Maintenance Manual

Field Master Pro™ MS2090A

Spectrum Analyzer

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Table of Contents

Appendix A—Test Records

Chapter 1 — General Information

1-1 Introduction

This manual provides the recommended test equipment, replaceable parts list, verification procedures, part replacement procedures, maintenance instructions and test record templates for the MS2090A Anritsu Field Master Pro.

Familiarity with the basic operation is assumed (for example, how to change measurement modes, preset the instrument, and set up measurements).

This chapter includes:

- General information
- Equipment to perform verification testing listed in Table 1-1 on page 1-2
- Replacement parts listed in Table 1-2 on page 1-3

Note	The MS2090A performance verification procedures are provided in Chapter 2 and Chapter 3. Test records templates are provided in Appendix A. Copy the test records templates and use them to record the measured values obtained when verifying the performance of the MS2090A. The measurement values taken and documented provide a record of the performance of your instrument. Anritsu recommends that you make a copy of the test records to document the measurements each time a Performance Verification is performed. Continuing to document this process each time it is performed provides a detailed history of instrument performance.

Additional Documentation

Document Part Number	Description
10100-00069	Important Product Information, Compliance, and Safety Notices
11410-01000	MS2090A Field Master Pro Technical Data Sheet
10580-00444	MS2090A Field Master Pro User Guide
10580-00445	MS2090A Field Master Pro Programming Manual

Updates, if any, can be downloaded from the Library tab on the Anritsu product page:

https://www.anritsu.com/en-us/test-measurement/products/ms2090a

1-2 Contacting Anritsu

To contact Anritsu, visit the following URL and select the services in your region:

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

1-3 Recommended Test Equipment

The test equipment recommended for performance verification of the MS2090A is listed below in Table 1-1.

Table 1-1. Required Test Equipment

Instrument / Component	Critical Specification	Recommended Manufacturer / Model
Synthesizer	Frequency: 0.1 Hz to 67 GHz	Anritsu MG3697C, with options 2C/3/4/15D/22
Synthesizer	Frequency: 2400 MHz	Anritsu MG2692C
Signal Generator	Frequency: 2400 MHz	Anritsu MG3710A
Power Meter	Frequency: 67 GHz	Rohde and Schwarz, NRP67T
Splitter	V-Type	Anritsu V241C
Attenuator	V-Type, 10 dB, Qty 2	Anritsu 41V-10, Qty 2
Attenuator	V-Type, 20 dB	Anritsu 41V-20
Termination	50 Ohm, N Type	Anritsu 28N50-2, for 9, 14, 20 GHz units
Termination	50 Ohm, K Type	Anritsu 28KF50, for 26.5, 32, 43.5 GHz units
Termination	50 Ohm, V Type	Anritsu 28VF50D, for 54 GHz units
Cable	V(m) to V(f)	Anritsu 3670V50A-2
Adapter	V(m) to K(f)	Anritsu 34VKF50
Adapter	K(m) to N(m)	Anritsu 34NK50
Low Pass Filter	Frequency: 50 MHz	Mini-Circuits, NLP-50
10 MHz Reference	10 MHz	Datum / 9390-6000
Splitter	N Type	Weinschel 1870A
Adapter	N Type	Anritsu 34NN50A
Adapter	N(f) to K(f)	Anritsu 71693-R, for 26.5, 32, 43.5 GHz units
Adapter	K(m) to V(f)	Anritsu 34VFK50, for 54 GHz units
Adapter	K(f) to N(f)	Anritsu 34NFKF50, for 54 GHz units
Attenuator, Qty 2	20 dB	Weinschel 44-20
Attenuator, Qty 2	8 dB	Weinschel 44-8
Coaxial Cable, Qty2	N Type	Anritsu 15NN50-1.5C
Power Meter	2400 MHz	Anritsu ML2438A
Power Sensor	2400 MHz	Anritsu MA2442D

1-4 Replacement Parts

The MS2090A replacement parts and their description are listed below in Table 1-2.

Table 1-2. List of Replaceable Parts

Part Number	Description
3-ND84381<R>	Main PCB[a]
3-ND84383<R>	VSA PCB, 9-20 GHz
3-ND84384<R>	VSA PCB, 26-43.5 GHz
3-ND84557<R>	VSA PCB, 54 GHz
3-ND84386	Battery Housing (includes battery cable and fan assembly)
3-ND84387	Fan Assembly
3-ND84388	Wi-Fi Antenna
2000-1859-R	Cable Assembly, USB Type C, 1 Meter
2000-1931-R	Stylus with S-Hook
3-2000-1927	Hand Strap
3-2000-1928	Shoulder Strap
3-30-102	Touchscreen / LCD Assembly
3-516-122	IF Out Cable (J5001 of VSA to IF Out Connector)
3-553-572	SMP Jack to Jack Adapter (Connection between Main and VSA PCB)
3-74842-3	Front Panel Cable (15 Wire Locking Connector Cable from J7 of Main PCB)
3-790-795	Speaker
3-806-373	LCD Cable (From J22 on Main PCB)
3-83203-1-0	Front Case
3-83204-1-0	Rear Case
3-83213-1-0	I/O Connector Panel
3-83214-1	I/O Connector Panel Door
3-83272-1	Tilt Bail Assembly
3-83403	RF In V Connector (54 GHz)
3-83408	RF In K Connector (26.5-43.5 GHz)
3-513-149	RF In N Connector (9-20 GHz)
3-83778	RF in to VSA Semi-Rigid Cable K(m)-K(m)(9-20 GHz units)
3-83781	RF in to VSA Semi-Rigid Cable K(m)-V(f)(26-43.5 GHz units)
3-83650	RF in to VSA Semi-Rigid Cable V(m)-V(f)(54 GHz units)
3-83878	Overlay (for Top Connector Panel)
3-83970	Top Connector Panel (metal)
3-742-69	D-Ring
3-83717	D-Ring Holder
3-905-2903	D-Ring Screw
40-204-R	AC/DC Adapter
633-75	Battery
3-83715-1	Battery Door

a. When ordering the Main PCB Assembly, include all the hardware and software options installed. Locate the options installed by pressing the MS2090A front panel System Status button.

Chapter 2 — Spectrum Analyzer Verification

2-1 Introduction

This chapter provides the verification procedures for the MS2090A Field Master Pro. Verification tests that are associated with other instrument options are described in Chapter 3, "Installed Options Verification". Record the measurement results in the test record templates provided in Appendix A, "Test Records"

This chapter includes the following performance verification procedures:

PASS/FAIL Determination for Instrument Key Parameter Performance Tests

Figure 2-1 shows the rule that is used to determine the pass/fail status of test results that are associated with warranted specifications.

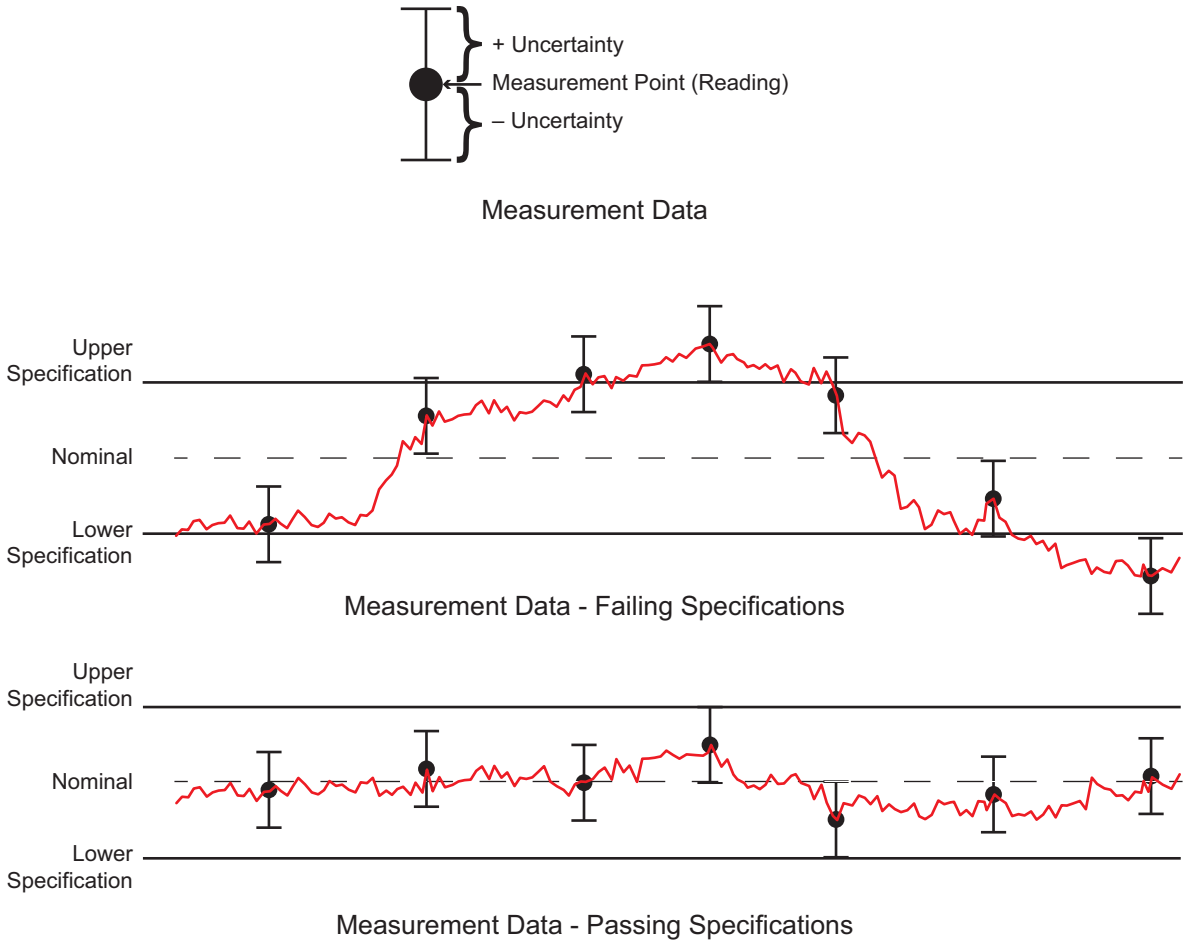

Figure 2-1. Pass/Fail Determination

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).

2-2 Frequency Accuracy

Use this procedure to verify the frequency accuracy of the MS2090A. Record the results in the test records provided in Appendix A.

