

Maintenance Manual

Remote Spectrum Monitor™ MS27201A

High-Performance RF Spectrum Monitor

MS27201A-0709 9 kHz to 9 GHz (Option 709)

MS27201A-0720 9 kHz to 20 GHz (Option 720)

MS27201A-0743 9 kHz to 43.5 GHz (Option 743)

The Anritsu logo is located in the bottom right corner of the page. It consists of the word "Anritsu" in a bold, sans-serif font. The letter "A" is stylized with a diagonal slash through it. The color of the logo is a dark blue-grey.

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Chapter 1 — General Information

1-1 Introduction

This manual provides the recommended test equipment and tools, replaceable parts list, verification procedures, part replacement procedures, maintenance instructions, and test record templates for the MS27201A Anritsu Remote Spectrum Monitor.

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

This manual includes:

- General information including:
 - Required Test Equipment and Tools listed in [Table 1-2 on page 1-2](#) and [Table 1-3 on page 1-3](#).
 - Replaceable Parts listed in [Table 1-4 on page 1-3](#)
- Performance verification procedures included in [Chapter 2, “Verification”](#)
- Assembly replacement and troubleshooting procedures:
 - [Chapter 3, “Assembly Replacement”](#)
 - [Chapter 4, “Troubleshooting”](#)
- Blank test records are included in [Appendix A](#).
 - Copy the blank test records from [Appendix A](#) and use them to record measured values. Anritsu recommends making a copy of the blank test records to document measurements each time a performance verification is performed. Continuing to document this process each time provides a detailed history of the instrument performance.

Additional Documentation

Table 1-1. Related Manuals

Document Part Number	Description
10100-00064	Product Information, Compliance, and Safety Notices
11410-02833	MS27201A Remote Spectrum Monitor Technical Data Sheet
10580-00481	MS27201A Remote Spectrum Monitor Programming Manual
10580-00480	MS27201A Remote Spectrum Monitor User Guide

1-2 Anritsu Customer Service Centers

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

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

1-3 Required Test Equipment and Tools

Table 1-2 provides a list of the test equipment used for the performance verification tests of the instrument. The test equipment is critical in making accurate measurements. In some cases, you may substitute certain test equipment having the same critical specifications as the test equipment indicated in the test equipment list.

Table 1-3 provides the list of tools that may be required to remove the screws and nuts of the instrument.

Table 1-2. 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 MG3692C
Signal Generator	Frequency: 2400 MHz	Anritsu MG3710A
Power Meter	Frequency: 67 GHz	Rohde and Schwarz, NRP67T
Power 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 Ω , N Type	Anritsu 28N50-2, for 9, 20 GHz units
Termination	50 Ω , K Type	Anritsu 28KF50, for 43.5 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
Power Splitter	N Type	Weinschel 1870A
Adapter	N Type	Anritsu 34NN50A
Adapter	N(f) to K(f)	Anritsu 71693-R, for 43.5 GHz units
Adapter	K(f) to N(f)	Anritsu 34NFKF50
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

Table 1-3. Required Tools

Tools	Specification
Wrench	5/16"
Wrench	1/2"
Wrench	5.5mm
Torque Wrench	8 in-lbs
Torx Screwdriver	T10
Phillips Screwdriver	#1
Phillips Screwdriver	#2
Nut Driver	5.5 mm

1-4 Replaceable Parts

Table 1-4. f Replaceable Parts

Part Number	Description	Reference Section
3-ND86514<R>	MS27201A Main PCB Assembly	Section 3-7 "Main PCB Removal"
3-ND86515<R>	MS27201A 9 to 20 GHz VSA Assembly	Section 3-6 "VSA Removal"
3-ND86517<R>	MS27201A 43.5 GHz VSA Assembly	Section 3-6 "VSA Removal"
3-513-156	RF In N Connector (9 to 20 GHz)	Section 3-9 "RF Input/IF Output Connector Removal"
3-83408	RF In K Connector (43.5 GHz)	Section 3-9 "RF Input/IF Output Connector Removal"
3-553-572	SMP Jack-to-Jack Adapter	Section 3-8 "SMP Jack-to-Jack Adapter Removal"
3-83778	Semi Rigid Cable 9 to 20 GHz Front Panel to VSA	Section 3-3 "Front Panel Removal"
3-83781	Semi Rigid Cable 43.5 GHz Front Panel to VSA	Section 3-5 "Semi-rigid Cable and DC Block Removal"
3-1091-373	DC Block	Section 3-5 "Semi-rigid Cable and DC Block Removal"
3-85975-3	PCIe Interface Assembly	Section 3-10 "PCIe Interface Assembly Removal"
3-516-124	Cable SMA Front Panel to SMP VSA	Section 3-3 "Front Panel Removal"
3-790-819	Handle	Section 3-4 "Handle Removal"
3-83271	Fan Assembly	Section 3-11 "Fan Assembly Removal"

Chapter 2 — Verification

2-1 Introduction

This chapter provides the verification procedures for the MS27201A Remote Spectrum Monitor. Verification tests that are associated with other instrument options are described in [Chapter 3, “Assembly Replacement”](#). Record the measurement results in the test record templates provided in [Appendix A, “Test Records”](#).

This chapter includes the following performance verification procedures:

- [Section 2-2 “Frequency Accuracy” on page 2-3](#)
- [Section 2-3 “Amplitude Accuracy” on page 2-5](#)
- [Section 2-4 “Single Side Band \(SSB\) Phase Noise” on page 2-8](#)
- [Section 2-5 “Second Harmonic Distortion” on page 2-10](#)
- [Section 2-6 “Displayed Average Noise Level \(DANL\)” on page 2-11](#)
- [Section 2-7 “Residual Spurs” on page 2-13](#)
- [Section 2-8 “Input Related Spurs” on page 2-15](#)
- [Section 2-9 “Third Order Intercept \(TOI\)” on page 2-16](#)

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.

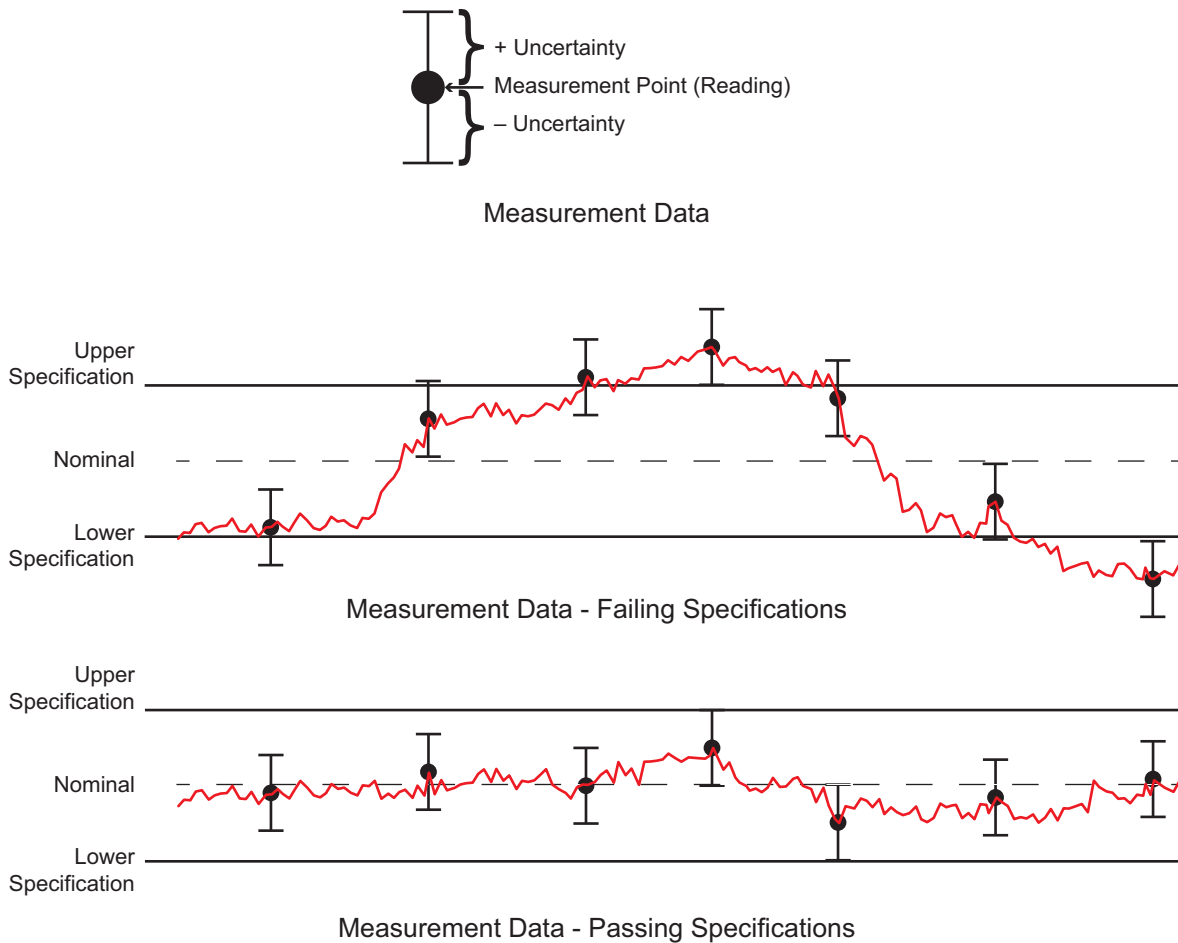


Figure 2-1. Pass/Fail Determination

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 the following procedures to verify the frequency accuracy of the MS27201A., without and with GPS connection. Record the results in the test records provided in [Appendix A](#)

There are two procedures involved in verifying the frequency accuracy:

- “Without GPS Connection”
- “With GPS Connection (Option 31)”

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

Without GPS Connection

Use the following procedures to verify the frequency accuracy of the MS27201A without GPS connection.

