	A18 P5	All MS4644B
57989-19		A112 J2	A105 J1	Option 31
57989-18		A112 J2	A108 J1	Option 51
57989-18		A112 J2	A108 J1	Option 61
57989-18		A112 J2	A108 J1	Option 62
57989-18		A112 J2	A108 J1	Standard
3-803-103		A112 P1	A18 P4	All MS4644B

Table D-4. MS4644B – Origin Connection Point Sort (3 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-62		A113 J2	A112 J1	Option 51
62112-62		A113 J2	A112 J1	Option 61
62112-62		A113 J2	A112 J1	Option 62
62112-62		A113 J2	A112 J1	Standard
3-803-104		A113 P1	A18 P6	All MS4644B
3-803-104		A113 P1	A18 P6	All MS4644B
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
62112-53		A116 J2	A125 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-36		A116 J2	RP S1 OUT	Option 51
62112-5		A116 J2	A125 J1	Option 61
62112-5		A116 J2	A125 J1	Option 62
62112-20		A116 J2	A118 J2	Standard
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-51		A116 J3	RP a1 OUT	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-40		A116 J3	RP a1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 62
62112-27		A116 J3	A15 J3	Standard
62112-54		A117 J2	A126 J1	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-34		A117 J2	RP S2 OUT	Option 51
62112-34		A117 J2	RP S2 OUT	Option 61
62112-11		A117 J2	A126 J1	Option 62
62112-21		A117 J2	A119 J2	Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-52		A117 J3	RP a2 OUT	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-41		A117 J3	RP a2 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 62
62112-28		A117 J3	A15 J5	Standard
62112-72		A118 J3	A15 J6	Option 31
62112-45		A118 J3	RP b1 OUT	Option 51

Table D-4. MS4644B – Origin Connection Point Sort (4 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-45		A118 J3	RP b1 OUT	Option 61
62112-45		A118 J3	RP b1 OUT	Option 62
62112-29		A118 J3	A15 J6	Standard
62112-73		A119 J3	A15 J7	Option 31
62112-43		A119 J3	RP b2 OUT	Option 51
62112-43		A119 J3	RP b2 OUT	Option 61
62112-43		A119 J3	RP b2 OUT	Option 62
62112-30		A119 J3	A15 J7	Standard
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
62111-14		A120 J2	A100 J1	Option 62
62111-15		A123 J2	A102 J1	Option 61
62111-15		A123 J2	A102 J1	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-12		A125 J2	RP S1 OUT	Option 61
62112-12		A125 J2	RP S1 OUT	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-26		A127 J2	A15 J7	Option 61
62112-26		A127 J2	A15 J7	Option 62
67355-13	ND71748	A13 J10	A11 J5	All MS4644B
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-15	ND71746	A13 J12	A18 J7	All MS4644B

Table D-4. MS4644B – Origin Connection Point Sort (5 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67355-16	ND80050	A13 J12	A18 J22	Option 31
62112-19		A13 J14	A113 J1	All MS4644B
67355-37		A13 J17	A111 J6	All MS4644B with Option 8x
67355-37		A13 J17	A111 J6	All MS4644B without Option 8x
62112-46		A13 J3	A14 J3	Option 31
62112-58		A13 J4	A111 J1	All MS4644B
62112-59		A13 J6	A15 J11 W/PAD	All MS4644B
62112-16		A13 J8	A115 J1	All MS4644B
62112-48		A13 J8	A116 J1	Option 31
62112-47		A13 J9	A14 J9	Option 31
57989-5		A131 J1	A111 J3	All MS4644B with Option 8x
57989-7		A131 J3	FP LO1	Option 82
57989-7		A131 J3	FP LO1	Option 83
57989-7		A131 J3	FP LO1	Option 84
57989-7		A131 J3	FP LO1	Option 85
57989-6		A132 J1	A111 J5	All MS4644B with Option 8x
57989-8		A132 J3	FP LO2	Option 82
57989-8		A132 J3	FP LO2	Option 83
57989-8		A132 J3	FP LO2	Option 84
57989-8		A132 J3	FP LO2	Option 85
57989-30		A133 J2	A108 J1	Option 82
57989-30		A133 J2	A108 J1	Option 83
57989-28		A133 J2	A105 J1	Option 84
57989-28		A133 J2	A105 J1	Option 85
57989-11		A133 J3	FP RF	Option 82
57989-11		A133 J3	FP RF	Option 83
57989-25		A133 J3	FP RF1	Option 84
57989-25		A133 J3	FP RF1	Option 85
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
67355-7	ND80053	A15 J13	A11 J11	All MS4644B
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-8	ND71750	A15 J16	A11 J14	All MS4644B
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-9	ND71751	A15 J20	A11 J17	All MS4644B
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-10	ND71752	A15 J22	A11 J20	All MS4644B

Table D-4. MS4644B – Origin Connection Point Sort (6 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67355-36	ND80057	A15 J22	A12 J19	Option 35
57989-20		A212 J2	A107 J1	Option 31
3-803-104		A212 P1	A18 P9	Option 31
62112-64		A213 J2	A212 J1	Option 31
3-803-132		A213 P1	A18 P10	Option 31
57989-29		A233 J2	A107 J1	Option 84
57989-29		A233 J2	A107 J1	Option 85
57989-27		A233 J3	FP RF2	Option 84
57989-27		A233 J3	FP RF2	Option 85
3-57989-16		A241 J2	A142 J3	Option 32/Standard
3-57989-16		A241 J2	A142 J3	Option 32/51
3-57989-16		A241 J2	A142 J3	Option 32/61
3-57989-16		A241 J2	A142 J3	Option 32/62
62104-229		A241 J3	A129 J2	Option 84
62104-229		A241 J3	A129 J2	Option 85
62104-229		A241 J3	A129 J2	Option 32/Standard
62104-229		A241 J3	A129 J2	Option 32/51
62104-229		A241 J3	A129 J2	Option 32/61
62104-229		A241 J3	A129 J2	Option 32/62
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4644B
67356-4		EXT 10M IN	A11 J3	All MS4644B
67356-5		EXT 10M OUT	A11 J4	All MS4644B
67356-6		EXT AN IN1	A11 J1	All MS4644B
67356-7		EXT AN IN2	A11 J2	All MS4644B
67356-8		EXT AN OUT	A13 J16	All MS4644B
67356-9		EXT TRIG	A17 P11	All MS4644B
57989-17		FP P1S IN	A142 J2	Option 32/51
57989-17		FP P1S IN	A142 J2	Option 32/61
57989-17		FP P1S IN	A142 J2	Option 32/62

Table D-4. MS4644B – Origin Connection Point Sort (7 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
57989-15		FP P2S IN	A241 J1	Option 85
57989-15		FP P2S IN	A241 J1	Option 32/51
57989-15		FP P2S IN	A241 J1	Option 32/61
57989-15		FP P2S IN	A241 J1	Option 32/62
62104-1		FP S1 IN	A128 J2	Option 51
62104-1		FP S1 IN	A128 J2	Option 61
62104-1		FP S1 IN	A128 J2	Option 62
62104-4		FP S2 IN	A129 J2	Option 51
62104-4		FP S2 IN	A129 J2	Option 61
62104-4		FP S2 IN	A129 J2	Option 62
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 51
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 61
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 62
3-806-175		MB2 P41	A18 P3	All MS4644B
3-806-185		MB2 P42	A18 J18	All MS4644B
3-803-107		MB2 P71	A17 P1	All MS4644B
3-803-107		MB2 P72	A17 P2	All MS4644B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 62
62112-24		RP a1 IN	A15 J3	Option 51
62112-24		RP a1 IN	A15 J3	Option 61
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 51
62112-25		RP a2 IN	A15 J5	Option 61
62112-25		RP a2 IN	A15 J5	Option 62
62112-33		RP b1 IN	A15 J6	Option 51
62112-33		RP b1 IN	A15 J6	Option 61
62112-10		RP b1 IN	A124 J1	Option 62
62112-35		RP b2 IN	A15 J7	Option 51
62112-9		RP b2 IN	A127 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84

Table D-4. MS4644B – Origin Connection Point Sort (8 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
62105-3	ND73937	RP IF A1	A11 J13	All MS4644B
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
62105-4	ND73938	RP IF A2	A11 J19	All MS4644B
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
62105-2	ND73935	RP IF B1	A11 J16	All MS4644B
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
62105-1	ND73936	RP IF B2	A11 J22	All MS4644B
67356-10		RP LOCK STATUS	A17 P10	All MS4644B
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 62
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
67356-12		RP TRIG OUT	A17 P8	All MS4644B
67356-11		RP TRIG RDY	A17 P9	All MS4644B

MS4644B – Sorted by Part Number

FP = Front Panel

RP = Rear Panel

Table D-5. MS4644B – Part Number Sort (1 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
3-803-103		A112 P1	A18 P4	All MS4644B
3-806-185		MB2 P42	A18 J18	All MS4644B
3-803-107		MB2 P71	A17 P1	All MS4644B
3-803-107		MB2 P72	A17 P2	All MS4644B
3-803-104		A113 P1	A18 P6	All MS4644B
3-803-104		A111 P1	A18 P5	All MS4644B
3-806-175		MB2 P41	A18 P3	All MS4644B
3-803-104		A113 P1	A18 P6	All MS4644B
3-803-104		A111 P1	A18 P5	All MS4644B
3-803-104		A212 P1	A18 P9	Option 31
3-803-132		A213 P1	A18 P10	Option 31
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-57989-16		A241 J2	A142 J3	Option 32/Standard
3-57989-16		A241 J2	A142 J3	Option 32/51
3-57989-16		A241 J2	A142 J3	Option 32/61
3-57989-16		A241 J2	A142 J3	Option 32/62

