Keysight N9020B MXA Signal Analyzers

This manual provides documentation for the following models:

N9020B Option 503 (20 Hz – 3.6 GHz)
N9020B Option 508 (20 Hz – 8.4 GHz)
N9020B Option 513 (20 Hz – 13.6 GHz)
N9020B Option 526 (20 Hz – 26.5 GHz)
N9020B Option 532 (20 Hz – 32 GHz)
N9020B Option 544 (20 Hz – 44 GHz)
N9020B Option 550 (20 Hz – 50 GHz)

KEYSIGHT

SERVICE GUIDE

Notices

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WARNING

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Where to Find the Latest Information

Documentation is updated periodically. For the latest information about this instrument, including firmware upgrades, application information, and product information, click the website link below.

https://www.keysight.com/find/mxa

To receive the latest updates by email, subscribe to Keysight Email Updates at the following URL:

https://www.keysight.com/find/MyKeysight

Information on preventing instrument damage can be found at:

https://www.keysight.com/find/PreventingInstrumentRepair

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https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security.html

Keysight also recommends that you secure your IT environments using appropriate third-party tools. For instruments that run the Microsoft Windows operating system, Keysight concurs with Microsoft's recommendations for ensuring that the instrument is protected:

- Get the latest critical Windows updates

- For network-connected instruments, use an Internet firewall (in Keysight instruments, Windows Firewall is enabled by default)

- For network-connected instruments, use up-to-date antivirus and anti-spyware software

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https://www.keysight.com/us/en/contact/responsible-disclosure-program.html

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https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security/report-a-product-cybersecurity-issue

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Keysight X-Series Signal Analyzers
N9020B MXA Signal Analyzer

Service Guide

1 Overview

What You Will Find in This Chapter

This chapter provides overview information on your spectrum analyzer.

The following sections are found in this chapter:

Keysight MXA Signal Analyzer Overview on page 16

Instrument Option Descriptions on page 17

Signal Analyzer Accessories on page 18

Before You Start Troubleshooting on page 21

ESD Information on page 23

Service Equipment You Will Need on page 25

After an Instrument Repair on page 40

Contacting Keysight Technologies on page 41

How to Return Your Instrument for Service on page 45

Keysight MXA Signal Analyzer Overview

The Keysight MXA signal analyzer measures and monitors complex RF and microwave signals. The analyzer integrates traditional spectrum measurements with advanced vector signal analysis to optimize speed, accuracy, and dynamic range. The MXA has Windows Embedded Standard 7 (WES7) built in as the operating system, which expands the usability of the analyzer. You will be able to manipulate various file types on your analyzer just like your personal computer. Having a Windows based instrument provides many benefits such as easier file management, built-in Windows based programs such as Internet Explorer, and much more.

The Keysight MXA signal analyzer is readily adaptable to meet changing measurement needs. Optional features, whether hardware or measurement application software, will enable the analyzer to be configured as a comprehensive analytical tool to test communications systems and components.

If customer requirements should change or expand, post sale upgrades can be purchased at any time. Many upgrades require a license key, which is obtained using the Keysight licensing process. If the Keysight Delivery Option is ordered, the entitlement certificate will be emailed to the customer the same day and the license key can be generated and installed in the MXA Signal Analyzer within minutes. Once the license key is entered into the analyzer, and the analyzer power is cycled, the new option is enabled and fully functional.

The service strategy for the MXA is assembly level repair, not component level.

Instrument Option Descriptions

The MXA signal analyzer has a variety of options and measurement applications that can be installed depending on your application. These options and measurement applications can be purchased and installed at the time of sale or as a post-sale upgrade. In order to find out all the requirements about installing an upgrade into the analyzer, refer to http://www.keysight.com/find/mxa_upgrades.

Signal Analyzer Accessories

A number of accessories are available from Keysight Technologies to help you configure your analyzer for your specific applications. They can be ordered through your local Keysight Sales and Service Office and are listed below.

Manual Set on CD/DVD

The documentation set provides extensive information for the signal analyzer. Documentation is updated periodically. The latest updates can be accessed via the web at:

http://www.keysight.com/manuals/N9020B.

Each manual is described below:

- Getting Started Guide: Describes analyzer features in detail. In addition, this manual covers unpacking and setting up the analyzer, analyzer features, and information on options and accessories, and what to do if you have a problem.
- Specifications Guide: Documents specifications, safety, and regulatory information.
- Instrument Messages: Includes instrument messages (and suggestions for troubleshooting them).
- User's/Programmer's References: Multiple manuals which include programming information and SCPI command descriptions for basic spectrum analyzers and for applications such as IQ analyzer, WCDMA, and LTE.
- Measurement Guides and Programming Examples: Multiple manuals which provide details on how to how to use catalogs and files, and how to measure various signals for basic spectrum analyzers and for applications such as IQ analyzer, WCDMA, and LTE.

The documentation set is available for purchase on CD/DVD by ordering option N9060EM1E-ABA.

50 Ohm Load

The Keysight 909 series loads come in several models and options providing a variety of frequency ranges and VSWRs. Also, they are available in either 50 ohm or 75 Ohm. Some examples include the:

909A: DC to 18 GHz
909C: DC to 2 GHz
909D: DC to 26.5 GHz

50 Ohm/75 Ohm Minimum Loss Pad

The Keysight 11852B is a low VSWR minimum loss pad that allows you to make measurements on 75 Ohm devices using an analyzer with a 50 Ohm input. It is effective over a frequency range of DC to 2 GHz.

AC Probe

The Keysight 85024A high frequency probe performs in-circuit measurements without adversely loading the circuit under test. The probe has an input capacitance of 0.7 pF shunted by 1 M Ω of resistance and operates over a frequency range of 300 kHz to 3 GHz. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of the spectrum analyzer.

AC Probe (Low Frequency)

The Keysight 41800A low frequency probe has a low input capacitance and a frequency range of 5 Hz to 500 MHz.

Broadband Preamplifiers and Power Amplifiers

Preamplifiers and power amplifiers can be used with your spectrum analyzer to enhance measurements of very low-level signals.

- The Keysight 83006A preamplifier provides a minimum of 26 dB gain from 10 MHz to 26.5 GHz.
- The 11909A low noise preamplifier provides a minimum of 32 dB gain from 9 kHz to 1 GHz and a typical noise figure of 1.8 dB.

RF and Transient Limiters

The Keysight 11867A and N9355C RF Limiters protect the analyzer input circuits from damage due to high power levels. The 11867A operates over a frequency range of dc to 1800 MHz and begins reflecting signal levels over 1 mW up to 10 W average power and 100 watts peak power. The N9355C microwave limiter (0.01 to 26.5 GHz) guards against input signals over 10 milliwatts up to 1 watt average power.

The Keysight 11947A Transient Limiter protects the analyzer input circuits from damage due to signal transients. It specifically is needed for use with a line impedance stabilization network (LISN). It operates over a frequency range of 9 kHz to 200 MHz, with 10 dB of insertion loss.

Power Splitters

The Keysight 11667A/B/C power splitters are two-resistor type splitters that provide excellent output SWR, at 50 Ω impedance. The tracking between the two output arms, over a broad frequency range, allows wideband measurements to be made with a minimum of uncertainty.

11667A: DC to 18 GHz
11667B: DC to 26.5 GHz
11667C: DC to 50 GHz

Static Safe Accessories

9300-1367	Wrist-strap, color black, stainless steel. Four adjustable links and a 7 mm post-type connection.
9300-0980	Wrist-strap cord 1.5 m (5 ft.)

Before You Start Troubleshooting

Before troubleshooting, complete the following tasks:

- Familiarize yourself with the safety symbols marked on the instrument and read the general safety considerations in the front of this guide.
- Read the ESD information below.
- Familiarize yourself with the troubleshooting information in Chapter 2, "Boot Up and Initialization Troubleshooting," and how it relates to information on troubleshooting the other assemblies.

WARNING These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

WARNING The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

WARNING The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from it's power supply.

WARNING The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).

CAUTION Always position the instrument for easy access to the disconnecting device (detachable power cord).

WARNING To prevent electrical shock, disconnect the analyzer from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

WARNING This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

CAUTION Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

CAUTION This instrument has an autoranging line voltage input; be sure the supply voltage is within the specified range.

Lithium Battery Disposal

The X-Series Signal Analyzer uses an internal 3.0 VDC battery that contains Lithium/Manganese Dioxide (Li/MnO2). The battery is located on the A4 CPU assembly to power the instrument clock and back up data in SRAM. When the battery is exhausted and ready for disposal, dispose of it according to your country's requirements. The Keysight part number is 1420-0356. The manufacturer's part number is CR2032. You can return the battery to your nearest Keysight Technologies Sales and Service office for disposal, if required. Refer to "Contacting Keysight Technologies" for a list of Keysight Technologies Sales and Service offices.

DO NOT THROW BATTERIES AWAY BUT COLLECT AS SMALL CHEMICAL WASTE.

ESD Information

Protection from Electrostatic Discharge

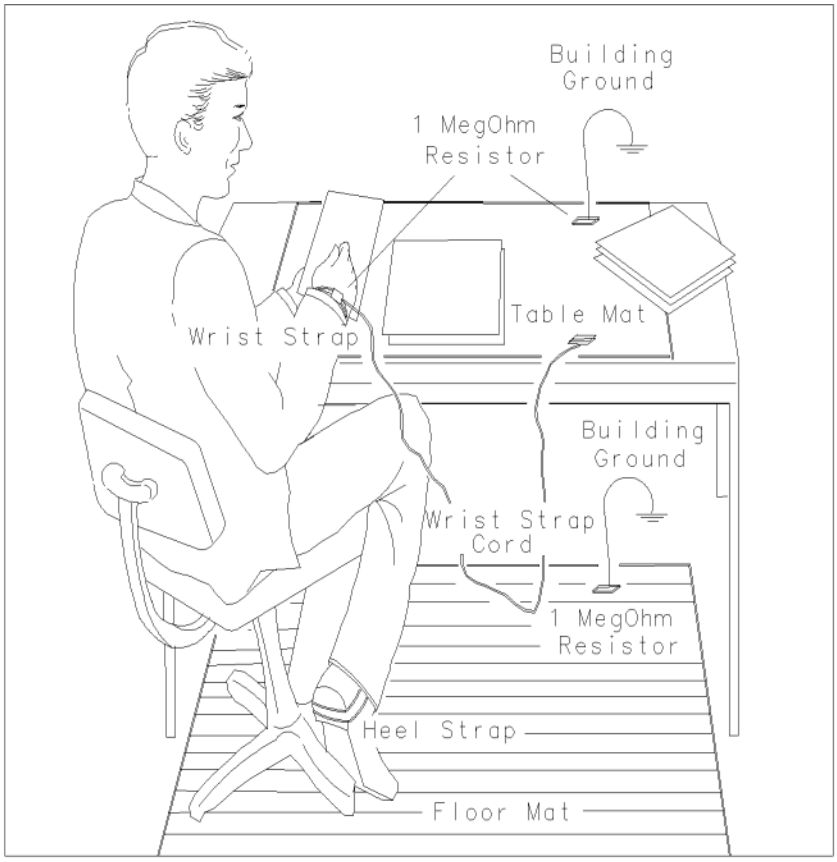
Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe workstation. Figure 1-1 shows an example of a static-safe workstation using two types of ESD protection:

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 megohm of isolation from ground.

WARNING **These techniques for a static-safe workstation should not be used when working on circuitry with a voltage potential greater than 500 volts.**

Figure 1-1 Example of a Static-Safe Workstation



Handling of Electronic Components and ESD

The possibility of unseen damage caused by ESD is present whenever components are transported, stored, or used. The risk of ESD damage can be greatly reduced by paying close attention to how all components are handled.

- Perform work on all components at a static-safe workstation.
- Keep static-generating materials at least one meter away from all components.
- Store or transport components in static-shielding containers.

CAUTION

Always handle printed circuit board assemblies by the edges. This will reduce the possibility of ESD damage to components and prevent contamination of exposed plating.

Test Equipment Usage and ESD

- Before connecting any coaxial cable to an analyzer connector, momentarily short the center and outer conductors of the cable together.
- Personnel should be grounded with a 1 megohm resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the analyzer.
- Be sure that all analyzers are properly earth-grounded to prevent build-up of static charge.

For Additional Information about ESD

For more information about preventing ESD damage, contact the Electrical Over Stress/Electrostatic Discharge (EOS/ESD) Association, Inc. The ESD standards developed by this agency are sanctioned by the American National Standards Institute (ANSI).

Service Equipment You Will Need

There are certain things that will be required to troubleshoot, adjust, and test the MXA Signal Analyzer. They include the following:

- Calibration Application Software
- Front End Controller Troubleshooting Kit
- USB Keyboard and Mouse
- USB Storage Device
- Test Equipment

Calibration Application Software

Information regarding the Keysight X-Series Signal Analyzer Calibration Application Software can be found at the following web site:

http://www.keysight.com/find/calibrationsoftware

Front End Controller Troubleshooting Kit

The Front End Troubleshooting kit contains a PC board, required cables, and installation instructions to verify the switch control logic from the A15 Front End Control board to the lower level front end components is correct. Oftentimes when troubleshooting an RF front end problem, the logic needs to be verified before one of the front end components is changed. This troubleshooting kit will help identify the defective area in a timely manner. In order to effectively isolate A15 Front End Control board problems from front end component problems, it is highly recommended that the N9020-60005 Front End Troubleshooting kit is purchased.

The Front End Troubleshooting kit lower level items can be purchased individually or as a complete kit with instructions. The complete listing of kit components, descriptions, and part numbers can be found below.

Keysight Part	Keysight Part Number	Notes
Front End Troubleshooting kit	N9020-60005	
Front End Troubleshooting board	E4410-60115	Part of N9020-60005 Troubleshooting kit
Cable, Low Band switch	E4410-60160	Part of N9020-60005 Troubleshooting kit
Cable, RF Downconverter	E4410-60156	Part of N9020-60005 Troubleshooting kit
Cable, YTF Preselector	E4410-60158	Part of N9020-60005 Troubleshooting kit
Cable, Input Attenuators	E4410-60157	Part of N9020-60005 Troubleshooting kit
Cable, Troubleshooting	8121-1400	
Connector, MMCX (f) to SMA (f)	n/a	www.hubersuhner.com item number: 31_MMCX-SMZ-50-1/111_OE

USB Keyboard and Mouse

A USB keyboard and mouse will be needed to accomplish many of the different troubleshooting tasks, as well as updating the instrument software. Any standard USB keyboard and mouse should work, but you can use the optional keyboard and mouse sold for the instrument. These can be purchased as:

Description	Model Number	Part Number[a]
USB Keyboard	1KBD001A	0960-2929
USB Mouse	1MSE001A	0960-3250

a. Part number is subject to change.

USB Storage Device

The main reason why a USB storage device will be needed is to backup calibration data when the hard drive in an instrument needs to be replaced, installing instrument software upgrades, and installing new option licenses. Recommended size is 2 gigabytes minimum, to allow storing at least one instrument software installer file.

Required Test Equipment List

The following table identifies the equipment recommended for troubleshooting, adjusting, and verifying the performance of the instrument. Only the recommended and alternate equipment is compatible with the performance verification testing. Some tests can use various models of a particular equipment type. The “Recommended Keysight Model” is the preferred equipment. However, the “Alternative Keysight Model” is an acceptable substitute.

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
Signal Sources				
Microwave Signal Generator #1	Frequency: 10 MHz to 50 GHz Frequency Resolution: 1 Hz Harmonic level: < –30 dBc Amplitude range: –40 to +13 dBm Amplitude resolution: 0.02 VSWR: < 20 GHz: 1.6:1 ≤ 31 GHz: 1.8:1	E8257D (Option 567, 1EA/1EU, 1E1) (Option 007, Analog Ramp Sweep, required for Frequency Response Adjustments)	For Adjustments: 83630A/B/L (Option 001, 008), 83640A/B/L (Option 001, 008), 83650A/B/L (Option 001, 008), PSG[c]	A, P, T
Microwave Signal Generator #2 (only required for Third Order Intermodulation and Gain Compression)	Frequency: 10 MHz to 26.5 GHz Frequency Resolution: 1 Hz Harmonic level: < –30 dBc Amplitude range: –20 to +13 dBm Amplitude resolution: 0.02 VSWR: < 20 GHz: 1.6:1 ≤ 31 GHz: 1.8:1	E8257D (Option 1EA/1EU)	83630A/B (Option 008), 83640A/B (Option 008), 83650A/B (Option 008) PSG[c]	P
Low Noise Signal Generator (one PSG may be used for multiple sources. See footnote [c])	Frequency: 50 MHz to 1.0 GHz Harmonics: < –30 dBc ≤ +13 dBm Spectral Purity SSB Phase Noise @ 1 GHz: –112 dBc at 100 Hz offset –121 dBc at 1 kHz offset –131 dBc at 10 kHz offset VSWR: < 1.5:1	E8257D (Options UNR, UNX, or UNY)	8663A PSG[c] (Options UNR, UNX, or UNY)	A, P, T
Ultra Low Noise Reference Frequency Source	Phase Noise (dBc/Hz) for 1 GHz tone and these offsets: 100 Hz –104 dBc/Hz 1 kHz –132 dBc/Hz 10 kHz –144 dBc/Hz 30 kHz –146 dBc/Hz 100 kHz –148 dBc/Hz 1 MHz –157 dBc/Hz 10 MHz –164 dBc/Hz	Wenzel Associates Inc.[d] Ultra Low Noise Reference Frequency Source Model 500-13428 Rev C		P, T

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
RF Signal Generator (one PSG may be used for multiple sources. See footnote [c])	Frequency: 300 kHz to 3.6 GHz Frequency Resolution: 1 Hz Harmonic level: < –40 dBc Amplitude range: –20 to +13 dBm Amplitude resolution: 0.02 Harmonic level: < 2 GHz, < -30 dBc ≥ 2 GHz & < 26.5 GHz, < -50 dBc VSWR: < 20 GHz: 1.6:1 ≤ 31 GHz: 1.8:1 For Option UNR or UNX: Harmonics: < –30 dBc ≤ +13 dBm Spectral Purity SSB Phase Noise @ 1 GHz: –112 dBc at 100 Hz offset –121 dBc at 1 kHz offset –131 dBc at 10 kHz offset VSWR: < 1.5:1	E8257D (Options UNR, UNX, or UNY)	8665B (for Freq Resp Phase Noise > 30 kHz test only) PSG[c] (Options UNR, UNX, or UNY)	A, P
Function Generator	Frequency: 10 Hz to 300 kHz Amplitude Resolution: 0.1 mv Harmonic Distortion: –35 dBc	33250A (required for Channel Match (Option BBA) test)	33120A (Option 001)	A, P
Counters				
Universal Counter	Frequency: 10 MHz Gate time: 10 to 100 seconds Must be capable of measuring signal at +7 dBm (0.5 Vrms)	53230A	53131A 53132A	A, P, T
Meters				
Digital Multimeter	Frequency: 3 Hz to 300 kHz AC Accuracy: ± 0.31% of reading	3458A		A, P, T
Power Meter	Dual Channel Instrumentation Accuracy: ± 0.5% Power Reference Accuracy: ± 0.6% Compatible with 8480 series power sensors dB relative mode	N1914A	E4419A/B N1912A	A, P

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
RF Power Sensor *(2 required)*	Frequency Range: 100 kHz to 3.6 GHz Amplitude Range: –30 to +20 dBm Zero Set: ± 50 nW Zero Drift: < ± 10 nW Measurement Noise: < 110 nW VSWR 100 kHz to 1 MHz: ≤ 1.20:1 1 MHz to 2 GHz: ≤ 1.10:1 2 GHz to 3 GHz: ≤ 1.30:1 Cal Factor Uncertainty (std): < 1.6% Option H84 Cal Factor: Characterized by standards lab to: ± 0.6%[e] Input Connector: Type-N (m)	N8482A	N8482A CFT[f] 8482A Option H84 8482A[f] (Non-H84 sensors will increase measurement uncertainty)	A, P
Microwave Power Sensor *(2 required)*	Frequency Range: 50 MHz to 26.5 GHz Amplitude Range: –30 to +20 dB Zero Set: ± 50 nW Zero Drift: < ± 10 nW Measurement Noise: < 110 nW Cal Factor Uncertainty: < 3.0% VSWR: 50 MHz to 100 MHz: 1.15:1 100 MHz to 2 GHz: 1.10:1 2 GHz to 12.4 GHz: 1.15:1 12.4 GHz to 18 GHz: 1.20:1 18 GHz to 26.5 GHz: 1.25:1 Input Connector: 3.5 mm (m)	N8485A[f]	N8485A CFT[f] 8485A[f]	A, P
Millimeter Power Sensor *(for Options ≥ 532)*	Frequency Range: 50 MHz to 50 GHz Amplitude Range: –30 to +20 dB Zero Set: ± 50 nW Zero Drift: < ± 10 nW Measurement Noise: < 110 nW Cal Factor Uncertainty: < 4.5% VSWR: 50 MHz to 100 MHz: 1.15:1 100 MHz to 2 GHz: 1.10:1 2 GHz to 12.4 GHz: 1.15:1 12.4 GHz to 18 GHz: 1.20:1 18 GHz to 26.5 GHz: 1.25:1 26.5 GHz to 40 GHz: 1.30:1 40 GHz to 50 GHz: 1.50:1 Input Connector: 2.4 mm (m)	N8487A	8487A	A, P

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
High Sensitivity Millimeter Power Sensor *(for Options ≥ 532)*	Frequency Range: 50 MHz to 50 GHz Amplitude Range: –70 to –20 dB Zero Set: ± 20 pW Zero Drift: < ± 4 pW Measurement Noise: < 4 pW Cal Factor Uncertainty: < 4.5% VSWR: 50 MHz to 100 MHz: 1.19:1 100 MHz to 4 GHz: 1.15:1 4 GHz to 12.4 GHz: 1.20:1 12.4 GHz to 18 GHz: 1.29:1 18 GHz to 34 GHz: 1.37:1 34 GHz to 40 GHz: 1.61:1 40 GHz to 50 GHz: 1.89:1 Input Connector: 2.4 mm (m)	8487D		A, P
Low Power Microwave Power Sensor *(2 required)* *(for Option P08, P13, or P26 only)*	Frequency Range: 50 MHz to 26.5 GHz Amplitude Range: –70 to +20 dBm Zero Set: ± 50 pW Zero Drift: < ± 4 pW Measurement Noise: < 4 pW Cal Factor Uncertainty: < 3.0% VSWR: 50 MHz to 100 MHz: 1.15:1 100 MHz to 2 GHz: 1.10:1 2 GHz to 12.4 GHz: 1.15:1 12.4 GHz to 18 GHz: 1.20:1 18 GHz to 26.5 GHz: 1.25:1 Input Connector: 3.5 mm (m)	8485D[f]		A, P
Power Sensor Cable *(2 required)*		11730A		A, P, T
Standards				
Frequency Standard	Frequency: 10 MHz Accuracy: < ±1 e10^{-10}	Microsemi 5071A-C002	Keysight 5061B, 5071A Symmetricom 5071A-C001	A, P
50 MHz, –25 dBm Calibrator	Frequency Drift: < 2.5 kHz Typical VSWR: 1.06:1 Output Power Variation: ±.004 dB Total Harmonic Content: -45 dBc	Z5602B (Option H51)	Z5602A (Option H51)	A

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
Attenuators				
10 dB Step Attenuator	Range: 0 to 80 dB Accuracy: Characterized by standards lab[g] Calibrated at 50 MHz VSWR: at 50 MHz: ≤ 1.05:1	8496G (Option 001, H50)	8496H (Option 001, H50)	P
1 dB Step Attenuator	Range: 0 to 9 dB Accuracy: Characterized by standards lab[g] VSWR: at 50 MHz: ≤ 1.05:1	8494G (Option 001, H50)	8494H (Option 001, H50)	P
Attenuator Interconnect Kit	Type N connector kit to connect 8496G to 8494G	11716A		P
Attenuator Driver	Compatible with the 8496G and 8494G step attenuators	11713B	11713A	P
3 dB Fixed Attenuator	Frequency: 50 MHz Loss: 3 dB (nominal) VSWR: at 50 MHz: ≤ 1.2:1 Connector: Type-N (m, f)	8491A (Option 003)	8491B (Option 003)	P
6 dB Fixed Attenuator	Frequency: 50 MHz Loss: 6 dB (nominal) VSWR: at 50 MHz: ≤ 1.05:1 Connector: Type-N (m, f)	8491A (Option 006, H33[h])	8491B (Option 006, H33[h])	P
6 dB Fixed Attenuator *(2 required)*	Frequency: 50 MHz to 3.6 GHz Loss: 6 dB (nominal) VSWR: at 50 MHz: ≤ 1.10:1 Connector: 3.5 mm (m, f)	8493C (Option 006)		A
10 dB Fixed Attenuator	Frequency: 50 MHz Loss: 10 dB (nominal) VSWR: at 50 MHz: ≤ 1.05:1 Connector: Type-N (m, f)	8491A (Option 010, H33[h])	8491B (Option 010, H33[h])	P
10 dB Fixed Attenuator	Frequency: 50 MHz to 19.5 GHz Loss: 10 dB (nominal) VSWR: 321.4 MHz to 8 GHz: ≤ 1.1:1 8 GHz to 12.4 GHz: ≤ 1.15:1 12.4 GHz to 19.5 GHz: ≤ 1.25:1 Connector: 3.5 mm (m, f)	8493C (Option 010)		A, P
20 dB Fixed Attenuator	Frequency: 10 MHz Loss: 20 dB (nominal) VSWR: 10 MHz: ≤ 1.20:1 Connector: Type-N (m, f)	8491A (Option 020)	8491B (Option 020)	A, P

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
30 dB Fixed Attenuator	Frequency: 50 MHz Loss: 30 dB ± 0.05 dB VSWR: 1.05 @ 50 MHz (For use with Low Power Sensors)	11708A		A, P
Terminations				
Type-N (m) (for Option 503, 508, 513)	Frequency: 10 kHz to 18 GHz VSWR: ≤ 1.05:1	909A (Option 012)		P, T
3.5 mm (f) (for Option 526)	50 Ω Frequency: 10 kHz to 50 GHz	909D (Option 526)		P, T
BNC (m) (required for Option BBA)	Frequency: 50 Hz to 300 kHz	1250-0207	11593A	P
Miscellaneous Devices				
RF Power Splitter	Frequency: 9 kHz to 3.6 GHz VSWR: ≤ 1.10:1 Tracking Error: < ± 0.15 dB Connector: Type-N (f)	11667A		A, P
Microwave Power Splitter	Frequency: 50 MHz to 26.5 GHz VSWR: < 50 MHz to 18 GHz: < 1.29:1 18 GHz to 26.5 GHz: < 1.20:1 26.5 GHz to 40 GHz: < 1.50:1 40 GHz to 50 GHz: < 1.65:1 Tracking Error: < ± 0.40 dB Connector: 2.4 mm (f)	11667B		A, P
Millimeter Power Splitter (for Options ≥ 532)	Frequency: 50 MHz to 50 GHz VSWR: 10 MHz to 3 GHz: < 1.22:1 3 GHz to 26.5 GHz: < 1.22:1 Tracking Error: < ± 0.40 dB Connector: 3.5 mm (f)	11667B		A, P
Directional Bridge	Frequency Range: 50 MHz to 3 GHz Directivity: 50 MHz to 2 GHz:40 dB 2 GHz to 3 GHz: 30 dB VSWR: ≤ 2 GHz: ≤ 1.15:1 ≤ 3 GHz: ≤ 1.22:1 Insertion Loss: ≤ 1.5, +0.1 dB/GHz (nominal) Coupling (nominal): 16 dB Connector: Type N (f)	86205A		P

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
Directional Coupler	Frequency 2 GHz to 20 GHz Directivity > 14 dB Transmission arm loss: < 1.5 dB (nominal) Coupled Arm Loss: ~10 dB (nominal) VSWR: ≤ 1.35:1 Connector: SMA (f)	87300C		P
Microwave Power Divider	Frequency: DC to 500 MHz VSWR: < 1.10:1 Tracking Error: $< \pm 0.25\ \delta B$ Connector: 3.5 mm (f)	11636B		A, P
Hybrid Power Divider	Frequency: 500 MHz to 3.6 GHz Isolation: 19 dB Insertion Loss: 4.5 dB (nominal) VSWR: <1.45:1	87302C		A
Cables				
3.5 mm (m) to 3.5 mm (m) *(2 required)*	Frequency: DC to 26.5 GHz Length: ≤ 92 cm (36 in) Insertion Loss: ~2 dB VSWR: DC to 18 GHz: ≤ 1.25:1 18 GHz to 26.5 GHz: ≤ 1.35:1	11500E	8120-4921	A, P
2.4 mm (m) to 2.4 mm (f) (for Options ≥ 532)	Frequency: DC to 50 GHz Length: 1 m Insertion Loss: < 26 GHz, ~4 dB < 40 GHz, ~5 dB < 50 GHz, ~6 dB VSWR: < 26.5 GHz: ≤ 1.30:1 < 40 GHz: ≤ 1.40:1 < 50 GHz: ≤ 1.55:1	8120-6164		A, P
Type-N *(2 required)*	Frequency: 10 MHz to 8 GHz Precision Type-N (m), both ends 62 cm (24 in.) VSWR: ≤ 18 GHz: 1.4:1 Insertion Loss: 1.5 dB	11500C		A, P, T
BNC *(3 required)*	Frequency: DC to 10 MHz 50 Ω Coax BNC (m), both ends 120 cm (48 in.)	8120-2582	10503A	A, P, T

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
Filters				
50 MHz Low Pass	Cutoff Frequency: 50 MHz Rejection at 65 MHz: > 40 dB Rejection at 75 MHz: > 60 dB Insertion Loss: ~1 dB VSWR: ≤ 1.5:1 BNC (m) to BNC (f)	Telonic Berkeley TLA 50-5AB2	0955-0306	P,T
300 MHz Low Pass *(2 Required)*	Cutoff Frequency: 300 MHz Rejection at > 435 MHz: > 45 dB VSWR: ≤ 1.5:1 BNC (m, f)	Telonic Berkeley TLP 300-4AB4	0955-0455	P
1.8 GHz Low Pass *(2 Required)*	Cutoff frequency: 1.8 GHz Rejection at 2.1 GHz to 6 GHz: > 45 dB Insertion Loss @ 1.8 GHz: < 1 dB VSWR: ≤ 1.50:1 DC to 1.8 GHz Connector: SMA (f) to SMA (f)	RLC L-1636	0955-0491	P
5.0 GHz Low Pass	3 dB frequency: 5.25 GHz 60 dB Rejection: > 6.7 GHz VSWR: 1.35:1	RLC F-30-5000-RF		P
8.0 GHz Low Pass	3 dB frequency: 8.4 GHz 60 dB Rejection: > 10.8 GHz VSWR: 1.35:1	RLC F-30-8000-RF		P
12.4 GHz Low Pass	3 dB frequency: 13.0 GHz 60 dB Rejection: > 16.74 GHz VSWR: 1.35:1	RLC F-30-12.4-RF		P
Adapters				
Type-N (f) to Type-N (f)	Frequency: DC to 18 GHz VSWR: ≤ 1.13:1	1250-1472		P
Type-N (m) to Type-N (m)	Frequency: DC to 18 GHz VSWR: ≤ 1.13:1	1250-1475		P
Type-N (f) to BNC (m)	Frequency: DC to 1.3 GHz VSWR: ≤ 1.13:1	1250-1477		P, T
Type-N (m) to BNC (m)	Frequency: DC to 1.3 GHz VSWR: ≤ 1.13:1	1250-1473		P, T
Type-N (m) to BNC (f)	Frequency: DC to 1.3 GHz VSWR: ≤ 1.13:1	1250-1476		P
Type-N (m) to 3.5 mm (m)	Frequency: DC to 18 GHz VSWR: ≤ 1.08:1	1250-1743		P

Table 1-1 Required Test Equipment

Instrument	Critical Specifications	Recommended Model[a]	Alternative Model	Use[b]
Type-N (m) to 3.5 mm (f) *(2 Required)*	Frequency: DC to 18 GHz VSWR: ≤ 1.08:1	1250-1744		P
3.5 mm (f) to Type-N (f) (for 3.5 mm source)	Frequency: DC to 18 GHz VSWR: ≤ 1.08:1	1250-1745		A, P
Type-N (f) to 3.5 mm (m)	Frequency: DC to 18 GHz VSWR: ≤ 1.14:1	1250-1750		A, P
3.5 mm (f) to 3.5 mm (f) (for 3.5 mm source)	Frequency: DC to 26.5 GHz VSWR: ≤ 1.05:1	83059B	1250-1749	P
3.5 mm (m) to 3.5 mm (m) *(2 Required)*	Frequency: DC to 26.5 GHz VSWR: ≤ 1.12:1	83059A	1250-1748	P
3.5 mm (f) to 2.4 mm (f) (for 2.4 mm source)	Frequency: DC to 26.5 GHz VSWR: ≤ 1.05:1	11901B		P
Type-N (f) to 2.4 mm (f) (for 2.4 mm source)	Frequency: DC to 18 GHz VSWR: ≤ 1.08:1	11903B		P
BNC (m) to SMA(f)	Frequency: DC to 1.3 GHz VSWR: ≤ 1.13:1	1250-1700		P
BNC Tee (BNC f,m,f)		1250-0781		A, P
SMB (f) to BNC (f)	Frequency: DC to 1.3 GHz	1250-1236		A, P
BNC (f) to SMA (m)	Frequency: DC to 1.3 GHz	1250-1200		A, P
BNC (f) to Dual Banana		1251-2277		A, P
3.5 mm (f) to Type-N (m)	Shipped with the 8485A for adapting to the Power Reference. Only to be used for power sensor cal.	08485-60005		A, P
2.4 mm (f) to Type-N (m)	Shipped with the 8487A for adapting to the Power Reference. Only to be used for power sensor cal.	08487-60001		A, P
Type-N Tee		1250-0559		P
Optional Equipment				
10 MHz Distribution Amplifier (only needed when using the 10 MHz Distribution Amplifier Setup)		Microsemi 5087B	Keysight 5087A Symmetricom 5087B	A, P

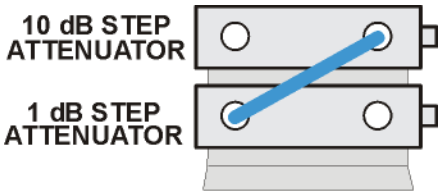
a. Keysight model numbers unless otherwise noted.
b. A = Adjustments, P = Performance Testing, T = Troubleshooting

c. Supported PSG models:

E8244A
E8247C
E8254A
E8257C
E8257D
E8267C
E8267D

Note: One PSG with Option 567, 1EA, 1E1, 007, and UNX or UNR can be used as the Microwave Signal Generator #1, Low Noise Signal Generator (for MXA's without Option EP2), and the RF Signal Generator.

d. Wenzel Associates Inc., 2215 Kramer Ln., Austin, TX 78758 (512) 835-2038 Fax (512) 719-4086
e. The 8482A power sensor uses cal factors to compensate the power sensor for frequency response errors. Cal factors are stated in percentages. The 8482A factory cal factor uncertainty ranges from 2.2% to 3.1%. The cal factor uncertainty can be reduced to < 1.0% by using metrology grade calibration techniques. The power sensor cal factor uncertainty becomes one component of the Verification Test uncertainty analysis. Lower cal factor uncertainties will translate to wider test margins.
f. When ordering a new STD or CFT Power Sensor from Keysight to be used with the N7800A series applications, order with Option 1A7. The 1A7 option provides an ISO17025 calibration and includes calibration data. When re-calibrating your STD or CFT Power Sensor for use with the N7800A series applications, we recommend the Keysight ISO17025 calibration.
g. The step attenuators should be permanently joined via the 11716A Interconnect Kit as shown in the following diagram.



step_atten_setup

For more information on step attenuator characterization, see the "Step Attenuator Loss Characterization" section below.

h. 8491A Option H33 is a fixed attenuator which has been characterized to have a VSWR ≤ 1.05:1 at 50 MHz. A VSWR of 1.05:1 is recommended to test Input Attenuator Switching Uncertainty, Display Scale Fidelity, and Absolute Amplitude Accuracy performance tests. Any 8491A/B attenuator can be mapped into this device if the VSWR at 50 MHz has been characterized to be ≤ 1.05:1. When mapping the attenuator, to indicate that is meets the required specification, the Option H33 checkbox will need to be checked in the configure test station Administration screen.

Step Attenuator Loss Characterization

The step attenuator combination should have each attenuator setting characterized by a metrology lab at 50 MHz. The following tables show which sections of the 10 dB and 1 dB step attenuators are utilized for each attenuator setting. The tables also list the Allowable Uncertainty for each attenuator setting. The interconnect cable should NEVER be disconnected once the loss characterization is performed.

Table 1-2 1 dB Step Attenuator

Nominal Attenuation (dB)	Attenuator Section				Allowable Uncertainty (dB)
	#1 (1 dB)	#2 (2 dB)	#3 (4 dB)	#4 (4 dB)	
0	Off	Off	Off	Off	0 (Reference)
1	On	Off	Off	Off	< 0.005
2	Off	On	Off	Off	< 0.005
3	On	On	Off	Off	< 0.005
4	Off	Off	On[a]	Off	< 0.005
5	On	Off	On	Off	< 0.005
6	Off	On	On	Off	< 0.005
7	On	On	On	Off	< 0.005
8	Off	Off	On	On	< 0.005
9	On	Off	On	On	< 0.005

a. TME requires that Section 3 be characterized.

Table 1-3 10 dB Step Attenuator

Nominal Attenuation (dB)	Attenuator Section				Allowable Uncertainty (dB)
	#1 (10 dB)	#2 (20 dB)	#3 (40 dB)	#4 (40 dB)	
0	Off	Off	Off	Off	0 (Reference)
10	On	Off	Off	Off	< 0.010
20	Off	On	Off	Off	< 0.015
30	On	On	Off	Off	< 0.020
40	Off	Off	On[a]	Off	< 0.025
50	On	Off	On	Off	< 0.030

Table 1-3 10 dB Step Attenuator

Nominal Attenuation (dB)	Attenuator Section				Allowable Uncertainty (dB)
	#1 (10 dB)	#2 (20 dB)	#3 (40 dB)	#4 (40 dB)	
60	Off	On	On	Off	< 0.035
70	On	On	On	Off	< 0.040

a. TME requires that Section 3 be characterized.

After an Instrument Repair

If any instrument assemblies have been repaired or replaced, perform the related adjustments and performance verification tests. These tests are done using the N7814A Keysight X-Series Signal Analyzer Calibration Application Software. Refer to Chapter 16, “Post-Repair Procedures,” for a list of post-repair adjustments and performance tests based on which hardware has been changed.

Information regarding the N7814A Keysight X-Series Signal Analyzer Calibration Application Software can be found at

http://www.keysight.com/find/calibrationsoftware

Contacting Keysight Technologies

If you have a problem with your instrument, see Chapter 2, "Boot Up and Initialization Troubleshooting." This section contains a checklist that will help identify some of the most common problems.

There is also support on the world-wide web. The address is:

http://www.keysight.com/support/N9020B

FAQs, instrument software updates, documentation, and other support information can be accessed from this site.

To obtain servicing information or to order replacement parts, contact the nearest Keysight office listed in Table 1-4. In any correspondence or telephone conversations, refer to the instrument by its model number (N9020B) and full serial number (ex. MY56080147). With this information, the Keysight representative can quickly determine whether your unit is still within its warranty period.

By internet, phone, or fax, get assistance with all your test and measurement needs.

Table 1-4 Contacting Keysight

Online assistance: http://www.keysight.com/find/contactus

Americas

Country	Phone Number
Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	1 800 829-4444

Asia Pacific

Country	Phone Number
Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe and Middle

Country	Phone Number
Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100

Europe and Middle

Country	Phone Number
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
http://www.keysight.com/find/contactus

Instrument Serial Numbers

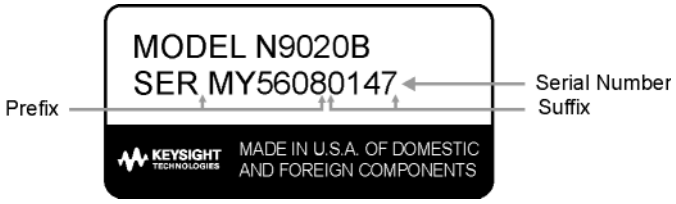
Keysight makes frequent improvements to its products enhancing performance, usability, or reliability. Keysight service personnel have access to complete records of design changes to each type of instrument, based on the instrument's serial number and option designation.

Whenever you contact Keysight about your instrument, have the complete serial number available. This will ensure that you obtain accurate service information.

A serial number label is attached to the rear of the instrument. This label has two instrument identification entries: the first provides the identification number for each option built into the instrument and the second provides the instrument's serial number.

The serial number has two parts: the prefix (two letters and the first four numbers), and the suffix (the last four numbers). Refer to the following figure.

Figure 1-2 Example Serial Number



The first two letters of the prefix identify the country in which the unit was manufactured. The remaining four numbers of the prefix identify the date of the last major design change incorporated in your instrument. The four digit suffix is a sequential number and, coupled with the prefix, provides a unique identification for each unit produced. Whenever you list the serial number or refer to it in obtaining information about your instrument, be sure to use the complete number, including the full prefix and the suffix.

The serial number is located on the rear panel serial sticker or when the analyzer is power up, press **System**, **Show System**. The system information can be very useful for updates and post-sale upgrades.

How to Return Your Instrument for Service

Service Order Number

If an instrument is being returned to Keysight for servicing, the phone numbers are mentioned in Table 1-4, “Contacting Keysight,” on page 42. In order for Keysight to expedite the repair please be as specific as possible about the nature of the failure.

Helpful failure descriptions:

- Signal level measures 10 dB too low at 1 GHz
- L.O. Unlock error message appears on screen in spans < 10 MHz
- Analyzer will not complete boot up sequence to signal analyzer mode

Failure descriptions that will most likely increase repair time:

- Analyzer broken
- Analyzer will not make accurate measurements
- Signal drifts

If you have recorded any error messages that appeared on the analyzer display, or have completed a Functional Test or Performance Verification Test, or have any other specific data on the performance of the instrument, please send a copy of this information with the instrument.

Original Packaging

Before shipping, pack the unit in the original factory packaging materials if they are available. If the original materials were not retained, see “Other Packaging” on page 46.

Other Packaging

CAUTION Instrument damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the equipment or prevent it from shifting in the carton. They cause equipment damage by generating static electricity and by lodging in the instrument louvers, blocking airflow.

You can repackage the instrument with commercially available materials, as follows:

1. Protect the control panel with cardboard.
2. Wrap the instrument in antistatic plastic to reduce the possibility of damage caused by electrostatic discharge.
3. Use a strong shipping container. A double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength is adequate. The carton must be both large enough and strong enough to accommodate the instrument. Allow at least 3 to 4 inches on all sides of the instrument for packing material.
4. Surround the equipment with three to four inches of packing material and prevent the equipment from moving in the carton. If packing foam is not available, the best alternative is S.D.-240
   Air Cap™ from Sealed Air Corporation, Hayward, California, 94545.

   Air Cap looks like a plastic sheet filled with 1-1/4 inch air bubbles. Use the pink-colored Air Cap to reduce static electricity. Wrapping the equipment several times in this material should both protect the equipment and prevent it from moving in the carton.
5. Seal the shipping container securely with strong nylon adhesive tape.
6. Mark the shipping container “FRAGILE, HANDLE WITH CARE” to assure careful handling.
7. Retain copies of all shipping papers.

2 Boot Up and Initialization Troubleshooting

What You Will Find in This Chapter

This chapter provides information that is useful when starting to troubleshoot a spectrum analyzer. It includes procedures for troubleshooting common failures and provides information on isolating problems in the analyzer.

The following sections are found in this chapter:

Check the Basics on page 48

Instrument Boot Up Process on page 49

Typical instrument boot-up process flow on page 50

Potential Problems During Boot Process on page 53

Yellow Standby LED Does Not Illuminate on page 53

Green Power On LED Does Not Illuminate on page 55

Fan(s) Are Not Operating on page 57

No Keysight Splash Screen Displayed on page 59

Instrument Hangs at the Keysight Splash Screen on page 60

PCI Enumeration Error on page 60

Instrument Cannot Completely Load or Run the Operating System on page 61

Troubleshooting a Blank Display on page 61

Initializations Did Not Complete on page 62

Fails an Initial Alignment on page 63

Signal Level Verification on page 69

Signal Level Problem with Input Frequencies < 3.6 GHz on page 69

Signal Level Problem with Input Frequencies > 3.6 GHz on page 70

Check the Basics

Before calling Keysight Technologies or returning the instrument for service, please make the following checks:

1. Is there power at the power outlet? At the power receptacle on the instrument?
2. Is the instrument turned on? Check to see if the front panel LED is green, which indicates the power supply is on.
3. If other equipment, cables, and connectors are being used with the instrument, make sure they are connected properly.
4. Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct?
5. If the instrument is not functioning as expected, return the unit to a known state by pressing the **Mode Preset** key.
6. Is the measurement being performed, and the results that are expected, within the specifications and capabilities of the instrument? Refer to the specifications book for specifications.
7. In order to meet specifications, the instrument must be aligned. Press **System**, **Alignments**, **Align Now**, **Align Now All.** The diagnostic tests should all pass. If the instrument displays a failure during these tests, refer to "Fails an Initial Alignment" on page 63.
8. Check to see if the instrument has the latest instrument software before starting the troubleshooting procedure. Press **System**, **Show System**. The software revision is listed under **Instrument S/W Revision**. For more information, refer to Chapter 18, "Instrument Software", on page 619.
9. Is the instrument displaying an error message? If so, refer to Chapter 3, "Instrument Messages", on page 71 for more information.
10. If the necessary test equipment is available, perform the functional checks in Chapter 17, "Functional Tests", on page 583.

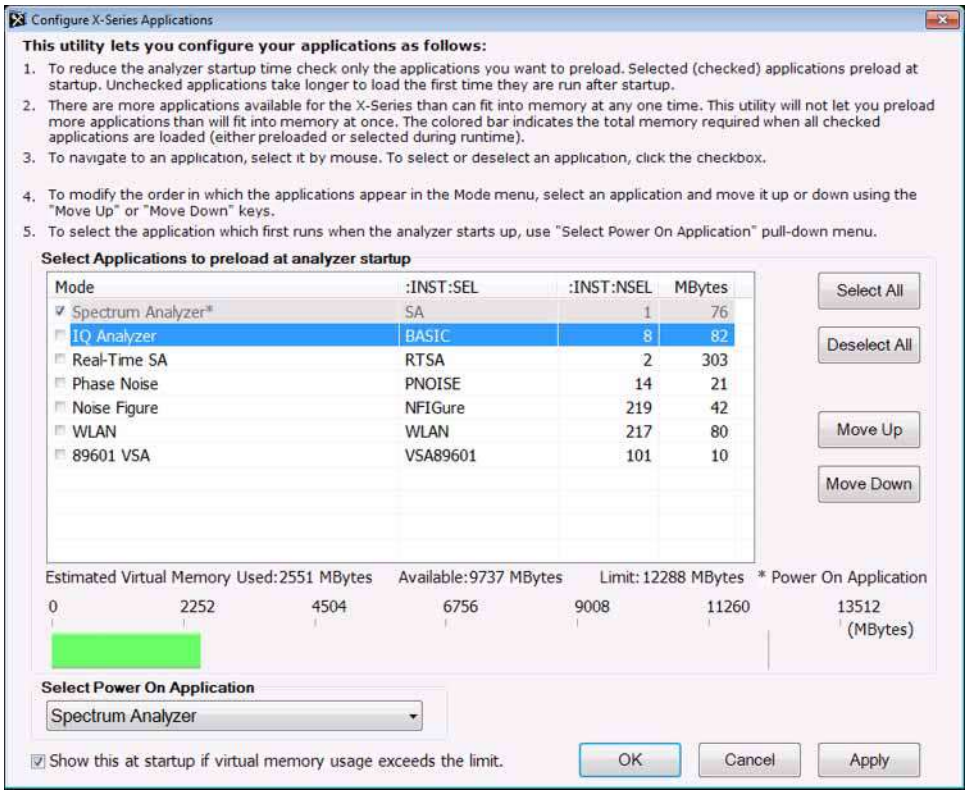
Instrument Boot Up Process

This section describes the signal analyzer boot up process from initial AC power to a normal analyzer sweep. The boot process time from start to finish will take 3 to 4 minutes. This boot time will vary depending on the analyzer hardware configuration, installed options and the number of measurement applications.

By default, the measurement applications will preload before the spectrum analyzer application is fully booted. The analyzer boot time can be shortened if needed by turning off the preload process for applications that are not going to be used. If this is done, the preload process will be bypassed during the application boot up. If a certain measurement mode is selected that did not preload during the original boot, that measurement application will preload at that time. When this occurs the mode switching time will take longer. Once the application is loaded all subsequent mode switches will be much faster.

If the user does not want the measurement applications to preload during the application boot process, select the Configure Applications icon on the desktop. This will bring up a window as shown in Figure 2-1 that shows the various applications and what is selected to preload. By default all applications are checked and therefore, will preload when the MXA application is launched. Uncheck any applications to bypass the preloading process, select Apply, and then OK to close the Configure Applications window when finished.

Figure 2-1 Configure Application



Typical instrument boot-up process flow

1. Plug in the AC power cord from a known good AC power source into the rear panel of the analyzer.
2. The yellow standby LED illuminates on the analyzer front panel to the right-hand side of the On/Off button. If the yellow Standby LED is not illuminating refer to the "Yellow Standby LED Does Not Illuminate" section in this chapter.
3. To turn the analyzer on, press the On/Off button. The yellow Standby LED should turn off and the green Power On LED should illuminate. A green Power On LED indicates that the power supply has received an "On" command from the A4 CPU assembly. If the green Power On LED is not illuminating refer to the "Green Power On LED Does Not Illuminate" section in this chapter.

NOTE

If the analyzer AC power source was removed by the operator by pulling the power cord or by turning off the analyzer via a power main switch on a test rack, the analyzer will automatically power on without having to press the On/Off button on the front panel when power is restored.

4. The instrument fans should start running. The fans are mounted on the left-hand side of the analyzer and draw air into the instrument to cool the internal circuitry. If a fan is not running refer to the "Fan(s) Are Not Operating" section in this chapter.
5. The Keysight Technologies splash screen is displayed in white font on a dark background for ~5-10 seconds after the analyzer is turned on. If the Keysight Technologies logo is not displayed refer to the "No Keysight Splash Screen Displayed" section in this chapter. If the instrument hangs at the Keysight Technologies splash screen refer to the "Instrument Hangs at the Keysight Splash Screen" section in this chapter.
6. Verify text is displayed on screen where the user has the option of booting Windows 7 FES or running the Instrument Recovery System. The default selection is to boot Windows 7 FES. If a recovery is required, press the Down Arrow key on the front panel of the analyzer within 5 seconds to highlight "Instrument Recovery System" and press the Enter key on the analyzer, otherwise Windows 7 FES will begin to boot. If the Windows 7 FES boot screen is not displayed within a few seconds refer to the "Instrument Cannot Completely Load or Run the Operating System" section in this chapter.
7. If the recovery system is not selected the Windows 7 FES operating system will begin to boot up. This will take ~20-30 seconds.

NOTE

If a recovery was selected follow the on-screen instructions and perform a system recovery. Additional information about performing a system recovery can be found in Chapter 9, "CPU/Disk Drive Troubleshooting", on page 329 in this manual.

8. The Keysight Technologies logo is displayed in white font on a black background while Windows finishes loading user preferences. This can take up to 4 minutes. If this does not occur refer to the "Instrument Cannot Completely Load or Run the Operating System" section in this chapter.
9. By default, the initialization process of the MXA Spectrum Analyzer application begins loading. The N9020B MXA Signal Analyzer screen appears. The screen remains for slightly over 1 minute. If any of the initializing processes do not complete, refer to the "Initializations Did Not Complete" section in this chapter.
10. While the application software is loading the instrument will perform a number of internal alignments before the analyzer begins to sweep. A screen with a black background appears and the alignment progress is shown in a grey box. The number of alignments is dependent on which hardware options are present. If an alignment fails, refer to the "Fails an Initial Alignment" section in this chapter.
11. If any of the initial alignments fail, check the alignment history for troubleshooting hints.
    The instrument alignment history can be found at:

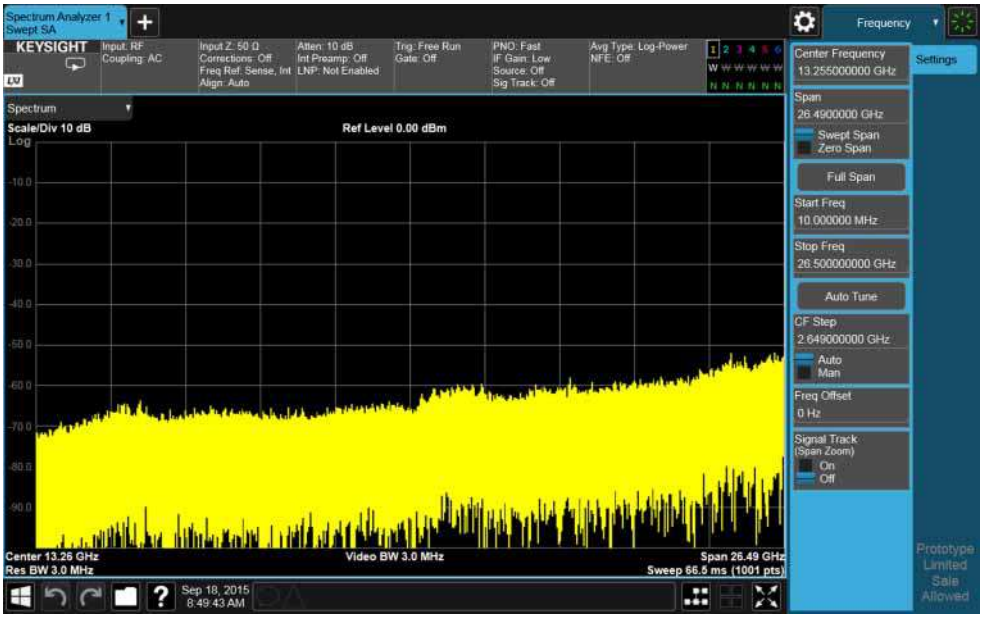
E:\AlignDataStorage\AlignmentHistory.txt

Look for any failed status for the various internal hardware items listed in this file.

Once the MXA application is fully initialized and aligned, the sweep should resemble Figure 2-2 when delivered from the factory. This completes the boot process from initial AC power to the spectrum analyzer application.

IMPORTANT If the power up state has been changed from the factory power on state by the user, the analyzer will boot to that state.

Figure 2-2 Typical Instrument Sweep at Power-up
(Display theme changed for printing clarity)



Potential Problems During Boot Process

This section describes potential problems that may occur if there is an internal hardware issue that prohibits the MXA from completing a full boot up to the spectrum analyzer application.

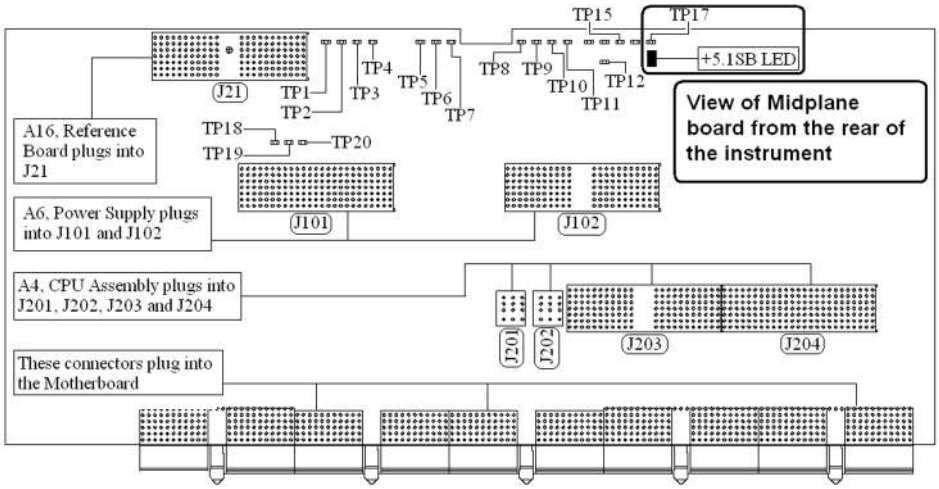
Yellow Standby LED Does Not Illuminate

Control of the yellow front panel Standby LED comes from the A4 CPU board assembly. This signal is routed through the A7 Midplane board and is then buffered on the A8 Motherboard before being sent to the A1A2 Front Panel Interface board through W1. Of course, the power for this all originates with the A6 Power Supply Assembly. When the Standby LED does not come on it could be due to any one of these assemblies. This procedure will help to determine which one is the cause.

If the instrument turns on and operates properly but the yellow Standby LED does not work then all that will need to be done is to trace where the control signal for the LED is being lost using the routing information in the preceding paragraph.

1. The Standby LED will only turn on when the instrument is connected to an AC source that has a voltage level and frequency of that specified for the instrument. Before proceeding verify that these requirements are being met. Refer to the instrument rear panel for these requirements.
2. Remove the AC power cord and then remove the instrument cover. Refer to the Chapter 15, “Assembly Replacement Procedures”, on page 451 in this manual.
3. Refer to Figure 2-3, verify the +5.1V standby LED on the A7 Midplane board is on.

Figure 2-3 A7 Midplane Board +5.1V LED



NOTE All DC power supplies come from the A6 Power Supply assembly. However, the most convenient measurement location for all the DC supplies is the A7 Midplane. All power supply LED's are accessible once the instrument cover has been removed.

Is the +5.1SB LED on the A7 Midplane board on?

If yes:

After verifying that the connections from the front panel Standby LED back to the A4 CPU board are not at fault, replace the A4 CPU board.

If no:

Replace the A6 Power Supply assembly.

NOTE Before replacing the power supply, verify the midplane and motherboard interconnects are mechanically secure.

Green Power On LED Does Not Illuminate

Control of the green front panel Power On LED comes from the A4 CPU board assembly. This signal is routed through the A7 Midplane board and is then buffered on the A8 Motherboard before being sent to the A1A2 Front Panel Interface board through W1. Of course, the power for this all originates with the A6 Power Supply Assembly. When the Power On LED does not come on it could be due to any one of these assemblies. This procedure will help to determine which one is the cause.

This procedure assumes that the yellow Standby LED does turn on when the AC power is connected to the rear panel of the instrument. If it doesn't, refer to the "Yellow Standby LED Does Not Illuminate" section before proceeding.

If the instrument turns on and operates properly but the green Power On LED does not work then all that will need to be done is to trace where the control signal for the LED is being lost using the routing information in the preceding paragraph.

1. The Power On LED will only turn on when the instrument is connected to an AC source that has a voltage level and frequency of that specified for the instrument and the front panel On/Off button has been pressed. Before proceeding verify that these requirements are being met. Refer to the instrument rear panel for these requirements.
2. Remove the AC power cord and then remove the instrument cover. Refer to Chapter 15, "Assembly Replacement Procedures", on page 451 in this manual.
3. Remove the MP7 Top Brace. Refer to Chapter 15, "Assembly Replacement Procedures", on page 451 in this manual.
4. With AC power connected to the rear of the instrument but without turning it on, leaving it in standby mode, measure the voltage at the top side of R867 of the A7 Midplane board assembly. See Figure 2-4 for R867 location.

Does the voltage at R867 measure 5 VDC?

If yes:

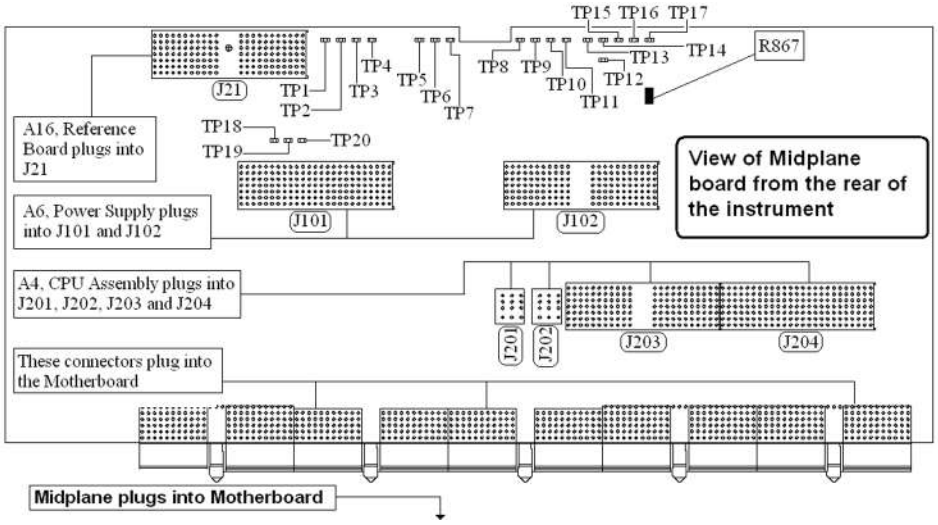
Proceed to step 5.

If no:

Replace the A6 Power Supply assembly.

NOTE Before replacing the power supply, verify the midplane and motherboard interconnects are mechanically secure.

Figure 2-4 A7 Midplane Board - R867



5. While monitoring the voltage at R867, turn the instrument power on by pressing the front panel On/Off button.

Does the voltage at R867 measure 0 VDC?

If yes:

Proceed to step 6.

If no:

After verifying that the connections from the front panel On/Off button back to the A4 CPU board are not at fault, replace the A4 CPU board.

6. Do all of the green power supply LEDs along the top of the A7 Midplane board come on?

If yes:

After verifying that the connections from the front panel On/Off button back to the A4 CPU board are not at fault, replace the A4 CPU board.

If no:

Replace the A6 Power Supply assembly.

NOTE Before replacing the power supply, verify the midplane and motherboard interconnects are mechanically secure.

Fan(s) Are Not Operating

Control of the instrument fans comes from the A6 Power Supply assembly. This signal is routed from the A6 Power Supply through the A7 Midplane board, where there is a test point and LED to monitor the level, and is then routed to the A8 Motherboard where it is filtered before being sent to the Fans. When the Fans do not come on it could be due to any one of these assemblies. This procedure will help to determine which one is the cause.

This procedure assumes that the green Power On LED on the front panel does turn on when the instrument is turned on. If it doesn't, refer to the "Green Power On LED Does Not Illuminate" section before proceeding.

1. The instrument fans will only turn on when the instrument is connected to an AC source that has a voltage level and frequency of that specified for the instrument and the front panel On/Off button has been pressed. Before proceeding verify that these requirements are being met. Refer to the instrument rear panel for these requirements.
2. Remove the AC power cord and then remove the instrument cover. Refer to the Chapter 15, "Assembly Replacement Procedures", on page 451 in this manual.
3. Are both fans not spinning?

If yes:

Proceed to step 4.

If no:

Proceed to step 6.

4. Remove the MP7 Top Brace. Refer to Chapter 15, "Assembly Replacement Procedures", on page 451 in this manual.
5. Refer to Figure 2-5, verify that the Fan LED on the A7 Midplane board is on. Is the Fan LED on?

If yes:

Measure the voltage level at TP1 on the A7 Midplane board. Is the TP1 voltage between +7 and +15 VDC

If yes:

Proceed to step 6.

If no:

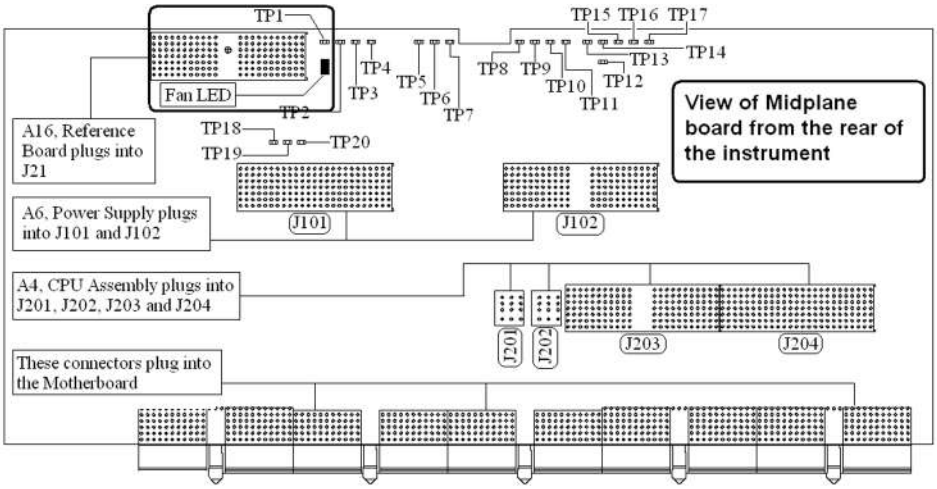
Replace the A6 Power Supply assembly.

If no:

Replace the A6 Power Supply assembly.

NOTE Before replacing the power supply, verify the midplane and motherboard interconnects are mechanically secure.

Figure 2-5 A7 Midplane Board - Fan LED



6. With the instrument turned off, and the AC power cord removed, remove the Fan Assembly including unplugging both fans from the A8 Motherboard. Refer to Chapter 15, “Assembly Replacement Procedures”, on page 451 in this manual.
7. Turn the instrument power back on and measure the fan voltage at both of the fan connectors (J6 & J7) on the A8 Motherboard.

   Both connectors have three pins. The outer conductors on both connectors are the FAN_P supply and the center conductors are FAN_N. The voltage between FAN_P and chassis ground should be between +7 and +15 VDC on both connectors.

   Does the A8 Motherboard fan connector for the fan(s) that do not work have the required voltage level?

If yes:

Replace the fan(s) that is not working

If no:

After verifying that the connections between the A7 Midplane board and the A8 Motherboard are mechanically and electrically secure replace the A8 Motherboard.

No Keysight Splash Screen Displayed

(Black background with white “Keysight Technologies” text)

A problem of not displaying the Keysight splash screen could be caused by many different things. It could be due to a down power supply, a processor hardware problem, an instrument boot-up process error, a display section failure, etc.

This procedure assumes that the green Power On LED on the front panel does turn on when the instrument is turned on. If it doesn't, refer to the “Green Power On LED Does Not Illuminate” section before proceeding.

1. Remove the AC power cord and then remove the instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures”, on page 451 in this manual.
2. Remove the MP7 Top Brace. Refer to Chapter 15, “Assembly Replacement Procedures”, on page 451 in this manual.
3. With the AC power applied and the On/Off button turned on, verify that all of the power supply voltages are at their proper level. This can easily be done by viewing the power supply LEDs on the back side of the A7 Midplane board. See “A7 Midplane Assembly Troubleshooting” on page 353 of this manual.

   Are all of the power supply voltages at the proper level?

If yes:

Proceed to step 4.

If no:

After verifying that the connections between the A6 Power Supply, the A7 Midplane board, and the A8 Motherboard are all mechanically and electrically secure, replace the A6 Power Supply assembly.

4. Connect an external VGA monitor to the rear panel display output and cycle power on the analyzer.

   Does the external monitor display the correct information?

If yes:

Proceed to the “Troubleshooting a Blank Display” section in this chapter.

If no:

Replace the A4 CPU Board assembly.

Instrument Hangs at the Keysight Splash Screen

A problem of the instrument hanging at the Keysight splash screen could be caused by many different things. It could be due to a down power supply, a processor hardware problem, an instrument boot-up process error, etc.

1. Remove the AC power cord and then remove the instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures,” in this manual.
2. Remove the MP7 Top Brace. Refer to Chapter 15, “Assembly Replacement Procedures”, on page 451 in this manual.
3. With the AC power applied and the On/Off button turned on, verify that all of the power supply voltages are at their proper level. This can easily be done by viewing the power supply LEDs on the back side of the A7 Midplane board. See “A7 Midplane Assembly Troubleshooting” on page 353 of this manual.

   Are all of the power supply voltages at the proper level?

If yes:

After verifying that the connections from the A7 Midplane board to the A4 CPU board are not at fault, replace the A4 CPU board.

If no:

After verifying that the connections between the A6 Power Supply, the A7 Midplane board, and the A8 Motherboard are all mechanically and electrically secure, replace the A6 Power Supply assembly.

PCI Enumeration Error

When the instrument is first booting up it runs some BIOS level self tests, one of which is that of the devices on the PCI bus. If there is a problem with a device on the PCI bus a “PCI enumeration” error may be seen on the boot screen. Since the only assembly connected to the PCI bus, other than the A4 CPU board, is the A3 Digital IF assembly, try removing this assembly and rebooting the instrument to see if the error goes away. Of course, you will have other error messages due to this assembly being missing, but this will allow you to isolate this particular error.

Instrument Cannot Completely Load or Run the Operating System

A problem of the instrument not loading the operating system can be caused by a few different things. It could be due to a down power supply, a processor hardware problem, an instrument boot-up process error, corrupt hard drive, etc.

This procedure assumes that the instrument can get past the Keysight splash screen at power on. If it doesn't, refer to the "Instrument Hangs at the Keysight Splash Screen" section before proceeding.

1. **Verify that there are no external USB storage devices connected to the instrument.**
2. **Does the instrument get far enough along in the boot process to run the "Keysight Recovery System"?**

If yes:

Run the "Keysight Recovery System" by referring to the "Disk Drive Recovery Process" on page 338. If this does not correct the problem replace the A5 Hard Disk Drive.

If no:

Replace the A5 Hard Disk Drive.

Troubleshooting a Blank Display

This section is intended to troubleshoot a display system problem that would cause the internal LCD to be blank. It is assumed that the rest of the instrument is booting up and functioning properly. To determine if the problem is an internal display issue only, connect an external VGA monitor to the rear panel display output. If the rear panel display output is also not working go to the "No Keysight Splash Screen Displayed" section in this chapter.

Once it has been determined that the rest of the instrument appears to be functioning properly there are a few possible problems that could be causing the display to be blank. They are:

- An LCD Backlight inverter problem
- A video signal path integrity problem
- A video controller / LCD problem

Verify Video Signal Path Integrity

The video controller is located on the A4 Processor assembly and is routed to the front panel LCD through a few interconnections. These interconnections are:

- A4 Processor assembly to A7 Midplane Board
- A7 Midplane Board to A8 Motherboard assembly
- A8 Motherboard assembly to A1A2 Front Panel Interface assembly via W1 ribbon cable
- A1A2 Front Panel Interface to A1A3 LCD via A1W1 flex-circuit

If all of these connections are properly made and none of the cables are damaged proceed to **"Video Controller / Touch Screen Display Troubleshooting"**.

Video Controller / Touch Screen Display Troubleshooting

The video controller is located on the A4 Processor assembly. The video signals that the controller outputs are LVDS. As described above, these signals are routed to the touch screen display via the A7 Midplane Board, A8 Motherboard, and A1A2 Front Panel Interface board.

On the A1A2 Front Panel Interface board the LVDS signals are buffered and then sent to the touch screen display via the A1W1 Flex circuit.

The most likely cause for a video problem is the A4 Processor assembly; however it could be the result of a defective touch screen display.

Initializations Did Not Complete

During the initialization of the MXA Signal Analyzer Application the following messages will be displayed on the application splash screen:

- Checking for required services (1 of 7)
- Initializing License Services (2 of 7)
- Initializing Message Services (3 of 7)
- Initializing Hardware (4 of 7)
- Initializing Data Services (5 of 7)
- Initializing SCPI Services (6 of 7)
- Initializing Front Panel EEPROM Services (7 of 7)

If there is a problem with any of these initializations not completing or causing an error message to be displayed refer to the instrument Event Log. This can be accessed by using an external USB keyboard and mouse and selecting Start, Command Prompt, enter Eventvwr.exe, and select OK.

Once the Event Viewer comes up, look under SA for the latest error entries. Double-click on the entries to view further details, which should give you some idea of what the problem is.

Fails an Initial Alignment

Troubleshooting Alignment Failures Using the Alignment History Text File

At instrument power on, an initial alignment is automatically performed. It is also possible to manually trigger an alignment by pressing **System**, **Alignments**, **Align Now**, **Align Now All**. The power on alignment performs a few more alignments than the manual Align Now All routine.

The number of alignments depends on the hardware options present in the signal analyzer.

Using an external USB keyboard and mouse, access the alignment history, which can be found in a text file at:

E:AlignDataStorage\AlignmentHistory.txt

You will find the most current alignment information at the bottom of this file. Look for the failed alignments. From the windows task bar you can click Edit, Find and type in FAILED and search for a failure.

Note that the information in the history file usually shows that multiple measurements are made for a given alignment routine, and measured values with upper and lower limits are given. For example, the Mechanical Attenuator Algorithm measures and displays all of the attenuator step values. In this case, you can view which steps fail, and by how much. Then based on the input attenuator drawing on the MXA RF Block Diagram, you can determine which attenuator steps are available on each of the two input attenuators. Then you can view the troubleshooting information for the Front End Controller or deduce from the attenuator steps that fail, which attenuator is faulty.

CAUTION

Assure there is no 50 MHz signal above 0 dBm applied to the signal analyzer input when the alignment routine is performed. This can cause errors.

The description of the alignment and the alignment hardware dependencies are listed in Table 2-1, “Initial Alignments,”**.**

Table 2-1 Initial Alignments

Alignment Description	Most Probable Hardware Failure	Related Hardware
Pre-tune 1st L.O. DAC	A14 L.O. Synthesizer	A16 Reference board is not providing correct 4.8 GHz signal
VCXO Tuning Curve (Power up alignment only) Measures the tuning voltage for the 100 MHz VCO at a number of different frequencies. Uses 10 MHz internal reference	A16 Reference	
VCXO Loop Bandwidth Adjusts gain of the PLL loop amplifier. Uses the 10 MHz internal reference	A16 Reference	
Dither Level Algorithm (4 measurements)	A3 Digital IF	
AIF LC Wide Prefilter Passband Tuning Algorithm Adjusts the LC prefilter centering with the prefilter BW set to about 1.12 MHz. Uses 322.5 MHz Comb Calibrator on the A-IF.	A2 Analog IF	
AIF LC Wide Prefilter Passband Fine Tuning Algorithm	A2 Analog IF	
AIF LC Narrow Prefilter Passband Tuning Algorithm Adjusts the LC prefilter centering with the prefilter BW set to about 413 kHz. Uses 322.5 MHz Comb Calibrator on the A-IF.	A2 Analog IF	
AIF LC Narrow Prefilter Passband Fine Tuning Algorithm	A2 Analog IF	
AIF Xtal Wide Prefilter Passband Tuning Algorithm Adjusts Centering, symmetry and dip of the crystal prefilter BW set to about 80 kHz Uses 322.5 MHz Comb Calibrator on the A-IF	A2 Analog IF	A3 Digital IF or A16 Reference

Table 2-1 Initial Alignments

Alignment Description	Most Probable Hardware Failure	Related Hardware
AIF Xtal Narrow Prefilter Passband Tuning Algorithm Adjusts Centering, symmetry and dip of the crystal prefilter BW set to about 13 kHz Uses 322.5 MHz Comb Calibrator on the A-IF	A2 Analog IF	
AIF Variable Gain Algorithm The Gain of the Analog IF System is measured and compared with the ideal gain value. Several conditions are tested, Dither on/ dither off, A-IF prefilter in and bypassed, alias filter set wide and narrow. Uses 322.5 MHz Comb Calibrator on the A-IF	A2 Analog IF	
AIF Step Gain Algorithm Measures the relative gain of the IF for high gain (10 dB) versus the low gain (0 dB) paths. In normal instrument operation these two states can be controlled by the user interface key called “Swept IF Gain”. Uses the Comb calibrator on the A-IF	A2 Analog IF	
AIF 140 Variable Gain Alignment Algorithm (Option B85, B1A, or B1X)	A25 Wideband A-IF	
LO Power Alignment Algorithm Measure max LO power then backs off for each band	A13 Front End Assembly or A15 Front End Controller	
AIF Variable Attenuator Algorithm Measures the gain in all settings of the A-IF 1 dB step attenuator. A reference power is measured with atten 4 dB The Comb calibrator on A-IF is used to provide a CW signal.	A2 Analog IF	
Mechanical Attenuator Algorithm Measures the attenuation of all DC coupled, and one AC coupled (10 dB) settings of the RF input attenuators. Reference atten setting is 10 dB	A9 and A10 RF Input Attenuators	50 MHz calibrator on A16 Reference

Table 2-1 Initial Alignments

Alignment Description	Most Probable Hardware Failure	Related Hardware
Electrical Attenuator Algorithm Each setting from 0 to 24 dB in steps of 1 dB is measured. The reference condition is electrical attenuator set to 0 dB and RF input attenuators set to 10 dB. (Option EA3)	A13 Front End	50 MHz calibrator on A16 Reference.
Electrical Attenuator Tail Algorithm Attenuation set to 0 dB (Option EA3)	A13 Front End	
Narrow Band Step Cal Alignment Algorithm		
Narrow Band Step Cal Adjustment Alignment Algorithm Recalled adjustment from calibration file. (Option B40)	Alignment signal originates on A3 D-IF, then goes through A16 Reference, through A13 Front End, through A2 Analog IF, and back to A3 Digital IF.	
DIF 40 Step Cal Adjustment Alignment Algorithm Recalled adjustment from calibration file. (Option B40)	Since this is wide band alignment done for 40 MHz BW signal path, A2 Analog IF is not included in the signal path.	
DIF 40 Step Cal Alignment Algorithm (Option B40)		
DIF 40 Variable Attenuator Algorithm Ref power at atten 21 dB (Option B40)	A3 Digital IF	
AIF 140 Variable Attenuator Algorithm Ref power at atten 12 dB (Option B85, B1A, or B1X)	A25 Wide band A-IF	
AIF 160 Band 0 Chirp Cal Alignment Algorithm (Option B85, B1A, B1X)	A25 Wide band A-IF	
AIF 160 μW Band Chirp Cal Alignment Algorithm (Option B85, B1A, B1X)	A25 Wide band A-IF	
E Cal Path System Gain Algorithm Measures the amplitude error of the low band signal path by injecting the 50 MHz E-Cal signal into the A13 Front End assembly. The E-Cal signal originates on the A16 Reference assembly.	Signal path from A13 Front End to A3 Digital IF	A16 Reference may not be providing 50 MHz E-Cal

Table 2-1 Initial Alignments

Alignment Description	Most Probable Hardware Failure	Related Hardware
Low Band Nominal Path System Gain Algorithm Aligns low band (3 Hz to 3.6 GHz path) with preamp and electronic attenuator OFF. Dependent on successful E-Cal alignment. Input attenuators set to 10 dB and DC coupled.	A13 Front End	50 MHz calibrator on A16 Reference. A9 and A10 Input attenuators
Low Band Preamp Path System Gain Algorithm Aligns low band (3 Hz to 3.6 GHz path) with preamp ON. Input attenuator set to 20 dB. (Options P03, P08, P13, P26, P32, P44, P50)	A13 Front End	50 MHz calibrator on A16 Reference. A9 and A10 Input attenuators
Low Band Elec Atten Path System Gain Algorithm Aligns low band with electronic attenuator in the signal path and set to 0 dB. (Option EA3)	A13 Front End	50 MHz calibrator on A16 Reference. A9 and A10 Input attenuators
Preselector Two Point Tuning Algorithm Aligns the YTF preselector centering near the maximum and minimum frequency points of the YTF. Uses the high band preamp noise as stimulus signal.	A12 YTF Preselector or A15 Front End Controller or All Low Band	A13 Front End
High Band Nominal Path System Gain Algorithm	Anything in Band 1 signal path	4800 MHz calibrator on A16 Reference
High Band Preamp Path System Gain Algorithm Measures change in signal level with high band preamp turned ON and OFF. Input attenuator set to 30 dB. (Options P03, P08, P13, P26, P32, P44, P50)	A11 Low Band Switch	4800 MHz calibrator on A16 Reference A9 and A10 Input attenuators A15 Front End Controller
High Band Preselector Bypass Path System Gain Algorithm A12 YTF Preselector is bypassed and amplitude of 4800 MHz calibrator measured. System gain is then computed. (Option MPB)	SW1 and SW2, coax switches and cabling (Options 503, 508, 513, 526)	A15 Front End Controller 4800 MHz calibrator on A16 Reference A9 and A10 Input attenuators

Table 2-1 Initial Alignments

Alignment Description	Most Probable Hardware Failure	Related Hardware
High Band Preselector Bypass Preamp Path System Gain Algorithm (Option MPB)	A11 Low Band Switch SW1, SW2, or SW4 Preselector Bypass Switches	
Burst Carrier Trigger Curve Fit Algorithm Detects the level of the signal envelope before filtering at the 22.5 MHz IF, and compares that detected level against the trigger threshold DC level.	A2 Analog IF	
Trigger Interpolation	A3 Digital IF	
DIF 25 Pulse Stretcher Alignment Algorithm	A3 Digital IF	
DIF 40 Pulse Stretcher Alignment Algorithm Adjusts time between trigger and clock signal. (Option B40)	A3 Digital IF	
WBDIF Pulse Stretcher Alignment Algorithm (Option B85, B1A, or B1X)	A26 WBDIF	
DC Offset Alignment Algorithm (Option BBA)	A19 BBIQ Main A18 BBIQ Interface	

Signal Level Verification

Signal Level Problem with Input Frequencies < 3.6 GHz

Measure the 50 MHz RF calibrator signal level by pressing **Input/Output**, **RF Calibrator**, **50 MHz**. Now press **FREQ**, and input **50 MHz**, **Span**, **1 MHz**, **Peak Search**. If the analyzer is functioning correctly in low band, the 50 MHz calibrator level should be –25 dBm ± 2 dB. See the figure below.

Is the signal level correct?

If yes:

The analyzer low band path is functioning properly at least at 50 MHz.

If no:

Refer to Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this manual.

NOTE

It is possible that other input frequencies < 3.6 GHz could have an amplitude problem even though the 50 MHz calibrator is within tolerance. Using the internal RF calibrator provides a quick check of the low band path.

Signal Level Problem with Input Frequencies > 3.6 GHz

Measure the 4.8 GHz RF calibrator signal level by pressing **Input/Output**, **RF Calibrator**, **4.8 GHz**. Now press **FREQ**, **4.8 GHz**, **Span**, **1 MHz**, **Peak Search**. If the analyzer is functioning correctly in high band, the 4.8 GHz calibrator level should be –28 dBm ± 2 dB. See the figure below.

Is the signal level correct?

If yes:

The analyzer high band path is functioning properly at least at 4.8 GHz.

If no:

Refer to Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)" in this manual.

NOTE

It is possible that other input frequencies > 3.6 GHz could have an amplitude problem even though the 4.8 GHz calibrator is within tolerance. Using the internal RF calibrator provides a quick check of the high band path.

3 Instrument Messages

Introduction

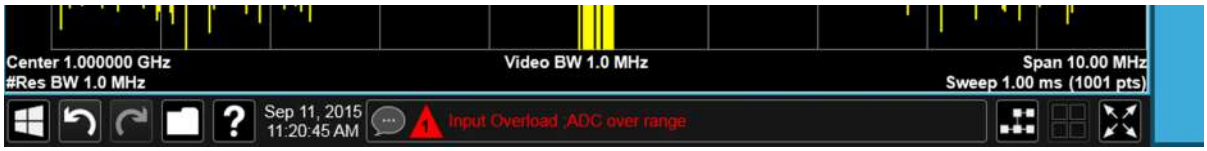
The Error and Status messaging system of the instrument reports events and conditions in a consistent fashion, as well as logging and reporting event history.

Event vs. Condition Messages

- An Event is simply a message indicating that something has happened. Events are sub-divided according to their severity, into Error, Warning or Advisory categories. The sub-divisions are described in more detail in the section "Event and Condition Categories" on page 72.
- A Condition is a state of the instrument, which is characterized by a Detection event and a Clearing event. Conditions may be Errors or Warnings.

  Event and Condition messages appear in the Status Bar at the bottom of the analyzer's display screen, as shown in Figure 3-1 below.

Figure 3-1 Instrument Message Line & Status Panel



Event and Condition Categories

The three categories of severity are described below, for both Events and Conditions.

Errors

Error messages appear when a requested operation has failed. (For example, “Detector not available”, “File not saved”.) Error messages are often generated during remote operation when an invalid programming command has been entered. (For example, “Undefined header”.)

Some errors are conditions rather than single events. They exist for a period of time, so they have associated “Detected” and “Cleared” events. (For example, “LO Unlocked” or “External reference out of range”.)

Error messages appear in the Status Bar at the bottom of the display. A message remains until you press a key, or another message is displayed in its place.

Error messages are logged in the error queues. If the error is a condition, both the Detected and Cleared events are logged.

Warnings

Warning messages appear when a requested operation has completed successfully, but there are modifications and/or side effects. (For example, if you requested too high a stop frequency, then “Data out of range” is displayed and the analyzer sets itself to the highest available stop frequency.)

Some warnings are conditions rather than single events. They exist for a period of time, so they have a “Detected” event and a “Cleared” event. (For example, if you set the sweep time too fast for a measurement to meet the instrument specifications then the “Meas Uncal” message is displayed until you slow down the sweep time.)

Warning messages appear in the Status Bar at the bottom of the display. The message remains until you press a key, or another message is displayed in its place.

Warnings are logged in the error queues. If the warning is a condition, both the Detected and Cleared event messages are logged.

Advisories

Advisory messages tell the front panel user some useful information. (For example, “File saved successfully” or “Measuring the fundamental”.)

Advisory messages appear in the Status Panel at the bottom of the display. The message remains until you press a key, or another message is displayed in its place.

Advisory messages are not logged in the error queues.

Grayout messages are a special type of Advisory, which appear when you attempt to access a function that is not available. This could be a grayed out front panel key, or an inappropriate SCPI command. There are two types of grayout messages: Benign and Forced.

1. **Benign**: the requested function is not available because it does not make sense with the current instrument settings. Changing it does not affect the current measurement. (For example, setting the number of FFTs/Span when you are not in the FFT mode.)

   A benign grayout gives an Advisory type of message only when the front panel key is pressed.

   The requested function cannot be changed from the front panel, but it can be changed remotely.

2. **Forced**: the requested function is not available either because changing it would cause an invalid measurement, or because of hardware limitations, or because the selection conflicts with other settings. (For example, selecting the electrical attenuator when the frequency span includes frequencies above 3.6 GHz.)

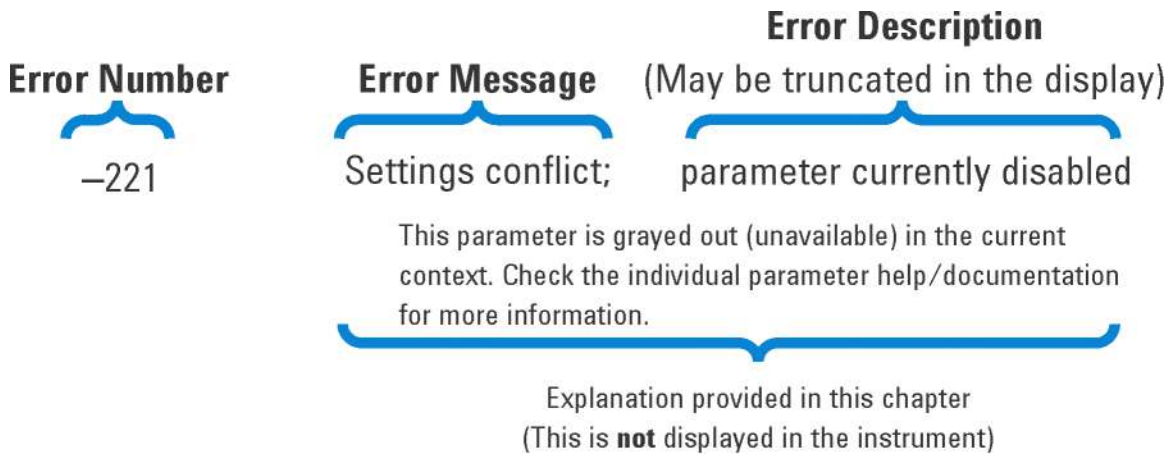
   A forced grayout function cannot be changed either from the front panel or remotely. It generates a special type of Advisory message. It also only appears on the front panel when the key is pressed. Remotely, the message will appear in the event queue as a warning “-221, Settings conflict; <conflict description>”.

Event Message Format

The event messages are listed in numerical order according to their message number. Advisory messages do not have numbers, and are listed in alphabetical order.

An explanation is included with each error to further clarify its meaning. Some errors are specified in industry standards, and may include references to Section 21.8 of the 1999 SCPI Syntax & Style Standard (http://www.ivifoundation.org/docs/scpi-99.pdf).

Figure 3-2 Error Message Example



Event Queues

There are several different event queues that are viewed/queried and managed separately. Note that Conditions are logged in the queues as pairs of events: a “Detected” event and a corresponding “Cleared” event.

Table 3-1 Event Queue and Display Types

Front Panel Status (Current Conditions)	Displayed as a list in the **Current Conditions** tab of the Status Dialog. The Status/Current Conditions list shows existing conditions. When an event is caused by a command sent over a remote interface, the resulting messages are logged in the queue for that interface. For convenience, such Events are also logged in the Front Panel queue.
Front Panel Event History	Displayed as a list in the **History** tab of the Status Dialog. The History list shows all the events that have occurred since the instrument was turned on, up to a maximum of 100 messages. When an error situation is caused by a command sent over a remote interface, the resulting messages are logged in the queue for that interface. For convenience, they are also logged in the Front Panel queue.
Remote interfaces	When an error event is caused by a command sent over a remote interface, the resulting messages are output to the queue for that interface. To return an error, you must query the queue for that interface. An error event that is caused by a front panel action is not reported to any remote interface queue. However, a status condition is usually caused by an internal event that is not related to a particular interface, so the Detected/Cleared Events for status conditions are reported to all the queues.

Table 3-2 Characteristics of the Event Queues

Characteristic	Front-Panel Status	Front-Panel History	Remote Interfaces (GPIB/LAN)
Viewing Entries	Tap anywhere in the Status Bar	Tap the Message Indicator balloon in the Status Bar	Send SCPI query to the desired interface: `:SYSTem:ERRor?`
Clearing the Queue	Select the History tab of the Status Dialog, then tap **Clear Message Queue** Clears the messages in all the queues.	Select the History tab of the Status Dialog, then tap **Clear Message Queue** Clears the messages in all the queues.	Send `*CLS` command to the desired interface. Clears messages in the queue for this particular interface only.

Table 3-3 Summary of Event Reporting Modes

Event Type	SCPI Error Queues	Front Panel History Queue	Status Panel Display
Error/Warning/Advisory Event	Logged	Logged	Displayed via Message Box
Error/Warning Condition: Detected (Start) Event	Logged[a]	Logged[a]	Displayed via Message Box
Error/Warning Condition: Cleared (End) Event	Logged[b]		
Grayout Advisory (Benign)	Not logged	Logged	Displayed via Message Box
Grayout Advisory (Forced)	See note[c]	Logged	Displayed via Message Box

a. Logged with the same severity (Error or Warning) as the Condition
b. Logged with a “green” severity (Condition Resolved)
c. Not logged, unless the cause of the Advisory was remotely generated, in which case a Warning message, type –221, is logged.

Advisory Messages

An advisory is simply a message that lets you know something useful; for example “File saved successfully” or “Measuring fundamental.” Operation completion and running status indications are common types of advisories. Advisories have no number and are not logged in the error queue.

Advisories have no number and are not logged in the error queue. They are not defined in the 1999 SCPI Syntax and Style Standard.

Advisories include gray-out “settings conflict” errors. These gray-outs are benign (that is, changing them has no impact on the current measurement).

Advisories are Events only. They are never conditions.

Message	Description/Correction Information
`All Auto/Man functions have been set to Auto`	Message generated by pressing the Auto Couple front-panel key
`Allowable Center Frequency exceeded for the current span`	When rotating the knob or step up/down keys to change the Center frequency, the value of the Span is kept constant. Therefore, the center frequency is limited by the frequency range of the instrument
`Allowable Span exceeded for the current center frequency`	When rotating the knob or step up/down keys to change the Span, the value of the Center frequency is kept constant. Therefore, the span is limited by the frequency range of the instrument
`Allowable Start Frequency exceeded for the current span`	When rotating the knob or step up/down keys to change the Start frequency, the value of the Span is kept constant. Therefore, the start frequency is limited by the frequency range of the instrument
`Allowable Stop frequency exceeded for the current span`	When rotating the knob or step up/down keys to change the Stop frequency, the value of the Span is kept constant. Therefore, the stop frequency is limited by the frequency range of the instrument
`Already in Single, press Restart to initiate a new sweep or sequence`	The instrument is already in the single state. If you want to start a new sweep or sequence, press the **Restart** key instead
`Auto sweep time rules do not apply in FFT sweeps`	FFT sweeps do not use the auto sweep time rules, so the rules setting cannot be changed from the front panel. The setting can be changed remotely and it will have no effect on the current operation unless the analyzer is switched out of FFT sweeps
`Band Adjust has no effect on a Fixed marker`	If a Marker is a Fixed type marker, the marker's value does not change from when it first became fixed. So you cannot change the band of a fixed marker
`Band Adjust has no effect with Mkr Function Off`	If Marker Function is off, changing the band has no effect
`Band-pass filter set to OFF`	Turning on any high-pass or low-pass filter turns off band pass filters

Message	Description/Correction Information
`Cal Cancelled; Calibration data cleared`	User has canceled the cal either directly or indirectly by changing the setup parameters. The current cal data has been erased. Perform a new user cal to obtain calibrated results again
`Cal Invalid: meas freq pt(s) > 3.6GHz are > 50MHz from existing Cal pts`	When freq points being measured are above 3.6 GHz and a calibration has been successfully performed, and the number of points are changed, the new points are required to be within 50 MHz of the current cal points or the preselector optimize frequencies become inaccurate and the whole cal needs to be invalidated. Interpolation of the cal can only be performed if the new freq points are within 50 MHz of the cal points. To overcome this problem, change the number of freq points back to match cal points or perform another user cal
`Carrier power is too low for optimum dynamic range.`	For better dynamic range, transmit band spur measurements require >10 dBm signal power at the RF input port
`Connecting to source…`	The External Signal Generator is being interrogated via SCPI, to see whether it is suitable for the instrument to control. Please wait until complete before pressing any buttons
`Demod Time is not available in Zero Span`	The Demod Time function is not available in zero span because in zero span we are **always** demodulating
`Detector <X> changed due to physical constraints`	You have selected more detectors than the instrument hardware can implement. An existing detector selection has been changed to allow the current detector choice to be selected. <X> indicates the trace number for which the detector was changed
`Dynamic range is not optimum. Set AUTO RF input.`	
`Exp. Averaging not available when AUTO PhNoise is active.`	
`FFT Width is not settable unless Sweep Type is set to FFT`	You must select the FFT sweep type before you can set the FFT Width
`File <filename> saved`	The file save operation executed successfully
`Filter BW function is only available for Gaussian filter type`	Flattop and CISPR/MIL filters have defined shapes that cannot be altered. Only the Gaussian filter type allows filter bandwidth definition changes
`Fixed LO freq should be greater than RF Stop freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO fixed freq should be greater than the RF freq's for an LSB or DSB (for DSB measurements the setup uses LSB values) downconverter setup. Use the graph icon on the DUT setup form to clarify the setup required

Message	Description/Correction Information
`Freq Scale Type=Log is not available in Zero Span`	Logarithmic scaling cannot be used for time domain sweeps (0 Hz span)
`Frequency Hopping enabled, waiting for valid burst`	The demodulated burst type has not been found in the originally demodulated slot location within the frame
`Frequency menu has changed to reflect frequency context switch`	The frequency context parameter has been changed either by the user or the system. The frequency menu will now contain the frequencies for the new context. No action required
`Gate required for valid results`	
`High-pass and Low-pass filters set to OFF`	Turning on any band pass filter will turn off high-pass and low-pass filters
`High-pass filter set to OFF`	Turning on any band pass filter will turn off high-pass filters
`IF Fixed freq should be greater than LO Stop freq`	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The IF fixed freq should be greater than the LO Stop freq for a USB upconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`IF Fixed freq should be greater than RF Stop freq`	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The IF fixed freq should be greater than the RF Stop freq for an upconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`IF Start freq should be greater than LO Fixed freq`	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The IF start freq should be greater than the LO fixed freq for an USB upconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`IF Start freq should be greater than RF Start freq`	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The IF start freq should be greater than the RF Start freq for an upconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`Input is internal`	The instrument's input is set to internal (the internal amplitude reference signal). So any signals connected to the front/rear panel inputs cannot be measured
`LO Fixed freq should be greater than IF Stop freq`	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO fixed freq should be greater than the IF Stop freq for an LSB upconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required

Message	Description/Correction Information
LO Fixed freq should be greater than RF Stop freq	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO fixed freq should be greater than the RF Stop freq's for an LSB or DSB (for DSB measurements the setup uses LSB values) downconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
LO Start freq should be greater than IF Fixed freq	The setup frequencies break the rules for an upconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO Start freq should be greater than the IF fixed freq for an LSB upconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
LO Start freq should be greater than RF Start freq	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO start freq should be greater than the RF Start freq's for an LSB downconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
LO Stop freq should be greater than RF Stop freq	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The LO Stop freq should be greater than the RF Stop freq's for a DSB (for DSB measurements the setup uses LSB values) downconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
Low-pass filter set to OFF	Turning on any band pass filter will turn off low-pass filters
No spurs have been found	You started a measurement in examine meas type in single or continual sweep mode, or full meas type in single sweep mode, but no spurs were found
Preparing Calculation…	
Preselector is centered	The preselector has been successfully centered
Preselector not used in this frequency range.	You cannot center or adjust the preselector because it is not used at all at the current marker frequency or between the current start and stop frequencies
Probe connected, cal data is being reapplied; <port>; <probe>	A probe has been connected, calibration data is being reapplied
Probe connected, no probe cal; using cable cal data; <port>; <probe>	A probe has been connected and no probe calibration data is available. The latest cable calibration data will be used
Probe disconnected, reverting to cable calibration data; <port>	A probe has been disconnected, calibration data reverting to the last cable calibration data
Reading SNS data…	The Keysight Smart Noise Source has been connected and the application is reading the device EEPROM data. Please wait until complete before continuing
Recalled File <filename>	A file recall (open/load) was successfully completed

Message	Description/Correction Information
`Refer to online help for assistance with DSB measurements`	The Double Side Band measurement requires careful setup to obtain valid results. Please refer to the manuals for help with this setup
`Requested timeslot number is not present.`	The selected timeslot is not on. (Timeslot is referenced to the trigger point)
`RF Start freq should be greater than IF Fixed freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The RF Start freq should be greater than the IF Fixed freq for a DSB (for DSB measurements the setup uses LSB values) downconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`RF Start freq should be greater than IF start freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The RF start freq should be greater than the IF Start freq's for an LSB downconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`RF Start freq should be greater than LO fixed freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The RF start freq should be greater than the LO fixed freq's for an USB downconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`RF Start freq should be greater than LO Start freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The RF start freq should be greater than the LO Start freq's for an USB downconverter swept LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`RF Stop freq should be greater than IF Stop freq`	The setup frequencies break the rules for a downconverter measurement. The measurement will still run, but check setup frequencies are correct before continuing. The RF Stop freq should be greater than the IF Stop freq's for an USB or DSB (for DSB measurements the setup uses LSB values) downconverter fixed LO setup. Use the graph icon on the DUT setup form to clarify the setup required
`Scale/Div only applies in Log Y Scale`	Setting the Scale/Division only makes sense when you are using a logarithmic Y scale
`Signal Track is turned off when Zero Span is selected`	Signal Track is not available when you have selected Zero Span. So if Zero Span is entered while in Signal Track is On, Signal Track is turned off
`Signals deleted`	The signals in the signal list were successfully deleted
`Sweep Points/Span is < minimum. Results may be inaccurate.`	The sweep point to span ratio is below the minimum required to ensure the bucket ratio is large enough to test DVB-T masks
`Sweep Setup is not available in Zero Span`	Zero span is a display at a single frequency, so there is no "sweeping" to set up

Message	Description/Correction Information
`Sync is RF Ampl (not Training Sequence). Bits are not accurate.`	
`Trace file saved.`	The trace saving operation was successful
`Use Gate View Sweep Time in the Gate menu.`	When in Gate View you use Gate View Sweep Time, rather than Sweep Time, to control the Gate View window
`User Cal valid. Apply Cal from Meas Setup menu`	The measurement setup has changed such that the current cal data can be applied to the results. To apply the cal, press Meas Setup/Cal Setup/Apply Calibration. A new cal can be performed if required

Event Messages

Event messages are displayed in the MSG area in the bottom left of the instrument display. Event messages and message numbers are defined by the SCPI standard.

In the X-Series, sub-messages are often attached to add additional information, to help you better understand the event being reported. For example, error –221 is defined as `Settings Conflict`, but in the X-Series you will often see a longer message appended to error –221, such as `Settings Conflict; Function not available in Zero Span`. This helps you understand the exact cause of the Settings Conflict error.

–800, Operation Complete Event

Err#	Message	Verbose/Correction Information
–800	`Operation complete`	The instrument has completed all selected pending operations in accordance with the IEEE 488.2, 12.5.2 synchronization protocol

–700, Request Control Event

Err#	Message	Verbose/Correction Information
–700	`Request control`	The instrument requested to become the active IEEE 4881 controller-in-charge

–600, User Request Event

Err#	Message	Verbose/Correction Information
–600	`User request`	The instrument has detected the activation of a user request local control

–500, Power on Event

Err#	Message	Verbose/Correction Information
–500	`Power on`	The instrument has detected an off to on transition in its power supply

–400 to –499, Query Errors

Err#	Message	Verbose/Correction Information
–400	`Query Error`	There was a problem with a query command. The exact problem cannot be specifically identified
–410	`Query INTERRUPTED`	Some condition caused an INTERRUPTED query to occur. For example, a query was followed by DAB or GET before a response was completely sent
–420	`Query UNTERMINATED`	Some condition caused an UNTERMINATED query to occur. For example, the device was addressed to talk and an incomplete program message was received
–430	`Query DEADLOCKED`	Some condition caused a DEADLOCKED query to occur. For example, both the input buffer and the output buffer are full and the analyzer cannot continue. The analyzer automatically discards output to correct the deadlock
–440	`Query UNTERMINATED after indefinite response`	A query was received in the same program message after a query requesting an indefinite response was executed

–300 to –399, Device-Specific Errors

Err#	Message	Verbose/Correction Information
–300	`Device-specific error`	An instrument error occurred and the exact problem cannot be specifically identified. Report this error to the nearest Keysight Technologies sales or service office
–310	`System error;`	An internal system-type error has occurred. The exact problem cannot be specifically identified. Report this error to the nearest Keysight Technologies sales or service office
–310	`System error; A license will soon expire;<feature code> will expire in <time>`	The indicated feature/software will expire in the specified time. Contact Keysight Technologies to purchase continued use of this functionality
–310	`System Error; enable GPIB controller mode`	Press **System, I/O Config, GPIB** and set GPIB Controller to Enabled so that the analyzer can control the source over GPIB
–310	`System error; Error transmitting a LAN event to the network.`	Communication with the network driver failed
–310	`System error; Failed to initialize the PTP clock to current time.`	Failure communicating with the DMC libraries' PTP controller
–310	`System error; Failed to instantiate the PTP ordinary clock.`	Failure in the starting up the DMC libraries' PTP controller
–310	`System error; feature <feature code> not licensed`	The specified feature, for example "N9073A-TR2", is not licensed. The license may have expired. You cannot use it until you obtain a license
–310	`System error; Feature expired; <feature code>`	The specified feature has expired. The license is no longer valid
–310	`System error; License installation failed;<feature code>`	The license installation of the specified feature, for example "N9073A-TR2", has failed. You should refer to the event log in the control panel for more details
–310	`System error; License removal failed; <feature code>`	The license removal of the specified feature, for example "N9073A-TR2" has failed. You should refer to the event log in the control panel for more details
–310	`System error; No license; <feature code> will terminate in <time>`	The specified feature will stop working in the specified time due to the license expiration You will be prompted to save results and exit

Err#	Message	Verbose/Correction Information
–310	`System Error; No supported source found`	Signal source at given IP address is not responding / IP does not belong to a source. Check IP address and network connection
–310	`System Error; source connection lost, check interface connection`	Signal source at given IP address is not responding / IP does not belong to a source. Check IP address and network connection
–310	`System error; The configured PTP hardware driver could not be instantiated.`	The PTP driver failed on initialization
–310	`System error; The PTP hardware driver reported a configuration error.`	Failure in the execution of the PTP driver. The most likely cause of this error is a mismatch between versions of the PTP driver and the LXI middleware
–310	`System error; The PTP ordinary clock reported a configuration error.`	Failure in execution of the DMC libraries' PTP controller
–310	`System error; The Trigger alarm delayed LAN event was not scheduled due to an existing pending event.`	Delayed LAN events cannot occur too close together (within 20 ms)
–310	`System error; The Trigger alarm delayed LAN event was not scheduled due to a conflict with an existing scheduled alarm.`	Delayed LAN events cannot occur too close to a scheduled Alarm (within 20 ms)
–310	`System error; The Trigger alarm was not scheduled due to a conflict with an existing scheduled alarm.`	Alarms cannot be scheduled to happen too close together (within 20 ms)
–311	`Memory error`	There is a physical problem with the instrument memory, such as a parity error
–312	`PUD memory lost`	Protected user data saved by the *PUD command has been lost
–313	`Calibration memory lost`	The nonvolatile calibration data used by the *CAL? command has been lost

Err#	Message	Verbose/Correction Information
–314	`Save/recall memory lost`	The nonvolatile data saved by the *SAV? command has been lost
–315	`Configuration memory lost`	The nonvolatile configuration data saved by the instrument has been lost
–320	`Storage fault;`	A problem was found while using data storage. The error is not an indication of physical damage or failure of any mass storage element
–321	`Out of memory`	An internal operation needed more memory than was available. Report this error to the nearest Keysight Technologies sales or service office
–330	`Self-test failed`	A self-test failure occurred. Report this error to the nearest Keysight Technologies sales or service office
–340	`Calibration failed`	The instrument requires an Align All Now. Restore the alignment by pressing **System, Alignments, Align All Now**
–340	`Calibration failed; <failure msg> <port>`	The calibration for one of the I-Q ports did not succeed. The information in the “failure msg” field can be used to troubleshoot this problem. Contact Keysight technical support
–350	`Queue overflow`	An error occurred that did not get put in the error queue because the queue was full
–360	`Communication error`	There was a problem with instrument remote communications. The exact problem cannot be specifically identified
–360	`Communication error; SNS data read failure. Disconnect then reconnect SNS`	The Keysight Smart Noise Source connected to the instrument has failed to be read by the application. Please disconnect and reconnect the SNS. If this continues to fail, then the SNS may have had its EEPROM corrupted or another hardware fault exists. Check SNS on another instrument, NFA and ESA are also SNS compatible instruments. Check that the device is not an Keysight power sensor which uses the same cable interface
–360	`Communication error; SNS is not connected`	The Keysight Smart Noise Source connected to the instrument has failed to be read by the application. Please disconnect and reconnect the SNS. If this continues to fail, then the SNS may have had its EEPROM corrupted or another hardware fault exists. Check SNS on another instrument, NFA and ESA are also SNS compatible instruments. Check that the device is not an Keysight power sensor which uses the same cable interface
–361	`Parity error in program message`	A parity bit was not correct when the data was received. For example, on a parallel port
–362	`Framing error in program message`	A stop bit was not detected when data was received. For example, on a remote bus port
–363	`Input buffer overrun`	A software or hardware input buffer on a port overflowed with data because of improper or nonexistent pacing
–365	`Time out error`	There was a time-out problem in the instrument. The exact problem cannot be specifically identified

–221 Settings Conflict Errors

This is one of the errors in the standard SCPI error range –200 to –299. For all other errors in this range, see "–200 to –299, Execution Errors" on page 99.

Err#	Message	Verbose/Correction Information
–221	`De-emphasis only available in FM`	The de-emphasis function is only available if FM demod is selected
–221	`Function not available in Zero Span`	The function you are trying to access is not available in zero span
–221	`Setting conflict; <trigger source> trigger is not available while input is <input port>`	The trigger source (Video, RF Burst, I/Q Mag, etc.) is not available with the current input port (RF, IQ, etc.)
–221	`Setting conflict; Differential setting determined by probe type`	A probe is connected that has a built in Differential setting. The setting cannot be changed manually
–221	`Setting conflict; Input Z unavailable when probe sensed`	A probe is connected and the Input Z is set based on the probe type. It cannot be changed manually
–221	`Settings conflict;`	A legal command was received but it could not be executed due to the current device state
–221	`Settings conflict; *.CSV file format is not available in this measurement.`	You cannot load or save base instrument traces, as this is not supported by the Log Plot measurement
–221	`Settings conflict; <Q Param> cannot be changed when Q same as I`	When the **Q Same as I** parameter is set to Yes, the I parameter value is copied to <Q Param> and the <Q Param> value cannot be changed. Set **Q Same as I** to No to enable explicit control of the <Q Param> value
–221	`Settings conflict; A Valid User Cal is required. Optimize aborted`	Optimize Preselector can only be performed if a valid user cal exists and is applied to current results. Perform a user cal first or apply existing cal
–221	`Settings conflict; Auto Tune not available in Tracking Source mode`	The Auto Tune feature cannot be used when you are using a Tracking Source
–221	`Settings conflict; BTS gain is not available in this Mode`	Base Transceiver Station gain correction is not available in some Modes, or in some measurements (for example, the SA measurement)

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Cal only available when Source Mode is Tracking`	You must be in Tracking Source mode to use the Cal functions under Normalize. Press Source, Source Mode and set it to Tracking
–221	`Settings conflict; Calibration cannot be performed without valid ENR data`	The cal ENR table has no values in it, and hence the cal cannot be performed. Correct by either populating the cal ENR table, set ENR mode to Spot, or set the 'Use Meas Table Data for Cal' to 'On'
–221	`Settings conflict; Cancellation is not available while measuring DANL floor.`	Phase Noise cancellation does not make sense when measuring the DANL Floor, so for this reason it has been disabled
–221	`Settings conflict; Cancellation Ref trace has no data.`	When performing phase noise cancellation, you need to supply a reference trace that will be used to cancel out the background noise of the analyzer. The reference trace must be in Reference (View) mode, and selected by the Ref Trace parameter under the Cancellation menu
–221	`Settings Conflict; Cancellation trace has different X-Scale`	Reference trace for the cancellation has a different range of X-axis against the target trace
–221	`Settings conflict; Cannot optimize while user cal in progress`	Optimize Preselector cannot be performed while a user cal is in progress. The user cal performs an optimize preselector prior to taking the noise source on/off level results for the cal data
–221	`Settings conflict; Can't Auto-Couple Res BW in Zero Span`	The resolution bandwidth cannot be set to auto while you are in zero span (time domain)
–221	`Settings conflict; Carrier freq not allowed with BMT. (Bottom/Middle/Top only)`	The transmit band spur measurement only allows bottom (B), middle (M), and top (T) channel frequencies for each supported frequency band. The carrier frequency must be set to the bottom, middle or top frequency of the current frequency band
–221	`Settings Conflict; Code channel duplication`	This error is reported when the given code channel overlaps other code channel
–221	`Settings conflict; Continuous Peak is not available with Fixed marker`	The continuous peak feature cannot be used with a marker that is fixed. By definition that marker value cannot change
–221	`Settings conflict; Continuous Peak is not available with Signal Track on`	The continuous peak feature cannot be used while you are also using the signal tracking function

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Destination trace for Trace Math cannot be a trace operand`	The resulting trace data (from doing a trace math function) cannot be put into the any of the traces that are being used by the math operation
–221	`Settings conflict; Downconv only available when DUT is Amplifier`	SCPI only message. The System Downconverter can only be set to 'On' when the DUT type is amplifier. Change DUT type to Amplifier if the System Downconverter is required
–221	`Settings conflict; EDGE EVM only supports EDGE TCH burst type.`	
–221	`Settings conflict; Electronic attenuator is disabled`	You are using the mechanical attenuator, and have not enabled the electronic attenuator. You cannot set the value of the electronic attenuator because it automatically sets/changes when enabled
–221	`Settings conflict; Electronic attenuator is not available above 3.6 GHz`	The maximum frequency of the electronic attenuator is 3.6 GHz. This is because of switching capacitance
–221	`Settings conflict; Electronic attenuator unavailable in current state`	
–221	`Settings conflict; Electronic attenuator unavailable with Preamp on`	The internal preamp is on. Electronic attenuator cannot be used while you are using the internal preamp
–221	`Settings conflict; EMI Detectors are not available in FFT sweep`	QPD, EMI Average, EMI Peak, and MIL Peak are not allowed when in the manually selected FFT sweep mode
–221	`Settings conflict; External Mixer not available`	A command has been sent to reference the External Mixer in a model that does not contain it
–221	`Settings Conflict; FAST method can only be used while Radio Std is W-CDMA`	
–221	`Settings conflict; Feature not available in this View`	Some functionality is available in one View, but not in another. (See the Views under the **Mode/Measurement/View** selection.) This error occurs if you send a SCPI command or push a grayed-out key that is not available in the current selected View

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Feature not supported for selected source`	You have selected a feature that the selected source does not support
–221	`Settings conflict; Feature not supported for this Input.`	Some functionality is not available when certain Inputs are selected. For example, Trigger Holdoff is not available for the BBIQ input
–221	`Settings conflict; Feature not supported for this measurement.`	Some functionality is available in one measurement, but not in another. (See the measurements under the **Mode/Measurement/View** selection.) This error occurs if you send a SCPI command or push a grayed-out key that is not available in the current selected measurement
–221	`Settings conflict; Feature not supported for this model number`	This functionality is not a part of the instrument you are using, but may be found in other models in the X-Series
–221	`Settings conflict; FFT IF Gain High not available when Swept IF Gain = Manual Low`	When Swept IF Gain is manually set to Low, you cannot set the FFT IF Gain to High because that would make the Reference Level couplings wrong in FFT mode
–221	`Settings conflict; FFT method is unavailable for level gating`	If you are using level gating, you cannot select the FFT Gate Method
–221	`Settings conflict; FFT sweep type is not available while in Gated LO`	The gated LO function turns the LO on and off as it sweeps, so the FFT sweep type is not available if you have selected gated LO
–221	`Settings conflict; FFT sweep type is not available while in Gated Video`	The FFT sweep type is not available if you have selected the gated video function
–221	`Settings conflict; FFT Sweeps unavailable in Tracking Source mode`	Since FFTs do not sweep, you cannot use a Tracking Source while doing FFTs
–221	`Settings conflict; Fixed marker adjust not available while Marker Function is on`	If a Marker Function is on for a Fixed marker, the marker's reported value is derived from the function. Therefore, you cannot directly set the X or Y value of a Fixed marker that has a marker function turned on
–221	`Settings conflict; Fixed Marker Y value is not adjustable with Normalize On`	If Normalize is on the Amplitude scale is in dB units, so adjusting the Y value of a Fixed marker is not possible

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Freq > 3.6 GHz unavailable while electronic attenuator enabled`	The electronic attenuator does not function above 3.6 GHz, so if you have that attenuator enabled, you cannot change the center frequency so that frequencies above 3.6 GHz are displayed/measured
–221	`Settings conflict; Function not available in External Mixing`	The frequency offset feature cannot be used when you have selected a log scale for the frequency axis
–221	`Settings conflict; Function not available in Tracking Source mode`	The feature cannot be used when you are using a Tracking Source
–221	`Settings conflict; Function only available in Tracking Source mode`	The feature cannot be used unless you are using a Tracking Source
–221	`Settings conflict; Function unavailable with MW Presel off`	You cannot center or adjust the preselector because the Microwave Preselector is currently off
–221	`Settings conflict; Gate control is Edge for Gated FFT`	You cannot use level triggering to control the gate if you are using the FFT gating method
–221	`Settings conflict; Gate control must be Edge for this Gate Source`	You cannot use level triggering to control the gate when you are using the currently selected gate source
–221	`Settings conflict; Gate is not available when Marker Count on`	The gate function cannot be used while you have marker count turned on
–221	`Settings conflict; Gate Length is not settable in FFT sweeps`	The sweep time for FFT sweeps is set by the calculations, so sweep time settings cannot be adjusted
–221	`Settings conflict; Gate Length is not settable in FFT sweeps`	The sweep time for FFT sweeps is set by the calculations, so sweep time settings cannot be adjusted
–221	`Settings conflict; Gate Method is not compatible with current Sweep Type setting`	If the Gate is On and you have the FFT Sweep Type manually selected, then the Gate Method cannot be selected

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Gate not available with external Tracking Source`	The Gate functions are unavailable when Source Mode is Tracking with an external source. This is because the Gate circuitry is used to sync the external source
–221	`Settings conflict; Gate not available with Tracking Generator`	If the Source Type is Tracking Generator, the Gate circuitry is used for TG sync and is not available for gating
–221	`Settings conflict; Gated FFT is not available while Sweep Type is set to Swept`	The gated FFT function is not available if you have selected the swept type of sweep. You must be in the FFT sweep type
–221	`Settings conflict; Gated LO is not available while Sweep Type is set to FFT`	The FFT sweep type moves the LO frequency in steps. So the gated LO function is not available if you have selected FFT sweep
–221	`Settings conflict; Gated Video is not available while Sweep Type is set to FFT`	The gated video function is not available if you have selected the FFT sweep type
–221	`Settings conflict; Incorrect RBW for demod. Change RBW`	
–221	`Settings conflict; Ind I/Q is not available for this measurement`	The Independent I and Q setting is not available for the current measurement. Only some measurements (initially, only VXA) support this setting
–221	`Settings conflict; Invalid trace number`	The subopcode used to specify the trace number is invalid for this measurement or query
–221	`Settings conflict; Knob is not available to modify this function`	You should select a specific value for this function. Scrolling through values with the knob is not allowed
–221	`Settings conflict; LO Phase Noise Adj not available`	For instruments without the Dual-Loop LO, this feature is not available
–221	`Settings conflict; Marker 1 Trace Update=off turns off Signal Track`	Signal Track not available unless the trace containing Marker 1 is updating
–221	`Settings conflict; Marker cannot be relative to itself`	A marker must be set relative to another marker, not to itself

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Marker Count is not available when Gate on`	The marker count function cannot be used while you have gating turned on
–221	`Settings conflict; Marker Function is not available for a Fixed marker`	If a Marker is a Fixed type marker, the marker's value does not change from when it first became fixed. You cannot turn on or change a Marker Function because there is no ongoing measurement data to use for the marker function calculation
–221	`Settings conflict; Marker type must be delta`	Mkr?->Span and Mkr?->CF require that the selected marker be a delta marker
–221	`Settings conflict; Marker-> function is not available in zero span`	Most of the **Marker To** functions are not available if you are in zero span (span = 0 Hz, or time domain), so you cannot send the commands for these functions
–221	`Settings conflict; Mask unavailable for current Span. Increase to display mask.`	The current span setting is either narrower than the mask width or so wide that there are too few display points to allow the mask to be drawn. Increase or decrease the span to display the mask
–221	`Settings conflict; Meas Type was changed to Examine for Exp Avg Mode.`	Average Mode has been changed to Exponential. Full Meas Type is not available for Exponential Average Mode, therefore Meas Type has been changed to Examine
–221	`Settings conflict; Meas Type was changed to Full for Repeat Avg Mode`	Average Mode has been changed to Repeat. Examine Meas Type is not available for Repeat Average Mode therefore Meas Type has been changed to Full
–221	`Settings Conflict; MinPts/RBW limit not met`	
–221	`Settings conflict; Mkr -> CF is not available when the x-axis is time domain`	The marker to center frequency functionality does not work when the X-axis is in the time domain
–221	`Settings conflict; Mod Scheme AutoDet unavailable when Burst Sync=RF Amptd`	The modulation scheme auto detection is unavailable when the burst sync is set to RF Amptd (GSM/EDGE)
–221	`Settings conflict; MS gain is not available in this Mode`	Mobile Station gain correction is not available in some Modes, or in some measurements (for example, the SA measurement)

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Must apply Amplitude Correction to make this unit available`	These special units only apply when you are doing antenna measurements, so you must have a correction that includes Antenna Units enabled
–221	`Settings conflict; No meas frequencies are above 3.6 GHz`	Optimize Preselector can only be performed on frequencies in high band, that is, above 3.6 GHz. The current setup does not have input frequencies (IF) in this range so an Optimize Preselector cannot be performed
–221	`Settings conflict; no source selected`	You must select a source using Select Source before you can do this
–221	`Settings conflict; Normalize is not available when Scale Type = Lin`	Normalize does not support Linear amplitude scale, since the results are always presented as a dB ratio
–221	`Settings conflict; Normalize is not available while Demod View is on`	The normalization (correction) function cannot be used if you are using the Demod View
–221	`Settings conflict; Normalize is not available while Trace Math is on`	The Normalize function works by doing trace manipulation, so if trace math is on you cannot turn on normalization
–221	`Settings conflict; Only active Antenna Unit available; no other Y axis units`	When a correction with antenna units is turned on, the only Y-axis units you can have are those that match the Antenna Unit. Turn off the Correction or the Antenna Unit under Input/Output, Corrections
–221	`Settings conflict; Option not available`	You have attempted to perform an action for which a required option is not installed
–221	`Settings conflict; Param only available when DUT is a freq converter`	SCPI only message. The sideband and freq context parameters are only available when a freq conversion setup is in use. Change setup to contain a freq conversion to use these parameters
–221	`Settings conflict; Param only available when External LO Mode is Swept`	SCPI only message. This parameter is only available when the LO mode is set to Swept. Change the LO Mode to Swept
–221	`Settings conflict; Param only available when External LO Mode is Fixed`	SCPI only message. This parameter is only available when the LO mode is set to Fixed. Change the Freq Mode to Fixed
–221	`Settings conflict; Param only available when Frequency Mode is Fixed`	SCPI only message. This parameter is only available when the Freq mode is set to Fixed. Change the Freq Mode to Fixed

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Param only available when Frequency Mode is Swept`	SCPI only message. This parameter is only available when the Freq mode is set to Swept. Change the Freq Mode to Swept
–221	`Settings conflict; Param only available when valid cal data exists`	SCPI only message. The 'Apply Calibration' parameter is only available when the stored cal data matches the current setup. Perform a fresh 'Calibrate Now' or change setup such that current cal data is valid
–221	`Settings conflict; Preamp gain is not available in this Mode`	Preamp gain correction is not available in some Modes or Measurements
–221	`Settings conflict; Preamp unavailable with electronic attenuator on`	The electronic attenuator is on. Internal preamp cannot be used while you are using the electronic attenuator
–221	`Settings conflict; Reference marker must be in same window`	A delta marker and its reference must be in the same window. This error occurs when you try to turn on a delta marker for which the reference is in a different window
–221	`Settings conflict; Relative Trigger needs hardware support for this meas`	To do Relative Triggering in this measurement requires optional hardware that is not present in this analyzer
–221	`Settings conflict; Scale Type = Lin is not available when Normalize is on`	Only the Log amplitude scale is available in Normalize, since the results are always presented as a dB ratio
–221	`Settings conflict; Settings conflict; Pre-trigger is insufficient for demod. Decrease Trig Delay.`	
–221	`Settings conflict; Signal Track is not available with Continuous Peak`	The signal tracking feature cannot be used while you are also using the continuous peak function
–221	`Settings conflict; Signal Track is only available in Swept SA measurement`	The signal track functionality can be used when making a swept SA measurement. It is not available in the SA measurement when you are using FFT sweeps

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; Signal Track is turned off when Zero Span is selected`	Signal Track is not available when you have selected Zero Span. So if Zero Span is entered while in Signal Track is On, Signal Track is turned off
–221	`Settings Conflict; Span limited to XXX`	
–221	`Settings conflict; Span Zoom is not available in Zero Span`	Span Zoom does not work with a time domain X-axis. You must select a span greater then 0 Hz
–221	`Settings conflict; Step keys are not available to modify this function`	You should select a specific value for this function. Using the **Up/Down** step keys to scroll through values is not allowed
–221	`Settings conflict; Sweep Setup only available in swept measurements`	The current measurement uses FFT mode, so does not use the Sweep Setup menu
–221	`Settings conflict; Sweep Time cannot be auto-coupled in FFT sweeps`	The sweep time for FFT sweeps is set by the calculations. So sweep time settings cannot be adjusted
–221	`Settings conflict; Sweep Time cannot be auto-coupled while in Zero Span`	You cannot send the remote command to set the sweep time to auto while you are in zero span
–221	`Settings conflict; Sweep Time cannot be set while in FFT sweeps`	The sweep time for FFT sweeps is set by the calculations. It cannot be manually controlled
–221	`Settings conflict; Swept IF Gain High not available when FFT IF Gain = Manual Low`	When FFT IF Gain is manually set to Low, you cannot set the Swept IF Gain to High because that would make the Reference Level couplings wrong in swept mode
–221	`Settings conflict; Swept LO not available when freq mode is Fixed`	SCPI only message. The LO Mode cannot be set to Swept when the freq mode is set to fixed. Change the freq mode away from fixed, or perform the measurement at several fixed frequencies
–221	`Settings conflict; Swept Type=Swept is not available while in Gated FFT`	If you have selected gated FFT then you are using the FFT sweep type and you cannot select the swept type of sweeping

Err#	Message	Verbose/Correction Information
–221	`Settings conflict; System Display Settings, Annotation is Off`	This is an override that turns off many of the annotations. This is available as a security feature
–221	`Settings conflict; T hot must be greater than T cold`	The Tcold value set under **Meas Setup, ENR, Tcold** needs to be lower than the Thot value currently being set. Tcold is often taken as the ambient temperature of the noise source. If using an SNS the Tcold value may be read automatically before every sweep
–221	`Settings Conflict; The parameter cannot be changed in FAST mode`	
–221	`Settings conflict; Trace Math is not available while Normalize is on`	The Normalize function works by doing trace manipulation, so trace math is not available while normalization is running
–221	`Settings conflict; Tracking Source unavailable in FFT Sweeps`	Since FFTs do not sweep, you cannot use a Tracking Source while doing FFTs
–221	`Settings conflict; Trigger input in use for source synchronization`	If Point Trigger is being used with an external trigger input to synchronize an external source to the analyzer, that trigger input is unavailable for triggering
–221	`Settings conflict; Trigger is not available with span > 0 Hz.`	
–221	`Settings conflict; Tx Band Spur meas does not support this frequency band.`	The transmit band spur measurement does not support all of the commercially available frequency bands. You need to change your selection under **Mode Setup, Radio, Band** to one of the supported bands
–221	`Settings conflict; Tx Band Spur measurement is not defined for mobiles.`	Only base station testing is available
–221	`Settings conflict;Administrator privileges required`	You must be logged in with administrator privileges to do this. Log out and log back in as the Administrator, then restart the SA application

Err#	Message	Verbose/Correction Information
–221	`Settings conflict;Auto Scan Time/Meas Time do not apply in Stepped Scan Type.`	The Auto Scan Time/Meas Time are not available when Scan Type =Stepped Scan
–221	`Settings conflict;Auto Scan Time/Meas Time do not apply in Stepped Scan Type.`	The Auto Scan Time/Meas Time are not available when Scan Type =Stepped Scan
–221	`Settings conflict;ClearList & Start not available when ScanSeq = (Re)measure`	Cannot perform Clear List & Start during (Re)measure, because we require the frequency information of the peaks in signal list to perform (Re)measure
–221	`Settings conflict;EMI Detectors and Average detector can’t be used together`	You cannot turn on any EMI Detector and Average detector together. They are always mutually exclusive
–221	`Settings conflict;Freq > 1 GHz is not available while RF Input 2 enabled`	Frequency is limited to 1GHz while RF Input 2 is enabled
–221	`Settings conflict;Function not available while measurement is running`	Settings change is not allowed while measurement is running. You must stop the current measurement if you wish to change the settings
–221	`Settings conflict;function unavailable with this EMC Standard`	
–221	`Settings conflict;Log Percent Auto Step Rule does not apply in Swept Scan Type.`	The Log Percent rule is not available when Scan Type=Swept Scan because we are always doing linear sweep
–221	`Settings conflict;QPD + EMI Average + RMS Average is not allowed`	You cannot turn on all 3 EMI detectors together. You must turn off one of the EMI Detectors before you turn this on

Err#	Message	Verbose/Correction Information
–221	`Settings conflict;Range <0> is turned off as total range points > 40001`	Max of Total range points is 400000. Reduce Scan Points or increase Step Size in order to turn on that range
–221	`Settings conflict;RF Input 2 is not available above 1GHz`	If the frequency range is set above 1GHz, you cannot change to RF Input 2
–221	`Settings conflict;Scan Time & Points do not apply in current Step/Time Control.`	The Scan Time & Points are not available when Step/Time Control is set to Step & Dwell
–221	`Settings conflict;Step Size & Meas Time do not apply in current Step/Time Control.`	The Step Size & Meas Time are not available when Step/Time Control is set to Scan Time&Pts

–200 to –299, Execution Errors

This section lists all messages in the range *except* –221 error messages. For details of –221 messages, see "–221 Settings Conflict Errors" on page 87.

Note that Execution Errors are divided into subclasses, as follows:

–21x Trigger errors

–22x Parameter error

–23x Data corrupt or stale (invalid data)

–24x Hardware error

–25x Mass storage error

–26x Expression data error

–27x Macro error

–28x Program error (a downloaded program-related execution error)

–29x Memory use error

Err#	Message	Verbose/Correction Information
–200	`All ranges are off. Turn on at least a range`	There are no range turn on in scan table. You need to turn on at least a range to initiate a scan
–200	`At Full Zoom`	Marker Zoom is not available as it has reached full zoom

Err#	Message	Verbose/Correction Information
–200	`At Full Zoom`	Marker Zoom is not available as it has reached full zoom
–200	`Execution Error`	A program execution error has occurred. The exact problem cannot be specifically identified
–200	`Execution error; Carrier frequency outside device's transmit band`	The entered channel/carrier frequency is not within the range of your current mode setup selection of standard and device
–200	`Execution error; Invalid GSM burst timing`	A GSM-like burst was acquired, but its timing is not valid. Ensure the correct Burst Type has been selected
–200	`Execution error; Invalid IP address`	The IP address supplied is either not valid or does not belong to a compatible Signal Generator. Please check the IP address and instrument connection and try again
–200	`Execution error; Invalid Marker Trace.`	Cannot place markers on the reference trace, because the reference trace is currently turned off or has no data
–200	`Execution Error; No peak found.`	No signal peak was found within the defined parameters of the search. (Note: for ESA/PSA compatibility, the Swept SA measurement uses 780 for this error number; all other measurements use –220)
–200	`Execution error; No ranges are defined. Activate a range.`	There are no active ranges in the range table. You will need to activate at least one range
–200	`Execution Error; Preselector centering failed`	Algorithm failed to center the preselector. This maybe caused by the signal peak being too low in amplitude, or it could be due to excessive CW input signal, alignment error, or hardware failure
–200	`Execution Error; Signal not stable enough to track`	The signal that you have selected to track is changing too much for the function to track it properly
–200	`Execution Error; Store ref trace before turning on Normalize`	The Reference trace data must be stored in the Ref trace before you turn on the Normalization function
–200	`Execution error; Sync word was not found.`	NADC & PDC: In an EVM measurement, the sync word is not found and the synchronization cannot be established when Sync Word is selected in the Burst Sync menu. Flexible Digital Demodulation: The sync word cannot be detected because of inappropriate parameter settings or incorrect signal
–200	`Execution error; Trace file contains no compatible traces.`	The trace file may have been created by another version of the Phase Noise personality, which uses a different trace format that is incompatible with the version you are running. Please check that you are running the most up-to-date version of the personality

Err#	Message	Verbose/Correction Information
–200	`Execution error; Trace file created by incompatible version of Phase Noise App`	The trace file may have been created by another version of the Phase Noise personality, which uses a different trace format that is incompatible with the version you are running. Please check that you are running the most up-to-date version of the personality
–200	`Function not available before Marker Zoom is performed`	Function not available before perform Marker Zoom
–200	`Must perform Scan before do Search`	Cannot perform Search as the trace data is empty
–200	`No marked signal`	Cannot perform the selected function because no signal was marked. You must mark the peak of interest before selecting the function
–200	`No Measure At Marker Added to Signal List`	No signal peak was added into Signal List as there is no valid measure to Marker result. You must perform Measure at Marker before selecting Measure At Marker --> List
–200	`No Peak Added to Signal List`	No signal peak was added from the Search to Signal List as no signal peaks were found within the defined parameters of the search criteria
–200	`Signal List is Empty`	Cannot perform the selected function because the signal list contains no data
–200	`Signal List is Full`	Cannot perform the selected function because the signal list is full. Please clear the list
–200	`Signal Selected is not in the Signal List`	The signal selected is not the list. You only can perform the operation on signal that is already available in the list
–201	`Invalid while in local`	The command cannot be executed while the instrument in Local control
–202	`Settings lost due to rtl`	A “return to local” control was forced and some settings were lost as a result of this
–203	`Command protected`	The command could not be executed because it is disabled. It was disabled by licensing or password protection
–203	`Command protected; feature not licensed`	The specified feature, for example “N9073A-TR2” is not licensed. The license may have expired. You cannot use it until you obtain a license
–210	`Trigger error`	A trigger error has occurred, but the exact problem cannot be specifically identified
–211	`Trigger ignored`	A GET, *TRG or other triggering signal was received, but was ignored because of timing considerations. For example, maybe the instrument was not ready to respond when the command was received
–212	`Arm ignored`	An arming signal was received, but it was ignored
–213	`Init ignored`	An initiate trigger/sweep request was received and ignored, because another measurement was already in progress

Err#	Message	Verbose/Correction Information
–214	`Trigger deadlock`	The trigger source for the initiation of a measurement is set to GET, and the following measurement query was received. The measurement cannot be started until a GET is received, but the GET would cause an INTERRUPTED error
–215	`Arm deadlock`	The arm source for the initiation of a measurement is set to GET and the following measurement query is received. The measurement cannot be started until a GET is received and the GET would cause an INTERRUPTED error
–220	`Parameter error`	A problem was found with a program data element. The exact problem cannot be specifically identified
–221	`Settings conflict;`	There are many types of settings conflict errors. For full details, see "–221 Settings Conflict Errors" on page 87
–222	`Data out of range;`	A data element was found but the instrument could not be set to that value because it was outside the range defined for the command. A descriptive message may be appended, such as "clipped to upper limit"
–222	`Data out of Range; clipped to source max/min`	A source parameter has been entered that exceeds the range of the selected source. The parameter has been clipped to match the range of the source
–222	`Data out of range; Invalid list data`	You tried to use a trace that has a number of sweep points that differs from the current sweep points setting
–222	`Data out of range; Two entries already exist at this x-axis value.`	When entering values for limit lines, you cannot have more than two Y-axis (amplitude) values entered for a specific X-axis (frequency) value
–223	`Too much data`	A data element (of block, expression, array type, or string type) had more data then allowed by the command, or by the available memory
–223	`Too much data; 200 spurs found. Additional spurs ignored.`	There are too many spurs for the table (the limit is 200), and any additional spurs that are found will be ignored
–224	`Illegal parameter value`	An exact data value (from a list of the allowed values) was required, but not found. See the specific feature description for information about the expected parameter values
–224	`Illegal parameter value; <Value> invalid. Fractional values are not allowed.`	The seconds parameter of an LXI time may not contain a fractional portion. For example 123456789.0 is valid, but 123456789.1 is not valid
–224	`Illegal parameter value; <value> out of range.`	The value does not fall within the valid range

Err#	Message	Verbose/Correction Information
–224	`Illegal parameter value; Exceeding the max list length`	The list parameters have a maximum allowed length. You are trying to set a length longer than the maximum
–224	`Illegal parameter value; Gated FFT is not available while Sweep Type is set to Swept`	The gated FFT function is not available if you have selected the swept type of sweep. You must select the FFT sweep type
–224	`Illegal parameter value; Gated LO is not available while Sweep Type is set to FFT`	The FFT sweep type moves the LO frequency in steps, so the gated LO function is not available if you have selected FFT sweep
–224	`Illegal parameter value; Gated Video is not available while Sweep Type is set to FFT`	The gated video function is not available if you have selected the FFT sweep type
–224	`Illegal parameter value; Illegal identifier <identifier>. This value may already be in use.`	The value for the LXI LAN identifier parameter must be unique (that is, LAN0 and LAN7 must have different identifier strings)
–224	`Illegal parameter value; Index out of range`	When querying the LXI Event Log or the Servo Log, an index may be used to look at a specific entry. This error occurs if the index provided does not point to a valid entry
–224	`Illegal parameter value; Invalid list length`	You are trying to set some list measurement settings, but the multiple lists that you sent had differing lengths. The number of settings must be consistent from list to list
–224	`Illegal parameter value; LXI Event <event> already exists.`	This error occurs when you try to add an LXI Event that has already been added
–224	`Illegal parameter value; LXI Event <event> contains illegal characters.`	When a new LXI Event is created, it may not use the comma, semicolon, or newline characters. All other printable ASCII characters are valid
–224	`Illegal parameter value; LXI Event <event> does not exist.`	The requested event has not been added yet

Err#	Message	Verbose/Correction Information
–224	`Illegal parameter value; Measurement not available`	You tried to turn on a measurement that is not available in the current mode
–224	`Illegal parameter value;This instrument is always DC coupled`	You cannot set AC coupling in this instrument
–224	`Illegal parameter value;This model is always AC coupled`	You cannot set DC coupling in this analyzer
–225	`Out of memory`	There is not enough memory to perform the requested operation
–225	`Out of memory; Insufficient resources to load Mode <mode name>`	If you attempt to load a mode via SCPI that will exceed memory capacity, the Mode does not load and this message is returned. “mode name” is the SCPI parameter for the Mode in question (for example, SA for Spectrum Analyzer Mode.) You can free up resources using the **System, Power On, Configure Applications** menu
–225	`Out of memory; Memory limit caused Data Acquisition to be truncated`	
–226	`List not same length`	You are using the LIST structure, but have individual lists of differing lengths
–230	`Data corrupt or stale;`	A legal data element was found, but it could not be used because the data format or the data structure was not correct. This could occur if a new measurement had been started but had not completed
–230	`Data corrupt or stale; Measurement data is not available`	Measurement data not available. The measurement that you are trying to get data from must be the current active measurement. Maybe you have not initiated the measurement, or it has not completed all the sweeps/averages needed
–230	`Data corrupt or stale; Trace contains no data.`	Trace cannot be displayed because currently there is no data assigned to it. Use the functions under the **Trace** menu, or load a previously saved trace, to assign data to the trace
–230	`Data corrupt or stale; Unable to load state from file`	There is something wrong with the state data in the desired file. Maybe the file is corrupt, or it is from an instrument/version that is not recognized by the current instrument
–231	`Data questionable`	Indicates that the measurement accuracy is suspect
–232	`Invalid format`	A data element was found but it could not be used because the data format or the data structure was not correct
–232	`Invalid format; Map information not loaded`	Instrument failed to load the burst mapping information from the selected file

Err#	Message	Verbose/Correction Information
–233	`Invalid version`	A legal data element was found but could not be used because the version of the data is incorrect. For example, state data changes as new instrument features are added, so old state files may not work in an instrument with a newer version of software
–240	`Hardware error`	A legal program command or query could not be executed because of a hardware error. The exact problem cannot be specifically identified
–240	`Hardware error; See details in Windows Event Log under SA`	The internal data acquisition system detected a problem at startup and logged the details in the Windows Event Log
–241	`Hardware missing`	The operation could not be performed because of missing hardware; perhaps the optional hardware is not installed
–241	`Hardware missing; Input not available`	The hardware required is not part of this model or the option is not installed
–241	`Hardware missing; Internal preamp not available at all frequency points`	The Internal Preamp is currently turned on, but the measurement is being performed completely or partially outside the range of the preamp. It is recommended that the user turns preamp off to ensure consistent results across the entire measurement
–241	`Hardware missing; not available for this model number`	The hardware required is not part of this model
–241	`Hardware missing; Option not installed`	The optional hardware is not installed
–250	`Mass storage error;`	A problem was found with the mass storage device (memory, disk drive, etc.). The exact problem cannot be specifically identified
–250	`Mass storage error; Access denied`	Access is denied
–250	`Mass storage error; Bad path name`	The specified path is invalid
–250	`Mass storage error; Can only import single trace .csv files`	Trace files containing multiple traces can not be imported. However, if you need to recall multiple traces you can use the **Save** and **Recall** functions, rather than the Import and Export functions
–250	`Mass storage error; Can only load an Antenna Unit into Correction 1`	The only Correction register that supports Antenna Units is number 1. You have attempted to load an Ampcor file that contains antenna units into another register
–250	`Mass storage error; Cannot make`	The directory or file cannot be created
–250	`Mass storage error; Different Antenna Unit already in use`	Attempt to import Corrections file with Antenna Unit that differs from an in-use correction

Err#	Message	Verbose/Correction Information
–250	`Mass storage error; Directory not found`	The system cannot find the path specified
–250	`Mass storage error; Failed to Load trace. Bad file format.`	The load trace operation could not be completed, as the input file was not in the expected format. You can only load traces that were previously saved using the **Save, Trace** feature
–250	`Mass storage error; File <filename> wrong type`	Attempt to import a data file that is not the proper type for this operation
–250	`Mass storage error; File <filename> and instrument version mismatch`	While opening a file, there was a mismatch between file version or model number with instrument version or model number. The import still tried to load as much as possible, but you should check it closely
–250	`Mass storage error; File contains incorrect data for this operation`	There is a mismatch between the file data type of the file specified and the destination indicated. For example, a correction set cannot be loaded/imported into a limit line
–250	`Mass storage error; File empty`	Cannot save trace because it contains no data. Check that the trace is turned on and contains some valid data
–250	`Mass storage error; Invalid register number for *SAV or *RCL Mass Storage error`	You have used the `*SAV` command to save a state to a non existent state register. Or You have used the `*RCL` command to recall a state register that wasn't previously saved with the `*SAV` command
–250	`Mass storage error; Lock violation`	The process cannot access the file because another process has locked a portion of the file
–250	`Mass storage error; Mkr Table must be on to save Mkr Table as Meas Results`	You have to have a Marker Table on the screen before you can save it. Turn on the Marker Table and try again
–250	`Mass storage error; No file names available`	Attempt to use the auto file name generation when all 10,000 file names are taken
–250	`Mass storage error; Open failed`	The system cannot open the device or file specified. This could be because the storage media is full, or possibly due to a filename error. If using an external storage device, check that the device is properly formatted
–250	`Mass storage error; Pk Table must be on to save Pk Table as Meas Results`	You must have a Peak Table on the screen before you can save it. Turn on the Peak Table and try again
–250	`Mass storage error; Read fault`	The system cannot read from the specified device

Err#	Message	Verbose/Correction Information
–250	`Mass storage error; Register <number> empty`	Attempt to recall a register with nothing in it
–250	`Mass storage error; Sharing violation`	The process cannot access the file because it is being used by another process
–250	`Mass storage error; Spectrogram must be on to save as Meas Results`	You must have a Spectrogram on the screen before you can save it. Turn on the Spectrogram and try again
–250	`Mass storage error; Too many open files`	The system cannot open the file
–250	`Mass storage error; Write fault`	The system cannot write to the specified device
–252	`Missing media`	A legal command or query could not be executed because of missing media
–253	`Corrupt media`	A removable media was found to be bad or incorrectly formatted. Any existing data on the media may have been lost
–254	`Media full`	A legal command/query could not be executed because the media was full
–255	`Directory full`	A legal command or query could not be executed because the media directory was full
–256	`File name not found;`	A legal command or query could not be executed because the file name was not found in the specified location
–257	`File name error;`	A legal command or query could not be executed because there was an error with the file name on the device media. For example, maybe you tried to copy to a duplicate file name
–257	`File name error; Allowable extension is .csv`	You are using the wrong type of file extension for the current data/file type
–257	`File name error; Allowable extension is .png`	You are using the wrong type of file extension for the current data/file type
–257	`File name error; Allowable extension is .state`	You are using the wrong type of file extension for the current data/file type
–257	`File name error; Invalid file name`	The filename, directory name, or volume label syntax is incorrect
–257	`File name error; name too long`	
–258	`Media protected`	A legal command or query could not be executed because the media was protected. For example, the write-protect was set

Err#	Message	Verbose/Correction Information
–260	`Expression error`	An error was found with an expression type of data element. The exact problem cannot be specifically identified
–261	`Math error in expression`	An expression that has legal syntax could not be executed because of a math error. For example, maybe you are dividing by zero
–270	`Macro error`	Indicates that a macro-related execution error occurred
–271	`Macro syntax error`	Indicates a syntax error within the macro definition
–272	`Macro execution error`	Indicates that a syntactically legal macro program data sequence could not be executed due to some error in the macro definition
–273	`Illegal macro label`	Indicates that the macro label defined in the *DMC command was a legal string syntax, but could not be accepted
–274	`Macro parameter error`	Indicates that the macro definition improperly used a macro parameter placeholder
–275	`Macro definition too long`	Indicates that a syntactically legal macro program data sequence could not be executed because the string or block contents were too long for the device to handle
–276	`Macro recursion error`	Indicates that a syntactically legal macro program data sequence could not be executed because the device found it to be recursive
–277	`Macro redefinition\ not allowed`	Indicates that a syntactically legal macro label in the *DMC command could not be executed because the macro label was already defined
–278	`Macro header not found`	Indicates that a syntactically legal macro label in the *GMC? query could not be executed because the header was not previously defined
–280	`Program error`	There was an execution error in a down-loaded program. The exact problem cannot be specifically identified
–281	`Cannot create program`	Indicates that an attempt to create a program was unsuccessful. A reason for the failure might include not enough memory
–282	`Illegal program name`	The name used to reference a program was invalid; for example, redefining an existing program, deleting a nonexistent program, or in general, referencing a nonexistent program
–283	`Illegal variable name`	An attempt was made to reference a nonexistent variable in a program
–284	`Program currently running`	Certain operations dealing with programs may be illegal while the program is running; for example, deleting a running program might not be possible
–285	`Program syntax error`	Indicates that a syntax error appears in a downloaded program. The syntax used when parsing the downloaded program is device-specific
–286	`Program runtime error`	
–290	`Memory use errors`	
–291	`Out of memory`	

Err#	Message	Verbose/Correction Information
–292	`Referenced name does not exist`	
–293	`Referenced name already exists`	
–294	`Incompatible type`	Indicates that the type or structure of a memory item is inadequate

–100 to –199, Command Errors

Err#	Message	Verbose/Correction Information
–100	`Command error`	There is a problem with the command. The exact problem cannot be specifically identified
–101	`Invalid character`	An invalid character was found in part of the command
–102	`Syntax error`	An unrecognized command or data type was found, for example a string was received for a command that doesn't accept strings
–103	`Invalid separator`	The command was supposed to contain a separator but we found an illegal character. For example, the semicolon was omitted after a command string
–104	`Data type error`	A data type differed from what was expected. For example, numeric or string data was expected, but block data was found
–105	`GET not allowed`	A Group Execute Trigger was received within a program message
–108	`Parameter not allowed`	More parameters were received than were expected for the command. For example, the `*ESE` common command only accepts one parameter, so sending `*ESE 0,1` is not allowed
–109	`Missing parameter`	Fewer parameters were received than required for this command
–110	`Command header error`	This is a general error that is generated when a problem is found in a command header, but no more specific information is available
–111	`Header separator error`	An illegal character was found in a command where a separator was expected
–112	`Program mnemonic too long`	The command contains a keyword that has more than twelve characters
–113	`Undefined header`	The command meets the SCPI syntax requirements, but is not valid in the current measurement environment
–114	`Header suffix out of range`	The value of a numeric suffix that is attached to a program mnemonic makes the header invalid. (A suffix is usually units, like Hz or DB)
–115	`Unexpected number of parameters`	The number of parameters received does not correspond to the number of parameters expected.
–120	`Numeric data error`	An error was found in a data element that appears to be numeric. The exact problem cannot be specifically identified
–121	`Invalid character in number`	A character was found that is not valid for the data type. For example, an alpha in a decimal numeric or a "9" in octal data
–123	`Exponent too large`	The magnitude of an exponent was greater than 32000
–124	`Too many digits`	The mantissa of a decimal-numeric contained more than 255 digits, excluding leading zeros
–128	`Numeric data not allowed`	A legal numeric data element was found, but that is not a valid element at this position in the command

Err#	Message	Verbose/Correction Information
–130	`Suffix error`	A problem was found in a suffix (units). The exact problem cannot be specifically identified
–131	`Invalid suffix`	There is a syntax problem with the suffix. You need to use the suffix (units) that are allowed by this command
–134	`Suffix too long`	The suffix contained more than twelve characters
–138	`Suffix not allowed`	A suffix was found after a numeric element that does not allow suffixes (units)
–140	`Character data error`	A problem was found with a character data element. The exact problem cannot be specifically identified
–141	`Invalid character data`	Either the character data element contains an invalid character or the element itself is not valid for this command
–144	`Character data too long`	The character data element contains more than twelve characters
–148	`Character data not allowed`	A character data element that you sent is valid, but it is not allowed at this point in the parsing
–150	`String data error`	A problem was found with a string data element. The exact problem cannot be specifically identified
–151	`Invalid string data`	A string type of data element was expected, but it is invalid for some reason. For example, an END message was received before the terminal quote character
–158	`String data not allowed`	A string data element that you sent is valid, but it is not allowed at this point in the parsing
–160	`Block data error`	A problem was found with a block data element. The exact problem cannot be specifically identified
–161	`Invalid block data`	A block data element was expected, but it was invalid. For example, an END message was received before the end length was satisfied
–168	`Block data not allowed`	A legal block data element was found, but it is not allowed at this point in the parsing
–170	`Expression error`	A problem was found with an expression data element. The exact problem cannot be specifically identified
–171	`Invalid expression`	An expression data element is not valid. For example, there may be unmatched parentheses or an illegal character
–178	`Expression data not allowed`	A legal expression data was found, but it is not allowed at this point in the parsing
–180	`Macro error`	A problem was found with a macro element. The exact problem cannot be specifically identified
–181	`Invalid outside macro definition`	Indicates that a macro parameter placeholder was encountered outside of a macro definition

Err#	Message	Verbose/Correction Information
–183	`Invalid inside macro definition`	Indicates that the program message unit sequence, sent with a *DDT or *DMC command, is syntactically invalid
–184	`Macro parameter error`	Indicates that a command inside the macro definition had the wrong number or type of parameters

0 Error

Err#	Message	Verbose/Correction Information
0	`No error`	The queue is empty. Either every error in the queue has been read, or the queue was cleared by power-on or `*CLS`

Condition Messages

Condition messages are displayed in the STATUS message area in the bottom right of the display. Condition messages are classified as either “Errors” or “Warnings.” In the tables in this section, an E in the **Error or Warning** column means that an error is displayed on the front panel and sent out to SCPI when this condition is detected. A W in this column means that a Warning is displayed on the front panel, but nothing is sent to SCPI.

For each Condition Message, there is a corresponding bit in one of the SCPI Status Registers. These bits are listed in the tables below. Some messages exist **only** as status bits; for these messages the **Error or Warning** column entry specifies “status bit only”.

Condition errors 1 to 99, Calibration

These errors correspond to the `STATus:QUEStionable:CALibration` register. Since this register is fanned out to three sub-registers, with summary bits in the main `STATus:QUEStionable:CALibration` register, each sub-register has its own range of error numbers.

Condition Errors 6 to 34, Calibration Skipped

This series of errors corresponds to the bits in the `STATus:QUEStionable:CALibration:SKIPped` sub-register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 6 indicates that the “RF Alignment being skipped” condition has been detected, and error 1006 indicates that failure has been cleared.

This register is summarized as bit 11 of the `STATus:QUEStionable:CALibration` register, as described in section “Condition Errors 36 to 64, Calibration Needed or Failed” on page 114.

Err#	Bit in status register	Message	Error or Warning	More Information
6	0	`Align RF Skipped`	W	
8	1	unused		
10	2	unused		
12	3	unused		
14	4	unused		
16	5	unused		

Err#	Bit in status register	Message	Error or Warning	More Information
18	6	unused		
20	7	unused		
22	8	unused		
24	9	unused		
26	10	unused		
28	11	unused		
30	12	unused		
32	13	unused		
34	14	unused		

Condition Errors 36 to 64, Calibration Needed or Failed

This series of errors corresponds to the bits in the `STATus:QUEStionable:CALibration` register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 42 indicates that the “RF Alignment Failure” condition has been detected, and error 1042 indicates that failure has been cleared.

Several bits in this register are “summary bits” for registers at a lower level. There are no error messages associated with these bits; they exist only as status bits, which can be read with a `STATus:QUEStionable:CALibration?` event query or a `STATus:QUEStionable:CALibration:CONDition?` query.

Note that these summary bits summarize the state and history of the event registers at the lower level. This is true even for bits in the `STATus:QUEStionable:CALibration` condition register. This means that:

– The summary bits read by the `STATus:QUEStionable:CALibration:CONDition?` query are true if any event bits are set in any of the :CALibration sub-registers :SKIPped, :EXTended:NEEDed or :EXTended:FAILure.

– The summary bits read by the `STATus:QUEStionable:CALibration?` event query are true if any event bit has undergone a false-to-true transition with the PTRansition filter set, or a true-to-false transition with the NTRansition filter set, in any of the :CALibration sub-registers :SKIPped, :EXTended:NEEDed or :EXTended:FAILure.

Thus, the summary bits **cannot** be used to determine the current state of a lower level condition bit; only the state and history of the lower level event bits.

This register is itself summarized as bit 8 of the `STATus:QUEStionable` register, as described in the section "Condition Errors 601 to 699, Error Summaries" on page 131.

Err#	Bit in status register	Message	Error or Warning	More Information
36	0	unused		
38	1	unused		
40	2	`TG Alignment Failure`	E	
42	3	`RF Alignment Failure`	E	
44	4	`IF Alignment Failure`	E	
46	5	`LO Alignment Failure`	E	
48	6	`ADC Alignment Failure`	E	
50	7	`FM Demod Alignment Failure`	E	
52	8	`Extended Align Needed Summary`	status bit only	This bit is the summary bit for the STATus:QUEStionable:CALibration:EXTended:NEEDed sub-register.
54	9	`Extended Align Failure Summary`	status bit only	This bit is the summary bit for the STATus:QUEStionable:CALibration:EXTended:FAILure sub-register.
56	10	unused		
58	11	`Align Skipped Sum Summary`	status bit only	This bit is the summary bit for the STATus:QUEStionable:CALibration:SKIPped sub-register.
60	12	`Align Now, RF required`	E	
62	13	unused		
64	14	`Align Now, All required`	E	In PSA, this was error 64

Condition Errors 65 to 92, Calibration Needed (Extended)

This series of errors corresponds to the bits in the `STATus:QUEStionable:CALibration:EXTended:NEEDed` sub-register. The second column in the table below shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 72 indicates that the “Input Attenuation not calibrated” condition has been detected, and error 1072 indicates that failure has been cleared.

This register is summarized as bit 8 of the `STATus:QUEStionable:CALibration` register, as described in the section “Condition Errors 36 to 64, Calibration Needed or Failed” on page 114.

Err#	Bit in status register	Message	Error or Warning	More Information
65	0	unused		
66	1	`Align 9kHz-30MHz required`	E	An EMI conducted frequency range alignment is needed.
68	2	`Align 30MHz-1GHz required`	E	An EMI radiated frequency range alignment is needed.
72	4	`Input Attenuation not calibrated`	E	Corrected measurements have been requested and the required RF front-end setting of x dB has not been calibrated.
74	5	unused		
76	6	unused		
78	7	unused		
80	8	unused		
82	9	unused		
84	10	unused		
86	11	unused		
88	12	unused		
90	13	unused		
92	14	unused		

Condition Errors 67 to 95, Calibration Failure (Extended)

This series of errors corresponds to the bits in the `STATus:QUEStionable:CALibration:EXTended:FAILure` sub-register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 71 indicates that the Characterize Preselector Failure has been detected, error 1071 indicates that failure has been cleared.

This register is summarized as bit 9 of the `STATus:QUEStionable:CALibration` register, as described in the section "Condition Errors 36 to 64, Calibration Needed or Failed" on page 114.

Err#	Bit in status register	Message	Error or Warning	More Information
67	0	`Align 9kHz to 30MHz failed`	W	In PSA, this was error 13749
69	1	`Align 30MHz to 1GHz failed`	W	In PSA, this was error 13751
71	2	`Characterize Preselector failure`	W	The preselector characterization routine failed.
73	3	unused		
75	4	unused		
77	5	unused		
79	6	unused		
81	7	unused		
83	8	unused		
85	9	unused		
87	10	unused		
89	11	unused		
91	12	unused		
93	13	unused		
95	14	unused		

Condition Errors 101 to 199, Measurement Integrity

This series of errors corresponds to the bits in the `STATus:QUEStionable:INTegrity` register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 141 indicates an Input Overload condition has been detected, error 1129 indicates that failure has been cleared.

