Keysight
N5166B CXG
N5171B/72B/73B EXG
N5181B/82B/83B MXG
X-Series Signal Generators

KEYSIGHT TECHNOLOGIES

Service Guide

Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

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

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

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

Information on preventing instrument damage can be found at:

www.keysight.com/find/PreventingInstrumentRepair

Is your product software up-to-date?

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Keysight Technical Support website at:

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

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- Accessories
- Operation Verification
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User's Guide

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- Setting Preferences & Enabling Options
- Basic Operation
- Optimizing Performance
- Using Analog Modulation (Option UNT Only)
- Using Pulse Modulation (Option UNU Only)
- Basic Digital Operation - No BBG Option Installed
- Basic Digital Operation (Option 651/652/654)
- Adding Real-Time Noise to a Signal (Option 403)
- Real-Time Phase Noise Impairments (Option 432)
- Custom Digital Modulation (Option 431)
- Multitone and Two-Tone Waveform Generator (Option 430)
- Working in a Secure Environment
- Troubleshooting

Programming Guide	▪ Getting Started with Remote Operation ▪ Using IO Interfaces ▪ Programming Examples ▪ Programming the Status Register System ▪ Creating and Downloading Files ▪ Creating and Downloading User-Data Files
SCPI Reference	▪ SCPI Basics ▪ Basic Function Commands ▪ LXI System Commands ▪ System Commands ▪ Analog Modulation Commands ▪ Arb Commands ▪ Real-Time Commands ▪ N5171B/72B/81B/82B SCPI Command Compatibility
Service Guide	▪ Troubleshooting ▪ Replaceable Parts ▪ Assembly Replacement ▪ Post-Repair Procedures ▪ Safety and Regulatory Information ▪ Instrument History
Key Help[a]	· Key function description · Related SCPI commands

a. Press the **Help** hardkey, and then the key for which you wish help.

Keysight Technologies
X-Series Signal Generators

Service Guide

1 Overview

What You Will Find in This Chapter

This chapter provides information on the following:

Service Manual Revision History on page 20

Before You Start Troubleshooting on page 21

General Safety Considerations on page 22

Instrument Options on page 24

Service Equipment You Will Need on page 26

ESD Information on page 27

Before an Instrument Repair on page 30

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Returning a Signal Generator for Service on page 34

Lithium Battery Disposal on page 35

Service Manual Revision History

N5180-90059

May 1, 2012

Initial release of the N5171B/72B, N5181B/82B MXG Signal Generators.

May 1, 2015

Initial release of the N5173B EXG and N5183B MXG Microwave Analog Signal Generators.

February 2018

Added new part information for introduction of new Keysight color palette for external parts (charcoal gray and other gray tones).

July 2019

- Updated block diagrams
- Updated replacement parts list
- Added detailed self test descriptions
- Updated post-repair procedures

August 2019

- Added support for N5166B CXG model

June 2020

- Post repair procedures updates
- Misc. minor updates

December 2020

- Added documentation for A7AT1 Step Attenuator replacement
- Updated Self Test 1304 troubleshooting information
- Corrected information on Option 1E1
- Misc. minor updates

Before You Start Troubleshooting

Before troubleshooting, complete the following tasks:

- Familiarize yourself with the safety symbols marked on the instrument.
- Read the General Safety Considerations section in this chapter.
- Read the ESD Information section in this chapter.
- Familiarize yourself with the troubleshooting information in Chapter 2, "Boot Up and Initialization", and how it relates to information on troubleshooting the other assemblies.

Error Messages

For more information on error messages see the X-Series Signal Generators Error Messages guide at:

http://literature.cdn.keysight.com/litweb/pdf/N5180-90075.pdf

General Safety Considerations

The following safety notes apply specifically to signal generators. These notes also appear in other chapters of this service guide as required.

WARNING These servicing instructions are for use by qualified personal 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 before starting to open.

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

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

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.

WARNING Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

WARNING Replace battery only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.

WARNING If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

CAUTION Many of the assemblies in this instrument are very susceptible to damage from electrostatic discharge (ESD). Perform service procedures only at a static-safe workstation and wear a grounding strap.

WARNING These troubleshooting instructions are for use by qualified personnel. To avoid electrical shock, do not perform any troubleshooting unless qualified.

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources before it is opened.

The following techniques related to ESD and static-safe workstations should not be used when working on circuitry with a voltage potential greater than 500 volts.

WARNING Keep fingers and all other objects away from the fans when the signal generator is plugged in.

NOTE For the instrument to meet performance specifications and for accurate self test results, allow a warm up period of 45 minutes within an operational temperature range of 0 to 55 °C. For more information, refer to the X-Series signal generator Data Sheets.

NOTE When a procedure instructs you to preset the signal generator, press the **Preset** hardkey, not the **User Preset** hardkey.

Instrument Options

Table 1-1

Options	Description	N5166B	N5171B	N5172B	N5173B	N5181B	N5182B	N5183B
003	Digital Output Connectivity with N5102A			X			X	
004	Digital Input Connectivity with N5102A			X			X	
006	Instrument Security		X	X	X	X	X	X
009	Internal Solid State Memory	X		X			X	
012	LO In/Out for Phase Coherency			X			X	
021	Upgrade BBG memory from 32 Msa to 256 Msa			X				
022	Upgrade BBG memory from 32 Msa to 512 Msa	X		X			X	
023	Upgrade BBG memory from 32 Msa to 1 Gsa							
042	Upgrade BBG memory from 256 Msa to 512 Msa			X				
043	Upgrade BBG memory from 512 Msa to 1 Gsa						X	
099	Expanded License Upgrades		X	X		X	X	
1E1	Step Attenuator, 115 dB				X			X
1EA	High Output Power		X	X	X	X	X	X
1ED	Type-N RF Output Connector				X			X
1EL	Differential I/Q Outputs			X			X	
1EM	Rear Panel Connector		X	X	X	X	X	X
1EQ	Low Power <-110 dBm					X	X	
1ER	Flexible Reference Input	X	X	X	X	X	X	X
221-229	Waveform License 5 Packs	X		X			X	
250-259	Waveform License 50 Packs	X		X			X	
302	Avionics		X	X		X	X	
303	Multifunction Generator	X	X	X	X	X	X	X
320	Pulse Train Generator	X	X	X	X	X	X	X
403	Calibrated AWGN	X		X			X	
430	Multitone and Two-Tone Generator	X		X			X	
431	Custom Digital Modulation	X		X			X	
432	Phase Noise Impairment			X			X	

Table 1-1

Options	Description	N5166B	N5171B	N5172B	N5173B	N5181B	N5182B	N5183B
501	Frequency Range - 9 kHz to 1 GHz		X					
503	Frequency Range - 9 kHz to 3 GHz	X	X	X		X	X	
506	Frequency Range - 9 kHz to 6 GHz	X	X	X		X	X	
513	Frequency Range - 9 kHz to 13 GHz				X			X
520	Frequency Range - 9 kHz to 20 GHz				X			X
532	Frequency Range - 9 kHz to 31.8 GHz				X			X
540	Frequency Range - 9 kHz to 40 GHz				X			X
653	BBG 60 MHz Bandwidth - 32 Msa	X		X				
655	BBG Upgrade from 60 MHz to 120 MHz Bandwidth	X		X				
656	BBG 80 MHz Bandwidth - 32 Msa						X	
657	BBG Upgrade from 80 MHz to 160 MHz Bandwidth			X			X	
660	Real-Time Capability			X			X	
FRQ	Frequency Extender Connectivity			X			X	
SD0	No Internal Non-Volatile User Memory		X	X	X	X	X	X
UN7	Internal Bit Error Rate Analyzer			X			X	
UNM	Standard Front Panel Connectors		X	X	X	X	X	X
UNT	AM, FM, Phase Modulation	X	X	X	X	X	X	X
UNV	Enhanced Dynamic Range			X			X	
UNW	Narrow Pulse Modulation	X	X	X	X	X	X	X
UNX	Low Phase Noise					X	X	
UNY	Enhanced Low Phase Noise					X	X	X
UNZ	Fast Switching		X	X	X	X	X	X
UW2	Narrow Pulse Modulation - Export Restriction				X			X
UZ2	Fast Switching - Export Restriction				X			X

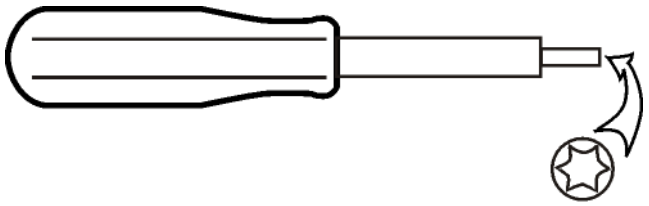
Service Equipment You Will Need

There are certain things that will be required to troubleshoot, adjust, and test the X-Series Signal Generators. They include the following:

- Calibration Application Software
- Misc Test Equipment

Tools you will need

Figure 1-1 TORX Tool



Hand Tool	Size
Pozi Driver	#1
Nut Driver	7 mm
Nut Driver	9/16 inch
Nut Setter (8710-2546)	5/8 inch
Open-End Wrench	5/16 inch
Torque Driver - Adjustable	Multi Bit
Torque Wrench - 9 inch-lbs	5/16 inch
TORX Driver	T-8
TORX Driver	T-10
TORX Driver	T-20

ESD Information

Protection from Electrostatic Discharge

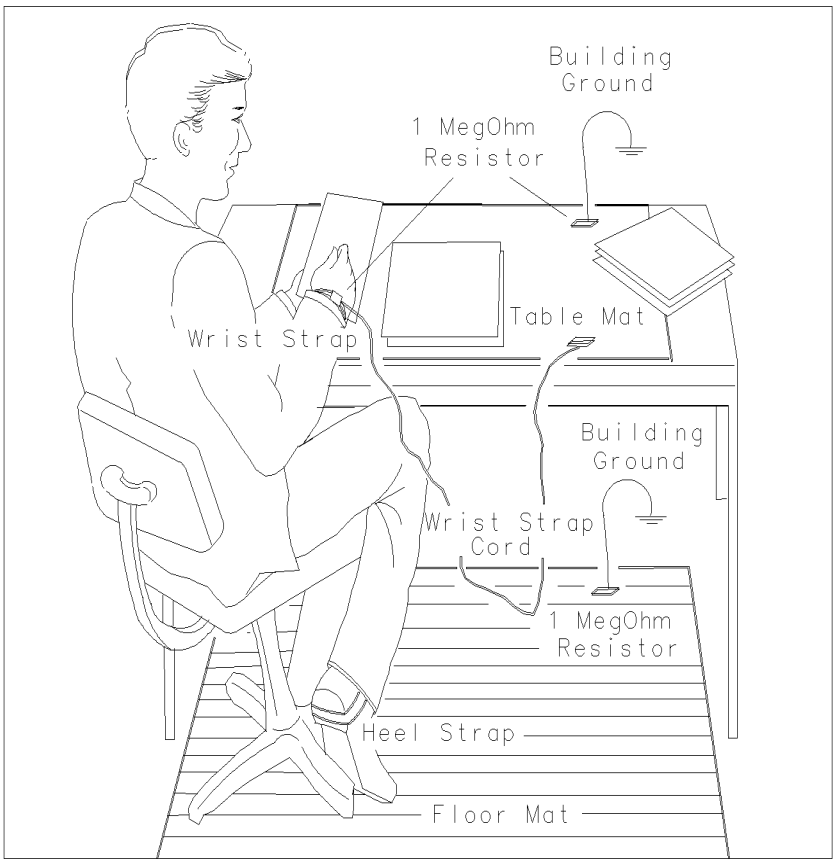
Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe workstation. Figure 1-2 shows an example of a static-safe workstation using two types of ESD protection:

- 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 1-2 Example of a Static-Safe Workstation



Electrostatic Discharge (ESD) Protective Supplies

Description	Part Number
ESD connector end cap front-panel RF output	1401-0247
ESD connector end cap-GPIB	1252-5007
2 X 4 Ft. Antistatic Table Mat with 15 FT. Ground Wire	9300-0797
5 Ft. Grounding Cord (for wrist strap)	9300-0980
Adjustable Antistatic Wrist Strap	9300-1367

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 any electronic equipment, 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 equipment is 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).

Calibration Application Software

Information regarding the N7822A Calibration Application Software for CXG/EXG/MXG Signal Generators can be found at the following web site:

www.keysight.com/find/calibrationsoftware

Before an Instrument Repair

Before replacing any instrument assembly, perform the related Pre-Repair Procedures found in Chapter 16, “Pre and Post-Repair Procedures”. Doing so will ensure that all required instrument information and calibration data will be properly preserved once the assembly replacement is completed.

For detailed information on the instrument information and calibration data refer to Chapter 3, “Instrument Information and Calibration Data”.

After an Instrument Repair

If any instrument assemblies have been repaired or replaced, perform the related adjustments and performance verification tests. Most of these tests are done using the N7822A Calibration Application Software for CXG/EXG/MXG Signal Generators. Refer to Chapter 16, "Pre and Post-Repair Procedures" for a list of post-repair adjustments and performance tests based on which hardware has been changed.

Information regarding the N7822A Calibration Application Software for CXG/EXG/MXG Signal Generators can be found at

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

Instrument Serial Numbers

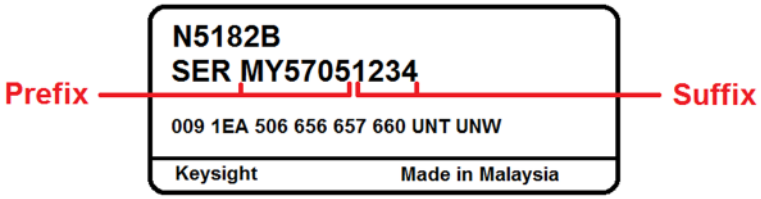
Keysight makes frequent improvements to its products enhancing performance, usability, or reliability. Keysight service personnel have access to complete records of design changes to each type of instrument, based on the instrument's serial number and option designation.

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 1-3 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 instrument is powered up, press **Utility**, **Instrument Info**, **Diagnostic Info**.

Contacting Keysight Technologies

Before contacting Keysight, read the warranty information that is shipped with your signal generator. If your signal generator is covered under a maintenance agreement, be familiar with its terms.

Assistance with test and measurements needs, and information on finding a local Keysight office is available on the Web at: **http://www.Keysight.com/find/assist**

If you do not have access to the internet, contact your local field engineer.

NOTE **In any correspondence or telephone conversation, refer to the signal generator by its model number and full serial number. With this information the Keysight representative can determine whether your signal generator is still within its warranty period.**

Be prepared to provide the following information:

- a complete description of the failure
- if the signal generator was dead on arrival (DOA) or if it functioned prior to failure
- the model number, all options, and the serial number of the signal generator
- the firmware revision date
- if the self tests have been run

Returning a Signal Generator for Service

Use the information in this section if you need to return the signal generator to Keysight Technologies.

Packaging the Signal Generator

1. Use the original packaging materials or a strong shipping container that is made of double-walled, corrugated cardboard with 159 kg (350 lb.) bursting strength. The carton must be both large enough and strong enough to accommodate the signal generator and allow at least 3 to 4 inches on all sides of the signal generator for packing material.

CAUTION

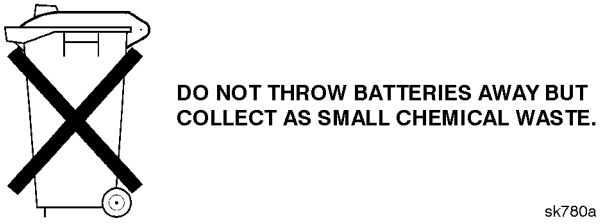
Signal generator damage can result from using packaging materials other than those specified. Never use styrene pellets, of any shape, as packaging material. They do not adequately cushion the signal generator or prevent it from shifting in the carton. Styrene pellets can cause equipment damage by generating static electricity and lodging in the signal generator fan.

2. Surround the signal generator with at least 3 to 4 inches of packing material, or enough to prevent the instrument from moving in the carton. If packing foam is not available, the best alternative is SD-240 Air Cap™ from Sealed Air Corporation (Hayward, CA 94545). Air Cap looks like a pink plastic sheet covered with 1-1/4 inch air-filled bubbles. Use the Air Cap to reduce static electricity. Wrap the signal generator several times in the material to protect the signal generator and to prevent it from moving in the carton.
3. Seal the shipping container securely with strong, nylon adhesive tape.
4. Mark the shipping container “FRAGILE, HANDLE WITH CARE” to ensure careful handling.
5. Retain copies of all shipping papers.

Lithium Battery Disposal

When the battery on the A3 RF assembly is exhausted and/or ready for disposal, dispose of it according to your country's requirements. You can return the battery to your nearest Keysight Technologies Sales and Service office for disposal, if required.

Figure 1-4



2 Boot Up and Initialization

What You Will Find in This Chapter

This chapter provides information on the following:

Typical Instrument Boot-up Process Flow on page 38

Potential Problems During Boot Process on page 39

Yellow Standby Front Panel LED is Not Working on page 40

Green Power On Front Panel LED is Not Working on page 42

Fans are Not All Operating on page 44

Instrument Display Is Blank on page 45

Instrument Hangs at the BIOS Splash Screen on page 50

Instrument Cannot Completely Load or Run the Operating System on page 51

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 instrument.
2. The yellow standby LED illuminates on the instrument front panel just above the On/Off button. If the yellow Standby LED is not illuminating refer to the "Yellow Standby Front Panel LED is Not Working" section in this chapter.

NOTE

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

3. To turn the instrument on, press the front panel **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 A3 RF assembly. If the green Power On LED is not illuminating refer to the "Green Power On Front Panel LED is Not Working" section in this chapter.
4. As soon as the green Power On LED illuminates the instrument fans should start running. The fans are mounted across the inside of the instrument just behind the front panel and draw air into the instrument to cool the internal circuitry. If a fan is not running refer to the "Fans are Not All Operating" section in this chapter.
5. After the instrument is turned on for a few seconds the Keysight Technologies BIOS splash screen is displayed for about 10-15 seconds. If the Keysight Technologies logo is not displayed refer to the "Instrument Display Is Blank" section in this chapter. If the instrument hangs at, or just after, the BIOS splash screen refer to the "Instrument Hangs at the BIOS Splash Screen" section in this chapter.
6. The operating system will then load, and the firmware splash screen will appear while it identifies the installed hardware and loads the application software. If the firmware does not properly load within a few seconds refer to the "Instrument Cannot Completely Load or Run the Operating System" section in this chapter.
7. If any errors occur during the boot process press the **Error** front panel hardkey and refer to the X-Series Signal Generators Error Messages guide at: http://literature.cdn.keysight.com/litweb/pdf/N5180-90075.pdf.
8. Depending on the options installed, the complete boot process can take between 25 and 90 seconds.

To further evaluate the functionality and performance of the instrument run the internal Self Test routine. For information on this see Chapter 4, "Self Test".

Potential Problems During Boot Process

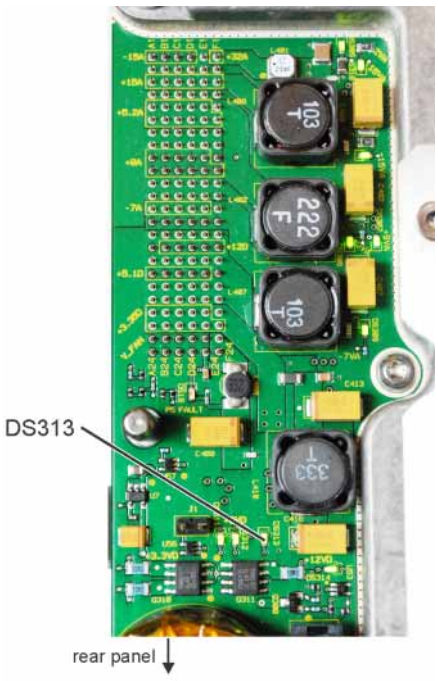
This section describes potential problems that may occur if there is an internal hardware issue that prohibits the instrument from completing a full boot up to the signal generator application.

Yellow Standby Front Panel LED is Not Working

The yellow standby LED is controlled by the +5.1 VDC standby line. The +5.1 VDC standby line is supplied by the A1 Power Supply and is routed through the A3 RF assembly to the front panel through ribbon cable W1. With the instrument plugged in to an AC power source and the power turned off, the yellow standby LED should be on. When the instrument is turned on, the yellow standby LED should turn off and the green front panel power on LED should turn on. If the yellow standby LED is not functioning as expected, follow the procedure below to identify the problem.

1. The Standby LED will only turn on when the instrument is connected to an AC power 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 outer and inner bottom covers. Refer to Chapter 15, “Assembly Replacement” of this manual.
3. Referring to Figure 2-1, verify the +5.1 VSB LED on the A3 RF assembly is on (green).

Figure 2-1 DS313 +5.1 VSB LED (Standby)



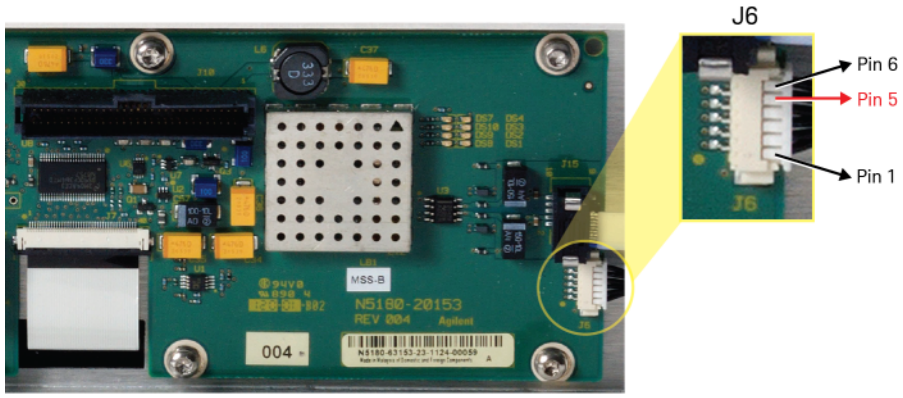
Is DS313 on (green)?

a. If DS313 is on proceed to step 4.

b. If DS313 is not on go to Chapter 8, “Power Supply” to determine why the +5.1 VSB is not turning on.

4. Remove the 4 screws attaching the front frame assembly to the chassis and tilt it down so that you have access to the rear of the A6A1 Front Panel Interface board assembly.
5. Referring to Figure 2-2, verify the standby LED drive voltage on pin 5 of J6 on the A6A1 Front Panel Interface board measures approximately +2.1 VDC.

Figure 2-2 A6A1 Front Panel Interface J6 Pinout



Is the voltage on pin 5 of J6 +2.1 VDC ±0.3 V?

a. If yes, the problem is most likely the A6A3 Power Switch Assembly.
b. If not, the problem is most likely the A6A1 Front Panel Interface assembly or the W1 Ribbon Cable from the A3 RF Assembly to the A6A1 Front Panel Interface assembly.

Green Power On Front Panel LED is Not Working

The power on LED is controlled by the +3.35 VD voltage line from the A1 Power Supply. When the instrument is turned on by pressing the A6A3 front panel power switch the +3.35 VDF line is routed through the A3 RF assembly to the front panel through ribbon cable W1. If the green power on LED is not functioning as expected, follow the procedure below to identify the problem.

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 Front Panel LED is Not Working" 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.

1. The Power On LED will only turn on when the instrument is connected to an AC power 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. Turn the instrument off, remove the AC power cord, and then remove the instrument outer and inner bottom cover. Refer to Chapter 15, "Assembly Replacement" of this manual.
3. Connect the AC power cord to the rear of the instrument but without turning it on, leaving it in standby mode.
4. Referring to Figure 2-3, press and release the front panel power switch and verify that DS311 comes on.

Figure 2-3 DS311 +3.35 VDF LED

Is DS311 on (green)?

a. If DS311 is not on go to Chapter 8, “Power Supply” to determine why the +3.35 VDF is not turning on.

b. If DS311 is on proceed to step 5.

5. Remove the 4 screws attaching the front frame assembly to the chassis and tilt it down so that you have access to the rear of the A6A1 Front Panel Interface board assembly.

6. Referring to Figure 2-2, verify the power on LED drive voltage on pin 3 of J6 on the A6A1 Front Panel Interface board measures approximately +2.1 VDC.

Is the voltage on pin 3 of J6 +2.1 VDC ±0.3 V?

a. If yes, the problem is most likely the A6A3 Power Switch Assembly.

b. If not, the problem is most likely the A6A1 Front Panel Interface assembly or the W1 Ribbon Cable from the A3 RF Assembly to the A6A1 Front Panel Interface assembly.

Fans are Not All Operating

The four instrument fans are connected directly to the A1 Power Supply. The fan motors are AC motors, with a DC to AC inverter built into the motor hub. The control, voltage, and filtering for the fans are integrated into the A1 Power Supply.

The fan control voltage is a nominal 12 VDC. The control range can vary from a minimum of 8 volts up to a maximum of 13.8 volts. Using internal sensors, the control circuit sets the fan voltage to adjust the fan speed to protect the A1 Power Supply and the signal generator.

The A1 Power Supply will function at full output load, up to 25° C, without raising the minimum fan voltage. The A1 Power Supply may begin to raise the fan voltage at 25° C and will reach maximum voltage at no lower than 45° C ambient.

If a single fan is inoperative

1. Turn the instrument off, remove the AC power cord, and then remove the instrument outer and top inner cover. Refer to Chapter 15, “Assembly Replacement” in this manual.
2. Connect the AC power cord to the rear of the instrument and turn the instrument on by pressing and releasing the front panel power switch.
3. Unplug the inoperative fan and one working fan and plug the inoperative fan into the working fan’s connector on the A1 Power Supply.

   Does the inoperative fan now work?

   a. If yes, the connector on the A1 Power Supply is faulty. Replace the A1 Power Supply.

   b. If not, the fan is faulty. Replace the faulty fan.

If two or more fans are inoperative

The most likely assembly at fault is the A1 Power Supply. The four fans are connected in parallel, so if the A1 Power Supply voltage is faulty for one fan, then by design, the voltage will be faulty for all four fans. Replace the faulty A1 Power Supply.

Instrument Display Is Blank

A problem of a blank display 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 Front Panel LED is Not Working" section before proceeding.

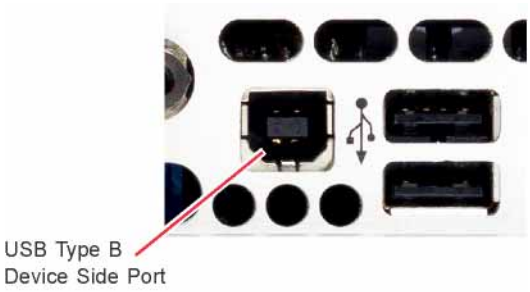
1. Turn the instrument off, remove the AC power cord, and then remove the instrument outer and bottom inner cover. Refer to Chapter 15, "Assembly Replacement" in this manual.
2. Connect the AC power cord to the rear of the instrument but without turning it on, leaving it in standby mode.
3. Turn the instrument on by pressing and releasing the front panel power switch. Verify that all the power supply voltages turn on. See Chapter 8, "Power Supply" in this manual for information on how to verify power supply voltages.

   Are all the power supply voltages at the proper level?

   a. If yes, proceed to step 4.

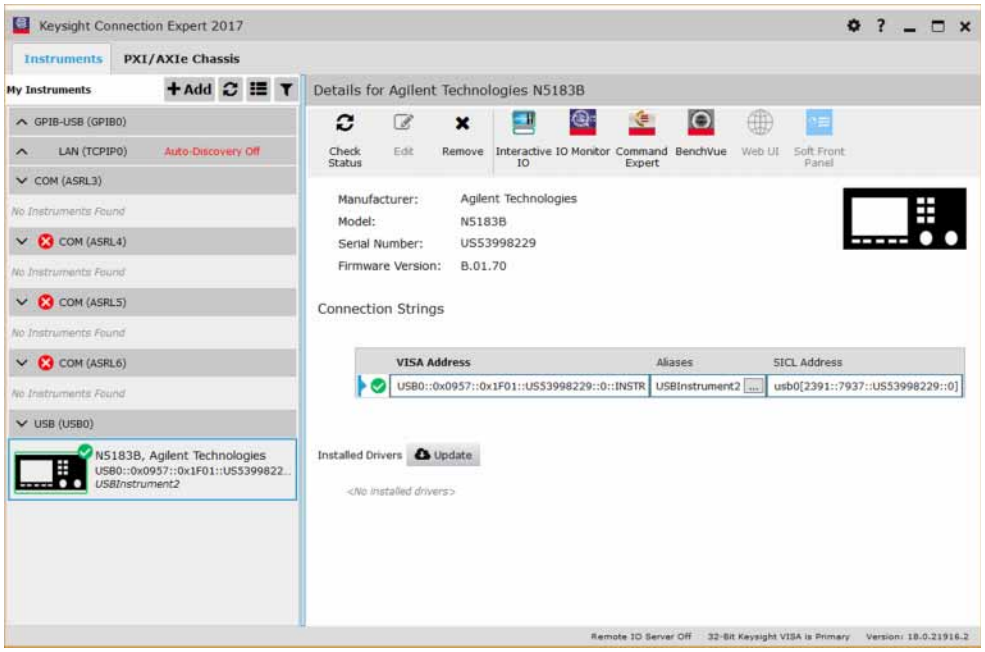
   b. If not, go to Chapter 8, "Power Supply" to determine why all power supply voltages are not working properly.
4. Referring to Figure 2-4, connect a USB cable to the USB-B device side port on the rear of the instrument.

Figure 2-4 Rear Panel USB-B Device Side Port



5. Before connecting the other end of the cable to a computer, start the Keysight Connection Expert software on the computer. Once it has started, connect the other end of the USB cable to a USB port on the computer.
6. If the instrument is functioning properly the instrument should initialize itself and appear in the connection expert, similar to what is shown in Figure 2-5.

Figure 2-5 Connection Expert Instrument Identification



Has the instrument been correctly recognized by the Connection Expert?

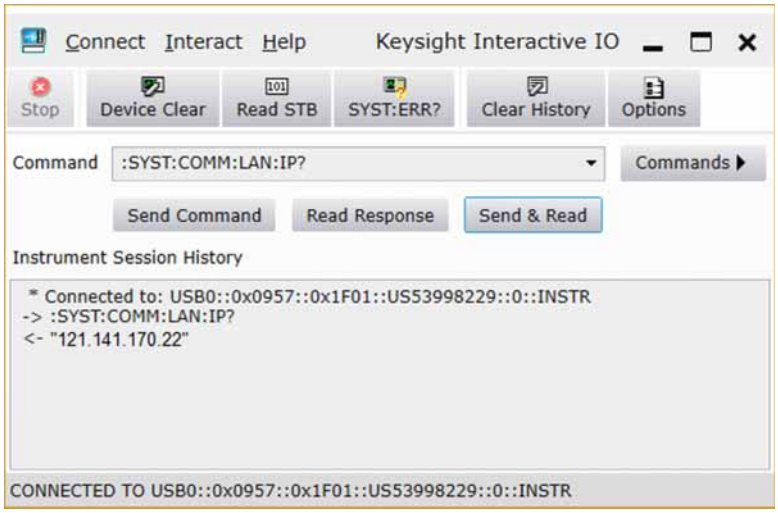
a. If yes, the instrument processor is running and communicating. Proceed to step 7.

b. If not, replace the A5 CPU assembly.

7. Using the LAN connector on the rear panel connect the instrument to your local area network and give it one minute to obtain an IP address.

8. In the Connection Expert select “Interactive IO”. A window like that shown in Figure 2-6 will appear.

Figure 2-6 Interactive IO Communication



9. In the Command field on the Interactive IO window type `:SYST:COMM:LAN:IP?` and press **Send & Read** to retrieve the instrument's IP address.

   Is the IP address that is returned valid for your local area network?

   a. If yes, proceed to step 10.

   b. If not, the instrument may not be set to automatically obtain an IP address. To correct this:

      i. Type `:SYST:COMM:LAN:CONF AUTO` into the Command field and press **Send Command** to switch it to automatically obtain an IP address.

      ii. Type `:SYST:COMM:LAN:REST` into the Command field and press **Send Command** to let the instrument automatically retrieve an IP from the server that will work on your network.

      iii. Allow the instrument one minute to obtain an IP address.

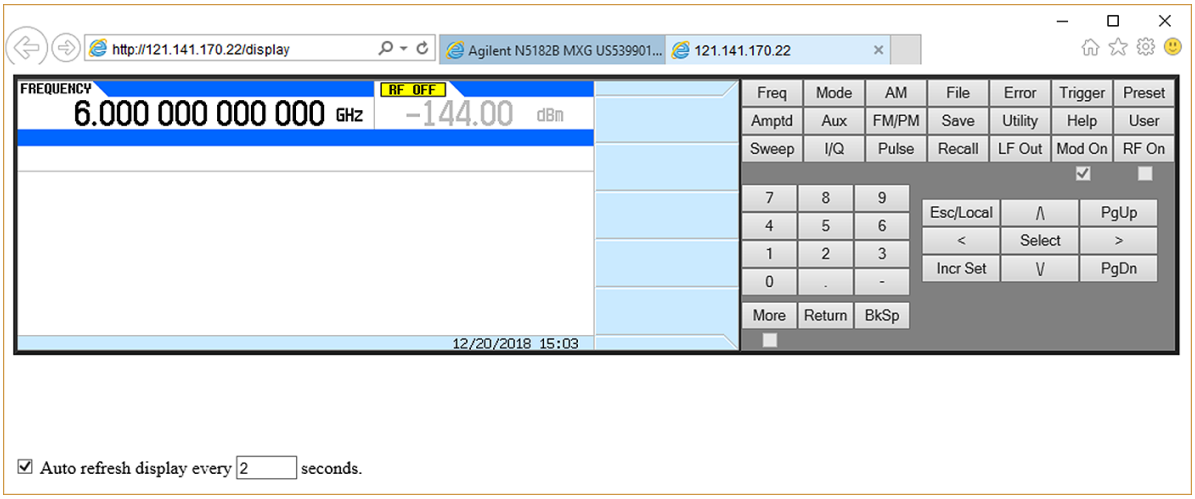
      iv. Type `:SYST:COMM:LAN:IP?` into the Command field and press **Send & Read** to retrieve the instrument's IP address.

10. Copy the instrument IP address from the Interactive IO window into the address field in a web browser and press **Enter**. The browser will go to the instrument internal web page as shown in Figure 2-7.

Figure 2-7 Instrument Internal Web Page

11. To verify that the video controller of the instrument is functioning properly select Signal Generator Web Control from the left side of the screen. After a few moments you should see a new window with a normal instrument display similar to what it shown in Figure 2-8.

Figure 2-8 Web Control Instrument Display



Does the instrument display look normal through the Web Control interface?

a. If yes, the video controller is working properly. Proceed to step 12.

b. If not, the video controller is the most likely cause of the problem. Replace the A3 RF Assembly.

12. Check the Auto refresh display every 2 seconds on the web control instrument display screen.

13. While viewing the instrument display in the web control instrument display window, press a few hard and soft keys on the instrument front panel and see if the remote display reacts accordingly.

Does the remote display react according to the front panel keys that are pressed?

a. If yes, the problem is most likely the display itself. Replace the A6A5 LCD Display Assembly

b. If not, the problem is most likely the front panel interface board. Replace the A6A1 Front Panel Interface assembly.

Instrument Hangs at the BIOS Splash Screen

Troubleshooting an issue causing the instrument boot process to hang during the BIOS splash screen is being displayed, or shortly thereafter is going to be limited. The initial splash screen is displayed by the A5 CPU BIOS, and there is no access to the BIOS settings or controls, even for servicing the instrument. But, there are a few things that can be checked.

1. Turn the instrument off, remove the AC power cord, and then remove the instrument outer and bottom inner cover. Refer to Chapter 15, "Assembly Replacement" in this manual.
2. Connect the AC power cord to the rear of the instrument and turn the instrument on by pressing and releasing the front panel power switch. Verify that all the power supply voltages turn on. See Chapter 8, "Power Supply" in this manual for information on how to verify power supply voltages.

   Are all the power supply voltages at the proper level?

   a. If yes, proceed to step 3.

   b. If not, go to Chapter 8, "Power Supply" to determine why all power supply voltages are not working properly.
3. Attempt to enter the boot up service menu by turning the instrument off, hold the **Preset** key pressed, turn the instrument on, and release the Preset key after 10 seconds.
4. If the instrument enters the boot service menu see Chapter 5, "Service and Utility Menus" for information on how to scan the internal memory for errors and start the instrument with no hardware support.
5. If the boot service menu does not provide any help in resolving the problem, replace the A5 CPU assembly.

Instrument Cannot Completely Load or Run the Operating System

If the instrument does not complete the boot process and arrive at the normal instrument display after being turned on it will hopefully just be due to a software issue, so that is what we will try to fix first. If that does not solve the problem we will then need to look at the hardware for a solution.

1. Enter the boot up service menu by turning the instrument off, hold the **Preset** key pressed, turn the instrument on, and release the Preset key after 10 seconds.
2. Once the instrument enters the boot service menu see Chapter 5, "Service and Utility Menus" for information on how to run the run the firmware without hardware, application harness, and test harness support.
3. Allow the instrument to booted from the service menu as far as it can.

NOTE Ignore any hardware errors that may be observed at this point, as they would be normal when booting with no hardware support.

---

4. Referring to Chapter 19, "Instrument Firmware and Operating System", attempt to install the latest version of instrument firmware.

   Did installing the instrument firmware resolve the issue?

   – If not, proceed to step 5.

5. Turn the instrument off, remove the AC power cord, and then remove the instrument outer and bottom inner cover. Refer to Chapter 15, "Assembly Replacement" in this manual.
6. Connect the AC power cord to the rear of the instrument and turn the instrument on by pressing and releasing the front panel power switch. Verify that all the power supply voltages turn on. See Chapter 8, "Power Supply" in this manual for information on how to verify power supply voltages.

   Are all the power supply voltages at the proper level?

   a. If yes, replace the A5 CPU assembly.
   b. If not, go to Chapter 8, "Power Supply" to determine why all power supply voltages are not working properly.

3 Instrument Information and Calibration Data

What You Will Find in This Chapter

This chapter provides information on the following:

Overview on page 54

Model Number on page 55

Serial Number on page 56

Option Licenses on page 57

Calibration Data on page 61

Overview

There are four types of instrument information that one should be concerned about when an assembly is being removed and replaced. They are:

- Model Number
- Serial Number
- Option Licenses
- Calibration Data

While the direction given in Chapter 16, “Pre and Post-Repair Procedures” outlines what needs to be done before and after an assembly replacement to properly preserve this information, this chapter will provide information on how each of these is saved in the instrument as well as what needs to be considered when servicing an instrument so that none of these are lost.

Model Number

The model number of the instrument is not programmed into it. Every time the instrument boots up it checks to see what hardware is installed and determines from that what its model number should be. If for some reason the model number is not correct it means that there is either a hardware problem somewhere in the instrument or that some of the hardware is not connected properly.

The hardware assemblies that are evaluated at boot up to determine what the model number should be are:

- A2 Vector BBG assembly
- A3 RF assembly
- A7A1 Microwave ALC assembly

For example: If the instrument finds an A2 Vector BBG assembly when it boots up it knows that it is either an N5166B, N5172B, or an N5182B. The determining factor between these three is what A3 RF assembly it finds.

If the instrument is an N5166B, N5172B, or an N5182B but the A2 Vector BBG assembly is either not connected or the connection to the A3 RF assembly is not fully making contact, it will identify as either an N5171B or an N5181B. This can easily happen when replacing an A3 RF assembly and the connection between the A2 and A3 assemblies is not fully making contact. If this happens, see the A3 RF assembly Replacement Procedure in Chapter 15, "Assembly Replacement".

The same can be said for the A7A1 Microwave ALC assembly. If the instrument is an N5173B or an N5183B but the A7A1 Microwave ALC assembly is either not connected or the connection to the A3 RF assembly is not fully making contact, it will identify as either an N5171B or an N5181B.

In rare cases where the instrument is unable to tell what its model number should be, due to a hardware failure of some sort or hardware connections not fully making contact, it will give the following error:

> *617, Configuration Error; The set of ID numbers obtained through JTAG do not match any known instrument model.*

If the model number is not correct this will also mean that the licensed options in the instrument will not be activated. When this happens, the instrument will give the following error:

> *617 Configuration Error; The instrument has no frequency range option installed. Use the service procedure to recover instrument licenses from the backup.*

Do not be concerned about resolving any licensing issues until after resolving the model number issue, as any license issue will most likely be resolved by fixing the model number issue.

Serial Number

When an instrument leaves the factory, it has its serial number saved in two different locations along with an encrypted license code. This is saved in the A5 CPU assembly and the A3 RF assembly. Neither location is accessible to the user or service technician.

Replacement A3 RF assemblies and A5 CPU assemblies do not have a serial number in them as they leave the factory.

When a replacement A3 RF assembly is installed, the instrument will recognize that there is no serial number in it and will use the serial number in the A5 CPU assembly.

When a replacement A5 CPU assembly is installed into an instrument it will recognize that there is no serial number in it and it will use the serial number found in the A3 RF assembly.

If for some reason during servicing a combination of a new A3 RF assembly and a new A5 CPU assembly both get installed into an instrument, with no serial number in either of them, the following errors will be seen:

617 Configuration Error; Instrument serial number is not set. Instrument must be returned for service.

617 Configuration Error: The backup memory contains license keys for serial number <serial number>. Use the service procedure to overwrite the backup memory.

617 Configuration Error; The instrument has no frequency range option installed. Use the service procedure to recover instrument licenses from the backup.

If this happens the instrument will need to be sent to a Keysight service location for the factory support team to remotely reprogram the instrument serial number into both the A3 RF assembly and the A5 CPU assembly.

Option Licenses

Option licenses are stored in two different locations in the instrument, the A5 CPU assembly and the A3 RF assembly. However, the instrument will only use those that are in the A5 CPU assembly. The licenses in the A3 RF assembly are for backup purposes only. When an instrument is shipped from the factory a backup copy of all licenses is saved in the A3 RF assembly backup memory location.

Whenever an option license is added to an instrument it will only be saved in the A5 CPU assembly. The licenses should then be backed up for it to be saved in the A3 RF backup memory location.

Restore Licenses

If the A5 CPU assembly is replaced the licenses that are backed up on the A3 RF assembly will need to be restored to the A5 CPU assembly so that the proper functionality is restored to the instrument.

When an A5 CPU assembly is replaced the following error messages will be displayed until the licenses are restored:

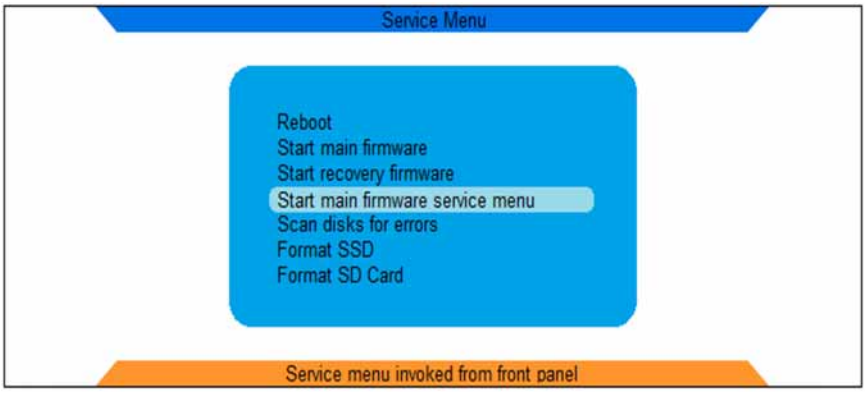
617 Configuration Error: The instrument has no frequency range option installed. Use the service procedure to recover instrument licenses from the backup.

617 Configuration Error: The backup memory contains license keys for serial number <serial number>. Use the service procedure to overwrite the backup memory.

The following procedure will restore the instrument licenses from the backup location on the A3 RF assembly to the A5 CPU memory:

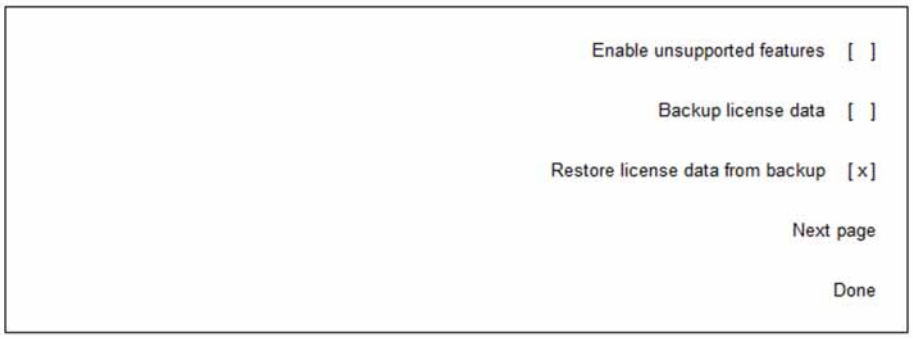
1. Turn the instrument off by using the front panel power button.
2. Once the instrument has turned off press and hold the front panel **Preset** key.
3. While holding the **Preset** key, press and release the power button to turn the instrument back on.
4. Continue to hold the **Preset** key for 10 seconds after pressing the power button, then release it.
5. After approximately 30 seconds the boot Service Menu will appear, as shown in Figure 3-1.

Figure 3-1 Service Boot Screen



6. Using the front panel arrow keys scroll down to **Start main firmware service menu** and press **Select**.
7. When the service menu warning screen is displayed press **Continue**.
8. On the main firmware service menu select **Next page** until a selection for **Restore license data from backup** is available.
9. Select **Restore license data from backup** as shown in Figure 3-2, and then select **Done**.

