Maintenance Manual

LMR Master S412D

An Integrated, Handheld Multi-function Land Mobile Radio Test Tool for Greater Flexibility and Technician Productivity

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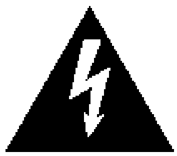
Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

Symbols Used in Manuals

Danger



This indicates a very dangerous procedure that could result in serious injury or death, and possible loss related to equipment malfunction, if not performed properly.

Warning

This indicates a hazardous procedure that could result in light-to-severe injury or loss related to equipment malfunction, if proper precautions are not taken.

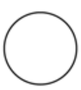
Caution

This indicates a hazardous procedure that could result in loss related to equipment malfunction if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

For Safety

Warning

Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.

Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

Warning

or

When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning

This equipment can not be repaired by the operator. Do not attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Warning

Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury if this equipment is lifted by one person.

Caution

Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

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

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Chapter 1 — General Information

1-1 Introduction

This manual provides maintenance instructions for the LMR Master Model S412D Land Mobile Radio test tool. It describes the product and provides performance verification procedures, parts replacement procedures, and a replaceable parts list.

1-2 Description

The LMR Master is a handheld SWR/RL (standing wave ratio/return loss), Distance-To-Fault, spectrum analysis, and power meter (optional) measurement instrument. It combines a synthesized source, VSWR bridge, receiver, and spectrum analyzer circuitry in a compact instrument.

Throughout this manual, the term “VNA” denotes Return Loss, SWR, Cable Loss and DTF modes, and the term “SPA” denotes Spectrum Analyzer mode. All other modes are referenced individually.

Chapter 2 — Performance Verification

2-1 Performance Verification

The following sections contain tests that can be used to verify the performance of the S412D. Before performing any of the tests in these sections, ensure the S412D has had a minimum of 30 minutes warm up and that the test equipment has been warmed up to the manufacturers' specifications. Table 2-1 lists the required equipment for performance verification.

Note	Using an AC/DC power adapter during performance verification of the S412D is recommended.

Table 2-1. Required Equipment

Instrument	Critical Specification	Recommended Manufacturer/Model
Synthesized Signal Source	Frequency: 0.1 Hz to 20 GHz	Anritsu Model MG3692A or B with options 2A, 4
Power Meter	Power Range: -70 to + 20 dBm	Anritsu Dual Channel Model ML2438A
Power Sensor	Frequency: 10 MHz to 18 GHz Power Range: -67 to +20 dB	Anritsu Model MA2442D or equivalent (quantity 2)
Frequency Reference	Frequency: 10 MHz	Symmetricom Model RubiSource T&M
50 MHz Lowpass Filter	N(m) to N(f)	Anritsu Part Number 1030-96
Power Splitter	Frequency: DC to 18 GHz	Aeroflex/Weinschel Model 1870A
Adapter	N(m)-N(m), 50 Ohm	Anritsu Model 34NN50A
Adapter	Frequency: DC to 20 GHz K(m)-N(f), 50 Ohm	Anritsu Model 34RKNF50
50 Ohm Termination	Frequency: DC to 18 GHz	Anritsu Model 28N50-2
RF Coaxial Cable	N(m)-N(f), 50 Ohm	Anritsu Model 15NN50-1.5C or equivalent
Spectrum Analyzer	9 kHz to 21.2 GHz	Anritsu Model MS2665C or equivalent
Open/Short	DC to 18 GHz N(m)	Anritsu Model 22N50
Fixed Attenuator	10 dB	Aeroflex/Weinschel Model 44-10
Fixed Attenuator	20 dB	Aeroflex/Weinschel Model 44-20
Fixed Attenuator	30 dB	Aeroflex/Weinschel Model 44-30
Offset Termination	20 dB, 4 GHz	Anritsu Model SC5270
Offset Termination	6 dB, 4 GHz	Anritsu Model SC5237
RF Detector (for Option 5)	10 MHz to 20 GHz	Anritsu Model 560-7N50B
Low Current Load Fixture (for Option 10)	105 Ohm, 1 Watt	Anritsu Part Number T3377
High Current Load Fixture (for Option 10)	40 Ohm, 5 Watt	Anritsu Part Number T2904

2-2 VNA Frequency Accuracy

The following test can be used to verify the VNA CW frequency accuracy of the LMR Master. Measurement calibration of the LMR Master is not required for this test.

1. Connect a 10 MHz Reference signal to the 10 MHz STD Ref In of the MS2665C.
2. Press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
3. Press the **FREQ/DIST** key, then press the F1 soft key and set F1 to 1000 MHz.
4. Press the F2 soft key, set F2 to 1000 MHz.
5. Press the **MEAS/DISP** key, then press the Fixed CW soft key to turn Fixed CW on.
6. Connect the RF cable from the LMR Master Reflection Test Port to the RF Input on the MS2665C.
7. Set up the MS2665C as follows:
    a. Press the **Preset** key, then select **Preset All** (F1).
    b. Press the **Frequency** key.
    c. Set the Center Frequency to 1 GHz.
    d. Press the **Span** key.
    e. Set the frequency span to 750 kHz.
    f. Press the **RBW** key.
    g. Set the RBW to 10 kHz.
    h. Press the **VBW** key.
    i. Press the Filter Off soft key (F3) to turn the VB filter off.
    j. Press the **Amplitude** key.
    k. Set the Reference Level to 0 dBm.
    l. Press the Log Scale soft key (F5).
    m. Select **2 dB/Div** (F3) and the press the return soft key.

Note If the LMR Master has gone into the hold mode, press the **RUN/HOLD** key to return to normal mode.

8. When a peak response appears on the Spectrum Analyzer, press the **Marker Peak Search** key on the Spectrum Analyzer. Record the frequency in Appendix A "Test Records".
9. On the LMR Master, press the **MEAS/DISP** key then the Fixed CW soft key to turn Fixed CW off.

2-3 VNA Return Loss Verification

The following test can be used to verify the accuracy of return loss measurements. Measurement calibration of the LMR Master is required for this test.

1. Press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
2. Press the **MODE** key.
3. Use the Up/Down arrow key to highlight Return Loss, then press **ENTER**.
4. Press the **START CAL** key.
5. Follow the instructions on the screen to perform a calibration using a 22N50 Open/Short and 28N50-2 Termination.
6. Connect the 20 dB offset to the RF Out port and record the minimum and maximum values in Appendix A “Test Records”.
7. Connect the 6 dB offset to the RF Out port and record the minimum and maximum values in Appendix A “Test Records”.

2-4 Spectrum Analyzer Frequency Accuracy

The following test can be used to verify the CW frequency accuracy of the LMR Master Spectrum Analyzer.

1. Connect the 10 MHz reference source to the Anritsu MG3692X Synthesized Signal Source.
2. Connect the output of the source to the Spectrum Analyzer RF Input of the LMR Master.
3. Press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
4. Set the MG3692X output to 1000 MHz CW, with an RF output level of 0 dBm.
5. On the LMR Master, press the **MODE** key. Use the up/down arrow key to highlight Spectrum Analyzer and press **ENTER** to select spectrum analyzer mode.
6. Press the **AMPLITUDE** key and the Ref Level soft key.
7. Enter 20 and press the **ENTER** key to set the Reference Level to 20 dBm.
8. Press the **FREQ/DIST** key and the Center soft key.
9. Enter 1000 and press **ENTER** to set the center frequency to 1000 MHz.
10. Press the Span soft key, enter 20, and press the kHz soft key to set the span to 20 kHz.
11. Confirm that the RBW is 100 Hz, and the VBW is 30 Hz. If adjustment of the RBW and VBW are required:
    a. Press the **MEAS/DISP** key and the Bandwidth soft key.
    b. Press the RBW Manual soft key and use the Up/Down arrow key to select 100 Hz. Press **ENTER** to set the resolution bandwidth to 100 Hz.
    c. Press the VBW Manual soft key and use the Up/Down arrow key to select 30 Hz. Press **ENTER** to set the video bandwidth to 30 Hz.
12. Press the **MARKER** key, then the M1 soft key.
13. Select the Edit soft key and use the Up/Down arrow key to center the marker on the waveform. Record the frequency in Appendix A “Test Records”.

2-5 Spectrum Analyzer Phase Noise Verification

This test can be used to verify the phase noise of the LMR Master Spectrum Analyzer.