Equipment Required

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

Procedure

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

Note Do not connect the 10 MHz Reference to the MS27201A.
--

2. Connect the MG3697C RF Out to the MS27201A RF In.
3. Set the MG3697C RF output as follows:
 - Power level: -30 dBm
 - CW frequency: 1 GHz
4. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
5. Set the MS27201A parameters as follows:
 - Center Frequency: 1 GHz
 - Reference Level: -10 dBm
 - Span: 10 kHz
 - RBW: 100 Hz
 - VBW: 30 Hz
6. Enable Marker 1 and perform a Peak Search. Record the marker frequency in [Table A-1, “Spectrum Analyzer Frequency Accuracy” on page A-2](#). Calculate the error by subtracting 1 GHz from the measured value and record the error in [Table A-1 on page A-2](#).
7. Set the MG3697C frequency to 7 GHz.
8. Set the MS27201A Center Frequency to 7 GHz.
9. Enable Marker 1 and perform a Peak Search. Record the marker frequency in [Table A-1, “Spectrum Analyzer Frequency Accuracy” on page A-2](#). Calculate the error by subtracting 7 GHz from the measured value and record the error in [Table A-1 on page A-2](#).

With GPS Connection (Option 31)

Use this procedure to verify the frequency accuracy of the MS27201A. Record the results in the test records provided in [Appendix A](#).

Equipment Required

- Anritsu MG3692x Synthesizer
- 10 MHz Frequency Reference
- Anritsu 34RKNF50 Adapter
- Anritsu 15NN50-1.5C RF Coaxial Cable
- BNC(m) to BNC(m) Coaxial Cable
- GPS Antenna

Procedure

1. Connect the 10 MHz Frequency Reference to the 10 MHz Ref In connector on the MG3692x Synthesizers.
2. Connect the MG3692x RF output to RF In, Port 1, on the MS27201A.
3. Power on the 10 MHz Reference Standard, Anritsu MG3692x, and the MS27201A. Allow the instruments to warm up for 10 minutes.
4. Connect the GPS Antenna to the MS27201A, and confirm GPS coordinates are shown where the message “No GPS Fix” was shown prior to connecting the antenna.
5. Set the MG3692x output to 1 GHz CW with an RF Output Level of –30 dBm.
6. Set the MS27201A parameters as follows:
 - Reference Level: –10 dBm
 - Center Frequency: 1 GHz
 - Span: 10 kHz
 - RBW: 1 kHz
 - VBW: 300 Hz
 - Sweep Type: Single
7. Enable Marker 1 and perform a Peak Search. Record the marker frequency in [Table A-2, “Option 31, GPS Frequency Accuracy” on page A-1](#). Calculate the error by subtracting 1 GHz from the measured value and record the error in [Table A-2 on page A-1](#).
8. Set the MG3697C frequency to 7 GHz.
9. Set the MS27201A Center Frequency to 7 GHz.
10. Enable Marker 1 and perform a Peak Search. Record the marker frequency in [Table A-2, “Option 31, GPS Frequency Accuracy” on page A-1](#). Calculate the error by subtracting 7 GHz from the measured value and record the error in [Table A-2 on page A-1](#).

2-3 Amplitude Accuracy

Use the following procedures to verify the amplitude accuracy of the MS27201A and record the results in the test records provided in [Appendix A](#).

There are two procedures involved in verifying the amplitude accuracy:

- “[Amplitude Accuracy – Preamplifier Off](#)”
- “[Amplitude Accuracy – Preamplifier On](#)”

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

Amplitude Accuracy – Preamplifier Off

Use the following procedure to verify the amplitude accuracy of the MS27201A with preamplifier off.

Equipment Required

- Anritsu MG3697C Synthesizer
- Anritsu V241C Power 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 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9 and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS27201A.
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 MS27201A to the 10 dB attenuator.
6. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
7. Set the MS27201A parameters as follows:
 - Reference Level: 10 dBm
 - Attenuation Level: 30 dB
 - Preamplifier: Off
 - Trace Menu:
 - Detector Type: Peak
 - Bandwidth Menu:
 - RBW: 1 kHz
 - VBW: 10 Hz
 - Span: 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 power level reading of MG3697C should be approximately +16 dBm.)
14. Set the MS27201A center frequency to 50 MHz.
15. Perform a marker peak search and record the amplitude in [Table A-3, “Power Level Accuracy at 50 MHz \(Preamplifier Off\)”](#) on [page A-2](#)
16. Adjust the Reference Level and Attenuation Level on the MS27201A for the other values in [Table A-3, “Power Level Accuracy at 50 MHz \(Preamplifier Off\)”](#) on [page A-2](#)
17. Adjust the Power Level on the MG3697C for the other power levels in [Table A-3, “Power Level Accuracy at 50 MHz \(Preamplifier Off\)”](#) on [page A-2](#), and record results for each measurement.
18. Repeat this procedure for the other frequencies using the tables listed below:
 - [Table A-4, “Power Level Accuracy at 5 GHz \(Preamplifier Off\)”](#) for all frequency options
 - [Table A-5, “Power Level Accuracy at 13 GHz \(Preamplifier Off\)”](#) for 20 and 43.5 GHz units
 - [Table A-6, “Power Level Accuracy at 18 GHz \(Preamplifier Off\)”](#) for 20 and 43.5 GHz units
 - [Table A-7, “Power Level Accuracy at 25 GHz \(Preamplifier Off\)”](#) for 43.5 GHz units
 - [Table A-8, “Power Level Accuracy at 31 GHz \(Preamplifier Off\)”](#) for 43.5 GHz units
 - [Table A-9, “Power Level Accuracy at 43 GHz \(Preamplifier Off\)”](#) for 43.5 GHz units

Amplitude Accuracy – Preamplifier On

Use the following procedure to verify the amplitude accuracy of the MS27201A with the preamplifier on. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

- Anritsu MG3697C Synthesizer
- Anritsu V241C Power 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 43.5 GHz units
- Anritsu 34NK50 Adapter, K(m) to N(m), for 9 and 20 GHz units
- 10 MHz Frequency Reference

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS27201A.
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 MS27201A to the 40 dB attenuation.
6. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
7. Set the MS27201A parameters as follows:
 - Reference Level: -40 dBm
 - Attenuation Level: 0 dB
 - Preamplifier: On
 - Trace Menu:
 - Detector Type: Peak
 - Bandwidth Menu:
 - RBW: 1 kHz
 - VBW: 10 Hz
 - Span: 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 MS27201A set the center frequency to 10 kHz and perform a peak search. Record the result in [Table A-10, “Power Level Accuracy \(Preamplifier On\)”](#) on [page A-6](#).
11. Repeat [Step 8](#) through [Step 10](#) for the remaining frequencies that apply to the unit being tested, in [Table A-10, “Power Level Accuracy \(Preamplifier On\)”](#) on [page A-6](#).

2-4 Single Side Band (SSB) Phase Noise

Use the following procedure to verify the single side-band (SSB) phase noise of the MS27201A. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

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

Procedure

1. Connect the external 10 MHz Reference to both the MG3697C and MS27201A.
2. Connect the MG3697C RF Out to the MS27201A 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 MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
6. Set the MS27201A parameters as follows:
 - Reference Level: 0 dBm
 - Input Attenuation: 15 dB
 - Preamplifier: Off
 - Trace Menu:
 - Detector Type: Peak
 - Type: Average
 - Averages: 3
 - Bandwidth Menu:
 - RBW: 1 kHz
 - VBW: 3 Hz
 - Sweep Points: 551
7. 10 kHz and 100 kHz Offset Settings:
 - Center Frequency: 1000.05 MHz
 - Span: 110 kHz
8. In the Sweep menu, turn off Continuous Sweep, and choose Sweep to 3 and allow it to finish.
9. In the Marker menu, use the Peak Search menu to set Marker 1 to the peak at 1 GHz. Exit the Peak Search menu and set the Marker Mode to Delta. Enter a frequency value of 10 kHz, so a marker is on the peak at 1 GHz and the delta marker is 10 kHz away. Record the difference in level between the peak at 1 GHz and the noise level 10 kHz away at 1000.010 MHz in [Table A-11, "Spectral Purity – SSB Phase Noise Offset from 1 GHz" on page A-6](#). Then subtract another 30 dB and record this as the 10 kHz Offset Measured Value reading in [Table A-11 on page A-6](#).

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

10. Change the Delta Frequency from 10 kHz to 100 kHz and record the difference in level between the peak at 1 GHz and the noise level 100 kHz away at 1000.100 MHz in [Table A-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page A-6](#). Then subtract another 30 dB and record this as the 100 kHz Offset Measured Value reading in [Table A-11 on page A-6](#).

For example: $-80 \text{ dBc measured} - 30 \text{ dB} = -110 \text{ dBc/Hz}$

11. Change the Center Frequency to 1000.545 MHz and the Span to 1.1 MHz. Run the sweep of 3 averages and allow it to finish. Using Delta Markers, measure the difference in level between the peak at 1 GHz and the noise level 1 MHz away at 1001.0 MHz in [Table A-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page A-6](#). Then subtract another 30 dB and record this as the 1 MHz Offset Measured Value reading in [Table A-11 on page A-6](#).

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

12. 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 levels between the peak at 1 GHz and the noise level 10 MHz away at 1010 MHz in [Table A-11, “Spectral Purity – SSB Phase Noise Offset from 1 GHz” on page A-6](#). Then subtract another 30 dB and record this as the 10 MHz Offset Measured Value reading in [Table A-11 on page A-6](#).

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

2-5 Second Harmonic Distortion

Use the following procedure to verify the second harmonic distortion of the MS27201A. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

- Anritsu MG3692C Synthesizer
- 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 43.5 GHz units
- K(m) to N(f)
- N(f) to K(m)

Procedure

1. Connect the 10 MHz reference to the MG3692C and MS27201A.
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 MS27201A.
3. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
4. Set the MS27201A parameters as follows:
 - Reference Level: -20 dBm
 - Attenuation Level: 0 dB
 - Preamplifier: Off
 - Bandwidth Menu:
 - RBW: 1 kHz
 - VBW: 10 Hz
 - Span: 100 kHz
 - Center frequency: 50.1 MHz
5. Set the MG3692C frequency to 50.1 MHz and adjust the level so the MS27201A shows -30 dBm at 50.1 MHz. Record this value in [Table A-12, “Second Harmonic Distortion” on page A-7](#)
6. Set the MS27201A Center Frequency to 100.2 MHz, perform a peak search, and record this value in [Table A-12 on page A-7](#).
7. Subtract 50.1 MHz value from the 100.2 MHz value and record this as the Second Harmonic Distortion in [Table A-12 on page A-7](#).