Figure 3-2 Restore License Data from Backup



10. The instrument will copy the licenses from the backup location on the A3 RF assembly into the A5 CPU memory and load the instrument firmware.
11. Once the instrument completes its boot up process all the previously licensed options should be enabled.
12. If the following error is seen at this point cycle the instrument power once more and it should then be gone.

    617 Configuration Error: The backup memory contains license keys for serial number <serial number>. Use the service procedure to overwrite the backup memory.

Backup Licenses

If the A3 RF assembly is replaced the licenses that are in the A5 CPU memory will need to be backed up to the backup storage location in the new A3 RF assembly so that there will be a copy of them in case the A5 CPU assembly should ever need replacement.

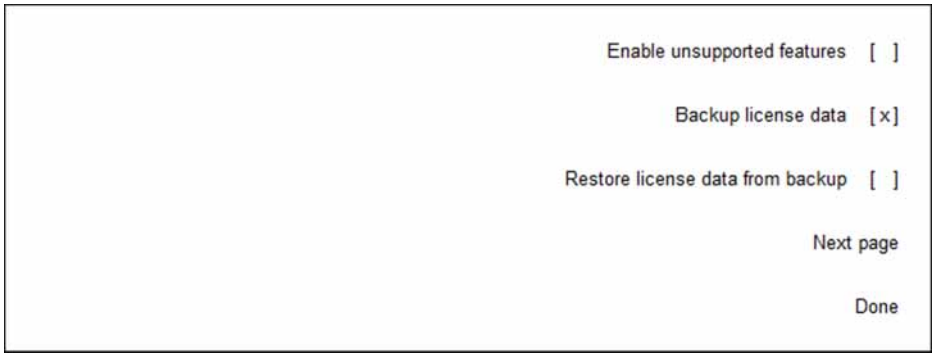
When an A3 RF assembly is replaced the following error message will be displayed until the licenses are backed up:

> *617 Configuration Error: Instrument licenses have not been copied to the backup storage. Use the service procedure to copy license keys to backup storage.*

The following procedure will backup the instrument licenses from the A5 CPU assembly memory to the backup memory location on the new A3 RF assembly:

1. Turn the instrument off by using the front panel power button.
2. Once the instrument has turned off press and hold the front panel **Preset** key.
3. While holding the **Preset** key, press and release the power button to turn the instrument back on.
4. Continue to hold the **Preset** key for 10 seconds after pressing the power button, then release it.
5. After approximately 30 seconds the boot Service Menu will appear, as shown in Figure 3-1.
6. Using the front panel arrow keys scroll down to **Start main firmware service menu** and press **Select**.
7. When the service menu warning screen is displayed press **Continue**.
8. On the main firmware service menu select **Next page** until a selection for **Backup license data** is available.
9. Select **Backup license data** as shown in Figure 3-3, and then select **Done**.

Figure 3-3 Backup License Data



10. The instrument will copy the licenses from the A5 CPU memory to the backup location on the new A3 RF assembly and load the instrument firmware.
11. If the error listed above is seen at this point cycle the instrument power once more and it should then be gone.

Calibration Data

Instrument calibration data is stored in three different location types:

1. Factory Calibration Data - Non-volatile memory on the assembly for which it is intended.
2. Working Data - Volatile memory on the A5 CPU.
3. Overwrite Data - Non-volatile memory on the A5 CPU.

Factory Calibration Data

Factory calibration data is saved in three different assemblies:

1. A2 Vector BBG assembly
2. A3 RF assembly
3. A7A1 Microwave ALC assembly

This is non-volatile memory on the assemblies where the factory calibration data is stored. While some of this data may be the same for all assemblies, this is also where the individual data is stored that has been generated by the instrument adjustments.

Replacement assemblies are also tested and adjusted at the factory and will contain the same data as they would if they were shipped in new instruments.

When an instrument adjustment is performed during servicing and then backed up, it will overwrite the factory data.

Working Calibration Data

This is the calibration data that is loaded into volatile memory in the A5 CPU assembly at instrument boot up. This data could have been loaded from either the factory data or overwrite data.

When an instrument adjustment is performed the working data is where the new calibration data is originally stored. It can then be saved to either the overwrite data or factory data location.

Since the working data location is volatile memory, if it were to be modified and not saved to another data location it would be lost if the instrument power is cycled.

Overwrite Calibration Data

Overwrite calibration data is saved in non-volatile memory on the A5 CPU assembly. There are separate overwrite data files for each of the assemblies that contain factory data, if overwrite data exists. As shipped from the factory, there are no overwrite data files, only factory data.

After an instrument adjustment is performed the adjustment data can be saved to overwrite data. If an overwrite data file does not already exist for the assembly being adjusted one will be created at that time. The only data that will be written to the overwrite data file is the arrays that were changed from the factory values during the adjustment.

Overwrite data files are deleted whenever the calibration data is backed up or restored.

Since the overwrite data location is non-volatile memory, data saved to it will not be lost if the instrument power is cycled.

What Happens at Boot Up

At boot up the factory calibration data is copied to working data in the A5 CPU memory. If there are any overwrite data files, the data for the arrays in them are loaded into working data and will overwrite those arrays that were loaded from the factory data.

Instrument Adjustments

When an instrument adjustment is performed the calibration data in the working memory is modified. At the end of each adjustment the adjustment software will save the modified data to the overwrite memory.

Once all adjustments are completed, or at any time along the way, a backup of the working data can be performed to save all modified calibration data to the factory data location by using the Backup Cal Data to Motherboard Memory adjustment.

Calibration Data Backup

Once instrument adjustments are performed the calibration data arrays that have been modified from the factory data values need to be backed up on the assemblies that have been adjusted.

The typical way to do this is to run the last adjustment in the adjustment software, which is **Backup Cal Data to Motherboard Memory**. However, the following remote command can also be used to perform a backup:

```
:SERVice:CALibrate:BACKup
```

When a calibration data backup is performed the factory data on the assemblies is overwritten by working data that has been modified, and all overwrite data files are deleted. The backup process will also backup the option license data to the A3 RF assembly backup memory location.

Calibration Data Restore

The calibration data restore causes the instrument to revert to the factory data saved on the instrument assemblies.

A restore needs to be performed whenever an assembly with factory calibration data saved on it is installed during a repair. This can also be useful if adjustments have been performed, but not yet backed up, and for some reason the data needs to be removed and have the instrument revert to the factory calibration data.

The typical way to do this is to run a utility that has been provided in the performance verification and adjustment software titled **Calibration Array Restore**. However, the following remote command can also be used to perform a restore:

```
:SERVice:CALibrate:RESTore
```

When a calibration data restore is performed all overwrite files that exist will be deleted and the factory data on the assemblies is copied into the working data on the A5 CPU assembly.

4 Self Test

What You Will Find in This Chapter

This chapter provides information on the following:

Self Test Overview on page 66

Limits on page 67

Multiple Failures on page 69

Running Self Test on page 70

Self Test Descriptions on page 75

Troubleshooting Self Test 102 on page 91

Troubleshooting Self Test 704 on page 92

Troubleshooting Self Test 901 to 905 on page 93

Troubleshooting Self Test 1105 on page 95

Self Tests Do Not Run or Self Tests Run Slowly on page 98

Self Test Overview

Self Tests are a series of internal tests designed as a diagnostic tool to check instrument hardware functionality and basic performance under controlled conditions. If the test results fall within predetermined limits a pass is reported.

Self Tests do not require the signal generator to be adjusted before they will pass. This means that some instrument performance failures may not be detected or reported as a Self Test failure.

Self Tests should be run before, and after, an assembly has been replaced.

If the signal generator powers up despite having a hardware issue or any performance verification failure, troubleshooting should always start with running the Self Test and resolving reported failures.

Not all Self Tests are run on all models of the X-Series signal generators. Depending on the installed standard and optional hardware, specific Self Tests are activated and made available.

Limits

Self Test limits are initially loaded into the signal generator at the factory. However, the limits are updated as needed when the instrument firmware is updated. If for some reasons the Self Test limits are missing, reinstall the instrument firmware to reload them.

Failures

Before replacing any hardware for a Self Test failure be sure that the instrument has the latest version of the Self Test limits, as these have changed over time.

As previously mentioned, Self Test limits are loaded along with the instrument firmware. So if the instrument has the latest instrument firmware, the Self Test limits should also be the latest.

If the instrument does not have the latest version of the instrument firmware, either load the latest instrument firmware and rerun the failing Self Test or compare the limits that the instrument is failing for with the limits in an instrument that has the latest version. If the limits have changed for the test that is failing, update the instrument firmware.

Multiple Failures

If more than one test result falls outside the limits, the Self Test routine evaluates the failures and reports the most likely cause of the failure. This can best be understood by using the following hypothetical example:

- There are three functional blocks in a series. A1 is the first block, A2 the second block, and A3 the third block. A1's output is the input for A2, and A2's output is the input for A3.
- If A1 is defective, A2 and A3 may also appear defective. Or, if A2 is defective, A3 may also appear defective.
- If A1, A2, and A3 all fail their Self Test the instrument will report the most likely cause of the failure as being the A1 functional block.
- If only A2 and A3 fail their Self Test the instrument will report the most likely cause of the failure as being the A2 functional block.

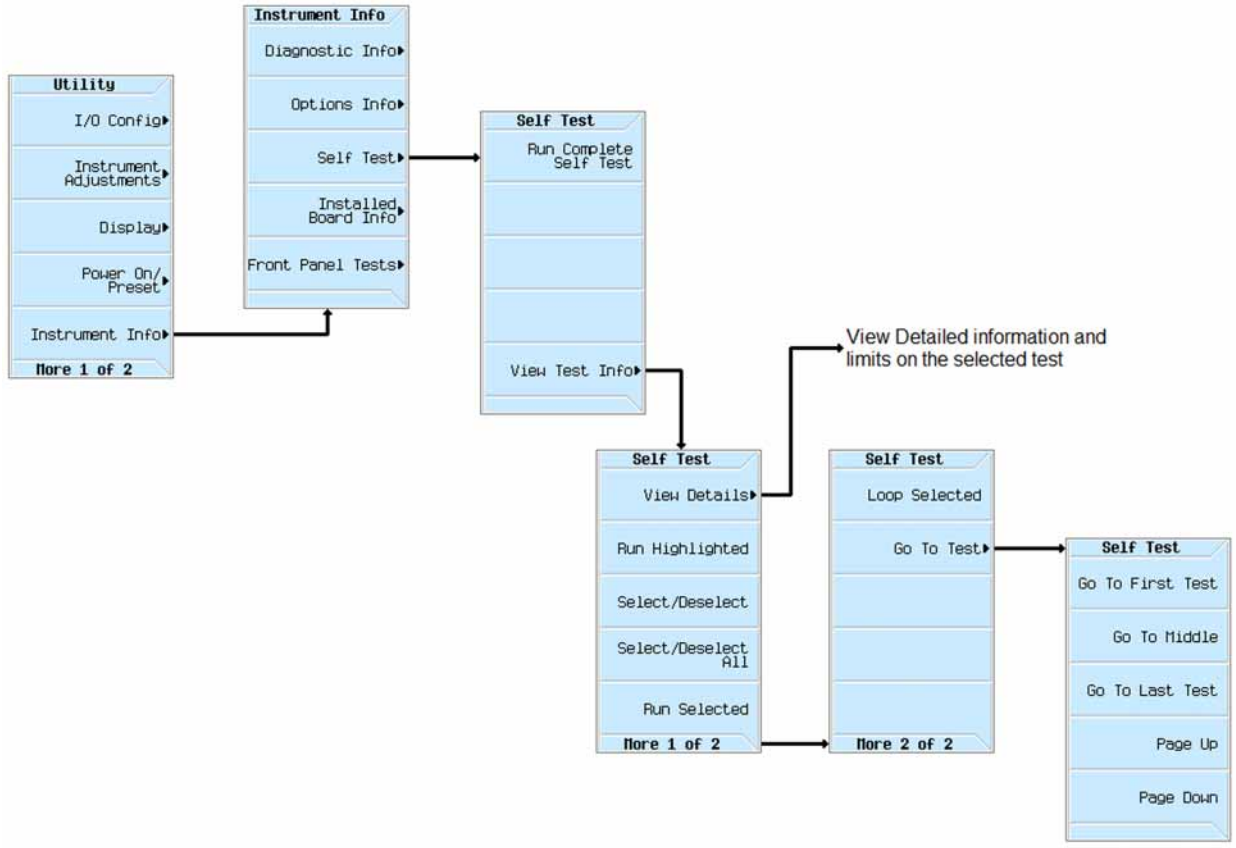
The instrument contains this dependency information that it uses to identify the most likely failure when there are multiple Self Test failures.

If two independent failures occur, Self Test reports only one root failure at a time and reports the second failure after the first reported failure is repaired and the Self Test is run again. However, all tests that fail will be reported under the View Test Info screen.

Running Self Test

The Self Tests can all be run at once or one test at a time. For the purpose of initial troubleshooting of an instrument it is highly recommend that they all be run at once to let the instrument evaluate which failure, if any, is the most significant.

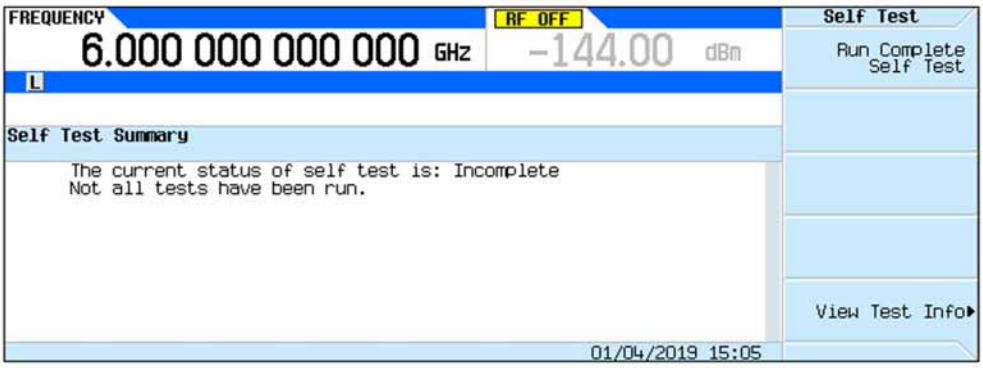
Figure 4-1 Self Test Menu Map



Use the following procedure to run all of the Self Tests at once:

1. Disconnect all unnecessary external cables, including all RF, GPIB, LAN, and USB cables.
2. Preset the signal generator: Press **Preset** > **Utility** > **Instrument Info** > **Self Test**.
3. The message in Figure 4-2 appears.

Figure 4-2 Initial Self Test Message



NOTE

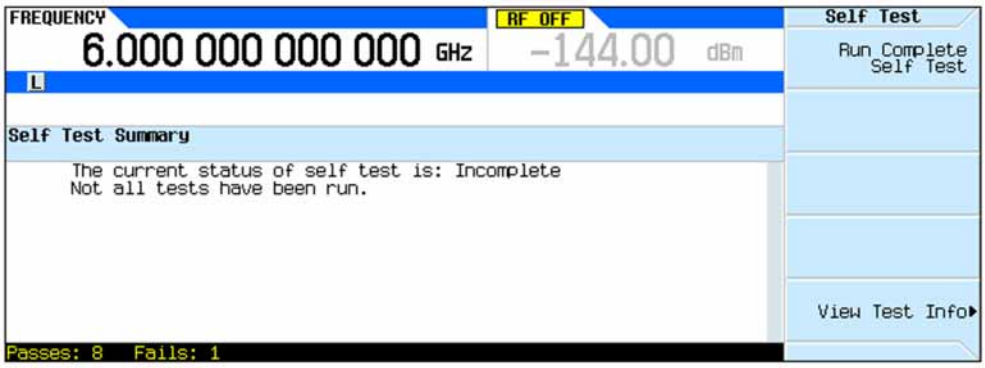
If self test takes longer than 10 minutes to complete, go to Chapter 8, "Power Supply" to troubleshoot a possible power supply failure.

4. Press **Run Complete Self Test**.

   An activity bar displays on the screen indicating the test progress.

   If you press Abort while Self Test is running, the message in Figure 4-3 is displayed.

Figure 4-3 Self Test Aborted Message



5. When Self Test completes, the messages in Figure 4-4 is displayed if all tests pass. If there are any failures the message in Figure 4-5 is displayed.

Figure 4-4 All Self Tests Passed Message

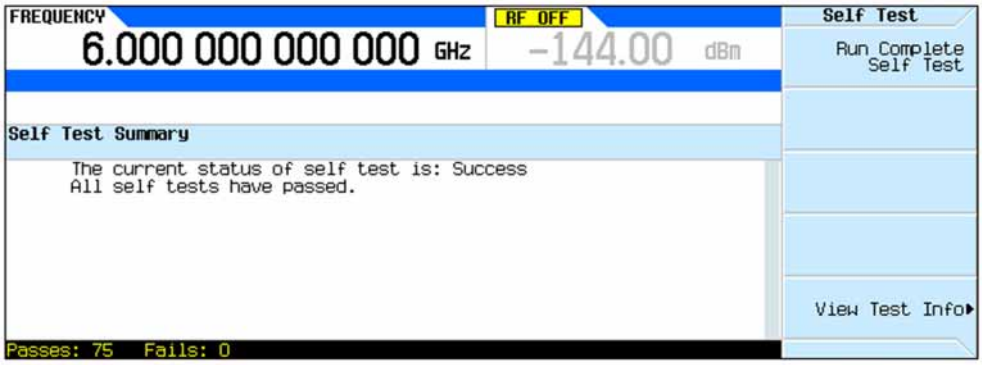
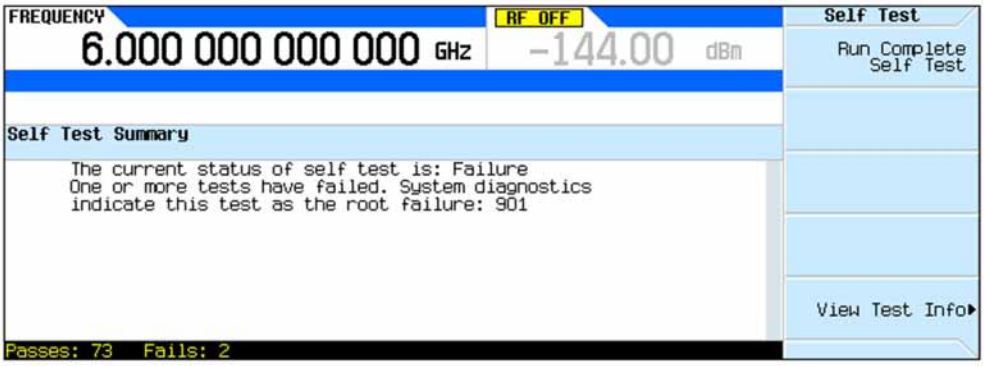


Figure 4-5 Self Test Failure Message



If the signal generator fails only one test, the number of the failed test displays. If the signal generator fails more than one test, the test number of the most likely cause of the failure displays, as shown in Figure 4-5.

6. If there is a Self Test failure locate the number given as the root failure in Table 4-1 and follow the resolution path given.
7. Before replacing any instrument assembly see Chapter 16, “Pre and Post-Repair Procedures”.

Table 4-1 Self Test Root Failures

Self Test Root Failure Number	Resolution
100 Digital Self Tests	
101	Replace the A3 RF assembly
102	Go to "Troubleshooting Self Test 102" on page 91
103	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
104	Replace the A3 RF assembly
105	Replace the A3 RF assembly
200 Reference Self Tests	
201	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
202 - 208	Replace the A3 RF assembly
300 Synthesizer Self Tests	
301	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
302 - 320	Replace the A3 RF assembly
400 Output Self Tests	
401	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
402 - 413	Replace the A3 RF assembly
	Error 405 for N5173B or N5183B, go to "N5173B, N5183B" in Chapter 6, "Troubleshooting."
500 Modulation Self Tests	
501 - 506	Replace the A3 RF assembly
507 Pulse Mod	Go to "Pulse Modulation Issues (Option UNW)" in Chapter 6, "Troubleshooting."
600 Attenuator Self Tests	
601	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
602 - 603	Replace the A3 RF assembly
700 BB Digital Self Tests	
701	Go to "Power Supply Status Quick-Check" in Chapter 8, "Power Supply."
702 to 703	Replace the A2 Vector Module

Table 4-1 Self Test Root Failures

Self Test Root Failure Number	Resolution
704	Go to "Troubleshooting Self Test 704" on page 92
705	Replace the A2 Vector Module
706	Replace the A2A1 Vector BBG Waveform Memory
800 BB Analog Baseband Self Tests	
801 - 804	Replace the A2 Vector Module
900 BB RF Self Tests	
901 - 905	Go to "Troubleshooting Self Test 901 to 905" on page 93
1100 MW ALC Self Tests	
1101 - 1104	Replace the A7 Micro Deck
1105	Go to "Troubleshooting Self Test 1105" on page 95
1106 - 1113	Replace the A7 Micro Deck
1200 MW Multiplier Self Tests	
1201 - 1205	Replace the A7 Micro Deck
1300 MW Mod Filter Self Tests	
1301 - 1303	Replace the A7 Micro Deck
1304	Go to "Troubleshooting Self Test 1304" on page 97
1400 MW Doubler Self Tests	
1401 & 1402	Replace the A7 Micro Deck
1500 RT Board Self Tests	
1501 - 1512	Replace the A7 Real-Time BBG

Self Test Descriptions

100 Digital Self Tests

The Digital Self Tests are designed to test the digital section of the A3 RF assembly.

101 Digital FPGA Checks

This test checks the ability to communicate properly with the three FPGAs situated on the A3 RF assembly. The three FPGAs are the PCIe Bridge FPGA, the Analog FPGA, and the Reference FPGA.

102 JTAG Chain Check

This test checks the JTAG chain throughout the instrument. The IDCODE for each part on the chain is read back and compared with what is expected.

103 Digital Voltages

This test checks the voltages used for the digital section.

104 Board Temperature

This test measures different temperature sensors within the A3 RF assembly and converts the values into degrees Celsius. Also, the largest measured temperature is subtracted with the smallest measured temperature and reported back.

105 Sweep Out

This test checks the proper operation of the sweep out circuitry which is located on the A3 RF assembly.

200 Reference Self Tests

The Reference Self Tests are designed to test the reference section of the A3 RF assembly.

201 Reference Voltages

This test checks the supply voltages used for the reference section.

202 Reference 100MHz Tank DAC

This test checks the MUAT Tank DAC by reporting back the REF MUAT Tank DAC setting and the 100MHz detected voltage.

203 Reference Tuning Voltage (Internal Ref)

This test measures the tuning voltage of the MUAT oscillator using the internal 10 MHz reference. The MUAT tuning voltage is the output of the reference phase-lock loop integrator.

204 Internal Oscillator Check

This test checks the proper operation of the internal 10MHz reference oscillator. For triple-loop boards, the 10MHz reference oscillator is an OCXO. For single-loop boards, the 10MHz reference oscillator is a TCXO. This test adjusts the tune DAC to nudge the internal 10MHz reference. By moving this internal 10 MHz reference frequency, the 100 MHz MUAT oscillator will also move by a factor of 10. Thus, the MUAT tuning voltage will change to move the oscillation frequency.

205 PLL Integrator

This test checks the 100 MHz PLL integrator and checks all the bandwidths. For each condition, the test first rails the integrator by opening the PLL loop. Then the test will close the loop with the appropriate gain and bandwidth setting.

206 PLL Divider (CXG/EXG)

This test checks the 100 MHz PLL by changing the reference divider number and keeping the 10 MHz internal reference constant. This requires that the 10 MHz reference is connected to the flexible reference phase detector. Thus, this test can only be tested with single-loop boards.

207 PLL Unlock Detector (CXG/EXG)

This test checks the reference PLL unlock detector circuit. A window comparator is used to detect the MUAT tune voltage. The test adjusts the tuning voltage by adjusting the PLL divide number. Thus, the test can only be run utilizing the flexible reference phase detector and thus can only be tested with single-loop boards.

208 Reference Detectors

This test checks the 500 MHz and the 1 GHz signals by measuring their respective detector voltages.

300 Synthesizer Self Tests

The Synthesizer Self Tests are designed to test the synthesizer section of the A3 RF assembly. For triple-loop RFs, all tests are available. However, for single-loop RFs, tests for the offset loop, FranN loops, and some of the sum loop are not available because of the physical differences in the hardware.

301 Synthesizer Voltages

This test checks the voltages used for the synthesizer section.

302 Offset Pretune DAC (MXG)

This test checks to make sure the synthesizer offset pretune DAC circuitry is working.

303 Offset VCO Detector (MXG)

This test checks that the offset VCO outputs a signal at various tuning voltages and that the power can be detected downstream with a power detector. The VCO should be able to oscillate from a tuning voltage of around -0.3V to over +16V. The test is performed with the offset loop set to open-loop mode so that the tuning voltage applied is predictable and based solely on the offset pretune DAC.

304 Offset Attenuator (MXG)

This test checks that the adjustable offset attenuator is working properly. The offset VCO is first set to open loop mode with a pretune DAC value set to 1/4 of max value. The attenuator is set to minimum attenuation (0 dB) and maximum attenuation (31.75 dB) while a power detector is used to sense the change in power.

305 Offset PLL Unlock Detector (MXG)

This test checks that the offset PLL unlock detector is properly working.

306 Offset Reference Select (MXG)

This test checks the reference select frequency to the offset loop is functioning properly.

307 Offset Tuning Voltage (MXG)

This test checks the offset loop tuning voltage at specific offset loop frequencies.

308 FracN Tuning Voltage (MXG)

This test checks the FracN loop tuning voltage at specific FracN loop frequencies.

309 FracN Detector (MXG)

This test checks that the FracN VCO is outputting power across the frequency range and can be measured downstream using the power detector. This test also checks that the VCO Collector DAC is functioning by measuring the effects on the FracN power.

310 FracN Unlock Detector (MXG)

This test checks that the FracN unlock detector is properly working.

311 Sum Pretune DAC

This test checks to make sure the sum pretune DAC circuitry is working.

312 Sum VCO Detector

This test checks that the sum VCO outputs a signal at various tuning voltages. This test is performed with the sum loop opened.

313 Sum Attenuator (MXG)

This test checks that the adjustable sum attenuator is working properly. The sum VCO is first set to open loop mode.

314 Sum PLL Unlock Detector

This test checks that the offset PLL unlock detector is properly working.

315 Sum Reference Select (MXG)

This test checks the reference frequency to the sum loop phase detector.

316 Sum Tuning Voltage

This test checks the tuning voltage of the sum VCO at different frequencies by setting the frequency appropriately. The sum loop will be closed while this test is executed.

317 First X2 Path

This test checks the VCO filter as well as the signal path through the first x2 multiplier path.

For the filter band tests, each filter band is tested with a frequency within the passband and a frequency outside the passband. In the case of the 1.9 to 2.4 GHz band, two frequencies are used to test the stop band: one lower and one higher.

318 Second x2 Multiplier Path

This test checks the signal path through the second x2 multiplier path.

Like the first x2 multiplier tests, each filter band is tested with a frequency within the passband and a frequency outside the passband. In the case of the 3.8 to 4.8 GHz band, two frequencies are used to test the stop band: one lower and one higher.

319 Divider Path

This test checks the signal path through the divider path of the synthesizer.

320 Multiplier Attenuator

This test checks that the adjustable multiplier attenuator is working properly. The synthesizer frequency is set to 6 GHz by setting the front panel frequency to 749.99999999 MHz and then switching the filter and divider paths appropriately to select the x4 path. The attenuator is set to minimum attenuation (0 dB) and maximum attenuation (31.75 dB) while a power detector is used to sense the change in power.

400 Output Self Tests

The Output Self Tests are designed to test the output RF section as well as the ALC section of the A3 RF assembly.

401 Output Voltages

This test checks some supply voltages as well as bias voltages on the FET amplifiers within the output section to ensure that they are properly biased.

402 ALC Detector Heater Voltage

This test checks the detector heater voltage to make sure that the heater is operating properly.

403 ALC Temperature Compensation (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks the ALC temperature compensation circuit to ensure that this circuit is working properly.

404 ALC Reference (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks the ALC reference DAC and circuitry.

405 ALC Mod Drive

This test checks the ability of the ALC Reference DAC and the ALC Mod Offset DAC to control the Mod Drive reference voltage. During the test, the ALC is set to open-loop mode and the power limit is effectively turned off.

406 ALC Mod Current

This test checks the ALC mod drive exponentiator and the mod current driver circuitries which drive the ALC modulators on the RF path. The test runs in open-loop mode so that the integrator does not contribute to this test. In addition, the RF is turned off during this test using the pulse modulator so that the RF signal is not large through the RF chain while this test is running.

407 ALC Detector

This test checks the ALC Detector as well as the RF power through the three main signal paths. This test is performed in open-loop mode so that the ALC does not try to correct (and corrupt) the measurements.

408 ALC Logger (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks the ALC logger circuitry. This test is performed in open-loop mode. During this test, the RF power is adjusted to achieve a certain detected voltage to get a known voltage into the logger circuit.

409 ALC Detector Offset (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks that the ALC Detector Offset DAC can properly adjust the ALC logger circuitry. This test is performed in open-loop mode. The RF is minimized by setting the ALC Mod DACs appropriately. Then the ALC Detector Offset DAC is set to both minimum and maximum while the LOG Det node is measured. The delta is reported back.

410 ALC Bulk R (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks that the ALC Bulk R DAC can properly adjust the ALC logger circuitry. This test is performed in open-loop mode. The RF is set high by adjusting the ALC Mod Offset DAC until the ALC detector voltage is -1.0V.

411 ALC Integrator (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks that the ALC integrator circuitry is working properly. For this test the ALC loop is closed.

412 ALC Unlevel Detector (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks that the ALC unlevel detector circuitry is working properly. The ALC unlevel detector circuitry uses a window comparator to detect the integrator voltage. This test is performed in openloop mode.

413 ALC Power Limit (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks that the ALC power clamp circuitry is working and that the power limit DAC can clamp the power as expected. The ALC loop is opened in this test.

500 Modulation Self Tests

The Modulation Self Tests are designed to test the different modulation circuitry available for the A3 RF assembly. These include AM, FM, PM, pulse, LF output, and the external modulation inputs.

501 AM DAC (Option UNT)

This test checks that the AM DAC is working. Note that the AM DAC supplies the analog AM signal as well as the op-amp band signal. The test sets the AM DAC to output various DC levels and measures the resultant voltage.

502 AM To ALC (Option UNT)

This test checks that the AM Path to the ALC section is working properly.

503 FM DACs (Option UNT)

This test checks that the FM DACs are working. The output of each DAC is connected directly to the ABUS. The test sets each FM DAC to output various DC levels and measures the resultant voltage.

504 FM Attenuators (Option UNT)

This test checks that the FM attenuators are working. There are two sets of FM attenuators: FracN and Sum. The inputs to the FM attenuators come directly from the FM DACs while the output goes directly to their respective VCOs. The testing is performed in CW mode and relies on the loops to maintain lock while the FM voltages are applied. Prior to testing, the instrument frequency is set to 566.40625 MHz to allow the VCO frequencies to be close to midrange. This puts the FracN frequency at 1500 MHz while the sum VCO frequency is at 1132.8125 MHz. The FM DAC is first set to the maximum value while the appropriate attenuator is set. Since the VCO will maintain the same frequency, this will cause the tuning voltage to shift in the opposite direction which is measured. The FM DAC is then set to the minimum value and again the tuning voltage is measured. The difference between the two voltages is then reported back. While testing the FM DAC for the sum loop, the sum pretune DAC value is manually shifted so that the loop maintains lock.

505 LF Out (Option UNT or 303)

This test checks that the LF Out DAC is working. The test sets the LF Out DAC to output various DC levels and measures the resultant voltage.

506 External Modulation Inputs (Option UNT or UNW)

This test checks the two external modulation input circuits (EXT1 and EXT2). Both are identical and include an ADC to digitize the analog signal. The digital signals then go directly to the analog FPGA. The test uses the +1V (gain) and ground (offset) cal signals. The test measures the output of the op-amp that feeds to ADC as well as the digital number that the ADC generates.

507 Pulse Mod (Option UNW)

This test checks the pulse modulator. This test is performed in ALC open mode.

600 Attenuator Self Tests

The Attenuator Self Tests are designed to test the attenuator section of the A3 RF assembly. Since the attenuators are located after the ALC detector, RF power through the attenuators cannot be tested.

601 Attenuator Voltages

This test checks the voltages used for the attenuator section.

602 LED Voltage (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test checks the voltage for the attenuator LEDs.

603 RPP Trip Status (Model N5166B, N5171B, N5172B, N5181B, N5182B)

This test makes sure that the RPP is not tripped. In normal operation, the RPP should never be tripped.

700 BB Digital Self Tests (Model N5166B, N5172B, N5182B)

The BB Digital Self Tests are designed to test the digital section of the A2 Baseband Generator assembly.

701 BB Board Voltages

This test checks the voltages used for the A2 Baseband Generator assembly.

702 Interface FPGA Checks

This test checks the ability to communicate properly with the interface FPGA on the A2 Baseband Generator assembly.

703 SPI Bus Test

This test checks the ability to communicate properly over the SPI Bus by writing to latches on the SPI bus and reading them back.

704 Clock Checks

This test checks the frequency of the 100MHz and 200MHz clocks going to the Interface and ARB FPGAs. The A3 RF assembly supplies a 100MHz clock which is multiplied up by 8 to yield an 800MHz clock that feeds the IQ DAC. The IQ DAC divides this down by 4 to yield a 200MHz clock. This 200MHz clock signal goes through a distributor. One of the outputs goes to the ARB FPGA. Another of the outputs gets divided down by 2 to yield a 100MHz clock. This 100MHz clock goes through another distributor. One set of outputs goes to the Interface FPGA. Another set goes to the ARB FPGA.

705 ARB FPGA Checks (Option 653, 655, 656, or 657)

This test checks the ability to communicate properly with the ARB FPGA on the A2 Baseband Generator assembly.

706 Memory Test (Option 653, 655, 656, or 657)

This test checks different memory areas within the A2 Baseband Generator assembly. The waveform memory for the I and Q data along with the marker data is located within the DDR memory modules. The total number of memory pages available within the instrument depends on the instrument option. For option 023, there are 4096 total pages. Option 022 has 2048, option 021 has 1024, and standard has 128 pages.

707 User Clock Test (Option 653, 655, 656, or 657)

This test checks the user clock functionality on the A2 Baseband Generator assembly. The user clock is generated digitally from within DSP and is recreated with the user clock DAC. The ARB must be turned on for the user clock to be functional. The user clock rate can go up to 200MHz. However, the actual frequency of the clock signal that gets generated from the user clock DAC is between 2MHz and 24MHz. Within the ARB FPGA, the clock signal from the user clock DAC can be routed to dividers, multipliers, or PLLs to generate actual user clock. The ARB FPGA also has a counter which is used to measure the actual frequency of the user clock.

708 Data Path CRC Test (Option 653, 655, 656, or 657)

This test checks the entire ARB data path from the memory through the ARB FPGA and through the DSP.

800 BB Analog Baseband Self Tests (Model N5166B, N5172B, N5182B)

The BB Analog Baseband Self Tests are designed to test the analog baseband section of the A2 Baseband Generator assembly.

801 Internal IQ Offset

This test checks the internal offset DACs for the IQ Modulator.

802 IQ DACs

This test checks the I and Q DAC on the A2 Baseband Generator assembly.

803 External IQ Offset

This test checks the External Out IQ Circuitry of the A2 Baseband Generator assembly.

804 External In IQ Cal

This test checks the External In IQ Cal Circuitry of the A2 Baseband Generator assembly.

900 BB RF Self Tests (Model N5166B, N5172B, N5182B)

The BB RF Self Tests are designed to test the RF section of the A2 Baseband Generator assembly.

901 Prelevel DAC

This test checks the prelevel circuitry on the A2 Baseband Generator assembly. This circuit sets the LO power that the IQ modulator sees. The LO power is inversely proportional to the prelevel DAC setting.

902 Quadrature DAC

This test checks the quadrature loop circuitry on the A2 Baseband Generator assembly.

903 IQ Modulation

This test checks the ability of the IQ modulator to modulate a signal on the RF path. For this test, all signals are passed through the 6 GHz low pass filter path to keep the path consistently independent of RF frequency.

While this test tries to check the power on the A2 Baseband Generator assembly, faults on the A3 RF assembly may influence the results. The primary reason for this is that the output of the A2 Baseband Generator assembly is expecting a 50 ohm load. When this is not the case (due to faults), then the RF signal will reflect back into the A2 Baseband Generator assembly causing unpredictable results.

904 BB Board Frequency Band

This test checks the RF power through the different filters on the A2 Baseband Generator assembly. The power is detected right before the RF signal leaves the assembly.

While this test tries to check the power on the A2 Baseband Generator assembly, faults on the A3 RF assembly may influence the results. The primary reason for this is that the output of the A2 Baseband Generator assembly is expecting a 50 ohm load. When this is not the case (due to faults), then the RF signal will reflect back into the A2 Baseband Generator assembly causing unpredictable results.

905 RF To Main Board

This test checks to ensure that the RF power from the A2 Baseband Generator assembly makes it to the A3 RF assembly. The power is detected using the ALC detector.

1100 MW ALC Self Tests (Model N5173B, N5183B)

The MW ALC Self Tests are designed to test the functionality of the A7A1 Microwave ALC assembly.

1101 MW ALC Voltages

This test checks the power supply voltages used by the A7A1 Microwave ALC assembly.

1102 MW ALC FPGA

This test checks the ability to communicate properly with the FPGA on the A7A1 Microwave ALC assembly.

1103 MW ALC Level

This test checks the ALC Level DAC and related circuitry.

1104 MW ALC Modulation HB

This test checks the High-Band ALC modulation driver circuitry. This test runs in open-loop mode so that the integrator will not contribute to this test. In addition, the RF is turned OFF during this test using the pulse modulator; otherwise, peak RF power would be present throughout the RF chain while this test is running.

1105 MW ALC Detector

This test checks both the Low-band and High-band ALC detectors by applying RF power through the three main signal paths. This test is performed in open-loop mode so that the ALC does not try to correct, thereby influencing the measurements. The frequency is set to select the desired RF path and associated ALC detector.

1106 MW ALC Power Limit

This test checks the MW ALC Power Limit and Clamping circuitry. This test is performed in open-loop mode. During this test, the RF power is adjusted to achieve an ALC detector voltage of -1.2V by adjusting the MW ALC Level DAC. The Power Clamping circuit operates as a secondary ALC loop that activates when the ALC detector level reaches the Power Limit DAC output. Above this level, the Power Clamp output will drive the ALC Mod Driver to prevent the ALC detector level from going more negative (higher power level) than set by the Power Limit DAC setting.

1107 MW ALC Logger

This test checks the MW ALC logger circuitry. This test is performed in open-loop mode. During this test, the RF power is adjusted to achieve a certain ALC detector voltage by adjusting the RF ALC MOD Offset DAC to get a known voltage into the logger circuit. The slope of the logger is measured at the high, mid, and low end of the ALC detector range.

1108 MW ALC Detector Offset

This test checks that the ALC Detector Offset DAC can properly adjust the ALC Logger Circuitry. This test is performed in open-loop mode. The ALC Detector Offset DAC compensates for the ALC detectors offset, which mostly affects the low power range. Therefore, the RF power is set low for an ALC Detector voltage of -0.15V by adjusting the ALC MOD Offset DAC.

1109 MW ALC BulkR

This test checks that the ALC Bulk R DAC can properly adjust the ALC logger circuitry. This test is performed in open-loop mode. The Bulk R DAC compensates for the Low Amp's transistor equivalent resistance that would

otherwise cause offset errors. The Bulk R errors are most evident at high ALC detector levels. Therefore, the RF power is set high for an ALC Detector voltage of -1.5V by adjusting the ALC MOD Offset DAC.

1110 MW ALC Log BreakPoint

This test checks that the ALC Log Break Point DAC can properly adjust the ALC logger circuitry, and ultimately, the RF power. This test is performed in open-loop mode. The ALC Log Break Ponit DAC sets the point at which the linear region moves into the square law region.

1111 MW ALC FET Drive

This test checks the ALC Integrator Hold FET Drive circuitry. This test is performed in open-loop mode.

1112 MW ALC Integrator

This test checks that the ALC Integrator circuitry is working properly. This test is performed with the ALC loop closed.

1113 MW ALC Unlevel Detector

This test checks that the ALC Unlevel detector circuitry is working properly. The ALC Unlevel detector circuitry uses a window comparator to detect when the integrator voltage is railed. This test is performed in ALC closed-loop mode sine the microwave ALC integrator output cannot be zeroed in open-loop mode.

1200 MW Multiplier Self Tests (Model N5173B, N5183B)

The MW Multiplier Self Tests are designed to test the operation of the A7A2 20 GHz Frequency Multiplier assembly. The main focus for these tests is to verify that attenuators are functioning as expected, filters are functioning properly and consistent across the frequencies of interest, and the Gain DAC is controllable and functioning properly.

1201 MW Multiplier First Attenuator

This test checks the performance of the multiplier first attenuator by referencing key attenuation states against the 0dB (thru) setting. The input detector is switched in to measure the 0 dB state. This measured voltage is then used as a reference for switching in and measuring subsequent attenuations states. Once the six states are measured, two additional delta attenuation states are measured to assure overall operation.

1202 MW Multiplier First RF Paths

This test verifies the operation of each bandpass filter located in the first section of the A7A2 20GHz Frequency Multiplier. A reference voltage is established, and filter edges are checked. The difference between the voltages are corrected for temperature and then reported for each test point.

1203 MW Multiplier Second Attenuator

This test checks the performance of the multiplier second attenuator by referencing key attenuations states against the 0dB (thru) setting. The input detector is switched in to measure the 0 dB state. This measured voltage is then used as a reference for switching in and measuring subsequent attenuations states. Once the six states are measured, two additional delta attenuation states are measured to assure overall operation.

1204 MW Multiplier Second RF Paths

This test verifies the operation of each bandpass filter located in the second section of the A7A2 20GHz Frequency Multiplier. A reference voltage is established, and filter edges are checked. The difference between the voltages are corrected for temperature and then reported for each test point.

1205 MW Multiplier Gain DAC

This test will verify the operation of the Gain DAC portion of the A7A2 20GHz Frequency Multiplier. With a test frequency of 10.1 GHz, the Gain DAC is set to both 0 and 4095, while the output voltage level is measured and compared to specification. The delta between both settings is then calculated and compared to specification.

1300 MW Mod Filter Self Tests (Model N5173B, N5183B)

The MW Mod Filter Self Tests are designed to test the operation of the A7A3 Mod Filter assembly. Output power level is verified for the frequency band of 3.2 GHz to 20 GHz. In addition, switchable filters used to minimize harmonics are also verified.

1301 MW Mod Filter Bias Board Voltages

This test checks the power supply voltages used by the A7A3 Mod Filter assembly.

1302 MW Mod Filter ALC Modulator

This test checks the A7A3 Mod Filter ALC modulator current for proper low, high and delta output power performance. This test performs the modulator measurements with the ALC off, while the ALC Level DAC, RF and MW Mod Offset DAC's, as well as the RF and MW Mod Gain DAC's, are at nominal settings.

1303 MW Mod Filter Pulse Modulation

This test checks the functionality of the Pulse Modulation performance of the A7A3 Mod Filter assembly.

1304 MW Mod Filter RF Paths

This test checks the filter paths through the A7A3 Mod Filter assembly. Various frequencies within a band, typically at each end and in the middle, are checked against known input levels. Discrepancies with filter paths are verified through absolute and delta voltage measurements.

1400 MW 40GHz Doubler Self Tests (Model N5173B, N5183B with Option 532 or 540)

The 40 GHz Doubler Self Tests are designed to test the operation of the A7A4 40 GHz Doubler assembly. This assembly is responsible for taking the 10-20 GHz RF output from the A7A3 20 Frequency Multiplier assembly and translating this to 20-40 GHz. The A7A4 40 GHz Doubler assembly consists of a biased multiplier, as well as several switchable bandpass filters. In addition, there is an output amplifier followed by a low-pass filter.

1401 MW 40GHz Doubler Bias Board Voltages

This test checks the power supply voltages used by the A7A4 40 GHz Doubler assembly.

1402 MW 40GHz Doubler RF Paths

This test checks the filter paths through the A7A4 40 GHz Doubler assembly. Various frequencies within a band, typically at each end and in the middle, are checked against known input levels. Discrepancies with filter paths are verified through absolute and delta voltage measurements.

1500 RT Board Self Tests (Option 660)

The RT Board Self Tests are designed to test the A7 Real Time Baseband Generator assembly.

1501 PCIe

This test checks the PCIe communication to the A7 Real Time Baseband Generator assembly. This is accomplished by writing to a test register within the PCIe bridge to the assembly.

1502 RT FPGA

This test checks that we are able to program and communicate to the interface and apps FPGAs on the A7 Real Time Baseband Generator assembly.

1503 RT FPGA Alignment

This test checks that the serdes signals between the interface and apps FPGAs on the assembly can be aligned.

1505 Apps FPGA - QDR Memory Test

This test checks the QDR SRAM memory chips that are connected to the Apps SX FPGAs. All of the testing is performed internally from a state machine within the SX FPGAs. The testing first performs a ramp test followed by a random test.

1506 RT Resampler

This test checks the signals to/from the resampler chip on the assembly. The test first performs a clock auto-alignment on the resampler and then checks the alignment range. Finally, a state machine within the SX FPGA is setup to test the data lines to and from resampler.

1507 DSP Check

This test checks the signals to/from the DSP chip on the assembly.

1508 DSP SDRAM Memory Test

This test checks SDRAM memory. Data patterns are written to an address in the SDRAM memory and subsequently read back. Within each address, multiple writes/reads are made with various data patterns.