Table D-5. MS4644B – Part Number Sort (2 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
3-62111-47		A110 Pad at J2	A103 J1	Option 84/88
3-67357-238		A110 Pad at J2	FP a2 OUT	Option 84/85/88/89
57989-5		A131 J1	A111 J3	All MS4644B with Option 8x
57989-6		A132 J1	A111 J5	All MS4644B with Option 8x
57989-19		A112 J2	A105 J1	Option 31
57989-20		A212 J2	A107 J1	Option 31
57989-18		A112 J2	A108 J1	Option 51
57989-23		A104 J2	FP b1 OUT	Option 51
57989-18		A112 J2	A108 J1	Option 61
57989-23		A104 J2	FP b1 OUT	Option 61
57989-18		A112 J2	A108 J1	Option 62
57989-23		A104 J2	FP b1 OUT	Option 62
57989-11		A133 J3	FP RF	Option 82
57989-30		A133 J2	A108 J1	Option 82
57989-7		A131 J3	FP LO1	Option 82
57989-8		A132 J3	FP LO2	Option 82
57989-11		A133 J3	FP RF	Option 83
57989-30		A133 J2	A108 J1	Option 83
57989-7		A131 J3	FP LO1	Option 83
57989-8		A132 J3	FP LO2	Option 83
57989-25		A133 J3	FP RF1	Option 84
57989-27		A233 J3	FP RF2	Option 84
57989-28		A133 J2	A105 J1	Option 84
57989-29		A233 J2	A107 J1	Option 84
57989-7		A131 J3	FP LO1	Option 84
57989-8		A132 J3	FP LO2	Option 84
57989-15		FP P2S IN	A241 J1	Option 85
57989-25		A133 J3	FP RF1	Option 85
57989-27		A233 J3	FP RF2	Option 85
57989-28		A133 J2	A105 J1	Option 85
57989-29		A233 J2	A107 J1	Option 85
57989-7		A131 J3	FP LO1	Option 85
57989-8		A132 J3	FP LO2	Option 85
57989-18		A112 J2	A108 J1	Standard
57989-33		A105 J3	A142 J2	Option 32/Standard
57989-24		A107 J3	A241 J1	Option 32/Standard

Table D-5. MS4644B – Part Number Sort (3 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
57989-21		A109 J2	FP a1 OUT	Option 32/51
57989-21		A109 J2	FP a1 OUT	Option 32/61
57989-21		A109 J2	FP a1 OUT	Option 32/62
57989-17		FP P1S IN	A142 J2	Option 32/51
57989-17		FP P1S IN	A142 J2	Option 32/61
57989-17		FP P1S IN	A142 J2	Option 32/62
57989-15		FP P2S IN	A241 J1	Option 32/51
57989-15		FP P2S IN	A241 J1	Option 32/61
57989-15		FP P2S IN	A241 J1	Option 32/62
62104-1		FP S1 IN	A128 J2	Option 51
62104-4		FP S2 IN	A129 J2	Option 51
62104-1		FP S1 IN	A128 J2	Option 61
62104-4		FP S2 IN	A129 J2	Option 61
62104-1		FP S1 IN	A128 J2	Option 62
62104-4		FP S2 IN	A129 J2	Option 62
62104-229		A241 J3	A129 J2	Option 84
62104-229		A241 J3	A129 J2	Option 85
62104-231		A105 J3	A128 J2	Standard
62104-232		A107 J3	A129 J2	Standard
62104-230		A105 J2	A109 J1	Option 32/Standard
62104-230		A105 J2	A109 J1	Option 32/51
62104-230		A105 J2	A109 J1	Option 32/61
62104-230		A105 J2	A109 J1	Option 32/62
62104-229		A241 J3	A129 J2	Option 32/Standard
62104-229		A241 J3	A129 J2	Option 32/51
62104-229		A241 J3	A129 J2	Option 32/61
62104-229		A241 J3	A129 J2	Option 32/62
62105-1	ND73936	RP IF B2	A11 J22	All MS4644B
62105-2	ND73935	RP IF B1	A11 J16	All MS4644B
62105-3	ND73937	RP IF A1	A11 J13	All MS4644B
62105-4	ND73938	RP IF A2	A11 J19	All MS4644B
62111-1		A100 J2	A111 J2	All MS4644B with Option 8x
62111-9		A102 J2	A111 J4	All MS4644B with Option 8x
62111-1		A100 J2	A111 J2	All MS4644B without Option 8x
62111-2		A103 J2	A111 J5	All MS4644B without Option 8x
62111-8		A101 J2	A111 J3	All MS4644B without Option 8x
62111-9		A102 J2	A111 J4	All MS4644B without Option 8x
62111-10		A100 J1	FP b1 IN	Option 51
62111-11		A101 J1	FP a1 IN	Option 51

Table D-5. MS4644B – Part Number Sort (4 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62111-12		A103 J1	FP a2 IN	Option 51
62111-13		A102 J1	FP b2 IN	Option 51
62111-10		A100 J1	FP b1 IN	Option 61
62111-11		A101 J1	FP a1 IN	Option 61
62111-12		A103 J1	FP a2 IN	Option 61
62111-15		A123 J2	A102 J1	Option 61
62111-11		A101 J1	FP a1 IN	Option 62
62111-12		A103 J1	FP a2 IN	Option 62
62111-14		A120 J2	A100 J1	Option 62
62111-15		A123 J2	A102 J1	Option 62
62111-3		A100 J1	A104 J2	Standard
62111-40		A109 J2	A101 J1	Standard
62111-41		A110 J2	A103 J1	Standard
62111-5		A102 J1	A106 J2	Standard
62111-42		A109 J2	A101 J1	Option 32/Standard
62112-16		A13 J8	A115 J1	All MS4644B
62112-19		A13 J14	A113 J1	All MS4644B
62112-58		A13 J4	A111 J1	All MS4644B
62112-59		A13 J6	A15 J11 W/PAD	All MS4644B
62112-46		A13 J3	A14 J3	Option 31
62112-47		A13 J9	A14 J9	Option 31
62112-48		A13 J8	A116 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-51		A116 J3	RP a1 OUT	Option 31
62112-52		A117 J3	RP a2 OUT	Option 31
62112-53		A116 J2	A125 J1	Option 31
62112-54		A117 J2	A126 J1	Option 31
62112-64		A213 J2	A212 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-72		A118 J3	A15 J6	Option 31
62112-73		A119 J3	A15 J7	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31

Table D-5. MS4644B – Part Number Sort (5 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-24		RP a1 IN	A15 J3	Option 51
62112-25		RP a2 IN	A15 J5	Option 51
62112-33		RP b1 IN	A15 J6	Option 51
62112-34		A117 J2	RP S2 OUT	Option 51
62112-35		RP b2 IN	A15 J7	Option 51
62112-36		A116 J2	RP S1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-43		A119 J3	RP b2 OUT	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-45		A118 J3	RP b1 OUT	Option 51
62112-62		A113 J2	A112 J1	Option 51
62112-12		A125 J2	RP S1 OUT	Option 61
62112-24		RP a1 IN	A15 J3	Option 61
62112-25		RP a2 IN	A15 J5	Option 61
62112-26		A127 J2	A15 J7	Option 61
62112-33		RP b1 IN	A15 J6	Option 61
62112-34		A117 J2	RP S2 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-43		A119 J3	RP b2 OUT	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-45		A118 J3	RP b1 OUT	Option 61
62112-5		A116 J2	A125 J1	Option 61
62112-62		A113 J2	A112 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-10		RP b1 IN	A124 J1	Option 62
62112-11		A117 J2	A126 J1	Option 62
62112-12		A125 J2	RP S1 OUT	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 62

Table D-5. MS4644B – Part Number Sort (6 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
62112-26		A127 J2	A15 J7	Option 62
62112-40		A116 J3	RP a1 OUT	Option 62
62112-41		A117 J3	RP a2 OUT	Option 62
62112-42		RP SRC2 IN	A119 J2	Option 62
62112-43		A119 J3	RP b2 OUT	Option 62
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-45		A118 J3	RP b1 OUT	Option 62
62112-5		A116 J2	A125 J1	Option 62
62112-62		A113 J2	A112 J1	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-9		RP b2 IN	A127 J1	Option 62
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-20		A116 J2	A118 J2	Standard
62112-21		A117 J2	A119 J2	Standard
62112-27		A116 J3	A15 J3	Standard
62112-28		A117 J3	A15 J5	Standard
62112-29		A118 J3	A15 J6	Standard
62112-30		A119 J3	A15 J7	Standard
62112-62		A113 J2	A112 J1	Standard
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
67354-1		A11 J21	A102 J3	All MS4644B with Option 8x
67354-2		A11 J18	A103 J3	All MS4644B with Option 8x
67354-3		A11 J15	A100 J3	All MS4644B with Option 8x
67354-4		A11 J12	A101 J3	All MS4644B with Option 8x
67354-1		A11 J21	A102 J3	All MS4644B without Option 8x
67354-2		A11 J18	A103 J3	All MS4644B without Option 8x
67354-3		A11 J15	A100 J3	All MS4644B without Option 8x
67354-4		A11 J12	A101 J3	All MS4644B without Option 8x
67355-15	ND71746	A13 J12	A18 J7	All MS4644B
67355-10	ND71752	A15 J22	A11 J20	All MS4644B
67355-13	ND71748	A13 J10	A11 J5	All MS4644B
67355-7	ND80053	A15 J13	A11 J11	All MS4644B
67355-8	ND71750	A15 J16	A11 J14	All MS4644B

Table D-5. MS4644B – Part Number Sort (7 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67355-9	ND71751	A15 J20	A11 J17	All MS4644B
67355-37		A13 J17	A111 J6	All MS4644B with Option 8x
67355-37		A13 J17	A111 J6	All MS4644B without Option 8x
67355-16	ND80050	A13 J12	A18 J22	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-36	ND80057	A15 J22	A12 J19	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
67356-10		RP LOCK STATUS	A17 P10	All MS4644B
67356-11		RP TRIG RDY	A17 P9	All MS4644B
67356-12		RP TRIG OUT	A17 P8	All MS4644B
67356-4		EXT 10M IN	A11 J3	All MS4644B
67356-5		EXT 10M OUT	A11 J4	All MS4644B
67356-6		EXT AN IN1	A11 J1	All MS4644B
67356-7		EXT AN IN2	A11 J2	All MS4644B
67356-8		EXT AN OUT	A13 J16	All MS4644B
67356-9		EXT TRIG	A17 P11	All MS4644B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84

Table D-5. MS4644B – Part Number Sort (8 of 8)