Two bits in this register are “summary bits” for registers at a lower level. There are no error messages associated with these bits; they exist only as status bits, which can be read with a `STATus:QUEStionable:INTegrity?` event query or a `STATus:QUEStionable:INTegrity:CONDition?` query.

Note that these summary bits summarize the state and history of the event registers at the lower level. This is true even for bits in the `STATus:QUEStionable:INTegrity` condition register. This means that:

– The summary bits read by the `STATus:QUEStionable:INTegrity:CONDition?` query are true if any event bits are set in any of the :INTegrity sub-registers :SIGNal or :UNCalibrated.

– The summary bits read by the `STATus:QUEStionable:INTegrity?` event query are true if any event bit has undergone a false-to-true transition with the PTRansition filter set, or a true-to-false transition with the NTRansition filter set, in any of the :INTegrity sub-registers :SIGNal or :UNCalibrated

Thus, the summary bits **cannot** be used to determine the current state of a lower level condition bit; only the state and history of the lower level event bits.

This register is itself summarized as bit 9 of the STATus:QUEStionable register, as described in the section “Condition Errors 601 to 699, Error Summaries” on page 131.

Err#	Bit in status register	Message	Error or Warning	More Information
133	0	`Signal Summary`	status bit only	This bit is the summary bit for the STATus:QUEStionable:INTegrity:SIGNal sub-register.
135	1	`No Result`	E	
135	1	`No Result;Turn on MCE`	E	To calculate Timing and Phase results in the Code Domain Power view of Mod Accuracy, the "Multi Channel Estimator" must be set to ON. Otherwise these results are invalid.

Err#	Bit in status register	Message	Error or Warning	More Information
135	1	`No Result; Meas invalid with I/Q inputs`	E	The current measurement does not support I/Q input; switch to the RF or another input or select a different measurement
137	2	unused		
139	3	`Uncalibrated Summary`	status bit only	This bit is the summary bit for the STATus:QUEStionable:INTegrity:UNCalibrated sub-register.
141	4	`Input Overload`	E[a]	
141	4	`Input Overload;ADC over range`	E[a]	The signal at the input to the IF section is too high. You should increase the attenuation or lower the signal level.
141	4	`Input Overload;I/Q ADC over range`	E[a]	The I or Q input exceeds the ADC upper limit.
141	4	`Input Overload;I/Q Voltage over range`	E[a]	The input voltage on the I or Q channel exceeds the channel limit. In differential mode the over voltage may occur without causing an ADC overload, for example, if I is at +5.01 V and I-bar is at +5.0 the ADC will be in range but both I and I-bar will exceed the voltage limit.
141	4	`Input Overload; RF Preselector Overload`	E[a]	The level at the input of the MXE RF Preselector has exceeded tolerances, reduce the input level
143	5	unused		
145	6	unused		
147	7	`Insufficient Data`	E	
147	7	`Insufficient Data; Incr. Demod Time`	E	There is insufficient acquisition data to provide accurate metrics. You should increase the Demod Time to acquire enough data.
147	7	`Insufficient Data; frequency list empty`	E	A measurement was attempted with List frequency mode or a SCPI query of the frequency list table was made and the frequency list table is empty.
147	7	`Insufficient Data; ENR table empty`	E	A measurement was attempted or a SCPI query of an ENR table was made and there were no entries in the relevant ENR table (Common, Meas or Cal).
147	7	`Insufficient Data; Loss table empty`	E	A measurement is attempted or a SCPI query of a before or after loss table is made and there are no entries in the relevant loss table

Err#	Bit in status register	Message	Error or Warning	More Information
149	8	`Meas Error`		
151	9	`Memory Error`	E	
151	9	`Memory Error;Shorten capture interval`	E	A shortage of free memory related to longer capture intervals has occurred. The measurement is aborted and all results return invalid values
153	10	`I/O Error`	E	
153	10	`I/O Error; Ext Source needs IP Addr`	E	No IP address entered for external source and external LO control is ON.
155	11	`Trig Error`	E	
157	12	`Invalid Data`	Status bit only	This is the “invalid data indicator”, same as the “*” in the upper right corner of the screen. It means that the on-screen annotation does not match the on-screen data, usually because a measurement is pending after a settings change. There is no message in the status line and nothing in the history queue, but there IS an on-screen indication and a status bit.
159	13	`Settings Alert`	W	
159	13	`Settings Alert;LO may overload IF`	W	If the sweep type is Swept, the start frequency of the instrument is less than 10 MHz, and you put Swept IF Gain in Manual High, then a warning condition is generated and remains in effect as long as this condition exists. In some older analyzers this was error 1109.
159	13	`Settings Alert; Diff probe mismatch; <I|Q|I,Q>`	W	The attenuation values of the two probes on the I and/or Q channels differ by too much for a valid differential reading.
159	13	`Settings Alert; Acquisition truncated`	W	In the Analog Demod mode, certain extreme settings combinations will result in a required acquisition length in excess of the capacity of the analyzer. Increase the AF Spectrum RBW or the RF Spectrum RBW, decrease the Channel BW, and/or decrease the Demod Waveform Sweep Time.

Err#	Bit in status register	Message	Error or Warning	More Information
159	13	`Settings Alert; Analog Out settings conflict`	W	The user has manually set the Analog Output under the Input/Output menu to a setting that conflicts with the current measurement. There will be no output on the Analog Out port until this conflict is resolved. In most cases, simply set Analog Out to Auto for the optimal setting.
159	13	`Settings Alert;I/Q mismatch:<Differential|Input Z|Attenuation>`	W	The impedance, differential, or attenuation settings for the I and Q channels do not match. For valid I+jQ measurements the impedance and differential settings should be the same on both channels and the attenuation should match within 1 dB
159	13	`Settings Alert;Parm/data mismatch`	W	For *Bluetooth*, the detected parameters did not match the data
159	13	`Settings Alert; Src pwr ramp>ALC range`	W	You have selected a Power Sweep range that exceeds the ability of the external Source to follow without changing mechanical attenuation. Lower the Power Sweep range.
159	13	`Settings Alert; Sweep Rate Unavailable`	W	The auto coupled sweep time exceeds the maximum allowed. Therefore, full amplitude accuracy cannot be attained. Please increase the RBW or reduce the span.
159	13	`Settings Alert; Span:RBW Ratio too big`	W	The chosen large ratio of span to RBW is not possible. Please reduce the span or increase the RBW and/or FFT Width.
161	14	`Setting Modified`	E	
161	14	`Setting Modified; Filter not applied`	E	The filter you have selected is larger than the sampling frequency. You should select a different filter.

a. The Input Overload error is not reported to the SCPI queue unless the :SYSTem:ERRor:OVERload ON command has been issued, however it always sets the status bit. For details of the `:SYSTem:ERRor:OVERload` command, see any X-Series User's & Programmer's Reference.

Condition Errors 201 to 299, Signal Integrity

This series of errors corresponds to the bits in the `STATus:QUEStionable:INTegrity:SIGNal` sub-register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 207 indicates a Burst Not Found condition has been detected, error 1207 indicates that failure has been cleared.

This register is summarized as bit 0 of the `STATus:QUEStionable:INTegrity` register, as described in the section "Condition Errors 101 to 199, Measurement Integrity" on page 118.

Err#	Bit in status register	Message	Error or Warning	More Information
203	0	unused	E	
205	1	unused	E	
207	2	`Burst Not Found`	E	The burst signal cannot be detected because of inappropriate parameter settings or incorrect signal. An in appropriate parameter setting could cause the signal to be partially, rather than fully, on the display, Burst Search Threshold and/or Burst Search Length may need to be adjusted. An incorrect signal could have either insufficient power, the rising or falling edges cannot be detected, or the burst is less than 126 microseconds. Carrier signal is not actually bursted. W-CDMA: Either the signal being analyzed has insufficient power, the rising or falling edges cannot be detected, or the burst is less than 126 microseconds. W-CDMA: Cannot synchronize measurement with PRACH channel for Power Control measurement, because the signal cannot be found. Make sure PRACH is present in the W-CDMA uplink signal, and that the preamble signature and scramble code are set correctly. GSM: Data was acquired but a GSM burst was not found, with the timeslot mode disabled. NADC, PDC: A valid burst is not found when the Device is MS. 1xEV-DO: Data was acquired but a 1xEV burst was not found, with the timeslot mode disabled. *Bluetooth*: The burst that has been found does not correspond to the currently selected *Bluetooth* packet type (the burst length may be too short). WLAN: The instrument cannot find a valid WLAN burst. You may need to extend the search length. In PSA, this error was reported as one of the following error numbers: 10772, 13104, 10160, 10286, 10420, 10454, 10614, 10904, 10928, 13074, 10287

Err#	Bit in status register	Message	Error or Warning	More Information
207	2	`Burst not found;with selected Time Slot`	E	The selected timeslot does not contain the expected burst.
209	3	`Timing Error`	E	
209	3	`Timing Error:No time ref pilot burst`	E	The pilot burst used for time reference is not active.
211	4	`Carrier(s) incorrect or missing`	E	In PSA, this error was reported as one of the following error numbers: 10165, 10173, 10178, 10419, 10421, 10535, 10560, 10642, 10648, 10650, 10960
213	5	`Freq Out of Range`	E	
213	5	`Freq Out of Range; System input (IF)`	E	One or more system input frequencies are out of range. If using a frequency list, check that all entries are valid for current measurement mode.
213	5	`Freq Out of Range; External LO`	E	One or more external LO frequencies are out of range. Check that the LO frequency limits are set correctly and check the entered measurement frequencies and measurement mode.
215	6	`Sync Error`	E	W-CDMA: Cannot sync DPCCH pilot. Cannot synchronize measurement with DPCCH pilot for Power Control measurement, because the pilot signal cannot be found. Make sure DPCCH is present in the W-CDMA uplink signal, and that the slot format and scramble code are set correctly.
215	6	`Sync Error;No pilot burst`	E	There is no Pilot burst detected.
215	6	`Sync Error;Sync code not found`	E	Synchronization code is not found in the measured time slot.
215	6	`Sync Error;No freq ref pilot burst`	E	The pilot burst used for frequency reference is not active.
215	6	`Sync Error;Midamble sync fail`	E	Failed to find the uplink slot, which caused the synchronization with the Midamble to fail.
215	6	`Sync Error;Preamble length zero`	E	Burst type is "Data" or "Preamble" and the measurement cannot find a Preamble

Err#	Bit in status register	Message	Error or Warning	More Information
217	7	`Demod Error`	E	This error is normally generated because of one of the following reasons: **1. There is no carrier signal.** **2. Walsh channels other than the pilot are active.** **3. There is some other modulation problem that will prevent the measurement from being made.** This problem must be corrected before the measurement can continue. cdma 2000 & W-CDMA: Cannot correlate to the input signal and no active channel is found. (from composite EVM measurement) An active channel must meet the default threshold criteria that it is within 20 dB of the highest power code channel. The threshold can be changed using the active set threshold function in the Meas Setup menu. cdmaOne: A correlation failure with the pilot CDMA channel occurred during synchronous demodulation. 1xEV-DO: Cannot correlate to the input signal and no active channel is found. (from composite EVM measurement) An active channel must meet the default threshold criteria that it is within 20 dB of the highest power code channel. The threshold can be changed using the active set threshold function in the Meas Setup menu. In PSA, this error was reported as one of the following error numbers: 10872, 10962, 13070, 10228, 10768
217	7	`Demod Error;Can’t correlate`	E	Cannot correlate to the input signal and no active channel is found. (from composite EVM measurement) An active channel must meet the default threshold criteria that it is within 20 dB of the highest power code channel. The threshold can be changed using the active set threshold function in the Meas Setup menu.
217	7	`Demod Error;Data interval too short`	E	There are not enough input I/Q pairs for the measurement calculation. This may be caused by an incorrect data capture.
217	7	`Demod Error;No active channel`	E	There is no active channel detected.
217	7	`Demod Error;Not an active slot`	E	There is no active slot detected.

Err#	Bit in status register	Message	Error or Warning	More Information
217	7	`Demod Error;No full subframe found`	E	No sub-frame or only part of one sub-frame is detected.
217	7	`Demod Error;Muxed bits not found`	E	Multiplexed Data Demod Bits are not generated even though Data channel is selected, because all 16 data code channels are not active
217	7	`Demod Error;Acq Time too short`	E	For *Bluetooth*, the detected packet type doesn't match the captured packet type because the payload start, end or data could not be found.
219	8	`Signal Too Noisy`	E	NADC & PDC: The valid EVM measurement cannot be performed, because the input signal is too noisy. GSM & EDGE: In a GSM measurement, indicates that a burst could not be found in a signal that appears noisy. In PSA, this error was reported as one of the following error numbers: 10702, 10824, 10906, 10930, 13024, 10626, 111
221	9	`Slot Error`	E	
221	9	`Slot error;No active slot found`	E	No valid active slot found in captured data, or no active slot found in captured interval. Synchronization may succeed and pilot found when this message is issued, but no results are included in peak/average calculation.
221	9	`Slot Error; No idle slot found`	E	No valid idle slot found in captured data, or no idle slot found in captured interval. Synchronization may succeed and pilot found when this message is issued, but no results are included in peak/average calculation.
223	10	unused	E	
225	11	unused	E	
227	12	unused	E	
229	13	unused	E	
231	14	unused	E	

Condition Errors 301 to 399, Uncalibrated Integrity

This series of errors corresponds to the bits in the `STATus:QUEStionable:INTegrity:UNCalibrated` sub-register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 301 indicates a Meas Uncal condition has been detected, error 1301 indicates that failure has been cleared.

This register is summarized as bit 3 of the `STATus:QUEStionable:INTegrity` register, as described in the section "Condition Errors 101 to 199, Measurement Integrity" on page 118.

Err#	Bit in status register	Message	Error or Warning	More Information
301	0	`Meas Uncal`	W	
303	1	`Signal ID on`	W	
305	2	`No Long Code Phase`	W	
307	3	`AC coupled: Accy unspec'd <10 MHz`	W	AC input coupling will function at lower frequencies, but the performance is not specified below 10 MHz.
309	4	`User cal`	W	

Err#	Bit in status register	Message	Error or Warning	More Information
309	4	`User Cal; Cal invalidated`	E,W	The existing user cal has been invalidated for one of the following reasons: **Frequency**: Setting the frequency outside the current valid user cal set (for example: If the current sweep range is 2 to 3GHz, then setting the start frequency to 1.9 GHz will invalidate the current user cal. Other frequency changes that will invalidate the user cal are: • If the cal was performed at a fixed frequency and you change this frequency. • If you are in "Freq List" mode and you change it to extend beyond the current user cal range. In this case you will see an error message. **DUT Type**: If the DUT Type parameter changes, causing the measurement frequencies to be pushed outside the current cal. Attenuation: If an attenuation setting is selected but has not been calibrated. Preamp: If set to condition different from current cal settings, for example: if calibrated with the preamp on, turning it off will invalidate the cal. **Points**: Changing the number of measured frequency points can make the stored preselector offsets become inaccurate and hence invalidate the calibration. This occurs when the following conditions exist: • A successful calibration has been performed. • Some measured freq points are > 3.6 GHz. • The new points > 3.6 GHz are located more than 50 MHz away from the current calibration points.
309	4	`User Cal; Freq outside cal range`	E	The existing user cal has been invalidated because the current measurement frequencies lie partially or wholly outside the range of frequencies used for user-cal. (UNCAL)
309	4	`User Cal; Cal will be interpolated`	W	The measurement frequency range has been changed such that it is a subset of the calibrated range. (~CAL)

Err#	Bit in status register	Message	Error or Warning	More Information
309	4	`User Cal; Adjusted for new RBW`	W	The measurement RBW has been changed since the last calibration (~CAL)
311	5	`Calibration`	W	
311	5	`Calibration; ENR table extrapolated`	W	One or more calibration or measurement frequency points exceed the currently loaded Cal or Meas ENR Table frequency ranges. The corresponding ENR table's lowest frequency ENR value will be re-used for frequencies less than the table range, and the highest frequency ENR value will be re-used for frequencies greater than the table range. (~ENR)
311	5	`Calibration; No ENR data present`	W	No ENR Data (ENR)
313	6	`Source Uncal`	W	
313	6	`Source Uncal;adj Start Freq or RBW`	W	While using a Tracking Source, you must make sure the Start Frequency is high enough to avoid capturing LO feedthrough in the trace. This depends on both Start Freq and RBW. If you get this message, increase the Start Freq or narrow the RBW.
315	7	`Preamp: Accy unspec'd <XX kHz`	W	Preamp will function at lower frequencies, but the performance is not specified below XX kHz (XX is model number specific).
317	8	unused	W	
319	9	unused	W	
321	10	unused	W	
323	11	unused	W	
325	12	unused	W	
327	13	unused	W	
329	14	unused	W	

Condition Errors 401 to 499, Power

This series of errors corresponds to the bits in the `STATus:QUEStionable:POWer` register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 409 indicates a 50 MHz Oscillator Unleveled condition has been detected, error 1409 indicates that failure has been cleared.

This register is summarized as bit 3 of the `STATus:QUEStionable` register, as described in the section "Condition Errors 601 to 699, Error Summaries" on page 131.

Err#	Bit in status register	Message	Error or Warning	More Information
401	0	`RPP Tripped`	W	(not currently in use)
403	1	`Source Unleveled`	W	
405	2	`Source LO Unleveled`	E	(not currently in use)
407	3	`LO Unleveled`	E	(not currently in use)
409	4	unused		
411	5	unused		
413	6	unused		
415	7	unused		
417	8	unused		
419	9	unused		
421	10	unused		
423	11	unused		
425	12	unused		
427	13	unused		
429	14	unused		

Condition Errors 501 to 599, Frequency

This series of errors corresponds to the bits in the `STATus:QUEStionable:FREQuency` register (s. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 503 indicates a Frequency Reference Unlocked condition has been detected, error 1503 indicates that failure has been cleared.

This register is summarized as bit 5 of the `STATus:QUEStionable` register, as described in the section "Condition Errors 601 to 699, Error Summaries" on page 131.

Err#	Bit in status register	Message	Error or Warning	More Information
501	0	`Source Synth Unlocked`	E	
503	1	`Frequency Reference Unlocked`	E	
505	2	`2nd LO Unlocked`	E	
507	3	unused		
509	4	`LO Unlocked`	E	
511	5	unused		
513	6	`IF Synthesizer Unlocked`	E	
515	7	`Calibration Oscillator Unlocked`	E	
517	8	unused		
519	9	`Demodulation`	E	
521	10	`Ref missing or out of range`	E	
521	10	`Ref missing or out of range; External`	E	The external frequency reference signal is missing or is not within the proper amplitude range. In PSA, this error was reported as error 622
521	10	`Ref missing or out of range; Pulse`	E	The pulse reference signal is missing or is not within the correct amplitude range.
523	11	unused		
525	12	unused		
527	13	unused		
529	14	unused		

Condition Errors 601 to 699, Error Summaries

This series of errors corresponds to the bits in the `STATus:QUEStionable` register, read with a `STATus:QUEStionable?` event query or a `STATus:QUEStionable:CONDition?` query.

The second column in the table shows the corresponding bit in the status register. These bits do not have any corresponding error messages, although error numbers have been reserved for them as seen in the Err# column; they are status bits only.

The bits in the `STATus:QUEStionable` register are “summary bits” for registers at a lower level. Note that these summary bits summarize the state and history of the event registers at the lower level. This is true even for bits in the `STATus:QUEStionable` condition register. This means that:

- The summary bits read by the `STATus:QUEStionable: CONDition?` query are true if any event bits are set in any of the :QUEStionable sub-registers :POWer, :TEMPerature, FREQuency, CALibration or :INTegrity.
- The summary bits read by the `STATus:QUEStionable?` event query are true if any event bit has undergone a false-to-true transition with the PTRansition filter set, or a true-to-false transition with the NTRansition filter set, in any of the :QUEStionable sub-registers :POWer, :TEMPerature, FREQuency, CALibration or :INTegrity.

Thus, the summary bits **cannot** be used to determine the current state of a lower level condition bit; only the state and history of the lower level event bits.

Err#	Bit in status register	Message	Error or Warning	More Information
601	0	unused		
603	1	unused		
605	2	unused		
607	3	`Power`	status bit only	This bit is the summary bit for the STATus:QUEStionable:POWer sub-register.
609	4	`Temperature`	status bit only	This bit is the summary bit for the STATus:QUEStionable:TEMPerature sub-register.
611	5	`Frequency`	status bit only	This bit is the summary bit for the STATus:QUEStionable:FREQuency sub-register.
613	6	unused		
615	7	unused		
617	8	`Calibration`	status bit only	This bit is the summary bit for the STATus:QUEStionable:CALibration sub-register.

Err#	Bit in status register	Message	Error or Warning	More Information
619	9	`Integrity`	status bit only	This bit is the summary bit for the STATus:QUEStionable:INTegrity sub-register.
621	10	unused		
623	11	unused		
625	12	unused		
627	13	unused		
629	14	unused		

Condition Errors 701 to 799, Operation

This series of errors corresponds to the bits in the `STATus:OPERation` register, which can be read with a `STATus:OPERation?` event query or a `STATus:OPERation:CONDition?` query.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated.

For example, error 721 indicates that the DC Coupled condition has been detected; error 1721 indicates that condition has been cleared.

Unless otherwise noted in the **Error or Warning** column below, these are status bits only, with no corresponding error message or number

Err#	Bit in status register	Message	Error or Warning	More Information
701	0	`Calibrating`	status bit only	
703	1	`Settling`	status bit only	
705	2	unused		
707	3	`Sweeping`	status bit only	
709	4	`Measuring`	status bit only	
711	5	`Waiting for Trigger`	status bit only	
713	6	`Waiting for Arm`	status bit only	

Err#	Bit in status register	Message	Error or Warning	More Information
715	7	unused		
717	8	`Paused`	status bit only	
719	9	`Source Sweeping`	status bit only	The "Source Sweeping" bit is used to indicate various conditions, depending on the Mode of operation: In the List Sequencer mode, it is used to indicate that the sequencer is running In the EMI Receiver mode, it is used to indicate that scan results are available from the Frequency Scan measurement
721	10	`DC Coupled`	W	
723	11	unused		
725	12	`Source Waiting for Trigger`	status bit only	
727	13	unused		
729	14	unused		

Condition Errors 801 to 899, Temperature

This series of errors corresponds to the bits in the `STATus:QUEStionable:TEMPerature` register. The second column in the table shows the corresponding bit in that register.

An event with the error number shown in the table means the condition has been detected. When the condition is cleared, an event with the error number plus 1000 is generated. These error numbers can be viewed in the Show Errors screen, along with the DETECTED and CLEARED indicators.

For example, error 801 indicates that the Ref Osc Oven Cold condition has been detected; error 1801 indicates that condition has been cleared.

This register is summarized as bit 4 of the `STATus:QUEStionable` register, as described in the section "Condition Errors 601 to 699, Error Summaries" on page 131.

Err#	Bit in status register	Message	Error or Warning	More Information
801	0	`Reference Oscillator Oven Cold`	W	(not currently in use)

Err#	Bit in status register	Message	Error or Warning	More Information
803	1	unused		
805	2	unused		
807	3	unused		
809	4	unused		
811	5	unused		
813	6	unused		
815	7	unused		
817	8	unused		
819	9	unused		
821	10	unused		
823	11	unused		
825	12	unused		
827	13	unused		
829	14	unused		

4 RF Section Troubleshooting (RF/Microwave Analyzers)

What You Will Find in This Chapter

The following information is found in this chapter:

1. Theory of operation of the RF section
2. Isolating the cause of an hardware problem by verifying the functionality of assemblies in the RF section signal path.

NOTE Each section describes how the assembly works and gives information to help you troubleshoot the assembly. Each description covers the purpose of the assembly, describes the main components, and lists external connections to the assembly.

This following descriptions are found in this chapter:

RF Section Description on page 136

Troubleshooting on page 144

Quick Check to Verify the Low Band Signal Path on page 144

Troubleshooting a Low Band Problem on page 148

Quick Check to Verify High Band RF Path #1 on page 170

Troubleshooting a High Band Problem on page 174

High Band Preamp (Option P08, P13, P26) on page 199

High Band Mixing Equations on page 199

Microwave Preselector Bypass (Option MPB) on page 200

RF Section Description

Purpose

This section covers only those optional frequency ranges listed below for the N9020B, Signal Analyzer.

- Option 503, 3.6 GHz Frequency Range
- Option 508, 8.4 GHz Frequency Range
- Option 513, 13.6 GHz Frequency Range
- Option 526, 26.5 GHz Frequency Range

The RF input signal can be routed through three different front end signal paths. These various paths are switched in and out based on where the signal analyzer center frequency is tuned.

1. **Low band RF path is used when the input frequency is ≤ 3600 MHz**
2. **High band RF path #1 is used when the input frequency is > 3.6 GHz to 13.6 GHz**
3. **High band RF path #2 is used when the input frequency is > 13.6 GHz to 26.5 GHz**

The RF section is designed to convert RF input signals to an intermediate frequency (IF) that is present at the RF output of the A13 Front End assembly. This IF depends on installed options and the IF path selected. This chapter will assume the default operation in Spectrum Analyzer mode. Therefore, the IF will be 322.5 MHz.

IF Path	IF	Mode
10 MHz (standard)	322.5 MHz	Spectrum Analyzer or IQ Analyzer
25 MHz (Option B25)	322.5 MHz	IQ Analyzer
40 MHz (Option B40)	250 MHz	IQ Analyzer
85 MHz (Option B85)	300 MHz	IQ Analyzer
125 MHz (Option B1A)	300 MHz	IQ Analyzer
140 MHz (Option B1X)	300 MHz	IQ Analyzer
160 MHz (Option B1Y)	300 MHz	IQ Analyzer

The RF section is comprised of the following major assemblies:

- A9 Input Attenuator A
- A10 Input Attenuator B
- A11 Low Band Switch Assembly
- A12 YTF Preselector
- A14 L.O. Synthesizer Assembly
- A13 RF Front End Assembly
- A15 Front End Control Assembly
- SW1 and SW2 - Option MPB Microwave Preselector Bypass

NOTE

SW1 and SW2 and their associated cables are the microwave preselector bypass hardware. This hardware is present in analyzers containing any or all of the following three options:

- MPB, Microwave Preselector Bypass
- B40, 40 MHz Analysis Bandwidth
- DP2, Digital Signal Processing & 2 GB Capture Memory

However, if there is no license for Option MPB, the hardware will default to the non-bypassed path (high band microwave signals will be routed through the A12 YTF Preselector). If a license for Option MPB is present, it will be possible to bypass the A12 YTF Preselector.

1. **RF input frequencies < 3600 MHz** route through the low band path. Refer to Chapter 12, “Block Diagrams” for details.

   The RF input signal level can be optimized by either Input Attenuator A or Input Attenuator B. The low band switch is biased in such a way that the signal is routed to the input of the A13 RF Front End assembly. There are (3) different signal paths on the input of the RF Front End assembly that the signal can be routed through depending on installed options and front panel settings.

   - Electronic Attenuator path, 0-24 dB (Option EA3)
   - Low Band Preamplifier path, 20 dB nominal gain (Option Pxx)
   - Direct to Mixer #1

NOTE

The RF input signal can route through the Electronic Attenuator section or the Preamplifier, but not both. All RF input frequencies < 3600 MHz go to Mixer #1.

The RF input signal is then mixed with the 1st L.O. from the A14 L.O. Synthesizer assembly in Mixer #1 to a 1st intermediate frequency of 5122.5 MHz. Since the RF input signal is <3600 MHz for low band, this RF input signal is upconverted in Mixer #1 to the 1st I.F. This 1st I.F. signal is then downconverted in Mixer #2 using the 4800 MHz 2nd L.O. generated on the A16 Reference assembly to a 2nd intermediate frequency of 322.5 MHz (5122.5 MHz (1st I.F.) – 4800 MHz (2nd L.O.)). The 2nd I.F. output is at A13J7 on the A13 RF Front End Assembly. This signal path is used for all frequency range options when the RF input frequencies are < 3600 MHz. The control voltages and biasing for these assemblies come from the A15 Front End Control assembly.

2. **RF input frequencies from 3.6 GHz to 13.6 GHz** go through high band path #1. Refer to Chapter 12, “Block Diagrams” for details.

   This signal level can be optimized by either Input Attenuator A or Input Attenuator B. The signal is then routed to the low band switch, which will route the signal to the A12 YTF Preselector.

   The signal then routes to the A12 YTF Preselector before going to the A13 RF Front End Assembly. The input switch in the RF Front End Assembly routes the RF input signal to Mixer #2. The RF input signal is then mixed with the 1st L.O. from the A14 L.O. Synthesizer Assembly in Mixer #2 to a 1st intermediate frequency of 322.5 MHz. The 322.5 MHz I.F. output is at A13J7 of the RF Front End Assembly. This is the signal path for Option 508, 8.4 GHz Frequency Range, Option 513, 13.6 GHz Frequency Range, and Option 526, 26.5 GHz Frequency Range (up to 13.6 GHz). The control voltages and biasing for these assemblies come from the A15 Front End Control Assembly.

3. **RF input frequencies from 13.6 GHz to 26.5 GHz** go through high band path #2. Refer to Chapter 12, “Block Diagrams” for details.

   This signal level can be optimized by either Input Attenuator A or Input Attenuator B. The signal is then routed to the low band switch, which will route the signal to the A12 YTF Preselector.

   The low band switch is biased by the A15 Front End Control Assembly. The signal then routes to the A12 YTF Preselector before going to the A13 RF Front End Assembly. The input switch in the RF Front End Assembly routes the RF input signal to Mixer #3. The RF input signal is then mixed with the 1st L.O. from the A14 L.O. Synthesizer Assembly in Mixer #3 to a 1st intermediate frequency of 322.5 MHz. The LO is doubled at tuned frequencies above 17 GHz. The 322.5 MHz I.F. output is at A13J7 of the RF Front End Assembly. This is the signal path for Option 526, 26.5 GHz Frequency Range (for frequencies ≥13.6 GHz). The control voltages and biasing for these assemblies come from the A15 Front End Control Assembly.

RF Section Theory of Operation

A9 Input Attenuator A

This assembly has two 2 dB attenuator sections, a DC block and a cal signal input port. With the DC block switched in (AC coupled mode), the low end minimum frequency range increases from 20 Hz to 10 MHz due to capacitive effects.

A10 Input Attenuator B

This assembly has a total of 66 dB of attenuation to control the RF level going to the mixer assemblies in the A13 RF Front End Assembly. There is a 6 dB, 10 dB, 20 dB, and 30 dB section in the A10 assembly. Total input attenuation with the A9 and the A10 combined is 70 dB in 2 dB steps.

A11 Low Band Switch

This assembly operates across the entire frequency range of the analyzer. The switch has 3 main functions:

- Switch RF input frequencies from 20 Hz to 3.59 GHz RF Output to A13 RF Front End Assembly.
- Switch RF input frequencies from 3.6 GHz to 26.5 GHz Microwave RF Output to A12, YTF Preselector.
- Optional high band preamplifier, which has a typical gain of 30 dB and a noise figure from 9-12 dB up to 18 GHz.

A12 YTF Preselector

The YTF Preselector is used for input frequencies greater than 3.6 GHz. Signals less than 3.6 GHz bypass the YTF assembly and are routed directly to the A13 RF Front End Assembly. The YTF Preselector is a YIG tunable bandpass filter whose main purpose is to filter out unwanted spurious or image response signals. When the YTF is calibrated, the tunable bandpass will track the RF input signal. The YTF Preselector has a 3 dB bandwidth greater than 40 MHz and an insertion loss of ~ 6.5 dB.

The preselector requires centering for optimum amplitude accuracy. The Auto Align routine will perform a rough centering during the preselector two-point tuning algorithm. However, when troubleshooting, press **Amplitude**, **Signal Path**, **Presel Adjust** to manually center the preselector.

The YTF Preselector is not present in most analyzers with Option 503, 3.6 GHz frequency range.

A14 L.O. Synthesizer Assembly

The L.O. Synthesizer Assembly provides the 1st L.O. power that is required for the A13 RF Front End Assembly. The 1st L.O. has a frequency range from 3.80 to 8.70 GHz. Harmonics of the 1st L.O. are used to down convert RF input signals up to 26.5 GHz. Table 4-1 provides some examples of how the L.O. is multiplied for the given center frequency of the analyzer and which high band mixer is being used on the A13 RF Front End assembly. The output power is +13 to +18 dBm. In order to maximize the conversion efficiency, sufficient L.O. power must be supplied to the mixer in the A13 RF Front End Assembly from this assembly.

Table 4-1 X-Series Signal Analyzers

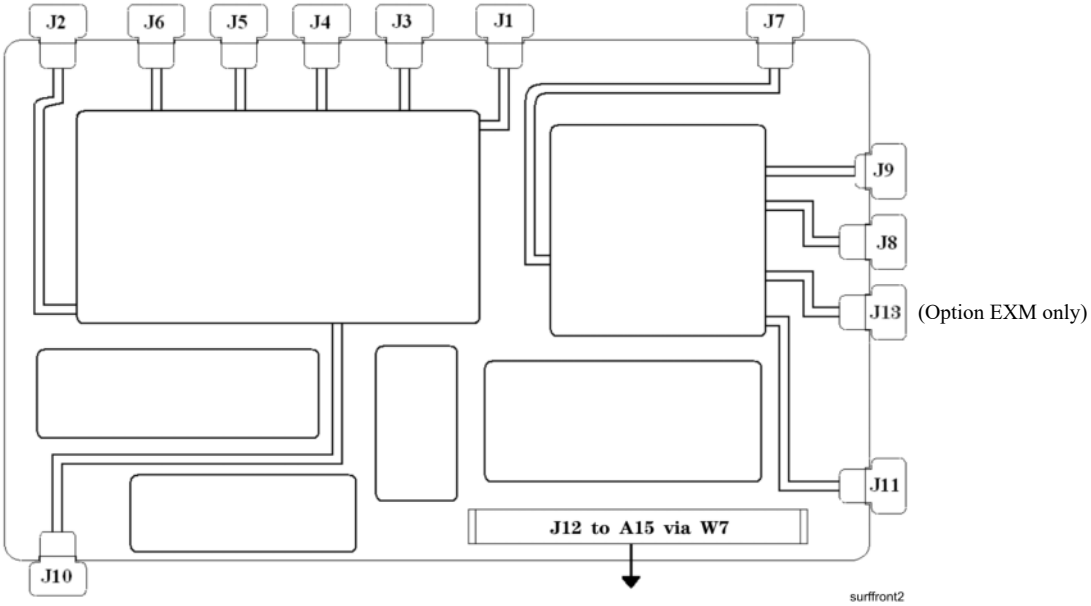
Analyzer Center Frequency[a]	1st L.O. @ A14J740	Desired 1st L.O. Harmonic @ Mixer 2 or 3
5 GHz	5.3225 GHz	5.3225 GHz[b]
10 GHz	5.16125 GHz	10.3225 GHz[b]
13.5 GHz	6.91125 GHz	13.8225 GHz[b]
14.5 GHz	7.41125 GHz	14.8225 GHz[c]
22 GHz	5.5806250 GHz	22.3225 GHz[c]

a. Set span to Zero Span to measure 1st L.O.
b. A13 Mixer 2 (refer to Chapter 12, “Block Diagrams.”)
c. A13 Mixer 3 (refer to Chapter 12, “Block Diagrams.”)

A13 RF Front End Assembly

This assembly is a self-contained microcircuit that is repaired at the assembly level. See Figure 4-1.

Figure 4-1 A13 RF Front End Assembly View from Front Panel



This assembly contains the following circuits:

- Input Low-pass filter (RF input signals < 3.6 GHz)
- Low Band Limiter
- Optional Electronic Attenuator (0-24 dB attenuation control)
- Optional Low Band Preamplifier
- RF Mixer #1 (RF input signals < 3.6 GHz)
- 1st L.O. Sub-system (3.8 GHz to 8.7 GHz)
- 1st I.F. Amplifier (5122.5 MHz)
- I.F. Band pass filter (5122.5 MHz)
- I.F. Low-pass filter (5122.5 MHz)
- Mixer #2 (RF input signals 3.6 GHz to 13.599 GHz)
- Microwave Input Amplifier
- Mixer #3 (RF input signals 13.6 GHz to 26.5 GHz)
- 2nd I.F. Amplifier (322.5 MHz)
- Microwave L.O. Sub-system (3.8 GHz to 8.7 GHz)
- L.O. Doubler

– External Mixing Diplexer (units with Option EXM only)

Table 4-2 A13 RF Front End Signals

Signal Name	Description	From	To
RF Input	20 Hz to 3.59 GHz RF Input	A11J2, Low Band Switch	A13J2
Microwave Input	3.6 GHz to 26.5 GHz U-wave RF Input	YTF Output or SW1	A13J9
E-cal Input	Cal Signal Port	A16J705, Ref. Bd	A13J6
1st L.O. Input	3.8225 to 8.7225 GHz 1st L.O.	A14J40, Synth. Bd	A13J4
2nd L.O. Input	4.8 GHz 2nd L.O.	A16J702, Ref Bd	A13J1
I.F. Output	322.5 MHz I.F. Signal	A13J7	A2J100, AIF or A15J902, EFEC
To Band Pass Filter	Filter Port, 1st I.F. Amplifier Output	A13J10	5.1225 GHz Cavity Input
From Band Pass Filter	Filter Port, 2nd Mixer Input	5.1225 GHz Cavity Output	A13J11

Front End Control Assembly

Provides the correct biasing and switch control logic to the following RF assemblies:

– Input Attenuator A

– Input Attenuator B

– Low Band Switch

– YTF Preselector (Input signals > 3.6 GHz)

– RF Front End Assembly

– (Optional) High Band Preamplifier

– (Optional) Low Band Preamplifier

– (Optional) Electronic Attenuator (0-24 dB)

– (Optional) Microwave Preselector Bypass

NOTE Refer to Chapter 6, “Front End Control Troubleshooting.” for detailed descriptions & troubleshooting procedures

Troubleshooting

Quick Check to Verify the Low Band Signal Path

The analyzer has an internal 50 MHz amplitude reference signal that is used to verify the low band path. Refer to Chapter 12, "Block Diagrams" for details.

Equipment needed:

Functioning Spectrum Analyzer

DVM

Cables & Connectors

NOTE To perform the following checks, it will be necessary to remove the outer cover and the top brace. See Chapter 15 for removal procedures.

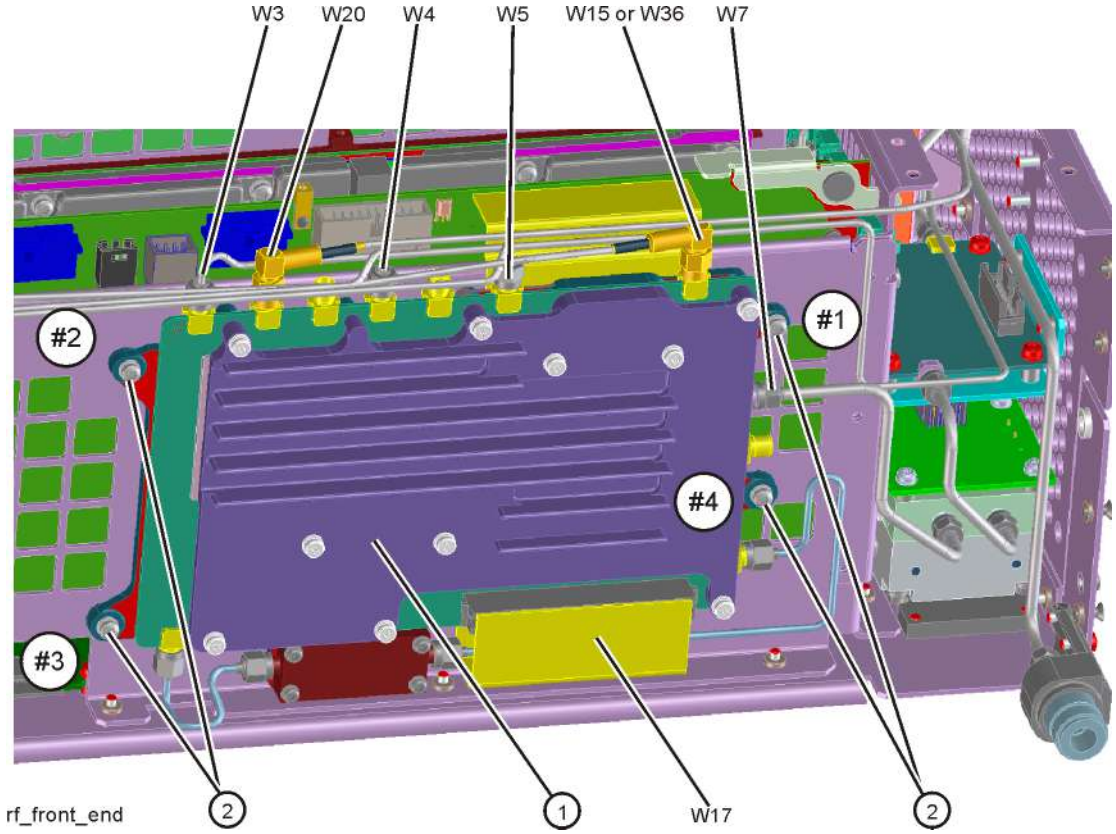
Turn the analyzer on and allow it to complete its full boot up process to Spectrum Analyzer mode. Use the internal 50 MHz, –25 dBm calibrator signal as a reference for troubleshooting by pressing **Mode Preset**, **Input/Output**, **RF Calibrator**, **50 MHz** on the analyzer. Now press **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search**. The 50 MHz reference signal should measure 50 MHz @ –25 dBm ± 2 dB on the analyzer display. If the power level is within tolerance, the low band path is functioning correctly at 50 MHz. To verify the high band path go to "Quick Check to Verify High Band RF Path #1" on page 170.

If the power level is not within tolerance, press **FREQ**, **Zero Span**, **AMPTD**, **Attenuation**, **Mech Atten, 10 dB**.

IMPORTANT Turn off auto align by pressing **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**.

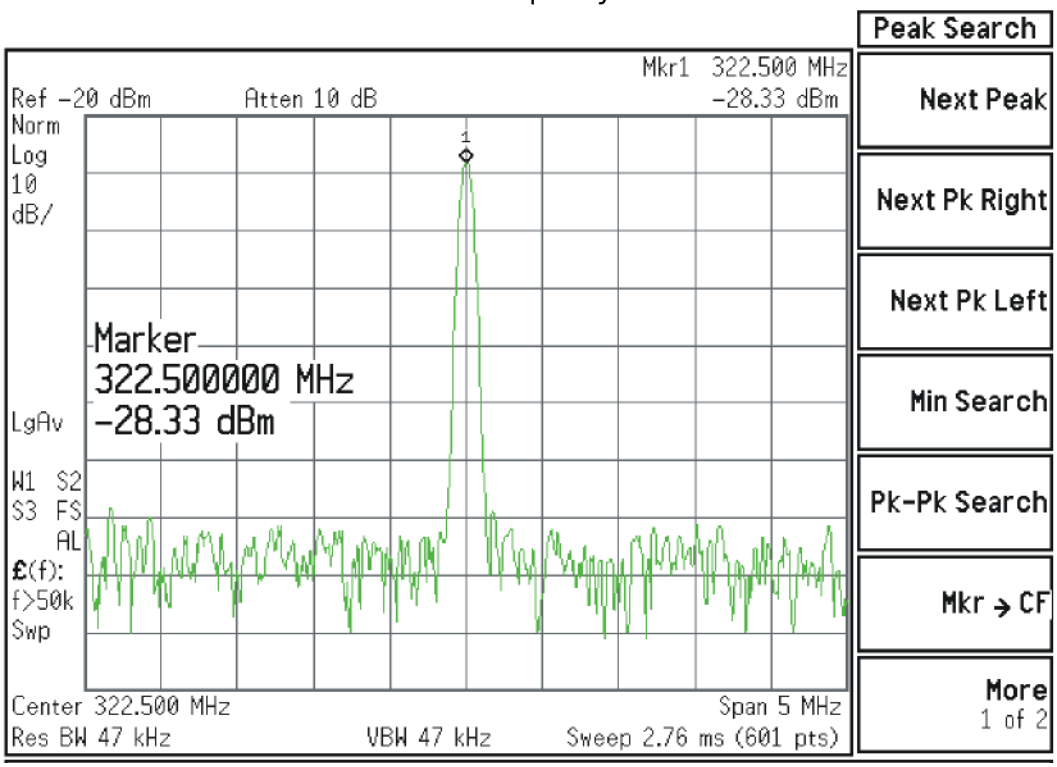
Disconnect the W15 or W36 cable from A13J7 on the RF Front End Assembly **(1)** 322.5 MHz output. See Figure 4-2.

Figure 4-2 W15 or W36 Location



Connect A13J7 output to a functioning spectrum analyzer and verify the 322.5 MHz intermediate frequency is measuring –28.5 ± 3 dB using the same analyzer settings as in Figure 4-3.

Figure 4-3 322.5 MHz Intermediate Frequency



If this power level is correct the RF assembly from the A9 50 MHz Reference signal input port to A13J7, 322.5 MHz I.F. Output is operating correctly using a 50 MHz input calibrator signal. Reconnect the W15 or W36 cable to A13J7.

NOTE Flatness issues or power level problems at other input frequencies below 3600 MHz may exist. This type of problem can be diagnosed using the suspect RF input frequency.

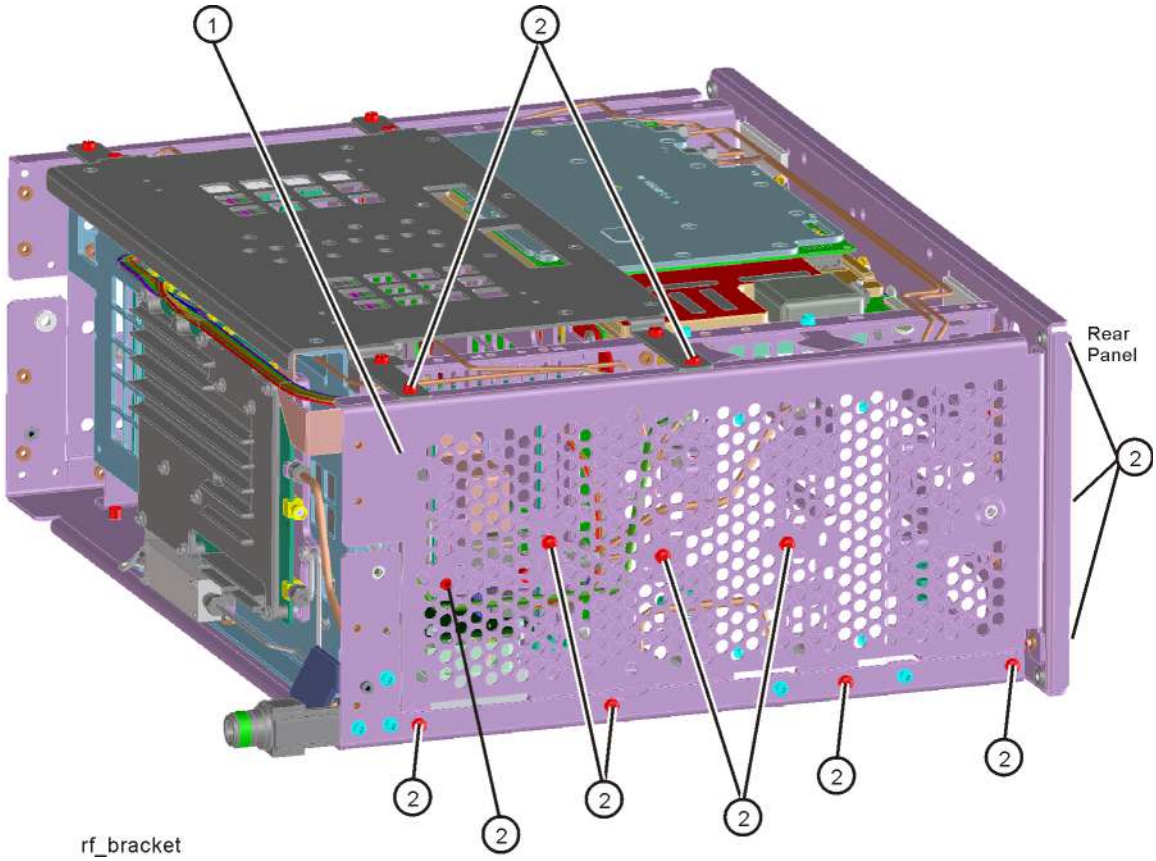
If this power level is incorrect, the following assemblies need to be verified in the order listed using the 50 MHz internal calibrator signal. Be sure the 50 MHz calibrator is turned on **Input/Output**, **RF Calibrator**, **50 MHz** when verifying the performance.

1. A16 Reference Assembly
2. A14 L.O. Synthesizer
3. A15 Front End Control Assembly
4. A9 Input Attenuator A
5. A10 Input Attenuator B
6. A11 Low Band Switch
7. A12 YTF Preselector
8. A13 RF Front End Assembly

NOTE

In order to gain access to the front end components, remove the side chassis **(1)** by removing the 10 screws **(2)**. Refer to Figure 4-4.

Figure 4-4 Remove the Side Chassis

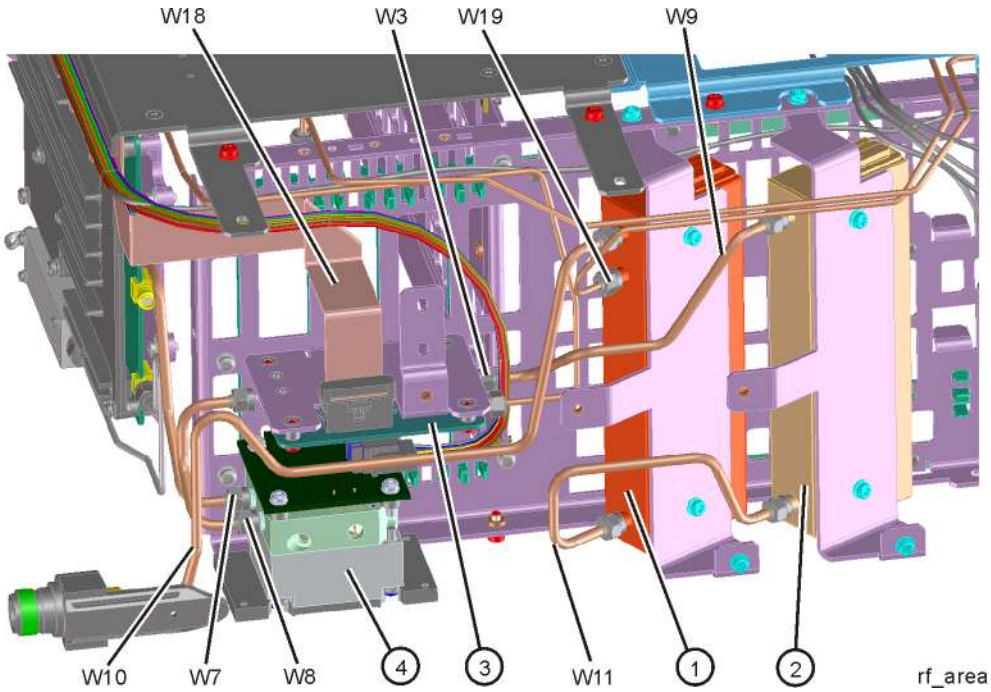


Troubleshooting a Low Band Problem

1. Reference Assembly Verification

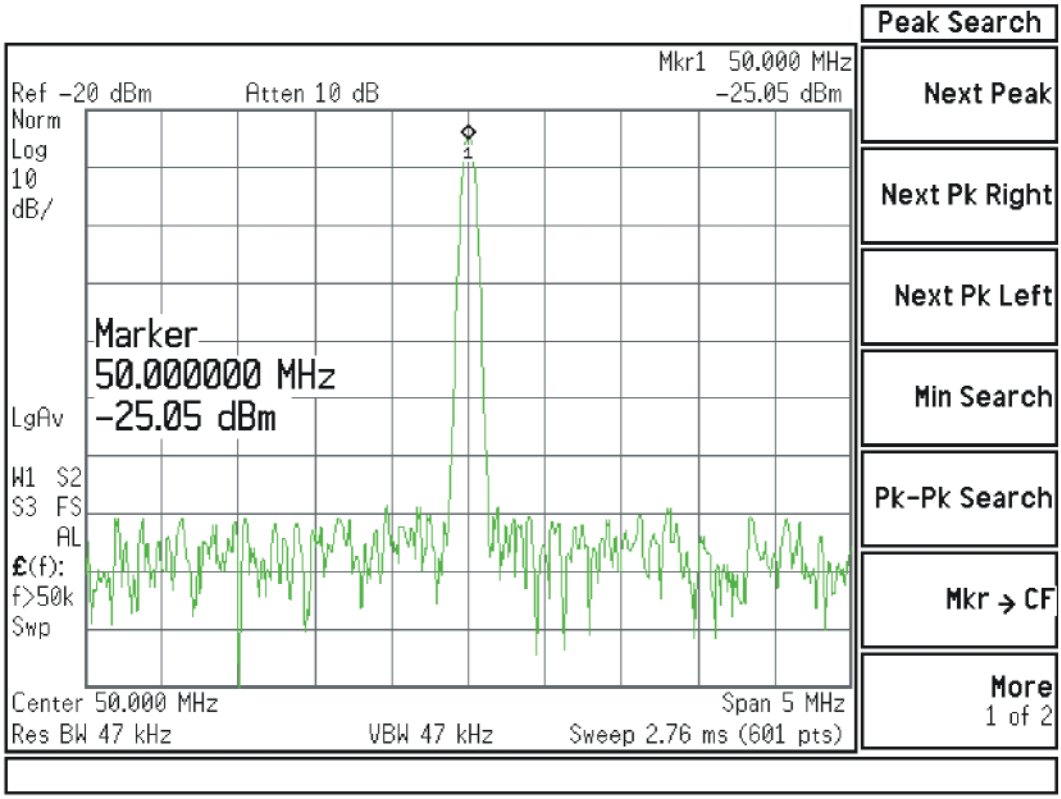
Remove cable W19 from A9 Input Attenuator A **(1)** and measure the 50 MHz calibrator signal on the cable end with a functioning Spectrum Analyzer. Refer to Figure 4-5.

Figure 4-5 W19 Location



If the Reference assembly calibrator is functioning properly the 50 MHz calibrator signal will measure 50 MHz at –25 dBm ± 3 dB. See Figure 4-6. If this level is incorrect, the Reference assembly is most likely defective. Reconnect W19 at A9 Input Attenuator A.

Figure 4-6 50 MHz Calibrator Signal



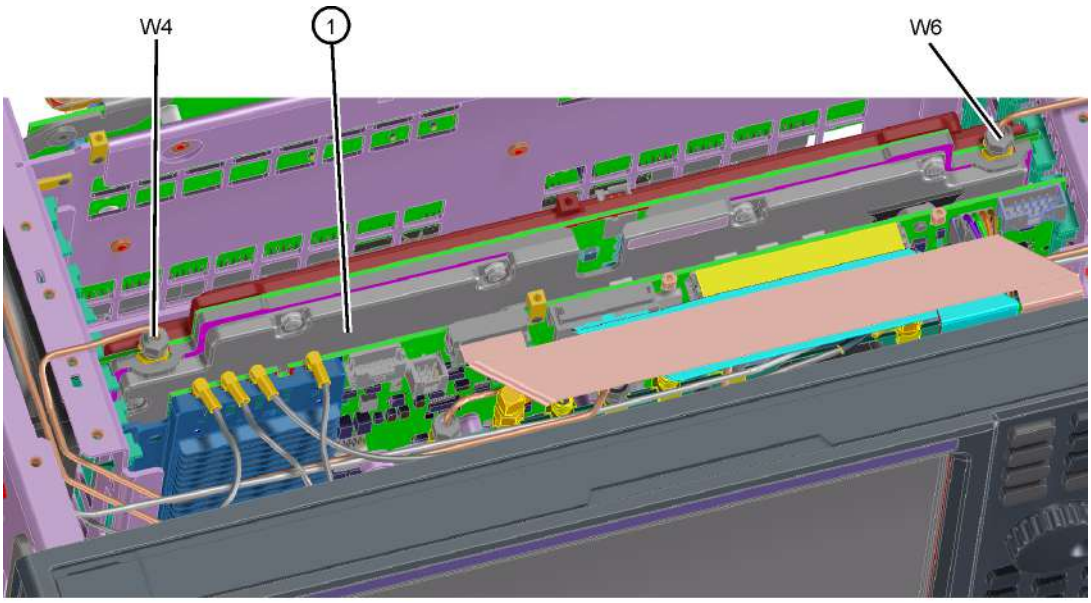
2. L.O. Synthesizer Assembly Verification

Press the following keys on the analyzer:

FREQ, 1 GHz
Zero Span

Refer to Figure 4-7. Disconnect cable W4 at A14J740 of the L.O. Synthesizer Assembly **(1)**.

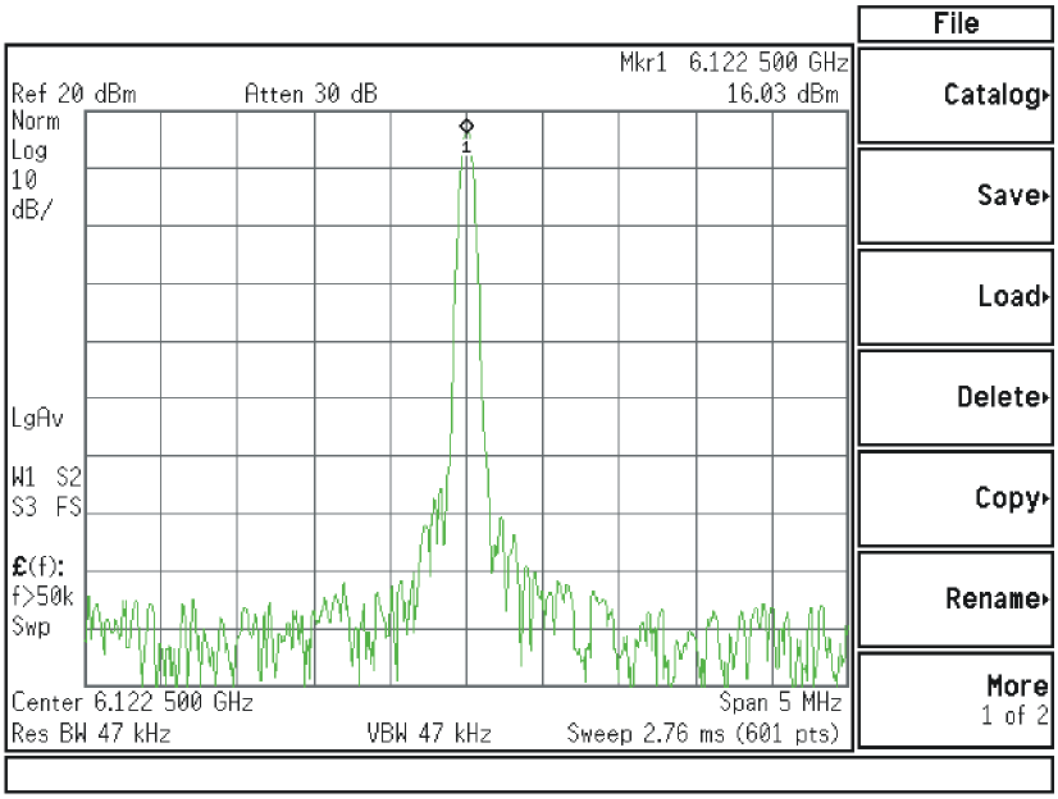
Figure 4-7 W4 and W6 Location



lo_synth

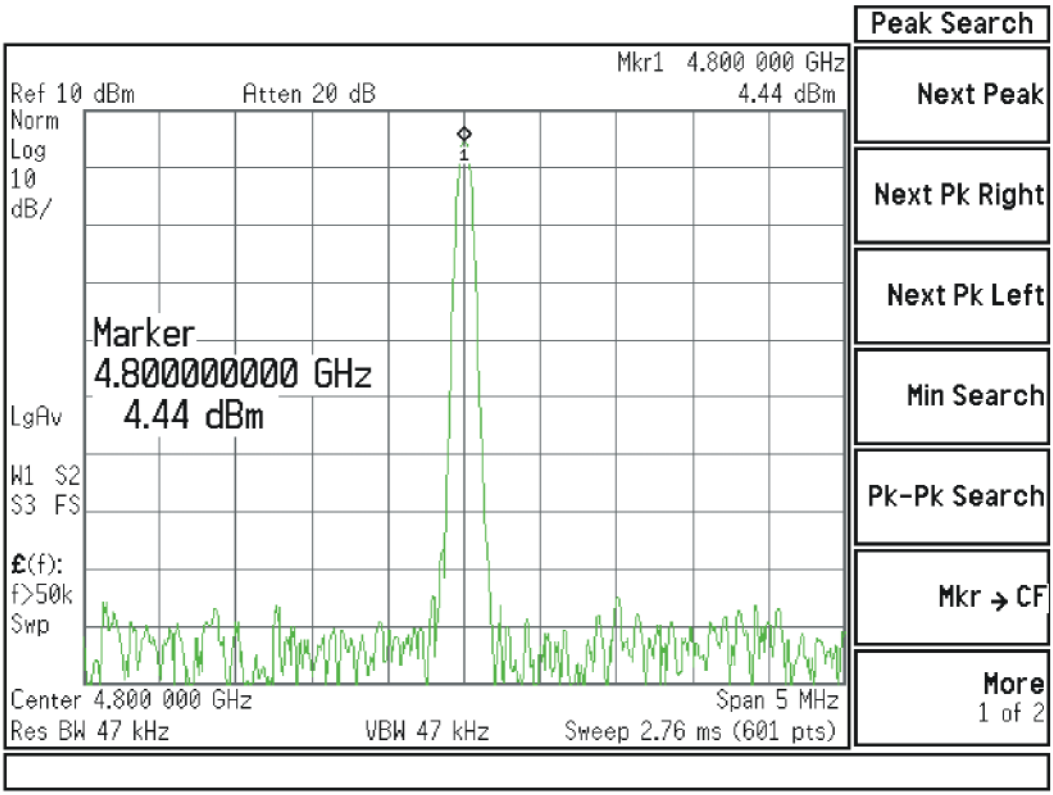
Connect the functioning Spectrum Analyzer and appropriate high frequency cable and connector to A14J740. Adjust the functioning Spectrum Analyzer to measure a signal at 6122.5 MHz at +16 dBm ± 4 dB as seen in Figure 4-8.

Figure 4-8 Measure 1st L.O.



If this power level is incorrect remove W6 at A14J200. Refer to Figure 4-7. Adjust the functioning spectrum analyzer to measure a signal at 4.800 GHz at +4.5 dBm ± 2 dB. See Figure 4-9.

Figure 4-9 4.800 GHz Signal at A14J200



If this power level is incorrect, the most probable cause is the A16 Reference Assembly. If this level is correct and yet the signal previously measured at A14J740 is incorrect, the most probable cause is the A14 L.O. Synthesizer Assembly. Reconnect W4 cable to A14J740. Reconnect W6 cable to A14J200.

3. Front End Control Assembly Verification

Verifying the Front End Control Assembly requires the RF Front End Troubleshooting board E4410-60115 or kit number N9020-60005. The kit includes the troubleshooting board and associated interconnect cables. The troubleshooting board and cables will help verify the control logic from this assembly to Input Attenuator A, Input Attenuator B, Low Band Switch, YTF Preselector, (Optional) Low Band Preamplifier, (Optional) High Band Preamplifier, (Optional) Electronic Attenuator and the RF Front End Assembly. The control logic should be verified going to each assembly while the Front End Troubleshooting board is connected.

NOTE

Even though the YTF Preselector is not used in low band (input frequencies < 3.59 GHz), it is easy to test the switch control logic with the RF Front End Troubleshooting board installed in case there is a high band problem. The Low Band Preamplifier (Option Pxx), High Band Preamplifier, and Electronic Attenuator (Option EA3) logic should be tested if these options are installed in the analyzer.

– Turn off the instrument.

– Connect the E4410-60115 Front End Troubleshooting board to the A15 Front End Control Assembly as shown in Figure 4-10 and Figure 4-11

Figure 4-10 RF Front End Troubleshooting Board

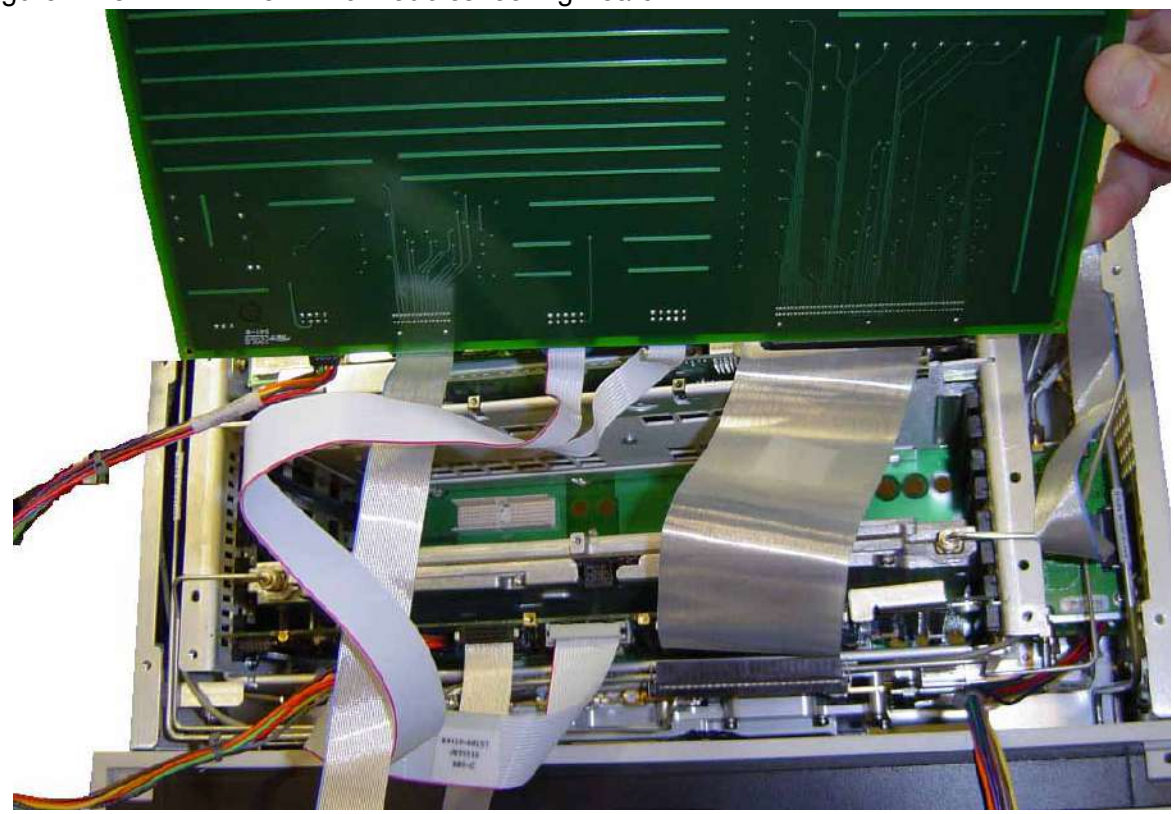
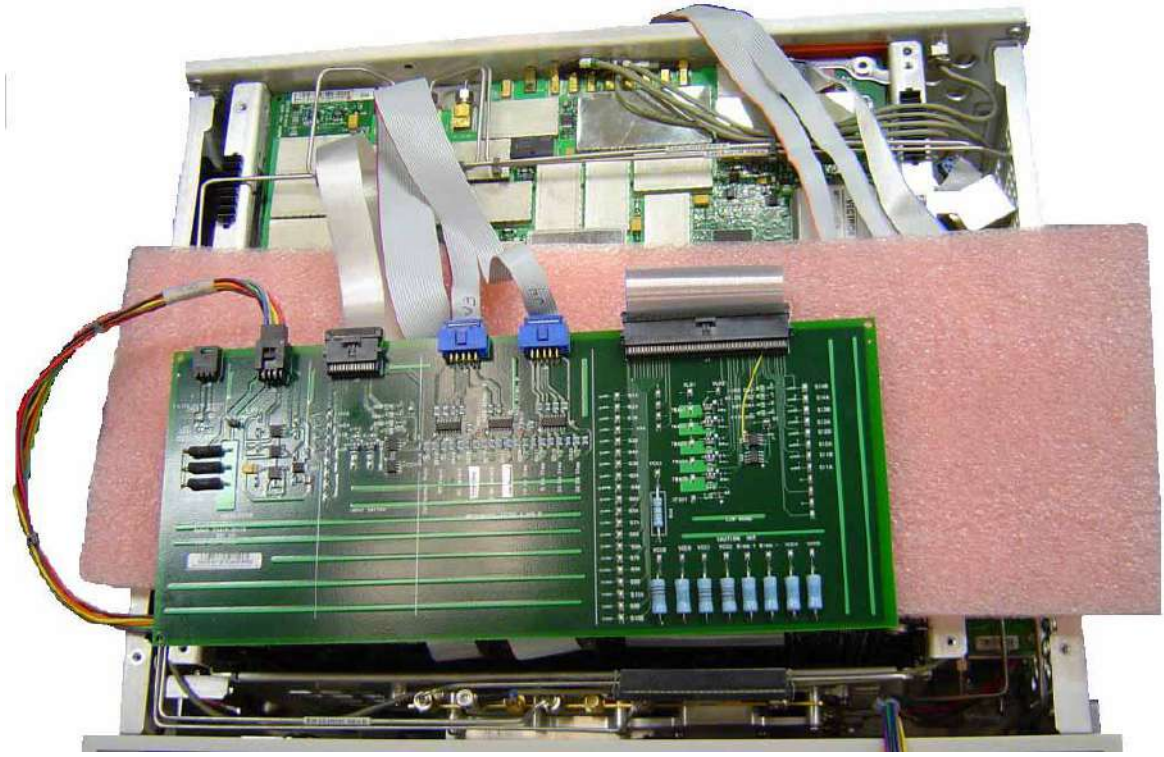


Figure 4-11 RF Front End Troubleshooting Board



– Turn the instrument on and allow it to complete its full boot up process to the signal analyzer application.

– Turn Auto Align off by pressing **System**, **Alignments**, **Auto Align**, **Auto Align, Off** on the analyzer.

CAUTION Resistors on the board can get very hot.

– Verify all power supply LED's on the Front End Troubleshooting board are turned on. Under the J2 connector, the supplies are +15 VDC, +9 VDC, +5.2 VDC, and –15 VDC. Under the J1 connector, the supplies are +15 VDC, –15 VDC, +9 VDC and +5.2 VDC. Verify both input attenuator power supplies. DS9 under J3 should be on if the +25V supply is up for Attenuator A. DS10 under J4 should be on if the +25V supply is up for Attenuator B. If any of the power supply LED's are not turned on, see Chapter 2, “Boot Up and Initialization Troubleshooting”.

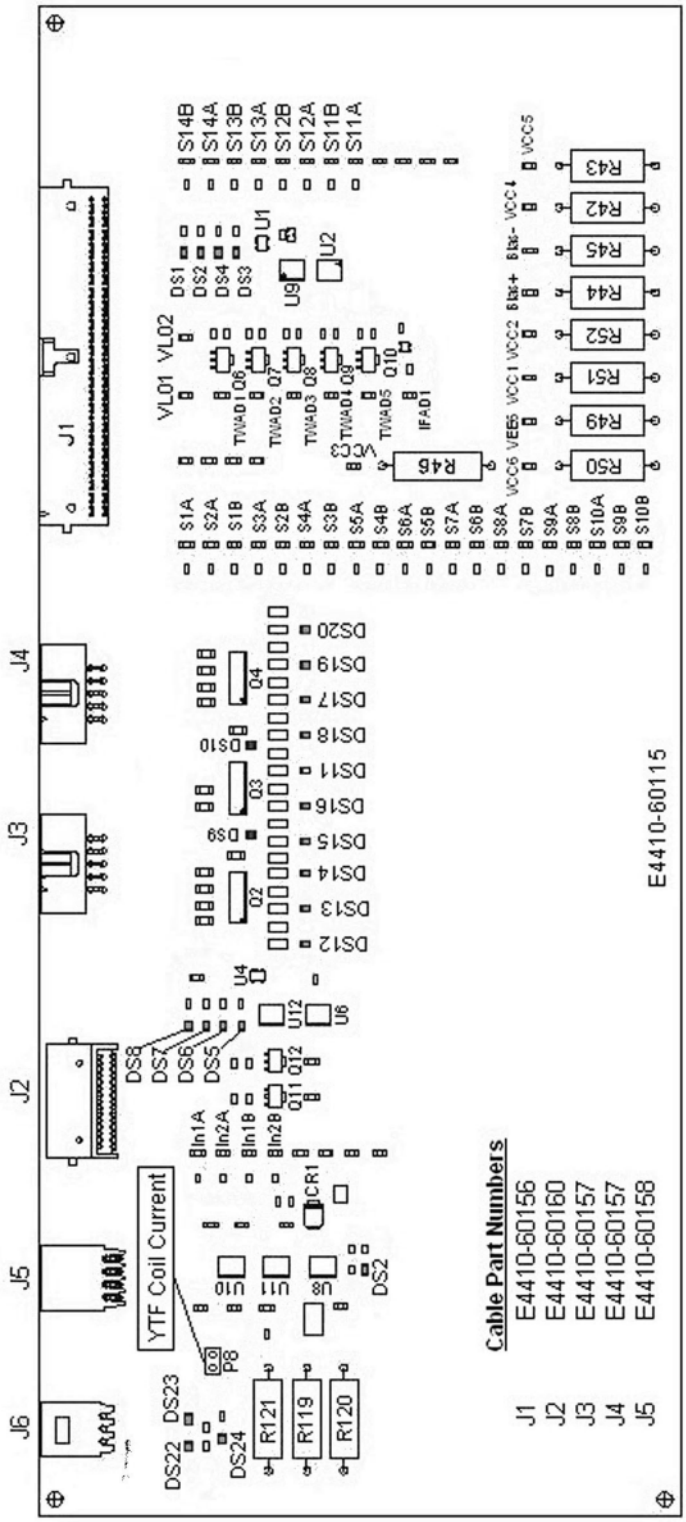
NOTE The analyzer will display an error dialogue box when booting up. Simply click “OK” so the instrument can complete its boot process. Additionally, the analyzer noise floor will be near the top of the display since the RF assemblies are not powered up. This is normal with the Front End Troubleshooting board connected to the A15 Front End Driver Assembly

4. Input Attenuator A Control Logic Verification

– Press **AMPTD**, **Attenuation, Mech Atten 0 dB**

All the attenuation LED's on the Front End Troubleshooting board should be off except for DS9 and DS10, +25V supply for Attenuator A and Attenuator B. Refer to Figure 4-12.

Figure 4-12 Front End Troubleshooting Board Attenuation LEDs



When the input attenuation is changed from 0 dB to 2 dB, the 2 dB Step LED DS15 should illuminate. When the input attenuation is changed from 2 dB to 4 dB, DS15 and DS16 should be illuminated as per Table 4-3.

Table 4-3 Attenuator A Logic

Attenuator Setting (dB)	DS15 2 dB Step LED	DS16 2 dB Step LED
0		
2	X	
4	X	X

The analyzer default setting for RF Coupling is AC mode. Verify the AC Select LED DS14 is illuminated at this time. Set **Input/Output**, **RF Coupling** to DC. DS14 turns off, DS11 DC Select yellow LED should illuminate. Switch the RF Coupling back to AC. If the LED's illuminate correctly, the switch control logic to Input Attenuator A from the A15 Front End Control Assembly is correct. If the LED's are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

5. Input Attenuator B Control Logic Verification

Press **AMPTD**, **Attenuation, Mech Atten, 6 dB** and verify the 6 dB Step LED DS17 is illuminated. Enter the input attenuation settings found in Table 4-4 and verify the proper LED's illuminate on the Front End Troubleshooting board according to Table 4-4.

Table 4-4 Attenuator B Logic

Attenuator Setting (dB)	DS20 30 dB Step LED	DS19 20 dB Step LED	DS18 10 dB Step LED	DS17 6 dB Step LED
10			X	
16			X	X
20		X		
30	X			
40	X		X	
50	X	X		
60	X	X	X	
66	X	X	X	X

Set the input attenuator back to 10 dB by pressing **AMPTD**, **Attenuation**, **Mech Atten, 10 dB** on the analyzer. If the LED's illuminate correctly, the switch control logic for the input attenuators from the A15 Front End Control Assembly is correct. If the LED's are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

6. Low Band Switch Control Logic Verification

Press **Mode Preset** on the analyzer. Press **FREQ**, **50 MHz**, **Span**, **2 MHz** on the analyzer. Connect the DVM positive lead to one of the In1A test points, and the negative lead to the bottom of R46 (blue resistor near the bottom) on the Front End Troubleshooting board. Verify the voltages in Table 4-5.

Table 4-5

In1A	–9.85
In2A	–9.85
In1B	+9.75
In2B	+9.75

Press **Center Frequency, 5 GHz** on the analyzer. Verify the voltages in Table 4-6.

Table 4-6

In1A	+9.72
In2A	–9.84
In1B	–9.84
In2B	+9.72

If the voltages are not correct, the most probable cause is the A15 Front End Control Assembly.

7. YTF Preselector Control Logic Verification (All except Option 503)

NOTE In order to properly measure the preselector tune output from the A15 Front End Control Assembly, the following items are required:

- E9637A Banana plug to BNC (f) adapter
- E9632A BNC (M) to SMA (f)
- 8120-1460 Small coaxial cable SMA (m) to mmcx (m)

Connect the mmcx end of the cable to A15J300, preselector tune output at the upper left corner of A15 Front End Control Assembly.

Press **Single/Cont** on the analyzer until the analyzer is in single sweep. Verify the voltages in Table 4-7 as the center frequency of the analyzer is changed. Press **Restart** after each center frequency change.

Table 4-7 YTF Tune Voltages

Center Frequency (GHz)	~ Tune Voltage (VDC)	Tolerance (VDC)
5.0	1.6	±0.5
10[a]	3.228	±1.0
15[b]	4.85	±1.0
20[b]	6.5	±1.0
26[b]	8.45	±1.0

a. Options 513 and 526
b. Option 526

NOTE Tolerances can be used as a guideline. The true test is whether or not the analyzer will function and meet published specification.

If any of the preselector tune voltages do not match the levels shown in Table 4-7, the most probable causes are a misaligned YTF or the A15 Front End Control Assembly. Perform the YTF characterization (press **System**, **Alignments**, **Advanced**, **Characterize Preselector**).

To further test the YTF control current, select Amps on the DVM and place the positive lead of the DVM on one of the YTF Coil Current P8 pins and the other DVM lead to the other Coil Current pin.

NOTE In order to measure the control current correctly, press **Restart** on the analyzer in between each measurement.

If any of the preselector control currents do not match the levels shown in Table 4-8, the most probable causes are a misaligned YTF or the A15 Front End Control Assembly. Perform the YTF characterization (press **System**, **Alignments**, **Advanced**, **Characterize Preselector**) and re-check the control current at various center frequencies.

Table 4-8 YTF Tune Current

Center Frequency (GHz)	Control Current (mA)	Tolerance (mA)
5.0	106	±20
10[a]	215	±25
15[b]	324	±30
20[b]	430	±40
26[b]	560	±50

a. Options 513 and 526
b. Option 526

NOTE Tolerances should be used as a guideline. The true test is whether or not the analyzer will function and meet published specification.

8. Front End Assembly Control Logic Verification

Since the RF Front End Troubleshooting board is connected, now is a good time to test out the remaining control circuits from the A15 Front End Control Assembly.

Table 4-9 Front End Control Logic

Test Point	Description	Instrument Settings	Voltage (VDC)	Tolerance (VDC)
S2A	Sets switch for Low Band/preamp path	CF 50 MHz preamp on	+9.67	±0.5
S2B	Sets switch for Low Band/preamp path	CF 50 MHz preamp on	+9.83	±0.5
S3A	Sets E-atten to 5 dB preamps off	E-atten = 5 dB	+9.67	±0.5
S3B	Sets E-atten to 5 dB preamps off	E-atten = 5 dB	+9.83	±0.5
S4A	Sets E-atten to 10 dB preamps off	E-atten = 10 dB	+9.67	±0.5
S4B	Sets E-atten to 10 dB preamps off	E-atten = 10 dB	+9.83	±0.5
S5A	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.67	±0.5
S5B	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.83	±0.5
S6A	Sets E-atten to 1 dB preamps off	E-atten = 1 dB	+9.67	±0.5
S6B	Sets E-atten to 1 dB preamps off	E-atten = 1 dB	+9.83	±0.5
S7A	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.67	±0.5
S7B	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.83	±0.5
S8A	Sets E-atten to 20 dB preamps off	E-atten = 20 dB	+9.67	±0.5
S8B	Sets E-atten to 20 dB preamps off	E-atten = 20 dB	+9.83	±0.5
S9A	Controls in & out to low band preamps off	E-atten = off	+9.83	±0.5
S9B	Controls in & out to low band preamps off	E-atten = off	+9.67	±0.5
S11A	Sets path for 1st or 2nd L.O.	CF 1 GHz	+9.67	±0.5
S11B	Sets path for 1st or 2nd L.O.	CF 1 GHz	+9.83	±0.5
S12A	Sets path for L.O. normal or x2 for band 4	CF 1 GHz	+9.83	±0.5
S12B	Sets path for L.O. normal or x2 for band 4	CF 1 GHz	+9.67	±0.5
S13A	Sets path for L.O. to either of the high band mixers and L.O. output	CF 5 GHz CF 20 GHz	–9.67 +9.67	±0.5
S13B	Sets path for L.O. to either of the high band mixers and L.O. output	CF 5 GHz CF 20 GHz	+9.83 –9.83	±0.5

Table 4-9 Front End Control Logic

Test Point	Description	Instrument Settings	Voltage (VDC)	Tolerance (VDC)
S14A	Sets path to either band 1 & 2 mixer or band 3 & 4 mixer	CF 5 GHz CF 20 GHz	–9.83 +9.83	±0.5
S14B	Sets path to either band 1 & 2 mixer or band 3 & 4 mixer	CF 5 GHz CF 20 GHz	+9.67 –9.67	±0.5
VCC1	Voltage always on		4.8	±0.5
VCC2	Voltage always on		4.8	±0.5
VCC3	Voltage always on		7.85	±0.5
VCC4	Voltage always on		5.0	±0.5
VCC5	Voltage always on		5.0	±0.5
TWAD1	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD2	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD3	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD4	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD5	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5

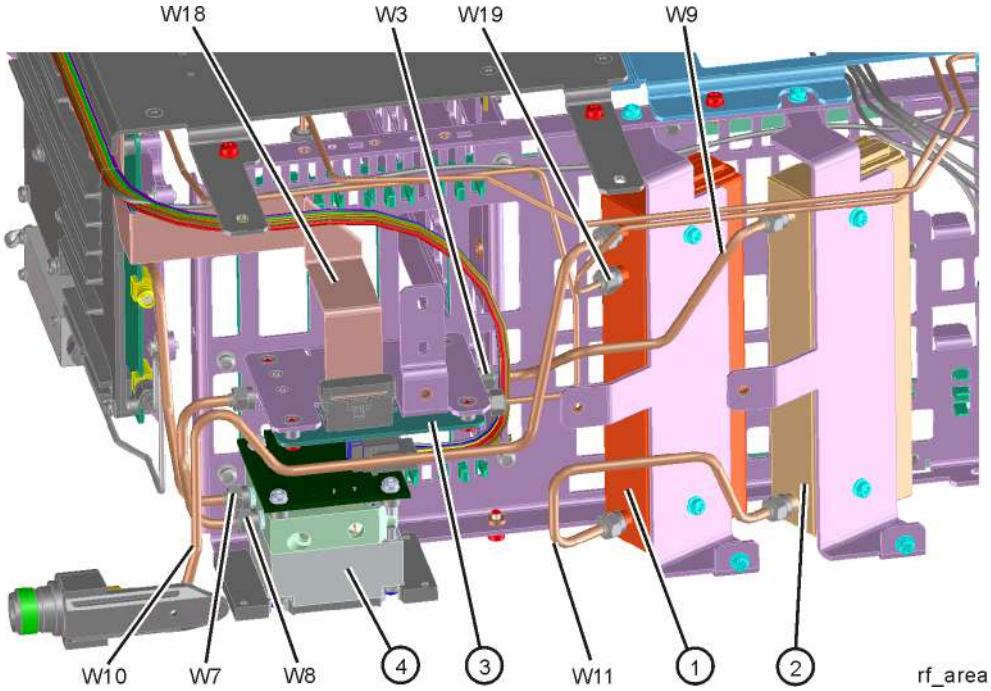
NOTE Tolerances should be used as a guideline.

If any of the voltages measured do not match the levels shown in Table 4-9, the most probable cause is the A15 Front End Control Assembly. Once the switch control logic has been verified, turn off the instrument, disconnect the RF Front End Troubleshooting board cables, and reconnect the analyzer cables to the A15 Front End Control Assembly. Turn the instrument on and allow it to complete its full boot up process to Spectrum Analyzer mode.

Input Attenuator A Power Level Verification

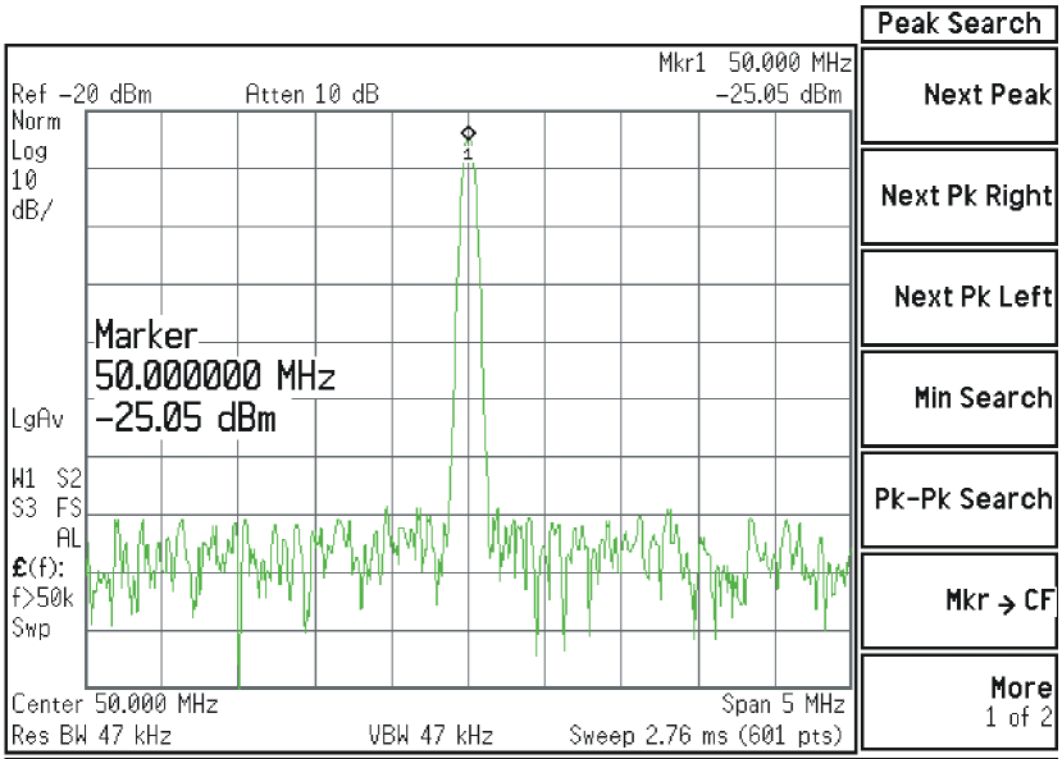
Press **Mode Preset**, **Input/Output**, **RF Calibrator**, **50 MHz**, **AMPTD**, **Attenuation**, **Mech Atten, 0 dB** on the analyzer. Refer to Figure 4-13, remove cable W11 from A9 **(1)** Output. Measure the 50 MHz calibrator signal on the output of the attenuator using a functioning Spectrum Analyzer.

Figure 4-13 Cable W11



The level should be –25 dBm ± 2 dB as shown in Figure 4-14.

Figure 4-14 50 MHz Calibrator Signal on Output of Attenuator A



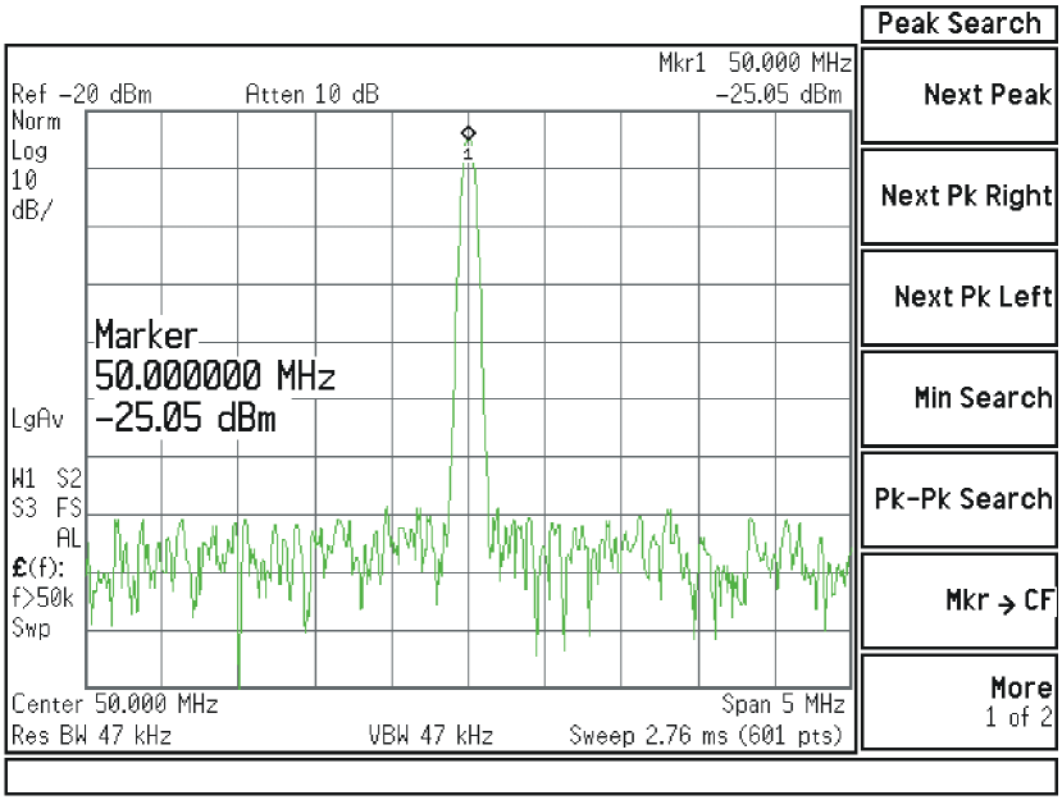
Press **Mech Atten** and enter 2 dB. The 50 MHz calibrator signal measured on the functioning Spectrum Analyzer should measure 2 dB lower than the previous step (~–27 dBm). Press **Mech Atten** and enter 4 dB. The 50 MHz calibrator signal measured on the functioning Spectrum Analyzer should measure an additional 2 dB lower than the previous step (~–29 dBm). If the power levels measure correctly, reconnect W11 cable. If either of these levels is incorrect, Input Attenuator A is the most probable cause, provided the control logic from the A15 Front End Control Assembly was previously verified.

Input Attenuator B Power Level Verification

Press **AMPTD**, **Attenuation**, **Mech Atten, 0 dB**. Remove output cable W9 from A10 **(2)**. Refer to Figure 4-13. Measure the 50 MHz calibrator signal on the output of the attenuator using a functioning Spectrum Analyzer.

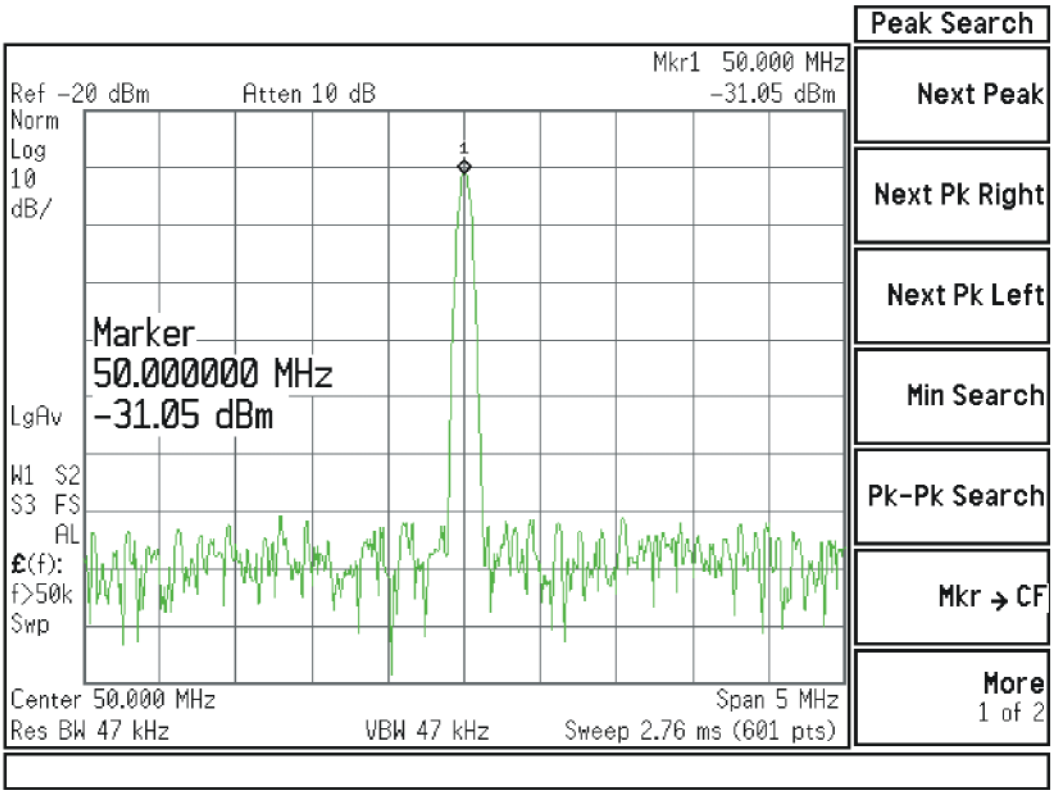
The level should be –25 dBm ± 2 dB as shown in Figure 4-15.

Figure 4-15 50 MHz Calibrator Signal on Output of Attenuator B



Press **Mech Atten** and enter 6 dB. The 50 MHz calibrator signal measured on the functioning Spectrum Analyzer should measure 6 dB lower than the previous step (~–31 dBm) as shown in Figure 4-16.

Figure 4-16 50 MHz Calibrator Signal on Output of Attenuator B (with 6 dB Attenuation)



Press **Mech Atten** and enter 10 dB. The 50 MHz calibrator signal measured on the functioning Spectrum Analyzer should measure 10 dB lower than the first step (~–35 dBm). Continue testing all the attenuation settings as described in Table 4-10.

Table 4-10

Attenuator Setting (dB)	Expected Level (dBm @ 50 MHz)	Tolerance
16	–41	±3 dB
20	–45	±3 dB
30	–55	±3 dB
40	–65	±4 dB
50	–75	±4 dB
60	–85	±4 dB
66	–91	±4 dB

NOTE

1. It may be difficult to measure the higher attenuator settings using the -25 dBm internal calibrator signal. Use an external source with the frequency set to 50 MHz and adjust the output level to 0 dBm. This will increase the measured power levels noted in the table above by 25 dB.
2. Tolerances should be used as a guideline.

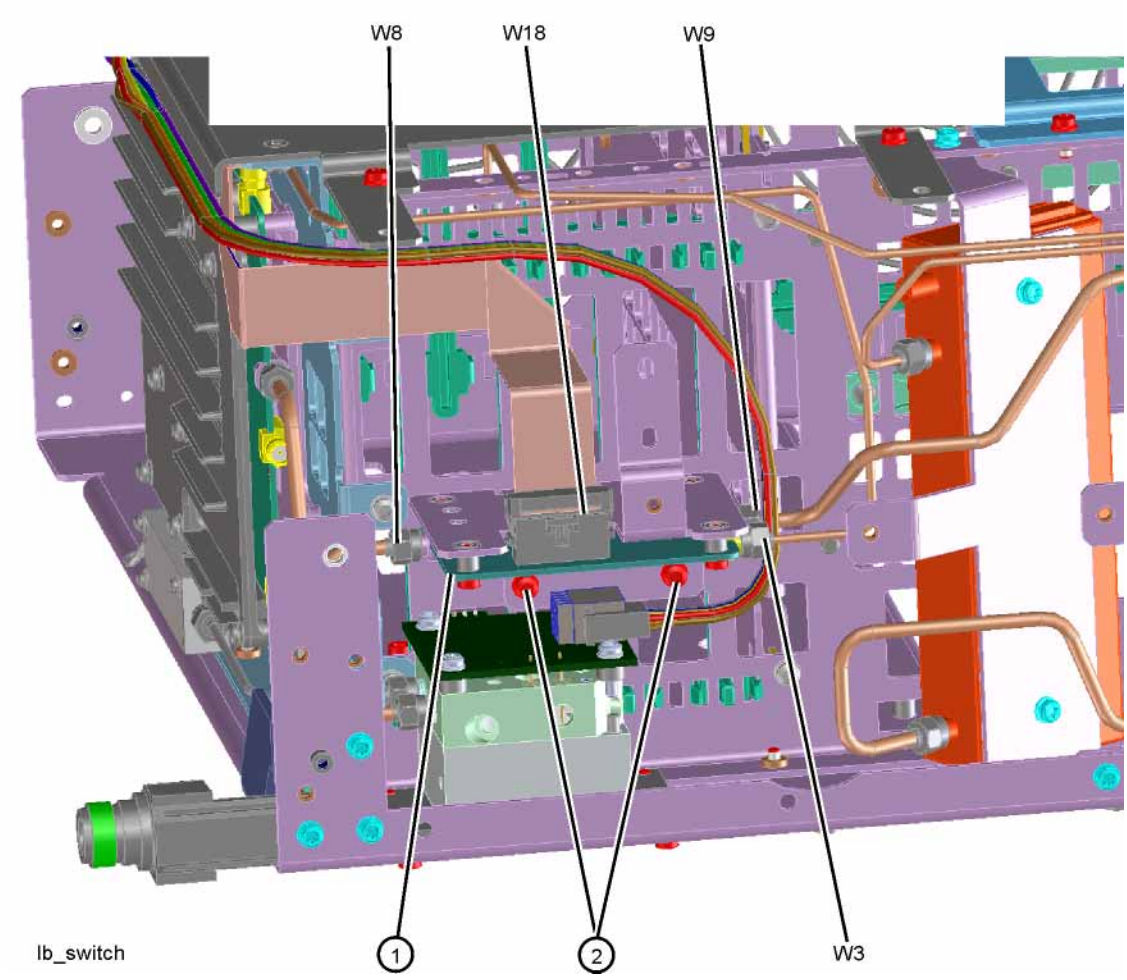
If the power levels measure correctly, reconnect the W9 cable and reset the input attenuation to 10 dB by pressing **Mech Atten**, **10 dB** on the analyzer.

If either of these levels measure incorrectly, Input Attenuator B is the most probable cause, provided the switch control logic has been verified.

Low Band Switch Power Level Verification

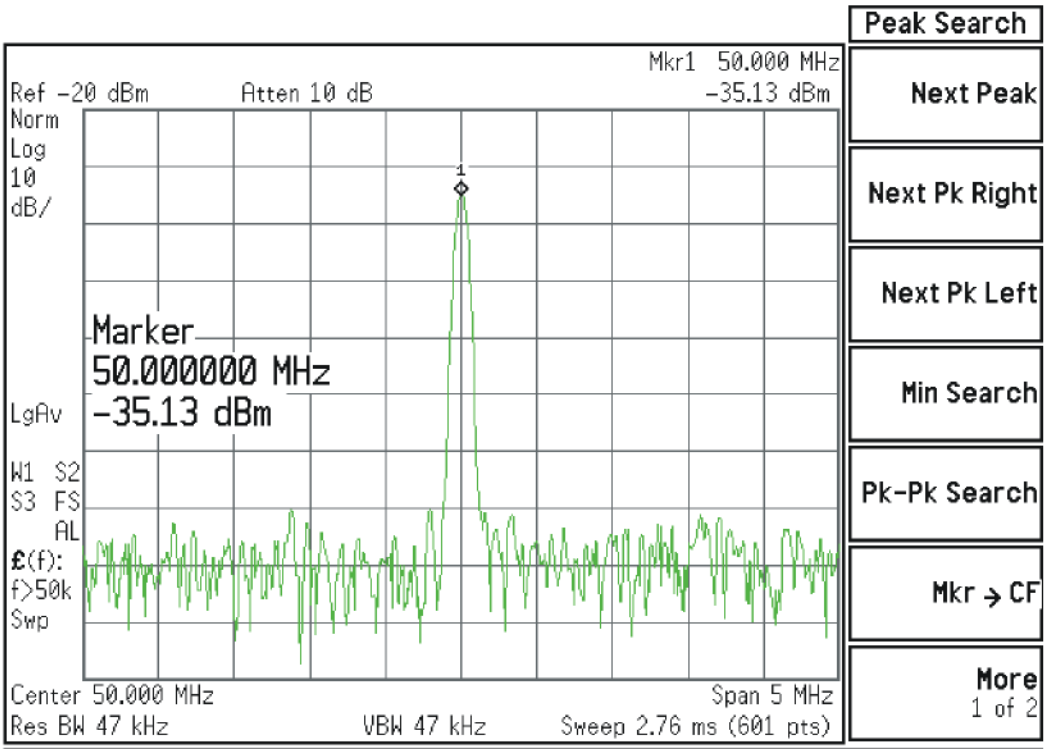
Refer to Figure 4-17. Disconnect the W3 cable at A11J2 of the A11 Low Band Switch **(1)**.

Figure 4-17 Cable W3 Location



When the analyzer is tuned to a center frequency of 50 MHz, the Low Band switch should have minimal loss. Press **Input/Output**, **RF Calibrator**, **50 MHz**, **AMPTD**, **Attenuation**, **Mech Atten, 10 dB** on the analyzer. Measure the 50 MHz calibrator signal on the output of A11J2 using a functioning Spectrum Analyzer. The level should be –35 dBm ± 5 dB as shown in Figure 4-18.

Figure 4-18 50 MHz Calibrator Signal at Output of W3 Cable



If the power level is incorrect the most probable cause is the low band switch assembly. Reconnect W3 cable.

The following Low Band path items have been verified in the RF section:

- 50 MHz Calibrator signal power level from the A16 Reference Assembly
- 1st L.O. power level from the A14 L.O. Synthesizer
- Switch control logic from the A15 Front End Control Assembly to:
  - Input Attenuator A
  - Input Attenuator B
  - Low Band Switch
  - Front End Assembly
- Input Attenuator A power level check
- Input Attenuator B power level check
- Low Band Switch logic and power level check

If all the power levels and biasing from the A15 Front End Control Assembly measure correctly up to this point, the most probable cause would be the A13 RF Front End Assembly.

Quick Check to Verify High Band RF Path #1

(RF Input Frequencies > 3600 MHz and < 13.6 GHz)

Refer to Chapter 12, “Block Diagrams.” for details.

Equipment needed:

Functioning Spectrum Analyzer

Functioning Signal Generator to 15 GHz

DVM

Cables & Connectors

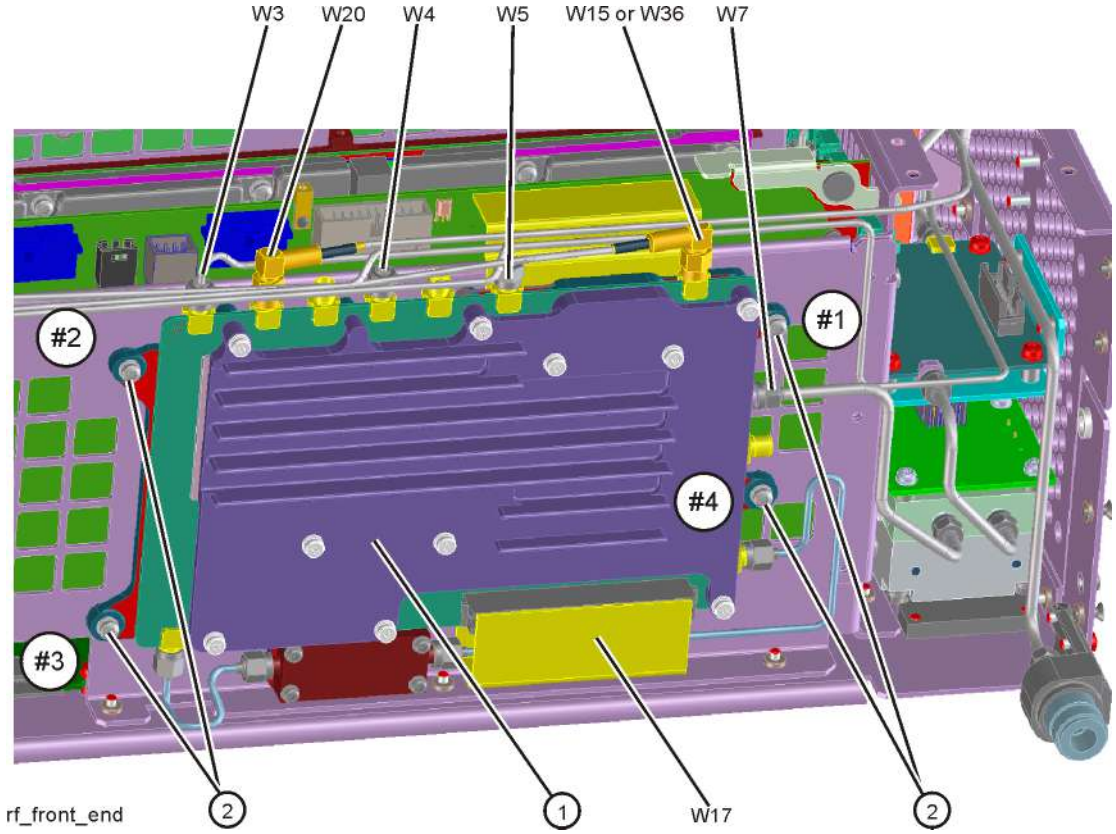
NOTE To perform the following checks, it will be necessary to remove the outer cover and the top brace. See Chapter 15 for removal procedures.

Turn the analyzer on and allow it to complete its full boot up process to Signal Analyzer mode. Use the internal 4.8 GHz, –28 dBm calibrator signal as a reference for troubleshooting by pressing **Mode Preset**, **Input/Output**, **RF Calibrator**, **4.8 GHz** on the analyzer. Now press **FREQ**, **4.8 GHz**, **Zero Span**, **AMPTD**, **Attenuation, Mech Atten, 10 dB** on the analyzer.

IMPORTANT Turn off auto align by pressing **System**, **Alignments**, **Auto Align**, **Auto Align, Off**.

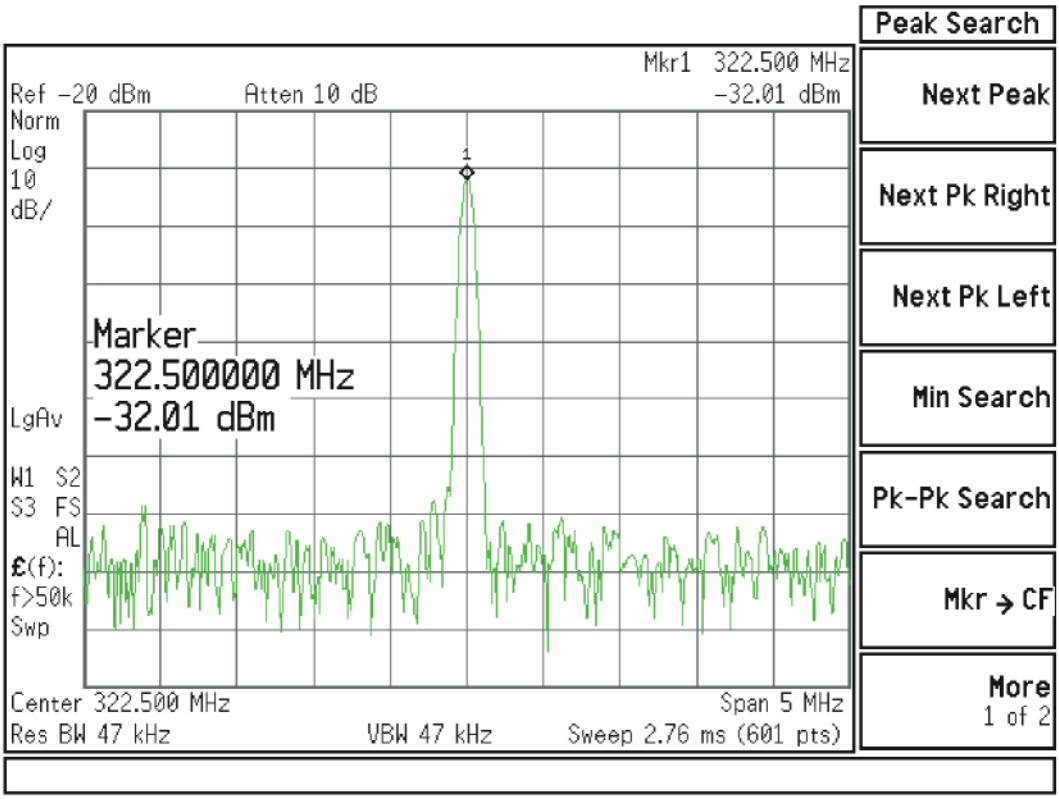
Disconnect cable W15 or W36 at A13J7, 322.5 MHz output on the Front End Assembly **(1)**. See Figure 4-19.

Figure 4-19 W15 or W36 Location



Connect A13J7 output to a functioning spectrum analyzer and verify the 322.5 MHz intermediate frequency is measuring –32 ± 4 dB as shown in Figure 4-20.

Figure 4-20 322.5 MHz Intermediate Frequency



If this power level is correct the entire RF section is operating correctly in high band. If this power level is incorrect verify the following assemblies in the order listed using the 4.8 GHz internal calibrator signal.

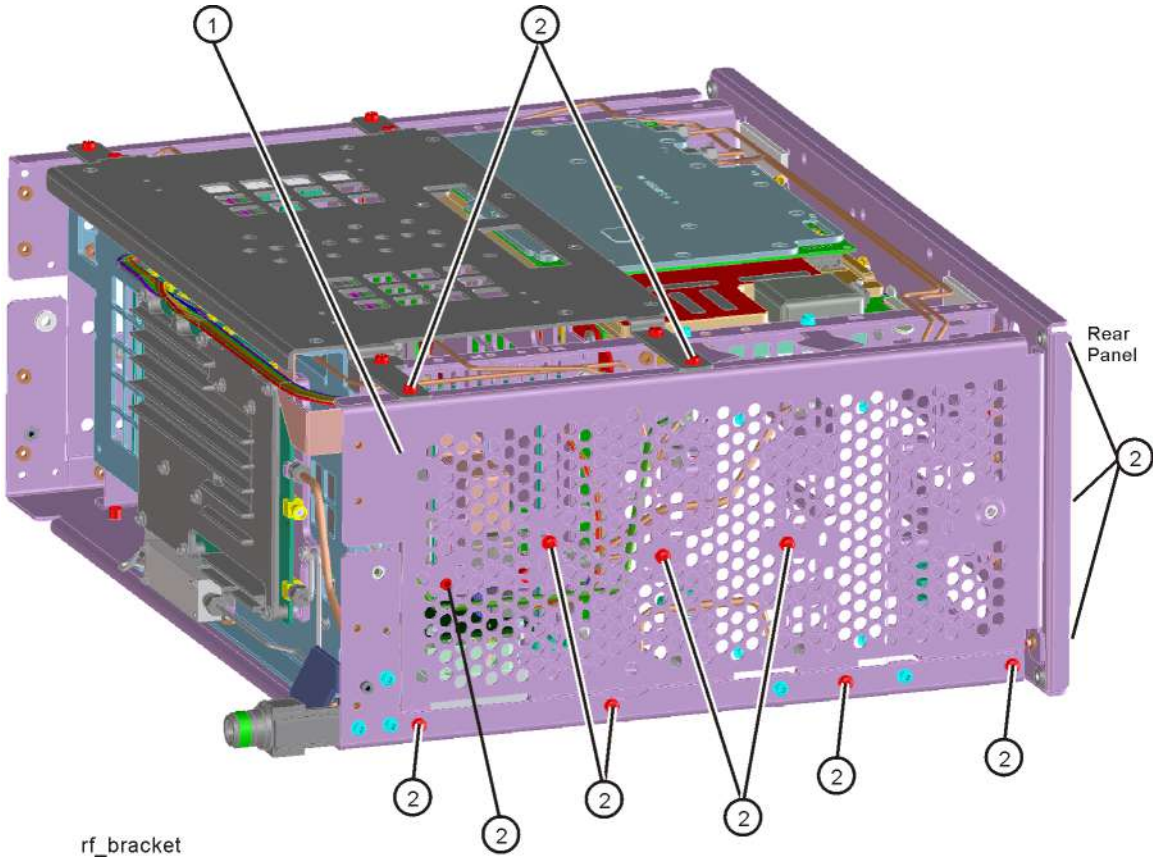
1. A16 Reference Assembly
2. A14 L.O. Synthesizer
3. A15 Front End Control Assembly
4. A9 Input Attenuator A
5. A10 Input Attenuator B
6. A11 Low Band Switch
7. A12 YTF Preselector
8. A13 RF Front End Assembly

NOTE

High Band #2 RF signal path utilizes a high band mixer internal to the A13 RF Front End Assembly for RF input frequencies from 13 GHz to 26.5 GHz. Since all the control voltages and biasing were already fully tested, failures from 13 GHz - 26.5 GHz will most likely be caused by the A13 RF Front End Assembly. If the failure is amplitude related, proper adjustments such as frequency response and the YTF Preselector adjust should be performed first before changing the A13 RF Front End Assembly. Refer to Chapter 12, “Block Diagrams.” for details.

In order to gain access to the front end components, remove the side chassis **(1)**. See Figure 4-21.

Figure 4-21 Remove the Side Chassis

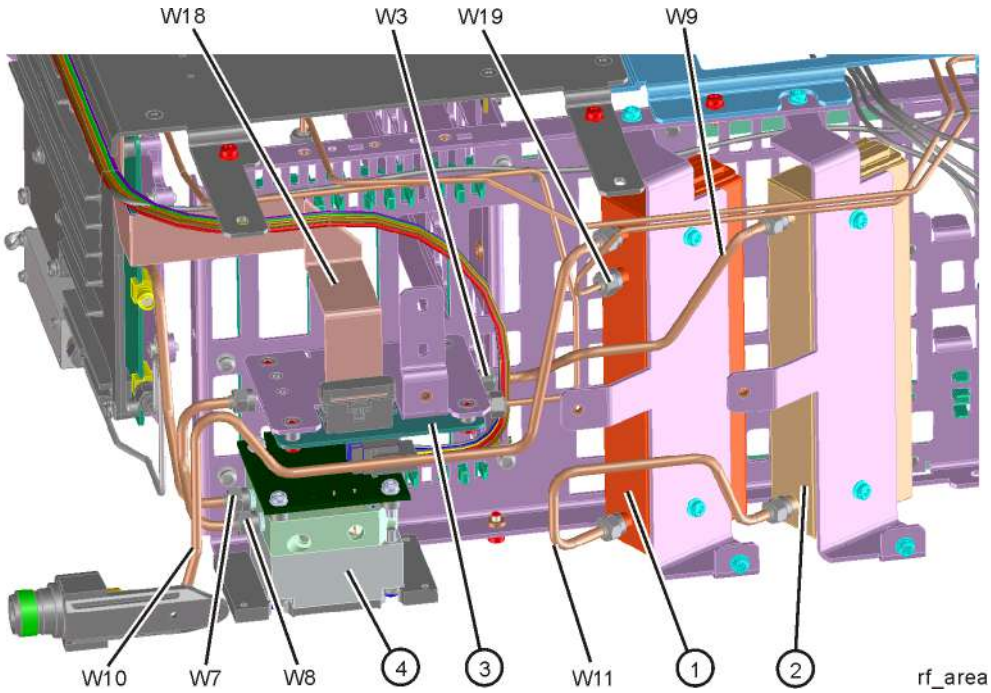


Troubleshooting a High Band Problem

1. Reference Assembly Verification

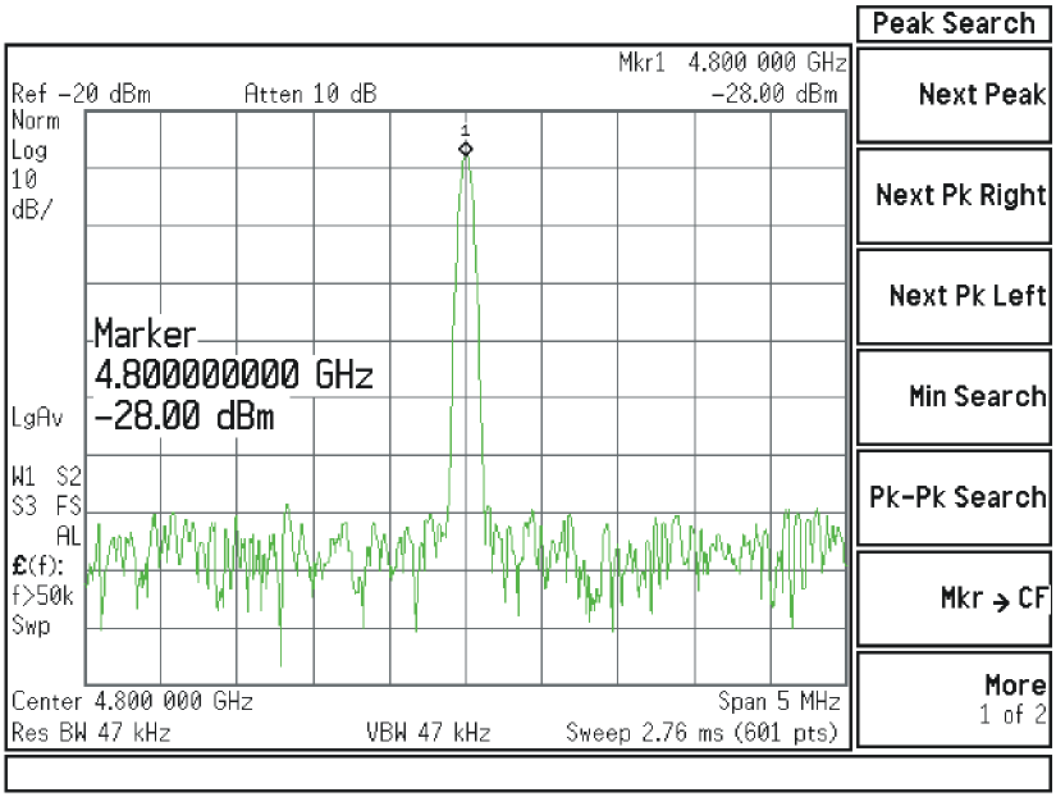
Refer to Figure 4-22. Remove cable W19 from A9 Input Attenuator A **(1)**. Measure the 4.8 GHz calibrator signal on the cable end with a functioning Spectrum Analyzer.

Figure 4-22 W19 Location



If the Reference Assembly calibrator is functioning properly the 4.8 GHz calibrator signal will measure 4.8 GHz at –28 dBm ± 3 dB as shown in Figure 4-23. If this level is incorrect, the Reference Assembly is most likely defective. Reconnect W19 at A9 **(1)**.

Figure 4-23 4.8 GHz Calibrator Signal



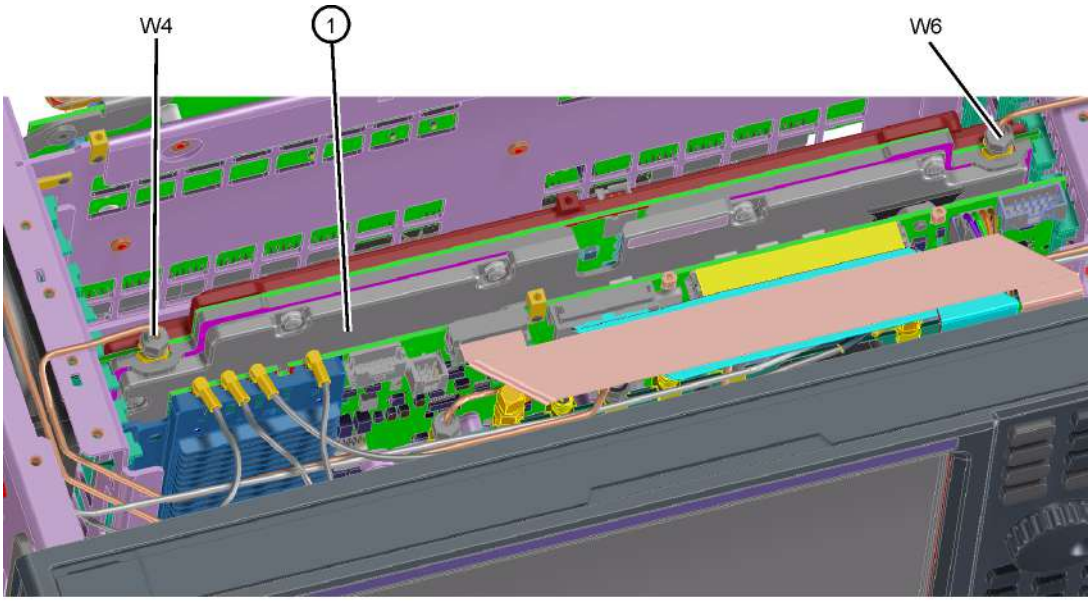
2. L.O. Synthesizer Assembly Verification

Press the following keys on the analyzer:

Mode Preset
FREQ, 5 GHz
Zero Span

Refer to Figure 4-24. Disconnect cable W4 at A14J740 of the L.O. Synthesizer Assembly **(1)**.

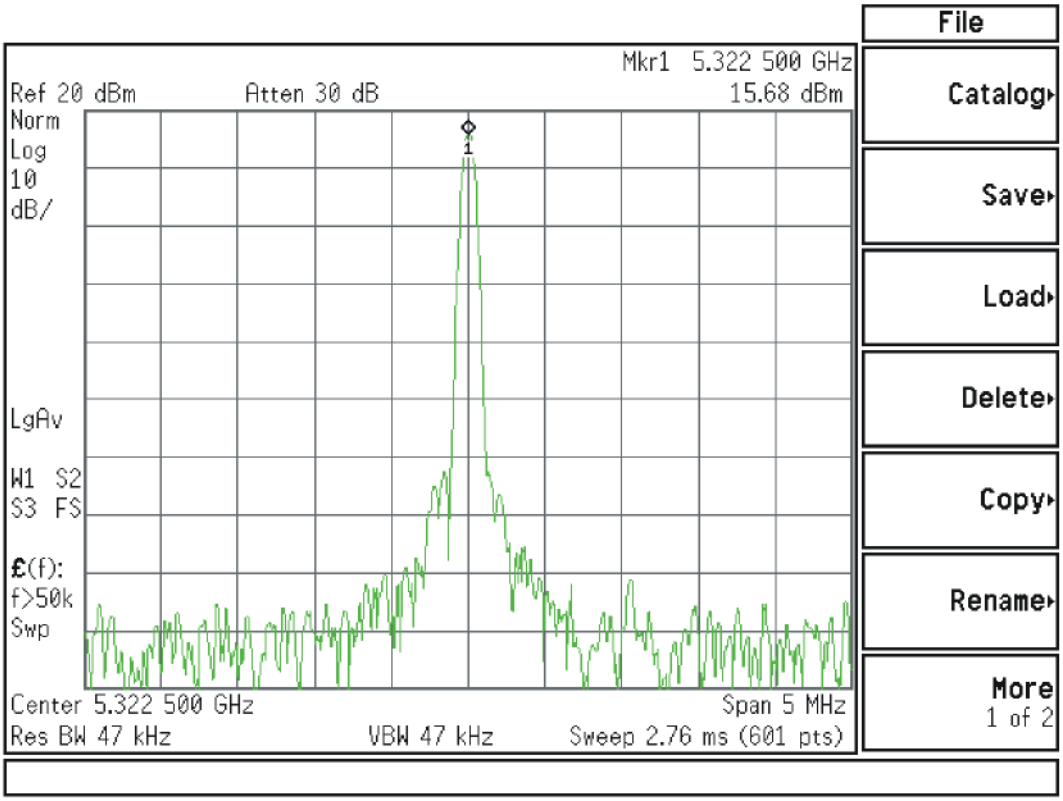
Figure 4-24 W4 and W6 Location



lo_synth

Connect the functioning Spectrum Analyzer and appropriate high frequency cable and connector to A14J740. Adjust the analyzer to measure a signal at 5322.5 MHz at +16 dBm ± 4 dB as shown in Figure 4-25.

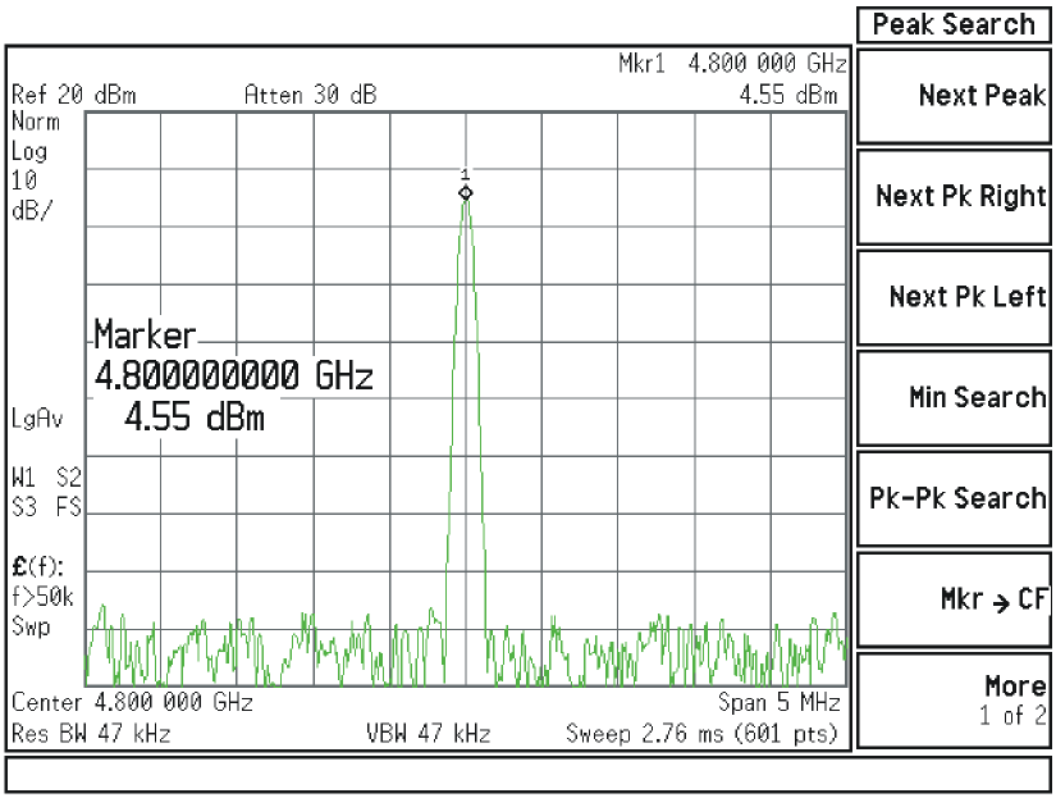
Figure 4-25 Measure 1st L.O.



If this power level is incorrect remove W6 at A14J200. Refer to Figure 4-24. Connect the functioning spectrum analyzer to the cable output using the appropriate high-frequency cable.

Adjust the functioning spectrum analyzer to measure a signal at 4.8 GHz at +4.5 dBm ± 2 dB as shown in Figure 4-26.

Figure 4-26 4.8 GHz Signal



If this power level is incorrect, the most probable cause is the A16 Reference Assembly. If this level is correct and yet the signal previously measured at A14J740 is incorrect, the most probable cause is the A14 L.O. Synthesizer Assembly. Reconnect W4 cable to A14J740. Reconnect W6 cable to A14J200.

3. Front End Control Assembly Verification

IMPORTANT **If the Front End Control Assembly logic was verified in the 'Low Band Quick Check' section above, skip to "Input Attenuator A Power Level Verification" step below.**

Verifying the Front End Control Assembly requires the RF Front End Troubleshooting board E4410-60115 or kit number N9020-60005. The kit includes the troubleshooting board and associated interconnect cables. The troubleshooting board and cables will help verify the control logic from this assembly to Input Attenuator A, Input Attenuator B, Low Band Switch, YTF Preselector, (Optional) Low Band Preamplifier, (Optional) High Band Preamplifier, (Optional) Electronic Attenuator and the RF Front End Assembly. The control logic should be verified going to each assembly while the Front End Troubleshooting board is connected.

- Turn off the instrument.
- Connect the E4410-60115 Front End Troubleshooting board to the A15 Front End Control Assembly as shown in Figure 4-27 and Figure 4-28.

Figure 4-27 RF Front End Troubleshooting Board

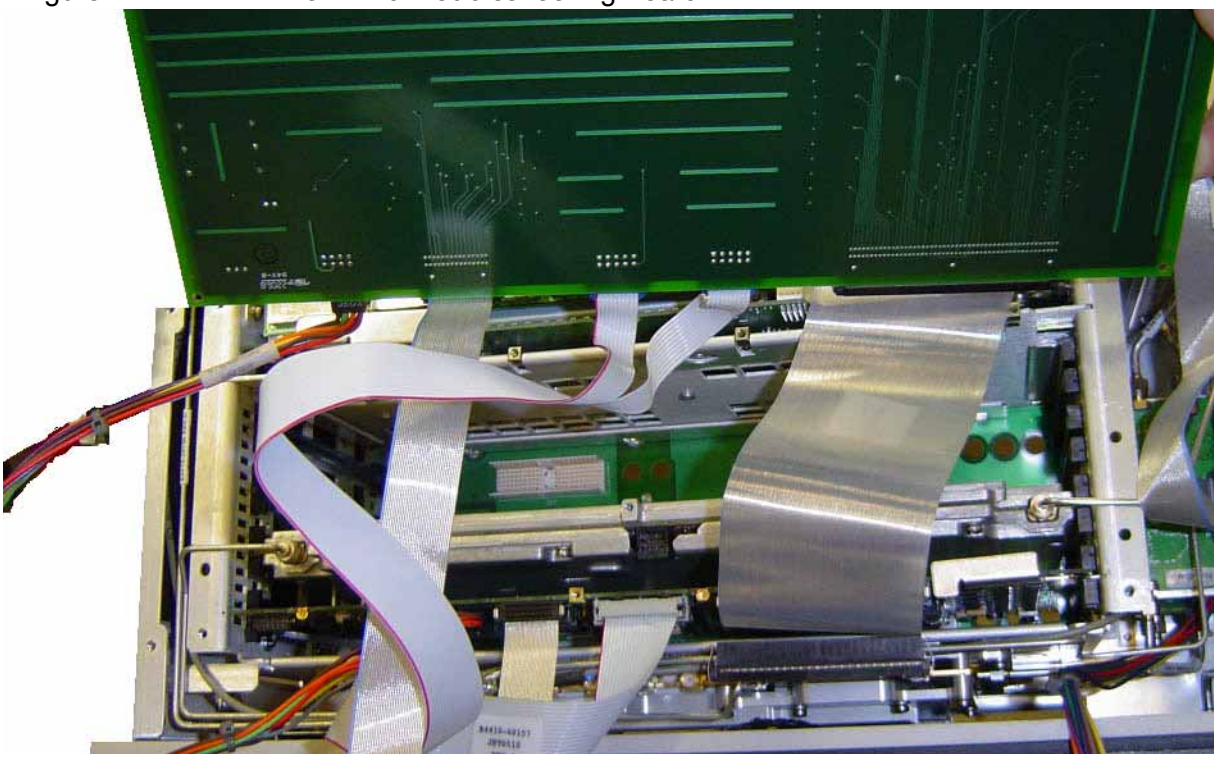
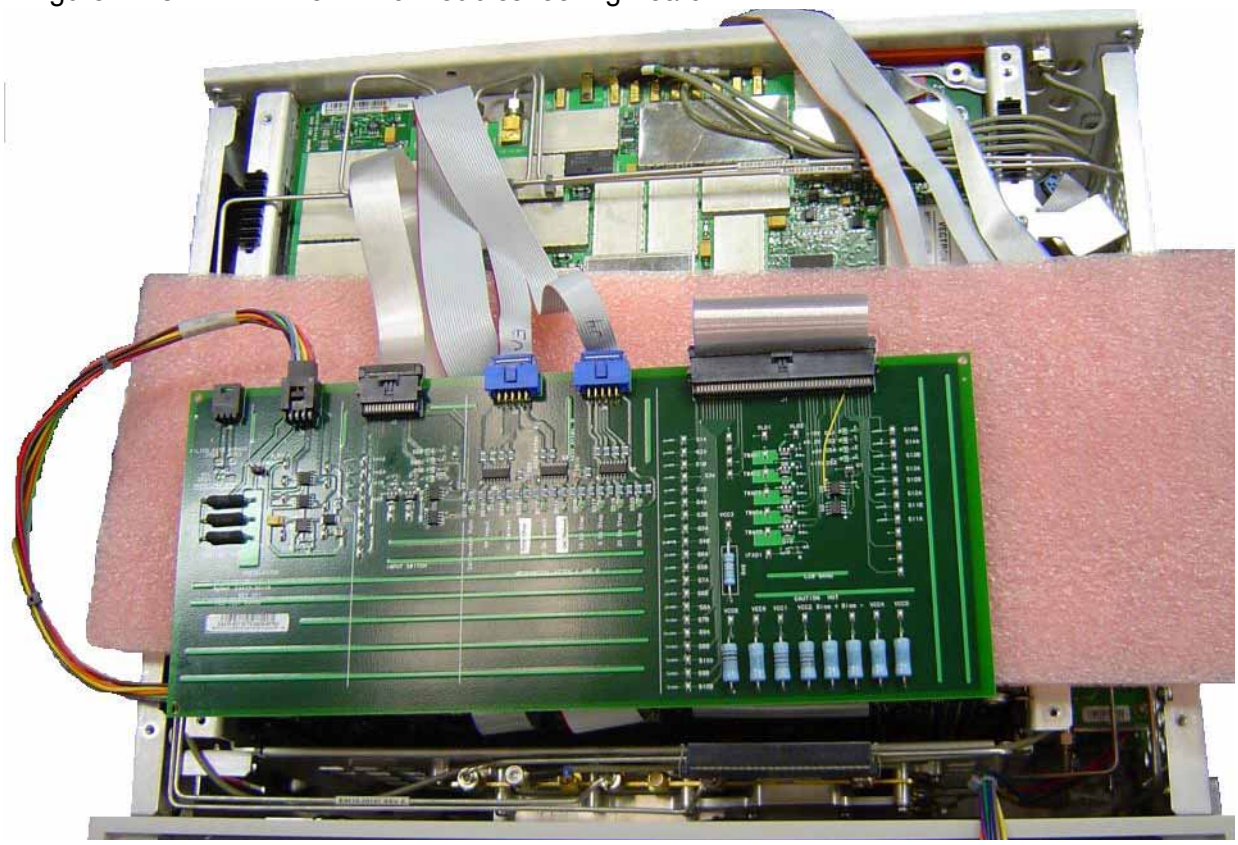


Figure 4-28 RF Front End Troubleshooting Board



– Turn the instrument on and allow it to complete its full boot up process to the signal analyzer application.

– Turn Auto Align off by pressing **System**, **Alignments**, **Auto Align, Auto Align**, **Off** on the analyzer.

CAUTION Resistors on the board can get very hot.

– Verify all power supply LED's on the Front End Troubleshooting board are turned on. Under the J2 connector, the supplies are +15 VDC, +9 VDC, +5.2 VDC, and –15 VDC. Under the J1 connector, the supplies are +15 VDC, –15 VDC, +9 VDC and +5.2 VDC. Verify both input attenuator power supplies. DS9 under J3 should be on if the +25V supply is up for Attenuator A. DS10 under J4 should be on if the +25V supply is up for Attenuator B. If any of the power supply LED's are not turned on, see Chapter 2, “Boot Up and Initialization Troubleshooting”.

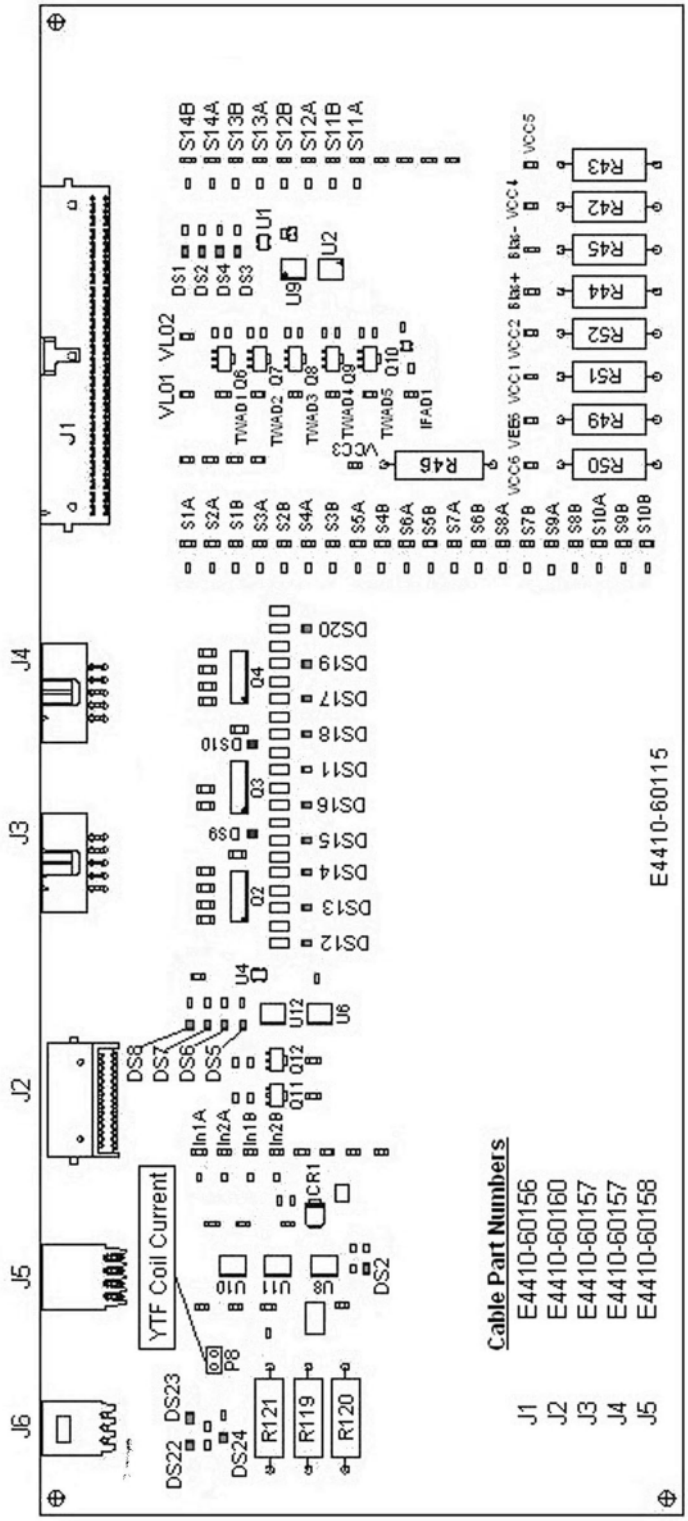
– Press **AMPTD**, **Attenuation, Mech Atten, 0 dB**

NOTE The analyzer will display an error dialogue box when booting up. Simply click “OK” so the instrument can complete its boot process. Additionally, the analyzer noise floor will be near the top of the display since the RF assemblies are not powered up. This is normal with the Front End Troubleshooting board connected to the A15 Front End Driver Assembly

4. Input Attenuator A Control Logic Verification

All the attenuation LED's on the Front End Troubleshooting board should be off except for DS9 and DS10, +25V supply for Attenuator A and Attenuator B.

Figure 4-29 Front End Troubleshooting Board Attenuation LEDs



When the input attenuation is changed from 0 dB to 2 dB, the 2 dB Step LED DS15 should illuminate. When the input attenuation is changed from 2 dB to 4 dB, DS15 and DS16 should be illuminated as per Table 4-11.

Table 4-11 Attenuator A Logic

Attenuator Setting (dB)	DS15	DS16
0		
2	X	
4	X	X

The analyzer default setting for RF Coupling is AC mode. Verify the AC Select LED DS14 is illuminated at this time. Set **Input/Output**, **RF Coupling** to DC. DS14 turns off, DS11 DC Select yellow LED should illuminate. Switch the RF Coupling back to AC. If the LED's illuminate correctly, the switch control logic to Input Attenuator A from the A15 Front End Control Assembly is correct. If the LED's are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

5. Input Attenuator B Control Logic Verification

Press **AMPTD**, **Attenuation, Mech Atten, 6 dB** and verify the 6 dB Step LED DS17 is illuminated. Enter the input attenuation settings found in Table 4-12 and verify the proper LED's illuminate on the Front End Troubleshooting board according to Table 4-12.

Table 4-12 Attenuator B Logic

Attenuator Setting (dB)	DS20 30 dB Step LED	DS19 20 dB Step LED	DS18 10 dB Step LED	DS17 6 dB Step LED
10			X	
16			X	X
20		X		
30	X			
40	X		X	
50	X	X		
60	X	X	X	
66	X	X	X	X

Set the input attenuator back to 10 dB by pressing **AMPTD**, **Attenuation**, **Mech Atten, 10 dB** on the analyzer. If the LED's illuminate correctly, the switch control logic for the input attenuators from the A15 Front End Control Assembly is correct. If the LED's are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

6. Low Band Switch Control Logic Verification

Press **Mode Preset** on the analyzer. Press **FREQ**, **50 MHz**, **Span**, **2 MHz** on the analyzer. Connect the DVM positive lead to one of the In1A test points, and the negative lead to the bottom of R46 (blue resistor near the bottom) on the Front End Troubleshooting board. Verify the voltages in Table 4-13.

Table 4-13

Test Point	Voltage
In1A	–9.85
In2A	–9.85
In1B	+9.75
In2B	+9.75

Press **Freq 5 GHz** on the analyzer. Verify the voltages in Table 4-14.

Table 4-14

Test Point	Voltage
In1A	+9.72
In2A	–9.84
In1B	–9.84
In2B	+9.72

If the voltages are not correct, the most probable cause is the A15 Front End Control Assembly.

7. YTF Preselector Control Logic Verification

NOTE

In order to properly measure the preselector tune output from the A15 Front End Control Assembly, the following items are required:

- **E9637A Banana plug to BNC (f) adapter**
- **E9632A BNC (M) to SMA (f)**
- **8120-1460 Small coaxial cable SMA (m) to mmcx (m)**

Connect the mmcx end of the cable to A15J300, preselector tune output at the upper left corner of A15 Front End Control Assembly.

Press **Single/Cont** on the analyzer until the analyzer is in single sweep. Verify the voltages in Table 4-15 as the center frequency of the analyzer is changed. Press **Restart** after each center frequency change.

Table 4-15 YTF Tune Voltages

Center Frequency (GHz)	~ Tune Voltage (VDC)	Tolerance (VDC)
5.0	1.6	±0.5
10[a]	3.228	±1.0
15[b]	4.85	±1.0
20[b]	6.5	±1.0
26[b]	8.45	±1.0

a. Options 513 and 526
b. Option 526

NOTE

Tolerances can be used as a guideline. The true test is whether or not the analyzer will function and meet published specification.

If any of the preselector tune voltages do not match the levels in Table 4-15, the most probable causes are a misaligned YTF or the A15 Front End Control Assembly. Perform the YTF characterization (press **System**, **Alignments**, **Advanced**, **Characterize Preselector**).

To further test the YTF control current, select Amps on the DVM and place the positive lead of the DVM on one of the YTF Coil Current P8 pins and the other DVM lead to the other Coil Current pin.

NOTE In order to measure the control current correctly, press **Restart** on the analyzer in between each measurement.

If any of the preselector control currents do not match the levels in Table 4-16, the most probable causes are a misaligned YTF or the A15 Front End Control Assembly. Perform the YTF characterization (press **System**, **Alignments**, **Advanced**, **Characterize Preselector**) and re-check the control current at various center frequencies.

Table 4-16 YTF Tune Current

Center Frequency (GHz)	Control Current (mA)	Tolerance (mA)
5.0	106	±20
10[a]	215	±25
15[b]	324	±30
20[b]	430	±40
26[b]	560	±50

a. Options 513 and 526
b. Option 526

NOTE Tolerances should be used as a guideline. The true test is whether or not the analyzer will function and meet published specification.

8. Front End Assembly Control Logic Verification

Since the RF Front End Troubleshooting board is connected, now is a good time to test out the remaining control circuits from the A15 Front End Control Assembly.

Table 4-17 Front End Control Logic

Test Point	Description	Instrument Settings	Voltage (VDC)	Tolerance (VDC)
S2A	Sets switch for Low Band/preamp path	CF 50 MHz preamp on	+9.67	±0.5
S2B	Sets switch for Low Band/preamp path	CF 50 MHz preamp on	+9.83	±0.5
S3A	Sets E-atten to 5 dB preamps off	E-atten = 5 dB	+9.67	±0.5
S3B	Sets E-atten to 5 dB preamps off	E-atten = 5 dB	+9.83	±0.5
S4A	Sets E-atten to 10 dB preamps off	E-atten = 10 dB	+9.67	±0.5
S4B	Sets E-atten to 10 dB preamps off	E-atten = 10 dB	+9.83	±0.5
S5A	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.67	±0.5
S5B	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.83	±0.5
S6A	Sets E-atten to 1 dB preamps off	E-atten = 1 dB	+9.67	±0.5
S6B	Sets E-atten to 1 dB preamps off	E-atten = 1 dB	+9.83	±0.5
S7A	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.67	±0.5
S7B	Sets E-atten to 2 dB preamps off	E-atten = 2 dB	+9.83	±0.5
S8A	Sets E-atten to 20 dB preamps off	E-atten = 20 dB	+9.67	±0.5
S8B	Sets E-atten to 20 dB preamps off	E-atten = 20 dB	+9.83	±0.5
S9A	Controls in & out to low band preamps off	E-atten = off	+9.83	±0.5
S9B	Controls in & out to low band preamps off	E-atten = off	+9.67	±0.5
S11A	Sets path for 1st or 2nd L.O.	CF 1 GHz	+9.67	±0.5
S11B	Sets path for 1st or 2nd L.O.	CF 1 GHz	+9.83	±0.5
S12A	Sets path for L.O. normal or x2 for band 4	CF 1 GHz	+9.83	±0.5
S12B	Sets path for L.O. normal or x2 for band 4	CF 1 GHz	+9.67	±0.5
S13A	Sets path for L.O. to either of the high band mixers and L.O. output	CF 5 GHz CF 20 GHz	–9.67 +9.67	±0.5
S13B	Sets path for L.O. to either of the high band mixers and L.O. output	CF 5 GHz CF 20 GHz	+9.83 –9.83	±0.5

Table 4-17 Front End Control Logic

Test Point	Description	Instrument Settings	Voltage (VDC)	Tolerance (VDC)
S14A	Sets path to either band 1 & 2 mixer or band 3 & 4 mixer	CF 5 GHz CF 20 GHz	–9.83 +9.83	±0.5
S14B	Sets path to either band 1 & 2 mixer or band 3 & 4 mixer	CF 5 GHz CF 20 GHz	+9.67 –9.67	±0.5
VCC1	Voltage always on		4.8	±0.5
VCC2	Voltage always on		4.8	±0.5
VCC3	Voltage always on		7.85	±0.5
VCC4	Voltage always on		5.0	±0.5
VCC5	Voltage always on		5.0	±0.5
TWAD1	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD2	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD3	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD4	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5
TWAD5	Amplifier bias to A13 RF Front End Assembly		6.0	±0.5

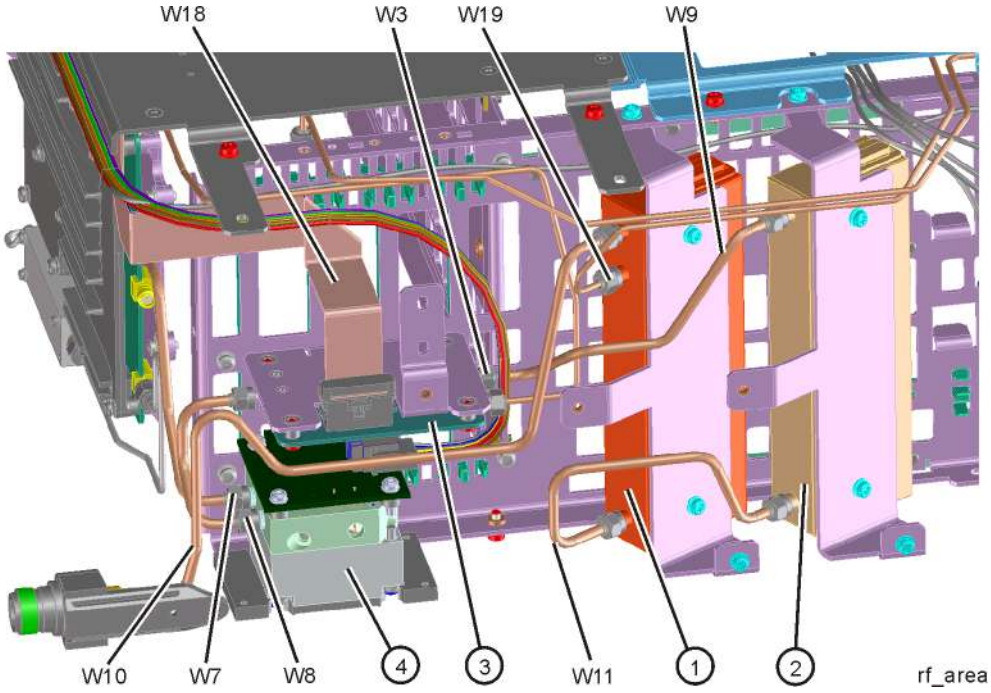
NOTE Tolerances should be used as a guideline.

If any of the voltages measured do not match the levels in Table 4-17, the most probable cause is the A15 Front End Control Assembly. Once the switch control logic has been verified, turn off the instrument. Disconnect the RF Front End Troubleshooting board cables, and reconnect the analyzer cables to the A15 Front End Control Assembly. Turn the instrument on and allow it to complete its full boot up process to Spectrum Analyzer mode.

Input Attenuator A Power Level Verification

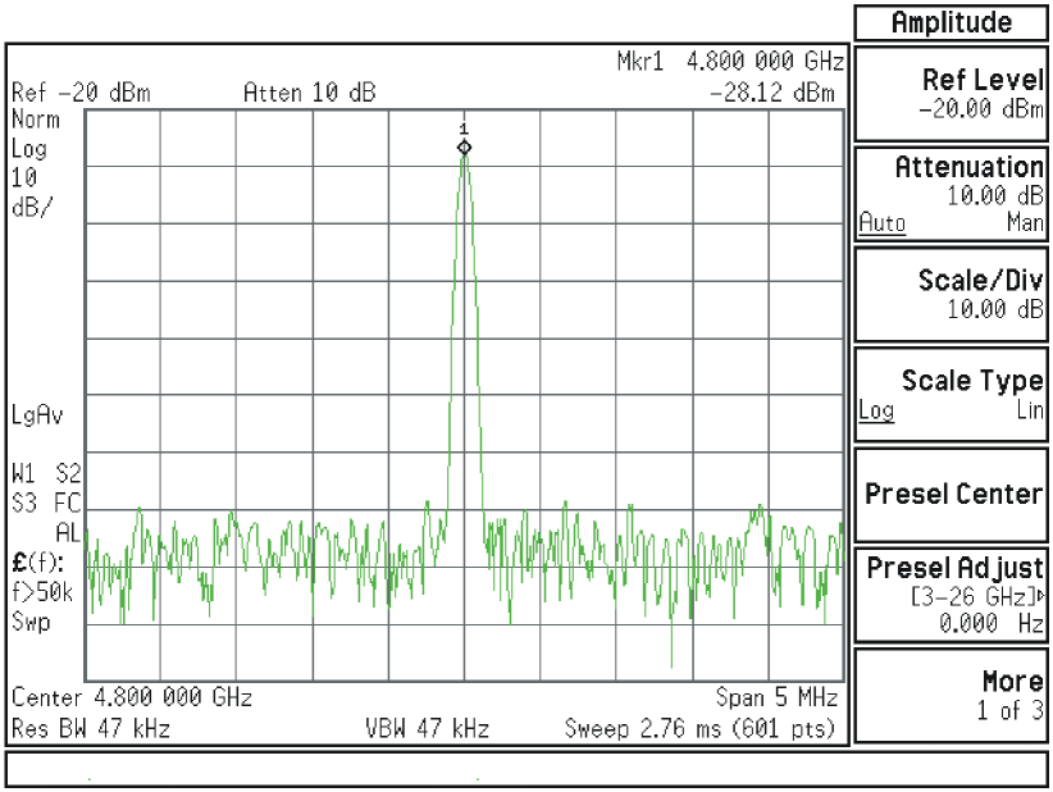
Press **Mode Preset**, **Input/Output**, **RF Calibrator**, **4.8 GHz**, **AMPTD**, **Attenuation**, **Mech Atten, 0 dB** on the analyzer. Refer to Figure 4-30, remove cable W11 from A9 **(1)** Output. Measure the 4.8 GHz calibrator signal on the output of the attenuator using the proper high frequency cables and connect to the functioning Spectrum Analyzer.

Figure 4-30 W9 and W11 Location



The level should be –28 dBm ±2 dB as shown in Figure 4-31.

Figure 4-31 4.8 GHz Calibrator Signal on Output of Attenuator A



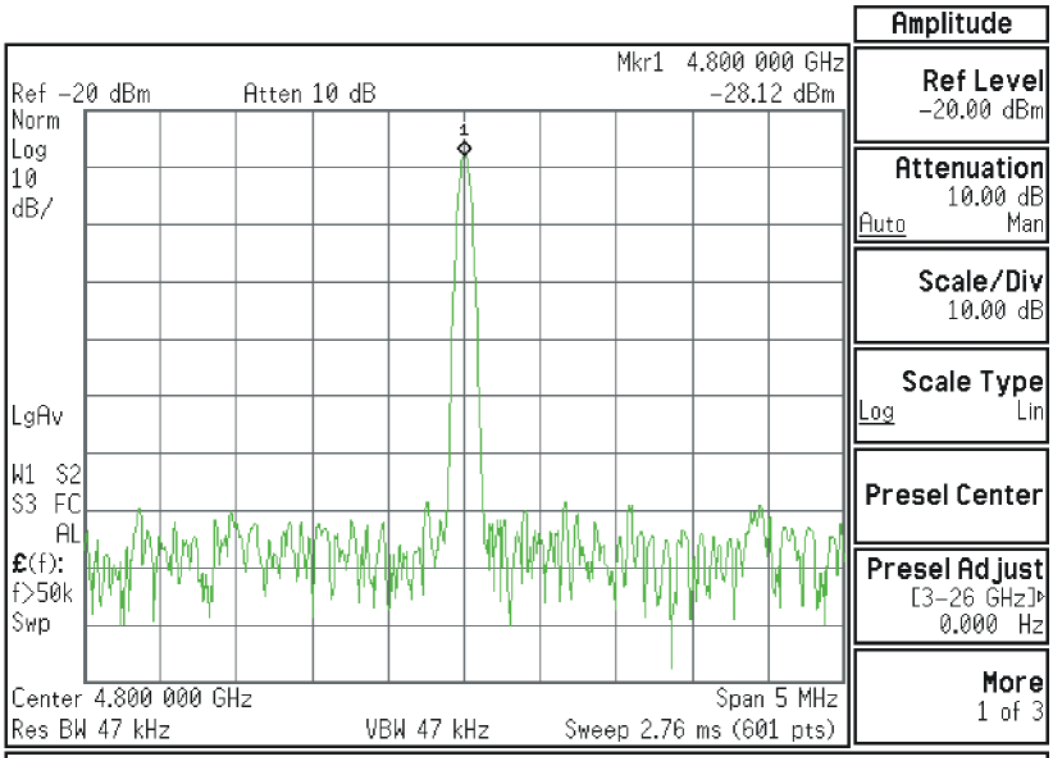
Press **Mech Atten** and enter 2 dB. The 4.8 GHz calibrator signal measured on the functioning Spectrum Analyzer should measure 2 dB lower than the previous step (~–30 dBm). Press **Mech Atten** and enter 4 dB. The 4.8 GHz calibrator signal measured on the functioning Spectrum Analyzer should measure an additional 2 dB lower than the previous step (~–32 dBm). If the power levels measure correctly, reconnect W11 cable. If either of these levels is incorrect, Input Attenuator A is the most probable cause, provided the control logic from the A15 Front End Control Assembly was previously verified.