1509 RT - BB Serdes Alignment

This test checks the serdes signals between the A2 Baseband Generator and the A7 Real Time Baseband Generator assemblies by performing an alignment. These serdes signals are the differential digital IQ signals that flow between the assemblies. There are two sets of these signals: one is for traffic from the A2 Baseband Generator to the A7 Real Time Generator, the second is for traffic from the A7 Real Time Generator to the A2 Baseband Generator. On the A2 Baseband Generator assembly, all of the serdes signals driven from and/or received from to the ARB FPGA. On the A7 Real Time Generator assembly, all of the serdes signals are driven from and/or received from the FX FPGA. The signals are passively connected in between by the A8 Real Time Baseband Jumper board.

1510 RT – BB Marker Trigger

This test checks the marker and trigger lines between the A7 Real Time Baseband Generator and A2 Baseband Generator assemblies.

1511 RT - BB Clocks

This test checks the “IO Clock” and “User Clock” lines for connectivity between the A2 Baseband Generator and the A7 Real Time Baseband Generator assemblies. These clock lines are connected to the ARB FPGA on the A2 Baseband Generator assembly and to the FX FPGA on the A7 Real Time Baseband Generator assembly.

1512 RT – BB FBI

This test checks the flexible bus interface (FBI) line for connectivity from the A2 Baseband Generator to the A7 Real Time Baseband Generator assembly. The FBI line consists of a differential pair of signals. The FBI line originate from the A2 Baseband Generator assembly ARB FPGA and goes to the A7 Real Time Baseband Generator assembly FX FPGA. The ARB FPGA serially broadcasts 16-bit data across the FBI line.

The testing involves broadcasting the FBI line with different 16-bit patterns. A register within the FX FPGA that contains the deserialized FBI signal is read which should be the same pattern that was sent.

Troubleshooting Self Test 102

A self test 102 failure can be caused by a number of possible causes; A1 Power Supply, A2 Vector, or the A3 RF assembly. Self test 102 is the JTAG Chain check (Joint Test Action Group). The testing makes use of a protocol to access a set of test registers that preset chip logic levels and device capabilities of various parts. The protocol verifies setting in the many different FPGA, PROMs, and individual IC's to determine the validity of each component. Instrument "Error" messages and/or other reported self test failures, listed under "View Details", should be considered prior to replacing any specific hardware. Validate all power supply voltages first by referring to Chapter 8, "Power Supply". Evaluating the specific self test failures and the power supply values may identify the probable faulty assembly.

Troubleshooting Self Test 704

Self test 704 validates the 100 MHz Reference clock signal that originates on the A3 RF assembly and is the clock pulse for the ARB FPGA on the A2 Vector assembly. If the 100 MHz clock is inadequate in amplitude or frequency the cause likely originates from the A3 RF assembly.

If self test 704 fails, see the "100 MHz Reference Signal" section in Chapter 12, "Baseband Generators" to verify the level of the 100 MHz reference signal.

Troubleshooting Self Test 901 to 905

These self tests validate the LO signal from the output of the synthesizer section of the A3 RF assembly. There is circuitry on the A3 RF assembly that cannot be isolated specifically to the A3 RF assembly by self tests, including the associated vertical SMA connector (J2004) that is on the A3 RF assembly. If this connector opens up or if there is a short, then a self test failure 901 can occur. A similar issue can occur and cause self test failures 903 and 904 if connector J2003 opens up or shorts. These same self test failures can also be caused by the corresponding vertical SMA connectors on the A2 Vector assembly should connectors P1 or P2 open or short. The connecting semi-rigid cables W7 or W8 should also be eliminated as possible causes for these self test failures.

If these self test(s) fail, perform the following:

1. Carefully remove W7 and W8 from both of their connectors.
2. Inspect and verify the cables are acceptable.
   a. If a cable is considered faulty, replace the cable.
3. Verify connectors J2004 and J2003 are properly attached to the PCB by gently attempting to move both connectors.
   a. If either connector is loose, replace the A3 RF assembly.
4. Similarly verify that both connectors P1 and P2 on the A2 Vector assembly are properly attached.
   a. If either connector is loose, replace the A2 Vector assembly
5. If the connectors are properly attached, go to step 6.
6. Connect the output from connector J2004 to a spectrum analyzer.
7. Setup the spectrum analyzer:
   a. Set the reference level to +10 dBm.
   b. Set the center frequency to 1GHz.
   c. Set the Span to 100 MHz.

8. Set up the generator:
    a. Press **Preset**
    b. Press **Frequency** and set to 1 GHz
    c. Press **I/Q, and set I/Q** to **On**
9. The output signal frequency from J2004 should be 1 GHz at 0 dBm ±5 dB.
10. Repeat steps 7b and 8b for frequencies 2, 3, 4, 5 and 6 GHz.
11. If the measurements are within range, the A3 RF assembly is likely good. replace the A2 Vector assembly.

Troubleshooting Self Test 1105

A self test 1105 failure can be caused by the A3 RF assembly or the A7 Micro Deck. The following procedure will help identify the defective assembly.

1. After running a complete self test, where self test 1105 failed, press **View Test Info.**
2. Scroll to self test 1304.
3. Press **View Details**.
   a. If multiple lower level 1304 self tests failed, replace the A3 RF assembly.
   b. If only 1304 lower level self test 3.199 GHz Delta H/LB Detector failed, continue to step 4.
4. Disconnect W20 from J2002 of the A3 RF assembly.
5. Connect A3 J2002 output to a spectrum analyzer.
6. Set up the spectrum analyzer:
   a. Press **Preset**.
   b. Set the reference level to +20 dBm.
   c. Set the center frequency to 100 MHz.
   d. Set the span to 100 MHz.
7. Set up the signal generator:
   a. Press **Preset**.
   b. Press **Freq**. Set the frequency to 100 MHz.
   c. Press **RF On/Off** to On.
   d. Press **AMPTD** and set to **+10 dBm**.
   e. Press **AMPTD** and verify that ALC is set to **On**.
8. The spectrum analyzer should be displaying a CW signal with an amplitude equal to the signal generator setting ±3 dB.
   a. If the signal generator's output level is significantly different than the typical 2 or 3 dB, replace the A3 RF assembly.
   b. If the signal generator's output level is as expected, continue to step 9.
9. Repeat step 6 through step 8, but change the spectrum analyzer's and the signal generator's frequencies to 1 GHz and then 1.5 GHz.
   – If the power level is as expected at all test frequencies, replace the A7 Micro Deck.

– If the power level is NOT as expected at all frequencies, replace the A3 RF assembly.

NOTE Depending on the interaction of the ALC circuit, the measured output power may increase as the frequencies increase.

NOTE Frequencies 2 GHz and above are controlled by the High Band ALC detector and will not be visible when making measurements in the Low Band ALC detector range.

Troubleshooting Self Test 1304

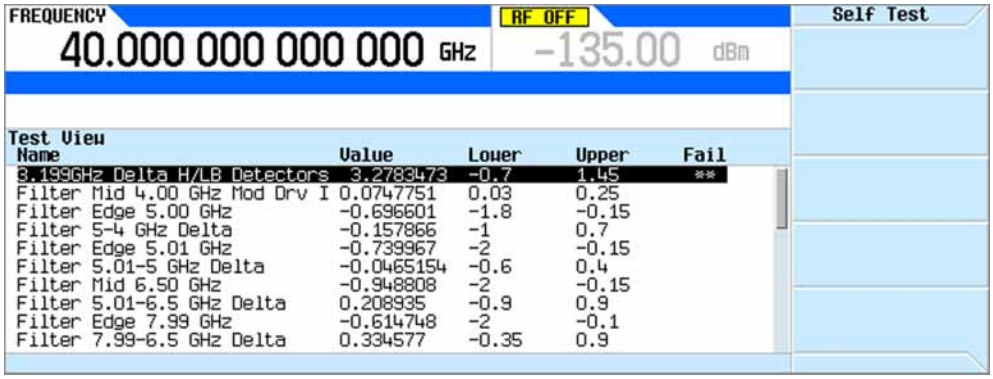
A self test 1304 failure can be caused by the A3 RF assembly or the A7 Micro-Deck. The following procedure will help identify the most likely defective assembly.

1. After running a complete self test, where self test 1304 is the root failure, press **View Test Info**.
2. Scroll to self test 1304 and press **View Details**.
3. If multiple lower level self tests have failed, replace the A7 Micro-Deck assembly.

   If only the lower level self test 3.199 GHz Delta H/LB Detector has failed, as shown in Figure 4-6, proceed to step 4.
4. If the value for the **3.199 GHz Delta H/LB Detector** test is **positive**, the most likely cause of the failure is the A3 RF assembly.

   If the value for the **3.199 GHz Delta H/LB Detector** test is **negative**, the most likely cause of the failure is the A7 Micro-Deck assembly.

Figure 4-6 Self Test 1304 - 3.199 GHz Delta H/LB Detector Failure



Self Tests Do Not Run or Self Tests Run Slowly

If self tests will not run or run slowly, the most likely cause is a faulty A1 Power Supply or A5 CPU assembly. The A5 CPU assembly relies on correct power supply voltages. If the A1 Power Supply is faulty, it could cause a false A5 CPU assembly error.

1. Reinstall the instrument firmware. Refer to Chapter 19, "Instrument Firmware and Operating System" for instructions on how to do this.
2. If reinstalling the instrument firmware does not resolve the issue verify all of the power supply voltages. Refer to the "Power Supply Status Quick-Check" in Chapter 8, "Power Supply" for detailed instructions.
3. If not fault is found with the power supply, replace the A5 CPU assembly.

5 Service and Utility Menus

What You Will Find in This Chapter

This chapter provides information on the following:

Service and Utility Menus Overview on page 100

Boot Service Menu on page 101

Main Firmware Service Menu on page 104

Utility Service Menu on page 109

Service and Utility Menus Overview

Service Menus

There are two areas in the instrument that have service menus that will be covered in this chapter. They are:

- Boot Service Menu
- Utility Menu

Boot Service Menu

The boot service menu provides access to functions that deal with service related options that can be accessed before the instrument boots up.

Utility Menu

The utility menu contains a wide variety of utilities used to determine instrument status and configure instrument settings. These utilities include the following:

- I/O configuration
- User accessible adjustments
- Display settings
- Power on and Preset settings
- Instrument information
    - Diagnostic information
    - Option information
    - Self tests
    - Installed board information
    - Front panel tests
- Service Menu

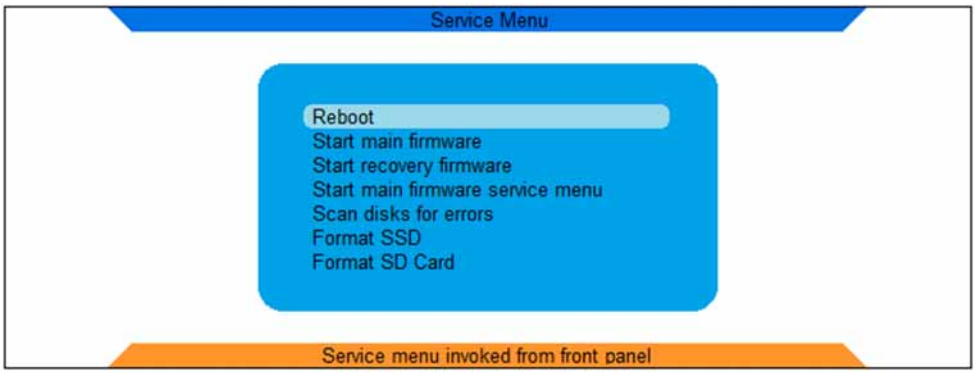
The use of many of these utility menu items is covered in the User's Guide and will not be covered here.

Boot Service Menu

The boot service menu is accessed when the instrument is first turned on and allows the selection of several service related utilities. To enter the boot service menu:

1. Turn the instrument off by using the front panel power button.
2. Once the instrument has turned off press and hold the front panel **Preset** key.
3. While holding the **Preset** key, press and release the power button to turn the instrument back on.
4. Continue to hold the **Preset** key for 10 seconds after pressing the power button, then release it.
5. After approximately 30 seconds the boot Service Menu will appear, as shown in Figure 5-1.
6. Use the front panel up and down arrow keys to navigate the menu and press **Select** when the desired function is highlighted.

Figure 5-1 Service Boot Menu



Menu Options

Reboot

Starts the instrument boot process over from the beginning.

Start main firmware

Continues the instrument boot process from where it left off to enter the Service Menu.

Start recovery firmware

The recovery firmware utility is used for recovery of corrupted firmware and/or FPGA images. When selected, this will start the firmware with a minimal amount of software and drivers loaded.

When the instrument boots up in firmware recovery mode the display will appear as shown in Figure 5-2. At this point the instrument firmware can be loaded using the LAN address shown on the instrument display.

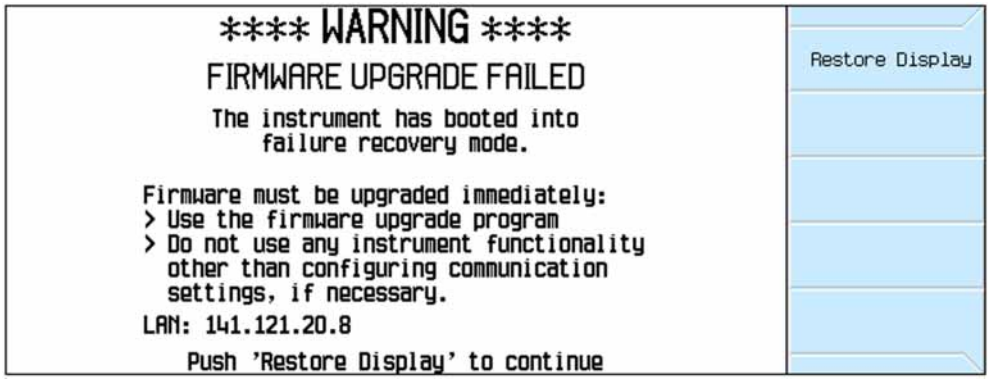
NOTE

At this point, ignore the "FIRMWARE UPGRADE FAILED" message, as well as "Push 'Restore Display' to continue", and proceed by starting the firmware update procedure.

If selected by accident, reboot the instrument to return it to normal operation.

Use this feature if the normal instrument firmware installation process will not work. See Chapter 19, “Instrument Firmware and Operating System” for information on where to download and how to reinstall the instrument firmware.

Figure 5-2 Service Boot Menu



Start main firmware service menu

Loads a menu that will allow access to other service related functions. See “Main Firmware Service Menu” later in this chapter for details.

Scan disks for errors

Loads a menu for selecting what disks to scan and repair.

NOTE

Both the Format SSD and Format SD Card functions will not ask for a confirmation of formatting once selected. Be sure this is the desired function before selecting it.

Format SSD

This will format the A4 Solid State Disk Drive in N5166B, N5172B, and N5182B instruments. The A4 disk drive contains both user files and files required by the instrument for certain functionality, and this utility will delete all of them. If this is used the instrument firmware will need to be reinstalled to recover full operation to the instrument.

When the instrument is restarted after performing this format the following errors may be seen:

-315, Configuration memory lost; Persistent state checksum is bad. Using factory defaults.

-256, File name not found; /USER/USERFLAT/LAST

-256, File name not found; /USER/PTRAIN/LAST

The instrument will correct these errors after the power is cycled again. However, the instrument will not be able to recover from the following error by itself:

-310, System error; Failed to start Application or CalTest harness

To recover from this error the instrument firmware will need to be reinstalled. See Chapter 19, “Instrument Firmware and Operating System” for information on how to reinstall the instrument firmware.

Since this function will erase all user files saved on the A4 Solid State Disk Drive it should not be used unless it is necessary. If possible, backup the user files to an external device before selecting this function.

Format SD Card

This will format the option 006 A3A1 Rear Panel SD Memory Card. The SD memory card contains only user files, if the user has selected to save data in this location.

When the instrument is restarted after performing this format the following errors may be seen:

-315, Configuration memory lost; Persistent state checksum is bad. Using factory defaults.

-256, File name not found; /USER/USERFLAT/LAST

-256, File name not found; /USER/PTRAIN/LAST

The instrument will correct these errors after the power is cycled again.

Since this function will erase all user files on the A3A1 Rear Panel SD Memory Card it should not be used unless it is necessary. If possible, backup the user files to an external device before selecting this function.

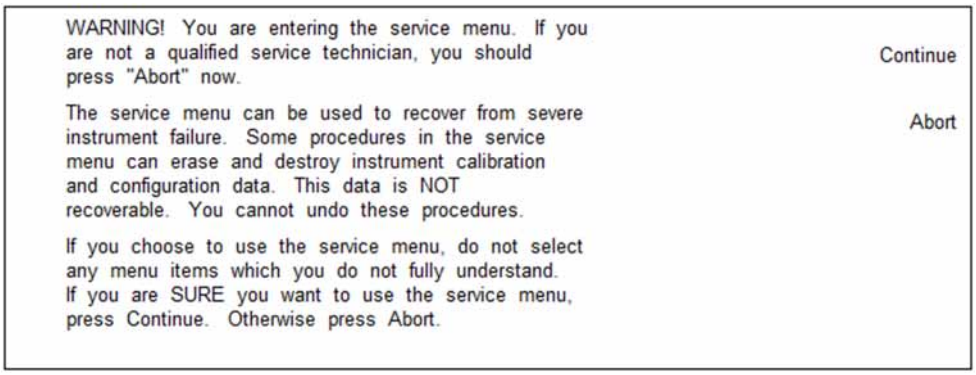
Main Firmware Service Menu

The Main Firmware Service Menu that is accessed through the boot service menu provides for the following functions:

- Boot while ignoring user or last state, or without persistent state
- Delete all user files
- Backup and Restore instrument licenses
- Boot without support for hardware, applications, or calibration and test

When the “Start main firmware service menu” selection is made from the boot service menu the warning message shown in Figure 5-3 will be displayed.

Figure 5-3 Main Firmware Service Menu Warning



After reading the message, press Continue to enter the menu. The selections available on the main firmware service menu are shown in Figure 5-4, Figure 5-5, Figure 5-6, and Figure 5-7.

Figure 5-4 Main Firmware Service Menu, Page 1

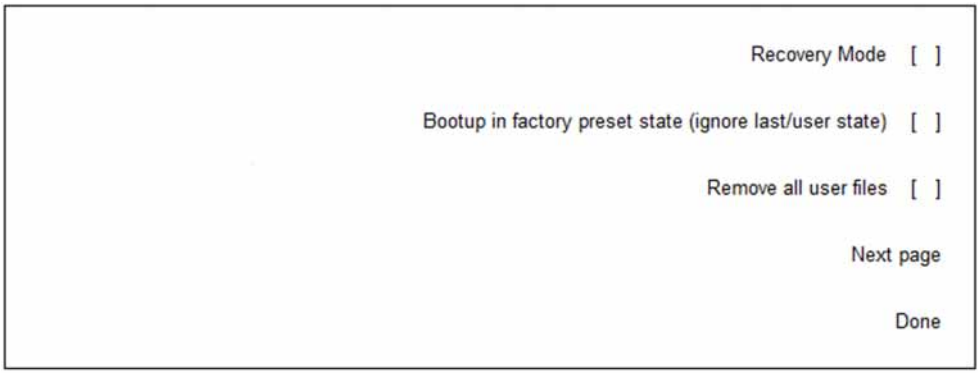


Figure 5-5 Main Firmware Service Menu, Page 2

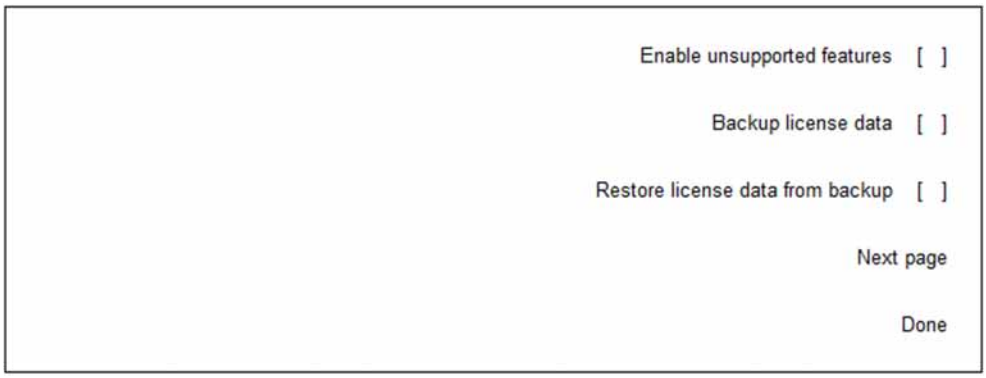


Figure 5-6 Main Firmware Service Menu, Page 3

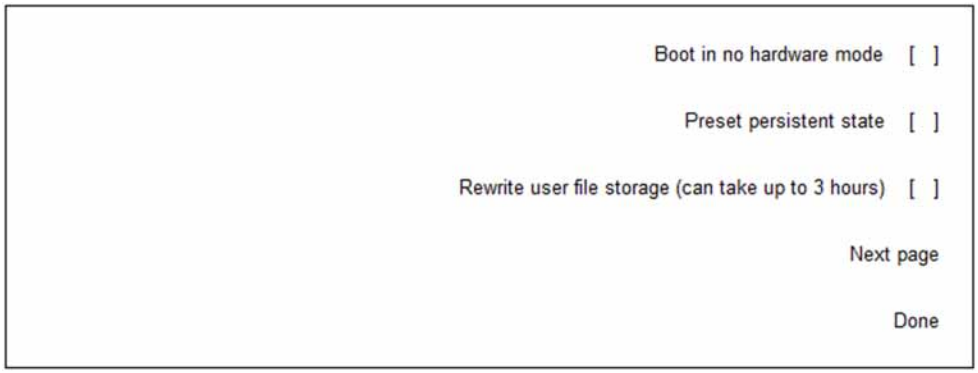
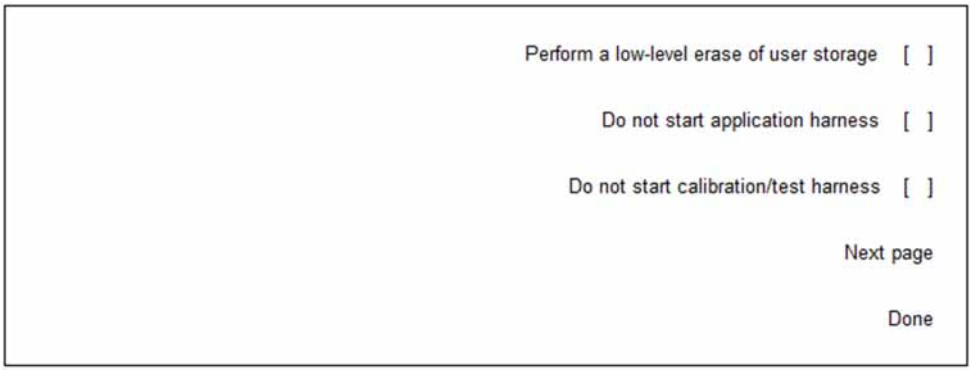


Figure 5-7 Main Firmware Service Menu, Page 4



These menu selections are:

Recovery Mode

This will start the recovery firmware. This is used for recovery of corrupted firmware and/or FPGA images. When the instrument boots up in firmware recovery mode the display will appear as shown in Figure 5-2. At this point the instrument firmware can be loaded.

If selected by accident, reboot the instrument to return it to normal operation.

Use this feature if the normal firmware installation process will not work. See Chapter 19, "Instrument Firmware and Operating System" for information on how to reinstall the instrument firmware.

Bootup in factory preset state (ignore last/user state)

When the instrument firmware is run it will ignore the last state or user preset state if one of them has been set to be used at power up. The instrument will use the factory preset state. This could be used if a corrupt state is keeping the instrument from booting up properly.

Remove all user files

This will delete all user files on the current user storage device. When the instrument is restarted after removing the user files the following errors may be seen:

-315, Configuration memory lost; Persistent state checksum is bad. Using factory defaults.

-256, File name not found; /USER/USERFLAT/LAST

-256, File name not found; /USER/PTRAIN/LAST

The instrument will correct these errors after the power is cycled again.

Since this function will erase all user files on the active user drive it should not be used unless it is necessary. If possible, backup the user files to an external device before selecting this function.

Enable unsupported features

For factory use only.

Backup license data

Backs up the instrument license data from the A5 CPU assembly to the A3 RF assembly.

Before an instrument leaves the factory, a backup of the installed license data was performed so it could be restored in the future if needed.

After installing any licensed upgrade in the field this process should be run to update the backed up license data.

Restore license data from backup

Restores licenses to the A5 CPU assembly that have been backed up to the A3 RF assembly. Before an instrument left the factory a backup of the license data was performed so that all installed licenses could be restored at a point in the future that they might be needed.

Boot in no hardware mode

Starts the instrument firmware without support for the hardware. This will result in multiple error messages stating that hardware could not be found.

Preset persistent state

Deletes the instrument persistent state. Performs the same function as the Restore System Settings to Default Values function under the Utility, Power On / Preset menu. This restores all persistent setting to their factory defaults. Persistent settings are those that are unaffected by a power cycle, preset, or recall. After selecting this function, the following error will be seen:

-315, Configuration memory lost; Persistent state preset. Using factory defaults.

The instrument will correct this error after the power is cycled again.

Rewrite user file storage (can take up to 3 hours)

Not supported.

Perform a low-level erase of user storage

Not Supported

Do not start application harness

Starts the instrument firmware without support for certain real-time applications. This only applies to N5172B and N5182B instruments, as the application harness is not started or needed for other models. Applications that are affected by this setting are ones such as:

- Real-Time Applications
- Real-Time Fading

Do not start calibration/test harness

Starts the instrument firmware without support for a variety of instrument tests and adjustments. Such as:

- Self Test
- I/Q Calibration (N5166B, N5172B, N5182B)
- User Flatness Calibration
- Finalize RF Assembly Installation (N5166B, N5172B, N5182B)
- Finalize BBG Assembly Installation (N5166B, N5172B, N5182B)
- I/Q Internal Channel Correction Calibrations (N5166B, N5172B, N5182B)

- Power Verify
- ALC Modulator Bias Adjustment

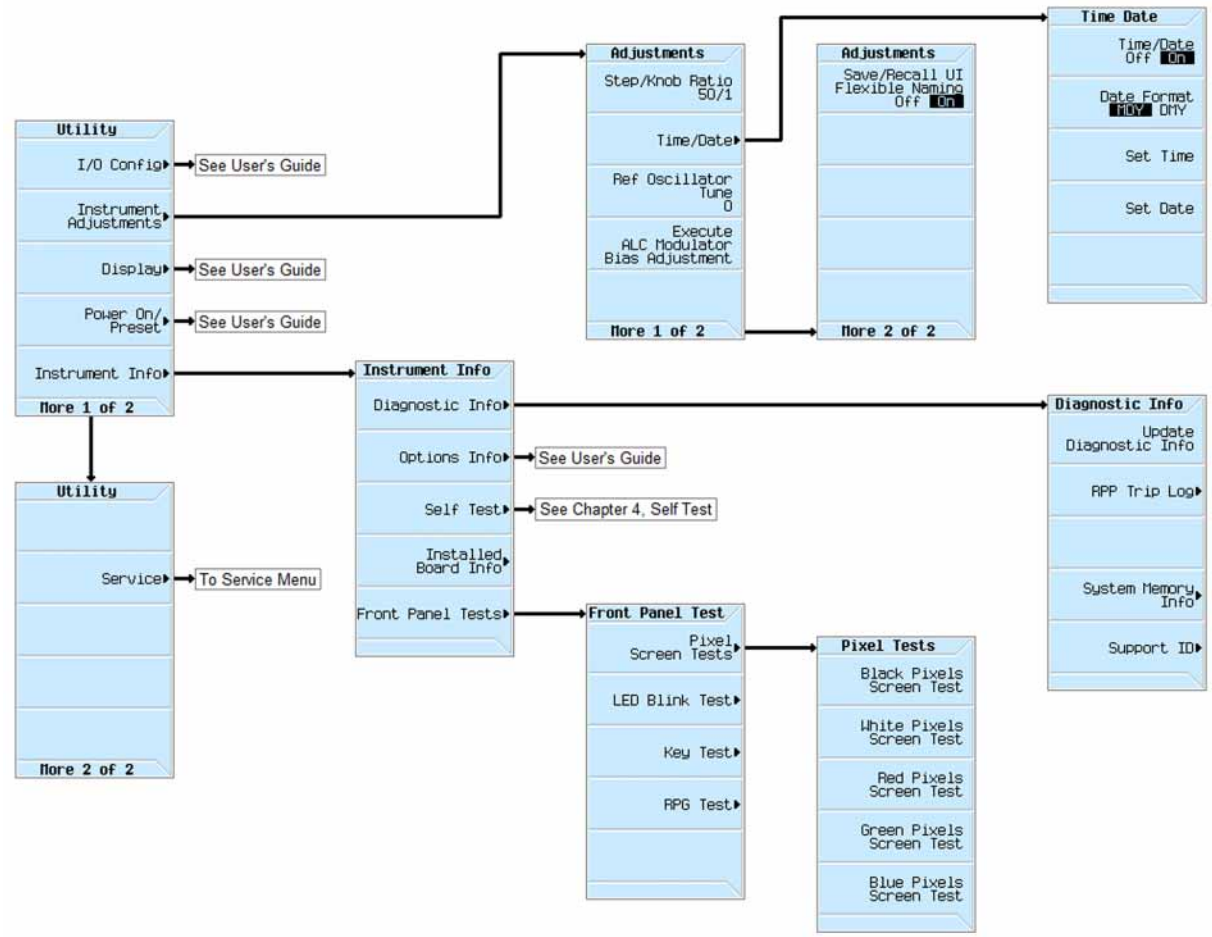
Done

Executes the selected service menu function(s) and loads the instrument firmware.

Utility Service Menu

The Utility menu provides access to many different functions, not all are service related. In this section, only the service related functions will be covered. Information on the rest can be found in the instrument User's Guide.

Figure 5-8 Utility Menu



I/O Config

Please see the instrument User's Guide for detailed information on the use of the menu.

Instrument Adjustments

The functions in the Instrument Adjustments menu are meant for the user to have access to certain instrument settings. These include:

Step / Knob Ratio

This is for user preference. The setting is persistent.

Time/Date

This is used to set the time and date of the instrument. The user is expected to adjust this to their specific time zone.

For servicing, this needs to be set if the A3BT1 Backup Battery is replaced during servicing. It will also need to be reset if at any time during servicing the A5 CPU assembly is disconnected from the A3 RF assembly, since the backup battery is on the A3 RF assembly and the real-time clock is on the A5 CPU assembly.

Since these instruments could have time-based licenses installed in them be careful not to set the date incorrectly. Setting it to the wrong date could invalidate time-based licenses. If there are time-based licenses in the instrument it will give the warning messages shown in Figure 5-9 or Figure 5-10 whenever the date is changed.

Figure 5-9 Moving Date Forward Warning

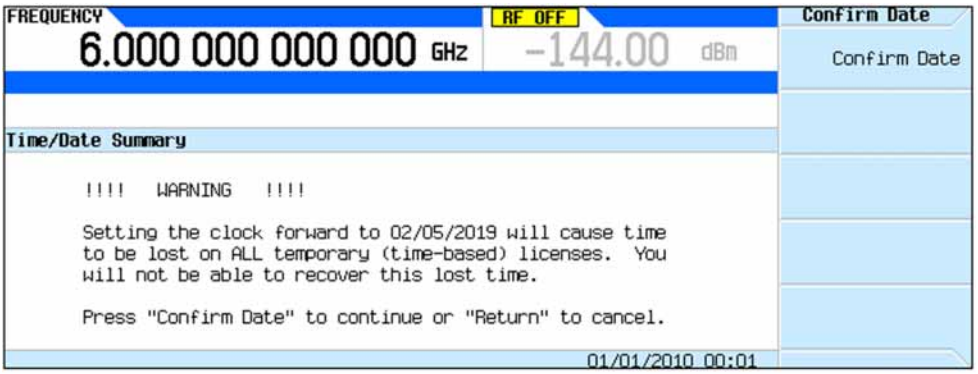
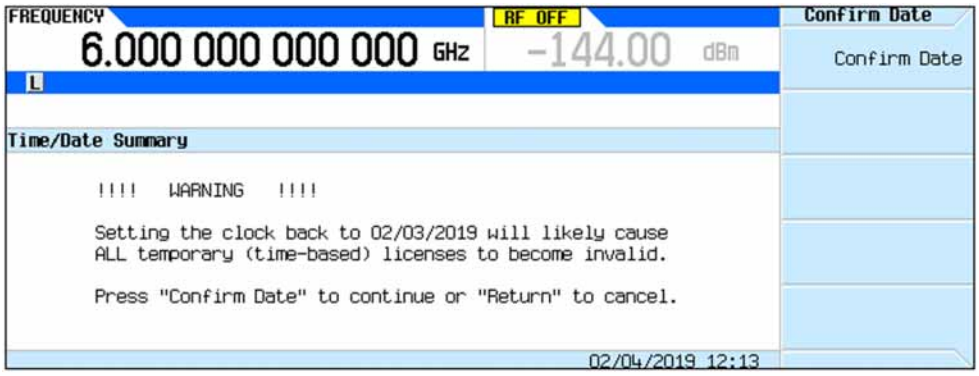


Figure 5-10 Moving Date Back Warning



Whenever one of these messages is seen be sure that the date entered is correct before confirming it.

Ref Oscillator Tune

This adjustment is intended for use by the user to make any fine tuning they would like to the frequency output of the instrument. This adjustment is not the same as the Reference Internal Standard Calibration provided with the Performance Verification and Adjustment software for servicing the instrument.

The value entered for this setting is used in addition to the factory tune setting. Setting this value to 0 will make the instrument use only the factory setting.

Execute ALC Modulator Bias Adjustment

This runs the Open Loop Power Calibration, which is the same as one of the adjustments in the Performance Verification and Adjustment software provided for servicing the instrument. Since there is no equipment required for this adjustment the user can execute it to compensate for open loop power drift due to temperature and humidity.

Save/Recall UI Flexible Naming

This is for user preference of the save and recall system for user state files.

Display

Please see the instrument User's Guide for detailed information on the use of the menu.

Power On / Preset

Please see the instrument User's Guide for detailed information on the use of the menu.

Instrument Info

Diagnostic Info

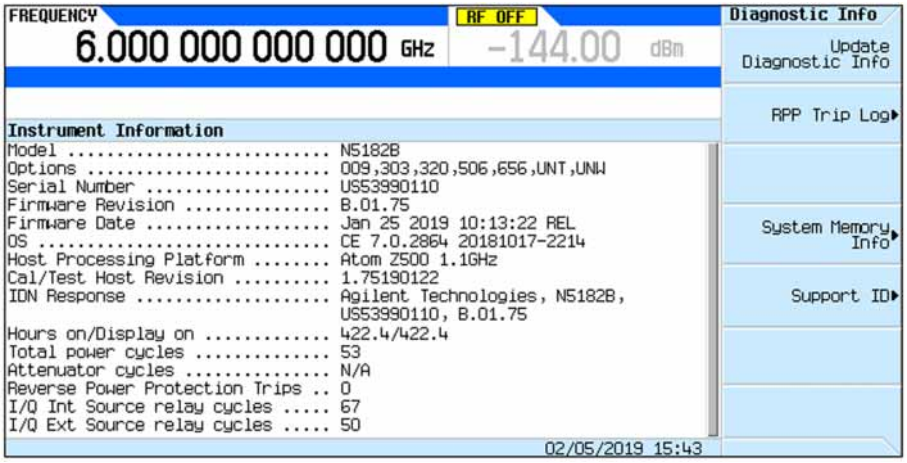
The Diagnostic Info screen contains much of the instrument configuration information that will be needed to service an instrument. As seen in Figure 5-11, this screen contains the following instrument information:

- Model number
- Installed options
- Serial number
- Firmware revision and date
- Operating system revision
- Host Processor platform
- Self Test revision
- Mechanical switch counts

– System memory size and usage

– And more...

Figure 5-11 Diagnostic Info Screen



RPP Trip Log

This information is only for N5166B, N5171B, N5172B, N5181B, and N5182B instruments. If the instrument reverse power protection has ever been tripped, information on the circumstances of the trip can be found here.

System Memory Info

This screen displays the system memory usage information. This is the memory on the A5 CPU assembly only. If the instrument user memory is in a different location (A4 Solid State Disk Drive or Option 006 A3A1 Rear Panel SD Memory Card) it is not included in these numbers.

Support ID

This information is used to identify the support contract for an instrument.

Option Info

Please see the instrument User's Guide for detailed information on the use of the menu. For servicing purposes see the list of installed options on the **Utility**, **Instrument Info**, **Diagnostic Info** screen.

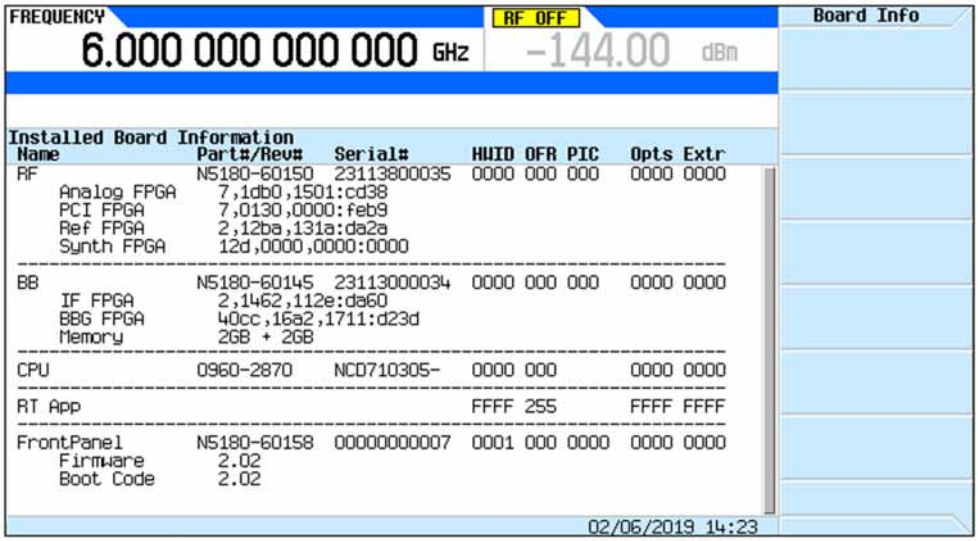
Self Test

See Chapter 4, "Self Test" for information on the Self Test capability of the instrument.

Installed Board Info

This is a list of the installed board assembly information. The assemblies listed here will vary depending on the model number and options installed. Figure 5-12 is an example of a typical Installed Board Info screen.

Figure 5-12 Typical Installed Board Information



The part numbers of the assemblies on this screen will most likely not match the part numbers found in the replacement parts list in Chapter 14, "Replacement Parts". The part numbers listed here are the actual assembly part numbers, not the replacement kit part numbers. These assembly part numbers can be very important to know when servicing an instrument. For example, service notes usually refer to the installed assembly part numbers, or even the serial number or hardware ID.

If an instrument is not able to identify its model number, or some functionality is missing, referring to the Installed Board Info screen can be helpful in determining the possible cause of these types of problems. Of course, knowing what assemblies and part numbers should be in this list would be important information to know. Table 5-1 lists the assemblies and possible part numbers for the different model numbers in this series. Where there are multiple part numbers for an assembly for a given model number, any one of them would be correct. Also, these were the possible part numbers at the time of the printing of this manual. Newer part numbers could be added later.

Table 5-1 Possible Installed Assembly Part Numbers

Assembly	Part #	N5166B	N5171B	N5172B	N5173B	N5181B	N5182B	N5183B
RF[a]	N5180-60203		X	X				
	N5180-60239		X	X				
	N5180-60279	X	X	X				
	N5180-60297	X	X	X				
	N5180-60173				X			
	N5180-60299				X			
	N5180-60150					X	X	
	N5180-60238					X	X	
	N5180-60278					X	X	
	N5180-60296					X	X	
	N5180-60151							X
	N5180-60298							X
BB[a]	N5180-60145			X			X	
	N5180-60280	X		X			X	
CPU	0950-2870		X	X	X	X	X	X
	0950-3295	X	X	X	X	X	X	X
MW[a]	N5180-60172				X			X
RT App[b]				X			X	
Front Panel	N5180-60158	X	X	X	X	X	X	X

a. If the installed assembly is a refurbished assembly it could be a -69xxx part number instead of -60xxx.
b. RT App is only present with option 660 and does not report a part number or serial number.

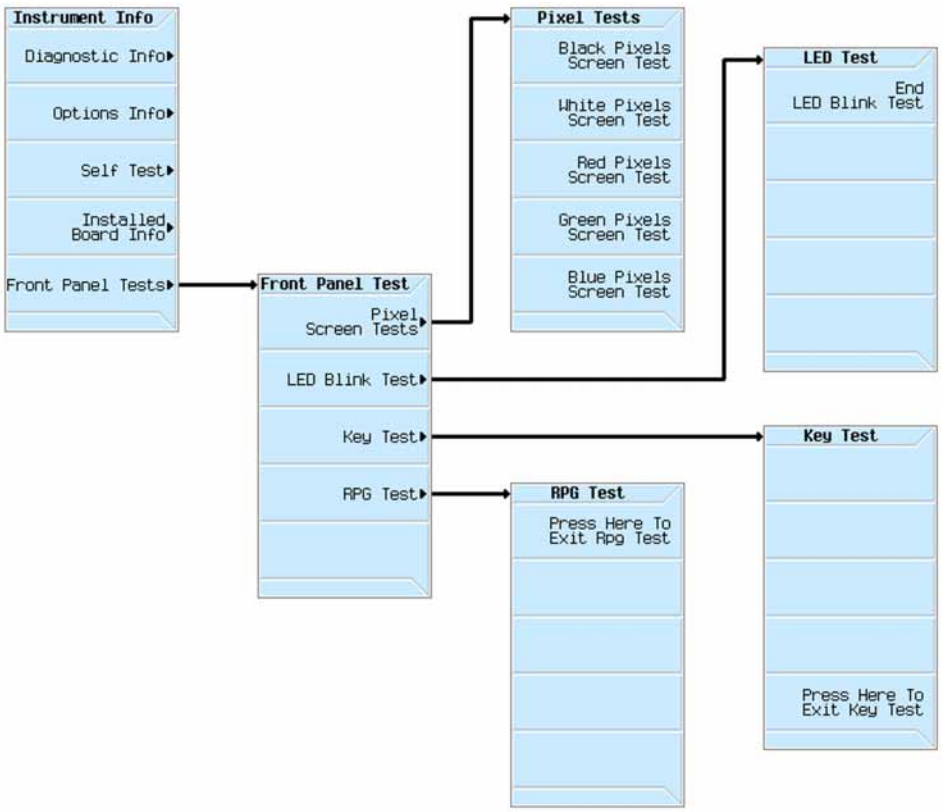
Front Panel Tests

The Front Panel Tests verify the functionality of multiple front panel operations, all of which should be verified after the instrument front panel has been repaired or replaced. These operations include:

1. LCD pixel test
2. Front panel indicator LED test
3. Front panel hard and soft key test
4. RPG test

To access the Front Panel Tests menu as shown in Figure 5-13, press **Utility**, **Instrument Info**.

Figure 5-13 Front Panel Tests Menu



Pixel Test

The Pixel Test verifies that the pixels in the liquid crystal display all function properly. Cycle through the different colors and verify that all pixels display the corresponding color.

LED Blink Test

The LED Blink Test will blink the three front panel indicator LEDs. These are the More, Mod On/Off, and RF On/Off LEDs. The Standby and Power On LEDs just above the power switch will not blink. Verify that all three of these LEDs are blinking.

Key Test

The Key test is used to verify the functionality of all the front panel hard and soft keys. Press each key once (except the power switch) to verify its functionality. Once all keys have been verified press the bottom softkey to exit the test.

RPG Test

The RPG test is used to verify the functionality of the rotary pulse generator. Rotate the RPG both clockwise and counterclockwise for at least 5 counts from its initial position to verify its functionality.

Service

The service menu contains functions that are needed to complete assembly replacements.

Remove Assembly

The idea behind the Remove Assembly menu, and all the “Prepare” functions within it, was to do any data transfer needed before removing an assembly that needed to be replaced. However, nothing has ever been implemented for these functions, so there currently is no use for this menu.