For example, if the 50.1 MHz value is -30 dBm and the 100.2 MHz value is -90 dBm, then:
 $-90 \text{ dBm} - (-30 \text{ dBm}) = -60 \text{ dBc}$

2-6 Displayed Average Noise Level (DANL)

Use the following procedures to verify the Displayed Average Noise Level (DANL) of the MS27201A. Record the results in the test records provided in [Appendix A](#).

There are two procedures involved in verifying the DANL of MS27201A:

- “DANL – Preamplifier Off”
- “DANL – Preamplifier On”

DANL – Preamplifier Off

Use the following procedure to verify the Displayed Average Noise Level (DANL) of the MS27201A with preamplifier off.

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

Equipment Required

- Anritsu 28N50-2 Termination, for 9 and 20 GHz units
- Anritsu 28KF50 Termination, for 43.5 GHz units

Procedure

1. Attach the Termination to the RF input of the MS27201A.
2. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
3. Set the MS27201A parameters as follows:
 - Reference Level: -20 dBm
 - Input Attenuation: 0 dB
 - Preamplifier: Off
 - Sweep Points: 551
 - Trace menu:
 - Detector Type: RMS/Avg
 - Bandwidth menu:
 - RBW: 1 MHz
 - VBW: 1 kHz
 - VBW Type: Logarithmic
 - Start Frequency: 10 MHz
 - Stop Frequency to 4 GHz
4. Using the Sweep menu, turn off Continuous Sweep, and Sweep Once.
5. Using the Marker menu, choose Peak Search, subtract 60 dB from the measurement, and record the power level in:
 - For 9 and 20 GHz Units: [Table A-13, “Displayed Average Noise Level \(Preamplifier Off, for 9 and 20 GHz Units\)” on page A-7](#)
 - For 43.5 GHz Units: [Table A-14, “Displayed Average Noise Level \(Preamplifier Off, for 43.5 GHz Units\)” on page A-7](#)
6. Repeat [Step 3](#) through [Step 5](#) by changing the Start/Stop frequencies for the remaining frequency ranges in [Table A-13 on page A-7](#) or [Table A-14 on page A-7](#).

DANL – Preamplifier On

Use the following procedure to verify the Displayed Average Noise Level (DANL) of the MS27201A with the Preamplifier On. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

- Anritsu 28N50-2 Termination, for 9 and 20 GHz units
- Anritsu 28KF50 Termination, for 43.5 GHz units

Procedure

1. Attach the Termination to the RF input of the MS27201A.
2. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
3. Set the MS27201A parameters as follows:
 - Reference Level: -50 dBm
 - Input Attenuation: 0 dB
 - Preamplifier: On
 - Sweep Points: 551
 - Trace Menu:
 - Detector Type: RMS/Avg
 - Bandwidth Menu:
 - RBW: 1 MHz
 - VBW: 1 kHz
 - VBW Type: Logarithmic
 - Start Frequency: 10 MHz
 - Stop Frequency: 4 GHz
4. Using the Sweep Menu, turn off Continuous Sweep, and Sweep Once.
5. Using the Marker menu, choose Peak Search, subtract 60 dB from the measurement, and record the power level in:
 - For 9 and 20 GHz Units: [Table A-15, “Displayed Average Noise Level \(Preamplifier On, for 9 and 20 GHz Units\)” on page A-8](#)
 - For 43.5 GHz Units: [Table A-17, “Displayed Average Noise Level \(Preamplifier On, for 43.5 GHz Units\)” on page A-9](#)
6. Repeat [Step 3](#) through [Step 5](#) by changing the Start/Stop frequencies for the remaining frequency ranges in [Table A-15 on page A-8](#) or [Table A-17 on page A-9](#).

2-7 Residual Spurs

Use the following procedures to verify the Residual Spurs of the MS27201A with the Preamplifier Off and Preamplifier On. Record the results in the test records provided in [Appendix A](#).

There are two procedures involved in verifying the Residual Spurs:

- “Residual Spurs – Preamplifier Off”
- “Residual Spurs – Preamplifier On”

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

Residual Spurs – Preamplifier Off

Use the following procedure to verify the Residual Spurs of the MS27201A with the Preamplifier Off and Record the results in the test records provided in [Appendix A](#).

Equipment Required

- Anritsu 28N50-2 Termination, for 9 and 20 GHz units
- Anritsu 28KF50 Termination, for 43.5 GHz units

Procedure

1. Attach the Termination to the RF input of the MS27201A.
2. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
3. Set the MS27201A parameters as follows:
 - Reference Level: –50 dBm
 - Input Attenuation: 0 dB
 - Preamplifier: On
 - Sweep Points: 551
 - Start Frequency: 9 kHz
 - Stop Frequency: 100 kHz
 - RBW: 300 Hz
 - VBW: 10 Hz
4. Using the Sweep Menu, turn off Continuous Sweep, and Sweep Once.
5. Using the Marker menu, choose Peak Search and record the power level in [Table A-16, “Residual Spurs \(Preamplifier Off\)” on page A-9](#).
6. Repeat [Step 3](#) through [Step 5](#) by changing the Start/Stop frequencies and RBW/VBW settings for the remaining frequency ranges in [Table A-16 on page A-9](#).

Residual Spurs – Preamplifier On

Use the following procedure to verify the Residual Spurs of the MS27201A with the Preamplifier On. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

- Anritsu 28N50-2 Termination, for 9 and 20 GHz units
- Anritsu 28KF50 Termination, for 43.5 GHz units

Procedure

1. Attach the Termination to the RF input of the MS27201A.
2. Set the MS27201A to Spectrum Analyzer mode and preset the instrument (PRESET > Preset Mode).
3. Set the MS27201A parameters as follows:
 - Reference Level: -50 dBm
 - Input Attenuation: 0 dB
 - Preamplifier: On
 - Sweep Points: 551
 - Start Frequency: 9 kHz
 - Stop Frequency: 100 kHz
 - RBW: 300 Hz
 - VBW: 10 Hz
4. Using the Sweep Menu, turn off Continuous Sweep, and Sweep Once.
5. Using the Marker menu, choose Peak Search and record the power level in [Table A-18, “Residual Spurs \(Preamplifier On\)”](#) on page A-10.
6. Repeat [Step 3](#) through [Step 5](#) by changing the Start/Stop frequencies and RBW/VBW settings for the remaining frequency ranges in [Table A-18 on page A-10](#).

2-8 Input Related Spurs

Use the following procedure to verify the Input Related Spurs of the MS27201A. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

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

Procedure

1. Connect the 10 MHz Reference to the MG3697C and MS27201A.
2. Connect the output of the MG3697C to the RF In of the MS27201A.
3. Set the MS27201A to Spectrum Analyzer mode and Preset the instrument (PRESET > Preset Mode).
4. Set the MS27201A parameters as follows:
 - Reference Level: -30 dBm
 - Attenuation Level: 0 dB
 - Preamplifier: Off
 - Span: 1.7 GHz
 - RBW: 3000 Hz
 - VBW: 300 Hz
 - Frequency: 5 GHz
5. Set the MG3697C frequency to 5 GHz, and set power level so -30 dBm is read on the MS27201A at 5 GHz.
6. Ensure no spurs are seen within the 1.7 GHz span that are greater than -90 dBm (-60 dBc). Record the highest spur level in [Table A-19, "Input Related Spurs" on page A-10](#).
7. Repeat [Step 4](#) to [Step 6](#) for the remaining frequencies in [Table A-19 on page A-10](#).

2-9 Third Order Intercept (TOI)

Use the following procedure to verify the Third Order Intercept (TOI) of the MS27201A. Record the results in the test records provided in [Appendix A](#).

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

Equipment Required

- Anritsu MG3692C Synthesizer
- Anritsu MG3710A Signal Generator
- Weinschel 1870A Power 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 43.5 GHz units

Procedure

1. Connect the 10 MHz Reference to the MG3692C, MG3710A, and MS27201A.
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. Preset the MS27201A unit (PRESET > Preset Mode), and then set the following parameters:
 - Center Frequency: 2400.151 MHz
 - Reference Level: -15 dBm
 - Attenuation Level: 0 dB
 - Preamplifier: Off
 - Span: 100 Hz
 - RBW: 30 Hz
 - VBW: 1 Hz
 - Detector Type: RMS / Avg
13. Disconnect the MA2442D from the power splitter and connect the MS27201A to the power splitter using the necessary adapters.

14. Turn on the RF output of both the MG3692C and MG3710A.
15. On the MS27201A perform a Peak Search and record the peak value at 2400.151 MHz in [Table A-20](#), “Third Order Intercept (TOI)” on page A-11.
16. On the MS27201A change the Center Frequency to 2399.851 MHz and perform a Peak Search. Record the value at 2399.851 MHz in [Table A-20 on page A-11](#).
17. 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

18. Record the TOI value in [Table A-20 on page A-11](#).

Chapter 3 — Assembly Replacement

3-1 Introduction

This chapter describes opening and closing the Remote Spectrum Monitor case along with basic parts replacement steps. The sections are as follows:

- [Section 3-2 “Top Cover Removal” on page 3-2](#)
- [Section 3-3 “Front Panel Removal” on page 3-3](#)
- [Section 3-4 “Handle Removal” on page 3-5](#)
- [Section 3-5 “Semi-rigid Cable and DC Block Removal” on page 3-6](#)
- [Section 3-6 “VSA Removal” on page 3-7](#)
- [Section 3-7 “Main PCB Removal” on page 3-8](#)
- [Section 3-8 “SMP Jack-to-Jack Adapter Removal” on page 3-9](#)
- [Section 3-9 “RF Input/IF Output Connector Removal” on page 3-10](#)
- [Section 3-10 “PCIe Interface Assembly Removal” on page 3-11](#)
- [Section 3-11 “Fan Removal” on page 3-12](#)

Caution

Only qualified personnel should open the case and replace internal assemblies. Assemblies shown in [Table 1-4](#) are typically the only items that may be replaced. Because they are highly fragile, items that must be soldered may not be replaced without specialized training.