Input Attenuator B Power Level Verification

Press **AMPTD**, **Attenuation**, **Mech Atten, 0 dB**. Remove output cable W9 from A10 **(2)**. Refer to Figure 4-30. Measure the 4.8 GHz calibrator signal on the output of the attenuator using a functioning Spectrum Analyzer.

The level should be –28 dBm ± 2 dB as shown in Figure 4-32.

Figure 4-32 4.8 GHz Calibrator Signal on Output of Attenuator B



Press **Mech Atten** and enter 6 dB. The 4.8 GHz calibrator signal measured on the functioning Spectrum Analyzer should measure 6 dB lower than the previous step (~–34 dBm).

Press **Mech Atten** and enter 10 dB. The 4.8 GHz calibrator signal measured on the functioning Spectrum Analyzer should measure 10 dB lower than the first step (~–38 dBm). Continue testing all the attenuation settings as described in Table 4-18.

Table 4-18

Attenuator Setting	Expected Level dBm @ 4.8 GHz	Tolerance
16	–44	±3 dB
20	–48	±3 dB
30	–58	±3 dB
40	–68	±4 dB
50	–78	±4 dB
60	–88	±4 dB
66	–94	±4 dB

NOTE

1. It may be difficult to measure the higher attenuator settings using the -28 dBm internal calibrator signal. Use an external source with the frequency set to 4.8 GHz and adjust the output level to 0 dBm. This will increase the measured power levels noted in the table above by 28 dB.
2. Tolerances should be used as a guideline.

If the power levels measure correctly, reconnect the W9 cable and reset the input attenuation to 10 dB by pressing **Mech Atten**, **10 dB** on the analyzer.

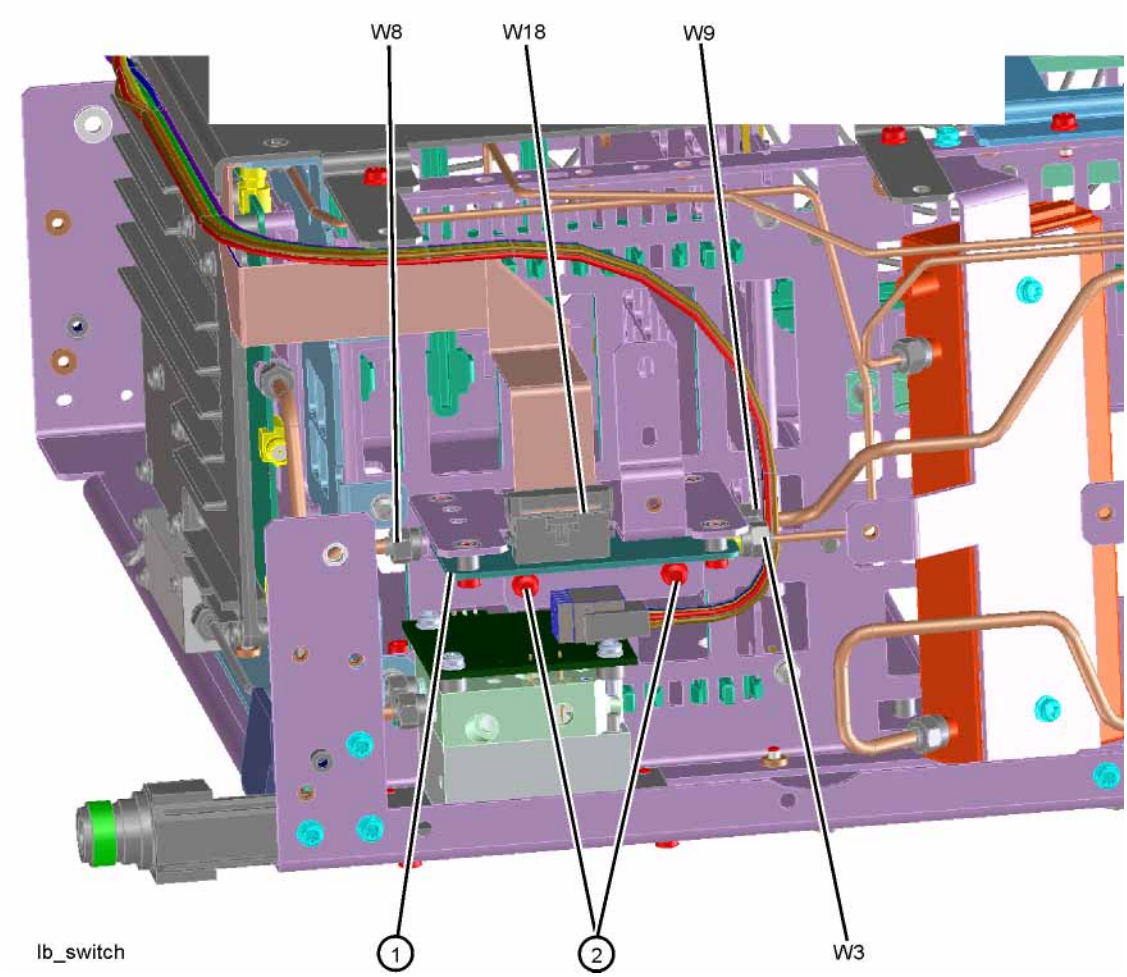
If either of these levels measure incorrectly, Input Attenuator B is the most probable cause, provided the switch control logic has been verified.

Low Band Switch Power Level Verification

(for High Band)

Refer to Figure 4-33. Carefully disconnect both ends of the W8 cable at A11J3 and A12 **(1)** input. If the microwave preselector bypass hardware is installed, disconnect both ends of W31 at A11J3 and SW2 port C.

Figure 4-33 W8 Location



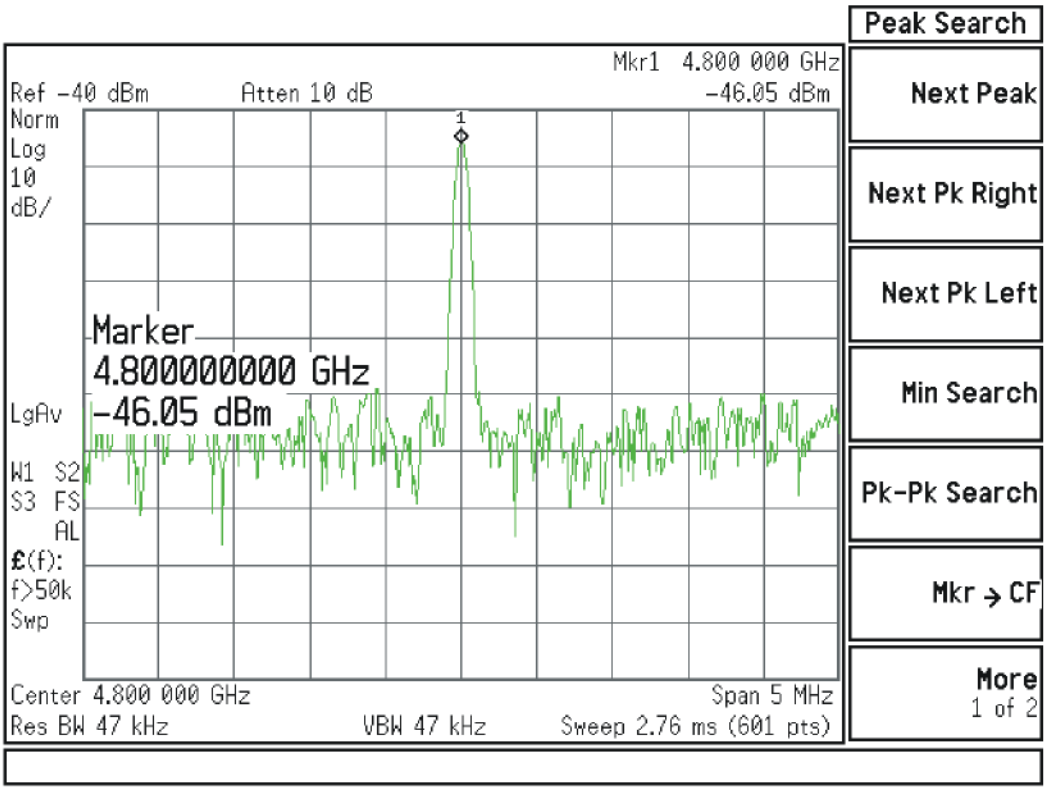
CAUTION Be careful not to short out components on the front panel interface board or the components on top of the A12 YTF Preselector when removing W8 or W31.

Press **Input/Output**, **RF Calibrator**, **4.8 GHz**, **AMPTD**, **Attenuation**, **Mech Atten, 10 dB**, **FREQ**, **4.8 GHz**, **Zero Span** on the analyzer.

IMPORTANT Turn off auto align by pressing **System**, **Alignments**, **Auto Align, Auto Align**, **Off**.

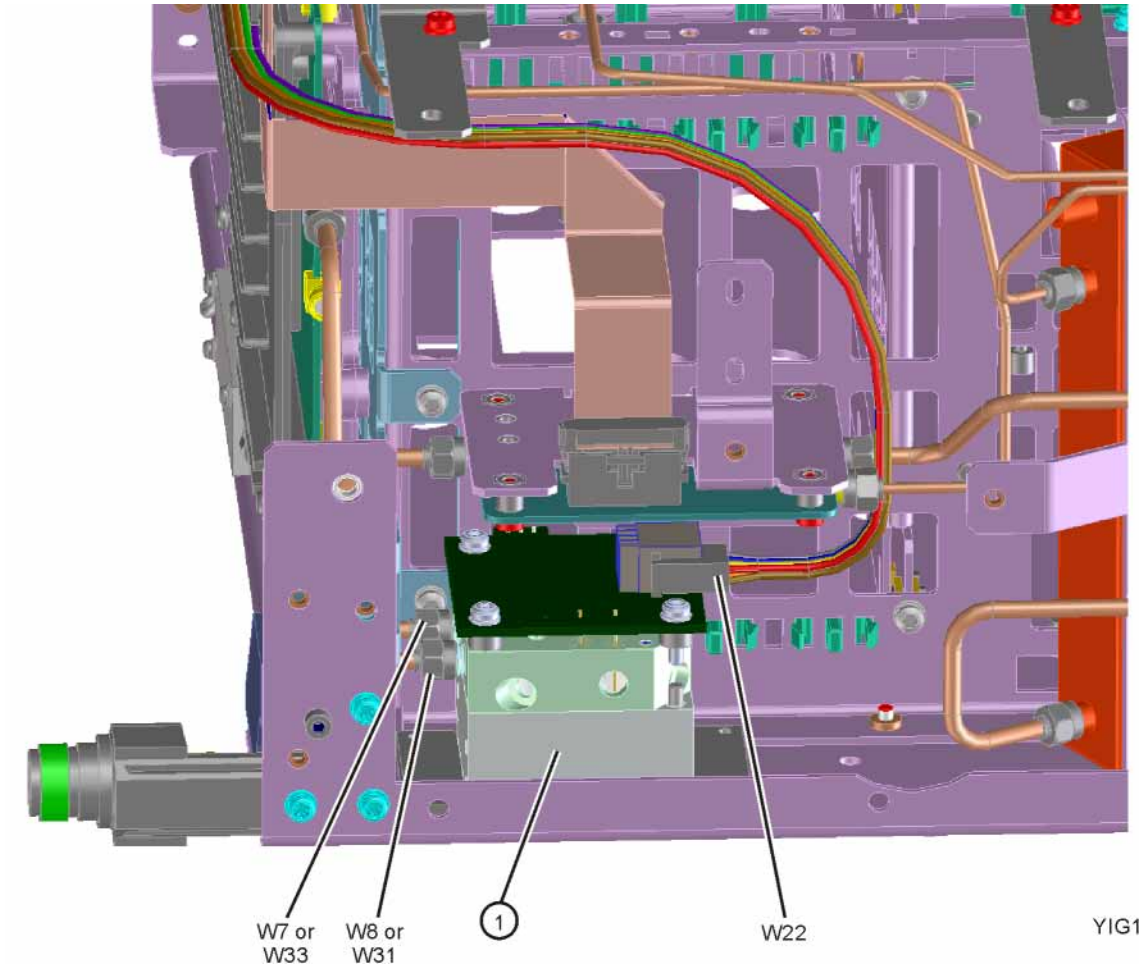
Measure the 4.8 GHz calibrator signal on the output of A11J3 Low Band Switch high band output port using a functioning Spectrum Analyzer. The level should be –46 dBm ± 3 dB as shown in Figure 4-34. There is ~8 dB of loss through the A11 Low Band Switch when using the 4.8 GHz reference signal.

Figure 4-34 4.8 GHz Calibrator Signal at Output of W8 Cable



If the power level is correct, do not reconnect W8 or W31 at this time. Refer to Figure 4-35, disconnect W7 at A12 **(1)** output and install a connector such that the A12 YTF Preselector output can be measured. If the preselector bypass hardware is installed, disconnect W33 at A12.

Figure 4-35 Cable W7 at A12 Output



Once the connector is installed, carefully reconnect W8 or W31to make the measurement. If the power level is incorrect, the most probable cause is the A12, YTF Preselector.

A12 YTF Preselector Power Level Verification

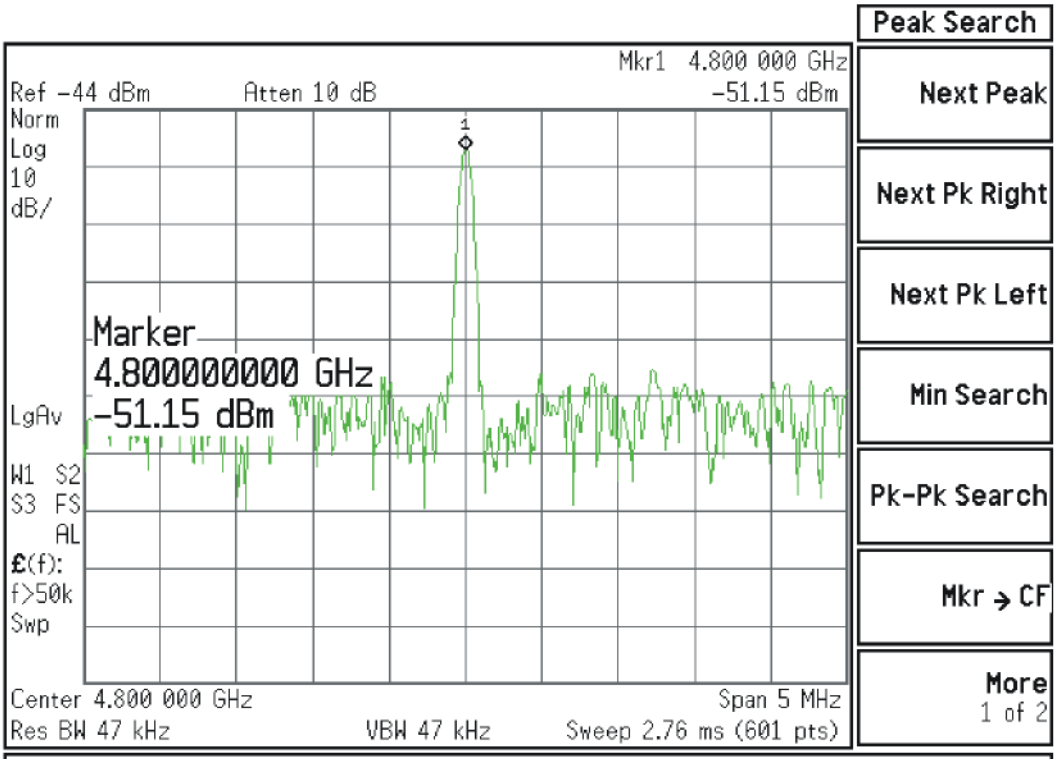
Press **Input/Output**, **RF Calibrator**, **4.8 GHz**, **AMPTD**, **Attenuation**, **Mech Atten, 10 dB**, **Zero Span** on the analyzer. Measure the 4.8 GHz calibrator on the output of either the W7 (or, if the microwave preselector bypass hardware is installed, W34) cable using a functioning spectrum analyzer. When the 4.8 GHz calibrator signal is used, there will be ~ 5 dB (~8 dB if microwave preselector bypass hardware is installed) ± 4 dB of insertion loss through the YTF Preselector. The tolerance is large because the A12 YTF loss varies between devices, and the YTF might not be perfectly aligned, or the frequency response adjustment may be required.

If the signal level is incorrect, and Option MPB, Microwave Preselector Bypass is installed and licensed, press **AMPTD**, **Signal Path**, **uW Path Control**, **uW Presel Bypass**. If the signal level is now ~ – 51 dBm ± 4 dB as shown in Figure 4-36, suspect the A12 YTF is either out of adjustment or faulty.

To perform the YTF alignment, reconnect W7 or W34 and press **System**, **Alignments**, **Advanced**, **Characterize Preselector**. The routine may take several minutes to align the YTF. Display the 4.8 GHz calibrator on screen as explained in the quick check section. If the signal level is still incorrect, suspect all assemblies, cables, and switches between the W7 (or W34) cable and the output of the A11 Low Band Switch.

Reconnect W7 and W8 cables (or W31 and W34 cables).

Figure 4-36 4.8 GHz Calibrator Signal at Output of W7 Cable



If the power level is incorrect, the most probable cause is the YTF Preselector. Reconnect W7 and W8 cables (or W31 and W34 cables).

The following High Band path items have been verified in the RF section:

- 4.8 GHz Calibrator signal power level from the A16 Reference Board
- 1st L.O. power level from the A14 L.O. Synthesizer
- Switch control logic from the A15 Front End Control Board to:
  - Input Attenuator A
  - Input Attenuator B
  - Low Band Switch
  - YTF Preselector
  - RF Front End Assembly
- Input Attenuator A
- Input Attenuator B
- Low Band Switch
- YTF Preselector

If all the power levels and biasing from the A15 Front End Control board measure correctly up to this point, the most probable cause would be the A13 Front End Assembly.

NOTE

High Band #2 RF signal path utilizes a high band mixer internal to the A13 RF Front End Assembly for RF input frequencies from 13.6 GHz to 26.5 GHz. Since all the control voltages and biasing were already fully tested, failures from 13.6 GHz - 26.5 GHz will most likely be caused by the A13 RF Front End Assembly. If the failure is amplitude related, proper adjustments such as frequency response and the YTF Preselector adjust should be performed first before changing the A13 RF Front End Assembly. Refer to Chapter 12, “Block Diagrams.” for details.

High Band Preamp (Option P08, P13, P26)

If any of the preamp options listed above is installed, the High Band preamp can be verified as follows:

View the 4.8 GHz calibrator signal on screen. Press **AMPTD**, **Signal Path**, **Internal Preamp**, **Full Range** to activate the preamp. The expected operation is the signal level will not change more than ± 0.5 dB and the noise floor will increase due to the fact the input attenuation was automatically increased.

If the amplitude error when switching the preamp on and off is greater than 0.5 dB, assure that any other internal alignment failures are resolved since the System Gain alignment must run before optimum performance is possible. The amplitude error could be caused by poor frequency response, and performing the high band frequency response adjustment (using the calibration software) will adjust the preamp on, high band path. Assure you have evaluated all causes including A15 Front End Controller switching problems, before you replace the Front End assembly.

High Band Mixing Equations

For input signal frequencies from 3.6 GHz to 8.4 GHz and 13.6 GHz to 17 GHz:

RF = LO x N – IF

IF = LO x N – RF

LO x N = IF + RF

where RF is the input signal at the signal analyzer

where N is the harmonic mixing mode:

N = 1 for 3.5 GHz to 8.4 GHz

N = 2 for 13.5 GHz to 17 GHz

For input signal frequencies above 8.4 GHz to 13.6 GHz and 17 GHz to 26.5 GHz:

RF = LO x 2 x N – IF

IF = LO x 2 x N – RF

LO x 2 x N = IF + RF

where RF is the input signal at the signal analyzer

where N is the harmonic mixing mode:

N = 1 for 8.4 GHz to 13.6 GHz

N = 2 for 17 GHz to 26.5 GHz

Microwave Preselector Bypass (Option MPB)

Allows the YTF to be bypassed, improving amplitude accuracy.

Assure start frequency is 3.6 GHz or greater. Press **Amplitude**, **Signal Path, uW Path Control**, **uW Presel Bypass**.

When the bypass switches Switch 1 and Switch 2 change state you will hear a click. Depending on the signal source connected, you may see many “signals” appear on screen because without pre-filtering, the analyzer will display image and multiple responses. The real input signal should not change amplitude when you switch the uW Preselector Bypass on and off.

5 RF Section Troubleshooting (Millimeter-Wave Analyzers)

What You Will Find in This Chapter

The following information is found in this chapter:

1. Theory of operation of the RF section.
2. Isolating the cause of an hardware problem by verifying the functionality of assemblies in the RF section signal path.

NOTE

Each section describes how the assembly works and gives information to help you troubleshoot the assembly. Each description covers the purpose of the assembly, describes the main components, and lists external connections to the assembly.

The following sections are found in this chapter:

RF Section Description on page 202

Quick Check to Verify the Low Band Signal Path on page 208

Troubleshooting a Low Band Problem on page 211

Quick Check to Verify High Band RF Path on page 218

Troubleshooting a High Band Problem on page 223

RF Section Description

This section covers only those optional frequency ranges listed below for the N9020B Signal Analyzer.

- Option 532, 32 GHz Frequency Range
- Option 544, 44 GHz Frequency Range
- Option 550, 50 GHz Frequency Range

The RF input signal can be routed through four different front end signal paths. These various paths are switched in and out based on where the signal analyzer center frequency is tuned.

1. **Low band RF path is used when the input frequency is ≤ 3600 MHz**
2. **High band RF path #1 is used when the input frequency is > 3.6 GHz to 17.1 GHz**
3. **High band RF path #2 is used when the input frequency is > 17 GHz to 34.5 GHz**
4. **High band RF Path #3 is used when the input frequency is > 34.4 GHz to 50 GHz**

The RF section is designed to convert RF input signals to an intermediate frequency that is present at the RF output of the A13 Front End assembly. This intermediate frequency (IF) depends on installed options and the IF path selected. This chapter will assume the default operation in Spectrum Analyzer mode. Therefore the IF frequency will be 322.5 MHz.

IF Path	IF	Mode
10 MHz (standard)	322.5 MHz	Spectrum Analyzer or IQ Analyzer
25 MHz (Option B25)	322.5 MHz	IQ Analyzer
40 MHz (Option B40)	250 MHz	IQ Analyzer
85 MHz (Option B85)	300 MHz	IQ Analyzer
125 MHz (Option B1A)	300 MHz	IQ Analyzer
140 MHz (Option B1X)	300 MHz	IQ Analyzer
160 MHz (Option B1Y)	300 MHz	IQ Analyzer

The RF section is comprised of the following major assemblies:

- A9 Input Attenuator A
- A10 Input Attenuator B
- A11 Low Band Switch Assembly
- A12 YTF Preselector
- A13 RF Front End Assembly - shown on the block diagram as A13 and A13A1, however replacement A13 assemblies include the A13A1.
- A15 Front End Control Assembly
- Option MPB - Microwave Preselector Bypass

1. **RF input frequencies < 3600 MHz** route through the low band path. Refer to the RF Lowband Path Block Diagram in Chapter 12 for details.

   The RF input signal level can be optimized by Input Attenuator A and/or Input Attenuator B. The low band switch assembly contains a limiter that offers added protection for the mixer, and routes the input signal to the low band input of the A13 RF Front End assembly. There are (3) different signal paths on the input of the RF Front End assembly that the signal can be routed through depending on installed options and front panel settings.

   - Electronic Attenuator path, 0-24 dB (Option EA3)
   - Low Band Preamplifier path, 20 dB nominal gain (Any preamp option)
   - Direct to Mixer #1

NOTE The RF input signal can route through the Electronic Attenuator section or the Preamplifier, but not both. All RF input frequencies < 3600 MHz go to Mixer #1.

The RF input signal is then mixed with the 1st LO from the A20 YTO assembly to a 1st intermediate frequency of 5122.5 MHz. Since the RF input signal is <3600 MHz for low band, this RF input signal is upconverted in Mixer #1 to the 1st IF. This 1st IF signal is then downconverted in Mixer #2 using the 4800 MHz 2nd LO generated on the A16 Reference assembly to a 2nd intermediate frequency of 322.5 MHz (5122.5 MHz (1st IF) – 4800 MHz (2nd LO)). The 2nd IF output is at A13A1J7. This signal path is used for all frequency range options when the RF input frequencies are < 3600 MHz. The control voltages and biasing for these assemblies come from the A15 Front End Control assembly.

2. **RF input frequencies from 3.6 GHz to 17.1 GHz** go through the high band path. Refer to the RF Highband Path #1 Block Diagram (Millimeter-Wave Analyzers) in Chapter 12 for details.

   The input signal level can be optimized by Input Attenuator A and/or Input Attenuator B. The Low Band Switch assembly routes the signal through the A12 YTF Preselector. If one of the optional high band preamps is licensed, the signal can be routed through the preamp. The A15 Front End Controller provides switching signals.

   The Low Band Switch assembly performs the following tasks:

   - Provides a limiter that offers added protection for the mixer and optional preamp.
   - Contains the high band preamp.
   - Routes the input signal to either the low band input of the A13 Front End assembly or to the A12 YTF Preselector. If Option MPB is installed, the signal is routed through a transfer switch, SW4.

   The high band input switch in the Front End Assembly routes the RF input signal to Mixer #2, where it mixes with the LO and provides a 1st intermediate frequency of 322.5 MHz. The 322.5 MHz IF output is at A13J7. The control voltages and biasing are provided by the A15 Front End Control Assembly. The LO is doubled for tuned frequencies > 8.4 GHz in this path.

3. **RF input frequencies from 17.1 GHz to 34.5 GHz** go through the high band path. Refer to the RF Highband Path #2 Block Diagram (Millimeter-Wave Analyzers) in Chapter 12, “Block Diagrams.” for details.

   The signal path for 17.1 GHz to 34.5 GHz operation is almost the same as the 3.6 GHz to 17.1 GHz path. The only difference is that Mixer #3 is used in this path. The LO is doubled for all tuned frequencies in this path.

4. **RF input frequencies from 34.5 GHz to 50 GHz** go through the high band path. Refer to the RF Highband Path #3 Block Diagram (Millimeter-Wave Analyzers) in Chapter 12, “Block Diagrams.” for details.

   The signal path for 34.5 GHz to 50 GHz operation is almost the same as the 3.6 GHz to 17.1 GHz path. The only difference is that Mixer #4 is used in this path. The LO is doubled for all tuned frequencies in this path.

A9 Input Attenuator A

This assembly has two 2 dB attenuator sections, a 6 dB attenuator section, and a cal signal input port. The 2 dB and 6 dB sections are only used if Option FSA is installed.

A10 Input Attenuator B

This assembly has a total of 60 dB of attenuation to control the signal level into the Low Band Switch assembly. There is a 10 dB, 20 dB, and 30 dB section in the A10 assembly. Total input attenuation with the A9 and the A10 combined is 70 dB in 2 dB steps.

A11 Low Band Switch

This assembly operates across the entire frequency range of the analyzer. The switch has 3 main functions:

- Switch RF input frequencies from 3 Hz to 3.59 GHz RF Output to A13 RF Front End Assembly.
- Switch input frequencies from 3.6 GHz to 50 GHz Millimeter-Wave RF Output to A12, YTF Preselector.
- Contains optional high band preamplifier, which has a typical gain of 35 dB to 40 dB and a noise figure from 9 to 23 dB up to 50 GHz.

A12 YTF Preselector

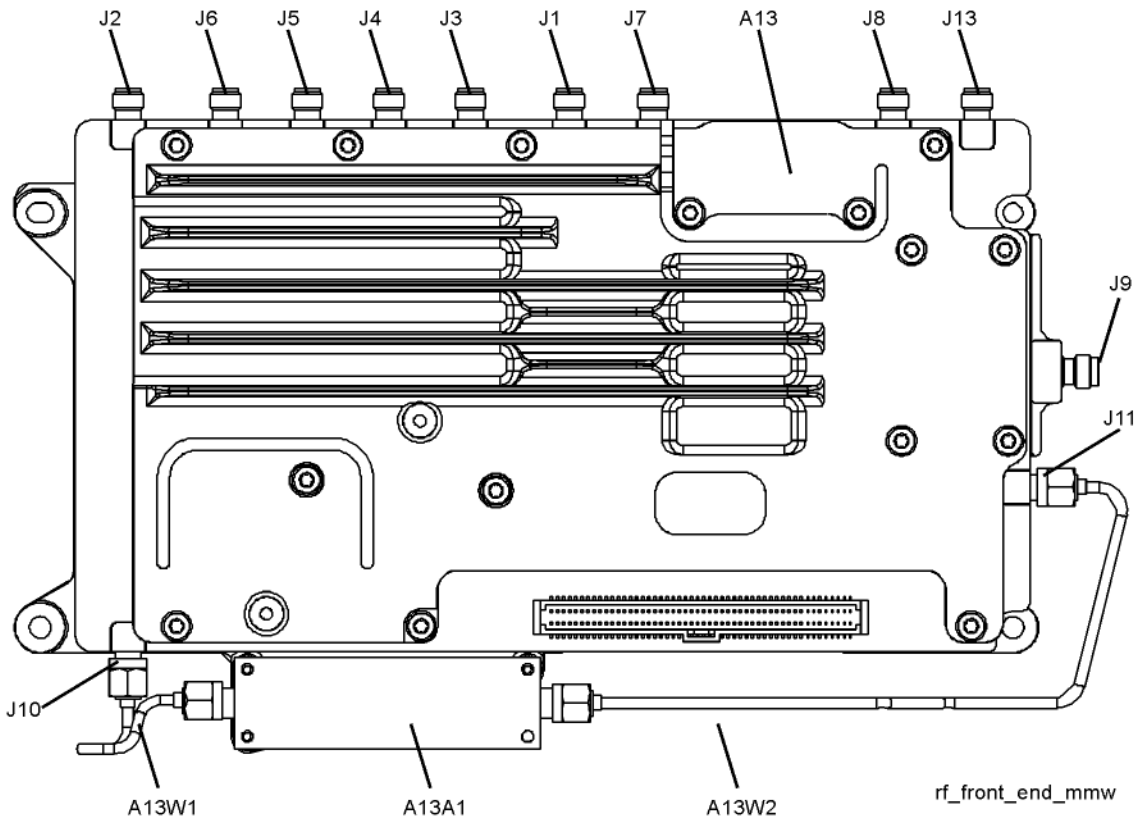
The YTF Preselector is used for input frequencies greater than 3.6 GHz. Signals less than 3.6 GHz bypass the YTF assembly and are routed to the low band input of the A13 RF Front End Assembly. The YTF Preselector is a YIG tunable bandpass filter whose main purpose is to track the input signal and to filter out unwanted spurious or image response signals. The YTF Preselector has a 3 dB bandwidth greater than 40 MHz and an insertion loss of ~ 6.5 dB.

The preselector requires centering for optimum amplitude accuracy. The Auto Align routine will perform a rough centering during the preselector two point tuning algorithm. However, when troubleshooting, press **Amplitude**, **Signal Path**, **Presel Adjust** to manually center the preselector.

A13 RF Front End Assembly (Options 532, 544, 550)

This assembly contains the major front end conversion components. The A13 is repaired at the assembly level. Replacement A13 assemblies include the A13A1 1st IF Bandpass Filter. See Figure 5-1.

Figure 5-1 A13 RF Front End Assembly View from Front Panel



This assembly contains the following circuits:

- Input Low-pass filter (RF input signals < 3.6 GHz)
- Optional Low Band Electronic Attenuator (0-24 dB attenuation control)
- Optional Low Band Preamplifier and Limiter
- RF Mixer #1 (RF input signals < 3.6 GHz)
- 1st LO Sub-system (3.8 GHz to 8.7 GHz)
- 1st IF Amplifier (5122.5 MHz)
- 1st IF Band Pass Filter (A13A1) (low band)
- Mixer #2 (RF input signals 3.6 GHz to 17.1 GHz)
- Microwave Input Amplifier
- Mixer #3 (RF input signals 17 GHz to 34.5 GHz)
- Mixer #4 (RF input signals 34.4 GHz to 50 GHz)
- LO Doubler
- External Mixing Diplexer

A15 Front End Control Assembly

Provides the correct biasing and switch control logic to the following RF assemblies:

- Input Attenuator A
- Input Attenuator B
- Low Band Switch
- YTF Preselector (Input signals > 3.6 GHz)
- (Option MPB) Microwave Preselector Bypass
- Front End Assembly including switched filter
- (Optional) High Band Preamplifier
- (Optional) Low Band Preamplifier
- (Option EA3) Electronic Attenuator (0-24 dB)

NOTE Refer to Chapter 6, “Front End Control Troubleshooting.” for detailed descriptions & troubleshooting procedures

Troubleshooting

Quick Check to Verify the Low Band Signal Path

The analyzer has an internal 50 MHz amplitude reference signal that is used to verify the low band path. This 50 MHz calibrator is used when the analyzer performs many of the internal alignment routines. Therefore, the functionality of the 50 MHz calibrator and low band path are critical to passing Align All Now. Refer to the RF Lowband Path Block Diagram (Millimeter-Wave Analyzers) in Chapter 12 for details. Reference the instrument settings box on the block diagram.

Equipment needed:

Spectrum Analyzer with frequency range to 8 GHz

Signal source with output power 0 dBm and frequency range to at least 3.6 GHz

Power splitter, 11667B or 11667C

2 each, quality SMA or 3.5 mm cables

90° SMA (m) to SMA (f) adapter

MMCX (f) to SMA (f) cable

SMA (f) to SMA (f) adapter

SMA (m) to SMA (m) adapter

3.5mm (f) to 2.4mm (m) adapters (2 required)

NOTE To perform the following checks, it will be necessary to remove the outer cover and the top brace. See Chapter 15 for removal procedures.

Turn the instrument on and allow it to complete its full boot up process to Spectrum Analyzer mode. Use the internal 50 MHz, –25 dBm calibrator signal as a reference for troubleshooting by pressing **Mode Preset**, **Input/Output**, **RF Calibrator**, **50 MHz** on the analyzer. Now press **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search**. The 50 MHz reference signal should measure 50 MHz @ –25 dBm ± 2 dB on the analyzer display. If the power level is within tolerance, the low band path is functioning correctly at 50 MHz. If the power level is incorrect, select the 4.8 GHz RF Calibrator and set the analyzer center frequency to 4.8 GHz. Since several of the same signal path components are shared between low band and high band, determining if the problem appears in both paths is helpful.

To verify the high band path go to “Quick Check to Verify High Band RF Path” on page 218.

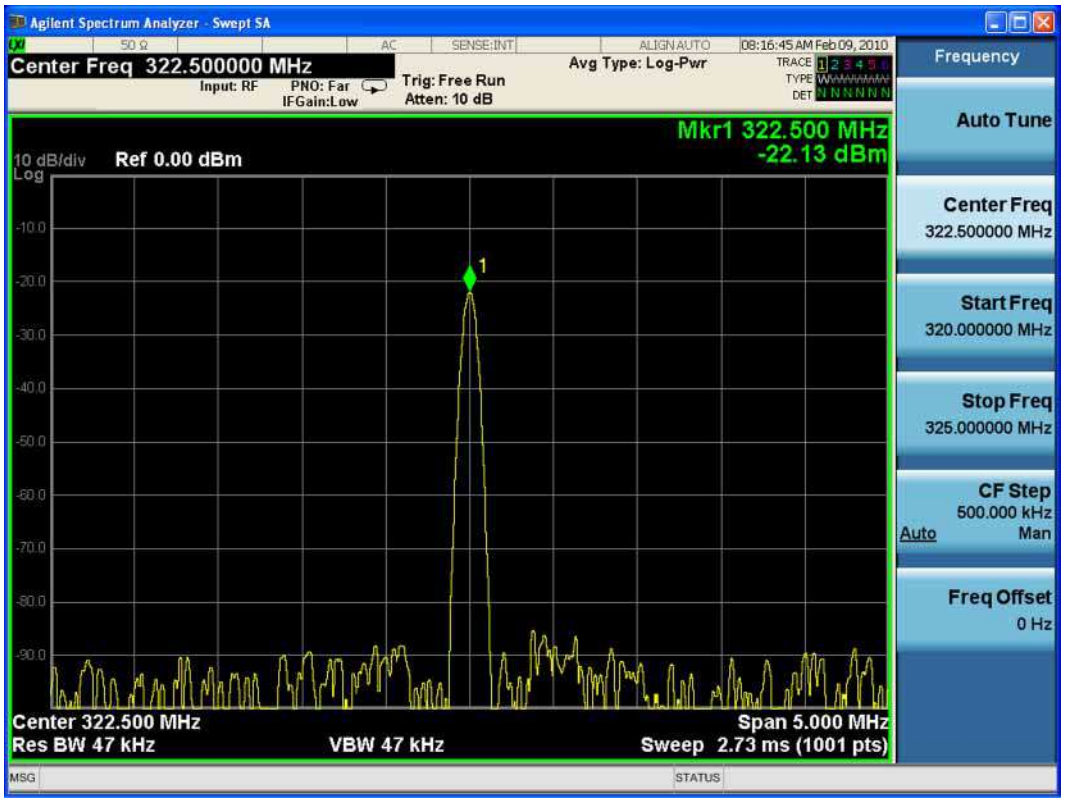
If the power level is not within tolerance, press **FREQ**, **Zero Span**, **AMPTD**, **Attenuation**, **Mech Atten**, **10 dB**.

IMPORTANT Turn off auto align by pressing **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**.

Disconnect the W36 cable from A13J7 on the Front End Assembly IF Out. See Figure 5-1.

Connect A13J7 output to a functioning spectrum analyzer and verify the 322.5 MHz intermediate frequency is measuring –22 dBm ± 3 dB using the same analyzer settings as in Figure 5-2.

Figure 5-2 322.5 MHz Intermediate Frequency



If this power level is correct the signal path from the A9 50 MHz Reference signal input port to A13J7, IF Output is operating correctly using a 50 MHz input calibrator signal. Reconnect the W36 cable to A13J7.

NOTE Flatness issues or power level problems at other input frequencies below 3600 MHz may exist. This type of problem can be diagnosed using an external source to verify performance.

If this power level is incorrect, the following assemblies need to be verified using the 50 MHz internal calibrator signal. Be sure the 50 MHz calibrator is turned on. Press **Input/Output**, **RF Calibrator**, **50 MHz** when verifying the performance.

1. A11 Low Band Switch
2. A10 Input Attenuator B
3. A9 Input Attenuator A
4. A16 Reference Assembly (50 MHz calibrator, 2nd LO)
5. A13 RF Front End Assembly

NOTE

In order to gain access to the front end components, remove the front frame assembly, but leave the ribbon cable connected so you can still control the instrument. Remove the right side chassis. Refer to the removal procedures in Chapter 15, “Assembly Replacement Procedures.”.

Troubleshooting a Low Band Problem

Refer to the RF Lowband Path Block Diagram (Millimeter-Wave Analyzers) in Chapter 12and follow the instructions in the settings box. To enable the internal 50 MHz, –25 dBm calibrator signal press **Input/Output**, **RF Calibrator**, **50 MHz**.

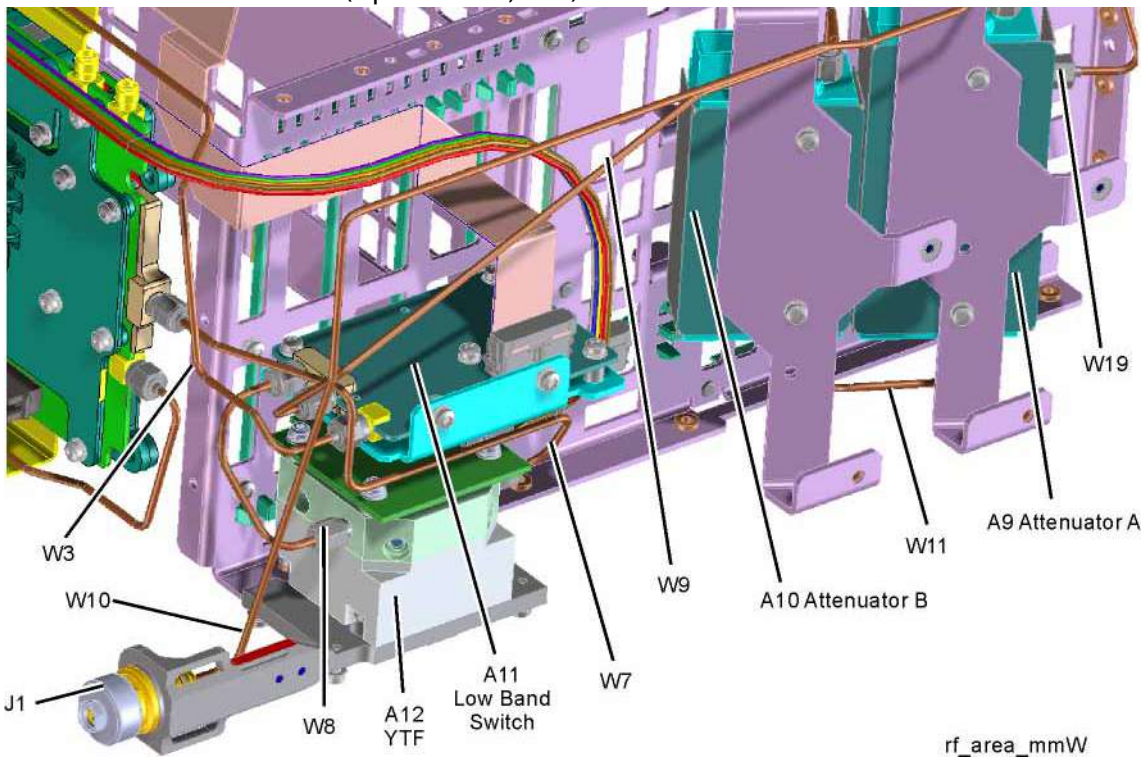
The Low Band signal path (sometimes referred to as Band 0) is used for all signals less than 3.6 GHz when the analyzer is used in normal operation. If the stop frequency is set to 3.6 GHz, the analyzer displays only the Low Band signal path. If the analyzer stop frequency is set above 3.6 GHz and the start frequency is set below 3.6 GHz, the analyzer will sweep up to 3.6 GHz in low band and then automatically switch to the high band path above 3.6 GHz.

A11 Low Band Switch Verification

Disconnect W3 from A13J2. See Figure 5-3 for location of connector. Attach a right angle SMA adapter to W3 and measure the output of the Low Band Switch with a spectrum analyzer. Expected signal is 50 MHz at –35.3 dBm since the Low Band Switch has a few tenths of a dB loss.

If the signal level is incorrect, remove A10 Input Attenuator B output cable and measure the output power. Expected signal is 50 MHz at –35 dBm. If the attenuator output signal is correct but the Low Band output at W3 is incorrect, suspect the A11 Low Band Switch, the interconnect cables, or the control signals. The control signals are explained in Chapter 6, “Front End Control Troubleshooting”, on page 231.

Figure 5-3 RF Section (Options 532, 544)



A9 Input Attenuator and A10 Input Attenuator Verification

Calibrator Switch Test

On the A16 Reference assembly, disconnect semi-rigid cable W3 from A16J701 and measure A16J701 with a spectrum analyzer. Expected signal is 50 MHz at –25 dBm ± 0.5 dB (RF calibrator set to 50 MHz). If signal level is incorrect, suspect A16 Reference assembly is faulty, or the 50 MHz calibrator amplitude requires adjustment using the field calibration software.

To verify calibrator switch operation, connect external signal source set to 50 MHz and –25 dBm to the RF input connector of analyzer under test. Press **Input/Output**, **RF Calibrator**, **Off**. If the signal level at the attenuator output is now correct, suspect the A9 Attenuator cal switch or a faulty control signal from the A15 Front End Controller assembly.

Attenuator Check

Set the signal source connected to the analyzer input port to 0 dBm. On the analyzer, press **Amplitude**, **Attenuation**, and change input attenuation to 0 dB. The measuring spectrum analyzer connected to A10 Attenuator output port should indicate a 0 dBm level.

Change the input attenuation on the analyzer under test to 2 dB (if Option FSA is present) or to 10 dB (if Option FSA is not present). See the chart below for expected measurement values at the A10 Attenuator output port.

Analyzer Under Test Attenuator Setting (dB)	Power at A10 Output Port (dBm)	Input Attenuator Being Tested (Options 532, 544)
0	0 dBm (reference)	Both set to through path
2	–2	A9
4	–4	A9
6	–6	A9
8	–8	A9
10	–10	A10
20	–20	A10
30	–30	A10
40	–40	A10
50	–50	A10
60	–60	A10
70	–70	A9 set to 10 dB A10 set to 60 dB

Second LO Level Verification

The second LO signal comes from the A16 Reference Assembly and is only used in Low Band. The second LO signal can be measured on the Front End Assembly at A13J1 or the A16 Reference Assembly at A16J702. Expected signal is 4800 MHz at +10 dBm when a low loss test cable is used and with the measuring spectrum analyzer input attenuator set to at least 20 dB to prevent overload.

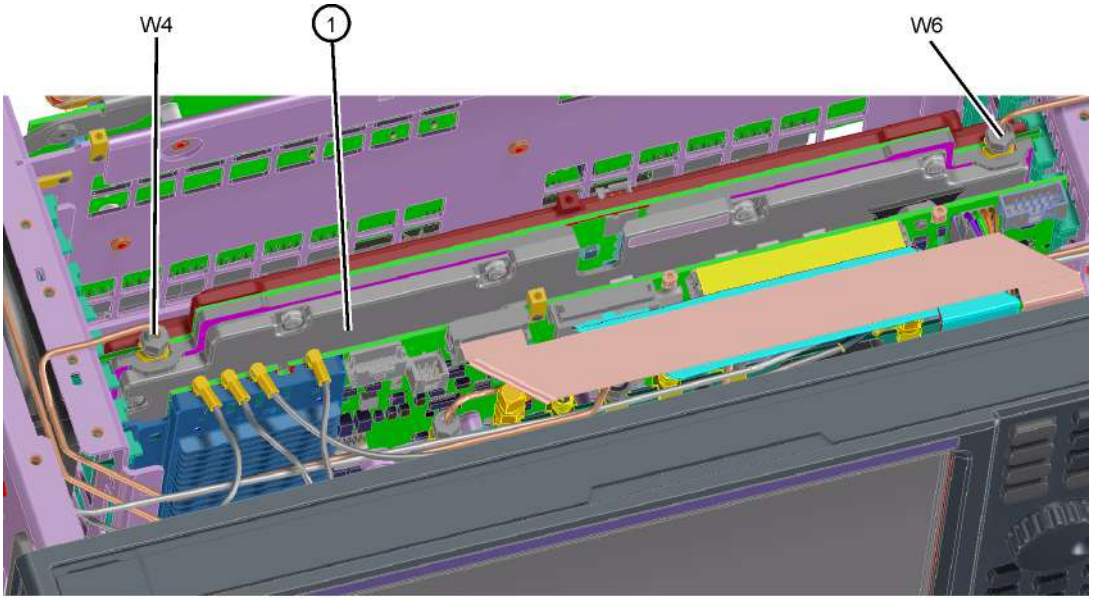
L.O. Synthesizer Assembly Verification

Press the following keys on the analyzer:

FREQ, 1 GHz
Span
Zero Span

Refer to Figure 5-4. Disconnect cable W4 at A14J740 of the L.O. Synthesizer Assembly **(1)**.

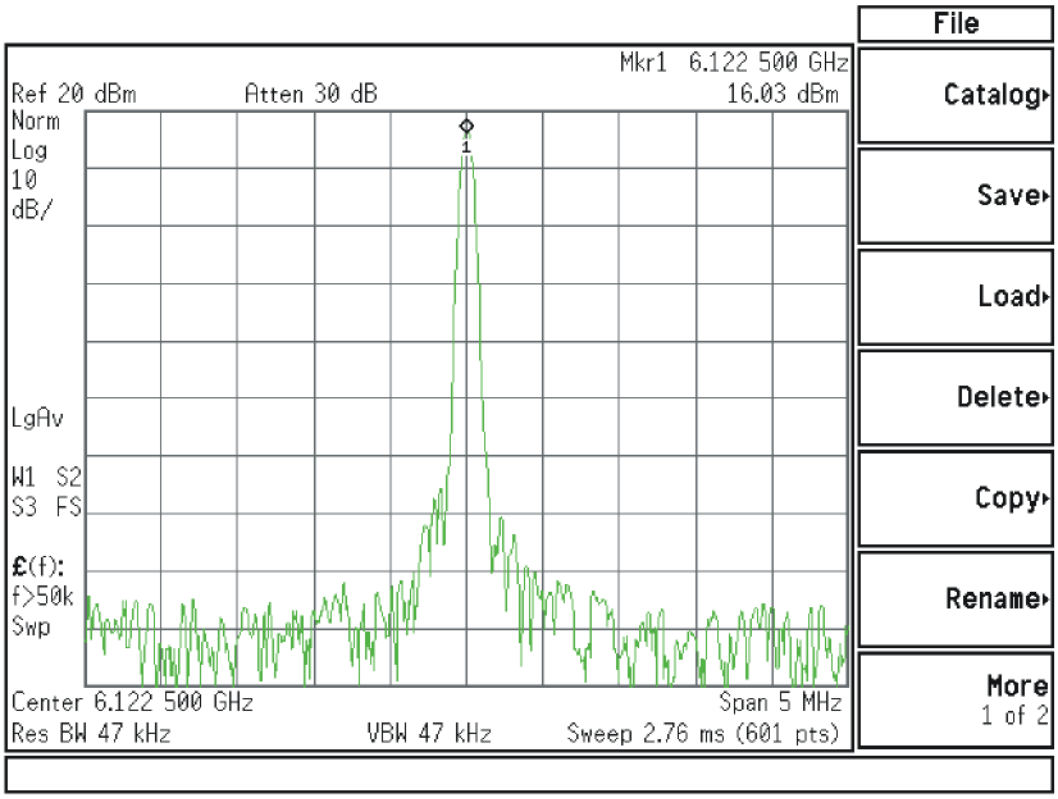
Figure 5-4 W4 and W6 Location



lo_synth

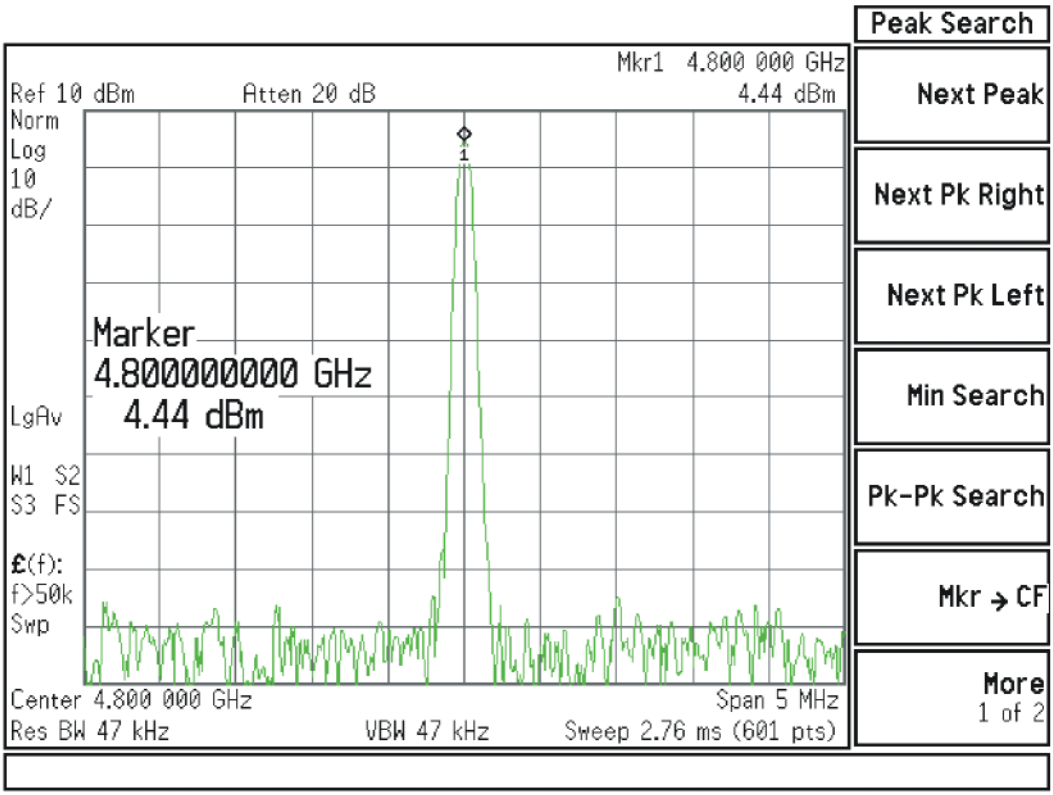
Connect the functioning Spectrum Analyzer and appropriate high frequency cable and connector to A14J740. Adjust the functioning Spectrum Analyzer to measure a signal at 6122.5 MHz at +16 dBm ± 4 dB as seen in Figure 5-5.

Figure 5-5 Measure 1st L.O.



If this power level is incorrect remove W6 at A14J200. Refer to Figure 5-4. Adjust the functioning spectrum analyzer to measure a signal at 4.800 GHz at +4.5 dBm ± 2 dB. See Figure 5-6.

Figure 5-6 4.800 GHz Signal at A14J200



If this power level is incorrect, the most probable cause is the A16 Reference Assembly. If this level is correct and yet the signal previously measured at A14J740 is incorrect, the most probable cause is the A14 L.O. Synthesizer Assembly. Reconnect W4 cable to A14J740. Reconnect W6 cable to A14J200.

A13 Front End Assembly Verification

NOTE The A13 Front End assembly is shown as A13 and A13A1 for troubleshooting clarification. However, A13A1 is not separately replaceable. The entire A13 assembly must be replaced which includes A13A1.

Many portions of the Front End Assembly have been verified earlier in the Low Band troubleshooting process outlined above.

The input signal level was measured on W3 as part of the A11 Low Band Switch verification.

The output signal level was measured at A13J7 during the quick check to verify the Low Band Signal Path.

The Second LO input was tested during the Second LO Verification.

The LO input at W4, and the LO outputs were tested when performing the First LO Verification.

It is possible to measure the A13W1 input cable to A13A1 where it connects to A13A1J2, and the output of the A13A1 at A13W2 where it connects to A13J11. A13A1 IF Band Pass Filter is not separately replaceable, but being able to determine where the signal level is faulty, can aid in verifying the faulty assembly. See the block diagram for signal levels.

Electronic Attenuator Test (Option EA3)

The electronic attenuator is aligned as part of the System Gain internal alignment process. See the description of the initial alignments and the location of the alignment history file in the Boot Up and Initialization Troubleshooting chapter. Viewing the Alignment History file will tell you if other alignment tests failed, and reveal which electronic attenuator steps failed.

To verify the electronic attenuator operation on instruments with Option EA3, set up the analyzer to view the 50 MHz calibrator signal on screen. Press **Input/Output**, **RF Calibrator**, **50 MHz**, **FREQ**, **Center Frequency**, **50 MHz**, **Span**, **500 kHz**

Press **Peak Search** to place a marker on the calibrator signal, then press **Marker Delta**

Activate the electronic attenuator. Press **AMPTD**, **Attenuation**, **Elec Atten**, **Enabled**.

Press the up arrow key to step through all attenuator steps while monitoring the marker delta readout. The signal level should not change more than 0.4 dB as indicated by the marker delta readout.

If the attenuator switches slowly, or the signal is not present when the electronic attenuator is switched into the signal path or the signal appears only when the attenuator is switched on, suspect the control signals from the A15 Front End Controller are faulty or the A13 Front End assembly is faulty. If the attenuator switches, but the switching error between attenuator settings is greater than ± 0.4 dB, assure that any other internal alignment failures are resolved since the System Gain alignment must run before optimum performance is possible. Assure you have evaluated all causes before you replace the Front End assembly.

If you determine the problem is at a frequency other than 50 MHz, perform the low band flatness adjustment before replacing the Front End assembly.

Low Band Preamp (Option P03, P08, P13, P26, P32, P44, P50)

The Preamp is aligned as part of the System Gain internal alignment process. See the description of the initial alignments and the location of the alignment history file in Chapter 2, “Boot Up and Initialization Troubleshooting”, on page 47. Viewing the Alignment History file will tell you if other alignment tests failed, and reveal pass or fail information for the preamp.

If any of the preamp options are installed, the Low Band preamp can be verified as follows:

Set up the analyzer to view the 50 MHz calibrator signal on screen

Press **AMPTD**, **Attenuation**, and verify that the Enable Elec Atten key is set to Disabled. It is not possible to turn on both the electronic attenuator and preamp at the same time.

Press **AMPTD**, **Signal Path**, **Internal Preamp**, **Low Band (On)** to activate the preamp.

The expected operation is the signal level will not change more than ± 0.5 dB and the noise floor will increase due to the fact the input attenuator is automatically increased. If the amplitude error when switching the preamp on and off is greater than 0.5 dB, assure that any other internal alignment failures are resolved since the System Gain alignment must run before optimum performance is possible. Assure you have evaluated all causes including A15 Front End Controller switching problems, before you replace the Front End assembly.

If you determine the problem is at a frequency other than 50 MHz, perform the low band flatness adjustment before replacing the Front End assembly.

Low Band Mixing Equations

Low Band first mixer:

RF = LO – IF
IF = LO – RF
LO = IF + RF
where RF is the input signal at the signal analyzer

Low Band second mixer:

RF = LO + IF
IF = RF – LO
LO = RF – IF
where RF in this case is the first IF signal (signal at A13J11)

Quick Check to Verify High Band RF Path

Refer to the RF Highband Path #1 Block Diagram (Options 532, 544, 550) in Chapter 12.

The High Band signal path (sometimes referred to as Band 1-Band 6) is used for all signals 3.6 GHz and above. If the start frequency is set to 3.6 GHz and above, the analyzer displays only the High Band signal path. If the analyzer start frequency is below 3.6 GHz and the Stop frequency is set above 3.6 GHz, the analyzer will start sweeping in Low Band up to 3.6 GHz, and then automatically switch to the high band path above 3.6 GHz.

Equipment needed:

Spectrum Analyzer with frequency range to 14 GHz

Signal source with output power 0 dBm and frequency range to at least the maximum frequency of the MXA

Power splitter, 11667C

2 each, quality 2.4 mm cables

90° SMA (m) to SMA (f) adapter

MMCX (f) to SMA (f) cable

SMA (f) to SMA (f) adapter

SMA (m) to SMA (m) adapter

3.5 mm (f) to 2.4 mm (m) adapters (2 required)

3.5 mm (m) to 2.4 mm (f) adapter

NOTE To perform the following checks, it will be necessary to remove the outer cover and the top brace. See Chapter 15 for removal procedures.

Turn the instrument on and allow it to complete its full boot up process to Signal Analyzer mode. Use the internal 4.8 GHz, –28 dBm calibrator signal as a reference for troubleshooting by pressing **Mode Preset**, **Input/Output**, **RF Calibrator**, **4.8 GHz** on the analyzer. Now press **FREQ**, **Center Frequency**, **4.8 GHz**, **Span**, **1 MHz**, **Peak Search)**.

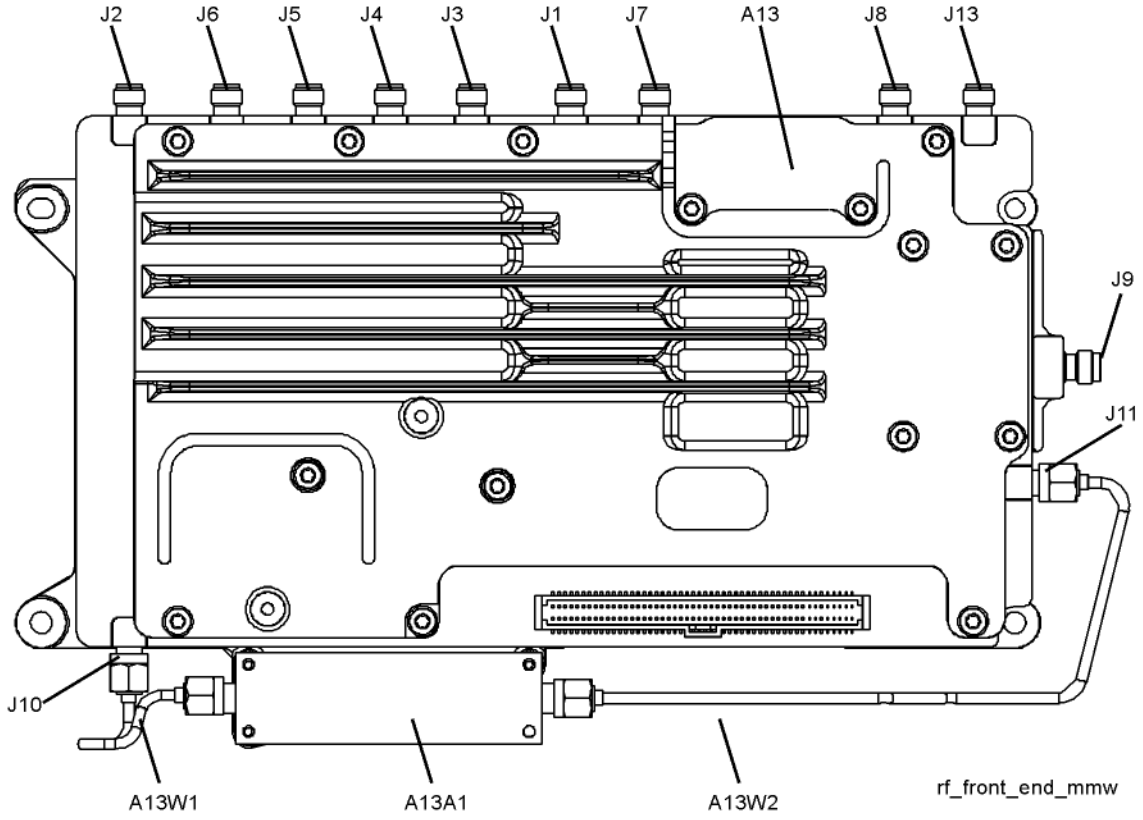
The 4.8 GHz reference signal should measure –28 dBm ± 2 dB on the analyzer display. If the power level is within tolerance, the 3.6 GHz to 17.1 GHz path is functioning correctly at 4.8 GHz.

If the power level is incorrect, select the 50 MHz RF calibrator and set the analyzer center frequency to 50 MHz. Since several of the same signal path components are shared between high band and low band, determining if the problem appears in both paths is helpful.

IMPORTANT Turn off auto align by pressing **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**.

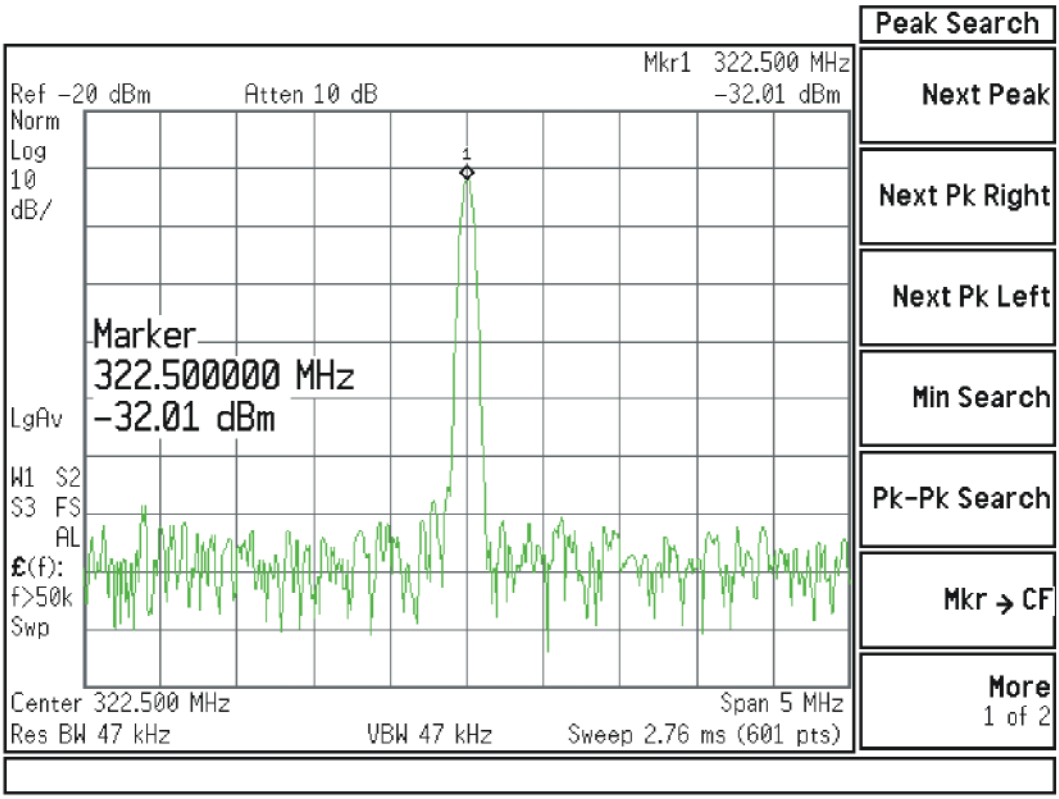
Disconnect cable W36 at A13J7, 322.5 MHz output on the Front End Assembly. See Figure 5-7. Select Span, 0 Hz.

Figure 5-7 A13A1J7 Location (Options 532, 544)



Connect A13J7 output to a functioning spectrum analyzer and verify the 322.5 MHz intermediate frequency is measuring –32 ± 4 dB as shown in Figure 5-8.

Figure 5-8 322.5 MHz Intermediate Frequency



If this power level is correct the Front End assembly is operating correctly in high band. If this power level is incorrect verify the following assemblies using the 4.8 GHz internal calibrator signal.

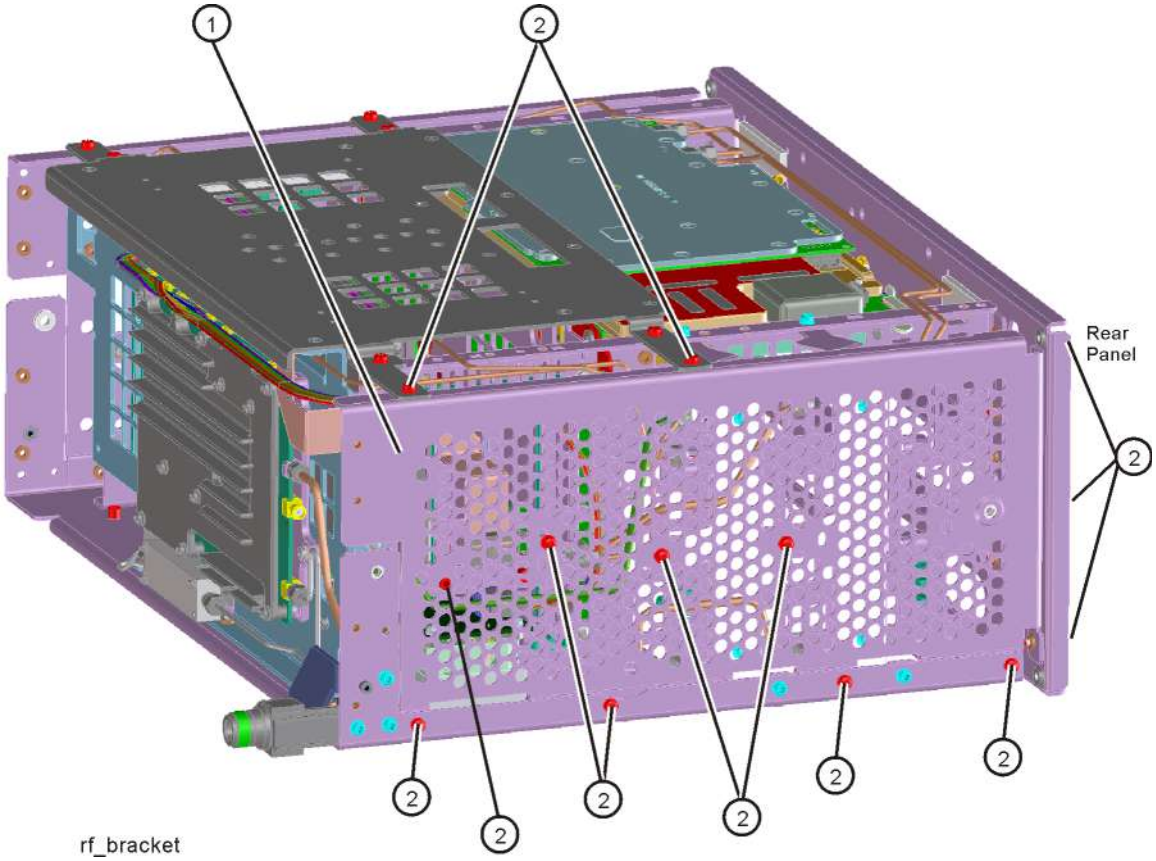
1. A11 Low Band Switch
2. A10 Input Attenuator B
3. A9 Input Attenuator A
4. A16 Reference Assembly (4.8 GHz calibrator)
5. A12 YTF Preselector
6. A13 Front End Assembly

NOTE

High Band #2 signal path utilizes a high band mixer internal to the A13 Front End Assembly for input frequencies from 17.0 GHz to 34.5 GHz. High Band #3 signal path utilizes a high band mixer internal to the A13 Front End Assembly for input frequencies from 34.4 to 50 GHz. Failures from 3.6 GHz to 50 GHz will most likely be caused by the A13 RF Front End Assembly. If the failure is amplitude related, proper adjustments such as frequency response and the YTF Preselector adjust should be performed first before changing the A13 RF Front End Assembly.

In order to gain access to the front end components, remove the side chassis **(1)** by removing the 16 screws **(2)**. See Figure 5-9.

Figure 5-9 Remove the Side Chassis



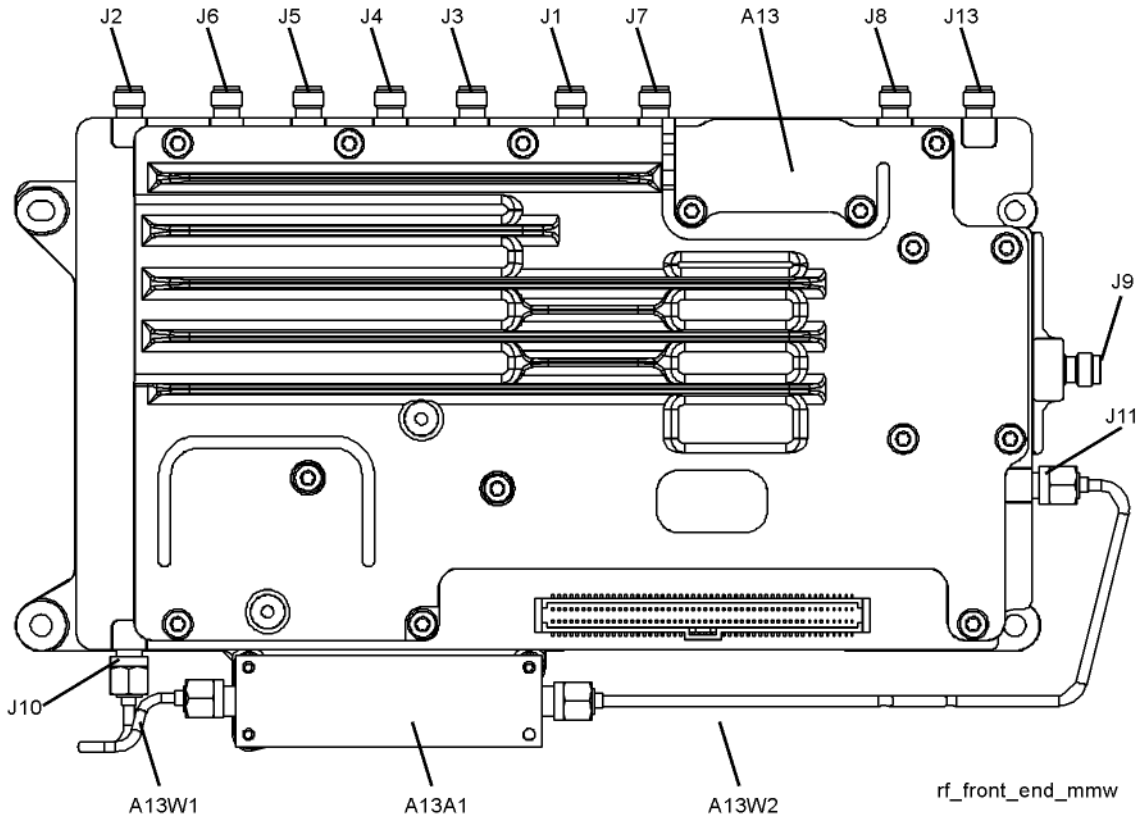
Troubleshooting a High Band Problem

Refer to the RF Highband Path #1 Block Diagram (Option 532, 544, 550) in Chapter 12 and follow the instructions in the settings box. To enable the internal 4.8 GHz, –28 dBm calibrator signal press **Input/Output**, **RF Calibrator**, **4.8 GHz**.

A13 Front End Input Verification

Disconnect W46 (if Option MPB is installed) or W7 (if Option MPB is not installed) from A13J9 See Figure 5-10 for location of connector. Loosen the other end of W46 or W7 if possible to avoid damaging the cable. Attach a right angle SMA adapter to W46 or W7 and measure the input to the A13 Front End with a spectrum analyzer.

Figure 5-10 A13J9 Location



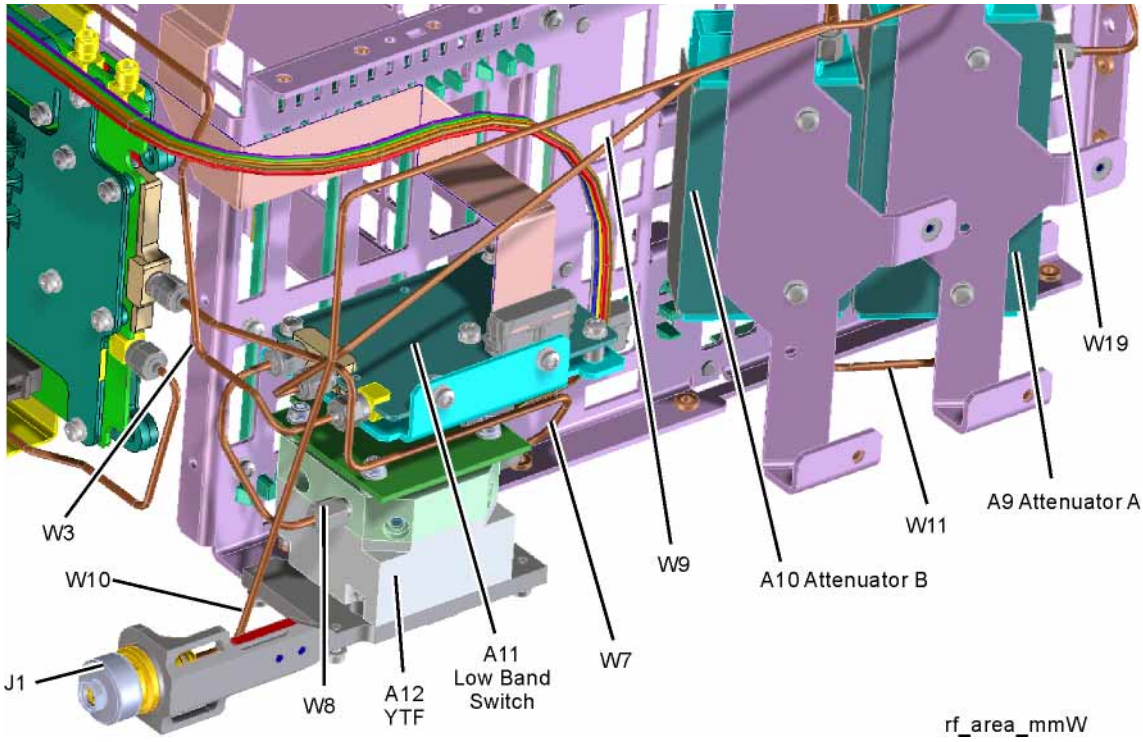
Expected signal is 4.8 GHz at –51 dBm ± 4 dB. The tolerance is large because the A12 YTF (microwave preselector) loss varies between devices, and the YTF may not be perfectly aligned, or the frequency response adjustment may be required.

If the signal level is incorrect, and Option MPB (Microwave Preselector Bypass) is installed, press **Amplitude**, **Signal Path**, **uWPath Control**, **uW Presel Bypass**. If the signal level is now –52 dBm, suspect the A12 YTF is out of adjustment or faulty.

To perform the YTF alignment, reconnect W46 or W7 cable, and press **System, Alignments, Advanced, Characterize Preselector**. The routine may take several minutes to align the YTF. Display the 4.8 GHz calibrator signal on screen as explained in the quick check section. If the signal level is still incorrect, suspect all assemblies, cables, switches and the A15 Reference calibrator signal between the W46/W7 cable and the input to the A9 Attenuator.

If Option MPB is not present, remove A10 Input Attenuator B output cable and measure the output power. Expected signal is 4.8 GHz –38 dBm. See Figure 5-11 for location of attenuator. If the attenuator output signal is correct suspect the A11 Low Band Switch, and if Option MPB is installed, suspect switch 4. Also suspect the switching signals from the A15 Front End controller. The control signals are explained in the Front End Control Troubleshooting section.

Figure 5-11 RF Section



A9 Input Attenuator A and A10 Input Attenuator B Verification

Calibrator Switch Test

On the A16 Reference assembly, disconnect semi-rigid cable W19 from A16J701 and measure A16J701 with a spectrum analyzer. Expected signal is 4.8 GHz at –28 dBm ± 0.5 dB. If signal level is incorrect, suspect A16 Reference Assembly.

To verify calibrator switch operation, connect external signal source set to 4.8 GHz and –25 dBm to the RF input connector of analyzer under test. Press **Input/Output**, **RF Calibrator**, **Off**. If the signal level at the attenuator output is now correct, suspect the A9 Attenuator cal switch or a faulty control signal from the A15 Front End Controller assembly.

Attenuation Check

Set the signal source connected to the analyzer input port to 0 dBm. On the analyzer, press **Amplitude**, **Attenuation**, **Mech Atten** and change input attenuation to 0 dB. The measuring spectrum analyzer connected to A10 Attenuator output port should indicate a 0 dBm level. Change the input attenuation on the analyzer under test to 2 dB.

See the chart below for expected measurement values at the A10 Attenuator output port.

Analyzer Under Test Attenuator Setting (dB)	Power at A10 Output Port (dBm)	Input Attenuator Being Tested
0	0 dBm (reference)	Both set to through path
2	–2	A9
4	–4	A9
6	–6	A9
8	–8	A9
10	–10	A10
20	–20	A10
30	–30	A10
40	–40	A10
50	–50	A10
60	–60	A10
70	–70	A9 set to 10 dB A10 set to 60 dB

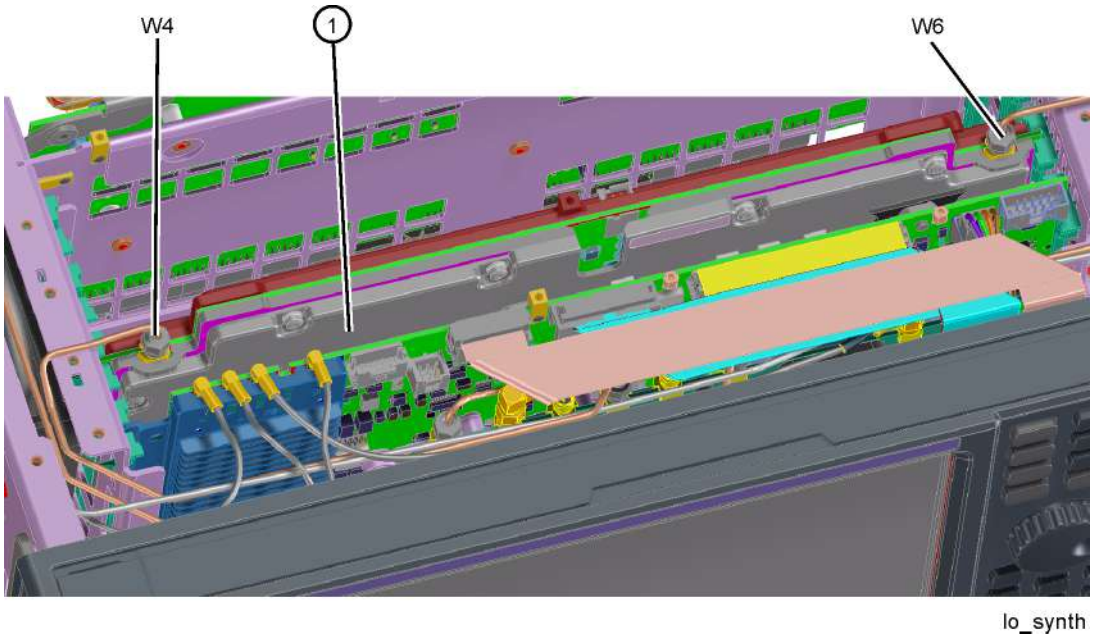
L.O. Synthesizer Assembly Verification

Press the following keys on the analyzer:

Mode Preset
FREQ, 5 GHz
Center Frequency
Span, Zero Span

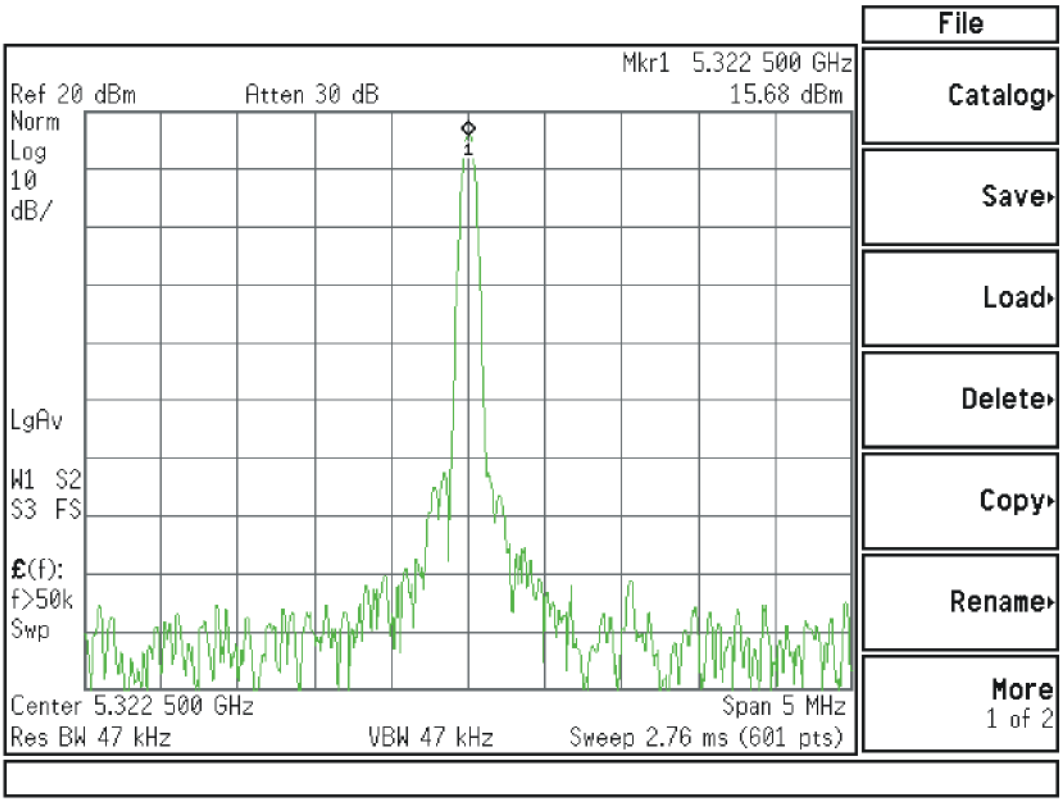
Refer to Figure 5-12. Disconnect cable W4 at A14J740 of the L.O. Synthesizer Assembly **(1)**.

Figure 5-12 W4 and W6 Location



Connect the functioning Spectrum Analyzer and appropriate high frequency cable and connector to A14J740. Adjust the analyzer to measure a signal at 5322.5 MHz at +16 dBm ± 4 dB as shown in Figure 5-13.

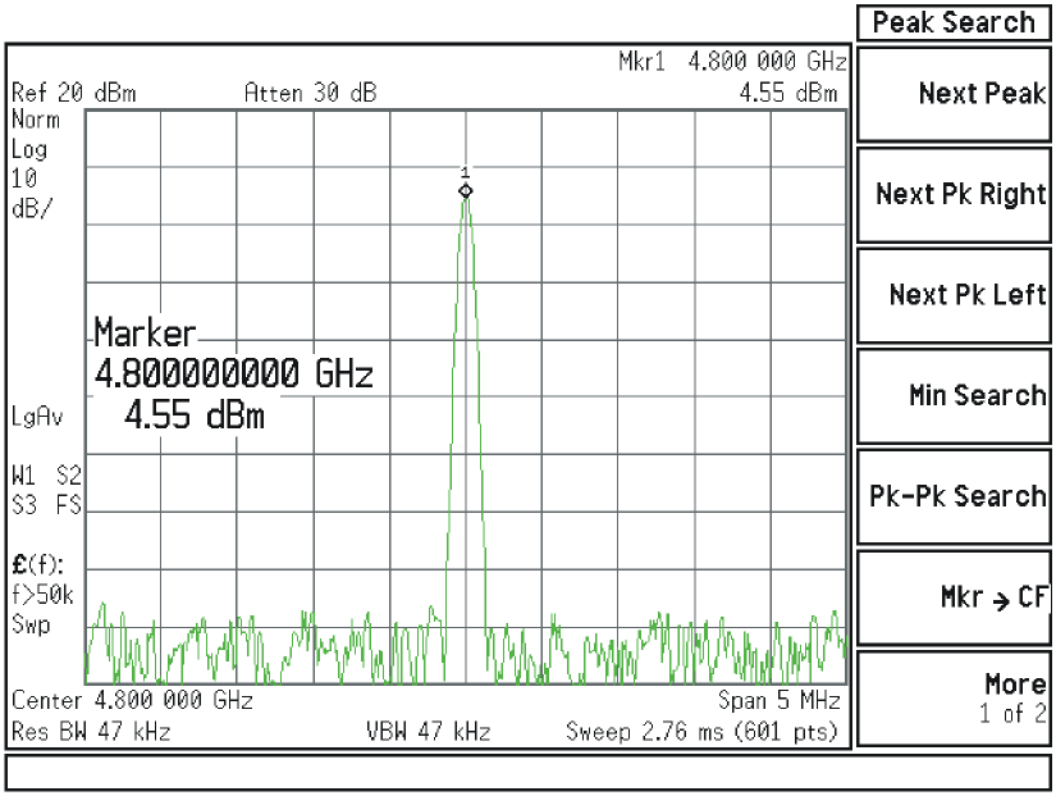
Figure 5-13 Measure 1st L.O.



If this power level is incorrect remove W6 at A14J200. Refer to Figure 5-12. Connect the functioning spectrum analyzer to the cable output using the appropriate high-frequency cable.

Adjust the functioning spectrum analyzer to measure a signal at 4.8 GHz at +4.5 dBm ± 2 dB as shown in Figure 5-14.

Figure 5-14 4.8 GHz Signal



If this power level is incorrect, the most probable cause is the A16 Reference Assembly. If this level is correct and yet the signal previously measured at A14J740 is incorrect, the most probable cause is the A14 L.O. Synthesizer Assembly. Reconnect W4 cable to A14J740. Reconnect W6 cable to A14J200.

A13 Front End Assembly Verification

NOTE The A13 Front End assembly is shown as A13 and A13A1 for troubleshooting clarification. However, A13A1 is not separately replaceable. The entire A13 assembly must be replaced which includes A13A1.

Many portions of the Front End Assembly have been verified earlier in the High Band troubleshooting process outlined above.

The input signal level was measured on W46 or W7 as part of the A13 Front End Input Verification.

The output signal level was measured at A13J7 during the quick check to verify the High Band signal path.

The LO input at A13J4, and the LO outputs were tested when performing the First LO Verification.

High Band Preamp (Option P08, P13, P26, P32, P44, P50)

If a preamp option listed above is installed, the High Band preamp can be verified as follows:

View the 4.8 GHz calibrator signal on screen. Press **AMPTD**, **Signal Path**, **Internal Preamp**, **Full Range**, **On** to activate the preamp.The expected operation is the signal level will not change more than +/- 0.5 dB and the noise floor will increase due to the fact the input attenuation was automatically increased.

If the amplitude error when switching the preamp on and off is greater than 0.5 dB, assure that any other internal alignment failures are resolved since the System Gain alignment must run before optimum performance is possible. The amplitude error could be caused by poor frequency response, and performing the high band frequency response adjustment (using the calibration software) will adjust the preamp on, high band path. Assure you have evaluated all causes including A15 Front End Controller switching problems, before you replace the Front End assembly.

High Band Mixing Equations

For input signal frequencies from 3.6 GHz to 8.4 GHz:

RF = LO x N – IF
IF = LO x N – RF
LO x N = IF + RF
where RF is the input signal at the signal analyzer
where N is the harmonic mixing mode:
N = 1 for 3.5 GHz to 8.4 GHz

For input signal frequencies above 8.4 GHz to 50 GHz:

RF = LO x 2 x N – IF
IF = LO x 2 x N – RF
LO x 2 x N = RF + IF
where RF is the input signal at the signal analyzer
where N is the harmonic mixing mode:
N = 1 for 8.4 GHz to 17.1 GHz
N = 2 for 17.1 GHz to 34.0 GHz
N = 4 for 34.0 GHz to 50 GHz

Microwave Preselector Bypass (Option MPB)

Allows the YTF to be bypassed improving amplitude accuracy.

Assure start frequency is 3.6 GHz or greater. Press **AMPTD**, **Signal Path**, **uW Path Control**, **uW Presel Bypass**. When the bypass switch, Switch 4, changes state you will hear a click. Depending on the signal source connected, you may

see many “signals” appear on screen because without preselection, the analyzer will display images and multiples. The real input signal should not change amplitude when you switch the uW Preselector Bypass on and off.

6 Front End Control Troubleshooting

What You Will Find in This Chapter

The following information is found in this chapter:

A15 Front End Control Description on page 232

A15 Front End Control Assembly Troubleshooting on page 238

A15 Front End Control Description

Purpose

The A15 Front End Controller board functionality can be broken down into (3) main categories

1. **Provides switch control logic and bias voltages to the major RF front end assemblies in the analyzer.**
2. **Contains on board circuitry providing various signal outputs to other locations within the analyzer.**
3. **Provides control logic for various instrument options within the analyzer.**

These signals are routed to and from the A15 via ribbon cables, wiring harnesses and coaxial cables. The RF front end assemblies require the correct control logic and bias in order to function properly. If the voltages from the A15 are not correct, the RF input signals will most likely be displayed at an incorrect power level if they even get displayed at all.

Depending upon the options installed, one of two different A15 Front End Control board assemblies may be installed. The standard A15 Front End Control assembly (“EFEC-Lite”) can only control the high band preamplifier options (P08, P13, P26) and the electronic attenuator option (EA3). The A15 Enhanced Front End Control assembly (“EFEC”) can also control the millimeter wave high band preamplifier options (P32, P44, and P50), IF Out options (CR3 and CRP), the microwave preselector bypass option (MPB), and provide the IF signal for the ≥ 40 MHz analysis bandwidth options (B40, B85, B1A, B1X). The A15 Enhanced Front End Control assembly is standard on MXA’s with either Option 532, 544, or 550.

Standard RF Assemblies Controlled by the A15:

- A9 Input Attenuator A (4 dB total for options 503, 508, 513, and 526, 10 dB total for Options 532, 544, and 550)
- A10 Input Attenuator B (66 dB total for options 503, 508, 513, and 526, 60 dB total for Options 532, 544, and 550)
- A11 Low Band Switch
- A12 YIG Tuned Filter
- A13 RF Front End Assembly

A15 On Board Circuits:

- RF Burst Trigger (When set to Relative Trigger or when center frequency is < 300 MHz.)
- YTF Tune Ramp
- Preselector Tune Out (Provides output voltage, not specified, reserved for future use)
- Mixer Bias
- Amplifier Bias
- Switch Control
- Sweep Ramp (reserved for future use)

Refer to Table 6-1 for details regarding which options are supported by the two choices of A15 assemblies.

Table 6-1 A15 Option Related Control

Option	Description	Physical Location in Analyzer	A15 Support
P03	Preamplifier, 3.6 GHz	A15 to A13	EFEC-Lite or EFEC
P08	Preamplifier, 8.4 GHz	A15 to A11	EFEC-Lite or EFEC
P13	Preamplifier, 13.6 GHz	A15 to A11	EFEC-Lite or EFEC
P26	Preamplifier, 26.5 GHz	A15 to A11	EFEC-Lite or EFEC
P32	Preamplifier, 32 GHz	A15 to A11	EFEC
P44	Preamplifier, 44 GHz	A15 to A11	EFEC
P50	Preamplifier, 50 GHz	A15 to A11	EFEC
CRP	Arbitrary IF Output	A15 to AUX IF OUT (rear panel)	EFEC
CR3	Second IF Output	A15 to AUX IF OUT (rear panel)	EFEC
MPB	Microwave Preselector Bypass	A15 to SW1 and SW2	EFEC
EA3	Electronic Attenuator, 3.6 GHz	A15 to A13	EFEC-Lite or EFEC
B40	40 MHz Analysis Bandwidth	A15 to A3	EFEC
B85, B1A, or B1X	85, 125, or 160 MHz Analysis Bandwidths	A15 to A25	EFEC
DP2	Digital Signal Processing & 2 GB Capture Memory	A15 to A3	EFEC
532	Frequency Range, 32 GHz	A15 to A13	EFEC
544	Frequency Range, 44 GHz	A15 to A13	EFEC
550	Frequency Range, 50 GHz	A15 to A13	EFEC

Figure 6-1 A15 Front View, Physical Connectors (EFEC)

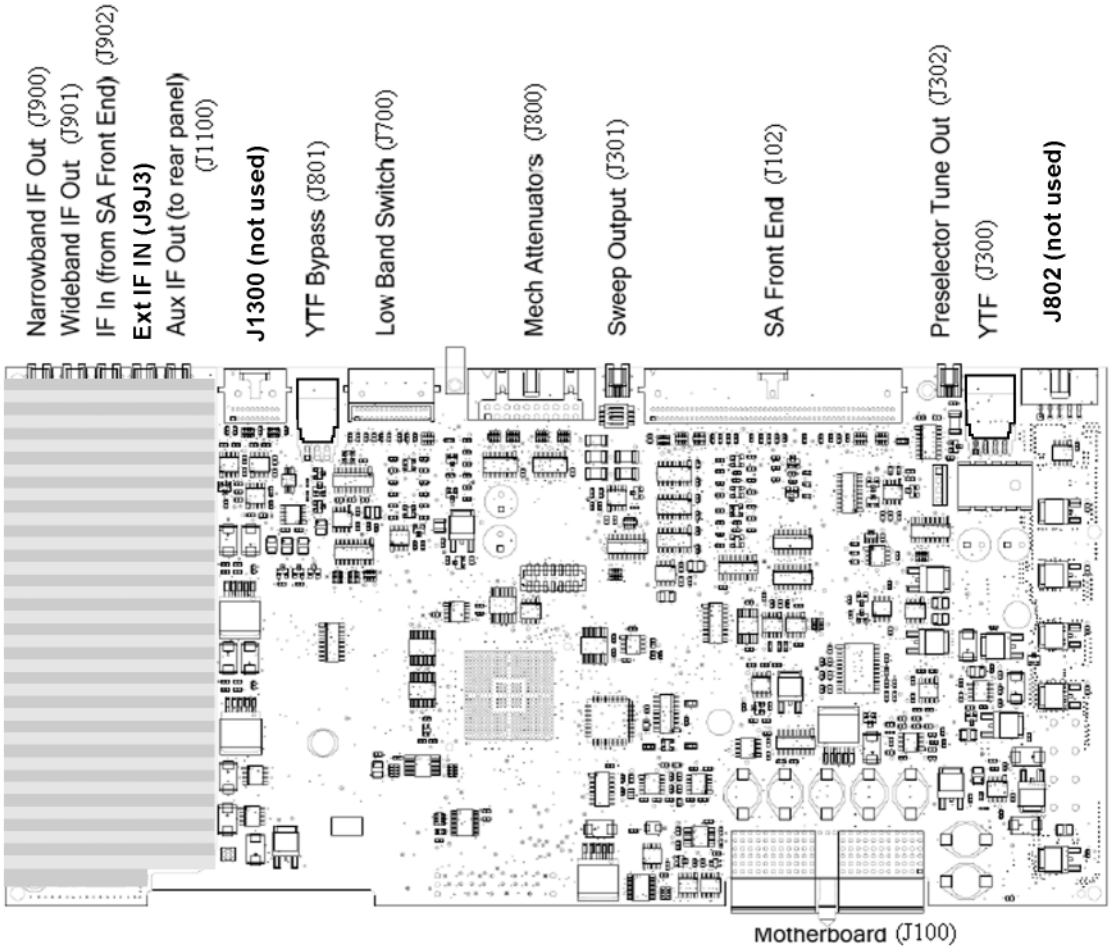
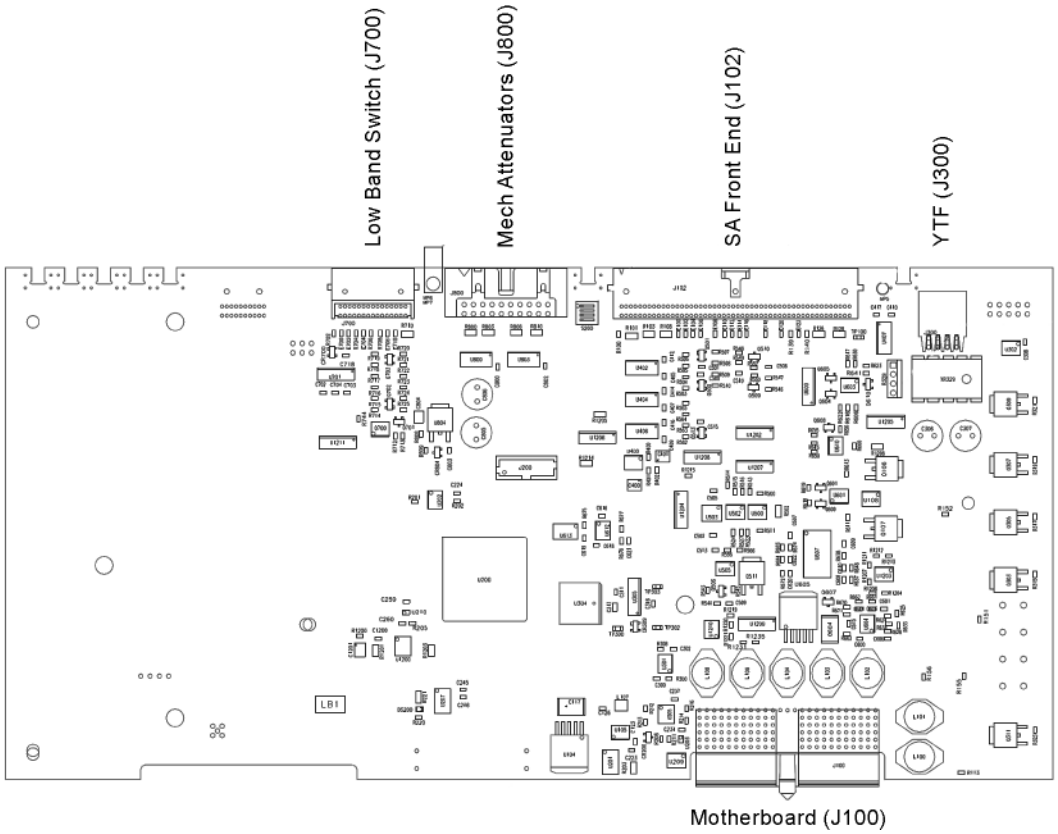


Figure 6-2 A15 Front View, Physical Connectors (EFEC-Lite)



The table below describes the connector location and the final destinations of the RF signal, switch control logic or bias voltage.

Table 6-2 A15 Connectors and Destinations

A15 Connector Designation		Description	Destination
EFEC-Lite	EFEC		
N/A	J900	Narrowband I.F. Out	To A2
N/A	J901	Wideband I.F. Out	To A3
N/A	J902	322.5 MHz I.F. In	From A13
N/A	J903	EXT I.F. In	From A13 to A15 (Option EXM)
N/A	J1100	Aux I.F. Out	To Rear Panel
N/A	J1300	Switched I.F. Filter Out	Reserved for future use
J801	J801	YTF Bypass Out	To SW1 & SW3 (Option MPB with Option 508, 513, or 526) or to SW4 (Option MPB with Option 532, 544, or 550)
J700	J700	Low Band Switch Logic Out	To A11
J800	J800	Mechanical Attenuator Logic Out	To A9 & A10
J301	J301	Sweep Out	Reserved for future use
J102	J102	R.F. Front End Logic Out	To A13
J302	J302	Preselector Tune Out	N/A (test point only)
J300	J300	YTF Bias Control Out	To A12
N/A	J802	Low Noise Bypass Switch Logic Out	Reserved for future use
J100	J100	Motherboard Connector	From A8

A15 Front End Control Assembly Troubleshooting

The N9020A MXA Signal Analyzer utilizes an RF front end troubleshooting board that can be used to verify some, but not all of the control circuitry on the N9020B MXA Signal Analyzer due to the additions of front end assemblies. The troubleshooting board kit part number is N9020-60005 and includes the troubleshooting board and required interconnect cables. If you have the interconnect cables, you can order the board by itself using part number E4410-60115. When using the troubleshooting board and cables on a MXA the control logic for Input Attenuator A, Input Attenuator B, Low Band Switch and some of the power supplies can be verified. The remaining control voltages and RF signals can be measured directly with a voltmeter, oscilloscope or functioning spectrum analyzer.

In order to verify the wide bandwidth I.F.'s and Aux I.F. output frequencies and power levels the following specialty cables and connector will be needed:

MMCX (m) to SMB (f) cable, p/n 8121-0655

MMCX (f) to MMCX (f) barrel. Huber & Suhner 31_mmcx-50-0-1/111_0E

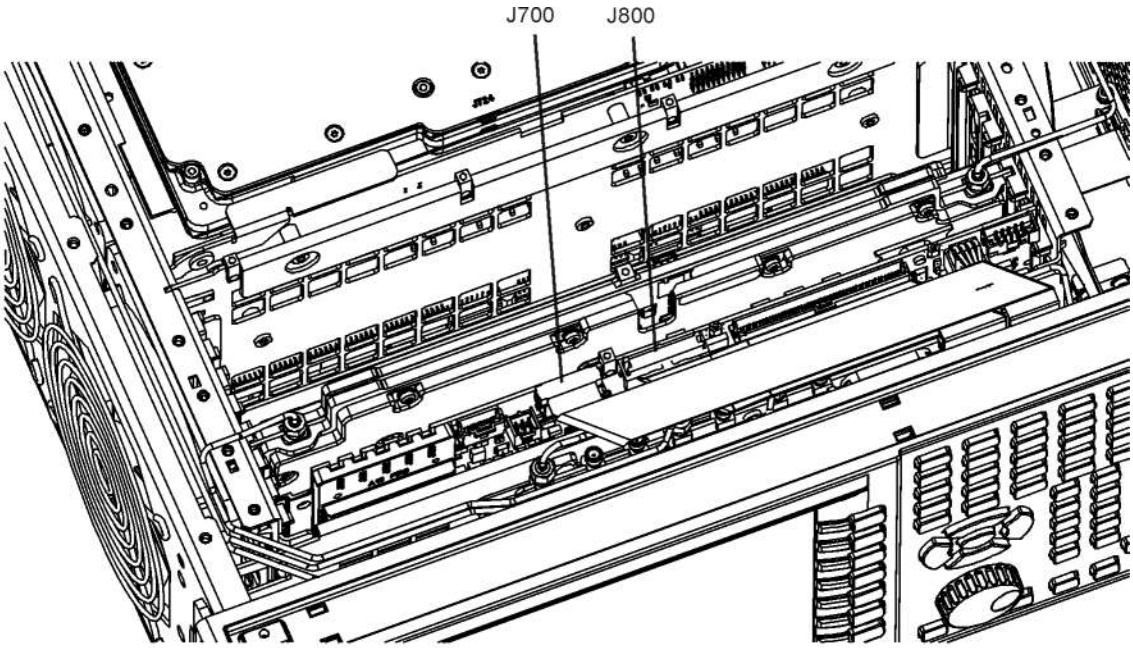
Visit: http://www.hubersuhner.com/de/ie70/hs-index

Other standard cables and connectors need to be used to adapt to the voltmeter or the RF input of the functioning spectrum analyzer.

Verifying Input Attenuator A, Input Attenuator B, Low Band Switch Logic and Power Supplies

1. Turn off the instrument.
2. Disconnect ribbon cables from A15J700 and A15J800 as shown Figure 6-3.

Figure 6-3 Ribbon Cables at A15J700 and A15J800



front_cables_ts

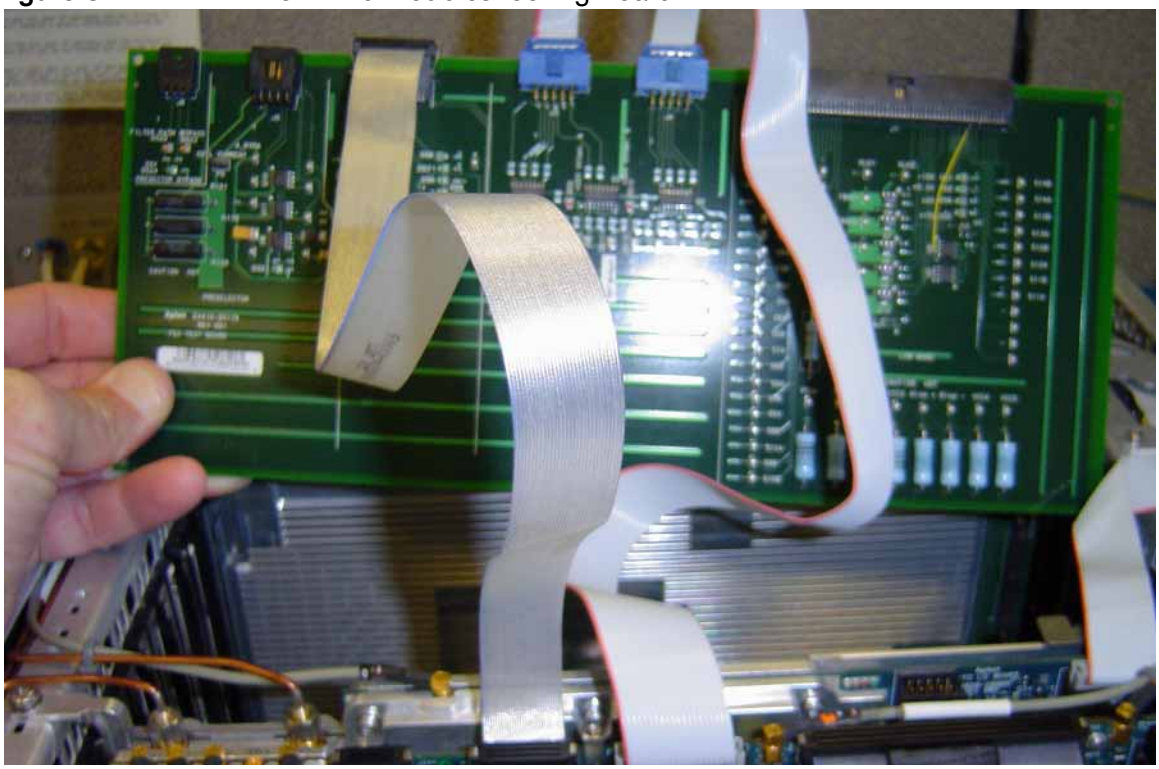
3. Connect the E4410-60115 RF Front End Troubleshooting board to the A15 Front End Control board using the E4410-60157 attenuator control cable. When connecting the attenuator control cable, E4410-60157, note that one end has two 10-pin connectors with one connector extending beyond the other. The shorter connector is marked with a red stripe. Connect the end with the 20-pin connector to A15J800. Connect the two 10-pin connectors to either J3 or J4 of the RF Front End Troubleshooting board based upon the MXA's frequency range as described below:

Table 6-3 MXA Frequency Range

Frequency Range Option	Shorter 10-pin connector (marked with red stripe)	Longer 10-pin connector
503, 508, 513, or 526	J3	J4
532, 544, 550	J4	J3

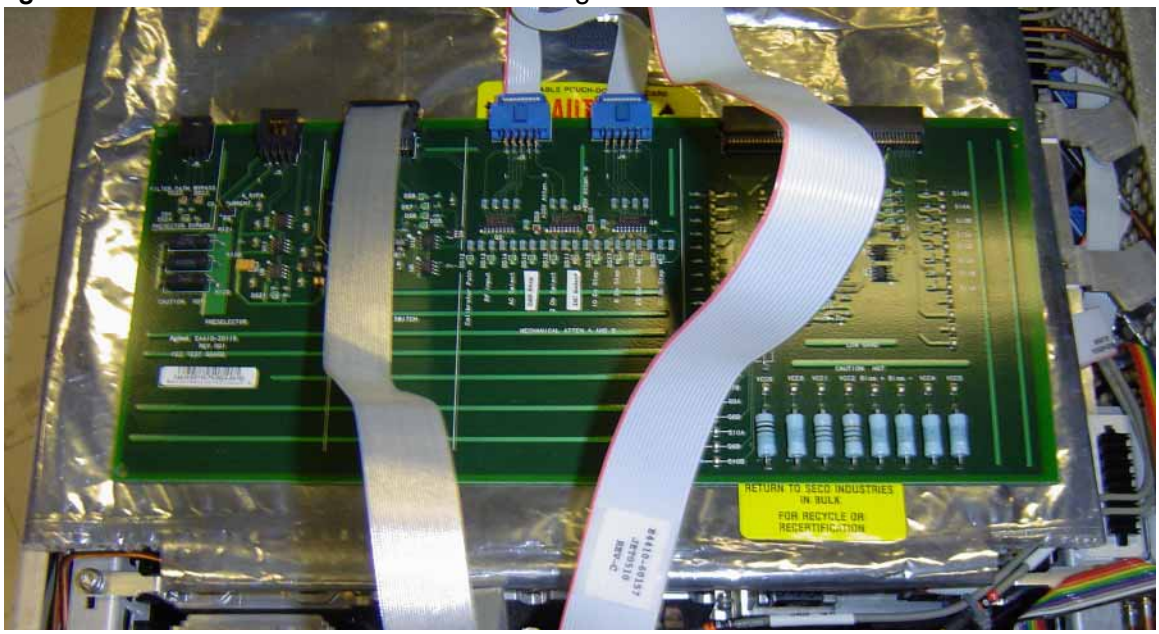
4. If the MXA has frequency range option 503, 508, 513, or 526, also connect the Low Band Switch Control Cable, E4410-60160 between A15J700 and J2 of the RF Front End Troubleshooting board. Do not connect this cable if the frequency range option is 532, 544, or 550.

Figure 6-4 RF Front End Troubleshooting Board



5. Place the RF front end troubleshooting board on an ESD safe bag or foam to ensure nothing shorts out. See Figure 6-5.

Figure 6-5 RF Front End Troubleshooting Board Placement



6. Turn the instrument on and allow it to complete its full boot up process to the Spectrum Analyzer application.

NOTE

You may notice an Align Now, All required message on the analyzer display. This can occur when the test board is connected.

7. Turn Auto Align off by pressing **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off** on the analyzer.

CAUTION

Resistors on the test board can get very hot. Handle with care.

Power Supply Verification

Looking at the test board, verify power supply green LED's DS5, DS6, DS7 and DS8 located under the J2 connector are turned on. Additionally red LED's DS9 and DS10 should also be on. The power supply voltages are listed in the table below.

Table 6-4 Power Supply Voltages

LED	Power Supply
DS5	+15 VDC
DS6	+9.0 VDC
DS7	+5.2 VDC
DS8	-15 VDC
DS9	+25 VDC
DS10	+25 VDC

If any of the power supply LED's are not turned on, see Chapter 2, “Boot Up and Initialization Troubleshooting”.

Input Attenuator A Control Logic Verification (Option 503, 508, 513, 526)

Press **AMPTD**, **Attenuation**, **Mech Atten**, **0 dB** on the analyzer.

Attenuation LED's DS15-20 on the test board should be off.

When the input attenuation is changed from 0 dB to 2 dB, the 2 dB Step LED DS15 should illuminate. When the input attenuation is changed from 2 dB to 4 dB, DS15 and DS16 should be illuminated as per Table 6-5.

Table 6-5 Input Attenuator A LED’s

Attenuator Setting (dB)	DS15	DS16
0	OFF	OFF
2	ON	OFF
4	ON	ON

If this is incorrect, the most probable cause is the A15, Front End Control assembly.

The analyzer default setting for RF Coupling is AC mode. Verify the AC Select LED DS14 is illuminated at this time. Press **Input/Output**, **Select Input**, **RF**, **RF Coupling**, **DC On** on the analyzer. DS14 should turn off and DS11, DC Select LED should illuminate. Switch the RF Coupling back to AC. If the LED's do not illuminate correctly, the most probable cause is the A15 Front End Control Assembly.

Input Attenuator A Control Logic Verification (Option 532, 544, or 550)

NOTE Ignore DS11 in this procedure.

Press **System, Show Hardware**. Look for an entry for the Low Band Switch and verify that the HW ID is 45. If the HW ID is something other than 45 (for example, 10) or there is no entry for the Low Band Switch, the analyzer will control the attenuators as if they are 26.5 GHz attenuators, not the 50 GHz attenuators that are actually installed. If this occurs, skip this procedure and troubleshoot the Low Band Switch.

Press **AMPTD, Attenuation**, **Mech Atten**, **0 dB** on the analyzer.

Attenuation LEDs DS14 through DS20 should be off.

When the input attenuation is changed from 0 to 8 dB in 2 dB steps, LEDs DS14 through DS16 should be illuminated as per Table 6-6.

Table 6-6 Input Attenuator A LED's (Opt 543, 544)

Attenuator Setting (dB)	DS14	DS15	DS16
0	OFF	OFF	OFF
2	OFF	ON	OFF
4	ON	ON	OFF
6	OFF	OFF	ON
8	OFF	ON	ON

If this is incorrect, the most probable cause is the A15 Front End Control Assembly.

Input Attenuator B Control Logic Verification (Option 503, 508, 513, 526)

Press **AMPTD**, **Attenuation**, **Mech Atten**, **6 dB** on the analyzer and verify the 6 dB Step LED DS17 is illuminated. Change to the input attenuation settings found in Table 6-7 and verify the proper LED's illuminate on the Front End Troubleshooting board according to Table 6-7.

Table 6-7 Input Attenuator B LED’s

Attenuator Setting (dB)	DS20 30 dB Step LED	DS19 20 dB Step LED	DS18 10 dB Step LED	DS17 6 dB Step LED
6	OFF	OFF	OFF	ON
10	OFF	OFF	ON	OFF
16	OFF	OFF	ON	ON
20	OFF	ON	OFF	OFF
30	ON	OFF	OFF	OFF
40	ON	OFF	ON	OFF
50	ON	ON	OFF	OFF
60	ON	ON	ON	OFF

If the LED's illuminate correctly, the switch control logic for the input attenuators from the A15 Front End Control Assembly is correct. If the LED's are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

Set the input attenuator back to 10 dB by pressing **AMPTD**, **Attenuation**, **Mech Atten**, **10 dB** on the analyzer.

Input Attenuator B Control Logic Verification (Option 532, 544, or 550)

Press **AMPTD**, **Attenuation**, **Mech Atten**, **10 dB** on the analyzer and verify that the 10 dB Step LED DS18 is illuminated.

Table 6-8 Input Attenuator B LED's (Opt 532, 544, or 550)

Attenuator Setting (dB)	DS17	DS18	DS19
10	OFF	ON	OFF
20	OFF	OFF	ON
30	ON	OFF	OFF
40	ON	ON	OFF
50	ON	OFF	ON
60	ON	ON	ON

If the LEDs illuminate correctly, the switch control logic for the input attenuators from the A15 Front End Control assembly is correct. If the LEDs are not illuminating as expected, the most probable cause is the A15 Front End Control Assembly.

Set the input attenuator back to 10 dB by pressing **AMPTD**, **Attenuation**, **Mech Atten**, **10 dB** on the analyzer.

Low Band Switch Control Logic Verification (Option 508, 513, 526 only)

NOTE

If your MXA has Option 532, 544, or 550 skip to "Disconnect RF Front End Troubleshooting Board" on page 247.

Press **Mode Preset** on the analyzer. Press **FREQ**, **50 MHz**, **Span**, **2 MHz** on the analyzer. Make sure the auto alignments are turned off by pressing **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**. Connect the voltmeter positive lead to test point listed in the table below and the negative lead to the instrument chassis. These test points are located under the J2 connector. Verify the voltages in Table 6-9.

Table 6-9

Test Board Test Point	Voltage (VDC)
In1A	–9.90
In2A	–9.90
In1B	+10.0
In2B	+10.0

Press **FREQ**, **5 GHz** on the analyzer. Verify the voltages in Table 6-10.

Table 6-10

Test Board Test Point	Voltage (VDC)
In1A	+10.0
In2A	–9.90
In1B	–10.0
In2B	+10.0

If the voltages are not correct, the most probable cause is the A15 Front End Control board.

NOTE

The procedure above will not work on analyzers with frequency range options 532, 544, or 550.

Disconnect RF Front End Troubleshooting Board

You do not need the RF front end troubleshooting board to test out the remaining front end hardware components. At this point it is advisable to shutdown the analyzer and disconnect the test board and cables. Be sure to reconnect the MXA Low Band switch ribbon cable and the input attenuator ribbon that were originally plugged into the Front End Control board before testing the input attenuator and low band switch logic.

Preselector Tune Output

The Presel Tune connector A15J302 is a test point used to verify the internal A12, YIG Tuned Filter drive voltage variations with center frequency. The YTF is used in the high band path (3.6 GHz to the analyzer's maximum frequency). Connect Presel Tune to a voltmeter. Use the MMCX (m) to SMB (f) to connect to Presel Tune on the A15 board and appropriate adapters to connect to the voltmeter. Refer to Figure 6-1 or Figure 6-2 or Presel Tune location. You may also need a Banana plug to BNC (f) adapter, part number E9637A for the Voltmeter. The preselector tune output voltage can be measured to verify this portion of the A15 is functioning.

Press **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off** on the analyzer once it has fully booted to the spectrum analyzer application. Press **Freq**, **Span**, **Zero Span** on the analyzer. The preselector tune output voltage in high band should change when the center frequency of the analyzer is changed.

NOTE Preselector tune output measurements are not valid for Option 503, 3 GHz frequency range.

Table 6-11 Preselector Tune Output Voltages

Center Frequency (GHz)	~ Tune Voltage (VDC)	Valid Frequency Range Option
5.0	1.6	508, 513, 526
10.0	3.3	513, 526
15.0	4.85	526
20.0	6.5	526
26.0	8.45	526

Table 6-12 Preselector Tune Output Voltages (Option 532, 544, 550)

Center Frequency (GHz)	~ Tune Voltage (VDC)	Valid Frequency Range Option
5.0	0.9	532, 544, 550
10.0	1.8	532, 544, 550
15.0	2.7	532, 544, 550
20.0	3.6	532, 544, 550
25.0	4.6	532, 544, 550
30.0	5.5	532, 544, 550
40.0	7.3	544, 550

Table 6-12 Preselector Tune Output Voltages (Option 532, 544, 550)

Center Frequency (GHz)	~ Tune Voltage (VDC)	Valid Frequency Range Option
42.5	7.75	544, 550
43.5	8.0	544, 550

Even if the voltages listed in the table are correct it does not guarantee the proper control current is getting to the YTF. There is not a convenient way to measure the control current, so if a high band issue is suspect it is recommended that the A15 is changed out first before changing the YTF since the A15 board has easy access.

Verifying Microwave Preselector Bypass Switch (Option MPB)

If the analyzer has frequency range option 508, 513, or 526, the switches which perform the microwave preselector bypass are SW1 and SW2, which operate in unison. If the frequency range option is 532, 544, or 550 SW4 performs this function.

SW1, SW2, and SW4 can be verified three different ways:

- “Click” Test
- Oscilloscope
- R.F. Signal Tracing

“Click” Test

This test changes between two different path modes. When this is done a distinct “click” noise from SW1 and SW2 or SW4 can be heard. In the case of SW1 and SW2, since both switches switch at the same time, it is difficult to decipher if one is switching and the other is not.

Press **Mode, Preset** on the analyzer. Press **FREQ, 5 GHz, Span, 1 MHz, AMPTD, Signal Path, uW Path Control**. Standard Path is the default. Select uW Presel Bypass and you should hear a distinct “click” noise if the control logic from the A15 Front End Control board is getting to the appropriate switch.

Oscilloscope Test

Measurements can be made to verify the current logic is getting to the appropriate switch from the A15. In order to perform this measurement, the outer cover and chassis RF bracket on the right hand side of the instrument must be removed. Refer to Chapter 15, “Assembly Replacement Procedures” for the removal procedures.

Figure 6-6, Figure 6-7, and Figure 6-8 illustrate the measurement location where the oscilloscope probe should be used to measure the logic. There are two connector bodies with three wires each. On one connector, the three wires are green, black and orange. On the other connector, the three wires are green, black, and yellow. On each connector, black is ground.

On analyzers with Option 508, 513, and 526, both connectors are used; one connects to SW1 and the other to SW2. It does not matter which connector connects to which switch. Both connectors are programmed to behave identically.

However, on analyzers with Option 532, 544, or 550 only the green, black, yellow connector is used to control SW4.

Figure 6-6 SW1 and SW2 Connector Location

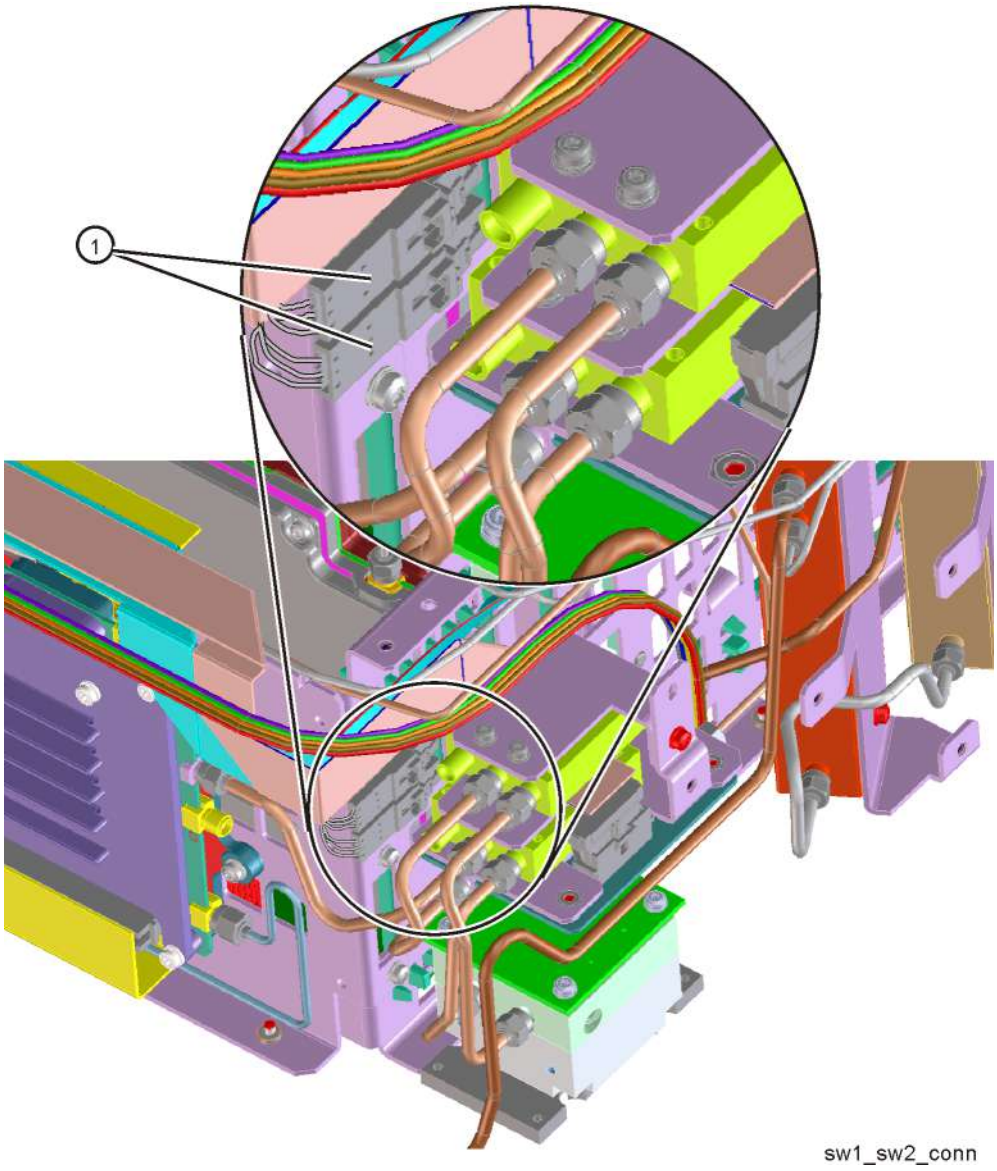


Figure 6-7 SW4 Connector Location (Option 532, 544, and 550)

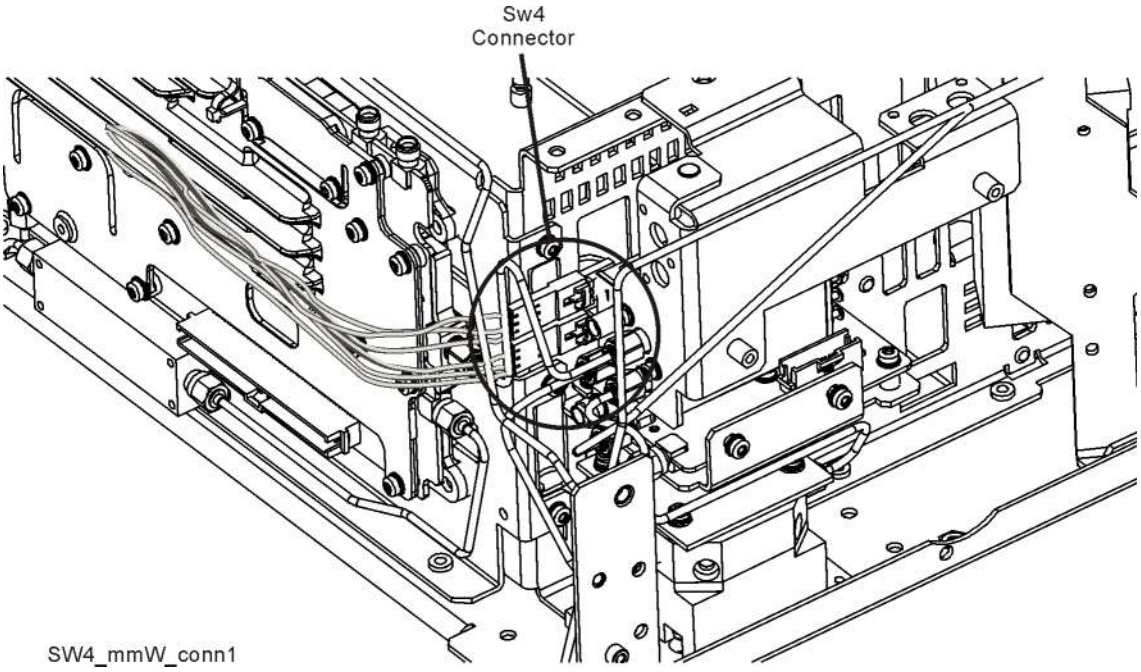
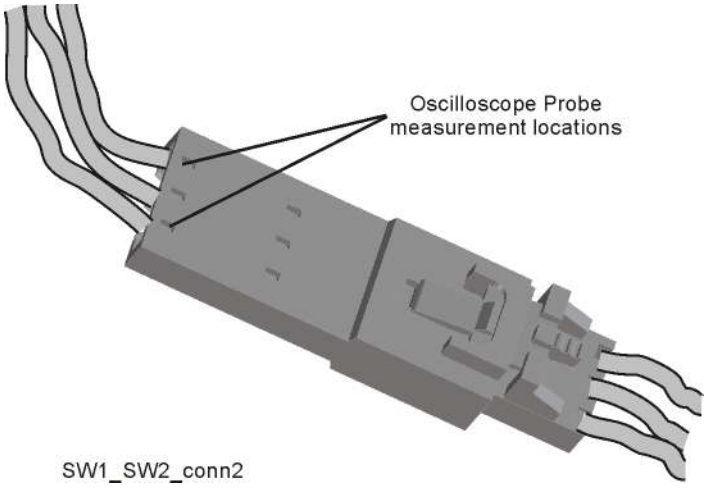
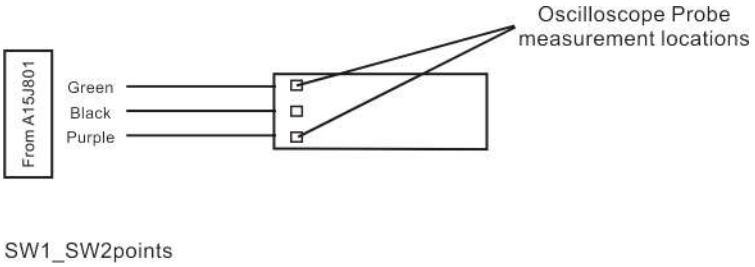


Figure 6-8 Connector Close-up



To verify the control logic, press **Mode Preset** on the analyzer. Press **FREQ**, **5 GHz**, **Span**, **1 MHz**, **AMPTD**, **Signal Path**, **uW Path Control**. Standard Path is selected by default. Carefully place the scope probe tip on the conductive portion where the green wire goes into the connector, see Figure 6-9.

Figure 6-9 Connector Detail



The voltage should be ~21.5 VDC steady state at this point. When you switch from Standard Path to uW Presel Bypass, you should see a negative going pulse to 0 VDC on the oscilloscope for ~15 mS before the voltage returns to ~21.5 VDC steady state. The oscilloscope triggering may need to be adjusted to see the negative going pulse. This can be tested on both connectors that contain the green wire.

Monitor the yellow or orange wires on each connector, one at a time. The yellow or orange wire starts at ~21.5 VDC. When switching from uW Preselector Bypass to Standard Path, you should see a negative going pulse to 0 VDC on the oscilloscope for ~15 mS before the voltage returns to ~21.5 VDC steady state.

If both the green wires and the yellow or orange wires measure this pulse correctly, the control logic from the A15, Front End Controller board is operating correctly.

The black wire is ground.

RF Signal Tracing

Refer to Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” for this method of troubleshooting if you are unable to use an Oscilloscope

Verifying Narrowband IF Out (A15J900)

The outer cover and top shield need to be removed to verify A15J900 I.F. output to the A2 Analog IF assembly. Refer to Chapter 15, “Assembly Replacement Procedures” for the removal procedure. Press **Mode**, **Spectrum Analyzer**, **Mode Preset** on the analyzer. Press **Input/Output**, **RF Calibrator**, **50 MHz**, **Freq**, **50 MHz**, **Span**, **0 Hz**, **Amptd**, **Attenuation**, **Mech Atten**, **10 dB**, **Amptd**, **Signal Path**, **Internal Preamp Off**, **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**. Disconnect the cable marked J900 that plugs into the top of the A15, Front End Controller board and connect a functioning spectrum analyzer where the cable was plugged in. J900's output should be 322.5 MHz at ~-23 dBm on the functioning spectrum analyzer if the Front End Controller board is switching this level correctly. If -23 dBm is not being measured correctly, remove the cable labeled J902 from the Front End Controller board and measure the output of that cable. This should also measure 322.5 MHz at ~-23 dBm. If the output of the J902 cable measures correctly and yet the output of J900 is incorrect, the most probable cause is the A15, Front End Controller board.

Reconnect all cables to their correct location when finished with the measurements.

IMPORTANT When plugging in an mmcx connector, a distinct “snap” should be heard when the cable is seated correctly.

Verifying Wideband IF Out (A15J901, Option B40, B85, B1A, or B1X only)

The outer cover and top shield need to be removed to verify A15J901 output. Refer to Chapter 15, “Assembly Replacement Procedures” for the removal procedure. Press **Mode**, **IQ Analyzer (Basic)**, **Mode Preset** on the analyzer. Press **Input/Output**, **RF Calibrator**, **50 MHz**, **Freq**, **50 MHz**, **Amptd**, **Mech Atten**, **10 dB**, **Amptd**, **Signal Path**, **Internal Preamp Off**, **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**. Disconnect the cable marked J901 that plugs into the Front End Controller board and connect a functioning spectrum analyzer where the cable was plugged in. J901's I.F. output will vary depending on the I.F. path that is chosen. Press **Meas Setup**, **IF Path** and select **40 MHz**. If the switch path is working correctly in the A15 Front End Controller board, the functioning spectrum analyzer should measure 250 MHz at ~-30 dBm.

In order for these I.F. levels to measure correctly, the I.F. input at A15J902 must be correct. Refer to Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)”. Reconnect all cables to their correct location when finished.

Verifying Aux IF Out, Rear Panel (Option CR3, CRP only)

The Aux I.F. output connector on the rear panel is installed on all analyzers equipped with the EFEC version of the A15, however the actual Aux I.F. output frequency will vary depending on the options installed. These options are all enabled with a license key. The first step in verifying the Aux I.F. output is the make sure the option is licensed by pressing **System**, **Show System** on the analyzer and make sure the option identifies itself in the table.

The I.F. switch path and frequency generation occurs on the A15, Front End Controller board. This troubleshooting procedure provides the instrument setups to verify options CR3 and CRP. Test the Aux I.F. output based on the options installed in the analyzer.

Standard Analyzer

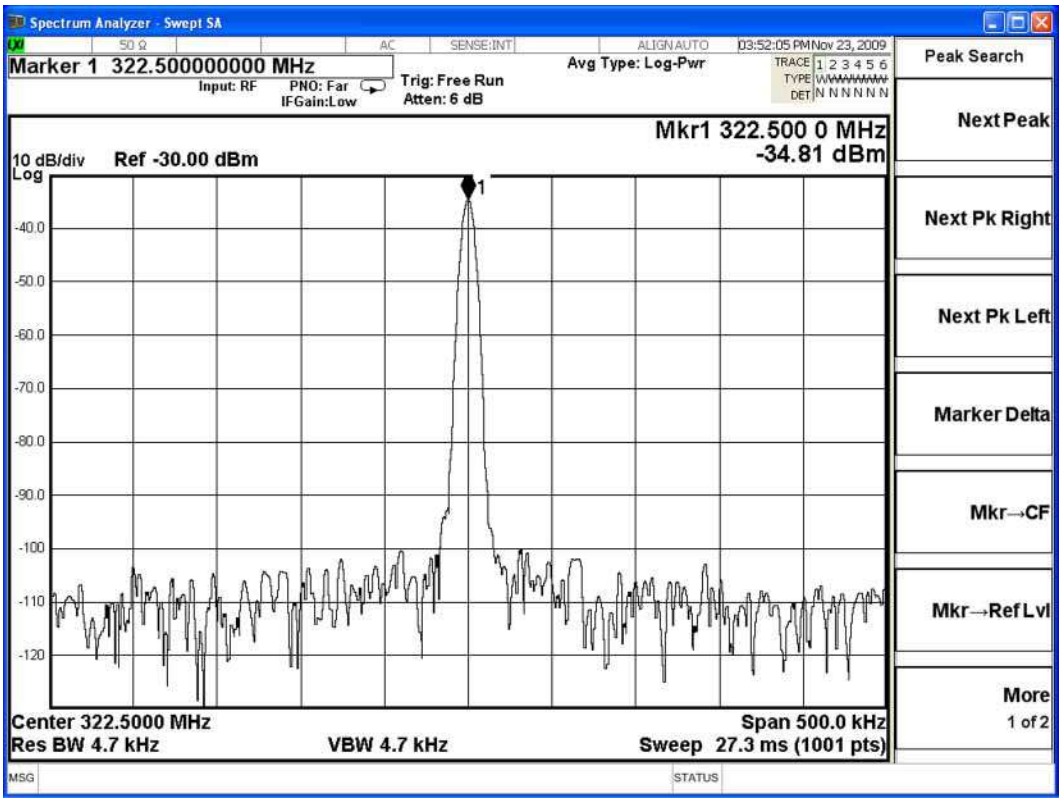
No test to perform.

Verifying Option CR3

Press the following keys on the analyzer:
Mode, **Spectrum Analyzer**, **Mode Preset, Input/Output, RF Calibrator, 50 MHz, Freq, 50 MHz, Span, 0 Hz, System, Alignments, Auto Align, Auto Align, Off, Input/Output, Output, Aux IF Out, Second IF**

Connect the Aux I.F. Output on the rear panel to the RF Input of a functioning spectrum analyzer. If the A15 Front End Controller is switching the I.F. correctly, you should measure 322.5 MHz at –35 dBm ±3 dB as per Figure 6-10.

Figure 6-10 322.5 MHz

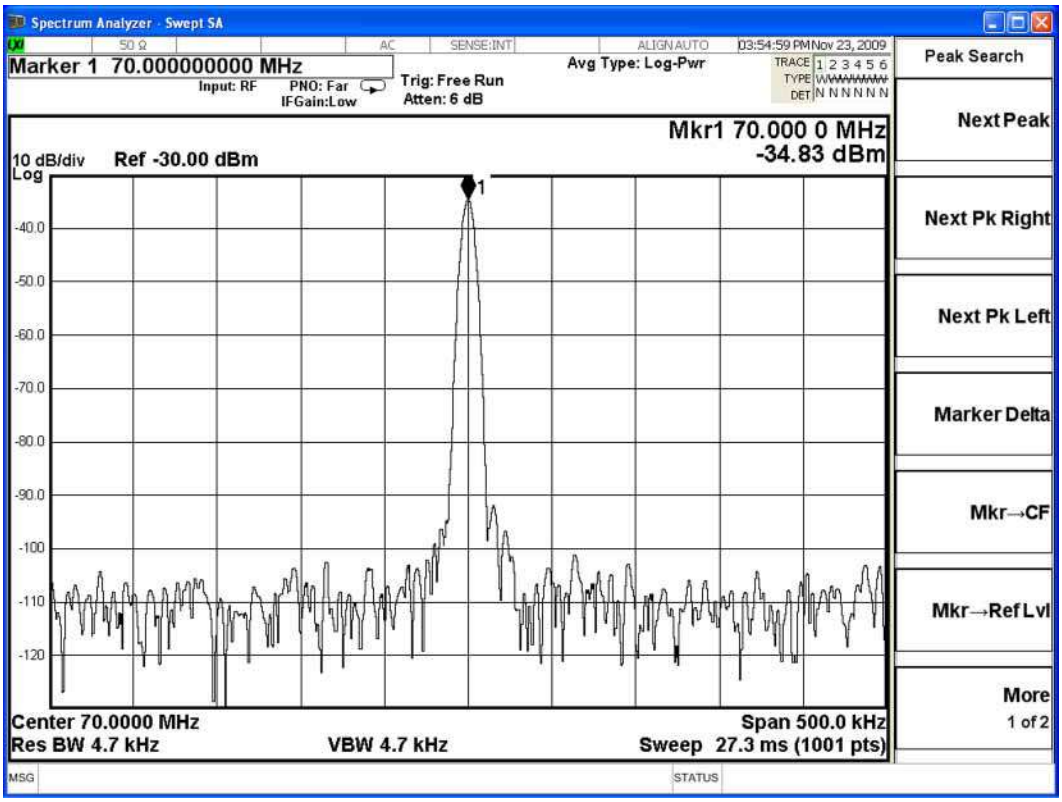


Verifying Option CRP

Press the following keys on the analyzer:
Mode, **Spectrum Analyzer**, **Mode Preset**, **Input/Output**, **RF Calibrator, 50 MHz**, **Freq**, **50 MHz**, **Span**, **0 Hz**, **System**, **Alignments**, **Auto Align**, **Auto Align**, **Off**, **Input/Output**, **Output**, **Aux IF Out**, **Arbitrary IF**.

The default is 70 MHz, which can be measured on a functioning spectrum analyzer. The amplitude level should be –35 dBm ±3 dB as per Figure 6-11. With the Arbitrary IF as the active function, you can vary the I.F. from 10 MHz to 70 MHz in 500 kHz steps and measure the Aux IF output. The amplitude level should remain fairly flat across the entire arbitrary IF output range.

Figure 6-11 70 MHz



7 Analog/Digital IF Troubleshooting

What You Will Find in This Chapter

The following information is presented in this chapter:

1. **Theory of operation of the IF section.**
2. **Isolating the cause of a hardware problem by verifying the functionality of assemblies in the IF section signal path.**

The analyzer can have one of three sets of IF hardware installed. The standard 25 MHz BW IF hardware supports analysis bandwidths up to 25 MHz. The optional 40 MHz BW IF hardware supports analysis bandwidths up to 40 MHz. The 40 MHz IF hardware is installed if any of the following options are installed:

– B40, 40 MHz Analysis Bandwidth

– MPB, Microwave Preselector Bypass

– DP2, Digital Processor & 2 GB Capture Memory

The ≥ 85 MHz BW IF hardware supports analysis bandwidths up to 160 MHz. It also includes the 40 MHz BW IF hardware.

NOTE

The following sections provide for each assembly a description of how the assembly works and then gives information to help you troubleshoot the assembly. Each description explains the purpose of the assembly, describes the main components, and lists external connections to the assembly.

This following sections are found in this chapter:

25 MHz BW IF Section

A2 Analog I.F. Assembly Description on page 259
A2 Analog I.F. Assembly Theory of Operation on page 260
A2 Analog I.F. Troubleshooting on page 263
A3 Digital I.F. Assembly Description on page 270
A3 Digital I.F. Assembly Theory of Operation on page 271
A3 Digital I.F. Troubleshooting on page 273

40 MHz BW IF Section

A2 Analog IF Assembly Description on page 278
A2 Analog IF Assembly Theory of Operation on page 279
A2 Analog IF Troubleshooting on page 282
A3 Digital IF Assembly Description on page 289
A3 Digital IF Assembly Theory of Operation on page 290
A3 Digital IF Troubleshooting on page 292

[3] 85 MHz BW IF Section

A25 Wideband Analog IF Assembly Description on page 300
A25 Wideband Analog IF Assembly Theory of Operation on page 300
A25 Wideband Troubleshooting on page 302
A26 140 MHz Wideband Digital IF Troubleshooting on page 305

25 MHz BW IF Section

A2 Analog I.F. Assembly Description

The analyzer's RF input signal is down converted to a 322.5 MHz intermediate frequency in the A13 RF Front End Assembly. This 322.5 MHz signal is the input to the A2 Analog I.F. Assembly. The Analog I.F. down converts the 322.5 MHz signal to a final 22.5 MHz intermediate frequency. In order to obtain optimal dynamic range and minimize unwanted spurious signals, this signal is filtered, amplified and attenuated throughout this assembly. The final 22.5 MHz signal goes through a series of variable band pass filters each having a specific bandwidth. Three things determine the signal path and which filters are chosen:

- Instrument resolution bandwidth (RBW) setting
- Application used
- Mode applied

This assembly contains the burst carrier trigger circuitry for performing mobile communication measurements. The output of the assembly is a filtered 22.5 MHz signal that goes to the ADC on the A3 Digital I.F. Assembly.

Inputs to the A2

322.5 MHz signal (from either the A13 RF Front End Assembly or the A15 Front End Control Assembly)

LO Input (300 MHz signal from A16 Reference Assembly)

22.5 MHz Cal Comb Signal (from the A3 Digital I.F. Assembly)

Outputs from the A2

22.5 MHz signal (to A3 Digital I.F. Assembly)

RF Trigger Detector (to A3 Digital I.F. Assembly)

A2 Analog I.F. Assembly Theory of Operation

NOTE Refer to Chapter 12, “Block Diagrams”.

Input Switch and Filter

A 322.5 MHz input signal is received from the A13 RF Front End Assembly. For analyzers equipped with Option CR3 and/or CRP, the 322.5 MHz input signal is routed from the A13 Front End Assembly to the IF MUX on the A15 Front End Control Assembly and from there to the A2 Analog IF Assembly. The signal then goes through a band pass filter centered at 322.5 MHz with a 25 MHz bandwidth. A cal comb signal can be automatically switched in at the input of the assembly to calibrate the prefilters.

Step Attenuator and Amplifier

A 1 dB step attenuator follows to compensate for band gain differences. The signal then goes through a high-dynamic range amplifier.

Image Filters

One of three different filter paths will be selected automatically, depending on the analyzer mode.

- The through path is selected in IQ Analyzer Mode and wide-band demod.
- The 12 MHz ceramic bandpass filter is used for normal Signal Analyzer swept and FFT operation.
- The 300 kHz Surface Acoustic Wave (SAW) is used for ACP modes.

Mixer

There are two mixers that reside on this assembly. The first mixer is used to down convert the 322.5 MHz input to the final 22.5 MHz I.F. The other mixer is described in the I.F. Comb Cal section.

3rd LO

The 300 MHz 3rd L.O. signal comes from the A16 Reference Assembly and conditions it for use as an L.O. in the two mixers that reside on this assembly. The third L.O. power is ~ +10 dBm to optimize the conversion efficiency of the first mixer.

I.F. Comb Cal

The 2nd mixer is used to mix the 300 MHz L.O. from the Reference Assembly with the 22.5 MHz cal comb signal from the A3 Digital I.F. to allow calibration of the prefilters and overall passband phase and amplitude. The signal is attenuated by 20 dB if necessary. A limiter is used to reduce amplitude variation effects.

Post Down Conversion Amplification and Prefiltering

The 22.5 MHz I.F. goes through a fixed gain amplifier. Then prefilters are switched in and out. The signal then goes through a variable gain amplifier.

The prefilters provide four single-pole filters to limit the bandwidth of the signal reaching the ADC on the A3 Digital I.F. assembly. There are five different signal paths for the 22.5 MHz I.F. when using Signal Analyzer swept mode:

1. LC wide
2. LC narrow
3. Crystal wide
4. Crystal narrow
5. Through path

The LC wide signal path is used when the analyzer Res BW setting is 180 kHz to 390 kHz.

The LC narrow signal path is used when the analyzer Res BW setting is 30 kHz to 160 kHz.

The Crystal wide signal path is used when the analyzer Res BW setting is 4.3 kHz to 27 kHz.

The Crystal narrow signal path is used when the analyzer Res BW setting is < 3.9 kHz.

The through path is used when the analyzer Res BW setting is 430 kHz and greater in analyzer swept mode.

NOTE

In IQ Analyzer mode or in Spectrum Analyzer mode with Sweep Type of FFT, the analyzer span setting determines the pre-filter settings.

Anti-Alias Filter and Final Amplifier

The anti-alias filters attenuate unwanted out-of-band noise and distortion products. The first anti-alias filter is centered at 22.5 MHz and is 25 MHz wide.

The signal can bypass the second anti-alias filter when the analyzer utilizes either the IQ Analyzer swept, or wide-band demod.

The through path is selected when the image filter is in the 25 MHz mode (for IQ Analyzer swept and wide-band demod)

In all other cases the signal will pass through the second 12 MHz anti-alias filter.

The step gain block provides an additional switchable 10 dB gain to overcome the ADC noise floor and provide an additional 2 dB of analyzer sensitivity.

Burst Carrier Trigger

The Burst Carrier Trigger detector provides a binary signal to be used as a trigger based on the presence of an RF input signal or not. The variable gain amplifiers drive a detector and its output drives a comparator which generates the trigger signal.

A2 Analog I.F. Troubleshooting

There are three steps to verify the A2 Analog I.F. Assembly.

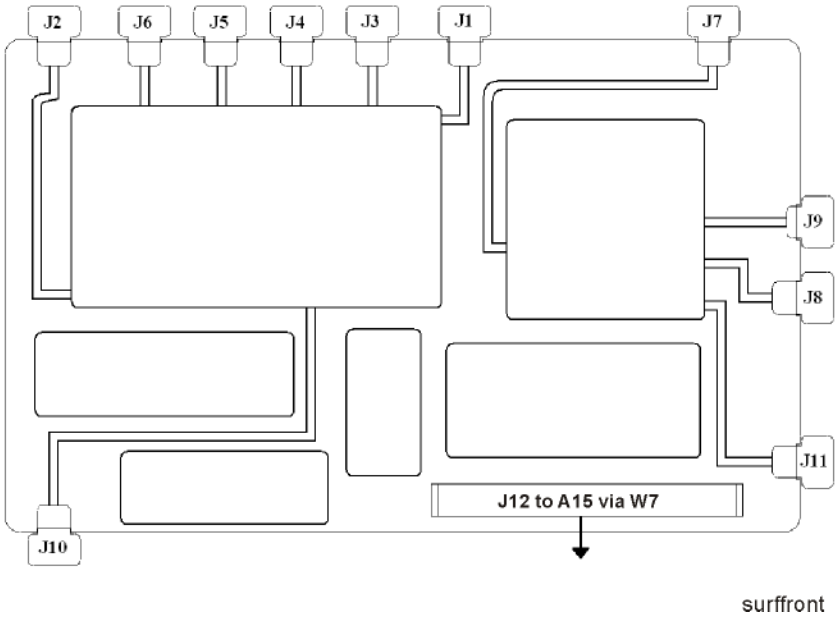
- Measure the input power and frequency accuracy of the 322.5 MHz signal (from the A13 RF Front End assembly or the A15 Front End Control Assembly).
- Measure the output power and frequency accuracy of the 22.5 MHz signal (to the A3 Digital I.F. Assembly)
- Measure the 300 MHz input LO signal (from the A16 Reference Assembly)

Verifying the 322.5 MHz Input Power

1. Turn the instrument off.
2. Remove instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn on the N9020B Signal Analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **Input/Output**, **RF calibrator**, **50 MHz**.
6. Verify the 50 MHz signal is at –25 dBm on the analyzer display by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the N9020B. The marker readout should be 50 MHz at –25 dBm ± 3 dBm. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)”in this service guide.
7. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the N9020B is set to 10 dB. Look near the top of the display near the center and verify that **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.

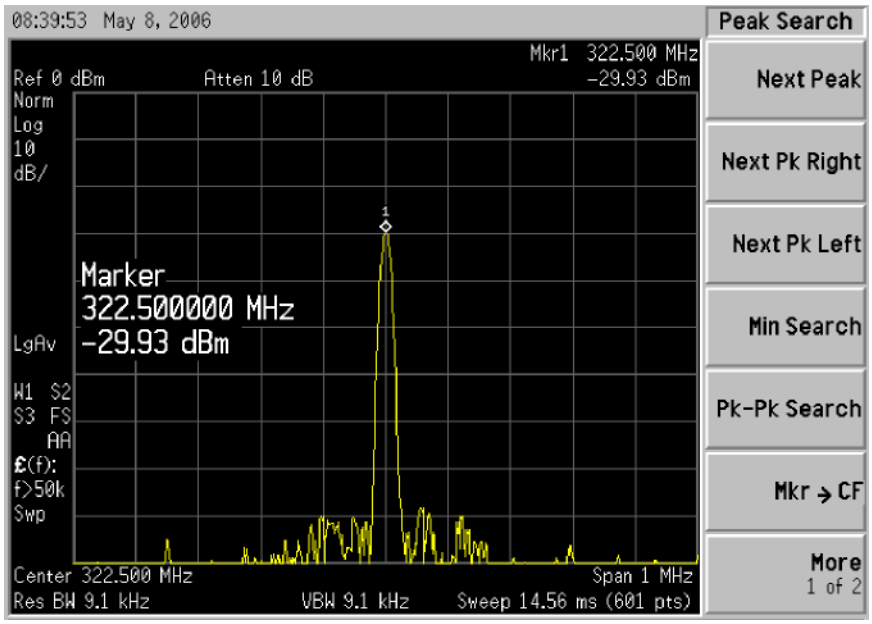
8. Carefully disconnect the W15 or W36 cable at A13J7 as shown in Figure 7-1.

Figure 7-1 A13 RF Front End Assembly - RF/Microwave Instruments



9. Connect A13J7 to a functioning spectrum analyzer using the appropriate SMA connectors and cables.
10. Press **Freq**, **322.5 MHz**, **Span, 1 MHz**, **Peak Search** on the functioning spectrum analyzer
11. The analyzer should read 322.5 MHz at –30 dBm ± 3 dBm as shown in Figure 7-2.

Figure 7-2 A13 322.5 MHz Output



NOTE If the 322.5 MHz signal is not measuring the correct power level, refer to Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)" in this service guide.

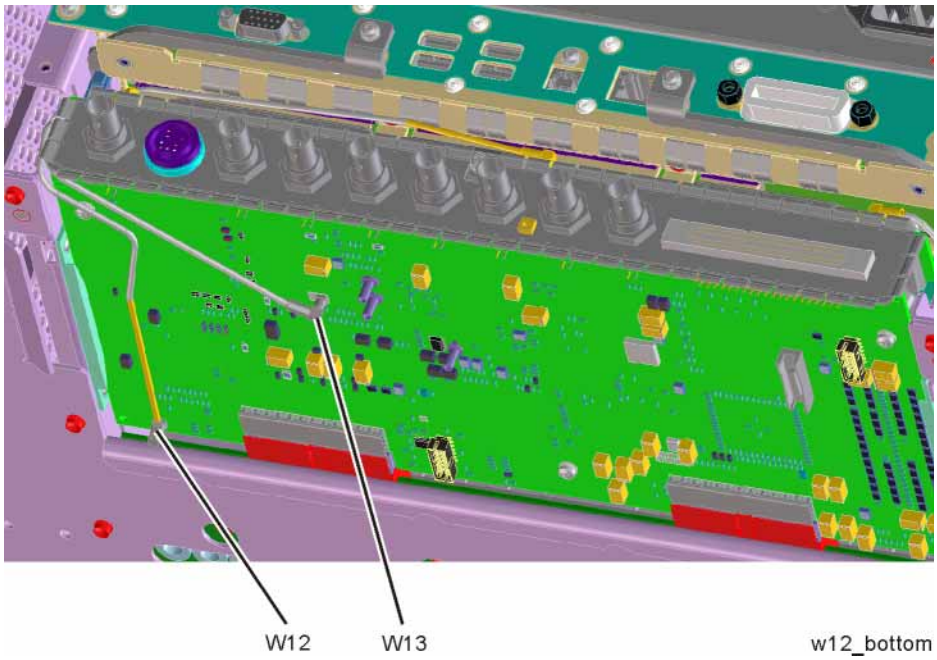
Reconnect W15 at A13J7.

IMPORTANT Measuring at this location is for convenience. The 322.5 MHz signal is an output at A13J7. Since the W15 cable connects from this output to the input of the Analog I.F. assembly at A2J100, the small coaxial cable has not been tested at this point. If the analyzer is equipped with either Option CR3 and/or CRP, the 322.5 MHz signal will also be routed from A13J7 to A15J902 via W36 and from A15J900 to A2J100 via W37.