1. Connect the output of the source to the LMR Master RF Input.
2. Press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
3. Set the MG3692X output to 1000 MHz CW, with an RF output level of –30 dBm.
4. On the LMR Master, press the **MODE** key. Use the Up/Down arrow key to highlight Spectrum Analyzer, then, press the **ENTER** key to select spectrum analyzer mode.
5. Press the **MEAS/DISP** key and the Bandwidth soft key.
6. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 kHz. Press **ENTER** to set the resolution bandwidth to 1 kHz.
7. Press the VBW Manual soft key and use the Up/Down arrow key to select 30 Hz. Press **ENTER** to set the video bandwidth to 30 Hz.
8. Press the **FREQ/DIST** key and the Center soft key.
9. Enter 1000 and press the **ENTER** key to set the center frequency to 1000 MHz.
10. Press the Span soft key and enter 0.1. Press the **ENTER** key to set the span to 0.100 MHz.
11. Press the **AMPLITUDE** key.
12. Press the Ref Level soft key and enter –27. Press **ENTER** to set the reference level to –27 dBm.
13. Press the **MARKER** key, then the M1 soft key.
14. Press EDIT and enter 1000. Press **ENTER** to set the M1 marker frequency to 1000 MHz.
15. Press the BACK soft key and the M2 soft key.
16. Press EDIT and enter 1000.03. Press **ENTER** to set the M2 marker frequency to 1000.03 MHz (30 kHz higher than the center frequency).
17. Press the DELTA (M2–M1) soft key.
18. Press the **RUN/HOLD** key and read and record the Δ2 reading
19. Press the **RUN/HOLD** key to read and record five values, then calculate the average of the five recorded values.
20. To convert to dBc/Hz, subtract 30 dB from the average value and verify that the result is ≤ –75 dBc/Hz. (For example: –45 dBc measured – 30 dB = –75 dBc/Hz.)
21. Press the **BACK** soft key and the M3 soft key.
22. Press the EDIT key and enter 999.97. Press MHz to set the M3 marker frequency to 999.97 MHz (30 kHz lower than the center frequency).
23. Press the DELTA (M3–M1) soft key.
24. Press the **RUN/HOLD** key. Read and record the Δ3 reading.
25. Press the **RUN/HOLD** key to read and record five values, then calculate the average of the five recorded values.
26. Subtract 30 dB from the average value and record the calculated value in Appendix A “Test Records” (for example, if the average value is –50, record –80).

2-6 Input Related Spurious Response Verification

The following test can be used to verify the input related spurious response of the LMR Master Spectrum Analyzer.

1. Connect the 10 MHz reference source to the Anritsu MG3692X Synthesized Signal Source.
2. Connect one end of the 50 MHz Low Pass Filter to the output of the source and the other end to the LMR Master Spectrum Analyzer RF Input with the coaxial cable.
3. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
4. Set the MG3692X output to 40 MHz CW, with an RF output level of –30 dBm.
5. On the LMR Master, press the **MODE** key. Use the Up/Down arrow key to highlight Spectrum Analyzer, then, press the **ENTER** key to select spectrum analyzer mode.
6. Press the **AMPLITUDE** key and the Ref Level soft key.
7. Enter –27 and press the **ENTER** key to set the Reference Level to –27 dBm.
8. Press the Scale soft key and enter 7 then press **ENTER**.
9. Press the Atten/Preamp soft key and then the Manual soft key.
10. Enter 0 and press **ENTER** to set the attenuation to 0 dB.
11. Press the **FREQ/DIST** key and then the Center soft key.
12. Enter 40 and press the MHz soft key to set the center frequency to 40 MHz.
13. Press the Span soft key and enter 0.2. Press the MHz soft key to set the span to 0.200 MHz.
14. Press the **MEAS/DISP** key and the Bandwidth soft key.
15. Press the RBW Manual soft key and use the Up/Down arrow key to select 10 kHz. Press **ENTER** to set the resolution bandwidth to 10 kHz.
16. Press the VBW Manual soft key and use the Up/Down arrow key to select 3 kHz. Press **ENTER** to set the video bandwidth to 3 kHz.
17. Press the **MARKER** key, then the M1 soft key.
18. Select the Edit soft key, then enter 40. Press the MHz soft key to set M1 to 40 MHz.
19. On the MG3692X Synthesized Signal Source, adjust the output level so that the M1 reading of LMR Master Spectrum Analyzer is –30 dBm at 40 MHz.
20. On the LMR Master, press the **FREQ/DIST** key and then the Center soft key.
21. Enter 80 and press the MHz soft key to set the center frequency to 80 MHz.
22. Press the **MARKER** key and the M1 soft key.
23. Select the Edit soft key, then enter 80. Press the MHz soft key to set M1 to 80 MHz.
24. Add 30 dB to the value measured at M1 to calculate the Input Related Spurious Response. Record the calculated value in Appendix A “Test Records” (for example if the M1 data is –80, record –50).

2-7 Spectrum Analyzer Resolution Bandwidth Accuracy Verification

The following tests can be used to verify the resolution bandwidth accuracy of the LMR Master Spectrum Analyzer at different frequencies.

1. Connect the 10 MHz reference source to the Anritsu MG3692X Synthesized Signal Source and the Ext Freq Ref input of the LMR Master.
2. Connect the output of the Anritsu MG3692X Synthesized Signal Source to the LMR Master Spectrum Analyzer RF Input.
3. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **On/Off** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
4. Set the MG3692X output to 1 GHz, with an RF output level of –30 dBm.
5. On the LMR Master, press the **MODE** key. Use the Up/Down arrow key to highlight Spectrum Analyzer, then, press the **ENTER** key to select spectrum analyzer mode.
6. Press the **AMPLITUDE** key and the Ref Level soft key.
7. Enter –27 and press the **ENTER** key to set the Reference Level to –27 dBm.
8. Press the Scale soft key and enter 3, then press **ENTER**.
9. Press the **FREQ/DIST** key and the Center soft key.
10. Enter 1 and press the GHz soft key to set the center frequency to 1 GHz.

1 MHz RBW Test

1. Press the Span soft key, enter 1.5 and press the MHz soft key to set the span to 1.5 MHz.
2. Press the **MEAS/DISP** key and the Bandwidth soft key.
3. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 MHz. Press **ENTER** to set the resolution bandwidth to 1 MHz.
4. Press the VBW Manual soft key and use the Up/Down arrow key to select 3 kHz and press **ENTER** to set the video bandwidth to 3 kHz and select BACK.
5. Press the Measure soft key, the OBW soft key, the dBc soft key, and then the **ENTER** key.
6. Press the Measure soft key, then the **MARKER** key. Press the M2 soft key and then the Delta (M2–M1) soft key. Record the Δ2 frequency in Appendix A “Test Records”.

300 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 450 and press the kHz soft key to set the span to 450 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 300 kHz. Press **ENTER** to set the resolution bandwidth to 300 kHz and select BACK.
5. Press the Measure soft key and then the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A “Test Records”.

100 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 150 and press the kHz soft key to set the span to 150 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 100 kHz. Press **ENTER** to set the resolution bandwidth to 100 kHz and select BACK.
5. Press the Measure soft key and then the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A "Test Records".

30 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 45 and press the kHz soft key to set the span to 45 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 30 kHz. Press **ENTER** to set the resolution bandwidth to 30 kHz and select BACK.
5. Press the Measure soft key to measure the bandwidth, then press the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A "Test Records".

10 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 15 and press the kHz soft key to set the span to 15 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 10 kHz. Press **ENTER** to set the resolution bandwidth to 10 kHz and select BACK.
5. Press the VBW Manual soft key and use the Up/Down arrow key to select 30 Hz. Press **ENTER** to set the video bandwidth to 30 Hz and select BACK.
6. Press the Measure soft key, then the **MARKER** key.
7. Press the M2 soft key. Record the Δ2 frequency in Appendix A "Test Records".

3 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 4.5 and press the kHz soft key to set the span to 4.5 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 3 kHz. Press **ENTER** to set the resolution bandwidth to 3 kHz and select BACK.
5. Press the Measure soft key to measure the bandwidth, then press the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A "Test Records".

1 kHz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 1.5 and press the kHz soft key to set the span to 1.5 kHz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 kHz. Press **ENTER** to set the resolution bandwidth to 1 kHz and select BACK.
5. Press the Measure soft key then the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A "Test Records".

300 Hz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 450 and press the Hz soft key to set the span to 450 Hz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 kHz. Press **ENTER** to set the resolution bandwidth to 300 Hz and select BACK.
5. Press the Measure soft key then the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A “Test Records”.

100 Hz RBW Test

1. Press the **FREQ/DIST** key.
2. Press the Span soft key, enter 150 and press the Hz soft key to set the span to 150 Hz.
3. Press the **MEAS/DISP** key and the Bandwidth soft key.
4. Press the RBW Manual soft key and use the Up/Down arrow key to select 100 Hz. Press **ENTER** to set the resolution bandwidth to 100 Hz and select BACK.
5. Press the Measure soft key then the **MARKER** key.
6. Press the M2 soft key. Record the Δ2 frequency in Appendix A “Test Records”.

2-8 Spectrum Analyzer Level Accuracy Verification

The tests in this section verify the level accuracy of the LMR Master Spectrum Analyzer. The two parts to this test are Level Accuracy with Frequency Test and Level Accuracy with Power Test.

Level Accuracy with Frequency Test

1. Turn on the power meter and signal source.
2. On the power meter, press the **Channel** key, the Setup soft key and then the CHANNEL soft key to display Channel 2 setup menu. Press the **INPUT** key twice to set the Input Configuration to B. Press the **Sensor** key to display both Sensor A and Sensor B readings.
3. Connect the power sensors to the power meter and calibrate the sensors.
4. Set the MG3692X output power level to 5 dBm.
5. Set the MG3692X output to 30 MHz CW.
6. On the power meter, press the **Sensor** key, the Cal Factor soft key, and then the FREQ soft key. Use the keypad to enter 30 MHz as the input signal frequency, which sets the power meter to the proper power sensor cal factor. Press the **System** key to display the power reading.
7. Connect Sensor A to the MG3692X output, measure the output power level and record the value in column A of Table 2-2.
8. Disconnect Sensor A from the MG3692X output.
9. Connect the power splitter to the MG3692X output and Sensor B to one of the power splitter outputs. Install the 10 dB Fixed Attenuator to the other power splitter output and then connect Sensor A to the end of the Attenuator. Refer to Figure 2-1.
10. Record the new Sensor A reading in column B of Table 2-2.
11. Record the Sensor B reading in column D of Table 2-2.
12. Calculate the Splitter/Attenuator Combined Loss using the formula $C = A - B$ and record the result in column C of Table 2-2.
13. Calculate the Sensor B path Power Splitter Loss using the formula $E = A - D$ and record the result in column E of Table 2-2.
14. Repeat steps 5 through 13 for all frequencies shown in Table 2-2.