> **Note** Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3697C
- Anritsu 3670V50A-2 Coaxial Cable, V(m) to V(f)
- Anritsu 34VKF50 Adapter, V(m) to K(f), for 9, 14, 20, 26.5, 32, and 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9, 14, and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to the MG3697C.

> **Note** Do not connect the 10 MHz Reference to the MS2090A.

2. Connect the MG3697C RF Out to the MS2090A RF In.
3. Set the MG3697C RF output as follows:
   - Power level to –30 dBm
   - CW frequency to 1 GHz.
4. Set the MS2090A to Spectrum Analyzer mode.
5. Press Preset on the MS2090A
6. Set the MS2090A parameters as follows:
   - Center Frequency: 1 GHz
   - Reference Level: –10 dBm
   - Span: 10 kHz
   - RBW: 100 Hz
   - VBW: 30 Hz
7. Enable Marker 1 and perform a Peak Search. Record the marker frequency in Table A-1, "Spectrum Analyzer Frequency Accuracy" on page A-2. Calculate the error by subtracting 1 GHz from the measured value and record the error in Table A-1 on page A-2.
8. Set the MG3697C frequency to 7 GHz.
9. Set the MS2090A center frequency to 7 GHz.
10. Enable Marker 1 and perform a Peak Search. Record the marker frequency in Table A-1, "Spectrum Analyzer Frequency Accuracy" on page A-2. Calculate the error by subtracting 7 GHz from the measured value and record the error in Table A-1 on page A-2.

2-3 Amplitude Accuracy – Preamplifier Off

Use the following procedure to verify the amplitude accuracy of the MS2090A. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3697C
- Anritsu V241C Splitter
- Anritsu 41V-10 Attenuator
- Rohde and Schwarz NRP67T Power Sensor
- Anritsu 3670V50A-2 Coaxial Cable, V(m) to V(f)
- Anritsu 34VKF50 Adapter, V(m) to K(f), for 9, 14, 20, 26.5, 32, and 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9, 14, and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS2090A.
2. Connect the MG3697C RF Out to the input of the splitter.
3. Connect the NRP67T directly to one output of the splitter.
4. Connect the 10 dB attenuator to the other output of the splitter.
5. Connect the RF input of the MS2090A to the 10 dB attenuator.
6. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
7. MS2090A Settings:
    - Set Reference Level to 10 dBm
    - Set Attenuation Level to 30 dB
    - Preamplifier is off
    - Trace Menu, set Detector Type = Peak
    - Bandwidth Menu set RBW to 1 kHz, and VBW to 10 Hz
    - Set Span to 10 kHz
8. Using the Rohde and Schwarz Power Viewer software, set the signal frequency to 50 MHz.
9. On the MG3697C, press RF OFF.
10. Zero the NRP67T sensor.
11. On the MG3697C, press RF ON.
12. On the MG3697C, set the frequency to 50 MHz.
13. Adjust the NRP67T power level to +10.0 dBm. (The MG3697C should be approximately +16 dBm.)
14. Set the MS2090A center frequency to 50 MHz.
15. Perform a peak search. Record the result in Table A-2 on page A-2
16. Adjust the Reference Level and Attenuation Level on the MS2090A for the other values in Table A-2.
17. Adjust the Power Level on the MG3697C for the other power levels in Table A-2 on page A-2, and record results for each measurement.

18. Repeat this procedure for the other frequencies listed below in Appendix A.

- Table A-3, "Power Level Accuracy at 5 GHz (Preamplifier Off) for all frequency options
- Table A-4, "Power Level Accuracy at 13 GHz (Preamplifier Off) for 14, 20, 26.5, 32, 43.5, and 54 GHz units
- Table A-5, "Power Level Accuracy at 18 GHz (Preamplifier Off) for 20, 26.5, 32, 43.5, and 54 GHz units
- Table A-6, "Power Level Accuracy at 25 GHz (Preamplifier Off) for 26.5, 32, 43.5, and 54 GHz units
- Table A-7, "Power Level Accuracy at 31 GHz (Preamplifier Off) for 32, 43.5, and 54 GHz units
- Table A-8, "Power Level Accuracy at 43 GHz (Preamplifier Off) for 43.5 and 54 GHz units
- Table A-9, "Power Level Accuracy at 53 GHz (Preamplifier Off) for 54 GHz units only

2-4 Amplitude Accuracy – Preamplifier On

Use the following procedure to verify the amplitude accuracy of the MS2090A with the Preamplifier On. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3697C
- Anritsu V241C Splitter
- Anritsu 41V-10 Attenuator, Qty 2
- Anritsu 41V-20 Attenuator
- Rohde and Schwarz NRP67T Power Sensor
- Anritsu 3670V50A-2 Coaxial Cable, V(m) to V(f)
- Anritsu 34VKF50 Adapter, V(m) to K(f), for 9, 14, 20, 26.5, 32, and 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9, 14, and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS2090A.
2. Connect the MG3697C RF Out to the input of the splitter.
3. Connect the NRP67T directly to one output of the splitter.
4. Connect 40 dB of attenuation to the other output of the splitter.
5. Connect the RF input of the MS2090A to the 40 dB attenuation.
6. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
7. MS2090A Settings:
   - Set Reference Level to –40 dBm
   - Set Attenuation Level to 0 dB
   - Turn Preamplifier on
   - Trace Menu, set Detector Type = Peak
   - Bandwidth Menu set RBW to 1 kHz, and VBW to 10 Hz
   - Set Span to 10 kHz
8. Using the Rohde and Schwarz Power Viewer software, set the signal frequency to 10 kHz. Ensure the MG3697C is not outputting any power, and zero the NRP67T sensor.
9. On the MG3697C, set the frequency to 10 kHz and adjust the power level so the NRP67T measures –10.0 dBm. (The MG3697C should be approximately –4 dBm.)
10. On the MS2090A set the center frequency to 10 kHz and perform a peak search. Record the result in Table A-10, “Power Level Accuracy (Preamplifier On)” on page A-6
11. Repeat Step 8 through Step 10 for the remaining frequencies that apply to the unit being tested, in Table A-10 on page A-6

2-5 Single Side Band (SSB) Phase Noise

Use the following procedure to verify the single side-band (SSB) phase noise of the MS2090A. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3697C
- Anritsu 3670V50A-2 Coaxial Cable, V(m) to V(f)
- Anritsu 34VKF50 Adapter, V(m) to K(f), for 9, 14, 20, 26.5, 32, and 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9, 14, and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS2090A.
2. Connect the MG3697C RF Out to the MS2090A RF In.
3. Set the MG3697C to output frequency to 1.0 GHz.
4. Set the MG3697C to output power to –2 dBm.
5. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.

MS2090A Settings:

- Set Reference Level to 0 dBm
- Set Input Attenuation to 15 dB
- Ensure Preamplifier is off
- Trace Menu, set Detector Type = Peak
- Trace Menu set Type = Average
- Trace Menu set Averages = 3
- Bandwidth Menu set RBW to 1 kHz, and VBW to 3 Hz
- Sweep Menu, set Points to 551

6. 10 kHz and 100 kHz Offset Settings
   - Set Center Frequency to 1000.05 MHz
   - Set Span to 110 kHz
7. In the Sweep menu, turn off Continuous Sweep, and choose Sweep to 3 and allow it to finish.
8. In the Marker menu, use the Peak Search menu to set Marker 1 to the peak at 1 GHz. Exit the Peak Search menu and set the Marker Mode to Delta. Enter a frequency value of 10 kHz, so a marker is on the peak at 1 GHz and the delta marker is 10 kHz away. Record the difference in level between the peak at 1 GHz and the noise level 10 kHz away at 1000.010 MHz, in Table A-11, "Spectral Purity – SSB Phase Noise Offset from 1 GHz" on page A-7. Then subtract another 30 dB and record this as the 10 kHz Offset Measured Value reading in Table A-11 on page A-7.

   For example: –80 dBc measured – 30 dB = –110 dBc/Hz

9. Change the Delta Frequency from 10 kHz to 100 kHz and record the difference in level between the peak at 1 GHz and the noise level 100 kHz away at 1000.100 MHz, in Table A-11, "Spectral Purity – SSB Phase Noise Offset from 1 GHz" on page A-7. Then subtract another 30 dB and record this as the 100 kHz Offset Measured Value reading in Table A-11 on page A-7.

   For example: –80 dBc measured – 30 dB = –110 dBc/Hz

10. Change the Center Frequency to 1000.545 MHz and the Span to 1.1 MHz. Run the sweep of 3 averages and allow it to finish. Using Delta Markers measure the difference in level between the peak at 1 GHz and the noise level 1 MHz away at 1001.0 MHz, in Table A-11, "Spectral Purity – SSB Phase Noise Offset from 1 GHz" on page A-7. Then subtract another 30 dB and record this as the 1 MHz Offset Measured Value reading in Table A-11 on page A-7.

For example: –85 dBc measured – 30 dB = –115 dBc/Hz

11. Change the Center Frequency to 1005.495 MHz and the Span to 11 MHz. Run the sweep of 3 averages and allow it to finish. Using Delta Markers measure the difference in level between the peak at 1 GHz and the noise level 10 MHz away at 1010 MHz, in Table A-11, "Spectral Purity – SSB Phase Noise Offset from 1 GHz" on page A-7. Then subtract another 30 dB and record this as the 10 MHz Offset Measured Value reading in Table A-11 on page A-7.

For example: –100 dBc measured –30 dB = –130 dBc/Hz

2-6 Second Harmonic Distortion

Use the following procedure to verify the second harmonic distortion of the MS2090A. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3692C Signal Generator
- Min-Circuits NLP-50 Low Pass Filter
- Anritsu 15NNF50-1.5C RF Cable
- Anritsu 34NN50A Adapter
- 10 MHz Frequency Reference
- 71693-R K(f) to N(f) Adapter, for 26.5, 32, and 43.5 GHz units
- Anritsu 34NFKF50 Adapter, for 54 GHz units
- Anritsu 34VFK50 Adapter, for 54 GHz units

Procedure

1. Connect the 10 MHz Reference to the MG3692C and MS2090A.
2. Connect the output of the MG3692C to the input of the low pass filter and the output of the low pass filter to the RF In of the MS2090A.
3. On the MS2090A, preset the unit, and then update the following settings:
   - Reference Level set to –20 dBm
   - Attenuation Level set to 0 dB
   - Ensure Preamplifier is turned off
   - Bandwidth Menu set RBW to 1 kHz, and VBW to 10 Hz
   - Span set to 100 kHz
4. Set the MS2090A Center Frequency to 50.1 MHz.
5. Set the MG3692C Frequency to 50.1 MHz and adjust the level so the MS2090A shows –30 dBm at 50.1 MHz. Record this value in Table A-12, “Second Harmonic Distortion” on page A-7
6. Set the MS2090A Center Frequency to 100.2 MHz, perform a peak search, and record this value in Table A-12 on page A-7.
7. Subtract 50.1 MHz value from the 100.2 MHz value and record this as the Second Harmonic Distortion in Table A-12 on page A-7.