Verifying the 22.5 MHz Output Power

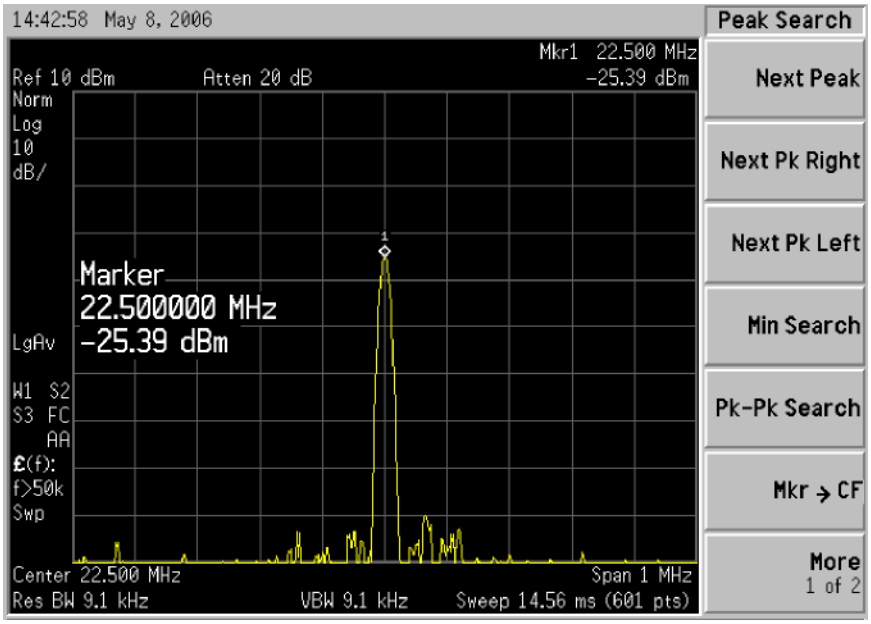
1. Turn the instrument off.
2. Turn the instrument over so the bottom side of the analyzer is facing up.
3. Turn on the N9020B Signal Analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **Input/Output**, **RF calibrator**, **50 MHz**.
6. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dBm. If this reference signal is measuring incorrectly, see Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)" in this service guide.
7. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the N9020B is set to 10 dB. Look near the top of the display near the center and verify that **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.
8. Refer to Figure 7-3, carefully disconnect the W13 cable at A3J15.

Figure 7-3 A3 Digital I.F. Cables



9. Connect the W13 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer to verify the 22.5 MHz I.F. and amplitude is correct.
10. Press **Freq**, **22.5 MHz**, **Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.
11. The analyzer marker should read 22.5 MHz at –25 dBm ± 4 dBm as shown in Figure 7-4.

Figure 7-4 A2 Analog I.F. Output



If the 22.5 MHz signal is not measuring the correct power level, do not assume the Analog I.F. is the most probable cause until the 3rd L.O. frequency and power level have been verified below.

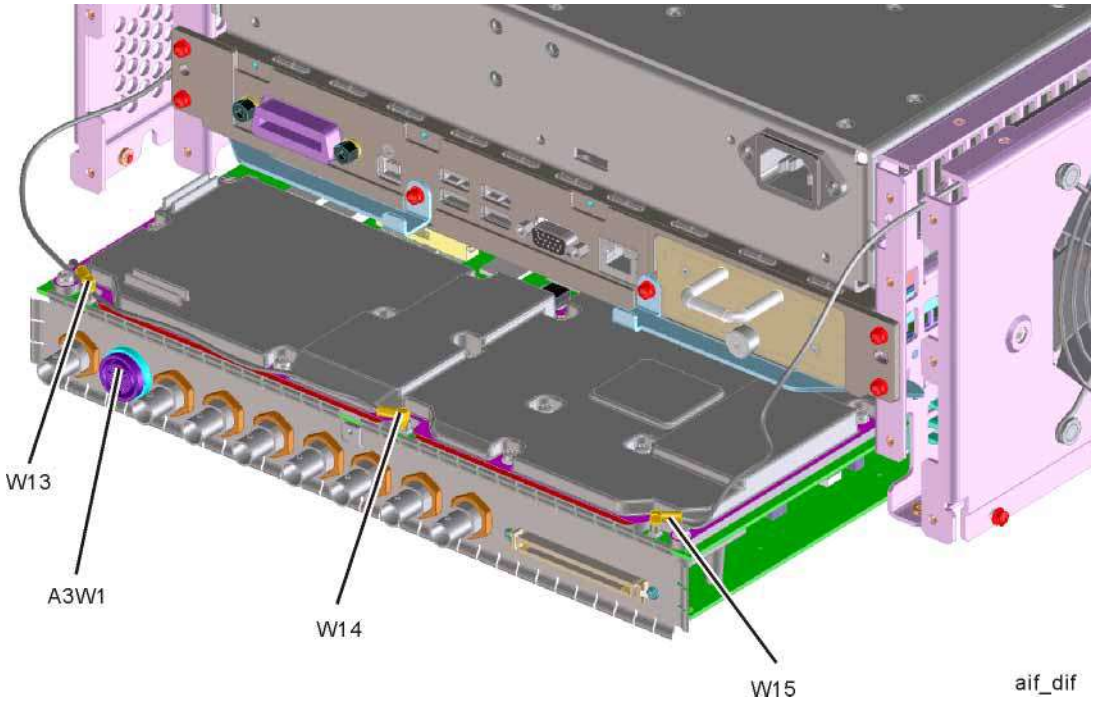
If the 22.5 MHz signal is within tolerance, carefully reconnect the W13 cable.

NOTE You should hear a distinct snap when reconnecting the W13 cable. If this cable is not installed properly, intermittent signal fluctuations may occur on the analyzer display.

Verifying the 300 MHz L.O. Input Power from the A16 Reference Assembly

1. Refer to Figure 7-5, carefully disconnect the W14 at A2J300

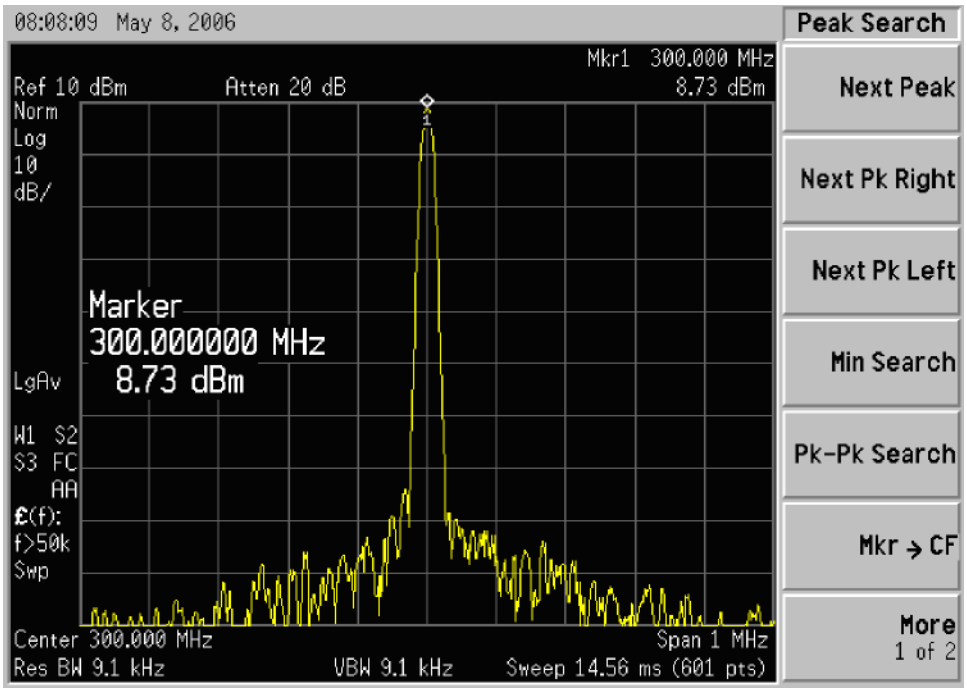
Figure 7-5 A2 Analog I.F. Cables



2. Connect the W14 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer.
3. Press **Freq**, **300 MHz**, **Span**, **1 MHz**, **Amplitude**, **10 dBm**, **Peak Search** on the functioning spectrum analyzer.

4. The analyzer marker should read 300 MHz at 10 dBm ± 3 dBm as shown in Figure 7-6.

Figure 7-6 300 MHz L.O.



If the 300 MHz signal is not measuring the correct power level, see the A16 Reference Assembly troubleshooting section in this service guide. If the 300 MHz L.O. is measuring the correct power level and frequency and the 22.5 MHz signal is low, the most probable cause is the A2 Analog I.F. assembly.

A3 Digital I.F. Assembly Description

The A3 Digital I.F. has circuitry that is needed to analyze complex communication signals that can occupy up to 25 MHz of information bandwidth. It digitizes the final 22.5 MHz I.F. from the A2 Analog I.F. board, by processing the time domain continuous data into I/Q (in-phase and quadrature) signals before sending the data to the A4 CPU assembly for further processing and front panel display.

The Digital I.F. has the following main functions:

- Digitizes the final 22.5 MHz Intermediate Frequency
- 14 bit ADC with a 90 MHz sample rate
- DSP for standard spectrum analysis
- Capture memory for complex signals
- Noise Source Control
- Dither for final I.F.
- Provides the alignment sequence generator for wide band alignments
- Provides wide band Comb Calibration Signal
- Trigger interpolation and associated alignment

A3 Digital I.F. Assembly Theory of Operation

NOTE Refer to Chapter 12, “Block Diagrams.”.

Data Acquisition

The 22.5 MHz IF comes from the A2 Analog IF assembly. The input level to the A3 Digital IF assembly is –25 dBm. The IF input has a 25 MHz bandwidth centered at 22.5 MHz. The analog circuitry leading to the ADC converts the singled ended signal from the Analog IF to differential required by the ADC. In addition, it is part of a filter, part of which is on the AIF, which improves distortion. Finally, it couples in the dither signal. The ADC is a 14 bit device sampling continuously at 90 Ms/Second.

Rear Panel Triggers

The board has two trigger inputs and two trigger outputs all used via a BNC connector. The trigger inputs are used when an external device has a trigger signal and the user wants to use that external trigger to trigger the signal analyzer. The trigger outputs are used to synchronize other pieces of test equipment to the analyzer. These outputs are configurable through the Input/Output menu via the front panel of the instrument.

The trigger inputs each allow trigger levels to be set from –5 to +5 volts using the control DAC. The circuits have relatively high input impedance. The trigger outputs have 50 Ω source impedance with TTL drive levels into no load.

Control DAC

The control DAC is used to set trigger levels and the gain of the reconstruction system. All three outputs can be adjusted from –2.5 to +2.5 volts.

Sample Rate Generator

The 10 MHz reference signal comes from the A16 Reference Assembly. This signal is fairly high power at +10 dBm. The signal goes through a 10 MHz to 30 MHz tripler. A 0 to 5V 10 MHz square wave is generated. Capacitors form a single-pole band pass filter to select the 3rd harmonic, 30 MHz.

The signal then passes through a 30 MHz to 90 MHz tripler. A 0 to 5V 30 MHz square wave is generated. Capacitors form a single-pole band pass filter to select the 3rd harmonic, 90 MHz.

Noise Source Voltage Regulator

Various external noise sources can be connected to the rear panel of the analyzer. These noise sources require a very accurate 28 volt DC power supply.

The 28 volt BNC output connector is used with the 346 series noise sources.

The Smart Noise Source (SNS) interface includes power switching for the 28 volt and 15 volt power supply. In addition, it has buffers to interface to the SNS I2C bus for control and read back of ENR data automatically. The SNS connector is used with the SNS series noise sources.

DSP

The signal from the ADC is sent to the Digital Signal Processor.

Digital Bus Common Mode Filtering

The Digital Bus is a real time digital interface. It is sometimes referred to as Messenger or LVDS. The implementation on the Digital IF is unidirectional, meaning it can only source data, not receive it. Common mode filtering is required to translate the digital ground referenced signals to analog ground at the rear panel.

A3 Digital I.F. Troubleshooting

Verifying the 22.5 MHz Input Power

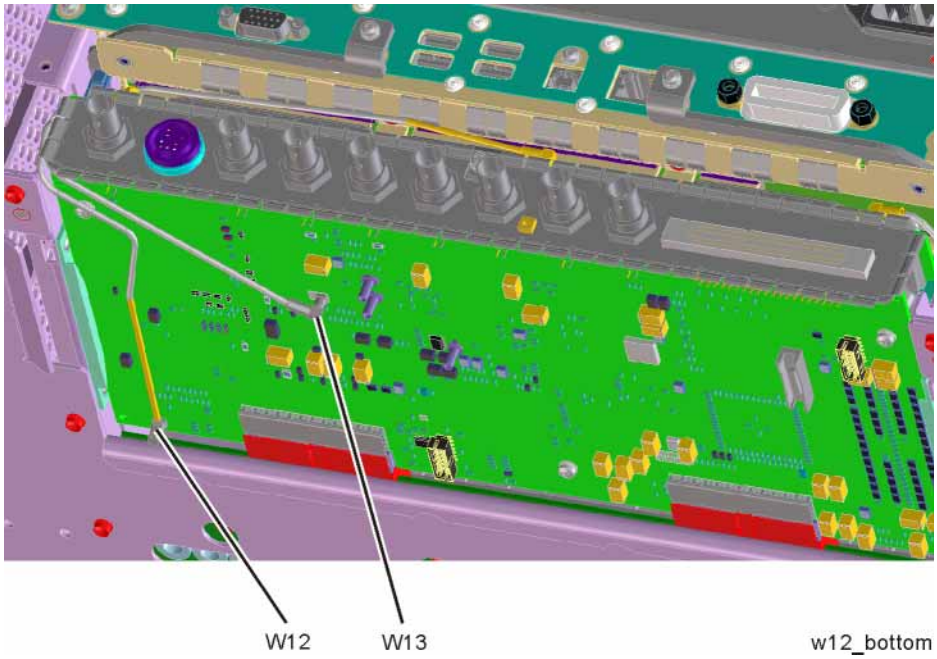
1. Perform an instrument shut down.
2. Remove the cover of the analyzer. Refer to Chapter 15, “Assembly Replacement Procedures”, on page 451 in this service guide.
3. Turn the instrument over so that the bottom is facing up.
4. Turn on the analyzer and wait for the instrument to complete the boot up process.
5. Press **System**, **Alignments**, **Auto Align**, **Off**
6. Press **Input**, **RF Calibrator**, **50 MHz**
7. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dBm. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)”, on page 135 in this service guide.
8. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the analyzer is set to 10 dB. (Look near the top of the display near the center and verify Atten: 10 dB)

NOTE

If the analyzer is not in 10 dB of input attenuation press **AMPTD**, **Attenuation**, **Mech Atten 10 dB**.

9. Refer to Figure 7-7, carefully disconnect W13 at A3J15.

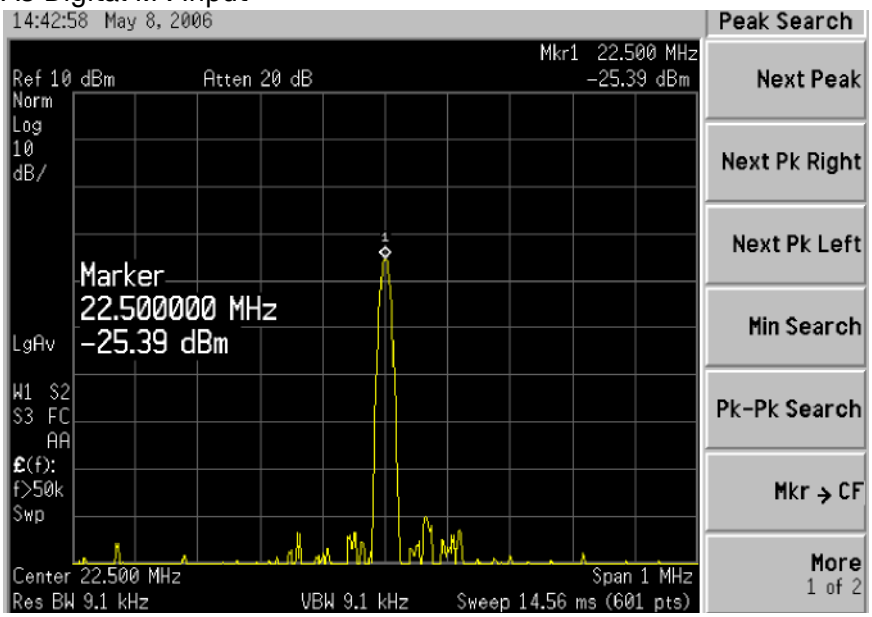
Figure 7-7 A3 Digital I.F. Cables



10. Connect the W13 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer.
11. Press **Freq**, **22.5 MHz Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

12. The analyzer should read 22.5 MHz at –25 dBm ± 4 dB as shown in Figure 7-8.

Figure 7-8 A3 Digital I.F. Input



If the 22.5 MHz signal is not measuring the correct power level, see "A2 Analog I.F. Troubleshooting" on page 263 in this service guide.

Verifying the 10 MHz Reference Input

1. Perform an instrument shut down.
2. Remove the cover of the analyzer. Refer to Chapter 15, "Assembly Replacement Procedures", on page 451 in this service guide.
3. Turn the instrument over so that the bottom is facing up.
4. Turn on the analyzer and wait for the instrument to complete the boot up process.
5. Press **System**, **Alignments**, **Auto Align**, **Off**.
6. Press **Input/Output**, **RF calibrator**, **50 MHz**.
7. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dBm. If this reference signal is measuring incorrectly, see Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)", on page 135 in this service guide.

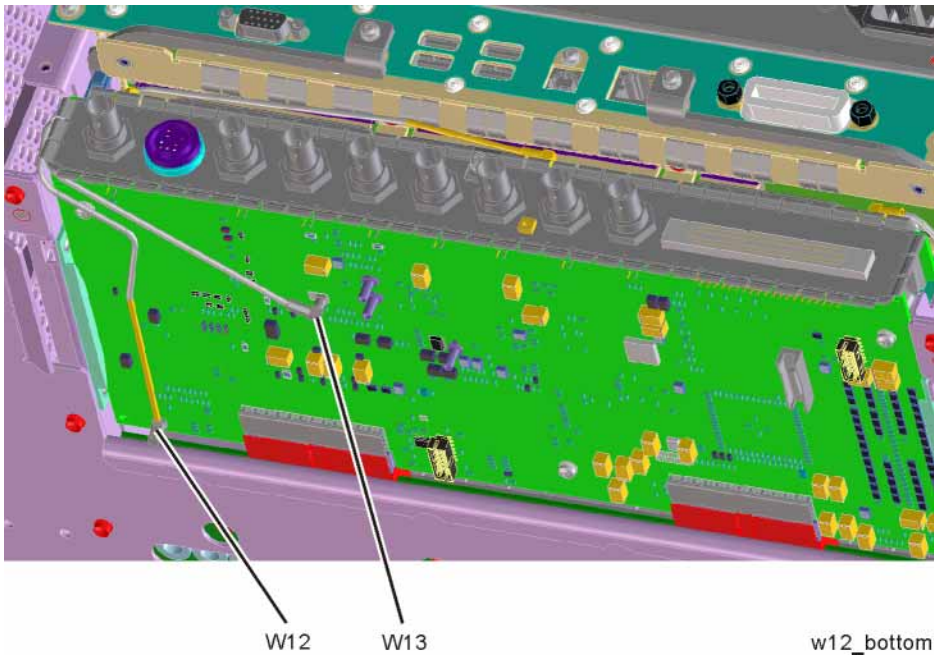
8. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the analyzer is set to 10 dB. (Look near the top of the display near the center and verify Atten: 10 dB)

NOTE

If the analyzer is not in 10 dB of input attenuation press **AMPTD**, **Attenuation**, **Mech Atten 10 dB**.

9. Refer to Figure 7-9, carefully disconnect W12 at A3J14.

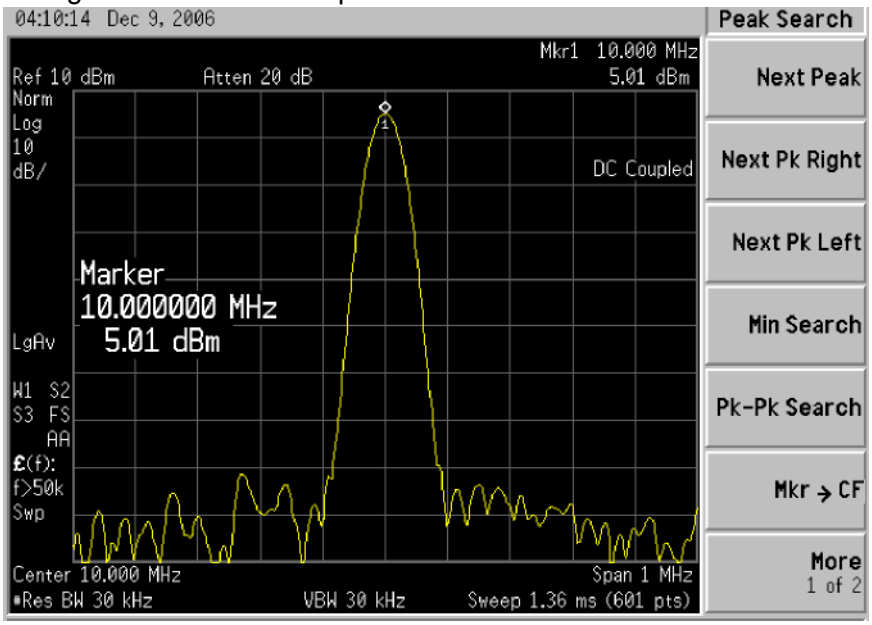
Figure 7-9 A3 Digital I.F. Cables



10. Connect the W12 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer.
11. Press **Freq**, **10 MHz**, **Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

12. The analyzer should read 10 MHz at +5 dBm ± 3 dBm as shown in Figure 7-10.

Figure 7-10 A3 Digital I.F. Reference Input



If the 22.5 MHz and 10 MHz signals measure the correct frequency and amplitude and yet the display is not processing the signal properly, the most probable causes are the A3 Digital IF or the A4 CPU. It is difficult to separate these two assemblies given the architecture of the analyzer. Each assembly will have to be tried to see which one is causing the failure.

40 MHz BW IF Section

A2 Analog IF Assembly Description

When the 10 MHz or 25 MHz IF Path is selected, or when any swept measurement is made, the analyzer's RF input signal is down converted to a 322.5 MHz intermediate frequency in the A13 RF Front End Assembly. This 322.5 MHz signal is routed through the IF MUX on the A15 Front End Control Assembly and then input to the A2 Analog I.F. Assembly.

The Analog I.F. down converts the 322.5 MHz signal to a final 22.5 MHz intermediate frequency. In order to obtain optimal dynamic range and minimize unwanted spurious signals, this signal is filtered, amplified and attenuated throughout this assembly. The final 22.5 MHz signal goes through a series of variable band pass filters each having a specific bandwidth. Three things determine the signal path and which filters are chosen:

- Instrument resolution bandwidth (RBW) setting
- Application used
- Mode applied

This assembly contains one of the two burst carrier trigger (BCT) circuits for performing mobile communication measurements. The BCT on the A2 assembly is relatively narrowband. The other BCT circuit is part of the IF MUX on the A15 Front End Control Assembly and has a much wider bandwidth.

The output of the A2 assembly is a filtered 22.5 MHz signal that goes to one of the two ADCs on the A3 Digital I.F. Assembly.

Inputs to the A2

322.5 MHz signal (from A15 Front End Control Assembly)

LO Input (300 MHz signal from A16 Reference Assembly)

22.5 MHz Cal Comb Signal (from the A3 Digital IF Assembly)

Outputs from the A2

22.5 MHz signal (to A3 Digital IF Assembly)

RF Trigger Detector (to A3 Digital IF Assembly)

A2 Analog IF Assembly Theory of Operation

NOTE Refer to Chapter 12, “Block Diagrams”.

Input Switch and Filter

A 322.5 MHz input signal is received from the A15 Front End Control Assembly. The signal then goes through a band pass filter centered at 322.5 MHz with a 25 MHz bandwidth. A comb cal signal can be automatically switched in at the input of the assembly to calibrate the prefilters.

Step Attenuator and Amplifier

A 1 dB step attenuator follows to compensate for band gain differences. The signal then goes through a high-dynamic range amplifier.

Image Filters

One of three different filter paths will be selected automatically, depending on the analyzer mode.

- The through path is selected in IQ Analyzer Mode and wide-band demod.
- The 12 MHz ceramic bandpass filter is used for normal Signal Analyzer swept and FFT operation.
- The 300 kHz Surface Acoustic Wave (SAW) is used for ACP modes.

Mixer

There are two mixers that reside on this assembly. The first mixer is used to down convert the 322.5 MHz input to the final 22.5 MHz IF. The other mixer is described in the IF Comb Cal section.

3rd LO

The 300 MHz 3rd LO signal comes from the A16 Reference Assembly and conditions it for use as an LO in the two mixers that reside on this assembly. The third LO power is ~ +10 dBm to optimize the conversion efficiency of the first mixer.

IF Comb Cal

The 2nd mixer is used to mix the 300 MHz LO from the Reference Assembly with the 22.5 MHz cal comb signal from the A3 Digital IF to allow calibration of the prefilters and overall passband phase and amplitude. The signal is attenuated by 20 dB if necessary.

Post Down Conversion Amplification and Prefiltering

The 22.5 MHz IF goes through a fixed gain amplifier. Then prefilters are switched in and out. The signal then goes through a variable gain amplifier.

The prefilters provide four single-pole filters to limit the bandwidth of the signal reaching the ADC on the A3 Digital IF assembly. There are five different signal paths for the 22.5 MHz IF when using Signal Analyzer swept mode:

1. LC wide
2. LC narrow
3. Crystal wide
4. Crystal narrow
5. Through path

The LC wide signal path is used when the analyzer Res BW setting is 180 kHz to 390 kHz.

The LC narrow signal path is used when the analyzer Res BW setting is 30 kHz to 160 kHz.

The Crystal wide signal path is used when the analyzer Res BW setting is 4.3 kHz to 27 kHz.

The Crystal narrow signal path is used when the analyzer Res BW setting is < 3.9 kHz.

The through path is used when the analyzer Res BW setting is 430 kHz and greater in analyzer swept mode.

NOTE

In IQ Analyzer mode or in Spectrum Analyzer mode with Sweep Type of FFT, the analyzer span setting determines the pre-filter settings.

Anti-Alias Filter and Final Amplifier

The anti-alias filters attenuate unwanted out-of-band noise and distortion products. The first anti-alias filter is centered at 22.5 MHz and is 25 MHz wide.

The signal can bypass the second anti-alias filter when the analyzer utilizes either the IQ Analyzer swept, or wide-band demod.

The through path is selected when the image filter is in the 25 MHz mode (for IQ Analyzer swept and wide-band demod)

In all other cases the signal will pass through the second 12 MHz anti-alias filter.

The step gain block provides an additional switchable 10 dB gain to overcome the ADC noise floor and provide an additional 2 dB of analyzer sensitivity.

Burst Carrier Trigger

The Burst Carrier Trigger detector provides a binary signal to be used as a trigger based on the presence of an RF input signal or not. The variable gain amplifiers drive a detector and its output drives a comparator which generates the trigger signal.

A2 Analog IF Troubleshooting

There are three steps to verify the A2 Analog IF Assembly.

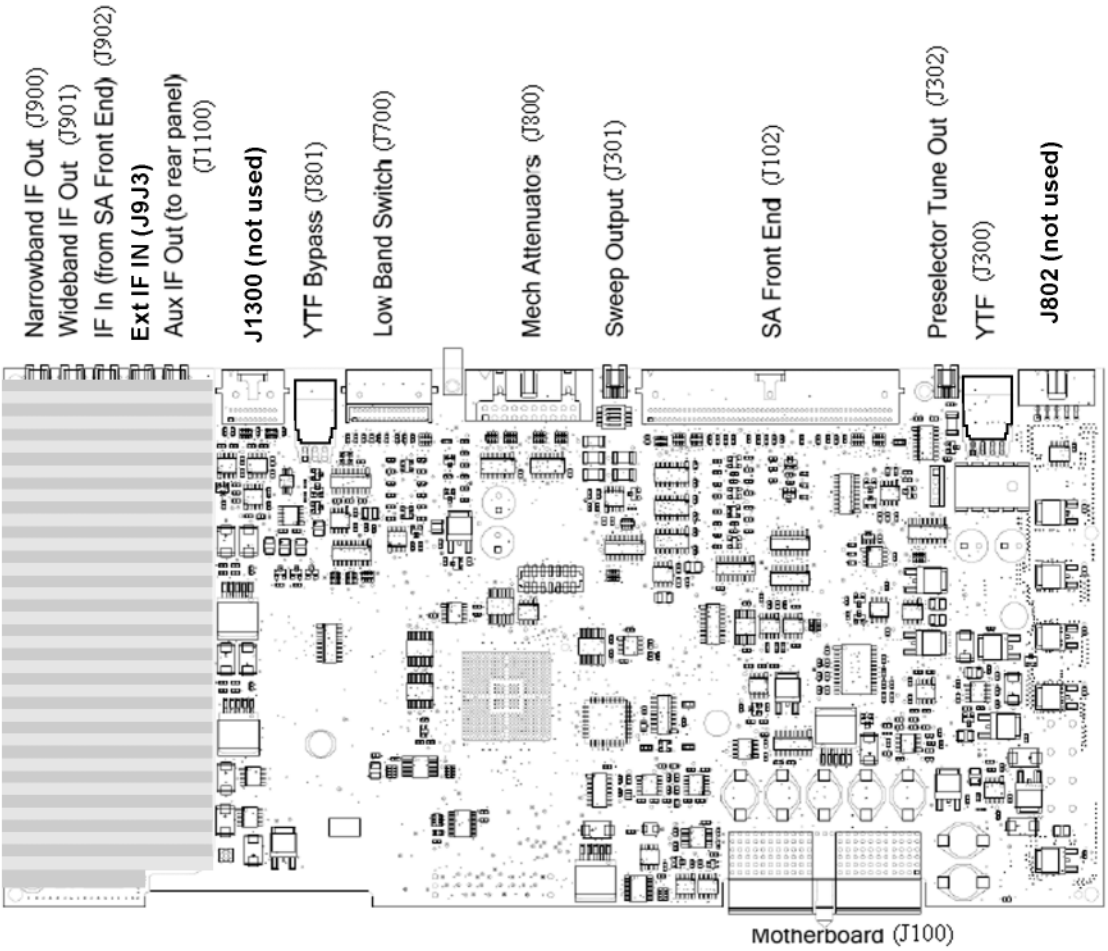
- Measure the input power and frequency accuracy of the 322.5 MHz signal (from the A13 RF Front End assembly)
- Measure the output power and frequency accuracy of the 22.5 MHz signal (to the A3 Digital IF Assembly)
- Measure the 300 MHz input LO signal (from the A16 Reference Assembly)

Verifying the 322.5 MHz Input Power

1. Turn the instrument off.
2. Remove instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn on the analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **Input/Output**, **RF calibrator**, **50 MHz**.
6. Verify the 50 MHz signal is at –25 dBm on the analyzer display by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dB. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.
7. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the analyzer is set to 10 dB. Look near the top of the display near the center and verify that **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.

8. Carefully disconnect W37 cable at A15J900 as shown in Figure 7-11.

Figure 7-11 A15 RF Front End Control Assembly

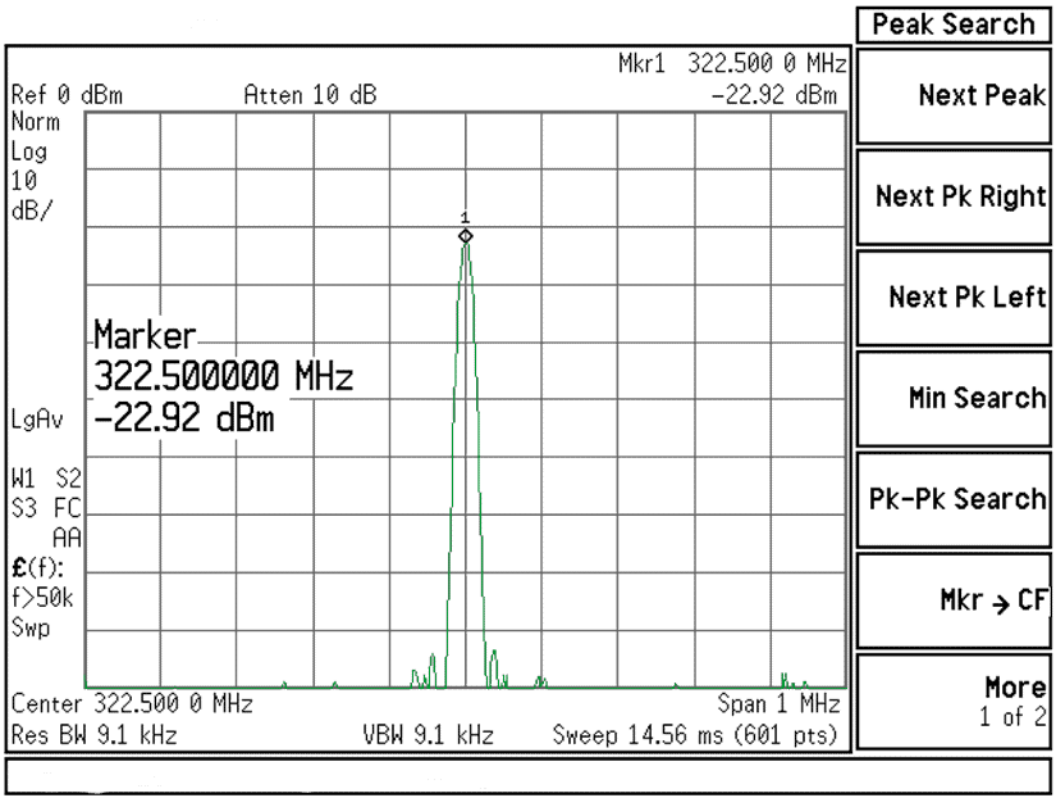


9. Connect A15J900 to a functioning spectrum analyzer using the appropriate MMCX connectors and cables.

10. Press **Freq**, **322.5 MHz**, **Span, 1 MHz**, **Peak Search** on the functioning spectrum analyzer.

11. The analyzer should read 322.5 MHz at –23 dBm ± 3 dB as shown in Figure 7-12.

Figure 7-12 A15 322.5 MHz Output



NOTE If the 322.5 MHz signal is not measuring the correct power level, refer to Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)" in this service guide.

Reconnect W37 to A15J900.

IMPORTANT Measuring at this location is for convenience. The 322.5 MHz signal is an output at A15J900. Since the W37 cable connects from this output to the input of the Analog I.F. assembly at A2J100, the small coaxial cable has not been tested at the A2J100 end.

Verifying the 22.5 MHz Output Power

1. Perform an instrument shutdown.
2. Turn the instrument over so the bottom side of the analyzer is facing up.
3. Turn on the analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **Input/Output**, **RF calibrator**, **50 MHz**.
6. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dB. If this reference signal is measuring incorrectly, see Chapter 4, "RF Section Troubleshooting (RF/Microwave Analyzers)" in this service guide.
7. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the analyzer is set to 10 dB. Look near the top of the display near the center and verify that **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.
8. Refer to Figure 7-13, carefully disconnect the W41 cable at A3J19.

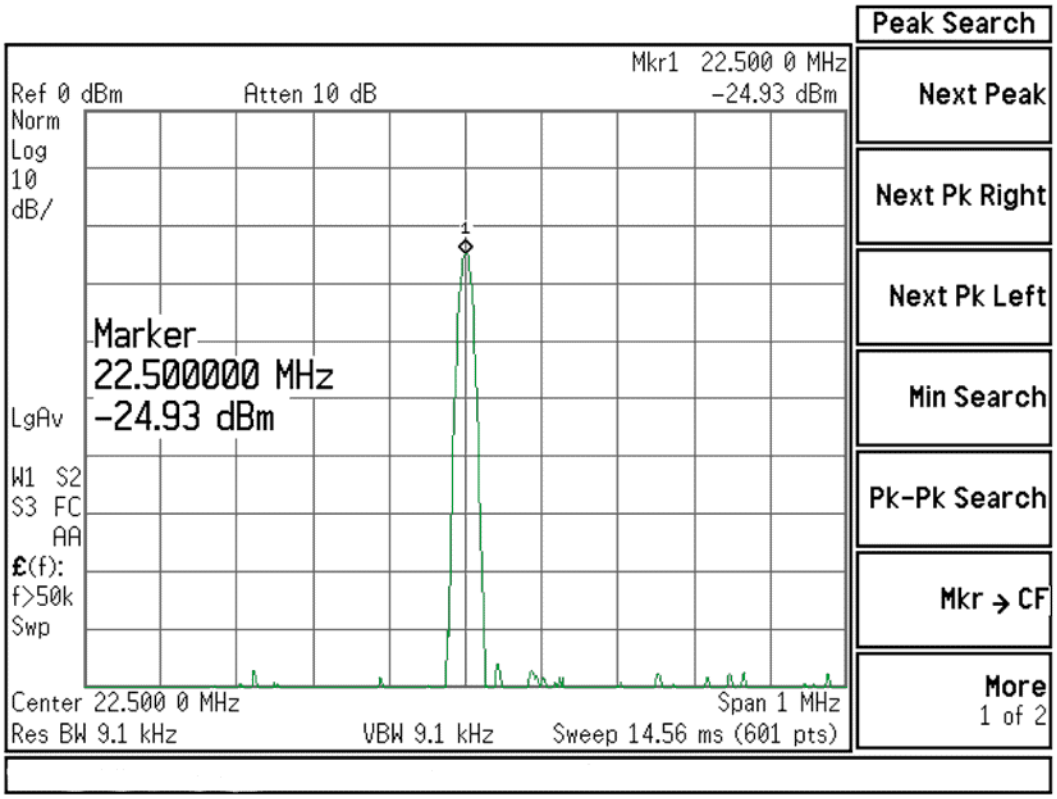
Figure 7-13 A3 Digital IF Cables

9. Connect the W41 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer to verify the 22.5 MHz I.F. and amplitude is correct.

10. Press **Freq**, **22.5 MHz**, **Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

11. The analyzer marker should read 22.5 MHz at –25 dBm ± 4 dB as shown in Figure 7-14.

Figure 7-14 A2 Analog IF Output



12. If the 22.5 MHz signal is not measuring the correct power level, do not assume the Analog IF is the most probable cause until the 3rd LO frequency and power level have been verified below.

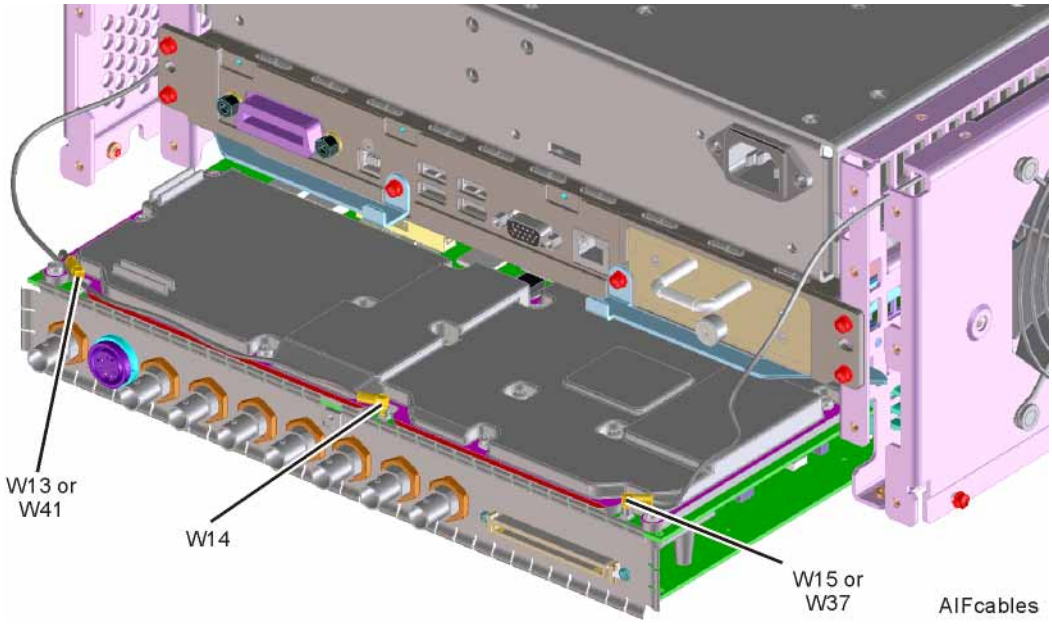
13. If the 22.5 MHz signal is within tolerance, carefully reconnect the W41 cable to A3J19.

NOTE You should hear a distinct snap when reconnecting the W41 cable. If this cable is not installed properly, intermittent signal fluctuations may occur on the analyzer display.

Verifying the 300 MHz LO Input Power from the A16 Reference Assembly

1. Refer to Figure 7-15, carefully disconnect the W14 at A2J300.

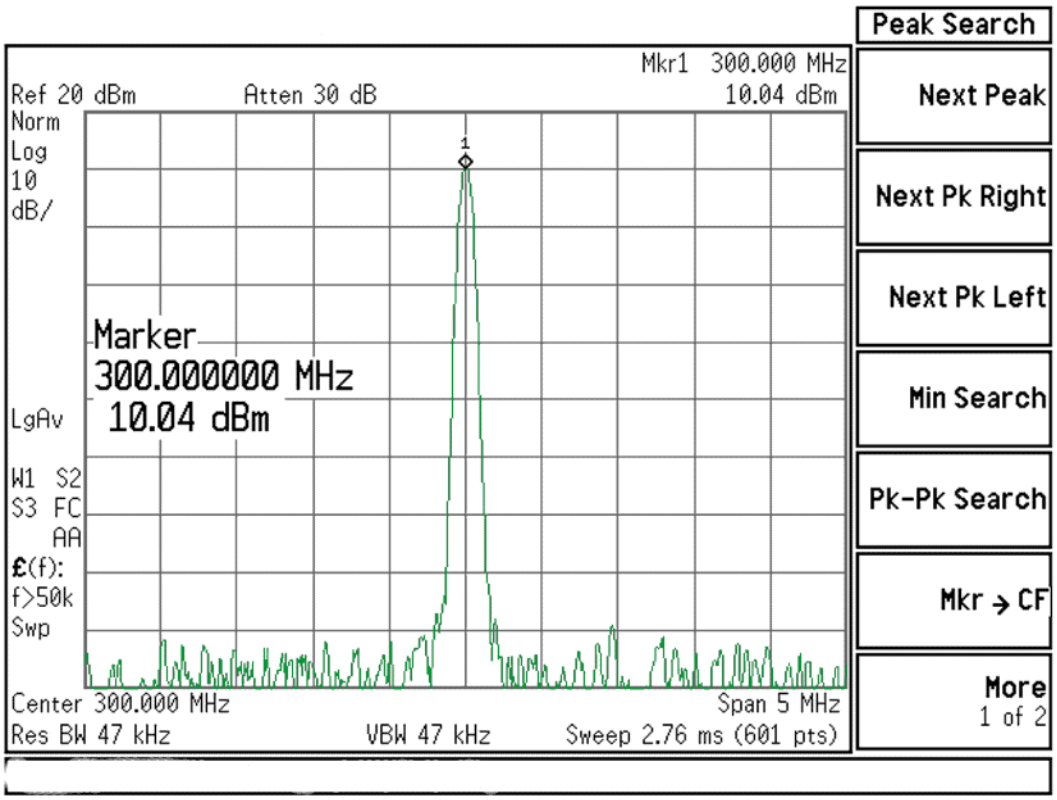
Figure 7-15 A2 Analog IF Cables



2. Connect the W14 cable to the MMCX female to SMA female adapter. Use an appropriate cable to go from the SMA adapter to the RF input of a functioning spectrum analyzer.
3. Press **Freq**, **300 MHz**, **Span**, **1 MHz**, **Amplitude**, **10 dBm**, **Peak Search** on the functioning spectrum analyzer.

4. The analyzer marker should read 300 MHz at 10 dBm ± 3 dB as shown in Figure 7-16.

Figure 7-16 300 MHz LO



5. If the 300 MHz signal is not measuring the correct power level, see the A16 Reference Assembly troubleshooting section in this service guide.
6. If the 300 MHz LO is measuring the correct power level and frequency and the 22.5 MHz signal is low, the most probable cause is the A2 Analog IF assembly.

A3 Digital IF Assembly Description

The A3 Digital I.F. has circuitry that is needed to analyze complex communication signals that can occupy up to 40 MHz of information bandwidth. This assembly has two inputs:

1. **The final 22.5 MHz I.F. from the A2 Analog I.F. for IF bandwidth paths up to 25 MHz wide. This input is used for swept and FFT spectrum analysis.**
2. **The 250 MHz IF from the A15 Front End Control Assembly for IF bandwidth of 40 MHz. If Option B85, B1A, or B1X is also installed, the 250 MHz IF will be routed to A3 via W53, A25, and W52.**

Each input has a separate ADC that processes the time domain continuous data into I/Q (in-phase and quadrature) signals before sending the data to the A4 CPU assembly for further processing and front panel display.

The Digital I.F. has the following main functions:

- Digitizes the 22.5 MHz and the 250 MHz IF signals
  - 16 bit ADC with a 100 MHz sample rate to digitize the 22.5 MHz IF
  - 12 bit ADC with a 200 MHz sample rate to digitize the 250 MHz IF
- DSP for standard spectrum analysis
- Capture memory for complex signals
- Noise Source Control
- Dither for final I.F
- Provides the alignment sequence generator for wide band alignments
- Provides wide band Comb Calibration Signal
- Trigger interpolation and associated alignment

A3 Digital IF Assembly Theory of Operation

NOTE Refer to Chapter 12, “Block Diagrams”.

Data Acquisition

The 22.5 MHz IF comes from the A2 Analog IF assembly. The input level to the A3 Digital IF assembly is –25 dBm when observing the 50 MHz calibrator signal. The IF input has a 25 MHz bandwidth centered at 22.5 MHz. The analog circuitry leading to the ADC converts the singled ended signal from the Analog IF to differential required by the ADC. In addition, it is part of a filter, part of which is on the AIF, which improves distortion. Finally, it couples in the dither signal. The ADC is a 16 bit device sampling continuously at 100 Ms/second.

The 250 MHz IF comes from the A15 Front End Control assembly. The input level is approximately -25 dBm when observing the 50 MHz calibrator signal. The IF input has a 40 MHz bandwidth centered at 250 MHz. The analog circuitry leading to the ADC converts the single-ended signal from the Front End Control to differential required by the ADC. Finally, it couples in the dither signal. The ADC is a 12-bit device sampling continuously at 200 Ms/second.

Rear Panel Triggers

The board has two trigger inputs and two trigger outputs all used via BNC connectors on the rear panel. The trigger inputs are used when an external device has a trigger signal and the user wants to use that external trigger to trigger the signal analyzer. The trigger outputs are used to synchronize other pieces of test equipment to the analyzer. These outputs are configurable through the Input/Output menu via the front panel of the instrument.

The trigger inputs each allow trigger levels to be set from –5 to +5 volts using the control DAC. The circuits have relatively high input impedance. The trigger outputs have 50 Ω source impedance with TTL drive levels into no load.

DSP

The outputs of the ADCs go to the T2 digital FPGA. T2 links the ADC with memory and the Feldspar DSP. T2 does all the swept SA DSP and orchestrates measurements. It also provides outputs to the reconstruction system. Feldspar is a DPSP ASIC which performs all the DSP for wide-band applications.

Reconstruction

Analog data from the digital FPGA, T2, is fed into a DAC that recreates an analog signal. It can be either video or the demodulated audio. The signal can be routed to the analyzer's audio system (to listen to the demodulated signals) or to the ANALOG OUT connector on the rear panel.

Clock Distribution

The 100 MHz reference from the A16 Reference Assembly feeds a power divider. One output of the divider is buffered, doubled, and filtered to generate the 200 MHz clock needed for ADC2, the ADC for the 40 MHz BW path,. The remaining output of the power divider is attenuated and buffered before being fed to the clock distribution IC. This IC generates all the other clocks needed by the A3 Digital I.F. Assembly as well as the 10 MHz OUT connector on the rear panel.

Noise Source Voltage Regulator

Various external noise sources can be connected to the rear panel of the analyzer. These noise sources require a very accurate 28 volt DC power supply.

The 28 volt BNC output connector is used with the 346 series noise sources.

The Smart Noise Source (SNS) interface includes power switching for the 28 volt and 15 volt power supply. In addition, it has buffers to interface to the SNS I2C bus for control and read back of ENR data automatically. The SNS connector is used with the SNS series noise sources.

Digital Bus Common Mode Filtering

The Digital Bus is a real time digital interface. It is sometimes referred to as Messenger or LVDS. The implementation on the Digital IF is unidirectional, meaning it can only source data, not receive it. Common mode filtering is required to translate the digital ground referenced signals to analog ground at the rear panel.

A3 Digital IF Troubleshooting

Verifying the 22.5 MHz Input Power

1. Perform an instrument shutdown.
2. Remove the cover of the analyzer. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn the instrument over so that the bottom side of the analyzer is facing up.
4. Turn on the analyzer and wait for the instrument to complete the boot up process.
5. Press **System**, **Alignments**, **Auto Align**, **Off**
6. Press **Input/Output**, **RF Calibrator**, **50 MHz**
7. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dB. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.
8. To continue verifying press **FREQ**, **Zero Span**. Verify the input attenuator on the analyzer is set to 10 dB. Look near the top of the display near the center and verify **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.

9. Refer to Figure 7-17, carefully disconnect W41 cable at A3J19.

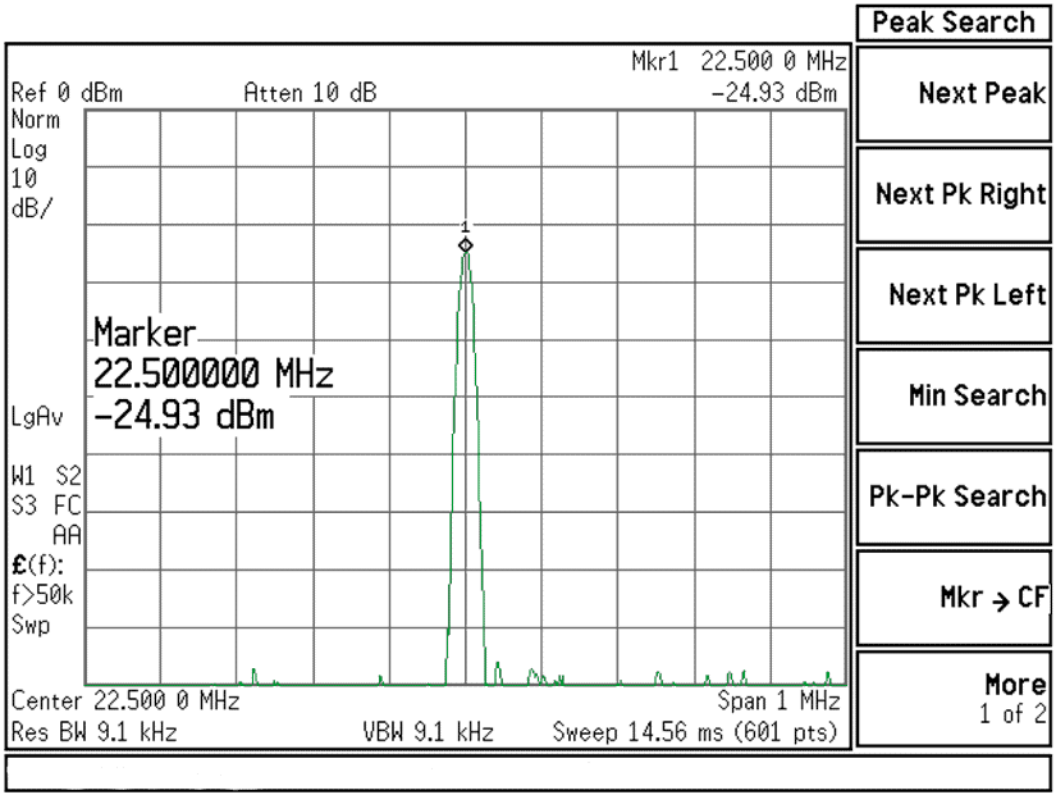
Figure 7-17 A3 Digital IF Cables

10. Connect the W41 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer to verify the 22.5 MHz I.F. signal frequency and amplitude is correct.

11. Press **Freq**, **22.5 MHz Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

12. The analyzer should read 22.5 MHz at –25 dBm ± 4 dB as shown in Figure 7-18.

Figure 7-18 22.5 MHz IF Input



13. If the 22.5 MHz signal is not measuring the correct power level, see "A2 Analog I.F. Troubleshooting" on page 263 in this service guide.

14. If the 22.5 MHz signal is within tolerance, carefully reconnect the W41 cable to A3J19.

Verifying the 250 MHz IF Input Power (Option B40 only)

NOTE Perform this procedure only if the analyzer is equipped with Option B40, Analysis Bandwidth, 40 MHz

1. Perform an instrument shutdown.
2. Remove the cover of the analyzer. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn the instrument over so that the bottom side of the analyzer is facing up.
4. Turn on the analyzer and wait for the instrument to complete the boot up process.
5. Press **MODE/MEAS**. Select **I/Q Analyzer (Basic)** mode, **Complex Waveform** measurement, and **Normal** view. Press **OK**.
6. Press **Meas Setup**, **IF Path**, **IF Path 40 MHz**.
7. Press **System**, **Alignments**, **Auto Align**, **Off**.
8. Press **Input/Output**, **RF calibrator**, **50 MHz**.
9. Verify the 50 MHz signal is at –25 dBm by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the analyzer. The marker readout should be 50 MHz at –25 dBm ± 3 dB. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.
10. To continue verifying press **MODE/MEAS**, **select IQ Waveform** measurement, **IQ Waveform** view. Press **OK**. Verify the input attenuator on the analyzer is set to 10 dB. Look near the top of the display near the center and verify **Atten: 10 dB** is visible. If needed change the input attenuator by pressing **AMPTD**, **Attenuation**, **Mech Atten 10 dB** on the analyzer.

11. Refer to Figure 7-19, carefully disconnect W38 or W52.

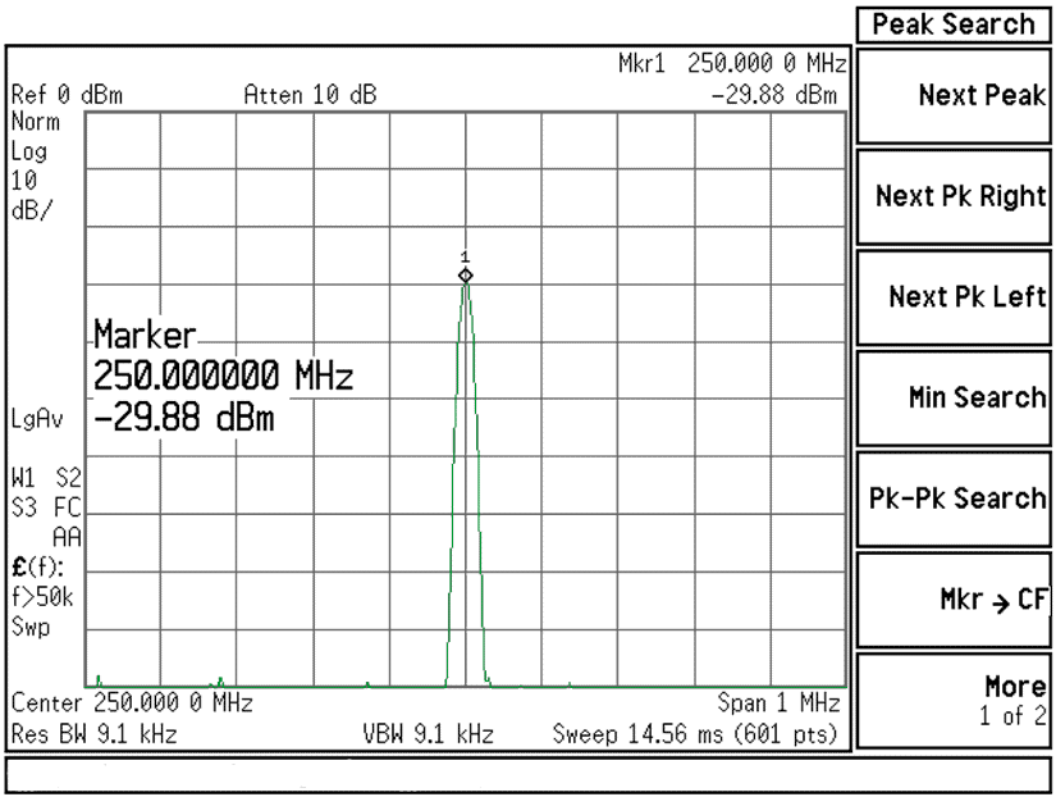
Figure 7-19 A3 Digital IF Cables

12. Connect the W38 or W52 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer to verify the 250 MHz I.F. signal frequency and amplitude is correct.

13. Press **Freq**, **250 MHz**, **Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

14. The analyzer marker should read 250 MHz at –30 dBm ± 4 dB as shown in Figure 7-20.

Figure 7-20 250 MHz IF Input



15. If the 250 MHz signal is not measuring the correct power level and neither of Options B85, B1A, or B1X are present, see Chapter 6, “Front End Control Troubleshooting” in this service guide. If the 250 MHz signal is not measuring the correct power level and either Option B85, B1A, or B1X is installed, see “A25 Wideband Troubleshooting” later in this chapter.

16. If the 250 MHz signal is within tolerance, carefully reconnect the W38 or W52 cable to A3J15.

NOTE You should hear a distinct snap when reconnecting the cable. If this cable is not installed properly, intermittent signal fluctuations may occur on the analyzer display.

Verifying the 100 MHz Reference Input

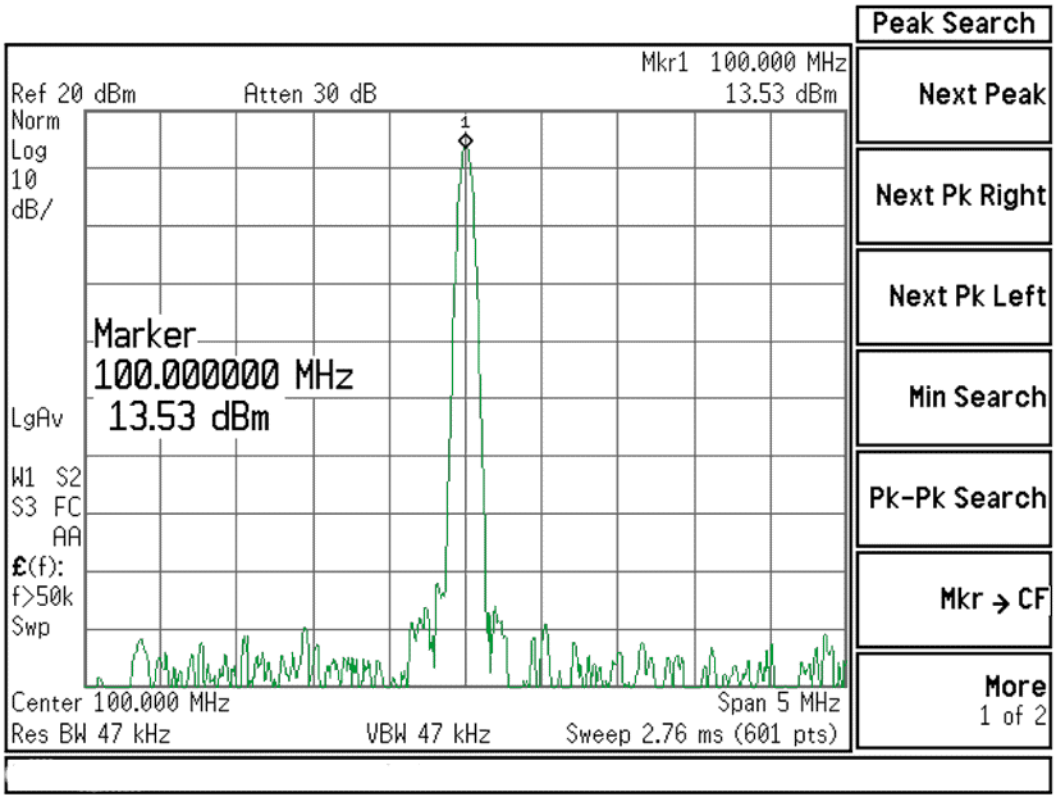
1. Perform an instrument shutdown.
2. Remove the cover of the analyzer. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn the instrument over so that the bottom side of the analyzer is facing up.
4. Turn on the analyzer and wait for the instrument to complete the boot up process.
5. Press **System**, **Alignments**, **Auto Align**, **Off**.
6. Press **Input/Output**, **RF calibrator**, **50 MHz**.
7. Refer to Figure 7-21, carefully disconnect W42 or W54 cable at A3J14.

Figure 7-21 A3 Digital IF Cables

8. Connect the W42 or W54 cable to the MMCX female to SMA female connector. Use an appropriate cable to go from the SMA connector to the RF input of a functioning spectrum analyzer to verify the 100 MHz reference frequency and amplitude is correct.
9. Press **AMPTD**, **Ref Level**, **20 dBm**, **Freq**, **100 MHz**, **Span**, **1 MHz**, **Peak Search** on the functioning spectrum analyzer.

10. The analyzer marker should read 100 MHz at +10 dBm ± 4 dB as shown in Figure 7-22.

Figure 7-22 100 MHz Reference Input



11. If the 100 MHz signal is measuring incorrectly, see Chapter 8, "L.O. Synthesizer/Reference Troubleshooting" in this service guide.

12. If the 22.5 MHz IF, 250 MHz IF (if appropriate) and 100 MHz reference signals measure the correct frequency and amplitude and yet the display is not processing the signal properly, the most probable causes are the A3 Digital IF or the A4 CPU. It is difficult to separate these two assemblies given the architecture of the analyzer. Each assembly will have to be tried to see which one is causing the failure.

≥ 85 MHz BW IF Section

A25 Wideband Analog IF Assembly Description

The analyzer's RF input signal is down converted to a 300 MHz intermediate frequency by the A13 Front End assembly and routed through the A15 Front End controller to A15J901. Cable W53 connects A15J901 to the input of the A25 Wideband Analog IF at J101. The signal is filtered, attenuation and gain applied based upon the instrument settings. This signal is then sampled by the ADC and the resultant data is the sent to the A26 Wideband Digital IF for processing via the J2 ribbon cable. The A26 Wideband Digital IF has no service accessible locations and should be troubleshot from the front panel controls.

Inputs to the A25 Assembly

A25J101 300 MHz IF signal (from A15J901 Front End Controller)

A25J301 2400 MHz reference from A16 Reference Assembly via W34 cable

A25J805 Step Calibrator from A3J17 40 MHz Digital IF via W45 cable

Outputs from the A25 Assembly

A25J302 2400 MHz Reference Out

A25J102 300 MHz IF Out to A3J15 of the 40 MHz Digital IF

A25J806 50 MHz Comb Out to A16 Reference assembly A16J726 via W56 cable

A25J2 ADC Data to 140 MHz Digital IF A26J504 via W44 cable

A25 Wideband Analog IF Assembly Theory of Operation

The A25 Wideband Analog IF assembly primary role is to properly filter and apply attenuation or gain to optimize the level going to the ADC and provide sufficient pre-filtering to reject images that would otherwise interfere with the signal of interest. Precision alignments are used to calibrate the filters, attenuators and gain of this assembly. It is not uncommon that the reported failure will come from failures reported when an alignment fails for this assembly. The alignment history file is a good indicator of a failure for this assembly. This file is a text file that can be edited with Notepad. The file is located in the following location:

E:\AlignDataStore\AlignmentHistory.txt

This file will list all alignments that have passed or failed. Alignments reporting a failure of the WBAIF assembly can in many cases be attributed to failure of this assembly. If however these errors follow errors in the RF section of the instrument, it is possible that additional WBAIF error will appear due to missing RF Calibration signals and not related to the A25 Wideband IF assembly.

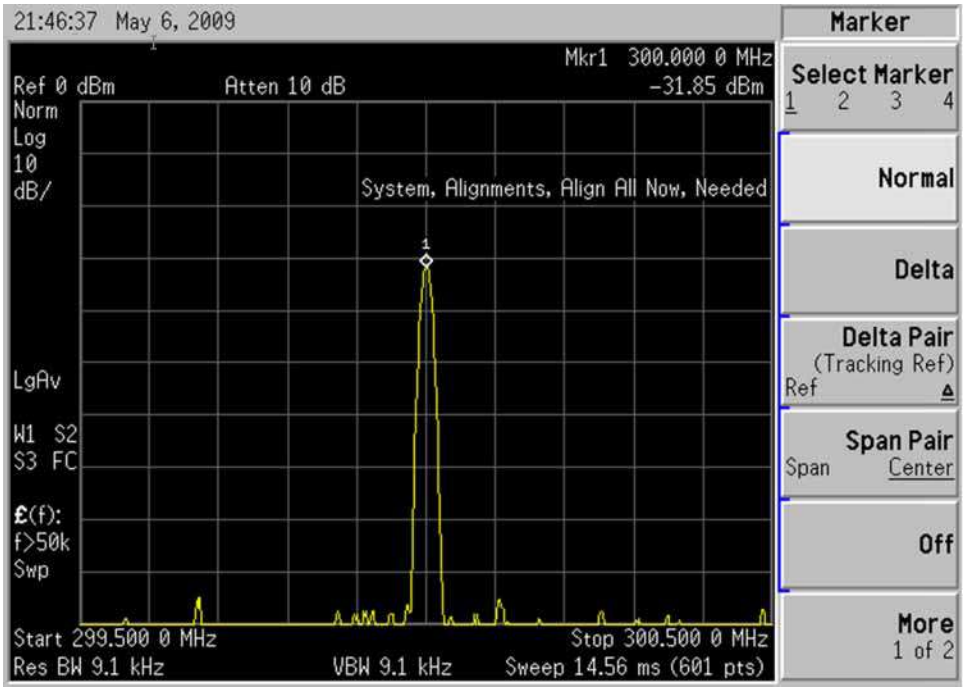
Manually troubleshooting the assembly is basically verifying the 300 MHz IF signal is present and at the proper level. In addition you will want to verify input and output levels of the various calibration and reference signals.

Additionally, the A25 Analog IF has a built in RF Burst Trigger that is available when either the 85 MHz, 125 MHz, 140 MHz, or 160 MHz IF path is selected

A25 Wideband Troubleshooting

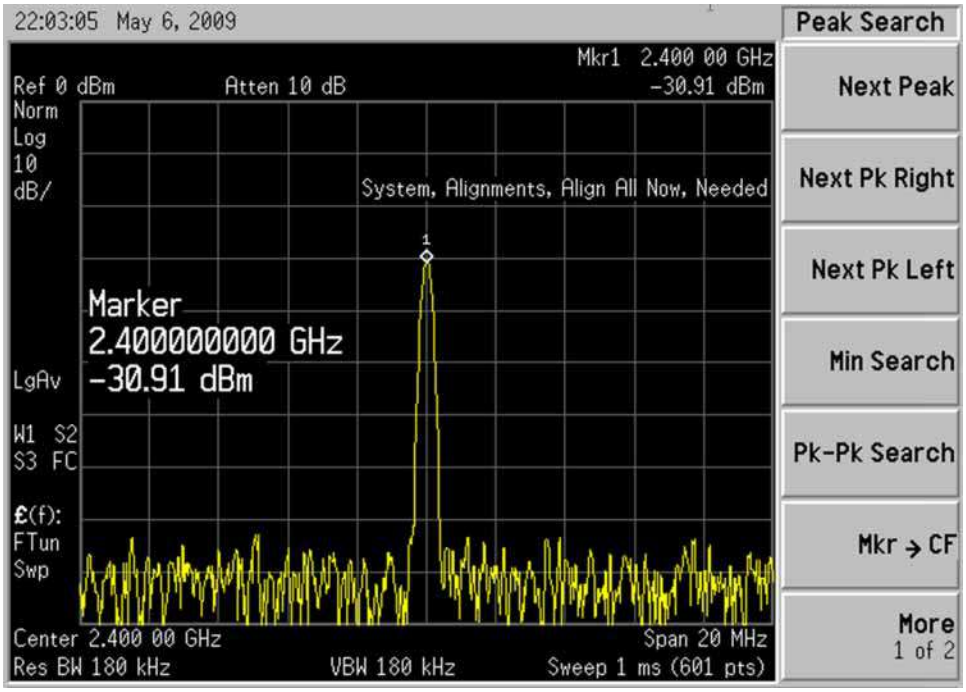
Verify the 300 MHz IF Input level

1. Turn the instrument off.
2. Remove the instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn on the N9020B Signal Analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **MODE/MEAS**. Select **I/Q Analyzer (Basic)** mode, **Complex Waveform** measurement, and **Normal** view. Press **OK**.
6. Press **Input/Output**, **RF Calibrator**, **50 MHz**
7. Press **Meas Setup**, **IF Path**, **IF Path 85, 120, or 140 MHz**
8. Verify the 50 MHz signal is at –25 dBm on the analyzer display by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the N9020B. The marker readout should be 50 MHz at –25 dBm ±3 dB. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.
9. Connect A25J02 to a known good spectrum analyzer. Tune the spectrum analyzer to 300 MHz.This port switches the 300 MHz IF that is input to the A25 Wideband Analog IF to be routed to the A3J16 40 MHz Digital IF. If this –30 dBm ±3 dB signal is present, you have verified the 300 MHz IF from the A15J901 Front End Controller. If this signal is not present, verify the signal is present on A15J901 of the A15 Front End Controller.


21:46:37 May 6, 2009
Mkr1 300.000 0 MHz
Ref 0 dBm
Atten 10 dB
-31.85 dBm
Norm
Log
10
dB/
System, Alignments, Align All Now, Needed
LgAv
W1 S2
S3 FC
£(f):
f>50k
Swp
Start 299.500 0 MHz
Stop 300.500 0 MHz
Res BW 9.1 kHz
VBW 9.1 kHz
Sweep 14.56 ms (601 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2

Verify the 2400 MHz Frequency Reference

1. Turn the instrument off.
2. Remove the instrument cover. Refer to Chapter 15, “Assembly Replacement Procedures” in this service guide.
3. Turn on the N9020B Signal Analyzer and wait for the instrument to complete the boot up process.
4. Press **System**, **Alignments**, **Auto Align**, **Off**.
5. Press **MODE/MEAS**. Select **I/Q Analyzer (Basic)** mode, **Complex Waveform** measurement, and **Normal** view. Press **OK**.
6. Press **Input/Output**, **RF Calibrator**, **50 MHz**
7. Press **Mode Setup**, **IF Path**, **IF Path 85, 125, or 140 MHz**
8. Verify the 50 MHz signal is at –25 dBm on the analyzer display by pressing **FREQ**, **50 MHz**, **Span**, **1 MHz**, **Peak Search** on the N9020B. The marker readout should be 50 MHz at –25 dBm ±3 dB. If this reference signal is measuring incorrectly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.
9. Connect a known good spectrum analyzer to A25J302. Verify reference signal at 2400 MHz at a level of –30 dBm.



A26 140 MHz Wideband Digital IF Troubleshooting

Verify the 300 MHz IF Input level

The A26 Digital IF has a single accessible input at A25J2. It is not advisable to disconnect this cable and make measurements. Normally failure of this assembly will occur during extensive alignments. Verify if there are alignment error related to the WBDIF located in the E:\AlignDataStore\AlignmentHistrory.txt files.

If errors are found related to WBDIF replace the A26 Wideband Digital IF assembly. To troubleshoot this module set the instrument up as below:

1. Turn on the N9020B Signal Analyzer and wait for the instrument to complete the boot up process.
2. Press **System**, **Alignments**, **Auto Align**, **Off**.
3. Press **MODE/MEAS**. Select **I/Q Analyzer (Basic)** mode, **Complex Waveform** measurement, and **Normal** view. Press **OK**.
4. Press **Input/Output**, **RF Calibrator**, **50 MHz**
5. Press **Span**, **10 MHz**
6. Press **Mode Setup**, **IF Path**, **IF Path 85, 125, or 140 MHz**
7. Verify the 50 MHz signal is at –25 dBm on the analyzer display by pressing **Peak Search** on the N9020B. The marker readout should be 50 MHz at –25 dBm ±3 dB.
8. If this signal is not present, determine if the issue is only present with the Wideband 85, 125, or 140 MHz path. Press **Mode Setup**, **IF Path**, **40 MHz**. If the signal is now present, there is a likely failure of the A26 Wideband Digital IF or the A25 Wideband Analog IF

8 L.O. Synthesizer/Reference Troubleshooting

What You Will Find in This Chapter

The following information is found in this chapter:

A14 L.O. Synthesizer Assembly Description on page 308

A14 L.O. Synthesizer Theory of Operation on page 309

A14 L.O. Synthesizer Troubleshooting on page 310

A16 Reference Assembly Description on page 318

A16 Reference Assembly Troubleshooting on page 321

A14 L.O. Synthesizer Assembly Description

Purpose

The L.O. Synthesizer assembly provides the 1st Local Oscillator to the A13 RF Front End Assembly for RF conversion. This assembly has the following inputs and outputs:

- Power Supply inputs
- Serial Bus input for L.O. Control
- Sweep input for L.O. Control
- 4800 MHz input signal from A16 Reference Assembly
- 1st L.O. output signal to A13 RF Front End Assembly

The input signal to the L.O. Synthesizer Assembly is a 4800 MHz signal that is generated on the A16 Reference Assembly. The 1st L.O. is then phase locked to this 4800 MHz reference, which is then phase locked back to the 10 MHz reference located on the A16 Reference Assembly. The quality of the phase lock design that locks the 1st L.O. has a direct relationship on the overall stability of the analyzer. Users can also provide their own external reference. The frequency accuracy of the user frequency reference is directly related to the overall frequency accuracy of the signal analyzer.

The 1st L.O. has a tuning range from 3.8 GHz to 8.7 GHz and an output power from +13 to +18 dBm. The RF input signal mixes with the 1st L.O. in one of three possible mixers on the RF Front End Assembly. For more detailed description on the RF Front End Assembly, see Chapter 4, “RF Section Troubleshooting (RF/Microwave Analyzers)” in this service guide.

A14 L.O. Synthesizer Theory of Operation

The main oscillator is a low frequency Voltage Controlled Oscillator (VCO) that has a frequency range from 570 MHz to 1150 MHz. This VCO has low-phase noise that is multiplied to the desired 1st LO frequency range.

This VCO/Multiplier technology uses built-in filters after each multiplier to suppress the undesired harmonics. The resultant output has enough power with a wide enough frequency range to measure RF input signals up to 26.5 GHz.

Brief Description of the Major Blocks:

- The Field Programmable Gate Array (FPGA) L.O. Controller has the capability to perform automatic pretune update, unlock detection, reference signal phase adjustment, and automatic segment sequencing using block RAM and its segment state machine.
- The fractional-N divider performs frequency division of the feedback VCO signal.
- The VCO is a low noise, voltage control oscillator multiplied up to the actual LO frequency. This wide-band oscillator features isolated input ports, allowing the main tune port and the FM tune port to be formed. It has more than an octave of tuning range with relatively flat tuning sensitivity.
- The LO Multiplier is a frequency multiplier with switched filters and amplifiers to produce the required output frequency.

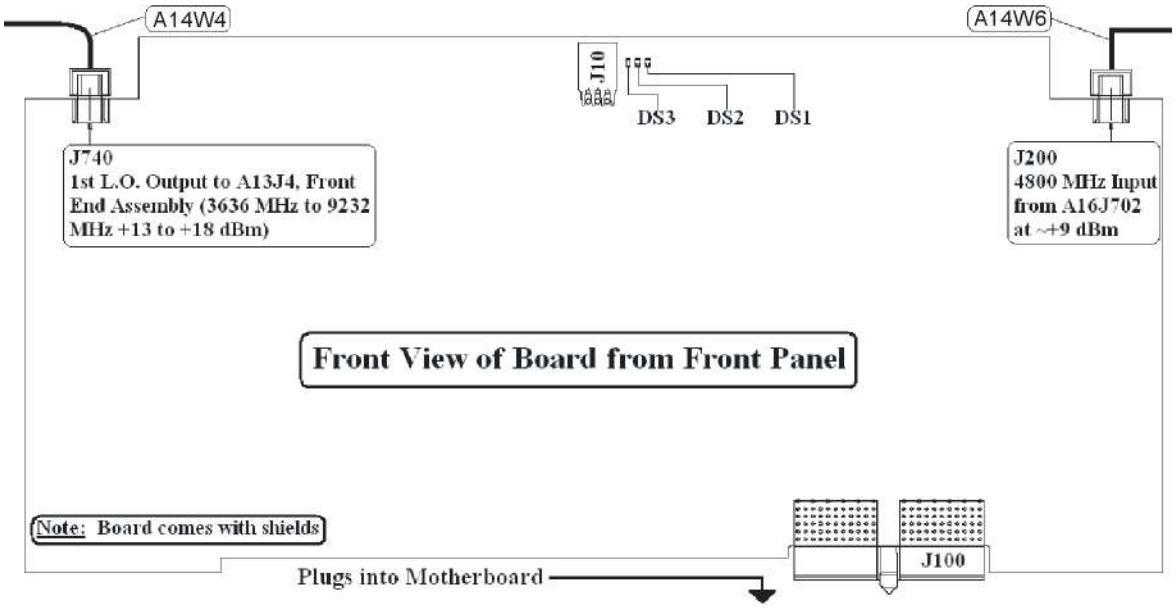
A14 L.O. Synthesizer Troubleshooting

Turn on the analyzer and wait for the instrument to complete the boot up process. There are (6) processes to perform, which will verify the L.O. Synthesizer Assembly is functioning properly:

- Press **FREQ**, **50 MHz**, **Zero Span**. LED's DS1-DS3 located near the top of the board next to J10 should all be off. See LED location in Figure 8-1 below.
- Press **System**, **Alignments**, **Align Now, Align Now All**. If the alignment functions correctly with no error messages on the analyzer display, most of the board is working properly.
- Measure 4800 MHz Input frequency (from A16 Reference Assembly)
- Measure 4800 MHz Input Power (from A16 Reference Assembly)
- Measure L.O. Output Power.
- Measure L.O. Output Frequency.

These items can be checked with a functioning spectrum analyzer using cables and connectors that function well up to 10 GHz.

Figure 8-1 A14 L.O. Synthesizer Assembly



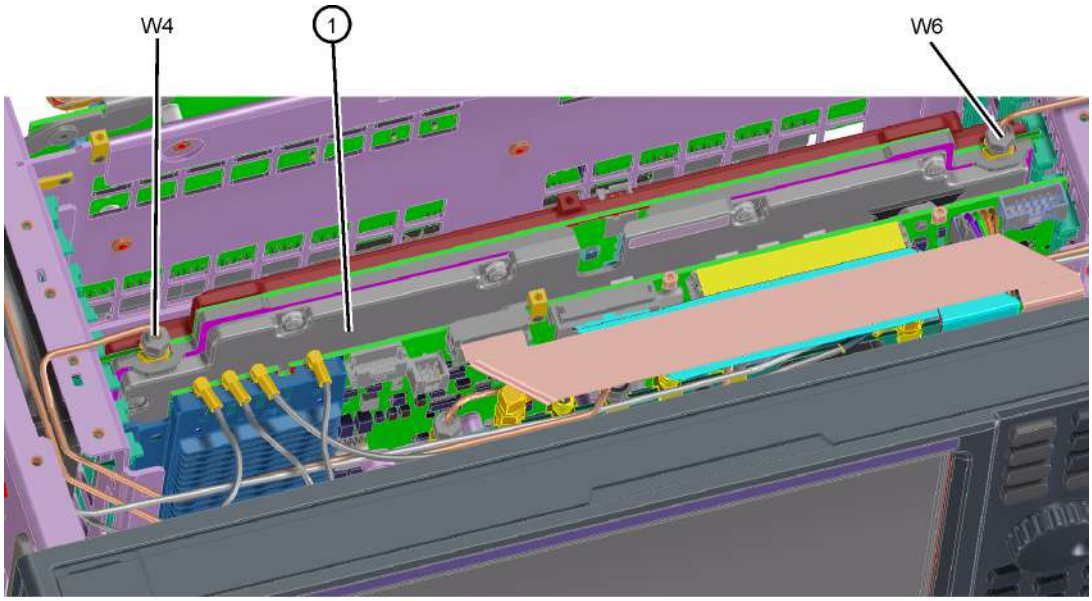
Verifying the 4800 MHz Input Power & Frequency Stability:

- Turn on the analyzer and wait for the instrument to complete the boot up process.
- Press **FREQ**, **4.2 GHz**, **Zero Span**.
- Disconnect A14W6 cable at A14J200 (see Figure 8-2).

NOTE DS2 and DS3 will illuminate when the W6 cable is removed. This is normal.

- Connect A14W6 cable end to the RF input of the functioning spectrum analyzer.

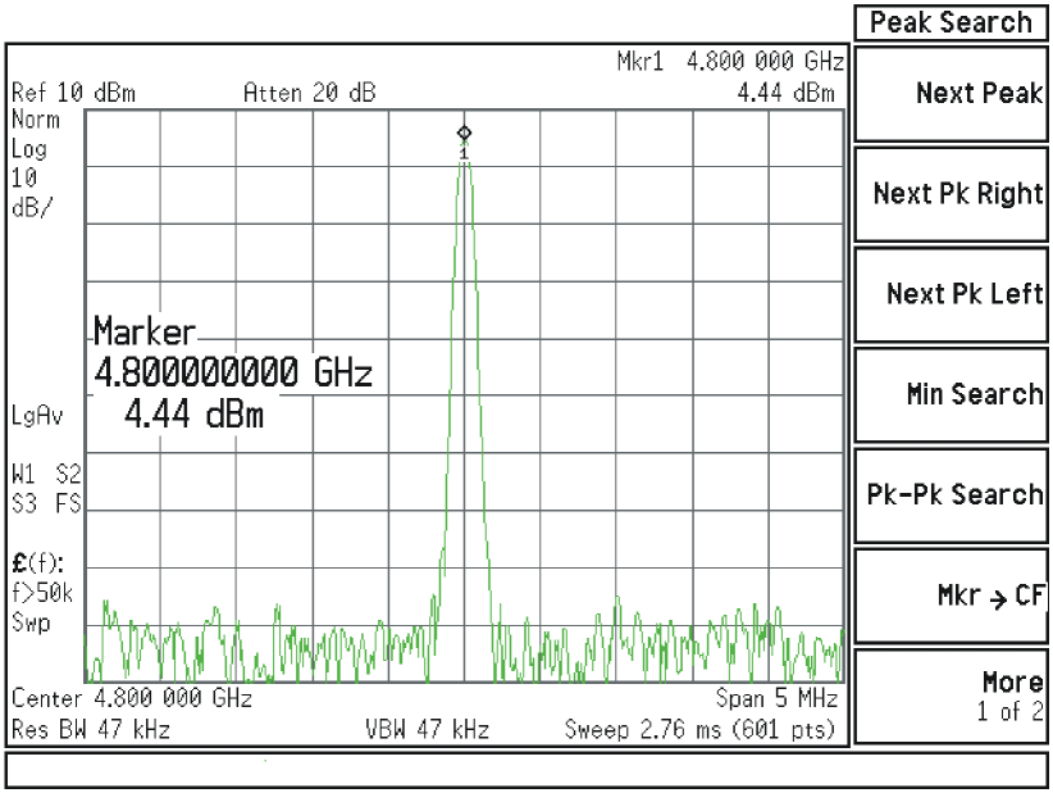
Figure 8-2 W4 and W6 Location



lo_synth

– The analyzer marker should read 4800 MHz at +4.5 dBm ± 2 dB as shown in Figure 8-3.

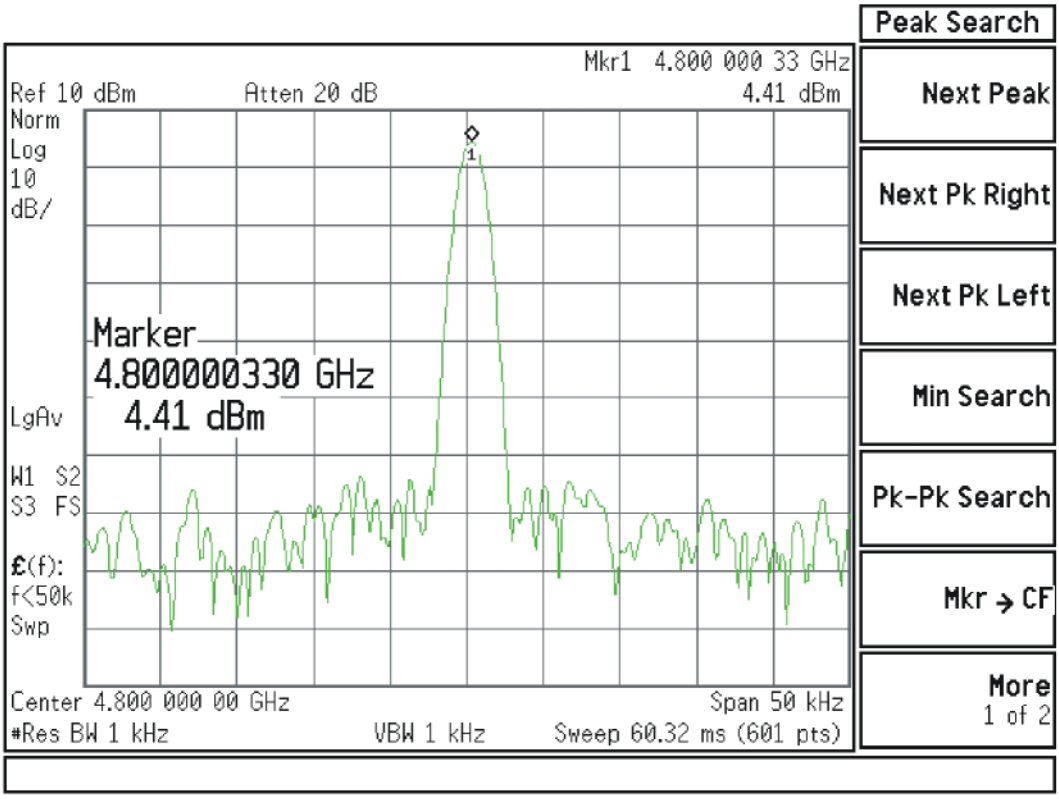
Figure 8-3 4800 MHz Wide Span



– Verify the 4800 MHz input signal from the A16 Reference Assembly is stable by pressing **FREQ, Span**, **50 kHz**, **BW**, **1 kHz**. The signal on the functioning spectrum analyzer should be very stable both in frequency and power as shown in Figure 8-4.

– Reconnect the W6 cable to A14J200.

Figure 8-4 4800 MHz Narrow Span



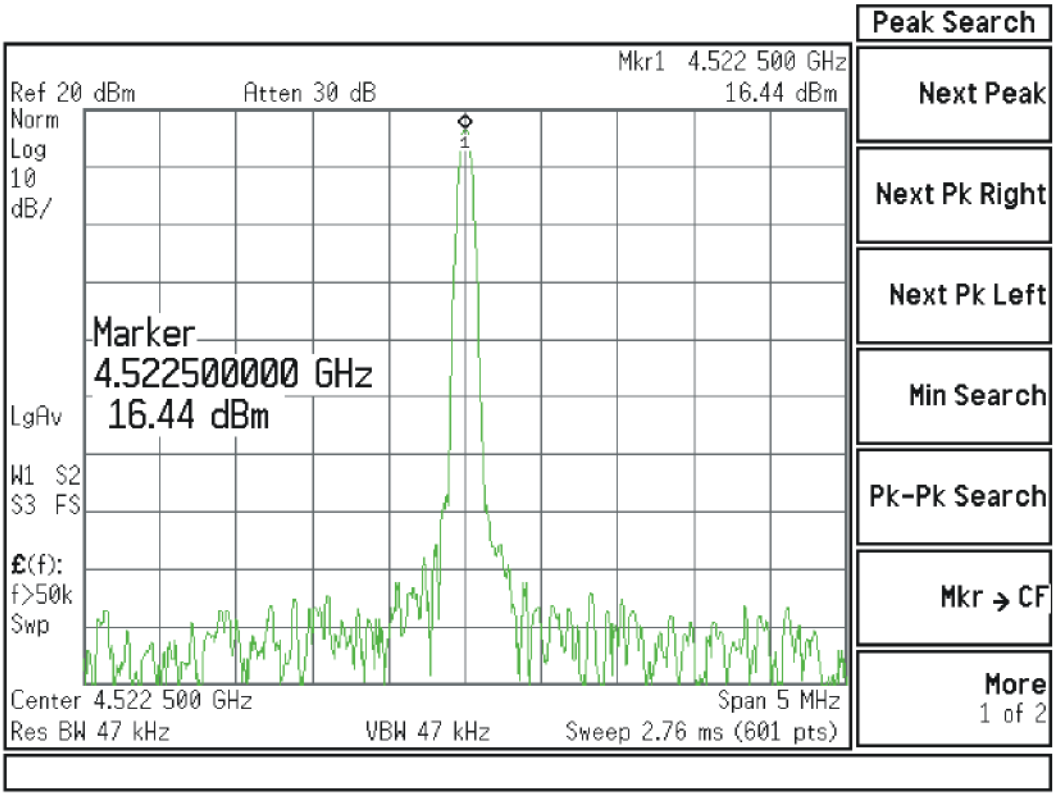
NOTE If the 4800 MHz signal is not measuring the correct power level, see the "A16 Reference Assembly Troubleshooting" section later in this chapter.

Verifying the 1st L.O. Output Power:

- Turn on the analyzer and wait for the instrument to complete the boot up process.
- If the analyzer has Option 503, press **FREQ, 600 MHz, Zero Span**.

  If the analyzer does not have Option 503 press **FREQ, 4.2 GHz, Zero Span**.
- Refer to Figure 8-1, disconnect A14W4 cable at A14J740.
- Connect A14J740 1st LO output to the RF input of the functioning spectrum analyzer using a cable that will function up to 10 GHz.
- Press **Frequency**, **4.5225 GHz** (if the analyzer does not have Option 503) or **Frequency 5.7225 GHz** (if the analyzer has Option 503), **Span**, **5 MHz**, **Peak Search** on the functioning spectrum analyzer. If the functioning spectrum analyzer has a preselector peak or preselector centering function, perform that operation to guarantee the preselector is optimized for the measurement.
- The analyzer marker should read 4.5225 GHz or 5.7225 GHz at +16.55 dBm ± 3 dB as shown in Figure 8-5.

Figure 8-5 4.5225 GHz 1st L.O. Measurement



NOTE If the 4.5225 GHz or 5.7225 GHz signal is not measuring the correct power level, the LO Synthesizer assembly is the most probable cause.

Continue changing the center frequency of the analyzer as per Table 8-1 and measure the LO output expected frequency and power using the functioning spectrum analyzer.

NOTE Perform the preselector peak or preselector centering on the functioning spectrum analyzer if any of the expected 1st L.O. power levels are not within tolerance.

Table 8-1

Center Frequency of analyzer (MHz)	Expected 1st L.O. Frequency (GHz) @A14J704	Expected 1st L.O. Power (dBm) @A14J704
4200[a]	4.5225	+16.5 ± 3 dB
4300[a]	4.6225	+16 ± 3 dB
600	5.7225	+16 ± 3 dB
700	5.8225 (see Figure 8-6)	+16 ± 3 dB
2100	7.2225	+16 ± 3 dB
2200	7.3225 (see Figure 8-7)	+16 ± 3 dB

a. Does not apply to analyzers with Option 503.

Figure 8-6 5.8225 GHz 1st L.O. Measurement

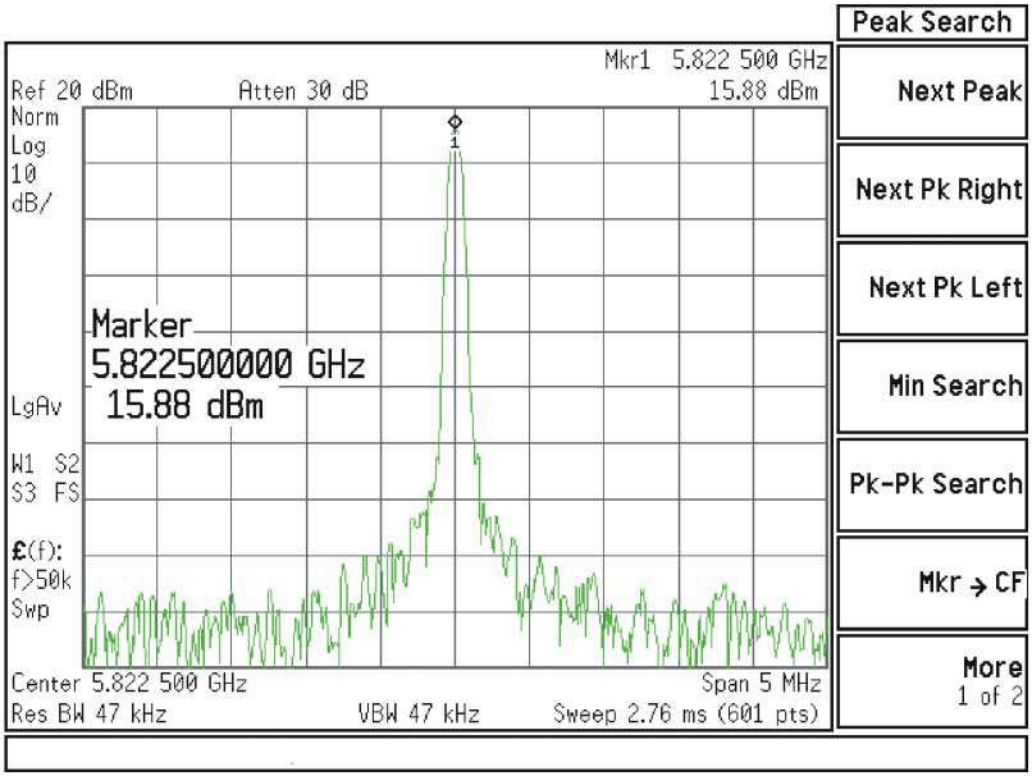
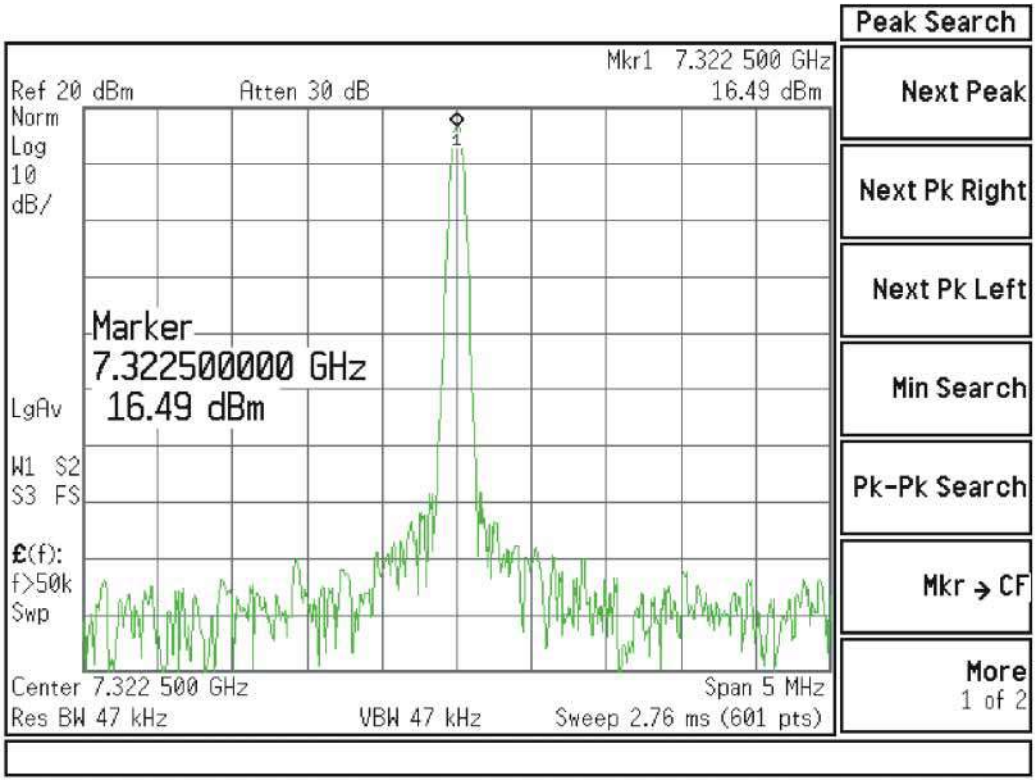


Figure 8-7 7.3225 GHz 1st L.O. Measurement



A16 Reference Assembly Description

Purpose

The A16 Reference Assembly provides the fundamental reference signals from which all instrument local oscillator and synchronous timing signals are derived The reference board also uses these same signals to generate CW and modulated RF calibration signals and a 10 MHz time base signal for the instrument

The Reference assembly must be replaced as a single assembly, although it is constructed of two boards, the A16 Reference Main board and A16A1 Reference Daughter board. These boards are listed individually in the Show Hardware screen, allowing identification of the individual board part numbers comprising the complete assembly.

The reference signals and local oscillators can be phase locked to a timebase in one of two ways:

1. The internal 10 MHz reference located on the A16 Main Board.
2. An externally provided reference such as a house standard or the reference from another instrument or a base transceiver system. The external reference can be any RF signal in the range of 1 MHz to 50 MHz, -5 dBm to +10 dBm.

If an external reference signal is within 200 Hz of the specified external reference frequency and **Freq Ref In** is set to **Sense**, the analyzer will automatically switch from SENSE:INT to SENSE:EXT.

The frequency accuracy of the analyzer is directly tied to the accuracy of the frequency reference that is being used.

Diagnostic LEDs monitor the status of the various PLLs on the A16 Reference Assembly.

Table 8-2 A16 Reference Assembly Signals

Signal Description	From Location	Originates From	To Location	Purpose
External Reference Input (1 to 50 MHz, -5 dBm to +10 dBm)	Input from User	n/a	A16704	Phase Lock analyzer with user reference.
10 MHz Out DIF	A16J710	10 MHz Reference	A3J14[a]	Used as a reference to other assemblies throughout the instrument.
50 MHz Align Signal	A16J701	100 MHz VCXO/2	A9, Cal Signal Input, Input Attenuator A.	50 MHz Low band alignment signal.
4800 MHz Align Signal	A16J701	2.4 GHz VCXO x 2	A9, Cal Signal Input, Input Attenuator A.	4.8 GHz High band alignment signal
50 MHz Ecal/300 MHz Comb Output	A16J705	100 MHz VCXO/2, 100 MHz VCXO x 3	A13J6, RF Front End Assembly	50 MHz Cal Signal or 300 MHz Comb for wideband I.F. phase linearity
100 MHz Ref A	A16J707	100 MHz VCXO	A19J901	Frequency reference for A19 BBIQ Main Board assembly
100 MHz Ref B	A16J716	100 MHz VCXO	A3J14[b]	Frequency reference for A3 Digital IF (DIF) assembly. Divided by 10 on DIF to provide 10 MHz OUT on rear panel.
100 MHz Ref C	A16J717	100 MHz VCXO	Not used	Reserved for future use.
300 MHz LO AIF	A16J711	100 MHz VCXO x 3	A2J300	Used as 3rd LO on A2 Analog IF (AIF) assembly
2.4 GHz Ref	A16J718[c]	2.4 GHz VCXO	A25J301	Reference for A25 Wideband Digital IF (WDIF)
4.8 GHz 2nd LO	A16J702	2.4 GHz VCXO x 2	A13J1	2nd LO for A13 Front End assembly, downconvert low band 1st IF to 322.5 MHz 2nd IF
4.8 GHz 1st LO Ref	A16J703	2.4 GHz VCXO x 2	A14J4	4GHz reference for Offset Loop, only used in Dual-Loop operation

a. The 10 MHz signal from A16J713 is used a reference for the standard A3 Digital IF, which supports analysis bandwidths up to 25 MHz.

b. The 100 MHz signal from A16J716 is used as the reference for the optional A3 Digital IF which supports analysis on analyzers with bandwidths up to 40 MHz. This A3 is used on analyzers with Options B40, B85, B1A, B1X, MPB, or DP2.
c. Any analyzers with Option B85, B1A, or B1X.

A16 Reference Assembly Troubleshooting

If the A16 Reference Assembly is suspect, verify the reference signals, local oscillator output frequencies, and power levels as per Table 8-2 using a functioning spectrum analyzer.

The board layout in Figure 8-8 and Figure 9-9 below identifies the input and output connectors and LEDs on the A16 Reference Assembly.

If these outputs measure correctly, the A16 Reference Assembly is functioning correctly. If not, the Reference Assembly is the most probable cause provided the power supply is operating correctly. Refer to "A7 Midplane Assembly Troubleshooting" on page 353 if the power supplies are suspect.

Figure 8-8 A16 Reference Assembly

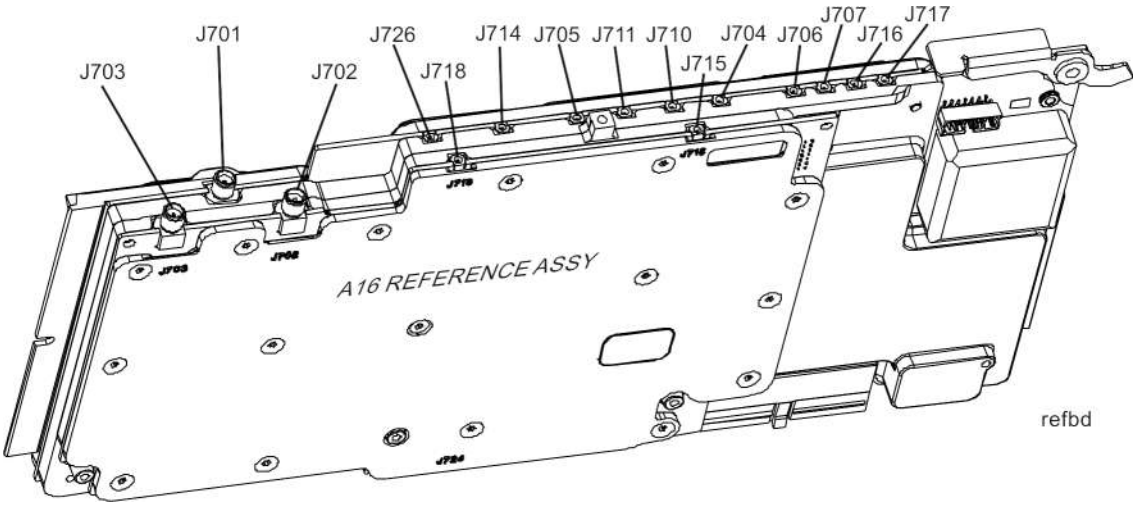


Figure 8-9 A16 Reference LEDs

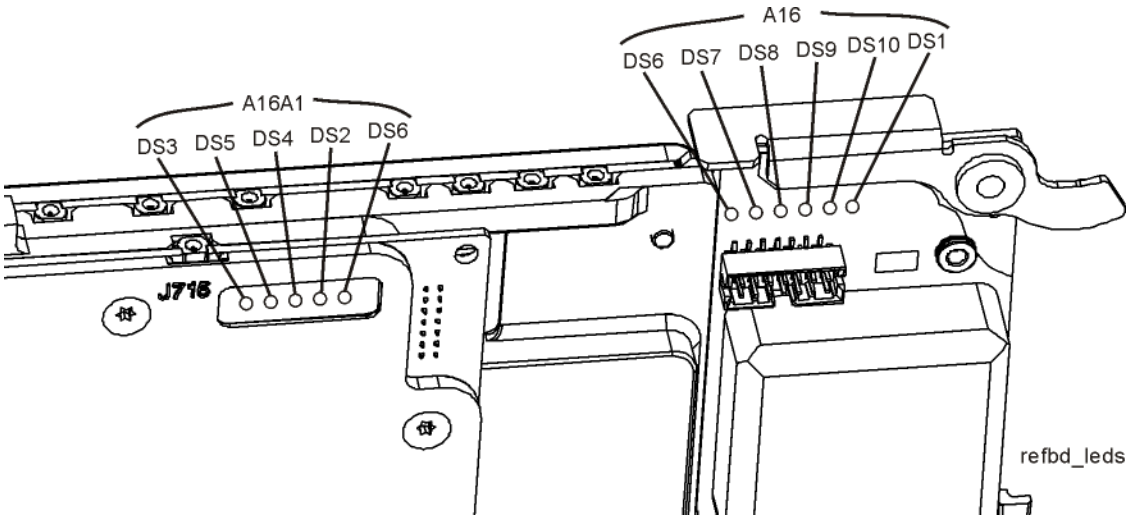


Table 8-3 A16 Reference Assembly Signal Measurement Details

Signal Description	Signal Location	Expected Frequency (MHz)	Expected Power Level (dBm)	Special Instrument Conditions	Figure
50 MHz Ecal Out	A16J705	50 MHz	–26 to –29 dBm typical	While monitoring A16J705 output, place functioning spectrum analyzer in Max Hold. Press **System**, **Alignments**, **Align Now, Align Now All** on MXA.	Figure 8-10
4.8 GHz 2nd LO Out	A16J702	4800 MHz	+10 dBm ± 2 dB	Press **Freq**, **1 GHz**, **Zero Span** on MXA	Figure 8-11
4.8 MHz 1st LO Ref Out	A16J703	4800 MHz	+4 dBm	Press **Freq**, **50 MHz**, **Zero Span**, **MEAS SETUP**, **Advanced, Phase Noise Optimization**, **Best Close in PNoise** on MXA	Figure 8-12
50 MHz Ref Out	A16J701	50 MHz	–25 dBm	Press **Input/Output**, **RF Calibrator**, **50 MHz** on MXA	Figure 8-13
4.8 GHz Ref Out	A16J701	4800 MHz	–28 dBm	Press **Input/Output**, **RF Calibrator**, **4.8 GHz** on MXA	Figure 8-14
2.4 GHz Ref Out	A16J718	2400 MHz	+10 dBm		Figure 8-15
300 MHz LO AIF	A16J711	300 MHz	+10 dBm		Figure 8-16
100 MHz Ref B Out	A16J716	100 MHz	+13 dBm		Figure 8-17
10 MHz Output[a]	A16J710	10 MHz	+7 dBm		Figure 8-18

a. Used in units without any of the following options: B40, DP2, MPB

Figure 8-10 50 MHz Ecal Out

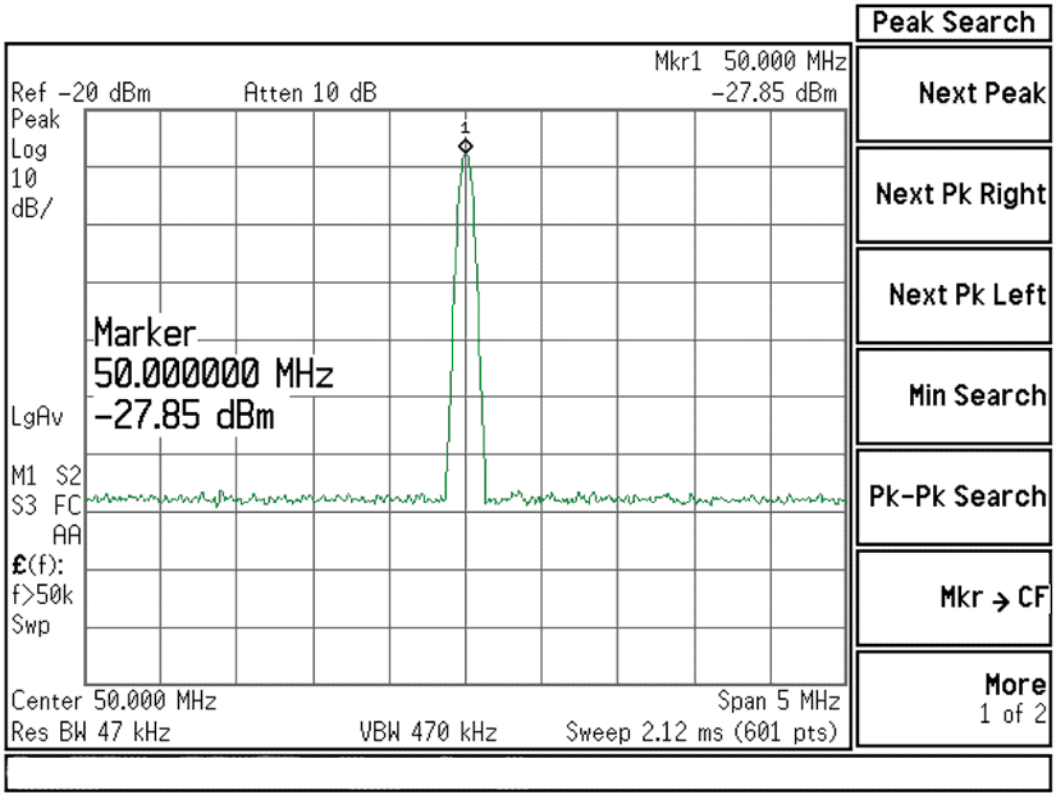


Figure 8-11 4.8 GHz 2nd LO Out

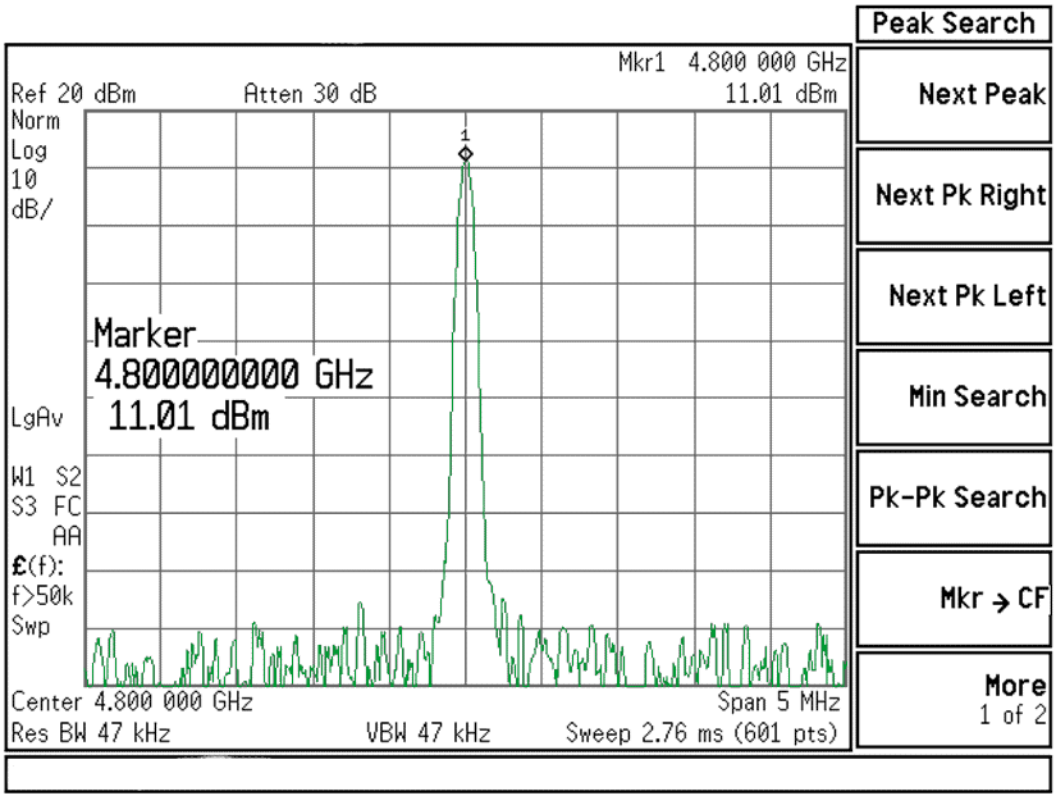


Figure 8-12 4.8 GHz 1st LO Ref Out

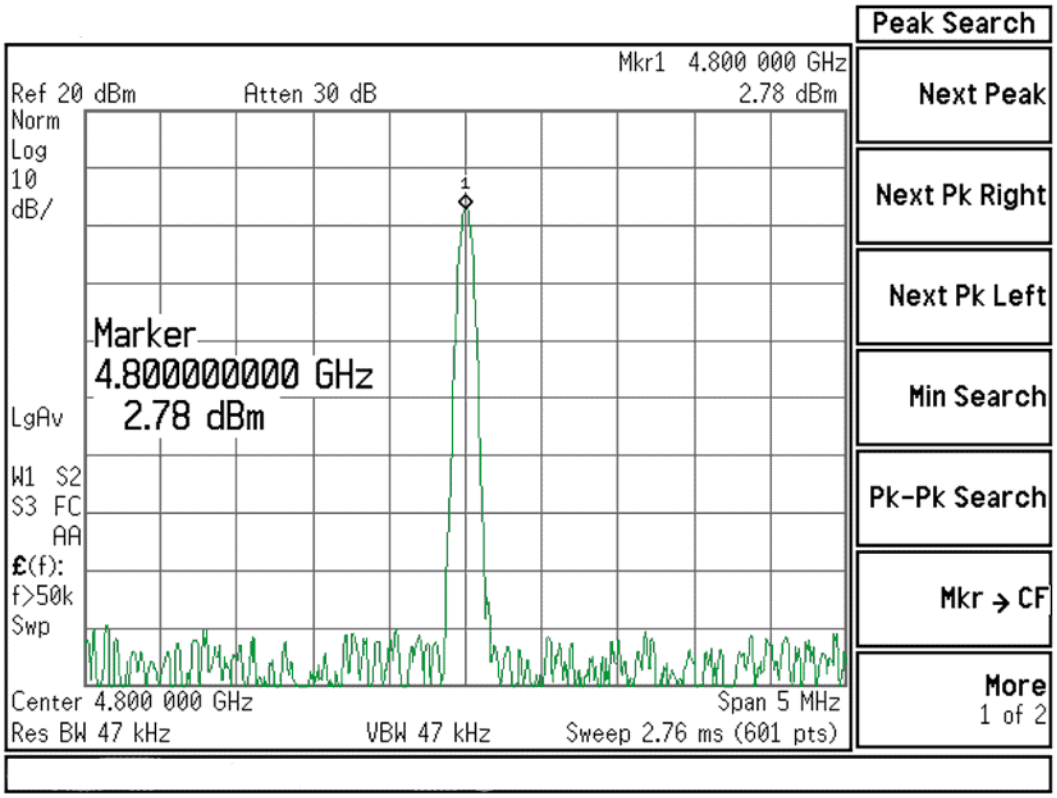


Figure 8-13 50 MHz Ref Out

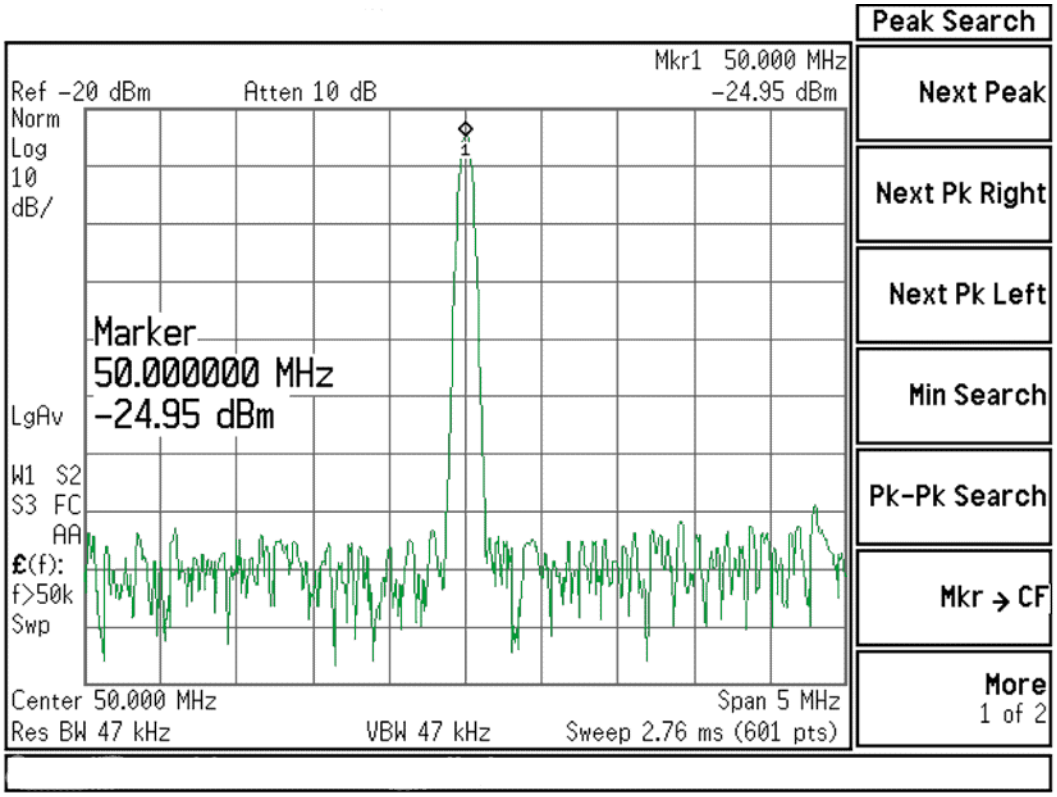


Figure 8-14 4.8 GHz Ref Out

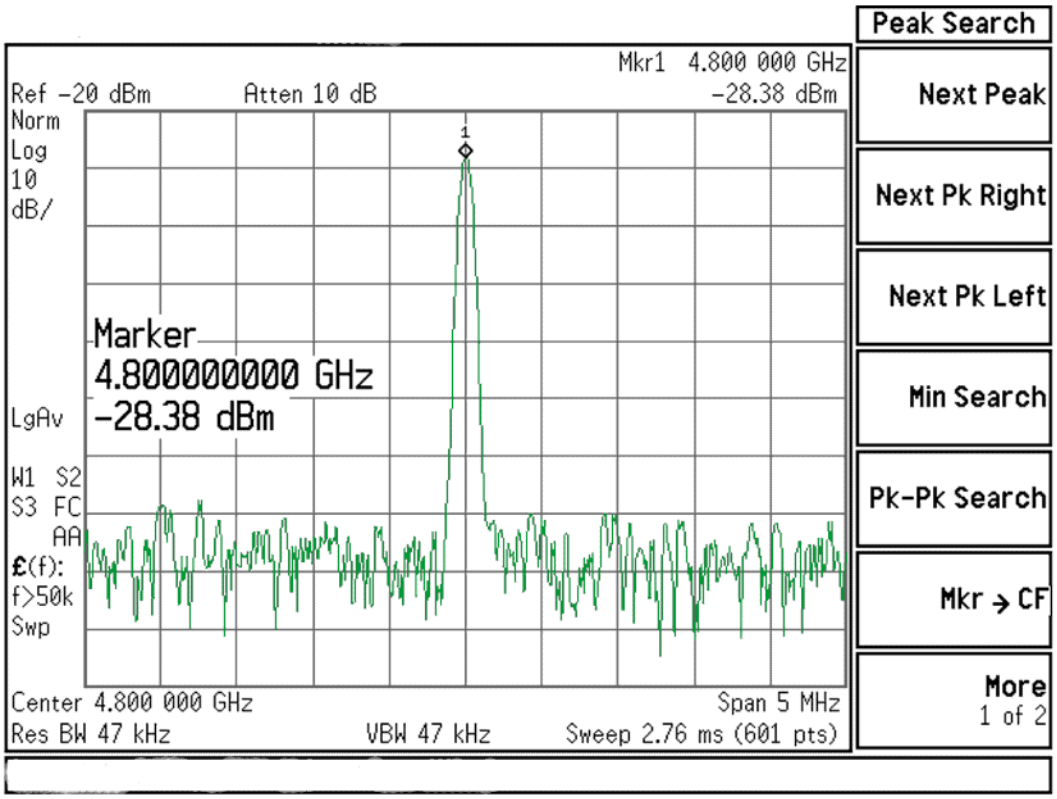


Figure 8-15 2.4 GHz Ref Output

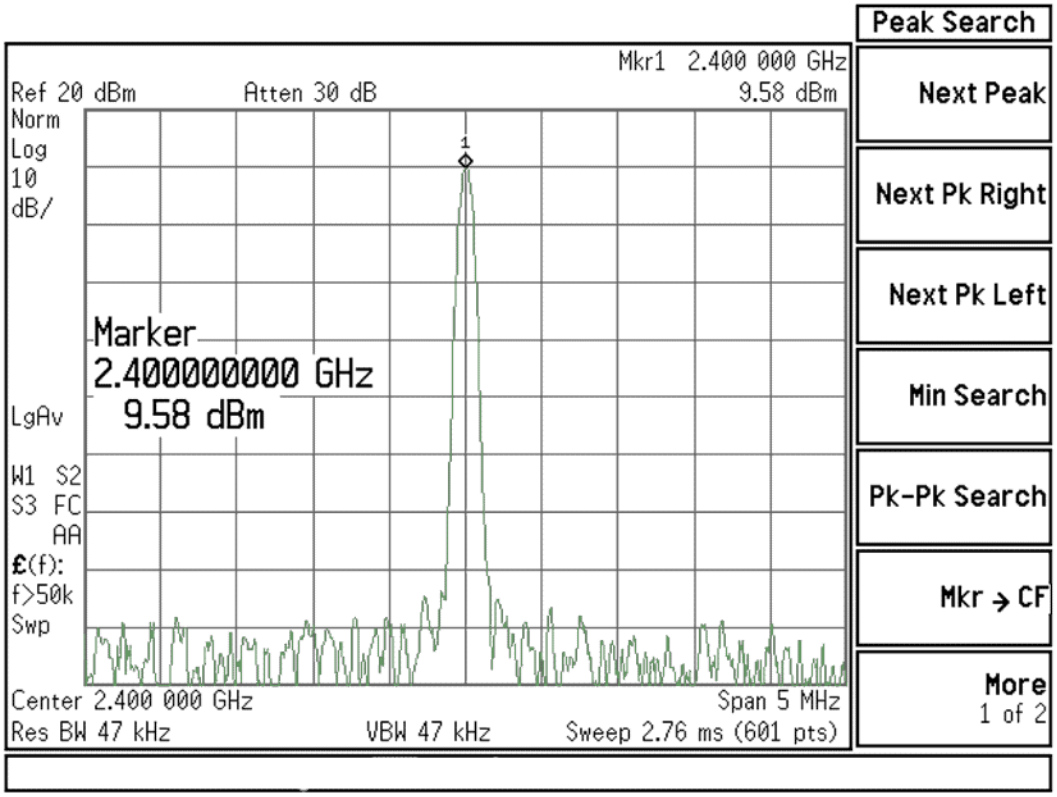


Figure 8-16 300 MHz LO AIF

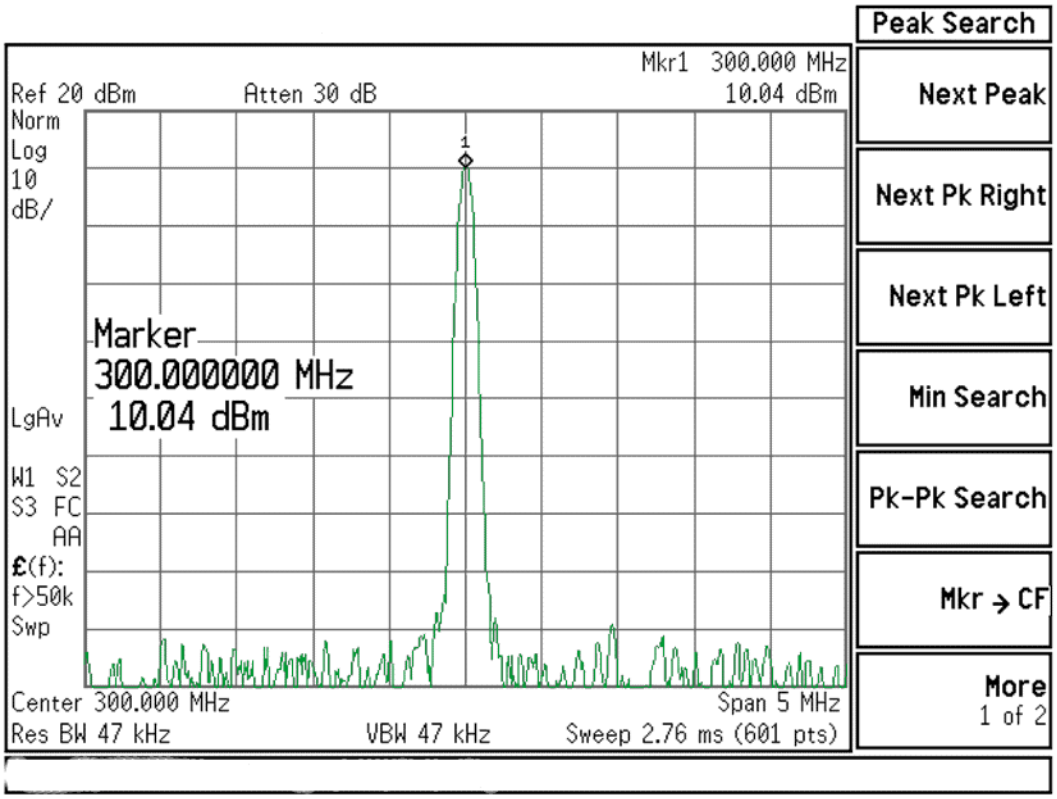


Figure 8-17 100 MHz Ref B Out

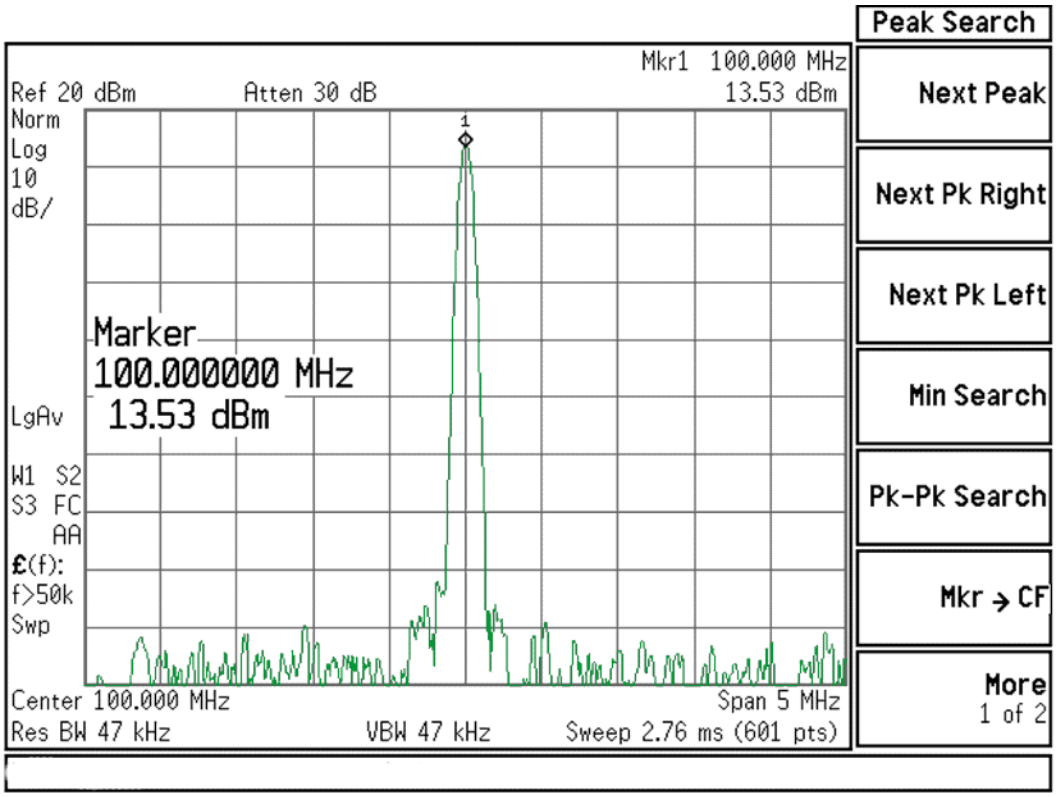
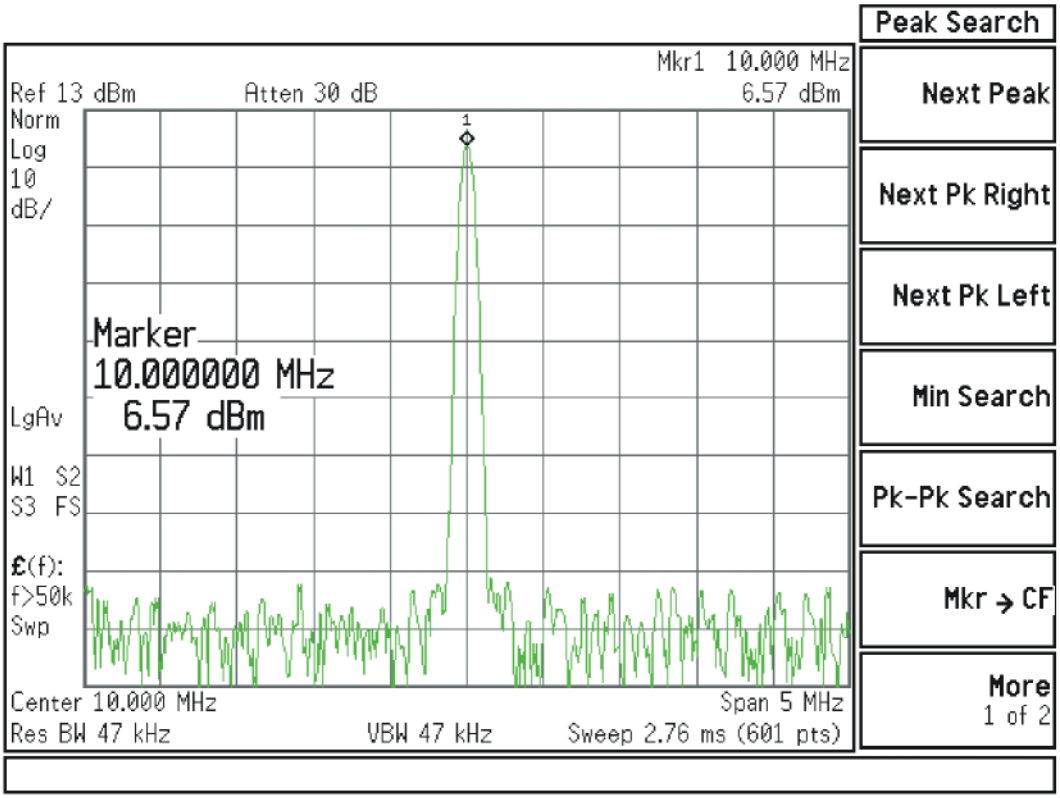


Figure 8-18 10 MHz Output



Diagnostic LEDs

There are two sets of diagnostics LEDs on the A16 Reference Assembly. Six LEDs are on the right side of the A16 Reference Main board and five LEDs are on the A16A1 Reference Daughter board. Refer to Figure 8-9. Table 8-4 lists the diagnostic LEDs and what their status indicates.

A blinking red LED typically indicates that an unleveled condition exists. The number of blinks indicates what circuitry is unleveled, as indicated in Table 8-4.

Table 8-4 A16 Reference Assembly Diagnostic LEDs

LED Number	Color	Description	Status
A16DS1	Yellow	When Program Code is loading	On=Loading code from EEPROM Off=Ready
A16DS6	Red	100 MHz Unlocked	On=100 MHz VCXO is unlocked 1 Blink = 4.8 GHz calibrator unleveled 2 Blinks = 50 MHz calibrator unleveled 3 Blinks = 300 MHz LO_AIF unleveled Off=Normal (locked)
A16DS7	Green	Is the 100 MHz PLL Unlocked?	On=Normal (locked) Off=Fault (unlocked)
A16DS8	Green	Is the 100 MHz VCXO working?	On=Yes (alive) Off=Fault (not alive)
A16DS9	Green	Is Internal 10 MHz Reference On?	On=Yes (enabled) Off=No (disabled; Ext Ref Mode)
A16DS10	Green	Is the +15V Standby supply working?	On=Yes (+15 Standby supply is on) Off=No
A16A1DS2	Red	When 2.4 or 4.8 GHz frequency is low	On=Fault (output frequency is low) 2 Blinks = 2.4 GHz Ref ALC unleveled 3 Blinks = 300 MHz Ref ALC unleveled Off=Normal
A16A1DS3	Red	When 2.4 or 4.8 GHz frequency is high	On=Fault (output frequency is high) 2 Blinks = 4.8 GHz LO ALC unleveled 3 Blinks = 2.4 GHz LO ALC unleveled Off=Normal
A16A1DS4	Green	Is the 2.4 GHz reference PLL locked?	On=Normal (locked) Off=Fault (unlocked)
A16A1DS5	Green	Is the 2.4 GHz VCXO working?	On=Yes (alive) Off=Fault (not alive)
A16A1DS6	Yellow	When Program Code is loading	On=Loading code from EEPROM Off=Ready

9 CPU/Disk Drive Troubleshooting

What You Will Find in This Chapter

The following information is presented in this chapter:

1. Theory of operation of the Processor section.
2. Isolating the cause of a hardware problem by verifying the functionality of assemblies in the Processor section.

NOTE Each section first describes how the assembly works, then gives information to help you troubleshoot the assembly. Each description explains the purpose of the assembly, describes the main components, and lists external connections to the assembly.

This following sections are found in this chapter:

A4 Processor Description on page 330

A4 Processor Assembly Troubleshooting on page 333

A5 Disk Drive Description on page 334

A5 Disk Drive Troubleshooting on page 337

Troubleshooting Software Related Issues on page 337

Reloading the Instrument Application Software on page 337

Disk Drive Recovery Process on page 338

Replacing the Instrument Disk Drive on page 339

A4 Processor Description

If the A4 Processor assembly is suspect in an instrument failure, a full description of the instrument boot process is described in Chapter 2, “Boot Up and Initialization Troubleshooting”.

Disk Drive

The A5 Disk Drive can easily be removed from the A4 Processor assembly without removing any of the instrument covers. The disk drive is attached to a tray that is accessed on the rear panel by loosening one screw and pulling the drive out of the processor assembly.

If the A4 Processor assembly is replaced, the existing A5 Disk Drive must be transferred to the replacement Processor assembly.

The A5 Disk Drive is field replaceable. See Chapter 14, “Replaceable Parts” for the correct replacement part number.

A4A1 Disk Drive Interface Board

There may be situations where the A5 disk drive must be removed and inserted many times, such as in a security sensitive environment. Therefore, the A4A1 disk drive interface board can be replaced if connector wear is an issue. See Chapter 14, “Replaceable Parts” for the correct replacement part number.

Front Panel Interface

The instrument USB bus is the electrical interface to the instrument front panel. One of the USB ports on the host controller located on the A4 Processor assembly is routed to the A1A2 Front Panel Interface board for this use. This port is a High Speed USB 2.0 compliant port.

Graphics Controller

The entire graphics subsystem is contained within the instrument system processor chipset. There are multiple outputs of the graphics controller that are used by the instrument. One provides the LVDS video control to drive the internal instrument LCD display, one supplies the analog signals to the rear panel VGA output, and one provide the display data to the rear panel DisplayPort connector, which can be used to drive multiple external display types.

Power Supply Control

The power control line from the front panel momentary power switch connects to the A4 Processor assembly. When the front panel power switch is pressed the A4 Processor assembly tells the A6 Power Supply assembly to turn on. Once the +12V D, +5.1V D, and +3.35V D supplies are all on and within

specification the A6 Power Supply assembly notifies the A4 Processor assembly, which then comes out of reset and boots-up. Outputs from the A4 Processor assembly also drive the two front panel power state LEDs.

Provisions have also been made to allow the processor board to remember which power state it was in when a power failure occurs. The instrument will return to the same power state after a power failure.

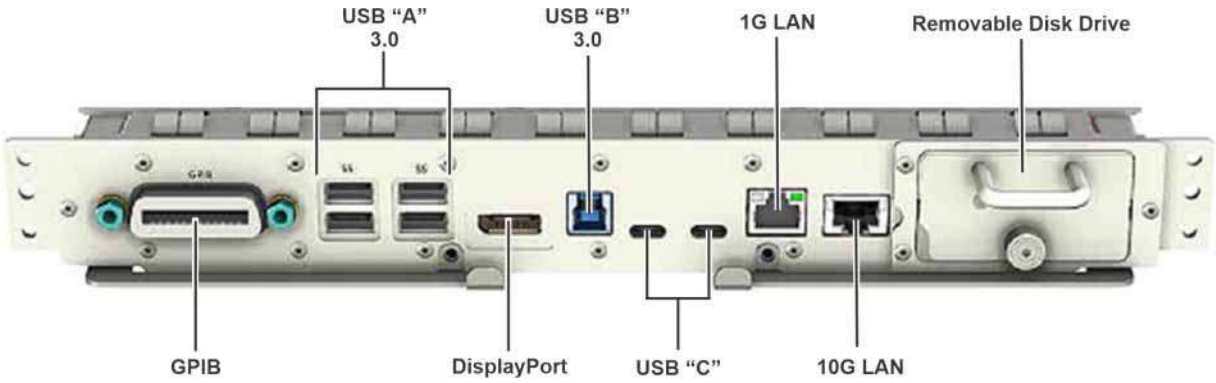
Rear Panel Connectivity

The A4 Processor assembly has direct access to the rear panel of the instrument.

The rear panel connections provided on the A4 Processor assembly are:

- GPIB Interface
- Cabled PCIe x4 Interface (PC6, PC6S, and PC8 only)
- LAN (RJ45) 10/100/1000 based-T Ethernet port
- LAN (RJ45) 10G Ethernet port (PCA only)
- USB Ports
    - 2 x Super Speed USB 3.0 Host Ports (PC6, PC6S, and PC8 only)
    - 1 x High Speed USB 2.0 Host Port (PPC6, PC6S, and PC8 only)
    - 4 x Super Speed USB 3.0 Host Ports (PCA only)
    - 2 x USB “C” Host Ports (PCA only)
    - 1 x Super Speed USB 3.0 Device Port
- DisplayPort Video Output
- VGA Output (PC6, PC6S, and PC8 only)
- SD Memory Card Slot (PC6, PC6S, and PC8 only; Accessible only when A5 disk drive is removed)

Figure 9-1 A4 Processor Assembly Rear Panel Connectivity (PCA shown)



System Memory

The type and amount of system SDRAM in the instrument may vary depending on the age and options installed in an instrument. Current instruments have 16 GB of DDR3 SDRAM in two 204-pin SODIMM memory modules.

The system SDRAM memory is not field replaceable.

System Processor

The processor used in the instrument may vary depending on the age and options installed in an instrument. Current instruments have a Quad Core Intel i7 processor chipset.

The system processor chipset is not field replaceable.

Processor Battery

The A4BT1 Processor battery used is a lithium manganese dioxide coin battery. It powers the instrument clock and maintains the settings for the CMOS BIOS configuration.

The A4BT1 Processor battery is field replaceable. See Chapter 14, “Replaceable Parts” for the correct replacement part number.

SD Memory Card Slot

The main purpose for the SD memory card is for instrument calibration database backup.

The SD memory card that is shipped with each new instrument is currently a 16 GB SDHC card. It is shipped with a backup of the instrument's factory calibration database.

The SD memory card can be removed if need for security or other reasons and the instrument will function as normal. The SD card can also be manually switched to the Lock (read only) position and the instrument will function normally as well.

While the instrument working calibration database is contained on the E: drive, if when the instrument first boots up and finds a newer database on the SD memory card it will prompt the user to select which database to use. This is intended for use when the A5 disk drive assembly has been changed and the calibration database needs to be transferred to it.

The SD memory card is field replaceable. See Chapter 14, “Replaceable Parts” for the correct replacement part number.

A4 Processor Assembly Troubleshooting

The A4 Processor assembly is serviced as an assembly only; no component level repair is supported.

Boot-Up or Initialization Problems

Typical failures of the A4 Processor assembly will cause the instrument to not boot-up or initialize properly. Of course, these types of failures can also be caused by a variety of other assemblies as well. In order to determine whether a problem such as this is being caused by a defective A4 Processor assembly, first see "Instrument Boot Up Process" on page 49 to eliminate other possibilities.

BIOS Settings

As with other types of PC processor assemblies the A4 Processor assembly has a number of settings particular to the hardware on the board assembly. These settings are saved in a separate memory location on the board and accessed by the BIOS (Basic Input Output System) Setup Utility. If these settings are changed from those that the instrument was initially shipped with this could cause a problem with the booting and/or functionality of the instrument.

If the instrument is having a problem booting up, but is functional enough to enter the BIOS Setup Utility you will want to verify that the BIOS settings have not been changed.

Accessing BIOS Setup Utility

To easily navigate the BIOS Setup Utility you will want to have an external USB keyboard connected to the instrument. Then, when the initial Keysight Technologies splash screen is displayed at power-up, press the key on the keyboard specified on the initial boot screen (typically the DEL key). Once this is pressed you will see the main BIOS Setup Utility screen.

Load Defaults

The instrument was originally shipped from the factory with all of the BIOS settings in their default position. If these have been changed for some reason they can all be returned to their default position by navigating to the **Save & Exit** screen and select **Restore Defaults**. Once the defaults have been loaded select **Save Changes** and **Exit**.

A5 Disk Drive Description

The A5 Disk Drive is a solid state (FLASH) drive. There may be different drive capacities being used, and due to continual changes being made by the drive manufacturers these will continue to change from time to time.

Failures of this disk drive can be either hardware or software related. The first step in troubleshooting is to determine if the failure is software related. If software is found not to be the issue, the disk drive should be replaced.

NOTE

Before replacing the A5 disk drive it is highly recommended that the factory calibration data be backed up to an external drive if at all possible. If this data is not backed up prior to replacing the disk drive all instrument adjustments and performance verification tests will need to be run after the drive is replaced.

For information on how to backup this data see the "Calibration Data Backup and Restore" section in Chapter 16, "Post-Repair Procedures.".

Drive Partitioning

The A5 Disk Drive assembly has been divided up into four different partitions. They are:

C. This partition contains the operating system and software installed at the factory. This is an open system which means you can install additional software, which should be installed on the C: partition. However, only a limited set of software applications are tested for use with the instrument software. The installation and/or use of other software is not warranted, and could interfere with the operation of the instrument software. If the Instrument Image Recovery process is ever run, the original version of the C: partition, as shipped from the factory, will be restored. The user will need to reload any other software that was previously installed in the instrument.

Do not save any user data to the C: partition, as any data saved in this partition will be lost if the Instrument Image Recovery process is run.

D. This partition is reserved for user data storage. The My Documents folders for the user accounts that are preconfigured from the factory are mapped to the D: partition. This is for the convenience of backing-up the user data. You should always back-up the data on the D: partition. This allows you to restore the data if the A5 Disk Drive assembly ever needs to be replaced.

Data saved in this partition will not be lost if the Instrument Image Recovery process is run.

E. E.This partition is reserved for Keysight's use. The primary use of the E: partition is for storing of the instrument calibration and alignment data. Do not change or overwrite the files on this partition. This could cause your instrument to not meet specifications, or even to stop functioning properly. It is recommended that you back up the calibration database saved on this partition. For information on how to backup this data see "Calibration Data Backup and Restore" in Chapter 16, "Post-Repair Procedures.". This allows you to restore the data if the A5 Disk Drive assembly ever needs to be replaced, which could otherwise require that all instrument adjustments be performed.

While data saved in this partition will not be lost if the Instrument Image Recovery process is run, do not use this drive for user data storage.

In addition, a hidden recovery partition is located on the drive. This partition contains an image of the C: drive as it was when the instrument was shipped from the factory.

Instrument Image Recovery System

The Instrument Image Recovery System can be used to repair software errors on the instrument's disk drive, or to restore the original factory configuration of the system software. The Instrument Image Recovery System is stored in a separate hidden disk drive partition. Repairing errors on the disk drive may result in loss of data or files.

Restoring the original factory system software does not restore any of the following items:

- Operating system configurations that were changed or updated after the instrument was shipped from the factory. After a recovery, these configurations will have to be redone by the end user.
- Additional software that was installed be the end user. After a recovery, that software will need to be re-installed by the end user.
- Any updates that were made to the instrument measurement application software.

Any user data saved to the D: partition will be retained and not altered by the recovery process. The same is true for the instrument calibration database since it resides on the E: partition.

To restore the C: drive using the image stored in this recovery partition see the section titled “Disk Drive Recovery Process” on page 338.

A5 Disk Drive Troubleshooting

Troubleshooting Software Related Issues

The C: partition contains the operating system and the instrument application software, so boot problems can be caused by either a failure of the operating system or the instrument application software. The failure could have occurred due to a failed installation procedure, instrument application software update failure, a virus, etc...

To correct these issues there are two procedures that can be initiated to resolve a software related issue.

- Reload the instrument application software.
- Use the Disk Drive Recovery Process to reinstall the operating system and instrument application software to the state it was in when the instrument left the factory.

Reloading the Instrument Application Software

The instrument application software contains all the required components for the instrument application as well as all software options. If the instrument application software has become corrupt the operating system will boot but the instrument application software will fail to start. In these cases go to Chapter 18, “Instrument Software.” for information on how to update the instrument application software. This procedure will not affect the instrument's calibration or user files.

If this does not resolve the boot issue, or the instrument never boots the operating system proceed to the “Disk Drive Recovery Process”.

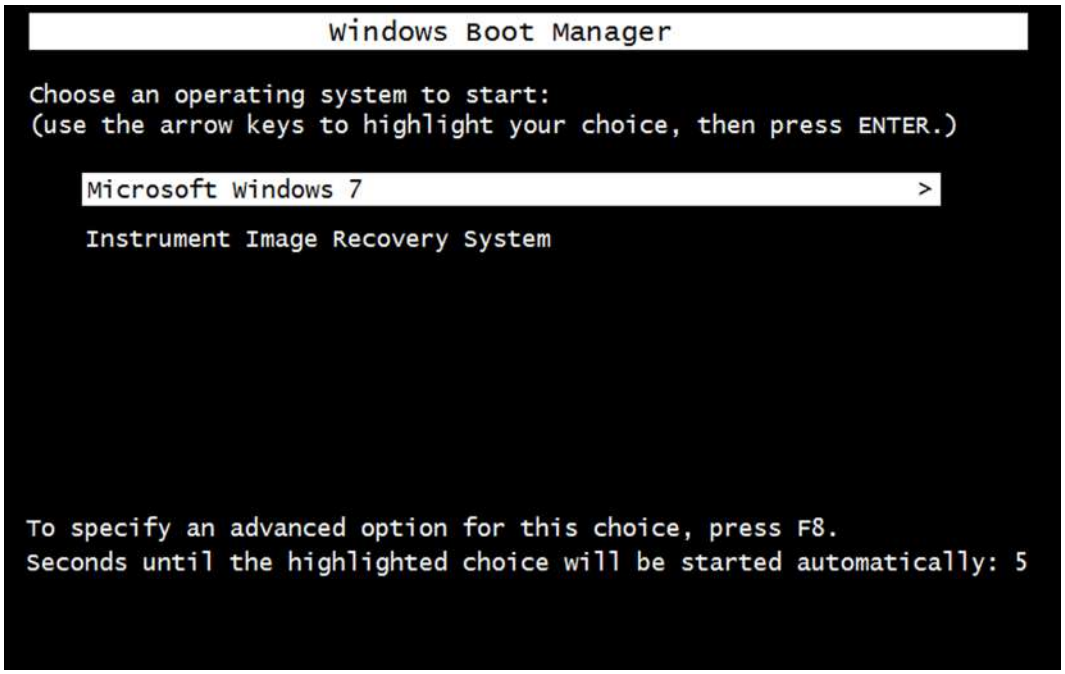
Disk Drive Recovery Process

The Instrument Image Recovery System is stored in a separate hidden disk drive partition. It can be used to attempt to repair errors or restore the original factory instrument system on the C: partition of the instrument disk drive.

Using the Instrument Image Recovery System

1. Make sure the instrument is turned off
2. Turn on the instrument
3. After the "Keysight Technologies" screen is displayed the Windows Boot Manager screen as shown in Figure 9-2 will be displayed for 5 seconds

Figure 9-2 Windows Boot Manager



4. Press the down arrow key to move the highlight to "Instrument Image Recovery System", and press the **Enter** key.
5. When the Instrument Image Recovery System has booted, follow the on-screen instructions to recover the image of the C: partition.
6. After exiting the Instrument Image Recovery System, the instrument may reboot a few times.
7. Update the instrument application software to the latest version by downloading it from the following URL: http://www.keysight.com/find/mxa_software

Replacing the Instrument Disk Drive

If the above two procedures did not resolve the booting issue, the disk drive should be replaced. Please refer to the "Disk Drive" on page 519 replacement section in Chapter 15, "Assembly Replacement Procedures", on page 451.

10 Power Supply/Midplane Troubleshooting

What You Will Find in This Chapter

The following information is found in this chapter:

A6 Power Supply Description on page 342

A6 Power Supply Basic Troubleshooting (Cover On) on page 348

A7 Midplane Description on page 350

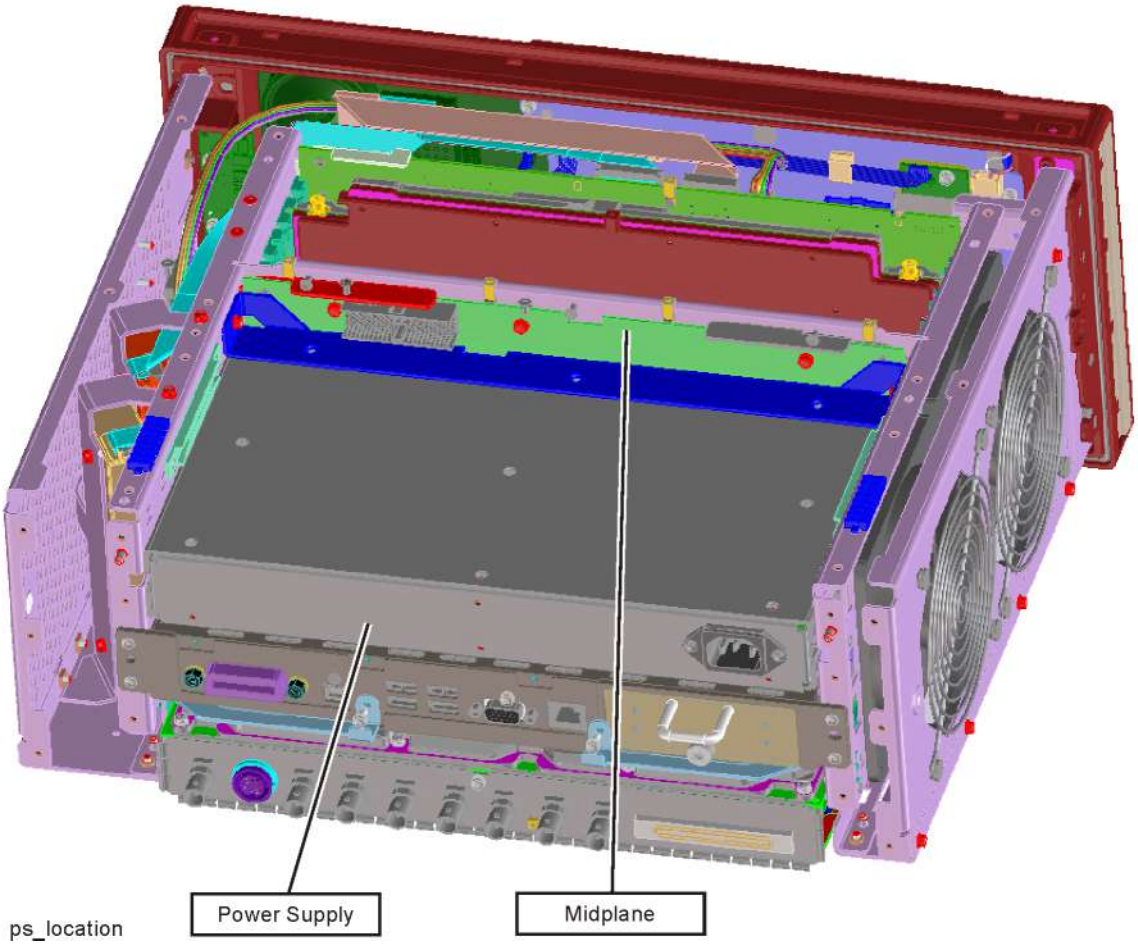
A7 Midplane Assembly Troubleshooting on page 353

A6 Power Supply Description

Purpose

The A6 Power Supply assembly provides all the necessary DC voltages for the entire signal analyzer to operate correctly. If any of the power supplies are not within their operating voltages, the analyzer will not function. The power supply outputs provide power to all the printed circuit boards, microcircuit assemblies, front panel display and fans, any of which can cause an over current condition if not operating correctly. The power supply will remain on in an over current state for a minimum of 0.1 second. The power supply will turn off no later than 0.4 seconds after the beginning of the over current state. Any one output over current condition will latch the supply off until the line voltage is removed from the rear panel AC power input connector and then reconnected. The power supply assembly plugs into the A7 Midplane Assembly from the rear of the instrument. (see Figure 10-1.)

Figure 10-1 Power Supply and Midplane



Power Supply Theory of Operation

The A6 Power Supply assembly is serviced as an assembly only; no component level repair is supported.

The A6 Power Supply assembly provides most all of the necessary DC voltages for the signal analyzer. If any of the power supplies are not within their operating voltages, the instrument will not function properly.

The A6 Power Supply assembly is a switching supply that operates at a frequency of ~120 kHz.

The A6 Power Supply assembly is an auto ranging supply, requiring no user selection of the input voltage. The input AC voltage and frequency requirements for the A6 Power Supply assembly are printed on the rear panel of the instruments as well as on the power supply itself.

While there are no test points or status LEDs accessible for troubleshooting on the A6 Power Supply assembly, there are both test points and status LEDs for all of the different power supply voltages, as well as other power supply status lines, on the A7 Midplane Board assembly. See the "A7 Midplane Description" on page 350 for detailed information on the location of each

Supply Voltages

The following voltage levels are produced by the A6 Power Supply assembly:

Voltage Level	Ground Reference	A7 Midplane Connector
+15V SB	ACOM	J101
+5.1V SB	DCOM	J111/J112
+32V A	ACOM	J101
+15V A	ACOM	J103/J104
+9V A	ACOM	J104
+5.2V A	ACOM	J102

Voltage Level	Ground Reference	A7 Midplane Connector
+12V D	DCOM	J111
+5.1V D	DCOM	J109/J110
+3.35V D	DCOM	J107/J108
-15V A	ACOM	J105
-7V A	ACOM	J105
FAN POS	FAN NEG	J101
FAN NEG	FAN POS	J101

Control Inputs

There are a number of control inputs for the A6 Power Supply assembly. They are:

PS_ON

PS_ON is a signal that when pulled low tells the A6 Power Supply assembly to turn on all of its outputs. This signal comes from the A4 CPU board assembly and is initiated by pressing the front panel power button.

DITHER

DITHER is an AC coupled analog signal going to the supply that is used to frequency modulate the power supply switching frequency for the purpose of lowering any power supply related interference.

OFFn

OFFn is an input that is to be used only as a “Panic Stop”. This signal can be used for such functions as an emergency over temperature shut down. This type of shut down is a last resort and does not perform the recommended operating system shut down of the instrument.

TEMP_SEN

TEMP_SEN is an analog input to the fan speed control circuit. The fan runs at a slow speed at room temperature to reduce noise and then will ramp up to full speed as the temperature increases.

Control/Status Outputs

There are a number of control and status outputs for the A6 Power Supply assembly. They are:

PWROK_H

PWROK_H is used to verify that the +12V D, +5.1V D, and +3.35V D are all on and within specification. A TTL high level on this output brings the CPU out of reset and initiates the instrument boot up process.

LINE_TRIG

LINE_TRIG is a TTL level signal that is synchronous to the AC line input. This signal is typically used in signal analyzers to trigger an instrument sweep synchronous to the AC power line.

PS_TEMP

PS_TEMP is a read out of the internal temperature of the power supply.

PS_FAULT

PS_FAULT will be a TTL low level signal to indicate that the supply is experiencing an over voltage, over current, or over temperature condition.

Fuse

The A6 Power Supply has no user replaceable fuse. While there is a fuse internal to the supply this is not meant for field replacement. If the internal fuse is blown, the power supply has experienced a major failure and should be replaced.

Standby Supplies

The A6 Power Supply assembly has two standby supplies that should always be on if the AC input voltage requirements are met. These are the +15V STBY and the +5.1V STBY supplies. These supplies are used by the instrument to keep certain circuits alive even when the power is turned off.