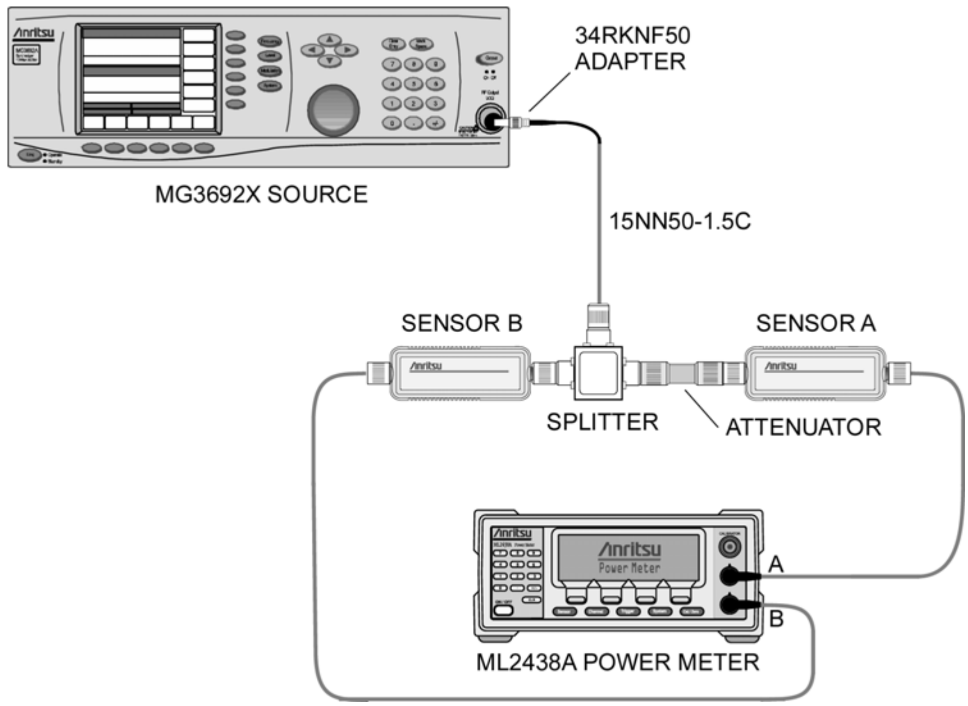


Figure 2-1. Level Accuracy with Frequency Test Setup

Table 2-2. Output Power Level

	A	B	C	D	E
Freq (MHz)	**Sensor A Reading @ Source Output**	**Sensor A Reading @ End of Attenuator**	**Splitter/ Attenuator Combined Loss**	**Sensor B Reading @ Power Splitter Output**	**Sensor B Path Power Splitter Loss**
30					
50					
550					
1000					
1244					
1411					
1580					

15. Calculate the desired Sensor B reading for 0 dBm and -39 dBm Test Power Level using the following formula:

Desired Sensor B Reading = Desired Test Power Level + $C - E$

16. Record the calculated results in Table 2-3.

Table 2-3. Level Accuracy with Frequency Test Setting

Freq (MHz)	Desired Sensor B reading for 0 dBm @ Attenuator Output	Desired Sensor B reading for –39 dBm @ Attenuator Output
30		
550		
1000		
1244		
1411		
1580		

17. Using the power splitter, coaxial cable, adapters and fixed attenuator, connect the LMR Master to the signal source and the power sensor as shown in Figure 2-2.

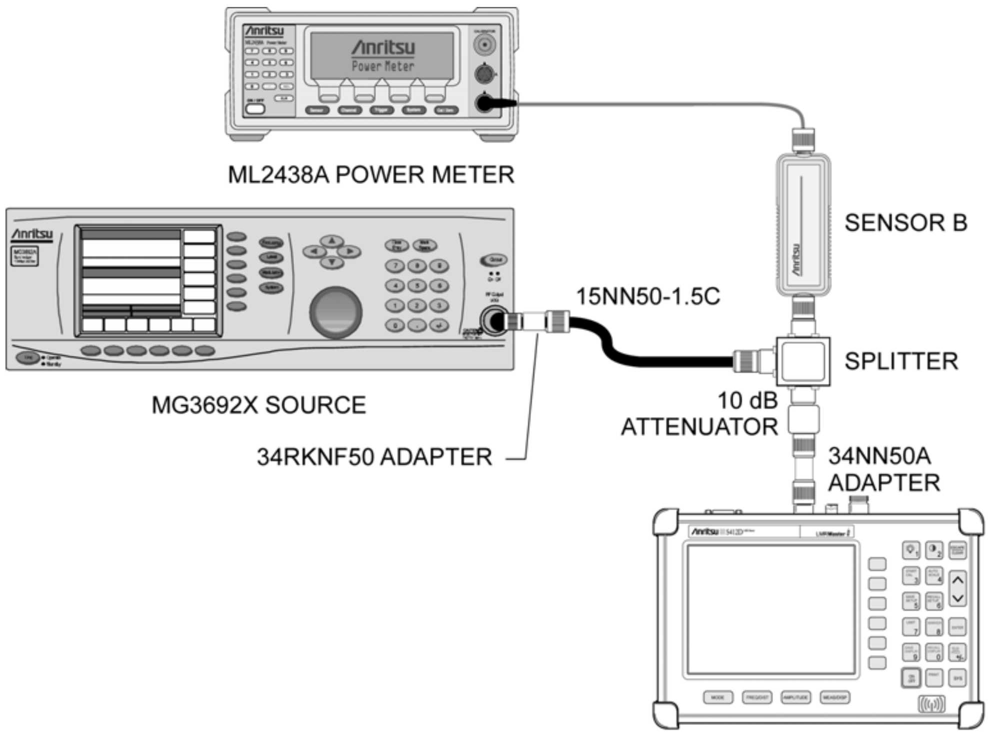


Figure 2-2. Level Accuracy with Frequency Test Setup

18. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)

19. On the LMR Master, press the **MODE** key. Use the up/down arrow key to highlight Spectrum Analyzer and press **ENTER** to select spectrum analyzer mode.

20. Press the **MEAS/DISP** key and the Bandwidth soft key.

21. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 kHz. Press **ENTER** to set the resolution bandwidth to 1 kHz.

22. Press the VBW Manual soft key and use the Up/Down arrow key to select 100 Hz. Press **ENTER** to set the video bandwidth to 100 Hz.

23. Press the **FREQ/DIST** key.

24. Press the Span soft key and enter .10, then press the MHz key to set the span to 0.10 MHz.

25. Press the **AMPLITUDE** key.
26. Press the Ref Level soft key, enter 10 and press the **ENTER** key to set the reference level to +10 dBm.
27. Press the **FREQ/DIST** key and the Center soft key.
28. Enter 30 and press the MHz soft key to set the center frequency to 30 MHz.
29. On the Power Meter, press the **Sensor** key and then the CalFactor soft key. Select the FREQ soft key and enter 30 MHz for the Input Signal Frequency. This sets the power meter to the proper power sensor cal factor. Press the **System** key to display the power reading.
30. Set the MG3692X output to 30 MHz CW. Adjust the source power level so that the power meter displays the corresponding desired Sensor B reading for 0 dBm (as recorded in Table 2-4).
31. On the LMR Master, press the **MARKER** key, then the M1 soft key.
32. Select the Marker To Peak soft key to position the marker at the center of the response for the test frequency.
33. Verify that the M1 reading is within the specification in Appendix A “Test Records”.
34. Repeat steps 27 to 33 for all frequencies shown in Appendix A “Test Records”.
35. Repeat steps 27 to 34 for a power level of –39 dBm.

Note	Change the reference level to –30 dBm.

Level Accuracy with Power Test

1. Using the recorded values for 50 MHz in Table 2-2, calculate the desired Sensor B Reading for Test Power Level > –50 dBm at 50 MHz using the following formula:

   Desired Sensor B Reading = Test Power Level + $C - E$

2. Record the calculated results in Table 2-4.

Table 2-4. Level Accuracy with Power Test Setting

Test Power Level (dBm) @ 50 MHz	Desired Sensor B Reading
+3	
0	
–11	
–13	
–19	
–27	
–32	
–39	
–49	
–51	
–53	
–60	

3. Using the power splitter, coaxial cable, adapters and fixed attenuator, connect the LMR Master to the signal source and the power sensor as shown in Figure 2-2.
4. On the power meter, press the **Sensor** key and then the CalFactor soft key. Select the FREQ soft key and enter 50 MHz for the Input Signal Frequency. This sets the power meter to the proper power sensor cal factor. Press the **System** key to display the power reading.

5. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
6. On the LMR Master, press the **MODE** key. Use the up/down arrow key to highlight Spectrum Analyzer and press **ENTER** to select spectrum analyzer mode.
7. Press the **MEAS/DISP** key and the Bandwidth soft key.
8. Press the RBW Manual soft key and use the Up/Down arrow key to select 1 kHz. Press **ENTER** to set the resolution bandwidth to 1 kHz.
9. Press the VBW Manual soft key and use the Up/Down arrow key to select 100 Hz. Press **ENTER** to set the video bandwidth to 100 Hz.
10. Press the **FREQ/DIST** key.
11. Press the Span soft key and enter .10, then press the MHz soft key to set the span to 0.10 MHz.
12. Press the **AMPLITUDE** key.
13. Press the Ref Level soft key, enter 10 and press the **ENTER** key to set the reference level to +10 dBm.
14. Press the **FREQ/DIST** key and the Center soft key.
15. Enter 50 and press the MHz soft key to set the center frequency to 50 MHz.
16. Set the MG3692X output to 50 MHz CW. Adjust the source power so that the power meter displays the corresponding desired Sensor B Reading for +3 dBm (as recorded in Table 2-4).
17. Press the **MARKER** key, then the M1 soft key.
18. Select the Marker To Peak soft key to position the marker at the center of the response for the test frequency.
19. Verify that the M1 reading is within the specification from the input signal. Record the M1 value in Appendix A “Test Records”.
20. Repeat steps 16 through 19 for input levels of 0 dBm, –11 dBm, –13 dBm, –19 dBm, –27 dBm, –32 dBm, –39 dBm and –49 dBm.

Note	Change the reference level as indicated in Appendix A “Test Records” for the corresponding test power level.

21. Disconnect the power splitter and attenuator from the LMR Master.
22. Set the MG3692X output power level to 5 dBm.
23. Connect Sensor A to the MG3692X output, measure the output power level and record the value in column A of Table 2-5.

Table 2-5. Output Power Level

	A	B	C	D	E
Freq (MHz)	**Sensor A Reading @ Source Output**	**Sensor A Reading @ End of Attenuator**	**Splitter/ Attenuator Combined Loss**	**Sensor B Reading @ Pwr Splitter Output**	**Sensor B Path Power Splitter Loss**
50					

24. Disconnect Sensor A from the MG3692X output.
25. Connect the power splitter to the MG3692X output and connect Sensor B to one of the power splitter outputs. Install the 30 dB fixed attenuator to the other power splitter output, and connect Sensor A to the attenuator. Refer to Figure 2-1.
26. Record the new Sensor A reading in column B of Table 2-5.

27. Record the Sensor B reading in column D of Table 2-5.

28. Calculate the Splitter/Attenuator Combined Loss using the following formula and record the result in column C of Table 2-5:

$C = A - B$

29. Calculate the Sensor B path Power Splitter Loss using the following formula and record the result in column E of Table 2-5:

$E = A - D$

30. Calculate the desired Sensor B Reading for Test Power Level < –50 dBm using the following formulas:

Desired Sensor B Reading = Test Power Level + $C - E$

31. Record the calculated results in Table 2-4.

32. Using the power splitter, coaxial cable, adapters and 30 dB fixed attenuator, connect the LMR Master to the signal source and the power sensor as shown in Figure 2-3.

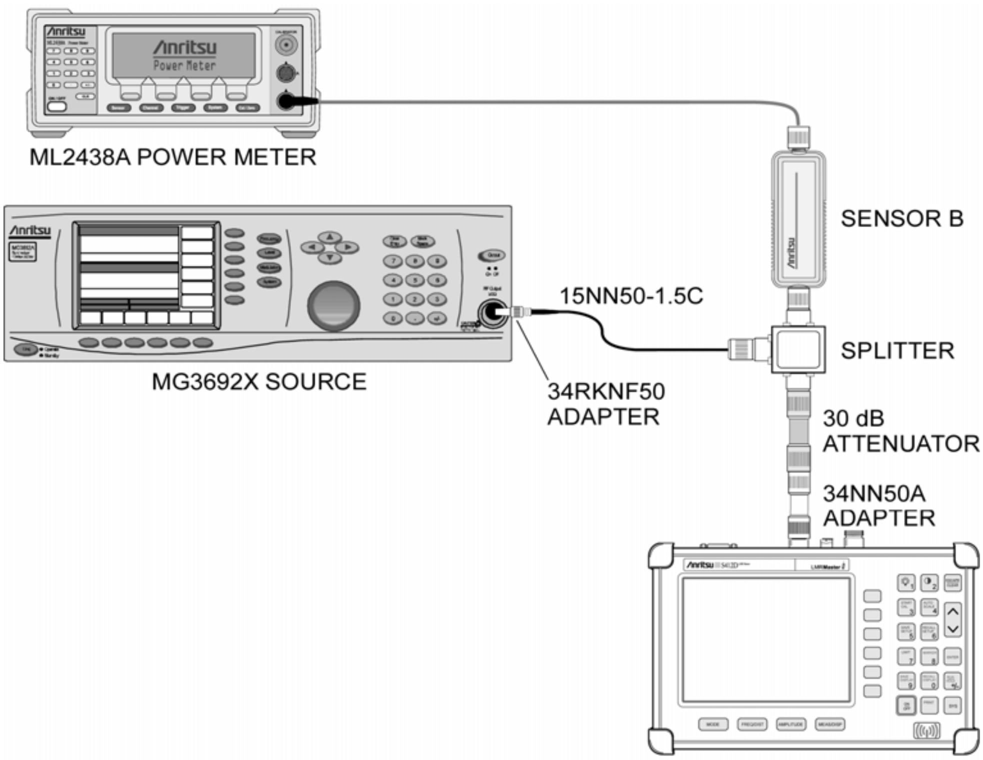


Figure 2-3. Level Accuracy Setup, 30 dB Attenuator

33. Adjust the MG3692X output power level so that the power meter displays the corresponding desired Sensor B reading for –51 dBm (as recorded in Table 2-4).

34. Press the **MARKER** key, then the M1 soft key.

35. Select the Marker To Peak soft key to position the marker at the center of the response for the test frequency.

36. Record the value of the marker in Appendix A “Test Records”. Verify that the M1 reading is within the specification from the input signal.

37. Repeat steps 33 to 36 for Test Power Levels of –53 dBm and –60 dBm.

Note	Change the reference level as indicated in Appendix A “Test Records” for the corresponding test power level.

2-9 Spectrum Analyzer Residual Spurious Response Verification

The following test can be used to verify the residual spurious response of the LMR Master Spectrum Analyzer. This test is performed using the positive peak detection mode.

1. Connect the 50 Ohm termination to the LMR Master RF Input.
2. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
3. On the LMR Master, press the **MODE** key. Use the Up/Down arrow key to highlight Spectrum Analyzer, then, press the **ENTER** key to select spectrum analyzer mode.
4. Press the **AMPLITUDE** key and the Ref Level soft key.
5. Enter –75 and press the **ENTER** key to set the Reference Level to –75 dBm. If AMP is not showing in the lower-left of the display, set Preamp to ON.
6. Press the Scale soft key and enter 5, then press **ENTER**.
7. Press the **MEAS/DISP** key and the Bandwidth soft key.
8. Press the RBW Manual soft key and use the Up/Down arrow key to select 10 kHz. Press **ENTER** to set the resolution bandwidth to 10 kHz.
9. Press the VBW Manual soft key and use the Up/Down arrow key to select 3 kHz and press **ENTER** to set the video bandwidth to 3 kHz.
10. Press the **FREQ/DIST** key and the Start soft key.
11. Enter 100 and press the kHz soft key to set the start frequency to 100 kHz.
12. Press the Stop soft key and enter 10, then press the MHz soft key to set the stop frequency to 10 MHz.
13. Wait till one full sweep is complete.
14. Press the **MARKER** key and then the M1 soft key.
15. Press the Marker To Peak soft key.
16. Record the M1 amplitude reading and verify whether it is ≤ –80 dBm.

Note	If a spur with an amplitude larger than –80 dBm occurs, wait another full sweep and observe whether the spur occurs at the same point on the second sweep. If the spur does not occur at the same point on the second sweep, then the spur on the first sweep does not cause the test to fail.

17. Press the **FREQ/DIST** key and the Start soft key.
18. Enter 10 and press the MHz soft key to set the start frequency to 10 MHz.
19. Press the Stop soft key and enter 1000, then press the MHz soft key to set the stop frequency to 1000 MHz.
20. Wait until one full sweep is complete.
21. Press the **MARKER** key and record the M1 amplitude reading and verify it is ≤ –90 dBm.

Note	If a spur with an amplitude larger than –90 dBm occurs, wait another full sweep and observe whether the spur occurs at the same point on the second sweep. If the spur does not occur at the same point on the second sweep, then the spur on the first sweep does not cause the test to fail.

22. Press the **FREQ/DIST** key and the Start soft key.
23. Enter 1000 and press the MHz soft key to set the start frequency to 1000 MHz.
24. Press the Stop soft key and enter 1600, then press the MHz soft key to set the stop frequency to 1600 MHz.
25. Wait until one full sweep is complete.

26. Press the **MARKER** key and turn on M1. Record the M1 reading in Appendix A "Test Records". Verify it is ≤ –90 dBm.

Note	If a spur with an amplitude larger than –90 dBm occurs, wait another full sweep and observe whether the spur occurs at the same point on the second sweep. If the spur does not occur at the same point on the second sweep, then the spur on the first sweep does not cause the test to fail.