Part Number	ND Part Number	Origin Connection Point	Destination Connection Point	Cable Used In
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
67357-10		A106 J2	FP b2 OUT	Option 51
67357-11		A105 J3	FP S1 OUT	Option 51
67357-12		A107 J3	FP S2 OUT	Option 51
67357-4		A108 J3	A105 J1	Option 51
67357-5		A108 J2	A107 J1	Option 51
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 51
67357-7		A109 J2	FP a1 OUT	Option 51
67357-8		A110 J2	FP a2 OUT	Option 51
67357-10		A106 J2	FP b2 OUT	Option 61
67357-12		A107 J3	FP S2 OUT	Option 61
67357-4		A108 J3	A105 J1	Option 61
67357-5		A108 J2	A107 J1	Option 61
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 61
67357-7		A109 J2	FP a1 OUT	Option 61
67357-8		A110 J2	FP a2 OUT	Option 61
67357-10		A106 J2	FP b2 OUT	Option 62
67357-4		A108 J3	A105 J1	Option 62
67357-5		A108 J2	A107 J1	Option 62
67357-6 or 3-67357-6		FP Semi Rigid, K M/M Loop		Option 62
67357-7		A109 J2	FP a1 OUT	Option 62
67357-8		A110 J2	FP a2 OUT	Option 62
67357-4		A108 J3	A105 J1	Standard
67357-5		A108 J2	A107 J1	Standard
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4644B

D-4 MS4645B Cable ID Lists

MS4645B – Sorted by Origin Connection Point

FP = Front Panel

RP = Rear Panel

Table D-6. MS4645B – Origin Connection Point Sort (1 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62107-2		A100 J1	A120 J2	Option 62
62111-1		A100 J2	A111 J2	All Models with Option 8x
62111-1		A100 J2	A111 J2	All Models without Option 8x
62111-8		A101 J2	A111 J3	All Models without Option 8x
62107-3		A102 J1	A123 J2	Option 61
62107-3		A102 J1	A123 J2	Option 62
62111-9		A102 J2	A111 J4	All Models with Option 8x
62111-9		A102 J2	A111 J4	All Models without Option 8x
62111-2		A103 J2	A111 J5	All Models without Option 8x
62109-2		A104 J2	A100 J1	Standard
62109-44		A104 J2	FP b1 OUT	Option 51
62109-44		A104 J2	FP b1 OUT	Option 61
62109-44		A104 J2	FP b1 OUT	Option 62
62107-8		A105 J2	A109 J1	Option 32/Standard
62107-8		A105 J2	A109 J1	Option 32/51
62107-8		A105 J2	A109 J1	Option 32/61
62107-8		A105 J2	A109 J1	Option 32/62
62107-10		A105 J3	A128 J2	Standard
62109-19		A105 J3	FP S1 OUT	Option 51
62109-48		A105 J3	A142 J2	Option 32/Standard
62109-3		A106 J2	A102 J1	Standard
62109-10		A106 J2	FP b2 OUT	Option 51
62109-10		A106 J2	FP b2 OUT	Option 61
62109-10		A106 J2	FP b2 OUT	Option 62
62107-11		A107 J3	A129 J2	Standard
62109-8		A107 J3	FP S2 OUT	Option 51
62109-8		A107 J3	FP S2 OUT	Option 61
62109-45		A107 J3	A241 J1	Option 84
62109-45		A107 J3	A241 J1	Option 32/Standard
62109-35		A108 J1	A114 J3	Standard
62109-35		A108 J1	A114 J3	Option 51
62109-35		A108 J1	A114 J3	Option 61
62109-35		A108 J1	A114 J3	Option 62

Table D-6. MS4645B – Origin Connection Point Sort (2 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62111-37		A108 J2	A112 J2	Standard
62111-37		A108 J2	A112 J2	Option 51
62111-37		A108 J2	A112 J2	Option 61
62111-37		A108 J2	A112 J2	Option 62
62111-38		A108 J2	A133 J2	Option 82
62111-38		A108 J2	A133 J2	Option 82
62109-12		A108 J3	A107 J1	Standard
62109-12		A108 J3	A107 J1	Option 51
62109-12		A108 J3	A107 J1	Option 61
62109-12		A108 J3	A107 J1	Option 62
62109-13		A108 J4	A105 J1	Standard
62109-13		A108 J4	A105 J1	Option 51
62109-13		A108 J4	A105 J1	Option 61
62109-13		A108 J4	A105 J1	Option 62
62109-49		A109 J2	A101 J1	Standard
62109-17		A109 J2	FP a1 OUT	Option 51
62109-17		A109 J2	FP a1 OUT	Option 61
62109-17		A109 J2	FP a1 OUT	Option 62
62109-46		A109 J2	A101 J1	Option 32/Standard
3-62109-41		A109 J2	FP a1 OUT	Option 32/51
3-62109-41		A109 J2	FP a1 OUT	Option 32/61
3-62109-41		A109 J2	FP a1 OUT	Option 32/62
67354-4		A11 J12	A101 J3	All Models with Option 8x
67354-4		A11 J12	A101 J3	All Models without Option 8x
67354-3		A11 J15	A100 J3	All Models with Option 8x
67354-3		A11 J15	A100 J3	All Models without Option 8x
67354-2		A11 J18	A103 J3	All Models with Option 8x
67354-2		A11 J18	A103 J3	All Models without Option 8x
67354-1		A11 J21	A102 J3	All Models with Option 8x
67354-1		A11 J21	A102 J3	All Models without Option 8x
62109-47		A110 J2	A103 J1	Standard
62109-18		A110 J2	FP a2 OUT	Option 51
62109-18		A110 J2	FP a2 OUT	Option 61
62109-18		A110 J2	FP a2 OUT	Option 62
3-62109-230		A110 Pad at J2	A103 J1	Option 84/88
3-62109-229		A110 Pad at J2	FP a2 OUT	Option 85/89
3-803-104		A111 P1	A18 P5	All MS4645B
57989-12		A112 J2	A140 J2	Option 31
3-803-103		A112 P1	A18 P4	All MS4645B

Table D-6. MS4645B – Origin Connection Point Sort (3 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-38		A113 J2	A114 J1	All MS4645B
3-803-104		A113 P1	A18 P6	All MS4645B
62112-39		A114 J2	A112 J1	All MS4645B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
62112-20		A116 J2	A118 J2	Standard
62112-36		A116 J2	RP S1 OUT	Option 51
62112-5		A116 J2	A125 J1	Option 61
62112-5		A116 J2	A125 J1	Option 62
62112-53		A116 J2	A125 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-27		A116 J3	A15 J3	Standard
62112-40		A116 J3	RP a1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 62
62112-51		A116 J3	RP a1 OUT	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-21		A117 J2	A119 J2	Standard
62112-34		A117 J2	RP S2 OUT	Option 51
62112-34		A117 J2	RP S2 OUT	Option 61
62112-11		A117 J2	A126 J1	Option 62
62112-54		A117 J2	A126 J1	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-28		A117 J3	A15 J5	Standard
62112-41		A117 J3	RP a2 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 62
62112-52		A117 J3	RP a2 OUT	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-29		A118 J3	A15 J6	Standard
62112-45		A118 J3	RP b1 OUT	Option 51
62112-45		A118 J3	RP b1 OUT	Option 61
62112-45		A118 J3	RP b1 OUT	Option 62

Table D-6. MS4645B – Origin Connection Point Sort (4 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-72		A118 J3	A15 J6	Option 31
62112-30		A119 J3	A15 J7	Standard
62112-43		A119 J3	RP b2 OUT	Option 51
62112-43		A119 J3	RP b2 OUT	Option 61
62112-43		A119 J3	RP b2 OUT	Option 62
62112-73		A119 J3	A15 J7	Option 31
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
62112-23		A124 J2	A15 J6	Option 62
62112-12		A125 J2	RP S1 OUT	Option 61
62112-12		A125 J2	RP S1 OUT	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-26		A127 J2	A15 J7	Option 61
62112-26		A127 J2	A15 J7	Option 62
67355-13	ND71748	A13 J10	A11 J5	All MS4645B
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-15	ND71746	A13 J12	A18 J7	All MS4645B
67355-16	ND80050	A13 J12	A18 J22	Option 31
62112-19		A13 J14	A113 J1	All MS4645B
67355-14	ND71747	A13 J15	A18 J12	All MS4645B
67355-37		A13 J17	A111 J6	All Models with Option 8x
67355-37		A13 J17	A111 J6	All Models without Option 8x

Table D-6. MS4645B – Origin Connection Point Sort (5 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-46		A13 J3	A14 J3	Option 31
62112-58		A13 J4	A111 J1	All MS4645B
62112-59		A13 J6	A15 J11 W/PAD	All MS4645B
62112-16		A13 J8	A115 J1	All MS4645B
62112-48		A13 J8	A116 J1	Option 31
62112-47		A13 J9	A14 J9	Option 31
57989-5		A131 J1	A111 J3	All Models with Option 8x
57989-7		A131 J3	FP LO1	Option 82
57989-7		A131 J3	FP LO1	Option 82
57989-7		A131 J3	FP LO1	Option 84
57989-7		A131 J3	FP LO1	Option 85
57989-6		A132 J1	A111 J5	All Models with Option 8x
57989-8		A132 J3	FP LO2	Option 82
57989-8		A132 J3	FP LO2	Option 82
57989-8		A132 J3	FP LO2	Option 84
57989-8		A132 J3	FP LO2	Option 85
57989-14		A133 J2	A140 J2	Option 84
57989-14		A133 J2	A140 J2	Option 85
57989-11		A133 J3	FP RF	Option 82
57989-11		A133 J3	FP RF	Option 82
57989-25		A133 J3	FP RF1	Option 84
57989-25		A133 J3	FP RF1	Option 85
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
62112-50		A14 J14	A213 J1	Option 31
67355-18	ND80069	A14 J15	A18 J24	Option 31
62112-49		A14 J8	A117 J1	Option 31
62109-36		A140 J3	A105 J1	Option 31
67355-7	ND80053	A15 J13	A11 J11	All MS4645B
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-8	ND71750	A15 J16	A11 J14	All MS4645B
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-9	ND71751	A15 J20	A11 J17	All MS4645B
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-10	ND71752	A15 J22	A11 J20	All MS4645B
67355-36	ND80057	A15 J22	A12 J19	Option 35
57989-13		A212 J2	A240 J2	Option 31
3-803-104		A212 P1	A18 P9	Option 31
62112-55		A213 J2	A214 J1	Option 31