Over Current Protection

The A6 Power Supply assembly has built in over current protection that will shut down the supply if current draw from the instrument is too great. The power supply will remain on in an over current state for a minimum of 1 second. The power supply shall turn off no later than 5 seconds after beginning the over current state. The power supply shall remain off until the line voltage is removed and then reconnected or the front panel power switch is cycled. Over current shut down does not apply to the standby supplies, the fan voltage, and the +32V A supply.

Thermal Protection

The A6 Power Supply assembly will protect itself by shutting down if it overheats. It will also reset itself with no user interaction after the temperature is reduced by approximately 10 degrees C.

Power Supply Output Signals

Table 10-1 describes the output signals from the Power Supply assembly.

Table 10-1 Power Supply Output Signals

Signal Name	Description	Maximum Output Current (Amps)	Test Load (Amps)
+32A	32 Volt Analog power supply.	1.8	0.5
+15A	15 Volt Analog power supply	4.25	1.3
+15SB	15 Volt Standby power supply	--	--
+9A	9 Volt Analog power supply	4.0	1.4
+9A_Sense			
+5.2A	5.2 Volt Analog power supply	11.5	3.7
+5.2_Sense			
-7A	-7 Volt Analog power supply	4.5	1.5
-7A_Sense			
-15A	-15 Volt Analog power supply	1.5	0.5
ACOM	Analog Ground. Connected to common ground inside power supply.	--	--
ACOM_Sense	Remote sense for analog ground.	--	--
PS_Faultn	Power supply fault output, active low.	--	--
PS_Temp	Analog temperature output. Control element for fan speed.	--	--
Line_Trig	Line Trigger Output.	--	--
Dither	Dither input from A7 Midplane for switching frequency modulation.	--	--
Temp_Sense	External temperature input for fan speed control.	--	--
Offn	Off input, active low. Used to turn off all non-standby supplies.	--	--
Fan_P	Positive fan power supply.	1.0	0.5
Fan_N	Negative fan power supply.	1.0	0.5
+12D	12 Volt Digital power supply.	8.0	2.6
+5.1D	5.1 Volt Digital power supply.	8.5	2.7
+5.1D_Sense	Remote sense for +5.1 digital supply.	--	--

Table 10-1 Power Supply Output Signals

Signal Name	Description	Maximum Output Current (Amps)	Test Load (Amps)
+5.1SB	5.1 Volt Standby power supply.	0.5	0.2
+3.35D	3.35 Volt Digital power supply.	6.5	2.0
+3.35D_Sense	Remote sense for +3.35 digital supply.	--	--
DCOM	Digital ground. Connected to the common ground point inside the power supply.	--	--
DCOM_Sense	Remote sense for DCOM.	--	--
PWR_OK	Power OK Output.	--	--
PS_ONn	Power supply turn on input, active low.	--	--
ChassisCOM	Power supply outer case. Connected to common ground point inside the power supply.	--	--

A6 Power Supply Basic Troubleshooting (Cover On)

NOTE

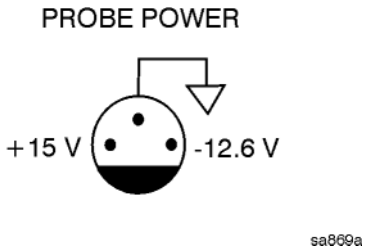
There are no user replaceable fuses on the power supply. If the internal fuse is blown, the power supply has experienced a major failure and should be replaced. If you determine that the power supply is the failed assembly, replace the power supply. If the power supply is suspect, perform the following quick checks before removing the instrument cover.

1. Ensure the instrument is plugged into a known good AC power source and the yellow standby LED near the power on switch is illuminated. A lit yellow LED indicates the +5.1 SB VDC power supply voltage is providing enough voltage to light the LED.
2. Power on the instrument and verify that the green LED on the front panel is lit. A lit LED indicates the power supply has received an “ON” command from the A4, CPU assembly and that the +5.2A VDC supply is on.
3. Verify both fans are operating on the side panel of the instrument. The fans can be heard once the analyzer is powered up. If the fans are operating, the fan power supply is functioning.
4. The front panel probe power connector can be used to check the +15 VDC (+/- 7%) and -12.6 VDC (+/-10%) supplies. The -12.6 VDC is produced by post regulating the -15 VDC supply. A voltmeter can be used to verify these supplies. Refer to Figure 10-2 for a diagram of the probe power connector.

CAUTION

Exercise great care when measuring voltages on the Probe Power connector. Accidentally shorting the +15V or -12.6V supply to ground can cause damage to the A1A2 or A1A5 assemblies.

Figure 10-2 Probe Power Connector



If these initial checks are functioning properly and yet the signal analyzer will not boot up properly, or the display is not turning on, refer to Chapter 2, “Boot Up and Initialization Troubleshooting” in this service manual.

It is possible that some portion of the initial troubleshooting check may fail. Chapter 2 should also be referenced if this is the case. As an example, the A15 Front End Control Assembly may be pulling down the +15 volt supply that is used for the probe power on the front panel. Chapter 2 describes the entire instrument boot process, from initial power on to a successful signal analyzer sweep. If any portion of the boot process fails, Chapter 2 describes a step-by-step troubleshooting procedure to help isolate the root cause of the failure.

A7 Midplane Description

Purpose

The Midplane links the following major assemblies:

- A4 CPU Assembly
- A6 Power Supply Assembly
- A8 Motherboard
- A16 Reference Assembly

Refer to Figure 10-3. The Midplane Assembly **(7)** plugs into the Motherboard. The CPU, Power Supply, and Reference Assemblies plug directly into the Midplane board from the rear of the instrument. The Analog and Digital I.F. Assemblies plug into the analyzer from the rear of the instrument into the Motherboard itself.

Instrument Power Supply LEDs and Test Points

While the A6 Power Supply assembly has no user accessible LEDs or test points the A7 Midplane board assembly does provide these for all of the different instrument power supplies as well as many of the power supply status lines. A complete list of these can be found in Table 10-3 and the location of each can be seen in Figure 10-4.

Additional Power Supply Regulation

There are two analog power supply regulators on the A7 Midplane board assembly. They are the +3.3VA and -5.2VA supplies. The +3.3VA supply is regulated down from the instrument +5.1VA supply while the -5.2VA supply is regulated down from the -7VA instrument supply. Both of these supply voltages have test points and LEDs on the A7 Midplane board assembly as seen in Figure 10-4.

Instrument Secure Storage

This is Non-volatile storage of instrument model number, serial number, and software license keys. While the license keys are also contained on the C: drive of the instrument, the model and serial numbers are only saved in this secure memory. There is no way for the user to access this memory in any way. This is reserved for the factory and field software when needed for instrument initialization, as well as the instrument software when installing an option license key. If for some reason any of these cannot be remembered by the instrument there could be a problem with this memory and the A7 Midplane board assembly would need to be replaced.

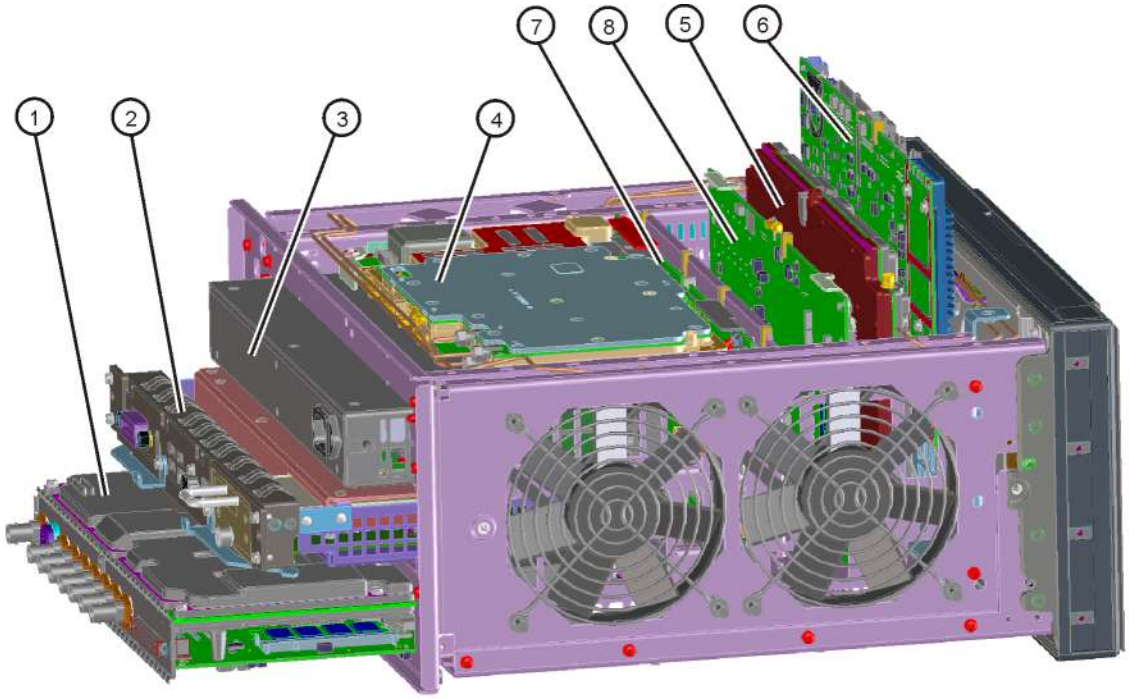
Power Supply Dithering

A triangle wave of approximately 100 Hz is generated and goes directly to the A6 Power Supply assembly. This is used to frequency modulate the power supply switching frequency for the purpose of lowering any power supply related interference. If for some reason the level of the power supply related interference is higher than normal this circuitry, or the A6 Power Supply assembly, could be suspect.

Miscellaneous Circuitry

Other circuitry on the A7 Midplane include a circuit to phase lock the CPU clock to the analyzer's 10 MHz reference and a Complex Programmable Logic Device (CPLD) used as an Instrument Local Bus (ILB) buffer to A16 Reference Assembly connector at J21.

Figure 10-3 Midplane



major_assy

Table 10-2

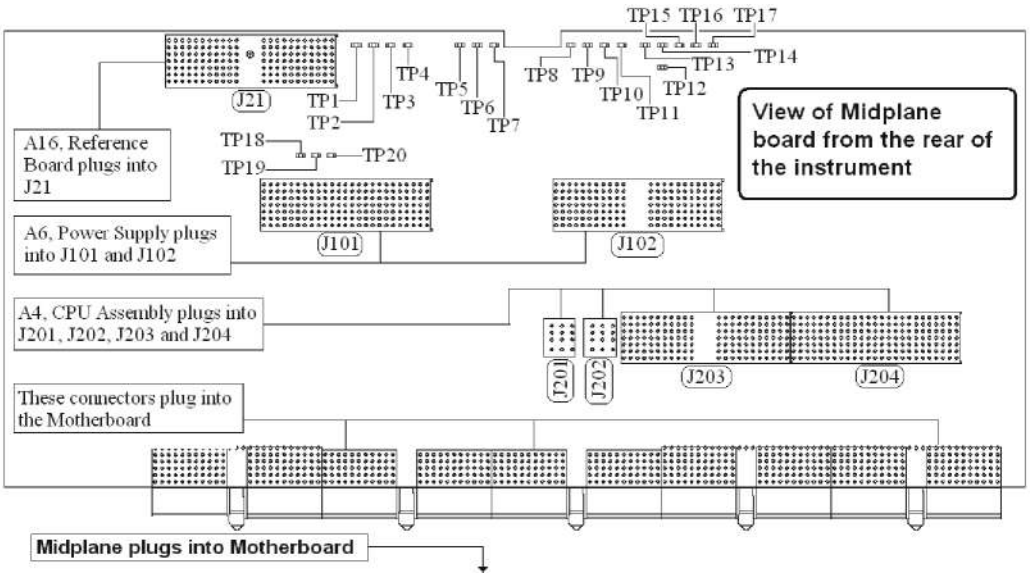
Item	Description
1	A2 Analog I.F. Assembly A3 Digital I.F. Assembly
2	A4 CPU Replacement Kit (w/o disk drive)
3	A6 Power Supply
4	A16 Reference Assembly
5	A14 L.O. Synthesizer Assembly
6	A15 Front End Control Assembly
7	A7 Midplane Assembly

NOTE The L.O. Synthesizer, Front End Control Assembly, Analog IF, and Digital IF plug into the Motherboard. All other assemblies mentioned plug into the Midplane from the rear of the instrument.

A7 Midplane Assembly Troubleshooting

If there is an analyzer function such as a boot up issue where the power supplies are suspect, view the power supply LED's on the Midplane Assembly by removing the instrument outer cover. See Figure 10-4.

Figure 10-4 Midplane Assembly



As shown above, the Midplane Assembly has test points for each power supply that can be used as measurement points. These DC voltages can be verified with a voltmeter. Continuity measurements can also be performed on each power supply if a shorted condition is suspect. Refer to the table below for measurement details.

NOTE Voltage readings are referenced to ACOM (TP4). All ohmmeter measurements were taken from the power supply test point to ACOM. Due to capacitive effects, wait for the ohmmeter readings to stabilize.

Table 10-3 A7 Midplane Board Test Points

Power Supply	Test Point	Description	Expected Voltmeter Reading (VDC) Power ON	Expected Ohmmeter Reading (KΩ) Power OFF
+32A	TP3	32 Volt Analog supply	+32 ± 2.0	1.3 kΩ
+15A	TP6	15 Volt Analog supply	+15 ± 1.0	260 Ω
+15SB	TP2	15 Volt Standby supply	+15 ± 1.0	264 Ω
+12D	TP16	12 Volt Digital supply	+12 ± 1.0	264 Ω
+9A	TP7	9 Volt Analog supply	+9 ± 1.0	120 Ω
+5.2A	TP5	5.2 Volt Analog supply	+5.2 ± 0.75	3.6 kΩ
+5.1D	TP15	5.1 Volt Digital supply	+5.1 ± 0.75	40 Ω
+5.1SB	TP17	5.1 Volt Standby	+5.1 ± 0.75	228 Ω
+3.35D	TP13	3.35 Volt Digital supply	+3.35 ± 0.75	47 Ω
+3.3A	TP10	3.3 Volt Analog supply	+3.3 ± 0.75	36 Ω
-5.2A	TP11	-5.2 Volt Analog supply	-5.2 ± 0.75	1.9 Ω
-7A	TP8	-7 Volt Analog supply	-7 ± 1.0	445 Ω
-15A	TP9	-15 Volt Analog supply	-15 ± 1.0	390 Ω
n/a	TP1	Fan Positive supply	8.5 to 13.5 VDC ~8.8 VDC @ 25C	490 Ω
n/a	TP4	Analog Common	n/a	n/a
n/a	TP14	Digital Common	n/a	n/a
n/a	TP12	Power OK	+3.9 ± 0.75	9.2 kΩ

11 Front Panel/Motherboard Troubleshooting

What You Will Find in This Chapter

The following information is found in this chapter:

A8 Motherboard Description on page 356

A1 Front Panel Assembly on page 358

Option BBA Description on page 359

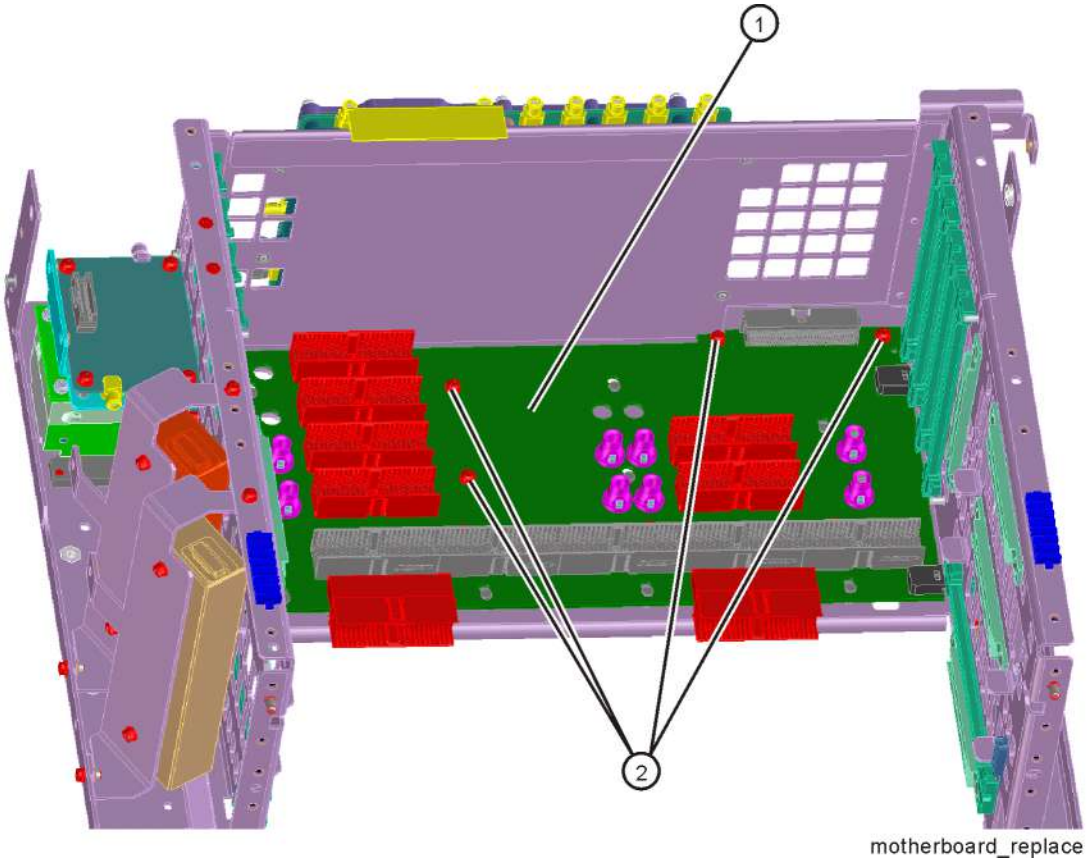
A8 Motherboard Description

Purpose

The Motherboard is an electrical link between many of the electrical assemblies in the instrument. The main functions of this PC board include:

- Distribute power
- Control and common signals between all the measurement PC boards including the A7 Midplane and the Front Panel Assembly
- Circuitry for fan speed control
- 10 MHz Reference distribution

Figure 11-1 Motherboard



The Motherboard is a horizontally mounted, located near the bottom of the analyzer. The Motherboard has the following connector types:

- (6) Analog Card Cage Connectors (J1, J11, J31, J41, J51, J61)
- (4) Digital Card Cage Signals and voltages using PCI connectors (J4, J12, J32, J42)
- (1)Analog Power (J2)
- (1) Mixed Power (J3)
- (2) Front Panel Connectors (J5 and J9)
- (2) Fan Connector (J6 and J7)

Figure 11-2 Motherboard Connectors

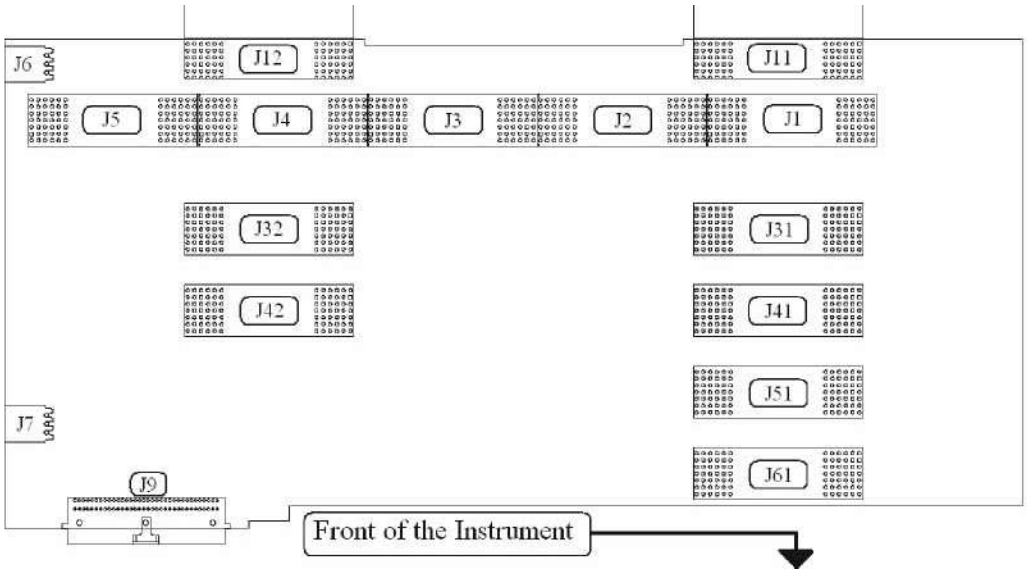


Table 11-1

Motherboard Connector	What Plugs In?
J1	A7, Midplane
J2	A7, Midplane
J3	A7, Midplane
J4	A7, Midplane
J5	A7, Midplane
J6	B2, Fan #2
J7	B1, Fan #1
J9	Front Panel

Motherboard Connector	What Plugs In?
J11	A3, Digital I.F, analog signals
J12	A3, Digital I.F, analog signals
J31	Option Slot
J32	Option Slot
J41	Option Slot
J42	Option Slot
J51	A14, L.O. Synthesizer
J61	A15, Front End Control

A8 Motherboard Troubleshooting

There are no troubleshooting procedures for this assembly. If the Motherboard is suspect, it must be replaced.

A1 Front Panel Assembly

The major components of the A1 Front Frame Assembly are the A1A2 Front Panel Interface Board, A1A3 LCD, which are serviceable as individual components.

The A1 assembly is used to display the measurement results, accept user input via the keyboard, and connect USB peripheral devices.

A1A2 Front Panel Interface Board

The A1A2 Front Panel Interface board is serviced as an assembly only; no component level repair is supported.

The Front Panel Interface Board contains LCD control, Inverter drive, audio amplifiers, internal speaker, a 4 port USB hub, and a USB keyboard microcontroller.

The two different front panel rubber keypads attach to the back side of the board, which has the keyboard contacts printed on the reverse side.

The 4 ports from the USB hub contained on this board go to the 3 front panel USB connectors and the keyboard microcontroller.

A1A3 LCD

The LCD used is a 10.6 inch WXGA TFT touchscreen display, which as a resolution of 1280 x 768. It has two backlights that are not individually replaceable.

Option BBA Description

The Analog Baseband I/Q inputs is a hardware option for the N9020B, Signal Analyzer. The option can be ordered at the time of sale as N9020B-BBA or as a post sale upgrade as N9020BU-BBA. This option requires a license key to be fully operational.

The BBIQ option consists of 4 main components:

- LED board
- BBIQ Interface board
- BBIQ Main board
- Low noise ribbon cable that connects the BBIQ Interface board to the BBIQ Main board

A17 LED Board

- Contains two edge connectors; J2 and J1 that plug into J20 and P100 edge connectors on the BBIQ Interface board
- Five visible LEDs for user information
- Probe interface contact signals for all four channels I, I, Q, and Q

A18 BBIQ Interface Board

- Allows switching between Single Ended (SE) and Differential (Balanced) for the two input channels.
- Accommodates 1 M Ω and 50 Ω input paths
- Converts all signals to a differential format with a 2.5V common-mode voltage to route to the BBIQ Main board over a 60-pin micro coaxial connector at J1
- Power and control for the BBIQ Interface board are provided from the BBIQ Main board via a ribbon cable, though some of the power supplies are locally regulated on the BBIQ Interface board to minimize spurious responses
- A square wave calibration signal is provided to the user via a BNC Cal Out connector on the BBIQ Interface board. This signal originates on the BBIQ Main board and is buffered and attenuated on the BBIQ Interface board
- Passes signals for the LED board and Infinimax probe ID and power from the 60-pin connector from the BBIQ Main board to a pair of edge connectors that interface to the LED board. ESD protection is provided on the BBIQ Interface board
- EEPROM is used to identify the board and relay drivers to accommodate the input path switching. Some of the relay drivers that require fast switching (for over voltage protection) are on the BBIQ Main board

- Shields are on the board to minimize spurious responses

A19 BBIQ Main Board

- Provides probe power to the BBIQ Interface board
- Power Supply filtering and regulation
- Contains FPGA (field programmable gate arrays)
- Provides LED control to the LED board
- Receives I, I, Q, and Q data from BBIQ Interface board
- Controls (9) relays on the BBIQ Interface board
- Provides probe identification for system use
- Overload detection
- On board relay control for various gain stages
- Variable gain stages
- Provides square wave calibrator output signal to BBIQ Interface board
- Dither
- 10 MHz input from the Reference board
- Onboard 16 bit 100Ms/S ADC
- Triggering Circuits

12 Block Diagrams

What You Will Find in This Chapter

The following sections are found in this chapter:

RF Lowband Path Block Diagram

RF Highband Path #1 Block Diagram

RF Highband Path #2 Block Diagram

Option 532, 544, 550 mmW RF (Low Freq) Block Diagram

Option 532, 544, 550 mmW RF (Highband Path #1) Block Diagram

Option 532, 544, 550 mmW RF (Highband Path #2) Block Diagram

Option 544, 550 mmW RF (Highband Path #3) Block Diagram

Reference and Synthesizer Block Diagram

25 MHz Bandwidth I.F. System Block Diagram

40 MHz Bandwidth I.F. System Block Diagram

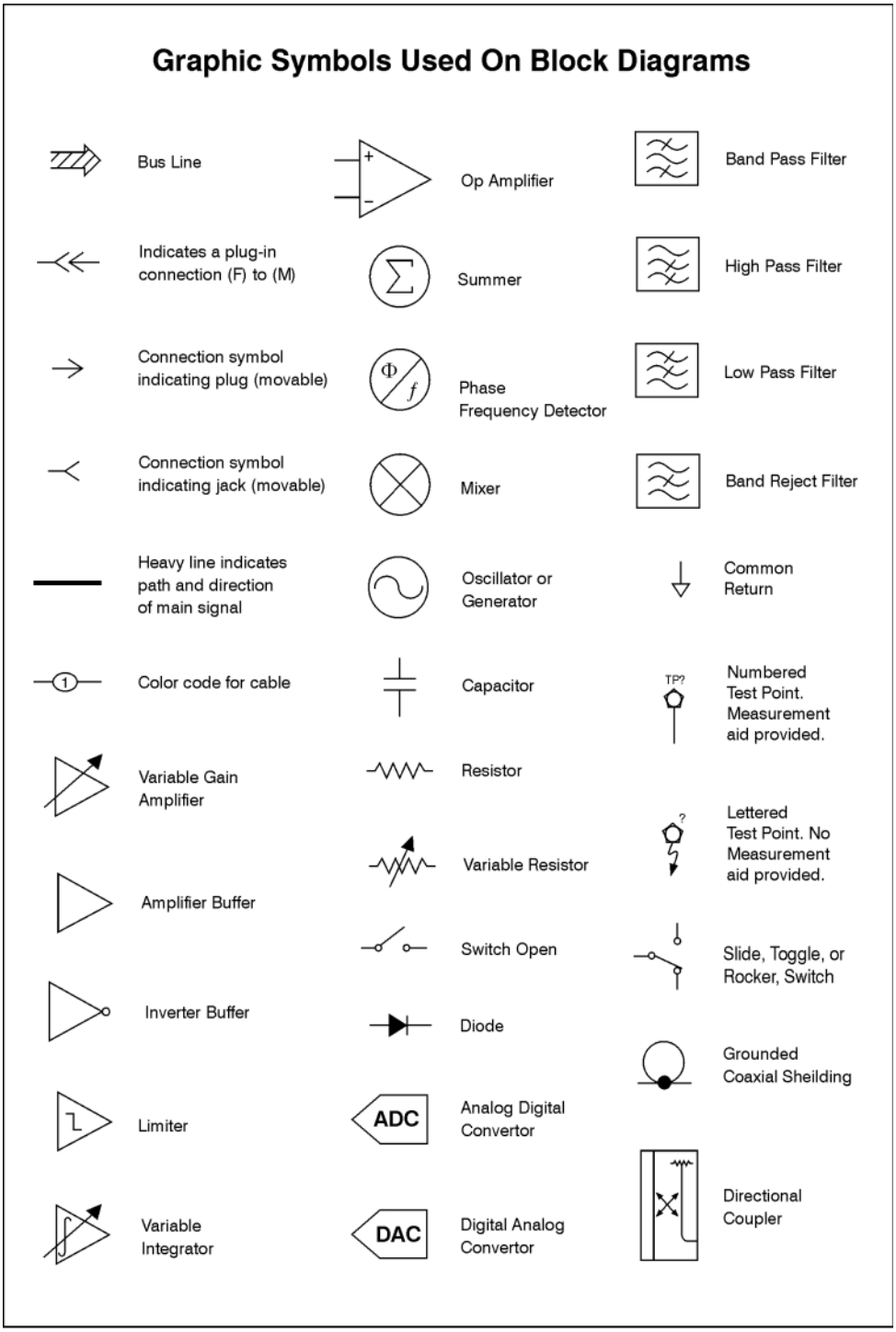
≥ 85 MHz Bandwidth I.F. System Block Diagram

MXA Computer Block Diagram

BBIQ System Block Diagram

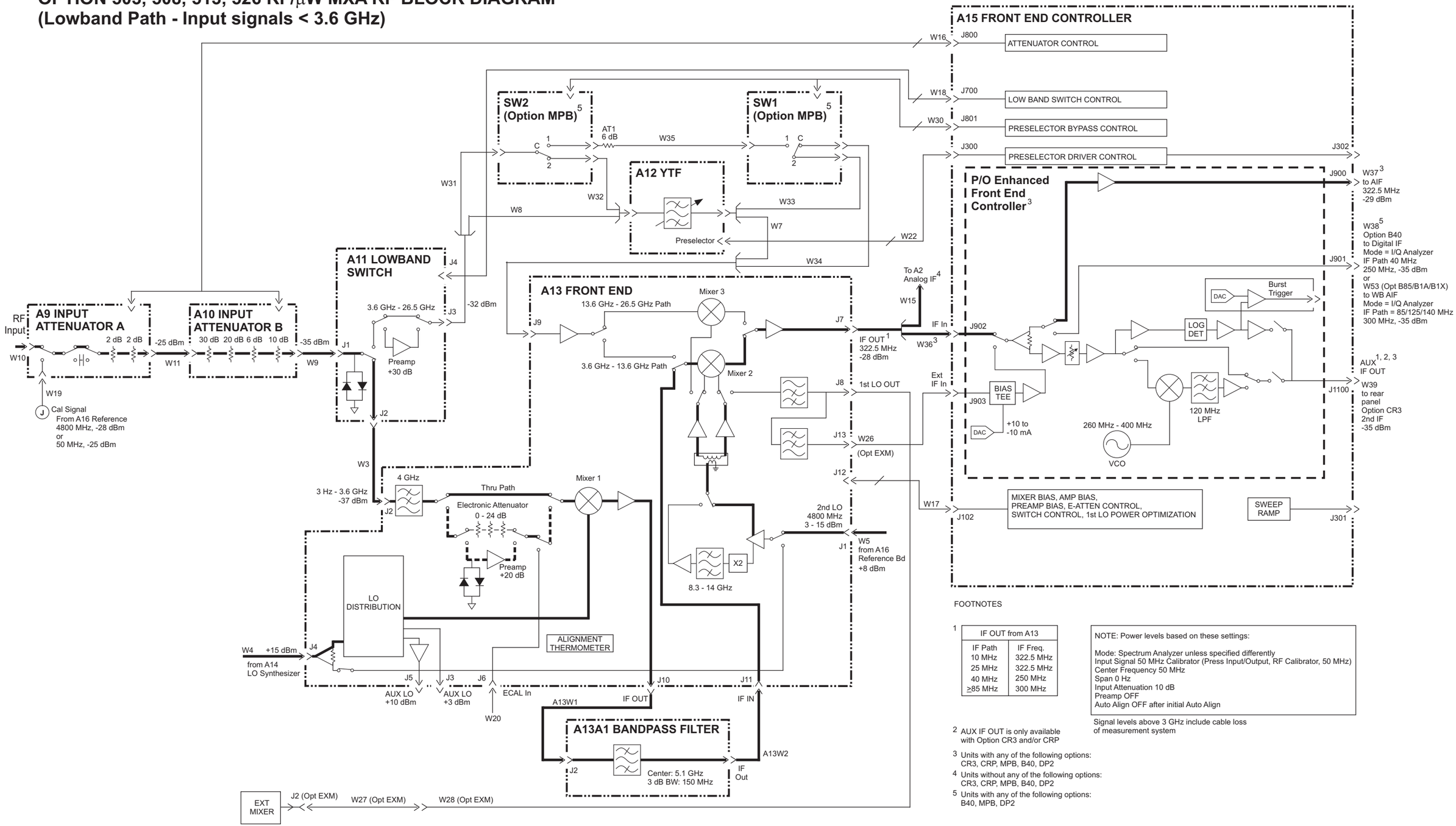
Block Diagrams

Block Diagrams



sa63a

OPTION 503, 508, 513, 526 RF/μW MXA RF BLOCK DIAGRAM
(Lowband Path - Input signals < 3.6 GHz)



FOOTNOTES

1

IF OUT from A13	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥85 MHz	300 MHz

NOTE: Power levels based on these settings:

Mode: Spectrum Analyzer unless specified differently
Input Signal 50 MHz Calibrator (Press Input/Output, RF Calibrator, 50 MHz)
Center Frequency 50 MHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measurement system

2 AUX IF OUT is only available with Option CR3 and/or CRP

3 Units with any of the following options: CR3, CRP, MPB, B40, DP2

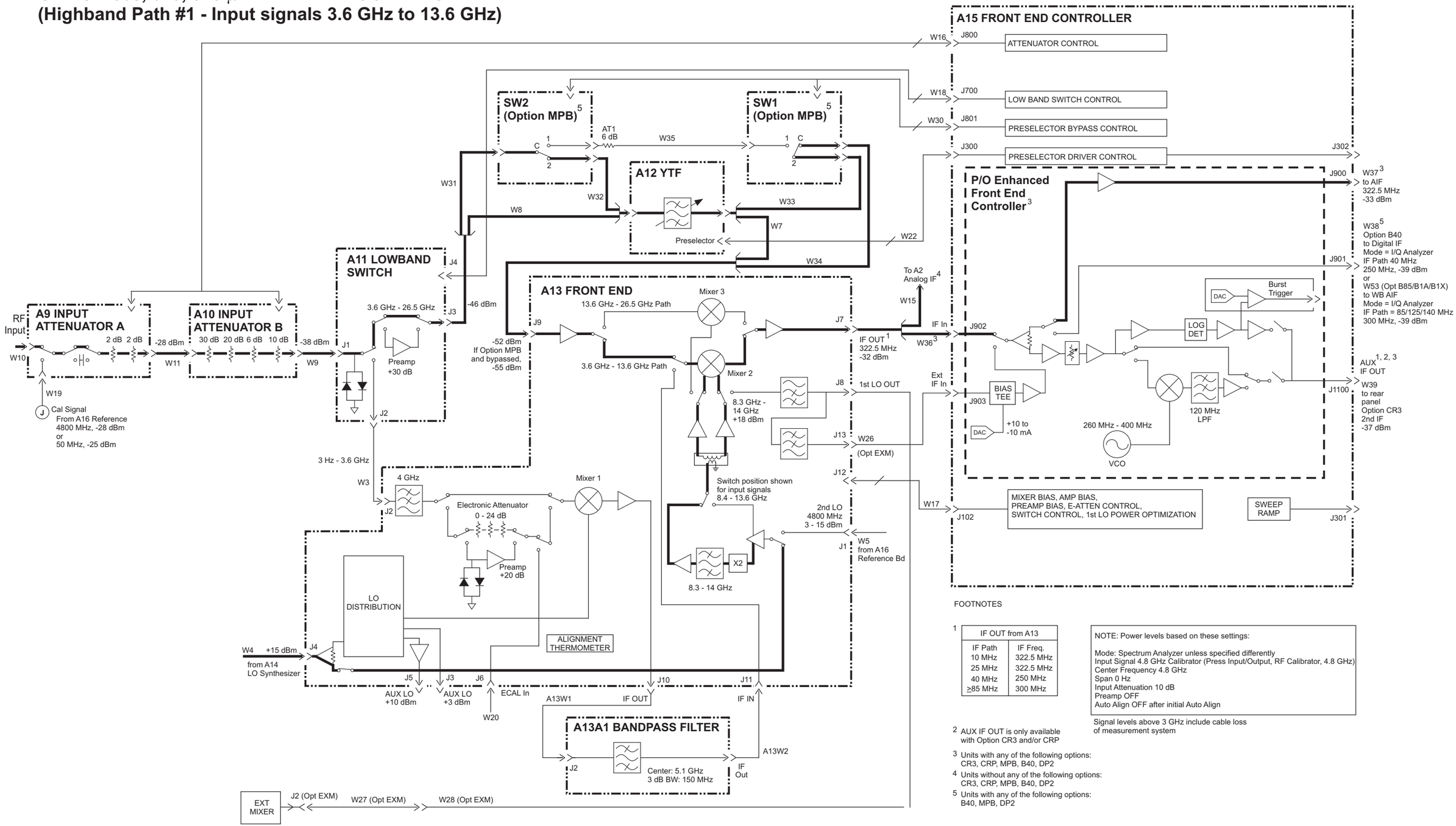
4 Units without any of the following options: CR3, CRP, MPB, B40, DP2

5 Units with any of the following options: B40, MPB, DP2

blockm40_rf_low

RF (Low Freq) BLOCK DIAGRAM

OPTION 508, 513, 526 μW MXA RF BLOCK DIAGRAM
(Highband Path #1 - Input signals 3.6 GHz to 13.6 GHz)



FOOTNOTES

1

IF OUT from A13	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥85 MHz	300 MHz

NOTE: Power levels based on these settings:

Mode: Spectrum Analyzer unless specified differently
Input Signal 4.8 GHz Calibrator (Press Input/Output, RF Calibrator, 4.8 GHz)
Center Frequency 4.8 GHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measurement system

2 AUX IF OUT is only available with Option CR3 and/or CRP

3 Units with any of the following options: CR3, CRP, MPB, B40, DP2

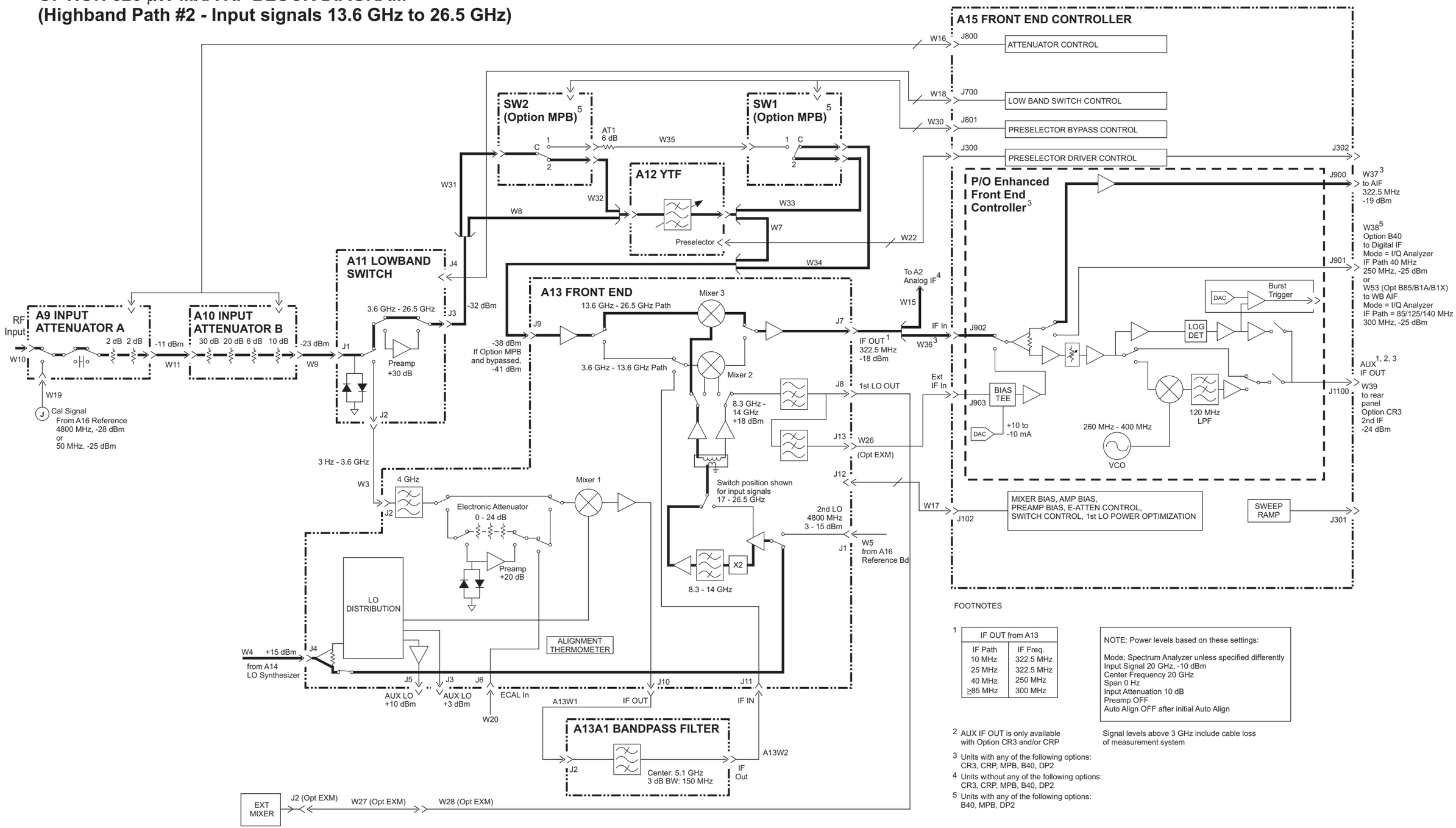
4 Units without any of the following options: CR3, CRP, MPB, B40, DP2

5 Units with any of the following options: B40, MPB, DP2

blockm40_rf_hi1

RF (High Freq) BLOCK DIAGRAM

OPTION 526 μW MXA RF BLOCK DIAGRAM
(Highband Path #2 - Input signals 13.6 GHz to 26.5 GHz)



FOOTNOTES

1

IF OUT from A13	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥85 MHz	300 MHz

NOTE: Power levels based on these settings:

Mode: Spectrum Analyzer unless specified differently
Input Signal 20 GHz, -10 dBm
Center Frequency 20 GHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

2 AUX IF OUT is only available with Option CR3 and/or CRP

Signal levels above 3 GHz include cable loss of measurement system

3 Units with any of the following options: CR3, CRP, MPB, B40, DP2

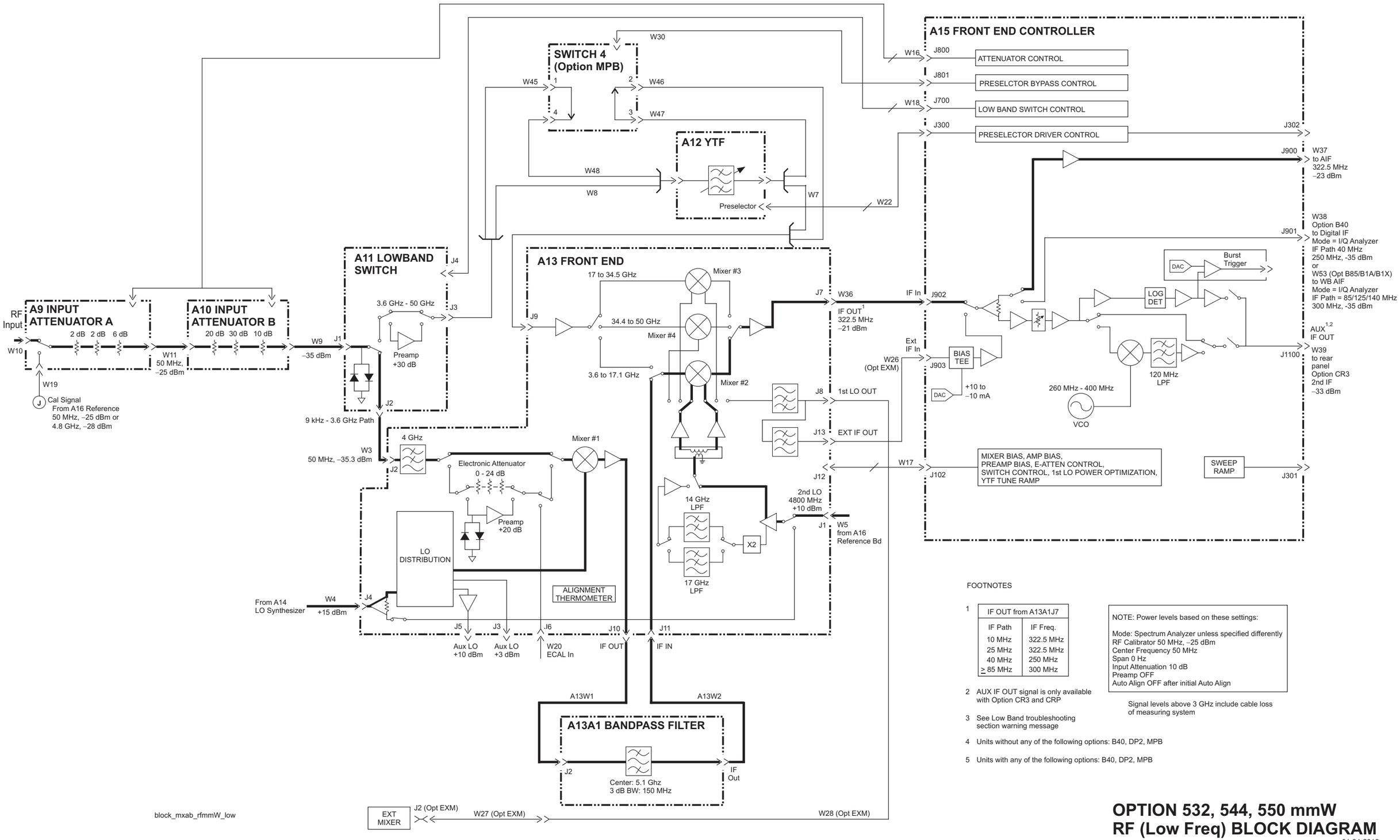
4 Units without any of the following options: CR3, CRP, MPB, B40, DP2

5 Units with any of the following options: B40, MPB, DP2

blockm40_rf_hi2

RF (High Freq) BLOCK DIAGRAM

OPTION 532, 544, 550 mmW N9020B MXA RF BLOCK DIAGRAM
(Lowband Path - Input signals < 3.6 GHz)



FOOTNOTES

1

IF OUT from A13A1J7	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥ 85 MHz	300 MHz

2 AUX IF OUT signal is only available with Option CR3 and CRP

3 See Low Band troubleshooting section warning message

4 Units without any of the following options: B40, DP2, MPB

5 Units with any of the following options: B40, DP2, MPB

NOTE: Power levels based on these settings:

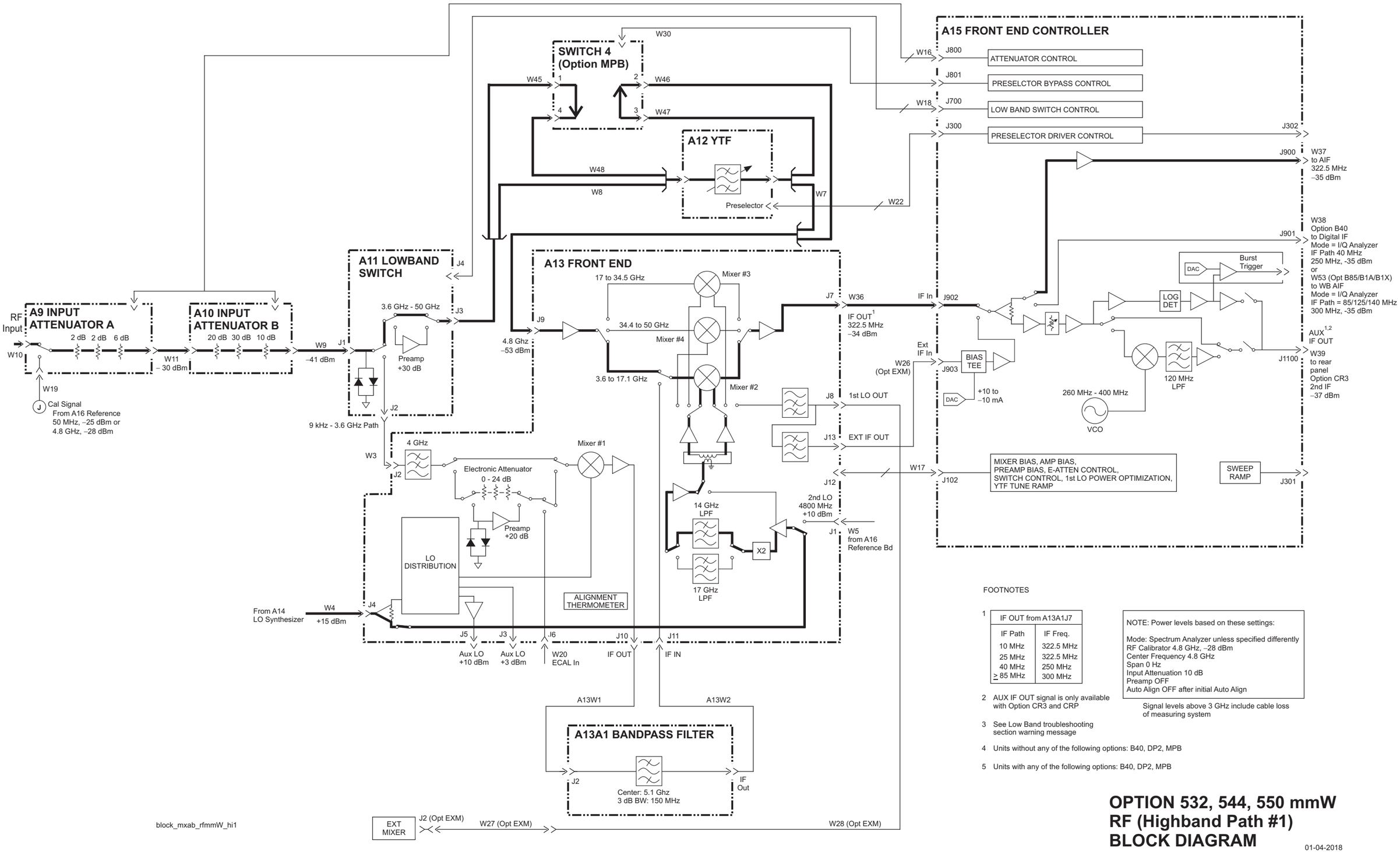
Mode: Spectrum Analyzer unless specified differently
RF Calibrator 50 MHz, –25 dBm
Center Frequency 50 MHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measuring system

OPTION 532, 544, 550 mmW
RF (Low Freq) BLOCK DIAGRAM

01-04-2018

OPTION 532, 544, 550 mmW N9020B MXA RF BLOCK DIAGRAM
(Highband Path #1 - Input signals 3.6 to 17.1 GHz)



FOOTNOTES

1

IF OUT from A13A1J7	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥ 85 MHz	300 MHz

2 AUX IF OUT signal is only available with Option CR3 and CRP

3 See Low Band troubleshooting section warning message

4 Units without any of the following options: B40, DP2, MPB

5 Units with any of the following options: B40, DP2, MPB

NOTE: Power levels based on these settings:

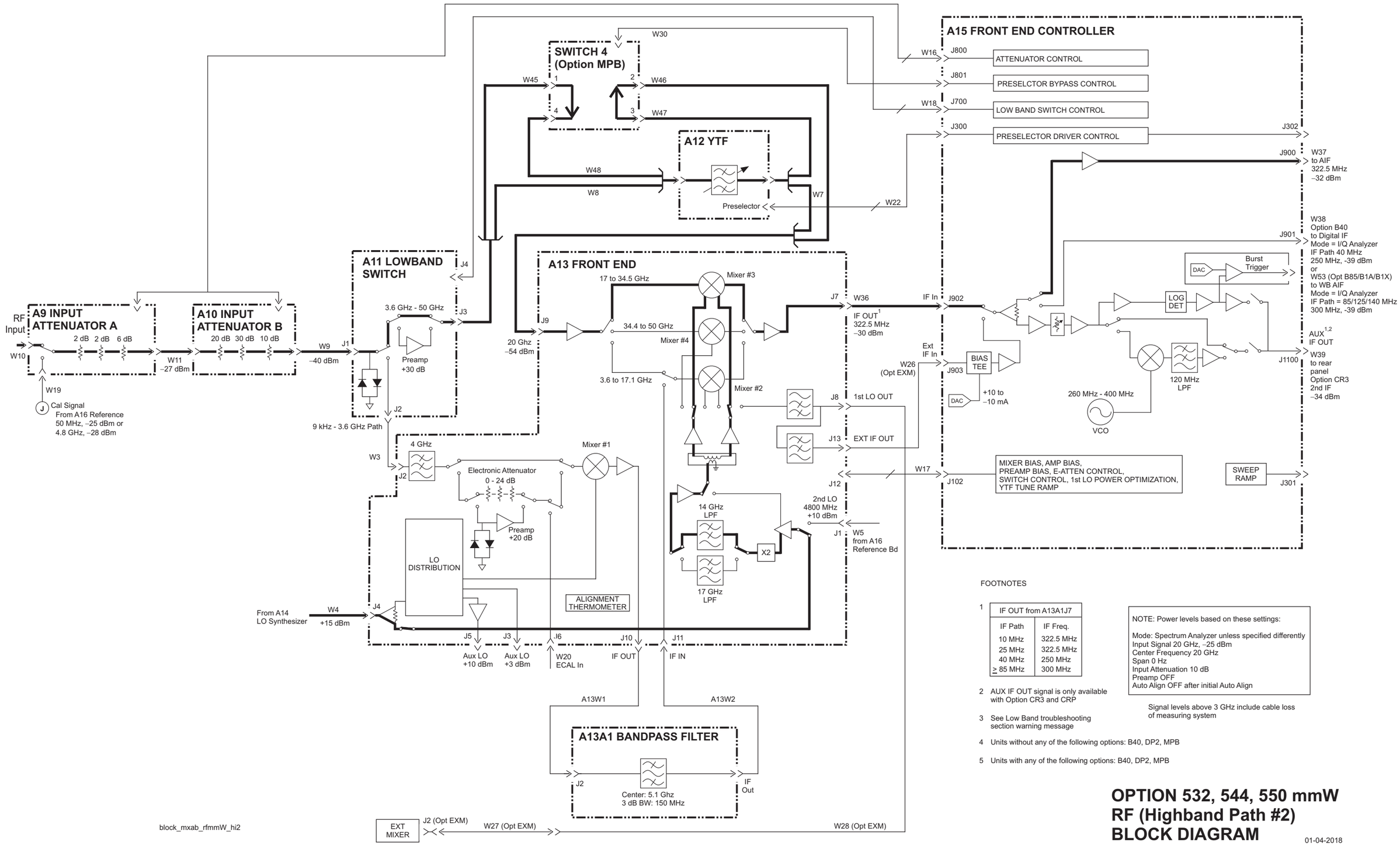
Mode: Spectrum Analyzer unless specified differently
RF Calibrator 4.8 GHz, –28 dBm
Center Frequency 4.8 GHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measuring system

OPTION 532, 544, 550 mmW RF (Highband Path #1) BLOCK DIAGRAM

01-04-2018

OPTION 532, 544, 550 mmW N9020B MXA RF BLOCK DIAGRAM
(Highband Path #2 - Input signals 17.1 to 34.5 GHz)



FOOTNOTES

1

IF OUT from A13A1J7	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥ 85 MHz	300 MHz

2 AUX IF OUT signal is only available with Option CR3 and CRP

3 See Low Band troubleshooting section warning message

4 Units without any of the following options: B40, DP2, MPB

5 Units with any of the following options: B40, DP2, MPB

NOTE: Power levels based on these settings:

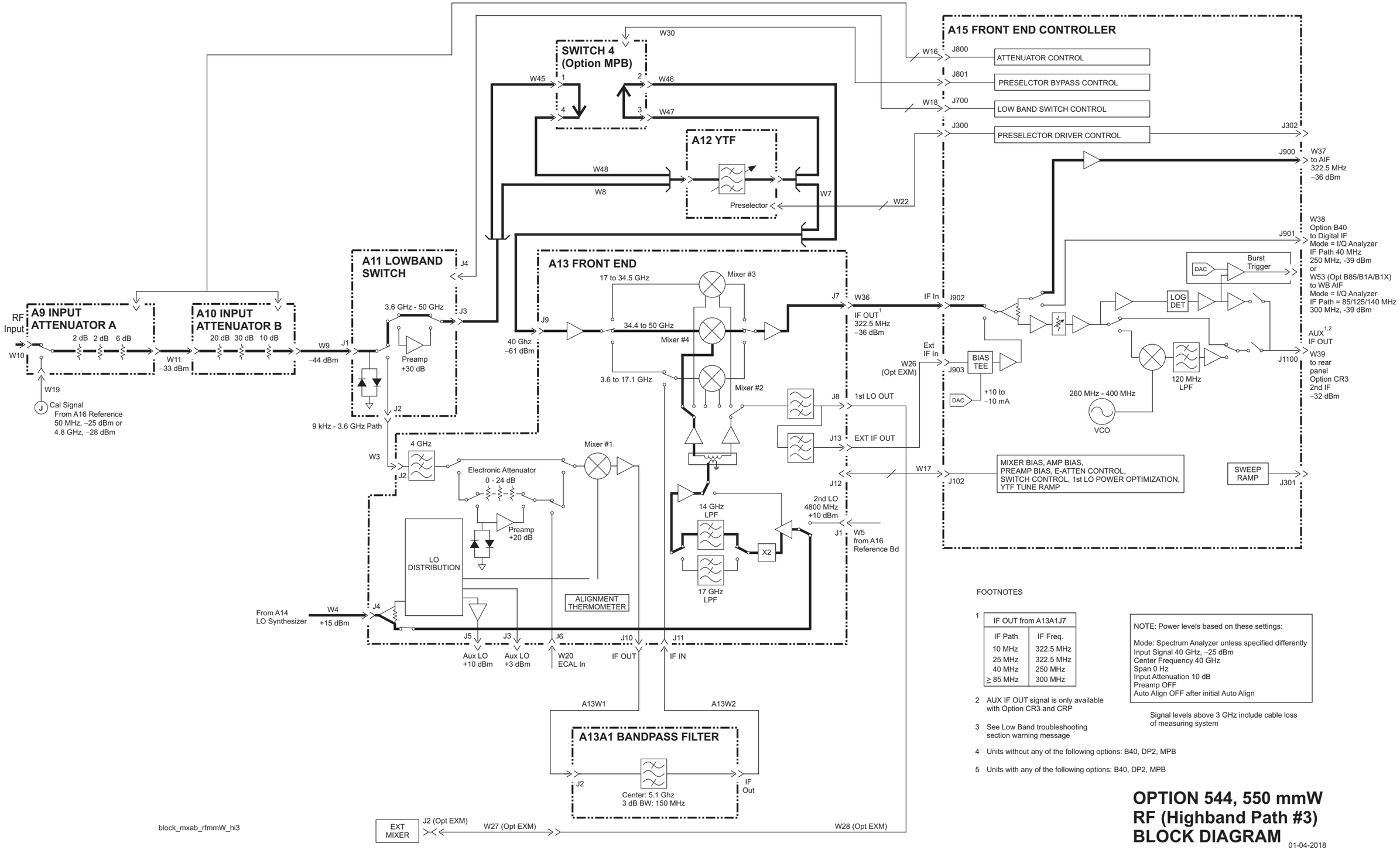
Mode: Spectrum Analyzer unless specified differently
Input Signal 20 GHz, –25 dBm
Center Frequency 20 GHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measuring system

OPTION 532, 544, 550 mmW RF (Highband Path #2) BLOCK DIAGRAM

01-04-2018

OPTION 544, 550 mmW N9020B MXA RF BLOCK DIAGRAM
(Highband Path #3 - Input signals 34.5 to 50 GHz)



FOOTNOTES

1

IF OUT from A13A1J7	
IF Path	IF Freq.
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
≥ 85 MHz	300 MHz

2 AUX IF OUT signal is only available with Option CR3 and CRP

3 See Low Band troubleshooting section warning message

4 Units without any of the following options: B40, DP2, MPB

5 Units with any of the following options: B40, DP2, MPB

NOTE: Power levels based on these settings:

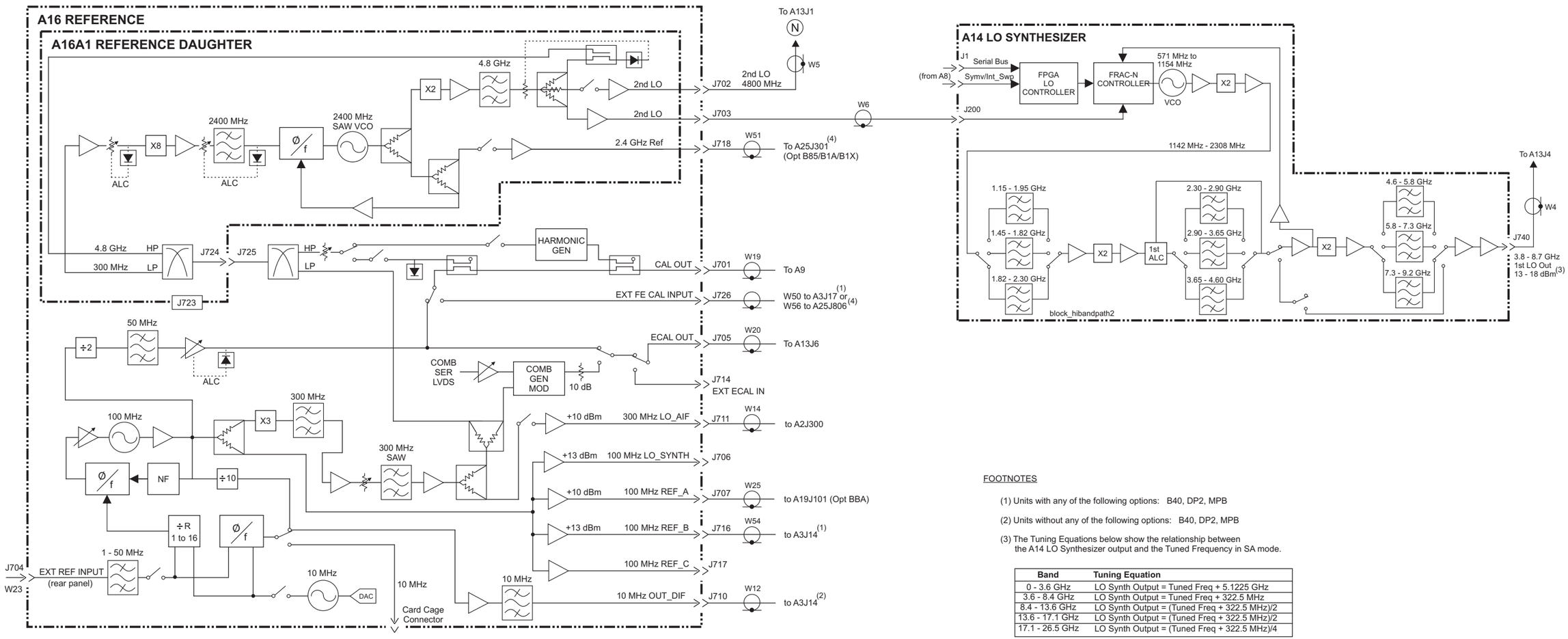
Mode: Spectrum Analyzer unless specified differently
Input Signal 40 GHz, –25 dBm
Center Frequency 40 GHz
Span 0 Hz
Input Attenuation 10 dB
Preamp OFF
Auto Align OFF after initial Auto Align

Signal levels above 3 GHz include cable loss of measuring system

OPTION 544, 550 mmW RF (Highband Path #3) BLOCK DIAGRAM

01-04-2018

REFERENCE and SYNTHESIZER BLOCK DIAGRAM



FOOTNOTES

(1) Units with any of the following options: B40, DP2, MPB

(2) Units without any of the following options: B40, DP2, MPB

(3) The Tuning Equations below show the relationship between the A14 LO Synthesizer output and the Tuned Frequency in SA mode.

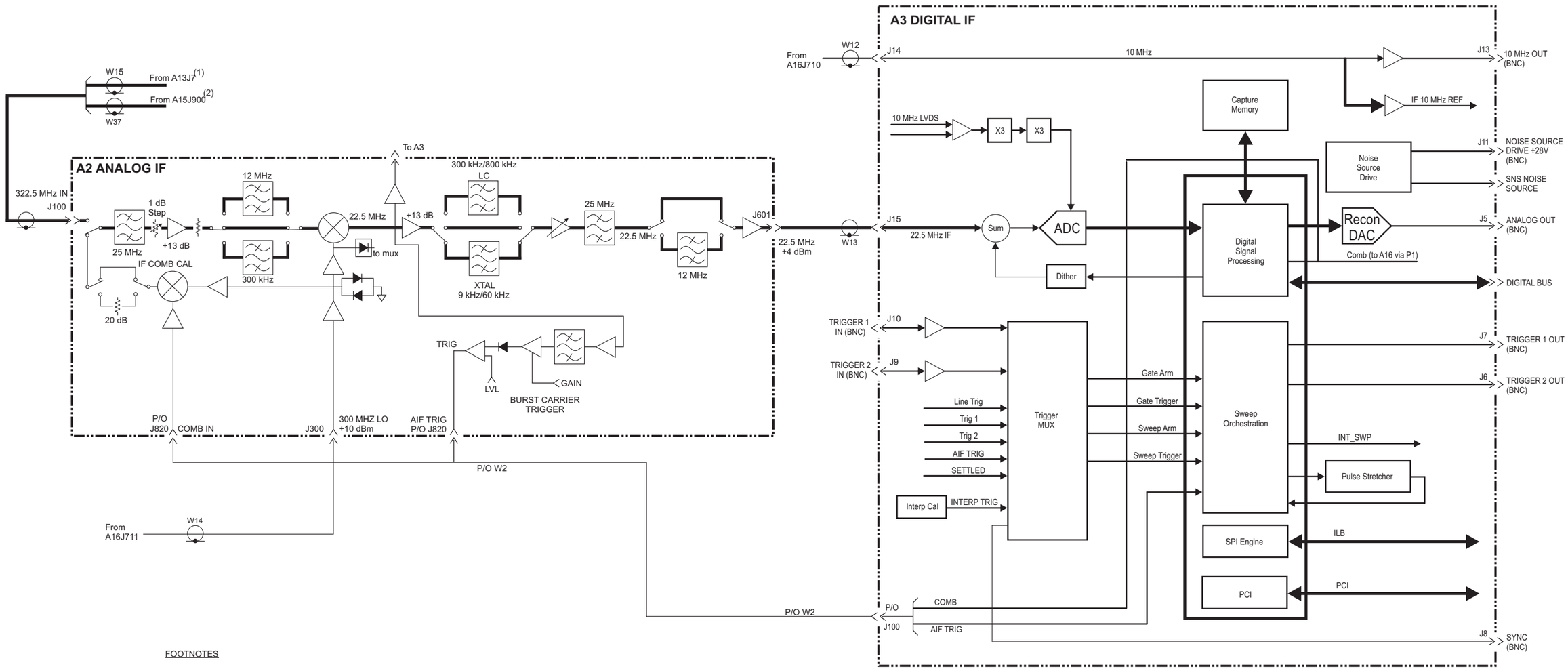
Band	Tuning Equation
0 - 3.6 GHz	LO Synth Output = Tuned Freq + 5.1225 GHz
3.6 - 8.4 GHz	LO Synth Output = Tuned Freq + 322.5 MHz
8.4 - 13.6 GHz	LO Synth Output = (Tuned Freq + 322.5 MHz)/2
13.6 - 17.1 GHz	LO Synth Output = (Tuned Freq + 322.5 MHz)/2
17.1 - 26.5 GHz	LO Synth Output = (Tuned Freq + 322.5 MHz)/4

(4) Units with any of the following options: B85, B1A, B1X

blockm40_refsynth2

REFERENCE and SYNTHESIZER BLOCK DIAGRAM

25 MHz BW IF SYSTEM BLOCK DIAGRAM



FOOTNOTES

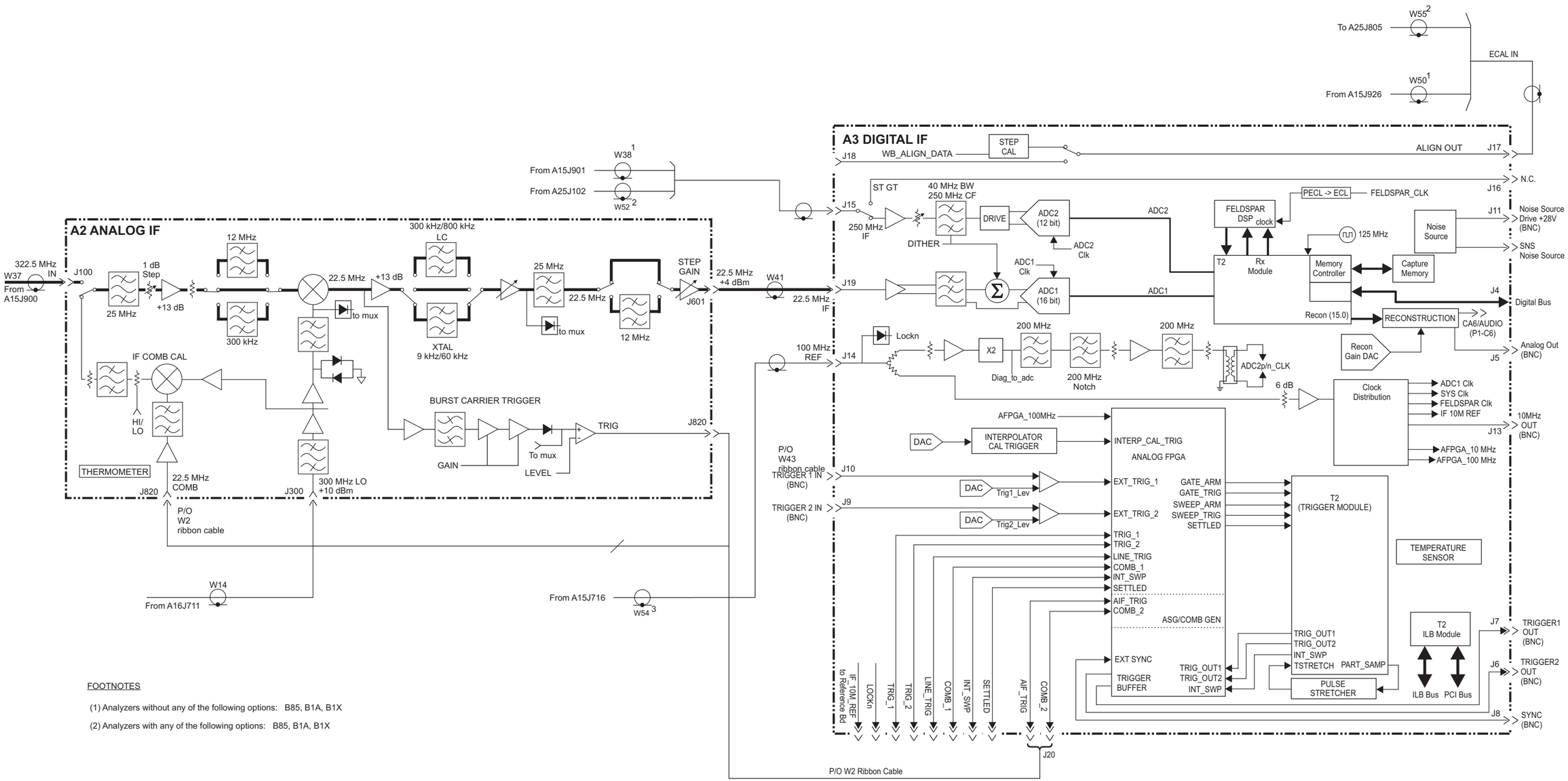
(1) Units without any of the following options: CR3, CRP

(2) Units with any of the following options: CR3, CRP

blockm40_if25

25 MHz BW IF SYSTEM BLOCK DIAGRAM

40 MHz BW IF SYSTEM BLOCK DIAGRAM



FOOTNOTES

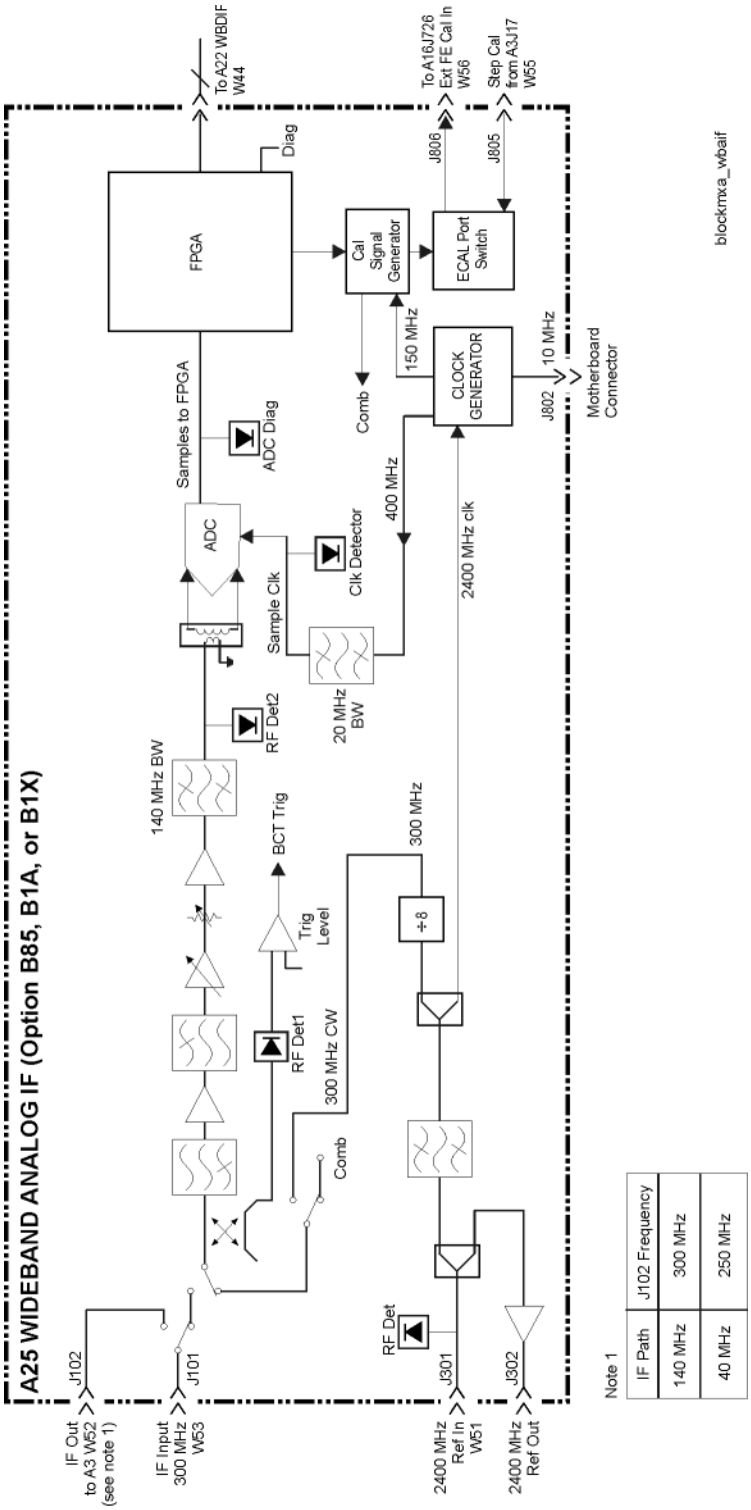
(1) Analyzers without any of the following options: B85, B1A, B1X

(2) Analyzers with any of the following options: B85, B1A, B1X

blockm40_if40

40 MHz BW IF SYSTEM BLOCK DIAGRAM

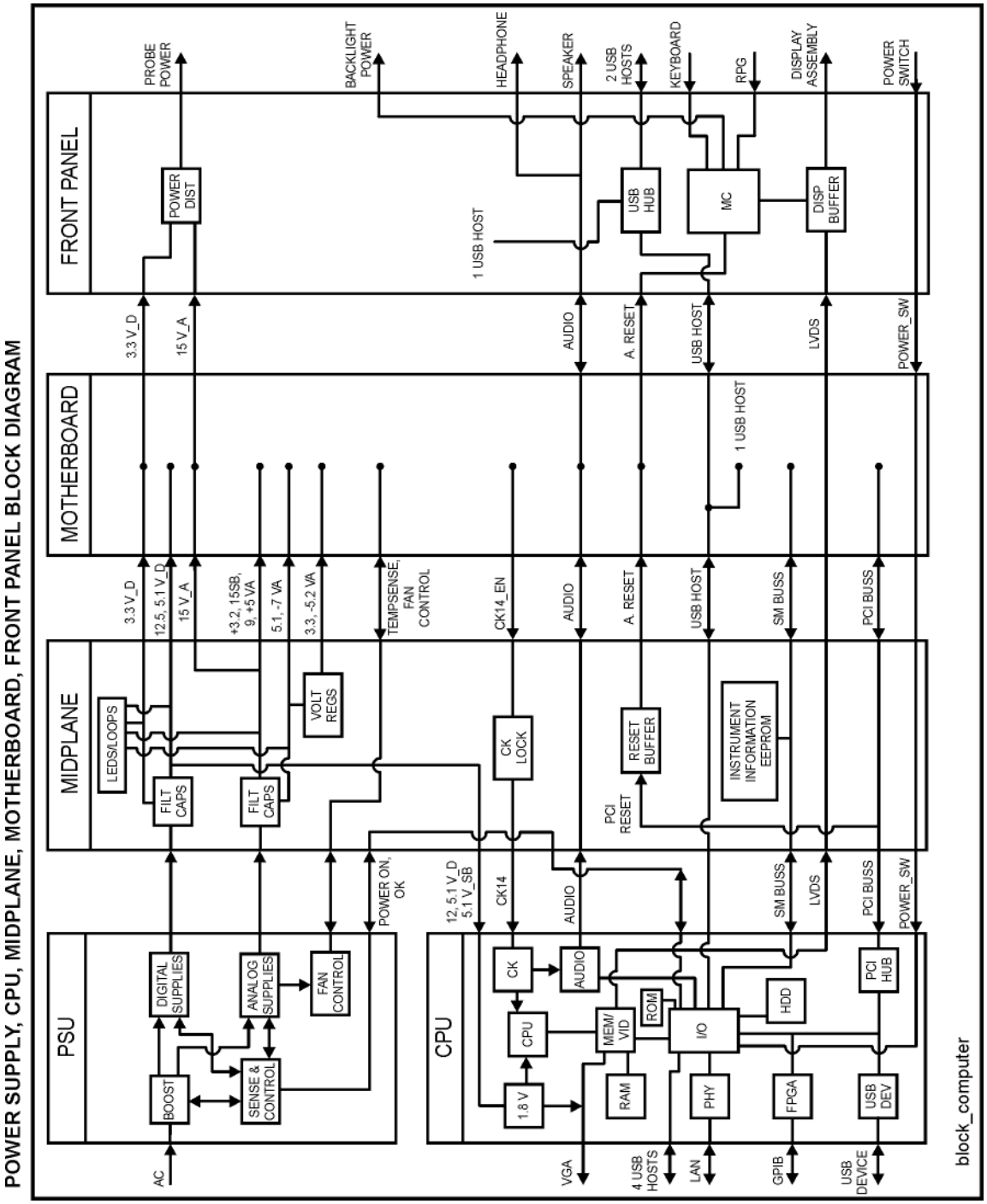
≥ 85 MHz Bandwidth IF System Block Diagram



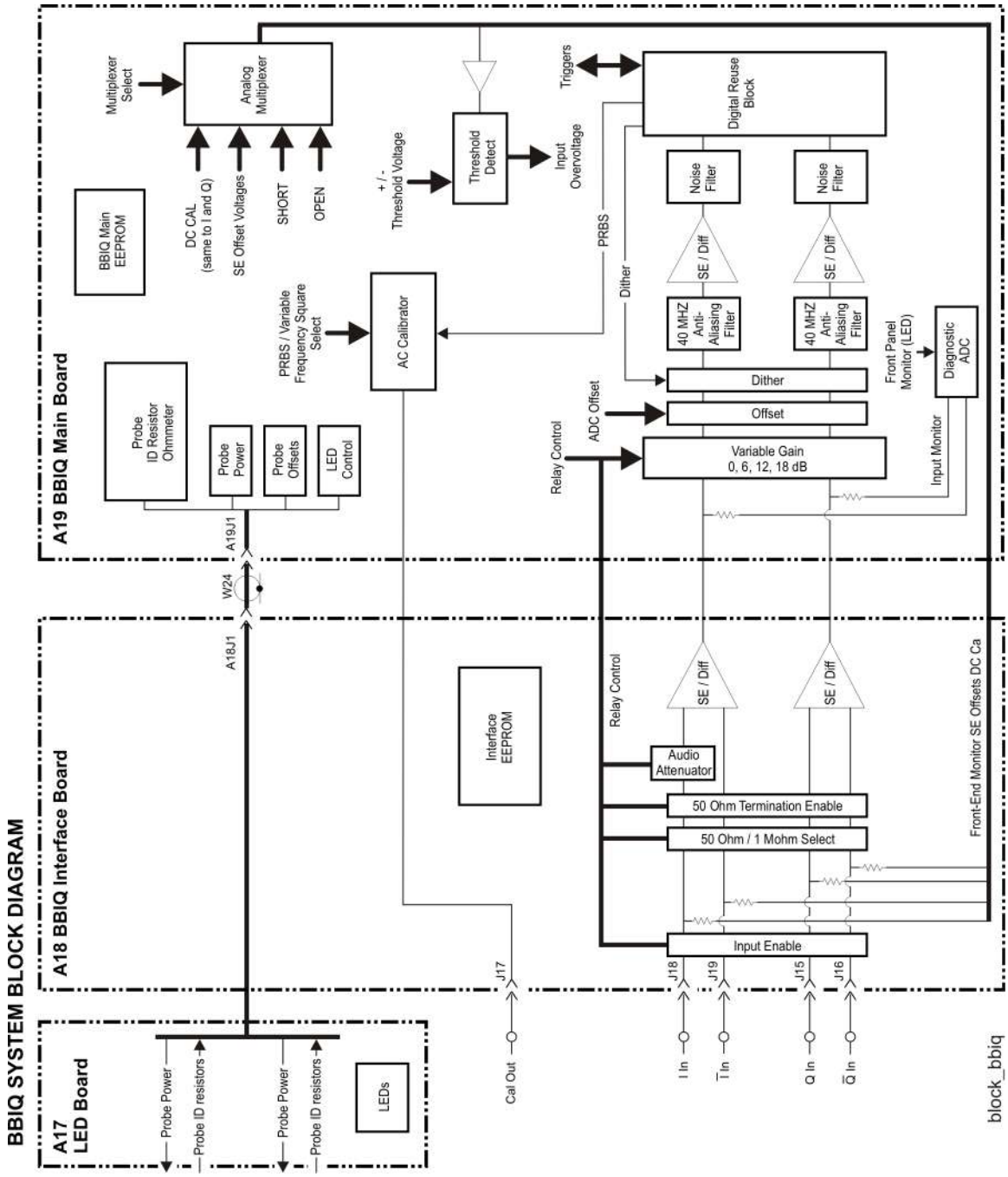
Note 1

IF Path	J102 Frequency
140 MHz	300 MHz
40 MHz	250 MHz

MXA Computer Block Diagram



BBIQ System Block Diagram



Block Diagrams

13 Service and Diagnostics Menus

Overview

The Service capabilities described below are accessed via the Service menus in the System Settings Diagnostic menu and Spectrum Analyzer mode Measure Setup menu. The Service capabilities are intended for field service technicians. These technicians may be at a Keysight Service Center or at a self-maintaining customer site.

There are two types of Service capabilities:

1. Diagnostics - These are available to any user and will assist in initial troubleshooting of instrument malfunctions. Examples are the ability to read the mechanical relay cycles.
2. Service Functions - These are for use by the factory or field repair technicians, access is controlled. Examples are the ability to band lock the analyzer and control the DAC which sets the 10 MHz Reference frequency.

Controlling Access

There are two levels of service and diagnostics capabilities:

1. “Regular access” to diagnostic capabilities that everyone is allowed access. Care may be required to use a feature appropriately. This is the “Diagnostic” type of Service capability defined above.
2. “Secure service access” to the Service menu. This prevents the casual user from accessing and using these features. It is intended to provide this access to Keysight Service Centers or any customer who purchases the Service Guide. The “Service Functions” type of Service capability is defined above.

To access secured service capabilities the technician is required to enter a specific numeric Service Code that is controlled by the instrument software. The Service Code is defined to be easily entered via the front panel; an external keyboard or mouse will not be required. Once access has been gained, it persists within the execution of the instrument application. If the user exits the instrument application, they must re-enter the Service Code to gain access.

NOTE

The Service Diagnostic menus are split into two separate locations for the Multi-touch user interface. They are available through the System -> Service menu and under the SA mode Measure Setup menu. Both menus require that you first login via the System -> Service menu.

Secure service access

To access the secure service capabilities press **System, Service** with the instrument application running. At this point you will see the window shown in Figure 13-1. Enter the Service Code and press **Login**.

The Service Code is: -2061

Figure 13-1 Service Code Entry

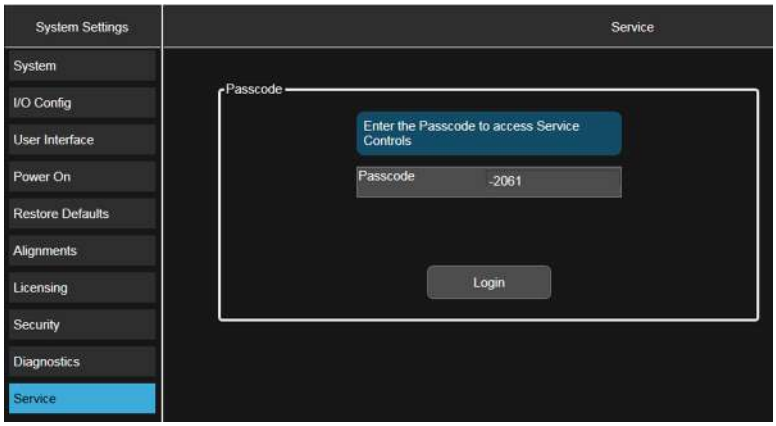


Figure 13-2 Secure Service Menus
(Accessed via System->Service)

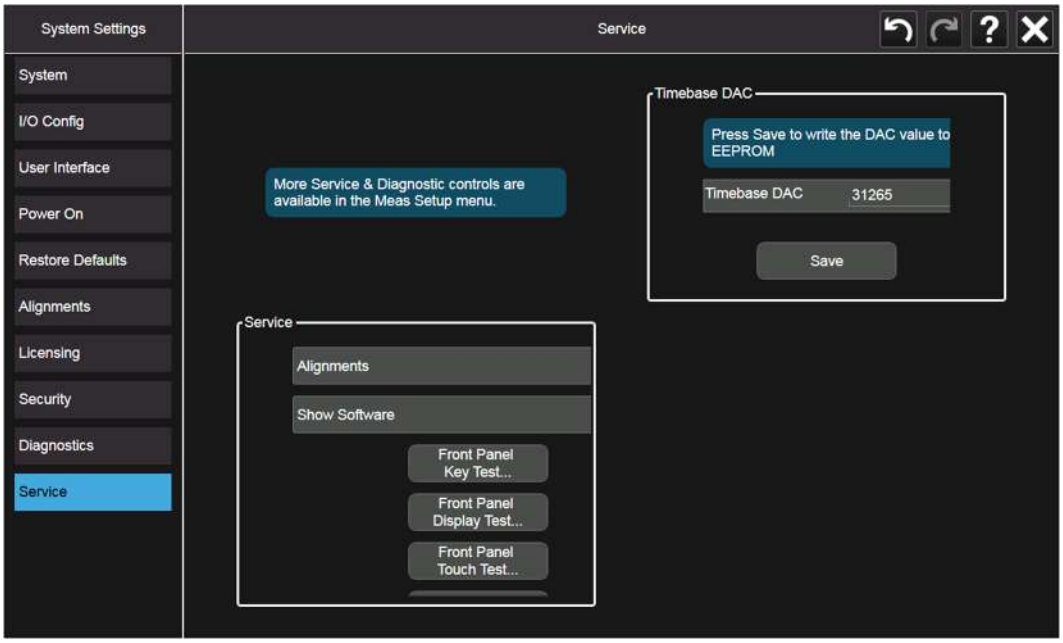


Figure 13-3 Lock and LO
(Accessed via Spectrum Analyzer Mode -> Meas Setup -> Lock and LO)

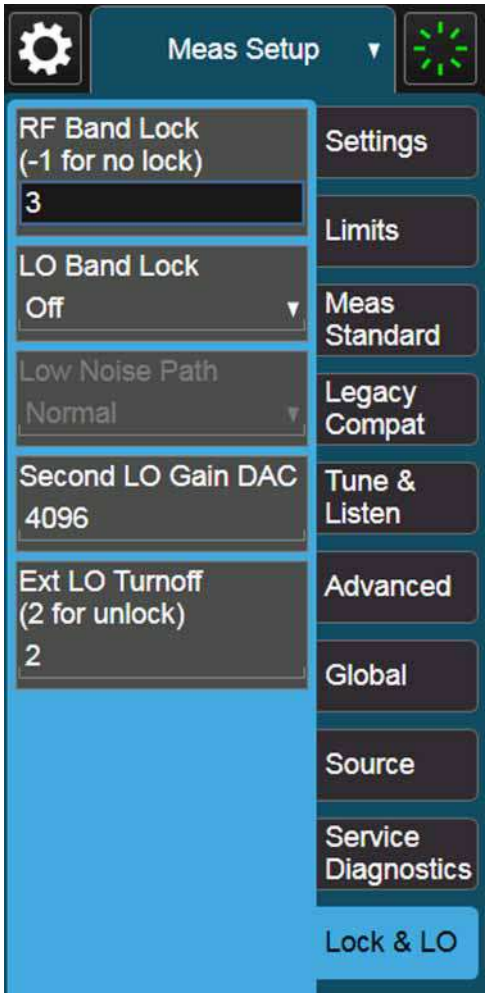


Figure 13-4 Diagnostics (Hardware Statistics)
(Accessed via System -> Diagnostics)

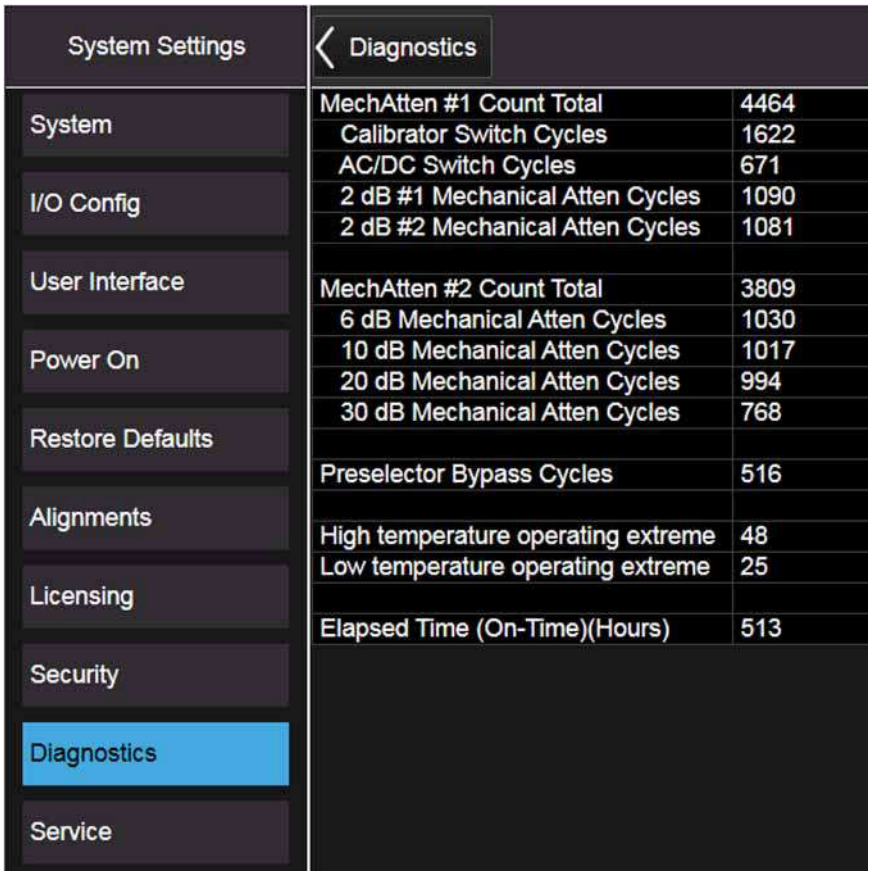
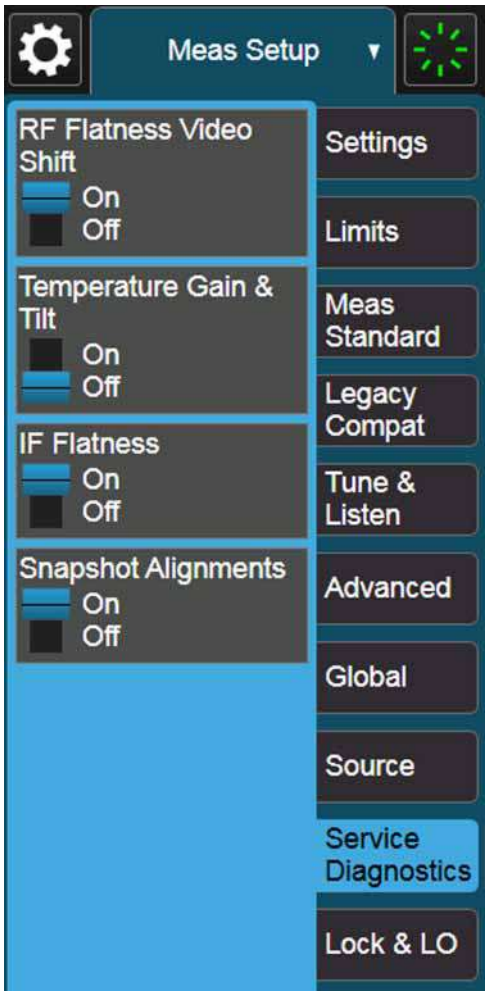


Figure 13-5 Service Diagnostics (Corrections Menu)
(Accessed via Spectrum Analyzer Mode -> Meas Setup -> Service Diagnostics)



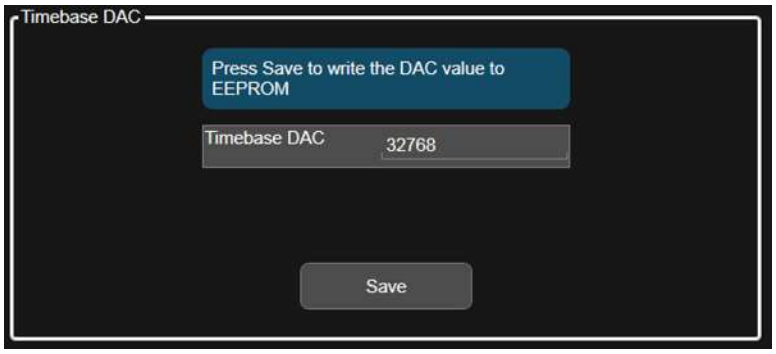
Service Key Descriptions

Timebase

Allows the technician to adjust the 10 MHz reference (“timebase”) manually.

Timebase DAC

Allows the technician the ability to adjust the 10 MHz reference (“timebase”). The adjustment is performed by changing the DAC setting controlling the reference. Once the reference is adjusted to the proper frequency, the DAC value can be saved in non-volatile memory by pressing the Save menu key.



Alignments

The Alignments Menu allows accessing Diagnostic capabilities of Alignment, and invoking alignments for individual subsystems.

Diagnostics

The Diagnostics menu contains items for controlling the operating behavior of Alignment and the Alignment reporting capabilities.

Visible Align

Controls the state of Visible Align. Visible Align replaces the “Aligning 1 or X” messages with descriptive messages describing the alignment piece begin executed.

Immediate Actions

The Immediate Actions menu allows invoking individual components of the internal alignments.

ADC

Immediately executes an alignment of the ADC subsystem. The instrument will stop any measurement currently underway, perform the alignment, then restart the measurement from the beginning.

A failure of ADC will set the Error Condition “Align ADC failed”. A failure will not employ new ADC alignment data.

Successful completion of ADC will clear the Error Condition “Align ADC failed”.

The Advisory Event “Alignment complete” is displayed when the alignment is complete.

Align ADC can be interrupted by pressing the Cancel (ESC) front-panel key. When this occurs, no new ADC alignment data will be employed.

LO

Immediately executes an alignment of the LO subsystem. The instrument will stop any measurement currently underway, perform the alignment, then restart the measurement from the beginning.

A failure of LO will set the Error Condition “Align LO failed”. A failure will not employ new LO alignment data.

Successful completion of LO will clear the Error Condition “Align LO failed”.

The Advisory Event “Alignment complete” is displayed when the alignment is complete.

Align LO can be interrupted by pressing the Cancel (ESC) front-panel key. When this occurs, no new LO alignment data will be employed.

IF

Immediately executes an alignment of the IF subsystem. The instrument will stop any measurement currently underway, perform the alignment, then restart the measurement from the beginning.

A failure of IF will set the Error Condition “Align IF failed”. A failure will not employ new IF alignment data.

Successful completion of IF will clear the Error Condition “Align IF failed” and clear bit 6 in the Status.

The Advisory Event “Alignment complete” is displayed when the alignment is complete.

Align IF can be interrupted by pressing the Cancel (ESC) front-panel key. When this occurs, no new IF alignment data will be employed.

IF Flatness

Immediately executes an alignment of the Current IF Flatness, for the purpose of improving the absolute amplitude accuracy within FFT Sweeps and improving the group delay in some digital demodulation measurements. The instrument will stop any measurement currently underway, perform the alignment, then restart the measurement from the beginning.

The Advisory Event “Alignment complete” is displayed when the alignment is complete.

Align Current IF Flatness can be interrupted by pressing the **Cancel (ESC)** front-panel key. When this occurs, no new Current IF Flatness alignment data will be employed.

Current System Gain

Immediately executes an alignment of the Current System Gain, for the purpose of improving small amplitude variations that occur as resolution bandwidth is switched. This alignment is done by measuring the response of the current system state configuration to the 50 MHz amplitude reference signal. All subsequent measurements are then compensated appropriately for absolute amplitude accuracy. The instrument will stop any measurement currently underway, perform the alignment, then restart the measurement from the beginning.

The Advisory Event “Alignment complete” is displayed when the alignment is complete.

Align Current System Gain can be interrupted by pressing the Cancel (ESC) front-panel key. When this occurs, no new Current System Gain alignment data will be employed.

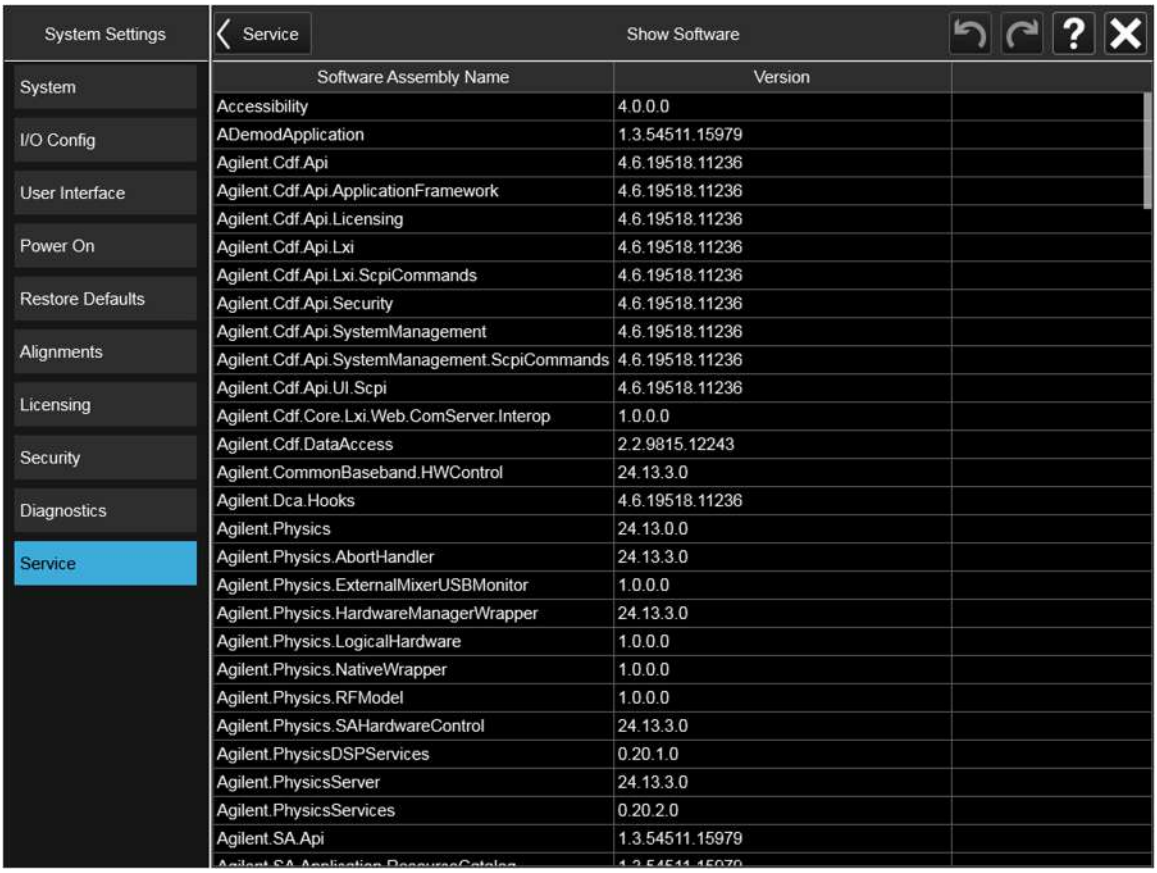
LO Phase Noise

Immediately executes an optimization for LO Phase Noise. When the optimization is finished the value is stored in non-volatile memory. The instrument will stop any measurement currently underway, perform the alignment, and then restart the measurement from the beginning (similar to pressing the **Restart** key).

Show Software

The Show Software screen displays revision information for Keysight internal software that comprises the embedded application and programmable hardware devices (FPGAs and PLDs).

Figure 13-6 Show Software Screen



Software Assembly Name	Version
Accessibility	4.0.0.0
ADemodApplication	1.3.54511.15979
Agilent.Cdf.Api	4.6.19518.11236
Agilent.Cdf.Api.ApplicationFramework	4.6.19518.11236
Agilent.Cdf.Api.Licensing	4.6.19518.11236
Agilent.Cdf.Api.Lxi	4.6.19518.11236
Agilent.Cdf.Api.Lxi.ScpiCommands	4.6.19518.11236
Agilent.Cdf.Api.Security	4.6.19518.11236
Agilent.Cdf.Api.SystemManagement	4.6.19518.11236
Agilent.Cdf.Api.SystemManagement.ScpiCommands	4.6.19518.11236
Agilent.Cdf.Api.UI.Scpi	4.6.19518.11236
Agilent.Cdf.Core.Lxi.Web.ComServer.Interop	1.0.0.0
Agilent.Cdf.DataAccess	2.2.9815.12243
Agilent.CommonBaseband.HWControl	24.13.3.0
Agilent.Dca.Hooks	4.6.19518.11236
Agilent.Physics	24.13.0.0
Agilent.Physics.AbortHandler	24.13.3.0
Agilent.Physics.ExternalMixerUSBMonitor	1.0.0.0
Agilent.Physics.HardwareManagerWrapper	24.13.3.0
Agilent.Physics.LogicalHardware	1.0.0.0
Agilent.Physics.NativeWrapper	1.0.0.0
Agilent.Physics.RFModel	1.0.0.0
Agilent.Physics.SAHardwareControl	24.13.3.0
Agilent.PhysicsDSPServices	0.20.1.0
Agilent.PhysicsServer	24.13.3.0
Agilent.PhysicsServices	0.20.2.0
Agilent.SA.Api	1.3.54511.15979

Corrections

The Corrections menu for the multi-touch display in MXA is labeled the Service Diagnostics menu under the Spectrum Analyzer Mode, Measure Setup menu. It allows the technician to activate and deactivate specific amplitude correction sets. With this capability, the technician can determine if an anomaly is a result of raw hardware performance or incorrect correction data. It also allows the technician the ability to measure the raw hardware performance when all corrections are set to Off.

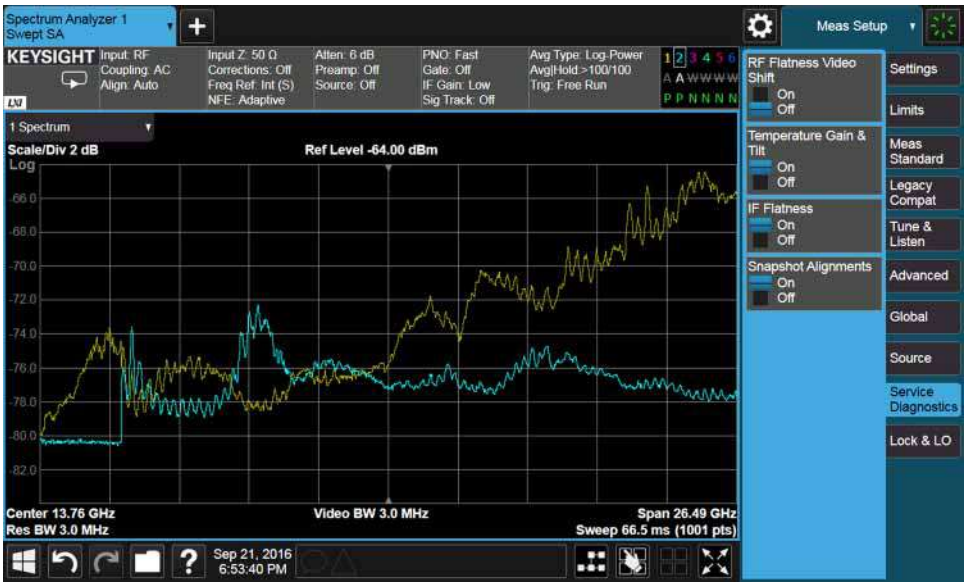
RF Flatness Video Shift On/Off

The Flatness Video Shift turns off the corrections for gain vs. frequency. It does not turn off the corrections for changes in the analog IF gain that accompany flatness changes. This function turns both the gain and video shift on or off, but does not affect the temperature corrections. When set to off, it is possible to measure the raw flatness of the spectrum analyzer while maintaining the temperature corrections.

When **Flatness Video Shift** is **Off**, the Advisory Event “Flatness Video Shift OFF” will be displayed.

When **Flatness Video Shift** is **ON**, the Advisory Event “Flatness Video Shift OFF” will be cleared.

The example spectrum below shows the effect of turning off RF Flatness Video. The yellow trace shows RF Flatness Video shift on, and the Blue trace shows RF Flatness Video shift off.



Temperature Gain & Tilt

This function controls both temperature adjustment mechanisms: overall gain vs. temperature, and the temperature-proportional tilt of the gain vs. frequency.

When **Temperature Gain & Tilt** is **OFF**, the Advisory Event “Flatness Temperature Gain & Tilt OFF” will be displayed.

When **Temperature Gain & Tilt** is **ON**, the Advisory Event “Flatness Temperature Gain & Tilt OFF” will be cleared.

IF Flatness

This function turns the corrections related to IF flatness On or Off.

When **IF Flatness** is **OFF**, the Advisory Event “IF Flatness corrections OFF” will be displayed.

When **IF Flatness** is **ON**, the Advisory Event “IF Flatness corrections OFF” will be cleared.

Snapshot Alignments On/Off

During normal auto alignment operation, the firmware will perform an RBW and IQ alignment when the analyzer RBW state is changed, and every 10 minutes thereafter. These alignments can hinder troubleshooting the analyzer since they can change correction factors when the state is changed. Turning snapshot alignments off disables the RBW portion of these alignments for more accurate troubleshooting. (Use **IF Flatness ON/OFF** to control the IQ alignment.)

When **Snapshot Alignments** are **OFF**, the Advisory Event “Snapshot OFF” will be displayed.

When **Snapshot Alignments** are **ON**, the Advisory Event “Snapshot OFF” will be cleared.

Band Lock

Provides the ability to tune the analyzer over as large a range as can be accommodated by the specified harmonic number and 1st LO frequency range. As a result, this feature can be used to check performance in the frequency band overlap regions. By definition, multi-band sweeps are not allowed.

When band lock is in effect the Advisory Event “Band Locked: Band <x>” where “x” is a value between 0 and 6.

When band lock is not in affect the Advisory Event “Band Locked: Band <x>” is cleared.

Dependencies/Couplings:

1. Band Lock is only available on analyzers with frequency range options beyond 3.6 GHz
2. The individual bands available for selection also depends upon the particular frequency range option. Enter one of the following values:

-1

Turns Band Lock to Off. Analyzer will tune from band to band normally.

0

Locks the analyzer to Band 0.

1

Locks the analyzer to Band 1.

2

Locks the analyzer to Band 2.

3

Locks the analyzer to Band 3.

4

Locks the analyzer to Band 4.

5

Locks the analyzer to Band 5. The Band 5 key label can be different depending on which option is installed.

6

Locks the analyzer to Band 6. The Band 6 key label can be different depending on which option is installed.

LO Band Lock

Provides the ability to tune the analyzer over as large a range as can be accommodated by the specified LO Band. As a result, this feature can be used to check performance in the LO band overlap regions. By definition, multi-band sweeps are not allowed.

When band lock is in effect the Advisory Event “LO Band Locked: Band <x>” where “x” is a value between 0 and 6.

When band lock is not in affect the Advisory Event “LO Band Locked: Band <x>” is cleared.

Dependencies/Couplings:

LO Bandlock will be grayed-out if Bandlock is OFF. If Harmonic Bandlock is any setting other than OFF, LO Bandlock menu key is enabled. If LO Bandlock is other than OFF, and the Harmonic Bandlock is transitioned to OFF, the LO Bandlock is set to OFF.

Off

Turns LO Band Lock to Off. Analyzer will tune from LO band to LO band normally.

Band 0

Locks the analyzer to LO Band 0.

Band 1

Locks the analyzer to LO Band 1.

Band 2

Locks the analyzer to LO Band 2.

Band 3

Locks the analyzer to LO Band 3.

LO Control

Provides keys that allow you to control the LO. This is only present on analyzers equipped with Opt EXM, External Mixing.

2nd LO Gain DAC

This parameter provides the ability to adjust the output gain of the 2nd LO DAC. The range is from 0 to 4095 where 0 is the minimum gain and 4095 is the maximum gain. Setting a value of 4096 or greater returns control to the instrument. In External Mixing, this DAC controls the level of the 1st LO signal at the front panel EXT MIXER connector.

External LO Turnoff

Disconnects the 1st LO path which will minimize the effect of the 1st LO signal at the front panel EXT MIXER connector.

Front Panel Key Test

Allows you to test the front panel keys of the instrument.

Front Panel Display Test

The display test will show 5 screens with colors: white, black, red, green, and blue. This allows you to test for bad pixels in the display. After the last color, the test will exit and results will be stored to the following log file: C:\Temp\DisplayTestResults.txt

Multitouch Test

This test includes a series of simple tests to test the basic functionality of the multi-touch screen. The test results will be stored to the following file: C:\Temp\MultitouchTestResults.txt

Rotate Test

A Picture will appear in the center of the screen. Use two fingers to rotate the image 45 degrees clockwise. Once this is completed, rotate the image 45 degrees counter-clockwise.

Zoom Test

A small picture will appear in the center of the screen. Use two fingers and spread them apart to scale the box until it fills the dotted rectangle around it. The dotted rectangle will resize. Pinch your fingers together to contract the box until it fits inside the now smaller dotted rectangle.

Drag Test

A blue circle will appear in the center of the screen. Drag the circle into each square of the gray grid on the screen to pass the test. Each square will be colored green when it has been dragged over.

Accuracy Test

The screen will display a series of lines. For each blue line, trace along the line with your finger to draw a matching line. Lines that deviate significantly from the blue trace line (i.e beyond the gray lines) will be marked in red.

14 Replaceable Parts

What You Will Find in This Chapter

1. Part number tables for assemblies, mechanical parts, cables, front panel connectors, and labels.
2. Part location diagrams for the following:

Figure 14-1, “Major Assemblies”

Figure 14-2, “External Hardware (Benchtop Configuration)”

Figure 14-3, “External Hardware and Bail Handle (Option PRC)”

Figure 14-4, “External Hardware (Option PRC)”

Figure 14-5, “CPU Assembly”

Figure 14-6, “Disk Drive Tray Assembly”

Figure 14-7, “Top Brace and Reference Bracket”

Figure 14-8, “RF Area - Standard RF/Microwave Instrument”

Figure 14-9, “RF Area - Millimeter Wave Instruments, Option 532, 544, 550”

Figure 14-10, “RF Area - RF/Microwave instruments with Options B40, MPB, or DP2”

Figure 14-11, “RF Area - RF/Microwave Instruments with Options B40, MPB, or DP2 (switch detail)”

Figure 14-12, “RF Area - Millimeter Wave Instruments with Option B40, MPB, or DP2”

Figure 14-13, “RF Area - Millimeter Wave Instruments with Opt B40, MPB, or DP2 (switch detail)”

Figure 14-14, “Front End Parts - Standard RF/Microwave Instruments”

Figure 14-15, “Front End Parts - Millimeter Wave Instruments”

Figure 14-16, “Front End Parts - RF/Microwave Instruments with Options MPB, B40, DP2, CR3, or CRP”

Figure 14-17, “Front End Control Cables”

Figure 14-18, “Front End Control Cables - Options B40, MPB, DP2, CR3, or CRP”

Figure 14-19, “Reference Board Cables - without Options B40, MPB, DP2, B85, B1A, or B1X”

Figure 14-20, “Reference Board Cables - with Options B40, MPB, DP2, B85, B1A, or B1X”

Figure 14-21, “AIF/DIF Cables - Standard Instruments”

Figure 14-22, “AIF/DIF Cables, bottom - Standard Instruments”

Figure 14-23, “AIF/DIF Cables - Options MPB, B40, or DP2”

Figure 14-24, “AIF/DIF Cables, bottom - Options MPB, B40, or DP2”

Figure 14-25, “AIF/DIF Assemblies - Standard Instruments”

Figure 14-26, “AIF/DIF Assemblies - Option DP2, MPB, B40”

Figure 14-27, “Chassis”

Figure 14-28, “Motherboard”

Figure 14-29, “Fan Hardware”

Figure 14-30, “Input Connector”

Figure 14-31, “Front Frame Parts”

Figure 14-32, “Front Frame Exploded View”

Figure 14-33, “Option BBA Parts”

How to Order Parts

To order an assembly or mechanical part listed in this chapter, go to: http://www.keysight.com/find/parts

If you do not have web access, or the parts you are interested in cannot be found in the parts list provided, contact your local Keysight Technologies sales and service office with the following information:

- Product model number
- Product serial number
- Description of where the part is located, what it looks like, and its function (if known)
- Quantity required

For a list of Keysight Technologies sales and service office locations, refer to "Contacting Keysight Technologies" on page 41.

Replaceable Parts

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
A1A1	Front Frame Assembly Replacement Kit[a] Includes:	N9020-60299
	Front Frame (with the following pre-installed)	N9020-20352
	USB Ground Spring	N9020-20258
	Braided gasket	8160-0660
	EMI Gasket long	8160-1997
	EMI Gasket short (2 included)	8160-1998
	Front Frame Side Trim Strips (plastic, 2 ea)	N9020-40018
	Top trim	N9020-40005
	Cover Plate	N9020-00002
	Screw, flat head M3 x 0.5 6 mm long (2 included)	0515-1946
	Display Boot	N9020-40002
	Hole Plug, 0.25 inch	6960-0076
	The following are in the kit but not installed:	
	Side trim, phantom gray, (adhesive, 2 included)	5041-7905
	Keyboard overlay (with EXM)	N9020-80127
	Keyboard overlay (without EXM)[b]	N9020-80168
	Keyboard Overlay (CXA)[a]	N9000-80045
	Overlay, solid left	N9020-80164
	Overlay, for CXA 75 ohm input[a]	N9000-80046
	Overlay, left for CXA TG Output[a]	N9000-80104
	Overlay, BBIQ Bottom	N9020-80166
	Overlay, BBIQ top	N9020-80163
A1A2	Front Panel Control Board	N9020-63294
A1A3	Liquid Crystal Display 10.6-in w/PCAP Touch 1280X768-Pixels	2090-1103
A1A4	Keyboard, PCA	N9020-63275

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
A1A5	Main Keypad	N9020-40001
A1MP1	Overlay, solid left	N9020-80164
A1MP2	Overlay, Keyboard	N9020-80127
A1MP3	Frequency Label, 3.6 GHz	N9020-80152
A1MP4	Frequency Label, 8.4 GHz	N9020-80153
A1MP5	Frequency Label, 13.6 GHz	N9020-80154
A1MP6	Frequency Label, 26.5 GHz	N9020-80155
A1MP7	Frequency Label, 32 GHz	N9020-80196
A1MP8	Frequency Label, 44 GHz	N9020-80197
A1MP9	Display hold down (compression pad)	N9020-40003
A1MP10	Bracket front panel shield	N9020-00064
A1MP11	Display Bracket, Front Panel	N9020-00078
A1MP13	RPG Knob	W1312-40179
A1MP14	Shield	N9020-00066
A1MP16	Core Bracket, Top (Option BBA)	N9020-00071
A1MP17	Overlay, BBIQ Bottom (Option BBA)	N9020-80166
A1MP18	Overlay, BBIQ Top (Option BBA)	N9020-80163
A1MP19	Core Bracket, Bottom (Option BBA)	N9020-00072
A1MP20	Frequency Label, 50 GHz	N9020-80198
A1W1	Flex Circuit, Display to Front Panel Control Board	N9020-60273
A1W2	Cable Assembly, Backlight	N9020-60217
A2	Analog I.F. Assembly	N9020-60011
A3	Digital I.F. Assembly	
	Standard Instruments	N9020-60119
	Options B40, MPB, or DP2, and all with Option B85, B1A, or B1X	N9020-60016
A3W1	Cable Assembly, Smart Noise Source (Wire Harness)	
	Standard Instruments	E4410-60163
	Options B40, MPB, or DP2	N9020-60090

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
A4	CPU (w/o disk drive) (Refer also to Service Note N9020B-09A)	
	Instruments with PC6 or PC6S CPUs	N9020-60247
	Instruments with PC8 CPUs	W1312-60687
	Instruments with PCA CPUs	N9020-60561
A4A1	Disk Drive Interconnect Board	
	Instruments with PC6 CPUs	W1312-63079
	Instruments with PC6S or PC8 CPUs	W1312-63377
A4A2	Memory card, SD (PC6, PC6S, or PC8 CPUs)	1819-1354
A4BT1	CPU Board Battery (CR2032)	1420-0356
A5	Disk Drive Replacement Kit	
	Instruments with WES7 OS and PC6 or PC6S CPUs	N9020-60355
	Instruments with Win10 OS and PC6 or PC6S CPUs	N9020-60381
	Instruments with Win10 OS and PC8 CPUs	N9032-60039
	Instruments with Win10 OS and PCA CPUs	N9032-60025
	Instruments with Win11 OS and PC8 CPUs	N9032-60044
	Instruments with Win11 OS and PCA CPUs	N9032-60043
A5MP1	Disk Drive Tray (PC6, PC6S, PC8)[c]	W1312-40078
A5MP2	Disk Drive Rear Panel (PC6, PC6S, PC8)[c]	W1312-00103
A5MP3	Disk Drive Assembly Handle[c]	
	Tray Assembly w/o Solid State Drive (includes A5MP1, A5MP2, A5MP3) (PC7, PC7S, PC9)	E6607-61820
A6	Power Supply	0950-5012
A7	Midplane Assembly	N9020-63120
A8	Motherboard Assembly	N9000-66404
A9	RF Attenuator A	
	0 to 4 dB (Option 503, 508, 513, 526)	33360-60011
	0 to 10 dB (Option 532, 544, 550)	33326-60013

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
A10	RF Attenuator B	
	0 to 66 dB (Option 503, 508, 513, 526)	33321-60085
	0 to 60 dB (Option 532, 544, 550)	33325-60020
A11	Low Band Switch Assembly	
	Option 503	E4410-60121[d]
	Option 508, 513, 526	E4410-60121
	Option 532, 544, 550	N9020-60051
A12	YTF Preselector (Not used in Opt 503)	
	Option 508, 513, 526	5087-7382
	Option 532, 544,550	5087-7383
A12MP1	Gap Pad YTF Base	5022-7179
A13	RF Front End Assembly	
	Option 503, 508,513, 526	N9020-60314
	Option 532, 544, 550	N9020-60315
A13A1	Bandpass Filter	0955-2469
A13W1	Cable Assembly, A13J10 to A13A1 Input (semi-rigid)	
	For all A13 part numbers for Option 503, 508, 513, 526	E6607-21178
	For all A13 part numbers for Option 532, 544, 550	N9020-20229
A13W2	Cable Assembly, A13J11 from A13A1 Output (semi-rigid)	
	For all A13 part numbers for Option 503, 508, 513, 526	N9020-20231
	For all A13 part numbers for Option 532, 544	N9020-20046
A14	L.O. Synthesizer Assembly	N9020-60118
A15	Front End Control Assembly	
	Standard Instruments	N9020-60098
	Options B40, MPB, DP2, CR3, CRP, 532, 544, 550	N9020-60172[d]
A16	Reference Assembly	N9020-60200
A17	BBIQ LED Board (Option BBA)[e]	N9020-63095
A18	BBIQ Interface Board (Option BBA)	N9020-60094

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
A19	BBIQ Main Board (Option BBA)	N9020-60093
A25	Wide-Band Analog IF Assembly (Option B85/B1A/B1X)	N9020-60044
A26	Wide-Band Digital IF Assembly (Option B85/B1A/B1X)	N9020-60311
AT1	Fixed Attenuator, 6 dB (Options B40, MPB, or DP2) (connects to SW2)	08493-60026
B1-B2	Fan	3160-4199
J1	Type N (f) Input Connector Assembly (Option 503, 508, 513, 526)	5002-0702
	2.4mm (m) Input Connector Assembly (Option 532, 544, 550)	N9030-60011
	EMI O-Ring 18.75 mm ID (used between RF Input Connector and Front Frame)	8160-1637
J2	EXT MIXER Connector (discard washer and nut, if supplied) (Option EXM)	1250-1666
MP1	Chassis Base	N9020-00032
MP2	Chassis Side, Right (inner)	W1312-00135
MP3	Chassis Side, Left (inner)	W1312-00136
MP4	Midplane Bracket	W1312-00048
MP5	Chassis Front Bracket	N9020-00059
MP6	Fan Bracket	W1312-00137
MP7	Top Brace (includes foam strips)	N9020-60018
MP8	Chassis Side, Right (Outer, attaches to Low Band Switch bracket, Attenuator brackets, and Chassis bottom)	N9020-00034
MP9	Rear Panel Replacement Kit (includes foam strip)	N9020-60298
MP10	Reserved	
MP11-12	Coax Cable Clips	5041-9690
MP13-15	Tie Wrap (For long semi-rigid cables)	1400-0249
MP16	Dress Cover (includes magnetic gasket)	N9020-00068
MP17-20	Rear Feet (Benchtop Configuration)	5041-7903
MP21-22	Strap Handles (Benchtop Configuration)	N9020-60252
MP25-26	Fan Guard	3160-0281
MP27-34	Rivet, Fan Mounting (8 pieces)	0361-1272

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
MP35	Z-Bracket Power Supply to Chassis	W1312-00016
MP36-37	Attenuator Bracket	
	Option 503, 508, 513, 526	N9020-00052
	Option 532, 544, 550	N9020-00019
MP38	Low Band Switch Assembly Bracket	
	Option 503, 508, 513, 526	N9020-00023
	Option 532, 544, 550	N9020-00013
MP39	O-ring, Type N (f) RF Input Connector	8160-1637
MP40	PC Board Plastic Guides (10 pieces)	W1312-40001
MP41-44	Front Bumpers (Option PRC, Portable Configuration)	N9020-40016
MP45-48	Rear Bumpers (Option PRC, Portable Configuration)	N9020-40015
MP49	Bail Handle (Option PRC, Portable Configuration)	N9020-60251
MP50	Front Panel Protective Cover	
	Benchtop Configuration	Refer to note [f]
	Portable Configuration (Option PRC)	N9020-40004[f]
n/a	Front End Troubleshooting Kit	N9020-60005
n/a	Front End Troubleshooting Bd.	E4410-60115
MP51	CPU & Power Supply Guide Pin Grommets (8 pieces)	0400-0353
MP52	50 Ω Termination (for A13)	1810-0118
MP53	Spiral Wrap	0890-0025
MP54	Rear Frame Lock Washer (External Reference Cable)	2190-0102
MP55	Rear Frame Lock Nut (External Reference Cable)	0590-2332
MP57-60	Bottom Feet Hole Plugs (Option PRC, Portable Configuration)	N9020-40007
MP61-64	Strap Handle Plugs (Option PRC, Portable Configuration)	N9020-40014
MP65	Reserved	
MP66-69	Bottom Feet (Benchtop Configuration)	5041-7906
MP70-71	Tilt Stands (Benchtop Configuration)	1460-1345
MP72-75	Bottom Feet Key Locks (Benchtop Configuration)	5021-2840
MP76	Vibration Mount (Option BBA Core Bracket)	0460-2725

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
MP77	BBIQ Main Board Warning Label	N9020-80036
MP78	Cable Hold Down, 41 mm	5023-2095
MP79	Bracket, Preselector Bypass Switch 1 (Option MPB, on top of bottom switch)	E4410-00104
MP80	Bracket, Preselector Bypass Switch 2 (Option MPB, on top of top switch)	E4410-00110
MP81	Shield, Magnetic, Attenuator A (Option 532, 544, 550)	N9020-00043
MP82	Shield, Magnetic, Attenuator B (Option 532, 544, 550)	N9020-00044
MP83	Gusset, Chassis (near RF Input connector)	W1312-00093
MP84	Bracket, Reference Support	E4410-00108
SW1 & 2	Coaxial Switch (Options B40, MPB, or DP2)	N1810-60069
SW4	Transfer Switch, 50 GHz (Options B40, MPB, or DP2)	87222-60031
W1	Cable, Front Panel Interface Board to Motherboard (Ribbon)	N9020-60216
W2	Cable, Interconnect from A2J820 to A3J20	N9020-60046
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20101
	Option 532, 544, 550	N9020-20131
W4	Cable Assembly, A14J740 to A13J4 (semi-rigid)	N9020-20156
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W6	Cable Assembly, A16J703 to A14J200 (semi-rigid)	N9020-20033
W7	Cable Assembly, A12 Output to A13J2 (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20124
	Option 532, 544, 550	N9010-20006
W8	Cable Assembly, A11J3 to A12 input (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20123
	Option 532, 544, 550	N9010-20005
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20153
	Option 532, 544, 550	N9010-20004

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20141
	Option 532, 544, 550	N9020-20133
W11	Cable Assembly, A9 Output to A10 Input (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20142
	Option 532, 544, 550	N9010-20002
W12	Cable Assembly, A16J710 to A3J14 (Flexible Coax)	8121-1401
W13	Cable Assembly, A2J601 to A3J15 (Flexible Coax)	8121-1411
W14	Cable Assembly, A16J711 to A2J300 (Flexible Coax)	8121-1401
W15	Cable Assembly, A13J7 to A2J100 (Flexible Coax)	8121-1400
W16	Cable Assembly, A9 & A10 to A15J801 or A15J102 (Ribbon Cable)	E4410-60157
W17	Cable Assembly, A13J12 to A15J104 (Ribbon Cable)	E4410-60156
W18	Cable Assembly, A11J4 to A15J700 (Ribbon Cable)	
	Option 503, 508, 513, 526	E4410-60160
	Option 532, 544, 550	N9020-60092
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20065
	Option 532, 544, 550	N9010-20010
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400
W21	Reserved	N/A
W22	Cable Assembly, A15J301 or A15J300 to A12J1 (Wire Harness)	N9020-60059
W23	Cable Assembly, Ext. Reference Cable (rear frame) to A16J704 (Flexible Coax)	8121-1402
W24	Cable Assembly, A18J1, BBIQ Interface Board to A19J1, BBIQ Main Board (Ribbon Cable) (Option BBA)	8121-1683
W25	Cable Assembly, A19J101, BBIQ Main Board to A16J707 Reference Board (Flexible Coax) (Option BBA)	8121-1401
W26	Cable Assembly, A13J13 to A15J903 (Flexible Coax) Option EXM	
	Option 503, 508, 513, 526	8121-2027
	Option 532, 544, 550	8121-2025

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
W27	Cable Assembly, J2 (front panel) to W28 (semi-rigid) Option EXM	N9020-20166
W28	Cable Assembly, W27 to A13J8 (semi-rigid) Option EXM	
	Option 503, 508, 513, 526	N9020-20241
	Option 532, 544, 550	N9020-20296
W29	Reserved	
W30	Cable Assembly, A15J801 to SW1 and SW2 (Wire Harness)	E4410-60159
W31	Cable Assembly, SW2 Center Port to A11J3 (semi-rigid)	E4410-20161
W32	Cable Assembly, SW2 Port 2 to A12J2 (semi-rigid)	E4410-20163
W33	Cable Assembly, SW1 Port 2 to A12J1 (semi-rigid)	E4410-20165
W34	Cable Assembly, SW1 Center Port to A13J9 (semi-rigid)	E4410-20164
W35	Cable Assembly, AT1 to SW1 Port 1 (semi-rigid)	N9020-20210
W36	Cable Assembly, A15J902 to A13J7 (Flexible Coax)	8121-1862
W37	Cable Assembly, A15J900 to A2J100 (Flexible Coax)	8121-1401
W38	Cable Assembly, A15J901 to A3J15 (Flexible Coax)	8121-1861
W39	Cable Assembly, A15J1100 to Rear Panel Port 9 (Flexible Coax)	8121-2028
W40	Cable Assembly,A13J6 to A3J17 (Flexible Coax)	8121-1940
W41	Cable Assembly, A2J601 to A3J19 (Flexible Coax)	8120-8868
W42	Cable Assembly, A16J706 to A3J14 (Flexible Coax)	8121-1401
W43	Cable Assembly, A16J705 to A3J18 (Flexible Coax)	8121-1401
W44	Cable Assembly, A25J2 to A26J504 (Flex cable)	8121-1854
W45	Cable Assembly, SW4 Port 1 to A11J3 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9010-20009
W46	Cable Assembly, SW4 Port 2 to A13J9 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20130
W47	Cable Assembly, SW4 Port 3 to A12 Output (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20129
W48	Cable Assembly, SW4 Port 4 to A12 Input (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20128
W49	Reserved	
W50	Cable Assembly, A16J726 to A3J17 (Flexible Coax)	8121-1401

Replaceable Parts

Table 14-1 All Replaceable Parts

Reference Designator	Description	Part Number
W51	Cable Assembly, A16J718 to A25J301 (Flexible Coax)	8121-1401
W52	Cable Assembly, A25J102 to A3J15 (Flexible Coax)	8121-2288
W53	Cable Assembly, A15J901 to A25J101 (Flexible Coax)	8121-2292
W54	Cable Assembly, A16J716 to A3J14 (Flexible Coax)	8121-2288
W55	Cable Assembly, A25J805 to A3J17 (Flexible Coax)	8121-2290
W56	Cable Assembly, A16J726 to A25J806 (Flexible Coax)	8121-2291

a. Included, but not required for use on N9020B.
b. Does not include nameplate. See A1MP3 through A1MP8 and A1MP20.
c. Disk drive removable through rear panel.
d. N9020-60172 is the preferred replacement for N9020-60222.
e. Does not include A1A1MP20 or A1A1MP21 overlays.
f. Front panel protective cover p/n N9020-40004 is optimized only for use on analyzers with the portable configuration, Opt PRC. Although the cover will fit on analyzers with the benchtop configuration, its use on benchtop configurations is not recommended.

Replaceable Parts

Table 14-2 Attaching Hardware

Attach	To	Qty	Part Number	Type	Tool	Torque
Analog IF	Digital IF	3	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Analog IF (Top Shield)	Analog IF (Bottom Shield)	16	0515-0664	M3 X 0.5 (12 mm long)	Torx T-10	9 inch-lbs
Attenuators	Attenuator Bracket	2 per	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Attenuators	Chassis	2 per	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Bail Handle	Front Frame	4	0515-0435	M4 X 0.7 (14 mm long)	Torx T-20	21 inch-lbs
Bandpass Filter	Bandpass Filter Spacer	3	0515-0661	M2 X 0.4 (6 mm long)	Torx T-6	3 inch-lbs
Bandpass Filter Spacer	RF Front End Assembly	4	0515-0658	M2 X 0.4 (6 mm long)	Torx T-6	3 inch-lbs
BBIQ Flex Ribbon (Option BBA)	BBIQ Interface Board	2	N9020-2001 7	Hex Shoulder Screw 4-40	1/4” socket	4 inch-lbs
BBIQ Core Bracket (Option BBA)	BBIQ Inverter Shield Top	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
BBIQ LED Board (Option BBA)	Front Frame	2	0515-1946	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
BBIQ Interface Board (Option BBA)	Front Frame (side)	1	0515-2032	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Bracket, Preselector Bypass SW1	Low Band Switch Bracket	2	0515-1992	M2.5 X 0.45 (20 mm long)	Torx T-8	6 inch-lbs
Bracket, Preselector Bypass SW2	Low Band Switch Bracket	2	0515-1992	M2.5 X 0.45 (20 mm long)	Torx T-8	6 inch-lbs
Chassis Bottom	Chassis Sides, Midplane & Front Bracket	15	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Chassis Side (Right Outside)	Low Band Switch Bracket, Attenuator Brackets, Chassis bottom	7	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
CPU Assembly	Chassis	6	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
CPU Shield	CPU & Hard Disk Drive	19	0515-5074	M3 X 0.5 (6 mm long)	Torx T-10	9 inch-lbs

Replaceable Parts

Table 14-2 Attaching Hardware

Attach	To	Qty	Part Number	Type	Tool	Torque
CPU Shield	CPU Assembly	3	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
		19	0515-1946	M3 X 0.5 (6 mm long)	Torx T-10	9 inch-lbs
DC-DC Converter	Display Bracket Serial Number >MY/SG51240000	2	0515-0430	M3 X 6.0	Torx T-10	9 inch-lbs
Digital IF	LVDS Connector	2	0515-4439	M2.5 X 6.0	Small Pozi	5 inch-lbs
Display	Display Bracket Serial Number >MY/SG51240000	4	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Display	Display Bracket Serial Number MY/SG51240000	4	0515-1934	M2.5 X 0.45 (6 mm long)	Torx T-8	5 inch-lbs
Display Bracket & Front Panel Interface/Speaker Bracket	Front Frame	7	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Disk Drive	Disk Drive Tray	4	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Disk Drive Interconnect	CPU Assembly	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Disk Drive Handle	Disk Drive Rear Panel	2	0515-1946	M3 X 0.5 (6 mm long)	Torx T-10	9 inch-lbs
Disk Drive Rear Panel	Disk Drive Tray	4	0515-2219	M2.5 X 0.45 (5 mm long)	Torx T-8	9 inch-lbs
External Reference BNC	Rear Panel	1	2190-0102	Lock Washer	n/a	n/a
External Reference BNC	Rear Panel	1	0590-2332	Hex Nut	9/16” Nut Driver	21 inch-lbs
Fan Assembly	Chassis	5	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Fan	Fan Bracket	8	0361-1272	Rivets	n/a	n/a
Front Bumpers (Opt. PRC)	Front Frame	8	0515-0435	M4 X 0.7 (14 mm long)	Torx T-20	21 inch-lbs
Front Chassis Bracket & Midplane Bracket	Chassis Sides	10	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs

Replaceable Parts

Table 14-2 Attaching Hardware

Attach	To	Qty	Part Number	Type	Tool	Torque
Front Frame	Chassis	8	0515-2032	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Front Frame Bottom	Chassis	2 per	0515-2032	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Front Panel Assy.	Chassis	6	0515-2032	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Front Panel Daughter Board	Front Frame	3	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Front Panel Interface	Front Frame	13	0515-1521	M3 X 0.5 (5 mm long)	Torx T-10	9 inch lbs.
Inverter Board	Inverter Bracket	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Inverter Board (Option BBA)	Display Bracket	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Inverter Shield Top (Option BBA)	Inverter Shield Bottom	8	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Low Band Switch Assy.	Chassis	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Low Band Switch Assy.	Low Band Switch Bracket	4	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Low Band Switch Bracket.	Bracket, Preselector Bypass SW2	1	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Midplane Assembly	Midplane Bracket	6	0515-0375	M3 X 0.5 (16 mm long)	Torx T-10	9 inch-lbs
Motherboard	Chassis Base	4	0515-0372	M3 X0.5 (8 mm long)	Torx T-10	9 inch-lbs
Power Supply 'Z' Bracket	Chassis Sides	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Power Supply 'Z' Bracket	Power Supply	3	0515-1946	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Rear Bumper Feet (Opt. PRC)	Rear Panel	4	0515-1619	M4 X 0.7 (25 mm long)	Torx T-20	21 inch-lbs.
Rear Bumper Feet (Opt. PRC)	Rear Panel	4	3050-0893	Flat Washer	n/a	n/a
Rear Feet	Rear Panel	4	0515-1619	M4 X 0.7 (25 mm long)	Torx T-20	21 inch-lbs
Rear Feet	Rear Panel	4	3050-0893	Flat Washer	n/a	n/a

Replaceable Parts

Table 14-2 Attaching Hardware

Attach	To	Qty	Part Number	Type	Tool	Torque
Rear Frame	Chassis	18	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Rear Frame	Top Bracket, Reference Assembly	4	0515-1946	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
RF Front End Assembly	Chassis	4	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
RF Input Connector	Chassis	2	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Strap Handle Plugs (Opt. PRC)	Instrument Cover	4	0515-5209	M5 X 0.8 (14 mm long)	Torx T-20	21 inch-lbs
Strap Handles	Chassis Side	2 per	0515-0710	M4 X 0.8 (18 mm long)	Torx T-20	21 inch-lbs
SW1 Bracket	SW1	2	0515-1992	M2.5 X 0.45 (20 mm long)	Torx T-8	6 inch-lbs
SW2 Bracket	SW2	2	0515-1992	M2.5 X 0.45 (20 mm long)	Torx T-8	6 inch-lbs
SW2 Bracket	Low Band Switch Bracket	1	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
Top Brace	Top Bracket, Reference Assembly	4	0515-1946	M3 X 0.5 (6 mm long)	Torx T-10	9 inch-lbs
Top Brace	Board Assemblies	6	0515-1946	M3 X 0.5 (6 mm long)	Torx T-10	9 inch-lbs
Top Brace & Reference Assembly Bracket	Chassis Components	12	0515-0372	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs
YTF Preselector	Chassis	4	0515-0372 (except Option 503)	M3 X 0.5 (8 mm long)	Torx T-10	9 inch-lbs

Hardware

Figure 14-1 Major Assemblies

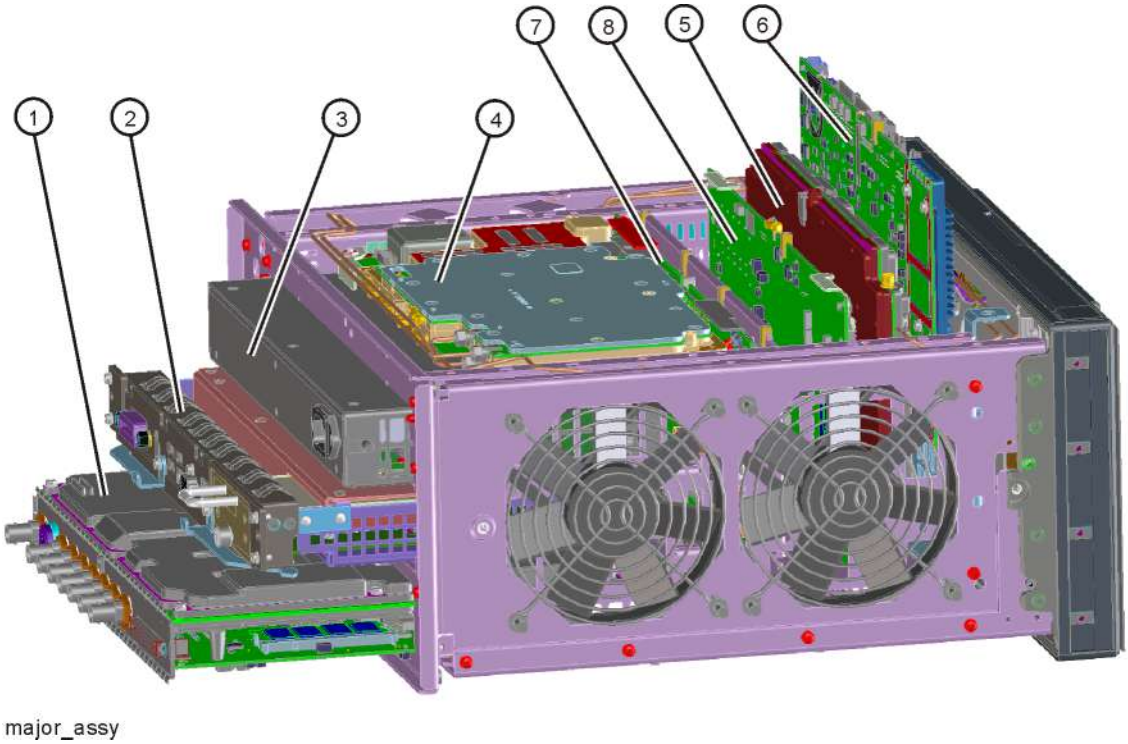


Table 14-3

Item	Description	Keysight Part Number
1	A2 Analog I.F. Assembly A3 Digital I.F. Assembly	See Table 14-1
2	A4 CPU (w/o disk drive) (Refer also to Service Note N9020B-09A)	See Table 14-1
3	A6 Power Supply	0950-5012
4	A16 Reference Assembly	See Table 14-1
5	A14 L.O. Synthesizer Assembly	See Table 14-1
6	A15 Front End Control Assembly	See Table 14-1
7	A7 Midplane Assembly	N9020-63120
8	A19 BBIQ Main Board (Option BBA)	N9020-60093

Figure 14-2 External Hardware (Benchtop Configuration)

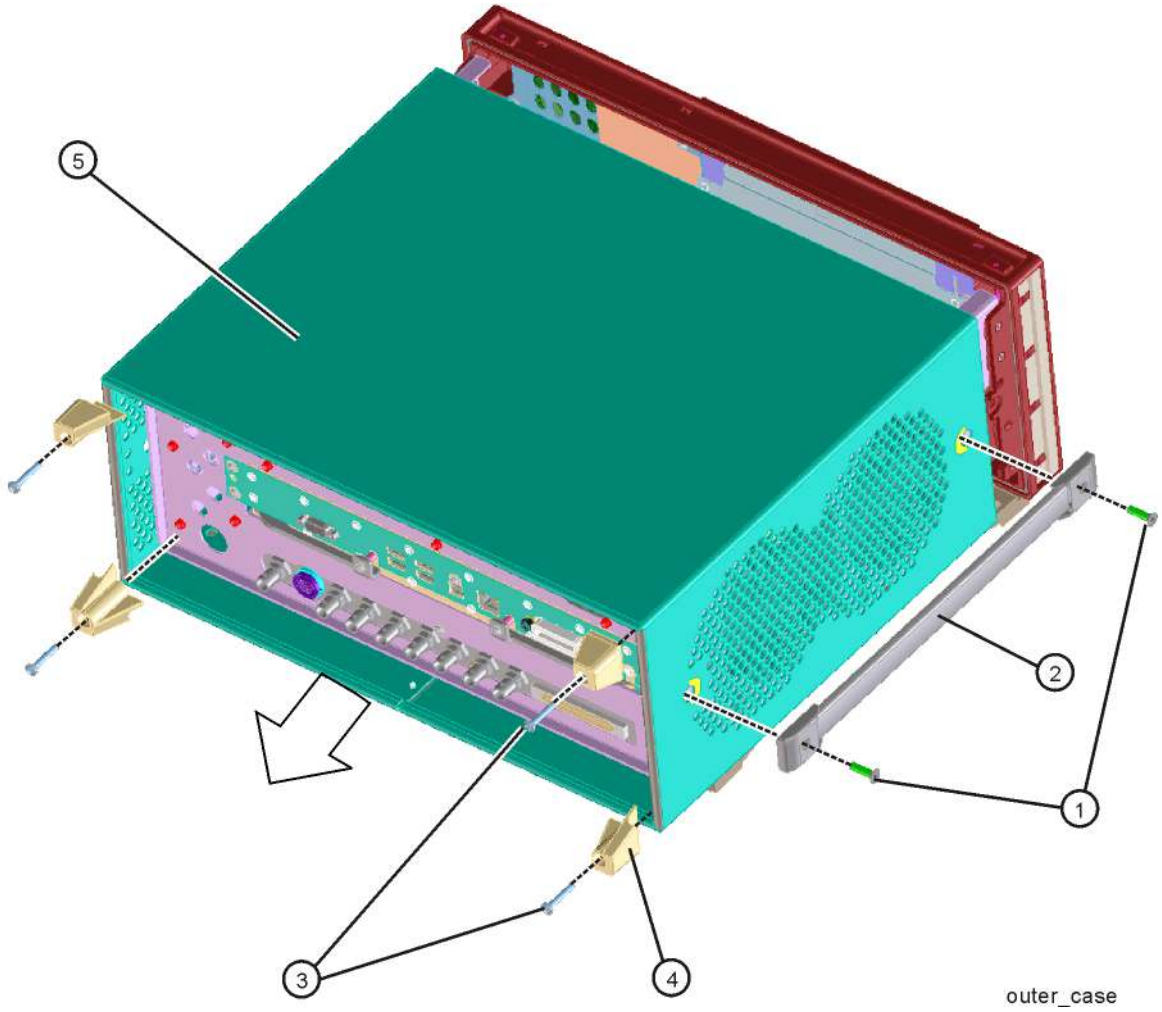


Table 14-4

Item	Description	Keysight Part Number
1, 2	MP21-22 Strap Handles (Benchtop Configuration) (includes screws)	N9020-60252
3	Screw M4 X 0.7 (25 mm long)	0515-1619
4	MP17-20 Rear Feet (Benchtop Configuration)	5041-7903
5	MP16 Dress Cover (includes magnetic gasket)	N9020-00068

Figure 14-3 External Hardware and Bail Handle (Option PRC)

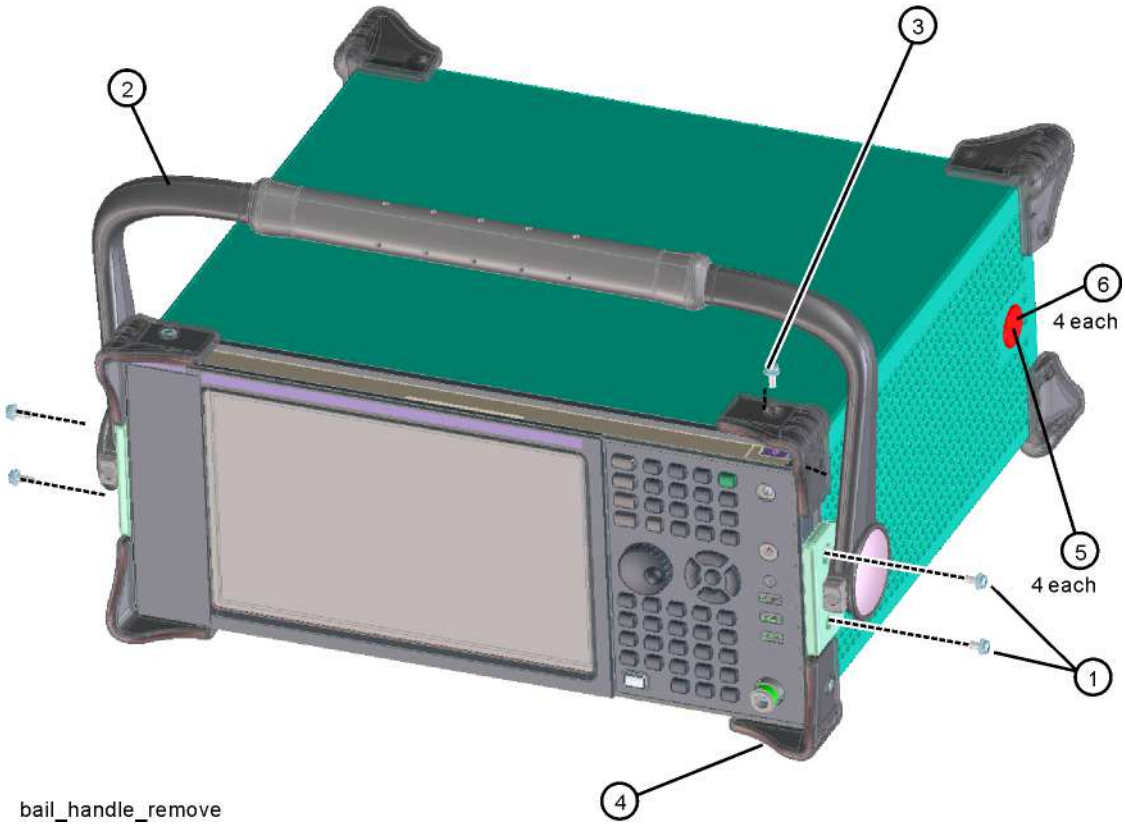


Table 14-5

Item	Description	Keysight Part Number
1	Screw M4 X 0.7 (14 mm long)	0515-0435
2	MP49 Bail Handle (Option PRC, Portable Configuration)	N9020-60251
3	Screw M4 X 0.7 (14 mm long)	0515-0435
4	MP41-44 Front Bumpers (Option PRC, Portable Configuration)	N9020-40016
5	MP61-64 Strap Handle Plugs (Option PRC, Portable Configuration)	N9020-40014
6	Screw M5 X 0.8 (14 mm long)	0515-5209

Figure 14-4 External Hardware (Option PRC)

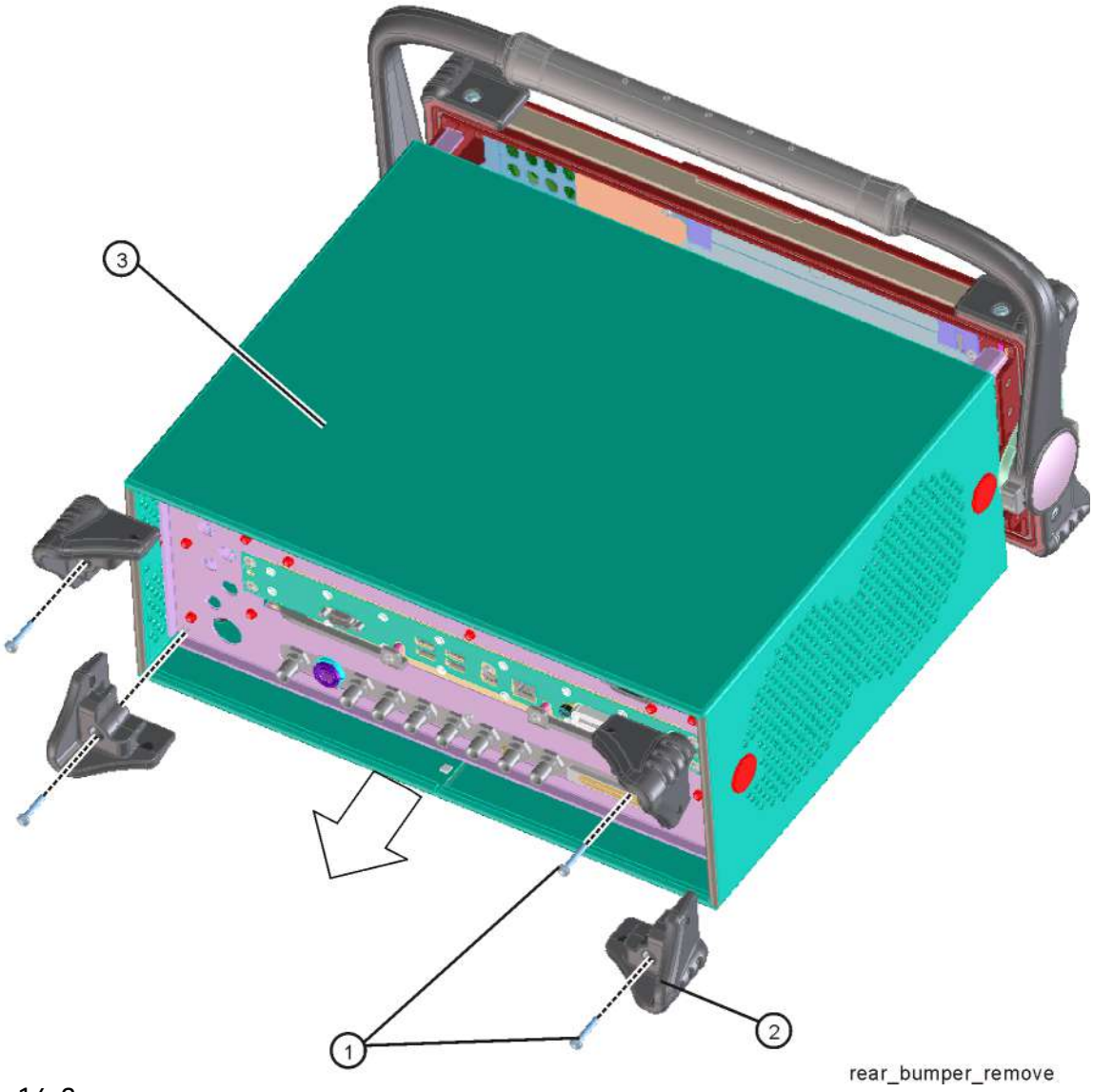


Table 14-6

Item	Description	Keysight Part Number
1	Screw M4 X 0.7 (25 mm long)	0515-1619
2	MP45-48 Rear Bumpers (Option PRC, Portable Configuration) (includes screws)	N9020-40015
3	MP16 Dress Cover (includes magnetic gasket)	N9020-00068

Figure 14-5 CPU Assembly

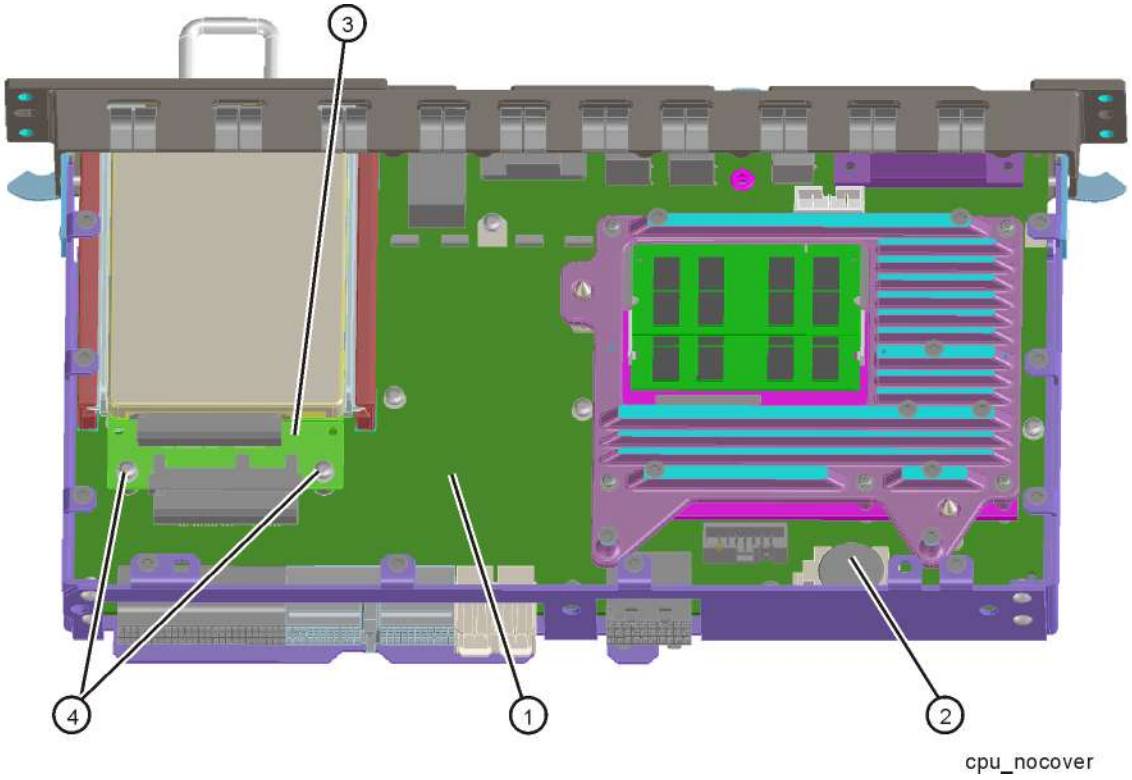


Table 14-7

Item	Description	Keysight Part Number
1	A4 CPU (w/o disk drive) (Refer also to Service Note N9020B-09A)	
	Instruments with PC6 or PC6S CPUs	N9020-60247
	Instruments with PC8 CPUs	W1312-60687
2	A4BT1 CPU Board Battery (CR2032)	1420-0356
3	A4A1 Disk Drive Interconnect Board	
	Instruments with PC6 CPUs	W1312-63079
	Instruments with PC6S or PC8 CPUs	W1312-63377
4	Screw M3 x 0.5 (8 mm long)	0515-0372