   For example if the 50.1 MHz value is –30 dBm and the 100.2 MHz value is –90 dBm then:

   –90 dBm – (–30 dBm) = –70 dBc

2-7 Displayed Average Noise Level (DANL) – Preamplifier Off

Use the following procedure to verify the Displayed Average Noise Level (DANL) of the MS2090A with the Pre Amp Off. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu 28N50-2 Termination, for 9, 14, and 20 GHz units
- Anritsu 28KF50 Termination, for 26.5, 32, and 43.5 GHz units
- Anritsu 28VF50D Termination, for 54 GHz units

Procedure

1. Attach the Termination to the RF input of the MS2090A.
2. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
3. MS2090A Settings:
   - Set Reference Level to –20 dBm
   - Set Input Attenuation to 0 dB
   - Ensure the Preamplifier is off
   - Sweep Menu, set Points to 551
   - Trace Menu, set Detector Type to RMS/Avg
4. Set RBW to 1 MHz.
5. Set VBW to 1 kHz.
6. Set VBW Type to Logarithmic.
7. Set Start Frequency to 10 MHz.
8. Set Stop Frequency to 4 GHz.
9. Using the Sweep Menu, turn Continuous Off, and Sweep Once.
10. Using the Marker menu, choose Peak Search, subtract 60 dB from the measurement, and record the power level in:
    - For 9, 14 and 20 GHz Units: Table A-13, “Displayed Average Noise Level (Preamplifier Off, for 9, 14, and 20 GHz Units)” on page A-7
    - For 26.5, 32, 43.5 and 54 GHz Units: Table A-14, “Displayed Average Noise Level (Preamplifier Off, for 26.5, 32, 43.5, and 54 GHz Units)” on page A-8
11. Repeat Step 7 through Step 10 by changing the Start/Stop frequencies for the remaining frequency ranges in Table A-13 on page A-7 or Table A-14 on page A-8.

2-8 Displayed Average Noise Level (DANL) – Preamplifier On

Use the following procedure to verify the Displayed Average Noise Level (DANL) of the MS2090A with the Pre Amp On. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu 28N50-2 Termination, for 9, 14, and 20 GHz units
- Anritsu 28KF50 Termination, for 26.5, 32, and 43.5 GHz units
- Anritsu 28VF50D Termination, for 54 GHz units

Procedure

1. Attach the Termination to the RF input of the MS2090A.
2. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
3. MS2090A Settings:
   - Set Reference Level to –50 dBm
   - Set Input Attenuation to 0 dB
   - Turn the Preamplifier On
   - Sweep Menu, set Points to 551
   - Trace Menu, set Detector Type to RMS/Avg
4. Set RBW to 1 MHz.
5. Set VBW to 1 kHz.
6. Set VBW Type to Logarithmic.
7. Set Start Frequency to 10 MHz.
8. Set Stop Frequency to 4 GHz.
9. Using the Sweep Menu, turn Continuous Off, and Sweep Once.
10. Using the Marker menu, choose Peak Search, subtract 60 dB from the measurement, and record the power level in:
    - For 9, 14 and 20 GHz Units: Table A-15, “Displayed Average Noise Level (Preamplifier On, for 9, 14, and 20 GHz Units)” on page A-8
    - For 26.5, 32, 43.5 and 54 GHz Units: Table A-16, “Displayed Average Noise Level (Preamplifier On, for 26.5, 32, 43.5, and 54 GHz Units)” on page A-8
11. Repeat Step 7 through Step 10 by changing the Start/Stop frequencies for the remaining frequency ranges in Table A-15 on page A-8 or Table A-16 on page A-8.

2-9 Residual Spurs – Preamplifier Off

Use the following procedure to verify the Residual Spurs of the MS2090A with the Pre Amp Off. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu 28N50-2 Termination, for 9, 14, and 20 GHz units
- Anritsu 28KF50 Termination, for 26.5, 32, and 43.5 GHz units
- Anritsu 28VF50D Termination, for 54 GHz units

Procedure

1. Attach the Termination to the RF input of the MS2090A.
2. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
3. MS2090A Settings:
   - Set Reference Level to –20 dBm
   - Set Input Attenuation to 0 dB
   - Ensure Preamplifier is Off
   - Sweep Menu, set Points to 551
4. Set Start Frequency to 9 kHz.
5. Set Stop Frequency to 100 kHz.
6. Set RBW to 300 Hz.
7. Set VBW to 10 Hz.
8. Using the Sweep Menu, turn Continuous Off, and Sweep Once.
9. Using the Marker menu, choose Peak Search and record the power level in Table A-17, “Residual Spurs (Preamplifier Off)” on page A-9.
10. Repeat Step 4 through Step 9 by changing the Start/Stop frequencies and RBW/VBW settings for the remaining frequency ranges in Table A-17 on page A-9.

2-10 Residual Spurs – Preamplifier On

Use the following procedure to verify the Residual Spurs of the MS2090A with the Pre Amp On. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu 28N50-2 Termination, for 9, 14, and 20 GHz units
- Anritsu 28KF50 Termination, for 26.5, 32, and 43.5 GHz units
- Anritsu 28VF50D Termination, for 54 GHz units

Procedure

1. Attach the Termination to the RF input of the MS2090A.
2. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
3. MS2090A Settings:
   - Set Reference Level to –50 dBm
   - Set Input Attenuation to 0 dB
   - Set the Preamplifier to On
   - Sweep Menu, set Points to 551
4. Set Start Frequency to 9 kHz.
5. Set Stop Frequency to 100 kHz.
6. Set RBW to 300 Hz.
7. Set VBW to 10 Hz.
8. Using the Sweep Menu, turn Continuous Off, and Sweep Once.
9. Using the Marker menu, choose Peak Search and record the power level in Table A-18, “Residual Spurs (Preamplifier On)” on page A-9.
10. Repeat Step 4 through Step 9 by changing the Start/Stop frequencies and RBW/VBW settings for the remaining frequency ranges in Table A-18 on page A-9.

2-11 Input Related Spurs

Use the following procedure to verify the Input Related Spurs of the MS2090A. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3697C
- Anritsu 3670V50A-2 Coaxial Cable, V(m) to V(f)
- Anritsu 34VKF50 Adapter, V(m) to K(f), for 9, 14, 20, 26.5, 32, and 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9, 14, and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the 10 MHz Reference to the MG3697C and MS2090A.
2. Connect the output of the MG3697C to the RF In of the MS2090A.
3. On the MS2090A, preset the unit, and then update the following settings:
   - Reference Level set to –30 dBm
   - Attenuation Level set to 0 dB
   - Ensure Preamplifier is turned off
   - Span set to 1.7 GHz
   - RBW set to 3000 Hz
   - VBW set to 300 Hz
4. Set the MS2090A Center Frequency to 5 GHz.
5. Set the MG3697C frequency to 5 GHz, and set power level so –30 dBm is read on the MS2090A at 5 GHz.
6. Ensure no spurs are seen within the 1.7 GHz span that are greater than –90 dBm (–60 dBc). Record the highest spur level in Table A-19, “Input Related Spurs” on page A-10.
7. Repeat Step 4 to Step 6 for the remaining frequencies in Table A-19 on page A-10.

2-12 Third Order Intercept (TOI)

Use the following procedure to verify the Third Order Intercept (TOI) of the MS2090A. Record the results in the test records provided in Appendix A.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

Equipment Required:

- Anritsu MG3692C Signal Generator
- Anritsu MG3710A Signal Generator
- Weinschel 1870A Splitter
- Weinschel 44-8 Attenuator, Qty 2
- Weinschel 44-20 Attenuator, Qty 2
- Anritsu ML2438A Power Meter
- Anritsu MA2442D Power Sensor
- Anritsu 34NN50A Adapter
- Anritsu 15NNF50-1.5C RF Cables, Qty 2
- 10 MHz Frequency Reference
- 71693-R K(f) to N(f) Adapter, for 26.5, 32, and 43.5 GHz units
- Anritsu 34NFKF50 Adapter, for 54 GHz units
- Anritsu 34VFK50 Adapter, for 54 GHz units

Procedure

1. Connect the 10 MHz Reference to the MG3692C, MG3710A, and MS2090A.
2. Connect an 8 dB and 20 dB attenuator to both outputs of the splitter, so 28 dB of attenuation is attached to each of the outputs.
3. Using two RF cables attach the outputs of the MG3692C and MG3710A to each of the splitter outputs.
4. Attach the MA2442D to the ML2438A, and zero the sensor.
5. Set the MA2442D Cal Factor to 2400 MHz.
6. Attach the MA2442D to the input of the power splitter.
7. Set the MG3692C to 2399.951 MHz, and set the MG3710A to 2400.051 MHz.
8. Ensure the MG3710A RF output is off.
9. On the MG3692C adjust the power so the power meter reads –20 dBm. (Approximately +16 dBm)
10. Turn off the RF output of the MG3692C and turn on the output from the MG3710A.
11. On the MG3710A adjust the power so the power meter reads –20 dBm. (Approximately +16 dBm)
12. On the MS2090A, preset the unit, and then update the following settings:
    - Center Frequency set to 2400.151 MHz
    - Reference Level set to –15 dBm
    - Attenuation Level set to 0 dB
    - Ensure Preamplifier is turned off
    - Span set to 100 Hz
    - RBW set to 30 Hz
    - VBW set to 1 Hz
13. On the MS2090A in the Sweep Menu change Detector Type to RMS / Avg.

14. Disconnect the MA2442D from the power splitter and connect the MS2090A to the power splitter using the necessary adapters.

15. Turn on the RF output of both the MG3692C and MG3710A.

16. On the MS2090A perform a Peak Search and record the peak value at 2400.151 MHz in Table A-20, "Third Order Intercept (TOI)" on page A-10.