2-10 Spectrum Analyzer Displayed Average Noise Level (DANL)

The following test can be used to verify the Displayed Average Noise Level of the S412D. This test is performed using the RMS detection mode, with pre-amp on.

1. Connect the 28N50-2 50 Ohm termination to the S412D Spectrum Analyzer RF In.
2. Set the S412D to Spectrum Analyzer mode.
3. Press the **AMPLITUDE** key and select Atten/Preamp, then Preamp Control Manual. Press Preamp On/Off so that AMP* appears on the bottom-left of the display.
4. Press the **AMPLITUDE** key and select Atten/Preamp, then select Manual, and enter 0 for Atten.
5. Press the **AMPLITUDE** key and select Ref Level, and set the Reference Level to -75 dBm.
6. Press the **MEAS/DISP** key and select Trace, then Detection, then select RMS Average.
7. Press the **MEAS/DISP** key and select Bandwidth, then RBW Manual. Set RBW to 10 kHz.
8. Press the **FREQ/DIST** key and set Start Frequency to 100 kHz and set Stop Frequency to 10 MHz.
9. After the sweep has finished, press the **MARKER** key and set M1 to Marker to Peak.
10. Convert the marker reading from 10 kHz RBW to 100 Hz RBW value by subtracting 20 dB. (For example, if the marker shows a value of –100 dBm at 10 kHz RBW, the computed value at 100 Hz RBW is –120 dBm.) Enter the computed value in Appendix A "Test Records".
11. Set Stop Frequency to 1.6 GHz and set Start Frequency to 10 MHz.
12. After the sweep has finished, press the **MARKER** key and set M1 to Marker to Peak.
13. Convert the marker reading from 10 kHz RBW to 100 Hz RBW value by subtracting 20 dB. (For example, if the marker shows a value of –120 dBm at 10 kHz RBW, the computed value at 100 Hz RBW is –140 dBm.) Enter the computed value in Appendix A "Test Records".

2-11 Power Monitor Verification (Option 5)

The following test can be used to verify the operation of the Power Monitor (Option 5).

1. Set the MG3692X output to 1GHz CW, and the Level to +5 dBm.

2. Power cycle the S412D while depressing the **Escape/Clear** key to set to factory preset state. Set the mode of the S412D to Power Monitor.

3. On the power meter, set the sensor cal factor to 1.0 GHz.

4. Connect the 560-7N50B detector, power splitter and MA2442D power sensor and other equipment as shown in Figure 2-4.

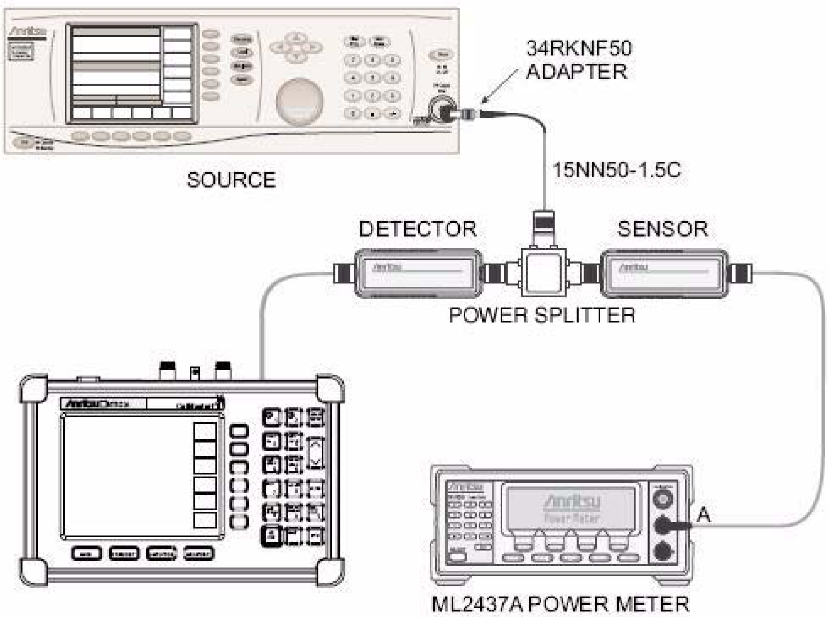


Figure 2-4. Power Monitor Verification

5. On the MG3692X synthesizer, adjust the Level so the power meter reads 0.0 dBm.

6. Record the power reading of the S412D in Appendix A “Test Records”.

7. Repeat Steps 5 and 6 for the other power values in Appendix A “Test Records”.

2-12 Bias Tee Verification (Option 10)

If the Bias Tee (Option 10) is installed in the S412D, the following test can be used to verify the performance of the bias termination.

1. Connect the external power supply to the S412D.
2. Press the **On/Off** key to turn on the S412D.
3. Press the **Recall Setup** key (6), then select the <Default> mode setting.
4. Press the **ENTER** key.

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

Bias Tee Test

1. Press the **SYS** key, then select the Application Options soft key and then select the Bias Tee soft key.
2. Select the Bias Tee Voltage soft key and enter 12 then select the **ENTER** key.
3. Connect the 105 Ohm load to the RF In test port.
4. Press the Bias Tee On/Off soft key to turn the Bias Tee on.
5. Verify the voltage and current readings displayed on the top left side of the screen are within the specifications shown in Table 2-6.
6. Press the Bias Tee On/Off soft key to turn the Bias Tee off.
7. Select each of the voltage settings and verify the voltage and current readings displayed on the top left side of the screen are within the specifications shown in Table 2-6.

Table 2-6. Bias Tee Verification, 105 Ohm Load, Low Current

Voltage Setting (V)	Voltage Specification (V)	Current Specification (mA)
12	±0.5	85–145
15	±0.6	113–173
18	±0.7	142–202
21	±0.8	172–230
24	±1.0	199–259

Fault Test

1. Disconnect the 105 Ohm load and connect the 40 Ohm load to the RF In port.
2. Select the Bias Tee Voltage soft key and enter 17 then select the **ENTER** key.
3. Press the Bias Tee On/Off soft key to turn the Bias Tee on.
4. Verify that the instrument makes a clicking sound and the Bias Tee Error/Fault dialog appears on the screen.
5. Press the Bias Tee On/Off soft key to turn the Bias Tee off.

2-13 Transmission Measurement Verification (Option 21)

The test in this section can be used to verify the Dynamic Range of a LMR Master equipped with Option 21.

1. On the LMR Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. (This sets the instrument to the factory preset state.)
2. On the LMR Master, press the **MODE** key. Use the Up/Down arrow key to highlight Transmission Measurement and press **ENTER** to select Transmission Measurement mode.
3. Press the **MEAS/DISP** key and then press the Calibrate TM soft key.
4. Connect the RF In port of the LMR Master to the RF Out port using the 15NN50-1.5C RF Coaxial Cable. Press the **ENTER** key on the LMR Master to calibrate. The LMR Master will beep when one sweep is completed.
5. Disconnect the RF cable from RF In Port and connect the 50 Ohm Termination.
6. Press the **Limit** key and select Single Limit.
7. Press the Edit soft key, enter –80 and then press the **ENTER** key.
8. Verify that the trace is below the limit line.
9. Press the **MARKER** key, select the M1 soft key and then Market to Peak. Record the Marker value in Appendix A “Test Records”.

2-14 iDEN Signal Analyzer Option Verification (Option 68)

The test in this section is used to verify the functionality of the iDEN Signal Analyzer in the Cell Master. This test is only used for MT8212B units equipped with Options 68.

Equipment Required:

- Anritsu MG3700A Vector Signal Analyzer with Options MG3700A-002, MG3700A-021
- Anritsu ML2438A Power Meter
- Anritsu MA2482D Power Sensor with Option 1
- Anritsu 34NN50A N(m) to N(m) Adapter
- Anritsu 15NN50-1.5C Cable
- Aeroflex/Wienschel 1870A Power Splitter
- 10 MHz Reference
- 50 Ohm BNC(m) to BNC(m) cables (2)

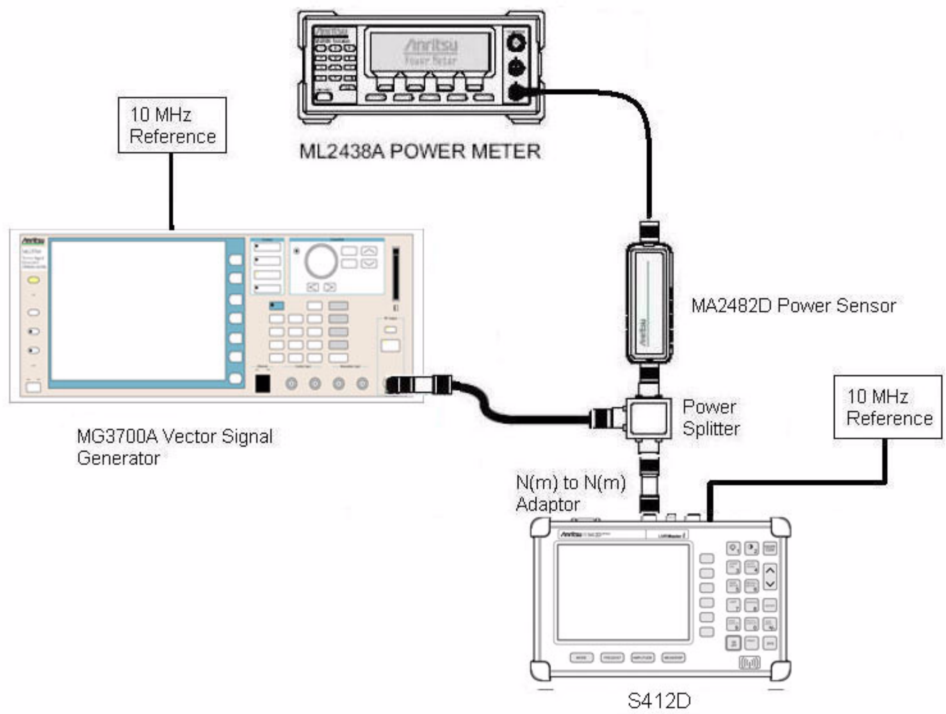


Figure 2-5. iDEN Signal Analyzer Setup

Procedure:

1. Connect the equipment a shown in Figure 2-5. Ensure that the external 10 MHz reference is connected to both the 10 MHz Ref input of the MG3700A and the Ext Freq Ref input of the MT8212B.
2. Calibrate the power sensor prior to connecting it to the power splitter.
3. On the MG3700A, press the **Preset** key (yellow key on the upper left hand side).
4. Press the down arrow key or turn the knob to select Yes.
5. Press the **Set** key.