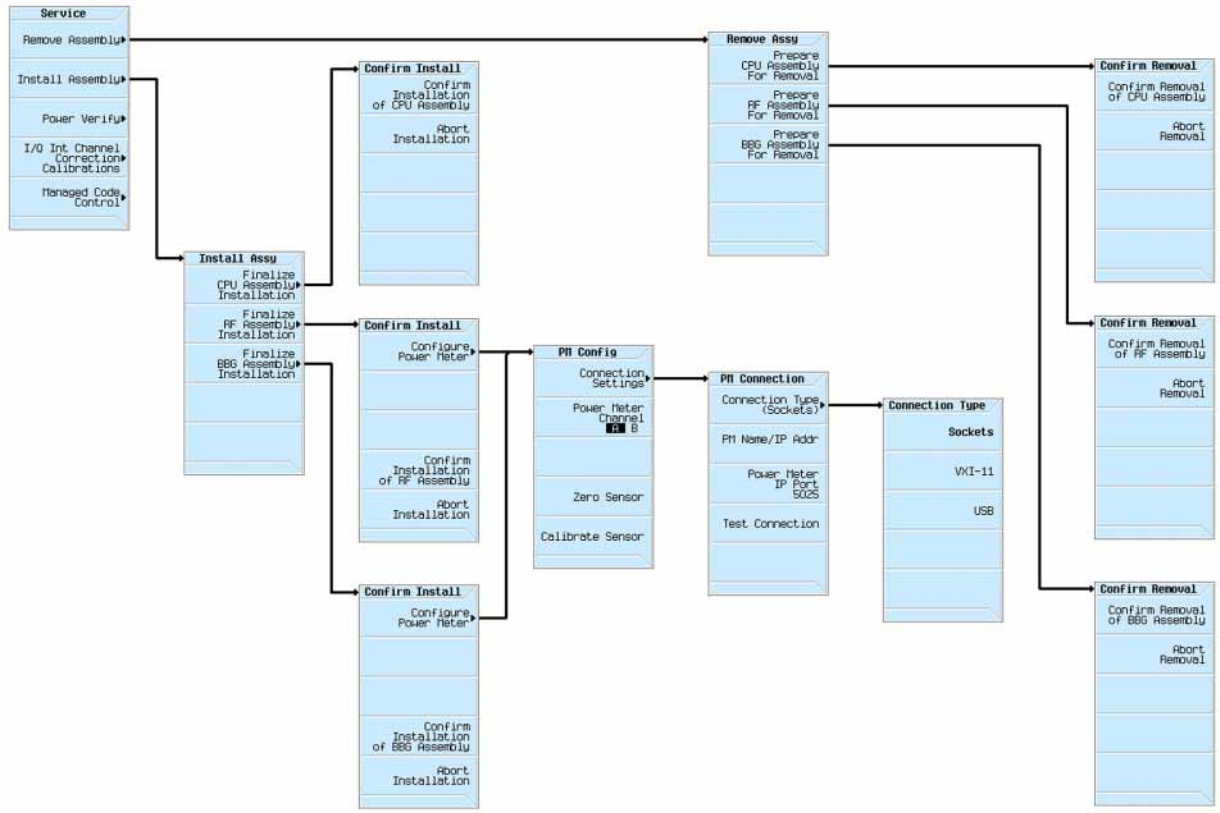
There are four types of instrument information that one should be concerned about when an assembly is being removed and replaced with a replacement assembly. They are:

- The instrument model number
- The instrument serial number
- The instrument licenses
- The instrument calibration data

For information on how and where all of these are saved in the instrument, see Chapter 3, “Instrument Information and Calibration Data”.

For information on what needs to be done to ensure that none of these are lost when an assembly is replaced, see Chapter 16, “Pre and Post-Repair Procedures”.

Figure 5-14 Service Menu Remove and Install Assemblies



Install Assembly

The “Finalize” routines contained within the Install Assembly menu are meant to perform certain required tasks after one of the assemblies listed is replaced. These assemblies include the following:

- A2 Vector BBG Assembly (N5166B, N5172B, N5182B)
- A3 RF Assembly
- A5 CPU Assembly
- A7 Micro-Deck Assembly (N5173B, N5183B)

However, these functions are not implemented for all instruments and all assemblies that are included on the list. The only functions that will need to be used when an assembly is replaced are:

- Finalize RF Assembly Installation

  N5166B

  N5172B

  N5182B

- Finalize BBG Assembly Installation

  N5166B

N5172B
N5182B

For the rest of the models in this series, and other assemblies for the models listed above, nothing has ever been implemented for these function, so there currently is no use of this menu for them.

For information on when these routines should be run see Chapter 16, "Pre and Post-Repair Procedures".

Finalize CPU Assembly Installation

Not used.

Finalize RF Assembly Installation

This is only used with an N5166B, N5172B, and N5182B.

This routine will run a few adjustments that are needed to ensure that the instrument functions and performs properly with the new A3 RF assembly and the existing A2 Vector BBG assembly. These adjustments are:

—Cal Array Defaults

—IQ Prelevel Calibration

—Open Loop Power Calibration

—IQ Calibration

—IQ Internal Channel Correction Calibration RF

—IQ Internal Channel Correction Calibration PM

These adjustments are built into the instrument calibration and test harness. It will take approximately 1 hour for these adjustments to complete, depending on the power meter/sensor used. Once this routine is started it cannot be paused, only aborted. If aborted, it can only be started again from the beginning.

For the last adjustment in this routine a power meter that can be controlled by the instrument is required. This can be connected to the instrument either via Sockets, VXI-11, or USB. However, the type of power meter/sensor used can have a large effect on the amount of time the adjustment will take to complete. Because of this, the recommended connection type is USB. When selecting a power meter/sensor to use for this adjustment the following parameters need to be considered:

Frequency Range: 10 MHz to 6 GHz

Power Level: -70 to +20 dBm

While there may be other sensors that meet the required parameters, the recommended USB power sensors are shown in Table 5-2. When using one of these USB power sensors it will take approximately 1 hour for them all to complete.

Table 5-2 Recommended USB Power Sensors

USB Sensor Model	Frequency Range	Power Range
U2042XA	10 MHz to 6 GHz	-70 to +26 dBm
U2044XA	10 MHz to 18 GHz	-70 to +26 dBm

Be sure to configure and test the communication with the power sensor prior to executing this routine. This would also include zeroing and calibrating the power sensor as needed.

If the following error occurs when running this routine, there is a required adjustment missing. Go to the I/Q Internal Channel Correction Calibrations section in this chapter and run the "Enhanced Factory Calibration".

517, Calibration Failure; Internal Channel Correction Calibration(new)failure. Prerequisite calibration not completed.

Finalize BBG Assembly Installation

This is only used with an N5166B, N5172B, and N5182B.

This routine will run a few adjustments that are needed to ensure that the instrument functions and performs properly with the new A2 Vector BBG assembly and the existing A3 RF assembly. These adjustments are:

—Cal Array Defaults

—IQ Prelevel Calibration

—Open Loop Power Calibration

—IQ Calibration

—IQ Internal Channel Correction Calibration RF

—IQ Internal Channel Correction Calibration PM

These adjustments are built into the instrument calibration and test harness. It will take approximately 1 hour for these adjustments to complete, depending on the power meter/sensor used. Once this routine is started it cannot be paused, only aborted. If aborted, it can only be started again from the beginning.

For the last adjustment in this routine a power meter that can be controlled by the instrument is required. This can be connected to the instrument either via Sockets, VXI-11, or USB. However, the type of power meter/sensor used can have a large effect on the amount of time the

adjustment will take to complete. Because of this, the recommended connection type is USB. When selecting a power meter/sensor to use for this adjustment the following parameters need to be considered:

Frequency Range: 10 MHz to 6 GHz

Power Level: -70 to +20 dBm

While there may be other sensors that meet the required parameters, the recommended USB power sensors are shown in Table 5-2. When using one of these USB power sensors it will take approximately 1 hour for them all to complete.

Be sure to configure and test the communication with the power sensor prior to executing this routine. This would also include zeroing and calibrating the power sensor as needed.

If the following error occurs when running this routine, there is a required adjustment missing. Go to the I/Q Internal Channel Correction Calibrations section in this chapter and run the "Enhanced Factory Calibration".

517, Calibration Failure; Internal Channel Correction Calibration(new)failure. Prerequisite calibration not completed.

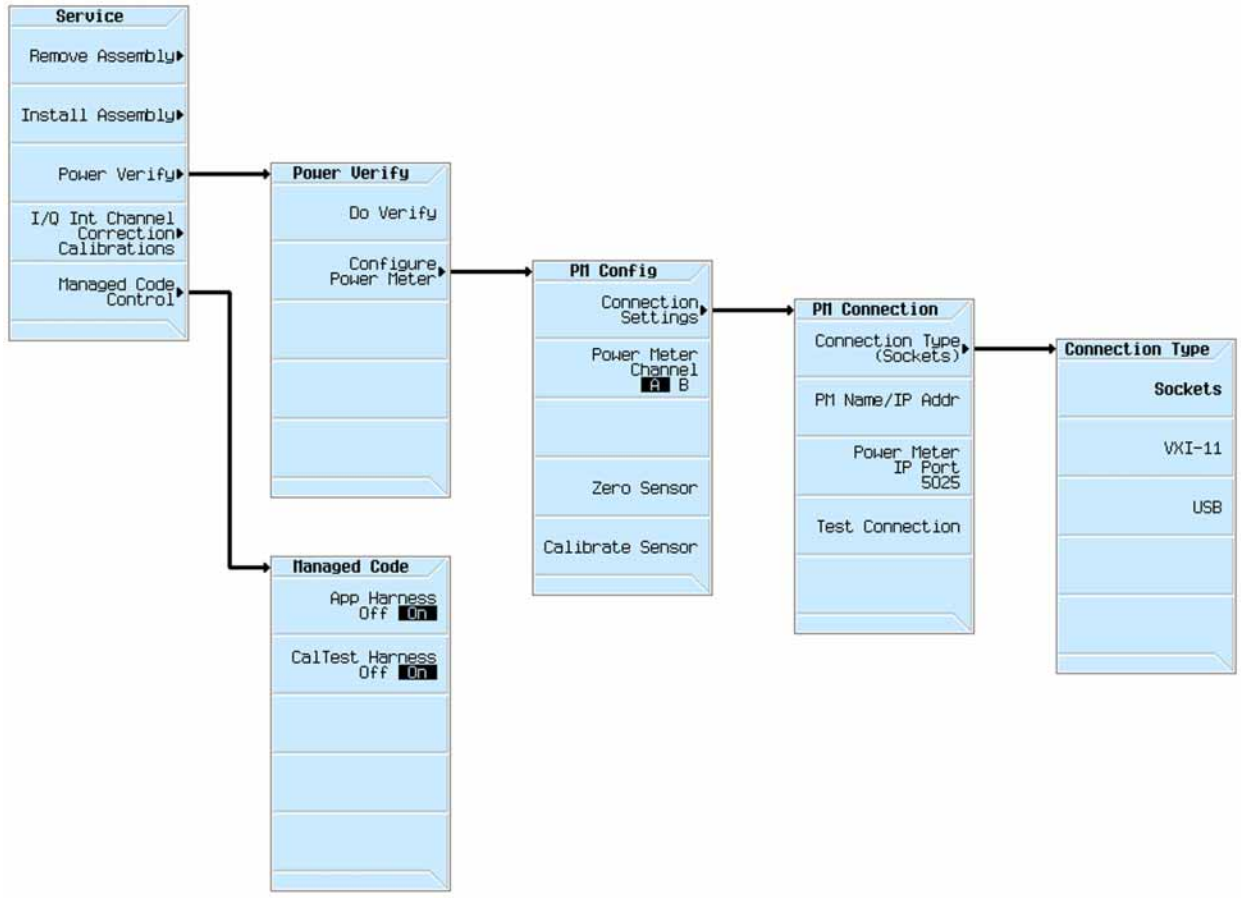
Finalize MW Assembly Installation

Not used.

Power Verify

This feature can be used to verify the output power of the instrument. It will measure multiple frequency points across the frequency range at a few different power level settings. However, this is not intended for servicing of the product or performance verification, and any failures of this should not be considered a failure of the instrument. Refer to Chapter 18, "Performance Verification and Adjustment Software" for performance verification testing.

Figure 5-15 Power Verify and Managed Code Control Service Menu



Managed Code Control

This control allows the disabling of the application and test software within the instrument.

App Harness

The application harness is only used in the N5172B and N5182B instruments, as it supports the use of certain real-time digital modulation applications. For other instrument models the application harness is not available. Applications that are affected by this setting are ones such as:

—Real-Time Applications

—Real-Time Fading

If the use of any of these is attempted with the application harness turned off it will appear that these options are not installed.

Under normal operation this should always be set to On for the N5172B and N5182B instruments. However, it is possible to boot the instrument with this set to Off through the Main Firmware Service Menu.

If the App Harness is turned Off the instrument power will need to be cycled for it to come back on.

If for some reason this software appears to be corrupt reload the instrument firmware to reinstall the App Harness software. See Chapter 19, "Instrument Firmware and Operating System" for information on reloading the instrument firmware.

CalTest Harness

The calibration and test harness is software in the instrument that is used to run a variety of instrument tests and adjustments. They include:

—Self Test

—I/Q Calibration (N5166B, N5172B, N5182B)

—User Flatness Calibration

—Finalize RF Assembly Installation (N5166B, N5172B, N5182B)

—Finalize BBG Assembly Installation (N5166B, N5172B, N5182B)

—I/Q Internal Channel Correction Calibrations (N5166B, N5172B, N5182B)

—Power Verify

—ALC Modulator Bias Adjustment

If any of these are executed when the calibration and test Harness is turned Off the following error message will be seen:

644, Firmware extension module error; Failed access to operation in calibration extension module (number)

Under normal operation this should always be set to On. However, it is possible to boot the instrument with this set to Off through the Main Firmware Service Menu.

If the calibration and test harness is turned Off the instrument power will need to be cycled for it to come back on.

If for some reason this software appears to be corrupt reload the instrument firmware to reinstall the calibration and test harness software. See Chapter 19, "Instrument Firmware and Operating System" for information on reloading the instrument firmware.

I/Q Internal Channel Correction Calibrations

This menu is only for N5166B, N5172B, and N5182B Instruments.

This menu is intended for use in instruments that originally shipped with firmware versions earlier than B.01.10 for them to be able to achieve performance levels equal to instrument shipped with firmware version B.01.10 or newer. However, it can be run at any point in any instrument to optimize performance.

As shown in Figure 5-17, once one of these calibrations has been run the date of the calibration will be displayed on the screen for this menu. If there is no date displayed in the menu the Factory Calibration selection will not be available and the Enhanced Factory Calibration will need to be run.

Figure 5-16 I/Q Internal Channel Correction Calibrations

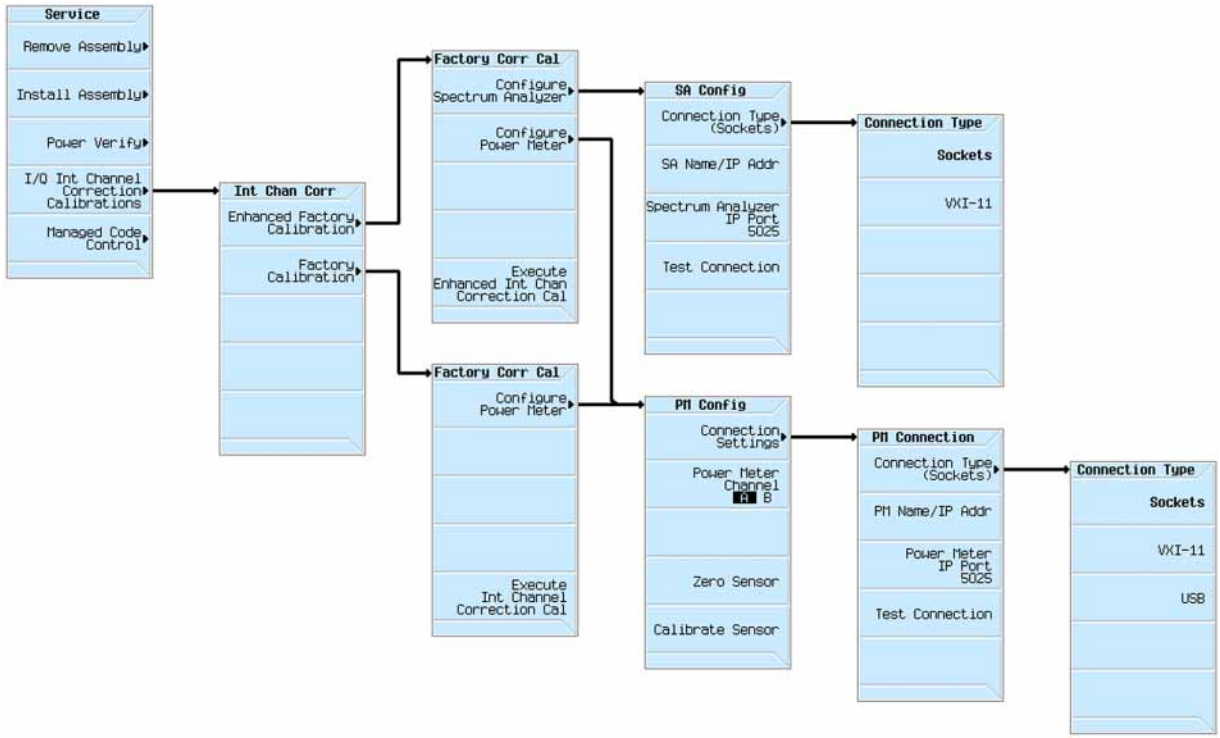
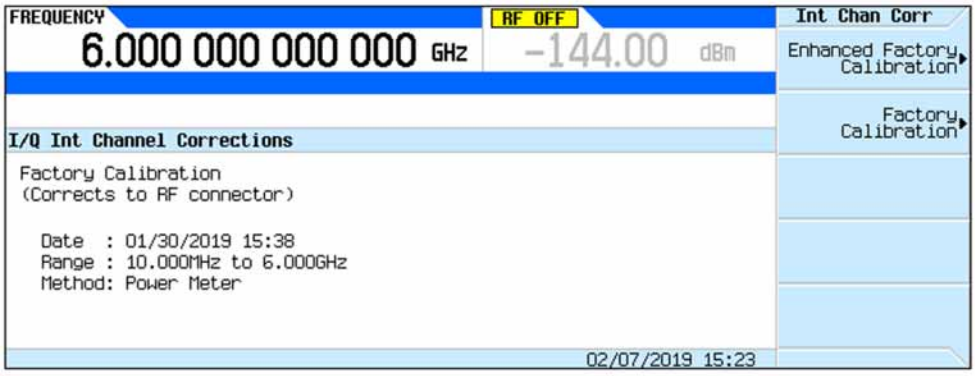


Figure 5-17 I/Q Internal Channel Correction Calibration Menu and Display



Enhanced Factory Calibration

This routine will run the following adjustments:

—IQ Calibration

—IQ Internal Channel Correction Coarse Calibration

—IQ Skew Calibration

—IQ Internal Channel Correction Fine Calibration

—IQ Internal Channel Correction Calibration PM

These adjustments are built into the instrument calibration and test harness. It will take approximately 1¼ hours for these adjustments to complete, depending on the power meter/sensor used. Once this routine is started it cannot be paused, only aborted. If aborted, it can only be started again from the beginning.

The IQ Skew Calibration will require that a spectrum analyzer be connected to the instrument output as well as be controlled by the instrument. This can be connected to the instrument for control either via Sockets or VXI-11. The spectrum analyzer must be either a PSA series or an N9030A PXA. The maximum tune frequency of the spectrum analyzer used must be at least as high as the instrument being serviced. Be sure to configure and test the communication with the spectrum analyzer prior to executing this routine.

NOTE

When connecting the signal generator RF output to the spectrum analyzer RF input be sure to also connect the spectrum analyzer reference output to the signal generator reference input, as per the on screen instructions. If the reference is not connected the IQ Skew Calibration will fail.

For the last adjustment in this routine a power meter that can be controlled by the instrument is required. This can be connected to the instrument either via Sockets, VXI-11, or USB. However, the type of power meter/sensor used can have a large effect on the amount of time the adjustment will take to complete. Because of this, the recommended connection type is USB. When selecting a power meter/sensor to use for this adjustment the following parameters need to be considered:

Frequency Range: 10 MHz to 6 GHz

Power Level: -70 to +20 dBm

While there may be other sensors that meet the required parameters, the recommended USB power sensors are shown in Table 5-2. When using one of these recommended USB power sensors it will take approximately 1¼ hour for them all to complete.

Factory Calibration

This routine will run the following adjustments:

– IQ Calibration

– IQ Internal Channel Correction Calibration PM

These adjustments are built into the instrument calibration and test harness. It will take approximately ½ an hour for these adjustments to complete, depending on the power meter/sensor used. Once this routine is started it cannot be paused, only aborted. If aborted, it can only be started again from the beginning.

For the last adjustment in this routine a power meter that can be controlled by the instrument is required. This can be connected to the instrument either via Sockets, VXI-11, or USB. However, the type of power meter/sensor used can have a large effect on the amount of time the adjustment will take to complete. Because of this, the recommended connection type is USB. When selecting a power meter/sensor to use for this adjustment the following parameters need to be considered:

Frequency Range: 10 MHz to 6 GHz

Power Level: -70 to +20 dBm

While there may be other sensors that meet the required parameters, the recommended USB power sensors are shown in Table 5-2. When using one of these recommended USB power sensors it will take approximately ½ an hour for them all to complete.

6 Troubleshooting

What You Will Find in This Chapter

This chapter provides information on the following:

Overview on page 128

Power On Issues on page 128

Communication Issues on page 129

Unlocked Issues on page 132

Unleveled Issues on page 136

Rear Panel BNC Connectors on page 150

Amplitude Modulation Issues (Option UNT) on page 152

Pulse Modulation Issues (Option UNW) on page 156

Overview

This chapter is intended to address some of the most common failures. While not all the answers may be found here, the information contained in this chapter should give some guidance that will allow a skilled technician to isolate the assembly at fault. If more information is needed see the chapter for the suspect assembly for detailed information on the assembly and information on the normal signal levels and behavior.

Power On Issues

If there are any issues with the instrument not completely powering up see Chapter 2, "Boot Up and Initialization" for troubleshooting information.

If the instrument model or serial numbers are incorrect see Chapter 3, "Instrument Information and Calibration Data" for detailed information on how these are determined.

Communication Issues

There are several different communication ports that the instrument can use for remote control and communication. They are:

- GPIB
- LAN
- USB

There are also USB ports on both the front and rear of the instrument that can be used to connect memory devices to. While all of these can be traced back to the A5 CPU assembly, there may be other contributors to faulty communication.

GPIB

If problems are being experienced in communicating with the instrument via GPIB try the following in the order listed to isolate the problem:

1. Try a known good GPIB cable to communicate with the instrument.
2. Verify that the PC attempting to communicate with the instrument can identify it using the Keysight Connection Expert.
3. Verify that the instrument GPIB address is set to the same address that the PC trying to communicate with it is using by pressing **Utility**, **I/O Config**, **GPIB Setup**.
4. Verify that the GPIB connector on the rear panel of the instrument is not damaged. If damaged, replace the W11 connector assembly.
5. Remove the instrument outer cover and inner bottom cover and inspect the condition of the inner GPIB ribbon cable and connection to the A3 RF assembly. If damaged, replace the W11 connector assembly.
6. If the problem persists after the preceding steps have all been taken replace the A5 CPU assembly.
7. If the problem persists after replacing the A5 CPU assembly replace the A3 RF assembly.

LAN

The instrument supports 100 MHz LAN communication through the rear panel ethernet connection. If problems are being experienced in communicating with the instrument via the ethernet connection try the following in the order listed to isolate the problem:

1. Try using a known good CAT5 cable to communicate with the instrument.
2. With a known good active CAT5 cable connected to the instrument ethernet connection the two LEDs on the connector should be active, one solid and one blinking. If not, replace the A5 CPU assembly.

3. Verify that the instrument IP address is set to the same address that the PC trying to communicate with it is using by pressing **Utility**, **I/O Config**, **LAN Setup**.
4. Verify that the PC attempting to communicate with the instrument can identify it using the Keysight Connection Expert.
5. Verify that the ethernet connector on the rear panel of the instrument is not damaged. If damaged, replace the A3 RF assembly.
6. If the problem persists after the preceding steps have all been taken replace the A5 CPU assembly.
7. If the problem persists after replacing the A5 CPU assembly replace the A3 RF assembly.

USB

The instrument can be controlled via USB, can access USB flash memory devices, and can control USB power sensors. All ports are USB 2.0.

Instrument Control (Device Side)

The instrument can be controlled by an external device using the rear panel USB 2.0 Type-B control port. The functionality of this can be verified with a PC running the Keysight Connection Expert and IO Libraries. When connected to the instrument the Connection Expert should recognize and identify the instrument. If it doesn't recognize the device try the following in the order listed to isolate the problem:

1. Try using a known good certified USB 2.0 cable connected from the PC USB port to the instrument rear panel USB Type-B control port.
2. Verify that the PC can communicate with another USB controllable instrument.
3. If the problem persists after the preceding steps have all been taken replace the A5 CPU assembly.
4. If the problem persists after replacing the A5 CPU assembly replace the A3 RF assembly.

External Device Control (Host Side)

Using either the front or rear panel USB 2.0 Type-A ports the instrument can access USB flash memory devices and control Keysight USB power sensors. However, not all flash memory devices are compatible.

USB flash devices used with these instruments must be formatted with a FAT file system, they cannot be NTFS. FAT32 or exFAT are the preferred file systems.

If a USB port does not recognize a supported device the easiest way to troubleshoot a USB problem is with a supported FAT formatted USB flash memory device. Use the following steps in the order listed to isolate the problem:

1. Insert the flash memory device into a PC and verify that it has a FAT file system.
2. Try a different FAT file system flash memory device from a different manufacturer in the instrument, as not all flash memory devices are compatible.
3. With a known good flash memory device, that can be successfully used in a different signal generator of the same type, check the functionality of both front panel USB ports and both rear panel USB ports and note which ports work and which ones do not.
   - If all four USB ports do not work replace the A5 CPU assembly.
   - If the front panel USB ports all work but any of the rear panel USB ports do not work replace the A3 RF assembly.
   - If the rear panel USB ports all work but both front panel USB ports do not work replace the A6A1 Front Panel Interface assembly.
   - If the rear panel USB ports all work and only one front panel USB ports works replace the A6A2 USB Interface assembly.

Unlocked Issues

There are two basic types of phase detector unlock errors that the instrument could have; reference unlock and synthesizer unlock. The reference unlock error number is 512 while the synthesizer unlocks are 508. There is only one 512 reference unlock error and 5 possible 508 synthesizer unlock errors.

512 Reference unlocked; There is a problem with the external reference settings or connections. If reference is internal check Ref Oscillator Tune.

508 Synthesizer Unlocked; FracN Loop. The synthesizer is unlocked. Service may be needed.

508 Synthesizer Unlocked; Offset Loop (over). The synthesizer is unlocked. Service may be needed.

508 Synthesizer Unlocked; Offset Loop (under). The synthesizer is unlocked. Service may be needed.

508 Synthesizer Unlocked; Sum Loop (over). The synthesizer is unlocked. Service may be needed.

508 Synthesizer Unlocked; Sum Loop (under). The synthesizer is unlocked. Service may be needed.

For more information on the Unlock error messages refer to the **X-Series Signal Generators Error Messages Guide** using the following link: http://literature.cdn.keysight.com/litweb/pdf/N5180-90075.pdf.

512 Reference Unlocked

This unlock indicates that the phase lock loop for the 100 MHz VCXO in the reference section of the A3 RF assembly is unlocked. The 100 MHz VCXO is supposed to be phase locked to either the instrument internal 10 MHz reference or an external reference input on the rear panel.

If the instrument has option 1ER the external reference frequency can be 1 MHz to 50 MHz as long as the Ref Oscillator Ext Freq setting under the Freq, Reference Oscillator menu is set to match it.

The instrument has three different settings for the selection of the Reference Oscillator Source. They are Internal, External, and Auto. The default setting is Auto. When set to Auto the instrument will use the internal reference oscillator if no external reference is present but will automatically switch to an external reference once one is detected. If the reference oscillator source is set to external and the signal goes away an error will be displayed, and the RF output of the signal generator will be turned off.

If the reference phase lock loop is unlocked the RF output of the signal generator will typically still be active, there will just be a larger than usual frequency error.

Internal Reference Unlocked

Use the following procedure to troubleshoot a 512 Reference Unlocked error when using the internal frequency reference oscillator:

1. Disconnect any cable attached to the **REF IN** port on the rear panel of the instrument.
2. Force the instrument to use the internal reference by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Source**, **Int**.
3. If the unlock persists verify that there is no user reference tuning that is affecting it by pressing **Utility**, **Instrument Adjustments**, **Ref Oscillator Tune** and setting it to 0.
4. If the unlock persists run the following instrument adjustments:
   - Reference VCO Tank DAC Calibration
   - Reference Internal Standard Calibration
   - Reference VCO Kv Calibration
5. If the unlock persists, replace the A3 RF assembly.

External Reference Unlocked

Use the following procedure to troubleshoot a 512 Reference Unlocked error when using an external frequency reference:

1. Connect a 10 MHz signal with a power level of 0 dBm to the **REF IN** port on the rear panel of the instrument. (The power level of the external reference should be between -3 dBm and +20 dBm.)
2. Force the instrument to use the external reference by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Source**, **Ext**.
3. If the instrument has option 1ER, flexible reference input, verify that the **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Ext Freq** setting is set to 10 MHz.
4. If the unlock persists, replace the A3 RF assembly.

508 Synthesizer Unlocked

This type of an unlock indicates that one of the phase lock loops in the synthesizer section of the A3 RF assembly is unlocked. While the CXG and EXG series instruments have only one phase lock loop in the synthesizer section, the MXG instruments have three.

The 100 MHz VCXO provides a reference for the phase lock loop in the CXG and EXG series and the initial FracN loop for the MXG series. If the 100 MHz reference phase lock loop is unlocked, a properly functioning synthesizer phase lock loop should be able to remain locked, as it should have enough range to lock to the 100 MHz reference signal at the extremes of it tunable range. However, a non-functioning 100 MHz reference could cause the synthesizer

phase lock loops to be unlocked. In this case both the reference and the synthesizer unlock error messages would be present. So before troubleshooting a synthesizer unlocked condition make sure that there is no reference unlock error. If there is, resolve the reference unlock condition first.

For the CXG and EXG series instruments there are two possible synthesizer unlock errors:

- *508 Synthesizer Unlocked; Sum Loop (over). The synthesizer is unlocked. Service may be needed.*
- *508 Synthesizer Unlocked; Sum Loop (under). The synthesizer is unlocked. Service may be needed.*

For the MXG series instruments there are five possible synthesizer unlock errors:

- *508 Synthesizer Unlocked; FracN Loop. The synthesizer is unlocked. Service may be needed.*
- *508 Synthesizer Unlocked; Offset Loop (over). The synthesizer is unlocked. Service may be needed.*
- *508 Synthesizer Unlocked; Offset Loop (under). The synthesizer is unlocked. Service may be needed.*
- *508 Synthesizer Unlocked; Sum Loop (over). The synthesizer is unlocked. Service may be needed.*
- *508 Synthesizer Unlocked; Sum Loop (under). The synthesizer is unlocked. Service may be needed.*

As can be seen from the unlock errors listed, the phase lock loop that is unlocked is clearly identified in each of the error messages. There are also adjustments for each of the phase lock loops in the performance verification and adjustment software.

Use the following procedure to troubleshoot a 508 Synthesizer Unlocked error:

1. Verify that there is no 512 Reference Unlocked or 515 Reference Missing errors. If there are, resolve those issues first.
2. From the 508 Synthesizer Unlocked error message given, determine which synthesizer phase lock loop is unlocked (FracN Loop, Offset Loop, or Sum Loop).
3. Referring to Table 6-1, run the applicable synthesizer adjustments for the phase lock loop that is unlocked.

Table 6-1 Applicable Adjustments for Synthesizer Unlocks

Loop Unlocked	Adjustments to Run
FracN	Synthesizer FracN KV Calibration[a]
Offset	Synthesizer Offset Pretune Calibration[a]
	Synthesizer Offset KV Calibration[a]
Sum	Synthesizer Sum Pretune Calibration
	Synthesizer Sum Attenuation Calibration[a]
	Synthesizer Sum KV Calibration

a. Not applicable for CXG and EXG series instruments.

4. If the unlock persists, replace the A3 RF assembly.

Unleveled Issues

An Automatic Leveling Control (ALC) loop in the instrument provides leveled output power. The ALC loop is a feedback control system that monitors the RF power and maintains it at the user-selected level. The RF path must provide a minimum power level to the ALC loop for the ALC loop to work correctly. The minimum required power is slightly higher than the instrument maximum output power level.

A leveled output power is obtained by comparing a detected voltage with a reference voltage. The detected voltage is generated by coupling off a portion of the RF output signal and converting it to a DC voltage using detector diodes. The reference voltage is generated using calibrated DAC's. When the reference and detected levels are not the same, the ALC integrator output ramps up or down, to increase or decrease the detected level. If the integrator cannot achieve a match between the detected and reference voltages an unleveled indicator is displayed.

The assemblies inside of the ALC loop vary by model number as shown in Table 6-2.

Table 6-2 Assemblies Within the ALC Loop

Model Numbers	Assemblies within ALC Loop
N5171B, N5181B	A3 RF Assembly
N5166B, N5172B N5182B	A2 Vector BBG Assembly
	A3 RF Assembly
N5173B, N5183B	A3 RF Assembly
	A7 Micro-Deck Assembly

The more assemblies within the ALC loop, the more complicated it becomes to determine what might be causing an unleveled condition. Refer to Chapter 13, "Block Diagrams" for information on where the ALC detectors and modulators are located in the A3 RF and A7 Micro-Deck assemblies.

Before troubleshooting any unleveled condition verify that there are no unlocked errors or Self Test failures. If there are any unlocked errors or Self Test failures resolve them before proceeding with any unleveled condition troubleshooting.

To start troubleshooting an unlevel condition determine under what conditions the unleveled is occurring. Is it only:

1. When tuned to certain frequencies.
2. When the power level is set to certain levels.
3. When I/Q modulation is turned on (N5166B, N5172B, N5182B).

Since the hardware within the ALC loop differs by instrument model, follow the troubleshooting procedure below for the instrument being serviced.

N5171B, N5181B

These instruments do not have any other assembly inside the ALC loop other than the A3 RF assembly. So, the ALC detectors, the ALC control, and the ALC modulators are all located on the A3 RF assembly. Any unlevel condition encountered is either the result of a hardware issue on the A3 RF assembly or of an adjustment error. To isolate the cause of the unlevel perform the following steps:

1. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply".
2. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data".
3. Run the following adjustments:

   ALC Linearity Calibration

   Absolute Power Calibration

   ALC Calibration
4. If the adjustments fail or the unlevel condition persists, replace the A3 RF assembly.

N5166B, N5172B, N5182B

Since the main difference between these models and the others is the addition of the A2 Vector BBG assembly, first determine if the A2 Vector BBG assembly is the cause of the unlevel. Use the following procedure to do so:

1. If the instrument has option 012 verify that the rear panel LO jumper cable (W16) is connected between the LO OUT and LO IN ports.
2. Determine if the unlevel error **only** occurs when the I/Q modulator is turned on.
   - If the unlevel error occurs only when the I/Q modulator is turned **On** go to the "I/Q Modulator Unlevel" section to continue troubleshooting this error.
3. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply".
4. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data".

5. Run the following adjustments:

   ALC Linearity Calibration

   Absolute Power Calibration

   ALC Calibration

6. If the adjustments fail or the unlevel condition persists, replace the A3 RF assembly.

I/Q Modulator Unlevel

If the I/Q modulator is turned on without a modulating signal, either from the internal A2 Vector BBG assembly or from the front panel I or Q Inputs, the instrument will display an unlevel condition when the RF power is turned On.

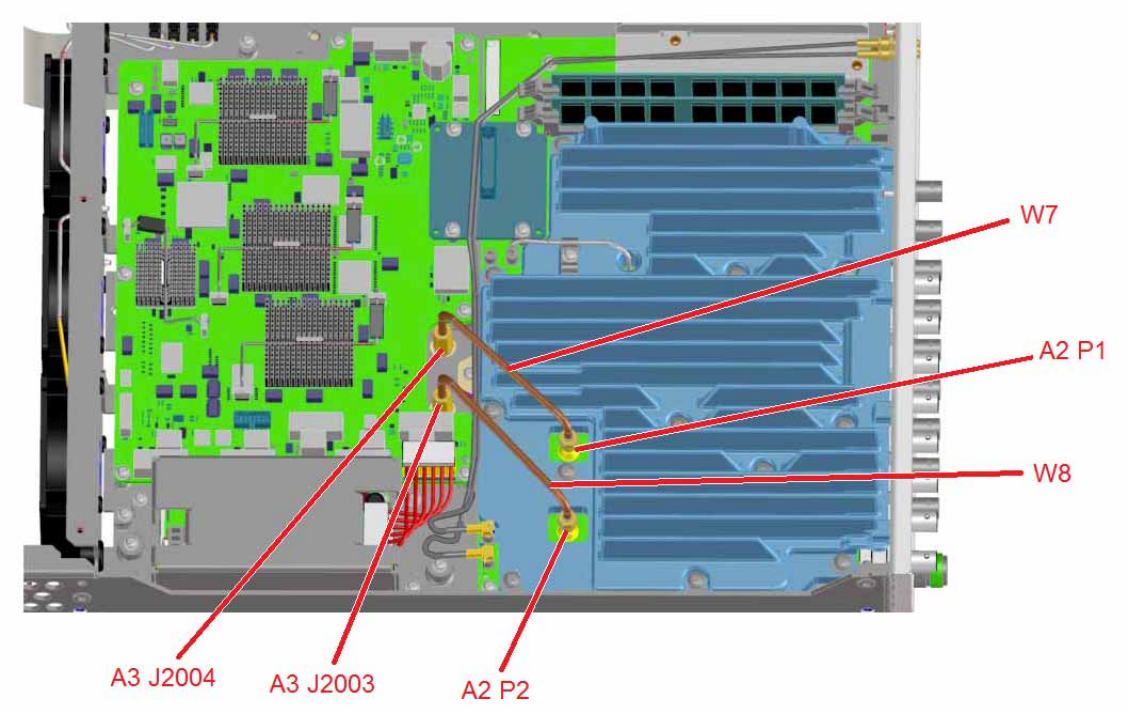
Use the following procedure to determine what is causing the unlevel condition when the I/Q modulator is turned on:

1. Return the instrument to a known state by pressing **Preset**.
2. Verify that the instrument is using the factory I/Q modulator calibration data by pressing **I/Q**, **I/Q Calibration**, **Revert to Default Cal Settings**.
3. Turn both the output power and modulation **On** by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
4. Using a function generator input a 300 mV sinewave signal at 1 MHz into the front panel **I Input** (rear panel if option 1EM).

CAUTION The I and Q Inputs have an input impedance of 50 ohms and a damage level of 1 VRMS.

5. Switch the I/Q source to external by pressing **I/Q**, **I/Q Source**, **External**. If there is no baseband generator option (65x) installed this setting will not be present and external will be used by default.
6. Turn the I/Q modulator on by pressing **I/Q**, **I/Q On**.
7. Tune the instrument output to a frequency and power level that causes the unlevel error to occur.
8. Verify that the Unlevel indicator is now on.
9. Referring to Figure 6-1, remove W7 (W14 and W15 if option 012 is installed) and W8.

Figure 6-1 I/Q Modulator Cable and Port Locations



10. Inspect both W7 (W14, W15, and W16 if option 012 is installed) and W8 and replace them if any damage is detected.

    If the cables are not damaged, or new ones do not resolve the unlevel condition, proceed to step 12.

11. Referring to Figure 6-1, connect a short RF cable between A3 J2003 and A3 J2004.

12. Verify that the Unlevel condition is gone.

    – If the Unlevel condition is gone replace the A2 Vector BBG assembly.

    – If the Unlevel condition persists replace the A3 RF assembly.

N5173B, N5183B

The N5173B and N5183B instruments have the ability to be hardware leveled by either the internal ALC detectors or an external detector. Whether using internal or external leveling there are band breaks in the ALC circuitry that will need to be considered that will make the isolating of any unleveled condition a little easier. The selection for internal and external leveling is found under the **AMPTD**, **Leveling Control**, **Leveling Mode** menu.

Internal Leveling

The different band breaks for internal leveling are:

5 MHz to <2.0 GHz

2.0 GHz to <3.2 GHz

3.2 GHz to Maximum Frequency limit

5 MHz to <2.0 GHz

In this frequency range both the ALC detector and modulators used are located on the A3 RF assembly. However, the ALC reference DAC, integrator, and summing amplifier are all located on the A7A1 Microwave ALC control assembly. Use the following procedure to isolate an internal ALC unlevel condition in this frequency range:

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the signal generator to 1 GHz by pressing **FREQ**, **1 GHz**.
3. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.
4. Set the power level to +10 dBm by pressing **AMPTD**, **10 dBm**.
5. Turn the attenuator hold on and by pressing **AMPTD**, **Atten/ALC Control**, **Atten Hold On**.
6. Verify that the **Set Atten** setting is set to **0 dB**.
7. Referring to Figure 6-2, Remove W20 from A3 J2002 and W23 from A3 J6000.

Figure 6-2 Less Than 3.2 GHz Internal ALC Leveling Loops

8. Connect a spectrum analyzer to A3 J2002 with the following settings:
   - Center Frequency = 1 GHz
   - Span = 20 MHz
   - Reference Level = +20.0 dBm
9. Measure the level of the 1 GHz output on the spectrum analyzer.
   - If the signal level does not measure at least -10 dBm replace the A3 RF assembly.
   - If the signal level measures greater than -10 dBm proceed to step 10.
10. Connect a DC voltmeter to the loose end of W23.
11. Verify that the DC voltage measured at the output of W23 is at least +10V.
   - If the DC voltage measures at least +10V proceed to step 12.

- If the DC voltage does not measure at least +10V proceed to step 14.

12. Adjust the power level of the signal generator to -20 dBm by pressing **AMPTD**, **-20 dBm**.
13. Verify that the DC voltage measured at the output of W23 measures -8V or less:
    - If the DC voltage measures -8V or less replace the A3 RF assembly.
    - If the DC voltage does not measure -8V or less proceed to step 14.
14. Referring to Figure 6-2, reconnect W20 to A3 J2002 and W23 to A3 J6000.
15. Connect the spectrum analyzer to the signal generator RF output.
16. Adjust the power level of the signal generator to 0 dBm by pressing **AMPTD**, **0 dBm**.

CAUTION When removing cables from the instrument when it is powered on exercise caution as to not touch the shielding to any of the components or traces on the assemblies.

17. Referring to Figure 6-2, remove W22 from both A3 J7 and A7A1 J11.
18. Remove W31 from A7A1 J10 and reconnect it to A7A1 J11.
    - If the unlevel condition is now gone replace the A3 RF assembly.
    - If the unlevel condition continues replace the A7 Micro-Deck assembly.

NOTE Due to the differences in the detector characteristics the signal level seen on the spectrum analyzer screen at this time, even with the ALC leveled, may not be as accurate as it would normally be.

2.0 GHz to <3.2GHz

In this frequency range the ALC modulators are located on the A3 RF assembly, while the detector, ALC reference DAC, integrator, and summing amplifier are all located on the A7 Micro-Deck assembly. Use the following procedure to isolate an internal ALC unlevel condition in this frequency range:

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the signal generator to 3 GHz by pressing **FREQ**, **3 GHz**.
3. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.
4. Set the power level to +10 dBm by pressing **AMPTD**, **10 dBm**.
5. Turn the attenuator hold on and by pressing **AMPTD**, **Atten/ALC Control**, **Atten Hold On**.

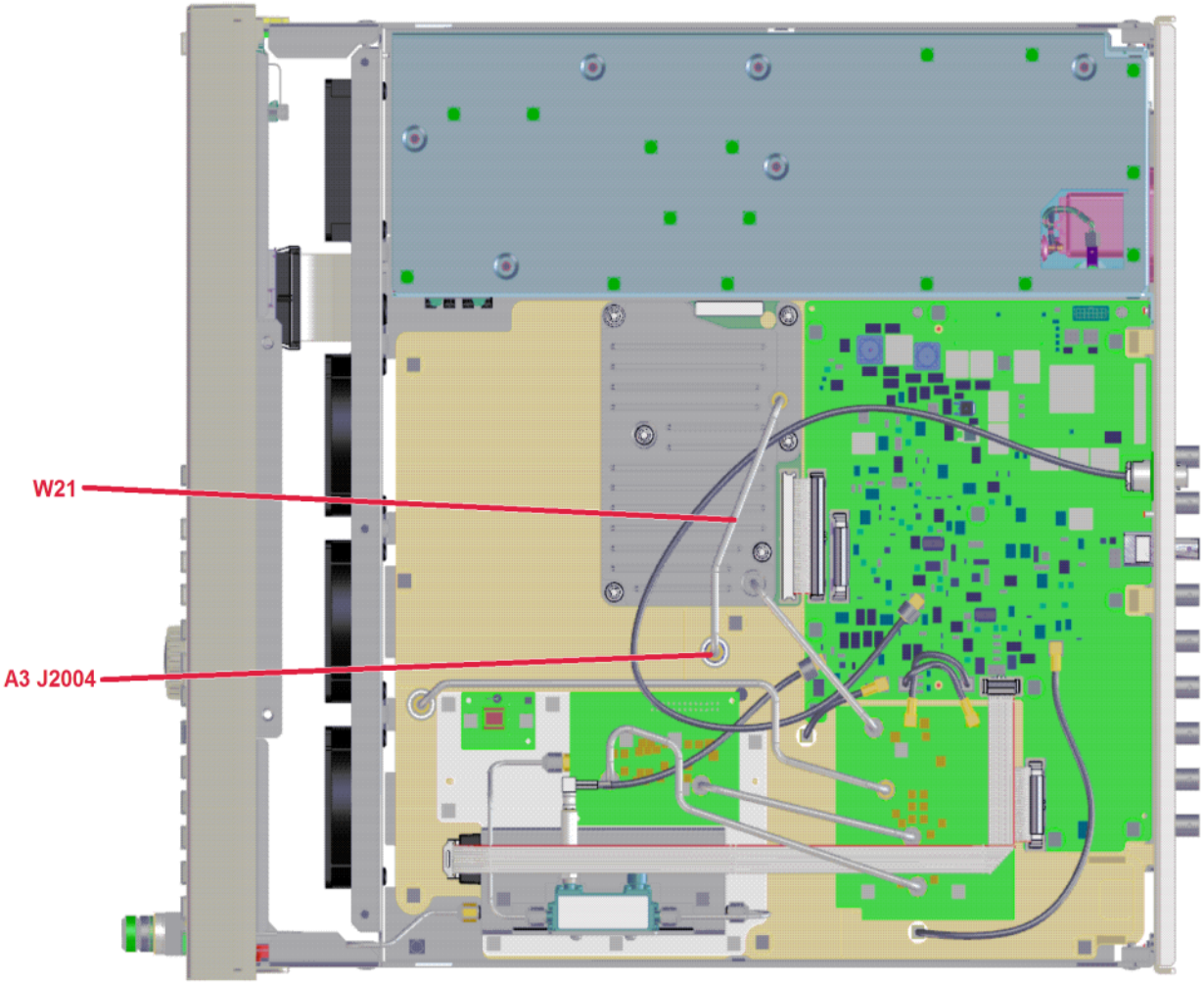
6. Verify that the **Set Atten** setting is set to **0 dB**.
7. Referring to Figure 6-2, remove W20 from A3 J2002.
8. Connect a spectrum analyzer to A3 J2002 through a **20 dB** attenuator with the following settings:
   - Center Frequency = 3 GHz
   - Span = 20 MHz
   - Reference Level = +20.0 dBm
9. Measure the level of the 3 GHz output on the spectrum analyzer, adding 20 dB to account for the attenuator:
   - If the signal level does not measure at least +20 dBm replace the A3 RF assembly.
   - If the signal level measures greater than +20 dBm proceed to step 10.
10. Remove the 20 dB attenuator and connect the spectrum analyzer to the signal generator RF output.
11. Referring to Figure 6-2, reconnect W20 to A3 J2002.
12. Remove W23 from A3 J6000 and connect a DC voltmeter to the loose end of W23.
13. Verify that the DC voltage measured at the output of W23 is at least +10V.
    - If the DC voltage measures at least +10V proceed to step 14.
    - If the DC voltage does not measure at least +10V replace the A7 Micro-Deck assembly.
14. Adjust the power level of the signal generator to -25 dBm by pressing **AMPTD**, **-25 dBm**.
15. Verify that the DC voltage measured at the output of W23 measures -8V or less:
    - If the DC voltage measures -8V or less replace the A3 RF assembly.
    - If the DC voltage does not measure -8V or less replace the A7 Micro-Deck assembly.