Removing RF shields from PC boards or adjustment of screws on or near the shields may detune sensitive RF circuits and will result in degraded instrument performance. All work should be performed in a static-safe work area.

Caution



Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

The MS27201A contains components that can be easily 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 subassemblies or components found in the instrument.

3-2 Top Cover Removal

This procedure provides instructions for opening the MS27201A case. With the case opened, the internal assemblies can be removed and replaced as detailed in the following sections.

1. Disconnect any external cables from the MS27201A; for example, Power, Ethernet, GPS, or External Reference cables.
2. Remove the 16 screws securing the top cover to remove the top cover. See [Figure 3-1](#).

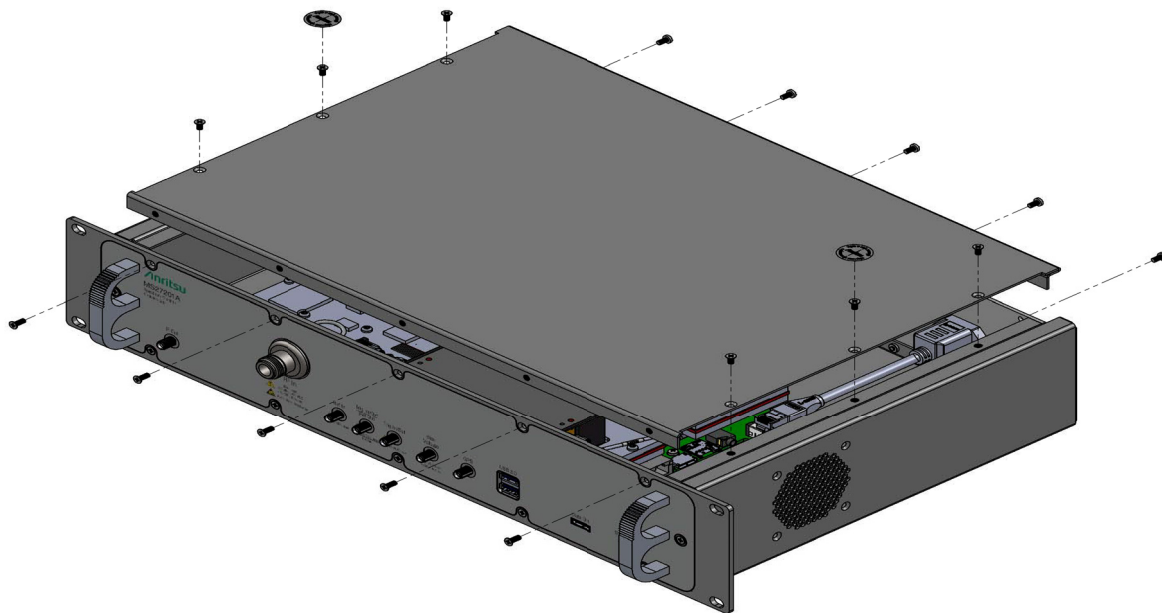


Figure 3-1. Location of 16 Cover Screws

3-3 Front Panel Removal

1. Remove the top cover of the instrument as described in [Section 3-2 “Top Cover Removal”](#) on page 3-2.
2. Remove the Kapton® tape and then disconnect the SMP cable from the VSA, shown at location 1. See [Figure 3-2](#).
3. Use a 5/16" wrench to loosen and disconnect the semi-rigid cable located at the rear of the RF Input adapter shown at location 2. See [Figure 3-2](#).

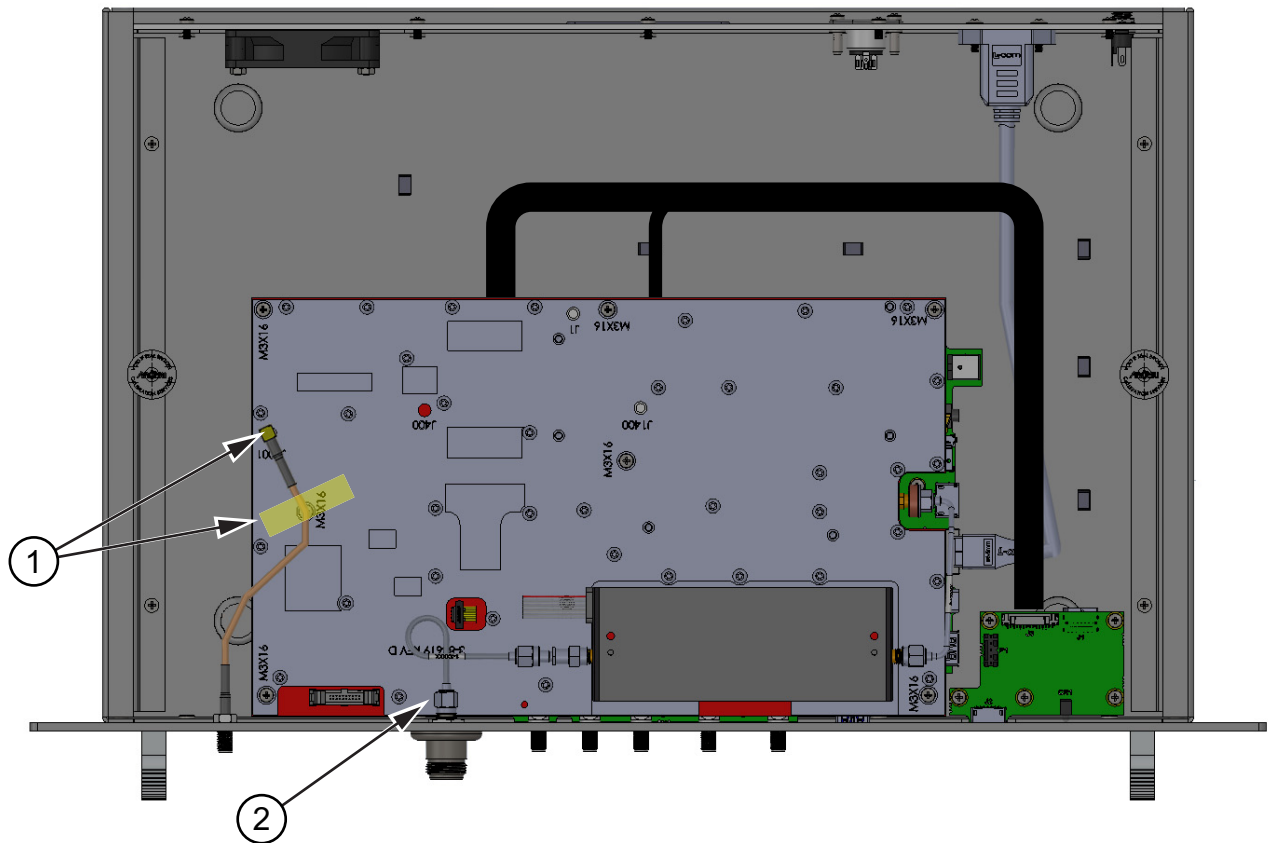


Figure 3-2. VSA Cables Removal

4. Remove the seven screws securing the front panel shown at location 1. See [Figure 3-3](#).
5. Using a 5/16" wrench, remove the five nuts and washers shown at location 2. See [Figure 3-3](#).
6. Remove front panel.

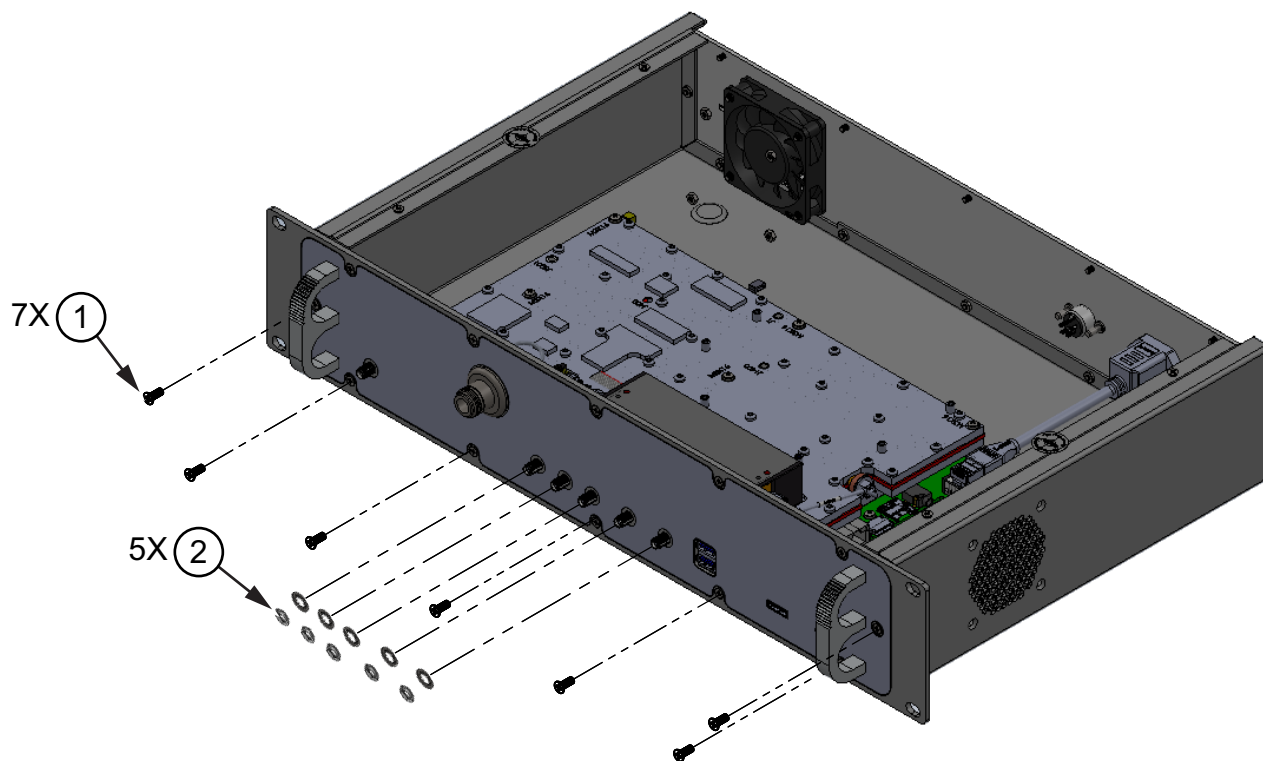


Figure 3-3. Front Panel Removal

Note

When reinstalling the front panel, it is important that the semi-rigid cable is torqued with the required torque spec using the Torque wrench shown at location 2. See [Figure 3-2](#).

