

## Maintenance Manual

# Field Master Pro<sup>TM</sup> MS2090A

## Handheld Spectrum Analyzer



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# 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 1-3 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 B](#). 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                               |
| Digital Multimeter     | N/A                         | Keysight 34401A                               |

## 1-4 Replacement Parts

The MS2090A replacement parts and their description are listed below in [Table 1-3](#).

Refer to [Table 1-2](#) to determine the instrument options and the corresponding serial numbers for MS2090A Revision 4.

**Table 1-2.** MS2090A Revision 4 cut in serial numbers

| Option       | Serial Number       |
|--------------|---------------------|
| MS2090A-0709 | 2141010 and greater |
| MS2090A-0714 | 2141031 and greater |
| MS2090A-0720 | 2141043 and greater |
| MS2090A-0726 | 2138018 and greater |
| MS2090A-0732 | 2142045 and greater |
| MS2090A-0743 | 2141030 and greater |
| MS2090A-0754 | 2145009 and greater |

**Table 1-3.** List of Replaceable Parts (1 of 2)

| Part Number   | Description                                                             |
|---------------|-------------------------------------------------------------------------|
| 3-ND85941-RFB | Main PCB Assy, Revisions 1-3                                            |
| 3-ND85986-RFB | Main PCB Assy, Revisions 1-3, with Option 6 (Wi-Fi Removed)             |
| 3-ND86799-RFB | Main PCB Assy, Revision 4                                               |
| 3-ND86800-RFB | Main PCB Assy, Revision 4, with Option 6 (Wi-Fi Removed)                |
| 3-ND84383-RFB | VSA PCB, 9 GHz, Revision 1-3                                            |
| 3-ND86812-RFB | VSA PCB, 9 GHz, Revision 4, for 2141010 <SN < 2507016                   |
| 3-ND88315-RFB | VSA PCB, 9 GHz, Revision 4, SN ≥ 2507016                                |
| 3-ND84383-RFB | VSA PCB, 14-20 GHz, Revision 1-3                                        |
| 3-ND86812-RFB | VSA PCB, 14-20 GHz, Revision 4                                          |
| 3-ND84384-RFB | VSA PCB, 26-43.5 GHz, Revision 1-3                                      |
| 3-ND86813-RFB | VSA PCB, 26-43.5 GHz, Revision 4                                        |
| 3-ND84557-RFB | VSA PCB, 54 GHz, Revision 1-3                                           |
| 3-ND86814-RFB | VSA PCB, 54 GHz, Revision 4                                             |
| 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), Revision 1-3           |
| 3-516-124     | IF Out Cable with SMA Connector, Revision 4                             |
| 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                                                                 |

**Table 1-3.** List of Replaceable Parts (2 of 2)

| Part Number | Description                                                |
|-------------|------------------------------------------------------------|
| 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), Revision 1-3            |
| 3-83970     | Top Connector Panel (metal), Revision 1-3                  |
| 3-86048     | Overlay (for Top Connector Panel SMA), Revision 4          |
| 3-86047     | Top Connector Panel with SMA, Revision 4                   |
| 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                                               |
| 3-83951-9   | MS2090A Label, 9 GHz                                       |
| 3-83951-14  | MS2090A Label, 14 GHz                                      |
| 3-83951-20  | MS2090A Label, 20 GHz                                      |
| 3-83951-26  | MS2090A Label, 26 GHz                                      |
| 3-83951-32  | MS2090A Label, 32 GHz                                      |
| 3-83951-43  | MS2090A Label, 43 GHz                                      |
| 3-83951-54  | MS2090A Label, 54 GHz                                      |

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 B, “Test Records”](#)

This chapter includes the following performance verification procedures:

- [“Frequency Accuracy” on page 2-3](#)
- [“Amplitude Accuracy – Preamplifier Off” on page 2-4](#)
- [“Amplitude Accuracy – Preamplifier On” on page 2-6](#)
- [“Single Side Band \(SSB\) Phase Noise” on page 2-7](#)
- [“Second Harmonic Distortion” on page 2-9](#)
- [“Displayed Average Noise Level \(DANL\) – Preamplifier Off” on page 2-10](#)
- [“Displayed Average Noise Level \(DANL\) – Preamplifier On” on page 2-11](#)
- [“Residual Spurs – Preamplifier Off” on page 2-12](#)
- [“Residual Spurs – Preamplifier On” on page 2-13](#)
- [“Input Related Spurs” on page 2-14](#)
- [“Third Order Intercept \(TOI\)” on page 2-15](#)

## 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.

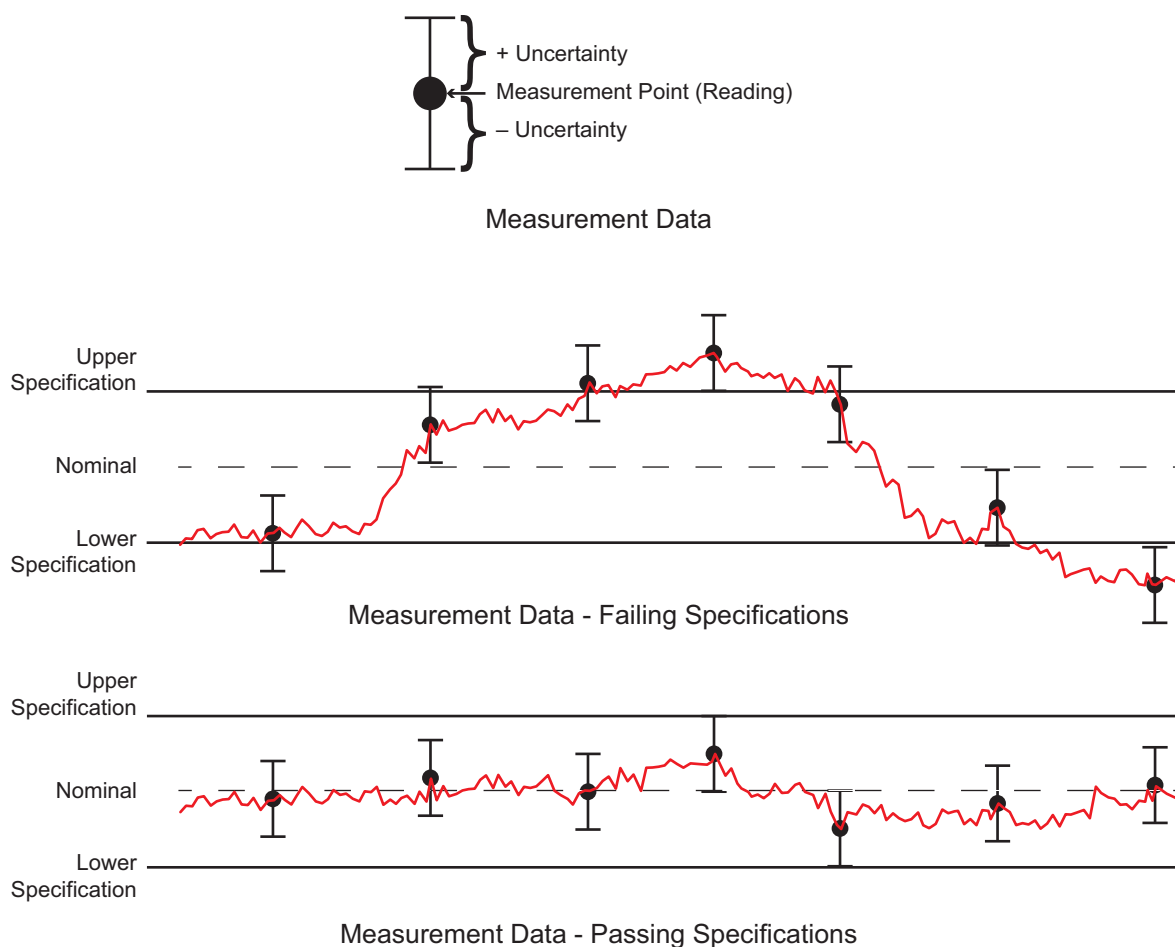


**Figure 2-1.** Pass/Fail Determination

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 B](#).

|                                                                                                   |
|---------------------------------------------------------------------------------------------------|
| <b>Note</b> 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.

|                                                                 |
|-----------------------------------------------------------------|
| <b>Note</b> 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 B-1, “Spectrum Analyzer Frequency Accuracy” on page B-2](#). Calculate the error by subtracting 1 GHz from the measured value and record the error in [Table B-1 on page B-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 B-1, “Spectrum Analyzer Frequency Accuracy” on page B-2](#). Calculate the error by subtracting 7 GHz from the measured value and record the error in [Table B-1 on page B-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 B](#).

|                                                                                                   |
|---------------------------------------------------------------------------------------------------|
| <b>Note</b> 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 B-2 on page B-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 B-2 on page B-2](#), and record results for each measurement.

18. Repeat this procedure for the other frequencies listed below in [Appendix B](#).

- [Table B-3, “Power Level Accuracy at 5 GHz \(Preamplifier Off\)”](#) for all frequency options
- [Table B-4, “Power Level Accuracy at 13 GHz \(Preamplifier Off\)”](#) for 14, 20, 26.5, 32, 43.5, and 54 GHz units
- [Table B-5, “Power Level Accuracy at 18 GHz \(Preamplifier Off\)”](#) for 20, 26.5, 32, 43.5, and 54 GHz units
- [Table B-6, “Power Level Accuracy at 25 GHz \(Preamplifier Off\)”](#) for 26.5, 32, 43.5, and 54 GHz units
- [Table B-7, “Power Level Accuracy at 31 GHz \(Preamplifier Off\)”](#) for 32, 43.5, and 54 GHz units
- [Table B-8, “Power Level Accuracy at 43 GHz \(Preamplifier Off\)”](#) for 43.5 and 54 GHz units
- [Table B-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 B](#).

|             |                                                                                       |
|-------------|---------------------------------------------------------------------------------------|
| <b>Note</b> | 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 B-10, “Power Level Accuracy \(Preamplifier On\)” on page B-6](#)
11. Repeat [Step 8](#) through [Step 10](#) for the remaining frequencies that apply to the unit being tested, in [Table B-10 on page B-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 B](#).

**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 B-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page B-7](#). Then subtract another 30 dB and record this as the 10 kHz Offset Measured Value reading in [Table B-11 on page B-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 B-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page B-7](#). Then subtract another 30 dB and record this as the 100 kHz Offset Measured Value reading in [Table B-11 on page B-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 B-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page B-7](#). Then subtract another 30 dB and record this as the 1 MHz Offset Measured Value reading in [Table B-11 on page B-7](#).

For example:  $-85 \text{ dBc measured} - 30 \text{ dB} = -115 \text{ dBc/Hz}$

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 B-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page B-7](#). Then subtract another 30 dB and record this as the 10 MHz Offset Measured Value reading in [Table B-11 on page B-7](#).

For example:  $-100 \text{ dBc measured} - 30 \text{ dB} = -130 \text{ dBc/Hz}$

## 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 B](#).

**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 B-12, “Second Harmonic Distortion” on page B-7](#)
6. Set the MS2090A Center Frequency to 100.2 MHz, perform a peak search, and record this value in [Table B-12 on page B-7](#).
7. Subtract 50.1 MHz value from the 100.2 MHz value and record this as the Second Harmonic Distortion in [Table B-12 on page B-7](#).

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

$$-90 \text{ dBm} - (-30 \text{ dBm}) = -70 \text{ dBc}$$

## 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 B](#).

|             |                                                                                       |
|-------------|---------------------------------------------------------------------------------------|
| <b>Note</b> | 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 B-13, “Displayed Average Noise Level \(Preamplifier Off, for 9, 14, and 20 GHz Units\)” on page B-7](#)
  - For 26.5, 32, 43.5 and 54 GHz Units: [Table B-14, “Displayed Average Noise Level \(Preamplifier Off, for 26.5, 32, 43.5, and 54 GHz Units\)” on page B-8](#)
11. Repeat [Step 7](#) through [Step 10](#) by changing the Start/Stop frequencies for the remaining frequency ranges in [Table B-13 on page B-7](#) or [Table B-14 on page B-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 B](#).

|                                                                                                   |
|---------------------------------------------------------------------------------------------------|
| <b>Note</b> 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 B-15, “Displayed Average Noise Level \(Preamplifier On, for 9, 14, and 20 GHz Units\)” on page B-8](#)
  - For 26.5, 32, 43.5 and 54 GHz Units: [Table B-16, “Displayed Average Noise Level \(Preamplifier On, for 26.5, 32, 43.5, and 54 GHz Units\)” on page B-8](#)
11. Repeat [Step 7](#) through [Step 10](#) by changing the Start/Stop frequencies for the remaining frequency ranges in [Table B-15 on page B-8](#) or [Table B-16 on page B-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 B](#).

**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 B-17, “Residual Spurs \(Preamplifier Off\)” on page B-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 B-17 on page B-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 B](#).