3.2 GHz to Maximum Frequency Limit

In this frequency range the ALC detector, reference DAC, integrator, summing amplifier, and modulator used are all located on the A7 Micro-Deck assembly. Since all the ALC circuitry for this frequency range is contained on the A7 Micro-Deck all that will need to be determined is if the A3 RF assembly is providing the correct power level and frequency required. Use the following procedure to isolate an internal ALC unlevel condition in this frequency range.

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the signal generator to a frequency that is causing the unlevel condition by pressing **FREQ**, **<frequency> GHz**.
3. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.
4. Verify that the unlevel indicator is on.
5. Referring to Figure 6-3, remove W21 from A3 J2004.

Figure 6-3 3.2 GHz and Higher Internal ALC Leveling Loop



6. Connect a spectrum analyzer to A3 J2004 with the following settings:
   - Span = 20 MHz
   - Reference Level = +10.0 dBm
7. Since the frequency of the signal coming from the A3 RF assembly at A3 J2004 will be multiplied by the A7 Micro-Deck assembly, the center frequency that the spectrum analyzer will need to be tuned to will have to

be calculated by dividing the signal generator output frequency by the multiplier that it uses. The multipliers for the different frequency ranges in this band are listed in Table 6-3.

8. Calculate the spectrum analyzer center frequency by dividing the signal generator output frequency by the corresponding multiplier listed in Table 6-3.

   Example:

   Signal generator frequency = 12 GHz

   Multiplier = 4

   Spectrum Analyzer Center Frequency = 12 GHz ÷ 4 = 3 GHz

Table 6-3 A7 Micro-Deck Frequency Multipliers

Frequency Range	Multiplier
3.2 GHz to 5 GHz	1
>5GHz to 10 GHz	2
>10 GHz to 20 GHz	4
>20 GHz to 40 GHz	8

9. Tune the center frequency of the spectrum analyzer to the calculated frequency.
10. Verify that the power level of the signal on the spectrum analyzer is at least -5 dBm:
    - If the power level of the signal is not at least -5 dBm replace the A3 RF assembly.
    - If the power level of the signal is at least -5 dBm replace the A7 Micro-Deck assembly.

External Leveling

Before attempting to troubleshoot an external unlevel condition verify that the internal leveling is working properly. If there is an internal unlevel condition resolve that issue first. If an external unlevel condition persists, use the following procedure to resolve the unlevel condition.

To replicate and troubleshoot an external leveling condition, use the following procedure. This procedure makes use of the internal crystal detector and coupler since they are not needed when external leveling is used.

1. Referring to Figure 6-4, remove W31 from the output of the A7A6 detector.
2. Using an SMB female to BNC male cable (or some equivalent combination of cables and adapters), connect the A7A6 detector output to the rear panel ALC IN connector.

Figure 6-4 External ALC Leveling Loop

3. Return the instrument to a known state by pressing **Preset**.
4. Tune the signal generator to a frequency that is causing the unlevel condition by pressing FREQ, <frequency> GHz.
5. Connect the RF output of the signal generator to the input of a spectrum analyzer with the following settings:
   - Center Frequency = Signal Generator Frequency
   - Span = 20 MHz
   - Reference Level = +10.0 dBm
6. Set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
7. Switch the ALC to External by pressing **AMPTD**, **Leveling Control**, **Leveling Mode**, **Ext Detector**.
8. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.

9. If the external ALC loop is functioning properly the unlevel indicator should not be on at this point and the signal level on the spectrum analyzer should be somewhere near 0 dBm.
   - If the signal level is not correct or the unlevel condition remains, proceed to step 10.
   - If the signal is at the correct level and there is no unlevel indicator, the external leveling is working correctly at this frequency.

NOTE

Due to the differences in the detector characteristics the signal level seen on the spectrum analyzer screen at this time, even with the ALC leveled, may not be as accurate as it would normally be.

10. Referring to Figure 6-4, remove W32 from A7A1 J12 and connect W31 to A7A1 J12:
    - If the unlevel condition persists, replace the A7 Micro-Deck assembly.
    - If the unlevel condition goes away replace W32 and/or the A8 BNC Bypass.

Maximum Power Out Check

Perform the following procedure to verify that the instrument is capable of providing the maximum power output level required:

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the ALC loop **Off** by pressing **AMPTD** and set **ALC** to **Off**.
3. Set the Power Search feature to manual by pressing **Power Search**, **Power Search**, **Manual**.
4. Turn the RF **On** by pressing **RF On/Off** so that the LED below it comes on.
5. Connect the RF output to a spectrum analyzer with the following settings:
   - Reference level +20 dBm
   - Input attenuation to 30 dB
   - Span 10 MHz
6. Tune the signal generator to a frequency that the unlevel condition is occurring.
7. Set the amplitude of the signal generator to its maximum settable value by pressing **AMPTD**, **30 dBm**. If the instrument does not have the High Power Output option (1EA) an error stating “value clipped to upper limit” will be displayed and the level will be set to its maximum settable value. The error can be ignored.
8. Tune the spectrum analyzer center frequency to the frequency of the signal generator.
9. Verify that the power level measured on the spectrum analyzer meets the maximum power level specified (+/- 3 dB) in Table 6-4 through Table 6-7 for the instrument being tested.

Table 6-4 N5166B, N5171B, N5172B Maximum Power Level

Frequency Range	Standard	Option 1EA
9 kHz to 10 MHz	+13 dBm	+17 dBm
> 10 MHz to 3 GHz	+18 dBm	+21 dBm
>3 GHz to 6 GHz	+16 dBm	+18 dBm

Table 6-5 N5181B, N5182B Maximum Power Level

Frequency Range	Standard	Option 1EA
9 kHz to 10 MHz	+13 dBm	+17 dBm
> 10 MHz to 3 GHz	+18 dBm	+24 dBm
>3 GHz to 5 GHz	+16 dBm	+19 dBm

Table 6-5 N5181B, N5182B Maximum Power Level

Frequency Range	Standard	Option 1EA
>5 GHz to 6 GHz	+16 dBm	+18 dBm

Table 6-6 N5173B, N5183B Maximum Power Level (Option 513, 520)

Frequency Range	Standard	Option 1EA
9 kHz to 3.2 GHz	+18 dBm	+23 dBm
> 3.2 GHz to 13 GHz	+18 dBm	+20 dBm
>13 GHz to 20 GHz	+15 dBm	+19 dBm

Table 6-7 N5173B, N5183B Maximum Power Level (Option 532, 540)

Frequency Range	Standard	Option 1EA
9 kHz to 3.2 GHz	+14 dBm	+21 dBm
> 3.2 GHz to 17 GHz	+14 dBm	+16 dBm
>17 GHz to 31.8 GHz	+13 dBm	+15 dBm
>31.8 GHz to 40 GHz	+11 dBm	+15 dBm

10. If the power level measured is within 3 dB of the value expected the Maximum Power Out Check has passed.

Rear Panel BNC Connectors

There are many different rear panel BNC connectors that provide many different instrument functions. While the performance verification tests, as well as the Self Tests, do not test the functionality of these, the user may report that one or more of these functions is not working properly. To verify the functionality of these connectors there is a procedure for doing so in the chapter for the assembly that they are connected to. To determine what chapter to see for these connectors see Figure 6-5, Figure 6-6, or Figure 6-7 for the instrument being serviced, as well as Table 6-8 to determine the chapter.

Figure 6-5 N5171B and N5181B Rear Panel BNC Connectors

Figure 6-6 N5166B, N5172B, and N5182B Rear Panel BNC Connectors

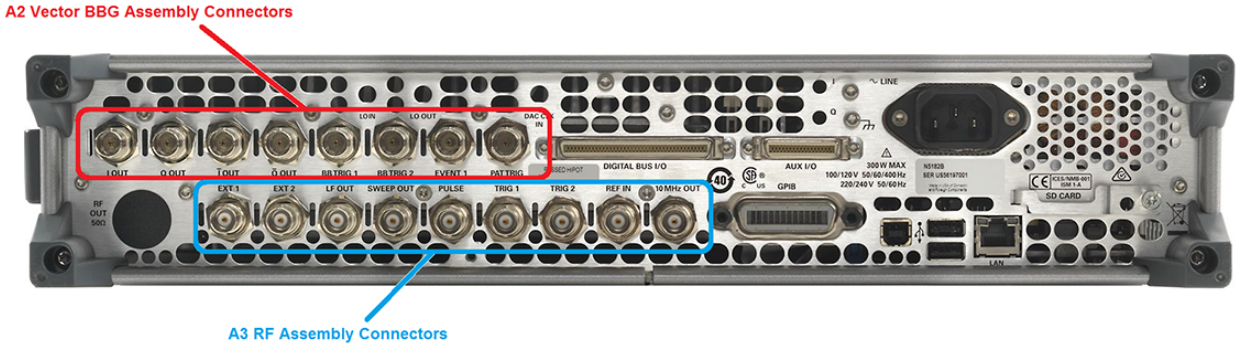


Figure 6-7 N5173B and N5183B Rear Panel BNC Connectors

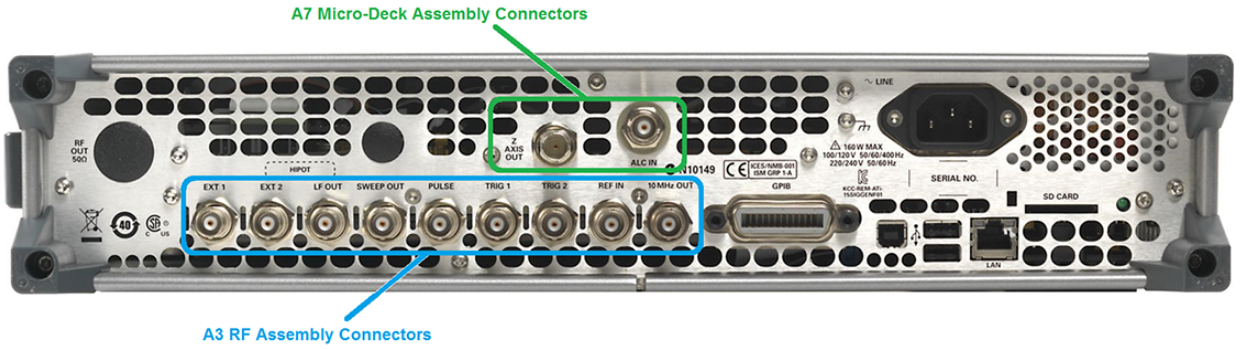


Table 6-8 Rear Panel BNC Connector versus Chapter

Connectors	Verification Procedure Location
A2 Vector BBG Assembly	Chapter 12, “Baseband Generators”
A3 RF Assembly	Chapter 10, “RF Assembly”
A7 Micro-Deck Assembly	Chapter 11, “Micro-Deck Assembly”

Amplitude Modulation Issues (Option UNT)

Depending on the instrument model number a problem with amplitude modulation could be caused by different assemblies due to the different hardware configurations. Refer to the section below for the model number being serviced for information on isolating the cause of the problem.

NOTE **The instrument can use either an internal or an external amplitude modulation generator to drive the amplitude modulator. This troubleshooting procedure deals only with the internal generator. If there is a problem only when using a valid external source, replace the A3 RF assembly.**

N5166B, N5171B, N5172B, N5181B, N5182B

For these instruments the amplitude modulation generator and modulators are all contained on the A3 RF assembly, so any AM failures that are due to a hardware failure will require the replacement of the A3 RF assembly. However, it is possible that an amplitude modulation failure could be caused by invalid calibration array data. So before replacing the A3 RF assembly for an amplitude modulation failure run the following adjustment:

AM Calibration

If the failure persists after the adjustment replace the A3 RF assembly.

N5173B, N5183B

For these instruments the amplitude modulation generator is located on the A3 RF assembly while there are two different modulators used, one on the A3 RF assembly and one on the A7 Micro-Deck assembly. See Table 6-9 for information as to which one is used for what frequency range.

Table 6-9 Amplitude Modulation Control versus Frequency

Frequency Range	AM Generator	Amplitude Modulator
9 kHz to < 3.2 GHz	A3 RF Assembly	A3 RF Assembly
3.2 GHz to Max Frequency	A3 RF Assembly	A7A3 Mod-Filter Assembly

9 kHz to <3.2 GHz

Since both the amplitude modulation generator and modulators used for amplitude modulation in this frequency range are contained on the A3 RF assembly, any amplitude modulation failures that are due to a hardware failure will require the replacement of the A3 RF assembly. However, it is possible that an amplitude modulation failure could be caused by invalid calibration array data. So before replacing the A3 RF assembly for an amplitude modulation failure run the following adjustment:

AM Calibration

If the failure persists after the adjustment replace the A3 RF assembly.

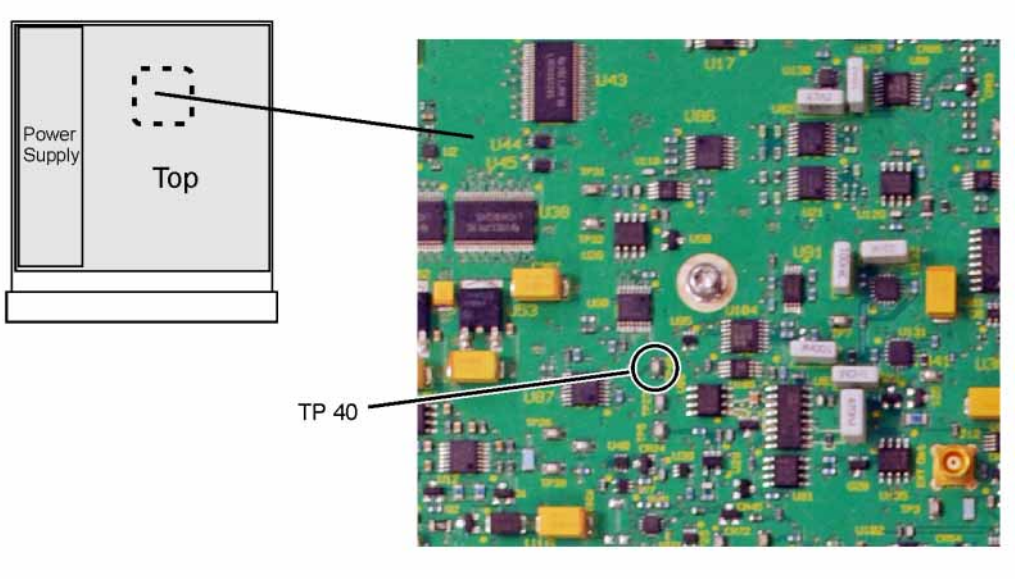
3.2 GHz to Max Frequency

Since the amplitude modulation generator and the modulator used for amplitude modulation in this frequency range are not contained on the same assembly the issue will need to be isolated to the assembly causing the problem. Use the following procedure to isolate the problem:

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the instrument to a frequency at or above 3.2 GHz that is having the problem by pressing **FREQ**, <frequency>.
3. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.
4. Set the signal level to 0 dBm by pressing **AMPTD**, **0 dBm**.
5. Turn AM on by pressing **AM**, **AM On**.
6. Set the AM Type to exponential by setting **AM Type**, **EXP**.
7. Set the AM Depth to 40 dB by pressing **AM Depth**, **40 dB**.
8. Verify that the AM Rate is set to 400 Hz by pressing **More**, **Setup AM Source**, **AM Rate**, **400 Hz**.
9. Connect the RF Output to a spectrum analyzer with the following settings:
   - Center Frequency = Signal Generator Frequency
   - Span = 0 Hz
   - Reference Level = 0.0 dBm
   - Sweep Time = 10.0 ms

   If the amplitude modulation was working properly there would be a sinewave signal on the spectrum analyzer with a peak-to-peak amplitude of 40 dB.
10. Referring to Figure 6-8, connect an oscilloscope to Test Point 40 (TP 40) on the A7A1 Microwave ALC Control board assembly.

Figure 6-8 Amplitude Modulation Drive Location – A7A1 Test Point 40

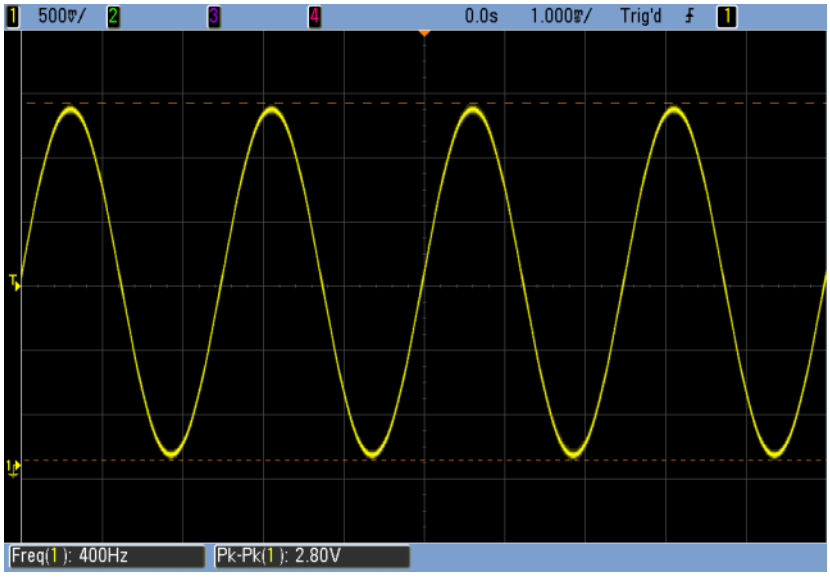


11. Setup the oscilloscope as follows:

- Amplitude scale = 500 mv/div
- Horizontal scale = 1 ms/div

12. A signal like that shown in Figure 6-9 should be seen on the oscilloscope screen.

Figure 6-9 Amplitude Modulation Drive Signal – A7A1 Test Point 40



13. If either no signal is seen on the oscilloscope, or the level is less than 2.5 Vpp proceed to step 14.

If the measured voltage is greater than or equal to 2.5 Vpp replace the A7 Micro Deck assembly.

14. Run the following adjustment:

AM Calibration

If the failure persists after the adjustment replace the A3 RF assembly.

Pulse Modulation Issues (Option UNW)

Depending on the instrument model number a problem with pulse modulation could be caused by different assemblies due to the different hardware configurations. Refer to the section below for the model number being serviced for information on isolating the cause of the problem.

NOTE **The instrument can use either an internal or an external pulse generator to drive the pulse modulator. This troubleshooting procedure deals only with the internal pulse generator. If there is a problem only when using a valid external source, replace the A3 RF assembly.**

N5166B, N5171B, N5172B, N5181B, N5182B

For these instruments the pulse generator and modulators are all contained on the A3 RF assembly, so any pulse modulation failures will require the replacement of the A3 RF assembly.

N5173B, N5183B

For these instruments the pulse generator is located on the A3 RF assembly while there are two different modulators used, one on the A3 RF assembly and one on the A7 Micro-Deck assembly. See Table 6-10 for information as to which one is used for what frequency range.

Table 6-10 Pulse Modulation Control versus Frequency

Frequency Range	Pulse Generator	Pulse Modulator
9 kHz to < 3.2 GHz	A3 RF Assembly	A3 RF Assembly
3.2 GHz to Max Frequency	A3 RF Assembly	A7A3 Mod-Filter Assembly

9 kHz to <3.2 GHz

Since both the pulse generator and modulators used for pulse modulation in this frequency range are contained on the A3 RF assembly, any pulse modulation failures will require the replacement of the A3 RF assembly.

3.2 GHz to Max Frequency

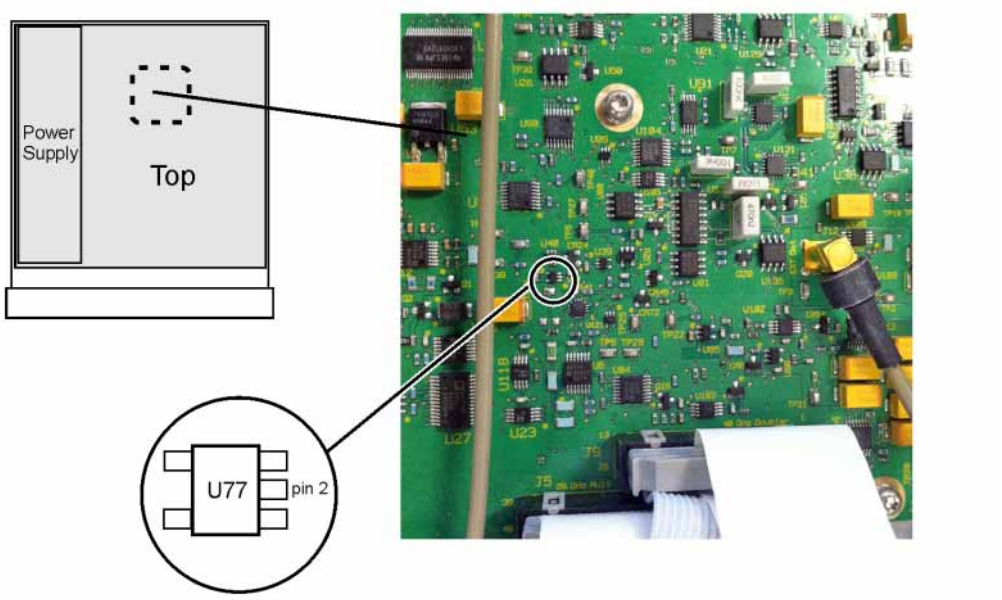
Since the pulse generator and the modulator used for pulse modulation in this frequency range are not contained on the same assembly the issue will need to be isolated to the assembly causing the problem. Use the following procedure to isolate the problem:

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the instrument to a frequency at or above 3.2 GHz that is having the problem by pressing **FREQ**, <frequency>.
3. Turn the RF on by pressing **RF On/Off** so that the LED below it comes on.

4. Set the signal level to 0 dBm by pressing **AMPTD**, **0 dBm**.
5. Set the Pulse Width to 2 µsec by pressing **Pulse**, **Pulse Width**, **2 µsec**.
6. Set the Pulse Period to 4 µsec by pressing **Pulse Period**, **4 µsec**.
7. Turn pulse modulation on by setting **Pulse** to **On**.
8. Connect the RF Output to a spectrum analyzer with the following settings:
   - Center Frequency = Signal Generator Frequency
   - Span = 0 Hz
   - Reference Level = 0.0 dBm
   - Sweep Time = 20.0 µs

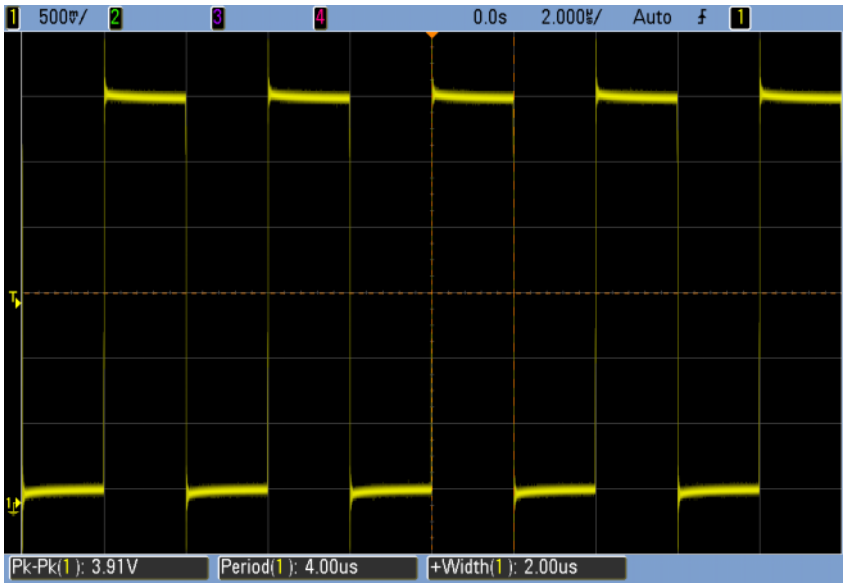
   If the pulse modulation was working properly there would be a pulsed signal on the spectrum analyzer with a peak amplitude of approximately 0 dB.
9. Referring to Figure 6-10, connect an oscilloscope to U77 pin 2 on the A7A1 Microwave ALC Control board assembly.

Figure 6-10 Pulse Modulation Drive Location – A7A1 U77 Pin 2



10. Setup the oscilloscope as follows:
    - Amplitude scale = 500 mv/div
    - Horizontal scale = 2 µs/div
11. A signal like that shown in Figure 6-11 should be seen on the oscilloscope screen.

Figure 6-11 Pulse Modulation Drive Signal – A7A1 U77 Pin 2



12. If either no signal is seen on the oscilloscope, the level is less than 3.2 Vpp, the period is not 4 µs, or the pulse width is not 2 µs, replace the A3 RF assembly.

If the measured voltage is greater than or equal to 3.2 Vpp, the period is 4 µs, and the pulse width is 2 µs, replace the A7 Micro Deck assembly.

7 Front Panel Assembly

What You Will Find in This Chapter

This chapter provides information on the following:

Assembly Overview on page 160

Troubleshooting on page 163

Assembly Overview

The A6 Front Panel assembly contains most of the user interface to the instrument. This includes the:

- Power Switch
- Display
- Keyboard
- USB Interface
- Front Panel Interface

Power Switch

The front panel power switch is a momentary switch that is located on the A6A3 Power Switch assembly. The power switch is used to toggle the power control circuitry on the A3 RF assembly. Except when being pressed, the power switch is always open.

There are also two LEDs located on the A6A3 Power Switch assembly. The yellow LED is used to indicate that the instrument status is standby. The green LED is used to indicate that the instrument status is on. Both LEDs are driven by the same control circuit on the A3 RF assembly and there should never be a condition in which they would both be on at the same time.

The A6A3 Power Switch assembly connects to the A6A1 Front Panel Interface board via cable harness W38.

Display

The A6A5 Display assembly is a 6.2-inch liquid crystal display (LCD) with a resolution of 640 x 240 (½ VGA). The display has a white Light Emitting Diode (LED) backlight system and polarized glare compensation.

The LVDS to RGB drive circuitry for the LCD, as well as the backlight control voltage, are located on the A6A1 Front Panel Interface board.

The A6A5 Display LCD assembly connects to the A6A1 Front Panel Interface board via ribbon cable W37.

Keyboard

The A6A4 Keyboard assembly contains a series of front panel hardkeys and softkeys that use a row and column configuration. There are 8 rows and 7 columns and pressing a key makes a connection between a row and a column. The keypad controller located on the A6A1 Front Panel Interface board scans and interprets the pressing of each of the front panel keys. The interpreted key press information is routed to the A5 CPU assembly via the USB hub located on the A6A1 Front Panel Interface board.

The Rotary Pulse Generator (RPG) is also located on the A6A4 Keyboard assembly. As the RPG is rotated it generates pulses. The faster it is rotated the narrower the pulses it generates. The pulses are routed to the keyboard controller on the A6A1 Front Panel Interface board, and then to the A5 CPU assembly via the USB hub located on the A6A1 Front Panel Interface board.

The RF On/Off, Mod On/Off, and More status LEDs on the A6A4 Keyboard assembly are controlled by the keyboard controller on the A6A1 Front Panel Interface board, which is controlled by the A5 CPU assembly via the USB hub on the A6A1 Front Panel Interface board.

The A6A4 Keyboard assembly connects to the A6A1 Front Panel Interface board via ribbon cable W3.

USB Interface

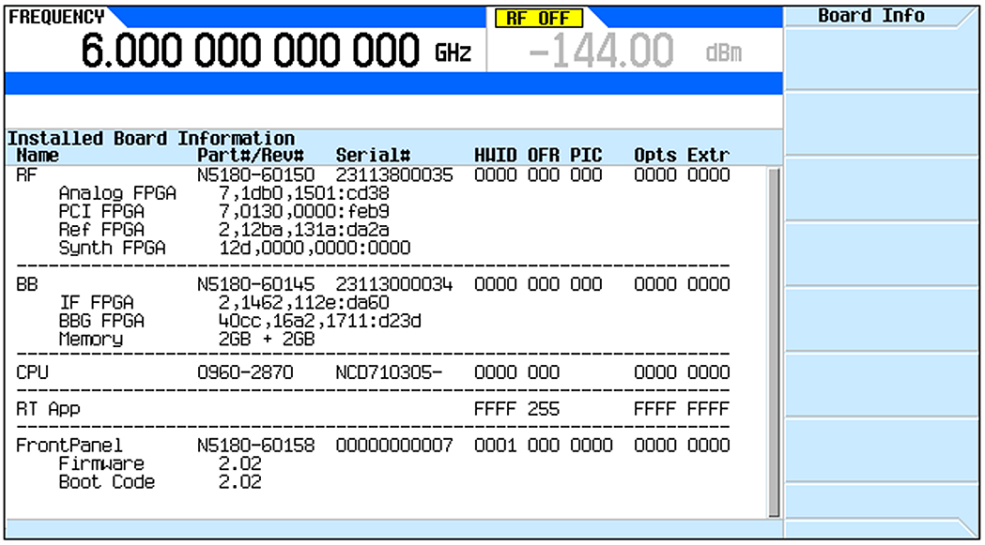
The two Type-A USB 2.0 connectors on the front panel of the instrument are attached to the A6A2 USB Interface assembly. The A5 CPU assembly communicates with the A6A2 USB Interface assembly via the USB hub on the A6A1 Front Panel Interface board.

The A6A2 USB Interface assembly connects to the A6A1 Front Panel Interface board via ribbon cable W2.

Front Panel Interface

The part number and serial number of the A6A1 Front Panel Interface assembly installed in an instrument can be seen on the **Utility**, **Instrument Info**, **Installed Board Info screen**, as shown in Figure 7-1.

Figure 7-1 Installed Board Info Screen



The A6A1 Front Panel Interface board handles all the communication between the user interface functions listed previously in this chapter and the rest of the instrument. The circuits contained on this board include:

- Four Port USB Hub (only 3 are used)
- Keypad Controller
- Keyboard Interrupt Generator
- LVDS Display Receiver
- LCD Power Control
- LCD Backlight Control

The A6A1 Front Panel Interface board connects to the A3 RF assembly via ribbon cable W1.

Troubleshooting

While the entire A6 Front Panel assembly can be replaced as one unit, it is much more cost effective, and highly recommended, to only replace the lower level assembly responsible for a given failure.

To provide access to the internal circuitry required to perform the troubleshooting procedures in this section the instrument outer cover and inner bottom cover will first need to be removed. Refer to Chapter 15, "Assembly Replacement," for instructions on how to remove and reinstall these covers.

Power Switch Issues

If the instrument will not turn on with the front panel power switch, see "Power Supply Will Not Turn On" in Chapter 8, "Power Supply"

If the Yellow standby LED does not turn on when power is applied to the rear panel AC main input, see "Yellow Standby Front Panel LED is Not Working" in Chapter 2, "Boot Up and Initialization"

If the green power on LED does not turn on when the instrument power switch has been pressed, see "Green Power On Front Panel LED is Not Working" in Chapter 2, "Boot Up and Initialization"

Display Problems

If the display remains blank after the instrument has been turned on and the Green power on LED is on, see "Instrument Display Is Blank" in Chapter 2, "Boot Up and Initialization"

Keyboard Issues

If there are any issues with either the front panel hardkeys, softkeys, RPG, or LED indicators see "Front Panel Tests" in Chapter 5, "Service and Utility Menus" If failures are detected during the Front Panel Test, follow the related procedure below.

Key Test Failures

If a single key does not work the problem is either with the A6A4 Keyboard or the A6MP1 Main Keypad. Remove and inspect them both to determine which one is causing the problem.

If rows or columns of keys do not work the problem is either the A6A4 Keyboard, the A6A1 Front Panel Interface board, or ribbon cable W3 that connects them together.

If all keys do not work the problem is most likely the A6A1 Front Panel Interface board. See the "Front Panel Interface" troubleshooting section in this chapter.

RPG Failures

If there is an RPG failure and the front panel key test passes the problem is most likely either the A6A4 Keyboard, the A6A1 Front Panel Interface board, or the ribbon cable W3 that connects them together. To isolate the problem, use the following procedure:

NOTE

If the response of the RPG appears to be too slow or too fast, make sure that its ratio setting is set to the default value by pressing **Utility**, **Instrument Adjustments**, **Step/Knob Ratio**. The default value is 50/1.

1. Remove the front panel from the instrument while leaving W1 connected to both the instrument and the front panel assembly. See Chapter 15, "Assembly Replacement," for instructions on how to remove and replace the A6 Front Panel assembly.
2. Referring to Figure 7-2, probe each of the RPG control lines on A6A1 J5 listed in Table 7-1 with an oscilloscope and verify that the levels indicated are present.

Figure 7-2 A6A1 J5 Pinout

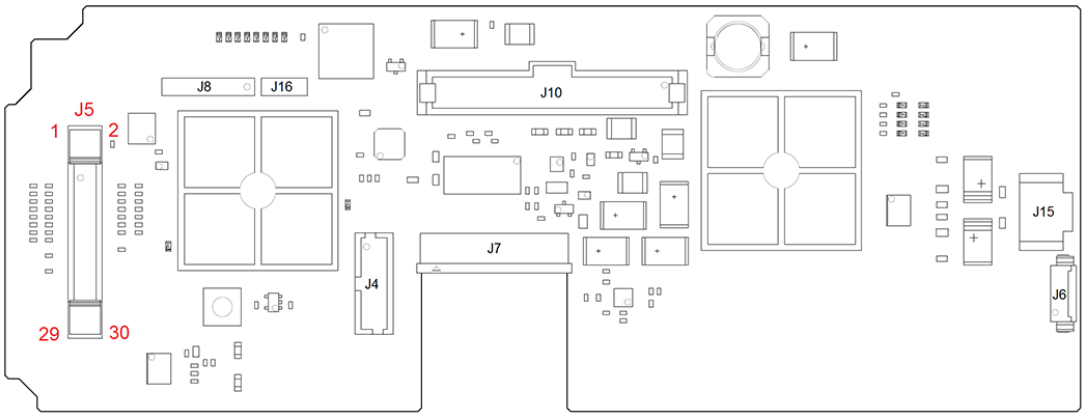


Table 7-1 RPG Control line Expected Levels

A6A1 J5 Pin #	RPG State	Expected Level (+/-10%)
26	Rotating	+4 V Pulses
28	Steady	+5 VDC
30	Rotating	+4 V Pulses

3. If there is no +5 VDC at pin #28, replace the A6A1 Front Panel Interface board.

   If there is +5 VDC at pin #28 but either pin # 26 or 30 has no pulses when the RPG is rotated, replace the A6A4 Keyboard.

If all the levels are correct, replace the A6A1 Front Panel Interface board.

LED Blink Test Failures

If any of the front panel status LEDs do not work use the following procedure to isolate the problem:

1. Remove the front panel from the instrument while leaving W1 connected to both the instrument and the front panel assembly. See Chapter 15, "Assembly Replacement," for instructions on how to remove and replace the A6 Front Panel assembly.
2. Activate the LED Blink Test by pressing **Utility**, **Instrument Info**, **Front Panel Tests**, **LED Blink Test**.
3. Referring to Figure 7-2, probe each of the LED control lines on A6A1 J5 listed in Table 7-2 with an oscilloscope and verify that the levels indicated are present.

Table 7-2 Status LED Control Line Expected Levels

A6A1 J5 Pin #	LED	Expected Level (+/-10%)
22	Mod On/Off	+3.2 V Pulses
23	More	+3.2 V Pulses
27	RF On/Off	+3.2 V Pulses

4. If any of the control lines do not have the expected pulses on them replace the A6A1 Front Panel Interface board.

   If all the control lines have the expected pulses, yet there are LEDs that are not working, replace the A6A4 Keyboard.

USB Interface Not Working

If there is a problem with the front panel USB connectivity see the "USB" section in Chapter 6, "Troubleshooting"

Front Panel Interface

The A6A1 Front Panel Interface board has an initialization routine that it goes through when the instrument is powered on. During this initialization routine, different lower level functions are initiated and verified. If the initialization routine can complete the communication and major component functionality is most likely not at fault.

The status of the initialization routine can be verified by observing the status LEDs provided on the A6A1 Front Panel Interface board. The normal operation of these LEDs can be seen in Table 7-3.

Table 7-3 A6A1 Front Panel Interface Status LEDs

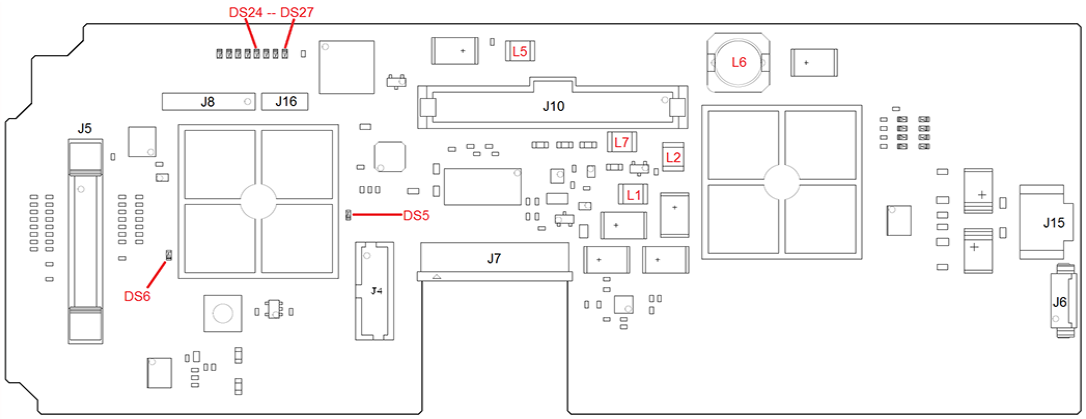
LED	Function	Normal Operation
DS5	Heartbeat of communication between the keypad controller and the instrument.	Blinking at approximately 24 Hz once the keypad controller is out of reset.
DS6	Keypad controller is in reset.	Off when the controller is out of reset.
DS24-DS27	Vertical sync delay CPLD status	On

Initialization Routine

Use the following procedure to verify the initialization routine status:

1. Remove the front panel from the instrument while leaving W1 connected to both the instrument and the front panel assembly. See Chapter 15, "Assembly Replacement," for instructions on how to remove and replace the A6 Front Panel assembly.
2. Referring to Figure 7-3, with the instrument turned off position the front panel so that DS5, DS6, and DS24 through DS27 can be viewed.

Figure 7-3 A6A1 Status LED and Power Supply Voltage Measurement Locations



3. Turn the instrument on and monitor the status of the LEDs mentioned in step 2 as the initialization routine is performed.

   If the initialization routine runs properly, DS6 (red) will come on for a very short period of time and then go off. DS24 through DS27 (yellow) will come on and stay on. When DS6 turns off DS5 (green) will begin to blink.

If any of the LEDs are not behaving as described, proceed to the next section to verify that the A6A1 Front Panel Interface board has the correct power supply voltages.

Supply Voltages

There are only two instrument DC power supply voltages used by the A6A1 Front Panel Interface board. They are +5.0 VD and +3.3 VD. These are then split and filtered to provide a total of five different power supply voltages on the board itself. These voltages are listed in Table 7-4.

Table 7-4 A6A1 Power Supply Voltage Levels

Instrument Voltage	A6A1 Supply Voltage	Measurement Location	Expected Level (+/-10%)
+5.0 VD	USB Power	L6	+3.3 V
	Display Backlight Control	L2	+5.0 V
+3.3 VD	USB Hub, CPLD, LVDS, Header, Interrupt	L7	+3.3 V
	LCD Power	L1	+3.3 V
	Keypad Controller	L5	+3.3 V

1. Referring to Figure 7-3, measure the supply voltage levels on both sides of the inductors indicated in Table 7-4.
2. If the voltages on both sides of the inductors are at the expected level the power supply voltages are not the problem. Replace the A6A1 Front Panel Interface board.

   If the power supply voltage does not meet the expected level on only one side of any of the inductors, replace the A6A1 Front Panel Interface board.

   If the power supply voltage does not meet the expected level on both sides of any inductor, inspect the ribbon cable W1 that connects to J10 of the board. If the cable is good see the "Power Supply Status Quick-Check" in Chapter 8, "Power Supply," to determine why the power supply voltage is not present.

8 Power Supply

What You Will Find in This Chapter

This chapter provides information on the following:

– Assembly Overview on page 170

Troubleshooting on page 172

Assembly Overview

WARNING

There are no user replaceable components inside the A1 Power Supply assembly. There are also voltage levels within it that could be hazardous to your health. As such, the cover on the A1 Power Supply assembly should NEVER be removed and no probes or anything else of any kind should ever be inserted into it, whether there is power applied to it or not.

The A1 Power Supply assembly is a switching supply designed with an automatic line-voltage and frequency selection. The supply has a maximum total output power draw of 210 watts. The supply converts AC line voltage to regulated DC voltages. For specifics on the voltage and frequency range that the power supply is specified to operate at refer to the rear panel of the instrument or the data sheet.

There is an internal power line fuse that is not replaceable. If the fuse opens, the power supply must be replaced.

Supply Outputs

All A1 Power Supply outputs, except for the +5.1 VSB (standby supply), are over-current protected and will not be damaged if a continuous short circuit occurs.

There is a total of 10 different DC voltages supplied by the A1 Power Supply assembly, as shown in Table 8-1.

Table 8-1 A1 Power Supply Assembly DC Voltage Outputs

DC Voltage	Referenced To
+32 VA	ACOM
+15 VA	ACOM
+9 VA	ACOM
+5 VA	ACOM
-7 VA	ACOM
-15 VA	ACOM
+12 VD	DCOM
+5 VD	DCOM
+3.3VD	DCOM
+5 VSB	DCOM

All analog voltages (VA) are referenced to the analog common (ACOM), and all digital voltages (VD) are referenced to the digital common (DCOM). The +5.1 VSB supply is reference to the digital common.

The A1 Power Supply assembly also provides the following outputs:

- An independent variable voltage required to operate the four instrument cooling fans.
- An AC line voltage output to supply the A7A1 Real Time Aux Power Supply.

Instrument Turn On

When the instrument turns the power supply on it pulls pin F24 of the control connector to ground. When the power supply voltages are all up and working without any errors the power supply will supply 5 V at pin E24.

Troubleshooting

CAUTION To allow the power supplies to discharge, wait 30 seconds after unplugging the instrument before removing or installing any covers or assemblies.

To provide access to the internal circuitry required to perform the troubleshooting procedures in this section the instrument outer cover and inner bottom cover will first need to be removed. Refer to Chapter 15, "Assembly Replacement," for instructions on how to remove and reinstall these covers.