Table D-6. MS4645B – Origin Connection Point Sort (6 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-803-132		A213 P1	A18 P10	Option 31
67383-6	ND80070	A214	A18 J27	Option 31
62112-56		A214 J2	A212 J1	Option 31
57989-26		A233 J2	A240 J2	Option 84
57989-26		A233 J2	A240 J2	Option 85
57989-27		A233 J3	FP RF2	Option 84
57989-27		A233 J3	FP RF2	Option 85
62109-37		A240 J3	A107 J1	Option 31
3-62109-39		A241 J2	A142 J3	Option 32/Standard
3-62109-39		A241 J2	A142 J3	Option 32/51
3-62109-39		A241 J2	A142 J3	Option 32/61
3-62109-39		A241 J2	A142 J3	Option 32/62
62107-7		A241 J3	A129 J2	Option 84
62107-7		A241 J3	A129 J2	Option 85
62107-7		A241 J3	A129 J2	Option 32/Standard
62107-7		A241 J3	A129 J2	Option 32/51
62107-7		A241 J3	A129 J2	Option 32/61
62107-7		A241 J3	A129 J2	Option 32/62
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
67356-4		EXT 10M IN	A11 J3	All MS4645B
67356-5		EXT 10M OUT	A11 J4	All MS4645B
67356-6		EXT AN IN1	A11 J1	All MS4645B
67356-7		EXT AN IN2	A11 J2	All MS4645B
67356-8		EXT AN OUT	A13 J16	All MS4645B
67356-9		EXT TRIG	A17 P11	All MS4645B
62109-6		FP a1 IN	A101 J1	Option 51
62109-6		FP a1 IN	A101 J1	Option 61
62109-6		FP a1 IN	A101 J1	Option 62
62109-7		FP a2 IN	A103 J1	Option 51
62109-7		FP a2 IN	A103 J1	Option 61

Table D-6. MS4645B – Origin Connection Point Sort (7 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62109-7		FP a2 IN	A103 J1	Option 62
62109-5		FP b1 IN	A100 J1	Option 51
62109-5		FP b1 IN	A100 J1	Option 61
62109-20		FP b2 IN	A102 J1	Option 51
3-62109-40		FP P1S IN	A142 J2	Option 32/51
3-62109-40		FP P1S IN	A142 J2	Option 32/61
3-62109-40		FP P1S IN	A142 J2	Option 32/62
62109-38		FP P2S IN	A241 J1	Option 85
62109-38		FP P2S IN	A241 J1	Option 32/51
62109-38		FP P2S IN	A241 J1	Option 32/61
62109-38		FP P2S IN	A241 J1	Option 32/62
62107-1		FP S1 IN	A128 J2	Option 51
62107-1		FP S1 IN	A128 J2	Option 61
62107-1		FP S1 IN	A128 J2	Option 62
62107-4		FP S2 IN	A129 J2	Option 51
62107-4		FP S2 IN	A129 J2	Option 61
62107-4		FP S2 IN	A129 J2	Option 62
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 51
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 61
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 62
67356-10		LOCK STATUS	A17 P10	All MS4645B
3-806-175		MB2 P41	A18 P3	All MS4645B
3-806-185		MB2 P42	A18 J18	All MS4645B
3-803-107		MB2 P71	A17 P1	All MS4645B
3-803-107		MB2 P72	A17 P2	All MS4645B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 62
62112-24		RP a1 IN	A15 J3	Option 51
62112-24		RP a1 IN	A15 J3	Option 61
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 51
62112-25		RP a2 IN	A15 J5	Option 61
62112-25		RP a2 IN	A15 J5	Option 62
62112-33		RP b1 IN	A15 J6	Option 51
62112-33		RP b1 IN	A15 J6	Option 61

Table D-6. MS4645B – Origin Connection Point Sort (8 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-10		RP b1 IN	A124 J1	Option 62
62112-35		RP b2 IN	A15 J7	Option 51
62112-9		RP b2 IN	A127 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
B41929		RP Fan Screw	Back Panel Ground	All MS4645B
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
62105-3	ND73937	RP IF A1	A11 J13	All MS4645B
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
62105-4	ND73938	RP IF A2	A11 J19	All MS4645B
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
62105-2	ND73935	RP IF B1	A11 J16	All MS4645B
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
62105-1	ND73936	RP IF B2	A11 J22	All MS4645B
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 62
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51

Table D-6. MS4645B – Origin Connection Point Sort (9 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
67356-12		TRIG OUT	A17 P8	All MS4645B
67356-11		TRIG RDY	A17 P9	All MS4645B
67367		USB A STRAIGHT TO 1X5		All MS4645B

MS4645B – Sorted by Part Number

FP = Front Panel

RP = Rear Panel

Table D-7. MS4645B – Part Number Sort (1 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-806-185		MB2 P42	A18 J18	All MS4645B
3-803-107		MB2 P71	A17 P1	All MS4645B
3-803-107		MB2 P72	A17 P2	All MS4645B
3-803-104		A113 P1	A18 P6	All MS4645B
3-803-104		A111 P1	A18 P5	All MS4645B
3-806-175		MB2 P41	A18 P3	All MS4645B
3-803-103		A112 P1	A18 P4	All MS4645B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	Option 51
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
3-803-104		A212 P1	A18 P9	Option 31
3-803-132		A213 P1	A18 P10	Option 31
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-62109-41		A109 J2	FP a1 OUT	Option 32/51
3-62109-41		A109 J2	FP a1 OUT	Option 32/61
3-62109-41		A109 J2	FP a1 OUT	Option 32/62
3-62109-39		A241 J2	A142 J3	Option 32/Standard
3-62109-39		A241 J2	A142 J3	Option 32/51

Table D-7. MS4645B – Part Number Sort (2 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-62109-39		A241 J2	A142 J3	Option 32/61
3-62109-39		A241 J2	A142 J3	Option 32/62
3-62109-40		FP P1S IN	A142 J2	Option 32/51
3-62109-40		FP P1S IN	A142 J2	Option 32/61
3-62109-40		FP P1S IN	A142 J2	Option 32/62
3-62109-229		A110 Pad at J2	FP a2 OUT	Option 85/89
3-62109-230		A110 Pad at J2	A103 J1	Option 84/88
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
57989-12		A112 J2	A140 J2	Option 31
57989-13		A212 J2	A240 J2	Option 31
57989-11		A133 J3	FP RF	Option 82
57989-7		A131 J3	FP LO1	Option 82
57989-8		A132 J3	FP LO2	Option 82
57989-11		A133 J3	FP RF	Option 82
57989-7		A131 J3	FP LO1	Option 82
57989-8		A132 J3	FP LO2	Option 82
57989-14		A133 J2	A140 J2	Option 84
57989-25		A133 J3	FP RF1	Option 84
57989-26		A233 J2	A240 J2	Option 84
57989-27		A233 J3	FP RF2	Option 84
57989-7		A131 J3	FP LO1	Option 84
57989-8		A132 J3	FP LO2	Option 84
57989-14		A133 J2	A140 J2	Option 85
57989-25		A133 J3	FP RF1	Option 85
57989-26		A233 J2	A240 J2	Option 85
57989-27		A233 J3	FP RF2	Option 85
57989-7		A131 J3	FP LO1	Option 85
57989-8		A132 J3	FP LO2	Option 85
57989-5		A131 J1	A111 J3	All Models with Option 8x
57989-6		A132 J1	A111 J5	All Models with Option 8x
62105-1	ND73936	RP IF B2	A11 J22	All MS4645B
62105-2	ND73935	RP IF B1	A11 J16	All MS4645B
62105-3	ND73937	RP IF A1	A11 J13	All MS4645B
62105-4	ND73938	RP IF A2	A11 J19	All MS4645B
62107-10		A105 J3	A128 J2	Standard
62107-11		A107 J3	A129 J2	Standard
62107-1		FP S1 IN	A128 J2	Option 51

Table D-7. MS4645B – Part Number Sort (3 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62107-4		FP S2 IN	A129 J2	Option 51
62107-1		FP S1 IN	A128 J2	Option 61
62107-3		A102 J1	A123 J2	Option 61
62107-4		FP S2 IN	A129 J2	Option 61
62107-1		FP S1 IN	A128 J2	Option 62
62107-2		A100 J1	A120 J2	Option 62
62107-3		A102 J1	A123 J2	Option 62
62107-4		FP S2 IN	A129 J2	Option 62
62107-7		A241 J3	A129 J2	Option 84
62107-7		A241 J3	A129 J2	Option 85
62107-8		A105 J2	A109 J1	Option 32/Standard
62107-8		A105 J2	A109 J1	Option 32/51
62107-8		A105 J2	A109 J1	Option 32/61
62107-8		A105 J2	A109 J1	Option 32/62
62107-7		A241 J3	A129 J2	Option 32/Standard
62107-7		A241 J3	A129 J2	Option 32/51
62107-7		A241 J3	A129 J2	Option 32/61
62107-7		A241 J3	A129 J2	Option 32/62
62109-12		A108 J3	A107 J1	Standard
62109-13		A108 J4	A105 J1	Standard
62109-2		A104 J2	A100 J1	Standard
62109-3		A106 J2	A102 J1	Standard
62109-35		A108 J1	A114 J3	Standard
62109-47		A110 J2	A103 J1	Standard
62109-49		A109 J2	A101 J1	Standard
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 51
62109-10		A106 J2	FP b2 OUT	Option 51
62109-12		A108 J3	A107 J1	Option 51
62109-13		A108 J4	A105 J1	Option 51
62109-17		A109 J2	FP a1 OUT	Option 51
62109-18		A110 J2	FP a2 OUT	Option 51
62109-19		A105 J3	FP S1 OUT	Option 51
62109-20		FP b2 IN	A102 J1	Option 51
62109-35		A108 J1	A114 J3	Option 51
62109-44		A104 J2	FP b1 OUT	Option 51
62109-5		FP b1 IN	A100 J1	Option 51
62109-6		FP a1 IN	A101 J1	Option 51
62109-7		FP a2 IN	A103 J1	Option 51