3-4 Handle Removal

1. Remove the top cover of the instrument as described in [Section 3-2 “Top Cover Removal”](#) on page 3-2.
2. Remove the front panel of the instrument as described in [Section 3-3 “Front Panel Removal”](#) on page 3-3
3. Using a Phillips screwdriver, remove the six screws shown at location 1. See [Figure 3-4](#).
4. Remove both handles from the front panel shown at location 2. See [Figure 3-4](#).

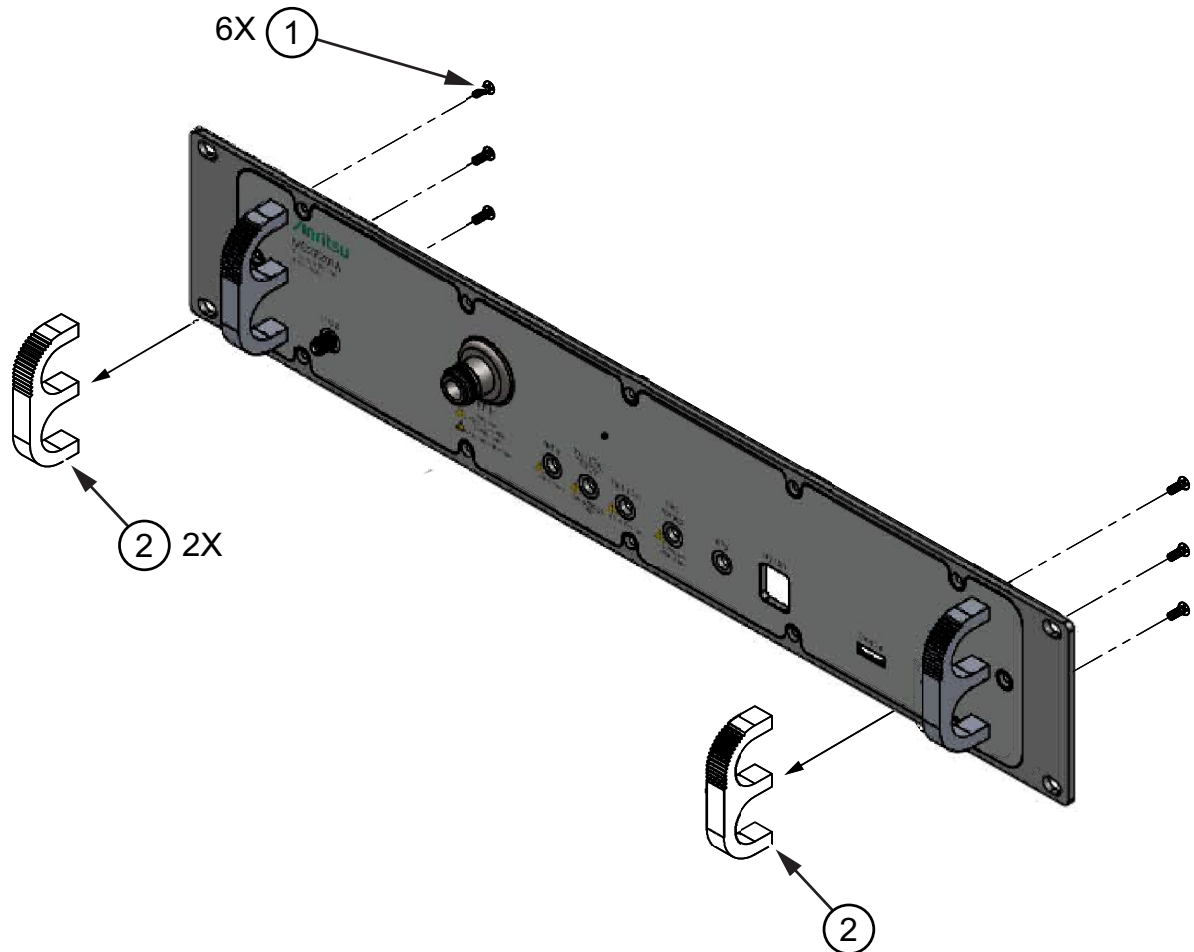


Figure 3-4. Handle Removal

3-5 Semi-rigid Cable and DC Block Removal

The semi-rigid cable connecting the RF input adapter and the step attenuator on the VSA is normally a part of the VSA Exchange Assembly, but it may be replaced independently.

1. Remove the top cover of the instrument as described in [Section 3-2 “Top Cover Removal”](#) on page 3-2.
2. Use a 5/16" wrench to disconnect the semi-rigid cable assembly from the front panel RF In connector shown at location 1, and from the step attenuator DC Block shown at location 2. See [Figure 3-5](#).
3. Using a 5/16" wrench remove the DC block from the step attenuator shown at location 3. See [Figure 3-5](#).

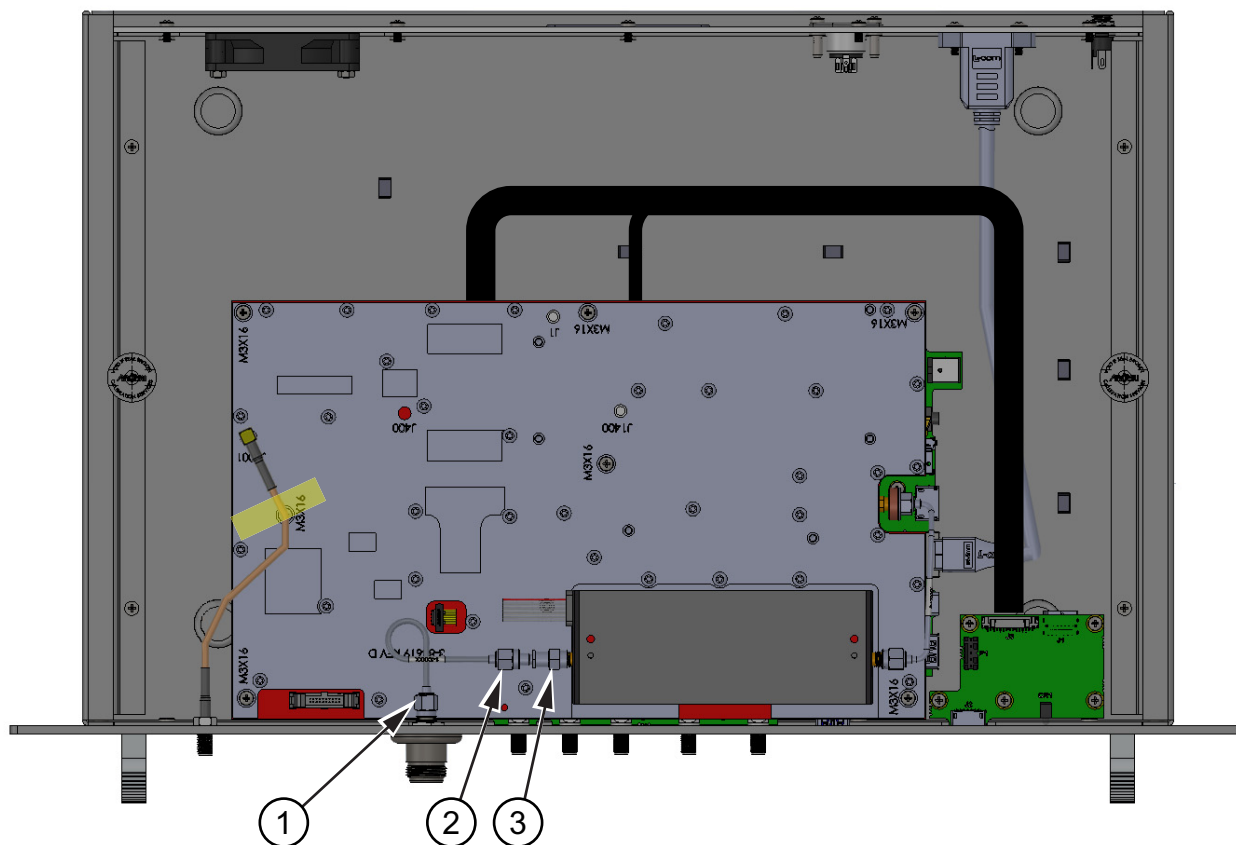


Figure 3-5. Semi-rigid Cable and DC Block Removal

Note

It is important that the semi-rigid cable and DC block are torqued with the proper spec using the torque wrench on reassembly.

3-6 VSA Removal

1. Remove the instrument's top cover as described in [Section 3-2 "Top Cover Removal"](#) on page 3-2.
2. Remove the front panel as described in [Section 3-3 "Front Panel Removal"](#) on page 3-3.
3. Using a T10 Torx driver, remove the seven screws securing the VSA to the Main PCB, shown at location 1. See [Figure 3-6](#).
4. Carefully lift the VSA straight up to remove it from the Main PCB, taking care of SMP Jack-to-Jack connector shown at location 2 and the high density connector shown at location 3. See [Figure 3-6](#).