**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 B-18, “Residual Spurs \(Preamplifier On\)”](#) on page B-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 B-18 on page B-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 B](#).

|                                                                                                   |
|---------------------------------------------------------------------------------------------------|
| <b>Note</b> 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 B-19, “Input Related Spurs” on page B-10](#).
7. Repeat [Step 4](#) to [Step 6](#) for the remaining frequencies in [Table B-19 on page B-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 B](#).

**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 B-20, “Third Order Intercept \(TOI\)” on page B-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 B-20 on page B-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:
$$\text{TOI} = -20 + [(-20 - \text{max}) / 2]$$
For example if max = -90 dBm, then TOI = +15 dB
19. Record the TOI value in [Table B-20 on page B-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 B, “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.

|             |                                                     |
|-------------|-----------------------------------------------------|
| <b>Note</b> | 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.

|             |                                                                                       |
|-------------|---------------------------------------------------------------------------------------|
| <b>Note</b> | 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 B-21, “Option 31, GPS Frequency Accuracy” on page B-10](#). Calculate the error by subtracting 7 GHz from the measured value and record the error in [Table B-21 on page B-10](#).

## 3-3 Option 31, GPS Receiver (Operational Test)

Use the following procedure to verify the GPS voltage of MS2090A Field Master Pro.

### Equipment Required:

- Keysight 34401A Digital Multimeter (DMM) or equivalent

### Procedure

1. Press the System menu (3-line icon on the upper left corner) on the MS2090A.
2. Select SETTINGS > GNSS (GPS)
3. Turn on the GNSS/GPS toggle.
4. Select either 3.3 V or 5.0 V from the ANTENNA VOLTAGE drop-down.
5. On the 34401A, select DC V from the front panel.
6. Using DMM probes, place the ground probe on the outside of the GPS connector. Place the other probe on the inner conductor of the GPS connector.
7. Take note for the DC voltage reading on the DMM.

# 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](#).

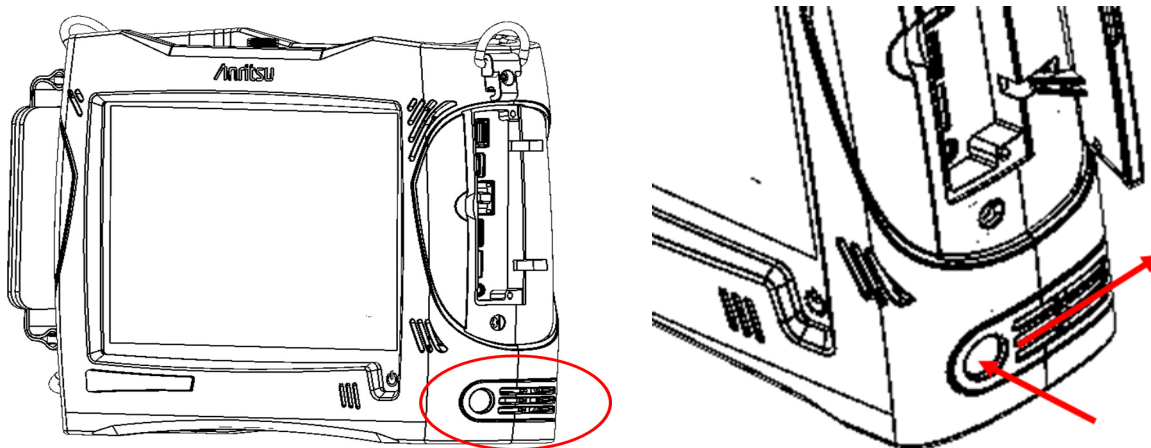


**Figure 4-1.** Battery Access Door Location and Removal

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:

- “Rear Case Removal” on page 5-2
- “Battery Compartment and Fan Removal” on page 5-3
- “Main and VSA PCB Removal” on page 5-4
- “Touchscreen/LCD Removal” on page 5-6
- “Separating The Main PCB From The VSA PCB Assembly” on page 5-7
- “Separating The Main PCB From The Bracket” on page 5-10
- “Separating the Wi-Fi Antennas From the Main PCB” on page 5-10
- “Separating The Fan From The Battery Compartment” on page 5-11

## 5-2 Replaceable Parts List

Refer to [Table 1-3, “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 1-3](#) 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](#).

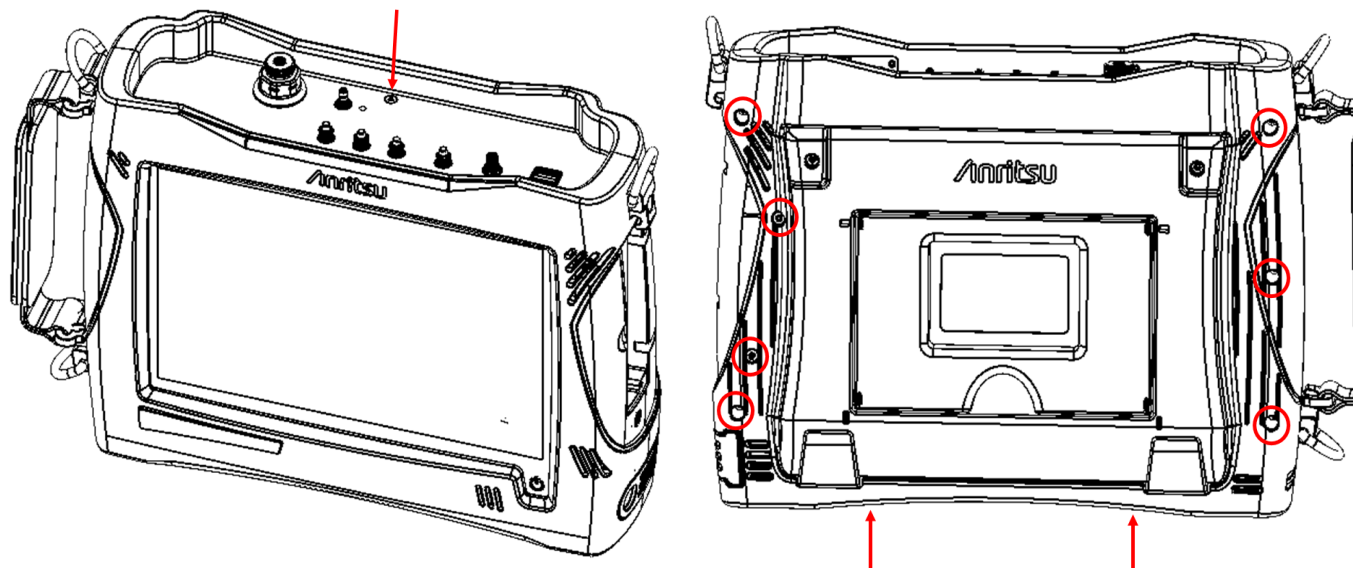


**Figure 5-1.** Rear Case Removal

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](#)

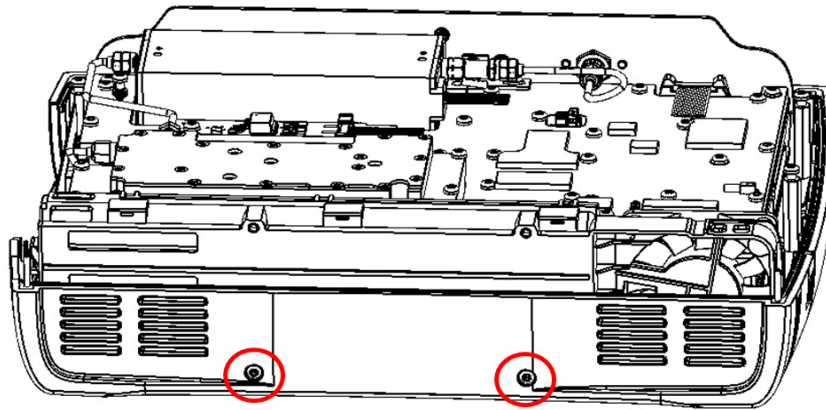


**Figure 5-2.** Battery Compartment and Fan Removal

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](#).

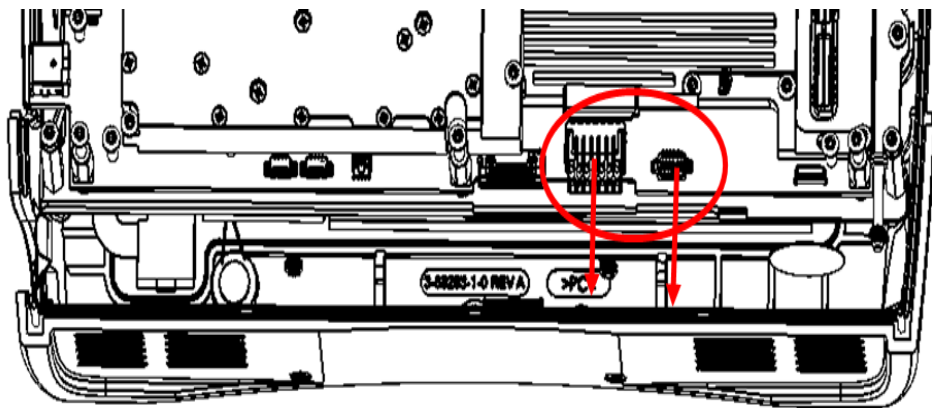


**Figure 5-3.** Removing Fan and Battery Cables

## 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](#).

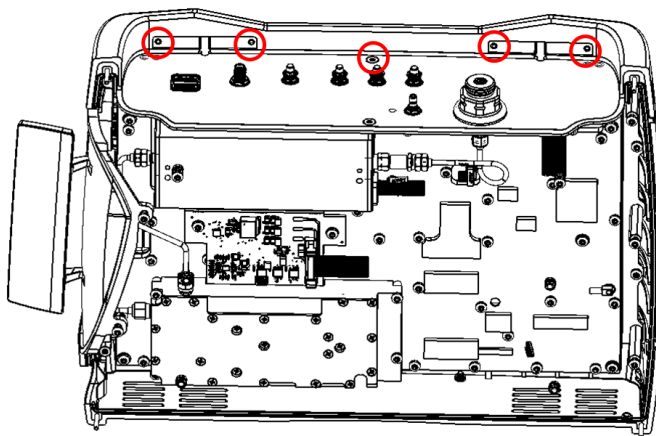


**Figure 5-4.** Two Wi-Fi Antennas

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.

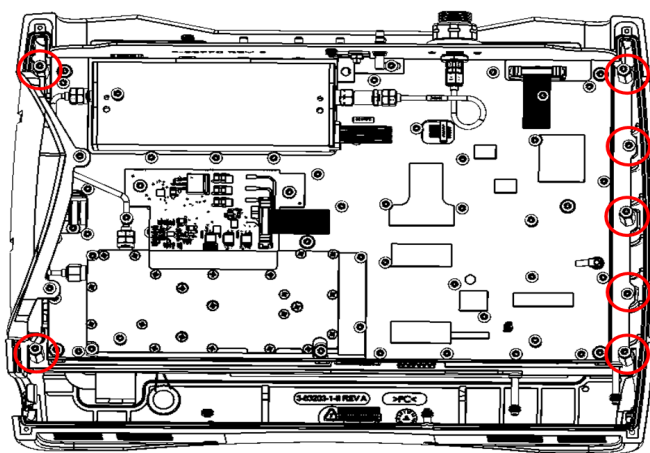


**Figure 5-5.** Main and VSA PCB Assembly

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.

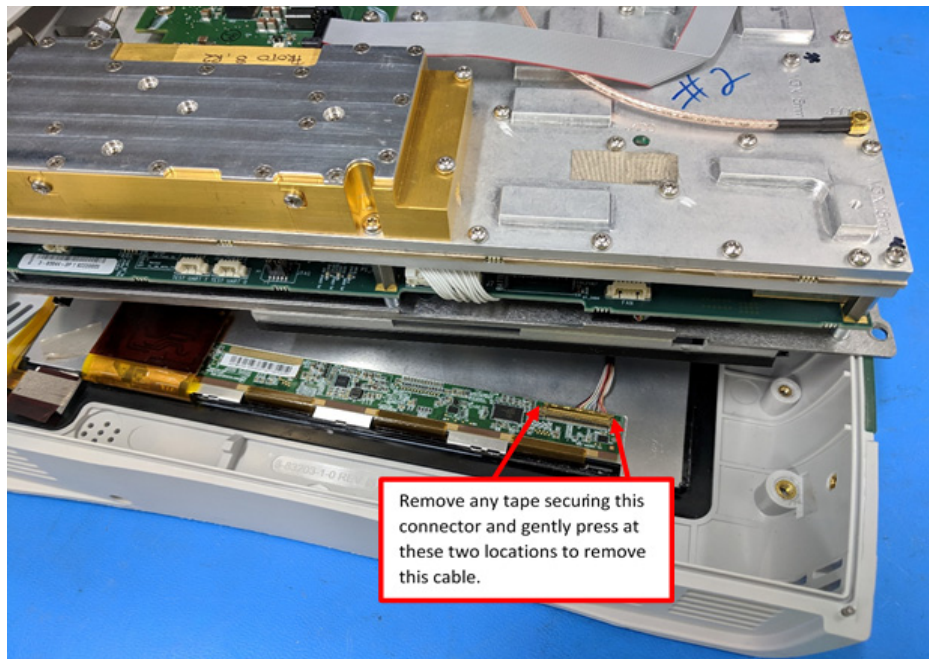


**Figure 5-6.** Main/VSA Separated From LCD/Touchscreen

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.