Note	Both **Set** keys on the MG3700A have the same function.

6. Press the F1 (Load File to Memory) soft key.
7. Press the F1 (Select Package) soft key again.
8. Using the down arrow key step through the selection list until the Convert_IQproducer option is highlighted.
9. Press the **Set** key.
10. Press the F6 (Return) soft key.
11. Press the **Set** key. The Select Package box will appear. Again select Convert_IQproducer and press **Set**.
12. Another file list will appear. Select iDEN_AMS.
13. Press the **Set** key.
14. Press the **MOD On/Off** key to turn the Modulation LED on and verify the “Playing” indicator is flashing.
15. Press the **Frequency** key and set the frequency to 858.50 MHz.
16. On the Cell Master, press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the Cell Master. This sets the instrument to the factory preset state.
17. Press the **MODE** key. Use the down arrow key to select GSM and then press the **ENTER** key.
18. Press the **SYS** key and then the Application Options soft key.
19. Press the **ENTER** key to accept the external 10 MHz reference.

Note	Before continuing, allow a 5 minute warm up for the internal circuitry to stabilize.

20. On the MG3700A, set the frequency to 858.50 MHz.
21. On the power meter, press the **Sensor** key, the Cal Factor soft key, and the Freq soft key. Use the keypad to enter the input signal frequency (e.g. 858.5 MHz), which sets the power meter to the proper power sensor cal factor. Press the System key to display the power reading.
22. Adjust the MG3700A output so that the power meter reads –20 dBm ± 0.2 dB. Record the power meter reading in see “Option 68 iDEN Signal Analyzer” on page A-4.
23. .On the Cell Master, press the **FREQ/DIST** key.
24. Press the Center soft key and change the frequency to 858.50 MHz.
25. Press the **MEAS/DISP** key and then the Spectrum soft key.
26. Allow the Cell Master to update its measurement display.
27. Record the Freq Error (Hz) and Main Ch Power (dBm) values to the test records in see “Option 68 iDEN Signal Analyzer” on page A-4.
28. Verify that the Freq Error value is ≤ ±43 Hz.
29. Use the following formula to calculate the channel power error and record the result to the error column of the test record in see “Option 68 iDEN Signal Analyzer” on page A-4.

    Channel power error = [power meter value in step 22] – [Main Ch Power (dBm)] + 0.1 dB
30. Verify that the channel power error is ≤ ±1.5 dB.

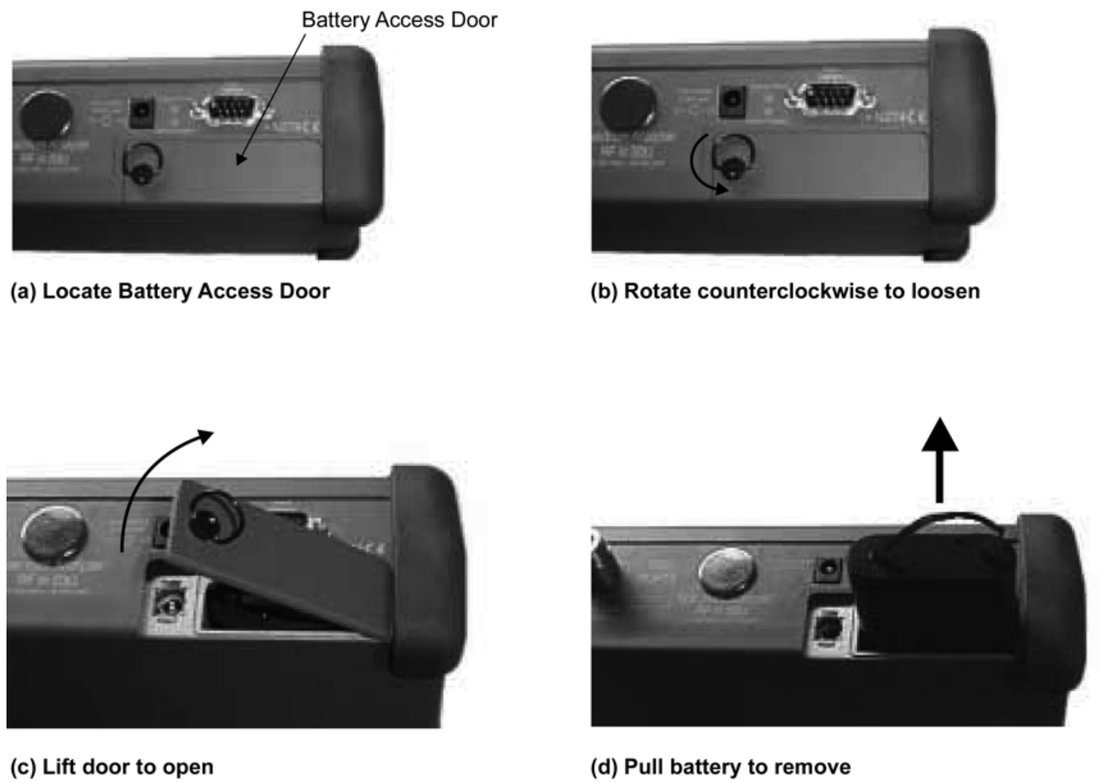
Chapter 3 — Removal and Replacement

3-1 Battery Pack Removal and Replacement

This procedure provides instructions for removing and replacing the LMR Master battery pack.

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 LMR Master.

1. With the LMR Master standing upright on a stable surface, locate the battery access door (Figure 3-1).



(a) Locate Battery Access Door

(b) Rotate counterclockwise to loosen

(c) Lift door to open

(d) Pull battery to remove

Figure 3-1. Battery Pack Removal

2. Lift up the access door handle and rotate it 90° counterclockwise, as illustrated in Figure 3-1.

3. Lift the door and remove, as illustrated in Figure 3-1.

4. Grasp the battery lanyard and pull the battery straight up and out of the unit, as illustrated in Figure 3-1.

5. Replacement of the battery is the reverse of removal. Note the orientation of the battery contacts, and be sure to insert the new battery with the contacts facing the rear of the unit (Figure 3-2).

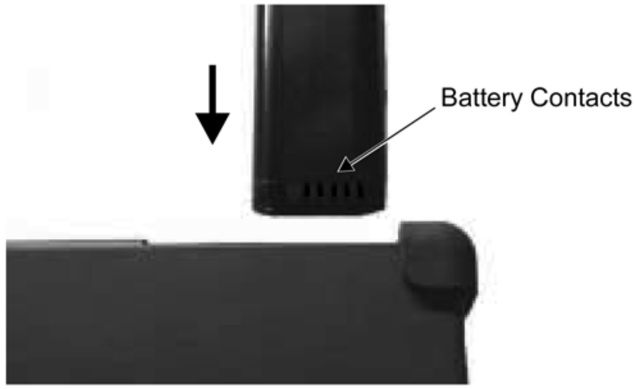


Figure 3-2. Battery Pack Replacement

3-2 Battery Information

The following information relates to the care and handling of the LMR Master battery, and NiMH batteries in general.

- The Nickel Metal Hydride (NiMH) battery supplied with the LMR Master is shipped in a discharged state. Before using the LMR Master, the internal battery must first be charged for three hours, either in the LMR Master or in the optional battery charger (Anritsu part number: 2000-1029).
- Use only Anritsu approved battery packs.
- Recharge the battery only in the LMR Master or in an Anritsu approved charger.
- With a new NiMH battery, full performance is achieved after three to five complete charge and discharge cycles.
- When the LMR Master or the charger is not in use, disconnect it from the 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 will affect the ability of the battery to charge: allow the battery to cool down or warm up as necessary before use or charging.
- Discharge an NiMH 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.

Battery Testing Procedure

1. With the LMR Master off and the battery installed, connect the Universal AC Adapter to the 12.5–15VDC (1350 mA) connector. The External Power LED and the Battery Charging LED will light.