Table D-7. MS4645B – Part Number Sort (4 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62109-8		A107 J3	FP S2 OUT	Option 51
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 61
62109-10		A106 J2	FP b2 OUT	Option 61
62109-12		A108 J3	A107 J1	Option 61
62109-13		A108 J4	A105 J1	Option 61
62109-17		A109 J2	FP a1 OUT	Option 61
62109-18		A110 J2	FP a2 OUT	Option 61
62109-35		A108 J1	A114 J3	Option 61
62109-44		A104 J2	FP b1 OUT	Option 61
62109-5		FP b1 IN	A100 J1	Option 61
62109-6		FP a1 IN	A101 J1	Option 61
62109-7		FP a2 IN	A103 J1	Option 61
62109-8		A107 J3	FP S2 OUT	Option 61
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 62
62109-10		A106 J2	FP b2 OUT	Option 62
62109-12		A108 J3	A107 J1	Option 62
62109-13		A108 J4	A105 J1	Option 62
62109-17		A109 J2	FP a1 OUT	Option 62
62109-18		A110 J2	FP a2 OUT	Option 62
62109-35		A108 J1	A114 J3	Option 62
62109-44		A104 J2	FP b1 OUT	Option 62
62109-6		FP a1 IN	A101 J1	Option 62
62109-7		FP a2 IN	A103 J1	Option 62
62109-36		A140 J3	A105 J1	Option 31
62109-37		A240 J3	A107 J1	Option 31
62109-45		A107 J3	A241 J1	Option 84
62109-38		FP P2S IN	A241 J1	Option 85
62109-48		A105 J3	A142 J2	Option 32/Standard
62109-45		A107 J3	A241 J1	Option 32/Standard
62109-46		A109 J2	A101 J1	Option 32/Standard
62109-38		FP P2S IN	A241 J1	Option 32/51
62109-38		FP P2S IN	A241 J1	Option 32/61
62109-38		FP P2S IN	A241 J1	Option 32/62
62111-37		A108 J2	A112 J2	Standard
62111-37		A108 J2	A112 J2	Option 51
62111-37		A108 J2	A112 J2	Option 61
62111-37		A108 J2	A112 J2	Option 62

Table D-7. MS4645B – Part Number Sort (5 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62111-38		A108 J2	A133 J2	Option 82
62111-38		A108 J2	A133 J2	Option 82
62111-1		A100 J2	A111 J2	All Models with Option 8x
62111-9		A102 J2	A111 J4	All Models with Option 8x
62111-1		A100 J2	A111 J2	All Models without Option 8x
62111-2		A103 J2	A111 J5	All Models without Option 8x
62111-8		A101 J2	A111 J3	All Models without Option 8x
62111-9		A102 J2	A111 J4	All Models without Option 8x
62112-16		A13 J8	A115 J1	All MS4645B
62112-19		A13 J14	A113 J1	All MS4645B
62112-58		A13 J4	A111 J1	All MS4645B
62112-59		A13 J6	A15 J11 W/PAD	All MS4645B
62112-38		A113 J2	A114 J1	All MS4645B
62112-39		A114 J2	A112 J1	All MS4645B
62112-20		A116 J2	A118 J2	Standard
62112-21		A117 J2	A119 J2	Standard
62112-27		A116 J3	A15 J3	Standard
62112-28		A117 J3	A15 J5	Standard
62112-29		A118 J3	A15 J6	Standard
62112-30		A119 J3	A15 J7	Standard
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-24		RP a1 IN	A15 J3	Option 51
62112-25		RP a2 IN	A15 J5	Option 51
62112-33		RP b1 IN	A15 J6	Option 51
62112-34		A117 J2	RP S2 OUT	Option 51
62112-35		RP b2 IN	A15 J7	Option 51
62112-36		A116 J2	RP S1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-43		A119 J3	RP b2 OUT	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-45		A118 J3	RP b1 OUT	Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-12		A125 J2	RP S1 OUT	Option 61
62112-24		RP a1 IN	A15 J3	Option 61
62112-25		RP a2 IN	A15 J5	Option 61

Table D-7. MS4645B – Part Number Sort (6 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-26		A127 J2	A15 J7	Option 61
62112-33		RP b1 IN	A15 J6	Option 61
62112-34		A117 J2	RP S2 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-43		A119 J3	RP b2 OUT	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-45		A118 J3	RP b1 OUT	Option 61
62112-5		A116 J2	A125 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-10		RP b1 IN	A124 J1	Option 62
62112-11		A117 J2	A126 J1	Option 62
62112-12		A125 J2	RP S1 OUT	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 62
62112-26		A127 J2	A15 J7	Option 62
62112-40		A116 J3	RP a1 OUT	Option 62
62112-41		A117 J3	RP a2 OUT	Option 62
62112-42		RP SRC2 IN	A119 J2	Option 62
62112-43		A119 J3	RP b2 OUT	Option 62
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-45		A118 J3	RP b1 OUT	Option 62
62112-5		A116 J2	A125 J1	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-9		RP b2 IN	A127 J1	Option 62
62112-46		A13 J3	A14 J3	Option 31
62112-47		A13 J9	A14 J9	Option 31
62112-48		A13 J8	A116 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-51		A116 J3	RP a1 OUT	Option 31
62112-52		A117 J3	RP a2 OUT	Option 31
62112-53		A116 J2	A125 J1	Option 31
62112-54		A117 J2	A126 J1	Option 31
62112-55		A213 J2	A214 J1	Option 31

Table D-7. MS4645B – Part Number Sort (7 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-56		A214 J2	A212 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-72		A118 J3	A15 J6	Option 31
62112-73		A119 J3	A15 J7	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-76		A116 J2	A144 J2	Option 32/Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
67354-1		A11 J21	A102 J3	All Models with Option 8x
67354-2		A11 J18	A103 J3	All Models with Option 8x
67354-3		A11 J15	A100 J3	All Models with Option 8x
67354-4		A11 J12	A101 J3	All Models with Option 8x
67354-1		A11 J21	A102 J3	All Models without Option 8x
67354-2		A11 J18	A103 J3	All Models without Option 8x
67354-3		A11 J15	A100 J3	All Models without Option 8x
67354-4		A11 J12	A101 J3	All Models without Option 8x
67355-14	ND71747	A13 J15	A18 J12	All MS4645B
67355-15	ND71746	A13 J12	A18 J7	All MS4645B
67355-10	ND71752	A15 J22	A11 J20	All MS4645B
67355-13	ND71748	A13 J10	A11 J5	All MS4645B
67355-7	ND80053	A15 J13	A11 J11	All MS4645B
67355-8	ND71750	A15 J16	A11 J14	All MS4645B
67355-9	ND71751	A15 J20	A11 J17	All MS4645B
67355-16	ND80050	A13 J12	A18 J22	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
67355-18	ND80069	A14 J15	A18 J24	Option 31
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35

Table D-7. MS4645B – Part Number Sort (8 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-36	ND80057	A15 J22	A12 J19	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
67355-37		A13 J17	A111 J6	All Models with Option 8x
67355-37		A13 J17	A111 J6	All Models without Option 8x
67356-10		LOCK STATUS	A17 P10	All MS4645B
67356-11		TRIG RDY	A17 P9	All MS4645B
67356-12		TRIG OUT	A17 P8	All MS4645B
67356-4		EXT 10M IN	A11 J3	All MS4645B
67356-5		EXT 10M OUT	A11 J4	All MS4645B
67356-6		EXT AN IN1	A11 J1	All MS4645B
67356-7		EXT AN IN2	A11 J2	All MS4645B
67356-8		EXT AN OUT	A13 J16	All MS4645B
67356-9		EXT TRIG	A17 P11	All MS4645B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-13	ND73939	RP EXT ALC	A13 J13	Option 82
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 85
67367		USB A STRAIGHT TO 1X5		All MS4645B
67383-6	ND80070	A214	A18 J27	Option 31
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62

Table D-7. MS4645B – Part Number Sort (9 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		RP Fan Screw	Back Panel Ground	All MS4645B

D-5 MS4647B Cable ID Lists

MS4647B – Sorted by Origin Connection Point

FP = Front Panel

RP = Rear Panel

Table D-8. MS4647B – Origin Connection Point Sort (1 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62107-2		A100 J1	A120 J2	Option 62
62111-1		A100 J2	A111 J2	All MS4647B with Option 8x
62111-1		A100 J2	A111 J2	All MS4647B without Option 8x
62111-8		A101 J2	A111 J3	All MS4647B without Option 8x
62107-3		A102 J1	A123 J2	Option 61
62107-3		A102 J1	A123 J2	Option 62
62111-9		A102 J2	A111 J4	All MS4647B with Option 8x
62111-9		A102 J2	A111 J4	All MS4647B without Option 8x
62111-2		A103 J2	A111 J5	All MS4647B without Option 8x
62109-2		A104 J2	A100 J1	Standard
62109-44		A104 J2	FP b1 OUT	Option 51
62109-44		A104 J2	FP b1 OUT	Option 61
62109-44		A104 J2	FP b1 OUT	Option 62
62107-8		A105 J2	A109 J1	Option 32/Standard
62107-8		A105 J2	A109 J1	Option 32/51
62107-8		A105 J2	A109 J1	Option 32/61
62107-8		A105 J2	A109 J1	Option 32/62
62107-10		A105 J3	A128 J2	Standard
62109-19		A105 J3	FP S1 OUT	Option 51
62109-48		A105 J3	A142 J2	Option 32/Standard
62109-3		A106 J2	A102 J1	Standard
62109-10		A106 J2	FP b2 OUT	Option 51
62109-10		A106 J2	FP b2 OUT	Option 61
62109-10		A106 J2	FP b2 OUT	Option 62
62107-11		A107 J3	A129 J2	Standard
62109-8		A107 J3	FP S2 OUT	Option 51
62109-8		A107 J3	FP S2 OUT	Option 61
62109-45		A107 J3	A241 J1	Option 84
62109-45		A107 J3	A241 J1	Option 32/Standard
62109-35		A108 J1	A114 J3	Standard
62109-35		A108 J1	A114 J3	Option 51
62109-35		A108 J1	A114 J3	Option 61
62109-35		A108 J1	A114 J3	Option 62