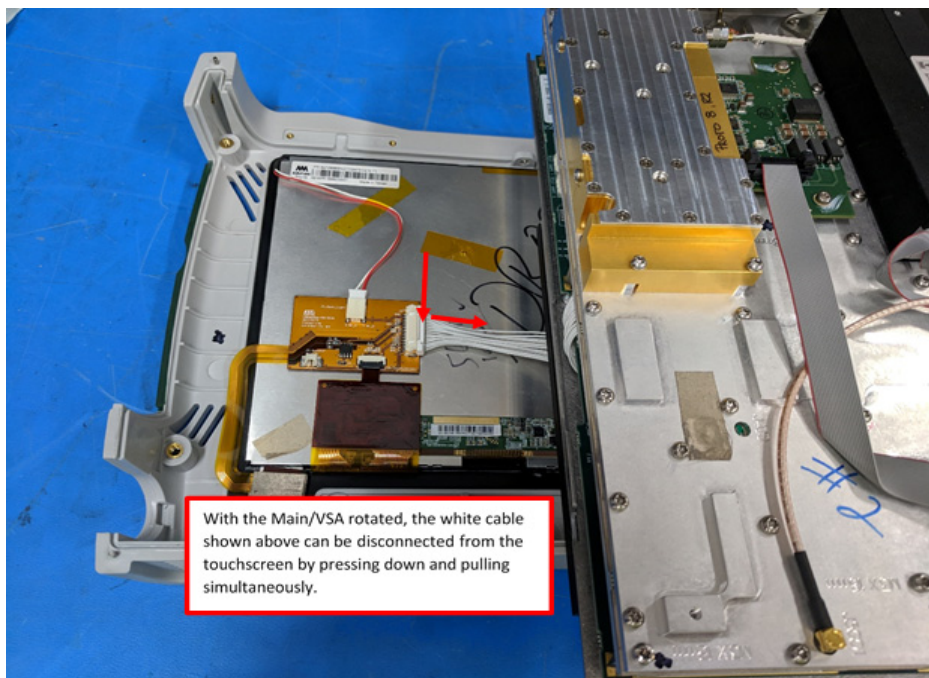


**Figure 5-7.** Main/VSA Rotated to Gain Access to Second Cable

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.

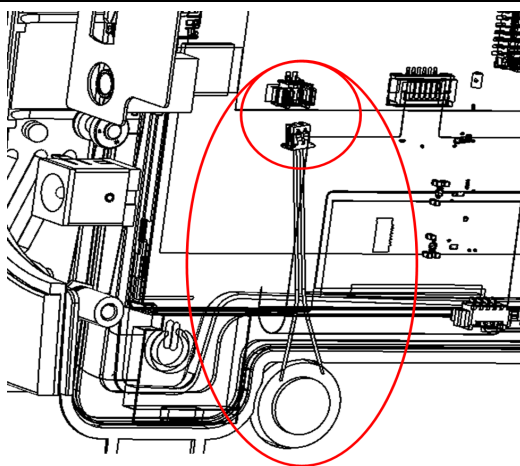


**Figure 5-8.** Speaker Assembly

## 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](#).

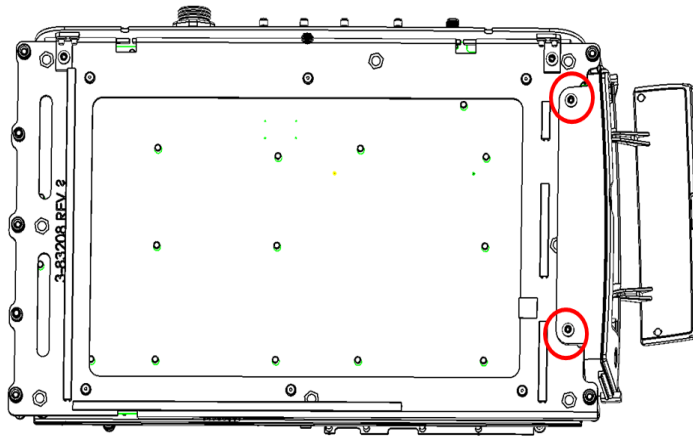


**Figure 5-9.** I/O Housing Removal

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](#).

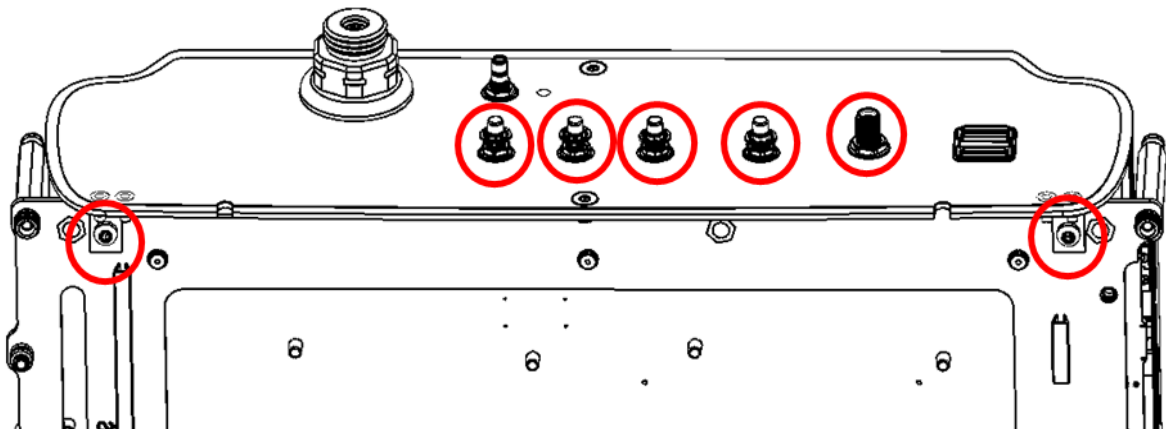


**Figure 5-10.** Top Panel Removal - Step A

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](#).

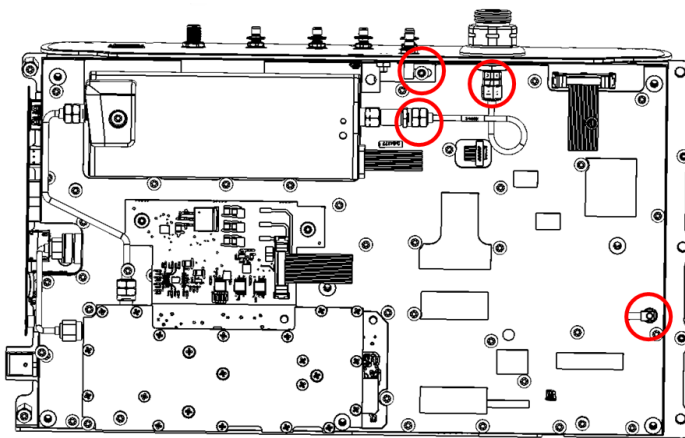


**Figure 5-11.** Top Panel Removal - Step B

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](#).

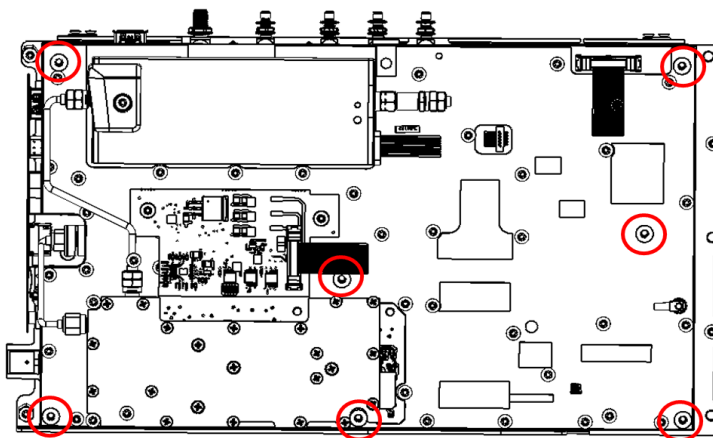


**Figure 5-12.** Main and VSA Separation

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.

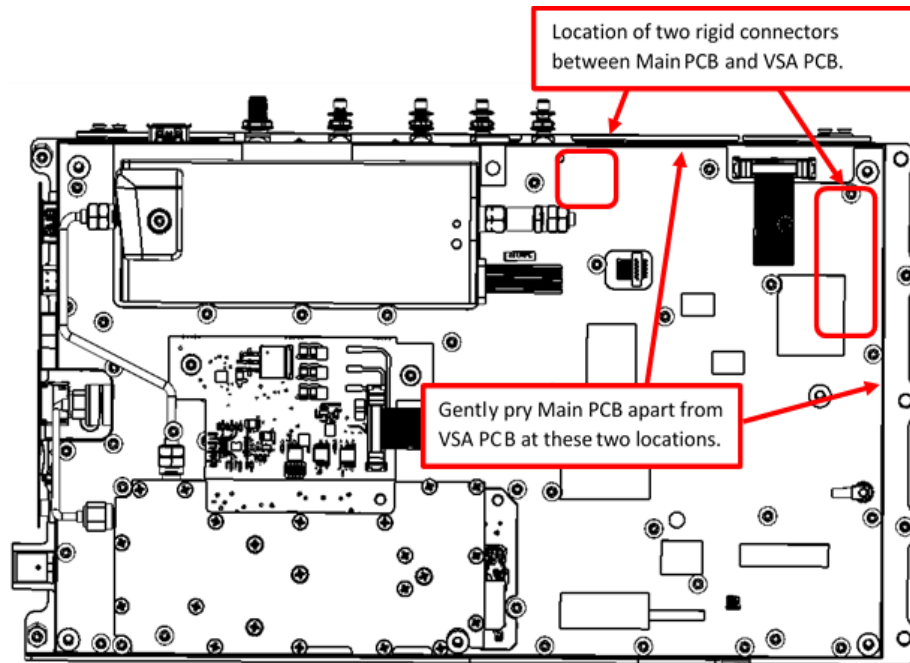


**Figure 5-13.** Main and VSA Connector Locations

## 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](#).

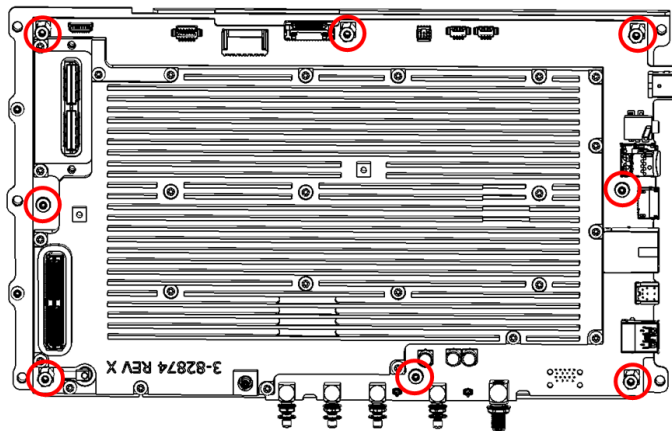


**Figure 5-14.** Main PCB and Bracket Separation

## 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](#).

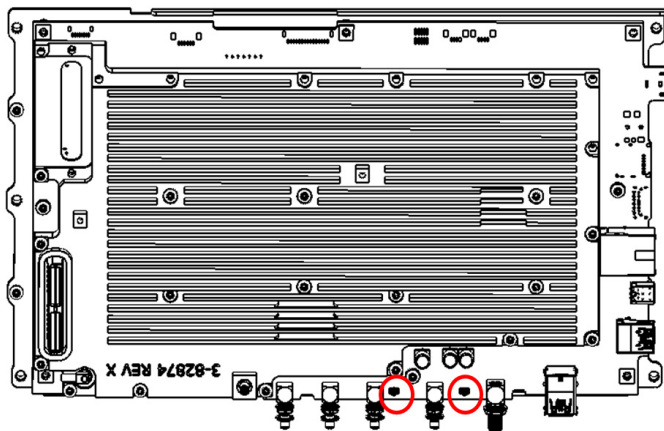


**Figure 5-15.** Removing Wi-Fi Antennas

## 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](#).

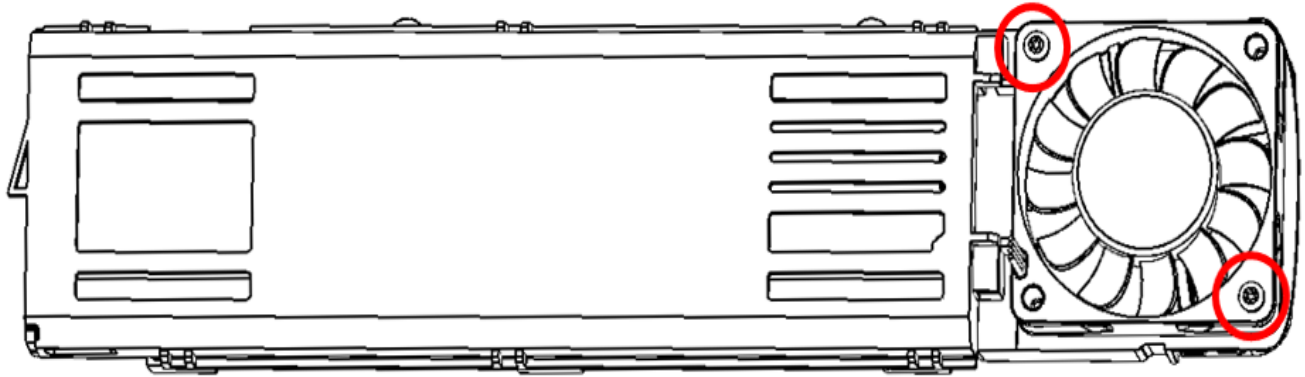


**Figure 5-16.** Fan and Battery Compartment Separation

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](#).