Note	If the Battery Charging LED does not light, the battery may be too low to immediately start full charging. Leaving the unit connected to AC power for several hours may bring the battery up to a level where full charging can begin. Turn the unit off and back on to see if the Battery Charging LED lights indicating a full charge cycle has begun. Charging is inhibited below 0°C and above 45°C. If the unit is too hot, the battery will not start charging until the unit temperature has cooled to 43°C.

2. Disconnect the AC-DC Adapter when the Battery Charging LED turns off, indicating the battery is fully charged.
3. Press and hold the **ESCAPE/CLEAR** key, then press the **ON/OFF** key to turn on the LMR Master. This sets the instrument to the factory preset state. Press **ENTER** when prompted to continue.
4. Press the **SYS** key, followed by the STATUS soft key. Verify that the indicated battery charge is ≥ 80%. If the value is 80% or above, press the **ESCAPE/CLEAR** key and continue with this procedure. If the value is lower than 80%, a discharge/charge cycle may be needed to improve the battery capacity. Completely discharge the battery, as described in Steps 5 and 6 below, and then recharge the battery as described in Steps 1 and 2. If the battery capacity does not increase after a discharge/charge cycle, replace the battery.
5. Press the **START CAL** key (to keep the LMR Master from going into HOLD mode) and make note of the test start time.
6. When the LMR Master display fades and the LMR Master switches itself off, make note of the test stop time.
7. The total test time (Step 5 to Step 6) should be ≥ 1.5 hours. If the battery charge started at 80% or more and the total battery test time is < 70 minutes, replace the battery.

3-3 Removal and Replacement Procedures

Table 3-1 provides a list of replaceable assemblies.

Table 3-1. List of Replaceable Assemblies

Part Number	Description
ND70107	S412D Main/SPA Assembly (without Option 10, without Option 31)
ND70109	S412D Main/SPA Assembly (with Option 31, without Option 10)
ND70108	S412D Main/SPA Assembly (with Option 10, without Option 31)
ND70110	S412D Main/SPA Assembly (with Option 31 and Option 10)
ND66432	Option 5 PCB
3-633-26	Coin Battery for RTC
15-123	LCD Display
46649-6	Keypad Membrane
67199-3	Keypad PCB
633-27	Rechargeable battery
790-523	Speaker
48231-1	Battery Door
61440-1	Case Top
58214	Case Bottom
46655	Corner Bumper
40-168-R	AC Adapter

Important Information Regarding Service of Anritsu Equipment

Only qualified Service personnel should attempt to perform repairs on this instrument. During the warranty period, opening of the case by non-Anritsu Service personnel will void the warranty.

Extreme care must be used when handling internal assemblies. Careless handling will cause damage.

Unless authorized by the factory, no attempts should be made to repair a defective assembly. (Discharged RTC batteries on the main PCB may be replaced). Exchange assemblies determined to be damaged by improper handling will not be accepted for credit.

Exchange Assemblies

The Base Assemblies and Option 5 PCB (as listed on Table 8) are factory-repairable exchange assemblies, which should be returned to Anritsu promptly for credit. AC adapters, batteries, LCDs, keypad parts and non-electrical parts are not exchange assemblies and need not be returned to Anritsu.

The Base Assembly consists of the main PCB and the spectrum analyzer assembly. They are a matched set. Failure of either assembly requires a new Base Assembly consisting of a main PCB with a spectrum analyzer PCB. Order the correct Base Assembly (determined by installed options) as shown in the Table 3-1. Return both the main and spectrum analyzer assemblies (without the Option 5 PCB) to Anritsu for credit. After replacement, no recalibration is required.

If only Option 5 is found to be defective, the Option 5 PCB should be removed from the main PCB (as described below) and returned to Anritsu. Do not return the main or spectrum analyzer assembly if there is a problem only with Option 5. After replacement of the PCB, no recalibration is required.

Note	For all assemblies in the S412D, installation steps are the reverse of the removal steps.

3-4 Opening the Case

Caution	**ESD Requirements:** The model S412D 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 S412D instrument. Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

1. Remove the four rubber corner bumpers by lifting and sliding them off the corners. This will reveal the four screws that hold the front and rear of the case together.

Figure 3-3. Removing the Corner Bumpers

2. Remove the 4 screws that connect the front and rear of the case.
3. Separate the front and rear of the case by about 2 inches. Gently unplug the 4 cables that connect into the main PCB. The 2 halves of the instrument can be completely separated.

3-5 Removal of the LCD and Keypad Assemblies

1. Remove the LCD wires from under the plastic retaining clips of the metal backing plate.
2. Remove the 14 screws which secure the backing plate to the case.
3. Lift up the backing plate. The LCD will often remain attached to the backing plate by the friction of the rubber gasket.
4. Disconnect the flexible PCB from the LCD circuit board by pulling outward at each end of the connector with tweezers or other pointed tool.
5. Lift the LCD away from the backing plate.
6. Lift off the rubber cushion, the keyboard PCB and the keypad membrane.

3-6 Removal of the Main PCB, Option 5 PCB, Spectrum Analyzer Assembly

1. Remove the 2 screws at the bottom of the main PCB, one screw in the center, and the 5 wire battery cable. (refer to Figure 3-4 below for locations).
2. Disconnect the SMA cable at the Spectrum Analyzer RF In, and disconnect the wire plugged into P5 near the RF Out connector.

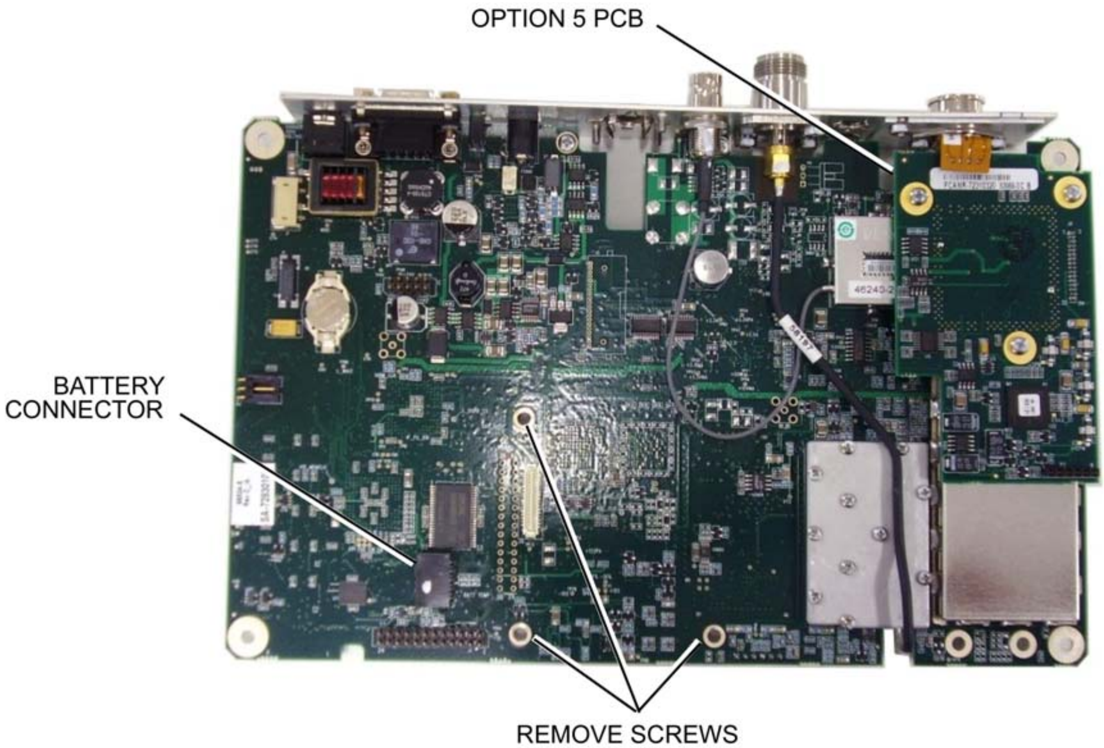


Figure 3-4. S412D Main PCB

3. Lift the main PCB about two inches out of the case and unplug the two cables connecting the spectrum analyzer board to the main PCB.
4. The main PCB and spectrum analyzer assemblies are now separated.
5. The Option 5 PCB must be removed if the main PCB, the spectrum analyzer, or Option 5 has failed. Unplug the 4 pin connector on the Option 5 PCB that connects to the front panel (refer to Figure 3-4). Remove the 3 screws holding the option 5 PCB and remove the PCB. It will be transferred to the replacement main PCB. Recalibration is not required after the replacement of Option 5.

6. The spectrum analyzer PCB can be removed from the case by removing the 4 screws and 3 standoffs around the edge of the PCB. Do not adjust any of the small screws that attach the RF shields of the PCB (See Figure 3-5).

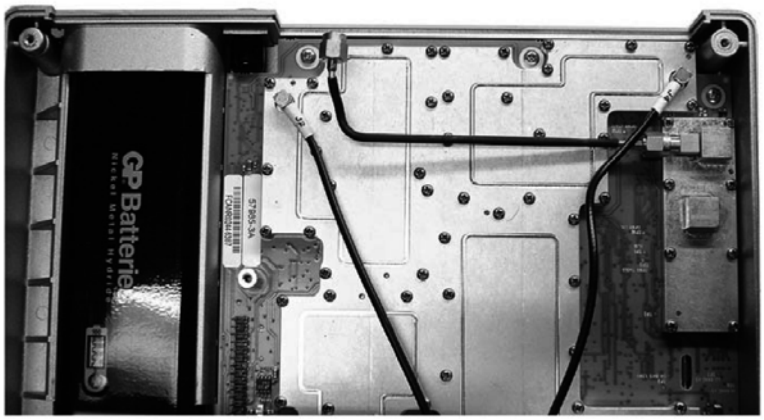


Figure 3-5. S412D Spectrum Analyzer PCB

3-7 RTC Battery Information

The date and time are saved using a +3V coin-style battery mounted on the main PCB. (Refer to Figure 3-6 for the location). This battery has a finite life span. When sufficiently discharged, the message RTC Invalid will appear in the boot-up self-test.