17. On the MS2090A change the Center Frequency to 2399.851 MHz and perform a Peak Search. Record the value at 2399.851 MHz in Table A-20 on page A-10.

18. Determine which signal is larger (the 2399.851 or 2400.151 MHz signal). Use the larger value for the "max" variable in the following formula to calculate the TOI value:

TOI = –20 + [(–20 - max) / 2]

For example if max = –90 dBm, then TOI = +15 dB

19. Record the TOI value in Table A-20 on page A-10.

Chapter 3 — Installed Options Verification

3-1 Introduction

This chapter describes the verification process for the options available on the MS2090A Field Master Pro. Record the measurement results in the test record templates provided in Appendix A, "Test Records".

3-2 Option 31, GPS Frequency Accuracy

The following test is used to verify the CW frequency accuracy of the Spectrum Analyzer with GPS enabled

Equipment Required:

- Anritsu MG3697C
- 10 MHz Frequency Reference
- GPS Antenna

Procedure

1. Connect the external 10 MHz Reference to the MG3697C.

Note	Do not connect the 10 MHz Reference to the MS2090A.

2. Connect the MG3697C RF Out to the MS2090A RF In.
3. Set the MG3697C to output –30 dBm at 7 GHz.
4. Set the MS2090A to Spectrum Analyzer mode and Preset the unit.
5. Attach a GPS antenna to the MS2090A and ensure a GPS signal can be received.
6. On the MS2090A, go to System > Settings > GPS menu, turn the GPS On.
7. Wait until Fix is shown as Good Fix, and GPS coordinates are shown.

Note	Before continuing, allow a 30 minute warm-up for the internal circuitry to stabilize.

8. MS2090A Settings:
    - Center Frequency: 7 GHz
    - Reference Level: –10 dBm
    - Spa: 10 kHz
    - RBW: 100 Hz
    - VBW: 30 Hz
9. Enable Marker 1 and perform a Peak Search. Record the marker frequency in Table A-21, "Option 31, GPS Frequency Accuracy" on page A-10. Calculate the error by subtracting 7 GHz from the measured value and record the error in Table A-21 on page A-10.

Chapter 4 — Battery Information

4-1 General Information

This chapter provides the care and handling information of the Anritsu 633-75 battery pack and Lithium-Ion batteries.

- The battery supplied with the Field Master Pro may need charging before use. Before using the instrument, the internal battery can be charged in the unit using the AC-DC Adapter (40-204-R).
- Use only Anritsu approved battery packs.
- Recharge the battery only in the instrument or in an Anritsu approved charger.
- When the instrument or the charger is not in use, disconnect it from the AC power source.
- Do not charge batteries for longer than 24 hours. Overcharging may shorten battery life.
- If left unused a fully charged battery will discharge itself over time.
- Temperature extremes affect the ability of the battery to charge. Allow the battery to cool down or warm up as necessary before use or charging.
- Discharge the battery from time to time to improve battery performance and battery life.
- The battery can be charged and discharged hundreds of times, but it will eventually wear out.
- The battery may need to be replaced when the operating time between charging becomes noticeably shorter than normal.
- Never use a damaged or worn out charger or battery.
- Storing the battery in extreme hot or cold places will reduce the capacity and lifetime of the battery.
- Never short-circuit the battery terminals.
- Do not drop, mutilate or attempt to disassemble the battery.
- Do not dispose of batteries in a fire!
- Batteries must be recycled or disposed of properly. Do not place batteries in household garbage.
- Always use the battery for its intended purpose only.

Warning

This equipment is supplied with a rechargeable battery that could potentially leak hazardous compounds into the environment. These hazardous compounds present a risk of injury or loss due to exposure. Anritsu Company recommends removing the battery for long-term storage of the instrument and storing the battery in a leak-proof, plastic container. Follow the environmental storage requirements specified in the product data sheet.

4-2 Battery Pack Removal and Replacement

This section provides instructions for the removal and replacement of the instrument battery pack.

1. Locate the battery access door on the right side of the unit.
2. Press the circular area while simultaneously sliding towards the rear of the MS2090A to remove as shown in Figure 4-1.

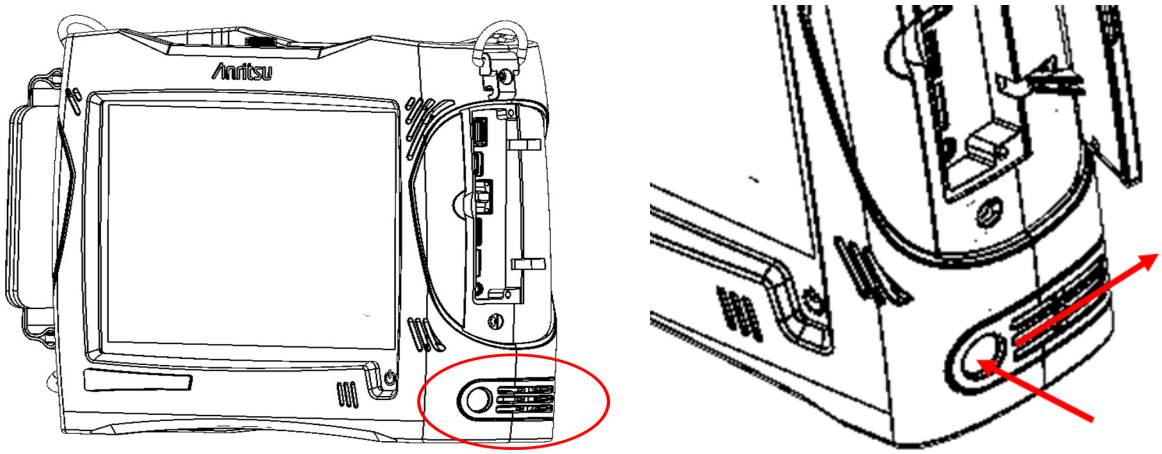

Figure 4-1. Battery Access Door Location and Removal

3. With the battery access door removed, grasp the battery lanyard and pull the battery straight out of the unit as illustrated in Figure 4-2.

Figure 4-2. Removing the Battery

Chapter 5 — Assembly Replacement

5-1 Introduction

This chapter describes opening and closing the Field Master Pro case along with basic parts replacement steps. The sections are as follows:

5-2 Replaceable Parts List

Refer to Table 1-2, "List of Replaceable Parts" on page 1-3 for the list of replacement parts.
Refer to the following sections for basic replacement instructions

Caution	Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. All work should be performed in a static-safe work area. Only qualified personnel should open the case and replace internal assemblies. Assemblies shown in Table 1-2 are typically the only items that may be replaced. The assemblies are highly fragile, items that must be soldered may not be replaced without specialized training. The Field Master Pro contains components that can easily be damaged by electrostatic discharge (ESD). 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. Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

Caution	Removing the RF shield from PC boards or adjustment of screws on or near the shields may detune sensitive RF circuits and will result in degraded performance.

Note	Many of the procedures in this section are generic and apply to many similar instruments. Photos and illustrations used are representative and may show instruments other than the Field Master Pro.

5-3 Rear Case Removal

This procedure provides instructions for removing the rear case of the instrument.

1. Remove the battery door and battery as shown in Section 4-2 “Battery Pack Removal and Replacement” on page 4-2.
2. Using a T10 Torx screwdriver, remove the rear case by removing ten screws. One screw will be located on the top, seven will be located on the rear, and two on the bottom of the MS2090A as shown in Figure 5-1.

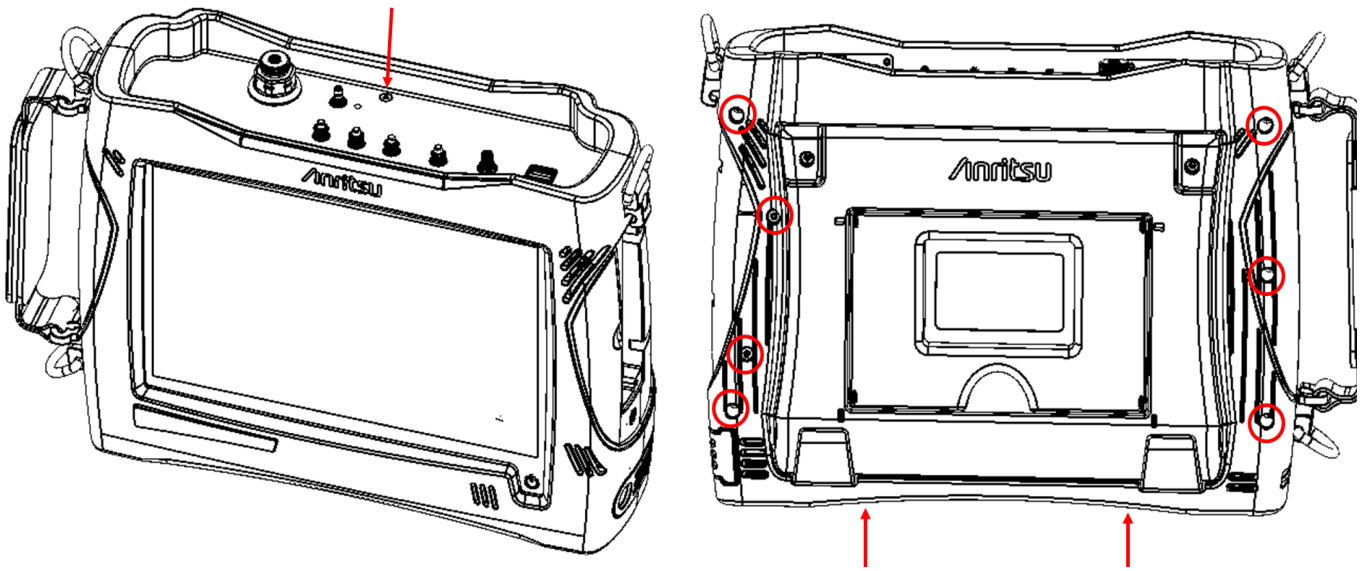

Figure 5-1. Rear Case Removal

3. With all screws removed, place the instrument face down on a stable flat work surface
4. Gently pull the rear case apart from the front case.

5-4 Battery Compartment and Fan Removal

This procedure provides instructions for removing the battery compartment and fan assembly. These will need to be removed in order to remove other components within the unit, including the VSA PCB, Main PCB, Front Panel, and LCD/Touchscreen.