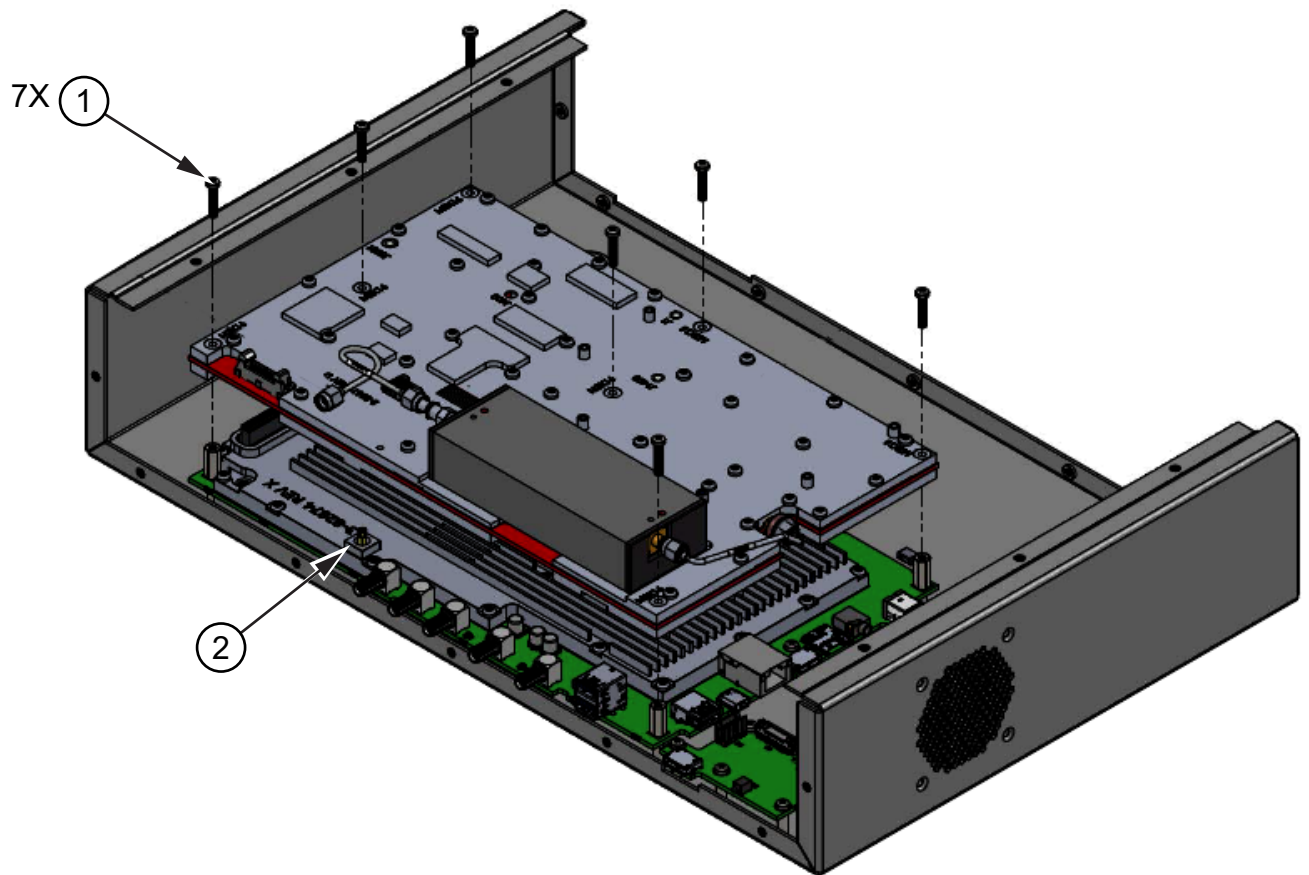


Figure 3-6. VSA Assembly Removal

Note To reinstall the VSA onto the Main PCB, ensure that SMP Jack-to-Jack adapter shown at location 2, and high density connector at location 3, are properly aligned.

3-7 Main PCB Removal

1. Remove the VSA from the Main PCB as described in [Section 3-6 “VSA Removal”](#) on page 3-7.
2. Using a 5.5 mm nut driver, remove the five standoffs shown at location 1. See [Figure 3-7](#).
3. Using a T10 Torx driver, remove the three screws shown at location 2. See [Figure 3-7](#).
4. Lift the Main PCB assembly straight up out of the chassis. See [Figure 3-7](#).

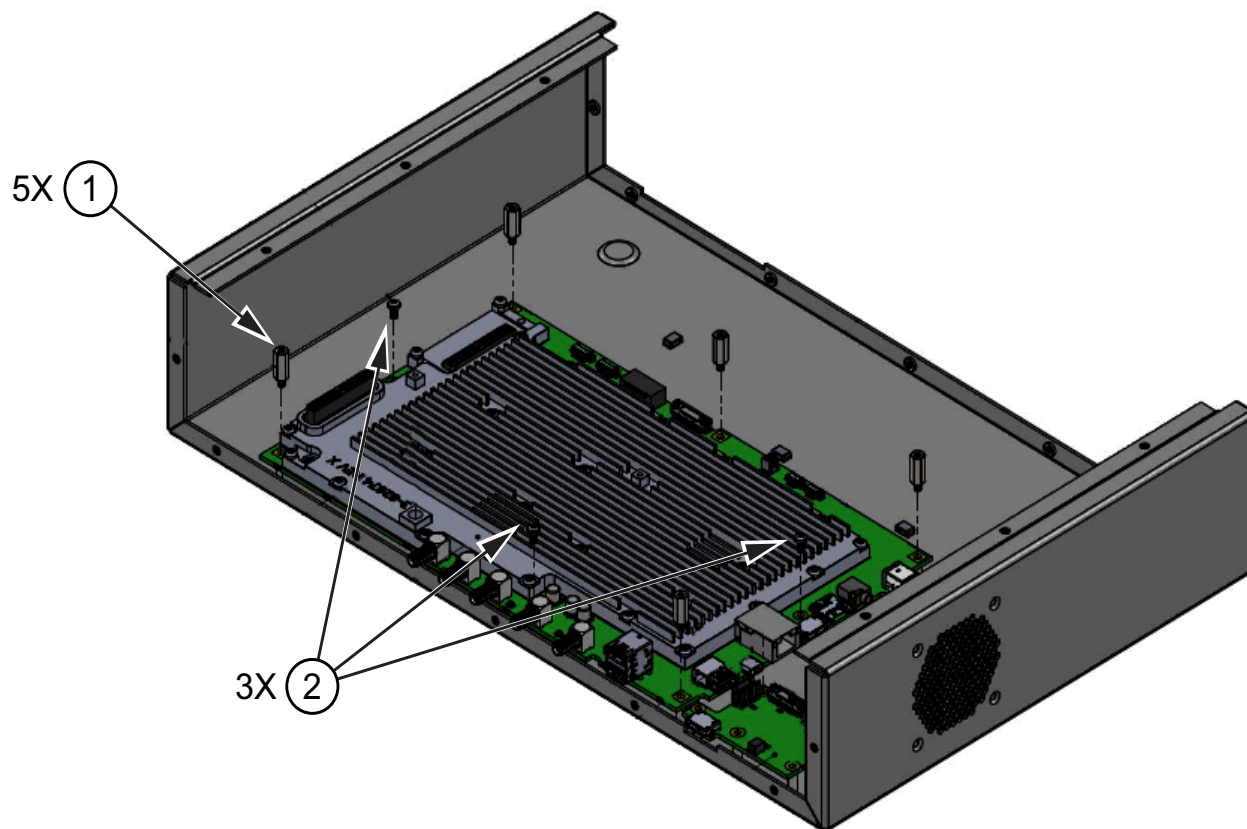


Figure 3-7. Main PCB Assembly Removal

3-8 SMP Jack-to-Jack Adapter Removal

1. Remove the VSA from the Main PCB as described in [Section 3-6 “VSA Removal”](#) on page 3-7.
2. Carefully remove the SMP Jack-to-Jack adapter located between the VSA and the Main PCB shown at location 1 by gently squeezing with your fingers and pulling the adapter straight up. See [Figure 3-8](#).

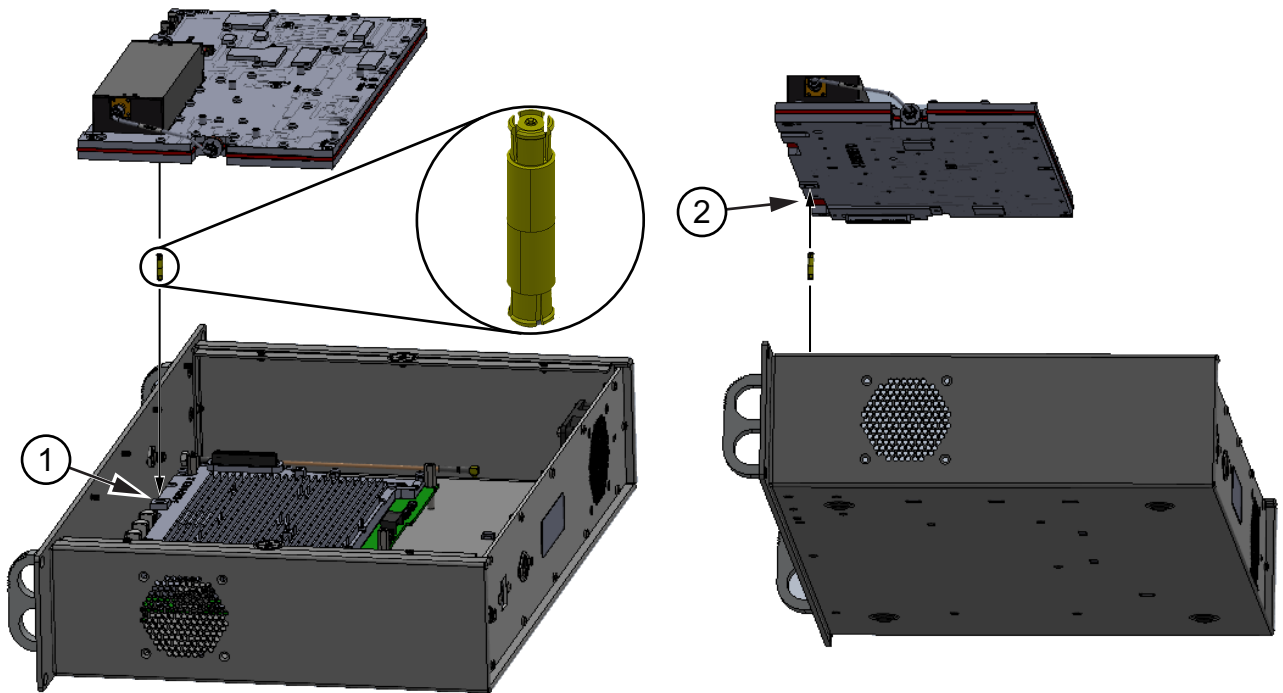


Figure 3-8. SMP Jack-to-Jack Adapter Removal

Note When reinstalling the VSA, ensure that the SMP Jack-to-Jack adapter shown at location 1 is perpendicularly aligned between the VSA and the Main PCB shown at location 2. See [Figure 3-8](#).