Power Supply Will Not Turn On

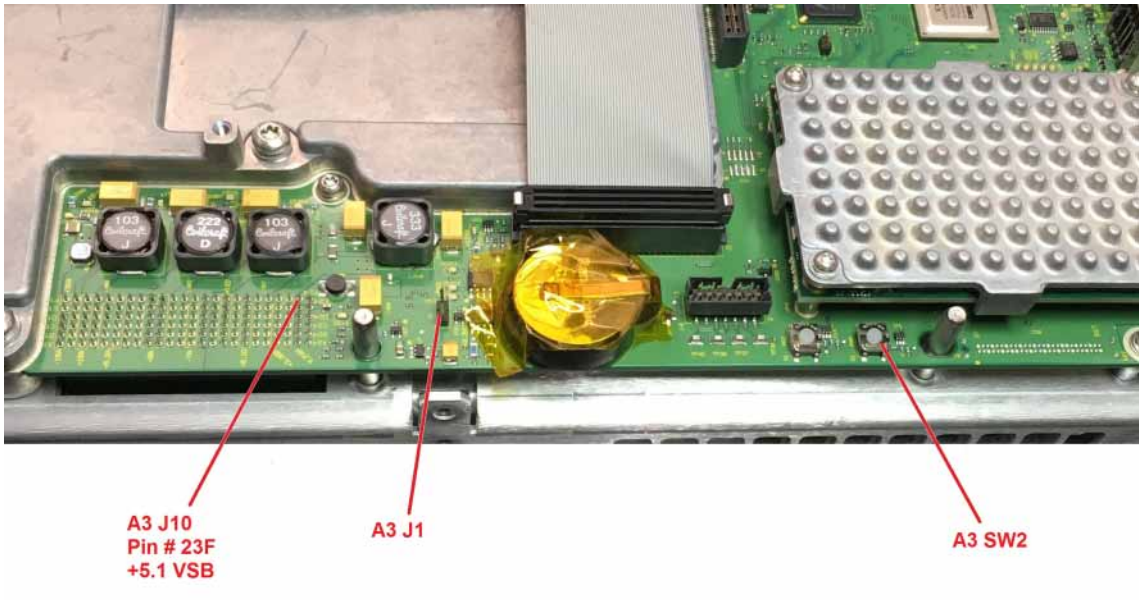
If the power supply will not turn on with the front panel power button, use the following procedure to isolate the problem:

1. Plug in the AC power cord from a known good AC power source into the rear panel of the instrument.
2. Verify that the Yellow front panel standby LED is on. If not, see the "Yellow Standby Front Panel LED is Not Working" in Chapter 2, "Boot Up and Initialization"
3. Referring to Figure 8-1, measure the +5.1 VSB at A3 J10 on pin # 23F.
   - If the voltage is not present replace the A1 Power Supply assembly
   - If the voltage is present continue to the next step.
4. Bypass the front panel power button by pressing A3 SW2.
   - If the instrument power comes on replace the A6A3 Power Switch assembly.

     If the power still does not come on continue to the next step.
5. Bypass the power on circuitry by shorting A3 J1 pins 1 and 2 together for two seconds.
   - If the power supply does not come on replace the A1 Power Supply assembly.

     If the power comes on replace the A3 RF assembly.

Figure 8-1 Power On Shortcuts



Power Supply Status Quick-Check

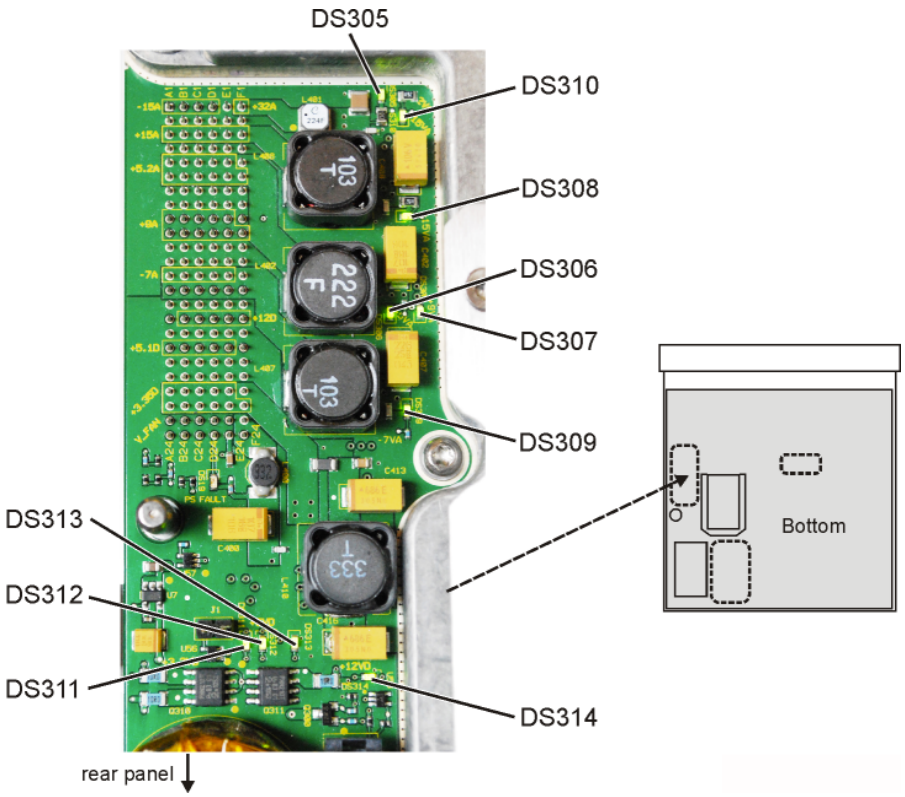
For a quick check of the status of all the DC voltages refer to Table 8-2 and Figure 8-2 for a visual check of the supply voltages with the use of LEDs on the A3 RF assembly.

While the rest of the voltages will not be on until the instrument is turned on, the +5 VSB should always be on when there is power applied to the rear panel power connector.

Table 8-2 Power Supply Voltages Versus Status LED

Voltage	LED
+32 VA	DS305
+15 VA	DS308
+9 VA	DS307
+5 VA	DS306
-7 VA	DS309
-15 VA	DS310
+12 VD	DS314
+5 VD	DS312
+3.3 VD	DS311
+5 VSB	DS313

Figure 8-2 Power Supply Voltage LED Locations



If any of the LEDs are not on when they should be, go to the "Measure Voltage Levels" section in this chapter to verify that the problem is the A1 Power Supply and not the filtering on the A3 RF assembly.

Measure Voltage Levels

The troubleshooting procedure in this section is designed to be used if any of the LEDs are not on during the "Power Supply Status Quick-Check".

Since a power supply LED located on the A3 RF assembly could be off due to a problem with the filtering of the power supply on that assembly, this procedure will measure the exact DC voltage levels coming out of the A1 Power Supply assembly where it connects to the instrument – J10 on the A3 RF assembly.

1. Position the instrument so the A3 RF assembly faces up and the A3 J10 Power Supply connector is easily accessible.
2. Referring to silkscreen on the A3 RF assembly as well as Figure 8-3 and Table 8-2, measure the DC voltage levels at A3 J10.

   If any DC voltages measured are not at the correct level (+/- 10%) replace the A1 Power Supply.

Figure 8-3 A1 Power Supply Connector at A3 J10

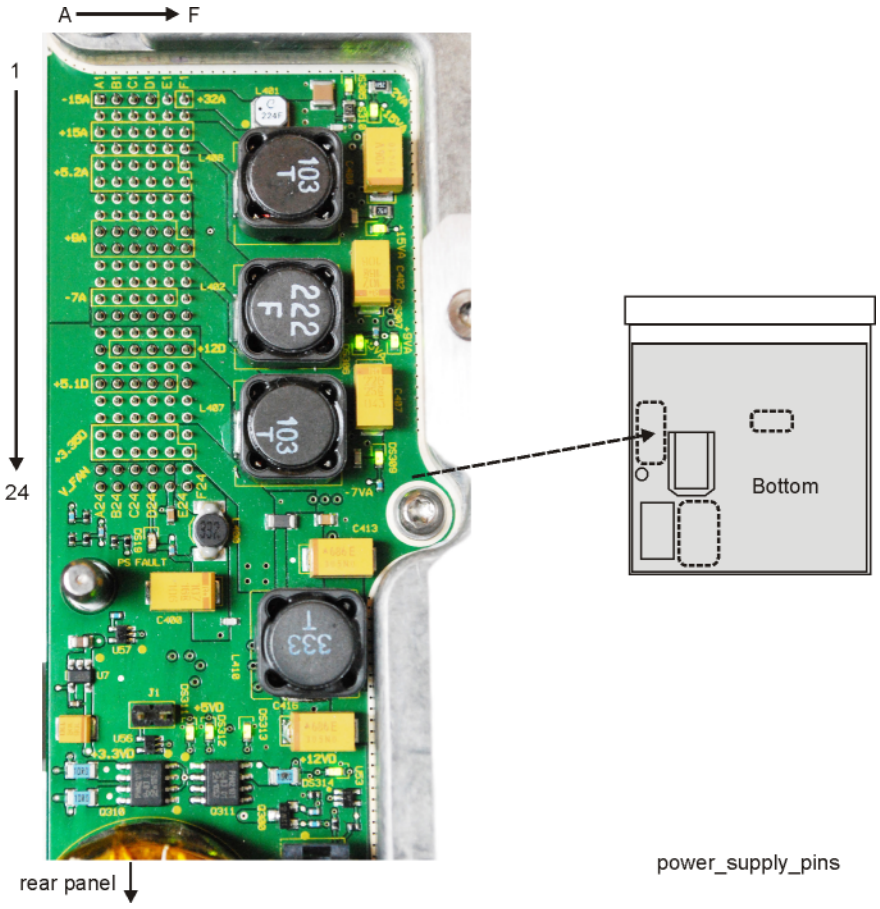


Table 8-3 Power Supply Connector Voltage Levels

Row	A	B	C	D	E	F
1	–15VA	–15VA	–15VA	–15VA	ACOM	+32VA
2	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM
3	+15VA	+15VA	+15VA	+15VA	+15VA	+15VA
4	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM
5	+5.2VA	+5.2VA	+5.2VA	+5.2VA	+5.2VA	+5.2VA_SENSE
6	+5.2VA	+5.2VA	+5.2VA	+5.2VA	+5.2VA	+5.2VA
7	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM
8	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM
9	+9VA	+9VA	+9VA	+9VA	+9VA	+9VA_SENSE
10	+9VA	+9VA	+9VA	+9VA	+9VA	+9VA
11	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM

Table 8-3 Power Supply Connector Voltage Levels

Row	A	B	C	D	E	F
12	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM
13	–7VA	–7VA	–7VA	–7VA	–7VA	–7VA_SENSE
14	ACOM	ACOM	ACOM	ACOM	ACOM	ACOM_SENSE
15	DCOM	DCOM	DCOM	DCOM	DCOM	DCOM_SENSE
16	N.C.	+12VD	+12VD	+12VD	+12VD	+12VD
17	DCOM	DCOM	DCOM	DCOM	DCOM	DCOM_SENSE
18	+5.1VD	+5.1VD	+5.1VD	+5.1VD	+5.1VD	+5.1VD_SENSE
19	DCOM	DCOM	DCOM	DCOM	DCOM	DCOM
20	DCOM	DCOM	DCOM	DCOM	DCOM	DCOM
21	+3.35VD	+3.35VD	+3.35VD	+3.35VD	+3.35VD	+3.35VD
22	+3.35VD	+3.35VD	+3.35VD	+3.35VD	+3.35VD	+3.35VD
23	FAN_P	FAN_P	FAN_N	FAN_N	PS_TEMP	+5.1SB
24	N.C	OFFn	TEMP_SENSE	PS_FAULTn	PWR_OK	PS_ONn

9 CPU and Disk Drives

What You Will Find in This Chapter

This chapter provides information on the following:

CPU Assembly Overview on page 180

Disk Drive Assembly Overview on page 182

CPU Troubleshooting on page 183

Disk Drive Troubleshooting on page 185

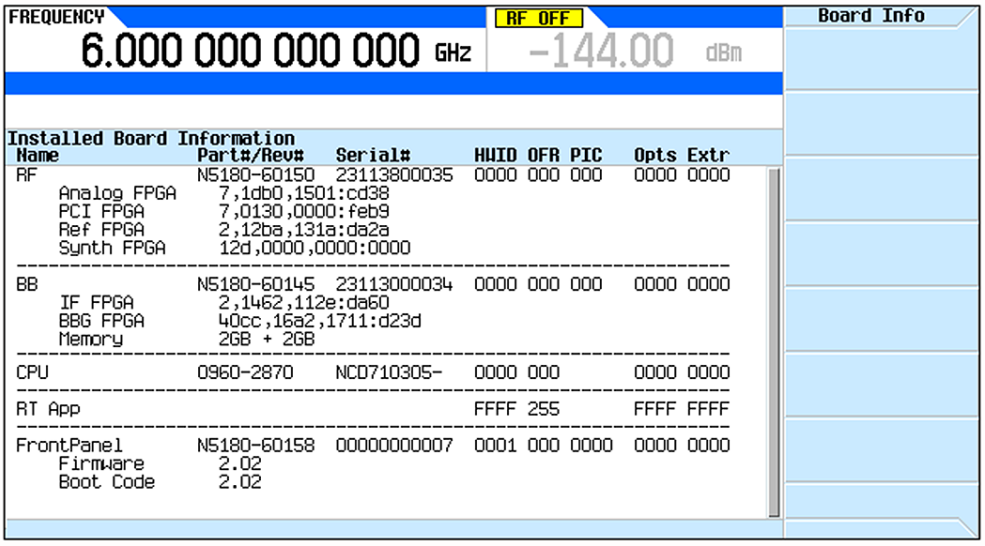
CPU Assembly Overview

The A5 CPU assembly contains an Intel Atom processor running a Win CE operating system. It controls all activities in the signal generator and translates information entered from the front panel keys as well as remote communication, such as LAN, GPIB, USB, and communicates the necessary instructions on the internal buses to the instrument hardware. It also monitors critical circuits, such as unleveled and unlocked conditions, and reports these problems to the user.

The CPU has non-volatile flash memory on it for the storage of the operating system, instrument firmware, configuration information, and calibration files. There is also storage available for user data files. The size of the overall memory as well as how much is allocated for each of the types of usage mentioned may vary depending on the vintage of the CPU assembly.

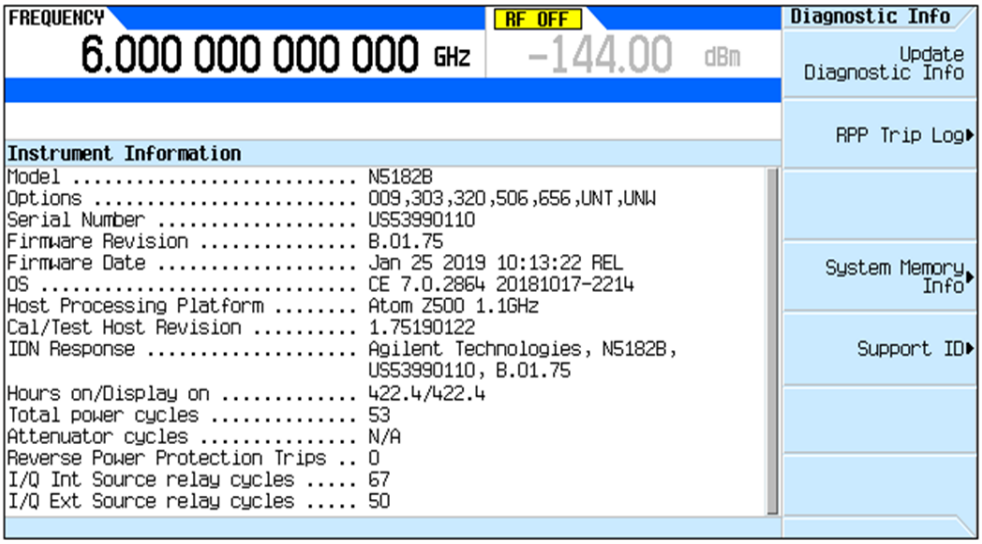
The part number and serial number of the A5 CPU assembly installed in an instrument can be seen on the **Utility**, **Instrument Info**, **Installed Board Info** screen, as shown in Figure 9-1.

Figure 9-1 Installed Board Info Screen



Basic information on the Host Processing Platform of the A5 CPU assembly installed in an instrument, as well as the revision of the operating system, can be seen on the **Utility**, **Instrument Info**, **Diagnostic Info** screen, as shown in Figure 9-2.

Figure 9-2 Diagnostic Info Screen



Disk Drive Assembly Overview

The A4 Solid State Disk Drive is only installed in the N5166B, N5172B, and N5182B instruments. A small portion of it is used for the storage of instrument real-time application software, while the majority of the drive is reserved for user data files. User access will be limited to approximately 4 GB of storage space in the standard configuration. If option 009 is installed the user will have access to all of the remaining drive. The amount of disk space available to the user can be seen by pressing the **File** key and viewing the “used” and “free” memory amounts displayed on the screen.

The main reason for this extra user memory is so the user can store waveform files. As shipped from the factory there are as series of waveform files installed in the user memory portion of the drive for many of the different digital modulation formats.

The storage size of the drive has varied over time and will continue to do so as long as memory prices continue to decrease, and the smaller drives are discontinued by the manufacturer.

If an instrument has option SD0 the drive will be omitted, and the real-time applications will not be compatible with that configuration. The user will also not be able to store data files inside the instrument.

CPU Troubleshooting

CPU failures could manifest themselves in a broad range of failure symptoms. If there is a CPU assembly failure some of the possible symptoms could be:

- Instrument will not boot up
- Instrument boots to Boot Service Menu
- Errors occur during operating system booting
- Displayed information is distorted
- Communication failure from external controllers
- Communication failure to internal assemblies

Before replacing the A2 CPU assembly be sure to see the "Pre Repair Procedures" section in Chapter 16, "Pre and Post-Repair Procedures"

Instrument will not boot up

See Chapter 2, "Boot Up and Initialization," and follow the procedure there to isolate the issue.

Instrument boots to Boot Service Menu

If the instrument boots directly to the Boot Service Menu, and at the bottom of the screen the statement "Failed to start firmware" appears, the operating system has been corrupted. Use the "Start recovery firmware" procedure in Chapter 5, "Service and Utility Menus," to try to reinstall the operating system and firmware. If this does not work replace the A5 CPU assembly.

Errors occur during operating system booting

Refer to the X-Series Signal Generators Error Messages guide for further clues as to what might be causing the errors.

http://literature.cdn.keysight.com/litweb/pdf/N5180-90075.pdf

Use the "Start recovery firmware" procedure in Chapter 5, "Service and Utility Menus," to try to reinstall the operating system and firmware.

Communication failure from external controllers

See the "Communication Issues" section in Chapter 6, "Troubleshooting," and follow the procedures there to isolate the issue.

Communication failure to internal assemblies

Make sure that the connections to each of the internal assemblies is solid and tight. When some assemblies are replaced others can become slightly dislodged, causing communication errors, and assemblies to fail to be identified. See the "Installed Board Info" section in Chapter 5, "Service and Utility Menus," and verify that all installed assemblies are being identified properly.

Additional things to try:

Use Boot Service Menu to:

- Scan disks for errors, Scan all partitions for errors
- Boot in factory preset state (ignore last/user state)
- Boot in no hardware mode

Reset all instrument setting to default by pressing **Utility**, **Power On/Preset**, **Restore System Settings to Default Values**, **Confirm Restore Sys Settings to Default Values**

Disk Drive Troubleshooting

Disk Drive failures could manifest themselves in a broad range of failure symptoms. If there is a drive failure some of the possible symptoms could be:

- Instrument does not recognize SSD and displays memory errors
- Errors occur during operating system booting
- Unable to complete the storing or retrieving of waveform files
- Time required for retrieving or storing data has become exceedingly long
- Instrument indicates incorrect drive capacity

If one or more of the above, or some other symptom is seen, there are a couple of utilities in the instrument that can help to either resolve or identify the source of the problem. They are:

- Run a disk scan to look for errors and hopefully repair them
- Reformat the disk drive and reload the software

Scan Disk

A scan of the disk drive can be run from the Boot Service Menu with the following procedure.

1. See "Boot Service Menu" in Chapter 5, "Service and Utility Menus," for instructions on how to access the menu.
2. Once in the Boot Service Menu highlight **Scan disks for errors** and press **Select**.
3. Highlight "Scan optional SSD for errors" and press **Select**.
4. The drive will be scanned for errors.
5. After the scan completes, whether errors are found or not, cycle the power of the instrument to see if the original problem with the drive persists.
6. If the problem does persist go to the Format Disk procedure below.

Format Disk

A complete formatting of the disk drive can be run from the Boot Service Menu with the following procedure in an attempt to correct whatever problem the disk is having.

This will format the entire disk drive, both the partition used for the firmware application software and the user stored data files. Because of this, once the formatting is complete the instrument firmware will need to be reloaded, and all user files will be lost.

NOTE

The Format SSD function will not ask for a confirmation of formatting once selected. Be sure this is the desired function before selecting it.

1. See "Boot Service Menu" in Chapter 5, "Service and Utility Menus," for instructions on how to access the menu.
2. Once in the Boot Service Menu highlight **Format SSD** and press **Select**.
3. The drive will be completely formatted.
4. After the format completes, highlight **Reboot** and press **Select** to restart the instrument.

When the instrument is restarted after the disk drive is formatted the following errors may be seen:

– *315, Configuration memory lost; Persistent state checksum is bad. Using factory defaults.*

– *256, File name not found; /USER/USERFLAT/LAST*

– *256, File name not found; /USER/PTRAIN/LAST*

The instrument will correct these errors after the power is cycled again. However, the instrument will not be able to recover from the following error by itself:

– *310, System error; Failed to start Application or CalTest harness*

To recover from this error the instrument firmware will need to be reinstalled. See Chapter 19, "Instrument Firmware and Operating System," for information on how to reinstall the instrument firmware.

If after formatting the disk drive the original problem persists, replace the A4 Solid State Disk Drive.

10 RF Assembly

What You Will Find in This Chapter

This chapter provides information on the following:

A3 RF Assembly Overview on page 188

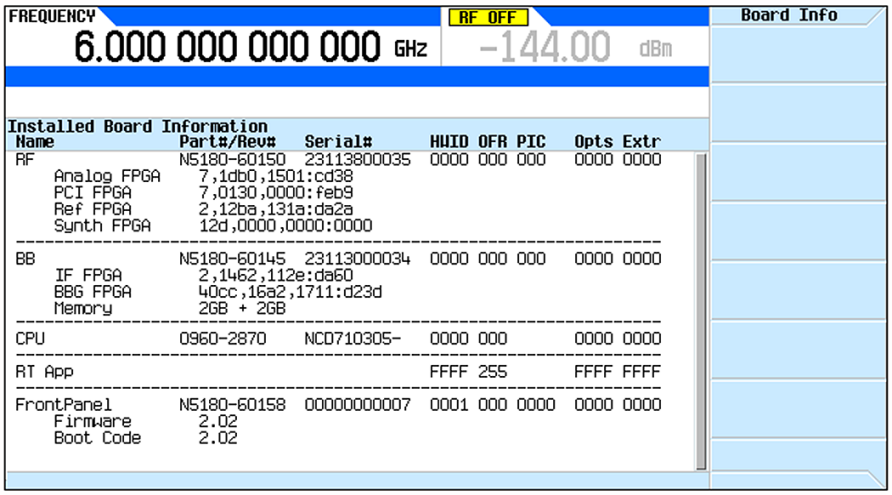
A3 RF Assembly Troubleshooting on page 201

A3 RF Assembly Overview

Refer to Chapter 13, "Block Diagrams," for a visual description of the major blocks of circuitry contained in the A3 RF assembly.

The part number and serial number of the A3 RF assembly installed in an instrument can be seen on the **Utility**, **Instrument Info**, **Installed Board Info** screen, as shown in Figure 10-1.

Figure 10-1 Installed Board Info Screen



The A3 RF assembly is made up of eight major sections that will be covered in this chapter. They are:

- Reference
- Synthesizer
- Synthesizer Multiplier / Divider
- RF Output
- Automatic Level Control
- Function Generator / Trigger Control
- Instrument Interface
- Rear Panel BNC Input / Output

There are five different variations of the A3 RF assembly. They are for:

- CXG RF Instruments (N5166B)
- EXG RF Instruments (N5171B, N5172B)
- MXG RF Instruments (N5181B, N5182B)
- EXG Microwave Instruments (N5173B)
- MXG Microwave Instruments (N5183B)

The CXG and EXG A3 RF assemblies are basically the same thing. However, they are programmed differently.

The difference between the A3 RF assemblies in the CXG, EXG, and MXG RF instruments is in the Reference and Synthesizer sections.

The difference between the A3 RF assemblies in the EXG and MXG Microwave instruments is in the Synthesizer section.

The difference between the A3 RF assemblies in the RF and Microwave instruments is in the RF Output and Automatic Level Control sections.

Detailed information on these differences can be seen in the block diagrams in Chapter 13, "Block Diagrams," and will be discussed in the descriptions of these sections.

Self Tests

There is an extensive number of Self Tests for the A3 RF assembly. All the 100, 200, 300, 400, 500, and 600 series Self Tests are for the A3 RF assembly. See Chapter 4, "Self Test," for more information on these tests. The A3 RF assembly Self Tests will also be discussed in the "A3 RF Assembly Troubleshooting" section later in this chapter.

Calibration Data

Calibration data for the assembly is stored on the A3 RF assembly. This is data that was either written to the assembly when the instrument was produced at the factory or by an adjustment in the performance verification and adjustment software. Also, replacement A3 RF assemblies come from the factory with calibration data stored in them. See "Calibration Data" in Chapter 3, "Instrument Information and Calibration Data," for more information on the instrument calibration data.

NOTE

For discussion purposes, it is assumed that RF instruments all have the option to operate up to 6 GHz (Option 506) and microwave instruments all have the option to operate up to 40 GHz (Option 540). The frequency range of each instrument may vary, but the operational theory up to the actual frequency range will be the same.

Reference Section

There are two difference Reference sections used in the five different A3 RF assemblies. All of them provide the following reference signals:

- 10 MHz to rear panel 10 MHz OUT
- 50 MHz to synthesizer FracN phase detector
- 100 MHz to A2 Vector BBG for vector instruments
- 1 GHz to RF output Het Band mixer LO

Additionally, the Reference section in the MXG instruments provides the following reference signals:

– 500 MHz to synthesizer offset phase lock loop

– 1 GHz to synthesizer mixer LO

The internal reference oscillator for all the MXG instruments, as well as the EXG microwave instruments, is an OCXO, while the internal reference oscillator for the CXG and EXG RF instruments is a TCXO.

All the reference signals generated by the Reference section are multiplied or divided from a 100 MHz crystal oscillator that is phase locked to either the internal 10 MHz reference oscillator or an external signal provided by the user. There is also a detector to sense if there is an external reference signal present.

An external reference signal must be at a frequency of 10 MHz unless option 1ER, Flexible Reference Input, is installed. With option 1ER the external reference signal can be between 1 MHz and 50 MHz, if **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Ext Freq** is set to match the frequency of the reference signal.

There are several adjustments related to the Reference section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

There are a couple of error messages that the instrument could display that relate to this section. They are:

– *512 Reference unlocked; There is a problem with the external reference settings or connections. If reference is internal check Ref Oscillator Tune.*

– *515 Reference Missing; Reference board: 10Mhz reference signal bad or missing*

If either of these is seen, see the "A3 RF Assembly Troubleshooting" section later in this chapter.

Synthesizer Section

There are two different Synthesizer sections used in the four different A3 RF assemblies. All the CXG and EXG instruments have a single phase lock loop synthesizer, while all the MXG instruments have a triple phase lock loop synthesizer. All the phase locked loops are ultimately locked to signals from the reference section of the assembly.

The output frequency of the Synthesizer section has a range of 750 MHz to 1.5 GHz and is supplied to the Synthesizer Multiplier / Divider section. A times four multiplier path of the Synthesizer Multiplier / Divider section returns a 3 to 6 GHz signal to the Synthesizer section as feedback for the phase lock loop of the synthesizer output.

The Synthesizer section can also be frequency modulated by the FM output of the Function Generator / Trigger Control section for the FM portion of option UNT, AM, FM, Phase Modulation.

There are several adjustments related to the Synthesizer section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

There are several error messages that the instrument could display that relate to this section. They are:

- *508 Synthesizer Unlocked*
- *508 Synthesizer Unlocked; FracN Loop*
- *508 Synthesizer Unlocked; Offset Loop (over)*
- *508 Synthesizer Unlocked; Offset Loop (under)*
- *508 Synthesizer Unlocked; Sum Loop (over)*
- *508 Synthesizer Unlocked; Sum Loop (under)*

If any of these is seen, see the "A3 RF Assembly Troubleshooting" section later in this chapter.

Synthesizer Multiplier / Divider Section

The Synthesizer Multiplier / Divider section is the same for all versions of the A3 RF assembly in all instruments.

The input to the Synthesizer Multiplier / Divider section comes from the output of the Synthesizer section and has a range of 750 MHz to 1.5 GHz. There are two outputs from this section, one that returns a 3 to 6 GHz signal to the Synthesizer section as feedback for the phase lock loop of the synthesizer output, and another that provides a 250 MHz to 6 GHz signal to the RF Output section.

The 250 MHz to 6 GHz signal can also be routed to and from the A2 Vector BBG assembly in vector instruments at J2004 and J2003 when digital modulation is turned on. For microwave instruments a 2.5 to 5 GHz signal is sent from J2004 to the A7A2 20 GHz Frequency Multiplier input on the A7 Micro-Deck assembly to generate output signals from 3.2 to 20 GHz.

As shown in Table 10-1, frequency multipliers and dividers are used to extend the synthesizer frequency range to cover 250 MHz to 6 GHz.

Table 10-1 Synthesizer Multiplier / Divider Ranges

Input Frequency	Multiplier / Divisor	Output Frequency
1 GHz to 1.5 GHz	÷ 4	250 to 375 MHz
750 MHz to 1.5 GHz	÷ 2	375 to 750 MHz
750 MHz to 1.5 GHz	X 1	750 MHz to 1.5 GHz

Table 10-1 Synthesizer Multiplier / Divider Ranges

Input Frequency	Multiplier / Divisor	Output Frequency
750 MHz to 1.5 GHz	X 2	1.5 to 3 GHz
750 MHz to 1.5 GHz	X 4	3 to 6 GHz

There is one adjustment that is related to the Synthesizer Multiplier / Divider section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

RF Output Section

There are two different RF Output sections used in the five different A3 RF assemblies. One is used by all RF instruments and one by all microwave instruments.

There are four different input signals to the RF Output section. They are:

- RF signal from the Synthesizer Multiplier / Divider section output
- 1 GHz signal from the Reference Section to provide the LO for the Het Band mixer
- Function Generator AM output to drive the Op-Amp Band
- Function Generator pulse output to drive the pulse modulator control

The RF signal level at the input of the RF Output section is a fixed level. For RF instruments, the output level is either amplified or attenuated to achieve the power level selected by the user. For microwave instruments, the RF Output section is only used up to 3.2 GHz, and when attenuation is needed, the attenuator is located on the A7 Micro-Deck assembly.

There are six main blocks in the RF Output section that will be discussed. They are:

- Pulse Modulator
- High Band
- Low Band
- Het Band
- Op-Amp Band
- Output Attenuator

There are four different output bands contained within the RF Output section to cover the instrument frequency range, as seen in Table 10-2.

Table 10-2 A3 RF Output Frequency Bands

RF Output Band	RF Instruments	Microwave Instruments
High Band	>3.0 GHz to 6.0 GHz	n/a
Low Band	250 MHz to 3.0 GHz	250 MHz to <3.2 GHz
Het Band	5 MHz to <250 MHz	5 MHz to <250 MHz
Op-Amp Band	9 kHz to <5 MHz	9 kHz to <5 MHz

For information on how frequencies 3.2 GHz and above are generated in microwave instruments see Chapter 11, “Micro-Deck Assembly”

There are several adjustments related to the RF Output section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

Pulse Modulator (Option UNW)

The Pulse Modulator block is only used in instruments with option UNW, Narrow Pulse Modulation.

The Pulse Modulator block on the A3 RF assembly is used for all frequencies in RF instruments, but only below 3.2 GHz in microwave instruments. There is an additional pulse modulator on the A7 Micro-Deck assembly for frequencies 3.2 GHz and above for microwave instruments.

The Pulse Modulator is made up of two electronic switches in series. The modulator control circuitry can be driven by either the internal function generator or an external pulse applied to the PULSE input on the rear panel.

The Pulse Modulator output is switched to either the input of the High Band or Low Band block. It is not routed to either the Het Band or the Op-Amp band. The Het Band block gets its input from the Low Band, and the Op-Amp band gets its input from the Function Generator / Trigger Control section, which controls any pulse modulation when that band is used.

High Band

The High Band block is only in the RF instruments, the microwave instruments do not have it.

The High Band block contains amplifiers, ALC modulators, filtering, and ALC detection for frequencies greater than 3 GHz in RF instruments.

Low Band

The Low Band block contains amplifiers, ALC modulators, filtering, and ALC detection for frequencies of 250 MHz to 3 GHz in RF instruments. In microwave instruments it is used from 250 MHz to just below 3.2 GHz.

The Low Band signal can also be switched to provide the input to the Het Band block.

Het Band

The heterodyne band block provides output frequencies from 5 MHz to just below 250 MHz. It generates these frequencies by mixing Synthesizer Multiplier / Divider section output frequencies of 1.005 GHz to just below 1.25 GHz with the 1 GHz frequency reference from the Reference section. The resultant IF signal is then filtered and amplified to provide the 5 MHz to 250 MHz RF output signal.

Op-Amp Band

The Op-Amp Band provides output frequencies from 9 kHz to just below 5 MHz. The Op-Amp Band is generated using direct digital synthesis (DDS) from the Function Generator / Trigger Control section. The DDS module uses the same 50 MHz clock used as a reference in the Synthesizer section.

There is no ALC loop involved in this path. The frequencies are low enough that op-amps are used as the amplifiers. These amplifiers have their own feedback loop and therefore do not need an external control to keep them level over temperature and time. Digital modulation in not available in the Op-Amp Band.

Output Attenuator

The Output Attenuator block is only in the RF instruments, the microwave instruments do not have it.

The Output Attenuator block is made up of three different variable electronic attenuators, Atten 1, Atten 2, and Atten 3. How these are used for the different overall instrument attenuator settings can be seen in Table 10-3.

Table 10-3 Attenuator Switching Versus User Selection

Attenuation Value	Atten 1			Atten 2	Atten 3		
	40 dB	10 dB	5 dB	20 dB	40 dB	10 dB	5 dB
0							
5							X
10			X				X
15						X	X
20			X			X	X
25		X				X	X
30		X	X			X	X
35				X		X	X
40			X	X		X	X
45		X		X		X	X
50		X	X	X		X	X
55	X					X	X
60	X		X			X	X
65	X	X				X	X
70	X	X	X			X	X
75	X			X		X	X
80	X		X	X		X	X
85	X	X		X		X	X
90	X	X	X	X		X	X
95	X				X	X	X
100	X		X		X	X	X
105	X	X			X	X	X
110	X	X	X		X	X	X
115	X			X	X	X	X
120	X		X	X	X	X	X
125	X	X		X	X	X	X
130	X	X	X	X	X	X	X

In addition to three switchable attenuator sections, Atten 1 contains an input selection switch as well as a bypass switch. It has the ability to switch in 5 dB to 55 dB of attenuation.

Atten 2 contains only one switchable attenuator section, 20 dB.

In addition to three switchable attenuator sections, Atten 3 contains a bypass switch and the reverse power sensing and protection circuitry. It has the ability to switch in 5 dB to 55 dB of attenuation.

Automatic Level Control Section

The Automatic Leveling Control (ALC) loop provides leveled output power. The ALC loop is a feedback control system that monitors RF power and maintains power at the user-selected level.

There are two different Automatic Level Control sections, one for the RF instruments and one for the microwave instruments. For the RF instruments this section contains the reference DAC, temperature compensation DAC, amplitude modulation amplifiers, output detector preamp, log amplifier, loop integrator, unlevel detector, ALC amplifiers and filters. For the microwave instruments this section contains only amplitude modulation amplifiers, output detector preamp, ALC amplifiers and filters. For the microwave instruments most of the automatic level control circuitry resides on the A7A1 Microwave ALC board on the A7 Micro-Deck assembly.

There are several adjustments related to the Automatic Level Control section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

Closed Loop

In closed loop mode (ALC On) leveled output power is obtained by comparing a detected voltage with a reference voltage. The detected voltage is generated by coupling off a portion of the RF output signal and converting it to a DC voltage using detector diodes. The reference voltage is generated using calibrated DACs. When the reference and detected levels are not the same, the ALC integrator output ramps up or down to increase or decrease the detected level. If the integrator cannot achieve a match between the detected and reference voltages, an unleveled indicator is displayed.

Open Loop

In open loop mode (ALC Off) leveled output power is obtained with a reference voltage. The reference voltage is used to control the modulation drive current. The reference voltage is determined by setting the desired power. It includes the stored calibration data used to compensate for any losses that occur after the detector.

Amplitude Modulation (Option UNT)

The AM output of the Function Generator / Trigger Control section is used to provide the modulating signal for analog amplitude modulation. This modulating signal is amplified in the Automatic Level Control section and summed with the ALC reference and temperature compensation DAC outputs. This ultimately drives the ALC modulator diodes to provide the desired amplitude modulation of the output signal.

Pulse Modulation (Option UNW)

For Pulse Modulation, ALC is only on for a short period within the pulse duration. Outside this short period of time, ALC is in a holding state waiting for the next pulse.

Microwave Instruments

While the majority of the ALC control circuitry is located on the A7 Micro-Deck assembly for microwave instruments, they do use the Low Band and Het Band modulator diodes on the A3 RF assembly for frequencies <3.2 GHz. They also use the ALC detectors on the A3 RF assembly for Low Band and Het Band below 2.0 GHz. For frequencies 2.0 GHz and higher the ALC detector is located on the A7 Micro-Deck assembly.

Function Generator / Trigger Control Section

There are three main blocks in the Function Generator / Trigger Control Section. They are:

- LF Function Generator
- Trigger Control
- Sweep Out Interface

There are a few adjustments related to the Function Generator / Trigger Control section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

LF Function Generator

Without option 303, Multifunction Generator, option UNT, AM, FM, Phase Modulation, or option UNW, Narrow Pulse Modulation, the LF Function Generator is not available for independent use.

The LF Function Generator has the ability to generate analog modulating signals for amplitude modulation, frequency modulation, phase modulation, and pulse modulation. It also has the ability to take externally generated analog modulating signals through the rear panel EXT 1, EXT 2, and PULSE inputs and route them to the internal analog modulators.

The LF Function Generator generates the 9 kHz to 5 MHz signal to the RF Output section to drive the Op-Amp Band.

If option 303 or option UNT is installed the LF Function Generator can route its available functions to the rear panel LF OUT port.

Trigger Control

The Trigger Control is used to route either one of the instrument internal trigger signals to the rear panel TRIG 1 or TRIG 2, or an external trigger to the internal trigger circuitry.

Sweep Out Interface

The Sweep Out Interface is used by the sweep function of the instrument. When a sweep is being run the instrument will generate a sweep ramp from 0 to 10 volts DC that will track the progress of the sweep and output it to the rear panel SWEEP OUT connector.

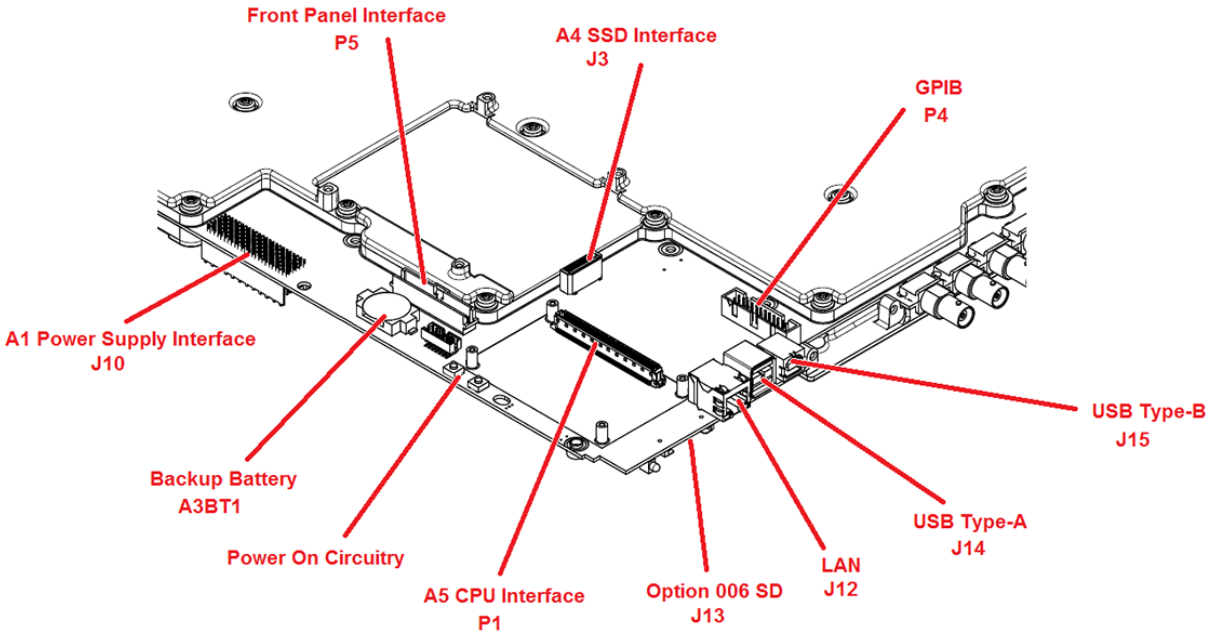
Instrument Interface Section

In addition to providing the RF output signal for the instrument, the A3 RF assembly also provides many other instrument interface functions. These include hosting the following:

- A4 Solid State Disk Drive (vector instruments)
- A5 CPU assembly
- Backup battery
- Power on and status circuitry
- Rear panel communication interface
  - USB (Type A and B)
  - LAN
  - GPIB
- Rear panel Option 006 SD memory card interface
- Interface from A5 CPU to A6 Front Panel Interface

The location of each of these is shown in Figure 10-2.

Figure 10-2 Instrument Interface Locations – A3 RF Assembly



Rear Panel BNC Input / Output Section

There are nine different rear panel BNC inputs and outputs that are used for triggering the instrument, triggering an external device, providing a low frequency function generator, locking the references of multiple instruments, and other functions. A list of these connectors can be seen in Table 10-4, along with other relevant information for each.

Table 10-4 Rear Panel BNC Input / Output Connectors

Connector	Impedance	Usage	Typical Level	Damage Level
EXT 1	50 Ω	Input	±1 Vp	5 Vrms or 10 Vp
EXT 2	50 Ω	Input	±1 Vp	5 Vrms or 10 Vp
LF OUT	50 Ω	Output	Settable	n/a
SWEEP OUT	Low	Output	0-10 V Ramp	n/a
PULSE	50 Ω	Input	0 V = Off, +1 V = On	≤ –0.3 and ≥+5.3 V
TRIG 1	High	Input / Output	TTL or CMOS	≤ –0.5 and ≥+5.5 V
TRIG 2	High	Input / Output	TTL or CMOS	≤ –0.5 and ≥+5.5 V
REF IN	50 Ω	Input	-3.5 to +20 dBm	
10 MHz OUT	50 Ω	Output	> +4 dBm	n/a

Many of these connectors can be internally routed to output different internally generated signals. So, they may be configured by the user to provide different output signals.

A3 RF Assembly Troubleshooting

A3 RF assembly faults could manifest themselves in a broad range of failure symptoms. While there are many circuits and multiple sections on the A3 RF assembly it is very limited in the amount of measurement points for troubleshooting. This section will address the most common failure symptoms.

To provide access to the internal circuitry required to perform the troubleshooting procedures in this section the instrument outer cover and inner top and bottom covers will first need to be removed. Refer to Chapter 15, "Assembly Replacement," for instructions on how to remove and reinstall these covers.

Before replacing the A3 RF assembly be sure to see the "Pre Repair Procedures" section in Chapter 16, "Pre and Post-Repair Procedures"

Reference Section

The only port that can be used to make a measurement of any of the Reference section outputs is the rear panel 10 MHz OUT port. As shown in Table 10-4, this output should be at a level of +4 dBm or greater. It should also always be at 10 MHz, even if an external reference of a different frequency is being used.

If there is a problem with the Reference section of any sort, including the failing of a Self Test or a performance verification test, do the following:

1. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"
2. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data"
3. Run the "Reference Related Adjustments" listed later in this section.
4. If the failure persists, replace the A3 RF assembly.

Reference Unlocked

If there are any reference unlocked errors see the "512 Reference Unlocked" section in Chapter 6, "Troubleshooting"

External Reference Not Detected

Use the following procedure to troubleshoot a 512 Reference Unlocked error when using an external frequency reference:

1. Connect a 10 MHz signal with a power level of 0 dBm to the REF IN port on the rear panel of the instrument. (The power level of the external reference should be between -3 dBm and +20 dBm.)
2. Force the instrument to use the external reference by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Source**, **Ext**.

3. If the instrument has option 1ER, flexible reference input, verify that the **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Ext Freq** setting is set to **10 MHz**.
4. If the unlock persists, replace the A3 RF assembly.

Self Tests

There are a series of Self Tests related directly to the Reference section. They are the 200 series tests. See Chapter 4, "Self Test," for a description of each of the tests. If there are Self Test failures, see Table 4-1 for instructions on how to proceed with determining a resolution for the failure.

Before replacing an A3 RF assembly for a Reference section Self Test failure be sure to run the "Reference Related Adjustments" listed later in this section. Also, be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

Reference Related Adjustments

There are three Reference section related adjustments in the performance verification and adjustment software. They are:

1. Reference VCO Tank DAC Calibration

   This adjustment is used to determine the range at which the 100 MHz tank circuit will operate, and then find the DAC value that provides the peak power level from the oscillator.

2. Reference Internal Standard Calibration

   This adjustment will tune the internal 10 MHz reference to deliver the most accurate reference frequency to the instrument.

3. Reference VCO Kv Calibration

   This adjustment is used to determine the tuning sensitivity of the internal reference oscillator.

Synthesizer Section

There are no ports that can be used to make a direct measurement of any of the Synthesizer section signals. The main indicator of a problem with the Synthesizer section will be the presence of a Synthesizer Unlock error message.

If there is a problem with the Synthesizer section of any sort, including the failing of a Self Test or a performance verification test, do the following:

1. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"
2. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data"

3. Run the "Synthesizer Related Adjustments" listed later in this section.
4. If the failure persists, replace the A3 RF assembly.