1. Remove the battery door and battery as shown in Section 4-2 “Battery Pack Removal and Replacement” on page 4-2.
2. Remove the rear case as shown in Section 5-3 “Rear Case Removal”.
3. On the bottom of the unit, remove the remaining two screws securing the battery compartment to the front case as shown in Figure 5-2

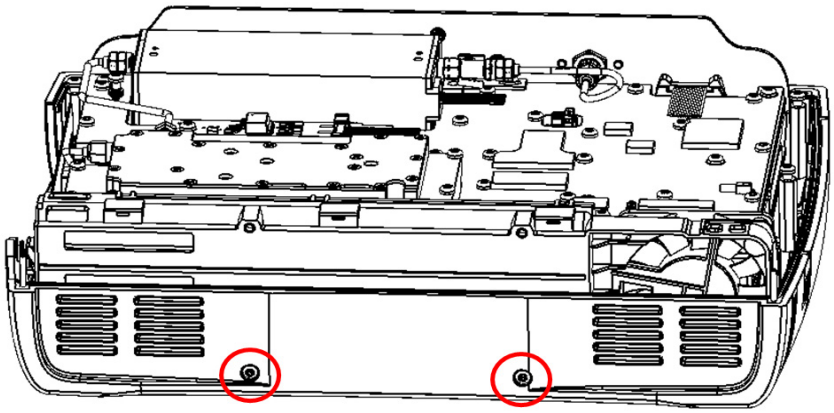

Figure 5-2. Battery Compartment and Fan Removal

4. Gently pull the battery compartment and fan assembly out of the unit. The cables connecting the battery and fan to the Main PCB will still be connected.
5. After the assembly is removed, disconnect both the battery and fan cable by pulling the connectors towards the bottom of the unit as shown in Figure 5-3.

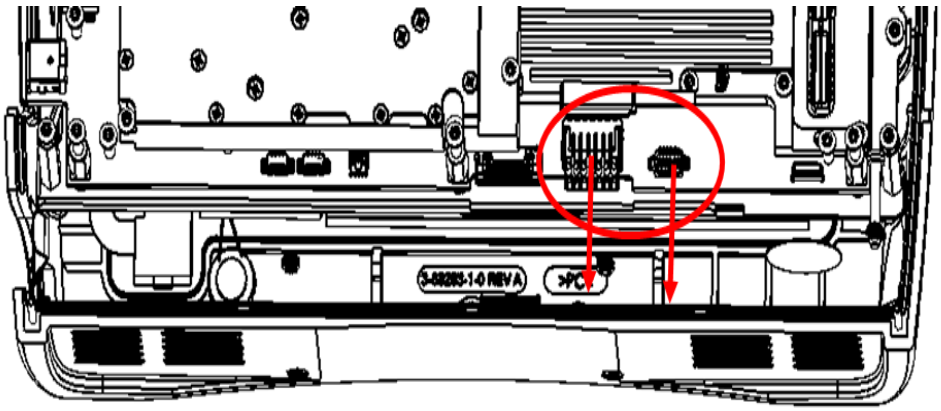

Figure 5-3. Removing Fan and Battery Cables

5-5 Main and VSA PCB Removal

This procedure provides instructions for removing the Main and VSA PCB Assembly.

1. Remove the battery door and battery as shown in Section 4-2 “Battery Pack Removal and Replacement” on page 4-2.
2. Remove the rear case as shown in Section 5-3 “Rear Case Removal”.
3. Remove the battery compartment and fan as shown in Section 5-4 “Battery Compartment and Fan Removal”.
4. Using a small Phillips screwdriver, remove the four screws holding the two Wi-Fi antennas to the front case.
5. Using a T10 Torx screwdriver, remove the remaining screw on the top plate as shown in Figure 5-4.

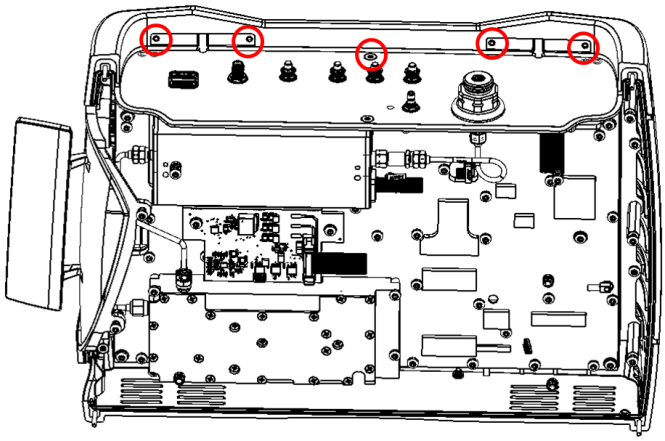

Figure 5-4. Two Wi-Fi Antennas

6. There are two screws and five stand-offs that will need to be removed. Use a Torx T10 screwdriver to remove the two screws and a 1/4 inch nut driver to remove the 5 stand-offs as shown in Figure 5-5.
7. After removing the screws and stand-offs, DO NOT remove the Main/VSA Assembly. Additional cables need to be disconnected prior to removing this assembly.

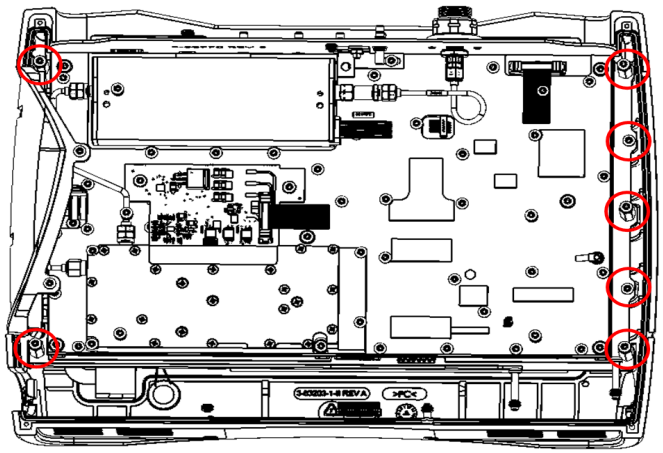

Figure 5-5. Main and VSA PCB Assembly

8. Gently separate the Main/VSA Assembly from the LCD/Touchscreen Assembly by a short distance to gain access to the LCD cable as shown in Figure 5-6. Disconnect this cable from the touchscreen.

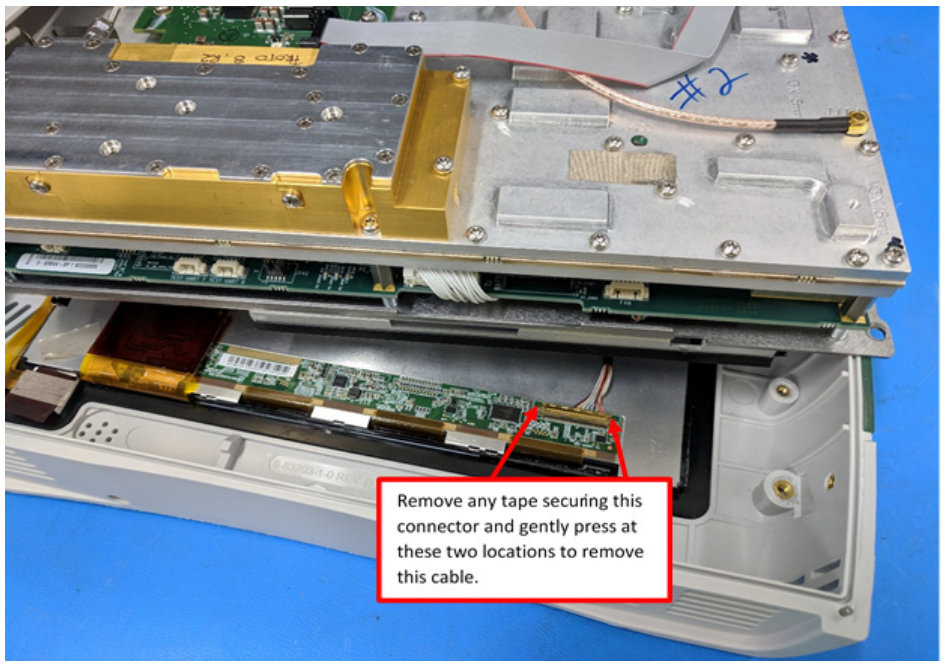

Figure 5-6. Main/VSA Separated From LCD/Touchscreen

9. With the first cable removed, the Main/VNA assembly can be rotated 90 degrees clockwise allowing for the second cable to be disconnected as shown in Figure 5-7.

10. The second cable has a locking connector. To remove, press on the locking tab and pull at the same time.

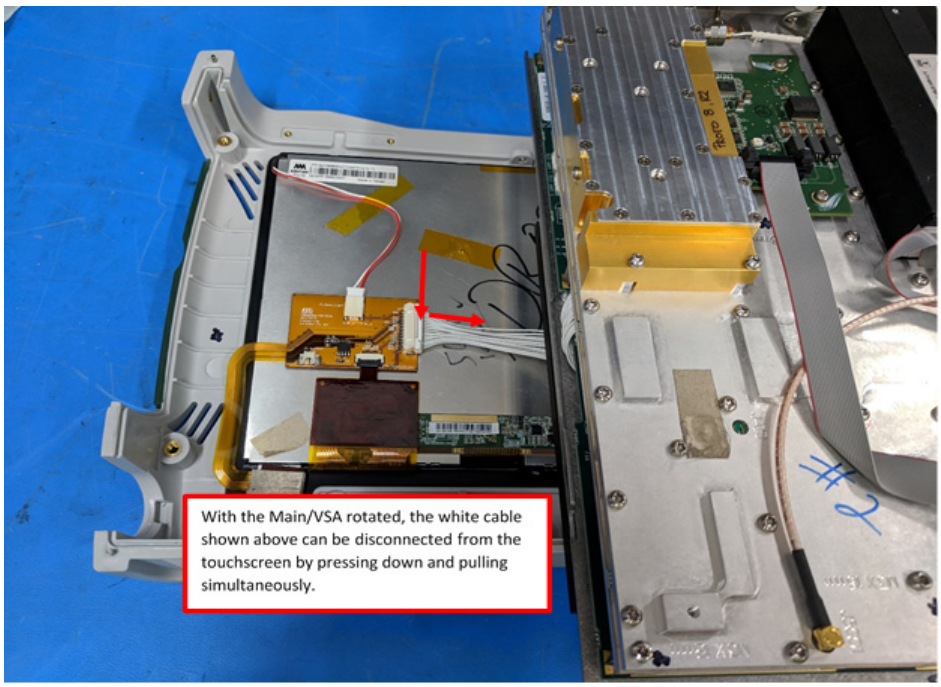

Figure 5-7. Main/VSA Rotated to Gain Access to Second Cable

11. With both cables from the previous two steps disconnected, the Main/VSA assembly can be removed from the touchscreen and front case.