Table D-8. MS4647B – Origin Connection Point Sort (2 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62111-37		A108 J2	A112 J2	Standard
62111-37		A108 J2	A112 J2	Option 51
62111-37		A108 J2	A112 J2	Option 61
62111-37		A108 J2	A112 J2	Option 62
62111-38		A108 J2	A133 J2	Option 80
62111-38		A108 J2	A133 J2	Option 81
62109-12		A108 J3	A107 J1	Standard
62109-12		A108 J3	A107 J1	Option 51
62109-12		A108 J3	A107 J1	Option 61
62109-12		A108 J3	A107 J1	Option 62
62109-13		A108 J4	A105 J1	Standard
62109-13		A108 J4	A105 J1	Option 51
62109-13		A108 J4	A105 J1	Option 61
62109-13		A108 J4	A105 J1	Option 62
62109-49		A109 J2	A101 J1	Standard
62109-17		A109 J2	FP a1 OUT	Option 51
62109-17		A109 J2	FP a1 OUT	Option 61
62109-17		A109 J2	FP a1 OUT	Option 62
62109-46		A109 J2	A101 J1	Option 32/Standard
3-62109-41		A109 J2	FP a1 OUT	Option 32/51
3-62109-41		A109 J2	FP a1 OUT	Option 32/61
3-62109-41		A109 J2	FP a1 OUT	Option 32/62
67354-4		A11 J12	A101 J3	All MS4647B with Option 8x
67354-4		A11 J12	A101 J3	All MS4647B without Option 8x
67354-3		A11 J15	A100 J3	All MS4647B with Option 8x
67354-3		A11 J15	A100 J3	All MS4647B without Option 8x
67354-2		A11 J18	A103 J3	All MS4647B with Option 8x
67354-2		A11 J18	A103 J3	All MS4647B without Option 8x
67354-1		A11 J21	A102 J3	All MS4647B with Option 8x
67354-1		A11 J21	A102 J3	All MS4647B without Option 8x
62109-47		A110 J2	A103 J1	Standard
62109-18		A110 J2	FP a2 OUT	Option 51
62109-18		A110 J2	FP a2 OUT	Option 61
62109-18		A110 J2	FP a2 OUT	Option 62
3-62109-230		A110 Pad at J2	A103 J1	Option 84/88
3-62109-229		A110 Pad at J2	FP a2 OUT	Option 85/89
3-803-104		A111 P1	A18 P5	All MS4647B
57989-12		A112 J2	A140 J2	Option 31
3-803-103		A112 P1	A18 P4	All MS4647B

Table D-8. MS4647B – Origin Connection Point Sort (3 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-38		A113 J2	A114 J1	All MS4647B
3-803-104		A113 P1	A18 P6	All MS4647B
62112-39		A114 J2	A112 J1	All MS4647B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	45B-47B-DECK-75167-3-051
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
62112-76		A116 J	A144 J2	Option 32/Standard
62112-20		A116 J2	A118 J2	Standard
62112-36		A116 J2	RP S1 OUT	Option 51
62112-5		A116 J2	A125 J1	Option 61
62112-5		A116 J2	A125 J1	Option 62
62112-53		A116 J2	A125 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-27		A116 J3	A15 J3	Standard
62112-40		A116 J3	RP a1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 62
62112-51		A116 J3	RP a1 OUT	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-21		A117 J2	A119 J2	Standard
62112-34		A117 J2	RP S2 OUT	Option 51
62112-34		A117 J2	RP S2 OUT	Option 61
62112-11		A117 J2	A126 J1	Option 62
62112-54		A117 J2	A126 J1	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-28		A117 J3	A15 J5	Standard
62112-41		A117 J3	RP a2 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 62
62112-52		A117 J3	RP a2 OUT	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-29		A118 J3	A15 J6	Standard
62112-45		A118 J3	RP b1 OUT	Option 51
62112-45		A118 J3	RP b1 OUT	Option 61
62112-45		A118 J3	RP b1 OUT	Option 62

Table D-8. MS4647B – Origin Connection Point Sort (4 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-72		A118 J3	A15 J6	Option 31
62112-30		A119 J3	A15 J7	Standard
62112-43		A119 J3	RP b2 OUT	Option 51
62112-43		A119 J3	RP b2 OUT	Option 61
62112-43		A119 J3	RP b2 OUT	Option 62
62112-73		A119 J3	A15 J7	Option 31
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
62112-23		A124 J2	A15 J6	Option 62
62112-12		A125 J2	RP S1 OUT	Option 61
62112-12		A125 J2	RP S1 OUT	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-26		A127 J2	A15 J7	Option 61
62112-26		A127 J2	A15 J7	Option 62
67355-13	ND71748	A13 J10	A11 J5	All MS4647B
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-15	ND71746	A13 J12	A18 J7	All MS4647B
67355-16	ND80050	A13 J12	A18 J22	Option 31
62112-19		A13 J14	A113 J1	All MS4647B
67355-14	ND71747	A13 J15	A18 J12	All MS4647B
67355-37		A13 J17	A111 J6	All MS4647B with Option 8x
67355-37		A13 J17	A111 J6	All MS4647B without Option 8x

Table D-8. MS4647B – Origin Connection Point Sort (5 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-46		A13 J3	A14 J3	Option 31
62112-58		A13 J4	A111 J1	All MS4647B
62112-59		A13 J6	A15 J11 W/PAD	All MS4647B
62112-16		A13 J8	A115 J1	All MS4647B
62112-48		A13 J8	A116 J1	Option 31
62112-47		A13 J9	A14 J9	Option 31
57989-5		A131 J1	A111 J3	All MS4647B with Option 8x
57989-7		A131 J3	FP LO1	Option 80
57989-7		A131 J3	FP LO1	Option 81
57989-7		A131 J3	FP LO1	Option 84
57989-7		A131 J3	FP LO1	Option 85
57989-6		A132 J1	A111 J5	All MS4647B with Option 8x
57989-8		A132 J3	FP LO2	Option 80
57989-8		A132 J3	FP LO2	Option 81
57989-8		A132 J3	FP LO2	Option 84
57989-8		A132 J3	FP LO2	Option 85
57989-14		A133 J2	A140 J2	Option 84
57989-14		A133 J2	A140 J2	Option 85
57989-11		A133 J3	FP RF	Option 80
57989-11		A133 J3	FP RF	Option 81
57989-25		A133 J3	FP RF1	Option 84
57989-25		A133 J3	FP RF1	Option 85
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
62112-50		A14 J14	A213 J1	Option 31
67355-18	ND80069	A14 J15	A18 J24	Option 31
62112-49		A14 J8	A117 J1	Option 31
62109-36		A140 J3	A105 J1	Option 31
67355-7	ND80053	A15 J13	A11 J11	All MS4647B
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-8	ND71750	A15 J16	A11 J14	All MS4647B
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-9	ND71751	A15 J20	A11 J17	All MS4647B
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-10	ND71752	A15 J22	A11 J20	All MS4647B
67355-36	ND80057	A15 J22	A12 J19	Option 35
57989-13		A212 J2	A240 J2	Option 31
3-803-104		A212 P1	A18 P9	Option 31
62112-55		A213 J2	A214 J1	Option 31

Table D-8. MS4647B – Origin Connection Point Sort (6 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-803-132		A213 P1	A18 P10	Option 31
67383-6	ND80070	A214	A18 J27	Option 31
62112-56		A214 J2	A212 J1	Option 31
57989-26		A233 J2	A240 J2	Option 84
57989-26		A233 J2	A240 J2	Option 85
57989-27		A233 J3	FP RF2	Option 84
57989-27		A233 J3	FP RF2	Option 85
62109-37		A240 J3	A107 J1	Option 31
3-62109-39		A241 J2	A142 J3	Option 32/Standard
3-62109-39		A241 J2	A142 J3	Option 32/51
3-62109-39		A241 J2	A142 J3	Option 32/61
3-62109-39		A241 J2	A142 J3	Option 32/62
62107-7		A241 J3	A129 J2	Option 84
62107-7		A241 J3	A129 J2	Option 85
62107-7		A241 J3	A129 J2	Option 32/Standard
62107-7		A241 J3	A129 J2	Option 32/51
62107-7		A241 J3	A129 J2	Option 32/61
62107-7		A241 J3	A129 J2	Option 32/62
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4647B
67356-17	ND80058	EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	EXT ALC 2	A14 J13	Option 85
62109-6		FP a1 IN	A101 J1	Option 51
62109-6		FP a1 IN	A101 J1	Option 61
62109-6		FP a1 IN	A101 J1	Option 62
62109-7		FP a2 IN	A103 J1	Option 51
62109-7		FP a2 IN	A103 J1	Option 61
62109-7		FP a2 IN	A103 J1	Option 62
62109-5		FP b1 IN	A100 J1	Option 51
62109-5		FP b1 IN	A100 J1	Option 61

Table D-8. MS4647B – Origin Connection Point Sort (7 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62109-20		FP b2 IN	A102 J1	Option 51
3-62109-40		FP P1S IN	A142 J2	Option 32/51
3-62109-40		FP P1S IN	A142 J2	Option 32/61
3-62109-40		FP P1S IN	A142 J2	Option 32/62
62109-38		FP P2S IN	A241 J1	Option 85
62109-38		FP P2S IN	A241 J1	Option 32/51
62109-38		FP P2S IN	A241 J1	Option 32/61
62109-38		FP P2S IN	A241 J1	Option 32/62
62107-1		FP S1 IN	A128 J2	Option 51
62107-1		FP S1 IN	A128 J2	Option 61
62107-1		FP S1 IN	A128 J2	Option 62
62107-4		FP S2 IN	A129 J2	Option 51
62107-4		FP S2 IN	A129 J2	Option 61
62107-4		FP S2 IN	A129 J2	Option 62
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 61
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 62
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 51
3-806-175		MB2 P41	A18 P3	All MS4647B
3-806-185		MB2 P42	A18 J18	All MS4647B
3-803-107		MB2 P71	A17 P1	All MS4647B
3-803-107		MB2 P72	A17 P2	All MS4647B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 62
62112-24		RP a1 IN	A15 J3	Option 51
62112-24		RP a1 IN	A15 J3	Option 61
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 51
62112-25		RP a2 IN	A15 J5	Option 61
62112-25		RP a2 IN	A15 J5	Option 62
62112-33		RP b1 IN	A15 J6	Option 51
62112-33		RP b1 IN	A15 J6	Option 61
62112-10		RP b1 IN	A124 J1	Option 62
62112-35		RP b2 IN	A15 J7	Option 51
62112-9		RP b2 IN	A127 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 62