Synthesizer unlocked

If there are any synthesizer unlocked errors see the "508 Synthesizer Unlocked" section in Chapter 6, "Troubleshooting"

Self Tests

There are a series of Self Tests related directly to the Synthesizer section. They are numbers 301 through 316. However, not all instruments use all the Self Test in this range. See Chapter 4, "Self Test," for a description of each of the tests. If there are Self Test failures, see Table 4-1 for instructions on how to proceed with determining a resolution for the failure.

Before replacing an A3 RF assembly for a Synthesizer section Self Test failure be sure to run the "Synthesizer Related Adjustments" listed later in this section. Also, be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

Synthesizer Related Adjustments

There are seven Synthesizer section related adjustments in the performance verification and adjustment software. However, not all instruments use all the adjustments. They are:

1. Synthesizer Offset Pretune Calibration

   This adjustment is only applicable for MXG instruments.

   This adjustment is used to determine the optimal offset pretune DAC setting for each offset loop frequency. This data is then used to pretune the offset loop to ensure that it locks to the correct frequency.

2. Synthesizer Offset Kv Calibration

   This adjustment is only applicable for MXG instruments.

   This adjustment is used to determine tuning sensitivity of the Offset phase lock loop.

3. Synthesizer Sum Pretune Calibration

   This adjustment is used to determine the optimal sum pretune DAC setting for the sum loop frequencies. This data is then used to pretune the sum loop and minimize switching times.

4. Synthesizer Sum Attenuation Calibration

   This adjustment is only applicable for MXG instruments.

   This adjustment is used to determine the sum attenuator value required to achieve the optimal power level to the RF input of the sum mixer for different sum loop frequencies.

5. Synthesizer Sum Kv Calibration

   This adjustment is used to determine tuning sensitivity of the sum phase lock loop.

6. Synthesizer FracN Kv Calibration

   This adjustment is only applicable for MXG instruments.

   This adjustment is used to determine tuning sensitivity of the FracN phase lock loop.

7. Synthesizer FM (Bessel) Calibration – (Option UNT)

   This adjustment calibrates the out-of-band FM gain. For MXGs, this involves both the FracN and sum loops. For CXGs and EXGs, this only involves the sum loop.

Synthesizer Multiplier / Divider Section

There is one output port that can be measured from this section, but only for certain instrument models. Since the output of this section can go to other assemblies in addition to going to the RF Output section for certain instrument models, measuring the output is something that will need to be done to isolate certain signal level issues. To do this follow the procedure for the models listed below.

N5171B, B5181B

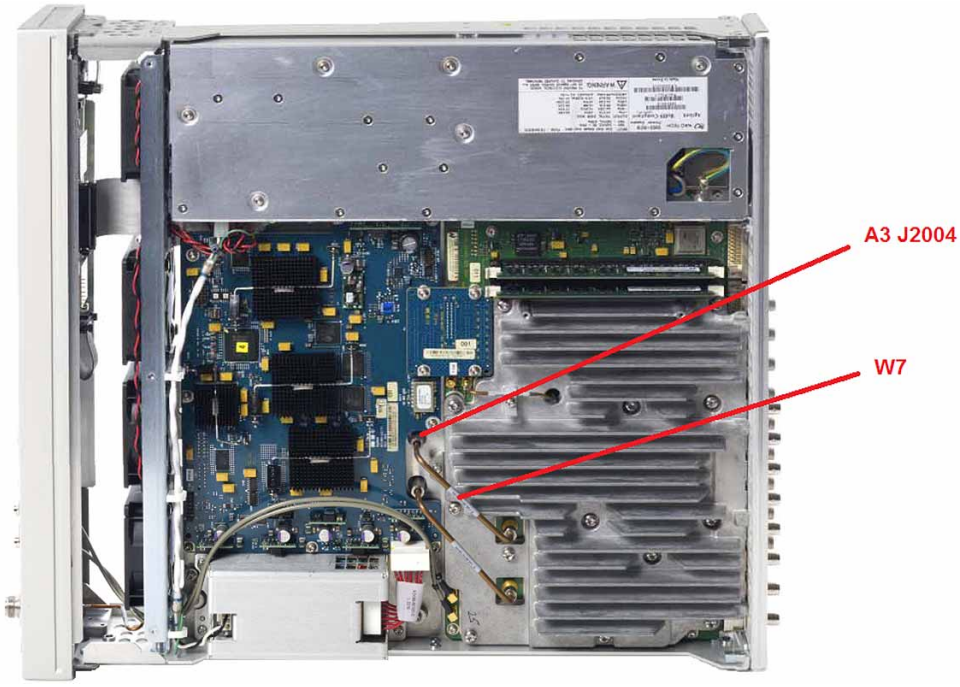
For these instruments there is no additional output of this section that can be measured.

N5166B, N5172B, N5182B

The output of this section can be measured at J2004, which is used to route the signal to the A2 Vector BBG assembly input when digital modulation is turned on. Use the following procedure to measure this output:

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the modulation on by pressing **Mod On/Off** so that the LED below it comes on.
3. Referring to Figure 10-3, remove semi-rigid cable W7.

Figure 10-3 Synthesizer Multiplier / Divider Section Output – Vector



4. Tune the instrument to a frequency that exhibits the power level issue.
5. Connect a spectrum analyzer to A3 J2004.
6. Configure the spectrum analyzer with the following settings:
   - Center Frequency = Frequency of signal generator
   - Span = 10 MHz
   - Reference Level = +10 dBm
7. Turn the signal path on by pressing **I/Q, I/Q On**.
8. The power level of the signal at A3 J2004 should be at a fixed level of 0 dBm, +/-6dB.
   - If the power level measured is not 0 dBm, +/-6 dBm, replace the A3 RF assembly since there are no adjustments for this power level.
   - If the power level measured is 0 dBm, +/-6 dB, the power level at the output of the Synthesizer Multiplier / Divider section is correct. The issue is somewhere farther down the signal path.

N5173B, N5183B

The output of this section can be measured at J2004, which is used to route the signal to the A7 Micro-Deck assembly input for frequencies of 3.2 GHz and above. However, since the A7 Micro-Deck will multiply the frequency of the signal to achieve the desired output frequency, the output frequency of this section will not match the output frequency selected by the user. To calculate the frequency at J2004 divide the instrument output frequency by the A7 Multiplier listed in Table 10-5.

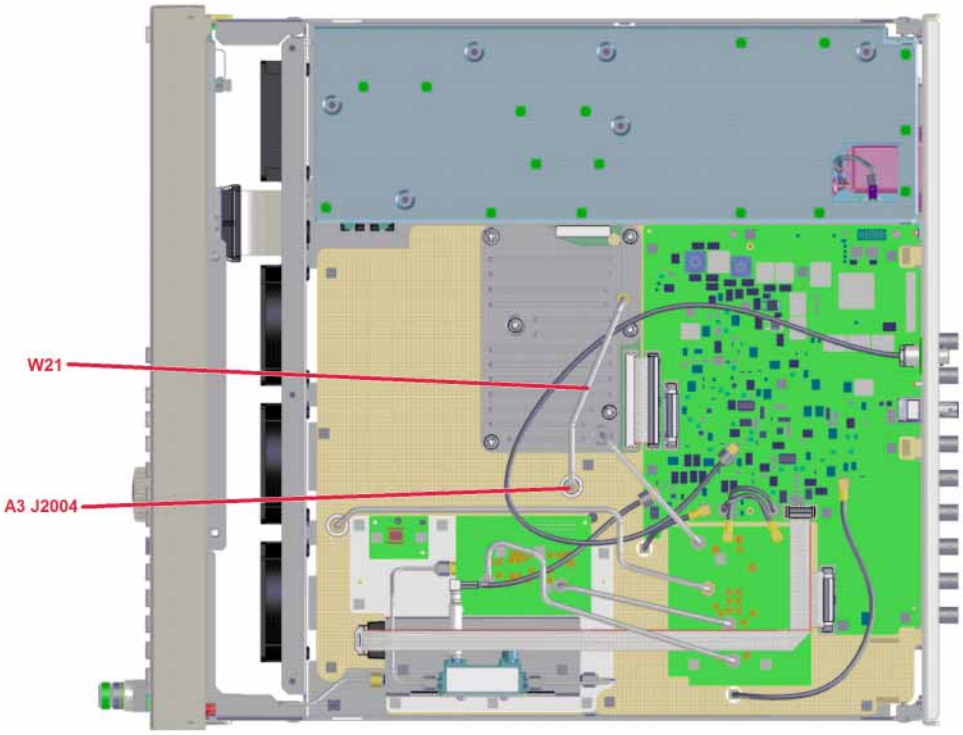
Table 10-5 Synthesizer Multiplier / Divider Output Versus Output Frequency

Output Frequency	A7 Multiplier	J2004 Frequency
3.2 to 5 GHz	1	3.2 to 5 GHz
>5 to 10 GHz	2	>2.5 to 5 GHz
>10 to 20 GHz	4	>2.5 to 5 GHz
>20 to 40 GHz	8	>2.5 to 5 GHz

Use the following procedure to measure this output:

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the output power on by pressing **RF On/Off** so that the LED below it comes on.
3. Referring to Figure 10-4, remove semi-rigid cable W21 from A3 J2004.

Figure 10-4 Synthesizer Multiplier / Divider Section Output - Microwave



4. Tune the instrument to a frequency that exhibits the power level issue.
5. Connect a spectrum analyzer to A3 J2004.
6. Calculate the Synthesizer Multiplier / Divider output frequency by dividing the frequency of the signal generator output by the corresponding A7 Multiplier listed in Table 10-5.
7. Configure the spectrum analyzer with the following settings:
   - Center Frequency = Frequency calculated in step 6
   - Span = 10 MHz
   - Reference Level = +10 dBm
8. The power level of the signal at A3 J2004 should be at a fixed level of 0 dBm, +/-6dB.
   - If the power level measured is not 0 dBm, +/-6 dBm, replace the A3 RF assembly since there are no adjustments for this power level.
   - If the power level measured is 0 dBm, +/-6 dB, the power level at the output of the Synthesizer Multiplier / Divider section is correct. The issue is somewhere farther down the signal path.

Self Tests

There are four Self Tests related directly to the Synthesizer Multiplier / Divider section. They are numbers 317 through 320. See Chapter 4, "Self Test," for a description of each of the tests. If there are Self Test failures, see Table 4-1 for instructions on how to proceed with determining a resolution for the failure.

Before replacing an A3 RF assembly for a Synthesizer Multiplier / Divider section Self Test failure be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

Synthesizer Multiplier / Divider Related Adjustments

There is only one Synthesizer Multiplier / Divider section related adjustment in the performance verification and adjustment software. This adjustment is only used for instrument with a frequency range option of 6 GHz or higher.

Synthesizer Bandcross Calibration

This adjustment is only used for instrument with a frequency range option of 6 GHz or higher.

This adjustment is used to determine the optimal bandcross frequency between two of the frequency bands in the Synthesizer Multiplier / Divider section such that the 0.75 subharmonics are sufficiently suppressed. The frequency bands of interest are the ones nominally from 3.0 GHz to 3.8 GHz and 3.8 GHz to 4.8 GHz.

RF Output Section

There are two different RF Output sections used, one for the RF instruments and one for the microwave instruments. The main difference between the two is that the microwave instruments do not have the high band block or the output attenuator block.

For RF instruments, the output of the RF Output section is the output of the instrument. However, for microwave instruments the RF Output section goes to the A7 Micro-Deck assembly for further filtering, detecting, and attenuation.

RF Instruments

If there is a problem with the RF Output section of any sort, including the failing of a Self Test or a performance verification test, do the following:

1. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"
2. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data"
3. Run the"RF Output Related Adjustments" listed later in this section.
4. If the failure persists, replace the A3 RF assembly.

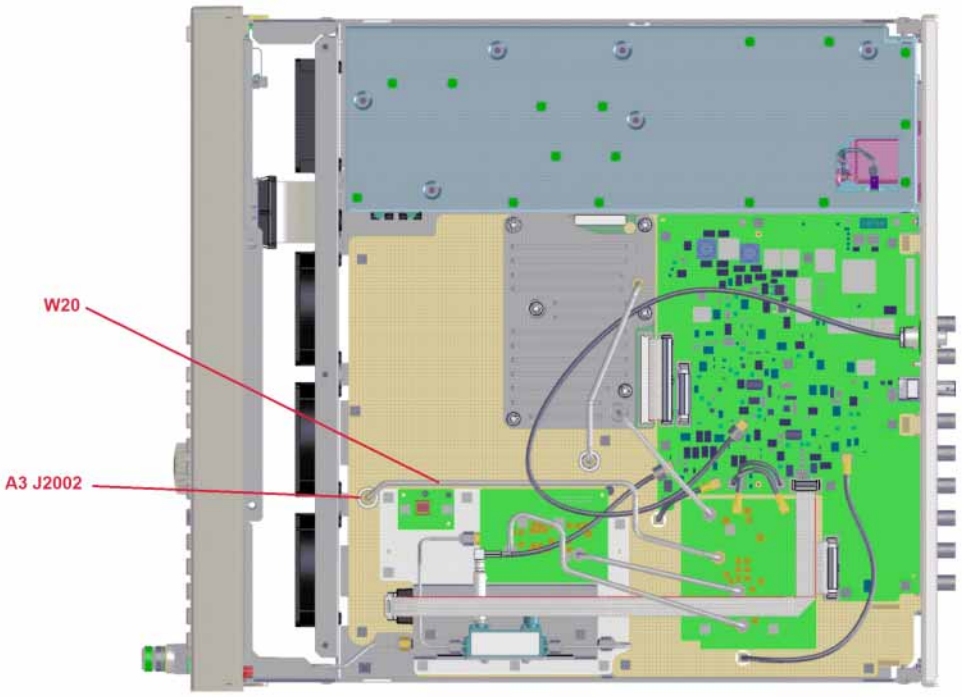
Microwave Instruments (N5173B, N5183B)

If the instrument is having a power level issue below 3.2 GHz it will need to be isolated to either the A3 RF assembly or the A7 Micro-Deck assembly. If there is a power level issue at 3.2 GHz and above, see the "N5173B, N5183B" section in the "Synthesizer Multiplier / Divider Section" in this chapter.

To isolate a signal level issue less than 3.2 GHz between the A3 RF assembly and the A7 Micro-Deck assembly use the following procedure:

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the automatic leveling control off by pressing **AMPTD**, **ALC Off**.
3. Set power search to manual by pressing **Power Search**, **Power Search**, **Manual**.
4. Turn the output power on by pressing **RF On/Off** so that the LED below it comes on.
5. Referring to Figure 10-5, remove semi-rigid cable W20 from A3 J2002.

Figure 10-5 RF Output Section Output - Microwave



6. Tune the instrument to a frequency and amplitude level that exhibits the power level issue.
7. Connect a spectrum analyzer to A3 J2002.
8. Configure the spectrum analyzer with the following settings:
   - Center Frequency = Frequency of signal generator

- Span = 10 MHz
- Reference Level = +10 dBm

9. Since A3 J2002 is before the output attenuator on the A7 Micro-Deck assembly the output level at A3 J2002 should be equal to the ALC Level.

   To find the ALC Level press AMPTD, Atten/ALC Control, Atten Hold On and read the Set ALC Level listed on the fourth softkey.

10. The power level of the signal at A3 J2002 should be equal to the ALC Level displayed, +/-3dB.

    - If the power level measured is not equal to the ALC Level, +/-3 dBm, the problems is with the A3 RF assembly. Proceed to step 11.
    - If the power level measured is equal to the ALC Level, +/-3 dB, the power level at the output of the RF Output section is correct. The issue is somewhere farther down the signal path on the A7 Micro-Deck assembly. See Chapter 11, "Micro-Deck Assembly," for further troubleshooting.

11. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

12. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data"

13. Run the "RF Output Related Adjustments" listed later in this section.

14. If the failure persists, replace the A3 RF assembly.

Unlevel

If there are any ALC issues, see "Unleveled Issues" in Chapter 6, "Troubleshooting"

Amplitude Modulation

If there are any amplitude modulation issues, see "Amplitude Modulation Issues (Option UNT)" in Chapter 6, "Troubleshooting"

Pulse Modulation

If there are any pulse modulation issues, see "Pulse Modulation Issues (Option UNW)" in Chapter 6, "Troubleshooting"

Self Tests

There is a series of Self Tests related directly to the RF Output section. They are the 400 series tests. See Chapter 4, "Self Test," for a description of each of the tests. If there are Self Test failures, see Table 4-1 for instructions on how to proceed with determining a resolution for the failure.

Before replacing an A3 RF assembly for a RF Output section Self Test failure be sure run the "RF Output Related Adjustments" listed later in this section. Also, be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

RF Output Related Adjustments

There are seven RF Output section related adjustments in the performance verification and adjustment software. They are:

1. ALC Linearity Calibration

   This adjustment is used to linearize the ALC circuitry.

2. Absolute Power Calibration

   This adjustment is used to find the power level associated with the mid vernier point. It also finds the correction factors for the 0 and 5 dB attenuator steps.

3. Op Amp Band Power Calibration

   This adjustment is used to set the Op-Amp band power gain and offset values.

4. ALC Calibration

   This adjustment is used to fill the power versus ref DAC lookup table.

5. Attenuator Calibration

   This adjustment is used to find the amplitude correction for each attenuator step.

6. Open Loop Power Calibration

   This adjustment is used to align the ALC open loop performance with the closed loop accuracy.

7. Op Amp Band Attenuator Calibration

   This adjustment is used to find the amplitude correction for each attenuator step in the Op-Amp band.

Automatic Level Control Section

If there are any ALC issues, see "Unleveled Issues" in Chapter 6, "Troubleshooting"

Function Generator / Trigger Control Section

There are three section in the Function Generator / Trigger Control Section that will be covered in this section. They are:

- LF Function Generator
- Trigger Control

– Sweep Out Interface

LF Function Generator

This functionality is only available with either option UNT, AM, FM, Phase Modulation or 303, Multifunction Generator. However, it is also used to provide the modulation signal for option UNW, Narrow Pulse Modulation.

The LF Function Generator provides the modulating signals for analog amplitude modulation, frequency modulation, phase modulation, and pulse modulation. If there is a problem with any of these internal analog modulation functionalities the problem could be the result of a fault with the LF Function Generator.

Amplitude Modulation

If there is a problem with amplitude modulation see the "Amplitude Modulation Issues (Option UNT)" section in Chapter 6, "Troubleshooting," to troubleshoot the issue.

Pulse Modulation

If there is a problem with pulse modulation see the "Pulse Modulation Issues (Option UNW)" section in Chapter 6, "Troubleshooting," to troubleshoot the issue.

LF Function Generator Related Adjustments

There are three LF Function Generator related adjustments in the performance verification and adjustment software. They are:

1. AM Calibration

   This adjustment is only applicable with option UNT.

   This adjustment calibrates the AM gain and offset.

2. LF Output Calibration

   This adjustment is only applicable with option UNT or 303.

   This adjustment is used to calibrate the gain and offset for the LF Output port.

3. External Mod Inputs Calibration

   This adjustment is only applicable with option UNT.

   This adjustment is used to calibrate the gain and offset for each of the two external modulation inputs (EXT 1 and EXT 2) to the ADC.

Trigger Control

See the "TRIG 1 and TRIG 2" section of the "Rear Panel BNC Input / Output Section" later in this chapter.

Sweep Out Interface

See the "SWEEP OUT" section of the Rear "Rear Panel BNC Input / Output Section" later in this chapter.

Instrument Interface Section

For problems with the instrument communication, see the "Communication Issues" section in Chapter 6, "Troubleshooting"

Rear Panel BNC Input / Output Section

There are multiple rear panel BNC connectors on the A3 RF assembly. Some of these rear panel connectors can be configured to perform many different tasks, some both inputs and outputs, and some for optional functionality. The procedures for verifying the functionality of these ports will use the most basic functionalities that can be used without the existence of optional features if possible. To verify the functionality of these connectors, follow the procedures below.

EXT 1 and EXT 2

This procedure is only applicable with option UNT, AM, FM, Phase Modulation.

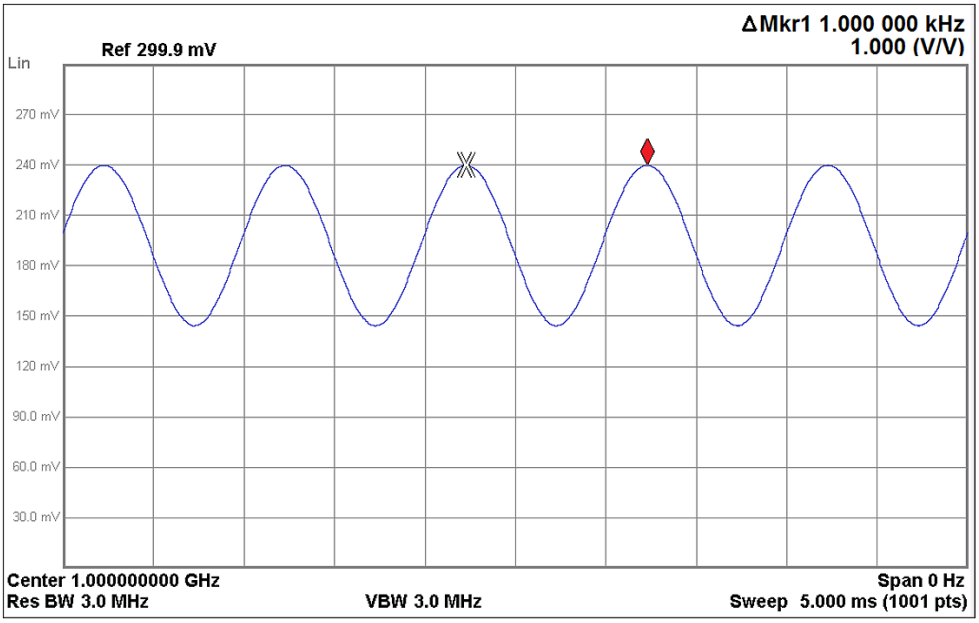
This procedure will verify that each of the two external modulation inputs are functioning properly. It will use the two external modulation inputs to amplitude modulate the instrument output. It assumes that the internal amplitude modulation is working properly. If there is a problem with amplitude modulation when the modulating source is internal, resolve that issue before proceeding with this procedure.

This procedure will require the use of a function generator and a spectrum analyzer.

1. Return the instrument to a known state by pressing **Preset**.
2. Turn both the output power and modulation on by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
3. Connect the signal generator RF output to the input of a spectrum analyzer.
4. Setup the spectrum analyzer with the following settings:
   - Center frequency = 1 GHz
   - Span = 0 Hz
   - Resolution Bandwidth = 3 MHz
   - Scale Type = Linear
   - Reference level = 300 mV
   - Sweep Time = 5 ms

5. Tune the instrument to 1 GHz by pressing **FREQ, 1 GHz**.
6. Set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
7. Turn amplitude modulation on by pressing **AM**, **AM On**.
8. Set the AM Source to EXT 1 by pressing **AM Source**, **EXT 1**.
9. Set the depth of modulation to 50% by pressing **AM Depth**, **50%**.
10. At this point there should be a flat line on the display of the spectrum analyzer at about 200 mV.
11. Setup the function generator with the following settings:
    - Function = Sinewave
    - Frequency = 1 kHz
    - Amplitude = 1 Vpp
    - Offset = 0 V
12. Connect the function generator output to the rear panel EXT 1 connector.
13. The signal on the spectrum analyzer display should now be a 1 kHz sinewave signal, as shown in Figure 10-6.

Figure 10-6 Amplitude Modulation Triggered By EXT 1



14. Change the AM source to EXT 2 by pressing **AM Source**, **EXT 2**.
15. The signal on the spectrum analyzer should now be a flat line again.
16. Move the function generator output from the rear panel EXT 1 input to EXT 2.

17. The signal on the spectrum analyzer should again be a 1 kHz sinewave signal, as shown in Figure 10-6.
18. If either of the EXT inputs is not working run the External Mod Inputs Calibration adjustment from the performance verification software. If this does not correct the problem, replace the A3 RF assembly.

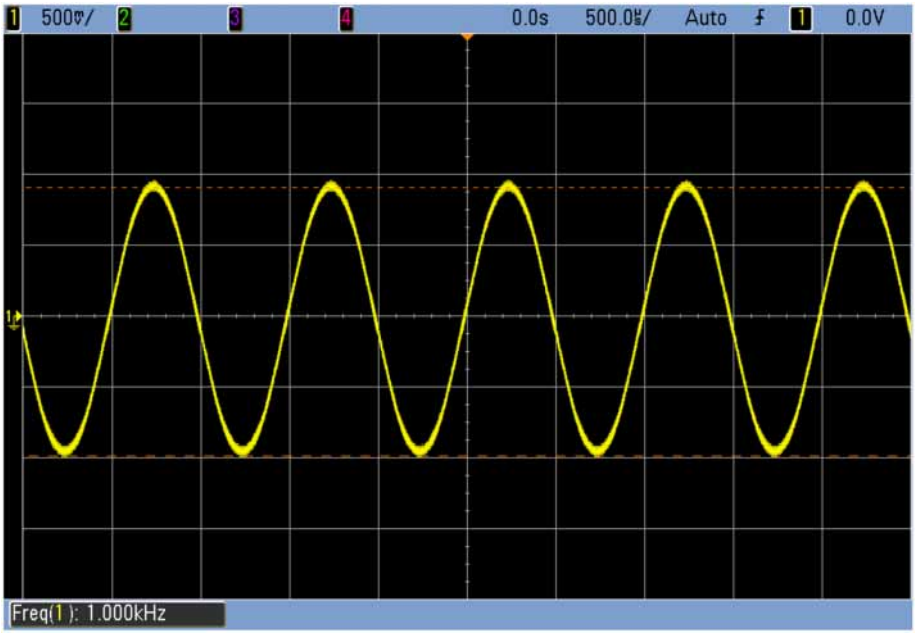
LF OUT

This procedure is only applicable with option 303, Multifunction Generator or option UNT, AM, FM, Phase Modulation.

This procedure will verify that the LF output is functioning properly. It will require the use of an oscilloscope.

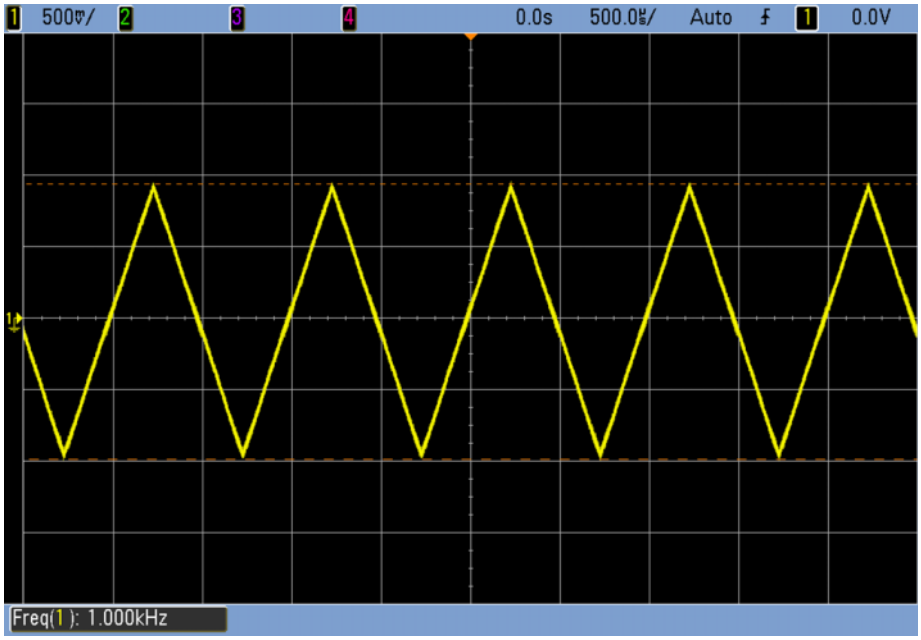
1. Return the instrument to a known state by pressing **Preset**.
2. Turn the modulation on by pressing **Mod On/Off** so that the LED below it comes on.
3. Connect the signal generator rear panel LF OUT connector to channel 1 of an oscilloscope.
4. Setup the oscilloscope with the following settings:
   - Channel 1 volts per division = 500 mV
   - Horizontal Scale per division = 500 µs
5. Set the LF output impedance to 1 MΩ by pressing **LF Out**, **More**, **Load Impedance 1 MOhm**.
6. Set the LF amplitude to 1 Vpp by pressing **More**, **LF Out Amplitude Into 1 MOhm**, **1 V**.
7. Set the LF frequency to 1 kHz by pressing **Setup LF Out Source**, **LF Out Freq**, **1 kHz**.
8. Turn the LF output on by pressing **LF Out**, **LF Out On**.
9. The signal on the oscilloscope display should now be a 1 kHz sinewave signal, as shown in Figure 10-7.

Figure 10-7 LF OUT – Sinewave Signal



10. The waveform generated can be changed to either Sine, Triangle, Square, Pos Ramp, or Neg Ramp by pressing **LF Out**, **Setup LF Out Source**, **LF Out Waveform** and selecting the desired waveform. The Triangle waveform is shown in Figure 10-8.

Figure 10-8 LF OUT – Triangle Wave Signal



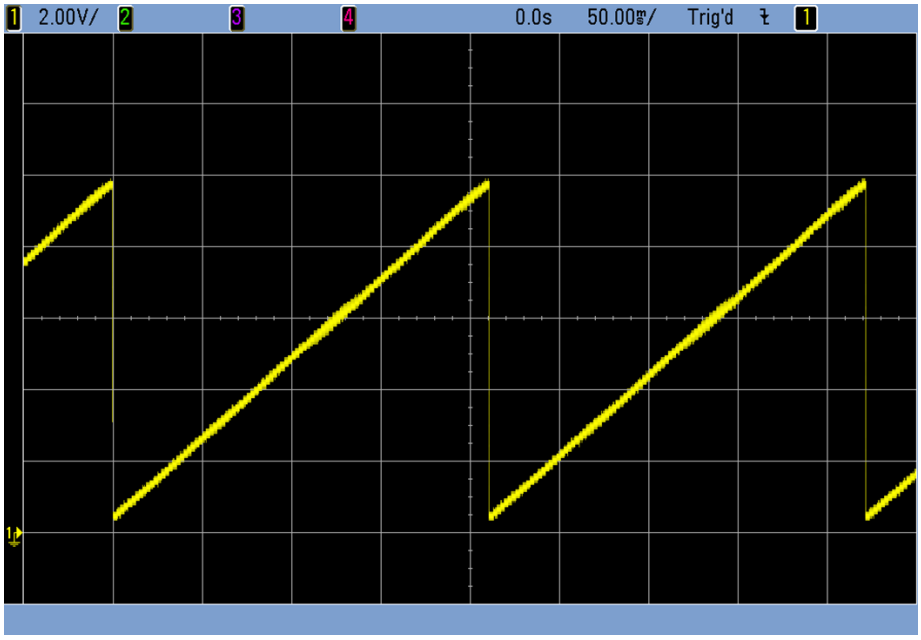
11. If any of the LF OUT waveforms are not being generated properly run the LF Output Calibration adjustment from the performance verification software. If this does not correct the problem, replace the A3 RF assembly.

SWEEP OUT

This procedure will verify that the SWEEP OUT output is functioning properly. It will require the use of an oscilloscope.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the signal generator rear panel SWEEP OUT connector to channel 1 of an oscilloscope.
3. Setup the oscilloscope with the following settings:
   - Channel 1 volts per division = 2 V
   - Horizontal Scale per division = 50 ms
4. Turn the step sweep on by pressing **Sweep**, **Sweep**, **Freq On**.
5. The signal on the oscilloscope display should now be a 0 to 10 V ramp with a duration of approximately 225 ms, as shown in Figure 10-9.

Figure 10-9 SWEEP OUT Ramp Signal



6. If the SWEEP OUT waveform is not being generated properly, replace the A3 RF assembly.

PULSE

This procedure will verify that the PULSE input is functioning properly. While the use of this input may typically be thought of as a trigger for pulse modulation, it can also be used without the pulse modulation option. Because of this there are two procedures below for testing the functionality of this input; one that will use the input to trigger the start of a sweep, and one that will use it as an external pulse for pulse modulation if option UNW, Narrow Pulse Modulation is installed.

Without Option UNW

This procedure assumes that the sweep function of the instrument is functioning properly when using an internal trigger signal. If there is a problem with the sweeping of the signal using an internal trigger, resolve that issue before proceeding with this procedure.

This procedure will require the use of a function generator and a spectrum analyzer.

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the output power on by pressing **RF On/Off** so that the LED below it comes on.
3. Connect the signal generator RF output to the input of a spectrum analyzer.
4. Setup the spectrum analyzer with the following settings:
   - Center frequency = 150 MHz
   - Span = 100 MHz
   - Reference level = 0 dBm
5. Tune the signal generator frequency to 150 MHz by pressing **FREQ**, **150 MHz**.
6. Set the signal generator power level to -10 dBm by pressing **AMPTD**, **-10 dBm**.
7. At this point there should a signal at the center of the spectrum analyzer display at -10 dBm.
8. Set the sweep start frequency to 100 MHz by pressing **SWEEP**, **Configure Step Sweep**, **Freq Start, 100 MHz**.
9. Set the sweep stop frequency to 200 MHz by pressing **Freq Stop**, **200 MHz**.
10. Set the trigger type to trigger and run by pressing **SWEEP**, **More**, **Sweep Trigger**, **Trigger Type**, **Trigger and Run**.
11. Set the trigger to the PULSE input by pressing **EXT**, **Pulse**.
12. Setup the function generator with the following settings:

- Function = Square Wave
- Frequency = 500 mHz
- Amplitude = 1 Vpp
- Offset = 0.5 V

13. Connect the function generator output to the rear panel PULSE input connector.
14. Turn the sweep on by pressing **SWEEP**, **Sweep**, **Freq On**.
15. At this point the signal on the spectrum analyzer display should be sweeping across the frequency range every two seconds.
16. If the signal is not sweeping across the spectrum analyzer display replace the A3 RF assembly.

With Option UNW

This procedure assumes that the pulse modulation function of the instrument is functioning properly when using the internally generated pulse source. If there is a problem with pulse modulation when using an internal source, resolve that issue before proceeding with this procedure.

This procedure will require the use of a function generator and a spectrum analyzer.

1. Return the instrument to a known state by pressing **Preset**.
2. Turn both the output power and modulation on by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
3. Connect the signal generator RF output to the input of a spectrum analyzer.
4. Setup the spectrum analyzer with the following settings:
   - Center frequency = 1 GHz
   - Span = 0 Hz
   - Sweep Time = 2 ms
   - Reference level = 0 dBm
5. Tune the signal generator frequency to 1 GHz by pressing **FREQ**, **1 GHz**.
6. Set the signal generator power level to -10 dBm by pressing **AMPTD**, **-10 dBm**.
7. At this point there should a flat line across the spectrum analyzer display at -10 dBm.
8. Set the pulse modulation source to external by pressing **Pulse**, **Pulse Source**, **More**, **EXT Pulse**.
9. Setup the function generator with the following settings:

- Function = Square Wave
- Duty Cycle = 20%
- Frequency = 1 kHz
- Amplitude = 1 Vpp
- Offset = 0.5 V

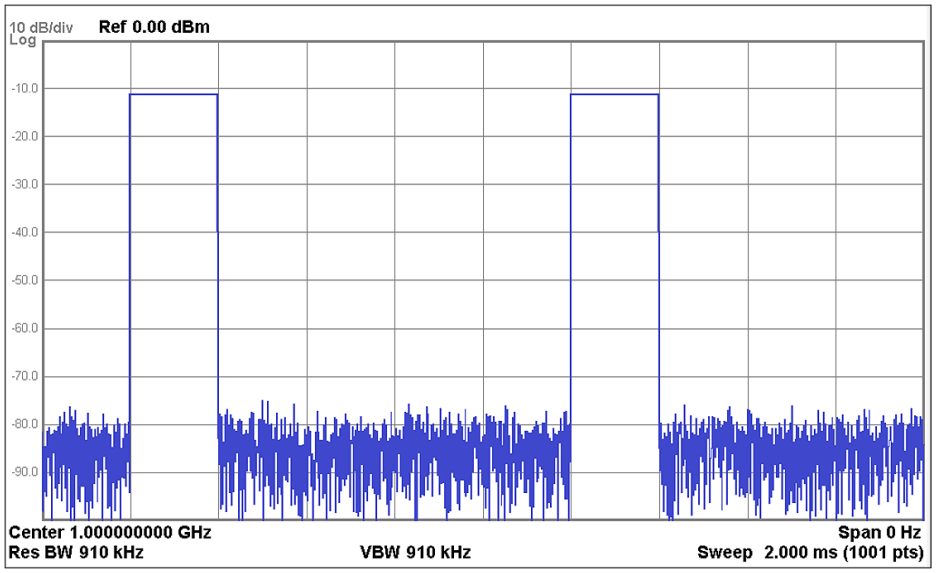
10. Connect the function generator output to the rear panel PULSE input connector.

11. Turn pulse modulation on by pressing **Pulse**, **Pulse On**.

12. Set the spectrum analyzer to video trigger with a trigger level of -30 dBm.

13. At this point the signal on the spectrum analyzer display should be a pulsed signal with a pulse width of 200 µs and a period of 1 ms, as shown in Figure 10-10.

Figure 10-10 Pulse Modulation – PULSE Input



14. If the signal is not pulsed, as seen in Figure 10-10, replace the A3 RF assembly.

TRIG 1 and TRIG 2

The TRIG 1 and TRIG 2 rear panel connectors can each be used as either an input or an output.

Input

This procedure assumes that the sweep function of the instrument is functioning properly when using an internal trigger signal. If there is a problem with the sweeping of the signal using an internal trigger, resolve that issue before proceeding with this procedure.

This procedure will require the use of a function generator and a spectrum analyzer.

1. Return the instrument to a known state by pressing **Preset**.
2. Turn the output power on by pressing **RF On/Off** so that the LED below it comes on.
3. Connect the signal generator RF output to the input of a spectrum analyzer.
4. Setup the spectrum analyzer with the following settings:
   - Center frequency = 150 MHz
   - Span = 100 MHz
   - Reference level = 0 dBm
5. Tune the signal generator frequency to 150 MHz by pressing **FREQ**, **150 MHz**.
6. Set the signal generator power level to -10 dBm by pressing **AMPTD**, **-10 dBm**.
7. At this point there should a signal at the center of the spectrum analyzer display at -10 dBm.
8. Set the sweep start frequency to 100 MHz by pressing **SWEEP**, **Configure Step Sweep**, **Freq Start**, **100 MHz**.
9. Set the sweep stop frequency to 200 MHz by pressing **Freq Stop**, **200 MHz**.
10. Set the trigger type to trigger and run by pressing **SWEEP**, **More**, **Sweep Trigger**, **Trigger Type**, **Trigger and Run**.
11. Set the trigger to external and the TRIG 1 input by pressing **EXT**, **Trigger 1**.
12. Setup the function generator with the following settings:
    - Function = Square Wave
    - Frequency = 500 mHz
    - Amplitude = 1 Vpp
    - Offset = 0.5 V
13. Connect the function generator output to the rear panel TRIG 1 connector.
14. Turn the sweep on by pressing **SWEEP**, **Sweep**, **Freq On**.
15. At this point the signal on the spectrum analyzer display should be sweeping across the frequency range every two seconds.
16. If the signal is not sweeping across the spectrum analyzer display replace the A3 RF assembly.

17. Set the trigger to the TRIG 2 input by pressing **SWEEP**, **More**, **Sweep Trigger**, **EXT**, **Trigger 2**.
18. Move the function generator output from the TRIG 1 rear panel connector to TRIG 2.
19. The signal on the spectrum analyzer display should again be sweeping across the frequency range every two seconds.
20. If the signal is not sweeping across the spectrum analyzer display replace the A3 RF assembly.

Output

This procedure will require the use of an oscilloscope.

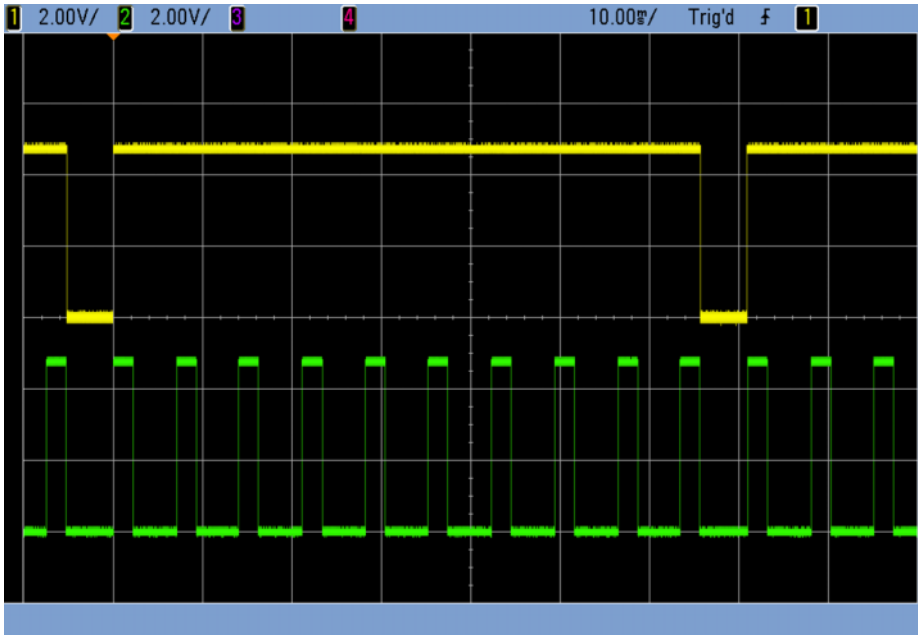
1. Return the instrument to a known state by pressing **Preset**.
2. Connect the rear panel TRIG 1 connector to channel 1 of an oscilloscope.
3. Connect the rear panel TRIG 2 connector to channel 2 of an oscilloscope.
4. Setup the oscilloscope with the following settings:
   - All channel volts per division = 2 V

     Horizontal Scale per division = 10 ms
5. Set the sweep start frequency to 100 MHz by pressing **SWEEP**, **Configure Step Sweep**, **Freq Start, 100 MHz**.
6. Set the sweep stop frequency to 200 MHz by pressing **Freq Stop**, **200 MHz**.
7. Set the number of sweep points to 10 by pressing **# Points**, **10**, **Enter**.
8. Configure the BNC connector routing by pressing **SWEEP**, **More**, **More**, **Route Connectors & Set Polarity**:
   - **Route to Trig 1 BNC**, **More**, **Sweep Run**
   - **Route to Trig 2 BNC**, **Sweep Trig Out**
9. Turn the step sweep on by pressing **Sweep**, **Sweep**, **Freq On**.
10. Channel 1 on the oscilloscope display should now be a positive pulse with a width of approximately 65 ms, and channel 2 should be a series of ten pulses within the length of the channel 1 pulse, as shown in Figure 10-11.

NOTE

If option UNZ, Fast Switching, is installed the oscilloscope horizontal scale can be set to 5 ms per division and the channel 1 pulse width should only be approximately 25 ms.

Figure 10-11 TRIG 1 and Trig 2 Sweep Out Signals



11. If either of the signals on the oscilloscope is not working, replace the A3 RF assembly.

REF IN

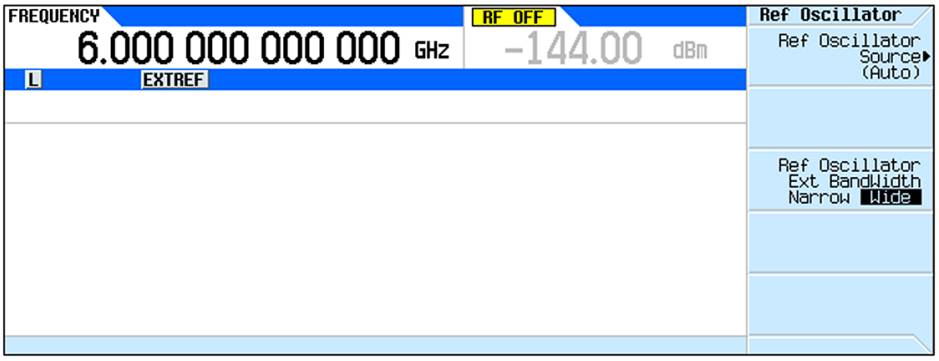
The standard external reference that can be used to lock the instrument to an external device or system is a 10 MHz sinewave signal with a power level of -3.5 to +20 dBm. However, with option 1ER, Flexible Reference Input, the frequency of the reference input signal can vary from 1 MHz to 50 MHz. So, there are two procedures for verifying the functionality of this input.

Standard

To verify the functionality of the standard 10 MHz external reference input, use the following procedure. This procedure will require the use of an additional signal generator that will be used as a reference frequency that can be varied in power.

1. Return the instrument to a known state by pressing **Preset**.
2. Set the instrument frequency reference selection to auto by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Source**, **Auto**.
3. Verify that the EXTREF indicator (Shown in Figure 10-12) is not on.
4. Tune the additional signal generator to 10 MHz.
5. Set the power level of the additional signal generator to 0 dBm.
6. Connect the output of the additional signal generator to the rear panel REF IN connector.
7. Verify that the EXTREF indicator is now on, as shown in Figure 10-12.

Figure 10-12 External Reference Indicator



8. Reduce the power level of the additional signal generator to -3 dBm and verify that the EXTREF indicator is still on and that there is no reference unlock error on the display.

   Increase the power level of the additional signal generator to +20 dBm (or as high as it will go below this level) and verify that the EXTREF indicator is still on and that there is no reference unlock error on the display.

   If the EXTREF indicator does not come on, or there is a reference unlock error when the power level is set within the limits, replace the A3 RF assembly.