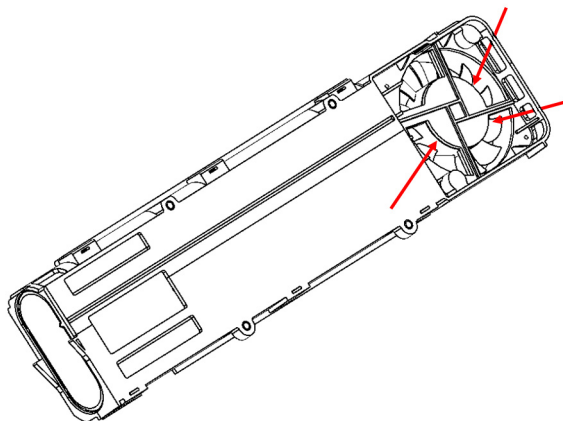


**Figure 5-17.** Removing Fan From Double Sided Tape



# Chapter 6 — Troubleshooting

## 6-1 Introduction

This chapter describes the primary troubleshooting operations that can be performed by all Anritsu service centers. Perform the troubleshooting suggestions in the order they are listed.

Only qualified Anritsu personnel should replace internal assemblies. Major subassemblies shown in [Table 1-3](#) are typically the items that may be replaced. Because they are highly fragile, items that must be soldered may not be replaced without special training. Removal of RF shields from PC boards or adjustment of screws on or near the shields will detune sensitive RF circuits and will result in degraded instrument performance.

### Unit will not power on when plugged in to a power source:

1. Inspect the power input port on the MS2090A for cleanliness and debris. If the port has an obstruction or is dirty, clean the port, then attach the power cable from the 40-204-R and re-try turning on the unit
2. Ensure the MS2090A is plugged into a working power outlet. This can be verified with a multi-meter.
3. If the 40-204-R power supply is defective, use a multi-meter, in AC voltage, to measure the voltage from the cable coming into the input of the 40-204-R. The voltage, depending on the region (country), should be between 100-240 VAC.
4. If the cable input voltage to the 40-204-R is acceptable, check the output voltage from the 40-204-R using the multi-meter in DC voltage, the voltage should be around 15 VDC.
5. If either step 3 or step 4 do not produce the correct voltages within the respective range, replace either the power cable or the power supply.
6. If the unit does not turn on, try an external battery. If the unit powers on with an external battery, replace the Main PCB or contact your local Anritsu service center.

### Unit will not power on with an external battery:

1. Ensure the external battery is charged and working.
2. Ensure the external battery is inserted in the correct orientation.
3. Try using a different external battery. If a different external battery works, replace the defective battery.
4. If the unit won't power on after trying a different battery, plug in the external power supply. If the unit turns on, perform a visual inspect the MS2090A battery housing for obstructions to the metal contacts that mate with the external battery.
5. If obstructions are present in the battery, carefully remove the obstructions and try the power up the MS2090A with a working battery.
6. If the unit does not power up with a different battery and no obstructions to the battery housing, contact your local Anritsu service center.

### Unit has discrepancies when measuring power; no power or low power:

1. Inspect the input connector for damage or contamination. If the connector is damaged, replace the connector using the parts listed in [Section 1-4 “Replacement Parts” on page 1-3](#).
2. If the connector is dirty, refer to the RF and Microwave Connector Care manual, PN:10100-00031 on the Anritsu website for instructions on cleaning and maintaining RF connectors.
3. Assess the input to the MS2090A. A defective cable or component may not allow or can limit the power to the MS2090A.
4. Replace the VSA PCB or contact your local Anritsu Service center for repair.

**Unit has Self-Test failures:**

1. For a self-test failure in either System or SPA, perform a Factory Reset by pressing System menu > Settings > RESET > FACTORY RESET.
2. If the Factory Reset does not fix the issue, replace the Main PCB for a System failure or replace the VSA PCB for a SPA failure

**Unit will not connect to a network:**

1. Verify if the Ethernet cable is working by plugging it into a PC or Laptop. The orange and yellow lights on the RJ-45 plug insert will turn on if an active Ethernet connection is established.
2. Press the System menu (3-line icon in the upper left corner) on MS2090A.
3. Select SETTINGS > ETHERNET.
4. Verify if the Network settings are aligned with the network.
5. If there is no connection via DHCP try configuring using Static IP. In ETHERNET settings screen press IP ADDRESS CONFIG drop-down to select MANUAL IP address (Static IP) and enter the static IP address and press APPLY button.
6. Press SETTINGS > Wi-Fi and attempt to connect with a Wi-Fi network.
7. If there is a successful connection, there might be a chance for defective Ethernet port. Replace the Main PCB or use the Wi-Fi network.

**USB Ports do not work:**

1. Try to connect a different USB storage device onto the USB port. If a different USB storage device works with the USB port, replace the USB storage device.
2. If a different USB storage device does not work, try plugging into a different USB port. If the USB storage device works on a different USB port, replace the Main PCB if necessary or use the working USB port.
3. If a working USB storage device does not work on any of the 3 USB ports, try to perform a Factory Reset by pressing System menu > Settings > RESET > FACTORY RESET.
4. If the Factory Reset does not fix the issue, replace the Main PCB for a System failure or replace the VSA PCB for a SPA failure.

**Unit hangs after powering on:**

1. Disconnect the power plug or remove the battery depending on the power source. Insert the power cable or the battery and then press the power button.
2. To reboot instrument from power on do the following:
  - a. Press the Power button and quickly remove your finger.
  - b. Wait for approximately 1-2 seconds and then press and hold the Power icon when the display turns green.
  - c. Continue to hold the Power button until the Power button turns light blue colored. Select Reboot. If this does not work, try System Recovery.
3. Initiate System Recovery by following instructions in [Section 6-2 “System Recovery” on page 6-3](#). Press BOOT ORDER > SWAP > CLOSE > REBOOT.
4. Replace Main PCB if steps 1-3 do not successfully fix the issue.

## 6-2 System Recovery

**Note**

Some features of RECOVERY MODE are not available in instruments that have been upgraded from firmware versions prior to 2021.11.1. This affects using SLOT B as the boot position or the target for a firmware update. These instruments must be returned to an Anritsu service center to update the recovery image. Visit [www.anritsu.com/contact-us](http://www.anritsu.com/contact-us) to find your nearest Anritsu Service and Support Center.

This section can be referred to in the event the MS2090A does not boot properly and the normal attempts to restart the instrument have failed. This section can also be used in conjunction with instructions in the troubleshooting section.

If the MS2090A fails to boot properly, a second boot attempt will load a recovery menu as shown in [Figure 6-1](#). This menu is only displayed when the instrument fails a normal boot process. A failure to boot properly might not indicate a problem. A boot disruption, such as removing power before the instrument can complete the boot process, will initiate a recovery menu on the next boot.

To initiate a System Recovery for troubleshooting, do the following:

1. Press the Power button once and quickly remove your finger.
2. Wait approximately for 1-2 seconds when the display screen turns green and then hold the Power button.
3. Continue to hold the Power icon until the Power icon becomes light blue colored to enter into Recovery Mode.

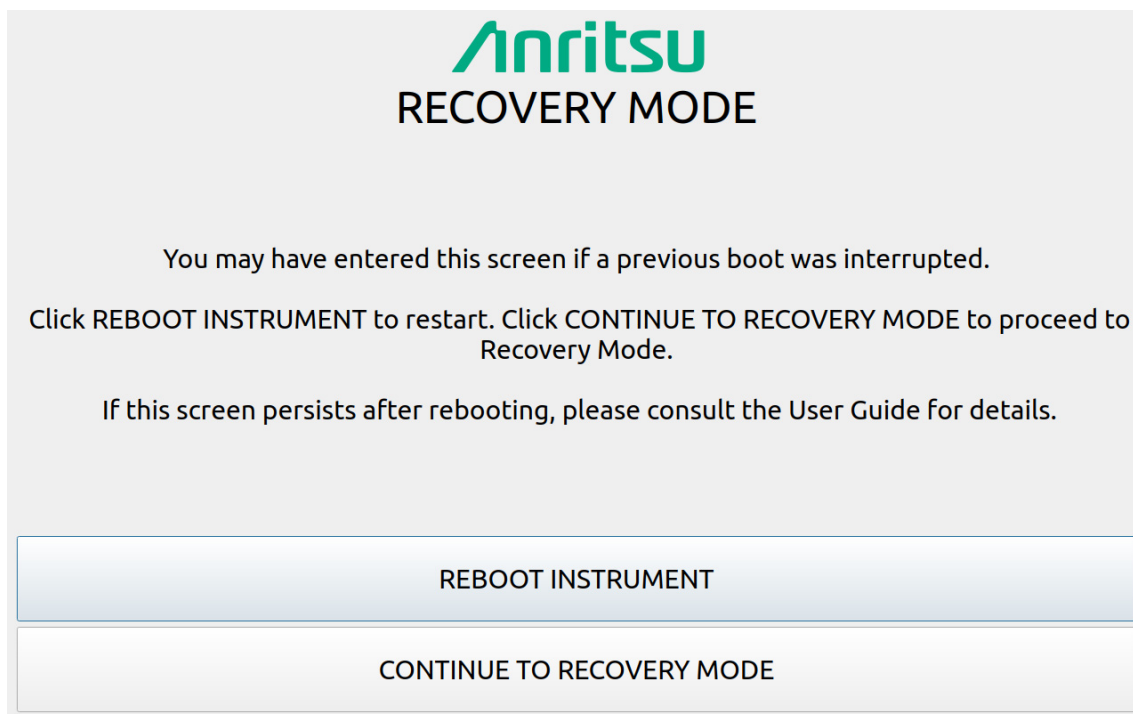


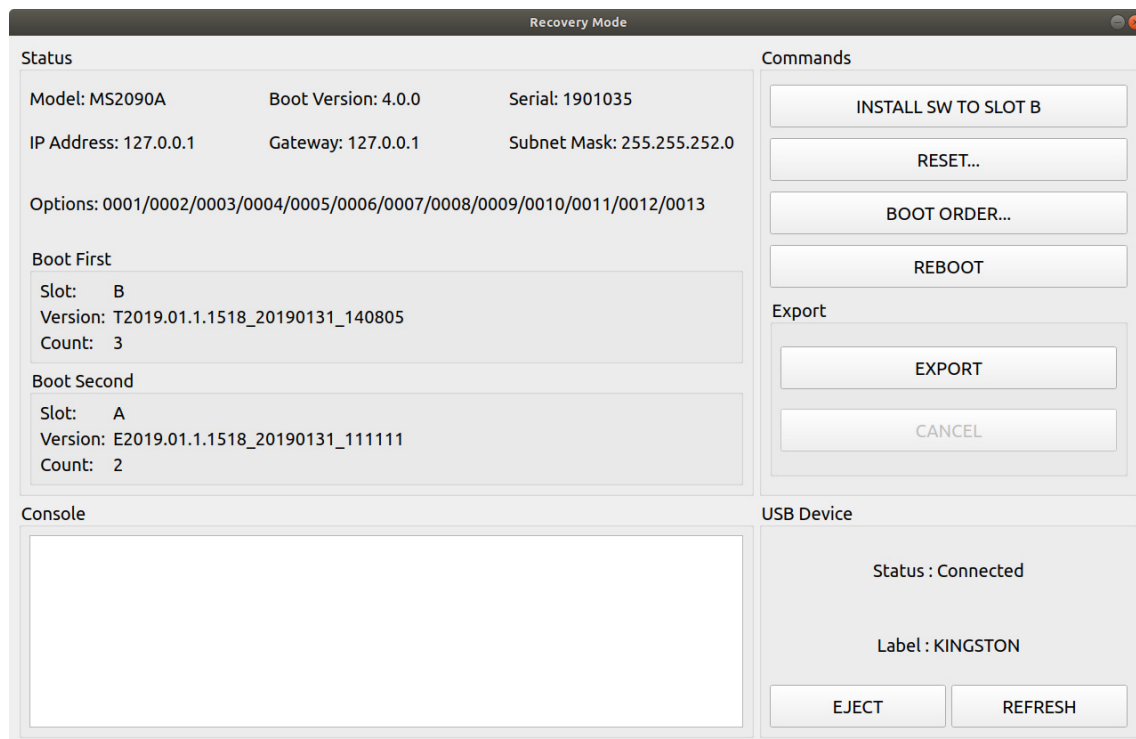
**Figure 6-1.** Recovery Mode

If you see this screen:

1. Select the REBOOT INSTRUMENT button once the recovery menu loads.
2. If boot failure continues, a system recovery can be performed by pressing CONTINUE TO RECOVERY MODE.