5-6 Touchscreen/LCD Removal

This procedure provides instructions for replacing the Touchscreen/LCD assembly.

1. Remove the battery door and battery as shown in Section 4-2 “Battery Pack Removal and Replacement” on page 4-2.
2. Remove the rear case as shown in Section 5-3 “Rear Case Removal”.
3. Remove the battery compartment and fan as shown in Section 5-4 “Battery Compartment and Fan Removal”.
4. Remove the Main/VSA Assembly as shown in Section 5-5 “Main and VSA PCB Removal”
5. Remove the Speaker connection from the back side of the LCD/Touchscreen assembly as shown in Figure 5-8.
6. With the speaker disconnected, the LCD/Touchscreen can be removed from the front case.

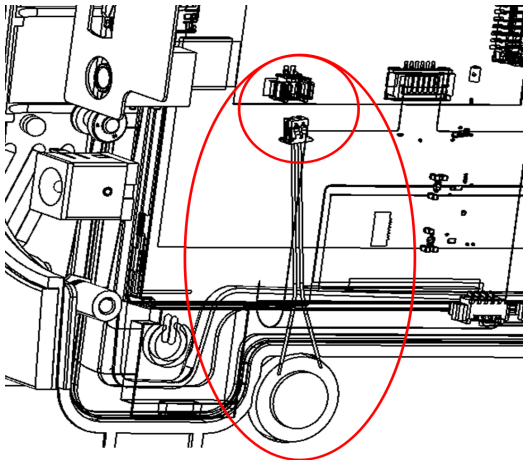

Figure 5-8. Speaker Assembly

5-7 Separating The Main PCB From The VSA PCB Assembly

This procedure provides instructions for separating the Main PCB from the VSA PCB Assembly.

1. Remove the battery door and battery as shown in Section 4-2 “Battery Pack Removal and Replacement” on page 4-2.
2. Remove the rear case as shown in Section 5-3 “Rear Case Removal” on page 5-2.
3. Remove the battery compartment and fan as shown in Section 5-4 “Battery Compartment and Fan Removal” on page 5-3.
4. Remove the Main/VSA Assembly as shown in Section 5-5 “Main and VSA PCB Removal” on page 5-4.
5. Remove the plastic I/O Housing by removing the two screws shown in Figure 5-9.

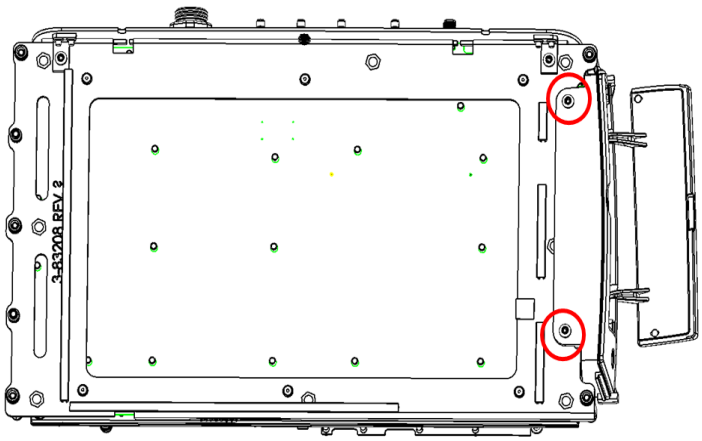

Figure 5-9. I/O Housing Removal

6. Remove the Top Panel by removing the two screws attaching the Top Panel to the Main PCB and the 5 nuts securing the 5 coaxial connections shown in Figure 5-10.

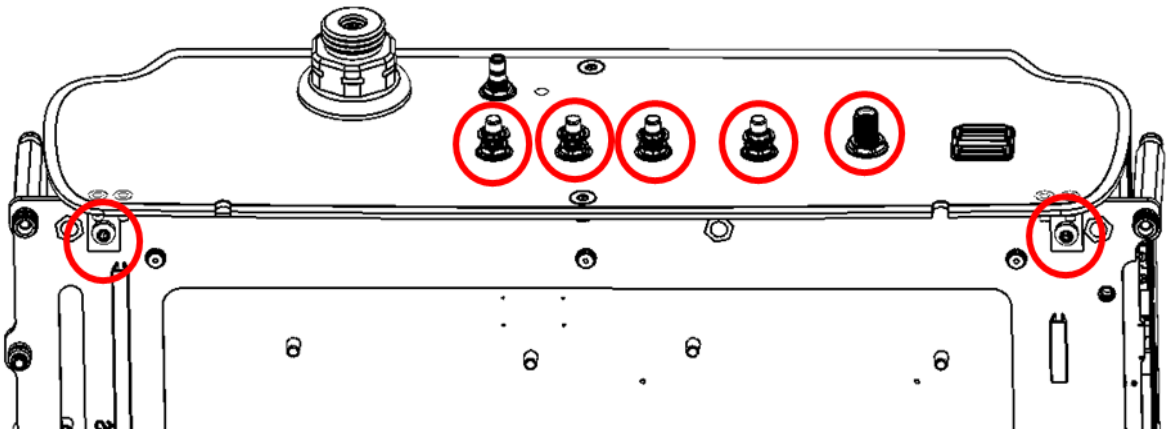

Figure 5-10. Top Panel Removal - Step A

7. Remove the screw attaching the Top Panel to the VSA PCB, the coaxial cable from J5001 of the VSA.

8. Remove the semi-rigid cable connecting the RF In port to the step Attenuator as shown in Figure 5-11.

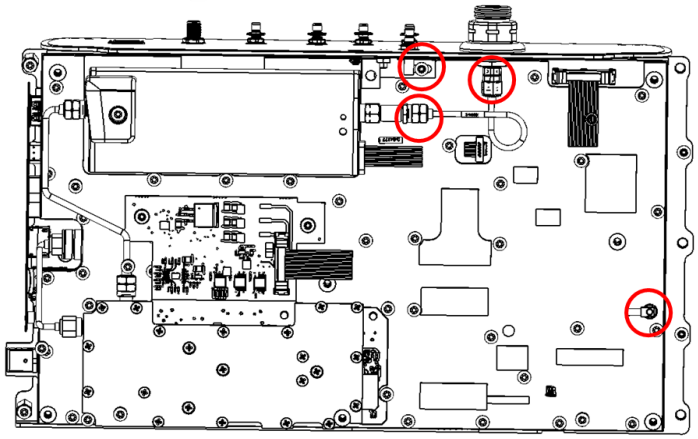

Figure 5-11. Top Panel Removal - Step B

9. After the top panel is removed, The seven screws securing the VSA to Main PCB can be removed as shown in Figure 5-12.

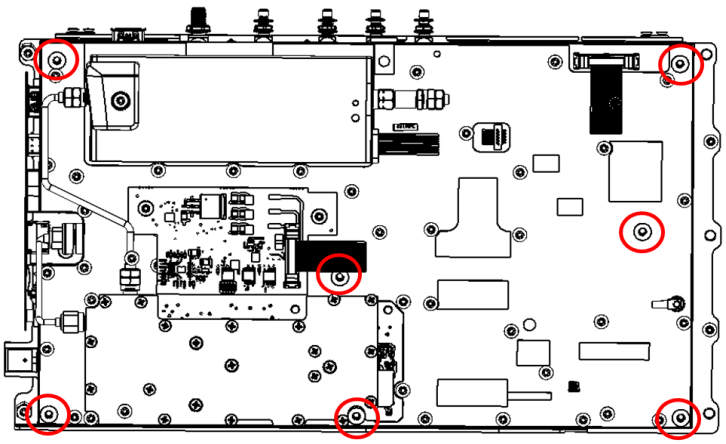

Figure 5-12. Main and VSA Separation

10. There are two rigid connectors between the Main and VSA PCB's that cannot be seen until the two PCB's are separated. Figure 5-13 shows the location of these hidden connectors and where to gently pry the two PCB's apart.

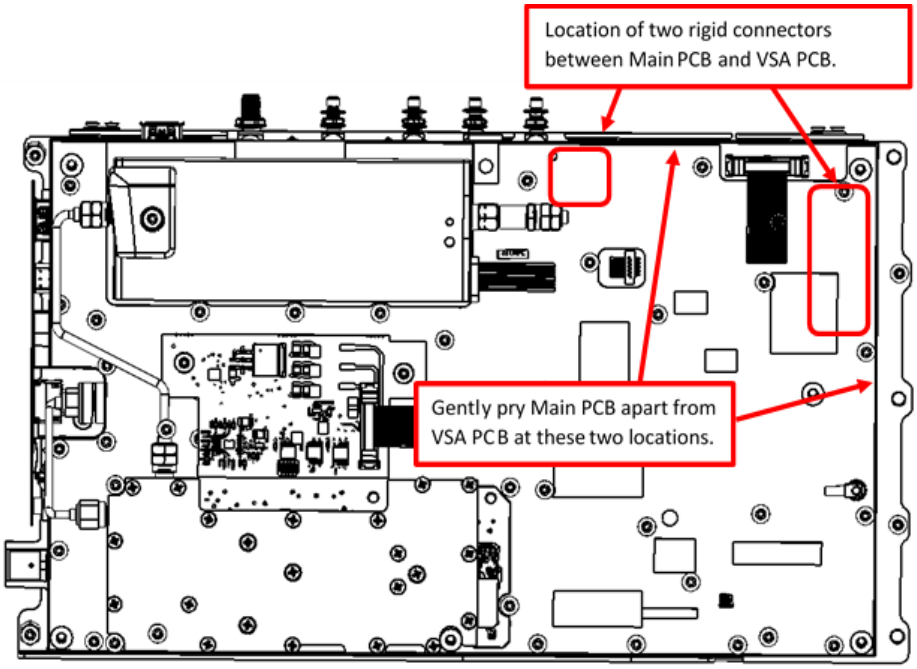

Figure 5-13. Main and VSA Connector Locations

5-8 Separating The Main PCB From The Bracket

This procedure provides instructions for separating the Main PCB from the metal bracket attaching the Main PCB to the front panel.