Figure 14-6 Disk Drive Tray Assembly

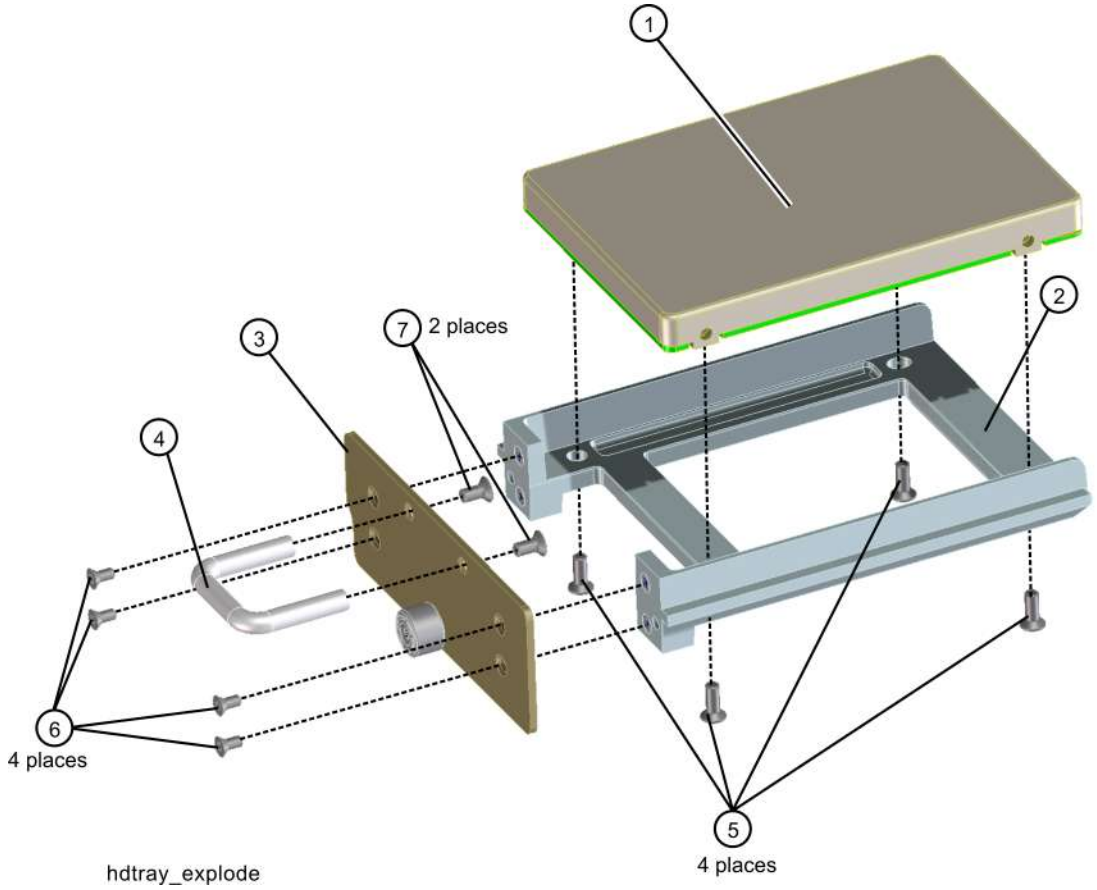


Table 14-8

Item	Description	Keysight Part Number
1	A5 Disk Drive Replacement Kit	
	Instruments with WES7 OS and PC6 or PC6S CPUs	N9020-60355
	Instruments with Win10 OS and PC6 or PC6S CPUs	N9020-60381
	Instruments with Win10 OS and PC8 CPUs	N9032-60039
2	A5MP1 Disk Drive Tray	W1312-40078
3	A5MP2 Disk Drive Rear Panel	W1312-00103
4	A5MP3 Disk Drive Assembly Handle	
5	Screw M3 x 0.5 (8 mm long) (For rev 6 and earlier of drive tray. For rev 7 and later, use 0515-1035 M3 (8 mm Flat-HD))	0515-0372

Table 14-8

Item	Description	Keysight Part Number
6	Screw M2.5 x 0.45 (5 mm long)	0515-2219
7	Screw M3 x 0.5 (6 mm long)	0515-1946

Figure 14-7 Top Brace and Reference Bracket

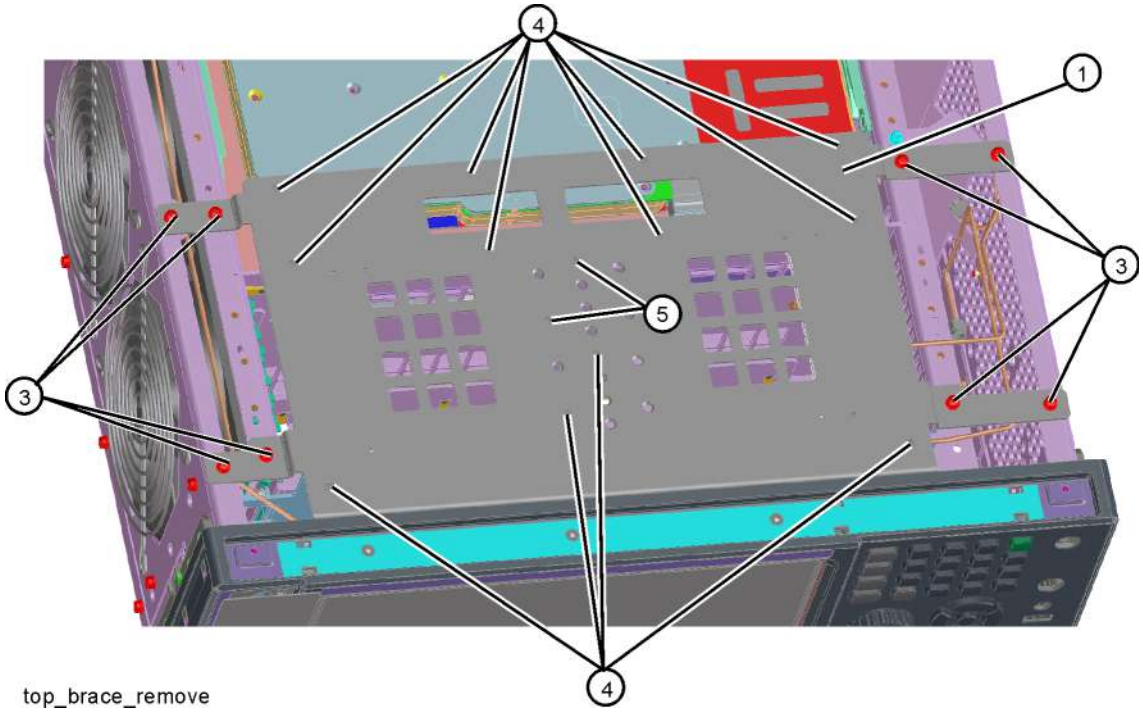


Table 14-9

Item	Description	Keysight Part Number
1	MP7 Top Brace (includes foam strips)	N9020-60018
2	MP65 Reserved	
3	Screw M3 X 0.5 (8 mm long)	0515-0372
4	Screw M3 X 0.5 (6 mm long)	0515-1946
5	Screw M3 X 0.5 (8 mm long)	0515-0372
6	Screw M3 X 0.5 (6 mm long)	0515-1946
7	Screw M3 X 0.5 (6 mm long)	0515-1946
8	Screw M3 X 0.5 (6 mm long)	0515-1946

Figure 14-8 RF Area - Standard RF/Microwave Instrument

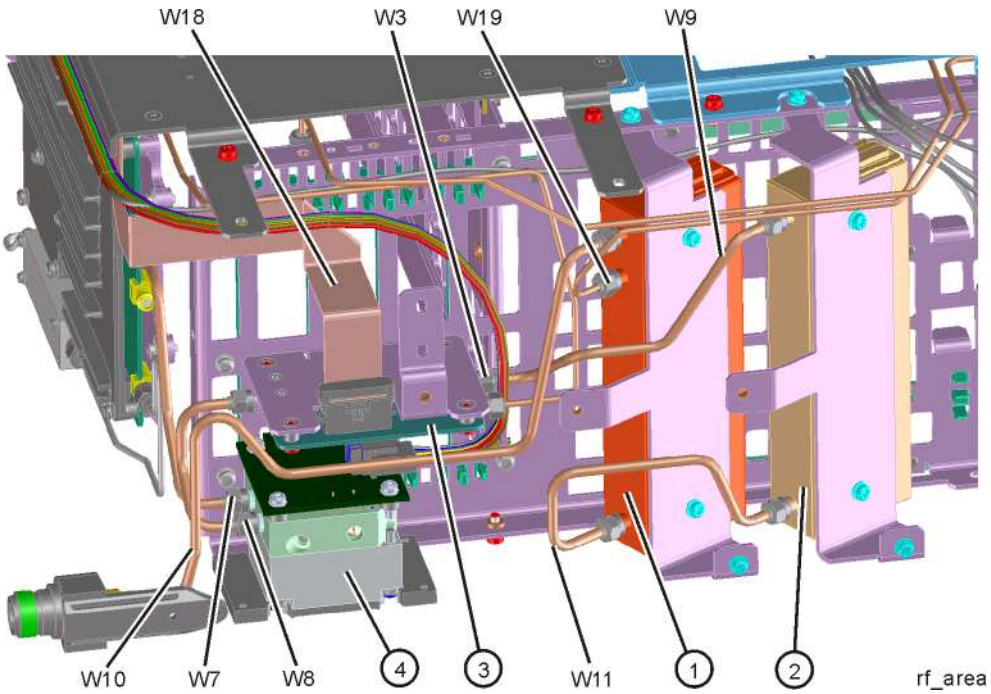


Table 14-10

Item	Description	Keysight Part Number
1	A9 RF Attenuator A, 0 to 4 dB (Option 503, 508, 513, 526)	33360-60011
2	A10 RF Attenuator B, 0 to 66 dB (Option 503, 508, 513, 526)	33321-60085
3	A11 Low Band Switch Assembly	E4410-60121
4	A12 YTF Preselector (Not used in Opt 503)	5087-7382
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20101
W7	Cable Assembly, A12 Output to A13J2 (semi-rigid)	N9020-20124
W8	Cable Assembly, A11J3 to A12 input (semi-rigid)	N9020-20123
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	N9020-20153
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20141
W11	Cable Assembly, A9 Output to A10 Input (semi-rigid)	N9020-20142
W18	Cable Assembly, A11J4 to A15J700 (Ribbon Cable)	E4410-60160
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	N9020-20065

Figure 14-9 RF Area - Millimeter Wave Instruments, Option 532, 544, 550

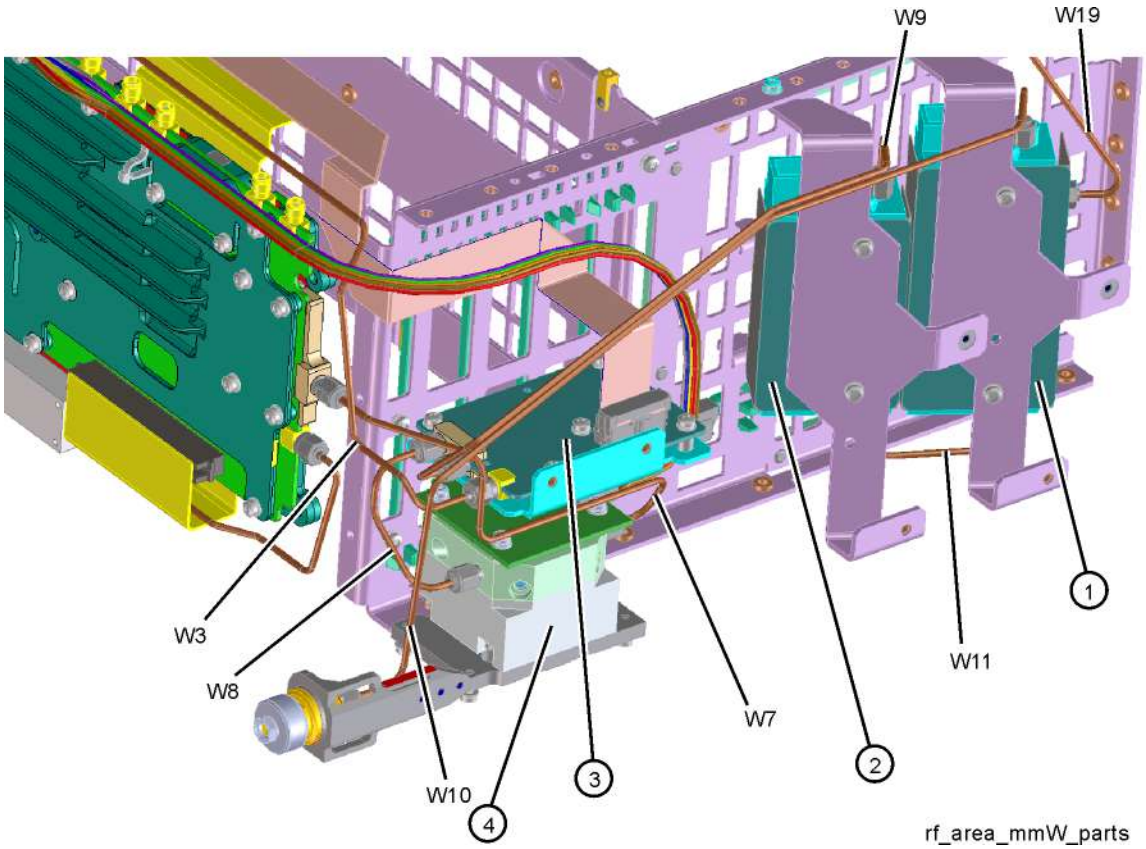


Table 14-11

Item	Description	Keysight Part Number
1	A9 RF Attenuator A	33326-60013
2	A10 RF Attenuator B	33325-60020
3	A11 Low Band Switch Assembly	N9020-60051
4	A12 YTF Preselector	5087-7383
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20131
W7	Cable Assembly, A12 Output to A13J2 (semi-rigid)	N9010-20006
W8	Cable Assembly, A11J3 to A12 input (semi-rigid)	N9010-20005
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	N9010-20004
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20133
W11	Cable Assembly, A9 Output to A10 Input (semi-rigid)	N9010-20002
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	N9020-20065

Figure 14-10 RF Area - RF/Microwave instruments with Options B40, MPB, or DP2

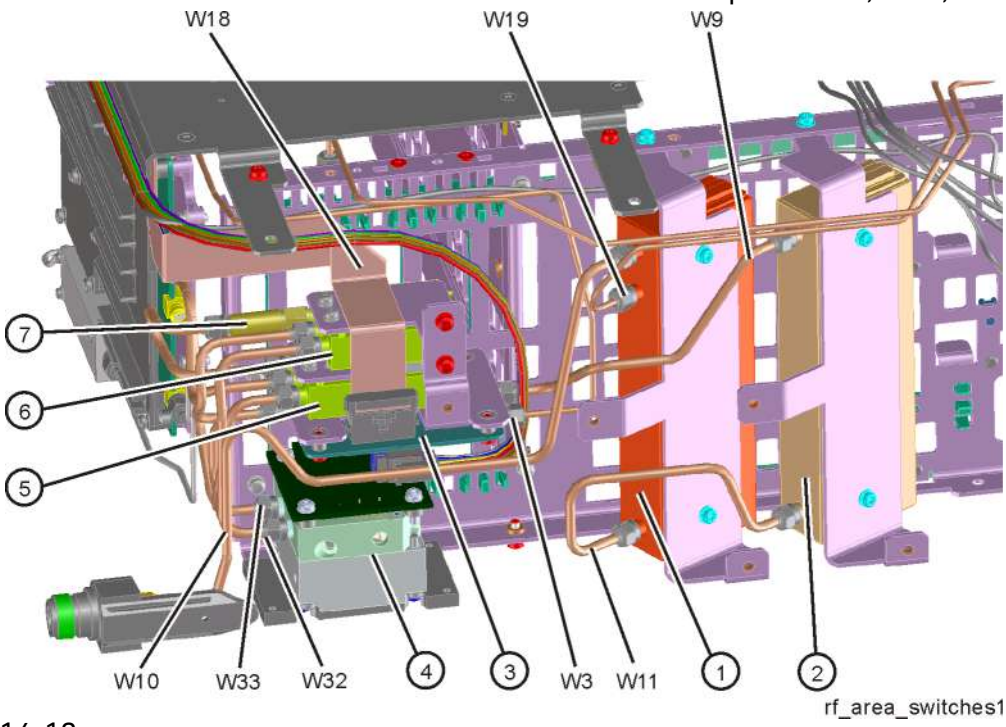


Table 14-12

Item	Description	Keysight Part Number
1	A9 RF Attenuator A, 0 to 4 dB (Option 503, 508, 513, 526)	33360-60011
2	A10 RF Attenuator B, 0 to 66 dB (Option 503, 508, 513, 526)	33321-60085
3	A11 Low Band Switch Assembly	E4410-60121
4	A12 YTF Preselector (Not used in Opt 503)	5087-7382
5	SW1 Coaxial Switch (Options B40, MPB, or DP2)	N1810-60069
6	SW2 Coaxial Switch (Options B40, MPB, or DP2)	N1810-60069
7	AT1 Fixed Attenuator, 6 dB	08493-60026
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20101
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	N9020-20153
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20141
W11	Cable Assembly, A9 Output to A10 Input (semi-rigid)	N9020-20142
W18	Cable Assembly, A11J4 to A15J700 (Ribbon Cable)	E4410-60160
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	N9020-20065
W32	Cable Assembly, SW2 Port 2 to A12J2 (semi-rigid)	E4410-20163
W33	Cable Assembly, SW1 Port 2 to A12J1 (semi-rigid)	E4410-20165

Figure 14-11 RF Area - RF/Microwave Instruments with Options B40, MPB, or DP2 (switch detail)

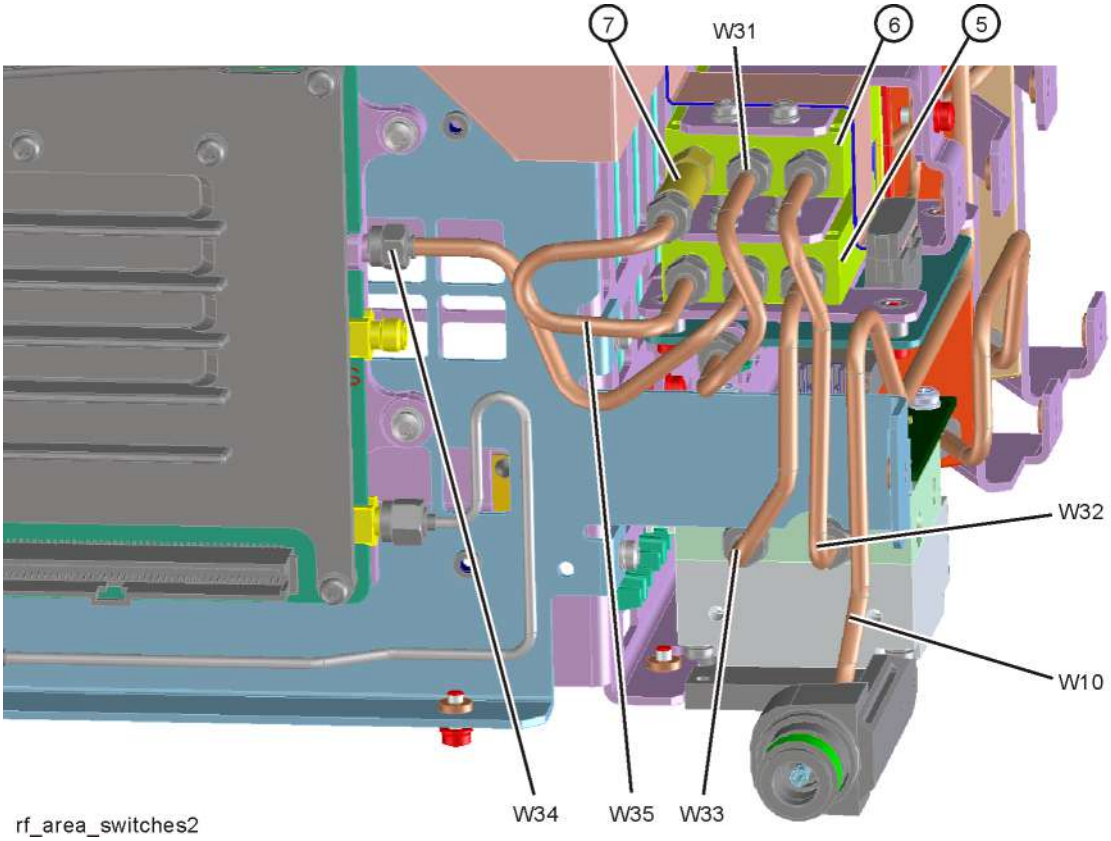


Table 14-13

Item	Description	Keysight Part Number
5	SW1 Coaxial Switch (Options B40, MPB, or DP2)	N1810-60069
6	SW2 Coaxial Switch (Options B40, MPB, or DP2)	N1810-60069
7	AT1 Fixed Attenuator, 6 dB	08493-60026
W10	Cable Assembly, A11J3 to A12 input (semi-rigid)	E4410-20161
W31	Cable Assembly, SW2 Center Port to A11J3 (semi-rigid)	E4410-20161
W32	Cable Assembly, SW2 Port 2 to A12J2 (semi-rigid)	E4410-20163
W33	Cable Assembly, SW1 Port 2 to A12J1 (semi-rigid)	E4410-20165
W34	Cable Assembly, SW1 Center Port to A13J9 (semi-rigid)	E4410-20164
W35	Cable Assembly, AT1 to SW1 Port 1 (semi-rigid)	N9020-20210

Figure 14-12 RF Area - Millimeter Wave Instruments with Option B40, MPB, or DP2

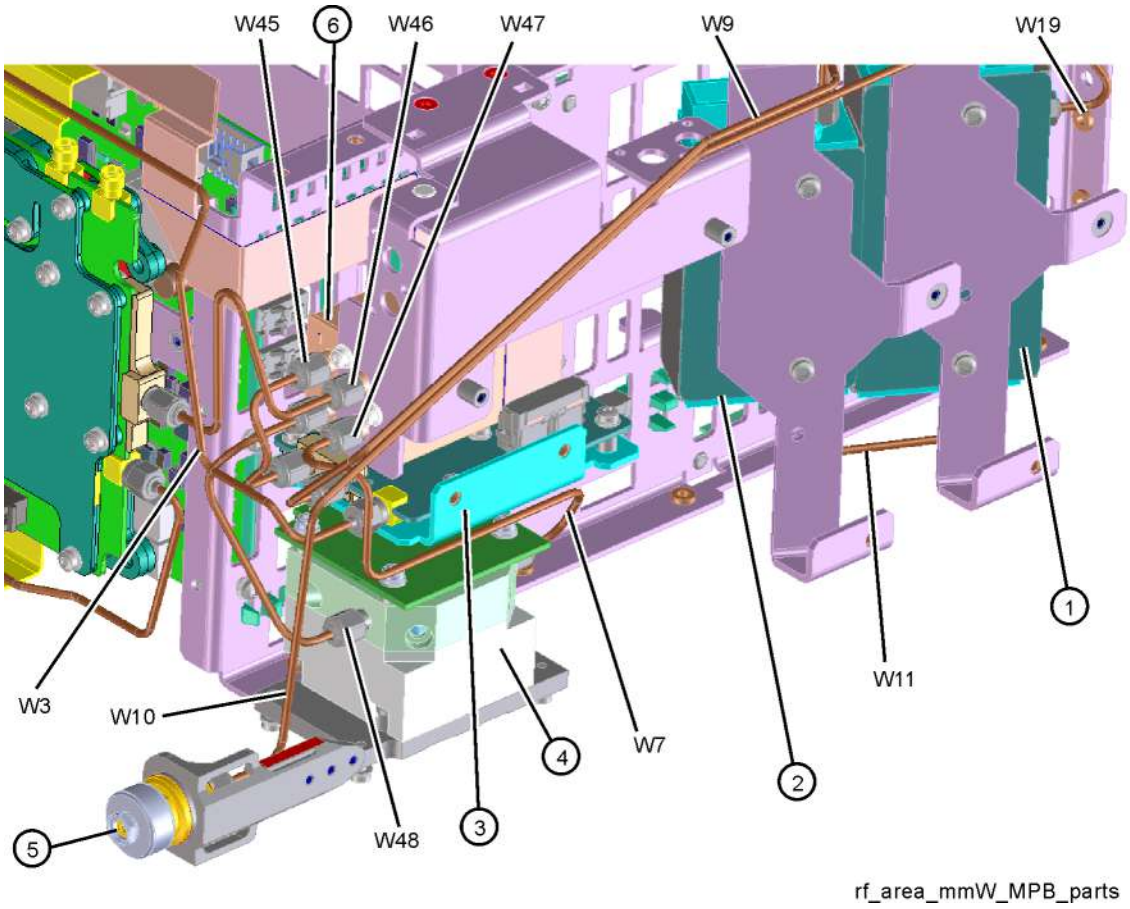


Table 14-14

Item	Description	Keysight Part Number
1	A9 RF Attenuator A	33326-60013
2	A10 RF Attenuator B	33325-60020
3	A11 Low Band Switch Assembly	N9020-60051
4	A12 YTF Preselector (Not used in Opt 503)	5087-7383
5	J1 2.4mm (m) Input Connector Assembly (Option 532, 544, 550)	N9030-60011
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20131
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	N9010-20004
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20133
W11	Cable Assembly, A9 Output to A10 Input (semi-rigid)	N9010-20002
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	N9010-20010

Table 14-14

Item	Description	Keysight Part Number
W45	Cable Assembly, SW4 Port 1 to A11J3 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9010-20009
W46	Cable Assembly, SW4 Port 2 to A13J9 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20130
W47	Cable Assembly, SW4 Port 3 to A12 Output (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20129
W48	Cable Assembly, SW4 Port 4 to A12 Input (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20128

Figure 14-13 RF Area - Millimeter Wave Instruments with Opt B40, MPB, or DP2 (switch detail)

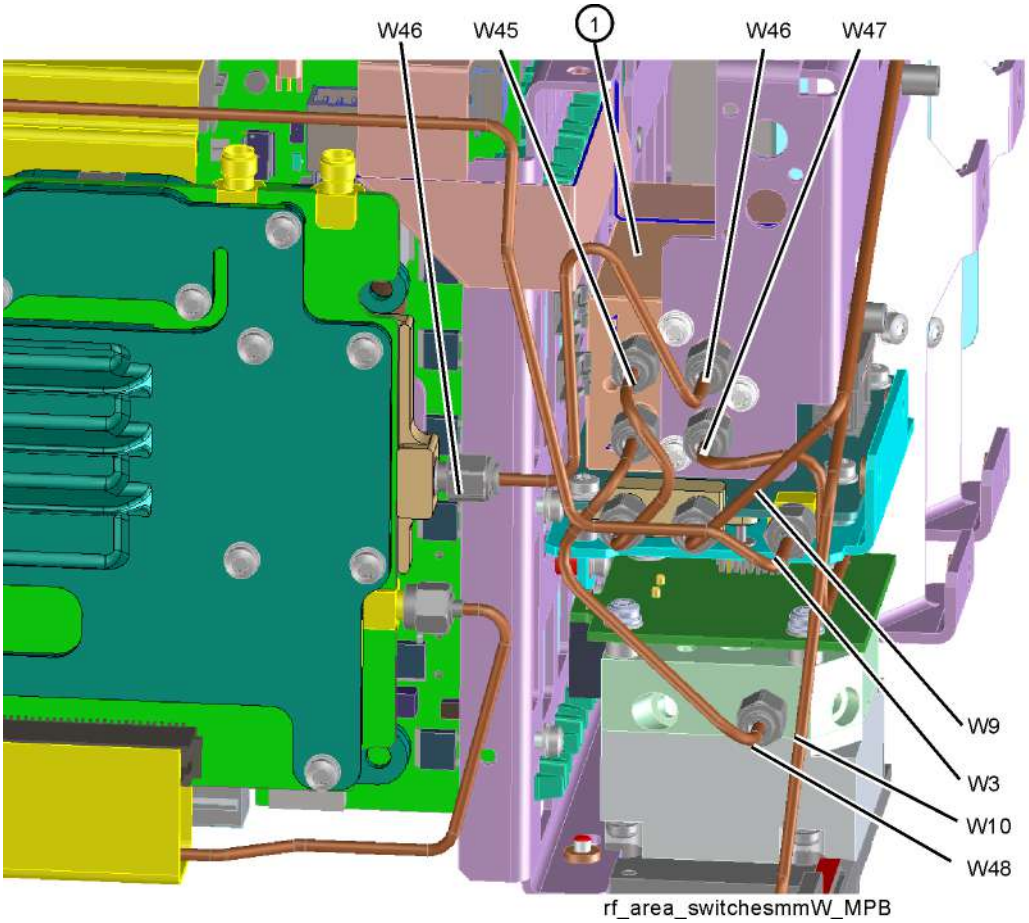
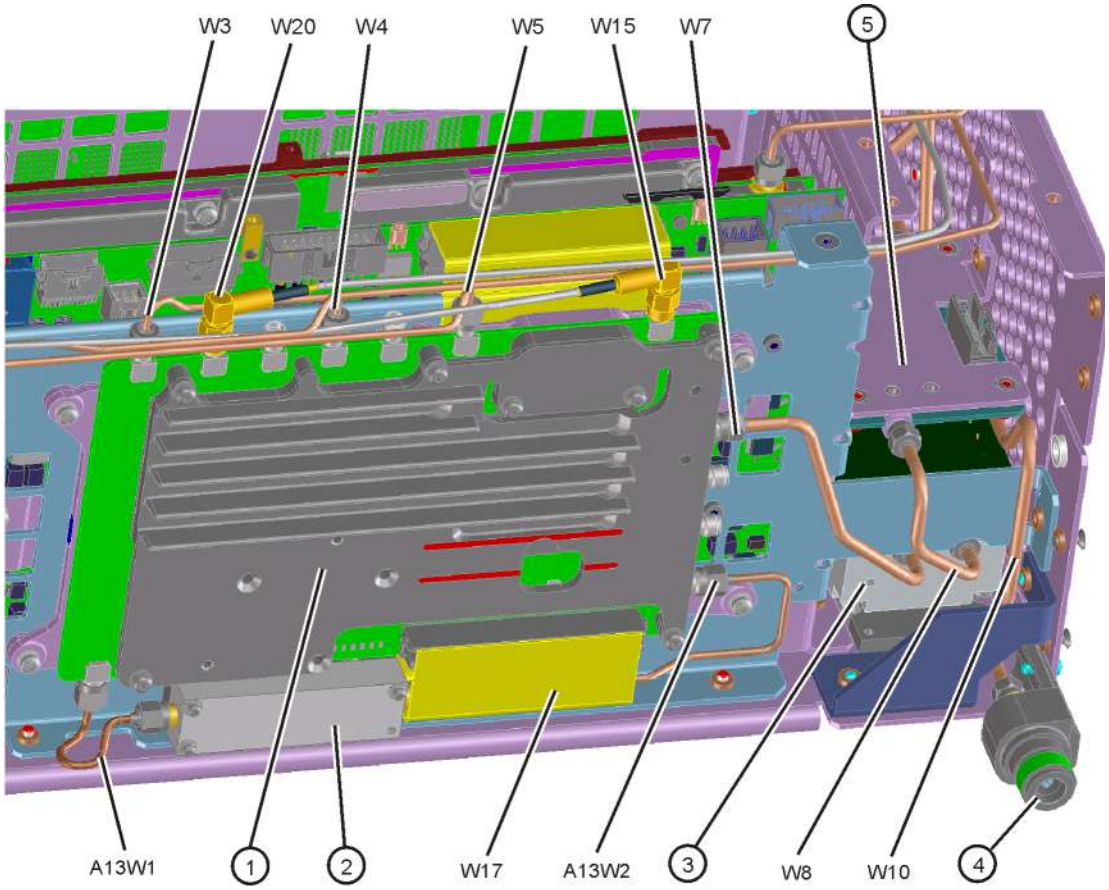


Table 14-15

Item	Description	Keysight Part Number
1	SW4 Transfer Switch, 50 GHz (Options B40, MPB, or DP2)	87222-60031
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20131
W9	Cable Assembly, A10 Output to A11J1 (semi-rigid)	N9010-20004
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20133
W45	Cable Assembly, SW4 Port 1 to A11J3 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9010-20009
W46	Cable Assembly, SW4 Port 2 to A13J9 (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20130
W47	Cable Assembly, SW4 Port 3 to A12 Output (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20129
W48	Cable Assembly, SW4 Port 4 to A12 Input (semi-rigid) Option 532, 544, 550 with Option B40, MPB, or DP2	N9020-20128

Figure 14-14 Front End Parts - Standard RF/Microwave Instruments



front_end_parts

Table 14-16

Item	Description	Keysight Part Number
1	A13 RF Front End Assembly	Refer to Table 14-1
2	A13A1 Bandpass Filter	Refer to Table 14-1
A13W1	Cable Assembly, A13J10 to A13A1 Input (semi-rigid)	Refer to Table 14-1
A13W2	Cable Assembly, A13J11 from A13A1 Output (semi-rigid)	Refer to Table 14-1
3	A12 YTF Preselector (Not used in Opt 503)	5087-7382
4	J1 Type N (f) Input Connector Assembly (Option 503, 508, 513, 526)	5002-0702
5	A11 Low Band Switch Assembly	Refer to Table 14-1
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20101
W4	Cable Assembly, A14J740 to A13J4 (semi-rigid)	N9020-20156
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W7	Cable Assembly, A12 Output to A13J2 (semi-rigid)	N9020-20124

Table 14-16

Item	Description	Keysight Part Number
W8	Cable Assembly, A11J3 to A12 input (semi-rigid)	N9020-20123
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20141
W15	Cable Assembly, A13J7 to A2J100 (Flexible Coax)	8121-1400
W17	Cable Assembly, A13J12 to A15J104 (Ribbon Cable)	E4410-60156
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400

Figure 14-15 Front End Parts - Millimeter Wave Instruments

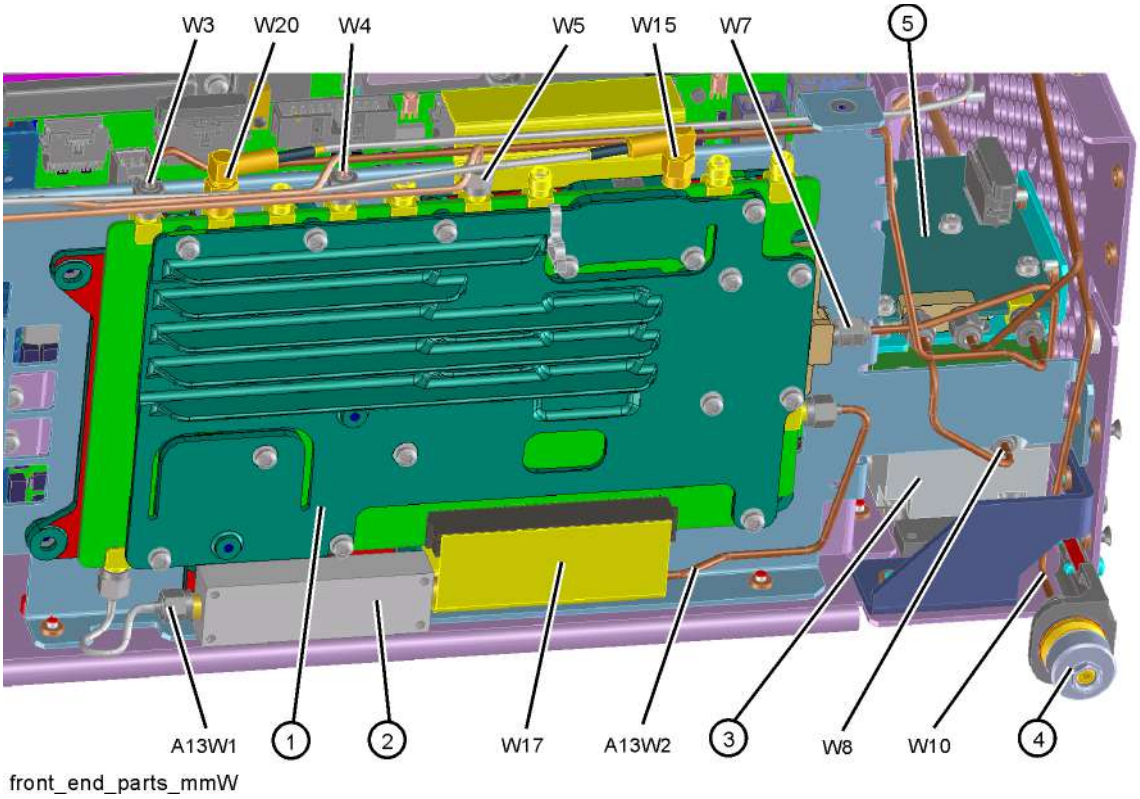


Table 14-17

Item	Description	Keysight Part Number
1	A13 RF Front End Assembly	N9020-60315
2	A13A1 Bandpass Filter	0955-2469
A13W1	Cable Assembly, A13J10 to A13A1 Input (semi-rigid)	N9020-20229
A13W2	Cable Assembly, A13J11 from A13A1 Output (semi-rigid)	N9020-20046
3	A12 YTF Preselector (Not used in Opt 503)	5087-7383
4	J1 2.4mm (m) Input Connector Assembly (Option 532, 544, 550)	N9030-60011
5	A11 Low Band Switch Assembly	N9020-60051
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20131
W4	Cable Assembly, A14J740 to A13J4 (semi-rigid)	N9020-20156
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W7	Cable Assembly, A12 Output to A13J2 (semi-rigid)	N9010-20006

Table 14-17

Item	Description	Keysight Part Number
W8	Cable Assembly, A11J3 to A12 input (semi-rigid)	N9010-20005
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	N9020-20133
W15	Cable Assembly, A13J7 to A2J100 (Flexible Coax)	8121-1400
W17	Cable Assembly, A13J12 to A15J104 (Ribbon Cable)	E4410-60156
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400

Figure 14-16 Front End Parts - RF/Microwave Instruments with Options MPB, B40, DP2, CR3, or CRP

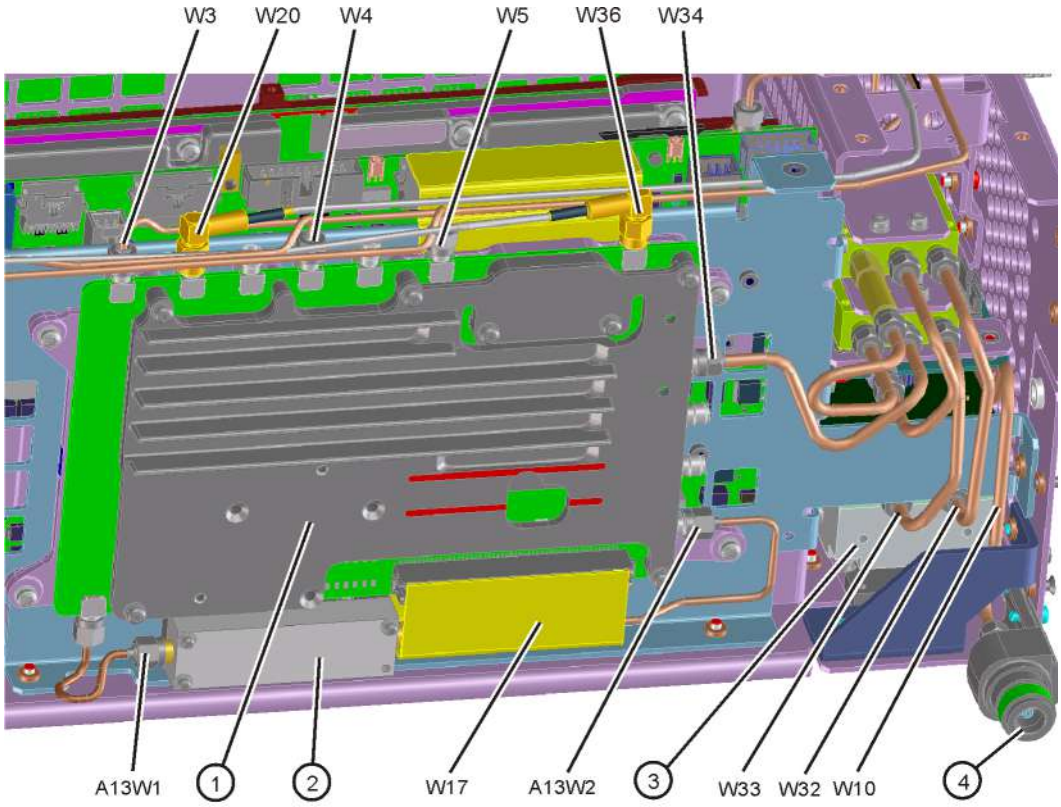


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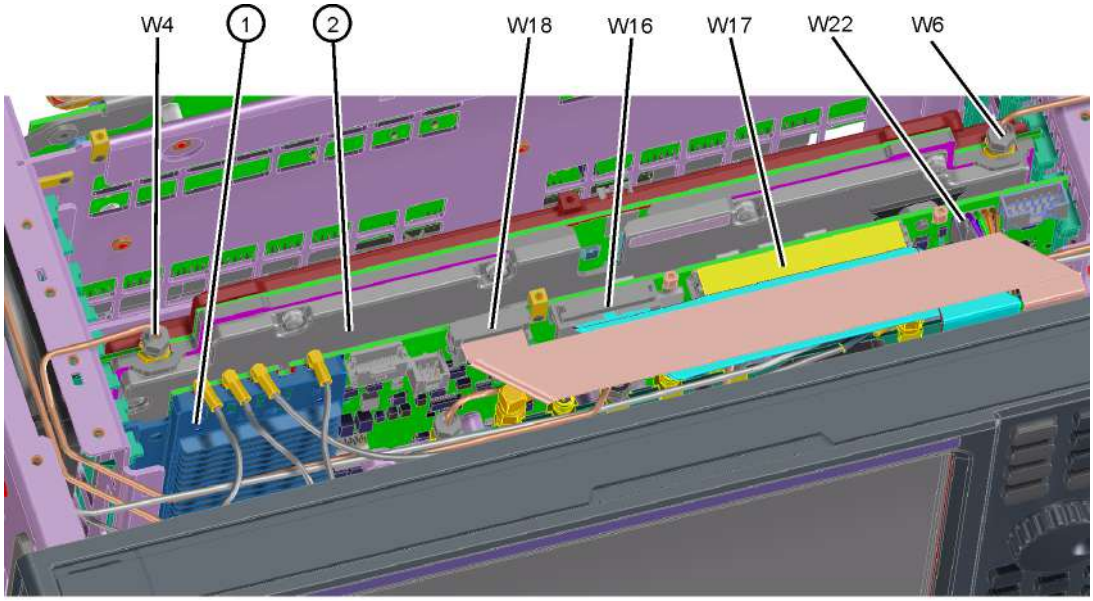
Table 14-18

Item	Description	Keysight Part Number
1	A13 RF Front End Assembly	Refer to Table 14-1
2	A13A1 Bandpass Filter	Refer to Table 14-1
A13W1	Cable Assembly, A13J10 to A13A1 Input (semi-rigid)	Refer to Table 14-1
A13W2	Cable Assembly, A13J11 from A13A1 Output (semi-rigid)	Refer to Table 14-1
3	A12 YTF Preselector (Not used in Opt 503)	5087-7382
4	J1 Type N (f) Input Connector Assembly (Option 503, 508, 513, 526)	5002-0702
W3	Cable Assembly, A11J2 to A13J2 (semi-rigid)	N9020-20101
W4	Cable Assembly, A14J740 to A13J4 (semi-rigid)	N9020-20156
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W10	Cable Assembly, A11J3 to A12 input (semi-rigid)	N9020-20141

Table 14-18

Item	Description	Keysight Part Number
W17	Cable Assembly, A13J12 to A15J104 (Ribbon Cable)	E4410-60156
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400
W32	Cable Assembly, SW2 Port 2 to A12J2 (semi-rigid)	E4410-20163
W33	Cable Assembly, SW1 Port 2 to A12J1 (semi-rigid)	E4410-20165
W34	Cable Assembly, SW1 Center Port to A13J9 (semi-rigid)	E4410-20164
W36	Cable Assembly, A15J902 to A13J7 (Flexible Coax)	8121-1862

Figure 14-17 Front End Control Cables

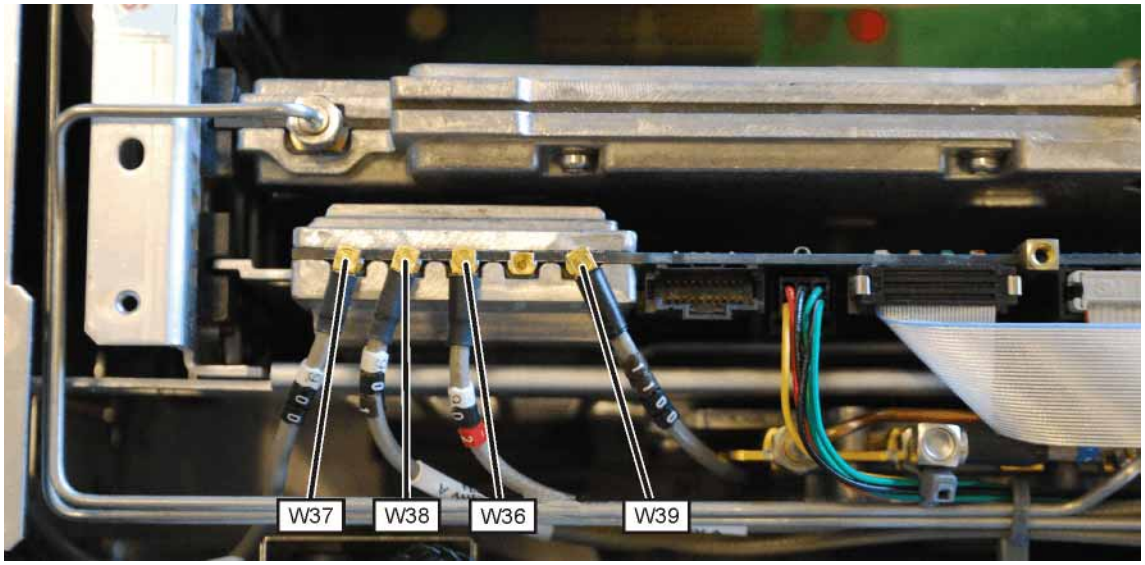


front_cables_efec2

Table 14-19

Item	Description	Keysight Part Number
1	A15 Front End Control Assembly	Refer to Table 14-1
2	A14 L.O. Synthesizer Assembly	N9020-60118
W4	Cable Assembly, A14J740 to A13J4 (semi-rigid)	N9020-20156
W6	Cable Assembly, A16J703 to A14J200 (semi-rigid)	N9020-20033
W16	Cable Assembly, A9 & A10 to A15J801 or A15J102 (Ribbon Cable)	E4410-60157
W17	Cable Assembly, A13J12 to A15J104 (Ribbon Cable)	E4410-60156
W18	Cable Assembly, A11J4 to A15J700 (Ribbon Cable)	E4410-60160
W22	Cable Assembly, A15J301 or A15J300 to A12J1 (Wire Harness)	N9020-60059

Figure 14-18 Front End Control Cables - Options B40, MPB, DP2, CR3, or CRP



The Front End Control Assembly used in Options MPB, B40, DP2, CR3, and CRP has these additional cables:

Table 14-20

Item	Description	Keysight Part Number
W36	Cable Assembly, A15J902 to A13J7 (Flexible Coax)	8121-1862
W37	Cable Assembly, A15J900 to A2J100 (Flexible Coax)	8121-1401
W38	Cable Assembly, A15J901 to A3J15 (Flexible Coax)	8121-1861
W39	Cable Assembly, A15J1100 to Rear Panel Port 9 (Flexible Coax)	8121-2028

Figure 14-19 Reference Board Cables - without Options B40, MPB, DP2, B85, B1A, or B1X

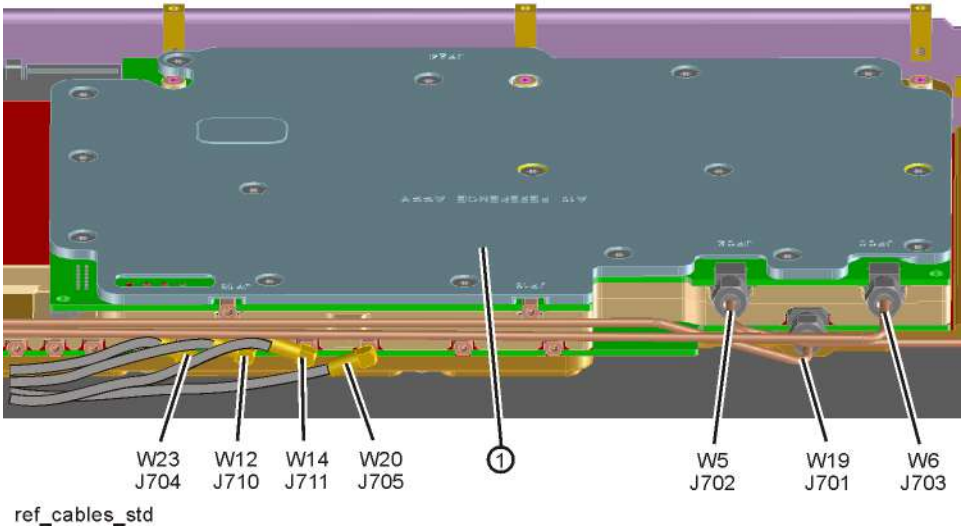


Table 14-21

Item	Description	Keysight Part Number
1	A16 Reference Assembly	N9020-60200
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W6	Cable Assembly, A16J703 to A14J200 (semi-rigid)	N9020-20033
W12	Cable Assembly, A16J710 to A3J14 (Flexible Coax)	8121-1401
W14	Cable Assembly, A16J711 to A2J300 (Flexible Coax)	8121-1401
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400
W23	Cable Assembly, Ext. Reference Cable (rear frame) to A16J704 (Flexible Coax)	8121-1402
W25	Cable Assembly A16J707 to A19J101 (Flexible Coax) Option BBA only	8121-1401

Figure 14-20 Reference Board Cables - with Options B40, MPB, DP2, B85, B1A, or B1X

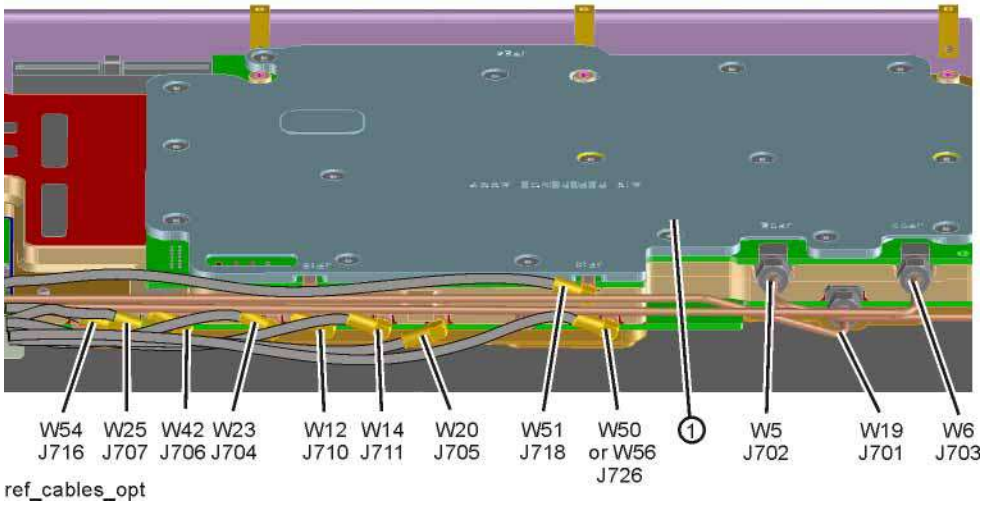


Table 14-22

Item	Description	Keysight Part Number
1	A16 Reference Assembly	N9020-60200
W5	Cable Assembly, A16J702 to A13J1 (semi-rigid)	N9020-20064
W6	Cable Assembly, A16J703 to A14J200 (semi-rigid)	N9020-20033
W14	Cable Assembly, A16J711 to A2J300 (Flexible Coax)	8121-1401
W19	Cable Assembly, A16J701 to A9 Cal Signal Input/Port 2 (semi-rigid)	
W20	Cable Assembly, A13J6 to A16J705 (Flexible Coax)	8121-1400
W23	Cable Assembly, Ext. Reference Cable (rear frame) to A16J704 (Flexible Coax)	8121-1402
W25	Cable Assembly A16J707 to A19J101 (Flexible Coax) Option BBA only	8121-1401
W51	Cable Assembly, A16J718 to A25J301 (Flexible Coax)	8121-1401
W54	Cable Assembly, A16J716 to A3J14 (Flexible Coax)	8121-2288
W56	Cable Assembly, A16J726 to A25J806 (Flexible Coax)	8121-2291

Figure 14-21 AIF/DIF Cables - Standard Instruments

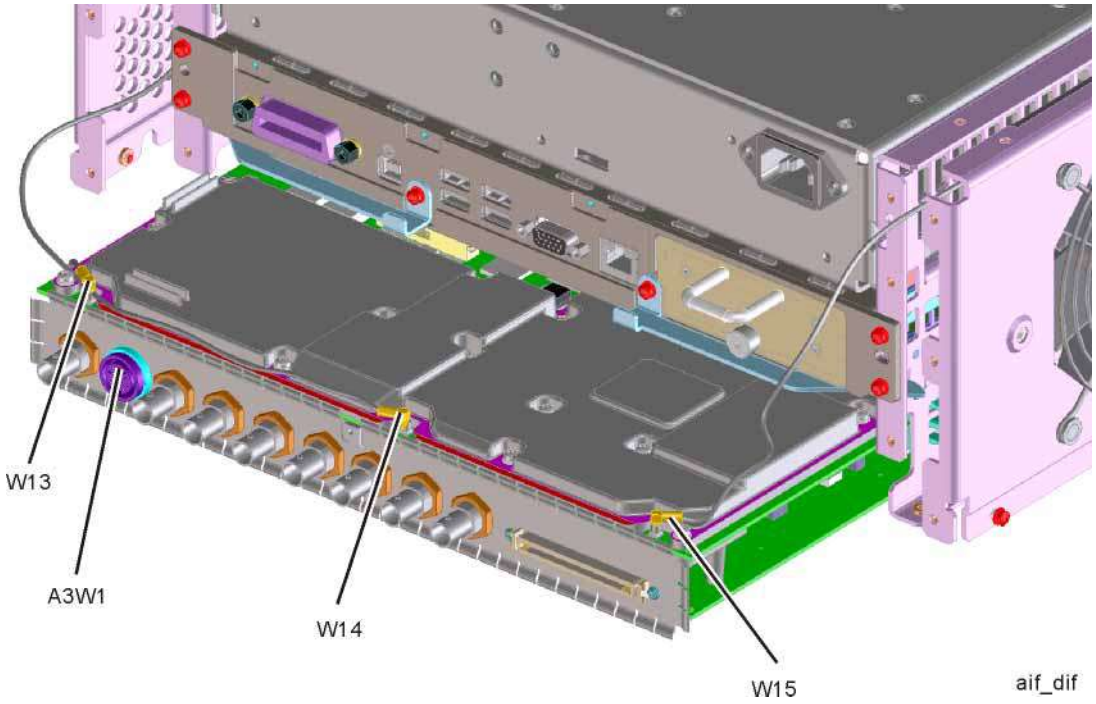


Figure 14-22 AIF/DIF Cables, bottom - Standard Instruments

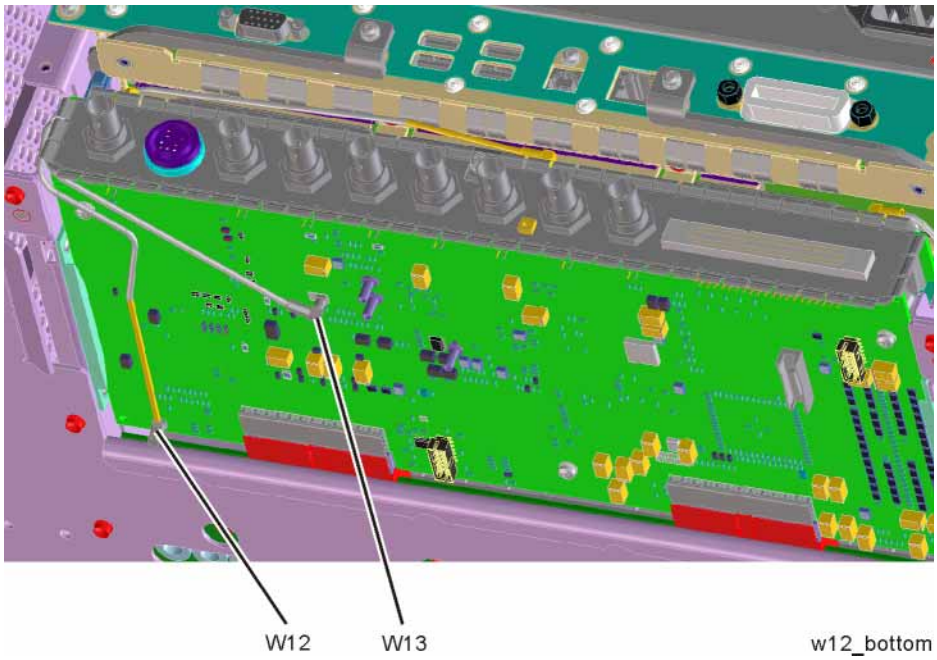


Table 14-23

Item	Description	Keysight Part Number
A3W1	Cable Assembly, Smart Noise Source (Wire Harness)	
	Standard Instruments	E4410-60163
	Options B40, MPB, or DP2	N9020-60090
W12	Cable Assembly, A16J710 to A3J14 (Flexible Coax)	8121-1401
W13	Cable Assembly, A2J601 to A3J15 (Flexible Coax)	8121-1411
W14	Cable Assembly, A16J711 to A2J300 (Flexible Coax)	8121-1401
W15	Cable Assembly, A13J7 to A2J100 (Flexible Coax)	8121-1400

Figure 14-23 AIF/DIF Cables - Options MPB, B40, or DP2

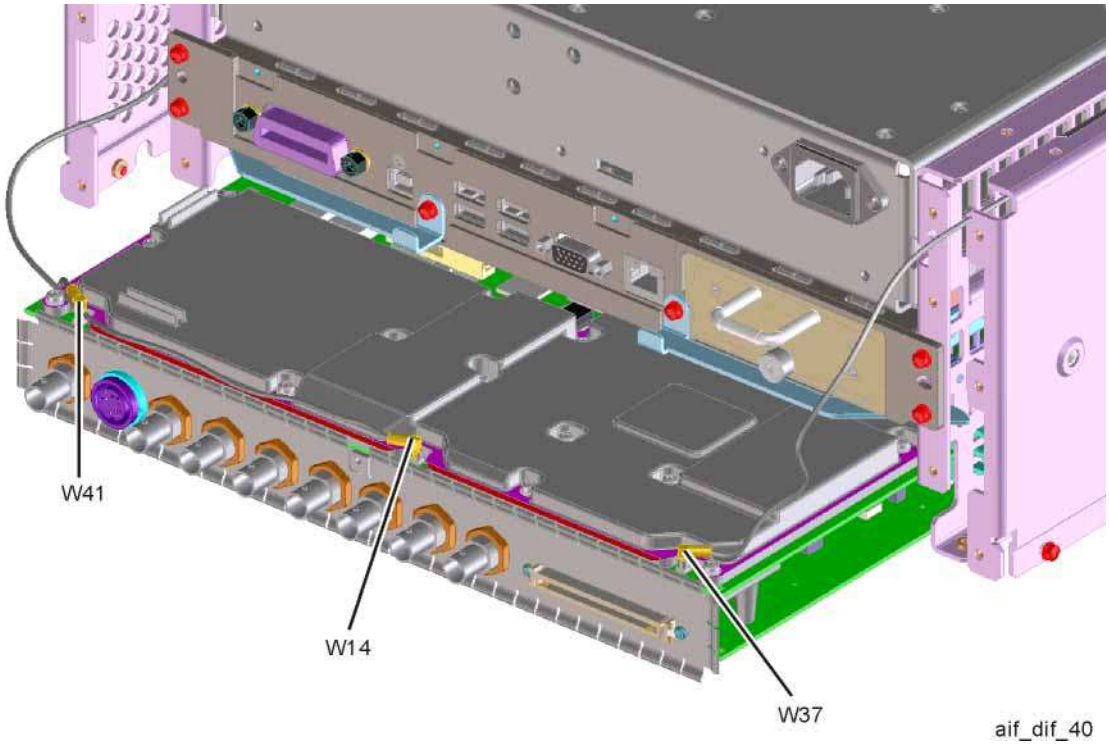


Figure 14-24 AIF/DIF Cables, bottom - Options MPB, B40, or DP2

Table 14-24

Item	Description	Keysight Part Number
W14	Cable Assembly, A16J711 to A2J300 (Flexible Coax)	8121-1401
W37	Cable Assembly, A15J900 to A2J100 (Flexible Coax)	8121-1401
W38	Cable Assembly, A15J901 to A3J15 (Flexible Coax)	8121-1861
W40	Cable Assembly,A13J6 to A3J17 (Flexible Coax)	8121-1940
W41	Cable Assembly, A2J601 to A3J19 (Flexible Coax)	8120-8868
W42	Cable Assembly, A16J705 to A3J18 (Flexible Coax)	8121-1401
W50	Cable Assembly, A16J726 to A3J17 (Flexible Coax)	8121-1401
W52	Cable Assembly, A25J102 to A3J15 (Flexible Coax)	8121-2288
W54	Cable Assembly, A16J716 to A3J14 (Flexible Coax)	8121-2288
W55	Cable Assembly, A25J805 to A3J17 (Flexible Coax)	8121-2290

Figure 14-25 AIF/DIF Assemblies - Standard Instruments

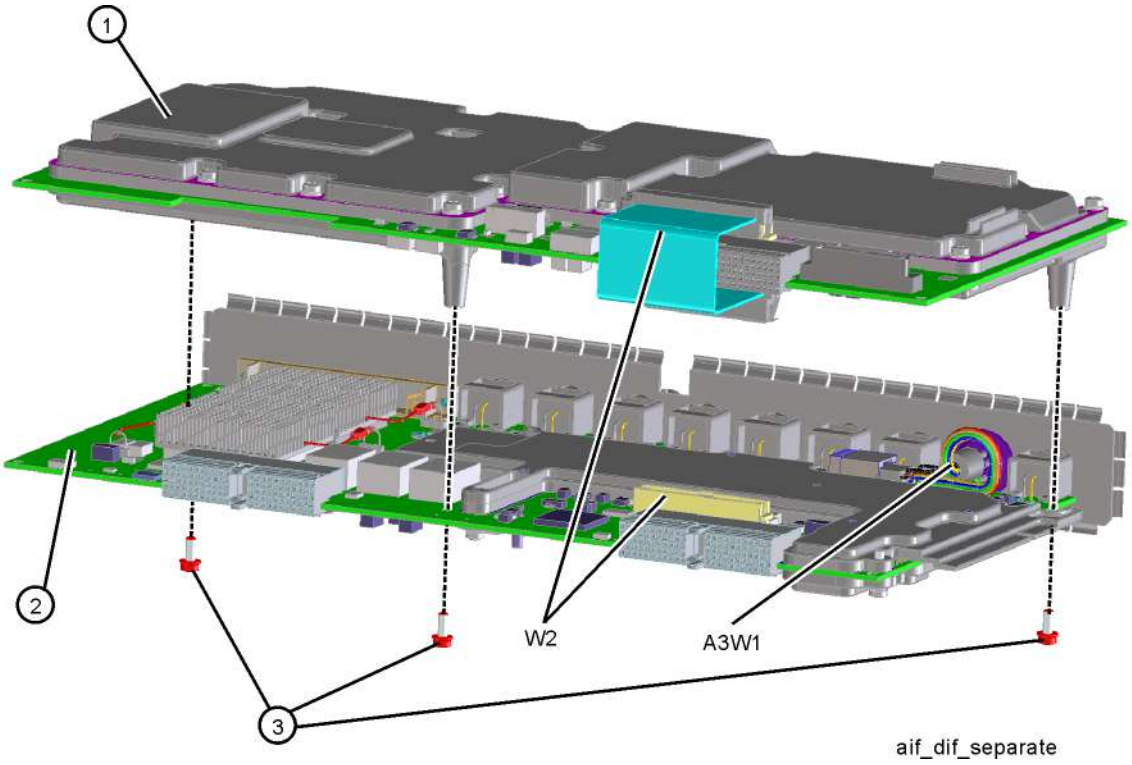


Table 14-25

Item	Description	Keysight Part Number
1	A2 Analog I.F. Assembly	N9020-60011
2	A3 Digital I.F. Assembly	N9020-60119
3	Screw, M3 X 0.5 (8 mm long)	0515-0372
W2	Cable, Interconnect from A2J820 to A3J20	N9020-60046
A3W1	Cable Assembly, Smart Noise Source (Wire Harness)	E4410-60163

Figure 14-26 AIF/DIF Assemblies - Option DP2, MPB, B40

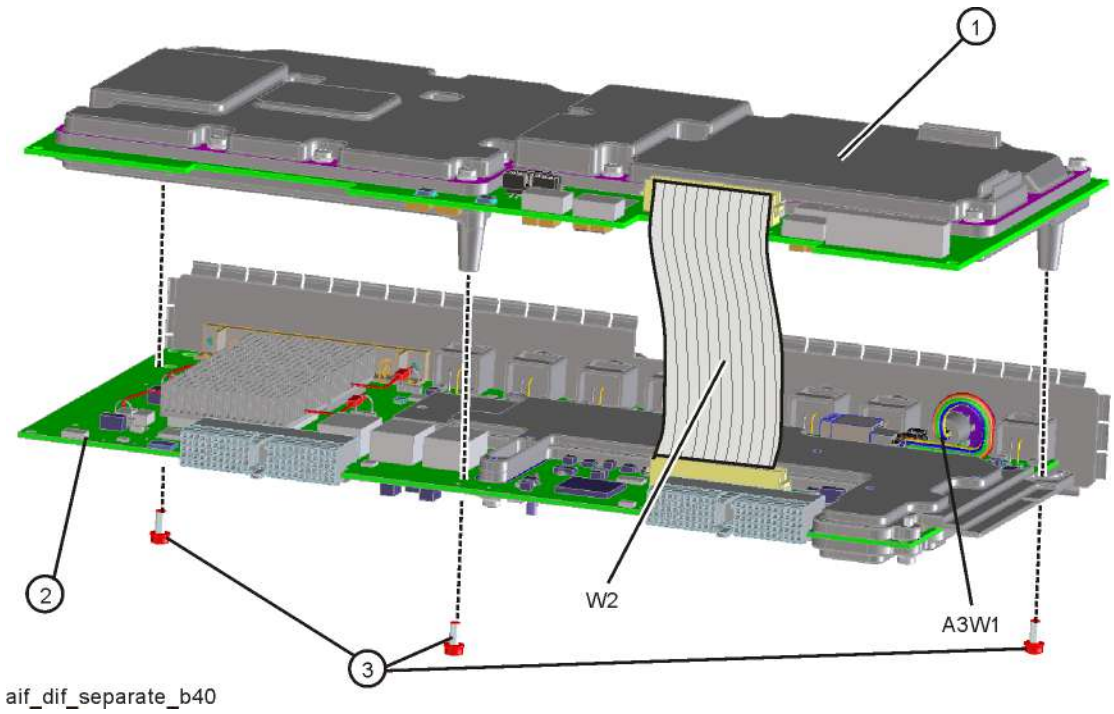


Table 14-26

Item	Description	Keysight Part Number
1	A2 Analog I.F. Assembly	N9020-60011
2	A3 Digital I.F. Assembly	N9020-60016
3	Screw, M3 X 0.5 (8 mm long)	0515-0372
W2	Cable, Interconnect from A2J820 to A3J20	N9020-60046
A3W1	Cable Assembly, Smart Noise Source (Wire Harness)	N9020-60090

Figure 14-27 Chassis

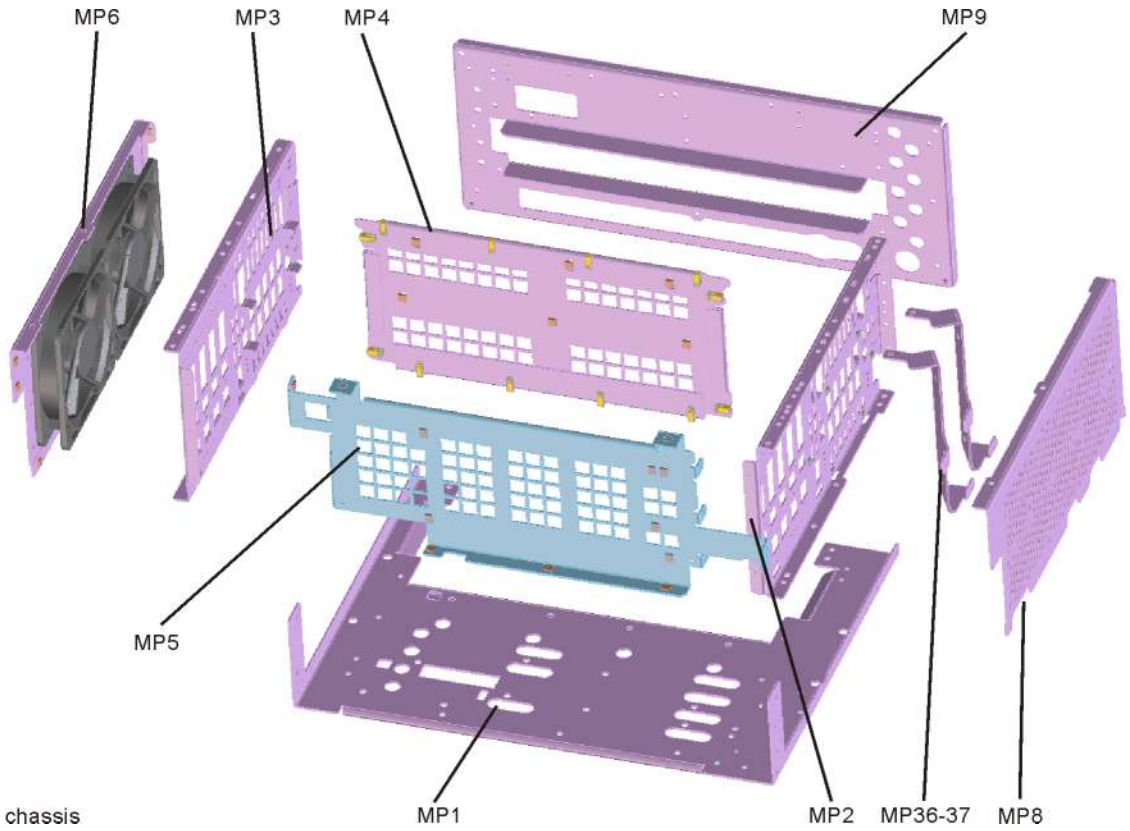


Table 14-27

Item	Description	Keysight Part Number
MP1	Chassis Base	N9020-00032
MP2	Chassis Side, Right (inner)	W1312-00135
MP3	Chassis Side, Left (inner)	W1312-00136
MP4	Midplane Bracket	W1312-00048
MP5	Chassis Front Bracket	N9020-00059
MP6	Fan Bracket	W1312-00137
MP8	Chassis Side, Right (Outer, attaches to Low Band Switch bracket, Attenuator brackets, and Chassis bottom)	N9020-00034
MP9	Rear Panel Replacement Kit (includes foam strip)	Refer to Table 14-1
MP36-37	Attenuator Bracket	N9020-00052

Figure 14-28 Motherboard

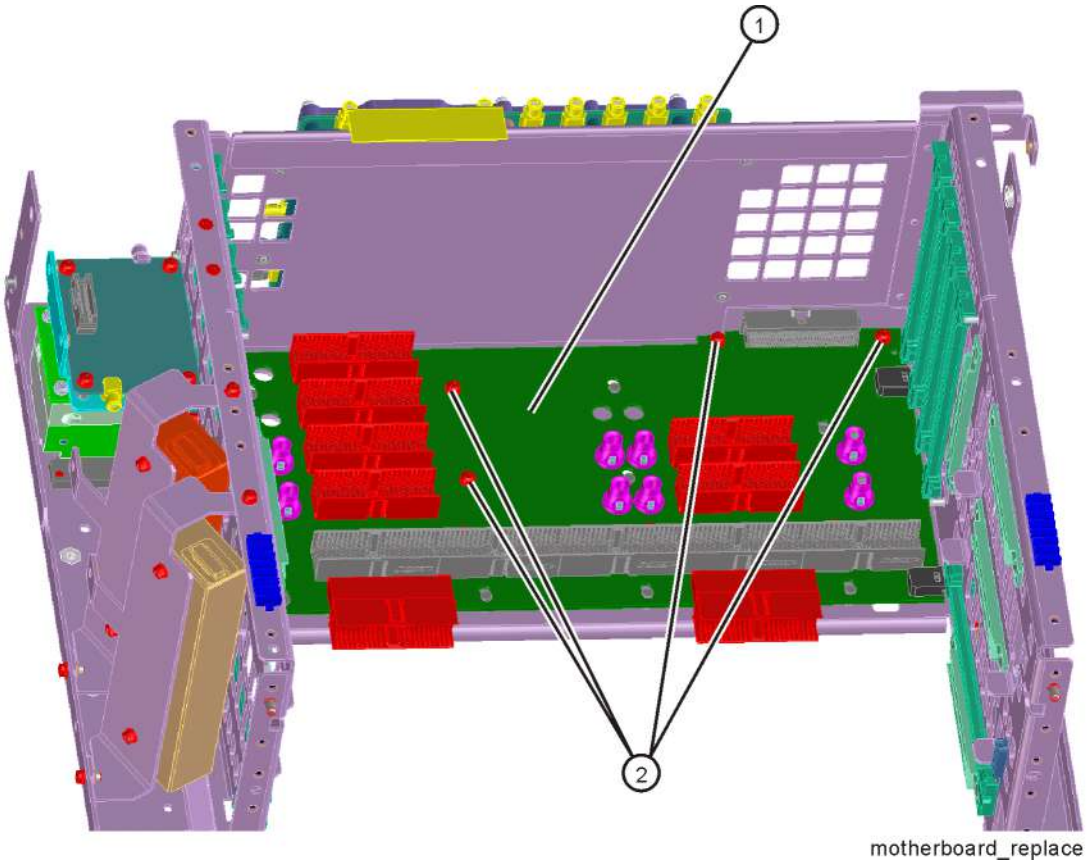


Table 14-28

Item	Description	Keysight Part Number
1	A8 Motherboard Assembly	N9000-66404
2	Screw M3 X0.5 (8 mm long)	0515-0372

Figure 14-29 Fan Hardware

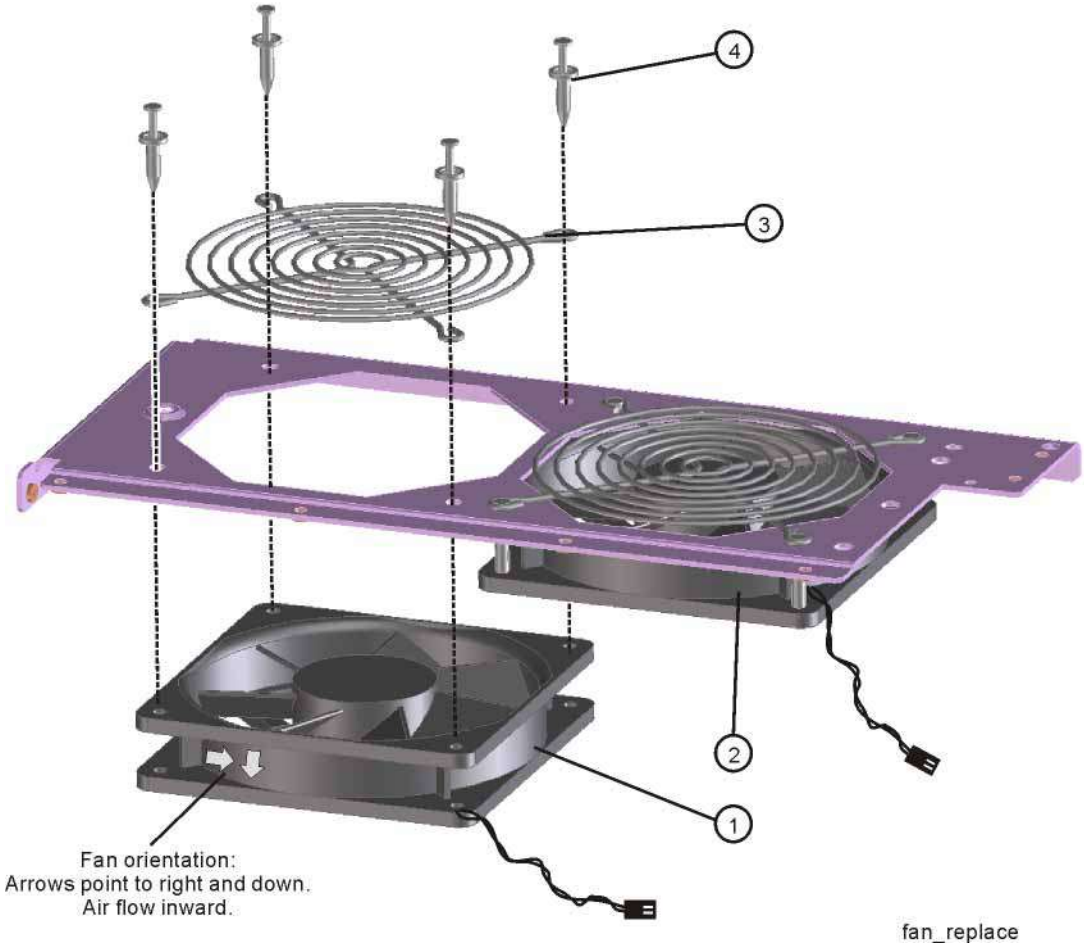


Table 14-29

Item	Description	Keysight Part Number
1	B1 Fan	3160-4199
2	B2 Fan	3160-4199
3	MP25-26 Fan Guard	3160-0281
4	MP27-34 Rivet, Fan Mounting (8 pieces)	0361-1272

Figure 14-30 Input Connector

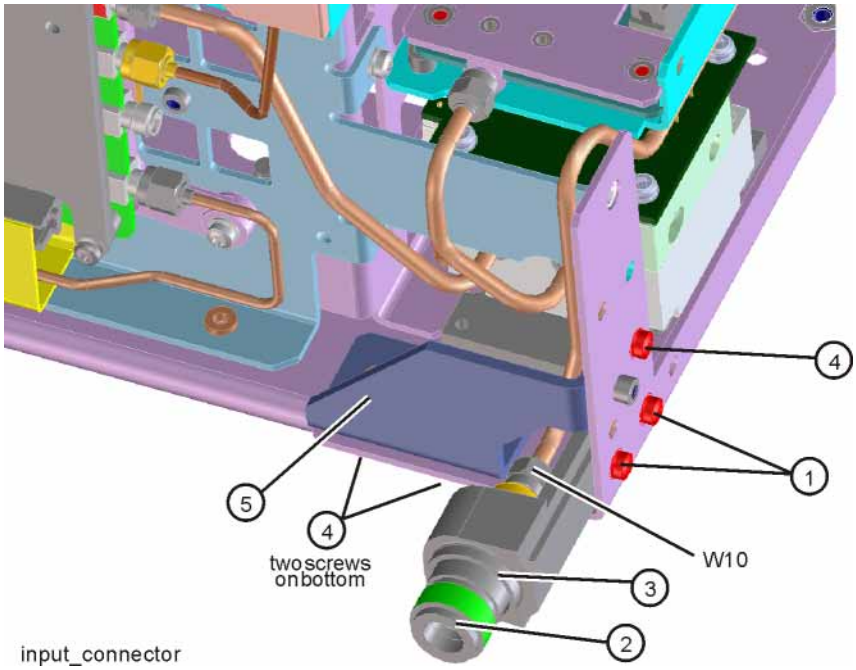


Table 14-30

Item	Description	Keysight Part Number
1	Screw M3 X 0.5 (8 mm long)	0515-0372
2	J1 Type N (f) Input Connector Assembly (Option 503, 508, 513, 526)	5002-0702
3	EMI O-Ring 18.75 mm ID (used between RF Input Connector and Front Frame)	8160-1637
4	Screw M3 X 0.5 (8 mm long)	0515-0372
W10	Cable Assembly, J1 to A9 Input (semi-rigid)	
	Option 503, 508, 513, 526	N9020-20141
	Option 532, 544, 550	N9020-20133
5	MP83 Gusset, Chassis (near RF Input connector)	W1312-00093

Figure 14-31 Front Frame Parts

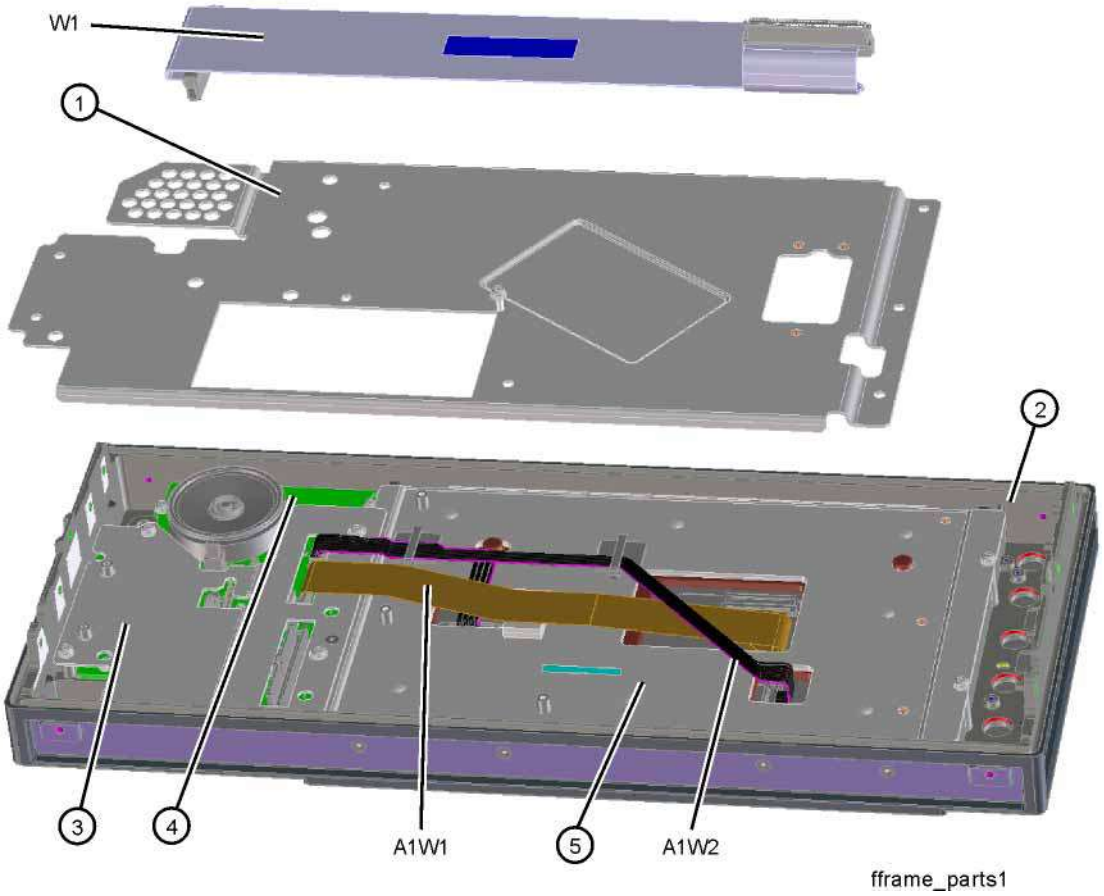


Table 14-31

Item	Description	Keysight Part Number
1	A1MP14 Shield	N9020-00066
2	A1A1 Front Frame	N9020-60299
3	A1MP10 Bracket front panel shield	N9020-00064
4	A1A2 Front Panel Control Board	N9020-63294
5	A1MP11 Display Bracket, Front Panel	N9020-00078
A1W1	Flex Circuit, Display to Front Panel Control Board	N9020-60273
A1W2	Cable Assembly, Backlight	N9020-60217

Figure 14-32 Front Frame Exploded View

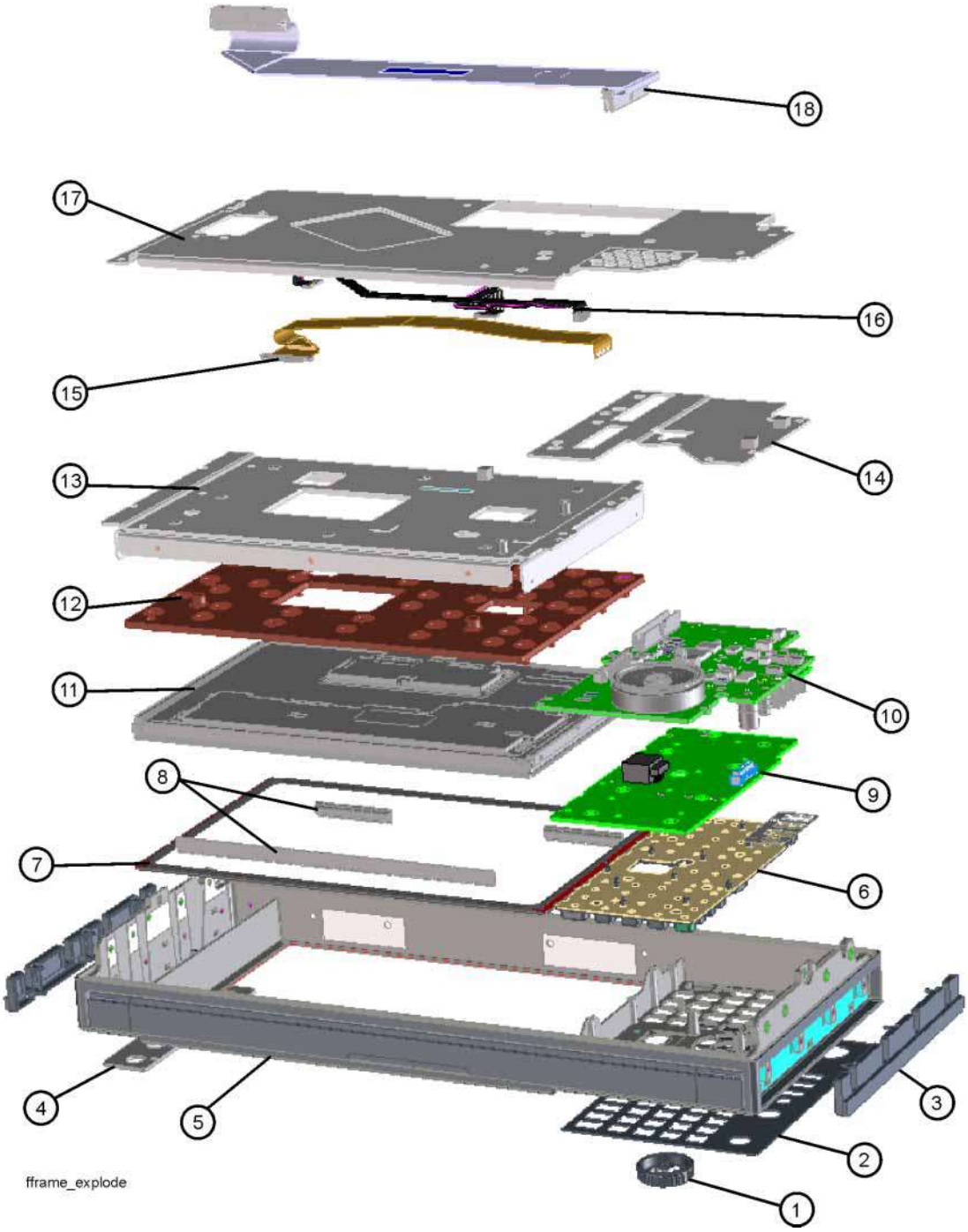


Table 14-32 Front Frame Exploded View

Item	Description	Keysight Part Number
1	RPG Knob	W1312-40179
2	Overlay, Keyboard	N9020-80127
3	Front Frame Side Trim Strip (plastic, 2 ea)	N9020-40018
4	Cover Plate	N9020-00002
5	Front Frame	---[a]
6	A1A5 Main Keypad	N9020-40001
7	Display Boot	N9020-40002
8	EMI Gasket	---[a]
9	A1A4 Keyboard, PCA	N9020-63275
10	A1A2 Front Panel Control Board	N9020-63294
11	A1A3 Liquid Crystal Display 10.6-in w/PCAP Touch 1280X768-Pixels	2090-1103
12	A1MP9 Display hold down (compression pad)	N9020-40003
13	A1MP11 Display Bracket, Front Panel	N9020-00078
14	A1MP10 Bracket front panel shield	N9020-00064
15	A1W1 Flex Circuit, Display to Front Panel Control Board	N9020-60273
16	A1W2 Cable Assembly, Backlight	N9020-60217
17	A1MP14 Shield	N9020-00066
18	W1 Cable, Front Panel Interface Board to Motherboard (Ribbon)	N9020-60216

a. Non-orderable item, see A1A1.

Figure 14-33 Option BBA Parts

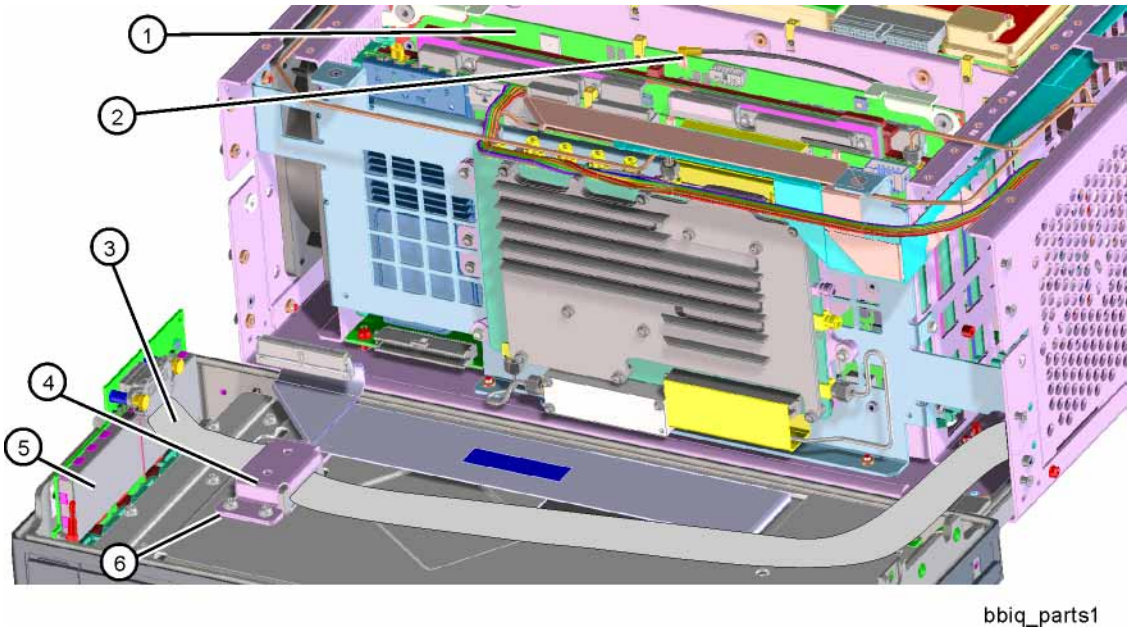


Table 14-33

Item	Description	Keysight Part Number
1	A19 BBIQ Main Board (Option BBA)	N9020-60093
2	W25 Cable Assembly, A19J101, BBIQ Main Board to A16J707 Reference Board (Flexible Coax) (Option BBA)	8121-1401
3	W24 Cable Assembly, A18J1, BBIQ Interface Board to A19J1, BBIQ Main Board (Ribbon Cable) (Option BBA)	8121-1683
4	A1MP16 Core Bracket, Top (Option BBA)	N9020-00071
5	A18 BBIQ Interface Board (Option BBA)	N9020-60094
6	A1MP19 Core Bracket, Bottom (Option BBA)	N9020-00072

15 Assembly Replacement Procedures

What You Will Find in This Chapter

Procedures in this chapter enable you to locate, remove, and replace the following major assemblies in your instrument.

Refer to Chapter 14, “Replaceable Parts.” for part numbers, assembly descriptions, and ordering information.

“Instrument Outer Case” on page 455
“Top Brace” on page 460
“RF Area (Option 503, 508, 513, 526)” on page 461
“RF Area (Option 532, 544, 550)” on page 488
“RF Front End Assembly (Option 503, 508, 513, 526)” on page 503
“RF Front End Assembly (Options 532, 544, 550)” on page 505
“Front End Control Assembly” on page 507
“L.O. Synthesizer Assembly” on page 510
“Rear Panel” on page 511
“Reference Assembly” on page 512
“Power Supply Assembly” on page 515
“CPU Assembly” on page 517
“A5 Solid State Drive” on page 519
“Analog I.F. (AIF)/Digital I.F. (DIF) Assembly” on page 524
“Wide Band Analog IF and Digital IF Assemblies” on page 529
“Midplane Assembly” on page 531
“Motherboard Assembly” on page 534
“Fan Assembly” on page 539
“Input Connector Assembly” on page 542
“Front Frame Assembly” on page 544
“Display Assembly” on page 553
“Option BBA” on page 557

Before Starting

Before starting to disassemble the instrument:

- Check that you are familiar with the safety symbols marked on the instrument. And, read the general safety considerations and the safety note definitions given in the front of this guide.
- The instrument contains static sensitive components. Read the section entitled "ESD Information" on page 23.

Safety

WARNING The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

WARNING The instrument contains potentially hazardous voltages. Refer to the safety symbols on the instrument and the general safety considerations at the beginning of this service guide before operating the unit with the cover removed. Failure to heed the safety precautions can result in severe or fatal injury.

Tools you will need

Figure 15-1 TORX Tool

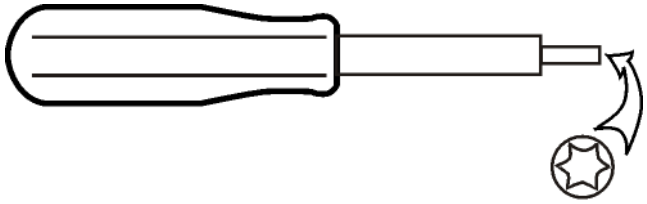


Table 15-1

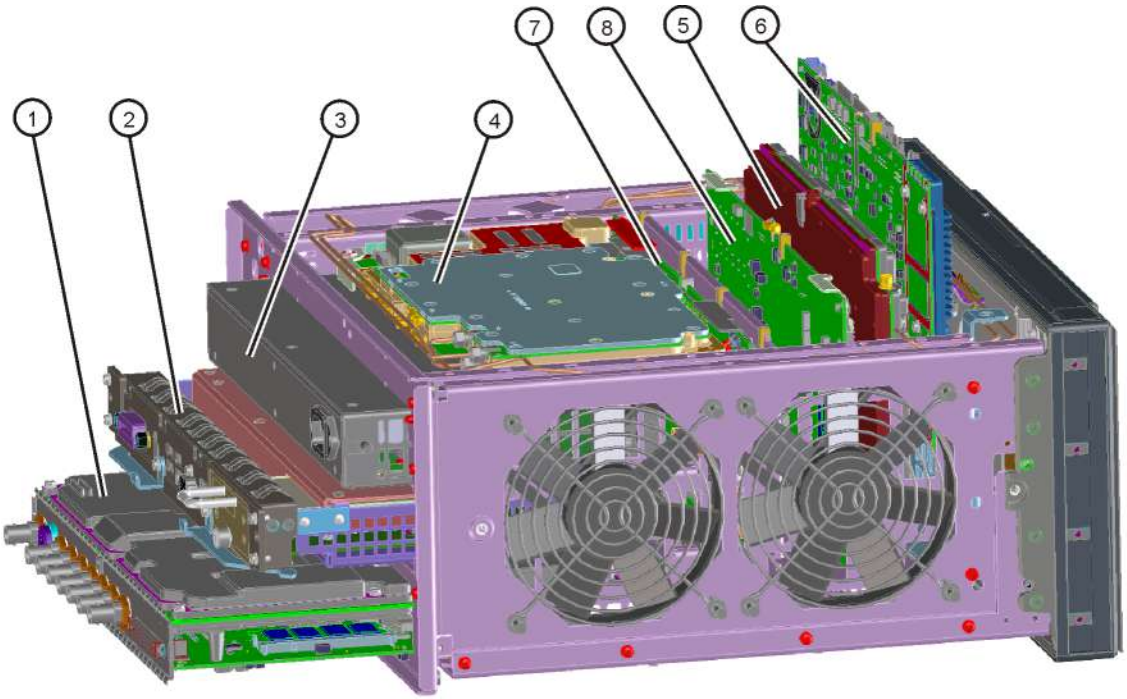
Description	Keysight Part Number
TORX Hand Driver - Size T-10	8710-1623
TORX Hand Driver - Size T-20	8710-1615
9/16 inch nut driver	8720-0008
5/16 inch open-end wrench	source locally
cable puller	5021-6773

Adjustments Tests after an instrument repair

Refer to Table 16-1 on page 567 for information about post-repair procedures. If one or more instrument assemblies have been repaired or replaced, perform the related adjustments and performance verification tests.

Major Assembly Locations

Figure 15-2 Major Assemblies



major_assy

Table 15-2

Item	Description
1	A2 Analog I.F. Assembly/A3 Digital I.F. Assembly
2	A4 CPU Assembly
3	A6 Power Supply
4	A16 Reference Assembly
5	A14 L.O. Synthesizer Assembly
6	A15 Front End Control Assembly
7	A7 Midplane Assembly
8	A19 BBIQ Main Board (Option BBA)

Instrument Outer Case

CAUTION If the instrument is placed on its face during any of the following procedures, be sure to use the front panel protective cover (MP50), a soft surface, or soft cloth to avoid damage to the front panel, keys, or input connector.

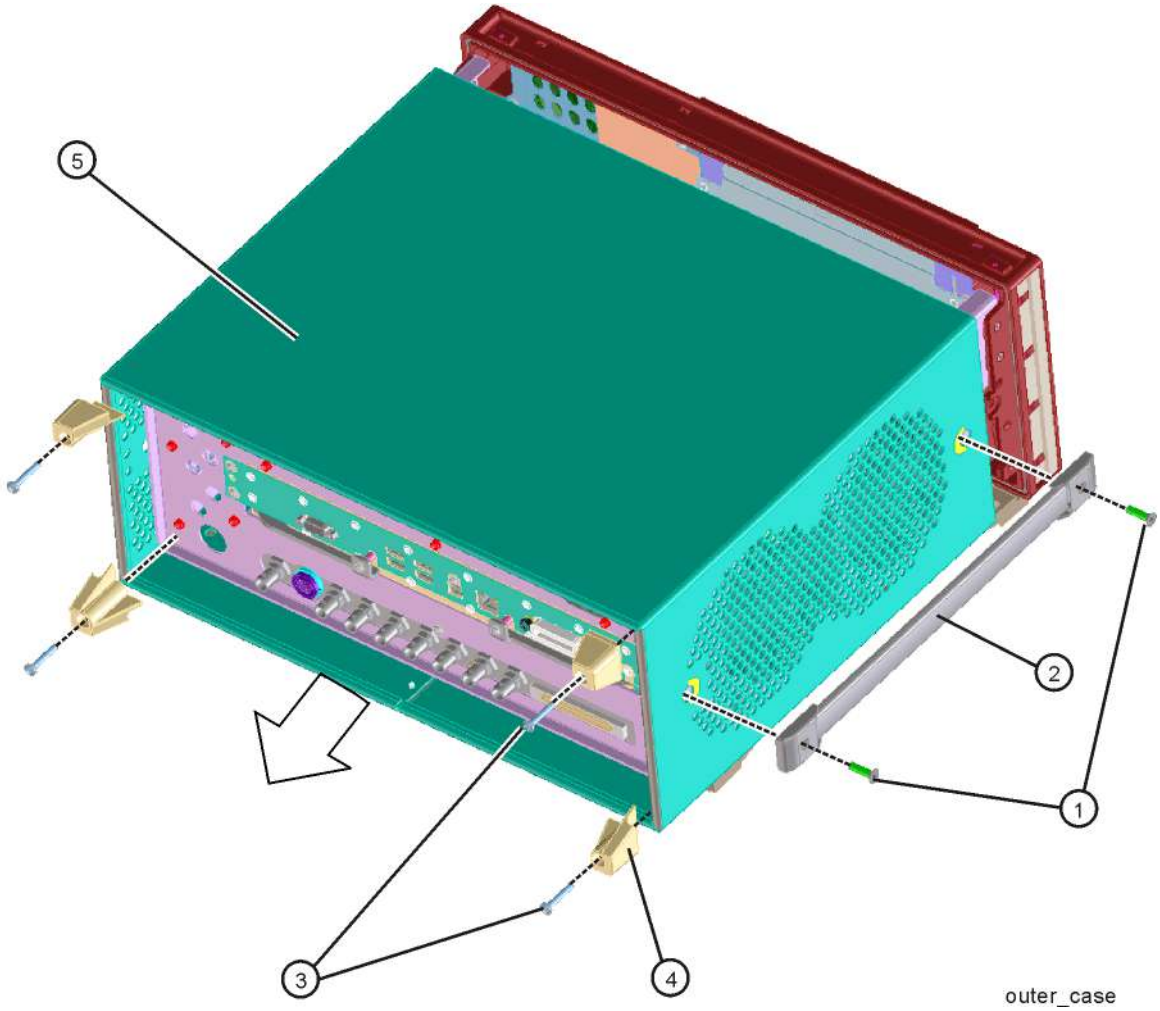
NOTE If the analyzer has Option PRC, Portable Configuration, refer to the "Option PRC" section on page 457 to remove the outer case.

Standard Instrument

Removal

1. Disconnect the instrument from ac power.
2. Refer to Figure 15-3. Using the T-20 driver, remove the four screws (two on each side) **(1)** that attach the handle strap **(2)** on each side of the instrument.
3. Using the T-20 driver, remove the four screws (including washers) **(3)** (two on each side) that hold the rear feet **(4)** (two on each side) in place.
4. Pull the instrument cover **(5)** off towards the rear of the instrument.

Figure 15-3 Standard Instrument Outer Case Removal



Replacement

1. Disconnect the instrument from ac power.
2. Slide the instrument cover back onto the deck from the rear. The seam on the cover should be on the bottom. Be sure the cover seats into the gasket groove in the Front Frame Assembly.
3. Replace the four rear feet to the rear of the instrument (two on each side). Torque the rear feet screws to 21 inch pounds.
4. Replace the handle straps on both sides of the instrument. Torque the handle strap screws to 21 inch pounds.

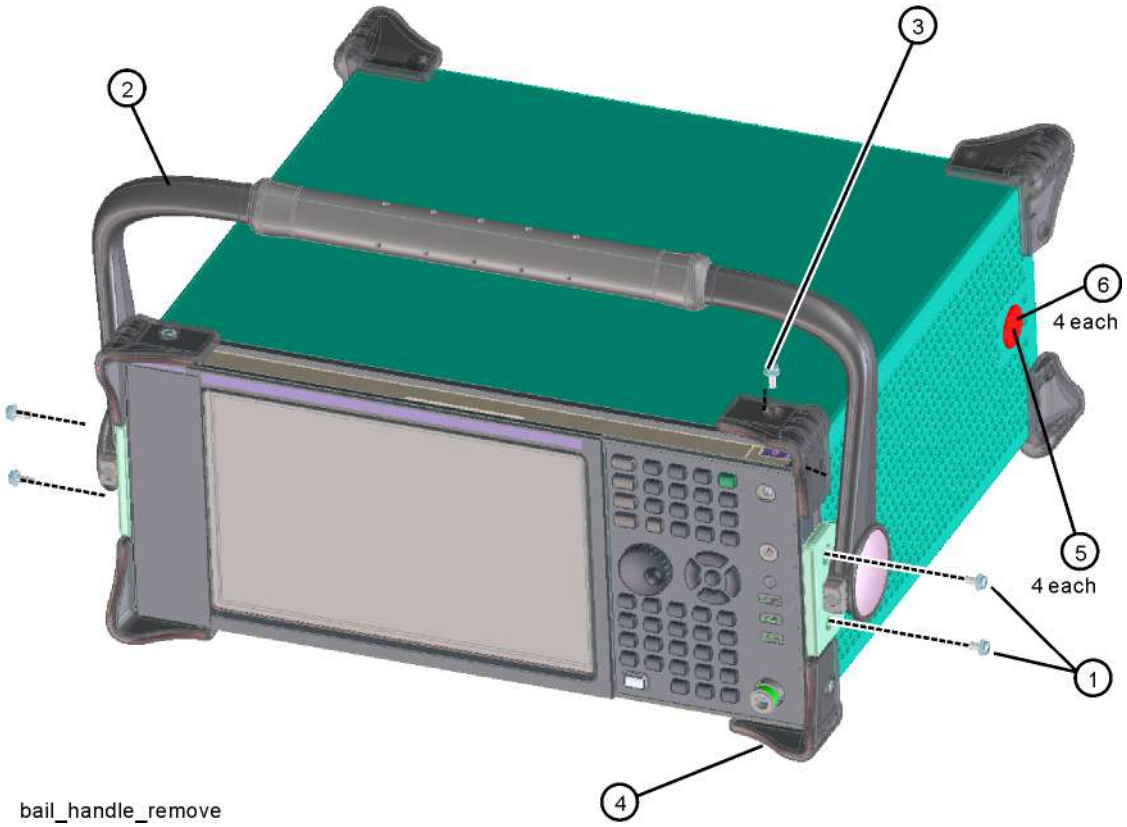
Option PRC

Removal

1. Disconnect the instrument from ac power.

   Refer to Figure 15-4. Using the T-20 driver, remove the four screws (two on each side) **(1)** that hold the bail handle **(2)** to the front frame.

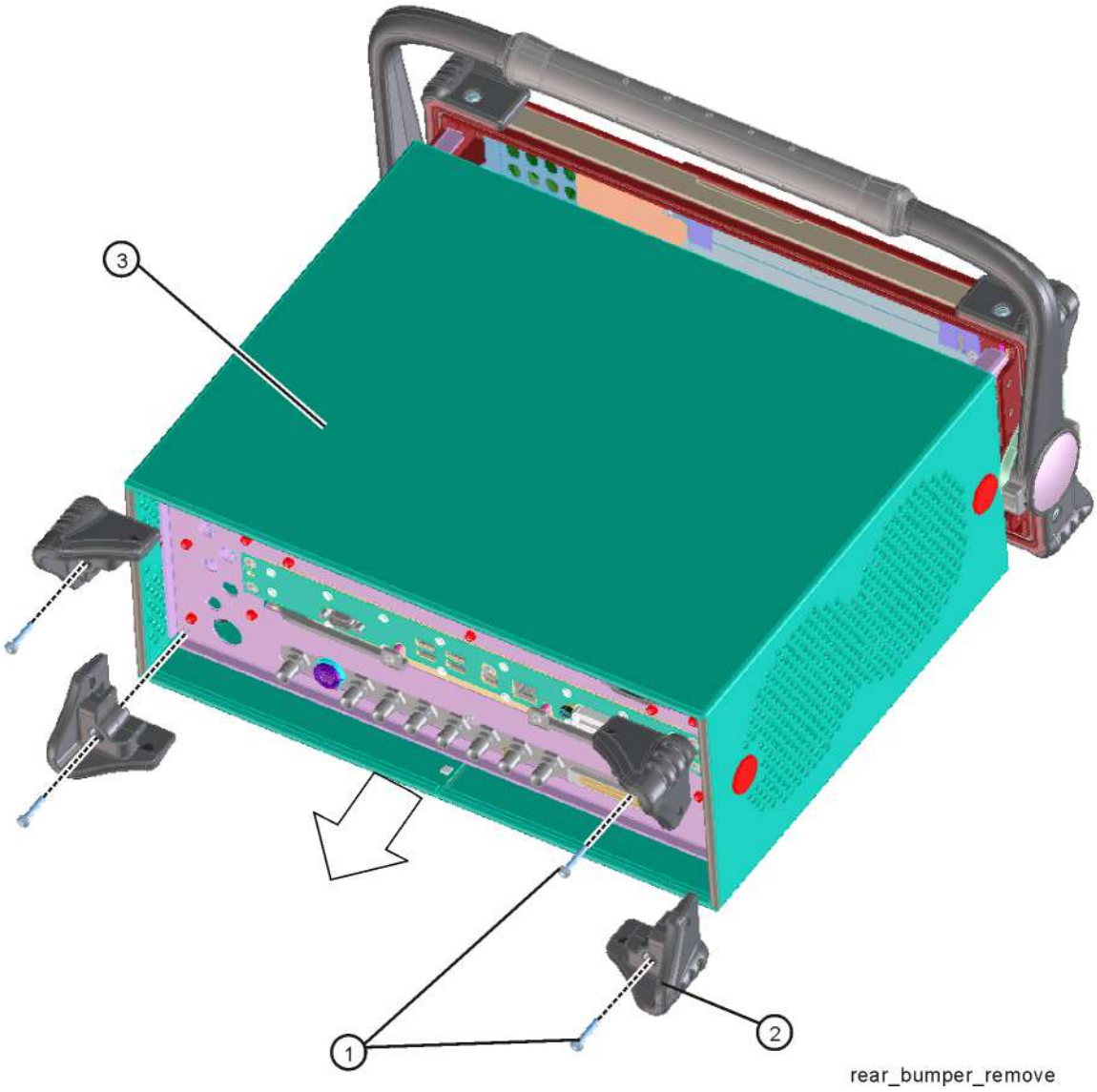
Figure 15-4 Bail Handle Removal



2. Using the T-20 driver, remove the four screws (two on each side) **(6)** that hold the strap handle plugs **(5)** in place.

3. Refer to Figure 15-5. Using the T-20 driver, remove the four screws including washers **(1)** that hold the rear bumpers **(2)** (two on each side) in place.

Figure 15-5 Option PRC Instrument Outer Case Removal



4. Pull the instrument cover **(3)** off towards the rear of the instrument.

Replacement

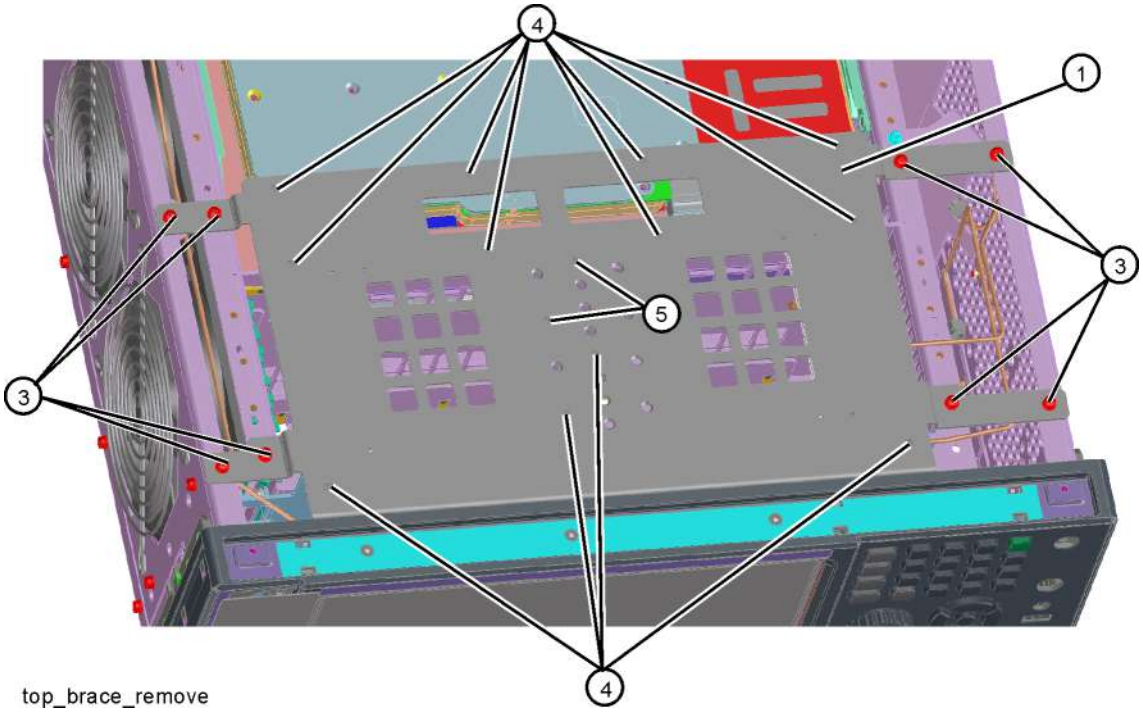
1. Disconnect the instrument from ac power.
2. Slide the instrument cover back onto the deck from the rear. The seam on the cover should be on the bottom. Be sure the cover seats into the gasket groove in the Front Frame Assembly.
3. Refer to Figure 15-4. Replace the strap handle plugs **(5)** in place and attach using the T-20 driver to replace the four screws (two on each side) **(6)**. Torque to 21 inch pounds.
4. Place the bail handle into position on the front frame and using the T-20 driver, replace the four screws (two on each side) **(1)** that hold the bail handle **(2)** to the front frame. Torque to 21 inch pounds.
5. Refer to Figure 15-5. Replace the four rear bumpers to the rear of the instrument. Torque to 21 inch pounds.

Top Brace

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Refer to Figure 15-6. To remove the Top Brace, use the T-10 driver to remove the eight screws **(3)** (0515-0372) attaching the Top Brace to the chassis. Remove the twelve flathead screws **(4)** (0515-1946) attaching the Top Brace to the chassis and boards.
3. If Option BBA, B85, B1A, or B1X are installed, remove the additional flathead screws **(5)** (0515-1946) securing the Top Brace to the boards.

Figure 15-6 Top Brace Removal



Replacement

1. Refer to Figure 15-6. To replace the Top Brace place it into the correct position and attach the appropriate screws. Torque to 9 inch-pounds.

RF Area (Option 503, 508, 513, 526)

Refer to Figure 15-7 and Figure 15-8. The RF area consists of RF attenuator A **(1)**, RF attenuator B **(2)**, low band switch assembly **(3)**, and YTF Preselector **(4)**.

Instruments with Options DP2, MPB, or B40 will also have coaxial switch #1 **(5)**, coaxial switch #2 **(6)**, and 6 dB fixed attenuator **(7)** (Figure 15-8).

NOTE The YTF Preselector is not typically installed in instruments with Option 503.

Figure 15-7 RF Area Components and Cables - Standard Instruments

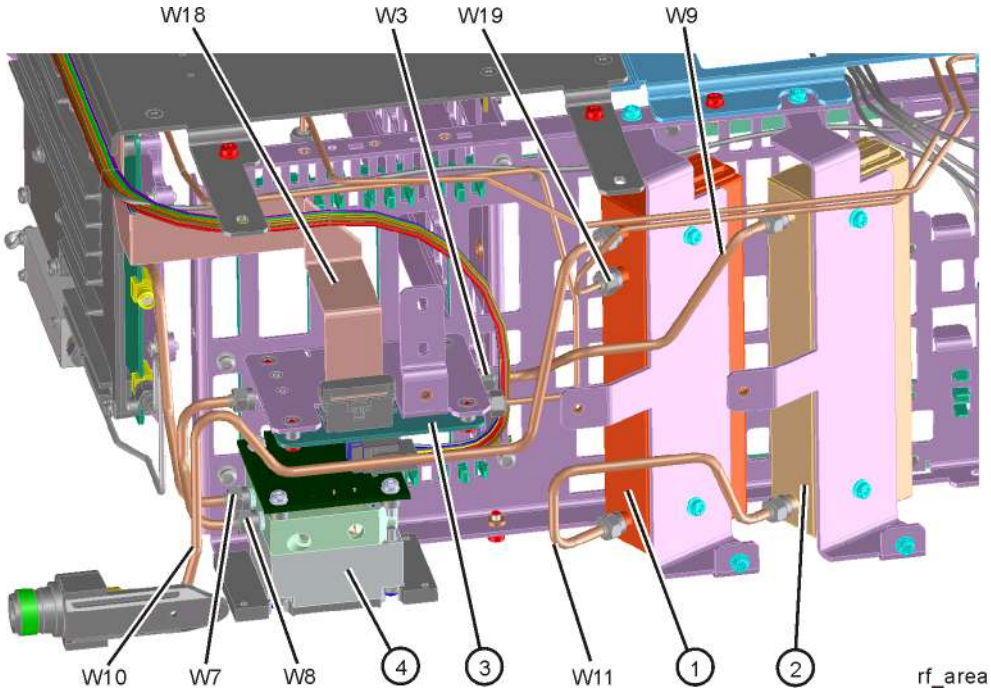
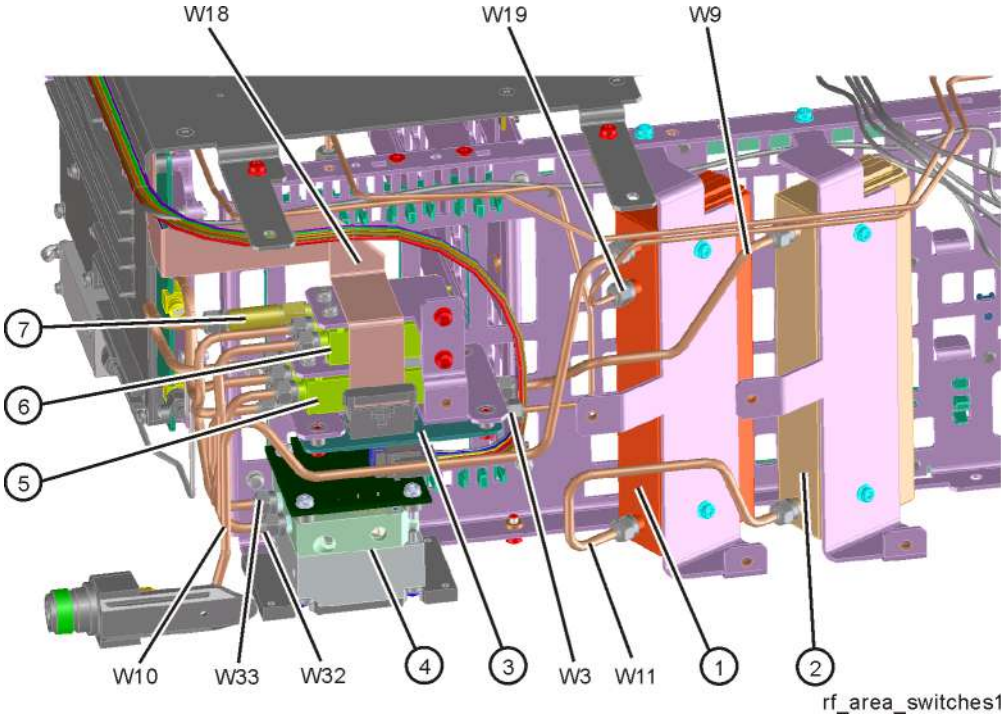


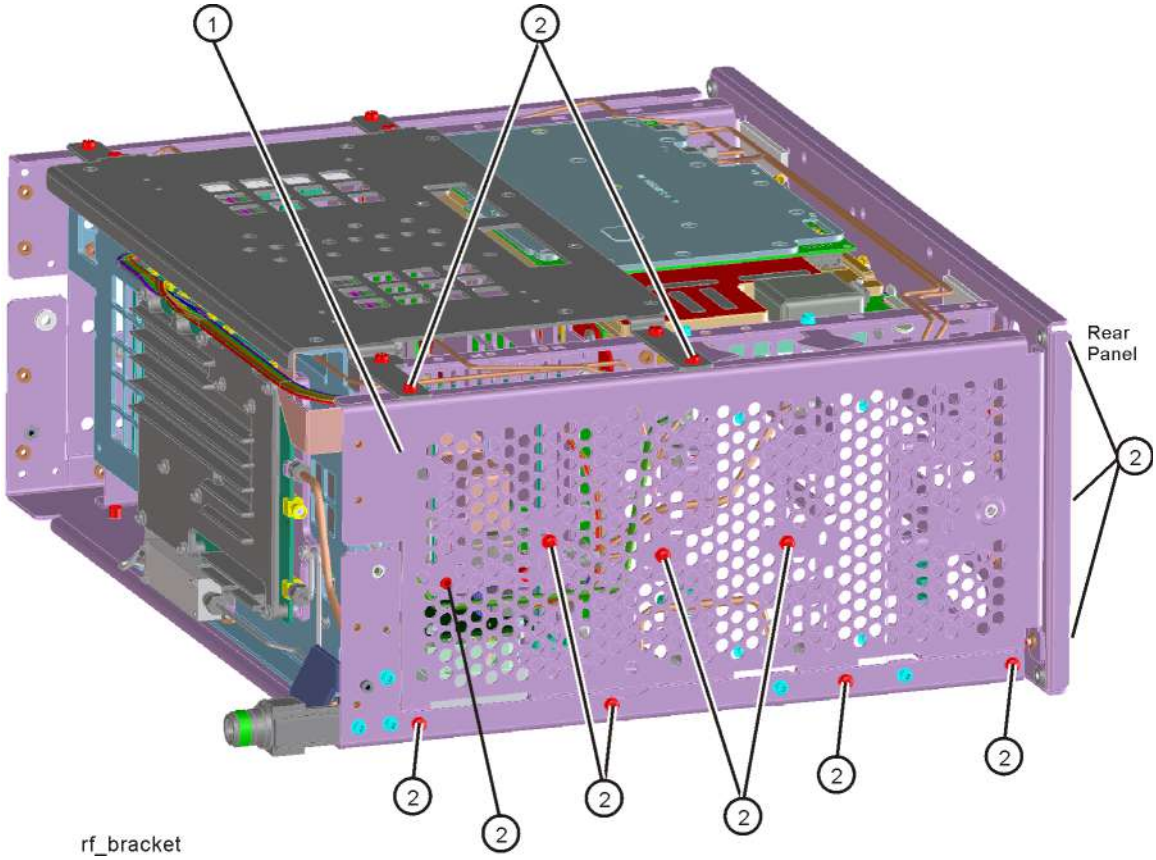
Figure 15-8 RF Area Components and Cables - Options DP2, MPB, B40



To gain access to any of these parts, follow these steps:

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the top brace. Refer to the "Top Brace" removal procedure.
3. Remove the front panel. Refer to the "Front Frame Assembly" removal procedure.
4. Refer to Figure 15-9. Remove the chassis side, right **(1)** by removing the thirteen screws **(2)** using the T-10 driver.

Figure 15-9 RF Bracket Removal



Low Band Switch - Standard Instruments

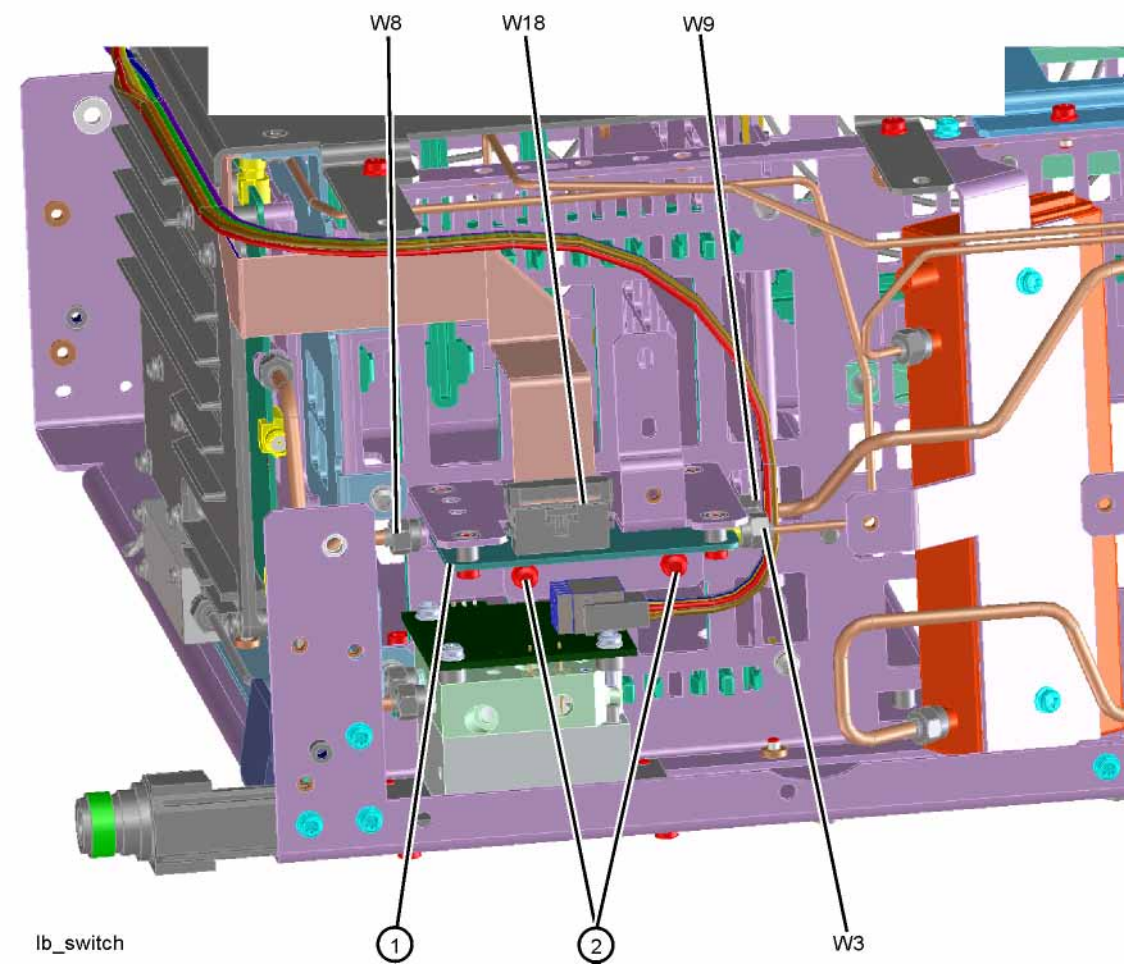
Removal

1. Refer to Figure 15-10. Remove the ribbon cable W18.
2. Remove the semi-rigid cables W3, W8, and W9 using the 5/16 inch wrench.

NOTE W8 will not be present in instruments with Option 503.

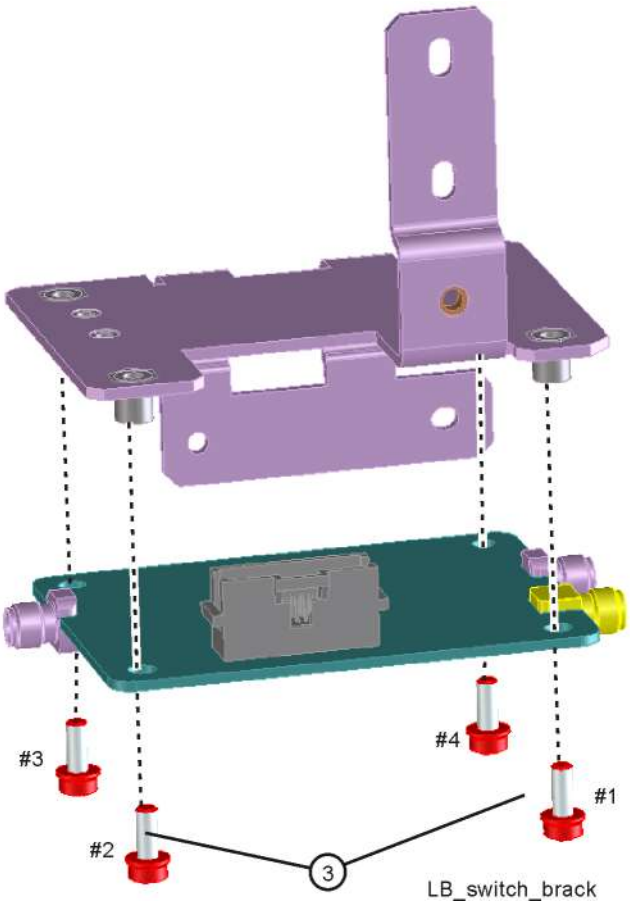
3. Remove the two screws **(2)** using the T-10 driver. The low band switch **(1)** can now be removed from the chassis.

Figure 15-10 Low Band Switch Removal



4. Refer to Figure 15-11. To separate the switch from the bracket, remove the four screws **(3)** using the T-10 driver.

Figure 15-11 Low Band Switch and Bracket Separation



Replacement

1. Refer to Figure 15-11. Place the switch onto the bracket and replace the four screws **(3)**. Torque to 9 inch-pounds in the sequence shown, starting with #1.
2. Place the switch/bracket into place into the chassis and replace the two screws. Torque to 9 inch-pounds starting with the screw closest to the front of the instrument.
3. Refer to Figure 15-10. Replace the semi-rigid cables W3, W8, and W9. Torque to 10 inch-pounds.

NOTE W8 will not be present in instruments with Option 503.

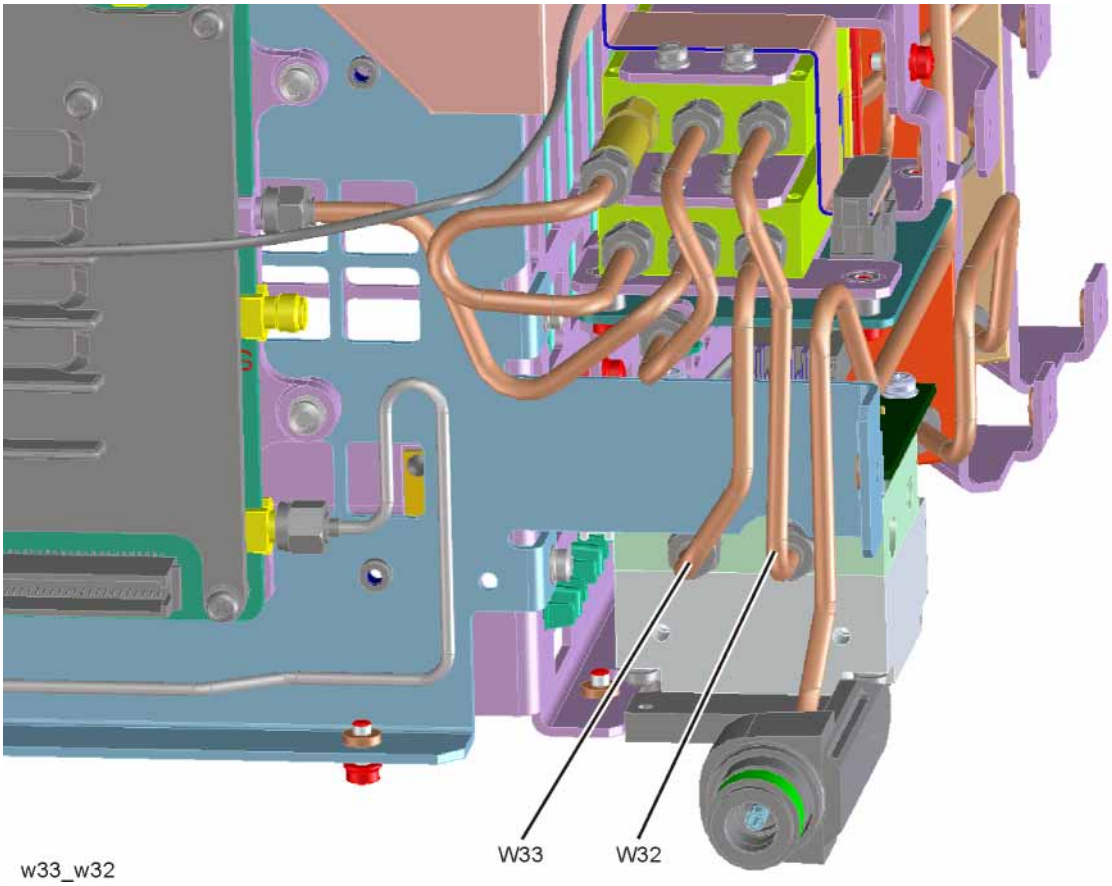
4. Replace the ribbon cable W18.
5. Refer to Figure 15-9. Position the chassis side, right onto the chassis and replace the thirteen screws. Torque to 9 inch-pounds.
6. Replace the front panel. Refer to the "Front Frame Assembly" replacement procedure.
7. Replace the top brace. Refer to the "Top Brace" replacement procedure.
8. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Low Band Switch and Coaxial Switches Options DP2, MPB, B40

Removal

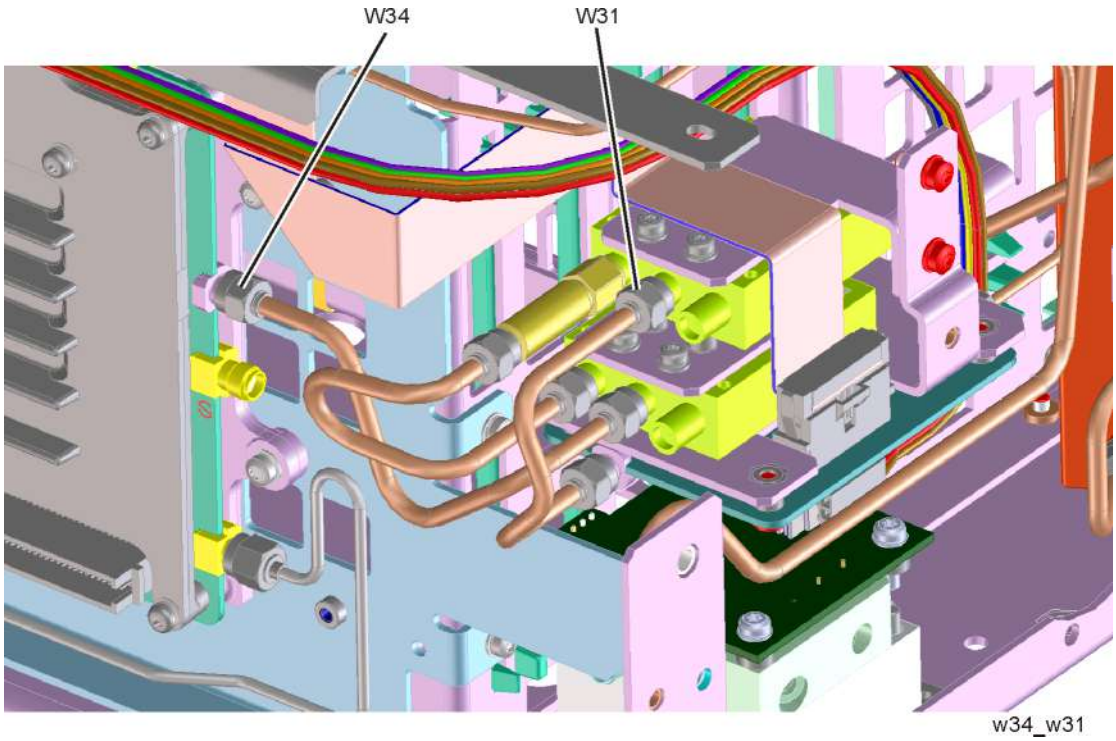
1. Refer to Figure 15-12. Remove semi-rigid coax cables W32 and W33.

Figure 15-12 Remove W33 and W32



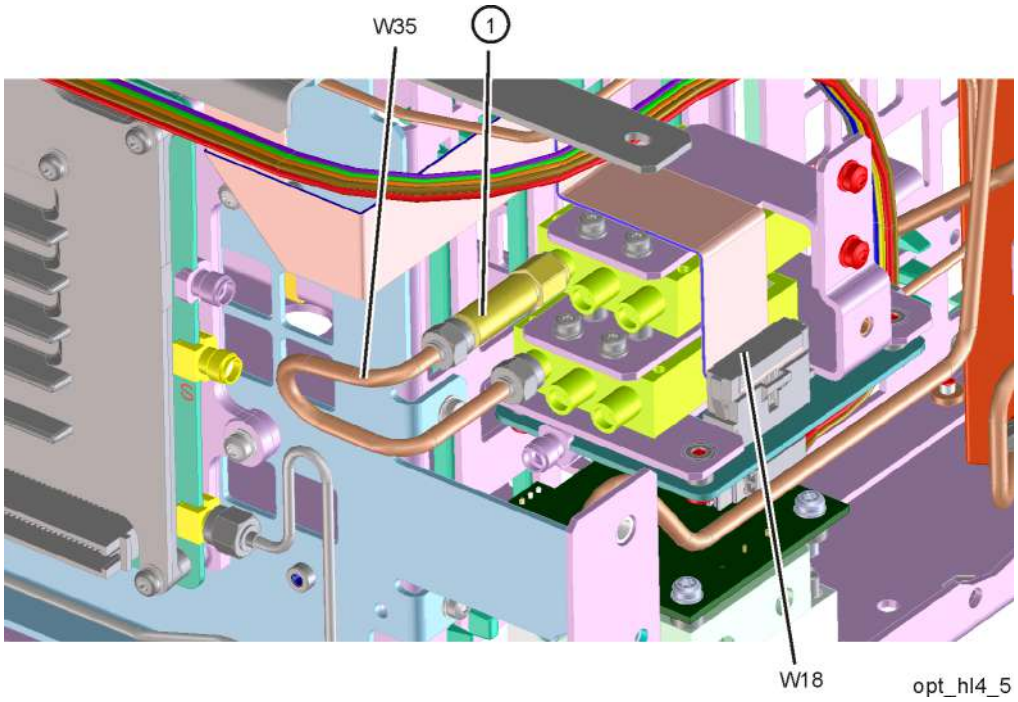
2. Refer to Figure 15-13. Remove semi-rigid coax cables W31 and W34.

Figure 15-13 Remove W34 and W31



3. Refer to Figure 15-14. Remove semi-rigid coax cable W35 and the fixed attenuator **(1)**.

Figure 15-14 W35 and Attenuator Removal



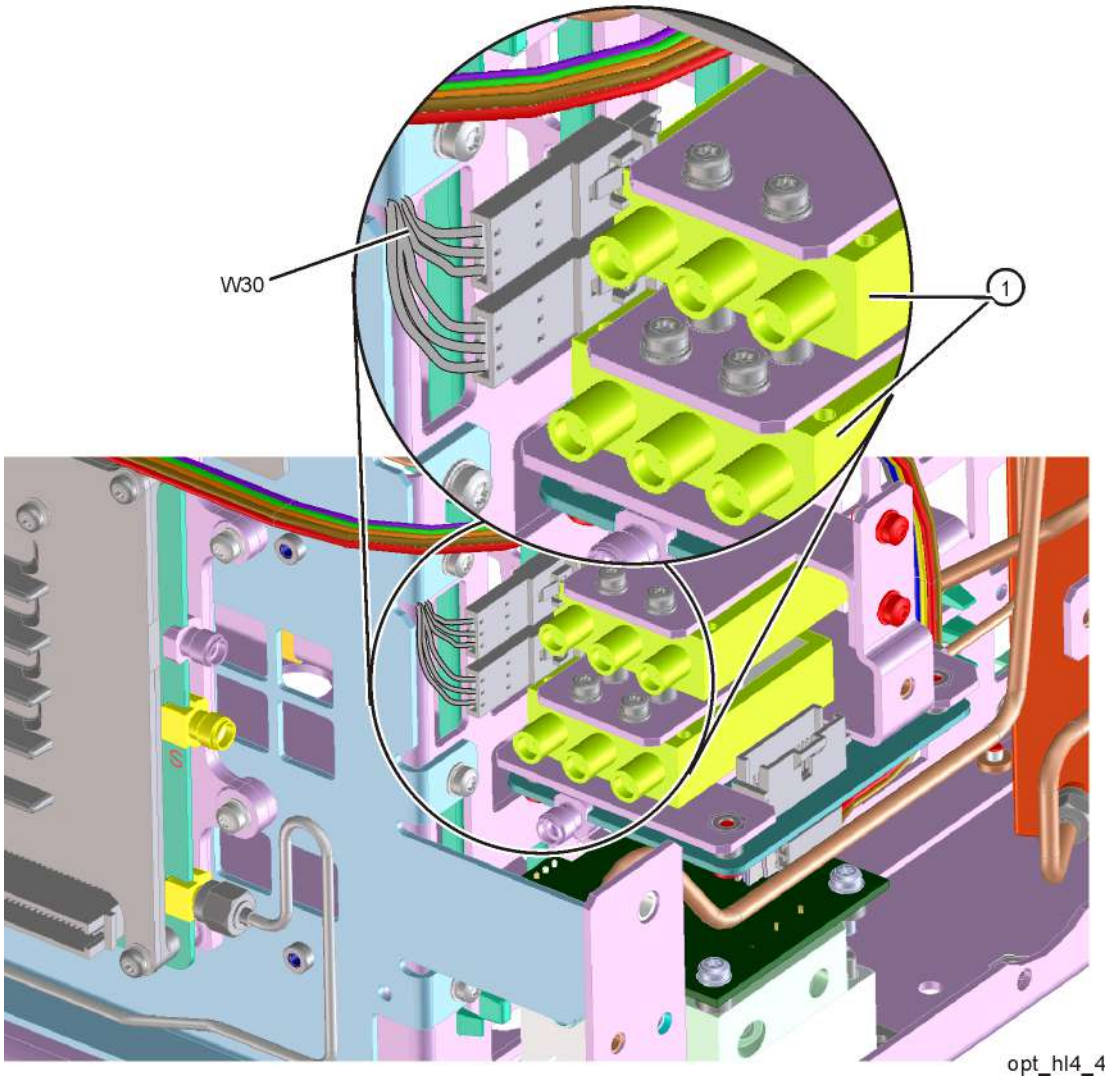
4. Remove ribbon cable W18 from J4 of the A11 Low Band Switch.

5. Refer to Figure 15-15. Disconnect the two wire harness connectors W30 from the switches **(1)**.

NOTE

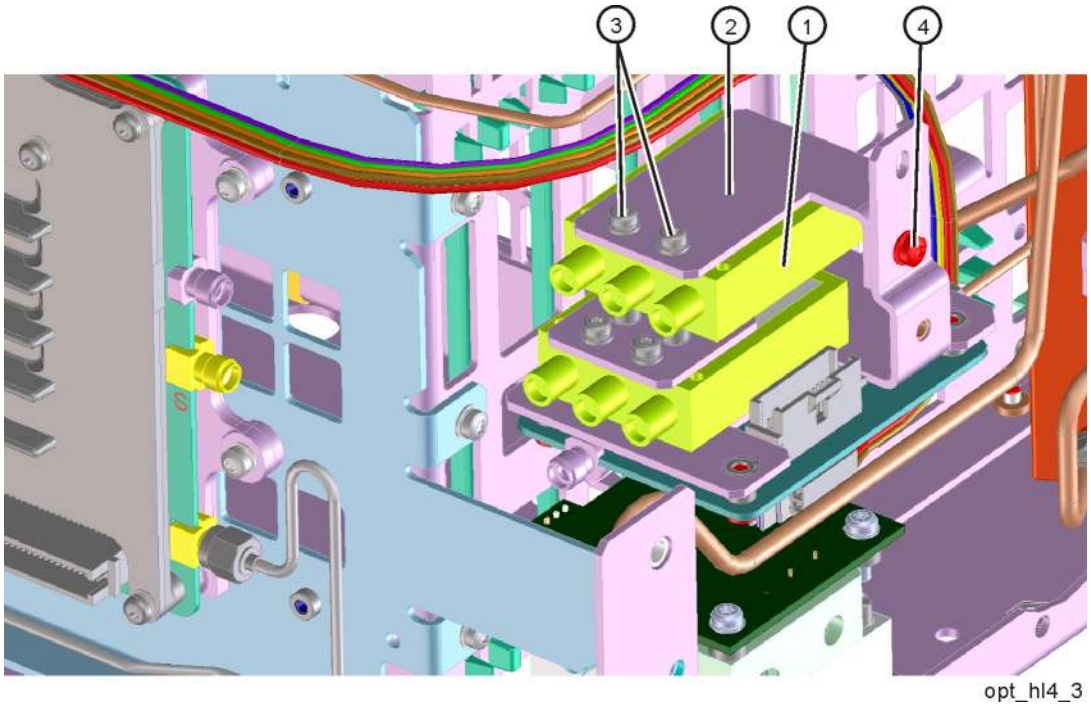
Even though the wire colors on W30 harness are different, it does not matter which one plugs into which switch.

Figure 15-15 Wire Harness Disconnect



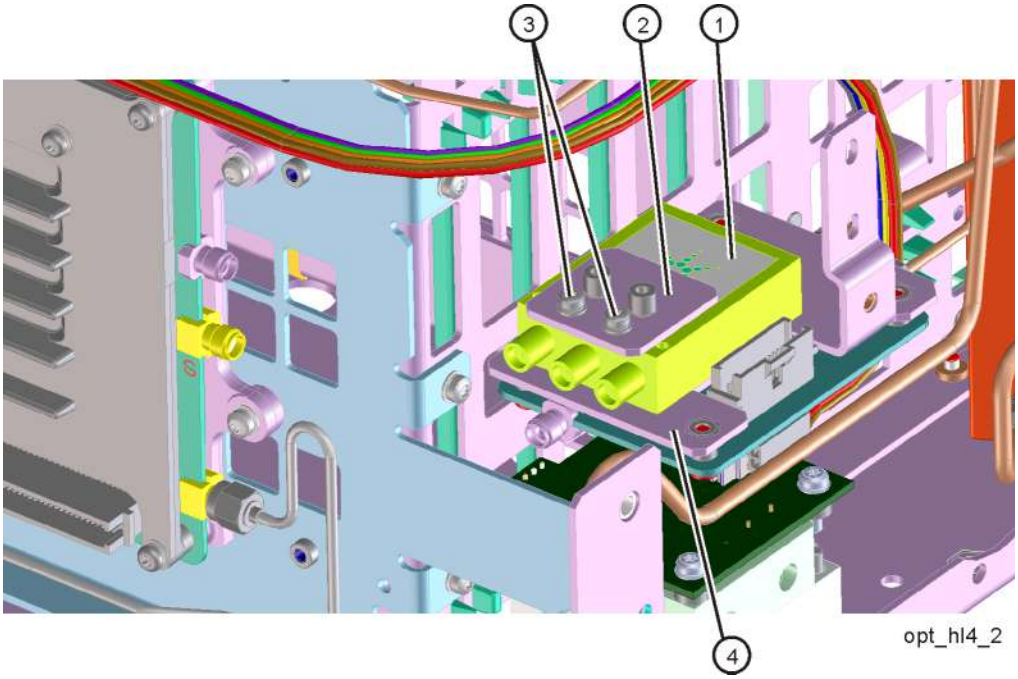
6. Refer to Figure 15-16. Using the T-10 driver, remove the single screw **(4)** to separate the switch 2/bracket assembly **(1)/(2)** from the low band switch bracket. To separate switch 2 **(1)** from it's bracket **(2)**, remove the two 0515-1992 screws **(3)** using the T-8 driver.

Figure 15-16 Switch 2 Removal



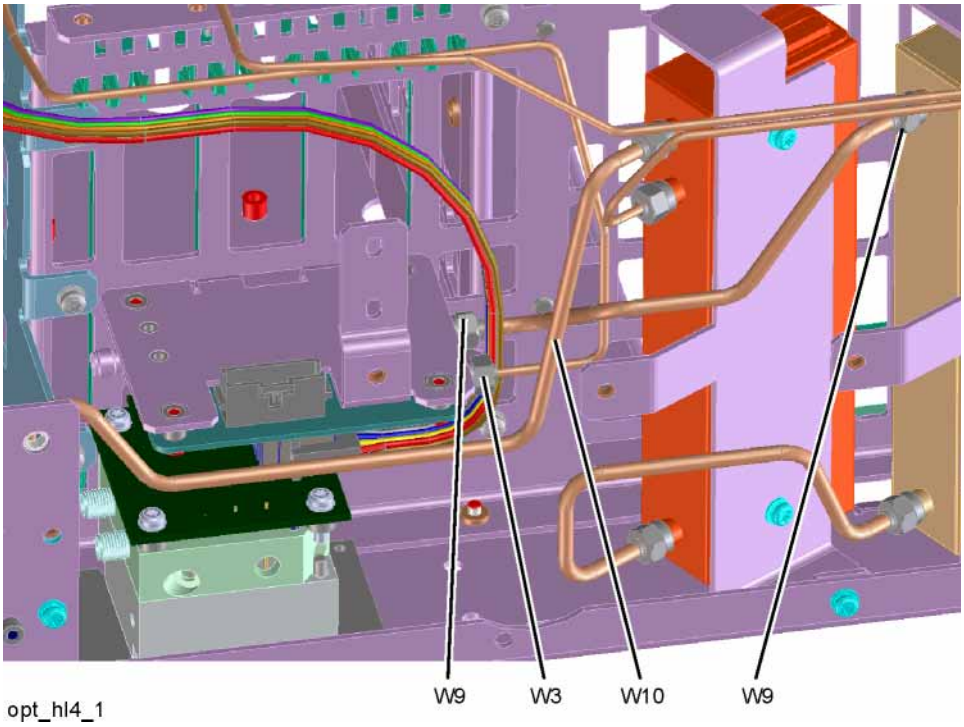
7. Refer to Figure 15-17. Using the T-8 driver, remove the two 0515-1992 screws **(3)** to separate the #1 switch/bracket assembly **(1)/(2)** from the low band switch bracket **(4)**.

Figure 15-17 Switch 1 Removal



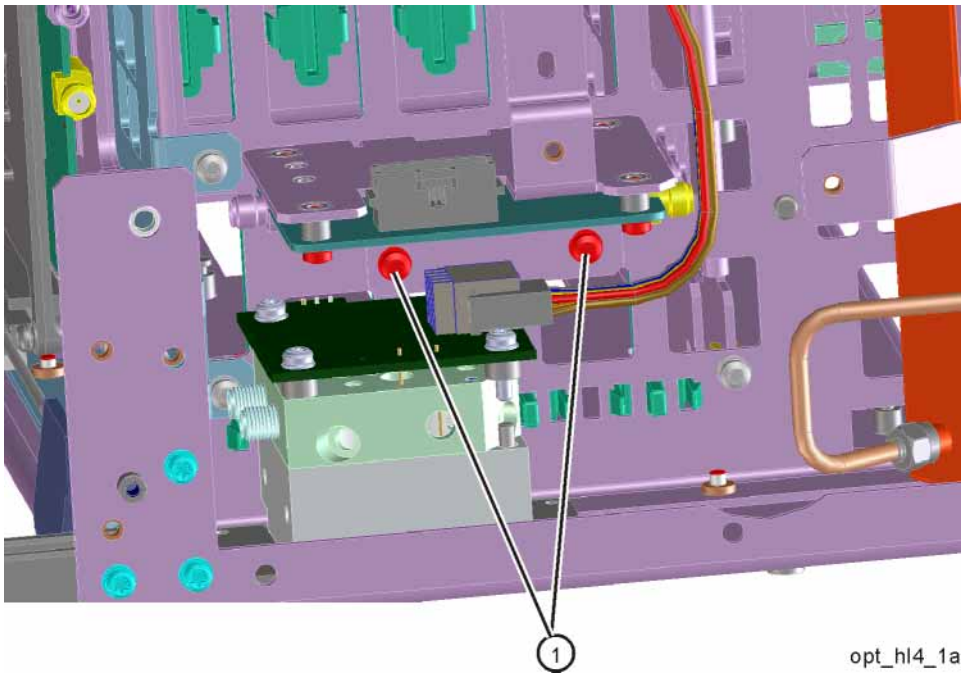
8. Refer to Figure 15-18. Remove the semi-rigid cables W3, W9, and W10.

Figure 15-18 Removing Coax Cables



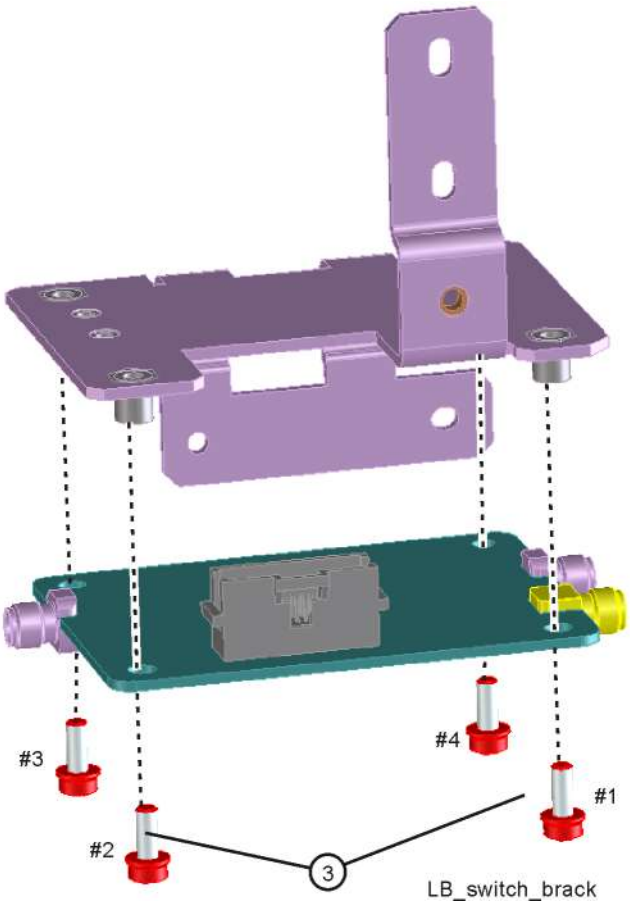
9. Refer to Figure 15-19. Using the T-10 driver, remove the two screws **(1)** to separate the low band switch/bracket from the chassis.

Figure 15-19 Low Band Switch/Bracket Removal



10. Refer to Figure 15-20. To separate the low band switch from the bracket, use the T-10 driver to remove the four screws **(3)**.