The Recovery Mode menu ([Figure 6-2](#)) shows instrument information and provides a variety of recovery options in ascending invasive order:

1. Select REBOOT to reboot the instrument without any further action.
2. Save all internal user files and logs by inserting a USB device and press the EXPORT button.
3. Refer to [“Reset” on page 6-5](#) for information about various reset options.
4. Refer to [“Boot Order” on page 6-5](#) to select a different boot order.
5. Refer to [“Install SW to SLOT X” on page 6-6](#) to reload or update the system software.



**Status:** Shows the Model, Boot Version, Serial Number of the MS2090A, IP Address, Gateway, Subnet Mask.

**Options:** Shows the Options currently installed.

**Boot First:** Shows the Slot, Version, and Count in the Boot First position.

**Boot Second:** Shows the Slot, Version, and Count in the Boot Second position.

**Console:** Provides a readout of the reboot activity.

**Commands:** Choose the command method to restart the instrument:

- **INSTALL SOFTWARE TO SLOT B:** Indicates which slot will be overwritten as described in [“Install SW to SLOT X”](#)
- **RESET:** Provides the RESET dialog as shown in [“Reset” on page 6-5](#).
- **BOOT ORDER:** Provides the Boot Order dialog as shown in [“Boot Order” on page 6-5](#).
- **REBOOT:** Reboots the instrument.

**Export:** Select EXPORT to save all internal user files and logs to a USB device. Select CANCEL to cancel the export. The saved files can be copied back to internal memory by using the file management menus.

**USB Device:** This section provides:

- **Status:** The USB memory device is connected or unconnected.
- **Label:** The Manufacturer of the USB memory device.
- **EJECT:** Select to eject and remove the USB memory device.
- **REFRESH:** Select to reconnect to the USB memory device.

**Figure 6-2.** Recovery Mode

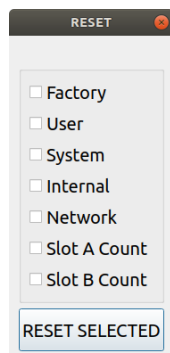
## Reset

The recovery RESET dialog is shown in [Figure 6-3](#). Here you can reset the MS2090A from the choices shown. In rare cases, system, internal, or other user files may interfere with instrument operation, so choosing to delete this data in that order may resolve a problem.

### Caution

Any data that is deleted by the following selections is unrecoverable. Use the EXPORT button to save this data before proceeding.

Once reset options are selected, press the RESET SELECTED button.



**Factory:** Performs a Factory reset, which deletes last saved settings files for all applications.

**User:** Performs a User reset, which deletes all user setup, measurement, csv, limit, screenshot, IQ captures, and user calibration files.

**System:** Performs a Factory reset and also deletes event and error logs.

**Internal:** For service use only. Performs an Internal reset, which deletes non-volatile system files, except for critical files such as the serial number, options, and network configuration. Does not take effect until the next boot.

**Network:** Performs a Network reset, which deletes manual Ethernet settings and reverts the networking to DHCP. All saved Wireless networks will also be lost.

**Slot A Count:** Resets Slot A Count to 3. This is used for the recovery mode countdown.

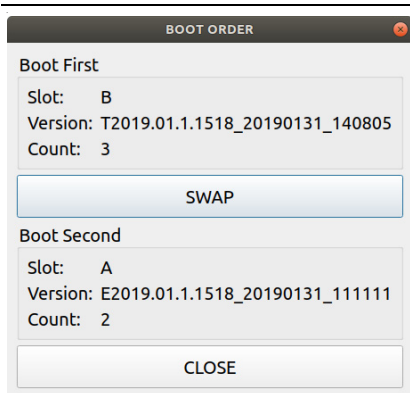
**Slot B Count:** Resets Slot B Count to 3. This is used for the recovery mode countdown.

**RESET SELECTED:** Resets the MS2090A by the method chosen.

**Figure 6-3.** RESET Dialog

## Boot Order

The order of which slot boots first can be changed from the BOOT ORDER menu (shown in [Figure 6-4](#)). You may want to change the boot order to select a different software image in case of corruption or for preference. Selecting SWAP will change the boot sequence order: Slot A or Slot B. Once selected, press CLOSE and then reboot the instrument. This setting can only be changed from the Recovery Mode menu.



**Boot First:** Provides the first boot version to boot.

- Slot: Provides the slot designated location.
- Version: Provides the boot version number.
- Count: Boot attempts with this version.

**SWAP:** Swap Slot A and Slot B in the boot sequence.

**Boot Second:** Provides the first boot version to boot.

- Slot: Provides the slot designated location.
- Version: Provides the boot version number.
- Count: Boot attempts with this version.

**Close:** Closes the BOOT ORDER dialog.

**Figure 6-4.** BOOT ORDER

## Install SW to SLOT X

The recovery mode shows two slots (A and B). These slots contain different system software packages that are installed. Each slot contains the following information:

- Slot name (A,B): Boot version package (A or B).
- Slot count (3,2,1): The count indicates how many unsuccessful boot attempts before the slot is marked as unbootable. Every failed attempt decrements the value until it reaches 0 (unbootable). This count can be reset to 3 using the [“Reset”](#) menu.
- Slot version: The version represents the software package version available in the slot.

You can install a new software package by inserting a USB memory device with the system software file (.raucb) and pressing “Install SW to SLOT X.” The X will be replaced with an A or B depending on which slot is to be overwritten. You will not be able to select which system software file will be installed from the attached USB, it will always install the first one found.

### 6-3 UDP Discovery Tool Firewall Settings

Follow the instructions below if the Discovery tool is not responding:

- 1. Go to Control Panel and open Windows Defender Firewall settings.
- 2. Click Allow an app or feature through Windows Defender Firewall.

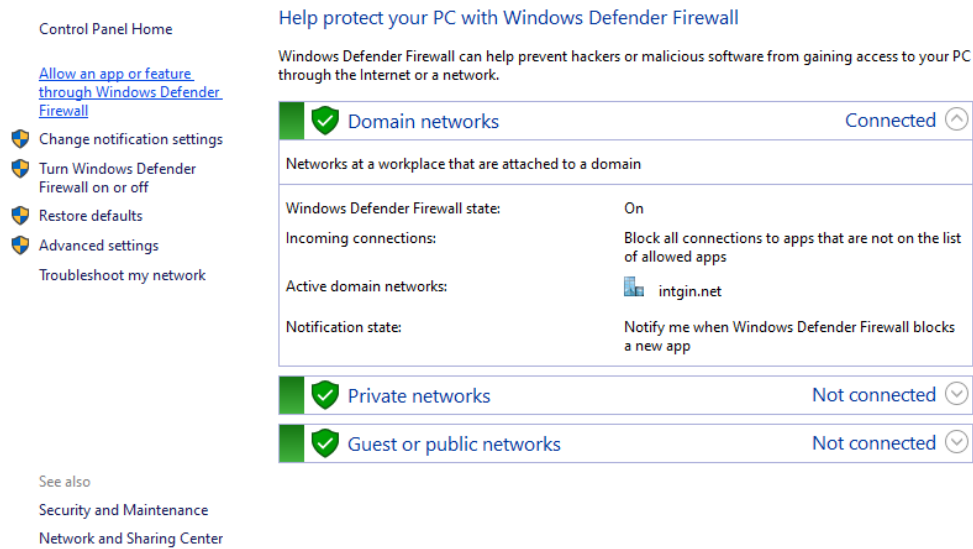


Figure 6-5. Windows Defender Firewall window

- 3. Click Change Settings button.

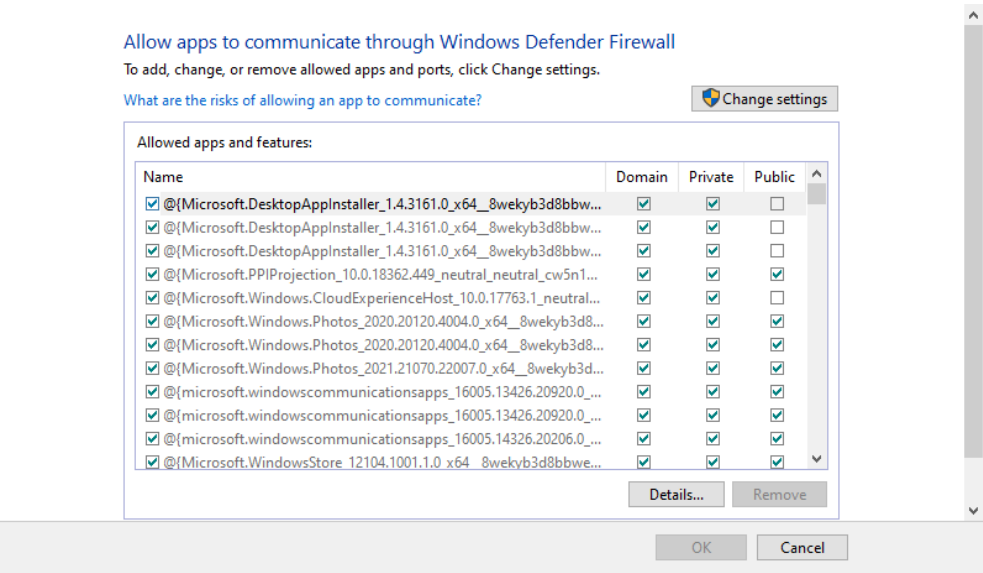


Figure 6-6. Allow apps to communicate through Windows Defender Firewall window

4. Find `fieldmaster_base` in the list of apps, and make sure that the `fieldmaster_base` box and Domain box are checked. Private and Public boxes may also need to be checked depending on where the instruments are on the network.
5. Click OK. Note that if the `fieldmaster_base` is missing, click Allow an app or feature through Windows Defender Firewall, and search for `fieldmaster_base.exe` file available in the installation directory.

Note that if more than one fieldmaster product is installed, multiple entries will need to be enabled.

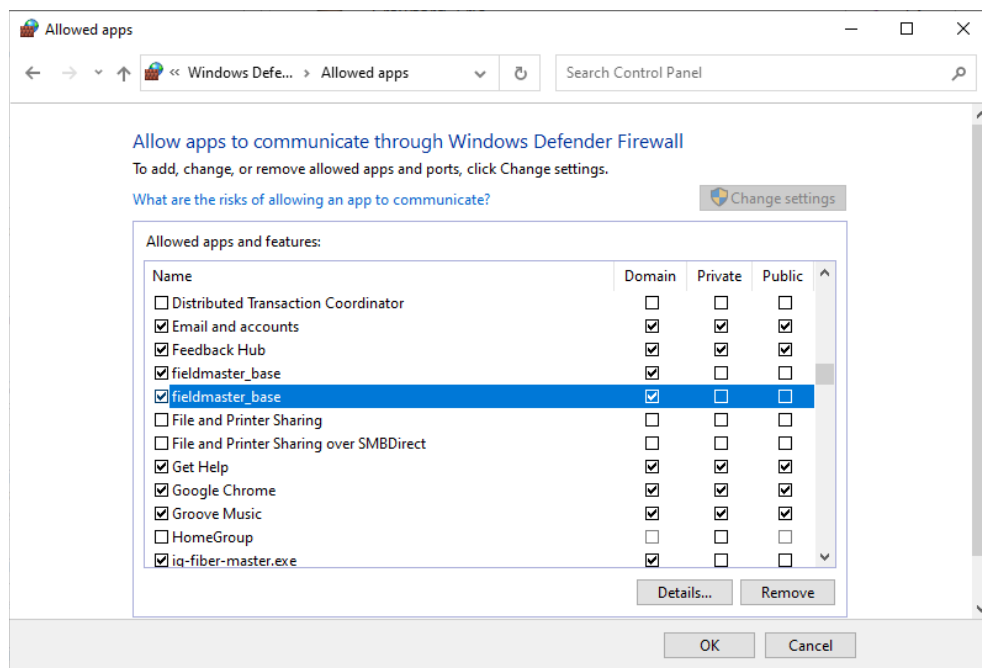


**Figure 6-7.** Field master base app

## 6-4 System Override

In the event that the instrument does not respond to SCPI commands (due to circumstances like a long sweep used in conjunction with \*OPC?) and needs to be reset remotely, the system override feature can be used. System override can be accessed through TCP port 8001 of the instrument. All commands except a password reset will require the instrument's password to be sent. The default password for an instrument is the MAC address interleaved with the word "system" between MAC address pairs. As an example, an instrument with the MAC address "1a:2b:3c:4d:5e:6f" will have a default password of "1as2by3cs4dt5ee6fm". Currently, system override supports the commands as described below:

1. Reboot the instrument:

To reboot the instrument, send the following string to the instrument through port 8001:

```
"force_reboot,<instrument_password>"
```

Replace <instrument\_password> with the password of the instrument. After the command has been sent, the instrument will respond with "ok" if the command has been successfully processed. If the password is incorrect, "password\_match\_fail" will be returned.