3-9 RF Input/IF Output Connector Removal

1. Remove the front panel from the chassis, as described in [Section 3-3 “Front Panel Removal”](#) on page 3-3
2. Using a 1/2" wrench, remove the nut and washer from the RF input connector shown at location 1. See [Figure 3-9](#).
3. Remove the RF input connector shown at location 2.
4. Using a 5/16" wrench, remove the nut and washer from the IF output cable shown at location 3. See [Figure 3-9](#).

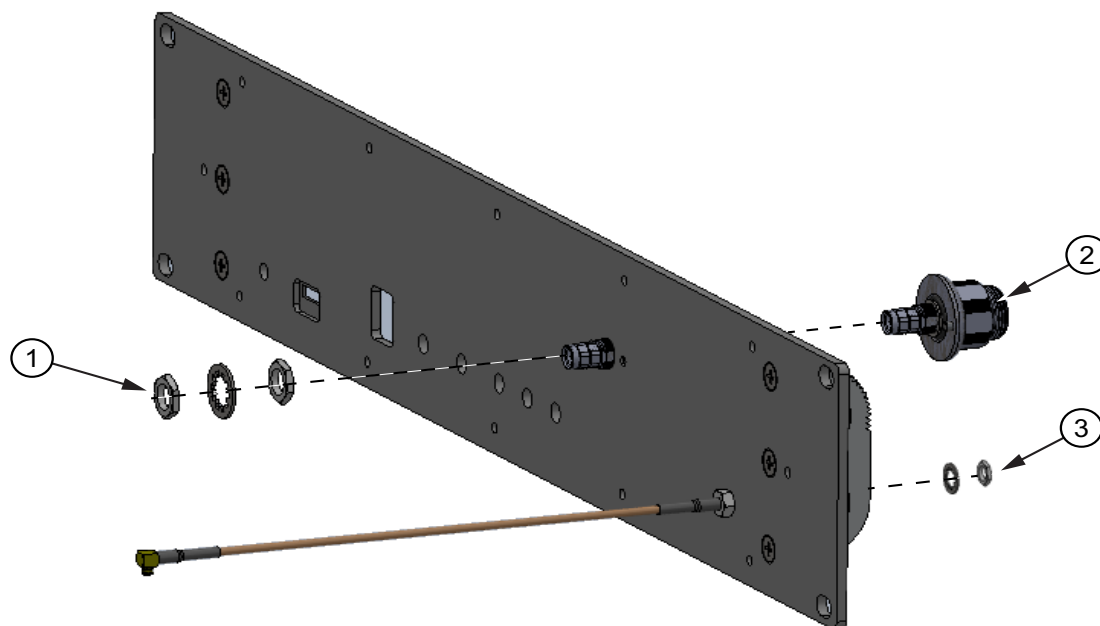


Figure 3-9. RF Input Connector Removal

3-10 PCIe Interface Assembly Removal

1. Remove the instrument's top cover as described in [Section 3-2 "Top Cover Removal"](#) on page 3-2.
2. Remove the white CLIK-Mate cable harness shown at location 1 by pressing the securing latch and pulling the connector out of the socket, then remove the Nano Pitch I/O cable by pulling the connector out of the socket. See [Figure 3-10](#).
3. Using a Phillips screwdriver, remove the five PCIe mounting screws shown at location 2. See [Figure 3-10](#).
4. Remove the PCIe interface assembly from the chassis. See [Figure 3-10](#).

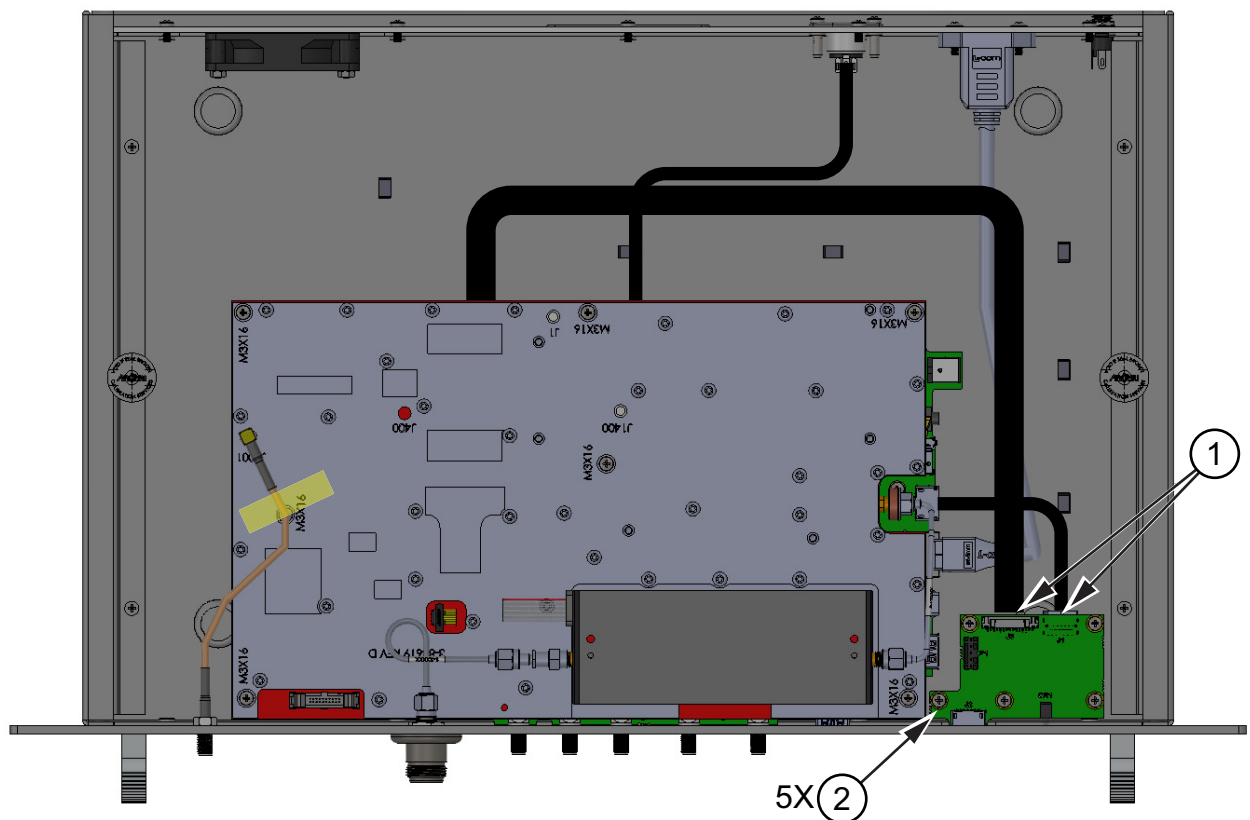


Figure 3-10. PCIe Interface Assembly Removal

3-11 Fan Assembly Removal

1. Remove the instrument's top cover as described in [Section 3-2 "Top Cover Removal"](#) on page 3-2.
2. Disconnect the fan cable from the Main PCB shown at location 1. See [Figure 3-11](#).
3. Using 5.5 mm wrench, remove the four nuts shown at location 2. See [Figure 3-11](#).

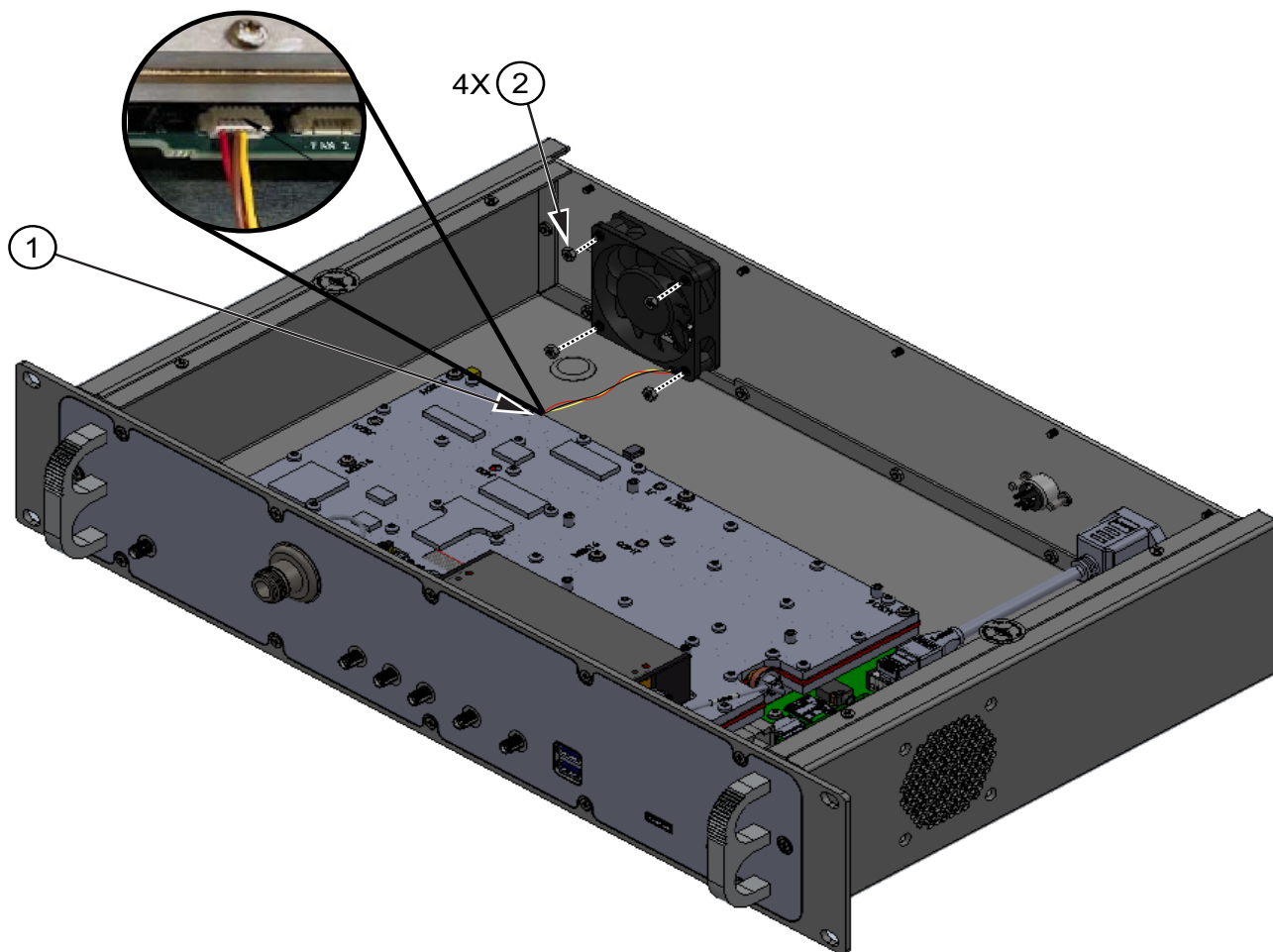


Figure 3-11. Fan Removal

Note When reinstalling the fan, connect the fan cable to the Fan 1 connector on the Main PCB. See [Figure 3-11](#).