Table D-8. MS4647B – Origin Connection Point Sort (8 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
67356-4		RP EXT 10M IN	A11 J3	All MS4647B
67356-5		RP EXT 10M OUT	A11 J4	All MS4647B
67356-13	ND73939	RP EXT ALC	A13 J13	Option 80
67356-13	ND73939	RP EXT ALC	A13 J13	Option 81
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-6		RP EXT AN IN1	A11 J1	All MS4647B
67356-7		RP EXT AN IN2	A11 J2	All MS4647B
67356-8		RP EXT AN OUT	A13 J16	All MS4647B
67356-9		RP EXT TRIG	A17 P11	All MS4647B
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
62105-3	ND73937	RP IF A1	A11 J13	All MS4647B
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
62105-4	ND73938	RP IF A2	A11 J19	All MS4647B
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
62105-2	ND73935	RP IF B1	A11 J16	All MS4647B
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
62105-1	ND73936	RP IF B2	A11 J22	All MS4647B
67356-10		RP LOCK STATUS	A17 P10	All MS4647B
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 62
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51

Table D-8. MS4647B – Origin Connection Point Sort (9 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
67356-12		RP TRIG OUT	A17 P8	All MS4647B
67356-11		RP TRIG RDY	A17 P9	All MS4647B

MS4647B – Sorted by Part Number

FP = Front Panel

RP = Rear Panel

Table D-9. MS4647B – Part Number Sort (1 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-806-185		MB2 P42	A18 J18	All MS4647B
3-803-107		MB2 P71	A17 P1	All MS4647B
3-803-107		MB2 P72	A17 P2	All MS4647B
3-803-104		A113 P1	A18 P6	All MS4647B
3-803-104		A111 P1	A18 P5	All MS4647B
3-806-175		MB2 P41	A18 P3	All MS4647B
3-803-103		A112 P1	A18 P4	All MS4647B
3-803-105		A115 P1	A18 P1	Standard
3-803-105		A115 P1	A18 P1	45B-47B-DECK-75167-3-051
3-803-105		A115 P1	A18 P1	Option 61
3-803-105		A115 P1	A18 P1	Option 62
3-62105-15	ND80060	RP IF A1	A12 J3	Option 35
3-62105-16	ND80062	RP IF B1	A12 J11	Option 35
3-62105-17	ND80061	RP IF A2	A12 J15	Option 35
3-62105-18	ND80063	RP IF B2	A12 J21	Option 35
3-75646-1	ND80064	RP PGEN 1	A12 J33	Option 35
3-75646-2	ND80065	RP PGEN 2	A12 J32	Option 35
3-75646-3	ND80066	RP PGEN 3	A12 J30	Option 35
3-75646-4	ND80067	RP PGEN 4	A12 J31	Option 35
3-75646-5	ND80068	RP PSYNCH IN	A12 J49	Option 35
3-75646-6	ND80048	A12 J50	RP PSYNCH OUT	Option 35
3-76490-1	ND80044	A12 J2	A101 J3	Option 35
3-76490-2	ND80045	A12 J10	A100 J3	Option 35
3-76490-3	ND80046	A12 J8	A103 J3	Option 35
3-76490-4	ND80047	A12 J20	A102 J3	Option 35
3-806-246		A12 J37	CB PCB J25	Option 35
3-803-104		A212 P1	A18 P9	Option 31
3-803-132		A213 P1	A18 P10	Option 31
3-76160-1		A242 J1	A18 J30	Option 84
3-76160-1		A242 J1	A18 J30	Option 85
3-62109-41		A109 J2	FP a1 OUT	Option 32/51
3-62109-41		A109 J2	FP a1 OUT	Option 32/61
3-62109-41		A109 J2	FP a1 OUT	Option 32/62
3-62109-39		A241 J2	A142 J3	Option 32/Standard
3-62109-39		A241 J2	A142 J3	Option 32/51

Table D-9. MS4647B – Part Number Sort (2 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-62109-39		A241 J2	A142 J3	Option 32/61
3-62109-39		A241 J2	A142 J3	Option 32/62
3-62109-40		FP P1S IN	A142 J2	Option 32/51
3-62109-40		FP P1S IN	A142 J2	Option 32/61
3-62109-40		FP P1S IN	A142 J2	Option 32/62
3-62109-229		A110 Pad at J2	FP a2 OUT	Option 85/89
3-62109-230		A110 Pad at J2	A103 J1	Option 84/88
3-62112-60		RP SRC2 IN	A243 J1	Option 32/51
3-62112-60		RP SRC2 IN	A243 J1	Option 32/61
3-62112-60		RP SRC2 IN	A243 J1	Option 32/62
57989-12		A112 J2	A140 J2	Option 31
57989-13		A212 J2	A240 J2	Option 31
57989-11		A133 J3	FP RF	Option 80
57989-7		A131 J3	FP LO1	Option 80
57989-8		A132 J3	FP LO2	Option 80
57989-11		A133 J3	FP RF	Option 81
57989-7		A131 J3	FP LO1	Option 81
57989-8		A132 J3	FP LO2	Option 81
57989-14		A133 J2	A140 J2	Option 84
57989-25		A133 J3	FP RF1	Option 84
57989-26		A233 J2	A240 J2	Option 84
57989-27		A233 J3	FP RF2	Option 84
57989-7		A131 J3	FP LO1	Option 84
57989-8		A132 J3	FP LO2	Option 84
57989-14		A133 J2	A140 J2	Option 85
57989-25		A133 J3	FP RF1	Option 85
57989-26		A233 J2	A240 J2	Option 85
57989-27		A233 J3	FP RF2	Option 85
57989-7		A131 J3	FP LO1	Option 85
57989-8		A132 J3	FP LO2	Option 85
57989-5		A131 J1	A111 J3	All MS4647B with Option 8x
57989-6		A132 J1	A111 J5	All MS4647B with Option 8x
62105-1	ND73936	RP IF B2	A11 J22	All MS4647B
62105-2	ND73935	RP IF B1	A11 J16	All MS4647B
62105-3	ND73937	RP IF A1	A11 J13	All MS4647B
62105-4	ND73938	RP IF A2	A11 J19	All MS4647B
62107-10		A105 J3	A128 J2	Standard
62107-11		A107 J3	A129 J2	Standard
62107-1		FP S1 IN	A128 J2	Option 51

Table D-9. MS4647B – Part Number Sort (3 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62107-4		FP S2 IN	A129 J2	Option 51
62107-1		FP S1 IN	A128 J2	Option 61
62107-3		A102 J1	A123 J2	Option 61
62107-4		FP S2 IN	A129 J2	Option 61
62107-1		FP S1 IN	A128 J2	Option 62
62107-2		A100 J1	A120 J2	Option 62
62107-3		A102 J1	A123 J2	Option 62
62107-4		FP S2 IN	A129 J2	Option 62
62107-7		A241 J3	A129 J2	Option 84
62107-7		A241 J3	A129 J2	Option 85
62107-8		A105 J2	A109 J1	Option 32/Standard
62107-8		A105 J2	A109 J1	Option 32/51
62107-8		A105 J2	A109 J1	Option 32/61
62107-8		A105 J2	A109 J1	Option 32/62
62107-7		A241 J3	A129 J2	Option 32/Standard
62107-7		A241 J3	A129 J2	Option 32/51
62107-7		A241 J3	A129 J2	Option 32/61
62107-7		A241 J3	A129 J2	Option 32/62
62109-12		A108 J3	A107 J1	Standard
62109-13		A108 J4	A105 J1	Standard
62109-2		A104 J2	A100 J1	Standard
62109-3		A106 J2	A102 J1	Standard
62109-35		A108 J1	A114 J3	Standard
62109-47		A110 J2	A103 J1	Standard
62109-49		A109 J2	A101 J1	Standard
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 51
62109-10		A106 J2	FP b2 OUT	Option 51
62109-12		A108 J3	A107 J1	Option 51
62109-13		A108 J4	A105 J1	Option 51
62109-17		A109 J2	FP a1 OUT	Option 51
62109-18		A110 J2	FP a2 OUT	Option 51
62109-19		A105 J3	FP S1 OUT	Option 51
62109-20		FP b2 IN	A102 J1	Option 51
62109-35		A108 J1	A114 J3	Option 51
62109-44		A104 J2	FP b1 OUT	Option 51
62109-5		FP b1 IN	A100 J1	Option 51
62109-6		FP a1 IN	A101 J1	Option 51
62109-7		FP a2 IN	A103 J1	Option 51

Table D-9. MS4647B – Part Number Sort (4 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62109-8		A107 J3	FP S2 OUT	Option 51
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 61
62109-10		A106 J2	FP b2 OUT	Option 61
62109-12		A108 J3	A107 J1	Option 61
62109-13		A108 J4	A105 J1	Option 61
62109-17		A109 J2	FP a1 OUT	Option 61
62109-18		A110 J2	FP a2 OUT	Option 61
62109-35		A108 J1	A114 J3	Option 61
62109-44		A104 J2	FP b1 OUT	Option 61
62109-5		FP b1 IN	A100 J1	Option 61
62109-6		FP a1 IN	A101 J1	Option 61
62109-7		FP a2 IN	A103 J1	Option 61
62109-8		A107 J3	FP S2 OUT	Option 61
62109-1 or 3-62109-1		FP Semi Rigid, V M/M Loop		Option 62
62109-10		A106 J2	FP b2 OUT	Option 62
62109-12		A108 J3	A107 J1	Option 62
62109-13		A108 J4	A105 J1	Option 62
62109-17		A109 J2	FP a1 OUT	Option 62
62109-18		A110 J2	FP a2 OUT	Option 62
62109-35		A108 J1	A114 J3	Option 62
62109-44		A104 J2	FP b1 OUT	Option 62
62109-6		FP a1 IN	A101 J1	Option 62
62109-7		FP a2 IN	A103 J1	Option 62
62109-36		A140 J3	A105 J1	Option 31
62109-37		A240 J3	A107 J1	Option 31
62109-45		A107 J3	A241 J1	Option 84
62109-38		FP P2S IN	A241 J1	Option 85
62109-48		A105 J3	A142 J2	Option 32/Standard
62109-45		A107 J3	A241 J1	Option 32/Standard
62109-46		A109 J2	A101 J1	Option 32/Standard
62109-38		FP P2S IN	A241 J1	Option 32/51
62109-38		FP P2S IN	A241 J1	Option 32/61
62109-38		FP P2S IN	A241 J1	Option 32/62
62111-37		A108 J2	A112 J2	Standard
62111-37		A108 J2	A112 J2	Option 51
62111-37		A108 J2	A112 J2	Option 61
62111-37		A108 J2	A112 J2	Option 62