1. Remove the five stand-offs and three screws shown in Figure 5-14.

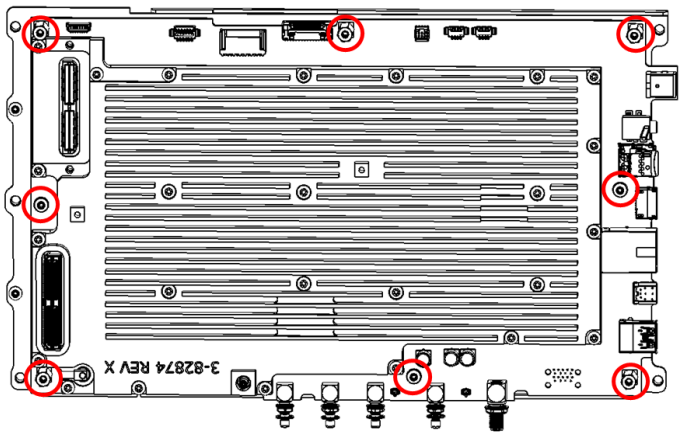

Figure 5-14. Main PCB and Bracket Separation

5-9 Separating the Wi-Fi Antennas From the Main PCB

This procedure provides instructions for removing the Wi-Fi Antennas from the Main PCB Assembly.

1. Using a small pliers, gently lift up on the Wi-Fi Antenna connectors shown in Figure 5-15.

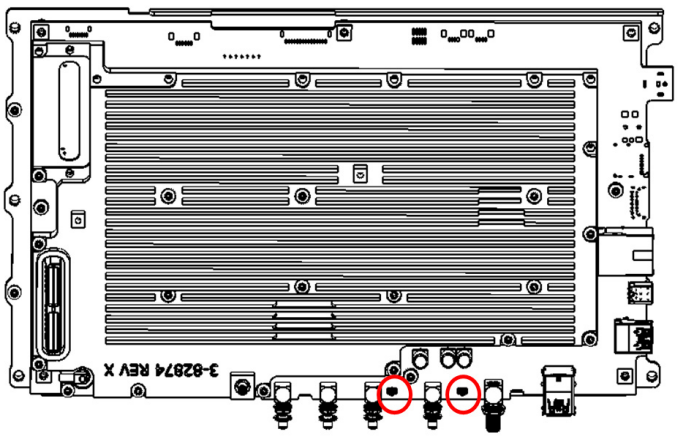

Figure 5-15. Removing Wi-Fi Antennas

5-10 Separating The Fan From The Battery Compartment

This procedure provides instructions for separating the fan from the battery compartment.

1. Remove the two screws securing the fan to the battery compartment as shown in Figure 5-16.

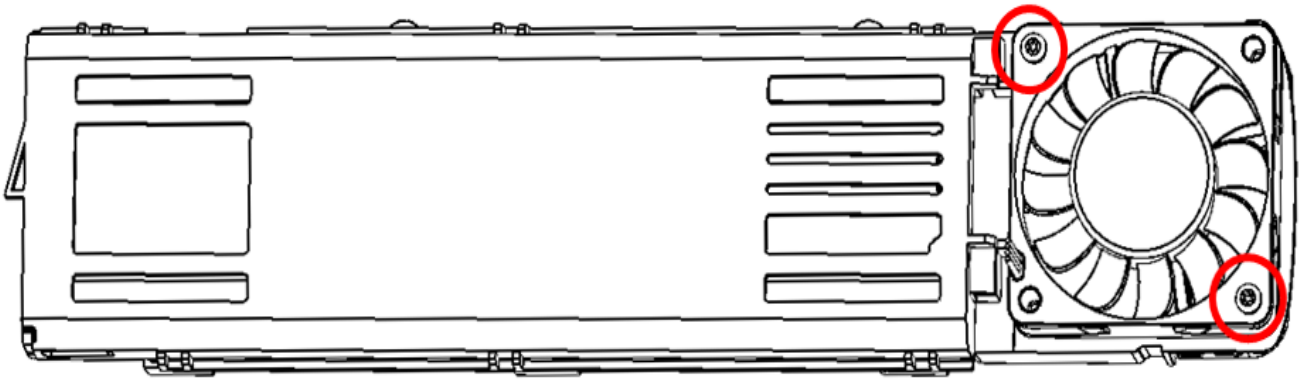

Figure 5-16. Fan and Battery Compartment Separation

2. With the two screws removed, there is still double sided tape on the plastic circle in the center of the fan securing the fan to the battery compartment. To remove the fan, the center back side of the fan will need to be separated from the battery compartment. This can be done using a small flathead screwdriver to pry the back side of the fan from the battery compartment as shown in Figure 5-17.

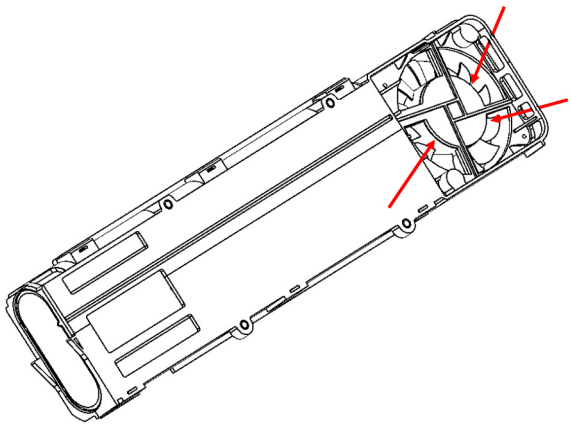

Figure 5-17. Removing Fan From Double Sided Tape

Appendix A — Test Records

A-1 Introduction

This appendix provides the test record templates to record the performance of the MS2090A Field Master Pro. Anritsu recommends that you make a copy of the following test record pages and document the measurements each time a performance verification is performed. Continuing to document this process each time it is performed provides a detailed history of instrument performance.

MS2090A **Firmware Rev:** _____ **Operator:** _____ **Date:** _____

Serial Number: _____ **Options:** _____

A-2 Test Records for Spectrum Analyzer Verification

Table A-1. Spectrum Analyzer Frequency Accuracy

Frequency	Measured Value	Error	Measurement Uncertainty	Specification
1 GHz	GHz	Hz	250 Hz (0.25 ppm)	± 300 Hz (0.3ppm)
7 GHz	GHz	Hz	1750 Hz (0.25 ppm)	± 2100 Hz (0.3ppm)

Table A-2. Power Level Accuracy at 50 MHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
50 MHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.30 dB	0 dBm ± 1.3 dB
50 MHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.30 dB	–4 dBm ± 1.3 dB
50 MHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.30 dB	–8 dBm ± 1.3 dB
50 MHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.30 dB	–10 dBm ± 1.3 dB
50 MHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.30 dB	–14 dBm ± 1.3 dB
50 MHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.30 dB	–18 dBm ± 1.3 dB
50 MHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.30 dB	–20 dBm ± 1.3 dB
50 MHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.30 dB	–24 dBm ± 1.3 dB
50 MHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.30 dB	–28 dBm ± 1.3 dB
50 MHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.30 dB	–30 dBm ± 1.3 dB

Table A-3. Power Level Accuracy at 5 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
5 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.30 dB	0 dBm ± 1.3 dB
5 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.30 dB	–4 dBm ± 1.3 dB
5 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.30 dB	–8 dBm ± 1.3 dB
5 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.30 dB	–10 dBm ± 1.3 dB
5 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.30 dB	–14 dBm ± 1.3 dB
5 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.30 dB	–18 dBm ± 1.3 dB
5 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.30 dB	–20 dBm ± 1.3 dB
5 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.30 dB	–24 dBm ± 1.3 dB
5 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.30 dB	–28 dBm ± 1.3 dB
5 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.30 dB	–30 dBm ± 1.3 dB

Table A-4. Power Level Accuracy at 13 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
13 GHz	30 dB	10 dBm	+10 dBm	0 –dBm	dBm	0.33 dB	0 dBm ± 1.3 dB
13 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.33 dB	–4 dBm ± 1.3 dB
13 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.33 dB	–8 dBm ± 1.3 dB
13 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.33 dB	–10 dBm ± 1.3 dB
13 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.33 dB	–14 dBm ± 1.3 dB
13 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.33 dB	–18 dBm ± 1.3 dB
13 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.33 dB	–20 dBm ± 1.3 dB
13 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.33 dB	–24 dBm ± 1.3 dB
13 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.33 dB	–28 dBm ± 1.3 dB
13 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.33 dB	–30 dBm ± 1.3 dB

Table A-5. Power Level Accuracy at 18 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
18 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.44 dB	0 dBm ± 1.3 dB
18 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.44 dB	–4 dBm ± 1.3 dB
18 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.44 dB	–8 dBm ± 1.3 dB
18 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.44 dB	–10 dBm ± 1.3 dB
18 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.44 dB	–14 dBm ± 1.3 dB
18 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.44 dB	–18 dBm ± 1.3 dB
18 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.44 dB	–20 dBm ± 1.3 dB
18 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.44 dB	–24 dBm ± 1.3 dB
18 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.44 dB	–28 dBm ± 1.3 dB
18 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.44 dB	–30 dBm ± 1.3 dB

Table A-6. Power Level Accuracy at 25 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
25 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.37 dB	0 dBm ± 1.8 dB
25 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.37 dB	–4 dBm ± 1.8 dB
25 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.37 dB	–8 dBm ± 1.8 dB
25 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.37 dB	–10 dBm ± 1.8 dB
25 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.37 dB	–14 dBm ± 1.8 dB
25 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.37 dB	–18 dBm ± 1.8 dB
25 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.37 dB	–20 dBm ± 1.8 dB
25 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.37 dB	–24 dBm ± 1.8 dB
25 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.37 dB	–28 dBm ± 1.8 dB
25 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.37 dB	–30 dBm ± 1.8 dB

Table A-7. Power Level Accuracy at 31 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
31 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.45 dB	0 dBm ± 1.8 dB
31 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.45 dB	–4 dBm ± 1.8 dB
31 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.45 dB	–8 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.45 dB	–10 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.45 dB	–14 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.45 dB	–18 dBm ± 1.8 dB
31 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.45 dB	–20 dBm ± 1.8 dB
31 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.45 dB	–24 dBm ± 1.8 dB
31 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.45 dB	–28 dBm ± 1.8 dB
31 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.45 dB	–30 dBm ± 1.8 dB