2. Set a new password:

To set a new password for the instrument, the following string should be sent through port 8001:

```
"change_password,<old_instrument_password>,<new_instrument_password>"
```

Note that the max length of a password is 50 characters. If the new password has been successfully set, "ok" will be returned. If the password is too long, a "password\_over\_50\_characters\_fail" will be returned. If the old password does not match, a "password\_set\_fail" message will be returned.

3. Reset the password:

In the case where the system override password needs to be reset to default, the following command can be sent through port 8001:

```
"reset_password"
```

Note that this command DOES NOT require the instrument password. If the password has been successfully reset, "ok" will be returned.

4. Disconnect SCPI connections:

This command causes all currently established SCPI connections (on TCP port 9001) to be disconnected.

```
reset_scpi_connection
```

It can be used to immediately clean up connections that were left open due to network interruption (e.g. close handshake packets were dropped, client thinks it is disconnected but the instrument thinks the connection is still there) or to establish sole control of an instrument by forcing all other clients to reconnect. This command is automatically executed when secure mode is turned on.

If an improperly formatted command is sent to the instrument, a "command\_match\_fail" will be sent back.

To use dbutil:

1. Open a command window in Windows.
2. Enter the command:

dbutil /f ip\_address where ip\_address is the address of Field Master Pro. Then the DNS name can be used instead of the ip\_address.



# Appendix A — Instrument Notifications

## A-1 Introduction

This appendix provides a list of instrument messages and their meaning and procedures for a full system recovery. If any error condition persists, contact your local Anritsu Service Center (<http://www.anritsu.com/contact-us>).

Field Master Pro displays the following message types:

- [Self-Test Messages](#), indicating self-test pass or fail conditions.
- [File Management Notifications](#), relating to the system menu (3-line icon on the upper left corner) FILES actions.
- [Informational Notifications](#), such as notification of a screen capture.
- [Warning Notifications](#), such as an ADC over-range warning.
- [Error Notifications](#), such as an internal instrument fault.

Messages have the following display characteristics:

- Transient messages appear briefly and then fade away.
- Persistent messages remain on the display and require user intervention to correct the condition.
- Some messages are logged but not displayed, such as messages in the event log.
- Messages may be displayed either in the Title bar or in a pop-up window.

## A-2 Self-Test Messages

Field Master Pro has built-in diagnostics that allow you to run a built-in self test. The test results can be viewed on the screen and saved to a log file. To run self test, use the 3-line menu to access DIAGNOSTICS, then select SELF TEST and RUN SELF TEST. Below is a sample list of self tests with passing results:

TEST DATE: 2019-03-21 09:51:47 MDT

OVERALL STATUS : PASS

SYSTEM : OVERALL STATUS : PASS

System voltage : 13.00 V, 4.00 V ,15.01 V (PASS)

System power : 32.2083 W

External current : 2.50 A, 2.50 A ,2.32 A (PASS)

Battery current : 4.00 A, 4.00 A ,0.18 A (PASS)

+0.85V LP core supply : 0.85 V, 0.09 V ,0.85 V (PASS)

+3.3V LP supply : 3.30 V, 0.33 V ,3.25 V (PASS)

+1.8V LP Vaux supply : 1.80 V, 0.18 V ,1.82 V (PASS)

+1.8V LP IO supply : 1.80 V, 0.18 V ,1.81 V (PASS)

+0.85V FP core supply : 0.85 V, 0.09 V ,0.85 V (PASS)

+1.8V DDR PLL supply : 1.80 V, 0.18 V ,1.81 V (PASS)

+0.85V PS transceiver AVCC : 0.85 V, 0.09 V ,0.85 V (PASS)

+1.8V PS transceiver AVTT : 1.80 V, 0.18 V ,1.83 V (PASS)

+2.5V DDR SODIMM supply : 2.50 V, 0.25 V ,2.49 V (PASS)

+1.2V DDR SODIMM supply : 1.20 V, 0.12 V ,1.20 V (PASS)

+0.85V FPGA core supply : 0.85 V, 0.09 V ,0.86 V (PASS)

+0.9V transceiver AVCC supply : 0.90 V, 0.09 V ,0.90 V (PASS)

+1.2V transceiver AVTT supply : 1.20 V, 0.12 V ,1.21 V (PASS)

+1.0V Ethernet supply : 1.00 V, 0.10 V ,0.99 V (PASS)

+1.8V FPGA supply : 1.80 V, 0.18 V ,1.79 V (PASS)

+2.5V FPGA supply : 2.50 V, 0.25 V ,2.48 V (PASS)

+3.3V FPGA supply : 3.30 V, 0.33 V ,3.29 V (PASS)

+5.0V USB/misc supply : 5.00 V, 0.50 V ,5.00 V (PASS)

+3.9V analog supply : 3.90 V, 0.39 V ,3.96 V (PASS)

+5.7V analog supply : 5.70 V, 0.57 V ,5.67 V (PASS)

-5.7V analog supply : -5.70 V, 0.57 V , -5.26 V (PASS)

+12.8V analog supply : 12.80 V, 1.28 V ,12.82 V (PASS)

+24.0V analog supply : 24.00 V, 2.40 V ,23.92 V (PASS)

Backlight voltage : 22.00 V, 4.40 V ,19.56 V (PASS)

Backlight current : 0.20 A, 0.20 A ,0.18 A (PASS)

12.0V for fan : 12.00 V, 1.20 V ,12.00 V (PASS)

CPU Temperature : 61.0 C

Motherboard Temperature : 46.5 C  
Fan speed, percent of full speed : 7 %  
Fan speed : 2638 RPM  
Temperature at Reference : 45.3 C

SPA : OVERALL STATUS : PASS

+12VG : 12.00 V, 1.20 V ,11.90 V (PASS)  
+5V\_PREAMP : 5.00 V, 0.50 V ,4.99 V (PASS)  
+5VA : 5.00 V, 0.50 V ,5.02 V (PASS)  
+5VG : 5.00 V, 0.50 V ,4.99 V (PASS)  
+5VH : 5.00 V, 0.50 V ,5.02 V (PASS)  
+5VI : 5.00 V, 0.50 V ,5.05 V (PASS)  
+5V\_VCO : 5.00 V, 0.50 V ,5.09 V (PASS)  
+5VM : 5.00 V, 0.50 V ,5.01 V (PASS)  
+5VP : 5.00 V, 0.50 V ,5.05 V (PASS)  
+5V\_SAW : 5.00 V, 0.50 V ,4.99 V (PASS)  
+3V3\_HBFA : 3.30 V, 0.33 V ,3.31 V (PASS)  
+3V3\_IF : 3.30 V, 0.33 V ,3.29 V (PASS)  
+3V6 : 3.60 V, 0.36 V ,3.55 V (PASS)  
+3V3\_CAL : 3.30 V, 0.33 V ,3.36 V (PASS)  
+3V3G : 3.30 V, 0.33 V ,3.33 V (PASS)  
+3V3H : 3.30 V, 0.33 V ,3.29 V (PASS)  
+3V3M : 3.30 V, 0.33 V ,3.32 V (PASS)  
+3V3P : 3.30 V, 0.33 V ,3.33 V (PASS)  
ADC\_AVDD3\_3V3 : 3.30 V, 0.33 V ,3.33 V (PASS)  
+3V3IFA : 3.30 V, 0.33 V ,3.33 V (PASS)  
+3V3DET : 3.30 V, 0.33 V ,3.35 V (PASS)  
+3V3IFC : 3.30 V, 0.33 V ,3.37 V (PASS)  
+3V3IFD : 3.30 V, 0.33 V ,3.35 V (PASS)  
+3V3IF\_OUT : 3.30 V, 0.33 V ,3.33 V (PASS)  
SPARE : 0.00 V, 1.00 V ,0.00 V (PASS)  
-5V : -5.00 V, 0.50 V ,-5.13 V (PASS)  
+24VH : 24.00 V, 2.40 V ,24.18 V (PASS)  
+3V3D : 3.30 V, 0.33 V ,3.27 V (PASS)  
+2V5D : 2.50 V, 0.25 V ,2.50 V (PASS)  
ADC\_AVDD2\_2V5 : 2.50 V, 0.25 V ,2.50 V (PASS)  
ADC\_AVDD1\_1V25 : 1.25 V, 0.13 V ,1.25 V (PASS)  
ADC\_DRVDD\_1V25 : 1.25 V, 0.13 V ,1.25 V (PASS)  
DCM Not Available For This Option : 0.00 V, 0.00 V ,0.00 V (PASS)  
Thermal Sensor 1 (Mid-band 1st IF) : 35.00 C, 90.00 C ,44.75 C (PASS)

Thermal Sensor 2 (Mid-band 2nd IF) : 35.00 C, 90.00 C ,46.00 C (PASS)

Thermal Sensor 3 (Low-band RF) : 35.00 C, 90.00 C ,42.00 C (PASS)

DCM Temperature Not Available For This Option : 0.00 C, 0.00 C ,0.00 C (PASS)

ADC Thermal Sensor : 35.00 C, 90.00 C ,39.93 C (PASS)

If any self test fails, try resetting the instrument with a RESET ALL and reboot, and run the test again. If the condition persists, contact your local Anritsu Service Center (<http://www.anritsu.com/contact-us>).

## A-3 File Management Notifications

File management functions (accessed by via System menu (3-line icon) > FILES) are used to organize, copy, and rename files. The following notifications are displayed in a persistent dialog when using the file manager features.

### **Cannot access File or Directory**

User does not have permission to access the file or directory.

### **Cannot copy/move items: no write permission on folder**

User does not have permission to access the file or directory.

### **Cannot move items: origin and destination folders are the same**

When attempting to move a file to the same location.

### **Could not remove the directory/file**

The file cannot be deleted.

### **Error creating new folder**

A folder cannot be created.

### **File or Directory does not exist**

When attempting to access a file or directory that does not exist.

### **Path or URL may not exist or cannot be read**

The file location cannot be accessed.

### **Rename error**

The file or directory cannot be renamed.

### **There is no space to copy**

There is not enough space to copy the file.

## A-4 Informational Notifications

### **Acquiring trace normalization data on next sweep**

In Title bar, Not Logged, Transient

### **Audio must be turned on to record.**

In Title bar, Not Logged, Transient

### **Audio file size too large, record duration truncated to current capacity.**

Pop-up, Not Logged, Transient

### **Battery Over Charge Temperature.**

In Title bar, Not Logged, Persistent

### **Cannot start measurement without a connected Antenna.**

### **Cal method <Cal method name> requires <Cal Type>. Switching cal type to <Cal Type>**

In Toolbar, Not Logged, Transient

In Title bar, Not Logged, Persistent

### **Calibration abort is not allowed.**

In Title bar, Not Logged, Transient

### **Calibration temperature range exceeded. User cal has been disabled.**

In Title bar, Not Logged, Transient

### **Cannot turn power cal on. <Reason>**

In Toolbar, Not Logged, Transient. Reason can be either target power, source power or frequency being out of range.

### **Concatenation has been aborted.**

When user aborts concatenation of streaming metadata files

### **Connecting to access point.**

In Title bar, Not Logged, Persistent

### **Current USB Site Master model or serial number does not match active calibration settings. 1-Port ReadyCal will be applied.**

Pop-up, Not Logged, Transient

### **Custom SEM File Imported**

In Title bar, Logged, Transient

### **Channel list is full, maximum size of <60>**

In Title bar, Not Logged, Transient

**Density data not available in playback**

In Title bar, Not Logged, Transient

**Disconnecting from Wi-Fi Network**

In Title bar, Not Logged, Transient

**Disconnecting from Wi-Fi Network Failed.**

In Title bar, Not Logged, Transient

**External reference detected - switching reference source to external**

In Title bar, Logged, Transient

**External reference disconnected – switching reference source to GPS**

In Title bar, Logged, Transient

**External reference disconnected – switching reference source to internal**

In Title bar, Logged, Transient

**External reference disconnected – switching reference source to Internal High**

In Title bar, Logged, Transient

**File Does Not Exist**

In Title bar, Not Logged, Transient

**File Recall Failed**

In Title bar, Not Logged, Transient

**File Recalled Successfully**

In Title bar, Not Logged, Transient

**File Save Failed**

In Title bar, Not Logged, Transient

**File Saved Successfully**

In Title bar, Not Logged, Transient

**File successfully saved as: filename**

When saving a file (e.g., trace, setup)

**File <filename> import successfully**

In Title bar, Not Logged, Transient. X represents the filename.