Table D-9. MS4647B – Part Number Sort (5 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62111-38		A108 J2	A133 J2	Option 80
62111-38		A108 J2	A133 J2	Option 81
62111-1		A100 J2	A111 J2	All MS4647B with Option 8x
62111-9		A102 J2	A111 J4	All MS4647B with Option 8x
62111-1		A100 J2	A111 J2	All MS4647B without Option 8x
62111-2		A103 J2	A111 J5	All MS4647B without Option 8x
62111-8		A101 J2	A111 J3	All MS4647B without Option 8x
62111-9		A102 J2	A111 J4	All MS4647B without Option 8x
62112-16		A13 J8	A115 J1	All MS4647B
62112-19		A13 J14	A113 J1	All MS4647B
62112-58		A13 J4	A111 J1	All MS4647B
62112-59		A13 J6	A15 J11 W/PAD	All MS4647B
62112-38		A113 J2	A114 J1	All MS4647B
62112-39		A114 J2	A112 J1	All MS4647B
62112-20		A116 J2	A118 J2	Standard
62112-21		A117 J2	A119 J2	Standard
62112-27		A116 J3	A15 J3	Standard
62112-28		A117 J3	A15 J5	Standard
62112-29		A118 J3	A15 J6	Standard
62112-30		A119 J3	A15 J7	Standard
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 51
62112-24		RP a1 IN	A15 J3	Option 51
62112-25		RP a2 IN	A15 J5	Option 51
62112-33		RP b1 IN	A15 J6	Option 51
62112-34		A117 J2	RP S2 OUT	Option 51
62112-35		RP b2 IN	A15 J7	Option 51
62112-36		A116 J2	RP S1 OUT	Option 51
62112-40		A116 J3	RP a1 OUT	Option 51
62112-41		A117 J3	RP a2 OUT	Option 51
62112-42		RP SRC2 IN	A119 J2	Option 51
62112-43		A119 J3	RP b2 OUT	Option 51
62112-44		RP SRC1 IN	A118 J2	Option 51
62112-45		A118 J3	RP b1 OUT	Option 51
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 61
62112-12		A125 J2	RP S1 OUT	Option 61
62112-24		RP a1 IN	A15 J3	Option 61
62112-25		RP a2 IN	A15 J5	Option 61

Table D-9. MS4647B – Part Number Sort (6 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-26		A127 J2	A15 J7	Option 61
62112-33		RP b1 IN	A15 J6	Option 61
62112-34		A117 J2	RP S2 OUT	Option 61
62112-40		A116 J3	RP a1 OUT	Option 61
62112-41		A117 J3	RP a2 OUT	Option 61
62112-42		RP SRC2 IN	A119 J2	Option 61
62112-43		A119 J3	RP b2 OUT	Option 61
62112-44		RP SRC1 IN	A118 J2	Option 61
62112-45		A118 J3	RP b1 OUT	Option 61
62112-5		A116 J2	A125 J1	Option 61
62112-9		RP b2 IN	A127 J1	Option 61
62112-1 or RoHS 3-62112-1		RP Semi Rigid, SMA M/M Loop		Option 62
62112-10		RP b1 IN	A124 J1	Option 62
62112-11		A117 J2	A126 J1	Option 62
62112-12		A125 J2	RP S1 OUT	Option 62
62112-23		A124 J2	A15 J6	Option 62
62112-24		RP a1 IN	A15 J3	Option 62
62112-25		RP a2 IN	A15 J5	Option 62
62112-26		A127 J2	A15 J7	Option 62
62112-40		A116 J3	RP a1 OUT	Option 62
62112-41		A117 J3	RP a2 OUT	Option 62
62112-42		RP SRC2 IN	A119 J2	Option 62
62112-43		A119 J3	RP b2 OUT	Option 62
62112-44		RP SRC1 IN	A118 J2	Option 62
62112-45		A118 J3	RP b1 OUT	Option 62
62112-5		A116 J2	A125 J1	Option 62
62112-8		A126 J2	RP SRC2 OUT	Option 62
62112-9		RP b2 IN	A127 J1	Option 62
62112-46		A13 J3	A14 J3	Option 31
62112-47		A13 J9	A14 J9	Option 31
62112-48		A13 J8	A116 J1	Option 31
62112-49		A14 J8	A117 J1	Option 31
62112-50		A14 J14	A213 J1	Option 31
62112-51		A116 J3	RP a1 OUT	Option 31
62112-52		A117 J3	RP a2 OUT	Option 31
62112-53		A116 J2	A125 J1	Option 31
62112-54		A117 J2	A126 J1	Option 31
62112-55		A213 J2	A214 J1	Option 31

Table D-9. MS4647B – Part Number Sort (7 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
62112-56		A214 J2	A212 J1	Option 31
62112-68		A116 J2	A118 J2	Option 31
62112-69		A117 J2	A119 J2	Option 31
62112-70		A116 J3	A15 J3	Option 31
62112-71		A117 J3	A15 J5	Option 31
62112-72		A118 J3	A15 J6	Option 31
62112-73		A119 J3	A15 J7	Option 31
62112-74		A117 J2	RP S2 OUT	Option 31
62112-75		A116 J2	RP S1 OUT	Option 31
62112-76		A116 J	A144 J2	Option 32/Standard
62112-77		A117 J2	A243 J1	Option 32/Standard
62112-61		RP SRC1 IN	A144 J2	Option 32/51
62112-61		RP SRC1 IN	A144 J2	Option 32/61
62112-61		RP SRC1 IN	A144 J2	Option 32/62
67354-1		A11 J21	A102 J3	All MS4647B with Option 8x
67354-2		A11 J18	A103 J3	All MS4647B with Option 8x
67354-3		A11 J15	A100 J3	All MS4647B with Option 8x
67354-4		A11 J12	A101 J3	All MS4647B with Option 8x
67354-1		A11 J21	A102 J3	All MS4647B without Option 8x
67354-2		A11 J18	A103 J3	All MS4647B without Option 8x
67354-3		A11 J15	A100 J3	All MS4647B without Option 8x
67354-4		A11 J12	A101 J3	All MS4647B without Option 8x
67355-14	ND71747	A13 J15	A18 J12	All MS4647B
67355-15	ND71746	A13 J12	A18 J7	All MS4647B
67355-10	ND71752	A15 J22	A11 J20	All MS4647B
67355-13	ND71748	A13 J10	A11 J5	All MS4647B
67355-7	ND80053	A15 J13	A11 J11	All MS4647B
67355-8	ND71750	A15 J16	A11 J14	All MS4647B
67355-9	ND71751	A15 J20	A11 J17	All MS4647B
67355-21	ND80031	A12 J4	A11 J11	Option 35
67355-22	ND80032	A12 J5	A11 J12	Option 35
67355-23	ND80033	A12 J6	A11 J13	Option 35
67355-24	ND80034	A12 J12	A11 J14	Option 35
67355-25	ND80035	A12 J13	A11 J15	Option 35
67355-26	ND80036	A12 J14	A11 J16	Option 35
67355-27	ND80037	A12 J16	A11 J17	Option 35
67355-28	ND80038	A12 J17	A11 J18	Option 35
67355-29	ND80039	A12 J18	A11 J19	Option 35
67355-30	ND80040	A12 J22	A11 J20	Option 35

Table D-9. MS4647B – Part Number Sort (8 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
67355-31	ND80041	A12 J23	A11 J21	Option 35
67355-32	ND80042	A12 J24	A11 J22	Option 35
67355-33	ND80054	A15 J13	A12 J1	Option 35
67355-34	ND80055	A15 J16	A12 J9	Option 35
67355-35	ND80056	A15 J20	A12 J7	Option 35
67355-36	ND80057	A15 J22	A12 J19	Option 35
67355-38	ND80043	A12 J28	A11 J30	Option 35
67355-16	ND80050	A13 J12	A18 J22	Option 31
67355-17	ND80052	A14 J12	A18 J23	Option 31
67355-18	ND80069	A14 J15	A18 J24	Option 31
67355-19	ND80049	A13 J11	A14 J11	Option 31
67355-20	ND80051	A14 J10	A11 J6	Option 31
67355-37		A13 J17	A111 J6	All MS4647B with Option 8x
67355-37		A13 J17	A111 J6	All MS4647B without Option 8x
67356-10		RP LOCK STATUS	A17 P10	All MS4647B
67356-11		RP TRIG RDY	A17 P9	All MS4647B
67356-12		RP TRIG OUT	A17 P8	All MS4647B
67356-4		RP EXT 10M IN	A11 J3	All MS4647B
67356-5		RP EXT 10M OUT	A11 J4	All MS4647B
67356-6		RP EXT AN IN1	A11 J1	All MS4647B
67356-7		RP EXT AN IN2	A11 J2	All MS4647B
67356-8		RP EXT AN OUT	A13 J16	All MS4647B
67356-9		RP EXT TRIG	A17 P11	All MS4647B
67356-2		P1 BIAS IN	A18 J8	Option 61
67356-3		P2 BIAS IN	A18 J11	Option 61
67356-2		P1 BIAS IN	A18 J8	Option 62
67356-3		P2 BIAS IN	A18 J11	Option 62
67356-13	ND73939	RP EXT ALC	A13 J13	Option 80
67356-13	ND73939	RP EXT ALC	A13 J13	Option 81
67356-17	ND80058	RP EXT ALC 1	A13 J13	Option 84
67356-18	ND80059	RP EXT ALC 2	A14 J13	Option 84
67356-17	ND80058	EXT ALC 1	A13 J13	Option 85
67356-18	ND80059	EXT ALC 2	A14 J13	Option 85
67383-6	ND80070	A214	A18 J27	Option 31
3-B37391-152		A243 J2	A119 J2	Option 32/Standard
3-B37391-152		A243 J2	A119 J2	Option 32/51
3-B37391-152		A243 J2	A119 J2	Option 32/61
3-B37391-152		A243 J2	A119 J2	Option 32/62
3-B37391-153		A243 J3	A144 J3	Option 32/Standard

Table D-9. MS4647B – Part Number Sort (9 of 9)

Part Number	ND	Origin Connection Point	Destination Connection Point	Cable Used In
3-B37391-153		A243 J3	A144 J3	Option 32/51
3-B37391-153		A243 J3	A144 J3	Option 32/61
3-B37391-153		A243 J3	A144 J3	Option 32/62
B41929		Back Panel Fan Screw	Back Panel Ground	All MS4647B

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