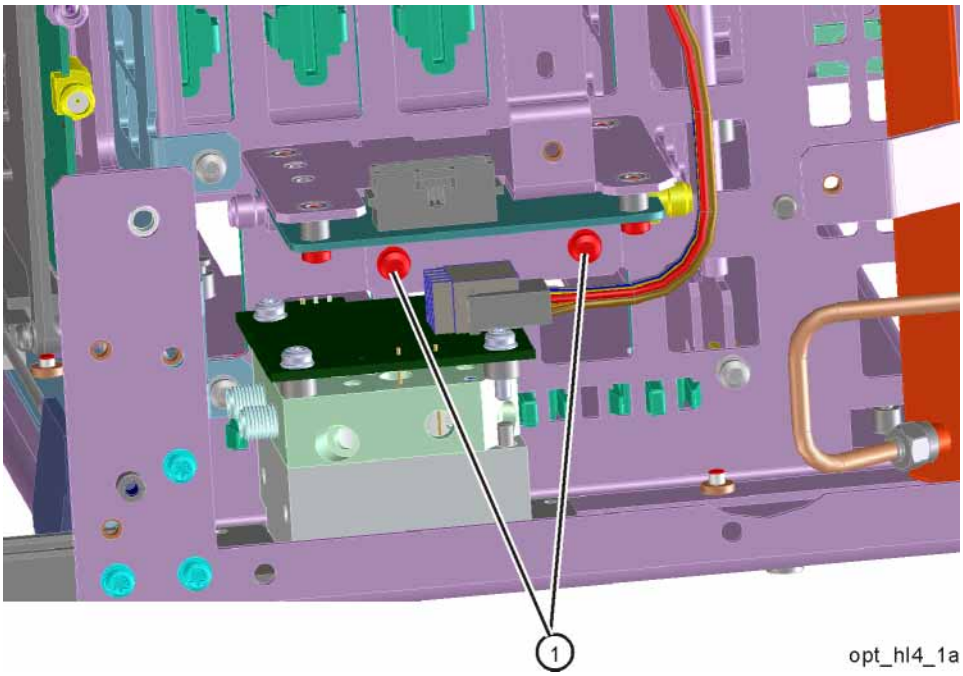
Figure 15-20 Low Band Switch and Bracket Separation



Replacement

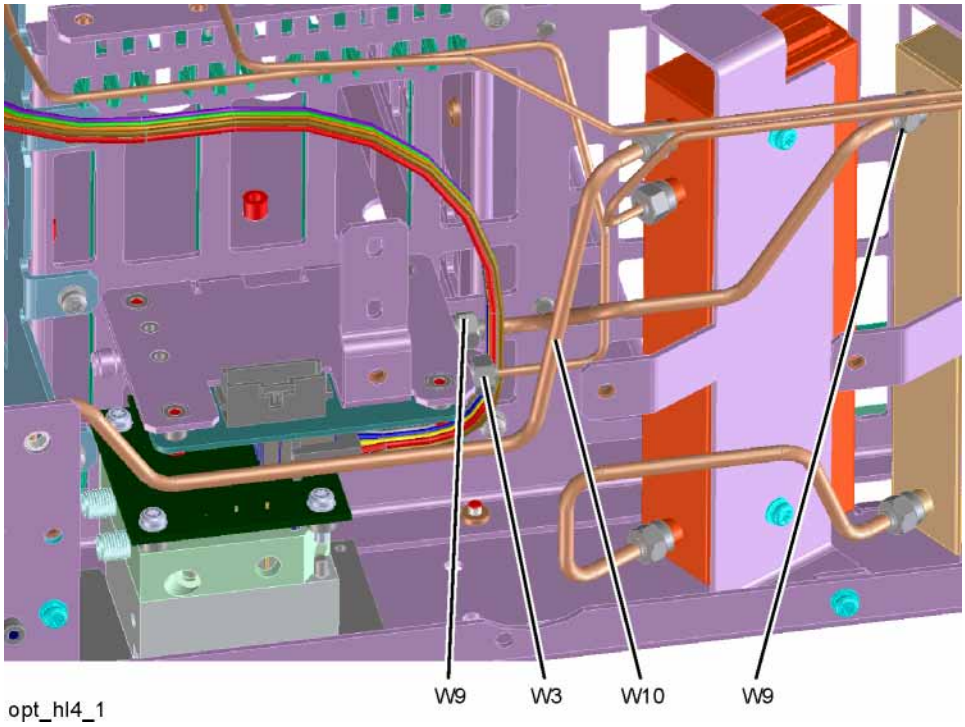
1. Refer to Figure 15-21. Place the switch onto the low band switch bracket and replace the four screws **(3)**. Torque to 9 inch-pounds in the sequence shown, starting with #1.
2. Refer to Figure 15-21. Place the switch/bracket into place onto the chassis and replace the two screws. Torque to 9 inch-pounds starting with the screw closest to the front of the instrument.

Figure 15-21 Bracket Installation



3. Refer to Figure 15-22. Install W9 between the output of the A10 Input Attenuator and A11J1. Torque to 10 inch-pounds.

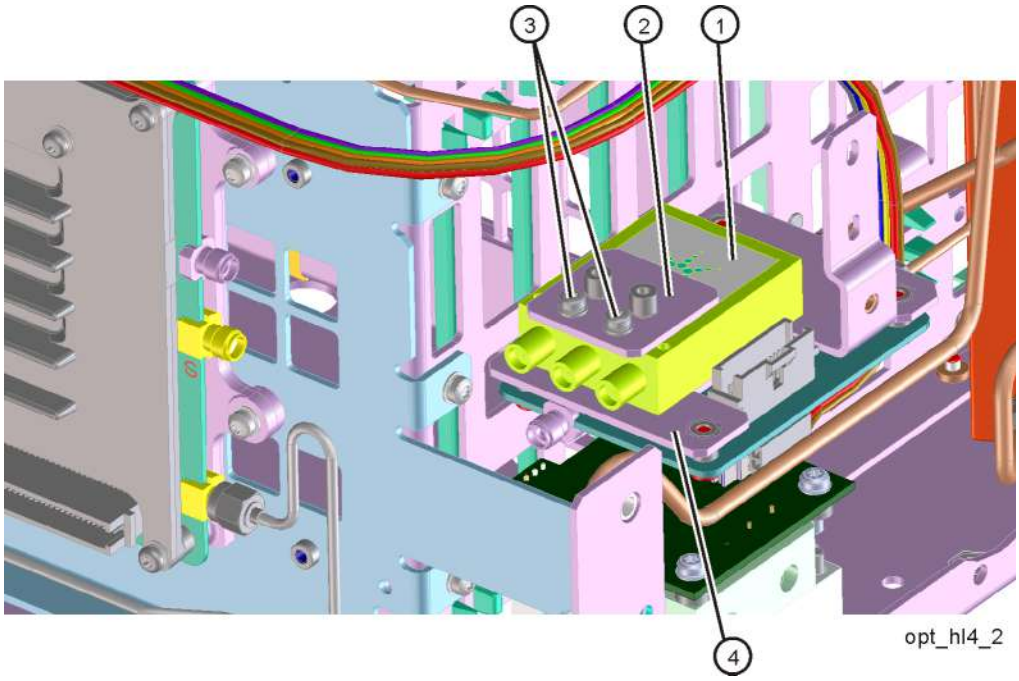
Figure 15-22 Installing Coax Cables



4. Install W3 between J2 of the A13 Front End Assembly and J2 of the A11 Low Band Switch. Torque to 10 inch-pounds.
5. Install W10 between the Type N input connector and the input of the A9 Input Attenuator. Torque to 10 inch-pounds.

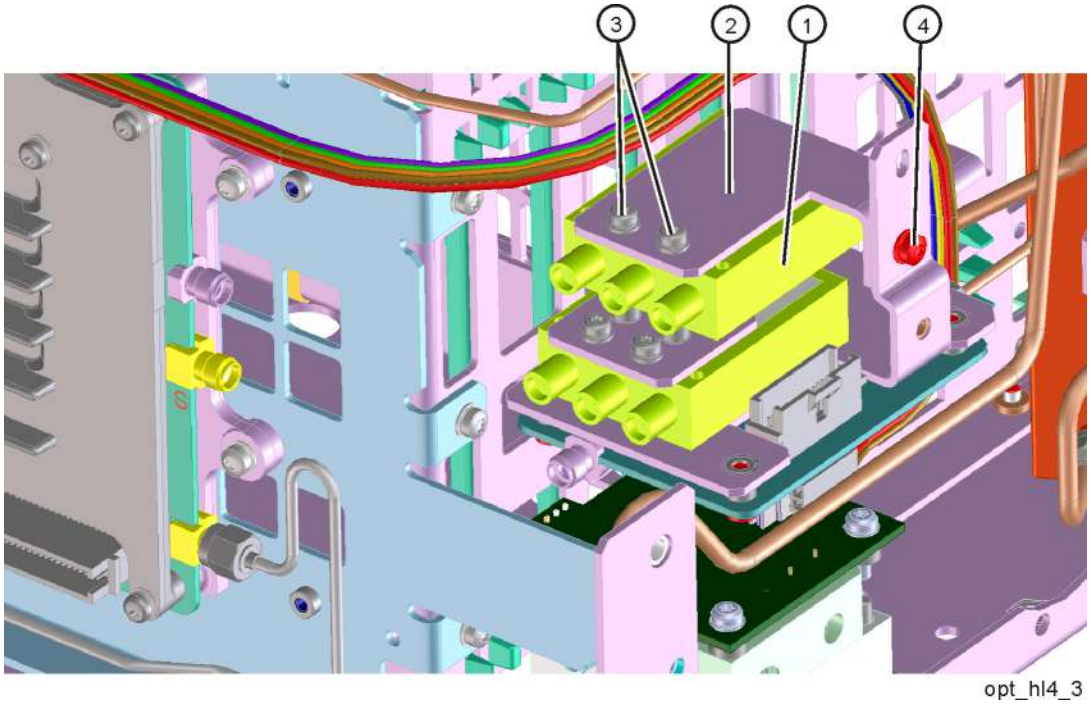
6. Refer to Figure 15-23. Place one of the two coaxial switches **(1)** and the Switch 1 Bracket **(2)** onto the low band switch bracket. Mount the switch with the Keysight label facing up. Attach the bracket and switch to the low band switch bracket using two 0515-1992 screws **(3)** using the T-8 driver. Do not torque the screws at this time

Figure 15-23 Switch 1 Placement



7. Refer to Figure 15-24. Place the second switch/bracket assembly **(1)/(2)** on the bracket previously installed. Assure Keysight label on switch is facing up. Attach the bracket and switch using two 0515-1992 screws **(3)** using the T-8 driver. Secure the bracket to the low band switch bracket with a single screw **(4)** using the T-10 driver. Do not torque.

Figure 15-24 Switch 2 Placement



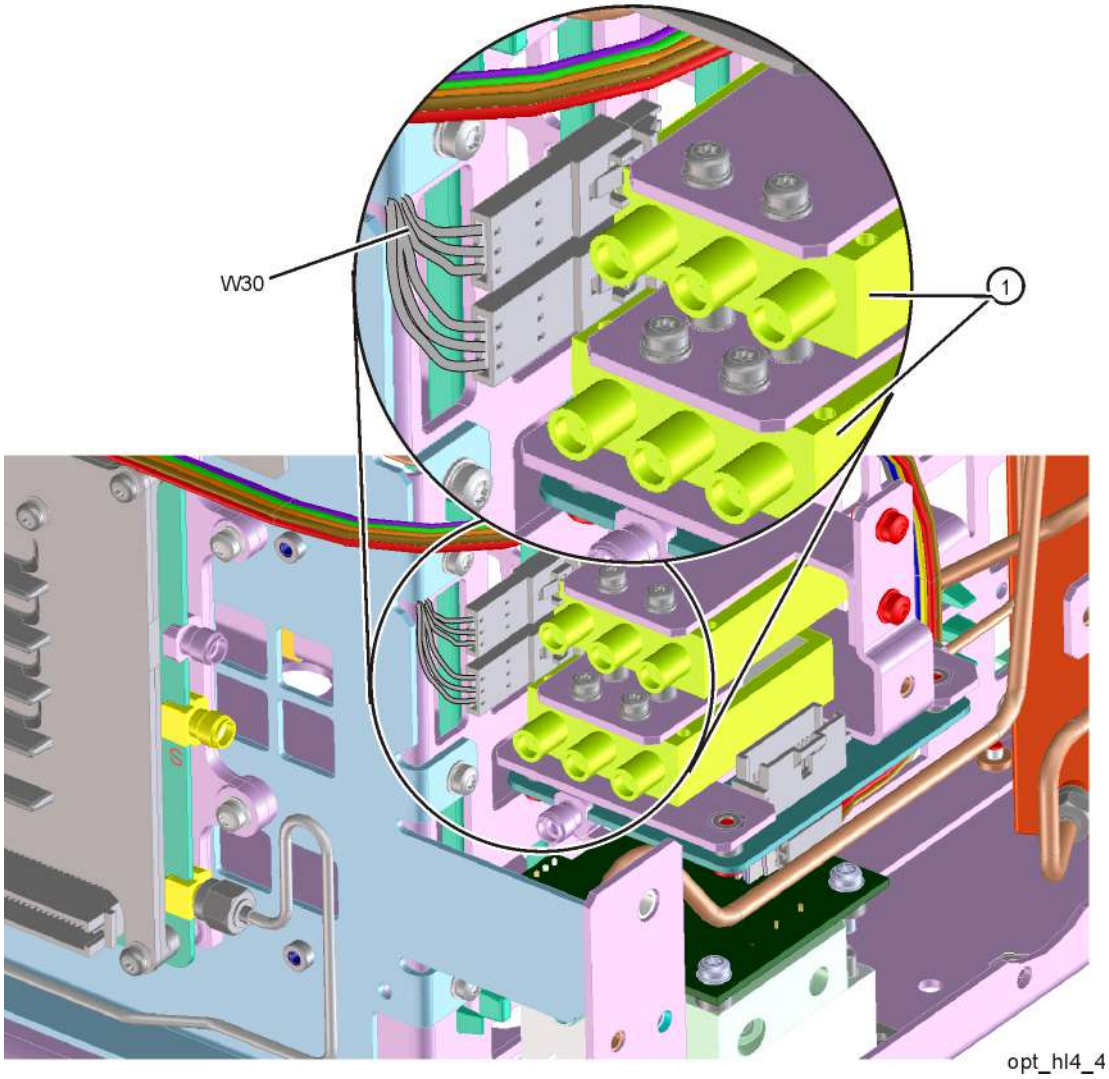
8. Align switches so they are parallel with the side of the instrument then torque the four screws **(3)** securing the switches to the brackets to 6 inch-pounds using the T-8 driver. Torque the screw **(4)** that secures the switch brackets together to 9 inch-pounds using the T-10 driver.

9. Refer to Figure 15-25. Connect the two wire harness connectors W30 to the switches **(1)**. Once connected, position the connections along side the switches.

NOTE

Even though the wire colors on W30 harness are different, it does not matter which one plugs into which switch.

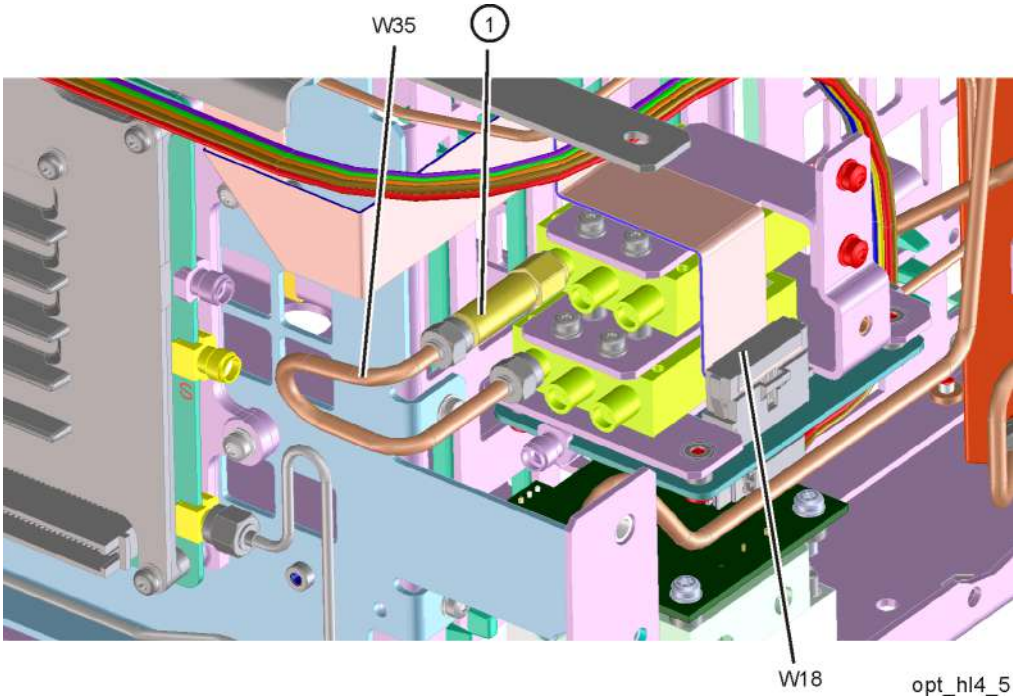
Figure 15-25 Wire Harness Routing



10. Refer to Figure 15-26. Connect ribbon cable W18 to J4 of the A11 Low Band Switch.

11. Attach the coaxial fixed attenuator **(1)** Switch 2 port 1. Torque to 10 inch-lbs.

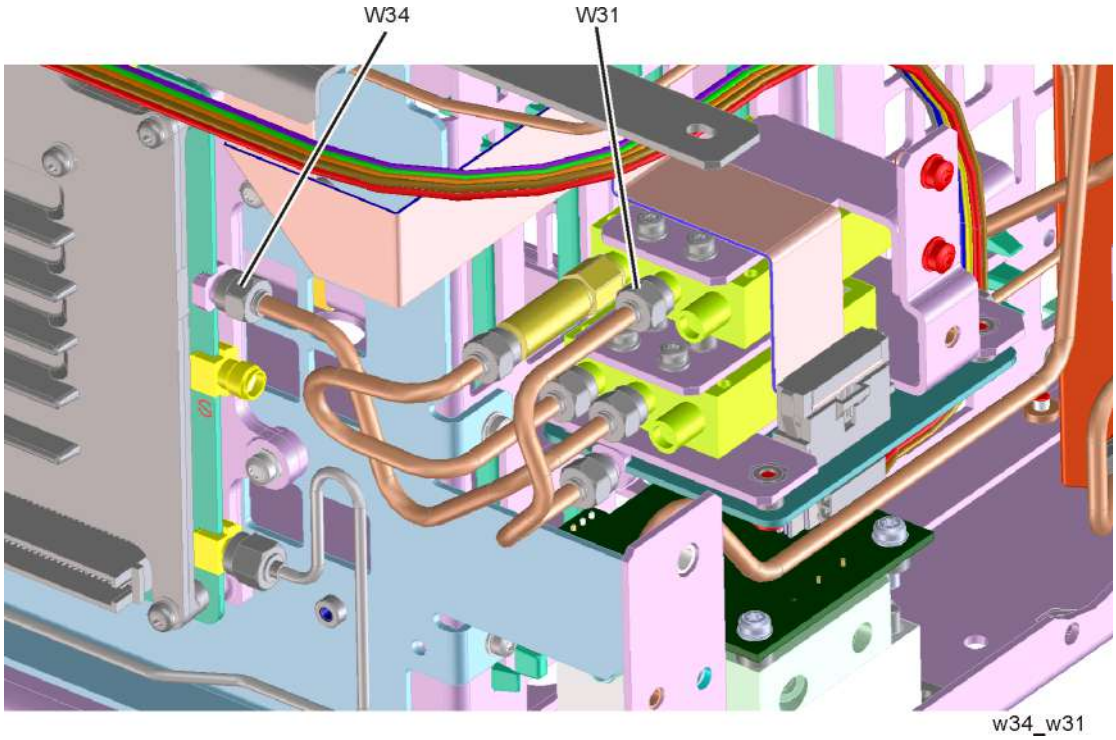
Figure 15-26 Attenuator Installation



12. Connect W35 semi-rigid coax cable between the coaxial fixed attenuator **(1)** and port 1 of Switch 1 (the lower switch). Torque to 10 inch-pounds.

13. Refer to Figure 15-27. Connect W34 semi-rigid coax cable between the center port of Switch 1 (the lower switch) and J9 of the A13 Front End Assembly. Torque to 10 inch-pounds.
14. Connect W31 semi-rigid coax cable between the center port of Switch 2 (the upper switch) and J3 of the A11 Low Band Switch. Torque to 10 inch-pounds.

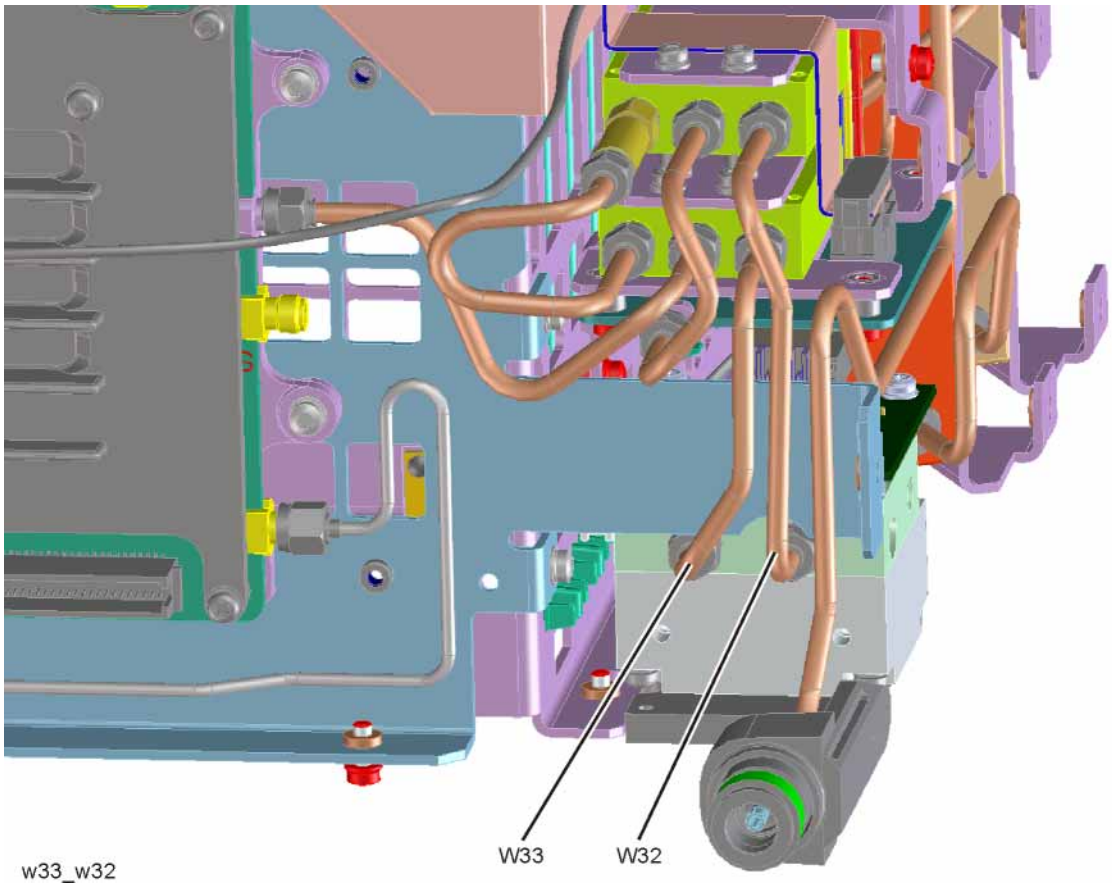
Figure 15-27 Install W34 and W31



15. Refer to Figure 15-28. Connect W33 semi-rigid coax cable between port 2 of Switch 1 (the lower switch) and the output of the A12 YTF Preselector. Torque the cable at the A12 end first to 10 inch-pounds and then torque the cable at the Switch 1 end to 10 inch-pounds.

16. Connect W32 semi-rigid coax cable between port 2 of Switch 2 (the upper switch) and the input of the A12 YTF Preselector. Torque the cable at the A12 end first to 10 inch-pounds and then torque the cable at the Switch 2 end to 10 inch-pounds.

Figure 15-28 Install W33 and W32

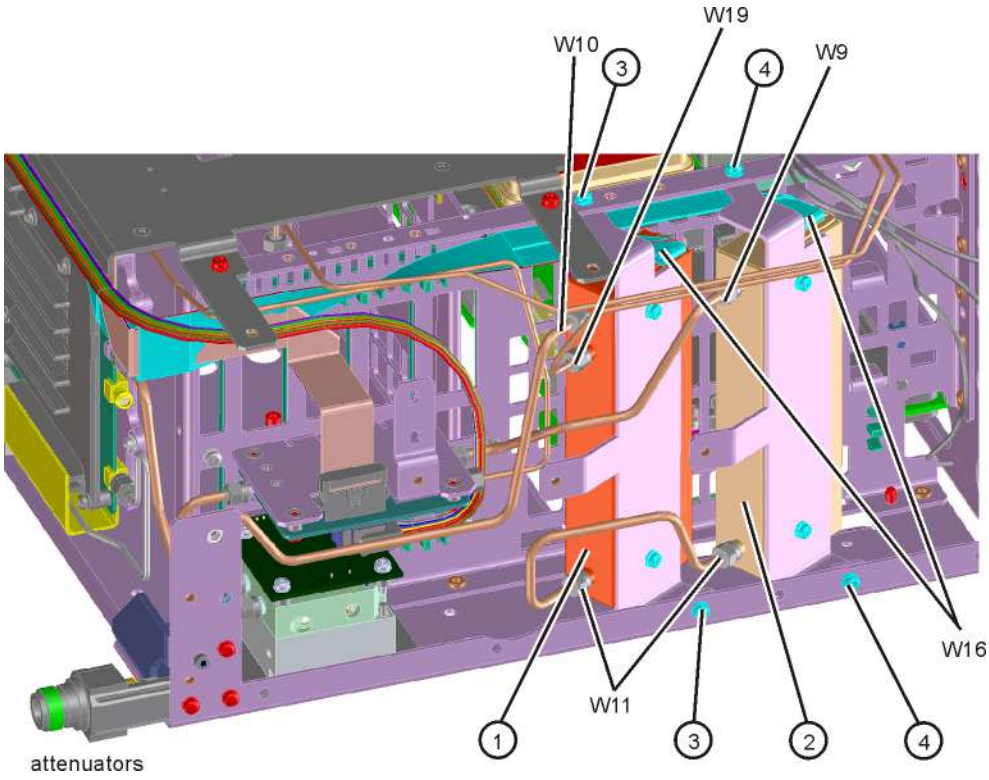


Attenuators

Removal

1. Refer to Figure 15-29. To remove Attenuator A **(1)** or Attenuator B **(2)**, remove the semi-rigid cables W9, W10, W11 and W19 attached to the attenuator using the 5/16 inch wrench.
2. Remove the W16 ribbon cable attached to the attenuator.
3. Remove the two screws **(3)** or **(4)** for each attenuator bracket to remove from the chassis using the T-10 driver.
4. Remove the two screws to separate the attenuator from the bracket.

Figure 15-29 Attenuators Removal



Replacement

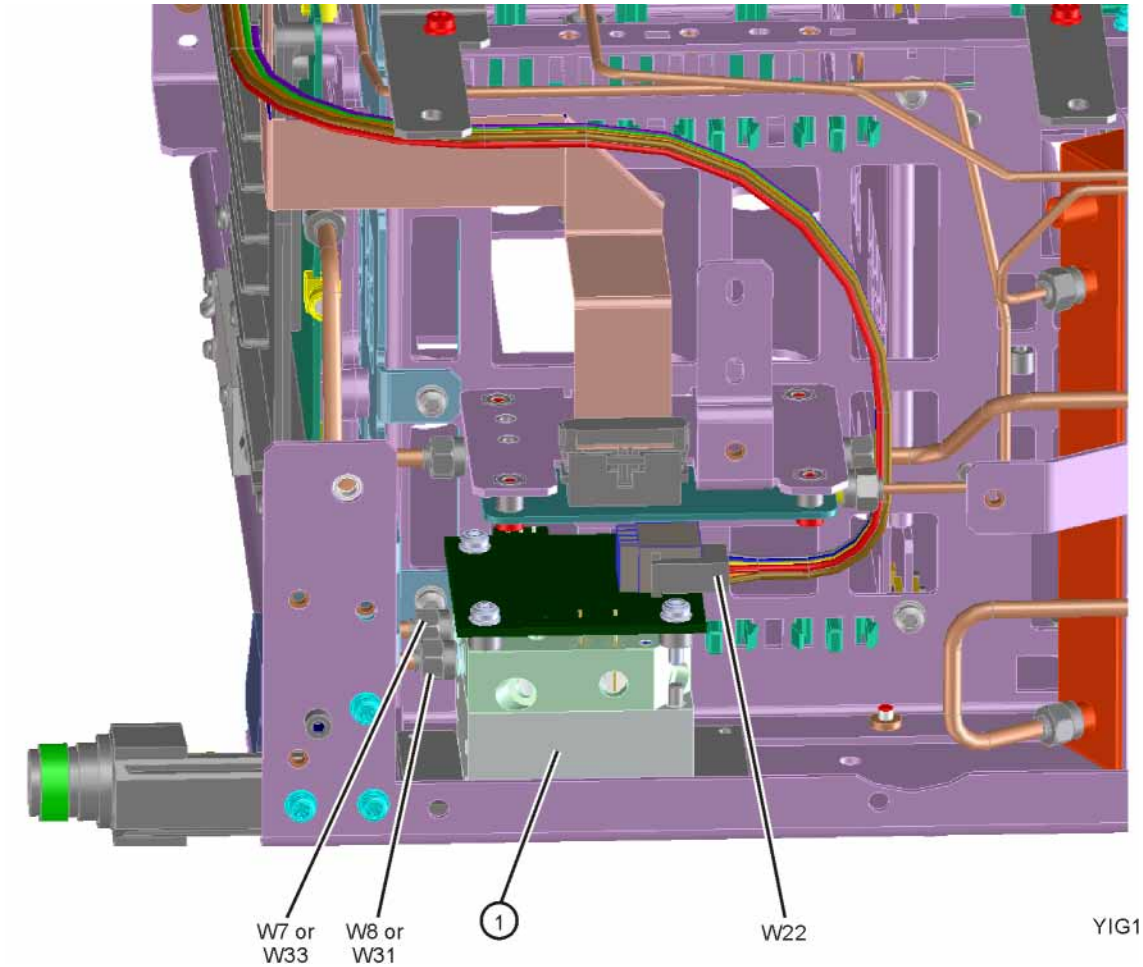
1. Refer to Figure 15-29. Position the attenuator in the bracket so that the ribbon connector end is “up”.
2. Replace the two screws that attach the attenuator to the bracket. Torque to 9 inch-pounds.
3. Position the attenuator and bracket into the chassis and attach with the two screws. Torque to 9 inch-pounds.
4. Replace the ribbon cable and semi-rigid cables W9, W10, W11 and W19 to the attenuator. Torque the semi-rigid cables to 10 inch-pounds.

YTF Preselector

Removal

1. Refer to Figure 15-30. Remove cables W7 and W8 from the YTF Preselector **(1)**.

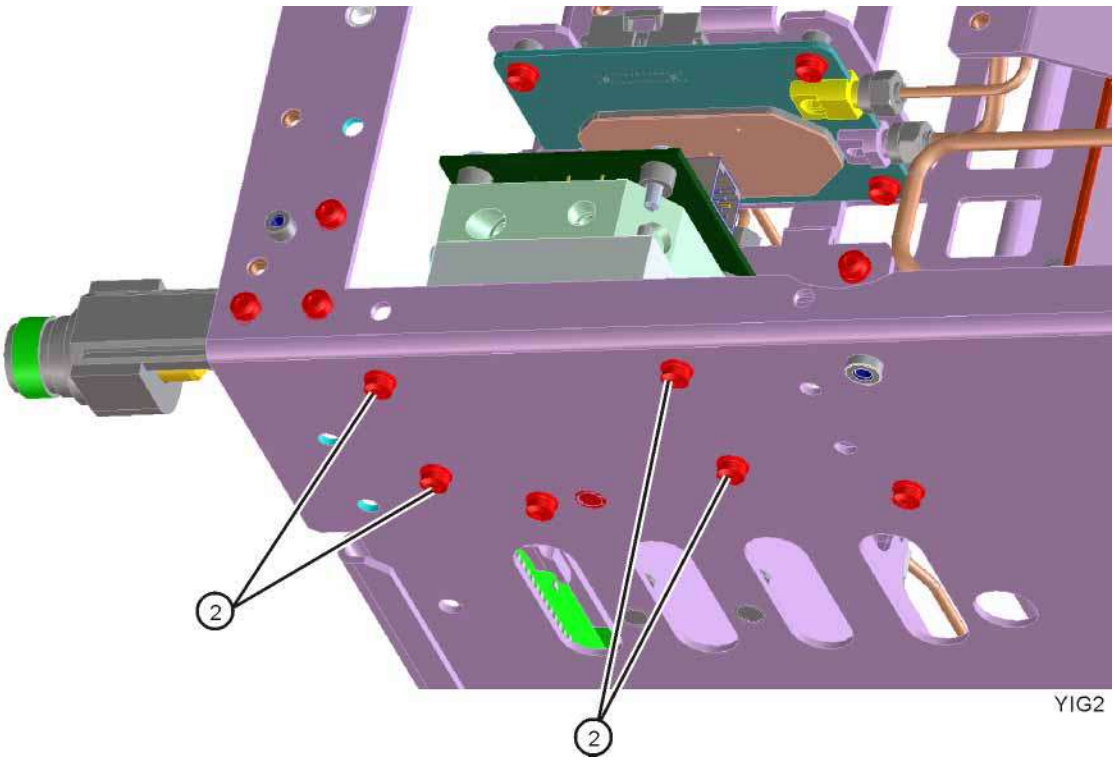
Figure 15-30 YTF Preselector Removal



2. Remove the wire harness W22.

3. Refer to Figure 15-31. From the bottom of the instrument, remove the four screws **(2)**. The YTF Preselector can now be removed from the chassis.

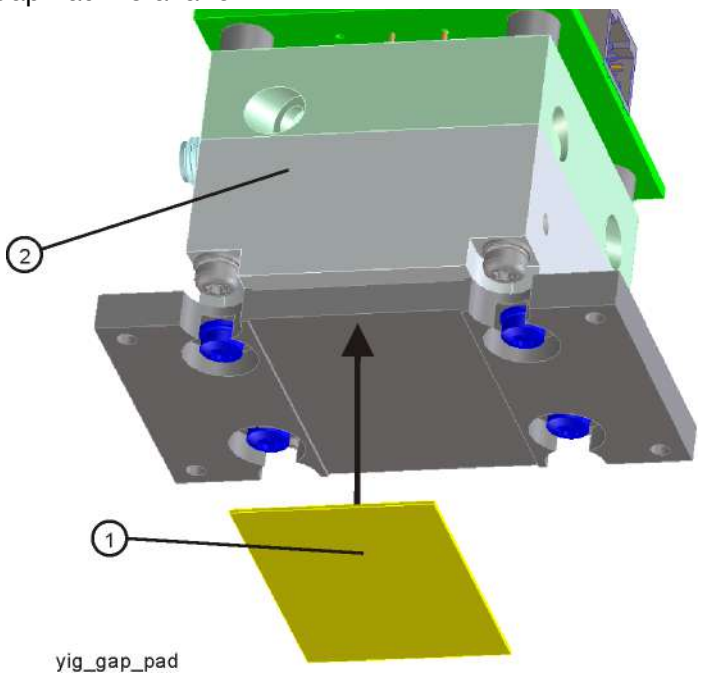
Figure 15-31 YTF Preselector Screws



Replacement

1. Inspect the chassis where the YTF Preselector mounts and remove the gap pad if present (see Figure 15-32, item **(1)**). The gap pad may remain attached to the faulty YTF Preselector.
2. Refer to Figure 15-32. Install the replacement gap pad **(1)** into the recess in the base of the replacement YTF Preselector **(2)** Refer to A11 in Chapter 14, "Replaceable Parts." for the gap pad part number. Peel back one corner of the clear plastic backing on the pink side of the gap pad. Remove the blue backing from the other side of the gap pad. Install the gap pad as shown with the pink side exposed. Carefully peel off the clear plastic backing and smooth the gap pad into the recess.

Figure 15-32 Gap Pad Installation



3. Refer to Figure 15-31. Place the YTF Preselector into the chassis with the connectors toward the front of the instrument. Replace the four screws **(2)**. Torque to 9 inch-pounds.
4. Figure 15-30. Replace the cables W7 and W8. Torque to 10 inch-pounds.
5. Replace the wire harness W22.
6. Refer to Figure 15-9. Position the chassis side, right onto the chassis and replace the thirteen screws. Torque to 9 inch-pounds.
7. Replace the front panel. Refer to the "Front Frame Assembly" replacement procedure.
8. Replace the top brace. Refer to the "Top Brace" replacement procedure.
9. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

RF Area (Option 532, 544, 550)

Refer to Figure 15-33 and Figure 15-34. The RF area consists of RF attenuator A **(1)**, RF attenuator B **(2)**, low band switch assembly **(3)**, and YTF Preselector **(4)**.

Instruments with Options DP2, MPB, or B40 will also have coaxial switch **(6)**, (Figure 15-34).

Figure 15-33 RF Area Components and Cables - Option 532, 544, 550

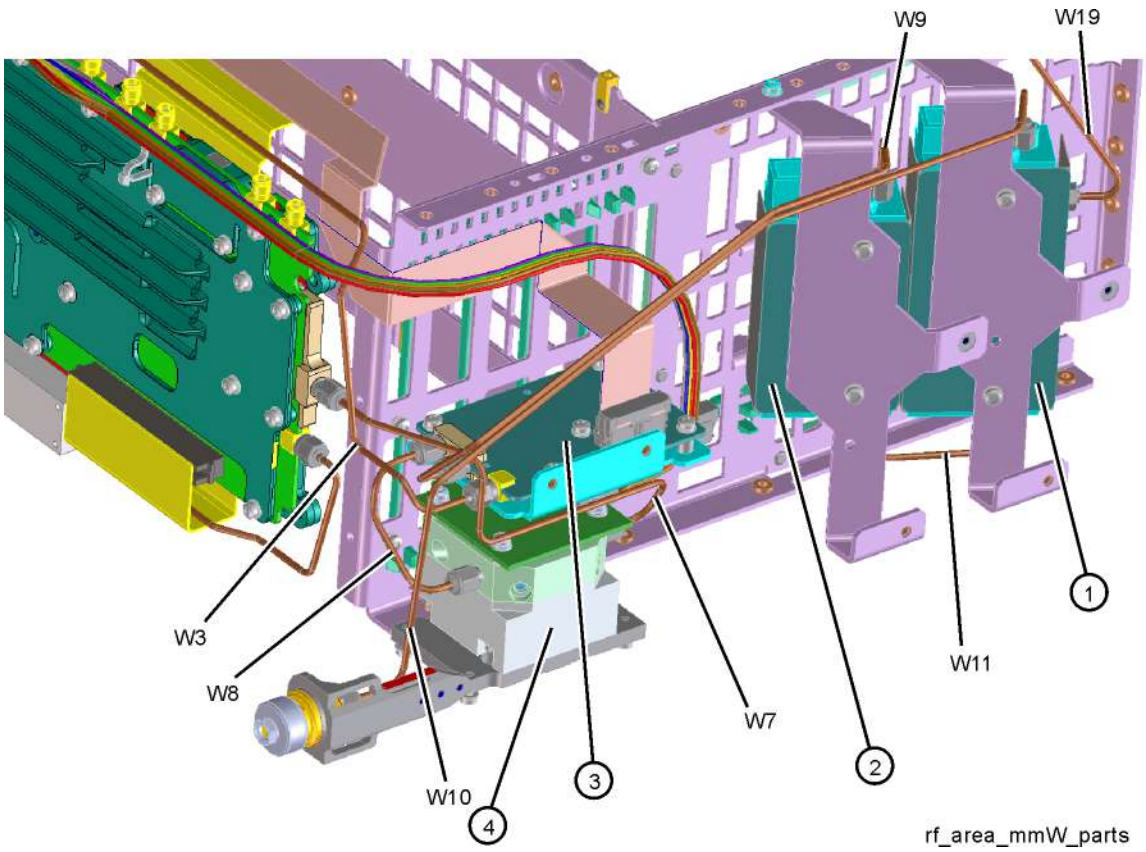
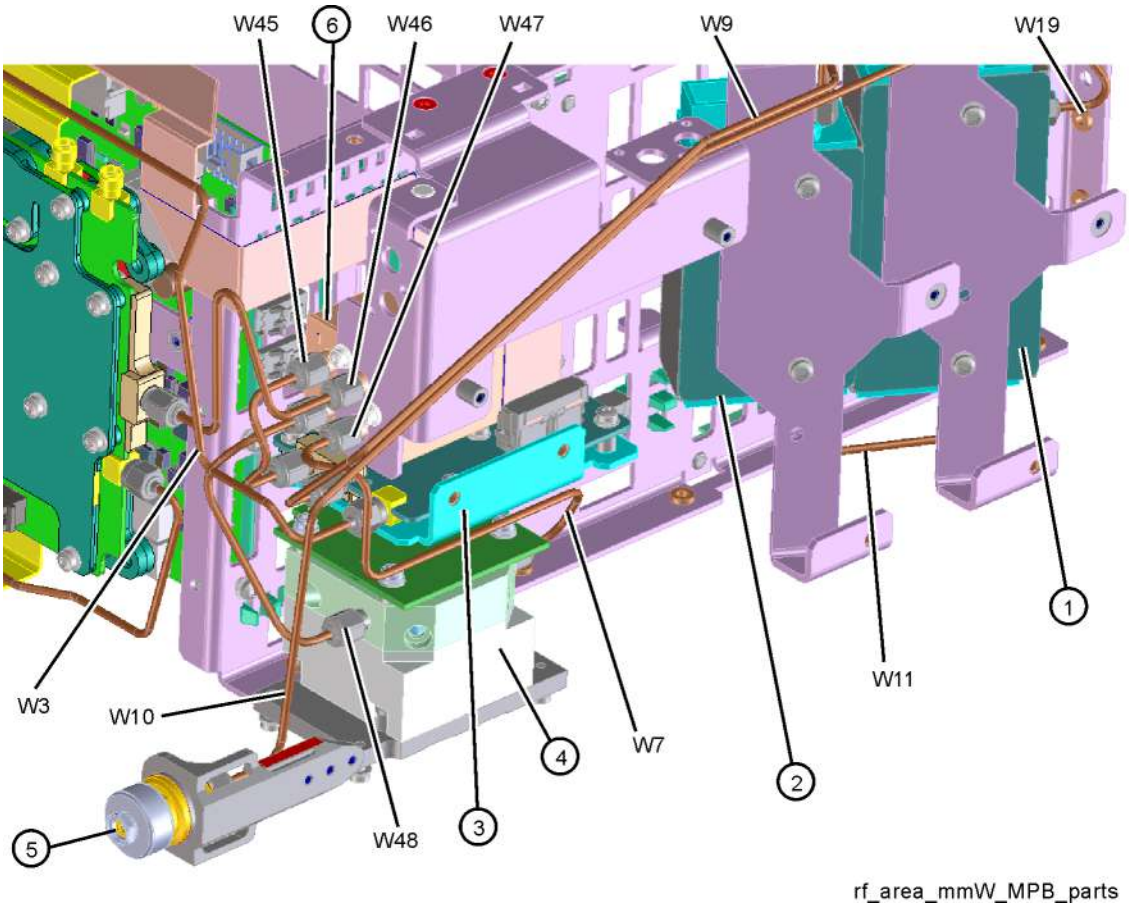


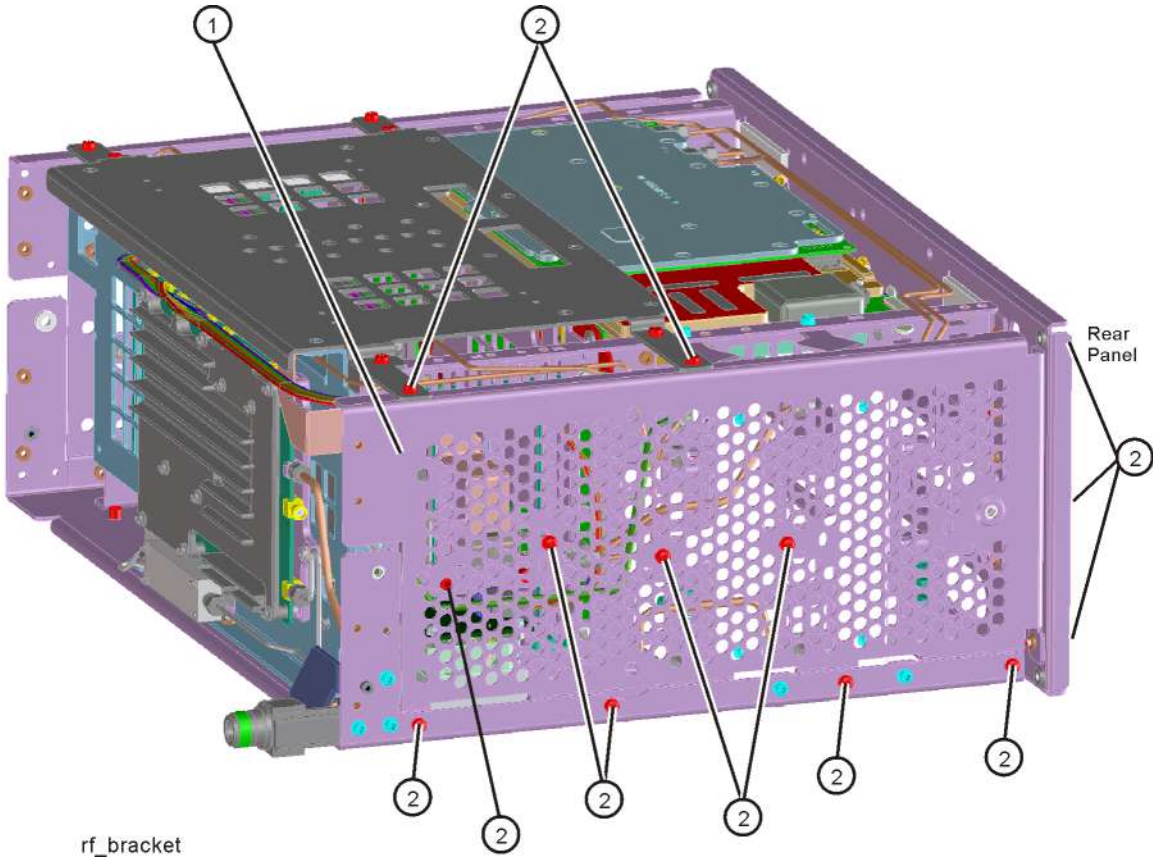
Figure 15-34 RF Area Components and Cables - Option 532, 544, 550 with Option DP2, MPB, B40



To gain access to any of these parts, follow these steps:

10. Remove the instrument outer case. Refer to the Instrument Outer Case removal procedure.
11. Remove the top brace. Refer to the Front Frame Assembly removal procedure.
12. Remove the front panel. Refer to the Front Frame Assembly removal procedure.
13. Refer to Figure 15-35. Remove the chassis side, right **(1)** by removing the thirteen screws **(2)** using the T-10 driver.

Figure 15-35 RF Bracket Removal

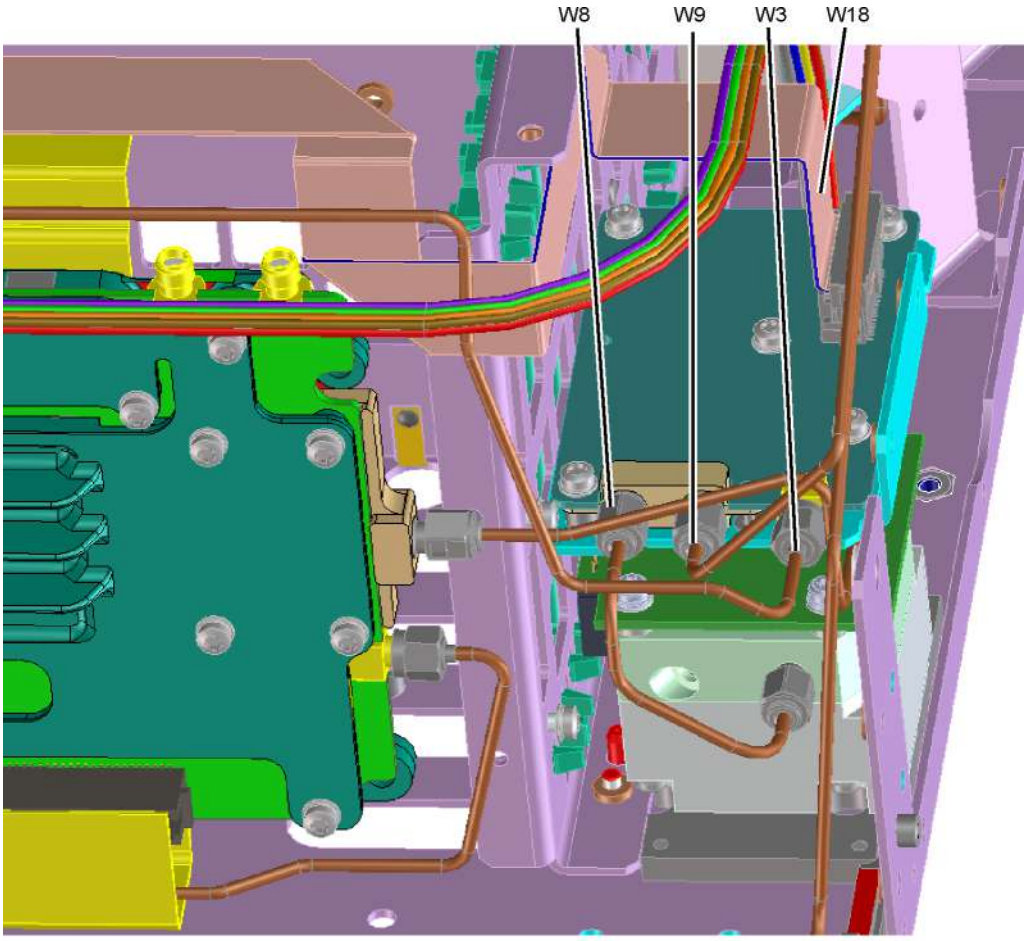


Low Band Switch

Removal

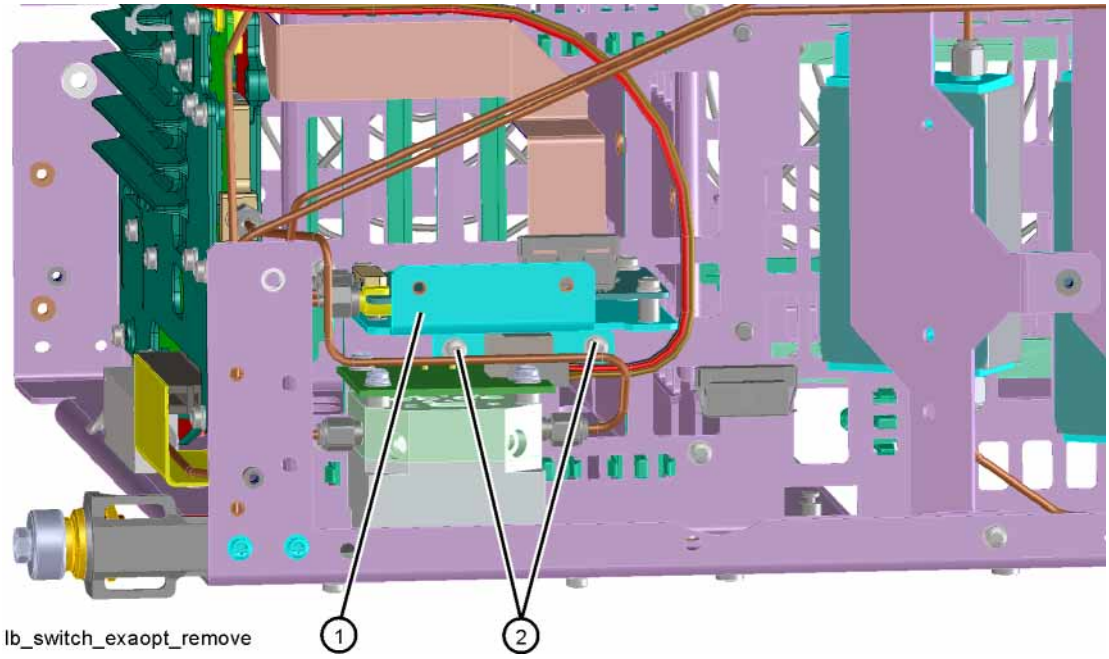
1. Refer to Figure 15-36 and Figure 15-37. Remove the ribbon cable W18.
2. Remove the semi-rigid cables W3, W8, and W9 using the 5/16 inch wrench.
3. Remove the two screws **(2)** using the T-10 driver. The low band switch and bracket **(1)** can now be removed from the chassis.

Figure 15-36 Low Band Switch Cable Removal



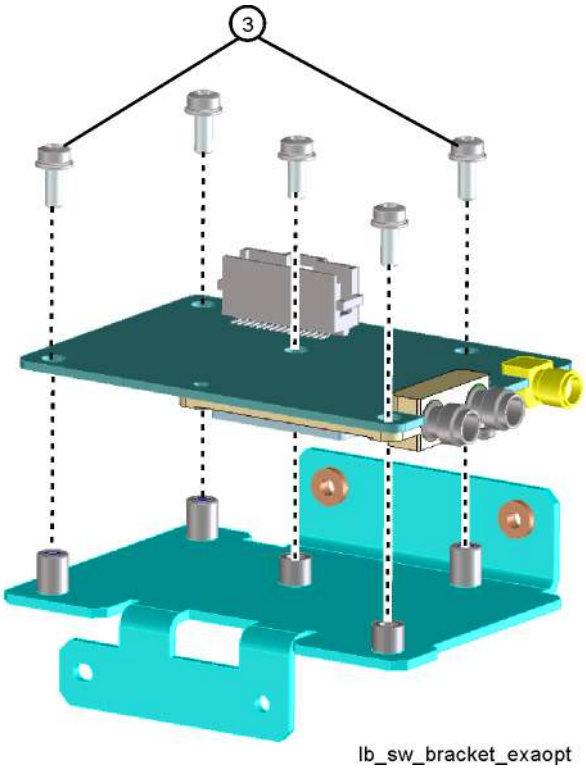
lb_switch_exaopt

Figure 15-37 Low Band Switch Removal



4. Refer to Figure 15-38. To separate the switch from the bracket, remove the five screws **(3)** using the T-10 driver.

Figure 15-38 Low Band Switch and Bracket Separation



Replacement

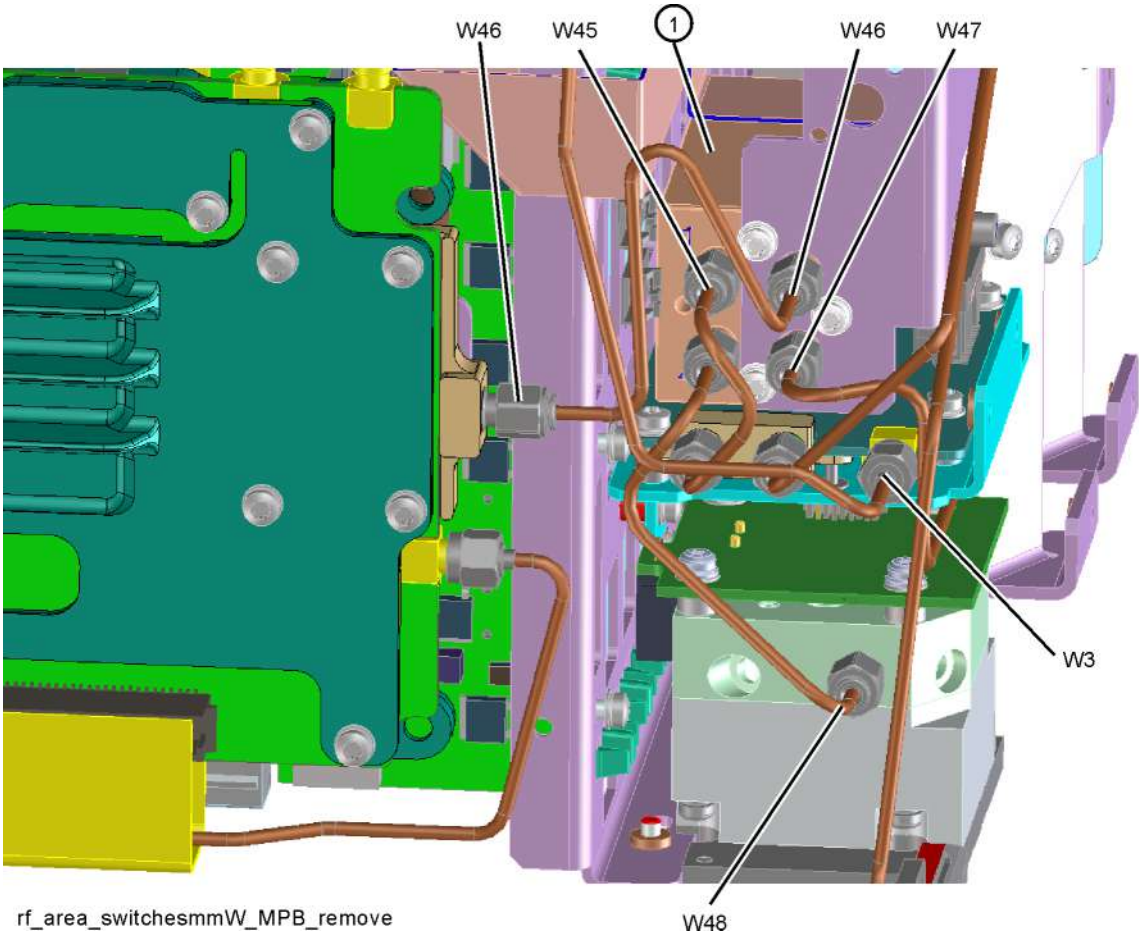
1. Refer to Figure 15-38. Place the switch onto the bracket and replace the five screws **(3)**. Torque to 9 inch-pounds.
2. Place the switch/bracket into place into the chassis and replace the two screws. Torque to 9 inch-pounds starting with the screw closest to the front of the instrument.
3. Refer to Figure 15-36. Replace the semi-rigid cables W3, W8, and W9. Torque to 10 inch-pounds.
4. Replace the ribbon cable W18.
5. Refer to Figure 15-35. Position the chassis side, right onto the chassis and replace the thirteen screws. Torque to 9 inch-pounds.
6. Replace the front panel. Refer to the Front Frame Assembly replacement procedure.
7. Replace the top brace. Refer to the Top Brace replacement procedure.
8. Replace the instrument outer case. Refer to the Instrument Outer Case replacement procedure.

Low Band Switch and Coaxial Switch Options DP2, MPB, B40

Removal

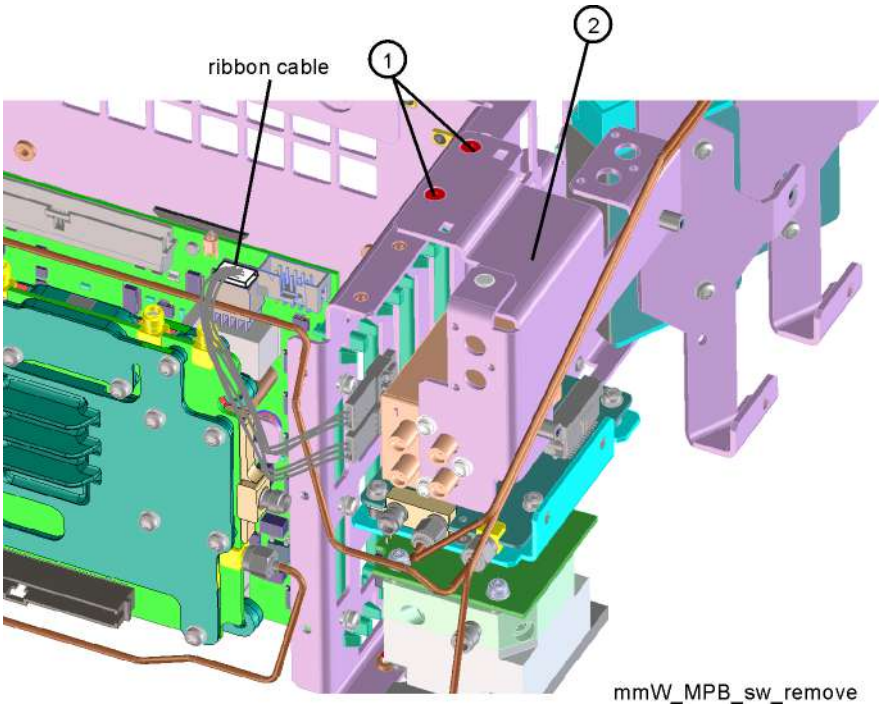
1. Refer to Figure 15-39. Remove semi-rigid coax cables W3, W45, W46, W47, and W48.

Figure 15-39 Remove Semi-Rigid Cables



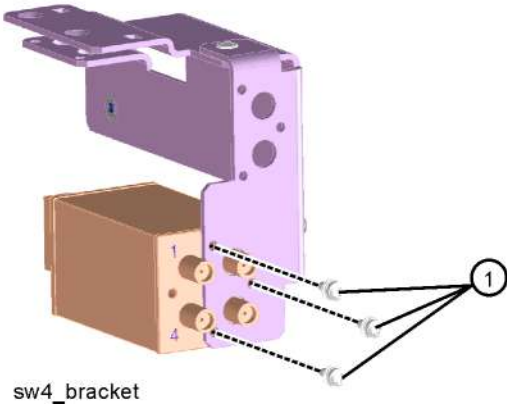
2. Refer to Figure 15-40. Unplug the ribbon cable from the A15 Front End Control assembly.

Figure 15-40 Remove SW4



3. Remove the two screws **(1)** that attach the bracket to the chassis. The bracket/switch **(2)** can now be removed.
4. Refer to Figure 15-41. Remove the three screws **(1)** to separate the switch from the bracket assembly.

Figure 15-41 Switch / Bracket Separation



Replacement

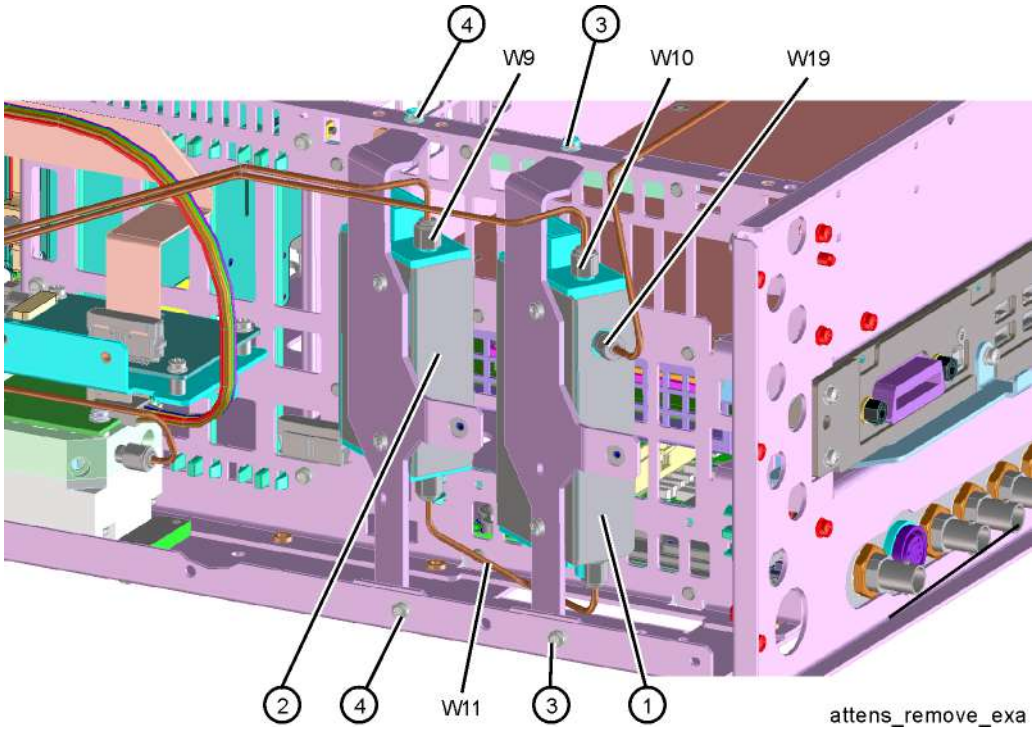
1. Refer to Figure 15-41. Place the switch onto the bracket and replace the three screws **(1)**. Torque to 6 inch-pounds.
2. Refer to Figure 15-40. Place the switch/bracket into place onto the chassis and replace the two screws. Torque to 9 inch-pounds.
3. Plug in the ribbon cable into the A15 Front End Control assembly.
4. Refer to Figure 15-39. Install W3, W45, W46, W47, and W48. Torque to 10 inch-pounds.

Attenuators

Removal

1. Refer to Figure 15-42. To remove Attenuator A **(1)** or Attenuator B **(2)**, remove the semi-rigid cables W9, W10, W11 and W19 attached to the attenuator using the 5/16 inch wrench.
2. Remove the W16 ribbon cable attached to the attenuator.
3. Remove the two screws **(3)** or **(4)** for each attenuator bracket to remove from the chassis using the T-10 driver.
4. Remove the two screws to separate the attenuator from the bracket.

Figure 15-42 Attenuators Removal



Replacement

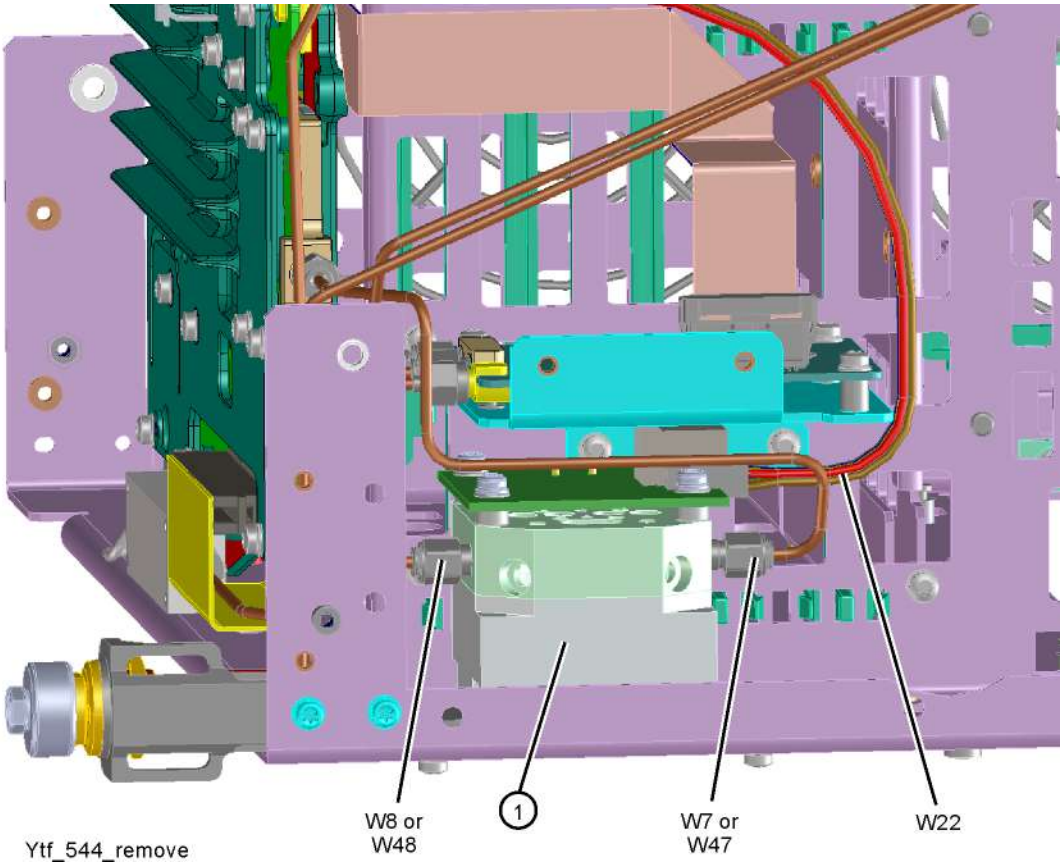
1. Refer to Figure 15-42. Position the attenuator in the bracket so that the ribbon connector end is “up”.
2. Replace the two screws that attach the attenuator to the bracket. Torque to 9 inch-pounds.
3. Position the attenuator and bracket into the chassis and attach with the two screws. Torque to 9 inch-pounds.
4. Replace the ribbon cable and semi-rigid cables W9, W10, W11 and W19 to the attenuator. Torque the semi-rigid cables to 10 inch-pounds.

YTF Preselector

Removal

1. Refer to Figure 15-43. Remove cables W7 and W8 (or W47 and W48 if Option MPB is installed) from the YTF Preselector **(1)**.

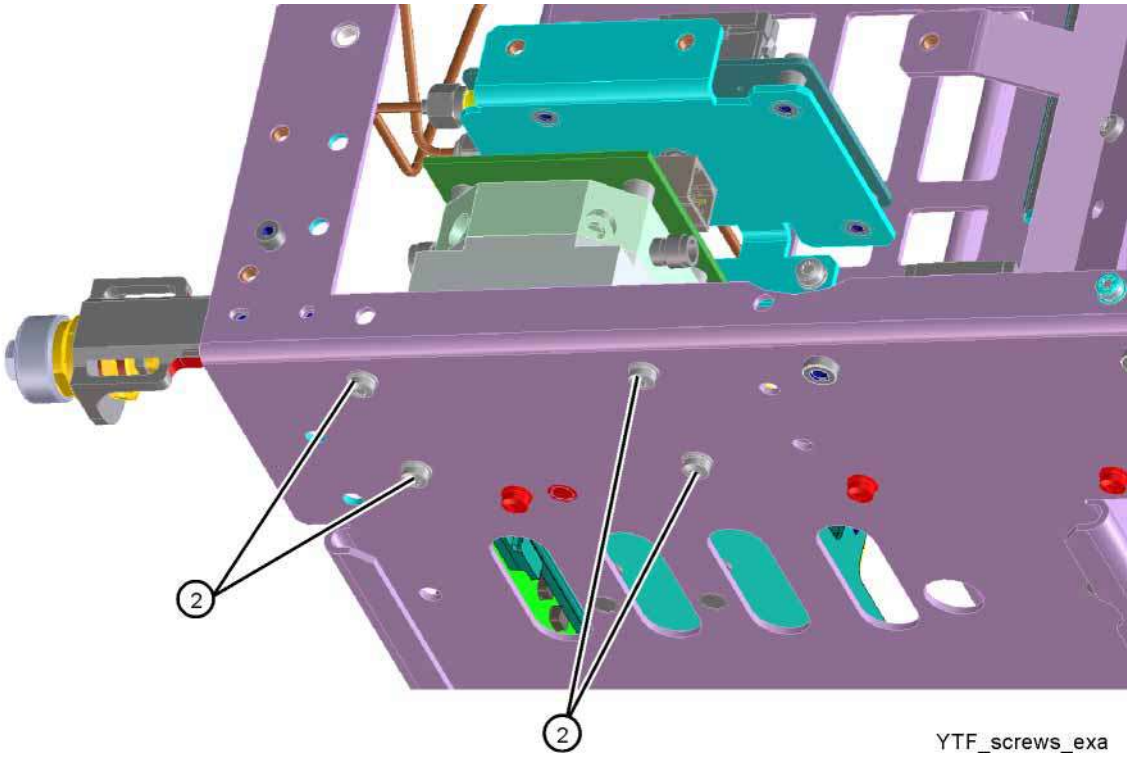
Figure 15-43 YTF Preselector Removal



2. Remove the wire harness W22.

3. Refer to Figure 15-44. From the bottom of the instrument, remove the four screws **(2)**. The YTF Preselector can now be removed from the chassis.

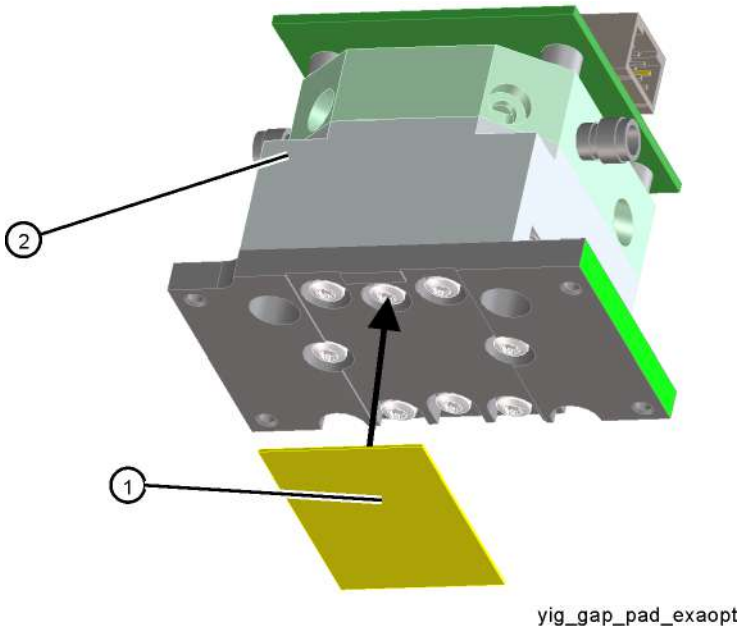
Figure 15-44 YTF Preselector Screws



Replacement

1. Inspect the chassis where the YTF Preselector mounts and remove the gap pad if present (see Figure 15-45, item **(1)**). The gap pad may remain attached to the faulty YTF Preselector.

Figure 15-45 Gap Pad Installation



Refer to Figure 15-45. Install the replacement gap pad **(1)** into the recess in the base of the replacement YTF Preselector **(2)** Refer to A12MP1 in Chapter 14, "Replaceable Parts." for the gap pad part number. Peel back one corner of the clear plastic backing on the pink side of the gap pad. Remove the blue backing from the other side of the gap pad. Install the gap pad as shown with the pink side exposed. Carefully peel off the clear plastic backing and smooth the gap pad into the recess.

2. Refer to Figure 15-44. Place the YTF Preselector into the chassis with the connectors toward the front of the instrument. Replace the four screws **(2)**. Torque to 9 inch-pounds.
3. Figure 15-43. Replace the cables W7 and W8 (or W47 and W48). Torque to 10 inch-pounds.
4. Replace the wire harness W22.
5. Refer to Figure 15-35. Position the chassis side, right onto the chassis and replace the thirteen screws. Torque to 9 inch-pounds.
6. Replace the front panel. Refer to the Front Frame Assembly replacement procedure.
7. Replace the top brace. Refer to the Top Brace replacement procedure.
8. Replace the instrument outer case. Refer to the Instrument Outer Case replacement procedure.

RF Front End Assembly (Option 503, 508, 513, 526)

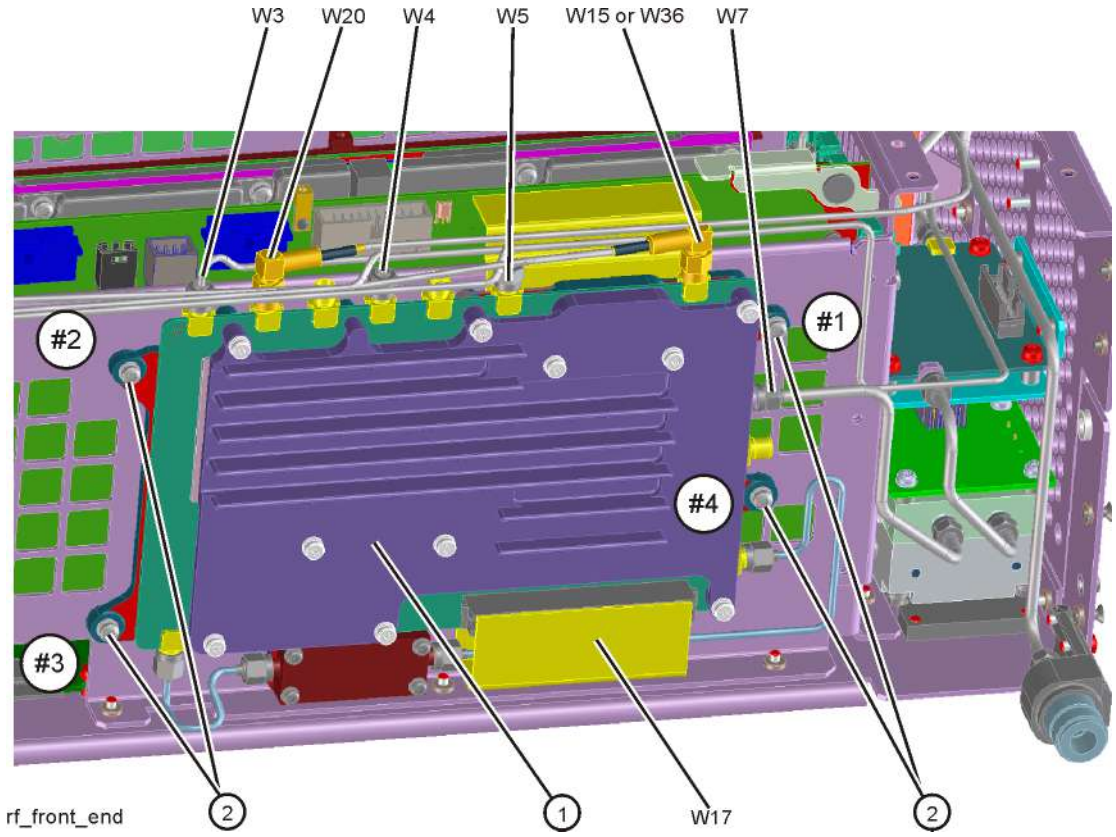
Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the instrument top brace. Refer to the "Top Brace" removal procedure.
3. Remove the front panel. Refer to the "Front Frame Assembly" removal procedure.
4. Refer to Figure 15-46. Using the 5/16 inch wrench, remove the cables W3, W4, W5, W7, W15 or W36, and W20 attached to the RF Front End Assembly **(1)**.

NOTE W7 will not be present in instruments with Option 503.

5. Remove the ribbon cable W17 from the RF Front End Assembly.
6. Remove the four screws **(2)** using the T-10 driver. The RF Front End Assembly can now be removed from the chassis.

Figure 15-46 RF Front End Assembly Removal



Replacement

1. Refer to Figure 15-46. Place the RF Front End Assembly into the chassis. Replace the four screws **(2)**. Torque to 9 inch-pounds in the sequence shown, starting with #1.
2. Reattach ribbon cable W17 to the RF Front End Assembly.
3. Reattach the cables W3, W4, W5, W7, W15 or W36, and W20 to the RF Front End Assembly **(1)**. Torque the semi-rigid cables to 10 inch-pounds.

NOTE W7 will not be present in instruments with Option 503.

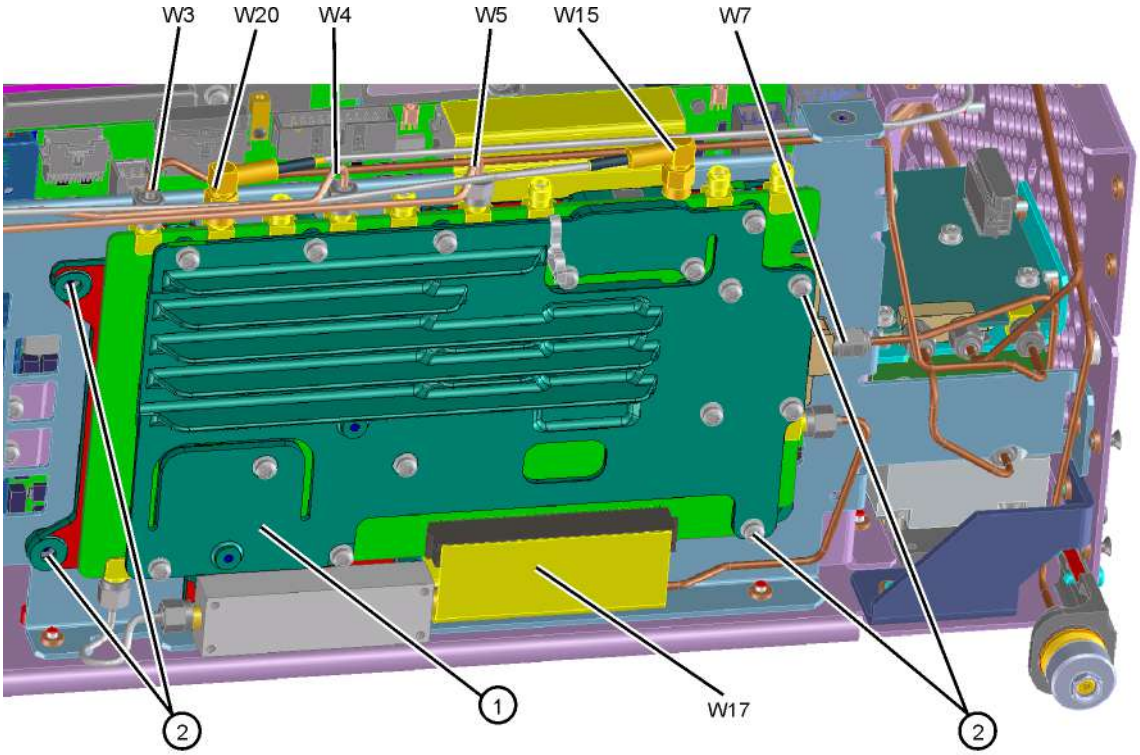
4. Replace the front panel. Refer to the "Front Frame Assembly" replacement procedure.
5. Replace the instrument top brace. Refer to the "Top Brace" replacement procedure.
6. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

RF Front End Assembly (Options 532, 544, 550)

Removal

1. Remove the instrument outer case. Refer to the Instrument Outer Case removal procedure.
2. Remove the instrument top brace. Refer to the Top Brace removal procedure.
3. Remove the front panel. Refer to the Front Frame Assembly removal procedure.
4. Refer to Figure 15-47. Using the 5/16 inch wrench, remove the cables W3, W4, W5, W7, W15 (or W36), and W20 attached to the RF Front End Assembly **(1)**.
5. Remove the ribbon cable W17 from the RF Front End Assembly.
6. Remove the four screws **(2)** using the T-10 driver. The RF Front End Assembly can now be removed from the chassis.

Figure 15-47 RF Front End Assembly (Option 532, 544) Removal



front_end_parts_mmW_remove

Replacement

1. Refer to Figure 15-47. Place the RF Front End Assembly into the chassis. Replace the four screws **(2)**. Torque to 9 inch-pounds.
2. Reattach ribbon cable W17 to the RF Front End Assembly.
3. Reattach the cables W3, W4, W5, W7, W15 (or W36), and W20 to the RF Front End Assembly **(1)**. Torque the semi-rigid cables to 10 inch-pounds.
4. Replace the front panel. Refer to the Front Frame Assembly replacement procedure.
5. Replace the instrument top brace. Refer to the Top Brace replacement procedure.
6. Replace the instrument outer case. Refer to the Instrument Outer Case replacement procedure.

Front End Control Assembly

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the instrument top brace. Refer to the "Top Brace" removal procedure.
3. Refer to Figure 15-48. Remove the ribbon cables W16, W17, and W18 and the wire harness W22 from the Front End Control assembly **(1)**.

NOTE W22 will not be present in instruments with Option 503.

NOTE Instruments with Options DP2, MPB, B40, CR3, or CRP will have the Enhanced Front End Control Assembly which will have additional cables as shown in Figure 15-49.

4. The Front End Control assembly can now be unplugged from the motherboard by leveraging up on the ejector and lifting the board up on the other side.

Figure 15-48 Front End Control Assembly Removal

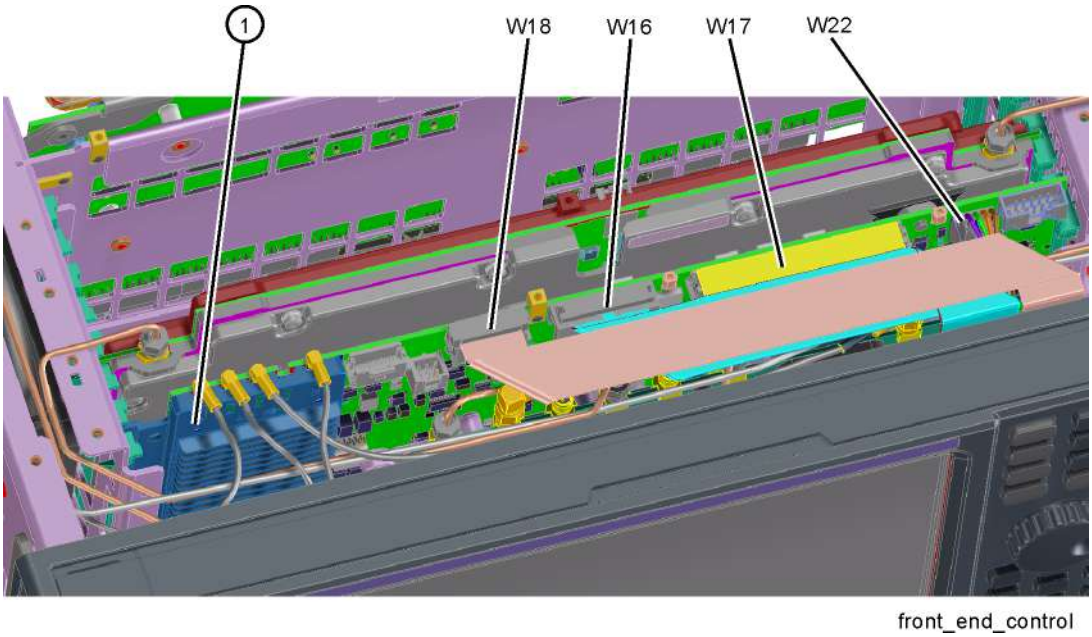
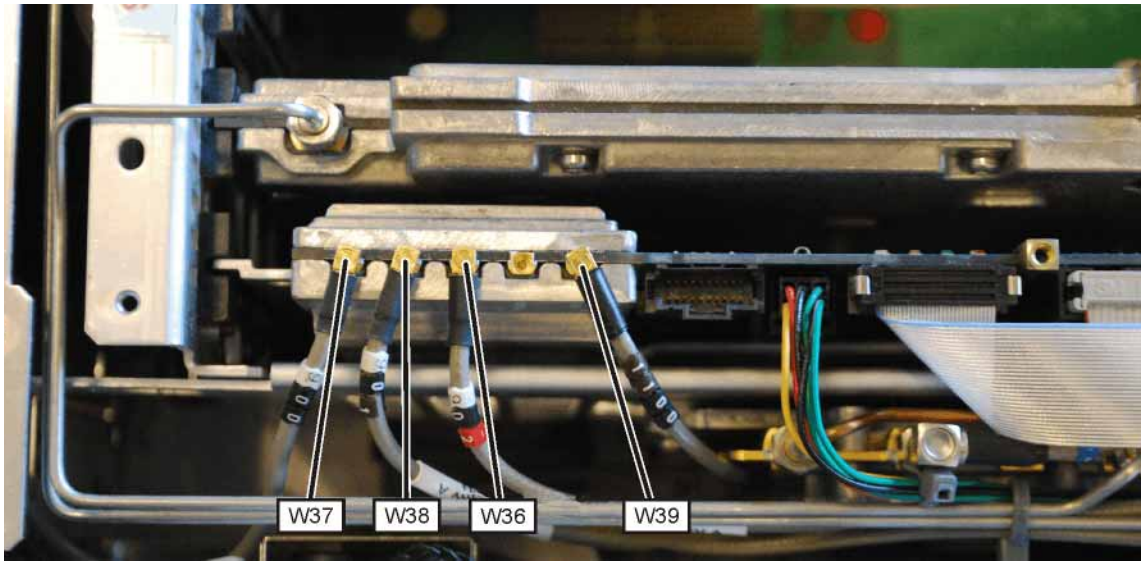


Figure 15-49 Enhanced Front End Control Assembly Cables



Replacement

1. Refer to Figure 15-48. Install the Front End Control assembly into slot 6 in the chassis securing with the ejector.
2. Reattach the ribbon cables W16, W17, and W18 and the wire harness W22 to the Front End Control assembly **(1)**. If the instrument has the Enhanced Front End Control Assembly, reattach the additional cables as shown in.Figure 15-49.

NOTE W22 will not be present in instruments with Option 503.

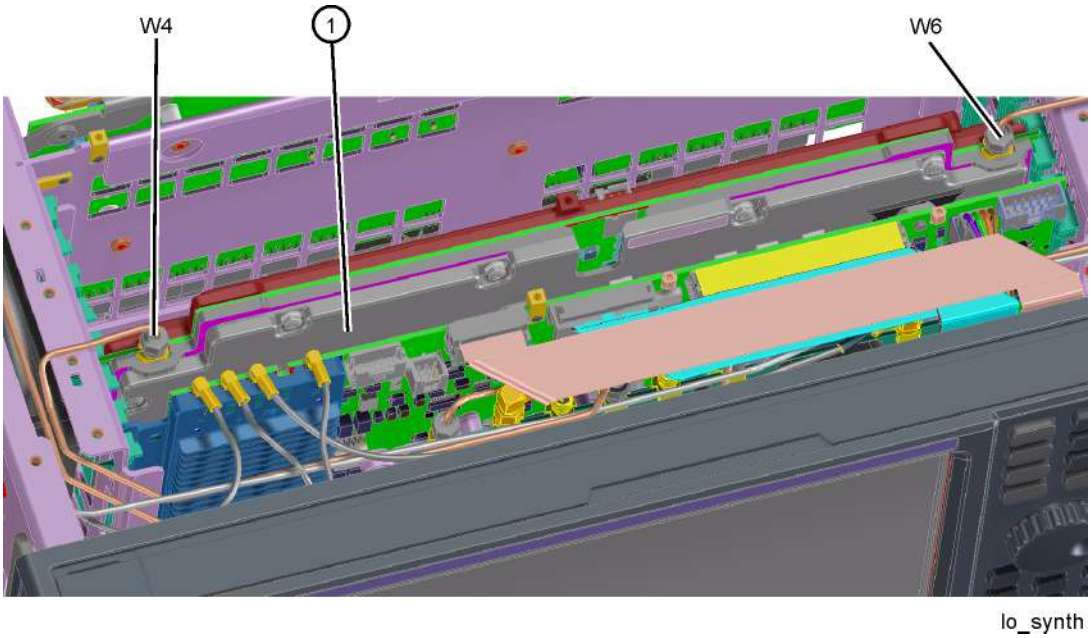
3. Replace the instrument top brace. Refer to the “Top Brace” replacement procedure.
4. Replace the instrument outer case. Refer to the “Instrument Outer Case” replacement procedure.

L.O. Synthesizer Assembly

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the instrument top brace. Refer to the "Top Brace" removal procedure.
3. Refer to Figure 15-50. Remove the cables W4 and W6 from the L.O. Synthesizer assembly **(1)** using the 5/16 inch wrench.
4. The L.O. Synthesizer assembly can now be unplugged from the motherboard by pulling up on the board and lifted out of the chassis.

Figure 15-50 L.O. Synthesizer Assembly Removal



Replacement

1. Refer to Figure 15-50. Install the L.O. Synthesizer assembly into slot 5 in the chassis and press down to plug it into the motherboard.
2. Reattach the cables W4 and W6 to the L.O. Synthesizer assembly **(1)**. Torque to 10 inch-pounds.
3. Replace the instrument top brace. Refer to the "Top Brace" replacement procedure.
4. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Rear Panel

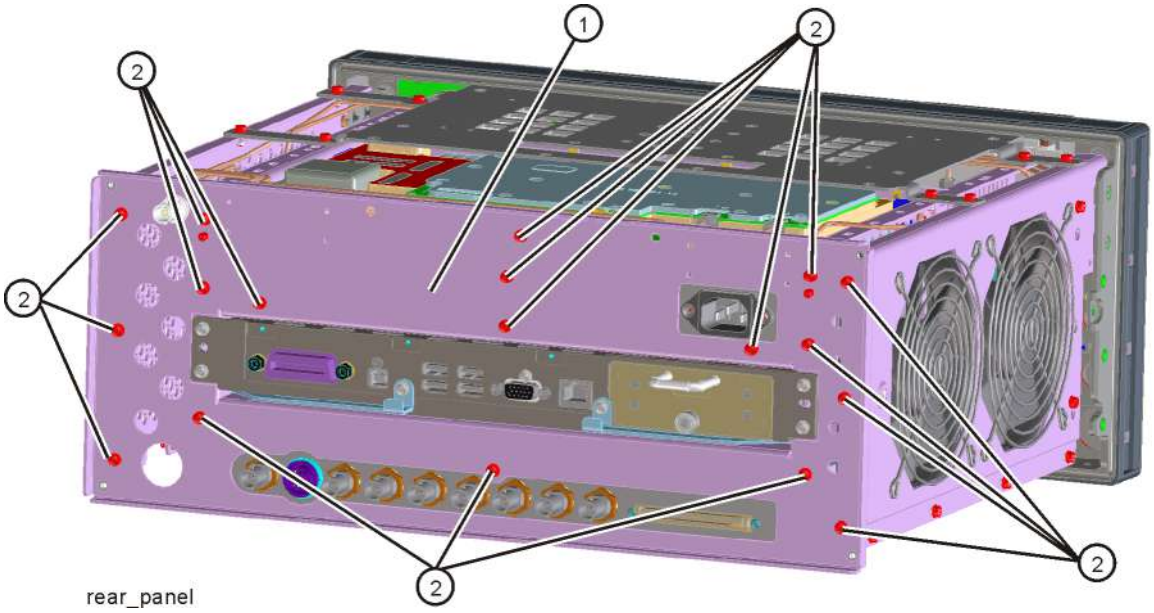
Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Refer to Figure 15-51. Using the T-10 driver, remove the twenty screws **(2)** attaching the rear panel **(1)** to the chassis and to the reference bracket. The rear panel can now be removed.
3. Refer to "Reference Assembly" on page 512. Remove W23 cable from the A16 Reference Assembly **(1)** at A16J704.

NOTE

If the rear panel is being replaced with a new rear panel, remove W23 at the rear panel using a 9/16-inch nut driver. Instruments with Option CR3 or CRP will have an additional cable W39 that is attached to the rear panel.

Figure 15-51 Rear Panel Removal



Replacement

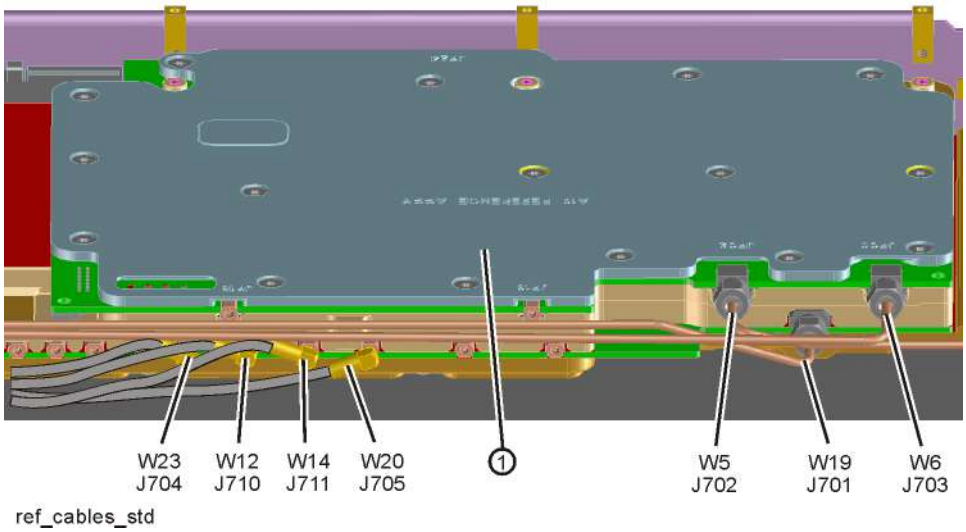
1. Reattach W23 cable to A16J704 or to the rear panel depending on how you removed it.
2. Refer to Figure 15-51. Place the rear panel **(1)** into position in the chassis. Replace the twenty screws **(2)** to attach the rear panel to the chassis. Torque to 9 inch-pounds.
3. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Reference Assembly

Removal

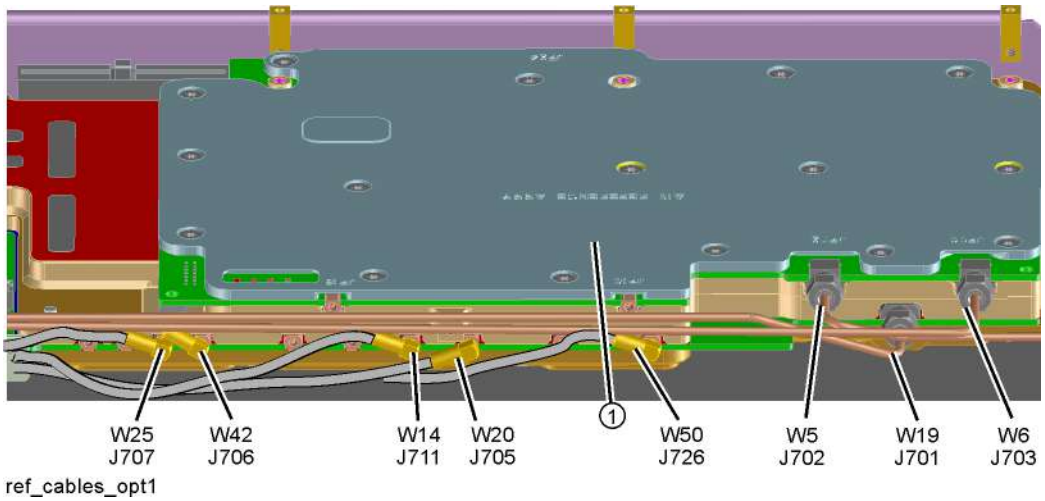
1. Remove the instrument outer case. Refer to the “Instrument Outer Case” removal procedure.
2. Remove the four flathead screws securing the top brace to the Reference Assembly.
3. Remove the rear panel. Refer to the “Rear Panel” removal procedure.
4. For standard instruments, refer to Figure 15-52. Remove cables W5, W6, W12, W14, W19, W20, W23, and W25 (Option BBA only) from the reference assembly **(1)**. Use the 5/16 inch wrench where necessary.

Figure 15-52 Reference Board Cables - without Option B40, MPB, or DP2



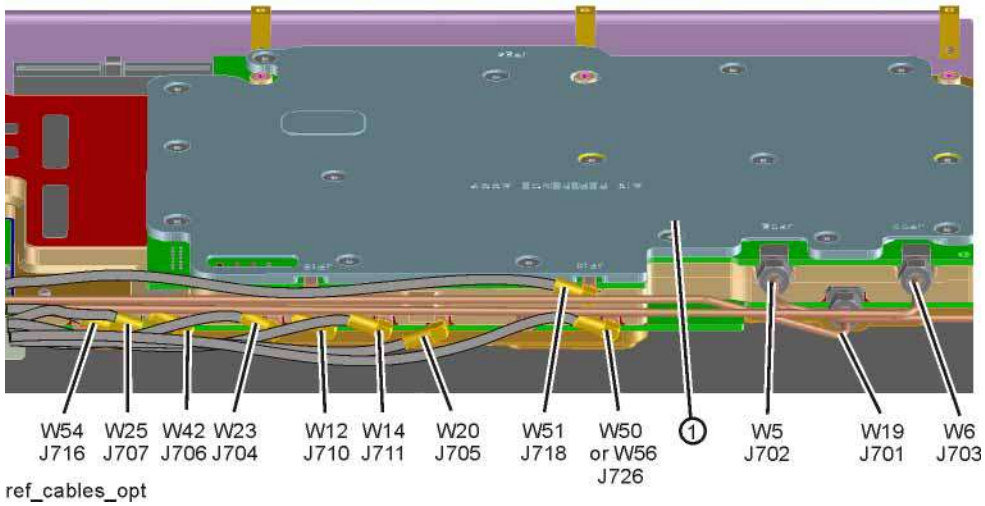
5. For instruments with Option B40, MPB, or DP2 but without Option B85, B1A, or B1X, refer to Figure 15-53. Remove cables W5, W6, W14, W19, W20, W42, W50, and W25 (Option BBA only) from the reference assembly **(1)**. Use the 5/16 inch wrench where necessary.

Figure 15-53 Reference Board Cables - with Option B40, MPB, or DP2 and without Option B85, B1A, or B1X



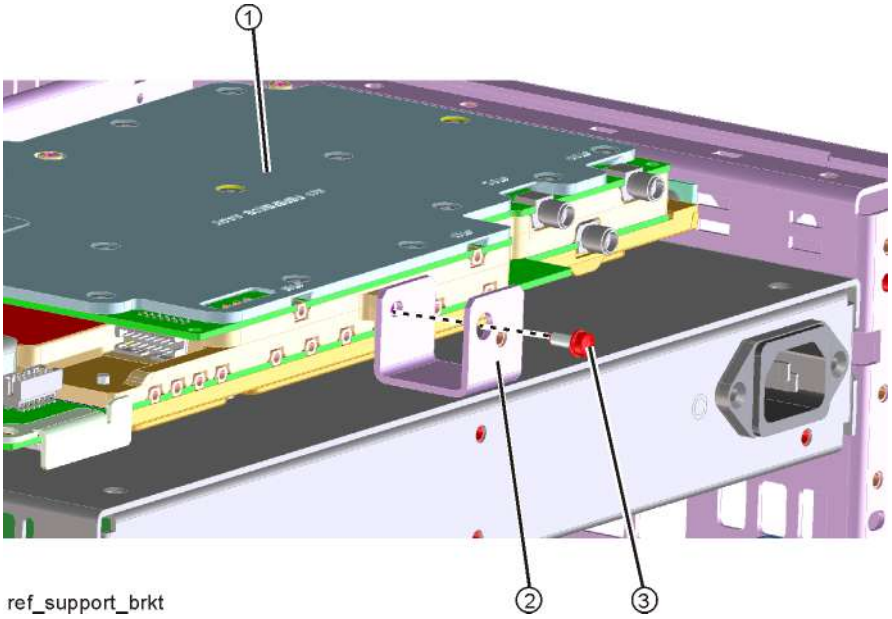
6. For instruments with Option B85, B1A, or B1X, refer to Figure 15-54. Remove cables W5, W6, W14, W19, W20, W23, W25 (Option BBA only), W51, W54, and W56 from the reference assembly **(1)**. Use the 5/16 inch wrench where necessary.

Figure 15-54 Reference Board Cables - with Option B85, B1A, B1X



7. Refer to Figure 15-55. Remove the reference support bracket **(2)** by removing the pan-head screw **(3)** (0515-0372) securing the bracket to the Reference assembly **(1)**.Figure 15-53.

Figure 15-55 Reference Support Bracket Removal



8. The reference assembly can be removed from the chassis by leveraging up on the ejector and pulling the board out on the other side.

Replacement

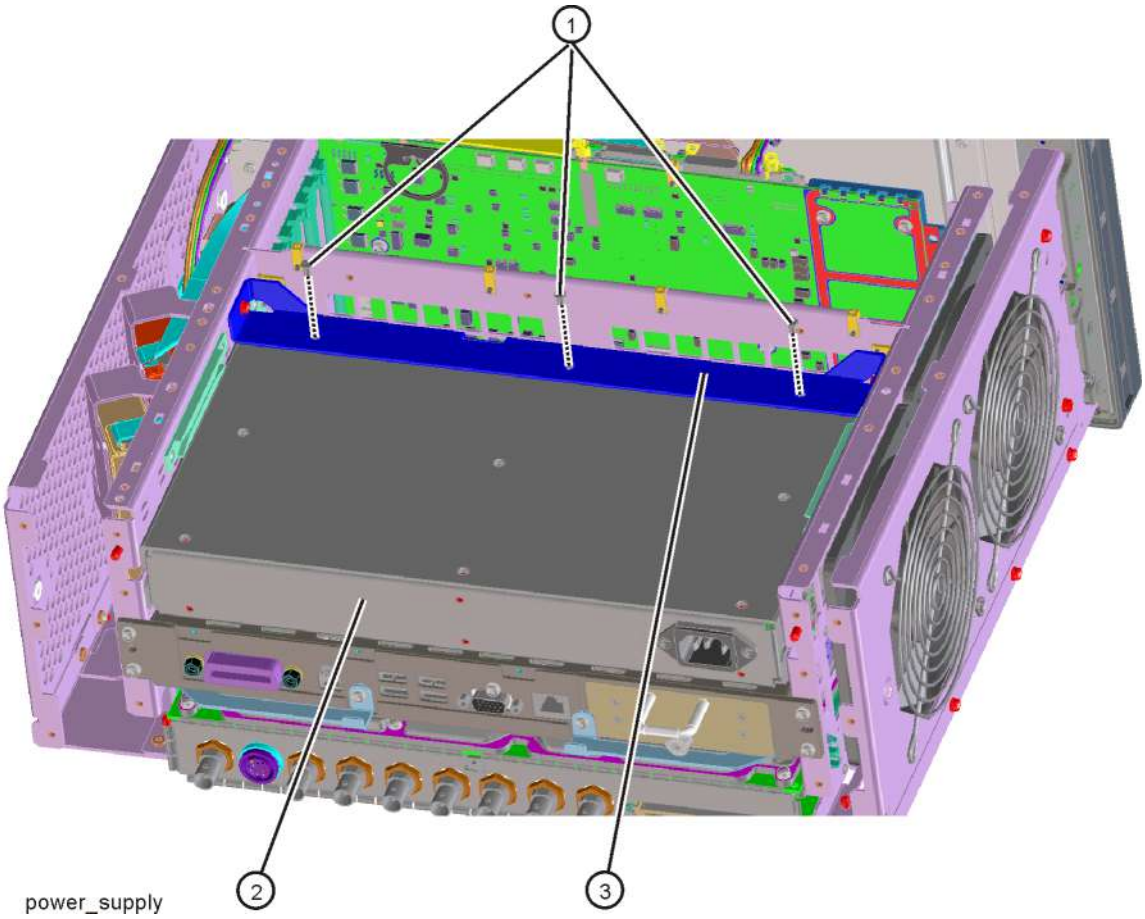
1. Slide the reference assembly into the slot at the rear of the instrument and push on the assembly to mate the connectors to the midplane assembly. Secure with the ejector.
2. Refer to Figure 15-55. Secure the reference support bracket **(2)** to the Reference assembly **(1)** using a pan-head screw **(3)** (0515-0372).
3. Refer to Figure 15-54, Figure 15-55, Figure 15-52, Figure 15-53, or Figure 15-54 as appropriate. Reconnect the cables to the correct locations. Torque the semi-rigid coax cables to 10 inch-pounds.
4. Replace the rear panel. Refer to the “Rear Panel” replacement procedure.
5. Replace the top brace. Refer to the “Top Brace” replacement procedure.
6. Replace the instrument outer case. Refer to the “Instrument Outer Case” replacement procedure.

Power Supply Assembly

Removal

1. Remove the instrument outer case. Refer to the “Instrument Outer Case” removal procedure.
2. Remove the rear panel. Refer to the “Rear Panel” removal procedure.
3. Remove the top brace and reference bracket. Refer to the “Top Brace” removal procedure.
4. Remove the reference assembly. Refer to the “Reference Assembly” removal procedure.
5. Remove the CPU assembly. Refer to the “CPU Assembly” removal procedure.
6. Refer to Figure 15-56. Remove the three screws **(1)** attaching the power supply **(2)** to the power supply bracket **(3)**.
7. The power supply assembly can be removed from the chassis by pulling straight out the back.

Figure 15-56 Power Supply Assembly Removal



Replacement

1. Slide the power supply assembly into the slot at the rear of the instrument and push on the assembly to mate the connectors to the midplane assembly.
2. Refer to Figure 15-56. Replace the three screws **(1)** through the power supply bracket **(3)** and into the power supply **(2)**. Torque to 9 inch-pounds.
3. Replace the CPU assembly. Refer to the "CPU Assembly" replacement procedure.
4. Replace the reference assembly. Refer to the "Reference Assembly" replacement procedure.
5. Replace the top brace and reference bracket. Refer to the "Top Brace" replacement procedure.
6. Replace the rear panel. Refer to the "Rear Panel" replacement procedure.
7. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

CPU Assembly

Removal

The CPU assembly will look like Figure 15-57.

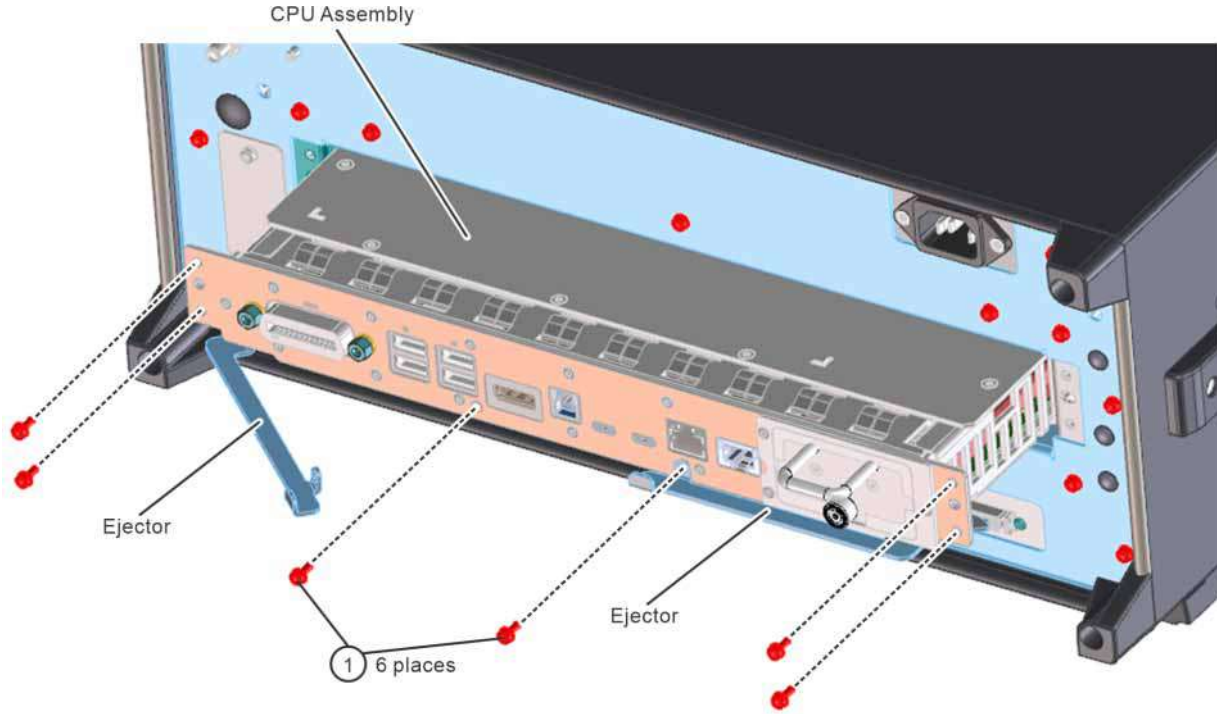
Figure 15-57 CPU Assembly - Rear Panel View

1. Refer to Figure 15-58. Remove the six screws **(1)** attaching the CPU assembly to the chassis.
2. The CPU assembly can be removed from the chassis by pulling straight out the back. Use the two ejectors to pull the CPU assembly out from the chassis.

NOTE

If the A4BT1 CPU board battery was changed, refer to Chapter 16, “Post-Repair Procedures.” for setup instructions.

Figure 15-58 CPU Assembly Removal



Replacement

1. Slide the CPU assembly into the slot at the rear of the instrument and push on the assembly to mate the connectors to the midplane assembly. Secure the board with the ejectors.
2. Refer to Figure 15-58. Replace the six screws **(1)** that attach the CPU assembly to the chassis. Torque to 9 inch-pounds.

A5 Solid State Drive

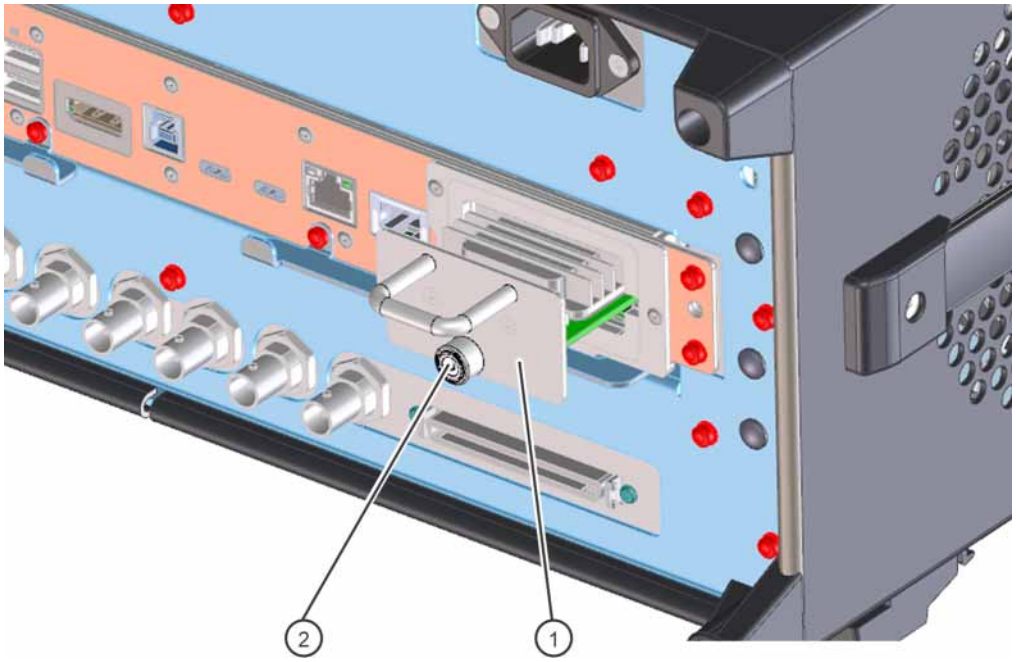
NOTE To remove the SSD or the memory card, it is not necessary to remove the CPU assembly from the chassis.

Disk Drive

Removal

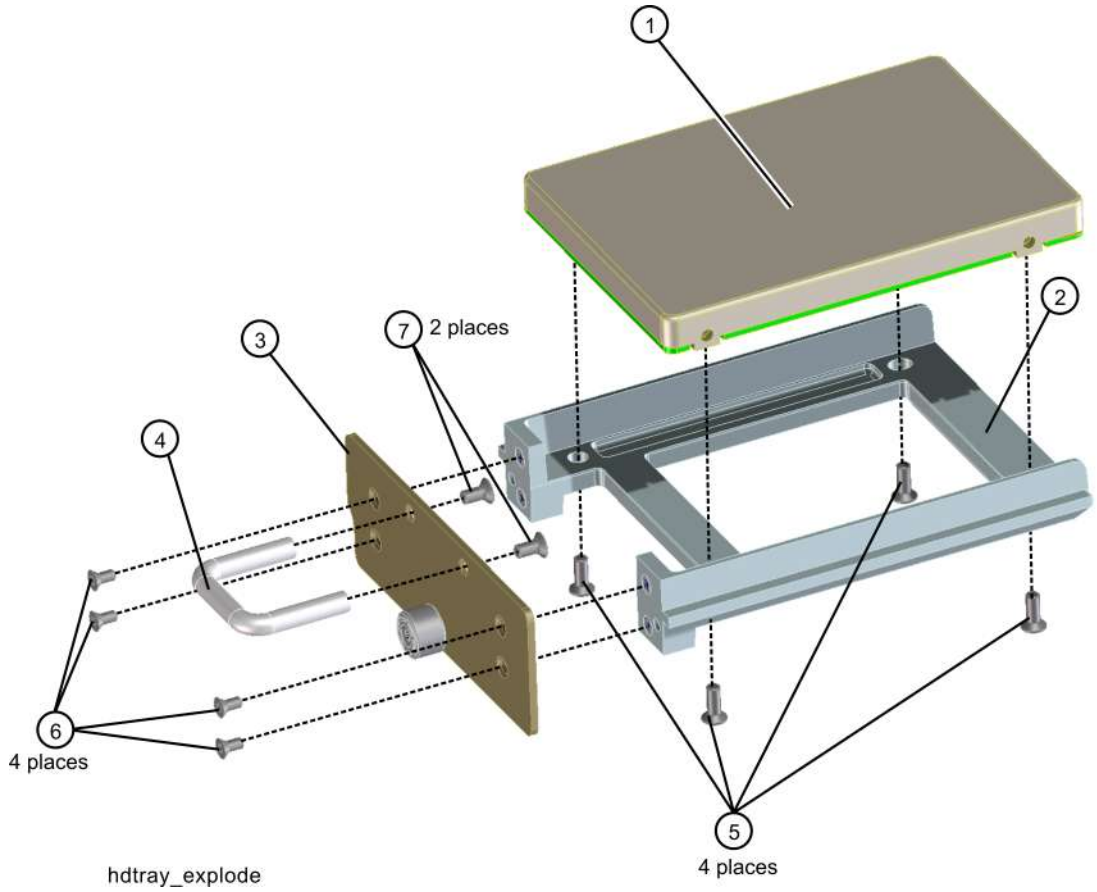
1. Refer to Figure 15-59. Loosen the thumb screw **(2)** and pull the SSD **(1)** out of the CPU assembly.

Figure 15-59 SSD Removal



2. Refer to Figure 15-60. Remove the four screws **(5)** (0515-1035) from the disk drive tray that secure the SSD **(1)**.

Figure 15-60 Disk Drive Tray Screws



Replacement

1. Refer to Figure 15-60. Place the new SSD into the tray assembly and attach with the four screws **(5)** (0515-1035). Torque to 9 inch-pounds.

NOTE Make sure not to use the 0515-0372 screw because for the PC6 processor it will cause the SSD to interfere with the CPU memory card.

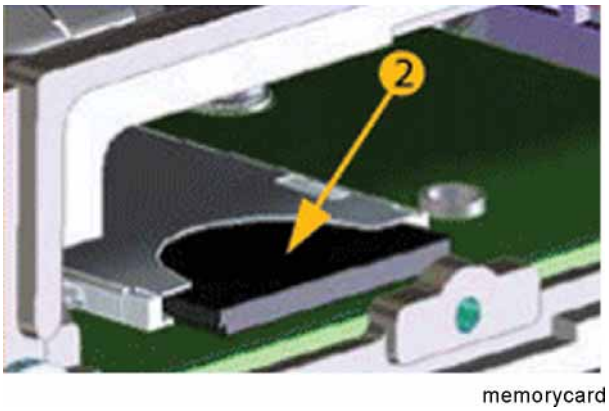
2. Refer to Figure 15-59. Slide the SSD into the CPU assembly and push to mate the connector. Secure the thumb screw to 9 inch-pounds.

NOTE Refer to Chapter 16, “Post-Repair Procedures.” and perform all of the specified tasks for replacing the A5 Disk Drive assembly.

A4A1 CPU Memory Card

1. Refer to Figure 15-61. Remove the SSD as described on page 519. The memory card **(2)** can be removed by pushing on the memory card and it will spring out. To install the memory card push it into the slot until you feel the spring catch. Then replace the SSD as described on page 520.

Figure 15-61 CPU Memory Card Removal

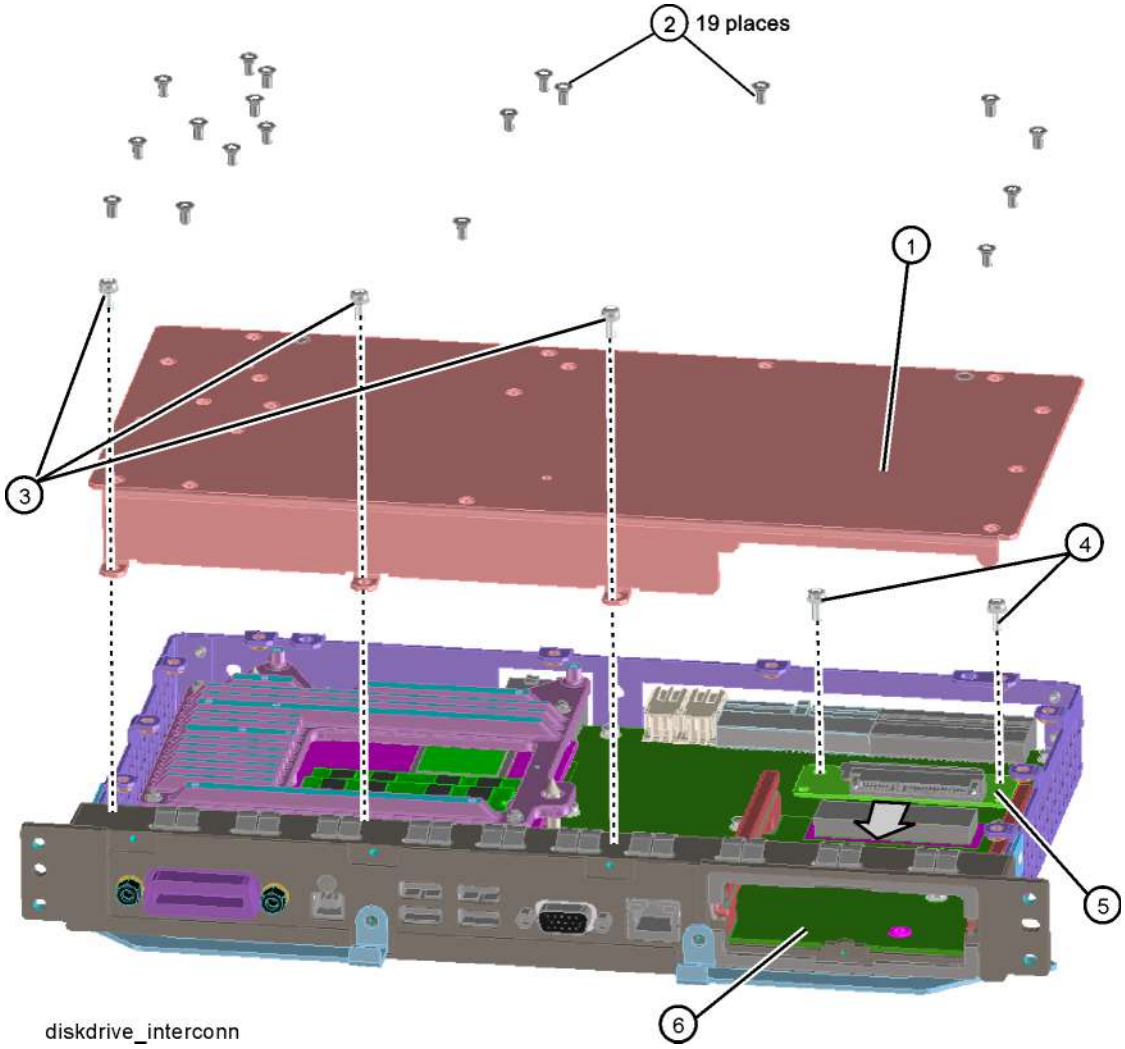


Disk Drive Interconnect

Removal

1. Remove the A5 Disk Drive assembly for the instrument. Refer to the "A5 Solid State Drive" removal procedure.
2. Remove the A4 CPU assembly from the instrument. Refer to the "CPU Assembly" removal procedure.
3. Refer to Figure 15-62. Remove the A4 CPU assembly cover **(1)** by first removing the 19 flat-head screws **(2)** and 3 pan-head screws **(3)**. The 19 flat-head screws need to be discarded and replaced since they are precoated with a thread locking compound and new screws will need to be used when the cover is re-installed.

Figure 15-62 A4A1 Disk Drive Interconnect Board Removal



4. Remove the 2 screws **(4)** that attached the A4A1 Disk Drive Interconnect board **(5)** to the A4 CPU assembly.
5. Unplug and remove the A4A1 Disk Drive Interconnect board from the A4 CPU assembly by carefully sliding the board out towards the disk drive bay opening **(6)**.

Installation

1. Refer to Figure 15-62. Plug the A4A1 Disk Drive Interconnect board **(5)** into the A4 CPU assembly by carefully sliding it into place from the disk drive bay opening **(6)**.
2. Install the 2 screws **(4)** that secure the A4A1 Disk Drive Interconnect board to the A4 CPU assembly and torque them to 9 inch-lbs.
3. Replace the A4 CPU assembly cover **(1)** and attach it with 19 new flat-head screws **(2)** and the 3 pan-head screws **(3)**. Torque all screws to 9 inch-lbs.
4. Re-install the A4 CPU assembly into the instrument. Refer to the CPU Assembly installation procedure.
5. Re-install the A5 Disk Drive assembly into the instrument. Refer to the Disk Drive installation procedure.

Analog I.F. (AIF)/Digital I.F. (DIF) Assembly

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the rear panel. Refer to the "Rear Panel" removal procedure.
3. Refer to Figure 15-63 and Figure 15-64. Depending on the installed options, remove the appropriate cables from the bottom of the DIF assembly.

Figure 15-63 W12, W13 Removal - Standard Instruments

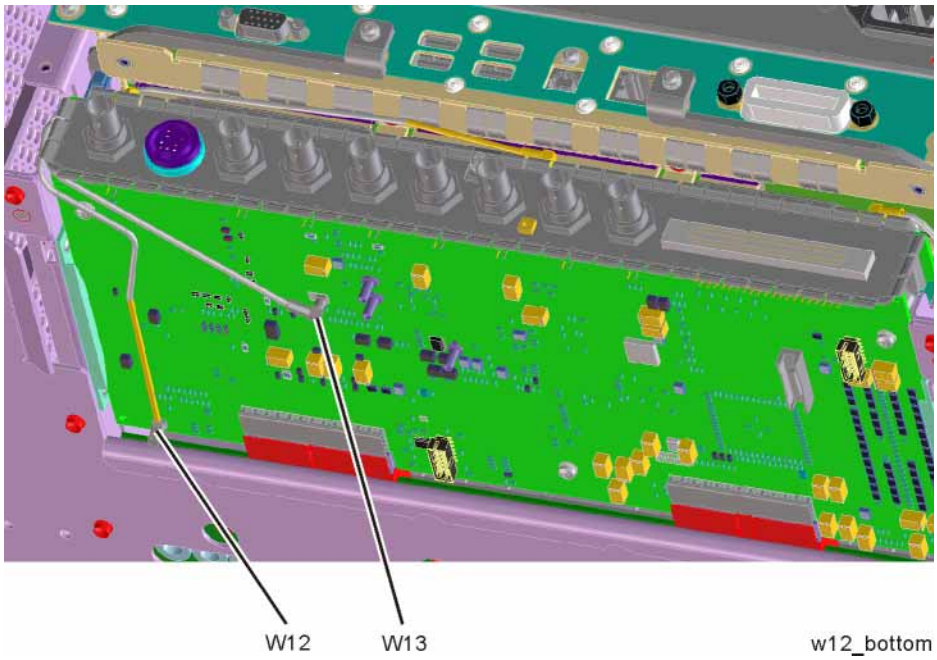
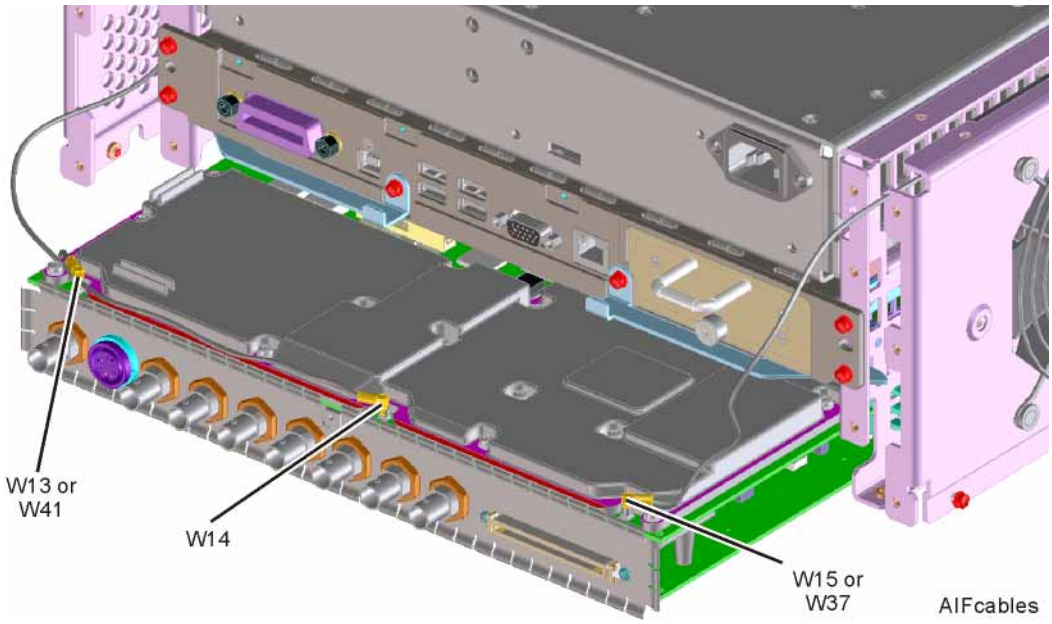


Figure 15-64 W38, W40, W41, W42 Removal - Option B40, MPB, or DP2

4. Refer to Figure 15-65. Pull the AIF/DIF assembly part way out of the chassis. Remove cables W13 or W41, W14, and W15 or W37 from the AIF assembly.
5. The AIF/DIF assembly can be removed from the chassis by pulling straight out the back.

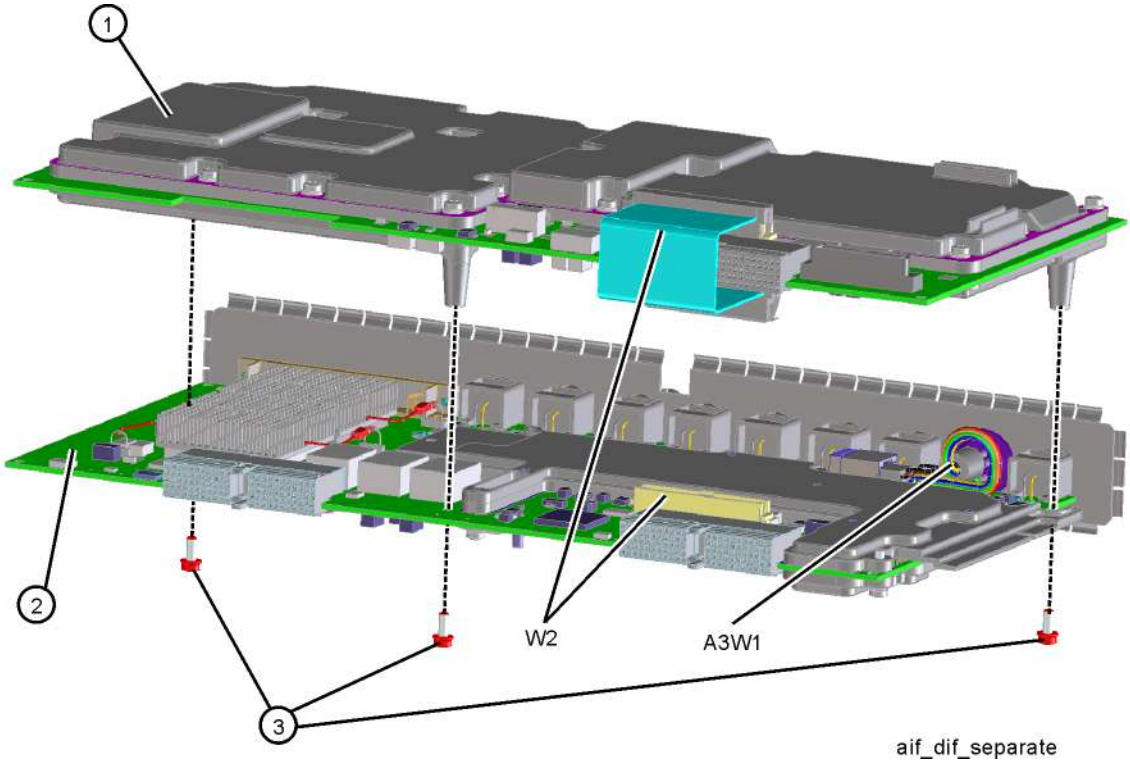
Figure 15-65 AIF/DIF Assembly Removal



Separate AIF/DIF Assembly

1. To separate the AIF **(1)** from the DIF **(2)**, unplug ribbon cable W2 from the AIF assembly.
2. Refer to Figure 15-66. From underneath the assembly, remove the three screws **(3)**.

Figure 15-66 AIF/DIF Separation



AIF/DIF Pre-installation

1. Set the DIF in position over the AIF. Reinstall the three screws removed before. Torque to 9 inch-pounds, starting with the middle screw.
2. To reconnect the AIF and the DIF, reconnect the ribbon cable W2.

Replacement

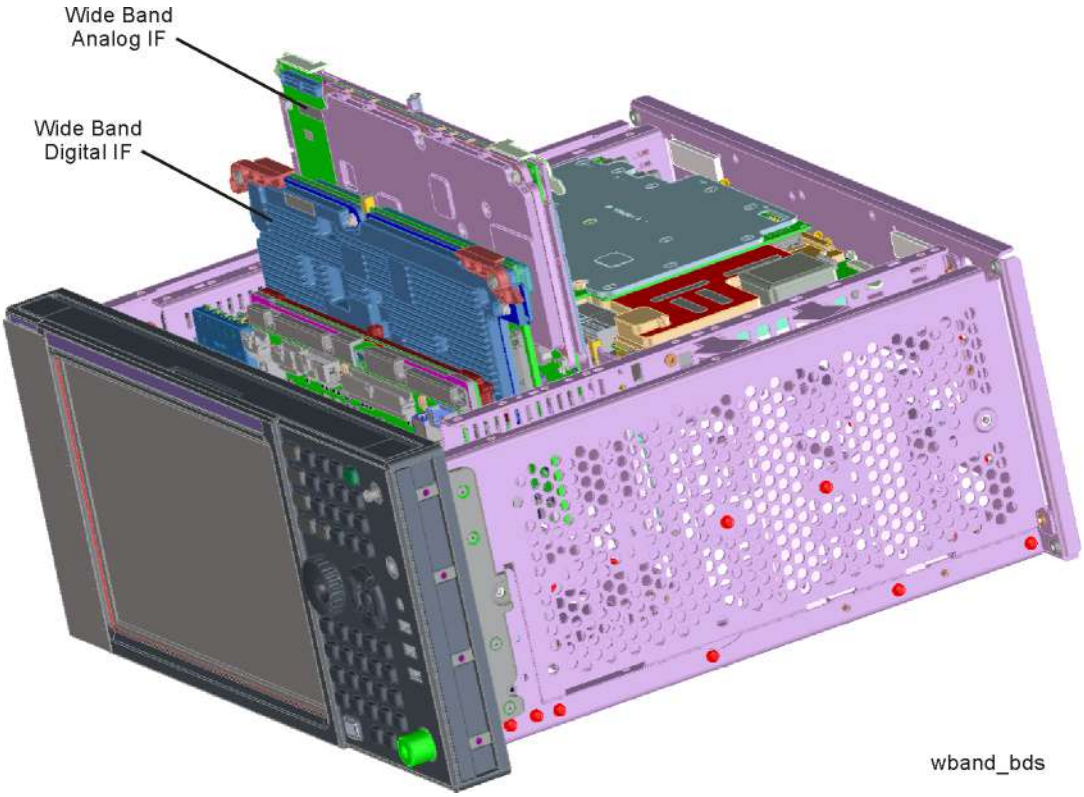
1. Slide the AIF/DIF assembly into the slot at the rear of the instrument and push on the assembly to mate the connectors to the midplane assembly.
2. Refer to Figure 15-65. Replace cables W13, W14, and W15 or W37 to the AIF assembly.
3. Refer to Figure 15-63 and Figure 15-64. Replace the appropriate cables to the bottom of the DIF assembly.
4. Replace the rear panel. Refer to the "Rear Panel" replacement procedure.
5. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Wide Band Analog IF and Digital IF Assemblies

Removal

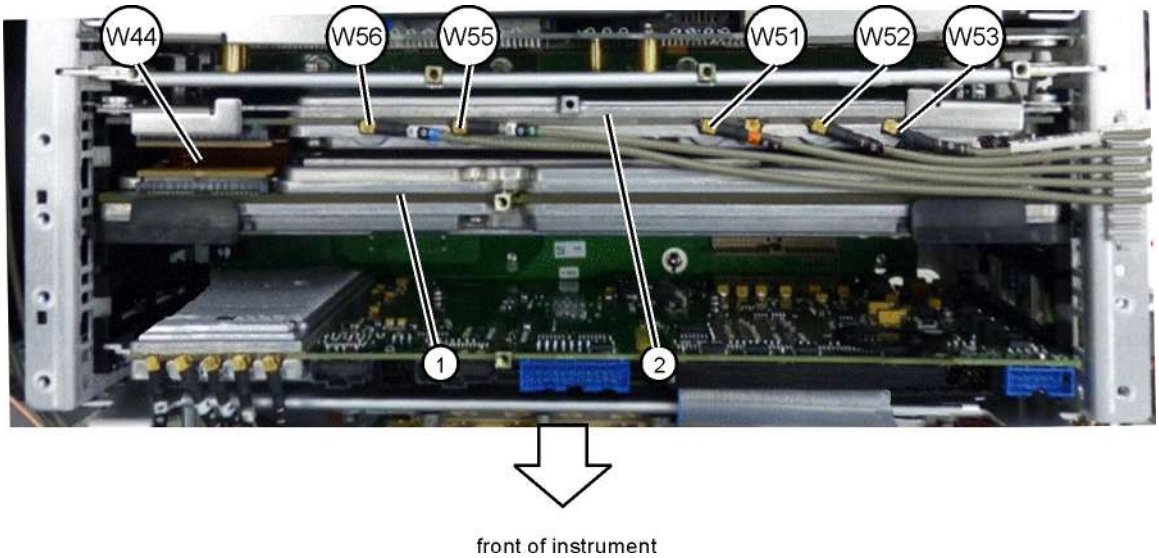
1. Remove the instrument outer case. Refer to the “Instrument Outer Case” removal procedure.
2. Remove the instrument top brace. Refer to the “Top Brace” removal procedure.
3. Refer to Figure 15-67. Locate the Wideband Analog IF and Wideband Digital IF assemblies.

Figure 15-67 Wideband I.F. Assemblies Location



4. Refer to Figure 15-68. Remove cables W51, W52, W53, W55, and W56 from the Wideband Analog IF assembly **(2)**.
5. Remove ribbon cable W44.

Figure 15-68 Option B1X Cables



6. The Wideband Analog IF **(2)** and Wideband Digital IF **(1)** assemblies can now be removed by pulling up on the ejectors to remove from the chassis.

Replacement

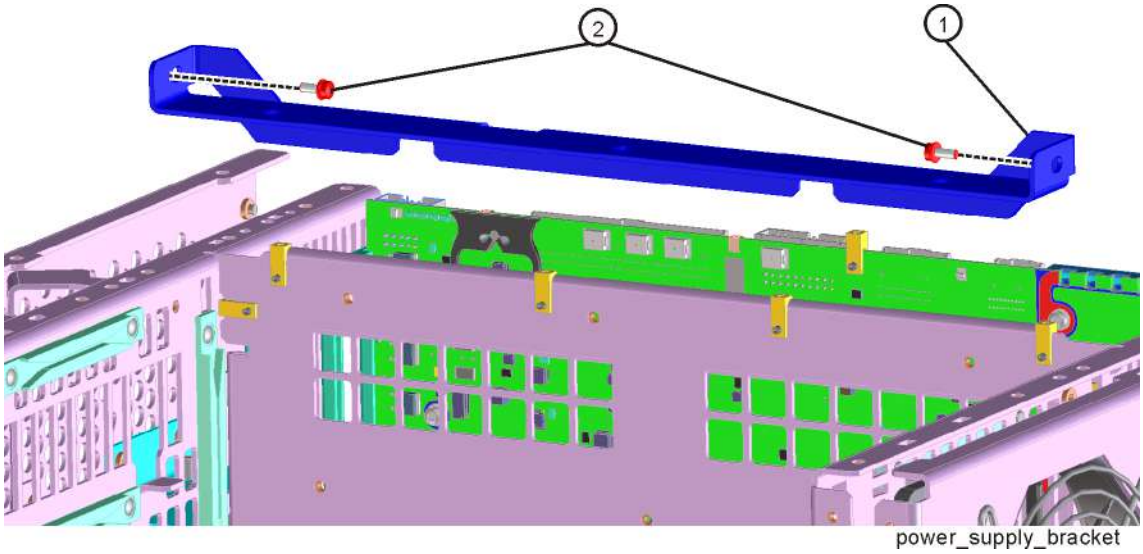
1. Slide the Wideband Analog IF assembly into slot 3 in the chassis and use the ejectors to push into place into the motherboard.
2. Slide the Wideband Digital IF assembly into slot 5 in the chassis and use the ejectors to push into place into the motherboard.
3. Refer to Figure 15-68. Reinstall cables W51, W52, W53, W55, and W56 to the Wideband Analog IF assembly **(2)**.
4. Reconnect ribbon cable W44.
5. Replace the instrument top brace. Refer to the "Top Brace" replacement procedure.
6. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Midplane Assembly

Removal

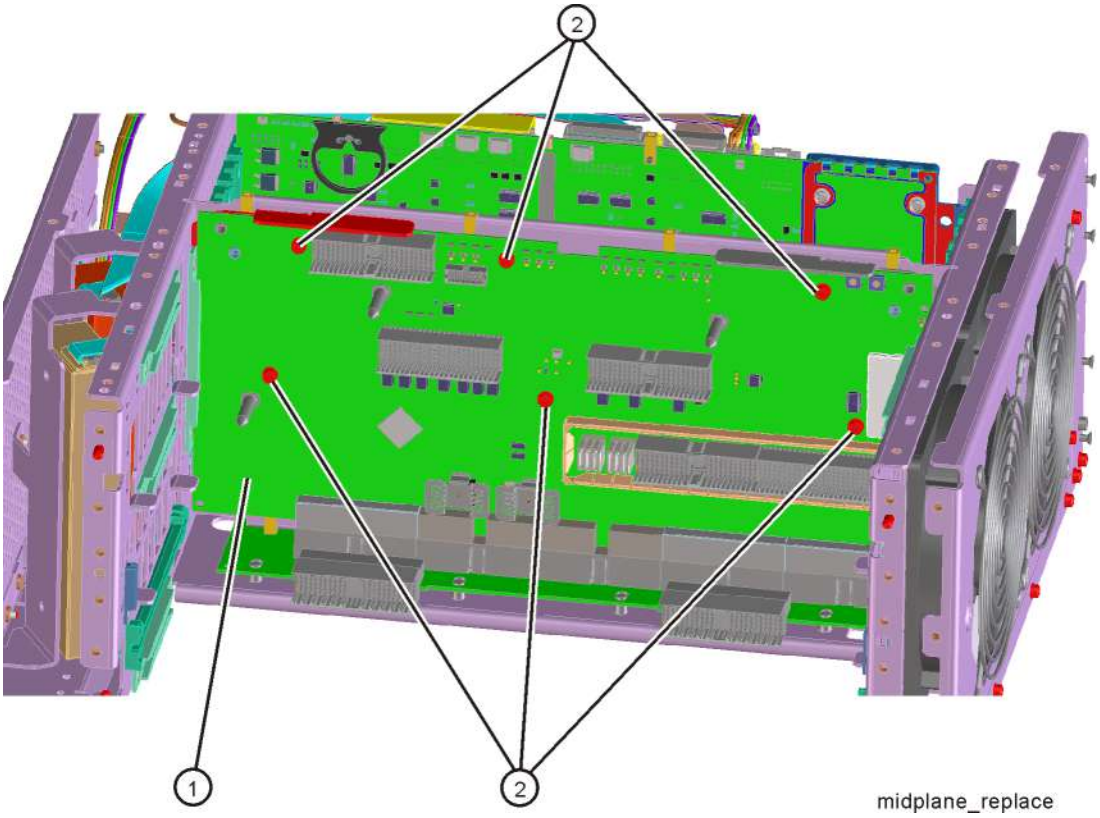
1. Remove the instrument outer case. Refer to the “Instrument Outer Case” removal procedure.
2. Remove the rear panel. Refer to the “Rear Panel” removal procedure.
3. Remove the top brace and reference bracket. Refer to the “Top Brace” removal procedure.
4. Remove the reference assembly. Refer to the “Reference Assembly” removal procedure.
5. Remove the CPU assembly. Refer to the “CPU Assembly” removal procedure.
6. Remove the power supply assembly. Refer to the “Power Supply Assembly” removal procedure.
7. Refer to Figure 15-69. Remove the power supply support bracket **(1)** by removing the two screws **(2)**.

Figure 15-69 Power Supply Bracket



8. Refer to Figure 15-70. Remove the six screws **(2)** attaching the midplane assembly **(1)** to the midplane bracket. The midplane assembly can now be pulled up from the chassis by leveraging up on the ejectors.

Figure 15-70 Midplane Assembly Removal



Replacement

1. Refer to Figure 15-70. Install the midplane assembly into the chassis and attach to the midplane bracket using the six screws **(2)** removed earlier. Torque to 9 inch-pounds.
2. Replace the power supply support bracket with the two screws. Torque to 9 inch-pounds.
3. Replace the power supply assembly. Refer to the "Power Supply Assembly" replacement procedure.
4. Replace the CPU assembly. Refer to the "CPU Assembly" replacement procedure.
5. Replace the reference assembly. Refer to the "Reference Assembly" replacement procedure.
6. Replace the top brace and reference bracket. Refer to the "Top Brace" replacement procedure.
7. Replace the rear panel. Refer to the "Rear Panel" replacement procedure.
8. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Motherboard Assembly

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the rear panel. Refer to the "Rear Panel" removal procedure.
3. Remove the top brace and reference bracket. Refer to the "Top Brace" removal procedure.
4. Remove the reference assembly. Refer to the "Reference Assembly" removal procedure.
5. Remove the CPU assembly. Refer to the "CPU Assembly" removal procedure.
6. Remove the power supply assembly. Refer to the "Power Supply Assembly" removal procedure.
7. Remove the AIF/DIF assembly. Refer to the "Analog I.F. (AIF)/Digital I.F. (DIF) Assembly" removal procedure.
8. Remove the Front End Control assembly. Refer to the "Front End Control Assembly" removal procedure.
9. Remove the L.O. Synthesizer assembly. Refer to the "L.O. Synthesizer Assembly" removal procedure.
10. Remove the Midplane assembly. Refer to the "Midplane Assembly" removal procedure.
11. Remove the Front Frame Assembly. Refer to the "Front Frame Assembly" removal procedure.
12. Remove the RF bracket. Refer to Figure 15-9 on page 463.
13. Remove the fan assembly. Refer to the "Fan Assembly" removal procedure.
14. Refer to Figure 15-71 and Figure 15-72. Remove the midplane bracket **(1)** by removing the eight screws **(2)** (two on each side and four on the bottom).

Figure 15-71 Midplane Bracket Removal

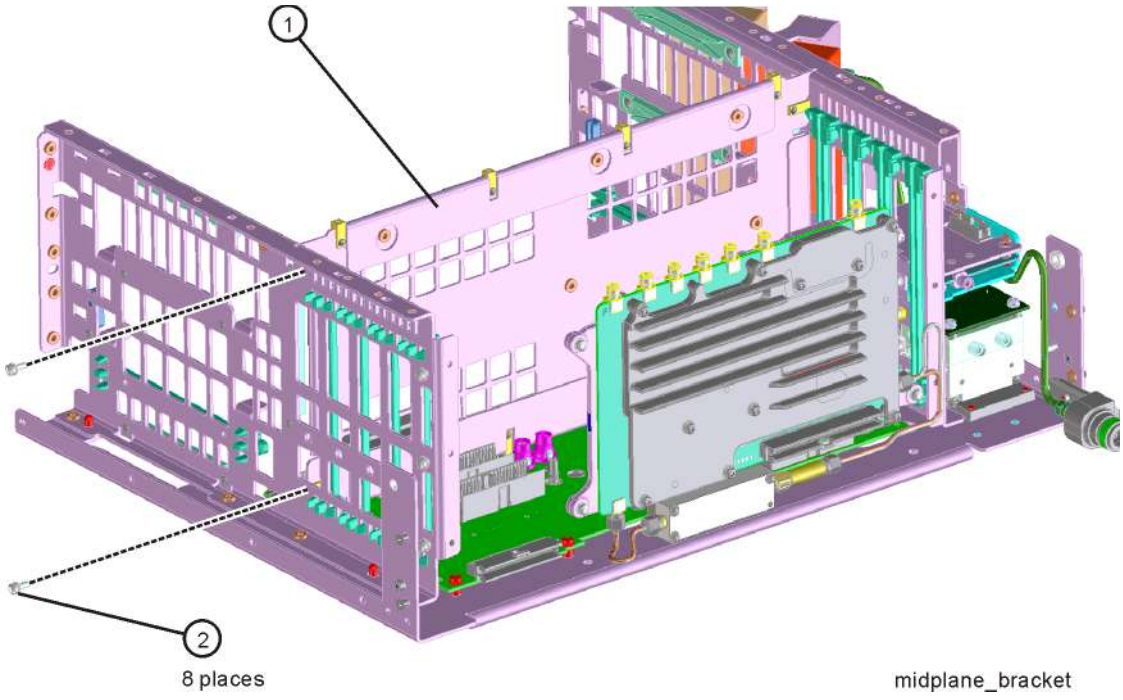
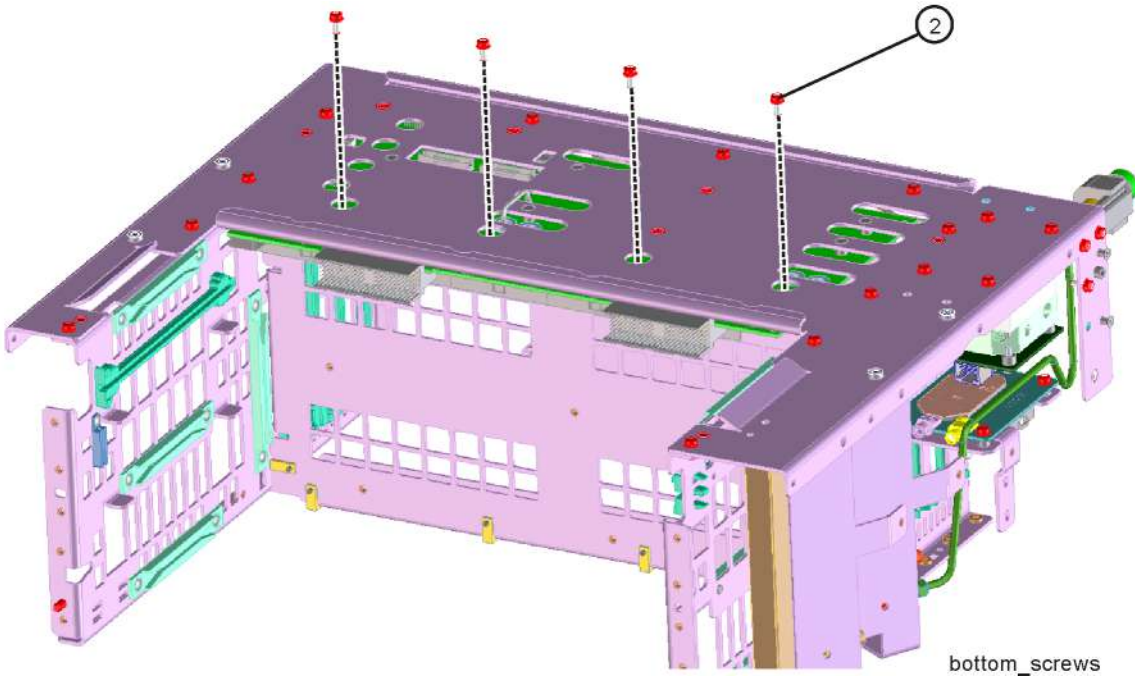
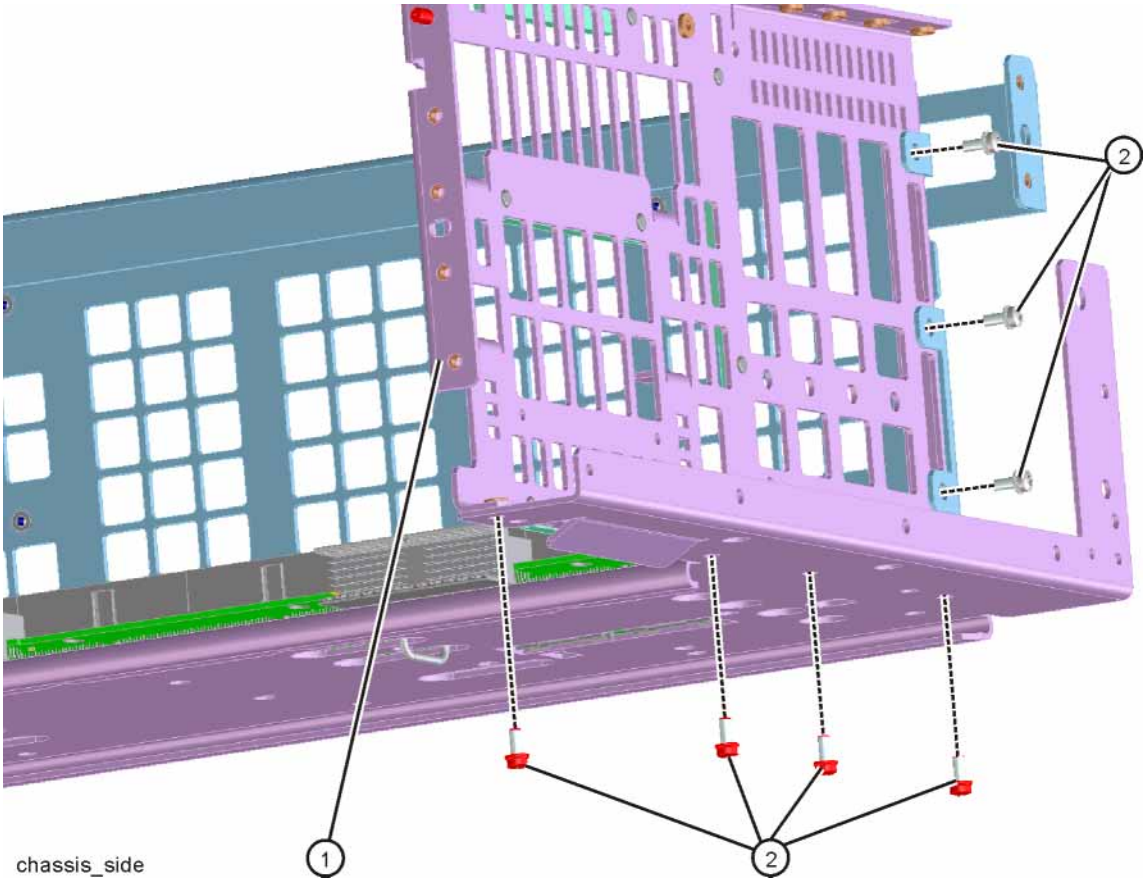


Figure 15-72 Bottom Screws



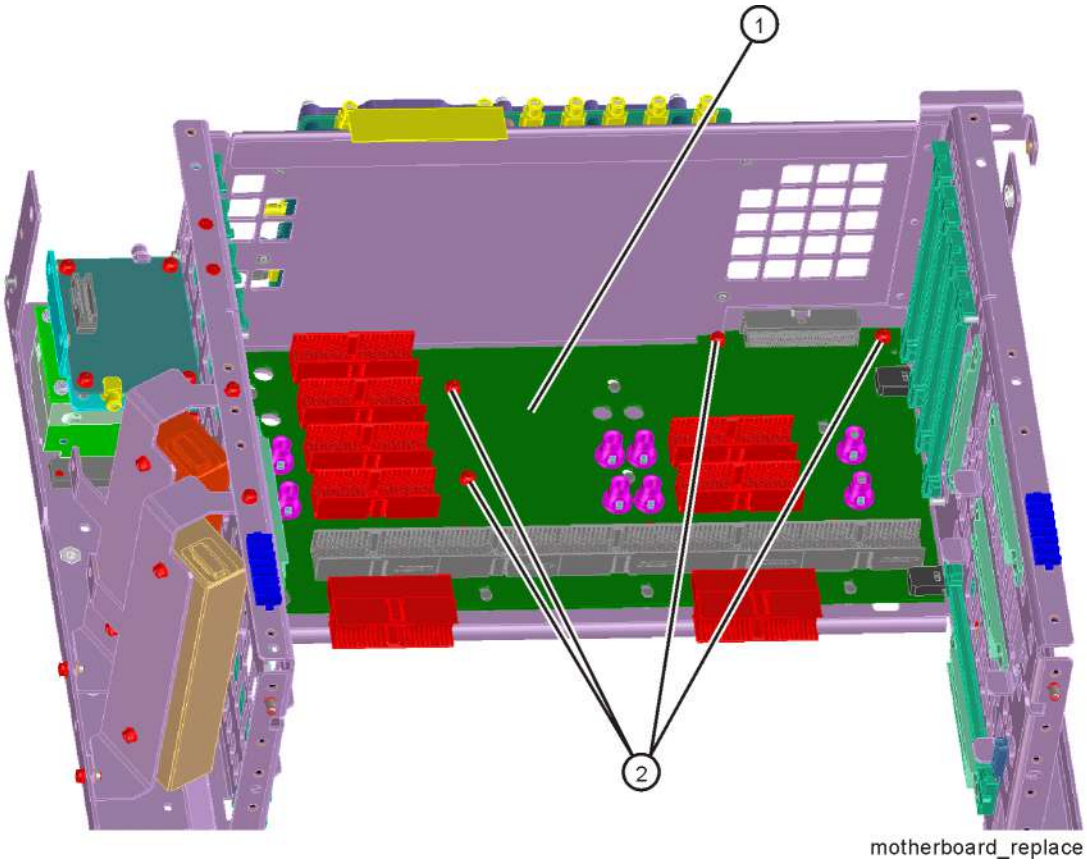
15. Refer to Figure 15-73. Remove the left side chassis (same side as the fan) by removing the seven screws (four on the bottom).