**File <filename> export successfully**

In Title bar, Not Logged, Transient. X represents the filename.

**Frequency setting is outside sensor range. Measurement performance is not guaranteed outside the range of sensor. It is recommended to keep start and stop frequencies within range listed on sensor**

Pop-up, Not Logged, Transient

**The following options will expire in less than 24 hours (9xxx)**

In Notifications bar

**GPS reference detected - acquiring GPS**

In Title bar, Logged, Transient

**GPS reference acquired - switching reference source to GPS**

In Title bar, Logged, Transient

**GPS reference disconnected – switching reference source to Internal**

In Title bar, Logged, Transient

**GPS reference no longer available – switching reference source to Internal High**

In Title bar, Logged, Transient

**High RF Immunity is not allowed with Transmission (Ext) measurements**

In Title bar, Logged, Transient

**IF Gain Cal completed**

In Title bar, Logged, Transient

**Internal High reference no longer valid – switching frequency reference source to Internal**

In Title bar, Logged, Transient

**Internal High reference no longer valid – switching time reference source to Internal**

In Title bar, Not Logged, Transient

**Insufficient data. A map point is skipped. Setting a higher distance or increasing sweep time can help.**

In Title bar, Not Logged, Persistent

**Initializing the USB VNA...**

In Title bar, Not Logged, Transient

**Input greater than DMax: <value>**

In Title bar, Not Logged, Transient. The value can be start or stop.

**IQ STREAM - Sweep paused while IQ stream is in progress**

In Title bar, Not Logged, Persistent

**IQ CAPTURE - Sweep paused while IQ capture is in progress**

In Title bar, Not Logged, Persistent

**Language successfully updated to <Language Name>**

In Title bar, Logged, Transient.

**Language failed to update to <Language Name>**

In Title bar, Logged, Transient.

**Limit recall initiated**

When a limit setup file is selected for recall.

**Limits are not available for circular graphs**

In Title bar, Not logged, Transient

**Logging in csv stopped**

In Title bar, Not logged, Transient

**Measurement changed. Trace recording stopped**

In Title bar, Logged, Transient

**Measurement changed. Trace playback stopped**

In Title bar, Logged, Transient

**Measurement changed. Trace recording in csv stopped**

In Title bar, Logged, Transient

**Memory Full**

Popup, Not Logged, Transient

**Memory Full**

In Title bar, Not Logged, Transient

**Model and/or serial number of the device does not match calibration stored. 1-Port ReadyCal will be applied**

In Title bar, Not Logged, Transient

**<Model name of the sensor> USB Instacal connected**

In Toolbar, Logged, Transient

**<Model name of the sensor> USB Instacal disconnected**

In Toolbar, Logged, Transient

**Missing GPS data. Ensure good GPS fix or directional antenna connection**

In Title bar, Not Logged, Persistent

**New calibration type is not supported by <cal method>.Switching cal method to <cal method name>**

In Title bar, Not Logged, Transient

**No bearing from directional antenna. Check connection and try again**

In Title bar, Not Logged, Transient

**No USB CAA HW connected**

In Title bar, Not Logged, Persistent. The user calibration may be turned off if CAA hardware is not connected.

**No USB Site Master is detected. Please connect device to continue.**

In Title bar, Not Logged, Transient

**No application loaded. Factory reset required**

In Title bar, Logged, Persistent

**<Model> Sensor connected**

In Title bar, Logged, Persistent

**Outdoor mapping requires GNSS/GPS**

In Title bar, Not Logged, Persistent

**Options upgraded. Please restart the instrument to use new features**

In Title bar, Not Logged, Transient

**PCAL step in progress. Cannot run two cal step at a time**

In Toolbar, Not Logged, Transient

**Power Calibration in progress**

In Toolbar, Not Logged, Persistent

**Preset Completed**

In Title bar, Not Logged, Transient

**Presetting Instrument**

In Title bar, Not Logged, Transient

**Please wait. Acquiring magnetic data for directional antenna**

In Title bar, Not Logged, Persistent

**Point count limited to 4,001 with RF Immunity set to HIGH**

In Title bar, Not Logged, Transient

**Power Calibration in progress**

In Toolbar, Not Logged, Persistent

**Performing receiver cal is not allowed when power cal is not enabled.**

In Toolbar, Not Logged, Transient

**Power Calibration completed <value>**

In Toolbar, Logged, Transient. Value can be success or failed

**Power Calibration aborted**

In Toolbar, Logged, Transient. Value can be success or failed

**Rebooting Instrument**

In Title bar, Not Logged, Transient

**Rebooting instrument into Recovery mode**

In Title bar, Not Logged, Transient

**Recall initiated**

When a file is selected for recall

**Reset Completed**

In Title bar, Logged, Transient

**Resetting Instrument**

In Title bar, Logged, Transient

**Restoring calibration settings**

In Title bar, Not Logged, Transient

**Recording In Progress**

In Title bar, Logged, Persistent

**Recording Complete. File saved as <filename>**

In Title bar, Logged, Transient

**Remove any RF input signal to the external sensor**

Pop-up, Not Logged, Transient

**RF Attenuation Auto must be OFF or Reference Level must be below -40dBm to enable PreAmp**

In Title bar, Logged, Transient

**Successfully concatenated <N> files**

When the concatenation of streaming metadata files is complete.

**Successfully connected to access point**

In Title bar, Not Logged, Transient

**Screenshot saved**

When saving a screenshot is successful

**Scale adjusted to accommodate user change**

In Title bar, Not logged, Transient

**<Name of Setting> range adjusted to accommodate user change**

In Title bar, Not logged, Transient. The setting can be distance, time and frequency.

**Self test Passed**

In Title bar, Logged, Transient

**Self test Failed**

In Title bar, Logged, Transient

**Software update files found on USB**

In Title bar, Not Logged, Transient

**Sensor <model> is not supported**

In Title bar, Logged, Transient

**<Source> not within Power Cal range. Power cal has been disabled**

In Toolbar, Not Logged, Transient. Source can be source power, target power or frequency

**Sensor does not support target power setting.**

In Title bar, Logged, Transient

**Stopped saving sweeps after sweep complete**

When the save on event triggers are disabled after end-of-sweep.

**Stopped saving sweeps after limit crossing**

When the save on event triggers are disabled after a limit fails.

**Switching Thru device selection to User Offset**

In Toolbar, Not Logged, Transient

**Trace normalization ready**

In Title bar, Not Logged, Transient

**Trigger delay updated to minimum allowable value for selected bandwidth and bit format**

In Title bar, Not Logged, Transient

**Settings changed; clearing EMF results**

In Title bar, Not Logged, Transient

**The selected mode is not yet available**

When an unavailable mode is selected.

**Transmission (Ext. Sensor) measurement requires supported USB sensor**

In Title bar, Not Logged, Persistent

**USB drive <name> ejected**

In Title bar, Not Logged, Transient

**USB Power Sensor MA24xxxA detected**

In Title bar, Logged, Transient, xxx represents the model number of the power sensor.

**USB Power Sensor MA24xxxA disconnected**

In Title bar, Logged, Transient, xxx represents the model number of the power sensor.

**User cable list import successfully**

In Title bar, Logged, Transient

**X of Y requested channels created**

In Title bar, Not Logged, Transient. X represents the number of user requested channels and Y indicates the total number of channels.

**Zeroing. Please wait**

In Title bar, Logged, Persistent

**Zeroing <sensor>**

In Title bar, Not Logged, Persistent

**Zeroing Sensor ...**

In Title bar, Logged, Persistent

**Zeroing Sensor completed <completion state>**

In Title bar, Logged, Transient. The completion state can be success or failure

**No sensor connected**

In Title bar, Not Logged, Persistent

**USB sensor <model> detected**

In Title bar, Logged, Transient

**USB sensor is required for this calibration**

In Title bar, Not Logged, Transient

**USB sensor is required for this calibration. Connect sensor and retry**

In Title bar, Not Logged, Transient

**Warning: User Cal must be turned off before Cal TYPE can be changed**

Pop-up, Not Logged, Transient



## A-5 Warning Notifications

### ADC Overrange

In Title bar, Logged, Persistent

### Antenna information invalid. Attach directional antenna or switch to manual.

In Title bar, Not Logged, Persistent

### Battery Fault

In Title bar, Logged, Transient

### Battery level is critically low. Automatic shutdown is imminent

Popup, Logged, Persistent

### Battery level low

Popup, Logged, Persistent

### Battery Low warning

Pop-up Window, Logged, Persistent: Requires User Intervention

This message is sent once per low battery charge condition per boot cycle per charge cycle. A low battery charge condition is defined as the battery charge being at or below 10%.

### Booted from backup SW slot. Reinstall SW to clear this message

Popup, Logged, Persistent

### Could not read from input file. Please verify that the storage device is still accessible and try again

In Title bar, Not Logged, Transient

### Could not create output file. Please verify that the device is accessible and can be written to

In Title bar, Not Logged, Transient

### Cannot verify data integrity

In Toolbar, Not Logged, Transient

### Channel Scanner CSV file failed to open

In Title bar, Logged, Transient

### Current settings do not allow for simultaneous sweep and audio output

In Title bar, Not Logged, Persistent

### Device transfer speed insufficient for gapless transfer at current BW/bit depth settings; some samples will be missed

In Title bar, Logged, Persistent

### Error occurred during concatenation. Error code: <code>

Popup, Not Logged, Transient

**Failed to recall limit**

When the limit setup file selected for recall could not be accessed.

**Failed to save file: filename**

When any other error occurred while trying to save a file.

**Failed to save screenshot. Device may be full.**

When saving a screenshot fails.

**IF Gain Calibration is off**

In Title bar, Logged, Persistent

**IF Shape Calibration is off**

In Title bar, Logged, Persistent

**Invalid frequency setup for this antenna**

In Title bar, Logged, Transient

**Limit recall initiated**

When a limit setup file is selected for recall.

**Maximum number of measurement points have been reached. To continue, save and clear current measurement points and start again.**

In Title bar, Not Logged, Persistent

**Not enough available space to save file: <filename>**

When the entire file could not be written.

**One or more shortcuts are no longer valid: <shortcut name>. File (s) cannot be found.**

In Title bar, Logged, Persistent

**Playback file corrupted, stopping playback**

In Title bar, Logged, Transient

**RBW changed: cannot be greater than IF bandwidth**

In Title bar, Logged, Transient

**Recall file does not exist**

When the file selected for recall could not be accessed

**Record CSV file failed to open**

In Title bar, Logged, Transient

**Reference Level Calibration is off**

In Title bar, Logged, Persistent

**Remote Lockout Warning: Warning Instrument Is Under Remote Control. Press “Return to Local” to exit remote control and enable on-screen**

Popup, Not Logged, Persistent

**Restart required for new settings to take effect.**

Persistent. When hostname or options (in the Debug menu) are changed.

**RF or Reference Level must be below <value> to enable PreAmp**

In Title bar, Logged, Transient

**Setting change detected; unloading playback file**

In Title bar, Logged, Transient

**Selected points is not valid with calibration applied, setting to nearest Cal point.**

In Title bar, Logged, Transient

**Save failed. File size exceeds save limits. Adjust setup and try again**

In Title bar, Logged, Transient

**Shutdown Battery Level Reached**

Pop-up Window, Logged, Persistent: Requires User Intervention

Sent after a **Battery Low** warning. A shutdown will occur when the battery charge is or below 5%.

**Shutdown Temperature Reached**

Popup, Logged, Persistent

**Simulated Test Signal data being displayed**

In Title bar, Logged, Persistent

**Spectrogram view not available**

In Title bar, Logged, Transient

**Segment gate length too short. Increase RBW or VBW setting for segments (X)**

In Title bar, Logged, Persistent. X indicates the incorrect segments.

**SSB frequency exceeds channel bandwidth**

In Title bar, Not Logged, Persistent

**TDD UL/DL common configuration invalid**

In Title bar, Logged, Persistent

**Temperature High Warning**

In Title bar, Logged, Persistent

**Triangulation line limit reached**

In Title bar, Logged, Transient

**The selected mode is not yet available.**

When an unavailable mode is selected.

**The ALC Cal Data is incorrect for the attached microwave module**

In Title bar, Logged, Persistent

**The following options will expire in less than 24 hours <Option Number>. Reboot required. The system will reboot at X.**

In Title bar, Logged, Persistent. X denotes the date and time.

**The following options have expired <Option Number>. Reboot required. The system will reboot at X**

Popup, Logged, Transient. X denotes the date and time.