When this message appears, it is necessary to replace the RTC battery. After replacing the battery, re-enter the date, time, and year (under the **Sys** key) to remove the RTC Invalid message.

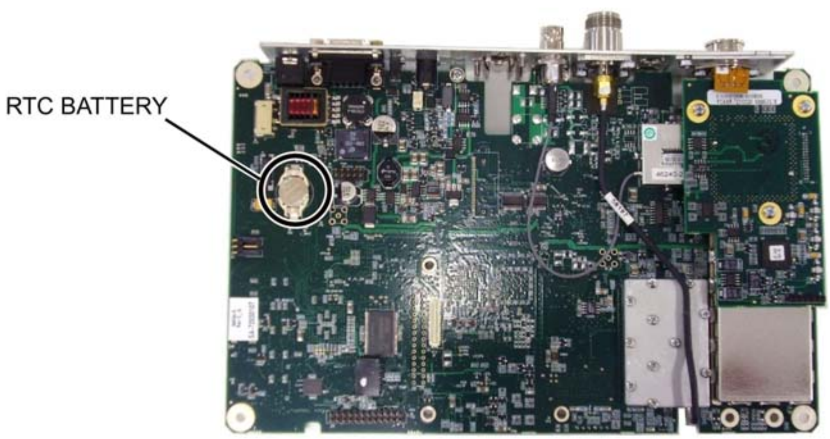


Figure 3-6. RTC Battery Location

Appendix A — Test Records

This appendix provides test records that can be used to record the performance of the S412D. Please make a copy of the following Test Record pages and document the measured values each time a Performance Verification is performed. Continuing to document this process each time it is performed provides a detailed history of the instrument's performance.

S412D	**Firmware Revision:**	**Operator:**	
Serial Number:		**Options:**	**Date:**

VNA Frequency Accuracy

Measured Value	Specification
Hz	1000 MHz ± 75 kHz

VNA Return Loss Verification

Offset	Measured Minimum Value	Min. Specification	Measured Maximum Value	Max. Specification	Notes
20 dB	dB	≥ –21.7 dB	dB	≤ –18.3 dB	
6 dB	dB	≥ –7.2 dB	dB	≤ –4.8 dB	

Spectrum Analyzer Frequency Accuracy

Measured Value	Specification
Hz	1,000 MHz ± 2 kHz

Spectrum Analyzer Phase Noise

Measured Value	Specification
dBc / Hz	≤ –75 dBc / Hz

Spectrum Analyzer Input Related Spurious Response

Measured Value	Specification
dBc	≤ –45 dBc

Spectrum Analyzer Resolution Bandwidth

RWB Setting	Lower Limit	Measured Value	Upper Limit
1 MHz	0.95 MHz		1.05 MHz
300 kHz	285 kHz		315 kHz
100 kHz	95 kHz		105 kHz
30 kHz	28.5 kHz		31.5 kHz
10 kHz	9.5 kHz		10.5 kHz
3 kHz	2.85 kHz		3.15 kHz
1 kHz	0.95 kHz		1.05 kHz
300 Hz	285 Hz		315 Hz
100 Hz	95 Hz		105 Hz

S412D	Firmware Revision:	Operator:	
Serial Number:		**Options:**	**Date:**

Spectrum Analyzer Level Accuracy Verification

Level Accuracy with Frequency

Freq (MHz)	Measured Value @ 0 dBm	Measured Value @ –39 dBm	Specification
30			±1.5 dB
550			±1.5 dB
1000			±1.5 dB
1244			±1.5 dB
1411			±1.5 dB
1580			±1.5 dB

Level Accuracy with Power

Input Power Level (dBm)	Reference Level	Specification	Measured Marker Reading (dBm)
+3	+10 dBm	±1.5 dB	
0	+10 dBm	±1.5 dB	
–11	–10 dBm	±1.5 dB	
–13	–10 dBm	±1.5 dB	
–19	–10 dBm	±1.5 dB	
–27	–20 dBm	±1.5 dB	
–32	–30 dBm	±1.5 dB	
–39	–30 dBm	±1.5 dB	
–49	–40 dBm	±1.5 dB	
–51	–40 dBm	±1.5 dB	
–53	–50 dBm	±1.5 dB	
–60	–50 dBm	±1.5 dB	

Spectrum Analyzer Residual Spurious Response

100 kHz to 10 MHz

Measured Value	Specification
dBm	≤ –80 dBm

10 MHz to 1.6 GHz

Measured Value	Specification
dBm	≤ –90 dBm

S412D	Firmware Revision:	Operator:	
Serial Number:		**Options:**	**Date:**

Spectrum Analyzer DANL Verification	
100 kHz to 10 MHz	
Measured Value	Specification
dBm	≤ –115 dBm
10 MHz to 1.6 GHz	
Measured Value	Specification
dBm	≤ –135 dBm

Option 5 Power Monitor Verification		
Power	Measured Power	Specification
0 dBm	dBm	0 dBm ± 1.0 dB
–7 dBm	dBm	–7.0 dBm ± 1.0 dB
–12 dBm	dBm	–21.0 dBm ± 1.0 dB
–40 dBm	dBm	–40.0 dBm ± 1.0 dB

Option 21 Transmission Measurement (Dynamic Range) Verification	
Measured Value	Specification
dB	≤ –80 dB

Option 68 iDEN Signal Analyzer	
Measured Frequency Error	**Specification**
Hz	≤ ± 43Hz

Main Channel Power Error

Frequency	Input Power	Power Meter Reading	Main Ch Power	Error	Specification
858.5 MHz	-20 dBm	dBm	dBm	dB	≤ ±1.5 dB

Appendix B — Test Fixture Schematics

The following schematics are provided for those wishing to build their own test fixtures for the Option 10 verification test. The part numbers referenced in the schematics are Anritsu part numbers.

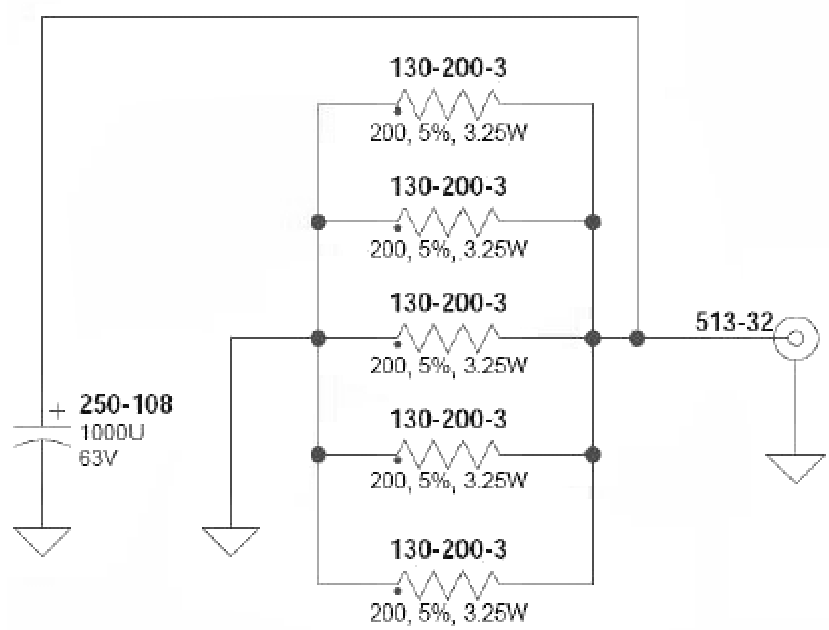


Figure B-1. Anritsu Model T2904 High Current Test Fixture (for Option 10)

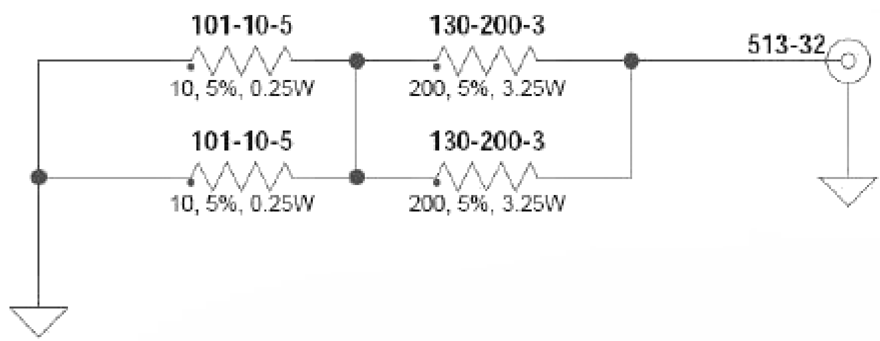


Figure B-2. Anritsu Model T3377 Low Current Test Fixture (for Option 10)

Anritsu prints on recycled paper with vegetable soybean oil ink.

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