Table A-8. Power Level Accuracy at 43 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
43 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.67 dB	0 dBm ± 1.8 dB
43 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.67 dB	–4 dBm ± 1.8 dB
43 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.67 dB	–8 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.67 dB	–10 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.67 dB	–14 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.67 dB	–18 dBm ± 1.8 dB
43 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.67 dB	–20 dBm ± 1.8 dB
43 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.67 dB	–24 dBm ± 1.8 dB
43 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.67 dB	–28 dBm ± 1.8 dB
43 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.67 dB	–30 dBm ± 1.8 dB

Table A-9. Power Level Accuracy at 53 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
53 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.38 dB	0 dBm ± 1.8 dB
53 GHz	30 dB	10 dBm	+6 dBm	–4 dBm	dBm	0.38 dB	–4 dBm ± 1.8 dB
53 GHz	30 dB	10 dBm	+2 dBm	–8 dBm	dBm	0.38 dB	–8 dBm ± 1.8 dB
53 GHz	20 dB	0 dBm	0 dBm	–10 dBm	dBm	0.38 dB	–10 dBm ± 1.8 dB
53 GHz	20 dB	0 dBm	–4 dBm	–14 dBm	dBm	0.38 dB	–14 dBm ± 1.8 dB
53 GHz	20 dB	0 dBm	–8 dBm	–18 dBm	dBm	0.38 dB	–18 dBm ± 1.8 dB
53 GHz	10 dB	–10 dBm	–10 dBm	–20 dBm	dBm	0.38 dB	–20 dBm ± 1.8 dB
53 GHz	10 dB	–10 dBm	–14 dBm	–24 dBm	dBm	0.38 dB	–24 dBm ± 1.8 dB
53 GHz	10 dB	–10 dBm	–18 dBm	–28 dBm	dBm	0.38 dB	–28 dBm ± 1.8 dB
53 GHz	0 dB	–20 dBm	–20 dBm	–30 dBm	dBm	0.38 dB	–30 dBm ± 1.8 dB

Table A-10. Power Level Accuracy (Preamplifier On)

Frequency	NRP67T Power Level	MS2090A Expected Power Level	MS2090A Measured Power Level	Measurement Uncertainty	Specification
10 kHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
10 MHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
150 MHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
1 GHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
3 GHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
5 GHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
8.9 GHz	–10 dBm	–50 dBm	dBm	0.30 dB	–50 dBm ± 1.3 dB
13 GHz	–10 dBm	–50 dBm	dBm	0.33 dB	–50 dBm ± 1.3 dB
18 GHz	–10 dBm	–50 dBm	dBm	0.44 dB	–50 dBm ± 1.3 dB
25 GHz	–10 dBm	–50 dBm	dBm	0.37 dB	–50 dBm ± 1.8 dB
31 GHz	–10 dBm	–50 dBm	dBm	0.45 dB	–50 dBm ± 1.8 dB
43 GHz	–10 dBm	–50 dBm	dBm	0.67 dB	–50 dBm ± 1.8 dB
53 GHz	–10 dBm	–50 dBm	dBm	0.38 dB	–50 dBm ± 1.8 dB

Table A-11. Spectral Purity – SSB Phase Noise Offset from 1 GHz

Frequency Offset	Measured Delta with 1kHz RBW	Calculated Value (Measured – 30 dB)	Measurement Uncertainty	Specification (For Calculated Value)
10 kHz	dBc	dBc/Hz	2.0 dB	–102 dBc/Hz max
100 kHz	dBc	dBc/Hz	2.0 dB	–106 dBc/Hz max
1 MHz	dBc	dBc/Hz	2.0 dB	–111 dBc/Hz max
10 MHz	dBc	dBc/Hz	2.0 dB	–123 dBc/Hz max

Table A-12. Second Harmonic Distortion

Frequency	Measured Value	Second Harmonic Distortion (100.2 Meas Value – 50.1 Meas Value)	Measurement Uncertainty	Specification
50.1 MHz	dBm			
100.2 MHz	dBm	dBc	1.0 dB	–54 dBc max

Table A-13. Displayed Average Noise Level (Preamplifier Off, for 9, 14, and 20 GHz Units)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value – 60 dB	Measurement Uncertainty	Specification
10 MHz	4 GHz	1 MHz	1 kHz	dBm	2.0 dB	–145 dBm max
> 4 GHz	9 GHz	1 MHz	1 kHz	dBm	2.0 dB	–142 dBm max
> 9 GHz	14 GHz	1 MHz	1 kHz	dBm	2.0 dB	–136 dBm max
> 14 GHz	20 GHz	1 MHz	1 kHz	dBm	2.0 dB	–138 dBm max

Table A-14. Displayed Average Noise Level (Preamplifier Off, for 26.5, 32, 43.5, and 54 GHz Units)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value – 60 dB	Measurement Uncertainty	Specification
10 MHz	4 GHz	1 MHz	1 kHz	dBm	2.0 dB	–145 dBm max
> 4 GHz	9 GHz	1 MHz	1 kHz	dBm	2.0 dB	–142 dBm max
> 9 GHz	14 GHz	1 MHz	1 kHz	dBm	2.0 dB	–136 dBm max
> 14 GHz	20 GHz	1 MHz	1 kHz	dBm	2.0 dB	–138 dBm max
> 20 GHz	26.5 GHz	1 MHz	1 kHz	dBm	2.0 dB	–135 dBm max
> 26.5 GHz	32 GHz	1 MHz	1 kHz	dBm	2.0 dB	–135 dBm max
> 32 GHz	43.5 GHz	1 MHz	1 kHz	dBm	2.0 dB	–135 dBm max
> 43.5 GHz	54 GHz	1 MHz	1 kHz	dBm	2.0 dB	–130 dBm max

Table A-15. Displayed Average Noise Level (Preamplifier On, for 9, 14, and 20 GHz Units)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value – 60 dB	Measurement Uncertainty	Specification
10 MHz	4 GHz	1 MHz	1 kHz	dBm	2.0 dB	–161 dBm max
> 4 GHz	9 GHz	1 MHz	1 kHz	dBm	2.0 dB	–159 dBm max
> 9 GHz	14 GHz	1 MHz	1 kHz	dBm	2.0 dB	–156 dBm max
> 14 GHz	20 GHz	1 MHz	1 kHz	dBm	2.0 dB	–156 dBm max

Table A-16. Displayed Average Noise Level (Preamplifier On, for 26.5, 32, 43.5, and 54 GHz Units)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value – 60 dB	Measurement Uncertainty	Specification
10 MHz	4 GHz	1 MHz	1 kHz	dBm	2.0 dB	–161 dBm max
> 4 GHz	9 GHz	1 MHz	1 kHz	dBm	2.0 dB	–159 dBm max
> 9 GHz	14 GHz	1 MHz	1 kHz	dBm	2.0 dB	–156 dBm max
> 14 GHz	20 GHz	1 MHz	1 kHz	dBm	2.0 dB	–156 dBm max
> 20 GHz	26.5 GHz	1 MHz	1 kHz	dBm	2.0 dB	–154 dBm max
> 26.5 GHz	32 GHz	1 MHz	1 kHz	dBm	2.0 dB	–154 dBm max
> 32 GHz	43.5 GHz	1 MHz	1 kHz	dBm	2.0 dB	–152 dBm max
> 43.5 GHz	54 GHz	1 MHz	1 kHz	dBm	2.0 dB	–147 dBm max

Table A-17. Residual Spurs (Preamplifier Off)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value	Measurement Uncertainty	Specification
9 kHz	100 kHz	300 Hz	10 Hz	dBm	4.0 dB	–90 dBm, max
100 kHz	30 MHz	1 kHz	100 Hz	dBm	4.0 dB	–90 dBm, max
30 MHz	9 GHz	3 kHz	300 Hz	dBm	4.0 dB	–90 dBm, max
9 GHz	<14 GHz	3 kHz	300 Hz	dBm	4.0 dB	–90 dBm, max
14 GHz	20 GHz	3 kHz	300 Hz	dBm	4.0 dB	–85 dBm, max
> 20 GHz	26.5 GHz	3 kHz	300 Hz	dBm	4.0 dB	–80 dBm, max
> 26.5 GHz	32 GHz	3 kHz	300 Hz	dBm	4.0 dB	–80 dBm, max
> 32 GHz	43.5 GHz	3 kHz	300 Hz	dBm	4.0 dB	–80 dBm, max
> 43.5 GHz	54 GHz	3 kHz	300 Hz	dBm	4.0 dB	–80 dBm, max

Table A-18. Residual Spurs (Preamplifier On)

Start Frequency	Stop Frequency	RBW	VBW	Measured Value	Measurement Uncertainty	Specification
9 kHz	100 kHz	300 Hz	10 Hz	dBm	4.0 dB	–100 dBm, max
100 kHz	30 MHz	1 kHz	100 Hz	dBm	4.0 dB	–100 dBm, max
30 MHz	9 GHz	3 kHz	300 Hz	dBm	4.0 dB	–100 dBm, max
9 GHz	<14 GHz	3 kHz	300 Hz	dBm	4.0 dB	–100 dBm, max
14 GHz	20 GHz	3 kHz	300 Hz	dBm	4.0 dB	–100 dBm, max
> 20 GHz	26.5 GHz	3 kHz	300 Hz	dBm	4.0 dB	–100 dBm, max
> 26.5 GHz	32 GHz	3 kHz	300 Hz	dBm	4.0 dB	–100 dBm, max
> 32 GHz	43.5 GHz	3 kHz	300 Hz	dBm	4.0 dB	–95 dBm, max
> 43.5 GHz	54 GHz	3 kHz	300 Hz	dBm	4.0 dB	–95 dBm, max

Table A-19. Input Related Spurs

Center Frequency	Measured Input Signal	Measured Spur	Calculated IRS (Input Signal – Spur)	Measurement Uncertainty	Specification
5 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
8 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
13 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
19 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
25 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
30 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
35 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
40 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
43 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc
53 GHz	dBm	dBm	dBc	4.0 dB	≤ –60 dBc

Table A-20. Third Order Intercept (TOI)

Frequency	Measured Value	Measurement Uncertainty	Specification
2400.151 MHz	dBm		
2399.851 MHz	dBm		
Calculated TOI at 2400 MHz	dBm	1.0 dB	+14 dBm minimum

Table A-21. Option 31, GPS Frequency Accuracy

Frequency	Measured Value	Error	Measurement Uncertainty	Specification
7 GHz	GHz	Hz	105 Hz (15 ppb)	± 175 Hz (25 ppb)

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