**The following options have expired <Option Number>**

In Title bar, Logged, Transient

**The following options have expired <Option Number>**

Popup, Logged, Transient

**Quasi-peak detection selected. Sweep will be slower**

In Title bar, Logged, Transient

**Zero Span is not available**

In Title bar, Logged, Transient

**<Name of setting> <Value of setting> exceeds the min/max range <minimum value - maximum value>**

In Title bar, Logged, Transient

**<setting> value change is not allowed with calibration applied**

In Title bar, Logged, Transient

**Setting change is not allowed while a calibration is in progress**

In Title bar, Logged, Transient

**Setting change is not allowed with flex calibration**

In Title bar, Logged, Transient

**Unsupported parameters. Invalid measurement result.**

In Title bar, Logged, Persistent

## A-6 Error Notifications

### **Antenna disconnected. Terminating measurement**

In Title bar, Logged, Transient

### **ALC Unlevel Error (X) @ Y Hz**

In Title bar, Logged, Transient. X represents the ALC that failed and Y represents the specific frequency value at which the failure occurred.

### **Attempt to reboot instrument into Recovery mode failed**

In Title bar, Logged, Transient

### **Cannot start measurement without a connected Antenna**

In Title bar, Logged, Transient

### **Cannot set auto RBW ON due to exceeding IF bandwidth. RBW set to IF bandwidth**

In Title bar, Not Logged, Transient

### **Command Error**

In Title bar, Logged, Persistent

### **Could not lock to internal reference**

In Title bar, Logged, Persistent

### **Could not lock to external reference - check connection and try again**

In Title bar, Logged, Transient

### **Failed to connect to hardware**

Persistent. When the connection to the hardware (server) could not be established.

### **Failed to import user cable list**

In Title bar, Logged, Transient

### **Failed to recall limit**

When the limit setup file selected for recall could not be accessed.

### **Failed to save file: filepath/filename**

When any other error occurred while trying to save a file or when the connection to the hardware (server) is broken.

### **Failed to save screenshot. Device may be full.**

When saving a screenshot fails.

### **HW communication problem: SPA app unloaded**

In Title bar, Logged, Persistent

**IQ capture complete. File saved**

In Title bar, Logged, Transient

**IQ capture file failed to save**

In Title bar, Logged, Transient

**IQ Capture Aborted**

In Title bar, Logged, Transient

**Model Mismatch. Shortcut Creation failed due to model mismatch. Model from file.**

In Title bar, Logged, Transient

**Not enough available space to save file: filepath/filename**

When the entire file could not be written

**Out of Range**

In Title bar, Not Logged, Transient

**Options upgrade failed due to <specific reason>**

In Title bar, Logged, Transient

**Options upgraded. Please restart the instrument to use new features.**

In Title bar, Not Logged, Transient

**Options <value> are not valid for the currently installed firmware version. The device might not function properly**

In Title bar, Logged, Persistent

**PLL Unlock Error (X)**

In Title bar, Logged, Persistent. X represents either LO1, LO2, SLO or a combination of them.

**PLL Unlock Error (X) @ Y Hz**

In Title bar, Logged, Persistent. X represents the PLL that failed and Y represents the specific frequency value at which the failure occurred. The frequency range of Y is from 30,000.00 Hz to 54,000,000,000 Hz.

**Query Error**

In Title bar, Not Logged, Transient

**Recall file does not exist**

When the file selected for recall could not be accessed.

**SPA FPGA Programming Error**

In Title bar, Logged, Persistent

**Self test failure:<error description for the self test failure>**

In Title bar, Logged, Transient

**Selftest failure:<error description of the selftest failure>**

In Toolbar, Logged, Persistent

**Setting mismatch; cannot display memory trace**

In Title bar, Logged, Transient

**To minimize distortion on higher level signals, please add external attenuation**

In Title bar, Not Logged, Persistent

**The selected custom mask is invalid**

In Title bar, Logged, Transient

**Trace playback not available**

In Title bar, Logged, Transient

**Trace recording not available**

In Title bar, Logged, Transient

**Trace has not been copied to memory**

In Title bar, Logged, Transient

**Unexpected software exception. Reboot required.**

When the instrument software requires a reboot due to unknown error, Persistent

**Options <value> are not valid. Running without any options**

In Title bar, Not Logged, Persistent. This error may occur after a firmware update. Indicates that invalid option numbers were detected (<value> indicates the invalid option numbers).

**Options listed <value> are not valid. Restored to previous options**

In Title bar, Not Logged, Transient. This error may occur when upgrading options from an options upgrade file fails due to an invalid option configuration. The options will be restored to the previous options numbers.

**Failed to upgrade options. Restored to previous options #**

In Title bar, Not Logged, Transient. This error may occur when upgrading options from an options upgrade file fails due to an unknown reason. The options will be restored to the previous options numbers.

**Zero Sensor Error, remove any RF input signal to the external sensor**

In Title bar, Logged, Transient



# Appendix B — Test Records

## B-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: \_\_\_\_\_

## B-2 Test Records for Spectrum Analyzer Verification

**Table B-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 B-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 B-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 $\pm$ 1.3 dB   |
| 5 GHz     | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.30 dB                 | -4 dBm $\pm$ 1.3 dB  |
| 5 GHz     | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.30 dB                 | -8 dBm $\pm$ 1.3 dB  |
| 5 GHz     | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.30 dB                 | -10 dBm $\pm$ 1.3 dB |
| 5 GHz     | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.30 dB                 | -14 dBm $\pm$ 1.3 dB |
| 5 GHz     | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.30 dB                 | -18 dBm $\pm$ 1.3 dB |
| 5 GHz     | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.30 dB                 | -20 dBm $\pm$ 1.3 dB |
| 5 GHz     | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.30 dB                 | -24 dBm $\pm$ 1.3 dB |
| 5 GHz     | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.30 dB                 | -28 dBm $\pm$ 1.3 dB |
| 5 GHz     | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.30 dB                 | -30 dBm $\pm$ 1.3 dB |

**Table B-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 $\pm$ 1.3 dB   |
| 13 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.33 dB                 | -4 dBm $\pm$ 1.3 dB  |
| 13 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.33 dB                 | -8 dBm $\pm$ 1.3 dB  |
| 13 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.33 dB                 | -10 dBm $\pm$ 1.3 dB |
| 13 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.33 dB                 | -14 dBm $\pm$ 1.3 dB |
| 13 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.33 dB                 | -18 dBm $\pm$ 1.3 dB |
| 13 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.33 dB                 | -20 dBm $\pm$ 1.3 dB |
| 13 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.33 dB                 | -24 dBm $\pm$ 1.3 dB |
| 13 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.33 dB                 | -28 dBm $\pm$ 1.3 dB |
| 13 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.33 dB                 | -30 dBm $\pm$ 1.3 dB |

**Table B-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 $\pm$ 1.3 dB   |
| 18 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.44 dB                 | -4 dBm $\pm$ 1.3 dB  |
| 18 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.44 dB                 | -8 dBm $\pm$ 1.3 dB  |
| 18 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.44 dB                 | -10 dBm $\pm$ 1.3 dB |
| 18 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.44 dB                 | -14 dBm $\pm$ 1.3 dB |
| 18 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.44 dB                 | -18 dBm $\pm$ 1.3 dB |
| 18 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.44 dB                 | -20 dBm $\pm$ 1.3 dB |
| 18 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.44 dB                 | -24 dBm $\pm$ 1.3 dB |
| 18 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.44 dB                 | -28 dBm $\pm$ 1.3 dB |
| 18 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.44 dB                 | -30 dBm $\pm$ 1.3 dB |

**Table B-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 $\pm$ 1.8 dB   |
| 25 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.37 dB                 | -4 dBm $\pm$ 1.8 dB  |
| 25 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.37 dB                 | -8 dBm $\pm$ 1.8 dB  |
| 25 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.37 dB                 | -10 dBm $\pm$ 1.8 dB |
| 25 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.37 dB                 | -14 dBm $\pm$ 1.8 dB |
| 25 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.37 dB                 | -18 dBm $\pm$ 1.8 dB |
| 25 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.37 dB                 | -20 dBm $\pm$ 1.8 dB |
| 25 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.37 dB                 | -24 dBm $\pm$ 1.8 dB |
| 25 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.37 dB                 | -28 dBm $\pm$ 1.8 dB |
| 25 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.37 dB                 | -30 dBm $\pm$ 1.8 dB |

**Table B-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 $\pm$ 1.8 dB   |
| 31 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.45 dB                 | -4 dBm $\pm$ 1.8 dB  |
| 31 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.45 dB                 | -8 dBm $\pm$ 1.8 dB  |
| 31 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.45 dB                 | -10 dBm $\pm$ 1.8 dB |
| 31 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.45 dB                 | -14 dBm $\pm$ 1.8 dB |
| 31 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.45 dB                 | -18 dBm $\pm$ 1.8 dB |
| 31 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.45 dB                 | -20 dBm $\pm$ 1.8 dB |
| 31 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.45 dB                 | -24 dBm $\pm$ 1.8 dB |
| 31 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.45 dB                 | -28 dBm $\pm$ 1.8 dB |
| 31 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.45 dB                 | -30 dBm $\pm$ 1.8 dB |

**Table B-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 $\pm$ 1.8 dB   |
| 43 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.67 dB                 | -4 dBm $\pm$ 1.8 dB  |
| 43 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.67 dB                 | -8 dBm $\pm$ 1.8 dB  |
| 43 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.67 dB                 | -10 dBm $\pm$ 1.8 dB |
| 43 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.67 dB                 | -14 dBm $\pm$ 1.8 dB |
| 43 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.67 dB                 | -18 dBm $\pm$ 1.8 dB |
| 43 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.67 dB                 | -20 dBm $\pm$ 1.8 dB |
| 43 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.67 dB                 | -24 dBm $\pm$ 1.8 dB |
| 43 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.67 dB                 | -28 dBm $\pm$ 1.8 dB |
| 43 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.67 dB                 | -30 dBm $\pm$ 1.8 dB |

**Table B-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 $\pm$ 1.8 dB   |
| 53 GHz    | 30 dB             | 10 dBm          | +6 dBm             | -4 dBm                       | dBm                          | 0.38 dB                 | -4 dBm $\pm$ 1.8 dB  |
| 53 GHz    | 30 dB             | 10 dBm          | +2 dBm             | -8 dBm                       | dBm                          | 0.38 dB                 | -8 dBm $\pm$ 1.8 dB  |
| 53 GHz    | 20 dB             | 0 dBm           | 0 dBm              | -10 dBm                      | dBm                          | 0.38 dB                 | -10 dBm $\pm$ 1.8 dB |
| 53 GHz    | 20 dB             | 0 dBm           | -4 dBm             | -14 dBm                      | dBm                          | 0.38 dB                 | -14 dBm $\pm$ 1.8 dB |
| 53 GHz    | 20 dB             | 0 dBm           | -8 dBm             | -18 dBm                      | dBm                          | 0.38 dB                 | -18 dBm $\pm$ 1.8 dB |
| 53 GHz    | 10 dB             | -10 dBm         | -10 dBm            | -20 dBm                      | dBm                          | 0.38 dB                 | -20 dBm $\pm$ 1.8 dB |
| 53 GHz    | 10 dB             | -10 dBm         | -14 dBm            | -24 dBm                      | dBm                          | 0.38 dB                 | -24 dBm $\pm$ 1.8 dB |
| 53 GHz    | 10 dB             | -10 dBm         | -18 dBm            | -28 dBm                      | dBm                          | 0.38 dB                 | -28 dBm $\pm$ 1.8 dB |
| 53 GHz    | 0 dB              | -20 dBm         | -20 dBm            | -30 dBm                      | dBm                          | 0.38 dB                 | -30 dBm $\pm$ 1.8 dB |

**Table B-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 $\pm$ 1.3 dB |
| 10 MHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 150 MHz   | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 1 GHz     | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 3 GHz     | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 5 GHz     | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 8.9 GHz   | -10 dBm            | -50 dBm                      | dBm                          | 0.30 dB                 | -50 dBm $\pm$ 1.3 dB |
| 13 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.33 dB                 | -50 dBm $\pm$ 1.3 dB |
| 18 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.44 dB                 | -50 dBm $\pm$ 1.3 dB |
| 25 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.37 dB                 | -50 dBm $\pm$ 1.8 dB |
| 31 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.45 dB                 | -50 dBm $\pm$ 1.8 dB |
| 43 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.67 dB                 | -50 dBm $\pm$ 1.8 dB |
| 53 GHz    | -10 dBm            | -50 dBm                      | dBm                          | 0.38 dB                 | -50 dBm $\pm$ 1.8 dB |

**Table B-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 B-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 B-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 B-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 B-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 B-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 B-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 B-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 B-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                  | $\leq -60$ dBc |
| 8 GHz            | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 13 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 19 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 25 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 30 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 35 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 40 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 43 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |
| 53 GHz           | dBm                   | dBm           | dBc                                  | 4.0 dB                  | $\leq -60$ dBc |

**Table B-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 B-21.** Option 31, GPS Frequency Accuracy

| Frequency | Measured Value | Error | Measurement Uncertainty | Specification         |
|-----------|----------------|-------|-------------------------|-----------------------|
| 7 GHz     | GHz            | Hz    | 105 Hz (15 ppb)         | $\pm 175$ Hz (25 ppb) |





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