Chapter 4 — Troubleshooting

4-1 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 1-4](#) 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.

4-2 Communication Problems

IP address is unknown:

1. Power On the MS27201A.
2. Connect the MS27201A to a network with an Ethernet cable.
3. Insert a USB memory device into one of the USB ports on the MS27201A.

Note Note that the MS27201A have external USB ports on the front panel.
--

4. After inserting the USB memory device into the unit, wait approximately for 10 seconds and then remove it. The USB memory device will now contain a text file named ip.txt, which will have the current IP address, along with some other information. Below is a sample file showing where the IP Address is located (highlighted in red).

```
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
   link/ether 00:00:91:f1:10:9a brd ff:ff:ff:ff:ff:ff
   inet 172.26.206.24/22 scope global eth0
   inet6 2000::200:91ff:feff:109a/64 scope global
3: sit0: <NOARP> mtu 1480 qdisc noop
   link/sit 0.0.0.0 brd 0.0.0.0
```

Instrument is powered on, but the Discovery Program will not detect it:

1. Ensure the Ethernet cable is connected.
2. The Discovery Program will only detect the MS27201A if the PC running the Discovery Program and the MS27201A are on the same network. The MS27201A is initially shipped with the DHCP setting set to Off and the default IP address set to 10.0.0.2. To communicate with the MS27201A in this state, connect the MS27201A directly to a PC with an Ethernet crossover cable, then set the PC to have a static IP setting of 10.0.0.1 and see if the MS27201A can be detected by entering the IP address of 10.0.0.2 into a browser address bar. If so, the DHCP setting and other network settings can be set on the MS27201A to match the network settings to which it will be connected. Refer to the Help menu for the SCPI commands to change the network settings.

4-3 Level Accuracy Problems

Measured signal is unexpectedly too high or too low:

For one- port instruments:

1. Check the N connector for damage and cleanliness.
2. Next, check the connections between the N connector and Main PCB.
3. If the connections are good, replace the Main PCB.

For multi-port instruments:

1. Check the faulty port's connector for damage and cleanliness.
2. Next, check the faulty ports connections between the input connector and MUX to SPA connections.
3. If the connections are good, replace the Front Panel Mux Assembly on the MS27201A.

Appendix A — Test Records

A-1 Introduction

This appendix provides the test record templates to record the performance of the MS27201A Remote Spectrum Monitor. 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.

MS27201A Firmware Rev: _____ Operator: _____ Date: _____
Serial Number: _____ Options: _____

A-2 Test Records for Spectrum Analyzer Verification

Table A-1. Spectrum Analyzer Frequency Accuracy

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

Table A-2. Option 31, GPS Frequency Accuracy

Frequency	Measured Value	Error	Measurement Uncertainty	Specification
1 GHz	GHz	Hz	250 Hz (0.25 ppm)	± 25 Hz (25ppb)
7 GHz	GHz	Hz	1750 Hz (0.25 ppm)	± 175 Hz (25ppb)

MS27201A Firmware Rev: _____ Operator: _____ Date: _____
 Serial Number: _____ Options: _____

Table A-3. Power Level Accuracy at 50 MHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A Measured Power Level	Measurement Uncertainty	Specification
50 MHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.30 dB	0 dBm \pm 1.3 dB
50 MHz	30 dB	10 dBm	+6 dBm	-4 dBm	dBm	0.30 dB	-4 dBm \pm 1.3 dB
50 MHz	30 dB	10 dBm	+2 dBm	-8 dBm	dBm	0.30 dB	-8 dBm \pm 1.3 dB
50 MHz	20 dB	0 dBm	0 dBm	-10 dBm	dBm	0.30 dB	-10 dBm \pm 1.3 dB
50 MHz	20 dB	0 dBm	-4 dBm	-14 dBm	dBm	0.30 dB	-14 dBm \pm 1.3 dB
50 MHz	20 dB	0 dBm	-8 dBm	-18 dBm	dBm	0.30 dB	-18 dBm \pm 1.3 dB
50 MHz	10 dB	-10 dBm	-10 dBm	-20 dBm	dBm	0.30 dB	-20 dBm \pm 1.3 dB
50 MHz	10 dB	-10 dBm	-14 dBm	-24 dBm	dBm	0.30 dB	-24 dBm \pm 1.3 dB
50 MHz	10 dB	-10 dBm	-18 dBm	-28 dBm	dBm	0.30 dB	-28 dBm \pm 1.3 dB
50 MHz	0 dB	-20 dBm	-20 dBm	-30 dBm	dBm	0.30 dB	-30 dBm \pm 1.3 dB

MS27201A Firmware Rev: _____ Operator: _____ Date: _____
 Serial Number: _____ Options: _____

Table A-4. Power Level Accuracy at 5 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A 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 A-5. Power Level Accuracy at 13 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A 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

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Table A-6. Power Level Accuracy at 18 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A 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 A-7. Power Level Accuracy at 25 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A 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

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Table A-8. Power Level Accuracy at 31 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A Measured Power Level	Measurement Uncertainty	Specification
31 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.45 dB	0 dBm ± 1.8 dB
31 GHz	30 dB	10 dBm	+6 dBm	-4 dBm	dBm	0.45 dB	-4 dBm ± 1.8 dB
31 GHz	30 dB	10 dBm	+2 dBm	-8 dBm	dBm	0.45 dB	-8 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	0 dBm	-10 dBm	dBm	0.45 dB	-10 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	-4 dBm	-14 dBm	dBm	0.45 dB	-14 dBm ± 1.8 dB
31 GHz	20 dB	0 dBm	-8 dBm	-18 dBm	dBm	0.45 dB	-18 dBm ± 1.8 dB
31 GHz	10 dB	-10 dBm	-10 dBm	-20 dBm	dBm	0.45 dB	-20 dBm ± 1.8 dB
31 GHz	10 dB	-10 dBm	-14 dBm	-24 dBm	dBm	0.45 dB	-24 dBm ± 1.8 dB
31 GHz	10 dB	-10 dBm	-18 dBm	-28 dBm	dBm	0.45 dB	-28 dBm ± 1.8 dB
31 GHz	0 dB	-20 dBm	-20 dBm	-30 dBm	dBm	0.45 dB	-30 dBm ± 1.8 dB

Table A-9. Power Level Accuracy at 43 GHz (Preamplifier Off)

Frequency	Input Attenuation	Reference Level	NRP67T Power Level	MS27201A Expected Power Level	MS27201A Measured Power Level	Measurement Uncertainty	Specification
43 GHz	30 dB	10 dBm	+10 dBm	0 dBm	dBm	0.45 dB	0 dBm ± 1.8 dB
43 GHz	30 dB	10 dBm	+6 dBm	-4 dBm	dBm	0.45 dB	-4 dBm ± 1.8 dB
43 GHz	30 dB	10 dBm	+2 dBm	-8 dBm	dBm	0.45 dB	-8 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	0 dBm	-10 dBm	dBm	0.45 dB	-10 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	-4 dBm	-14 dBm	dBm	0.45 dB	-14 dBm ± 1.8 dB
43 GHz	20 dB	0 dBm	-8 dBm	-18 dBm	dBm	0.45 dB	-18 dBm ± 1.8 dB
43 GHz	10 dB	-10 dBm	-10 dBm	-20 dBm	dBm	0.45 dB	-20 dBm ± 1.8 dB
43 GHz	10 dB	-10 dBm	-14 dBm	-24 dBm	dBm	0.45 dB	-24 dBm ± 1.8 dB
43 GHz	10 dB	-10 dBm	-18 dBm	-28 dBm	dBm	0.45 dB	-28 dBm ± 1.8 dB
43 GHz	0 dB	-20 dBm	-20 dBm	-30 dBm	dBm	0.45 dB	-30 dBm ± 1.8 dB

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

Frequency	NRP67T Power Level	MS27201A Expected Power Level	MS27201A Measured Power Level	Measurement Uncertainty	Specification
10 kHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
10 MHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
150 MHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
1 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
3 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
5 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
8.9 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
13 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
18 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
25 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
31 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB
43 GHz	-10 dBm	-50 dBm	dBm	0.30 dB	-50 dBm ± 1.3 dB

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

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

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Table A-12. Second Harmonic Distortion

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

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

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

Table A-14. Displayed Average Noise Level (Preamplifier Off, for 43.5 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

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Table A-15. Displayed Average Noise Level (Preamplifier On, for 9 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

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Table A-16. Residual Spurs (Preamplicifier 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

Table A-17. Displayed Average Noise Level (Preamplicifier On, for 43.5 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

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Table A-18. Residual Spurs (Preamplifier On)

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

Table A-19. Input Related Spurs

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


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Table A-20. Third Order Intercept (TOI)

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

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