Figure 15-73 Chassis Side Removal



16. Refer to Figure 15-74. Remove the motherboard **(1)** by removing the four screws **(2)**.

Figure 15-74 Motherboard Assembly Removal



Replacement

1. Refer to Figure 15-74. Place the motherboard **(1)** into position in the chassis and replace the four screws **(2)**. Torque to 9 inch-pounds.
2. Refer to Figure 15-73. Replace the left side chassis by replacing the seven screws. Torque to 9 inch-pounds.
3. Refer to Figure 15-71. Replace the midplane bracket **(1)** by replacing the eight screws **(2)**. Torque to 9 inch-pounds.
4. Replace the fan assembly. Refer to the Fan Assemblyreplacement procedure.
5. Replace the RF bracket. Refer to Figure 15-9 on page 463. Torque the screws to 9 inch-pounds.

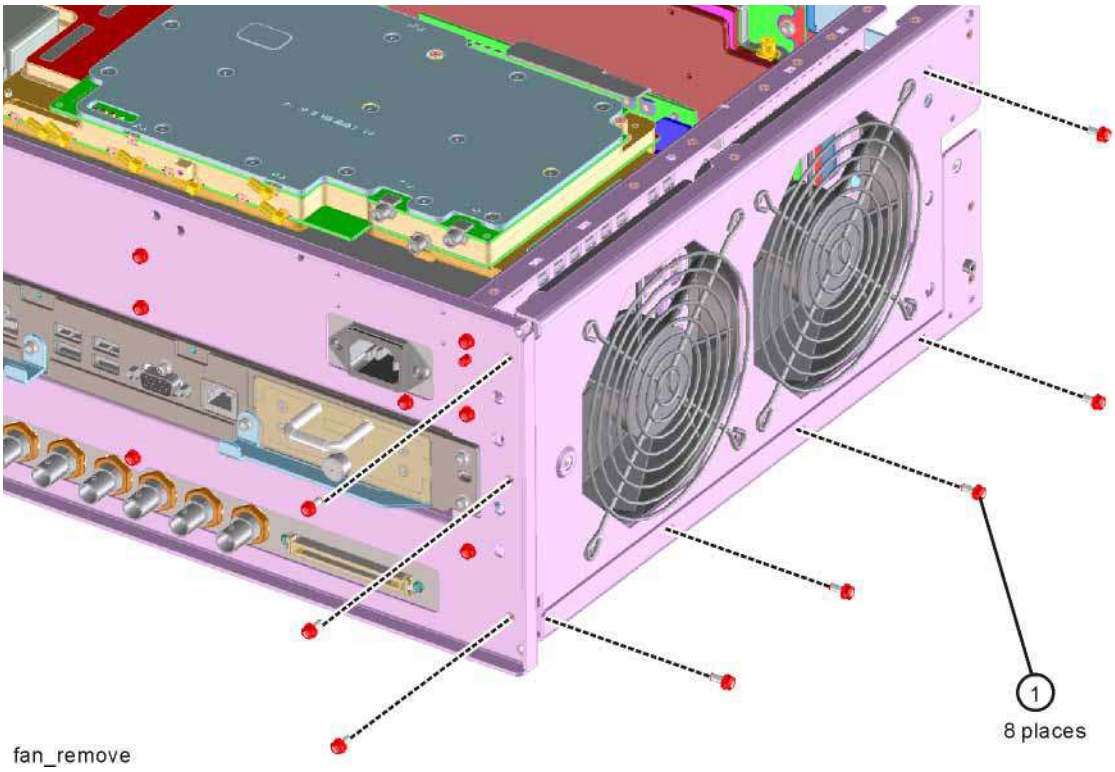
6. Replace the Front Frame Assembly. Refer to the “Front Frame Assembly” replacement procedure.
7. Replace the Midplane assembly. Refer to the “Midplane Assembly” replacement procedure.
8. Replace the L.O. Synthesizer assembly. Refer to the “L.O. Synthesizer Assembly” replacement procedure.
9. Replace the Front End Control assembly. Refer to the “Front End Control Assembly” replacement procedure.
10. Replace the AIF/DIF assembly. Refer to the “Analog I.F. (AIF)/Digital I.F. (DIF) Assembly” replacement procedure.
11. Replace the power supply assembly. Refer to the “Power Supply Assembly” replacement procedure.
12. Replace the CPU assembly. Refer to the “CPU Assembly” replacement procedure.
13. Replace the reference assembly. Refer to the “Reference Assembly” replacement procedure.
14. Replace the top brace and reference bracket. Refer to the “Top Brace” replacement procedure.
15. Replace the rear panel. Refer to the “Rear Panel” replacement procedure.
16. Replace the instrument outer case. Refer to the “Instrument Outer Case” replacement procedure.

Fan Assembly

Removal

1. Remove the instrument outer case. Refer to the “Instrument Outer Case” removal procedure.
2. Remove the top brace. Refer to the “Top Brace” removal procedure.
3. Remove the Front Frame Assembly. Refer to the “Front Frame Assembly” removal procedure.
4. Refer to Figure 15-75. Remove the eight screws **(1)** that attach the fan assembly to the chassis.

Figure 15-75 Fan Assembly Removal

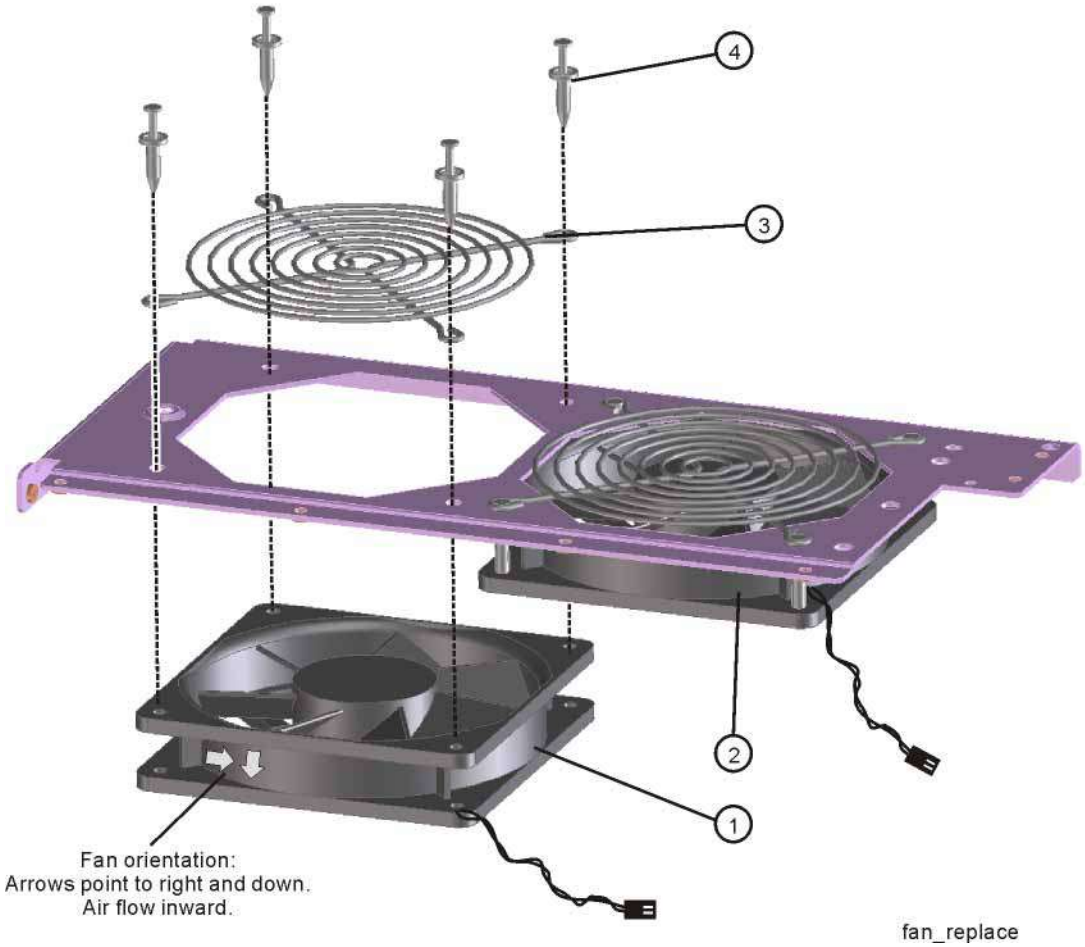


5. Unplug the fan wires from the motherboard. The fan assembly can now be lifted from the chassis.

Replacing a Fan

1. Refer to Figure 15-76. To replace a fan, it is necessary to remove the 4 plastic rivets **(4)** that attach the fan **(1)** and guard **(3)** to the fan bracket. To do this use a small screwdriver to unscrew the rivet and remove it from the bracket.

Figure 15-76 Fan Replacement



2. Position the new fan on the work surface with the arrows pointing to the right and down.
3. Orient the fan guard so that the rings are on the outside, and that the “V” of the support legs are pointing to the neighboring fan.
4. With the rivets center posts raised, snap the rivets into place through the fan grill and fan bracket and into the fan. Screw the center posts into place.

Replacement

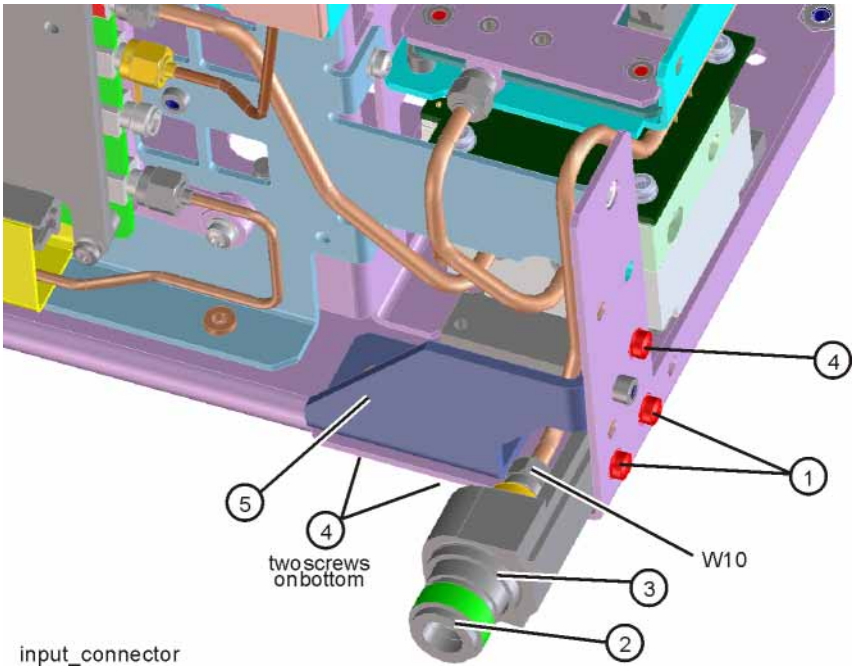
1. Plug the fan wires into the motherboard.
2. Refer to Figure 15-75. Place the fan assembly into position in the chassis. Replace the eight screws **(1)** to attach the fan assembly to the chassis. Torque to 9 inch-pounds.
3. Replace the Front Frame Assembly. Refer to the "Front Frame Assembly" replacement procedure.
4. Replace the top brace. Refer to the "Top Brace" replacement procedure.
5. Replace the instrument outer case. Refer to the "Instrument Outer Case" replacement procedure.

Input Connector Assembly

Removal

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.
2. Remove the Front Frame Assembly. Refer to the "Front Frame Assembly" removal procedure.
3. Refer to Figure 15-77. Disconnect the semi-rigid cable W10 from the Input Connector Assembly **(2)**.

Figure 15-77 Input Connector Assembly Removal



4. Remove the two screws **(1)** that attach the Input Connector Assembly **(2)** to the chassis. The connector assembly can now be lifted from the chassis.
5. To remove the gusset **(5)** remove the three screws **(4)**, one on the side of the chassis and two on the bottom.

Replacement

1. Refer to Figure 15-77. Place the Input Connector Assembly **(2)** into position in the chassis. Replace the two screws **(1)** to attach the Input Connector Assembly to the chassis. Torque to 9 inch-pounds.

NOTE Make sure that the O-ring **(3)** is installed correctly on the input connector.

2. Reconnect the semi-rigid cable W10 to the Input Connector Assembly. Torque to 10 inch-pounds.
3. Place the gusset (5) in position and replace the three screws (4) that attach it to the chassis. Torque to 9 inch-pounds.
4. Replace the Front Frame Assembly. Refer to the "Front Frame Assembly." replacement procedure.
5. Replace the instrument outer case. Refer to the “Instrument Outer Case” replacement procedure.

Front Frame Assembly

Removal

NOTE Make sure any connectors on the front panel are removed.

1. Remove the instrument outer case. Refer to the "Instrument Outer Case" removal procedure.

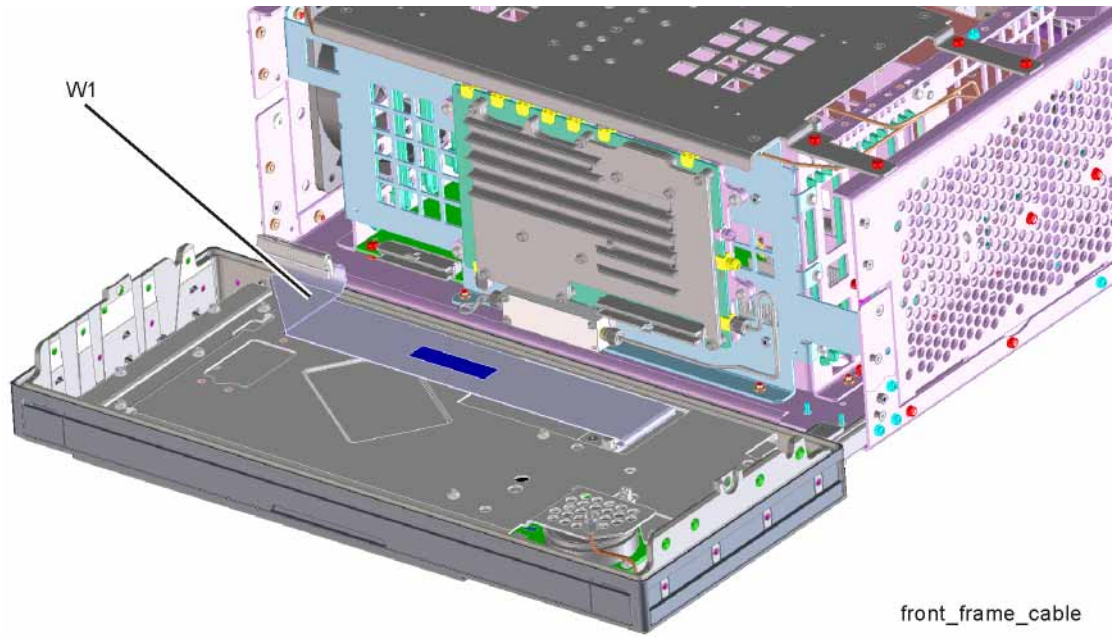
NOTE If the analyzer has Option PRC, Portable Configuration, and you want to remove the bail handle and bumpers from the front frame, refer to the "Bail Handle Removal (Option PRC)" section on page 546.

2. If Option EXM, External Mixing, is installed disconnect semi-rigid cable connection **(2)** on LO/IF cable.
3. Refer to Figure 15-78. Using the T-10 driver, remove the eight screws **(1)**, four on each side, to detach the Front Frame Assembly from the chassis.

Figure 15-78 Front Frame Assembly Removal

4. Refer to Figure 15-79. Pull the Front Frame Assembly carefully away from the chassis. Remove the ribbon cable W1 from the mother board.
5. If the instrument has Option BBA (BBIQ inputs), there will be an additional cable (W24) that will need to be removed. W24 connects to the A18 BBIQ Interface Board. Pull the Front Frame Assembly carefully away from the chassis. Remove the ribbon cable W1 from the mother board.

Figure 15-79 Front Panel Cable



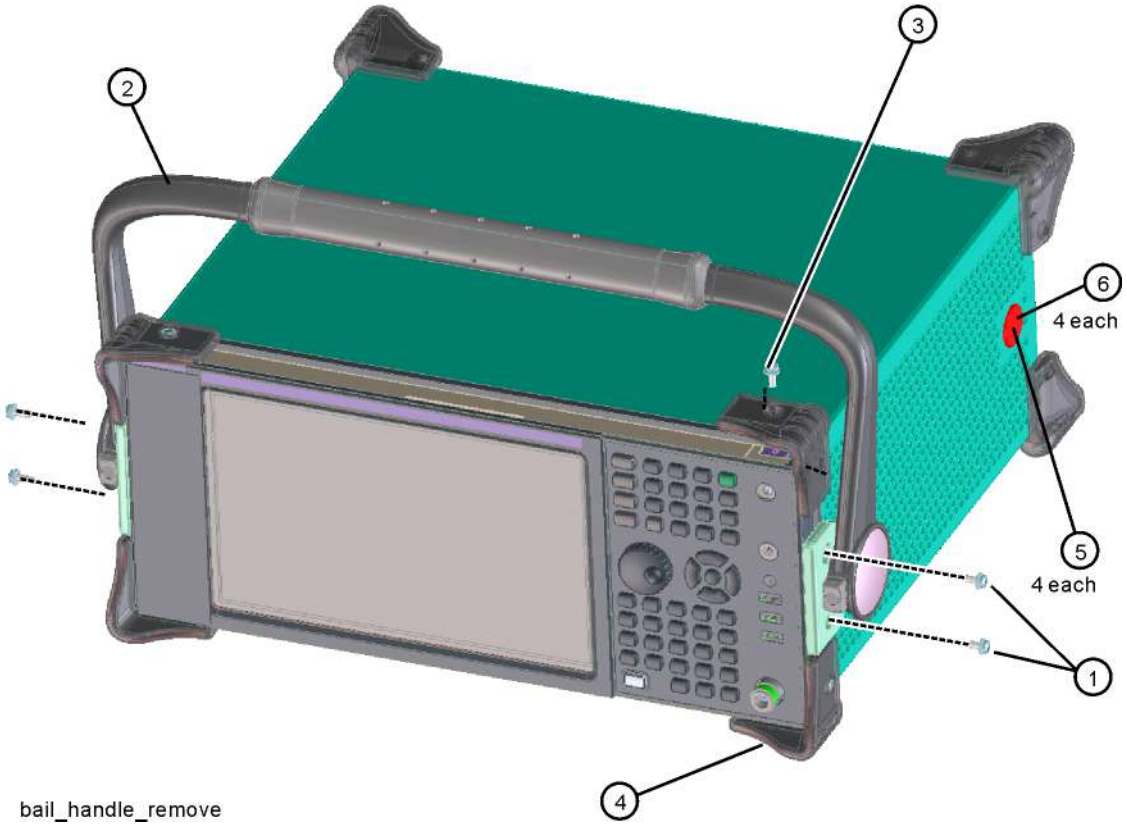
Replacement

1. Reattach the ribbon cable W1.
2. Reattach the ribbon cable W24 for instruments with Option BBA.
3. Refer to Figure 15-78. Carefully position the Front Frame Assembly onto the chassis. Ensure no cables are crushed. Replace the eight screws **(1)**, four on each side of the chassis. Torque to 9 inch pounds.
4. If Option EXM, External Mixing, is installed attach semi-rigid LO/IF cable. Torque to 10 inch-pounds.
5. Replace the outer case. Refer to the “Instrument Outer Case” replacement procedure.

Bail Handle Removal (Option PRC)

1. Refer to Figure 15-80. Using the T-20 driver, remove the four screws **(1)**, two on each side, to detach the Bail Handle Assembly **(2)** from the front frame.
2. Using the T-20 driver, remove the two screws **(3)** on each front bumper **(4)** and remove from the front frame.
3. When replacing these parts, torque to 21 inch-pounds.

Figure 15-80 Bail Handle and Front Bumpers Removal



Front Frame Assembly Components

NOTE Access to any of the Front Frame assemblies requires removal of the Front Frame Assembly from the chassis.

Figure 15-81 Front Frame Parts

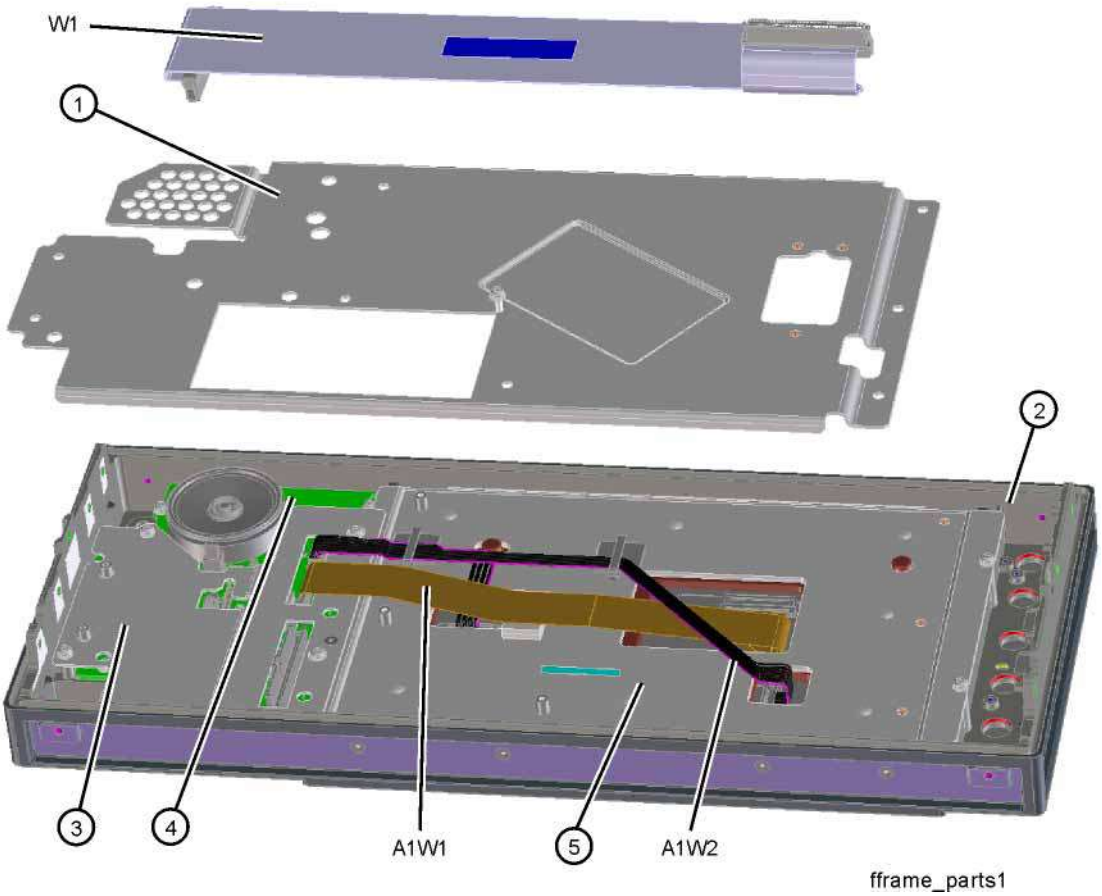


Table 15-3 Front Frame Parts

Item	Description
1	A1MP14 Shield
2	A1A1 Front Frame
3	A1MP10 Bracket front panel shield
4	A1A2 Front Panel Control Board
5	A1MP11 Display Bracket, Front Panel
A1W1	Flex Circuit, Display to Front Panel Control Board
A1W2	Cable Assembly, Backlight

Figure 15-82 Front Frame Exploded View

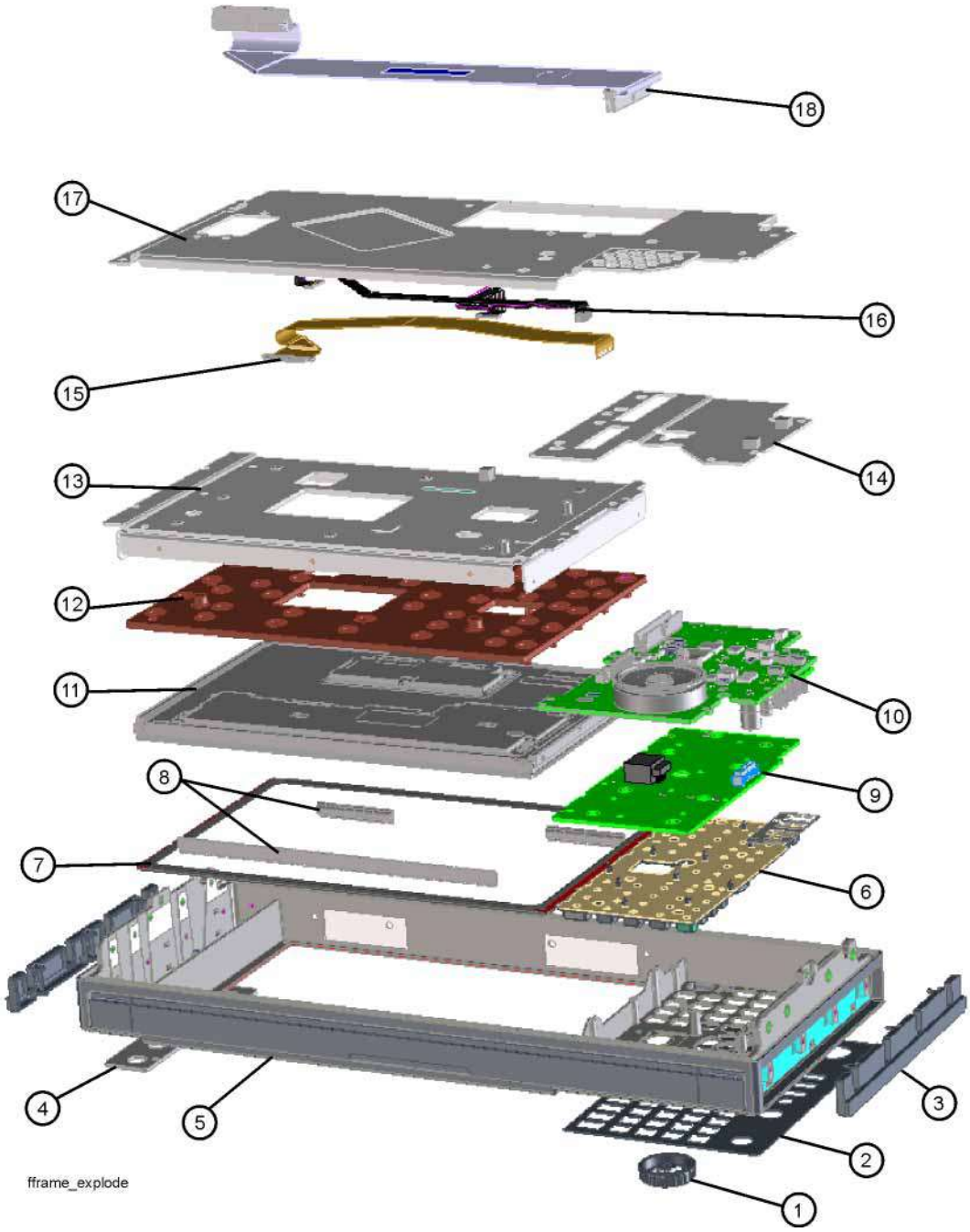
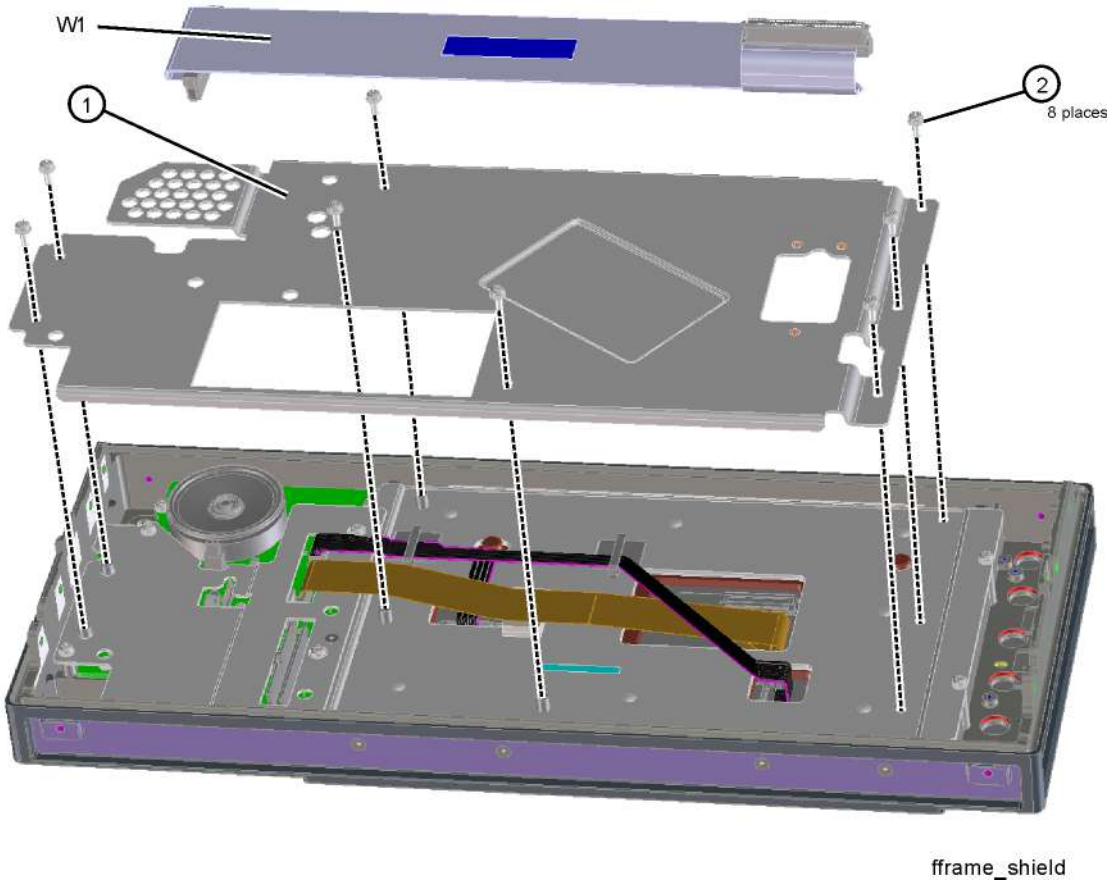


Table 15-4

Item	Description
1	RPG Knob
2	Overlay, Keyboard
3	Front Frame Side Trim Strip (plastic, 2 ea)
4	Cover Plate
5	Front Frame
6	A1A5 Main Keypad
7	Braided Gasket
8	EMI Gasket
9	A1A4 Keyboard, PCA
10	A1A2 Front Panel Control Board
11	A1A3 Liquid Crystal Display 10.6-in w/PCAP Touch 1280X768-Pixels
12	A1MP9 Display hold down (compression pad)
13	A1MP11 Display Bracket, Front Panel
14	A1MP10 Bracket front panel shield
15	A1W1 Flex Circuit, Display to Front Panel Control Board
16	A1W2 Cable Assembly, Backlight
17	A1MP14 Shield
18	W1 Cable, Front Panel Interface Board to Motherboard (Ribbon)

Front Panel Shield

Figure 15-83 Front Panel Shield



1. Refer to Figure 15-83. Remove ribbon cable W1.
2. To remove the front panel shield **(1)**, remove the eight screws **(2)** (0515-0372).
3. When replacing the front panel shield, torque all screws to 9 inch-pounds, When replacing ribbon cable W1 press firmly on each side to ensure the hooks catch on the boards mating connector.

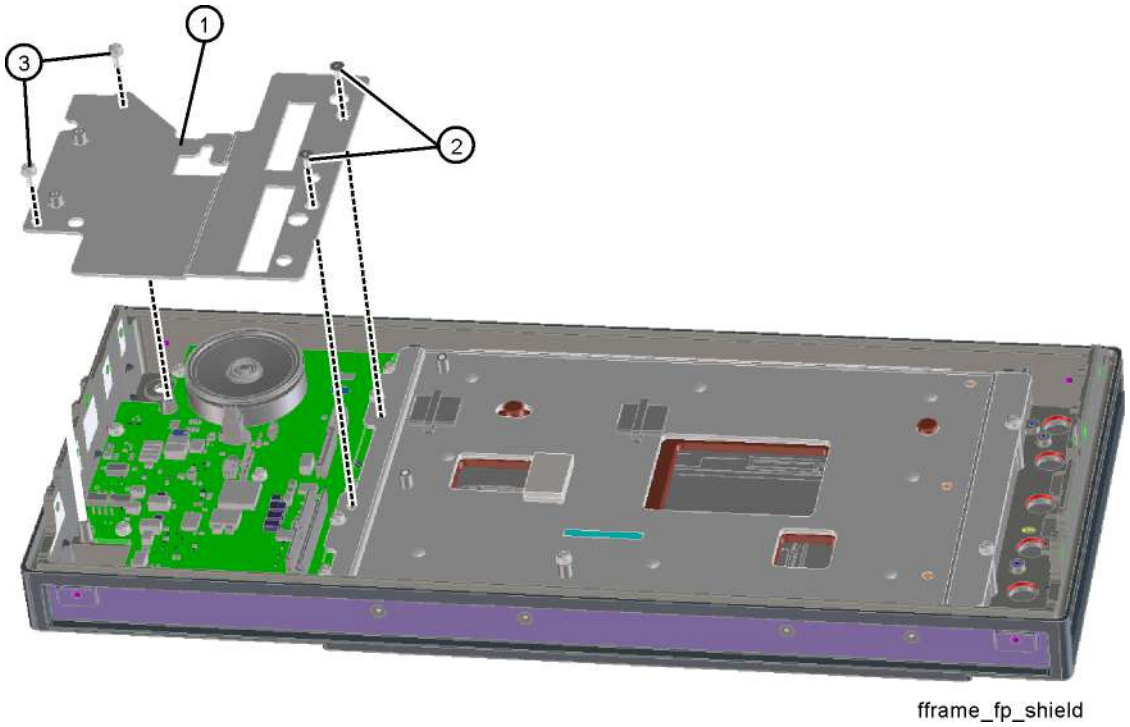
Front Panel Cables

1. Refer to Figure 15-81. Remove cables A1W1 and A1W2.
2. When replacing the cables, dress in the appropriate cable clamps.

Front Panel Control Board and Shield

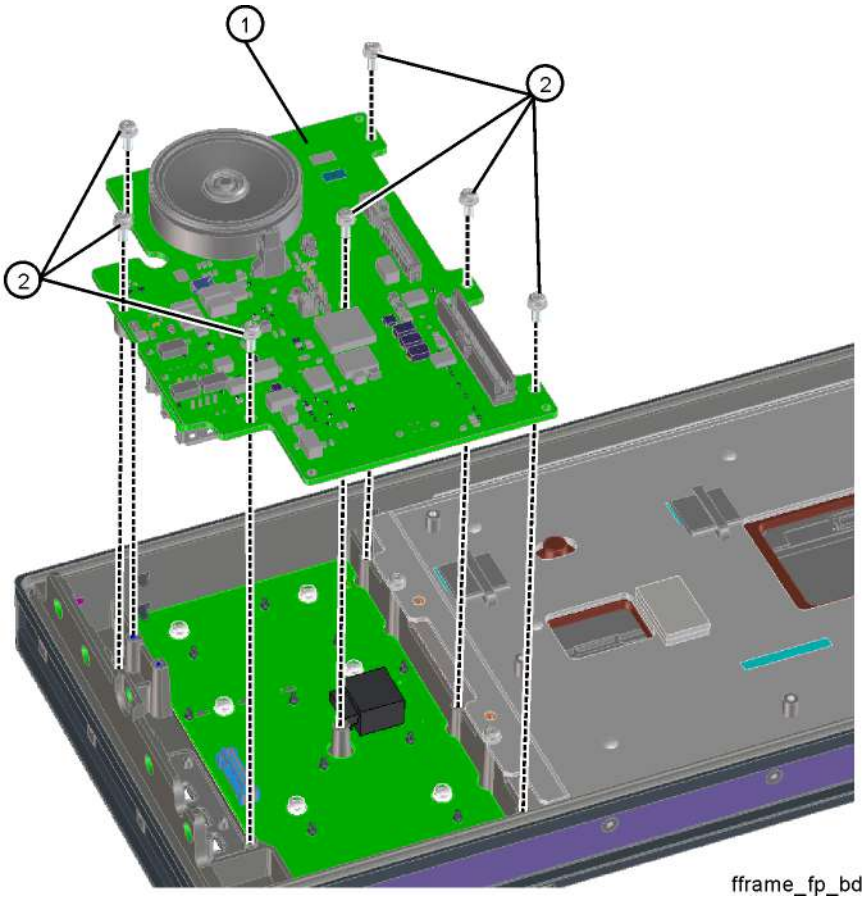
1. Refer to Figure 15-84. To remove the Front Panel Control Shield **(1)**, remove the two screws **(2)** (0515-1946) and the two screws **(3)** (0515-0372).

Figure 15-84 Front Panel Control Shield and Board Removal



2. Refer to Figure 15-85. To remove the Front Panel Control board **(1)**, remove the seven screws **(2)** (0515-0372). When replacing the board torque the screws to 9 inch-pounds.

Figure 15-85 Front Panel Control Board

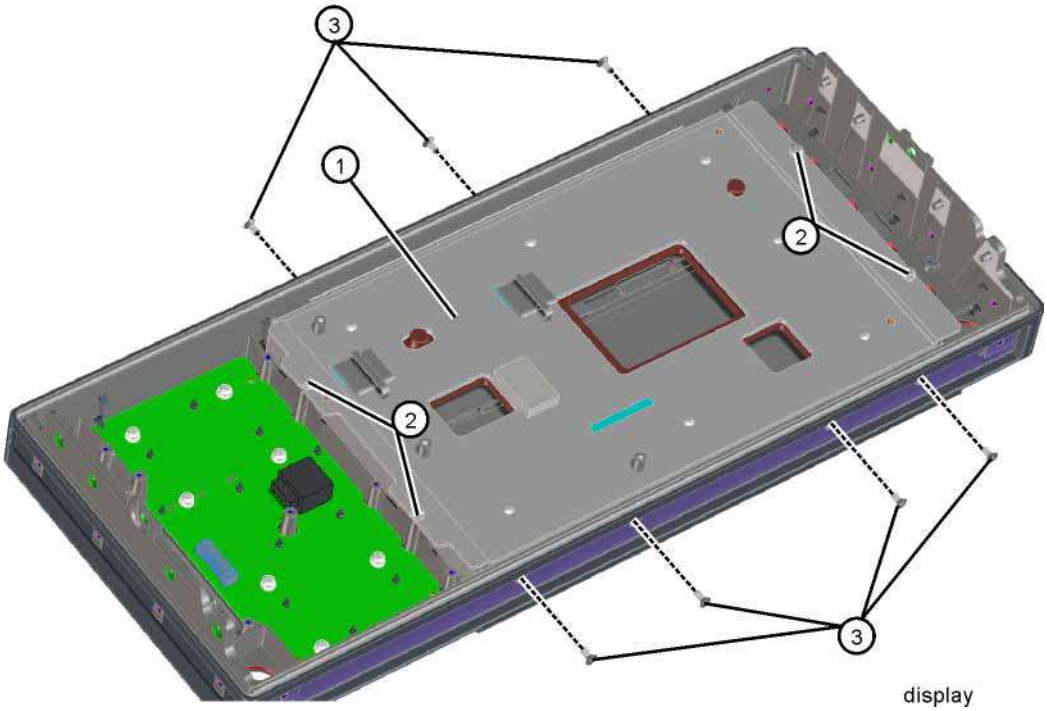


Display Assembly

Removal

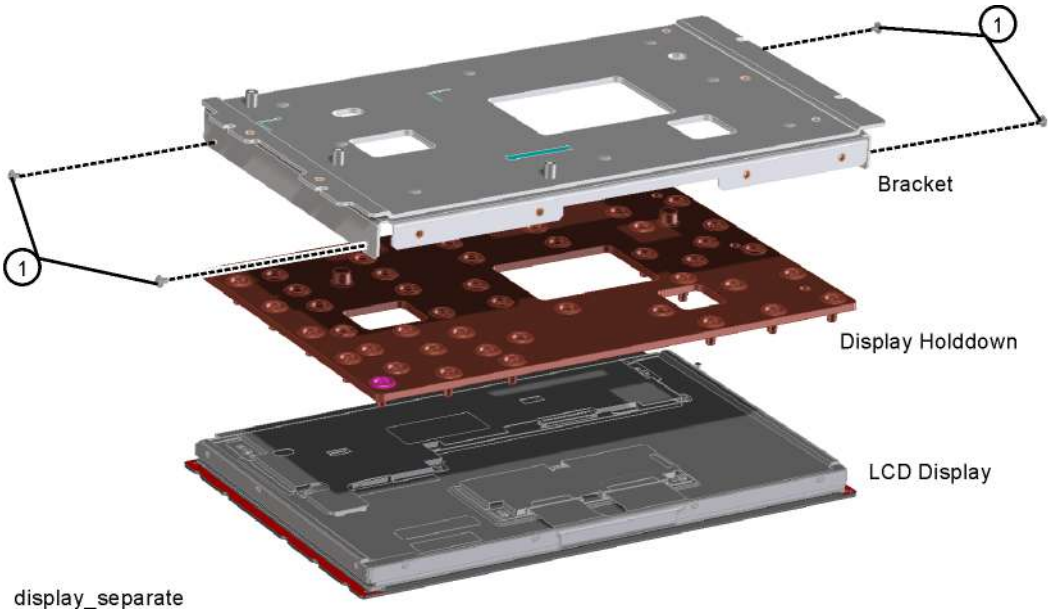
1. Refer to Figure 15-86. Remove the four screws **(2)** (0515-0372) and the seven screws **(3)** (0515-1946). The display assembly **(1)** can now be lifted out of the front frame. When replacing the display assembly in the front frame, torque the screws to 9 inch-pounds.

Figure 15-86 Display Removal



2. Refer to Figure 15-87. To separate the display and display holddown from the display bracket, remove the four screws **(1)** (0515-0365). When reassembling the display assembly, torque the screws to 2 inch-pounds.

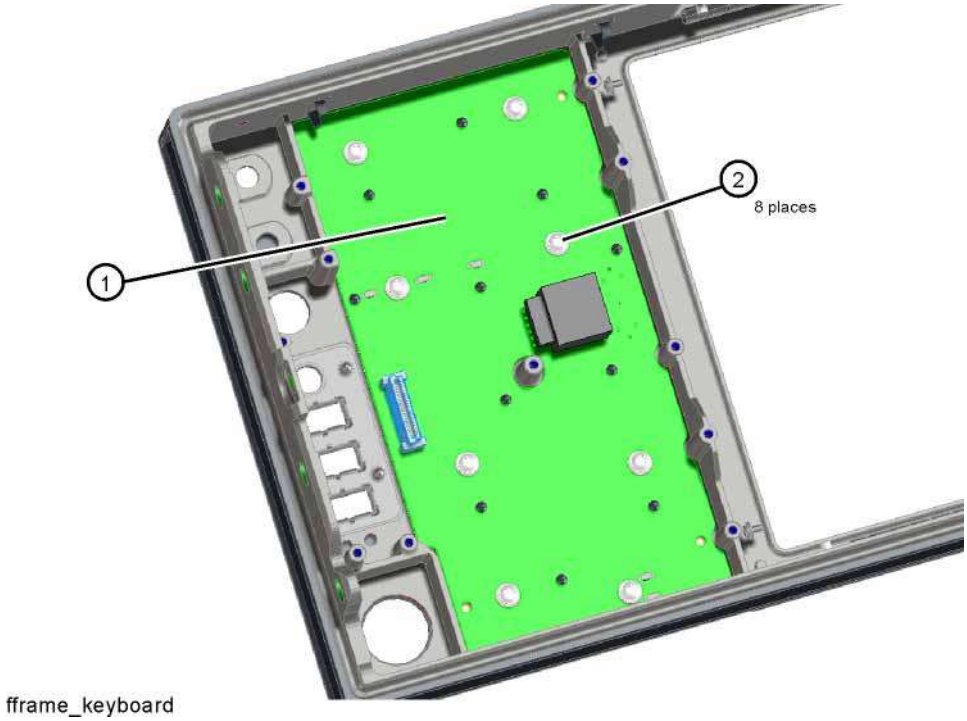
Figure 15-87 Display and Bracket Separation



Keyboard/Keypad

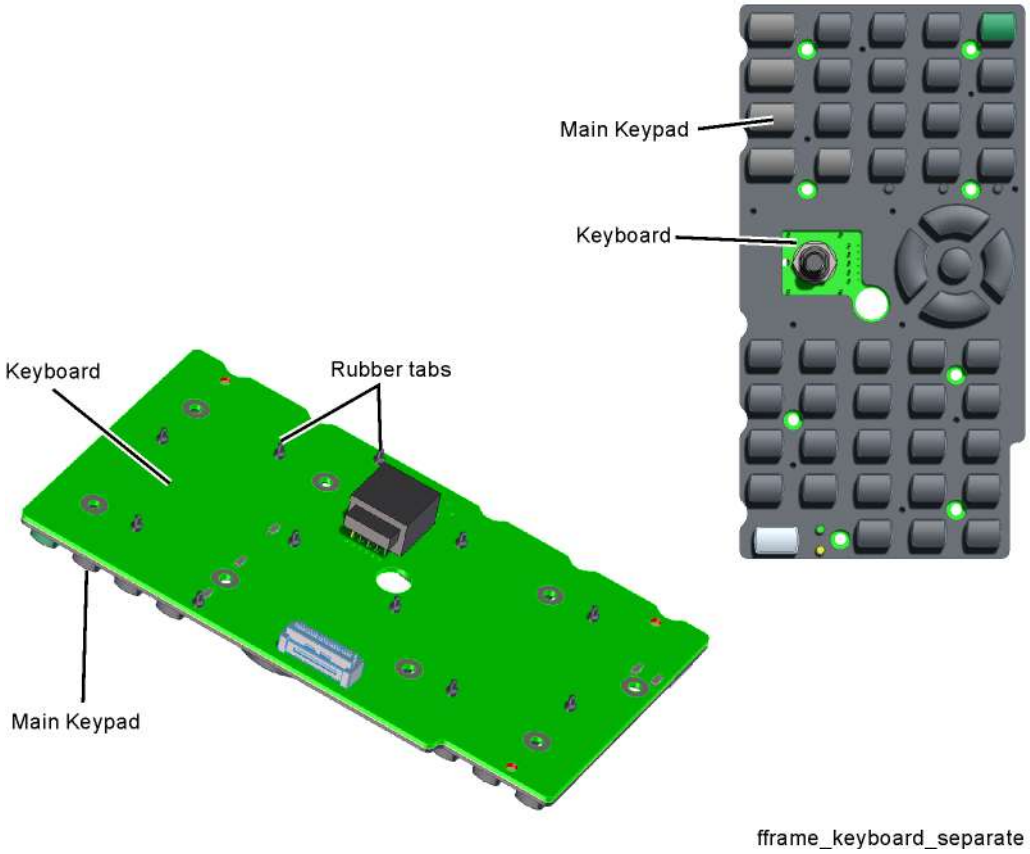
1. Refer to Figure 15-88. Remove the RPG knob by carefully pulling it off the shaft. To remove the keyboard **(1)**, remove the eight screws **(2)** (0515-0430). When replacing the keyboard into the front frame, torque the screws to 9 inch-pounds. Replace the RPG knob by firmly pushing it onto the shaft.

Figure 15-88 Keyboard



2. Refer to Figure 15-89. To separate the keypad from the keyboard pull the keypad away from the keyboard to release the multiple rubber tabs.

Figure 15-89 Keyboard Keypad Separation



3. Remove the protective film from the new keypad (if replacing). Lay the keypad on the keyboard and pull up on the tabs from the back of the board to seat them in place.

Option BBA

NOTE Access to any of the Option BBA Front Frame assemblies requires removal of the Front Frame Assembly from the chassis.

Figure 15-90 Option BBA Parts Locator

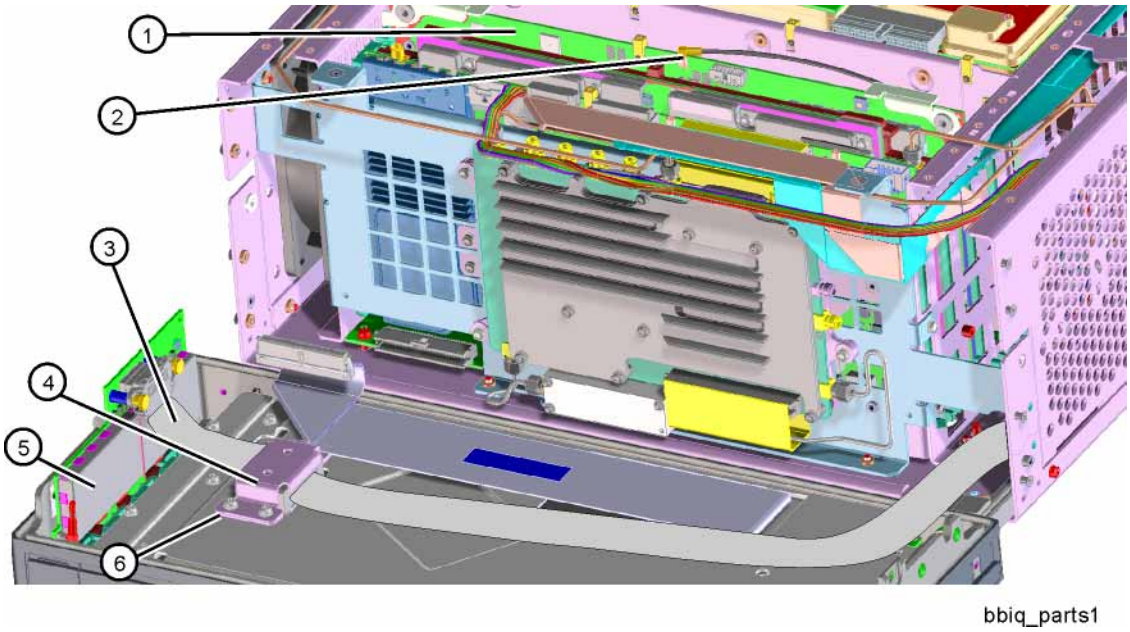


Table 15-5

Item	Description
1	A19 BBIQ Main Board (Option BBA)
2	W25 Cable Assembly, A19J101, BBIQ Main Board to A16J707 Reference Board (Flexible Coax) (Option BBA)
3	W24 Cable Assembly, A18J1, BBIQ Interface Board to A19J1, BBIQ Main Board (Ribbon Cable) (Option BBA)
4	A1MP16 Core Bracket, Top (Option BBA)
5	A18 BBIQ Interface Board (Option BBA)
6	A1MP19, Core Bracket, Bottom (Option BBA)

BBIQ Interface Board, LED Board, and Overlay

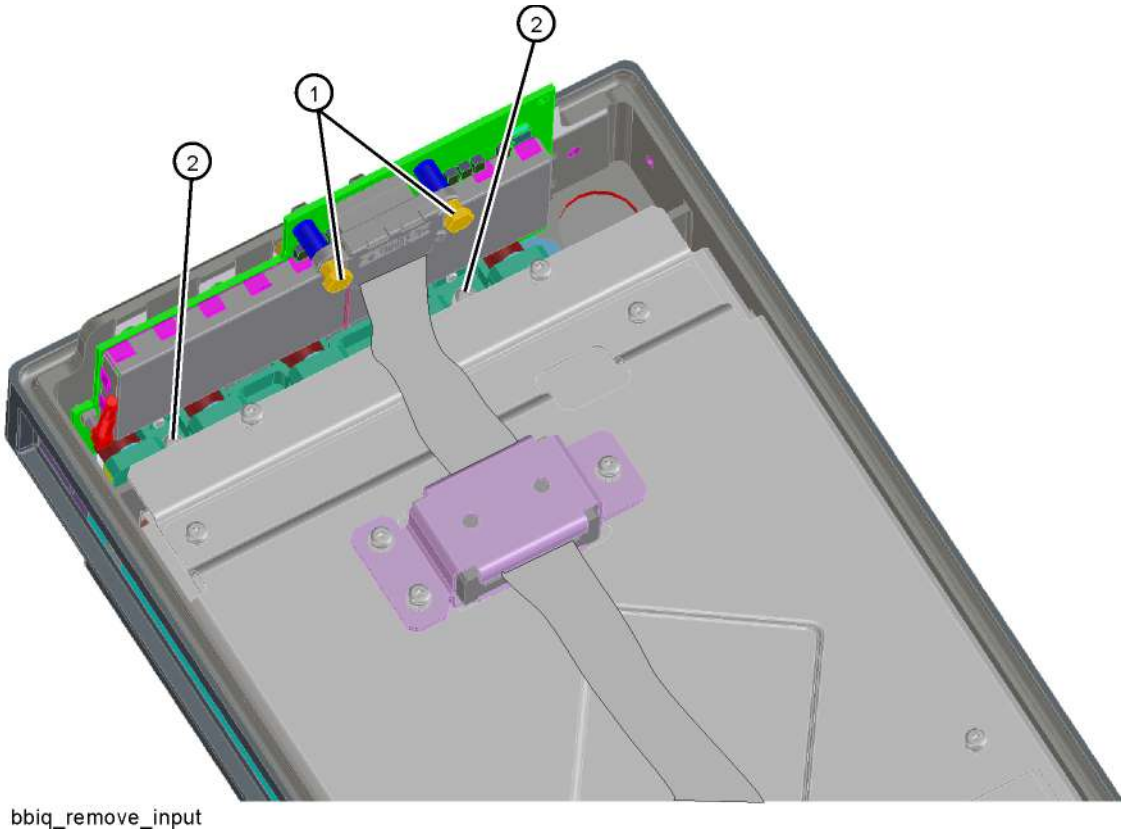
Removal

1. Refer to Figure 15-91. Using a ¼-inch socket remove the two Hex screws **(1)** that secure the flex ribbon into the connector.

NOTE The flex ribbon cannot have tight radial bends as this will damage the cable.

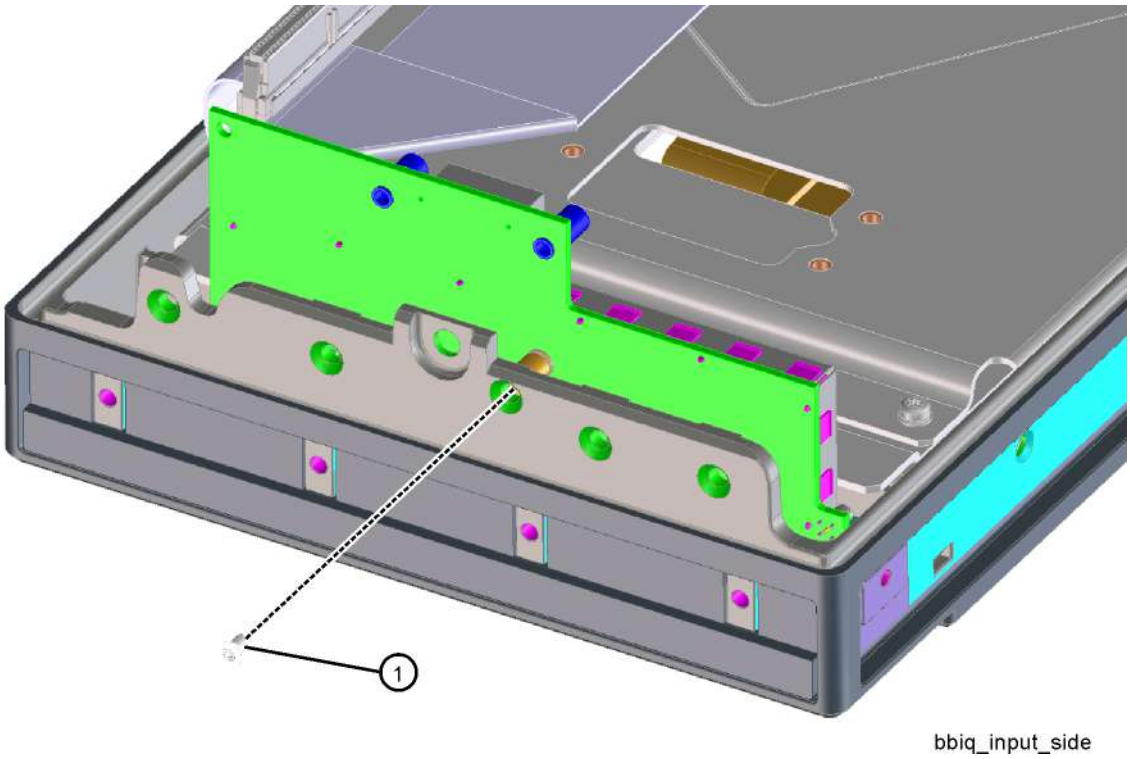
2. Remove the two screws **(2)** attaching the BBIQ Interface board to the front frame.

Figure 15-91 BBIQ Interface Board Removal



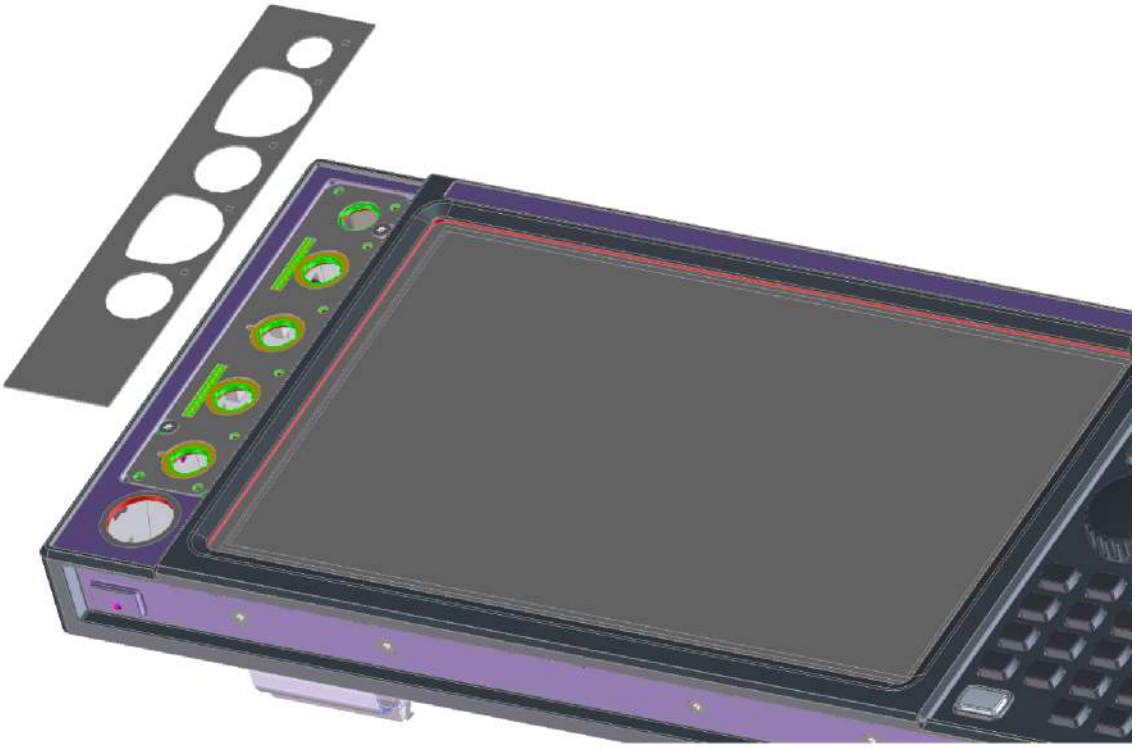
3. Refer to Figure 15-92. Remove the side screw **(1)** attaching the BBIQ Interface board to the front frame.

Figure 15-92 BBIQ Interface Board Side Screw



4. Refer to Figure 15-93. Carefully pry up the top overlay to separate it from the LED board.

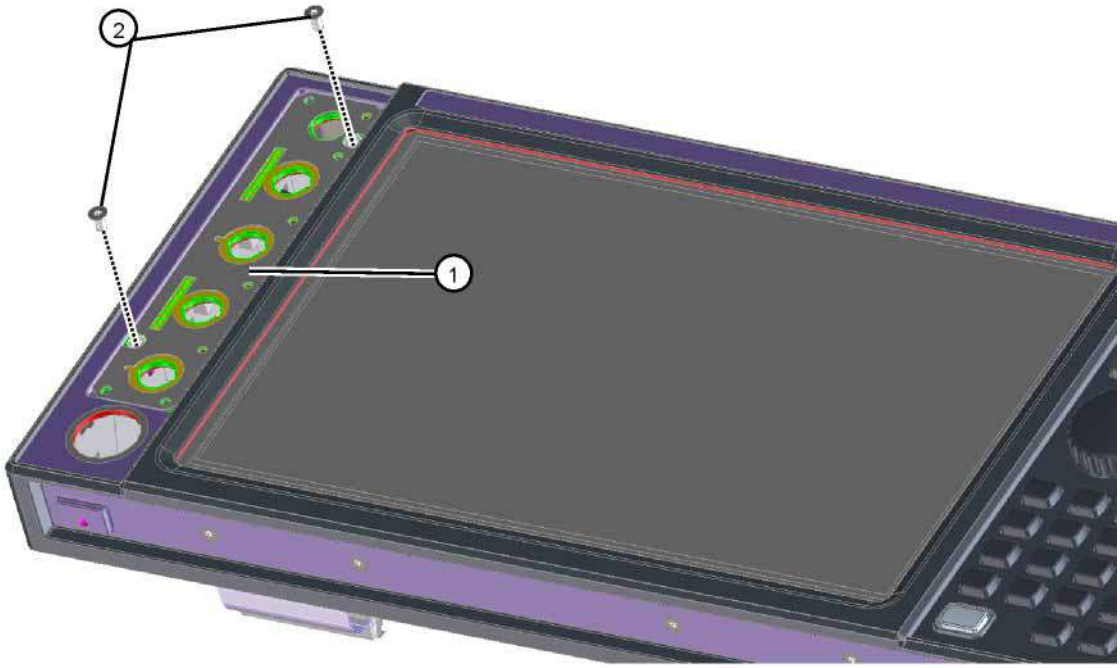
Figure 15-93 Top Overlay Removal



bbiq_ff_2

5. Refer to Figure 15-94. Remove the two screws **(2)** attaching the LED board and bottom overlay to the front frame assembly.

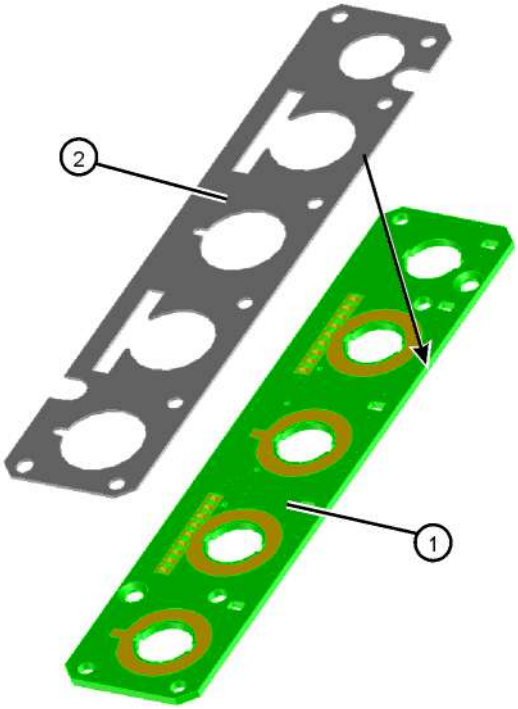
Figure 15-94 LED Board Installation



bbiq_ff_1

6. Refer to Figure 15-95. The LED board **(1)** can now be separated from the LED board overlay **(2)**.

Figure 15-95 LED Board and Overlay



Replacement

1. Refer to Figure 15-95. Line up the holes and carefully attach the overlay **(2)** to the LED board **(1)**.
2. Refer to Figure 15-94. Install the LED board with overlay attached into the front frame.
3. Secure the LED board with two screws **(2)**. Torque to 9 in-lbs.
4. Refer to Figure 15-91. Install the BBIQ Interface board, into the front frame passing the BNC connectors through the holes. Secure the board with two screws **(2)**. Torque to 9 in-lbs.
5. Reconnect the ribbon cable to the connector on the BBIQ Interface board. Using a ¼-inch socket reinstall the two Hex screws **(1)** that secure the flex ribbon into the connector. Torque to 4 in-lbs.
6. Refer to Figure 15-92. Secure the BBIQ Interface board to the side of the front frame with a single screw **(1)**. Torque to 9 in-lbs.
7. Refer to Figure 15-93. Line up and carefully attach the top overlay over the lower overlay.
8. Press firmly down over the entire surface area of the top overlay.

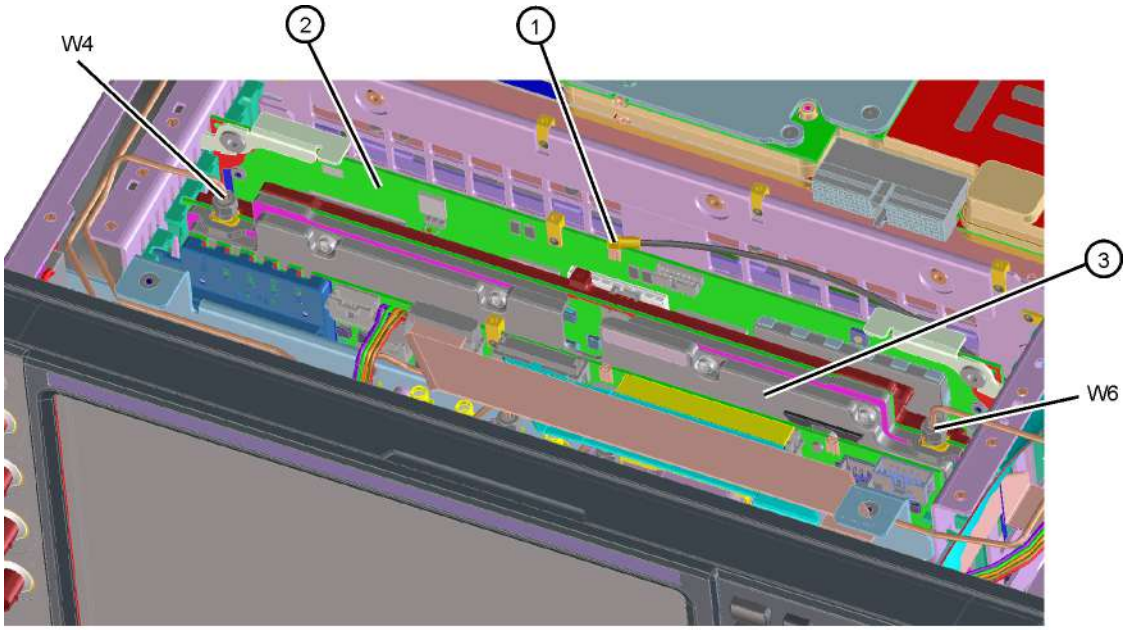
BBIQ Main Board

Removal

1. Refer to Figure 15-96. Remove W4 and W6 from the A14 L.O. Synthesizer board. Lift and remove the A14 **(3)** from the instrument. Remove the coax cable **(1)** and the ribbon cable (along the side of the board) first before lifting the board extractors to remove the A19 BBIQ Main board **(2)**. Otherwise damage to the ribbon cable will occur.

NOTE The flex ribbon cannot have tight radial bends as this will damage the cable.

Figure 15-96 BBIQ Main Board Removal



bbiq_remove_main

Replacement

1. Refer to Figure 15-96. Install the A19 BBIQ Main board into slot 4 and use the board extractors to secure the board into the motherboard connectors. Reattach the coax cable **(1)**. Carefully route the ribbon cable through the chassis side wall and gently press the cable into place until it snaps into the A19J1 connector off the BBIQ Main board. Re-install the A14 L.O. Synthesizer board and re-attach W4 and W6 cables.

16 Post-Repair Procedures

What You Will Find in This Chapter

This chapter provides information that will enable you to return an instrument to full operation following the replacement of any instrument assembly. This information includes a table that shows which adjustments and/or performance tests must be executed after replacing an assembly.

Before Starting

There are three things you should do before starting any of the procedures listed or described in this chapter:

- Familiarize yourself with the safety symbols, and read the general safety considerations and the safety note definitions in the front of this guide, **before** you begin the procedures in this chapter.
- Check that the analyzer has been turned on and allowed to warm up.
- Ensure that the analyzer is operating within a temperature range of 20 °C to 30 °C.

Test equipment you will need

Refer to Table 1-1 on page 28, for a list of recommended equipment and critical test equipment specifications for the performance verification and adjustments.

Post-Repair Procedures

Post-Repair Procedures

Table 16-1 lists the adjustments and performance verification tests needed after an assembly replacement.

After an assembly is replaced, find the assembly that has been replaced in the left-hand column, and then perform the recommended adjustment and/or performance verification test. Making the recommended adjustments and/or performance verification tests doesn't guarantee all published specifications are being met. Only a full instrument calibration will do this.

NOTE

Refer to the analyzer user's guide for information on instrument warm-up before performing any of the procedures listed in this chapter.

The following procedures are also included in the "Additional Tasks" on page 571.

- "Calibration Data Backup and Restore"
- "BIOS Settings Verification"
- "Operating System Initialization"
- "FPGA Synchronization"
- "Programming Model and Serial Numbers"

Post-Repair Procedures

Table 16-1 Post-Repair Testing Requirements

Assembly	Adjustments to Perform (in the order listed)[a]	Performance Verifications to Perform After Adjustments [ab]
A1A2 Front Panel Interface	None	Residual Responses Displayed Average Noise Level
A1A3 Liquid Crystal Display	None	Residual Responses Displayed Average Noise Level
A2 Analog I.F. Assembly	IF Frequency Response[c]	Power Bandwidth Accuracy Resolution Bandwidth Switching Uncertainty Residual Responses Displayed Average Noise Level I.F. Frequency Response Absolute Amplitude Accuracy Display Scale Fidelity
A3 Digital I.F. Assembly	FPGA Synchronization[d]	Power Bandwidth Accuracy Resolution Bandwidth Switching Uncertainty Residual Responses Displayed Average Noise Level I.F. Frequency Response Absolute Amplitude Accuracy Display Scale Fidelity
A4 CPU Assembly	BIOS Settings Verification[d] Set Instrument Time and Date[e]	Residual Responses Displayed Average Noise Level
A4BT1 Battery	BIOS Settings Verification[d] Set Instrument Time and Date[e]	Residual Responses Displayed Average Noise Level
A5 Disk Drive[f]	Accept End User License Agreement (EULA)[d] Instrument Software Update[g] All Adjustments[f]	Residual Responses Displayed Average Noise Level Frequency Response (All Tests)
A6 Power Supply	None	Residual Responses Displayed Average Noise Level Spurious Responses
A7 Midplane board	None	Residual Responses Displayed Average Noise Level
A8 Motherboard	None	Residual Responses Displayed Average Noise Level

Post-Repair Procedures

Table 16-1 Post-Repair Testing Requirements (Continued)

Assembly	Adjustments to Perform (in the order listed)[a]	Performance Verifications to Perform After Adjustments [ab]
A9 & A10 RF Attenuators	Hardware Statistical Reset Utility 50 MHz Calibrator Adjustment Frequency Response (All Adjustments) Attenuator Slope Attenuator Slope, Preamp On	Residual Responses Displayed Average Noise Level Spurious Responses Third Order Intermodulation Absolute Amplitude Accuracy Input Attenuation Switching Uncertainty Frequency Response (All Tests)
A11 Low Band Switch	Frequency Response (All Tests) Attenuator Slope Attenuator Slope, Preamp On	Residual Responses Displayed Average Noise Level Spurious Responses Third Order Intermodulation Second Harmonic Distortion Absolute Amplitude Accuracy Frequency Response (All Tests)
A12 YTF Preselector	YTF Alignment (Press **System**, **Alignments**, **Advanced**, **Characterize Preselector**) Frequency Response (All Adjustments) Attenuator Slope Attenuator Slope, Preamp On	Residual Responses Displayed Average Noise Level Spurious Responses Third Order Intermodulation Second Harmonic Distortion Absolute Amplitude Accuracy Frequency Response (All Tests)
A13 Front End Assembly	Frequency Response (All Tests) Attenuator Slope Attenuator Slope, Preamp On	Residual Responses Displayed Average Noise Level Spurious Responses Third Order Intermodulation Second Harmonic Distortion Absolute Amplitude Accuracy Frequency Response (All Tests)
A14 L.O. Synthesizer Assembly	FPGA Synchronization[d]	Residual Responses Displayed Average Noise Level Spurious Responses Phase Noise (All Tests) Frequency Response (All Tests)
A15 Front End Control Assembly	FPGA Synchronization[d] YTF Alignment (Press **System**, **Alignments**, **Advanced**, **Characterize Preselector**) Front End Controller Attenuator Adjustment (Option CR3 or CRP)	Residual Responses Displayed Average Noise Level Absolute Amplitude Accuracy Frequency Response (All Tests)

Post-Repair Procedures

Table 16-1 Post-Repair Testing Requirements (Continued)

Assembly	Adjustments to Perform (in the order listed)[a]	Performance Verifications to Perform After Adjustments [ab]
A16 Reference Assembly	FPGA Synchronization[d] 10 MHz Frequency Reference Adjust 50 MHz Calibrator Amplitude Adjust 4800 MHz Calibrator Amplitude Adjustment (Option MPB)	Frequency Reference Accuracy Residual Responses Displayed Average Noise Level Frequency Readout Accuracy Count Accuracy Absolute Amplitude Accuracy Phase Noise (All Tests)
A17 LED Board (Option BBA)	None	Residual Responses Displayed Average Noise Level
A18 BNC Interface Board (Option BBA)	Press **Input/Output**, **I/Q**, **I/Q Cable Calibrate** Absolute Amplitude (Option BBA) Adjust	Residual Responses Displayed Average Noise Level Absolute Amplitude Accuracy at 250 kHz Frequency Response Below 250 kHz Frequency Response Above 250 kHz Channel Match
A19 BBIQ Main Board (Option BBA)	FPGA Synchronization[d] Press **Input/Output**, **I/Q**, **I/Q Cable Calibrate** Absolute Amplitude (Option BBA) Adjust	Residual Responses Displayed Average Noise Level Absolute Amplitude Accuracy at 250 kHz Frequency Response Below 250 kHz Frequency Response Above 250 kHz Channel Match
A25 Wide Band Analog IF (Option B85, B1A, B1X)	IF Frequency Response	Noise Density
A26 Wide Band Digital IF (Option B85, B1A, B1X)	FPGA Synchronization[d]	
SW1 Preselector Bypass Switch (Opt MPB)	Frequency Response (all tests) Attenuator Slope Attenuator Slope, Preamp On Hardware Statistical Reset	Frequency Response (all)
SW2 Preselector Bypass Switch (Opt MPB)	Frequency Response (all tests) Attenuator Slope Attenuator Slope, Preamp On Hardware Statistical Reset	Frequency Response (all)

Post-Repair Procedures

Table 16-1 Post-Repair Testing Requirements (Continued)

Assembly	Adjustments to Perform (in the order listed)[a]	Performance Verifications to Perform After Adjustments [ab]
SW4 Preselector Bypass Switch (Option MPB)	Frequency Response (All tests) Attenuator Slope Attenuator Slope (Preamp On) Hardware Statistical Reset	Frequency Response (All)
W24 BBIQ Cable Assembly (Option BBA)	Press **Input/Output**, **I/Q**, **I/Q Cable Calibrate** Absolute Amplitude (Option BBA) Adjust	Residual Responses Displayed Average Noise Level Absolute Amplitude Accuracy at 250 kHz Frequency Response Below 250 kHz Frequency Response Above 250 kHz Channel Match

a. Calibration Application Software is required for all performance tests and most adjustments. For details go to http://www.keysight.com/find/calibrationsoftware.
b. If Adjustments to Perform for a given assembly are listed as “None”, the Performance Verifications listed should still be performed to ensure performance has not been compromised.
c. IF Frequency Response adjustment only performed if Option B25 and/or B40 are present and analyzer is equipped with Option MPB.
d. See the Additional Tasks section in this chapter for detailed instructions on this task.
e. To set the instrument time and date press **Windows icon, Start**, **Control Panel**, **Clock, Language, and Region**, **Date and Time**.
f. Before replacing the A5 Disk Drive, see the “Calibration Data Backup and Restore” section in this chapter for details.
g. See Chapter 18, “Instrument Software.” for instructions on updating the instrument software to the latest version.

NOTE Some Adjustment tests may be found in the Utility portion of the Test Plan.

Post-Repair Procedures

Additional Tasks

Calibration Data Backup and Restore

In order for the instrument being repaired to not need all of the instrument adjustments and performance verification tests to be run after the A5 Disk Drive is replaced the calibration data will need to be backed up onto an external drive prior to removing the existing disk drive.

NOTE

While the backing up and restoring of the calibration data to the new disk drive will return the instrument performance to the state that it was prior to a repair this does not guarantee that all instrument performance parameters meet their specified values. A full instrument calibration would be required to verify this.

Data Backup

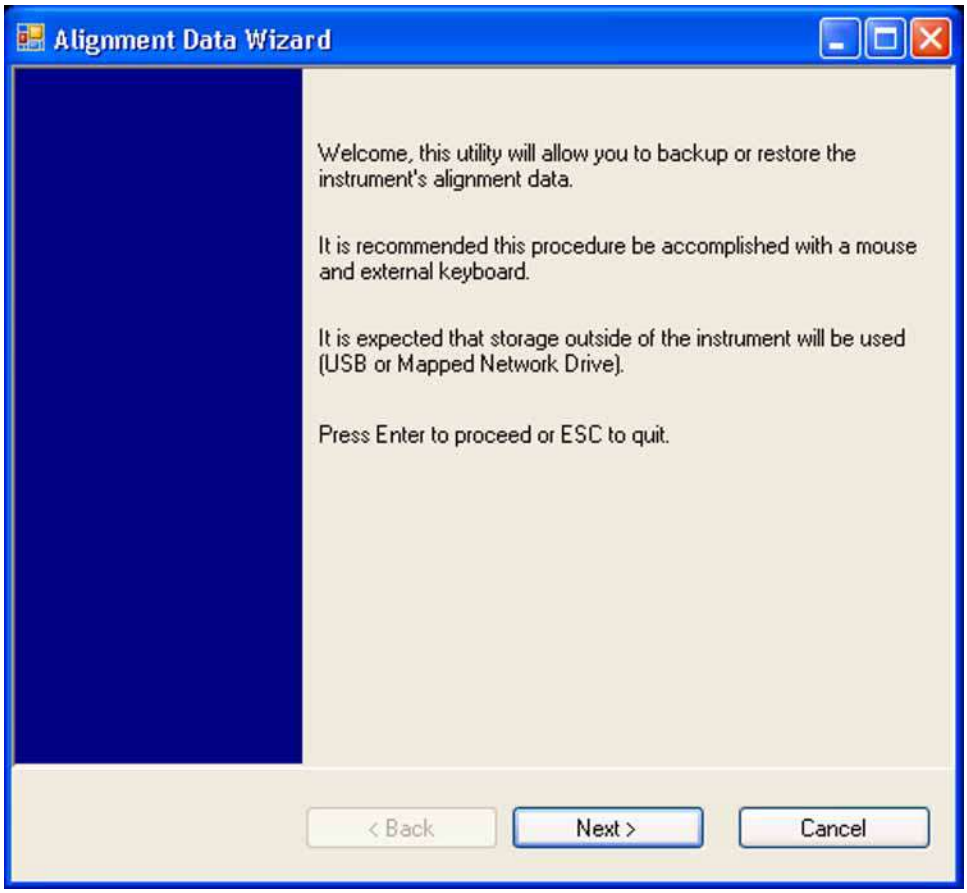
There are two different backup procedures that might need to be followed. Which backup procedure to be run will depend on whether the software will run or not.

If the Instrument Software Application Will Run

1. Connect a USB keyboard and mouse to two of the instrument rear panel USB ports
2. Connect a USB FLASH drive to one of the front panel USB port.
3. Press **System**, **Alignments**, **Backup or Restore Align Data**.
4. After the XSA application closes the Alignment Data Wizard window as shown in Figure 16-1 will appear.

Post-Repair Procedures

Figure 16-1 Alignment Data Wizard



5. Follow the on-screen instruction to backup the calibration data to the USB FLASH drive.

If the Instrument Software Application Will Not Run

1. Connect a USB mouse to one of the instrument front panel USB ports.
2. Connect a USB FLASH drive to the other front panel USB port.
3. Using the mouse double-click on the Windows Explorer link on the desktop and navigate to the following folder:

   C:\Program Files\Agilent\SignalAnalysis\Physics

4. Double-click on BackupAndRestore.exe and the window shown in Figure 16-2 will appear.

Post-Repair Procedures

Figure 16-2 Calibration Data Backup

5. Under the “Specify Backup Folder or File Name” use the mouse to select the “...” button to open the “Browse For Folder” dialog box.
6. Select the USB FLASH drive and press **OK**.

NOTE

While you can use the “Make New Folder” button in the “Browse For Folder” dialog box to create a sub-folder on the USB FLASH drive, and you can specify a filename in the “Specify Backup Folder or File Name” window, you can also just use the root directory on the drive and let the instrument select a default filename for you.

7. Select “Backup” and wait for the calibration database to be backed up.
8. When the backup has completed close the Calibration Data Backup And Restore window.

Post-Repair Procedures

Data Restore

1. Connect a USB mouse to one of the instrument front panel USB ports.
2. Locate the USB FLASH drive that was earlier used to backup the instrument calibration file and insert it into one of the instrument front panel USB ports.
3. Restore the instrument calibration data by pressing: **System**, **Alignments**, **Backup or Restore Align Data...**. The Alignment Data Wizard window as shown in Figure 16-1 will appear.
4. Follow the on-screen instruction to restore the previously saved calibration data from the USB FLASH drive.
5. Cycle instrument power.

Post-Repair Procedures

BIOS Settings Verification

Whenever either the A4 CPU assembly or the A4BT1 CPU Battery is changed there are certain BIOS settings that need to be verified. If these are not set correctly the instrument may not boot up or operate correctly.

Default BIOS Settings

1. Connect an external USB keyboard to one of the front panel USB ports.
2. Turn on instrument power.
3. Confirm Keysight Technologies splash screen comes up within a few seconds.
4. Press the key on the keyboard specified on the initial boot screen to enter the setup utility.
5. Navigate to the Exit screen and select “Restore Defaults” or “Load Setup Defaults”, whichever is present.
6. Once the defaults have been loaded select “Save Changes” and “Exit”.

Post-Repair Procedures

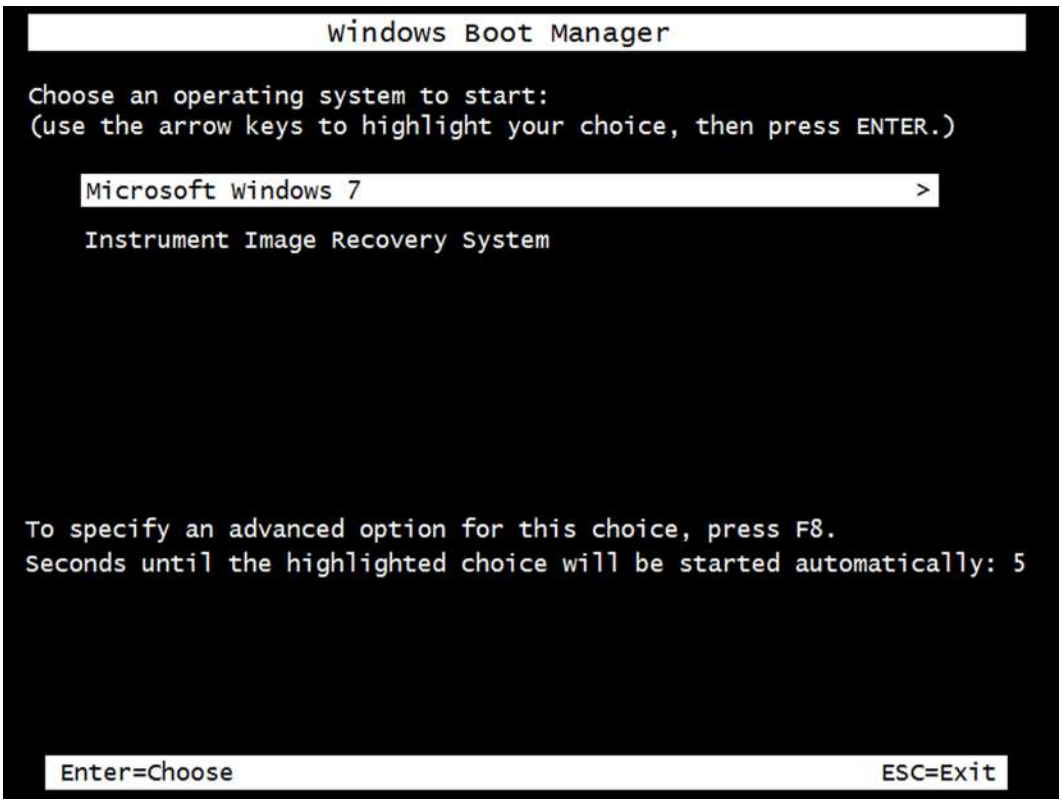
Operating System Initialization

When a new disk drive is powered on for the first time the operating system will need to initialize itself before the instrument can be used. This will take just a few minutes to complete and will require very little user interaction.

Initialization

1. With the new disk drive installed power the instrument on.
2. Within a few seconds you will see the initial Keysight Technologies splash screen, and then the boot selection menu as seen in Figure 16-3.
3. Allow the instrument to boot the Windows operating system. (This will happen automatically after 5 seconds if the instrument is left alone).

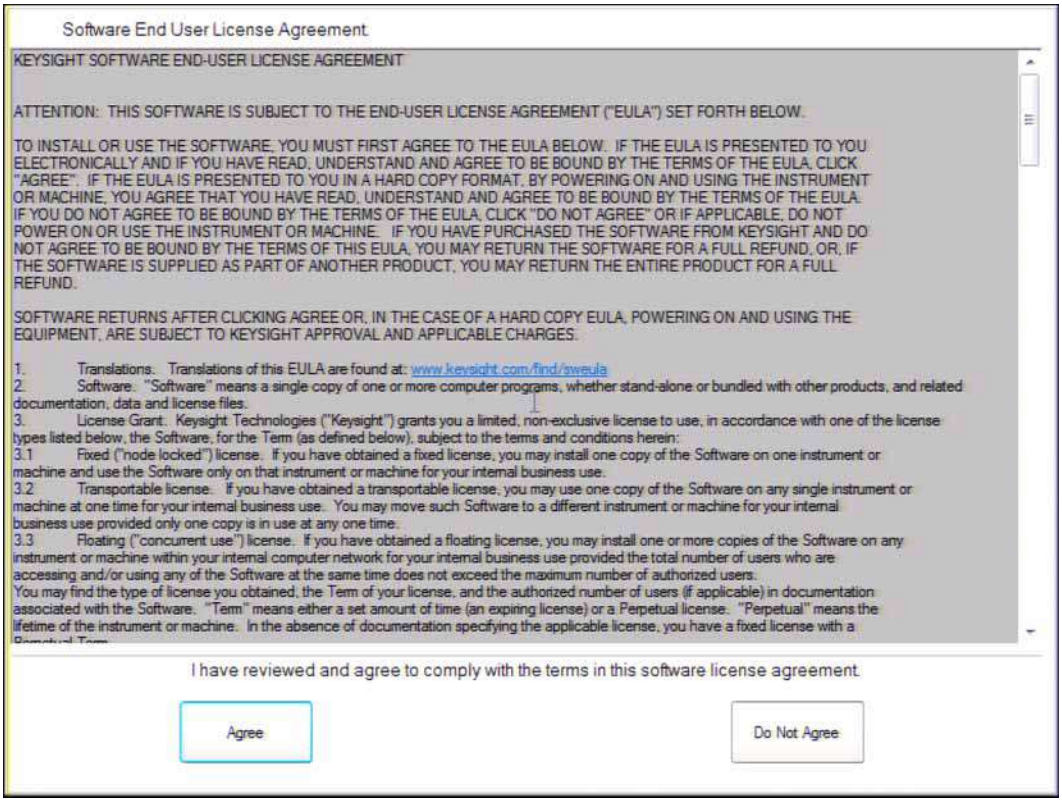
Figure 16-3 Boot Selection Screen



Post-Repair Procedures

4. After a few moments the License Agreement message window will appear, as shown in Figure 16-4.

Figure 16-4 License Agreement Window



5. Select “Agree” to continue with the operating system initialization.

NOTE

If the initialization process would like to be postponed select “Do Not Agree” at this time to safely shut the instrument off. The next time this disk drive is powered on this process will be restarted.

Post-Repair Procedures

6. The instrument will now reboot and complete the initialization process. Once this process has completed the Anti-Virus Message. At this point the operating system initialization process will be completed and either selection can be made, or the instrument can be powered off.

NOTE

Keysight Technologies does not load anti-virus software into the signal analyzer. It is the customer's responsibility to install anti-virus software.

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7. The disk drive in use is now ready for further configuration.

Post-Repair Procedures

FPGA Synchronization

There is FPGA (Field-Programmable Gate Array) program code on many different assemblies inside of the instrument, and all of these must be of a compatible version with the instrument software revision. In order to ensure that this requirement is met when either an assembly is replaced that contains FPGA code on it, or if the A5 Disk Drive is replaced with a drive that has a different version of software than the previous drive, you will need to take certain steps to ensure that the instrument operates properly.

NOTE

Even if an instrument appears to work properly when an assembly with FPGA code is replaced, that does not mean that the FPGA code is completely compatible with the software version installed in the instrument. There could be incompatibilities that will only be seen under certain measurement conditions.

Updating the Instrument FPGA Code

All instruments have a utility included in them that will update the FPGA code on all of the different assemblies in the instrument that have it. When this utility is run it will detect the assemblies that need to be updated and will update them to the correct revision.

NOTE

Once you start the FPGA programming process you MUST NOT interrupt the process for any reason. This would include turning the instrument off or unplugging the power cord to the instrument. Doing so will result in an inoperative instrument, requiring the affected assembly to be replaced.

1. Close the instrument application software by pressing **System**, **Exit Program**, **OK** using the front panel keys.
2. Connect a USB mouse to one of the instrument front panel USB ports.
3. Using the mouse double-click on the Windows Explorer link on the desktop and navigate to the following folder:

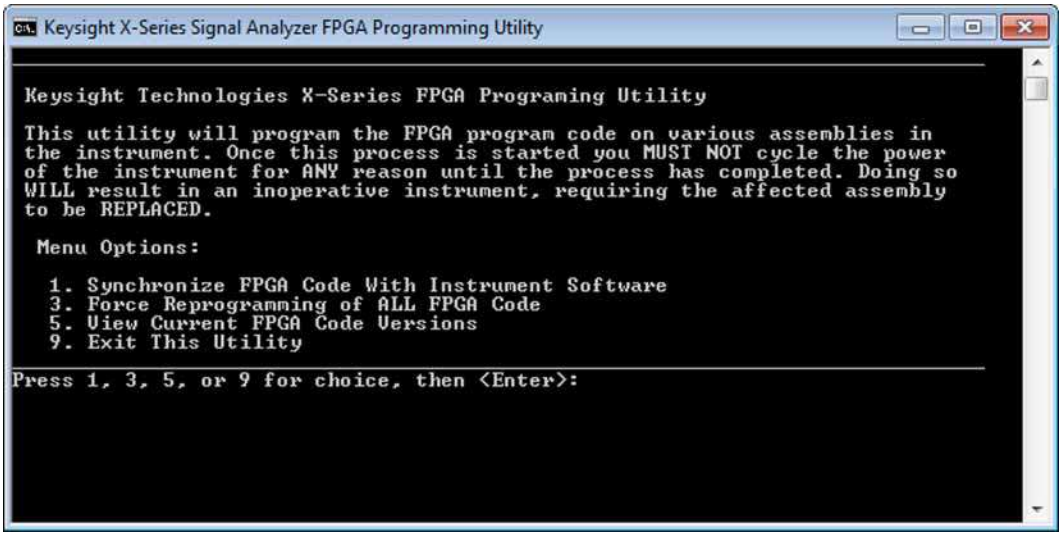
   C:\Program Files\Agilent\SignalAnalysis\Physics
4. In this folder find and execute the file named:

   FPGA_Prog.bat

Post-Repair Procedures

5. The FPGA Programming Utility will start and a window as shown in Figure 16-5 will appear.

Figure 16-5 FPGA Programming Utility



6. To program the FPGA code enter **1** and press **Enter**. You will need to confirm this selection by pressing **1** and **Enter** one more time.
7. The programming of the FPGA code could take a few minutes to complete. Once it has finished the instrument will reboot itself to use the new code and this process will then be completed.

Post-Repair Procedures

Programming Model and Serial Numbers

Since the instrument model and serial numbers are stored only on the A7 Midplane board assembly, this information will be lost when this board assembly is replaced. Until the instrument model and serial numbers are restored the instrument application software will not allow any user measurements to be made, due to the fact that all previously installed license keys will not be accepted. However, the license files will not be automatically deleted. Once the model and serial numbers are restored the license files will then be recognized and accepted, returning the instrument to the capability that was available prior to the A7 Midplane board assembly replacement.

To program the model and serial numbers into a replacement A7 Midplane board assembly the N7800A Keysight Calibration Application Software will be required.

Information regarding N7800A Keysight Calibration Application Software can be found at:

http://www.keysight.com/find/calibrationsoftware

When the calibration software first detects the instrument it will recognize that it does not have a valid model and serial number and will prompt the user to enter the correct values.

NOTE

Be very careful when entering the instrument serial number into the software, because once it has been written it can no longer be changed.

Since the instrument model and serial numbers are stored on the A7 Midplane board assembly, this should only be required when this assembly has been replaced with a new one.

Post-Repair Procedures

17 Functional Tests

Functional Test Performance Verification

Functional tests are tests of various instrument parameters that give a high degree of confidence that the analyzer is operating correctly. They are recommended as a check of analyzer operation for incoming inspection or after a repair. Measurement uncertainty analysis is not available for functional tests, and the analyzer is checked against limits that are wider than the published specifications. The functional tests are designed to test an analyzer operating within the temperature range defined by the analyzer specifications using a minimum set of test equipment. If a test does not pass, performance verification tests must be run to determine whether a problem exists.

Functional tests use a minimum set of test equipment to check a much smaller range of parameters (and a limited number of data points for each parameter) than do performance verification tests. Functional tests use limits that are wider than the published specifications; measurement uncertainty analysis is **not** available for functional tests.

NOTE If a functional test does not pass, you must run performance verification tests to determine whether a problem exists.

Performance verification tests span a wide range of instrument parameters and provide the highest level of confidence that the instrument conforms to published specifications. These tests can be time consuming and require extensive test equipment.

Before Performing a Functional Test

1. Ensure that you have the proper test equipment.
2. Switch on the unit under test (UUT) and let it warm up (in accordance with warm-up requirements in the instrument specifications).
3. Allow sufficient warm-up time for the required test equipment (refer to individual instrument documentation for warm-up specifications).
4. Ensure that the analyzer's frequency reference is set to Internal:
   a. Press the **Input/Output**, **Freq Ref Input** keys.
   b. If the **Freq Ref Input** does **not** show Internal, press the **Freq Ref Input** softkey and select Internal.
5. Following instrument warm-up, perform the auto align routine:

   Press **System**, **Alignments**, **Align Now, Align Now All**.

NOTE Functional test accuracy depends on the precision of the test equipment used. Ensure that all of the test equipment is calibrated before running a functional test.

Test Equipment

The table below summarizes the test equipment needed to perform all of the functional tests. Alternate equipment model numbers are given in case the recommended equipment is not available. If neither the recommended nor the alternative test equipment are available, substitute equipment that meets or exceeds the critical specifications listed.

Table 17-1

Analyzer Option	Item	Critical Specifications	Recommended Keysight Model	Alternate Keysight Model
	Adapters			
503, 507, 513, 526	3.5 mm (f) to 3.5 mm (f) (connector saver for source)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.1:1	83059B	1250-1749
532, 544, 550	2.4 mm (f) to 2.4 mm (f)	Frequency: 10 MHz to 50 GHz VSWR: < 1.1:1	11900B	
532, 544, 550	2.4 mm (f) to 3.5 mm (f) (connector saver for source)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.1:1	11901B	
All	BNC (f) to SMA (m)	Frequency: 40 MHz	1250-1200	
All	Type N (f) to Type N (f)	Frequency: 10 MHz to 18 GHz VSWR: < 1.05:1	1250-1472	1250-0777
All	Type N (m) to 3.5 mm (m)	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1743	
All	Type N (m) to 3.5 mm (f)	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1744	
All	Type N (f) to 3.5 mm (f)	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1745	
All	Type N (m) to BNC (f)	Frequency: 10 MHz to 1 GHz VSWR: < 1.05:1	1250-1476	
	Attenuators			
All	10 dB Step Attenuator	Frequency: 50 MHz Range: 0 to 70 dB	8495A	8496A
All	10 dB Fixed Attenuator (2 required)	Frequency: 50 MHz VSWR: < 1.2:1	8493C Option 010	8493A Option 010 or 8493B Option 010

Table 17-1

Analyzer Option	Item	Critical Specifications	Recommended Keysight Model	Alternate Keysight Model
Preamp Options (Pxx)	30 dB Fixed Attenuator	Accuracy: < 0.05 dB @ 50 MHz	11708A	
	Cables			
All	3.5 mm (1 meter)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.4:1 Loss: < 2.0 dB	11500E	8120-4921
532, 544, 550	2.4 mm (f) to 2.4 mm (m) (1 meter)	Frequency: 10 MHz to 50 GHz VSWR: < 1.55:1 @ 44 GHz Loss: < 6.0 dB	8120-6164	
All	Cable, BNC (3 required)	120 cm (48 in.) BNC cable	10503A	
BBA	Cable, BNC	120 cm (48 in.) BNC cable Flatness (250 kHz to 40 MHz) < 0.5 dB	10503A	
BBA	Cable, BNC	BNC male 23 cm (9 in) max	10502A	
	Signal Source			
All	Synthesized Sweeper	Frequency: 10 MHz to 44 GHz[a] Harmonic level: < – 40 dBc Amplitude: 10 to – 20 dBm Frequency Accuracy: 0.02%	PSG[b]	83630B, 83640B, 83650B
BBA	Signal Generator	Frequency: 250 kHz to 40 MHz Amplitude: ~–10 dBm Flatness: < ±0.75 dB	E4438C	33250A
	Power Meter			
All	Power Meter	Power Reference Accuracy: ±1.2% Compatible with power sensor	E4418B	E4419B
All	Power Sensor	Frequency: 50 MHz to 3.66 GHz Amplitude: –70 to –10 dBm	8481D	8487D 8485D
503, 508, 513	Power Sensor	Frequency: 50 MHz to 13.66 GHz Amplitude: –30 to +20 dBm	8481A	N8481A
526	Power Sensor	Frequency: 50 MHz to 26.5 GHz Amplitude: –30 to +20 dBm	8485A	N8485A
532, 544, 550	Power Sensor	Frequency: 50 MHz to 50 GHz[c] Amplitude: –30 to +20 dBm	8487A	

Table 17-1

Analyzer Option	Item	Critical Specifications	Recommended Keysight Model	Alternate Keysight Model
P03	Low Power Sensor	Frequency: 50 MHz to 3.6 GHz Amplitude: –70 to –10 dBm	8481D	8485D 8487D
Pxx other than P03	Low Power Sensor	Frequency: 50 MHz to 50 GHz[c] Amplitude: –70 to –10 dBm	8487D	
	Miscellaneous Equipment			
All	Filter, 50 MHz Low Pass	Cutoff Frequency: 50 MHz Rejection at 65 MHz: > 40 dB Rejection at 75 MHz: > 60 dB Rejection at 80 MHz: > 60 dB	0955-0306	
526	Power Splitter, 3.5 mm	Nominal Insertion Loss: 6 dB Tracking Between Ports: < 0.25 dB	11667B	
532, 544, 550	Power Splitter	Nominal Insertion Loss: 8.5 dB Tracking Between Ports: < 0.4 dB	11667C	
503, 508, 513	Power Splitter	Nominal Insertion Loss: 6 dB Tracking Between Ports: < 0.25 dB	11667A	11667B
All	Termination, 50?	Type N (m) Connector Frequency: 30 Hz to 26.5 GHz	909A Option 012	
532, 544, 550	Termination, 50?	2.4 mm (f) Connector Frequency: 9 kHz to 44 GHz	85138B	

a. Maximum frequency equal to or greater than the maximum frequency of the MXA.
b. PSG model numbers: E8244A, E8254A, E8247C Option 520, E8247C Option H31 or 540, E8257D Option 520, E8257D Option 550, E8257D Option 567, E8267D Option 544.
c. Maximum frequency equal to or greater than the maximum frequency of the preamplifier option.

Displayed Average Noise Level (DANL)

Test Limits (with 0 dB input attenuation)

See Table 17-2 for values.

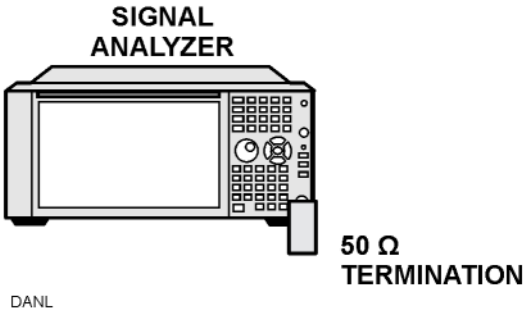
The Displayed Average Noise Level (DANL) of the signal analyzer is measured across a 10 kHz frequency span at several center frequencies. The analyzer input is terminated into a 50 Ω load. A test is performed to assure the measurement is not performed in the presence of a residual response. The measurement is then averaged, and the result is normalized to a 1 Hz bandwidth.

Table 17-2 DANL Measurement Requirements

Item	Critical Specifications (for this test)	Recommended Keysight Model
Termination, 50 Ω Type-N (m)[a]	Frequency: 10 MHz to 18 GHz	909A Option 012
Termination, 50 Ω 2.4 mm (f)[b]	Frequency: 10 MHz to 50 GHz	85138B

a. For Options 503, 507, 513, and 526
b. For Options 532, 544, and 550

Figure 17-1 DANL Test Setup



Procedure

1. Configure the equipment as shown in Figure 17-1
2. Press **MODE/MEAS**. Select **Spectrum Analyzer** mode, **Swept SA** measurement, **Normal** view. Press **OK**. Press **Mode Preset** on the analyzer.
3. Set up the signal analyzer by pressing:

   FREQ, **Center Frequency**, 10, **MHz**
   Input/Output, Input, **RF Coupling**, select **DC**
   FREQ, **Span**, 10, **kHz**
   AMPTD, –70, **dBm**
   AMPTD, **Attenuation, Mech Atten**, **0, dB**

BW, **Res BW**, 1, **kHz**
BW, **Video BW**, 100, **Hz**
Meas Setup, Avg/Hold, Number, 20, **Enter**
Trace, **Trace Average**
Single/Cont until single sweep is selected.

4. Press **Restart**, then wait for Average/Hold to display 20/20.
5. Press **Display**, **Meas Display**, then press **Display Line**, **On**.
6. Rotate the knob and set the display line at the average amplitude of the displayed noise floor by visual inspection.
7. Confirm that the measurement is performed on the analyzer noise floor and not on a residual response within the displayed 10 kHz span.

NOTE Ignore the residual response if one appears when taking the measurement.

---

8. Enter the value of the display line as the Measured Average Noise Level at 10 MHz column in Table 17-2 on page 588.
9. Normalize the measured value to a 1 Hz BW by adding –30 dB to the measured value.

NOTE The –30 dB value is added because the formula used to calculate the value of the noise power in a 1 Hz BW when measured with a 1 kHz BW is:

Normalized Noise = 10 Log (BW 2/BW 1) where BW 2 is the 1 kHz BW we measure and BW 1 is 1 Hz BW to which we want to normalize.

Therefore, 10 Log (1000) = 30 dB, so the noise floor will be 30 dB lower in a 1 Hz BW.

---

10. Enter the normalized value of the displayed average noise level in Table 17-2 on page 588.
11. The value of the normalized displayed average noise should be less than the specification value.
12. Change the analyzer center frequency to the next value listed in Table 17-2 on page 588. Press: **FREQ**, **Center Frequency**, [Table 2-1 Value], **GHz**
13. Repeat step 4 through step 12 to fill in the remainder of Table 17-2 on page 588 for your analyzer frequency range.

Center Frequency	Measured Average Noise Level (dBm)	Normalized Average Noise Level/(1 Hz BW) (dBm)	Test Limits (dBm) (Options 503, 508, 513, 526)	Test Limits (dBm) (Options 532, 544, 550)
10 MHz			–150	–150
2 GHz			–150	–151
6 GHz			–148	–142
13 GHz			–147	–145
20 GHz			–142	–138
26.5 GHz			–135	–138
30 GHz			N/A	–136
35 GHz			N/A	–133
40 GHz			N/A	–131
43.5 GHz			N/A	–131
50 GHz			N/A	–127

Frequency Readout Accuracy

Test Limits

Frequency Readout Accuracy is equivalent to the following equation:

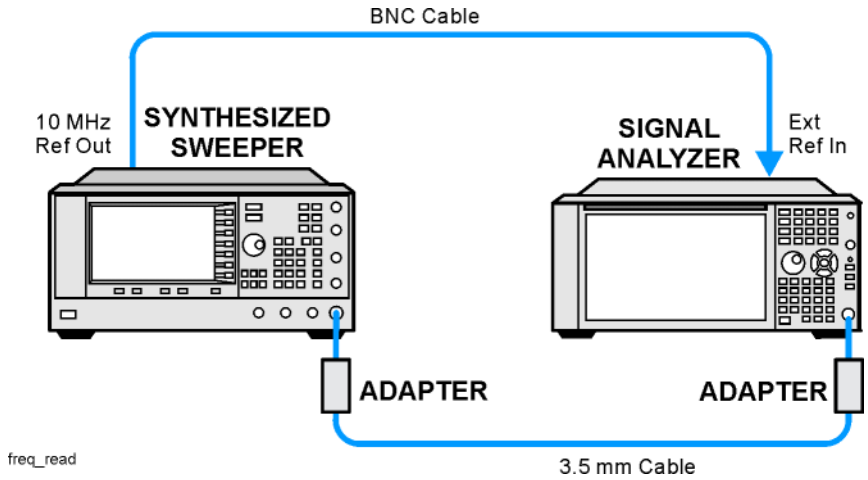
$$\pm(\mathbf{0.25\%} \times span + \mathbf{5\%} \times RBW + \mathbf{2}\ Hz + \mathbf{0.5} \times horizontal\ resolution)$$

See results table for actual values.

The frequency readout accuracy is measured in several spans and center frequencies that allow both internal analyzer synthesizer modes and prefilter bandwidths to be tested. Frequency reference error is eliminated by using the same frequency standard for the analyzer and signal source.

Item	Critical Specification (for this test)	Recommended Keysight Model
Adapter, Type-N (m), to 3.5 mm (f)	Frequency: 10 MHz to 1.51 GHz VSWR: < 1.1:1	1250-1744
Adapter, 3.5 mm (f) to 3.5 mm (f)	Frequency: 10 MHz to 1.51 GHz VSWR: < 1.1:1	83059B
Cable, 3.5 mm, 1 meter	Frequency: 10 MHz to 1.51 GHz VSWR: < 1.4:1	11500E
Cable, BNC, 120 cm	Frequency: 10 MHz	10503A
Synthesized Sweeper	Frequency: 10 MHz to 1.51 GHz	PSG

Figure 17-2 Frequency Readout Accuracy Test Setup



Procedure

1. Configure the equipment as shown in Figure 17-2. Confirm the analyzer's built-in auto alignment has been performed within the past 24 hours.

2. On the synthesized sweeper, press **PRESET**, then set the controls as follows:

   FREQUENCY, 1505, **MHz**
   POWER LEVEL, –10, **dBm**

3. Set up the signal analyzer by pressing:

   MODE/MEAS. Select **Spectrum Analyzer** mode, **Swept SA** measurement, **Normal** view. Press **OK**. Press **Mode Preset**
   Input/Output, Freq Ref Input, **Freq Ref Input External**
   FREQ, **Center Frequency**, 1505, **MHz**
   Span, 2990, MHz
   Trace, **Detector**, **Sample**
   Single/Cont to place analyzer in Single Sweep.

4. Press **Restart**.

   Press **Peak Search** on the analyzer. If the instrument is functioning correctly, the marker reading in the active function block will be between the values listed in Table 17-3. Record the marker value in the Marker Frequency Readout column in Table 17-3.

5. On the signal analyzer, change the span and center frequency as listed in Table 17-3.

6. Change the synthesized sweeper frequency to match the center frequency of the analyzer.

7. Repeat step 4 through step 6 until the Marker Frequency Readout column of Table 17-3 is complete.

Table 17-3 Frequency Readout Accuracy Results

Span (MHz)	Center Frequency (MHz)	Minimum	Marker Frequency Readout	Maximum
2990	1505	1495.9 MHz		1514.1 MHz
127.2	1505	1504.56 MHz		1505.44 MHz
54.1	1505	1504.8122 MHz		1505.1878 MHz
7.95	1505	1504.97240 MHz		1505.0276 MHz
0.106	1505	1504.999630 MHz		1505.000370 MHz
1.98	517.59	517.58316 MHz		517.59684 MHz
1.98	832.50	832.49316 MHz		832.50684 MHz

Second Harmonic Distortion (SHD)

Test Limits

Applied Frequency	Mixer Level	Distortion
40 MHz	–10 dBm	< –55 dBc

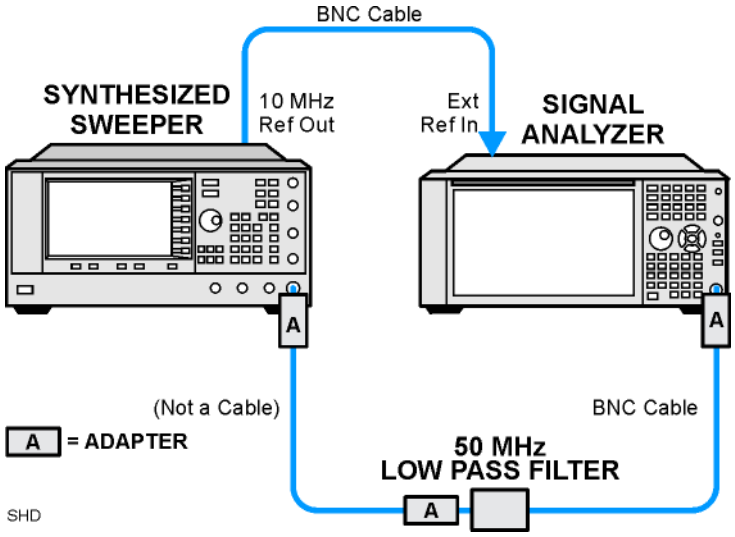
This test checks the second harmonic distortion of the signal analyzer by tuning to twice the input frequency and examining the level of the distortion product. A low pass filter is inserted between the source and the signal analyzer to prevent the source second harmonic from artificially raising the second harmonic product displayed on the analyzer.

The power level at the input mixer is 20 dB higher than specified to allow the distortion product to be seen. For example, the instrument specification may state that with a –15 dBm signal at the input mixer, the distortion product should be suppressed by > –60 dBc.

The equivalent Second Harmonic Intercept (SHI) is 45 dBm (–15 dBm + 60 dBc). This test is performed with –10 dBm at the mixer and verifies the distortion product is suppressed by –55 dBc. This ensures the SHI is also 45 dBm (–10 dBm + 55 dBc).

Item	Critical Specifications (for this test)	Recommended Keysight Model
Adapter, Type-N(m) to BNC(f)	Frequency: 10 MHz to 80 MHz VSWR: < 1.05:1	1250-1476
Adapter, BNC(f) to SMA(m)	Frequency: 40 to 80 MHz	1250-1200
Adapter, 3.5 mm(f) to 3.5 mm(f)	Frequency: 10 MHz to 80 MHz VSWR: < 1.1:1	83059B
Cable, BNC 120 cm (2 required)	Frequency: 10 to 40 MHz	10503A
Filter, 50 MHz Low Pass	Cutoff Frequency: 50 MHz Rejection at 65 MHz: > 40 dB Rejection at 75 MHz: > 60 dB	0955-0306
Synthesized Sweeper	Frequency: 50 MHz Spectral Purity: Better than –30 dBc	PSG

Figure 17-3 Second Harmonic Distortion Test Setup



Procedure

1. Configure the equipment as shown in Figure 17-3.
2. Press **MODE/MEAS.** Select the **Spectrum Analyzer** mode, **Swept SA** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**.
3. Set up the synthesized sweeper by pressing:

   Frequency, 40, **MHz**
   Amplitude, –10, **dBm**

4. Set up the signal analyzer by pressing:

   Input/Output, **Freq Ref Input**, **Freq Ref Input External**
   FREQ, **Center Frequency** 40, **MHz**
   Span, 1, **MHz**

5. On the analyzer, press **Peak Search**.
6. Adjust the synthesized sweeper amplitude for a signal analyzer display of –10 dBm ±0.1 dB.
7. On the analyzer, activate the marker delta function by pressing the **Marker** and **Delta** keys.
8. On the signal analyzer, press:

   FREQ, **Center Frequency**, 80, **MHz**
   Meas Setup, **Avg/Hold Number**, 20, **Enter**
   Trace, Trace Average
   Single

9. Press **Peak Search**. Enter the displayed value under the Measured Second Harmonic Distortion (dBc) heading in Table 17-4.

Table 17-4 Second Harmonic Distortion Results

Applied Frequency (MHz)	Measured Second Harmonic Distortion (dBc)	Mixer Level (dBm)	Specification (dBc)
40		–10	–55

Amplitude Accuracy at 50 MHz

Test Limits

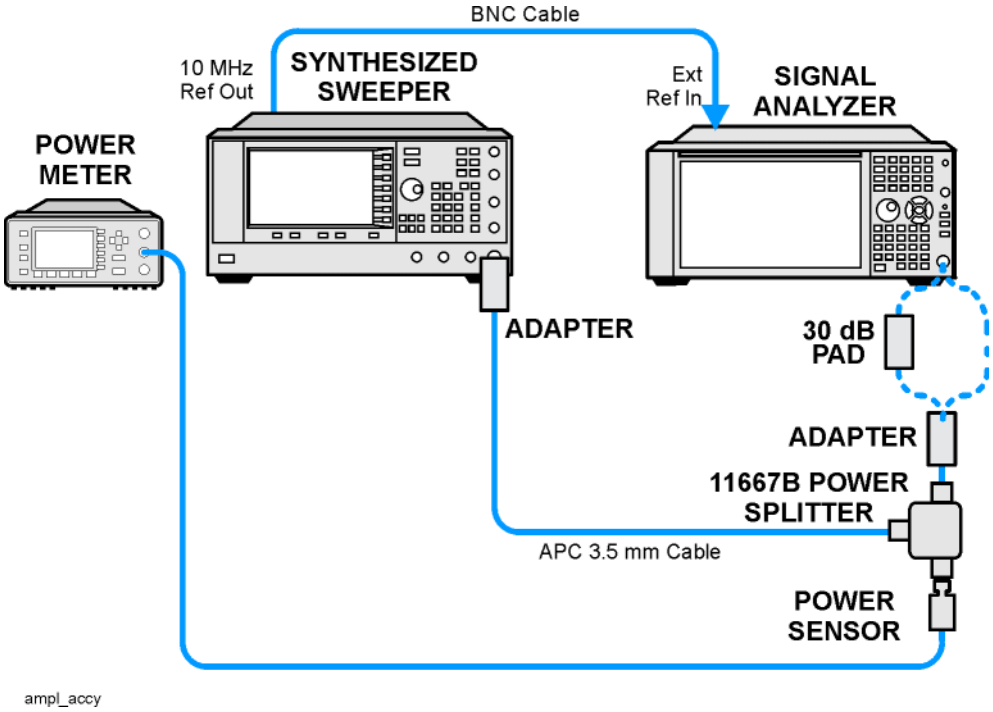
Amplitude Accuracy should remain within 1.13 dB of the measured source value across the range of source levels and changes in resolution bandwidth. The Preamp (option P03, P08, P13, P26) should remain within ±1.3 dB of measured values.

A synthesized sweeper is used as the signal source for the test. The source amplitude is varied using the signal source amplitude control. The attenuation and resolution bandwidth are varied on the signal analyzer. The source amplitude is measured by the power meter and signal analyzer at each setting, and the values compared. The difference between each pair of measurements indicates the amplitude accuracy.

Item	Critical Specifications	Recommended Keysight Model
Adapter[a]	Type-N (m), to 3.5 mm (m)	1250-1743
Adapter[a]	3.5 mm (f) to 3.5 mm (f)	83059B
Adapter[b]	2.4 mm (f) to 3.5 mm (m)	11901A
Adapter	2.4 mm (f) to 3.5 mm (f)	11901B
Attenuator, 30 dB	Accuracy: < 0.5 dB at 50 MHz	11708A
Cable	3.5 mm, 1 meter	11500E
Cable	BNC, 120 cm	10503A
Power Meter	Compatible with power sensor	E4418B
Power Sensor	Amplitude: -25 dBm to 10 dBm	8485A
Power Splitter	3.5 mm (f) connectors 6 dB loss	11667B
Synthesized Sweeper	Typical Temperature Stability: 0.01 dBc/°C	PSG

a. For Options 503, 508, 513, and 526
b. For Options 532, 544, and 550

Figure 17-4 Amplitude Accuracy Test Setup



Procedure

1. Zero and calibrate the power meter.
2. Configure equipment as shown in Figure 17-4, with the power splitter connected directly to the signal analyzer input through the adapter.

CAUTION To minimize stress on the test equipment connections, support the power sensor.

3. If the auto alignment for the analyzer has not been performed within the past 24 hours, press **System**, **Alignments**, **Align Now, Align Now All** to perform the auto alignment routine.
4. Press **MODE/MEAS.** Select the **Spectrum Analyzer** mode, **Swept SA** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**.
5. Set up the synthesized sweeper by pressing:

   CW, 50, **MHz**
   Power Level, -4, **dBm**
   RF (On)

6. Set up the signal analyzer by pressing:

   Input/Output, Freq Ref Input, **Freq Ref Input External**
   FREQ, Center Frequency, 50, **MHz**
   Span, 2, **MHz**

AMPTD, Attenuation, Mech Atten, 10, dB
Input/Output, **Input**, **RF Coupling**, select **DC**
SWEEP, **Sweep Config, Sweep Time Rules**, **SA - Accuracy**
Meas Setup, **Avg/Hold Number**, 20, **Enter**
Trace, **Trace Average**
Single

7. Perform the following steps for each row listed in Table 17-5:
   a. Set the synthesized sweeper amplitude to the value listed in the Nominal Source Amplitude column in Table 17-5
   b. Set the Mech Atten as indicated in the Attenuation column in Table 17-5
   c. Set the Span as listed in the Span column of Table 17-5
   d. Record the source amplitude, as measured by the power meter, in the Power Meter Amplitude column of Table 17-5
   e. On the signal analyzer, press **Restart**.
   f. Wait for the signal analyzer to finish averaging.
   g. Press Peak Search.
   h. Record the signal amplitude, as measured by the analyzer in the Measured Amplitude column of Table 17-5
   i. Calculate the signal amplitude accuracy error using the following equation, and record the results under the Amplitude Accuracy Error column:

$$\text{Amplitude Accuracy Error} = \text{Meas_amp} - \text{Power_meter}$$

Table 17-5 Amplitude Accuracy Results

Nominal Source Amplitude (dBm)	Attenuation (dB)	Span (MHz)	Measured Amplitude Meas_amp (dBm)	Power Meter Amplitude Power_meter (dBm)	Amplitude Accuracy Error (dB)	Test Limit (dB)
-4	10	2				±1.13 dB
-9	10	1				±1.13 dB
-14	10	0.5				±1.13 dB
-4	20	0.1				±1.13 dB
-14	20	0.1				±1.13 dB
-4	30	0.1				±1.13 dB
-14	30	0.1				±1.13 dB

Testing Preamp Option (P03, P08, P13, P26, P32, P44, P50)

Instruments containing Options P03, P08, P13, P26 must have the preamp function turned on and tested.

Procedure

1. On the analyzer, press **AMPTD, Signal Path**, **Internal Preamp**, **Low Band**.
2. Connect the equipment as shown in Figure 17-4 on page 597, using a 30 dB Pad between the adapter and the signal analyzer input.
3. Set the synthesized sweeper amplitude to the value listed in the Nominal Source Amplitude column in Table 17-6.
4. Set the signal analyzer input attenuation to 0 dB.
5. Set the Span as listed in Table 17-6.
6. Record the source amplitude, as measured by the power meter, in the Power Meter Amplitude column of Table 17-6.
7. On the signal analyzer, press **Restart**.
8. Wait for the analyzer to finish averaging.
9. Press **Peak Search**.
10. Record the signal amplitude as measured by the analyzer in the measured amplitude column of Table 17-6.
11. Calculate the signal amplitude accuracy using the following equation:

    Amplitude Accuracy Error = Meas_amp + 30 dB - Power_meter

12. Record the results under the Amplitude Accuracy Error column of Table 17-6

Table 17-6 Amplitude Accuracy Results (Option P03, P08, P13, P26, P32, P44, P50)

Nominal Source Amplitude (dBm)	Low- band Preamp	Res BW (kHz)	Span (kHz)	Measured Amplitude Meas_amp (dBm)	Power Meter Amplitude Power_meter (dBm)	Amplitude Accuracy Error (dB)	Test Limit (dB)
-13	ON	1	106				±1.30 dB

Frequency Response (Flatness)

Test Limits

Frequency Range	Limit Relative to 50 MHz
20 Hz to 3.6 GHz	±1.5 dB
> 3.6 GHz to 8.4 GHz	±2.5 dB
> 8.4 GHz to 13.6 GHz	±3.0 dB
> 13.6 GHz to 26.5 GHz	±3.5 dB
> 26.5 GHz to 34.5 GHz	±3.5 dB
> 34.5 GHz to 50 GHz	±4.2 dB

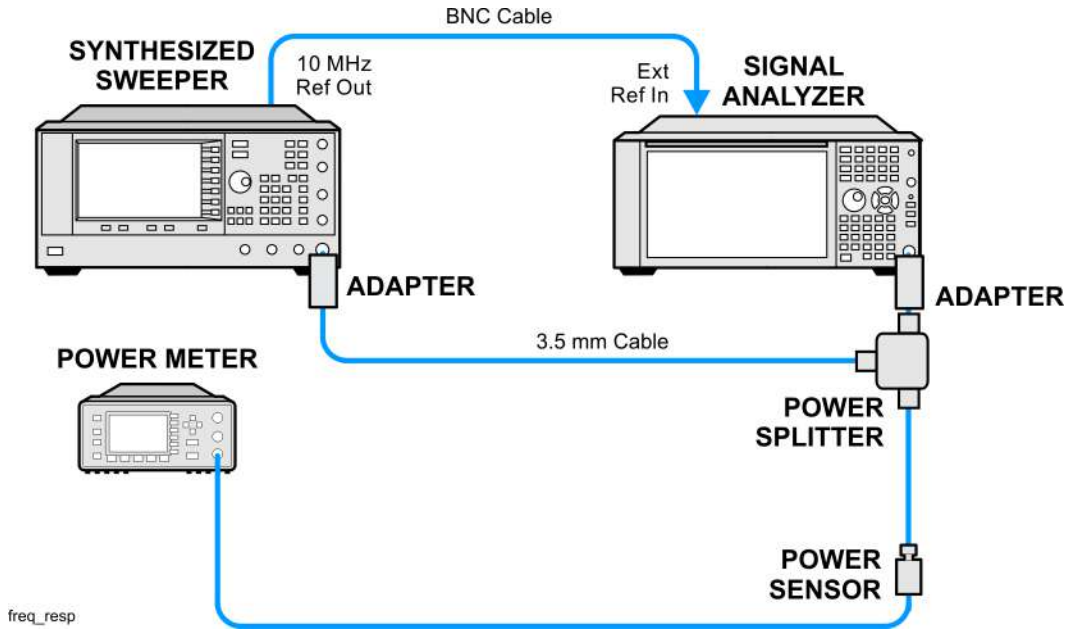
The frequency response test measures the signal analyzer's amplitude error as a function of the tuned frequency. Measurements are made ranging from 50 MHz to the maximum frequency range of your analyzer. The signal source amplitude is measured with a power meter to eliminate error due to source flatness. The measured value is normalized to 50 MHz.

Item	Critical Specifications (for this test)	Recommended Keysight Model
Adapter, Type N (m) to 3.5 mm (m)	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1743
Adapter, 3.5 mm (f) to 3.5 mm (f)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.1:1	83059B
Cable, 3.5 mm, 1 meter	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.4:1	11500E
Cable, 2.4 mm, 1 meter	Frequency: 10 MHz to 50 GHz VSWR: < 1.55:1	8120-6164
Cables, BNC 120 cm	Frequency: 10 MHz	10503A
Power Meter	Compatible with power sensor	E4418B
Power Sensor[a]	Frequency: 50 MHz to 26.5 GHz	8485A
Power Sensor[b]	Frequency: 50 MHz to 50 GHz	8487A
Power Splitter[a]	Frequency: 50 MHz to 26.5 GHz Tracking between ports: < 0.25 dB	11667B

Item	Critical Specifications (for this test)	Recommended Keysight Model
Power Splitter[b]	Frequency: 50 MHz to 50 GHz Tracking between ports: < 0.4 dB	11667C
Synthesized Sweeper	Frequency: 50 MHz to 50 GHz	PSG

a. For Options 503, 508, 513, and 526
b. For Options 532, 544, and 550

Figure 17-5 Frequency Response Test Setup



Procedure

1. Zero and calibrate the power meter and power sensor as described in the power meter operation manual.
2. Configure the equipment as shown in Figure 17-5.

NOTE Connect the power splitter to the signal analyzer input using the appropriate adapter. Do not use a cable.

3. Assure the signal analyzer's built-in auto alignment has been performed within the last 24 hours.
4. Press **MODE/MEAS** on the analyzer. Select the **Spectrum Analyzer** mode, **Swept SA** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**. Press **Preset** on the synthesized sweeper.
5. Set up the synthesized sweeper by pressing:

CW, 50, **MHz**
Power level, –4, **dBm**

6. Set up the signal analyzer by pressing:

   Input/Output, **Freq Ref Input**, **Freq Ref Input External**
   FREQ, Center Frequency, 50, **MHz**
   Span, 50, **kHz**
   AMPTD, **Ref Level,** 0, **dBm**

7. Adjust the synthesized sweeper output power for a power meter reading of –10 dBm ±0.1 dB.
8. On the signal analyzer, press **Single**.
9. Press the **Peak Search** key on the signal analyzer to position the marker on the peak of the signal.
10. Refer to Table 17-7, "Frequency Response (Flatness) Results." Enter the amplitude of the signal displayed on the signal analyzer into the $Meas_{Amp}$ column of Table 17-7.
11. Enter the power meter reading into the $Power_{Meter}$ column of Table 17-7.
12. Tune the synthesized sweeper and signal analyzer to the next frequency listed in Table 17-7.
13. Enter the power sensor calibration factor into the power meter.
14. For frequencies 3.6 GHz and above, press **AMPTD Signal Path**, then **Presel Center** to center the preselector filter for an optimum amplitude measurement.
15. Repeat step 7 through step 14 and complete the remainder of Table 17-7 for the frequency range of your analyzer.
16. Compute the measurement error ($Meas_{Error} = Meas_{Amp} - Power_{Meter}$).
17. Compute the flatness error normalized to 50 MHz:
    ($Meas_{Error} - Meas_{Error}$ @ 50 MHz)
18. Enter the computed flatness error valu651e into the $Flat_{Norm}$ column of Table 17-7.
19. Compare the value of $Flat_{Norm}$ to the test limit.

Table 17-7 Frequency Response (Flatness) Results

Center Frequency	Analyzer Amplitude $Meas_{amp}$	Power Meter Measurement $Power_{meter}$	Meas Error $Meas_{error}$	Flatness Normalized to 50 MHz $Flat_{Norm}$	Flatness Error Test Limits (dB)
50 MHz				0	Ref
1 GHz					±1.5 dB
2 GHz					1.5 dB
3 GHz					±1.5 dB
3.5 GHz					±1.5 dB
4 GHz					±2.5 dB
6 GHz					±2.5 dB
8 GHz					±2.5 dB
9 GHz					±3.0 dB
11 GHz					±3.0 dB
13 GHz					±3.0 dB
14 GHz					±3.5 dB
17 GHz					±3.5 dB
20 GHz					±3.5 dB
23 GHz					±3.5 dB
26 GHz					±3.5 dB
29 GHz					±3.5 dB
32 GHz					±3.5 dB
35 GHz					±4.2 dB
38 GHz					±4.2 dB
41 GHz					±4.2 dB
43.5 GHz					±4.2 dB
46 GHz					±4.2 dB
49 GHz					±4.2 dB

Frequency Response (Flatness), Preamp On

Test Limits

Frequency Range	Limit Relative to 50 MHz
100 kHz to 3.6 GHz	±2.0 dB
> 3.6 GHz to 8.4 GHz	±3.0 dB
> 8.4 GHz to 13.6 GHz	±3.5 dB
> 13.6 GHz to 26.5 GHz	±4.0 dB
> 26.5 GHz to 34.5 GHz	±4.0 dB
> 34.5 GHz to 50 GHz	±5.1 dB

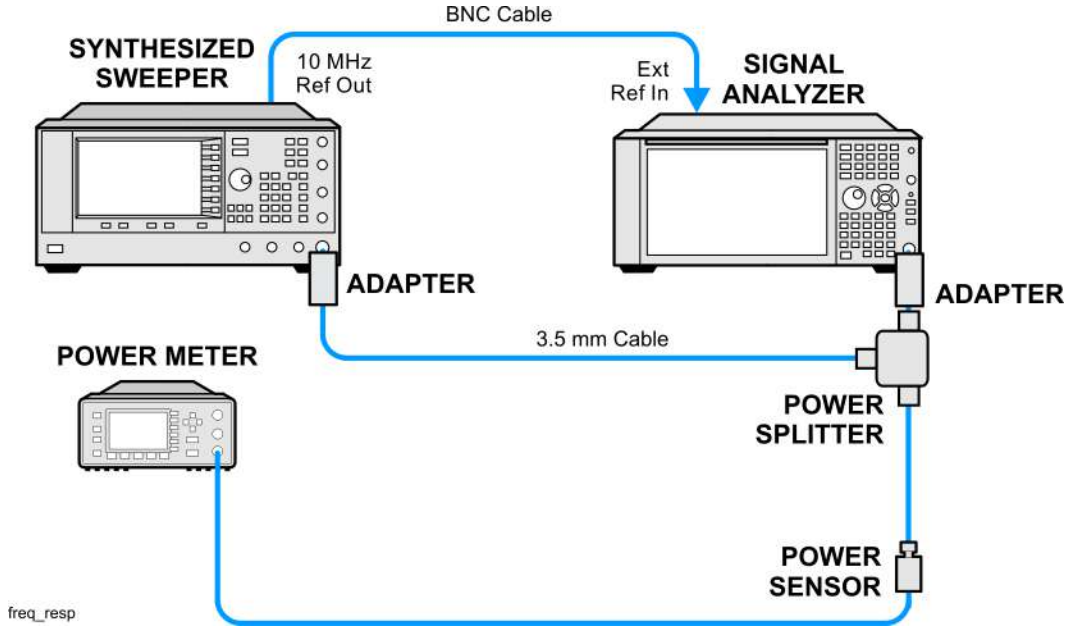
The frequency response test, with preamplifier on, measures the signal analyzer's amplitude error as a function of the tuned frequency. Measurements are made ranging from 50 MHz to the maximum frequency range of the preamp. The signal source amplitude is measured with a power meter to eliminate error due to source flatness. The measured value is normalized to 50 MHz.

Item	Critical Specifications (for this test)	Recommended Keysight Model
Adapter, Type N(m) to 3.5 mm(m)	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1743
Adapter, 3.5 mm(f) to 3.5 mm(f)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.1:1	83059B
Cable, 3.5 mm, 1 meter	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.4:1	11500E
Cable, 2.4 mm, 1 meter	Frequency: 10 MHz to 50 GHz VSWR: < 1.55:1	8120-6164
Cables, BNC 120 cm	Frequency: 10 MHz	10503A
Power Meter	Compatible with power sensor	E4418B
Attenuator, 30 dB Fixed	Frequency: 50 MHz Accuracy: ±0.05 dB	11708A

Item	Critical Specifications (for this test)	Recommended Keysight Model
Power Sensor[a]	Frequency: 50 MHz to 26.5 GHz Amplitude: –65 dBm to –55 dBm	8485D
Power Sensor[b]	Frequency: 50 MHz to 50 GHz Amplitude: –65 dBm to –55 dBm	8487D
Power Splitter[a]	Frequency: 50 MHz to 26.5 GHz Tracking between ports: < 0.25 dB	11667B
Power Splitter[b]	Frequency: 50 MHz to 50 GHz Tracking between ports: < 0.4 dB	11667C
Synthesized Sweeper	Frequency: 50 MHz to 50 GHz	PSG

a. For Options 503, 508, 513, and 526
b. For Options 532, 544, and 550

Figure 17-6 Frequency Response Test Setup



Procedure

1. Zero and calibrate the power meter and power sensor as described in the power meter operation manual.
2. Configure the equipment as shown in Figure 17-6.

NOTE Connect the power splitter to the signal analyzer input using the appropriate adapter. Do not use a cable.

3. Assure the signal analyzer's built-in auto alignment has been performed within the last 24 hours.
4. Press **MODE/MEAS** on the analyzer. Select the **Spectrum Analyzer** mode, **Swept SA** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**. Press **Preset** on the synthesized sweeper.
5. Set up the synthesized sweeper by pressing:

   CW, 50, **MHz**
   Power level, –54, **dBm**

6. Set up the signal analyzer by pressing:

   Input/Output, **Freq Ref Input**, **Freq Ref Input External**
   FREQ, Center Frequency, 50, **MHz**
   Span, 50, **kHz**
   AMPTD, Signal Path, **Internal Preamp**, **Full Range**
   AMPTD, Attenuation, **Mech Atten**, 0, **dB**
   AMPTD, Y Scale, **Ref Level**, –55, **dBm**

7. Adjust the synthesized sweeper output power for a power meter reading of –60 dBm ±0.1 dB.
8. On the signal analyzer, press **Single**.
9. Press the **Peak Search** key on the signal analyzer to position the marker on the peak of the signal.
10. Refer to Table 17-7, "Frequency Response (Flatness) Results." Enter the amplitude of the signal displayed on the signal analyzer into the $Meas_{Amp}$ column of Table 17-7.
11. Enter the power meter reading into the $Power_{Meter}$ column of Table 17-7.
12. Tune the synthesized sweeper and signal analyzer to the next frequency listed in Table 17-7.
13. Enter the power sensor calibration factor into the power meter.
14. For frequencies 3.6 GHz and above, press **AMPTD, Signal Path**, then **Presel Center** to center the preselector filter for an optimum amplitude measurement.
15. Repeat step 7 through step 14 and complete the remainder of Table 17-7 for the frequency range of your preamp.
16. Compute the measurement error ($Meas_{Error} = Meas_{Amp} - Power_{Meter}$).
17. Compute the flatness error normalized to 50 MHz:
    ($Meas_{Error} - Meas_{Error}$ @ 50 MHz)
18. Enter the computed flatness error value into the $Flat_{Norm}$ column of Table 17-7.
19. Compare the value of $Flat_{Norm}$ to the test limit.

Table 17-8 Frequency Response (Flatness) Results

Center Frequency	Analyzer Amplitude $Meas_{amp}$	Power Meter Measurement $Power_{meter}$	Meas Error $Meas_{error}$	Flatness Normalized to 50 MHz $Flat_{Norm}$	Flatness Error Test Limits (dB)
50 MHz				0	Ref
1 GHz					±2.0 dB
2 GHz					±2.0 dB
3 GHz					±2.0 dB
3.5 GHz					±2.0 dB
4 GHz					±3.0 dB
6 GHz					±3.0 dB
8 GHz					±3.0 dB
9 GHz					±3.5 dB
11 GHz					±3.5 dB
13 GHz					±3.5 dB
14 GHz					±4.0 dB
17 GHz					±4.0 dB
20 GHz					±4.0 dB
23 GHz					±4.0 dB
26 GHz					±4.0 dB
29 GHz					±4.0 dB
31 GHz					±4.0 dB
34 GHz					±4.5 dB
37 GHz					±5.1 dB
40 GHz					±5.1 dB
43 GHz					±5.1 dB
47 GHz					±5.1 dB
49.5 GHz					±5.1 dB

Scale Fidelity

Test Limits

The scale fidelity error will be ≤ ±1.0 dB with ≤ -10 dBm at the mixer.

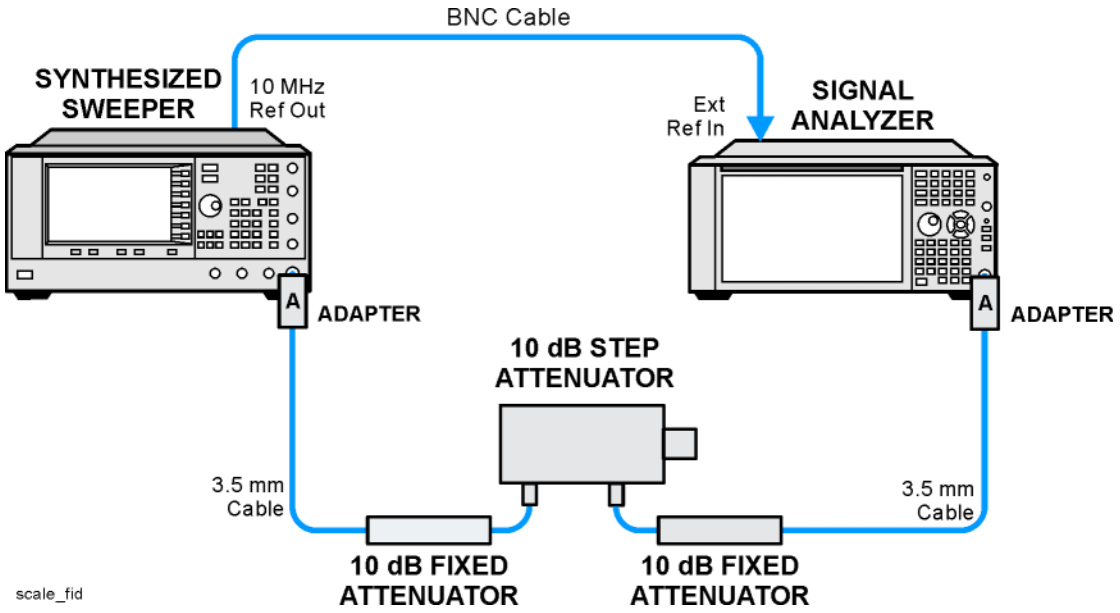
This test checks the scale fidelity of the instrument by maintaining a constant reference level and measuring signals of different amplitudes over most of the display range. This test sets the input attenuator to 10 dB and the Reference Level to 0 dBm. The external attenuator is set to 0 dB, and the amplitude of the source is adjusted to set the displayed signal at the reference level.

The instrument's internal marker is used to measure the reference amplitude. The Marker Delta function is activated and the RF input is reduced using the external precision step attenuator. Signal input levels from 0 dBm to -50 dBm are measured.

Item	Critical Specifications (for this test)	Recommended Keysight Model
Adapter, Type-N (m), to 3.5 mm (f)[a]	Frequency: 10 MHz to 18 GHz VSWR: < 1.1:1	1250-1745
Adapter, 3.5 mm (f) to 3.5 mm (f)[a]	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.1:1	83059B
Adapter, 2.4 mm (f) to 3.5 mm (f) (2 required)[b]	Frequency: 50 MHz VSWR: < 1.1:1	11901B
Attenuator, 10 dB Step	Range: 0-50 dB Frequency: 50 MHz Accuracy: ±0.25 dB	8495A
Attenuator, 10 dB fixed (2 required)	Frequency: 50 MHz VSWR: < 1.2:1	8493C, option 010
Cable, 3.5 mm, 1 meter (2 required)	Frequency: 10 MHz to 26.5 GHz VSWR: < 1.4:1	11500E
Cable, BNC 120 cm	Frequency: 10 MHz	10503A
Synthesized Sweeper	Output Level Accuracy: 0 to –15 dBm: ±1.0 dB	PSG

a. For Options 503, 508, 513, and 526
b. For Options 532, 544, and 550

Figure 17-7 Scale Fidelity Setup



NOTE Averaging is used for all measurements to improve repeatability and reduce measurement uncertainty.

Procedure

1. Configure the equipment as shown in Figure 17-7.
2. Preset the Source and press **MODE/MEAS** on the analyzer. Select the **Spectrum Analyzer** mode, **Swept SA** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**.
3. Set up the synthesized sweeper by pressing:

   Frequency, 50, **MHz**
   Amplitude, +5, **dBm**
   RF On/Off, On

4. Set up the signal analyzer by pressing:

   Input/Output, **Freq Ref Input**, **Freq Ref Input External**
   FREQ, **Center Frequency**, 50, **MHz**
   Span, **1, MHz**
   AMPTD, Y Scale, Ref Level, 0, **dBm**
   Meas Setup, Avg/Hold Number, 10, **Enter**
   Trace, Trace Average
   Peak Search

5. Set the external 10 dB step attenuator to 0 dB.
6. Adjust the amplitude on the signal source until the marker amplitude on the analyzer reads –15 dBm ±0.2 dB.

7. On the analyzer, press the **Single** key to trigger a 10 sweep average.
8. On the analyzer, activate the Marker Delta function by pressing **Peak Search**, **Marker Delta**.
9. Perform the following steps for each attenuator setting listed in the table below:
    a. Select the next External attenuator setting.
    b. Press the **Restart** key to trigger a 10 sweep average.
    c. Enter the delta marker value into Table 17-9.
    d. Check delta marker reading against the test limits.

Table 17-9 Scale Fidelity Results

External Attenuator Setting	Minimum (dB)	Marker Delta Value (dB)	Maximum (dB)
0	N/A	Reference	N/A
10	–11.0		–9.0
20	–21.0		–19.0
30	–31.0		–29.0
40	–41.0		–39.0
50	–51.0		–49.0

BBIQ Input Frequency Response (Option BBA only)

Test Limits

Frequency Range	Limit Relative to 250 kHz
Frequency Range	Limit Relative to 250 kHz
250 kHz to 10 MHz (Standard)	± 1.75 dB
250 kHz to 25 MHz (Option B25)	± 1.75 dB
250 kHz to 40 MHz (Option B40)	± 1.75 dB

This procedure tests the amplitude response of each of the BBIQ inputs versus frequency. For each input, a reference measurement is made at 250 kHz and then subsequent measurements are made at several frequencies up to the maximum IQ bandwidth. The amplitude difference between the measurement at 250 kHz and subsequent frequencies is calculated and compared to the test limit.

Item	Critical Specifications	Recommended Keysight Model
RF Signal Generator	Frequency: 250 kHz to 40 MHz Amplitude: ~–10 dBm Flatness: < ±0.75 dB	E4438C
Cable, BNC	Connectors: BNC male Length: 23 cm (9 in) max	10502A
Cable, BNC, 120 cm	Connectors: BNC male Frequency: 250 kHz to 40 MHz	10503A
50 Ohm Termination	Connector: BNC male Frequency: 250 kHz to 40 MHz	11593A

Figure 17-8 BBIQ Input Frequency Response Setup (I Input)

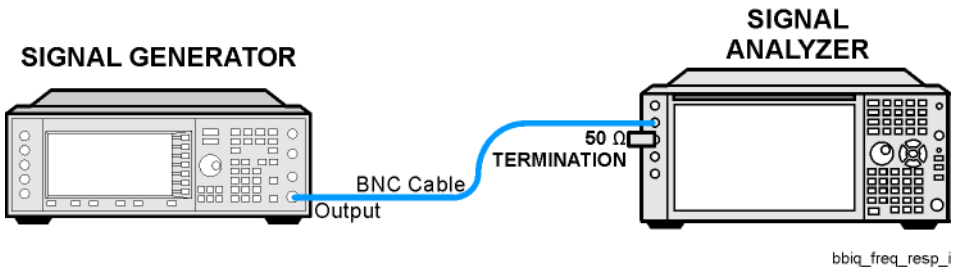


Figure 17-9 BBIQ Input Frequency Response Setup (I Input)

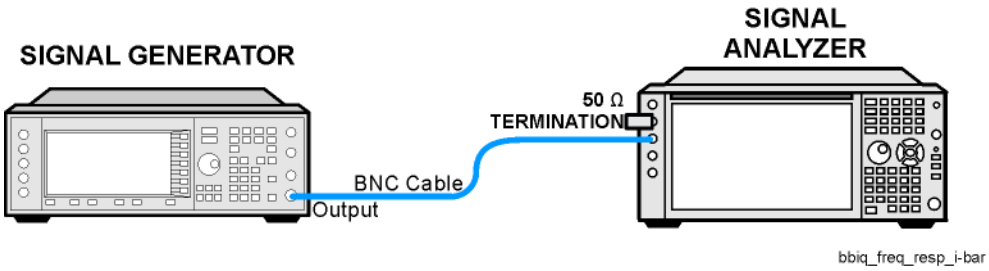


Figure 17-10 BBIQ Input Frequency Response Setup (Q Input)

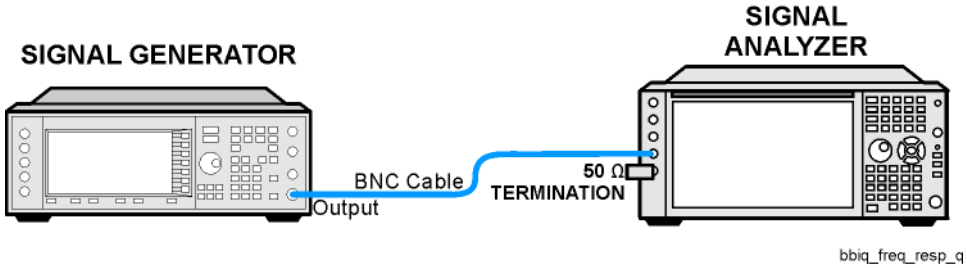
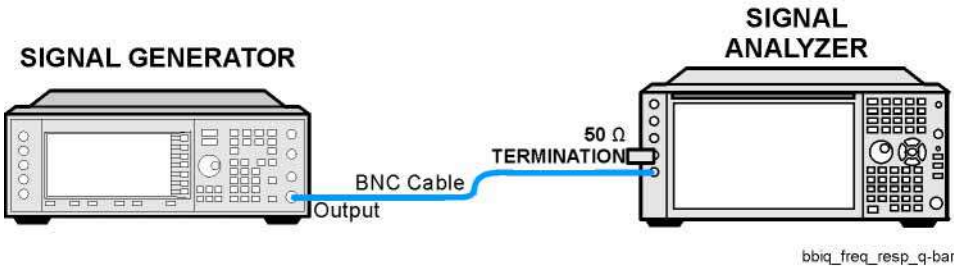


Figure 17-11 BBIQ Input Frequency Response Setup (Q Input)



Procedure

1. Press **MODE/MEAS** on the analyzer. Select the **I/Q Analyzer (Basic)** mode, **Complex Spectrum** measurement, and **Normal** view. Press **OK**. Press **Mode Preset**.
2. Press **Input/Output Input**, **Select Input, I/Q**, (to change to I/Q inputs), **I/Q** (to bring up the I/Q input menu), **I/Q Cable Calibrate**. Follow the instructions on screen. Use the short BNC cable listed above to perform the calibration. This process has several steps and will take about 3 minutes to perform.
3. Press **I/Q Path**, **I+jQ**, **I/Q Setup, I Setup**, **Differential** (On). Press **Return**, **Q Setup**, **Q Same as I** (On).
4. Preset the RF Signal Generator and set the controls as follows:

Frequency	250 kHz
Amplitude	–10 dBm
RF	On

NOTE Once the RF Signal Generator's Amplitude is set, do not change the RF Signal Generator's Amplitude setting during the rest of this procedure.

5. Connect the longer BNC cable between the RF Signal Generator's RF OUTPUT and the I input of the X-Series analyzer, see Figure 17-7.
6. Connect the 50 Ohm termination to the I input of the X-Series analyzer, see Figure 17-7.
7. Press **Mode Preset** on the X-Series analyzer. Press **System**, **Show System**. Note if either of the options listed below are present:

   N9020B-B25
   N9020B-B40

8. If none of the options listed in step 7 are present, the maximum IQ bandwidth is 10 MHz.
9. If N9020B-B25 is present, but N9020B-B40 is not present, the maximum IQ bandwidth is 25 MHz.
10. If N9020B-B40 is present, the maximum IQ bandwidth is 40 MHz.
11. Press **FREQ** on the X-Series analyzer and set the Center Freq equal to one half the maximum IQ bandwidth determined above. For example, if the maximum IQ bandwidth is 40 MHz, set the Center Freq to 20 MHz.
12. Press **FREQ, Span** on the X-Series analyzer and set the Span equal to the maximum IQ bandwidth determined above.
13. Press **BW** on the X-Series analyzer and set the Res BW to 100 kHz.
14. Press **Peak Search** on the X-Series analyzer. Record the marker amplitude reading in Table 17-10 for the I Input at 250 kHz.

15. Set the RF Signal Generator to each of the remaining frequencies listed in Table 1, up to the maximum IQ bandwidth of the X-Series analyzer. At each frequency, do the following:

a. Press **Peak Search**

b. Record the marker amplitude reading in Table 17-10 for the I Input at the current RF Signal Generator frequency

Table 17-10 BBIQ Input Frequency Response, I and I Inputs

RF Signal Generator Frequency	I Input		I Input		Test Limits
	Marker Amplitude	Frequency Response	Marker Amplitude	Frequency Response	
250 kHz		0.0 dB		0.0 dB	±1.75 dB
2 MHz					±1.75 dB
5 MHz					±1.75 dB
7.5 MHz					±1.75 dB
9.9 MHz					±1.75 dB
Stop here if Maximum IQ Bandwidth is 10 MHz					
12.5 MHz					±1.75 dB
15 MHz					±1.75 dB
17.5 MHz					±1.75 dB
20 MHz					±1.75 dB
22.5 MHz					±1.75 dB
24.9 MHz					±1.75 dB
Stop here if Maximum IQ Bandwidth is 25 MHz					
30 MHz					±1.75 dB
35 MHz					±1.75 dB
39.9 MHz					±1.75 dB

16. Set the RF Signal Generator frequency to 250 kHz

17. Connect the BNC Cable between the RF Signal Generator RF Output and the I input on the X-Series analyzer, see Figure 17-9

18. Connect the 50 Ohm termination to the I input on the X-Series analyzer, see Figure 17-9

19. Press **Peak Search** on the X-Series analyzer. Record the marker amplitude reading in Table 17-10 for the I Input at 250 kHz.

20. Set the RF Signal Generator to each of the remaining frequencies listed in Table 17-10, up to the maximum IQ bandwidth of the X-Series analyzer. At each frequency, do the following:

a. Press **Peak Search**

b. Record the marker amplitude reading in Table 17-10 for the I Input at the current RF Signal Generator frequency

NOTE

Since the input is set for I + Q and the input signal is being applied to I only, the analyzer will measure 6 dB lower than the signal generator output; in this case

-10 dB - +6 dB = -16 dB

This will be the case for I, I, Q, and Q inputs.
This is because the Fourier transform of

Asin (w+) = Am(W-w) + 1/2 Am(W+w).

Since a signal is placed at w or -w, the result will be 20log(1/2) lower.
The transform is in voltage and not power.

---

21. Connect the BNC Cable between the RF Signal Generator RF Output and the Q input on the X-Series analyzer, see Figure 17-10

22. Connect the 50 Ohm termination to the Q input on the X-Series analyzer, see Figure 17-10

23. Set the RF Signal Generator frequency to 250 kHz.

24. Press **Peak Search** on the X-Series analyzer. Record the marker amplitude reading in Table 17-11 for the Q Input at 250 kHz.

25. Set the RF Signal Generator to each of the remaining frequencies listed in Table 17-11, up to the maximum IQ bandwidth of the X-Series analyzer. At each frequency, do the following:

Press **Peak Search**

Record the marker amplitude reading in Table 17-11 for the Q Input at the current RF Signal Generator frequency

Table 17-11 BBIQ Input Frequency Response, Q and Q Inputs

RF Signal Generator Frequency	I Input		I Input		Test Limits
	Marker Amplitude	Frequency Response	Marker Amplitude	Frequency Response	
250 kHz		0.0 dB		0.0 dB	±1.75 dB
2 MHz					±1.75 dB
5 MHz					±1.75 dB
7.5 MHz					±1.75 dB
9.9 MHz					±1.75 dB
Stop here if Maximum IQ Bandwidth is 10 MHz					
12.5 MHz					±1.75 dB
15 MHz					±1.75 dB
17.5 MHz					±1.75 dB
20 MHz					±1.75 dB
22.5 MHz					±1.75 dB
24.9 MHz					±1.75 dB
Stop here if Maximum IQ Bandwidth is 25 MHz					
30 MHz					±1.75 dB
35 MHz					±1.75 dB
39.9 MHz					±1.75 dB

26. Set the RF Signal Generator frequency to 250 kHz

27. Connect the BNC Cable between the RF Signal Generator RF Output and the Q input on the X-Series analyzer, see Figure 17-11

28. Connect the 50 Ohm termination to the Q input on the X-Series analyzer, see Figure 17-11

29. Press **Peak Search** on the X-Series analyzer. Record the marker amplitude reading in Table 17-11 for the Q Input at 250 kHz.

30. Set the RF Signal Generator to each of the remaining frequencies listed in Table 17-11, up to the maximum IQ bandwidth of the X-Series analyzer. At each frequency, do the following:

a. Press **Peak Search**

b. Record the marker amplitude reading in Table 17-11 for the Q Input at the current RF Signal Generator frequency

31. In Table 17-10 and Table 17-11, calculate the Frequency Response for each input by subtracting the Marker Amplitude at 250 kHz for that input from the Marker Amplitude for each frequency greater than 250 kHz.

Frequency Response = Marker Amplitude (Freq > 250 kHz) – Marker Amplitude (250 kHz)

32. Compare the Frequency Response values to the Test Limits.

18 Instrument Software

What You Will Find in This Chapter

Instrument Software Overview on page 620

Software Licensing on page 621

Software Updates on page 622

Instrument Measurement Application Software on page 622

89601 VSA Software on page 622

Instrument Software Overview

The instrument software, installed in every instrument, contains not only the spectrum analyzer measurement application, but also all of the other currently available measurement applications. However, only the licensed applications will be seen and available for use.

To view the currently licensed measurement applications press **System**, **Show System**. In addition to listing the application model number and description you will also see the revision of each. However, the complete package itself also has a revision associated with it, which can also be found on this screen as the “Instrument S/W Revision”.

Since the instrument application software is distributed in one complete package, when an update is installed they are all updated at the same time. One of the benefits of this is that you cannot have revisions that are incompatible with each other installed in an instrument. However, there is one exception to this, which would be the 89601B VSA software. While the latest revision of the 89601B VSA software is installed in each instrument as it left the factory, it must be updated, and kept in sync with the rest of the instrument application software independently.

Software Licensing

All application software needs to have a valid license in order to be available for use. This also includes the spectrum analyzer application (N9060C).

Software Updates

Instrument Measurement Application Software

Updates are installed much like most other types of commercial software packages. The latest revision of the software, along with complete installation instructions, can be obtained as follows:

Web Download:

The latest revision of the software can be downloaded from:

www.keysight.com/find/xseries_software

89601 VSA Software

Updates for the 89601 VSA software can be downloaded from:

http://www.keysight.com/find/89600_VSA_sw_download

The revision of the 89601 VSA software must be compatible with the revision of the instrument measurement application software package that is installed in the instrument. To determine what revisions are compatible, and if a further updates are required, please see the software compatibility information on the instrument measurement application software download web page listed above.

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