Option 1ER

To verify the functionality of the option 1ER flexible external reference input, use the following procedure. This procedure will require the use of an additional signal generator that will be used as a reference frequency that can be varied in power and frequency.

During this procedure the “512, Reference unlock” error will come on along with the UNLOCK indicator. As long as this is while the additional signal generator is set to a different frequency than the Ref Oscillator Ext Freq setting it can be ignored. Once the settings are synchronized the UNLOCK indicator will clear itself if there is no problem and pressing the Cancel/(Esc) button can be used to clear the unlock error at the bottom of the display.

1. Return the instrument to a known state by pressing **Preset**.
2. Set the instrument frequency reference selection to auto by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Source**, **Auto**.
3. Verify that the EXTREF indicator (Shown in Figure 10-12) is not on.
4. Tune the additional signal generator to 10 MHz.
5. Set the power level of the additional signal generator to 0 dBm.
6. Connect the output of the additional signal generator to the rear panel REF IN connector.
7. Verify that the EXTREF indicator is now on, as shown in Figure 10-12.

Power Level Test

8. Reduce the power level of the additional signal generator to -3 dBm and verify that the EXTREF indicator is still on and that there is no reference unlock error on the display.
9. Increase the power level of the additional signal generator to +20 dBm (or as high as it will go below this level) and verify that the EXTREF indicator is still on and that there is no reference unlock error on the display.
10. If the EXTREF indicator does not come on, or there is a reference unlock error when the power level is set within the limits, replace the A3 RF assembly.

Frequency Test

11. Set the power level of the additional signal generator to 0 dBm.
12. Tune the additional signal generator to 1 MHz.

NOTE

When the Ref Oscillator Ext Freq is tuned to a frequency other than 10 MHz the Ref Oscillator Ext Bandwidth will automatically be set to Narrow and a message will be displayed in the status bar stating "External reference bandwidth changed to narrow."

13. Change the external reference frequency to 1 MHz by pressing **FREQ**, **More**, **Reference Oscillator**, **Ref Oscillator Ext Freq**, **1 MHz**.
14. Clear the errors that occurred while the frequencies were being changed by pressing **Error**, **Clear Error Queue(s)**.
15. Verify that no errors return once they are cleared.
16. Verify that the EXTREF indicator is now on, as shown in Figure 10-12.
17. Repeat steps 12 to 16 for a frequency of 50 MHz as well as any other frequency of interest between 1 MHz and 50 MHz.
18. If there are any unlock errors that do not clear when both the frequency settings are the same, or the EXTREF indicator does no come on, replace the A3 RF assembly.

Additionally, testing with any combination of power level and frequency used can be performed as long as the limits of both do not exceed the limits used in this testing.

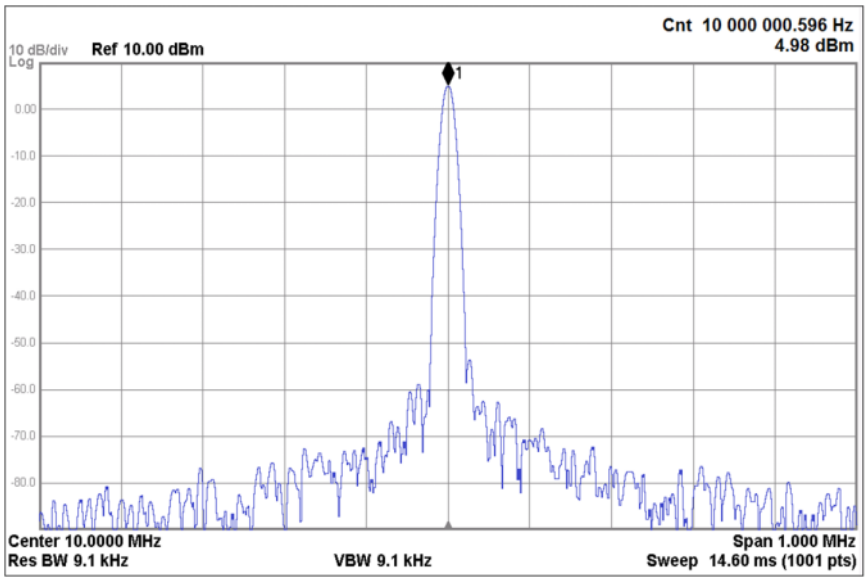
10 MHz OUT

The rear panel 10 MHz OUT connector should always have a 10 MHz signal at >+4 dBm. Use the following procedure to verify this.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the rear panel 10 MHz OUT connector to the input of a spectrum analyzer.

3. Setup the spectrum analyzer with the following settings:
   - Center frequency = 10 MHz
   - Span = 1 MHz
   - Reference level = +10 dBm
4. Verify that the power level is +4 dBm or greater, accounting for any cable loss, and that the frequency is 10 MHz +/-1 Hz, as shown in Figure 10-13.
5. If the power level or frequency does not meet the requirements run the "Reference Related Adjustments" listed earlier in this chapter. If they do not resolve the problem, replace the A3 RF assembly.

Figure 10-13 10 MHz OUT



11 Micro-Deck Assembly

What You Will Find in This Chapter

This chapter provides information on the following:

A7 Micro-Deck Assembly Overview on page 228

A8 BNC Bypass Board Overview on page 234

A7 Micro-Deck Assembly Troubleshooting on page 235

A8 BNC Bypass Board Troubleshooting on page 245

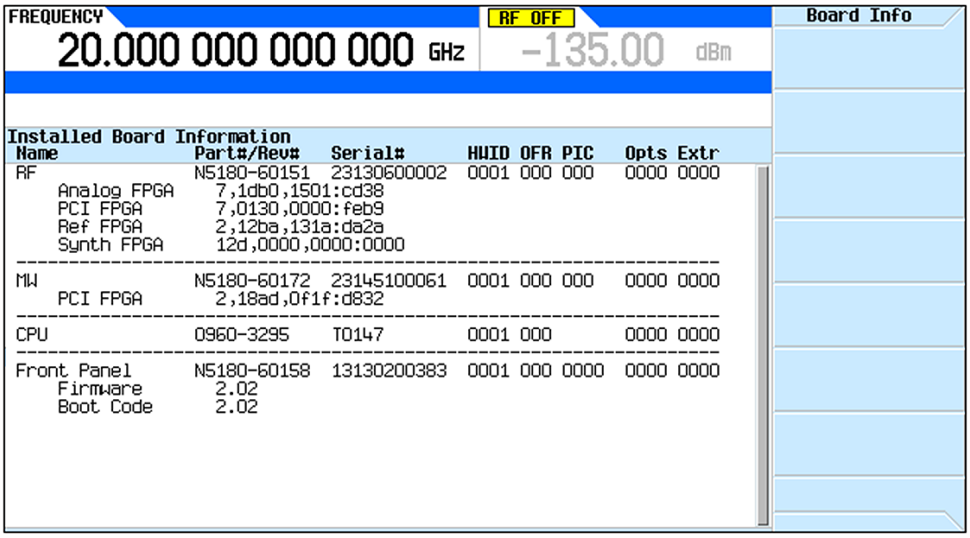
A7 Micro-Deck Assembly Overview

Refer to Chapter 13, “Block Diagrams,” for a visual description of the major blocks of circuitry contained in the A7 Micro-Deck assembly.

The information in this chapter is for the N5173B and N5183B instruments, which will be referred to as microwave instruments since they have the ability to operate above 6 GHz.

The part number and serial number used for identifying the A7 Micro-Deck assembly installed in an instrument can be seen as the MW entry on the **Utility**, **Instrument Info**, **Installed Board Info** screen, as shown in Figure 11-1. This part number and serial number is actually the information for the A7A1 Microwave ALC assembly.

Figure 11-1 Installed Board Info Screen



The A7 Micro-Deck assembly is made up of six major sections. They are:

- A7A1 Microwave ALC
- A7A2 20 GHz Frequency Multiplier
- A7A3 Mod-Filter
- A7A4 40 GHz Doubler (Option 532 and 540 only)
- A7A5, A7A6, A7A7 Directional Coupler / Detector
- A7AT1 Attenuator

Self Tests

There is an extensive number of Self Tests for the A7 Micro-Deck assembly. All the 1100, 1200, 1300, and 1400 series Self Tests are for the A7 Micro-Deck assembly. See Chapter 4, "Self Test," for more information on these tests. The A7 Micro-Deck assembly Self Tests will also be discussed in the "A7 Micro-Deck Assembly Troubleshooting" section later in this chapter.

Calibration Data

Calibration data for the assembly is stored on the A7A1 Microwave ALC assembly. This is data that was either written to the assembly when the instrument was produced at the factory or by an adjustment in the performance verification and adjustment software. Also, replacement A7 Micro-Deck assemblies come from the factory with calibration data stored in them. See "Calibration Data" in Chapter 3, "Instrument Information and Calibration Data," for more information on the instrument calibration data.

Adjustments

There are several adjustments related to the A7 Micro-Deck assembly found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

NOTE

For discussion purposes, it is assumed that microwave instruments all have the option to operate up to 40 GHz (Option 540). The frequency range of each instrument may vary, but any major difference will be called out in the different overview sections.

Frequency Range

There are four frequency range options available in the microwave instruments, as shown in Table 11-1.

Table 11-1 Microwave Frequency Range Options

Frequency Range Option	Frequency Range
513	9 kHz to 13 GHz
520	9 kHz to 20 GHz
532	9 kHz to 31.8 GHz
540	9 kHz to 40 GHz

To cover the different frequency range options there are two variations of the A7 Micro-Deck assembly. One is for the Option 513 and 520 instruments, and the other is for the Option 532 and 540 instruments. The main difference between these two assemblies is that the one for the Option 532 and 540 instruments has the addition of the A7A4 40 GHz Doubler assembly.

Signal Path

There are two main signal paths on the A7 Micro-Deck. They are:

9 kHz to <3.2 GHz

Below 3.2 GHz the signal comes from J2002 of the A3 RF assembly to J3 of the A7A3 Mod-Filter assembly. From there it is switched into the RF output path of the signal generator as needed. However, there are no amplifiers or modulators in the path for these frequencies on the A7 Micro-Deck assembly, all amplitude level adjustments are made on the A3 RF assembly. The only exception to this would be the A7AT1 Attenuator, which works in conjunction with the ALC circuitry to achieve the amplitude range desired.

3.2 GHz and Above

For frequencies of 3.2 GHz and above, the signal comes from J2004 of the A3 RF assembly to J1 of the A7A2 20 GHz Frequency Multiplier assembly. The frequency range of this signal is 2.5 GHz to 5 GHz. Depending on the desired output frequency, the A7A2 20 GHz Frequency Multiplier will either pass it through as is, multiply it by two, or multiply it by four, as seen in Table 11-2.

Table 11-2 A7A2 20 GHz Frequency Multiplier Usage

Desired Output Frequency	Multiplier	Input Frequency
3.2 GHz to 5 GHz	1	3.2 GHz to 5 GHz
5 GHz to 10 GHz	2	2.5 GHz to 5 GHz
10 GHz to 20 GHz	4	2.5 GHz to 5 GHz

For frequencies above 20 GHz the A7A4 40 GHz Doubler is used to double the 10 GHz to 20 GHz output of the A7A2 20 GHz Frequency Multiplier.

The 3.2 GHz to 20 GHz output of the A7A2 Frequency Multiplier assembly is at a fixed amplitude level.

The output of the A7A2 Frequency Multiplier is routed to the A7A3 Mod-Filter assembly which contains the ALC modulator, pulse modulator, amplifiers, and a bank of lowpass filters. The drive voltages for the modulators comes from the A7A1 Microwave ALC assembly.

For instruments with Option 532 (31.8 GHz) or 540 (40 GHz) the A7A4 40 GHz Doubler assembly is also included. This takes the 10 GHz to 20 GHz output of the A7A3 Mod-Filter and multiplies it by two to produce the 20 GHz to 40 GHz frequencies.

The signal is then routed to the A7A5 Directional Coupler that has the A7A6 High Band Detector attached to the coupled port. While all frequencies pass through the A7A5 Directional Coupler, the A7A6 High Band Detector is only used for frequencies of 2 GHz and above. The output of the A7A6 High Band Detector is routed to the A7A1 Microwave ALC assembly.

The signal is then routed to the A7AT1, which is used to reduce the power level of the signal beyond the range of the ALC modulators. Instruments without Option 1E1 have a limited lower amplitude range of -20 dBm, so they will only use the 5, 10, and 20 dB sections of the A7AT1 Attenuator.

Automatic Level Control

For an overall description of the Automatic Leveling Control (ALC) system see the "Automatic Level Control Section" in Chapter 10, "RF Assembly"

The microwave instruments have the ability to be hardware leveled by either the internal ALC detectors or an external detector. For internal leveling there are three band breaks in the ALC circuitry.

5 MHz to <2.0 GHz

In this frequency range the ALC detector and modulators used are both on the A3 RF assembly.

2.0 GHz to <3.2 GHz

In this frequency range the ALC detector used is on the A7 Micro-Deck and the modulators are on the A3 RF assembly.

3.2 GHz and Above

In this frequency range the ALC detector and modulator used are both on the A7 Micro-Deck assembly.

Below 5 MHz the automatic leveling control is handled by feedback loops of the op-amps that are used for this frequency range.

For external leveling control the same band breaks listed above apply with the only change being that the ALC detector is always external.

Amplitude Modulation

The modulating drive signal for all amplitude modulation is generated in the Function Generator / Trigger Control section of the A3 RF assembly. However, there are ALC modulators that are used to amplitude modulate the output signal on both the A3 RF assembly and the A7A3 Mod-Filter on the A7 Micro-Deck assembly. The modulators on the A3 RF assembly are used for frequencies less than 3.2 GHz, while the modulator on the A7 Micro-Deck assembly is used for frequencies of 3.2 GHz and higher.

Pulse Modulation

The modulating drive signal for all pulse modulation is generated in the Function Generator / Trigger Control section of the A3 RF assembly. However, there are pulse modulators on both the A3 RF assembly and the A7A3 Mod-Filter on the A7 Micro-Deck assembly. The modulators on the A3 RF assembly are used for frequencies less than 3.2 GHz, while the modulator on the A7 Micro-Deck assembly is used for frequencies of 3.2 GHz and higher.

A7AT1 Step Attenuator

The automatic leveling control (ALC) system can only control the power level across a finite range. The A7AT1 Attenuator is used to reduce the power level of the signal beyond the range of the ALC modulators. The A7AT1 Attenuator has five attenuator sections. How these sections are used to achieve the desired attenuation values is shown in Table 11-3.

Table 11-3 A7AT1 Attenuator Switching

Atten Setting	A7AT1 Section[a]				
	5 dB	10 dB	20 dB	40 dB	40 dB
0 dB					
5 dB	X				
15 dB	X	X			
25 dB	X		X		
35 dB	X	X	X		
45 dB	X			X	
55 dB	X	X		X	
65 dB	X		X	X	
75 dB	X	X	X	X	
85 dB	X			X	X
95 dB	X	X		X	X
105 dB	X		X	X	X
115 dB	X	X	X	X	X

a. Instruments without Option 1E1 only use the 5, 10, and 20 dB sections.

A8 BNC Bypass Board Overview

The A8 BNC Bypass board isolation circuit is a filter that minimizes interference caused when external equipment is connected to the rear panel external ALC IN connector. The circuit isolates DC voltage and high frequency signal components that might be present between different grounding paths.

A7 Micro-Deck Assembly Troubleshooting

A7 Micro-Deck assembly faults could manifest themselves in a broad range of failure symptoms. While there are many assemblies on the A7 Micro-Deck assembly it can only be replaced as an assembly, so isolating the fault to one of the lower level assemblies will not be necessary. The goal of the procedures found in this section will be to determine if a fault is caused by this assembly or not.

To provide access to the internal circuitry required to perform some of the troubleshooting procedures in this section the instrument outer cover and inner top cover will first need to be removed. Refer to Chapter 15, "Assembly Replacement," for instructions on how to remove and reinstall these covers.

Before replacing the A7 Micro-Deck assembly be sure to do the following:

1. Verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"
2. Verify that the instrument is using the factory calibration data by restoring the data. See "Calibration Data Restore" in Chapter 3, "Instrument Information and Calibration Data"
3. Run the A7 Micro-Deck Related Adjustments listed later in this section.

If it has been determined that the A7 Micro-Deck needs to be replaced see the "Pre Repair Procedures" section in Chapter 16, "Pre and Post-Repair Procedures," before removing the defective assembly.

Signal Path

Generally speaking, if an instrument has a power level issue only below 3.2 GHz, it will most likely be due to a problem with the A3 RF assembly. If the problem exists only at 3.2 GHz or above, it will most likely be due to a problem with the A7 Micro-Deck assembly. If the problem is both below and above 3.2 GHz, it could be due to a problem with either the A3 RF assembly or the A7 Micro-Deck assembly. Since a power level issue will almost always be accompanied by an unleveled condition, the cause of a power level issue can be verified by using the procedure for these instruments found in the "Unleveled Issues" section of Chapter 6, "Troubleshooting"

If there is a power level issue and there is no unlevel error the most likely cause will be the A7AT1 Attenuator, as it is outside of the ALC loop.

Automatic Leveling Control

If there are any ALC issues, see "Unleveled Issues" in Chapter 6, "Troubleshooting"

Amplitude Modulation

If there are any amplitude modulation issues, see "Amplitude Modulation Issues (Option UNT)" in Chapter 6, "Troubleshooting"

Pulse Modulation

If there are any pulse modulation issues, see "Pulse Modulation Issues (Option UNW)" in Chapter 6, "Troubleshooting"

Self Tests

There is a series of Self Tests related directly to the A7 Micro-Deck assembly. They are the 1100, 1200, 1300, and 1400 series tests. See Chapter 4, "Self Test," for a description of each of the tests. If there are Self Test failures, see Table 4-1 for instructions on how to proceed with determining a resolution for the failure.

Before replacing an A7 Micro-Deck assembly for a Self Test failure be sure to run the "A7 Micro-Deck Related Adjustments" listed later in this section. Also, be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

A7 Micro-Deck Related Adjustments

1. **MW ABUS Calibration**

   This adjustment is used to calibrate the internal diagnostics measuring ADC.

2. **MW Multiplier Prelevel Calibration**

   This adjustment is used to determine the optimal power out of the A7A2 20 GHz Frequency Multiplier. If the power is too low, it will impact the ability of the system to deliver enough output power. If the power is too high, it will increase the harmonic content of the output.

3. **MW Linearity Calibration**

   This adjustment is used to linearize the ALC detector for the best power accuracy.

4. **MW Low Band Absolute Power Calibration**

   This adjustment measures the absolute power at the mid-point of the ALC vernier and generates a cross calibration file for the ALC calibration and attenuator calibration. This adjustment also calibrates the first two attenuator steps (bypass, 0 dB and 5 dB), covering the frequency range of 9 kHz to 50 MHz.

5. **MW High Band Absolute Power Calibration**

   This adjustment measures the absolute power at the mid-point of the ALC vernier and generates a cross calibration file for the ALC calibration and attenuator calibration. This adjustment also calibrates the first two attenuator steps (bypass, 0 dB and 5 dB), covering the frequency range of 50 MHz to 40 GHz.

6. **MW ALC Calibration**

   This adjustment calibrates the ALC Reference DAC values to corresponding power levels.

7. **MW Attenuator Calibration**

   This adjustment calibrates the accuracy of the attenuator steps 10 through 130 dB.

8. **MW Open Loop Power Calibration**

   This calibration is used to align the ALC open loop performance with the closed loop accuracy.

Rear Panel BNC Connectors

There are two rear panel BNC connectors associated with the A7 Micro-Deck assembly, ALC IN and Z AXIS OUT. The following procedures can be used to verify the functionality of each.

ALC IN

This procedure will verify the operation of the rear panel external ALC IN connector. It will require the use of a 16 dB coupler, a negative crystal detector (such as the ones used in these instruments for internal leveling), and a spectrum analyzer.

This procedure assumes that the instrument is able to level its power when using internal leveling. If this is not the case, resolve any internal leveling problem before attempting to verify the operation of the external ALC IN functionality.

1. Return the instrument to a known state by pressing **Preset**.
2. Tune the instrument to 10 GHz by pressing **FREQ**, **10 GHz**.
3. Set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
4. Connect the input port of the directional coupler to the RF output of the instrument.
5. Connect the detector to the coupled port of the directional coupler.
6. Connect the detector output to the rear panel ALC IN port.
7. Connect the coupler output to the spectrum analyzer input.

8. Setup the spectrum analyzer with the following settings:
   - Center frequency = 10 GHz
   - Span = 10 MHz
   - Reference level = +10 dBm
9. Turn the output power on by pressing **RF On/Off** so that the LED below it comes on.
10. The power level of the signal on the spectrum analyzer display should be approximately 0 dBm, minus any loss through the coupler, connectors, and cable.
11. Set the external leveling amplitude offset to match the coupling factor of the directional coupler by pressing **AMPTD**, **Leveling Control**, **Ext Leveling Amptd Offset** <coupling factor> (If unknown enter 16 dB).
12. Switch the instrument to external leveling by pressing **Leveling Mode**, **Ext Detector**.
13. The signal level on the spectrum analyzer display as well as the indicated power level on the signal generator may change by a few dB, but the Unlevel indicator should not be displayed on the signal generator display.
14. Place a measurement marker on the 10 GHz signal on the spectrum analyzer and note the level.
15. Adjust the **Ext Leveling Amptd Offset** on the signal generator until the power level displayed equals the spectrum analyzer marker level, +/-1 dB.
16. Once the power level displayed on the signal generator equals the spectrum analyzer marker level, set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
17. At this point the power level on the spectrum analyzer display should equal the power level on the signal generator, +/-1 dB.

This procedure so far has tested the instrument's ability to use an external leveling detector along with the ALC modulator located on the A7 Micro-Deck assembly. To test its ability to do the same when using the ALC modulators on the A3 RF assembly continue with the steps below.

18. Tune the spectrum analyzer center frequency to 1 GHz.
19. Tune the signal generator to 1 GHz by pressing FREQ, 1 GHz.
20. Reset the external leveling amplitude offset to match the coupling factor of the directional coupler by pressing **AMPTD**, **Leveling Control**, **Ext Leveling Amptd Offset** <coupling factor> (If unknown enter 16 dB)
21. Set the power level to 0 dBm by pressing **AMPTD**, **0dBm**.

22. The power level of the signal on the spectrum analyzer display should be approximately 0 dBm, minus any loss through the coupler, connectors, and cable.
23. Adjust the **Ext Leveling Amptd Offset** on the signal generator until the power level displayed equals the spectrum analyzer marker level, +/-1 dB.
24. Once the power level displayed on the signal generator equals the spectrum analyzer marker level, set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
25. At this point the power level on the spectrum analyzer display should equal the power level on the signal generator, +/-1 dB.

As was mentioned at the start of this procedure, it is assumed that the automatic leveling control system is operating properly when using internal leveling. So, if there is a problem with external leveling, whether it is when using the modulator on the A7 Micro-Deck or the A3 RF assembly, the problem is most likely with the A7A1 Microwave ALC assembly on the A7 Micro-Deck. Replace the A7 Micro-Deck assembly.

Z AXIS OUT

This procedure will verify that the Z AXIS OUT output is functioning properly. It will require the use of an oscilloscope.

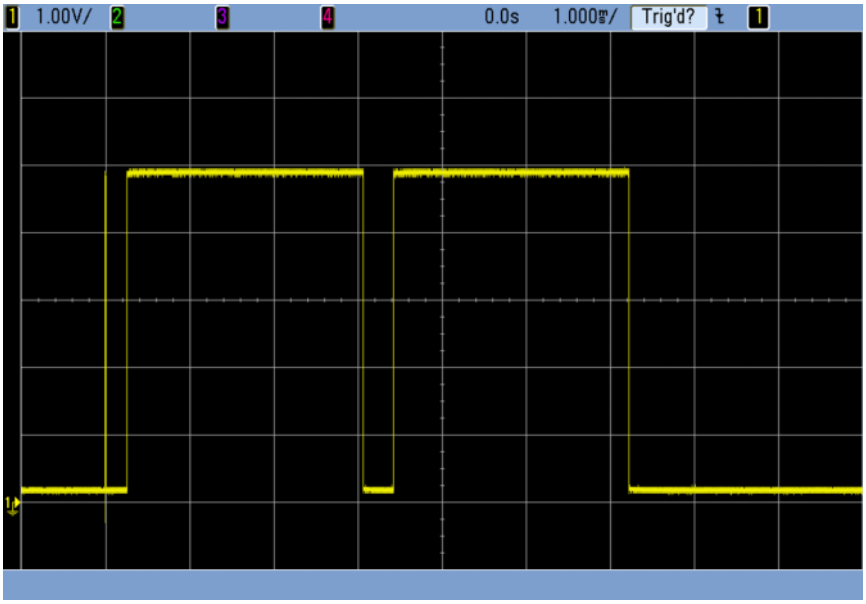
1. Return the instrument to a known state by pressing **Preset**.
2. Connect the signal generator rear panel Z AXIS OUT connector to channel 1 of an oscilloscope.
3. Setup the oscilloscope with the following settings:
   - Channel 1 volts per division = 1 V
   - Horizontal Scale per division = 1 ms

NOTE If Option UNZ, Fast Switching, is installed the oscilloscope horizontal scale should be set to 200 µs per division.

4. Set the sweep start frequency to 1 GHz by pressing **SWEEP**, **Configure Step Sweep**, **Freq Start**, **1 GHz**.
5. Set the sweep start frequency to 2 GHz by pressing **Freq Start**, **2 GHz**.
6. Set the number of sweep points to 3 by pressing **# Points**, **3**, **Enter**.
7. Set the dwell time to 100 µs by pressing **More**, **Step Dwell**, **100 µs**.
8. Set the sweep to single by pressing **SWEEP**, **Sweep Repeat Single**.
9. Turn the step sweep on by pressing **SWEEP**, **Sweep**, **Freq On**.
10. Trigger the sweep by pressing **SWEEP**, **Single Sweep**.

11. The signal on the oscilloscope display should now be a pulsed signal similar to that shown in Figure 11-2.

Figure 11-2 Z AXIS OUT Signal



A7AT1 Step Attenuator Troubleshooting

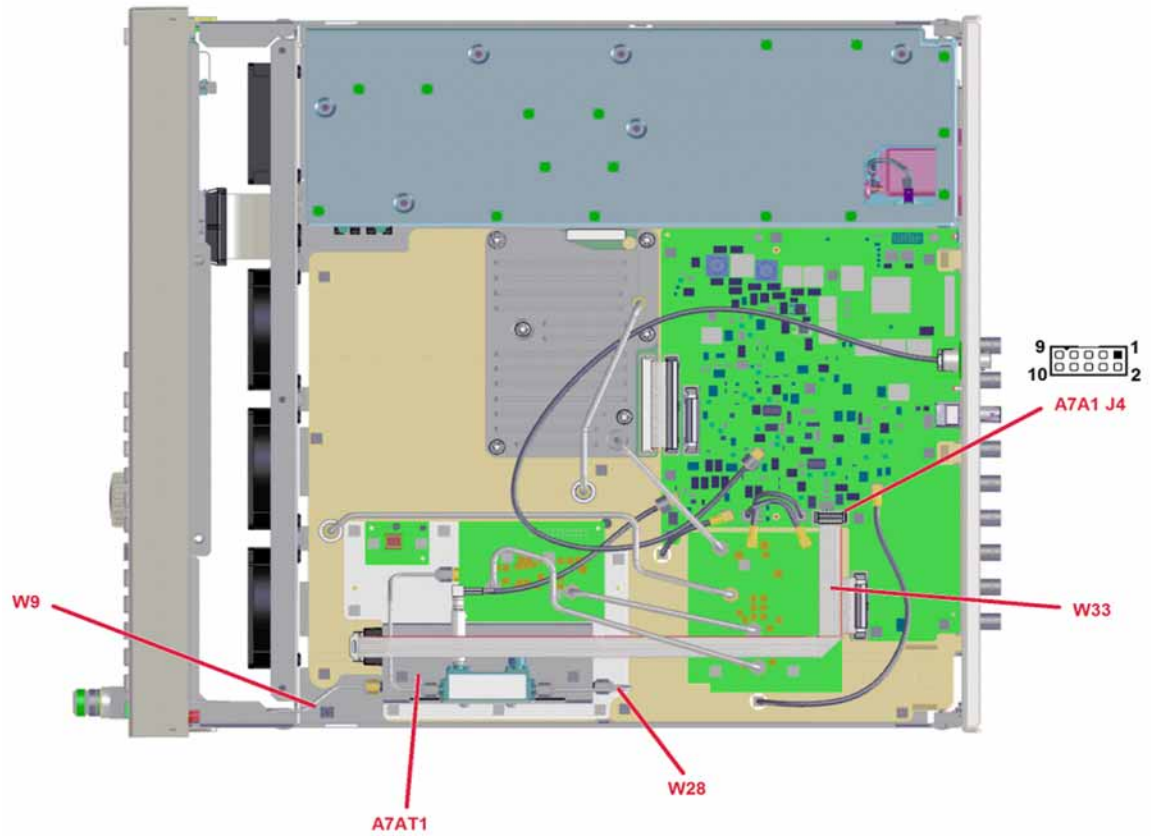
This procedure is intended to be used once a power level issue has been attributed to the A7 Micro-Deck assembly to determine if the failure is the result of a defective A7AT1 Step Attenuator. This will isolate the problem to either the A7AT1 Step Attenuator or the attenuator control circuitry on the A7 Micro-Deck assembly.

With a mechanical attenuator the typical failure will be the complete lack of switching of an individual step or group of steps. This would be caused by either a mechanical or electrical failure in the attenuator itself, an electrical problem with the control circuitry, or a damaged control cable.

1. Referring to Chapter 15, “Assembly Replacement”, remove the instrument outer cover and inner top cover.
2. Referring to Figure 11-3, remove W9 from the output of the A7AT1 Attenuator and connect the attenuator output to the input of a spectrum analyzer.

NOTE The output of the attenuator is a 2.4 mm connector. Be sure to use the proper connectors and/or cable to connect it to the spectrum analyzer input.

Figure 11-3 A7AT1 Attenuator and Control Locations - Typical



3. Return the signal generator to a known state by pressing **Preset**.
4. Tune the signal generator to a frequency that is having the power level issue.
5. Set the signal generator power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
6. Turn the ALC off by pressing **AMPTD**, **ALC Off**.
7. Turn the attenuator hold on by pressing **AMPTD**, **Atten/ALC Control**, **Atten Hold On**.
8. Turn the RF power on by pressing **RF On/Off** so that the LED below it comes on.
9. Setup the spectrum analyzer as follows:
   - Center frequency = Signal source frequency
   - Span = 1 MHz
   - Reference level = 0 dBm
10. Use the peak search function on the spectrum analyzer to measure the level of the signal.
    - If the signal level is not 0 dBm +/- 3 dB remove the W28 input cable from the attenuator and connect the spectrum analyzer input to the output of the cable. If the power level is still incorrect resolve that issue before continuing with this procedure.
    - If the signal level is 0 dBm +/-3 dB proceed to step 10.
11. Turn on the marker delta feature of the spectrum analyzer.
12. Using the values in column 1 of Table 11-4 step through the signal source attenuator values by pressing **AMPTD**, **Atten/ALC Control**, **Set Atten** <Atten Setting> and verify that the marker delta value from the spectrum analyzer is between the upper and lower limits shown in Table 11-4 for each attenuator setting.

NOTE

When the attenuator value gets above 85 dB the signal on the spectrum analyzer will not be able to be seen with the current settings. However, by this point all the different attenuator sections will have been tested, so it is unlikely that a unique problem would occur at a higher attenuator level than this.

Table 11-4 Attenuator Settings versus Error Limit

Signal Source Attenuator Setting	Spectrum Analyzer Marker Delta Value	
	Lower Limit	Upper Limit
0 dB	0 dB	0 dB
5 dB	3 dB	7 dB

Table 11-4 Attenuator Settings versus Error Limit

Signal Source Attenuator Setting	Spectrum Analyzer Marker Delta Value	
	Lower Limit	Upper Limit
15 dB	13 dB	17 dB
25 dB	23 dB	27 dB
35 dB	33 dB	37 dB
45 dB	43 dB	47 dB
55 dB	53 dB	57 dB
65 dB	63 dB	67 dB
75 dB	73 dB	77 dB
85 dB	83 dB	87 dB

13. If all the measurements are within the limits there is nothing wrong with either the A7AT1 attenuator or the control circuitry. Replace the A7 Micro-Deck assembly.

If any of the values exceed the limits proceed to step 14.

14. Set the attenuator to the value in Table 11-4 that exceeds the limits to the greatest extent.

15. Referring to Figure 11-3, remove W28 from the A7AT1 Attenuator input.

16. Connect the spectrum analyzer to the loose end of W28.

17. Verify that the power level coming out of W28 is 0 dBm +/-3 dB.

- If the power level is not 0 dBm +/-3 dB replace the A7 Micro-Deck.
- If the power level is 0 dBm continue with this procedure.

At this point the most likely cause of the problem is the A7AT1 Attenuator. However, to further investigate the problem there are two options.

- Connect a spare known functional A7AT1 Attenuator in place of the existing one and switch through the steps outlined in Table 11-4.
  - If the results are the same, the original attenuator is fine, the attenuator control circuitry is defective. Replace the A7 Micro-Deck assembly.
  - If the errors are gone with the spare attenuator replace the A7AT1 Attenuator.
- Continue with step 18 to measure the attenuator control voltages.

18. Referring to Figure 11-3, remove and inspect the attenuator control cable W33.

19. Using a DC voltmeter, measure the supply voltages at A7A1 J4 as defined in Table 11-5.

- If the supply voltages are not within the tolerance stated replace the A7 Micro-Deck.
- If the supply voltages are within the tolerance stated proceed to step 19.

Table 11-5 Attenuator Settings versus Error Limit

A7A1 J4 Pin	DC Voltage	Tolerance
1	+15 V	+/-1.0 V
2	+5 V	+/-0.75 V

20. Use a DC voltmeter to verify the control line voltages at A7A1 J4 for the attenuator setting selected as outlined in Table 11-6, +/-1.0 V.

- If the control line voltages are correct replace the A7AT1 Attenuator.
- If the control line voltages are not correct replace the A7 Micro-Deck assembly

Table 11-6 A7AT1 Control Line Voltage

Atten Setting	A7A1 J4 Pin				
	# 10 (5 dB)	# 9 (10 dB)	# 6 (20 dB)	# 5 (40 dB)	# 7 (40 dB)
0 dB	0 V	0 V	0 V	0 V	0 V
5 dB	5 V	0 V	0 V	0 V	0 V
15 dB	5 V	5 V	0 V	0 V	0 V
25 dB	5 V	0 V	5 V	0 V	0 V
35 dB	5 V	5 V	5 V	0 V	0 V
45 dB	5 V	0 V	0 V	5 V	0 V
55 dB	5 V	5 V	0 V	5 V	0 V
65 dB	5 V	0 V	5 V	5 V	0 V
75 dB	5 V	5 V	5 V	5 V	0 V
85 dB	5 V	0 V	0 V	5 V	5 V
95 dB	5 V	5 V	0 V	5 V	5 V
105 dB	5 V	0 V	5 V	5 V	5 V
115 dB	5 V	5 V	5 V	5 V	5 V

A8 BNC Bypass Board Troubleshooting

The intent of the A8 BNC Bypass board is to isolate ALC circuitry ground, chassis ground, and external equipment ground from each other. Diodes are used to shunt DC current and capacitors to remove interference components to ground.

If the external ALC appears unstable or noisy, use a digital multimeter to verify the bypass board is functioning properly. Using the ohm setting on your digital multimeter, test the bypass board. There should be a minimum resistance, typically ~100 ohms, between the outside barrel of the BNC and the chassis ground.

- If the resistance is ~100 ohms the A8 assembly is good.
- If the resistance is not ~100 ohms, replace the A8 assembly.

NOTE Be sure to remove any cable connected to the rear panel ALC IN connector before making this resistance measurement.

12 Baseband Generators

What You Will Find in This Chapter

This chapter provides information on the following:

A2 Vector BBG Assembly Overview on page 248

A7 Real-Time BBG Assembly Overview on page 250

A7A1 Real-Time Aux. Power Supply Overview on page 251

A2 Vector BBG Assembly Troubleshooting on page 252

A7 Real-Time BBG Assembly Troubleshooting on page 268

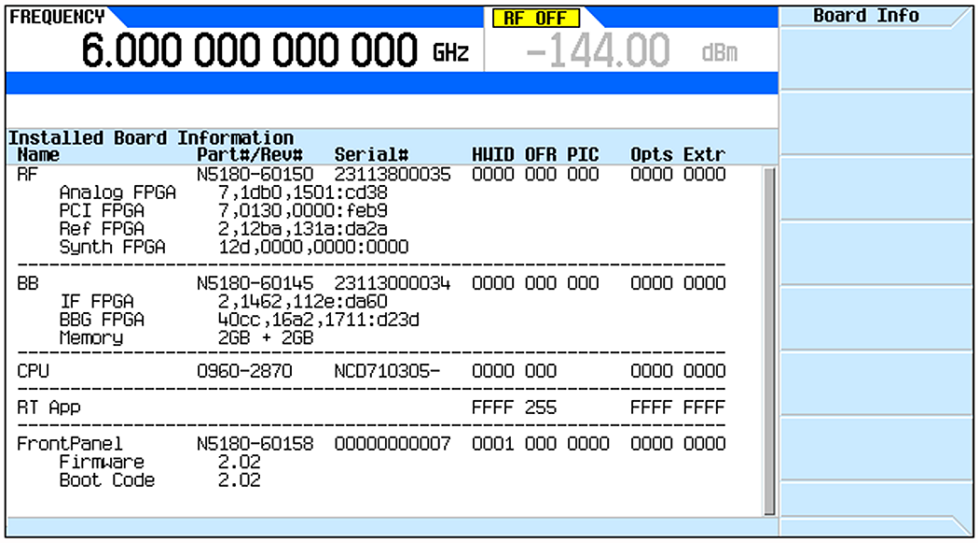
A7A1 Real-Time Aux. Power Supply Troubleshooting on page 271

A2 Vector BBG Assembly Overview

Refer to Chapter 13, "Block Diagrams," for a visual description of the major blocks of circuitry contained in the A2 Vector BBG assembly.

The part number and serial number of the A2 Vector BBG assembly installed in an instrument can be seen as the BB entry on the **Utility**, **Instrument Info**, **Installed Board Info** screen, as shown in Figure 12-1.

Figure 12-1 Installed Board Info Screen



The A2 Vector BBG assembly is a self-contained Arbitrary (ARB) Baseband Generator (BBG) assembly, that supports digital modulation in the N5166B, N5172B, and N5182B vector signal generators.

There are two basic sections of the A2 Vector BBG assembly:

– RF Section

– Digital Section

RF Section

The RF section of the A2 Vector BBG assembly receives the RF signal at P1 from the A3 RF assembly from the output of the synthesized multiplier/divider section. The signal is then adjusted for an optimum level, I/Q modulated, filtered, and amplified before being returned at P2 to the A3 RF assembly just prior to its RF output section. There are several adjustments related to the RF section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

When digital modulation is turned off the A2 Vector BBG assembly's RF section is bypassed by the A3 RF assembly.

Digital Section

The digital section receives a 100 MHz clock signal from the A3 RF assembly at P500. This reference clock is multiplied and divided within the assembly to provide different clock frequencies for the different circuits on the assembly.

There are several adjustments related to the digital section found in the performance verification and adjustment software for these instruments, which will be covered later in this chapter.

The digital section has an I/Q mux that gives it the ability to select what I/Q data is sent to the I/Q modulator, whether it is the I/Q pairs generated by the internal arbitrary waveform generator or what is applied to the external I/Q inputs. It also routes the internally generated I and Q signals to the baseband I and Q output connectors.

The digital section of the A2 Vector BBG assembly also contains the volatile BBG waveform memory that is installed in the two 240 pin DIMM slots on the assembly. The amount of memory that ships with an N5166B or N5172B instrument is 2 GB, while an N5182B instrument ship with 4 GB. The amount of memory installed on the assembly can be seen on the **Installed Board Info** screen, as can be seen in Figure 12-1. In this example the amount of memory shown is 2GB + 2GB for a total of 4 GBs. There are two values shown since there is memory in both slots. However, it should be noted that replacement A2 Vector BBG assemblies come with 4 GBs of memory installed in them, so it is possible to have more than 2 GBs of memory in N5166B or N5172B instruments. However, the options installed will limit the amount of memory that is available to the user.

Self Test

There is an extensive number of Self Tests for the A2 Vector BBG assembly. All the 700, 800, and 900 series Self Tests are for the A2 Vector BBG assembly. See Chapter 4, “Self Test,” for complete information on these tests.

Calibration Data

Calibration data for the assembly is stored on the A2 Vector BBG assembly. This is data that was either written to the assembly when the instrument was produced at the factory or by an adjustment in the performance verification and adjustment software. Also, replacement A2 Vector BBG assemblies come from the factory with calibration data stored in them. See “Calibration Data” in Chapter 3, “Instrument Information and Calibration Data,” for complete information on the instrument calibration data.

A7 Real-Time BBG Assembly Overview

The A7 Real-Time BBG assembly is only included in instruments with Option 660.

The A7 Real Time BBG assembly contains a general purpose real-time digital signal processor featuring a single I/Q channel.

The presence of the A7 Real-Time BBG assembly installed in an instrument can be seen as the RT App entry on the **Utility**, **Instrument Info**, **Installed Board Info** screen, as shown in Figure 12-1. However, it will not report its part number and serial number.

Self Test

There is an extensive number of Self Tests for the A7 Real-Time BBG assembly. All the 1500 series Self Tests are for the A7 Real-Time BBG assembly. See Chapter 4, "Self Test," for complete information on these tests.

A7A1 Real-Time Aux. Power Supply Overview

The A7A1 Real-Time Aux. Power Supply provides the A7 Real-Time BBG assembly with the +12 volts DC power it requires to operate. The power supply operates off the instrument AC power line voltage it gets from the A1 Power Supply assembly auxiliary AC output.

The output of the A7A1 Real-Time Aux. Power Supply is rated to provide 5 amps of current at +12 VDC and has short-circuit overload protection.

WARNING

Whenever the instrument is connected to an AC power source - whether the instrument is turned on or not - the auxiliary AC output of the A1 Power Supply assembly will be on. NEVER plug in or remove the A7A1 Real-Time Aux. Power Supply connection to the A7A1 Power Supply when AC power is applied to the instrument rear panel.

This also means that the A7A1 Real-Time Aux. Power Supply will have live voltages in it and at its output whenever there is AC power applied to the instrument rear panel. NEVER remove the cover from the A7A1 Real-Time Aux. Power Supply or probe the inside of it with anything when AC power is applied to the instrument rear panel.

A2 Vector BBG Assembly Troubleshooting

A2 Vector BBG assembly faults could manifest themselves in a broad range of failure symptoms. This section will address the most common failure symptoms.

To provide access to the internal circuitry required to perform the troubleshooting procedures in this section the instrument outer cover and inner top cover will first need to be removed. Refer to Chapter 15, "Assembly Replacement," for instructions on how to remove and reinstall these covers.

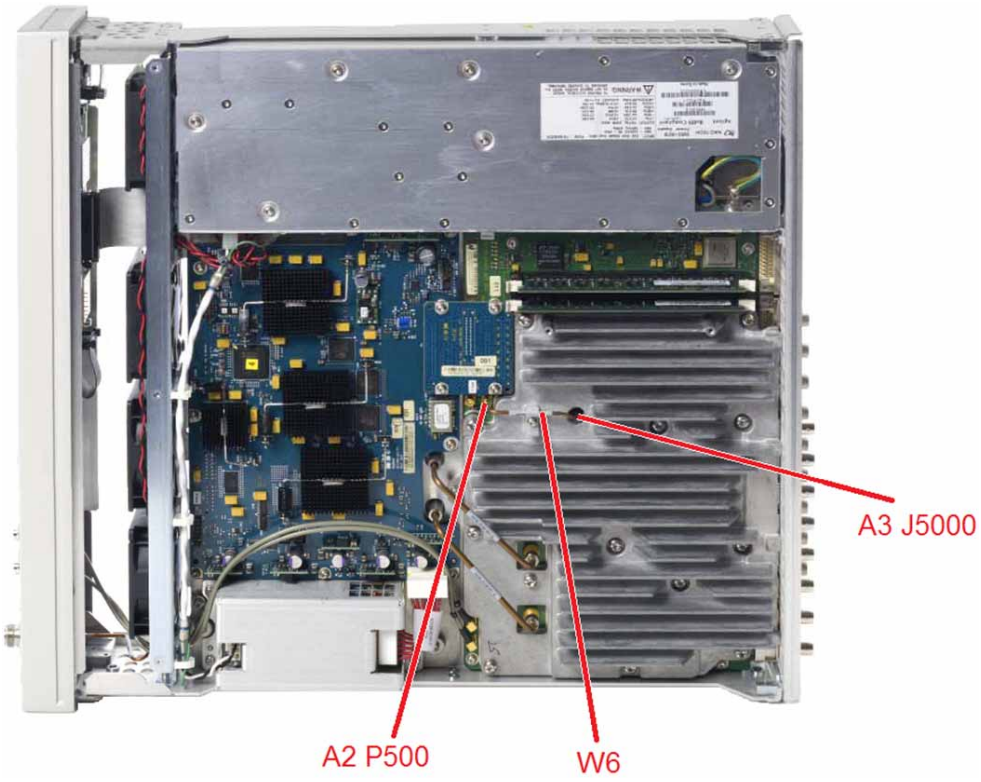
The troubleshooting information in this section is assuming that there are no error messages referring to any problems with the frequency reference or synthesizer sections on the A3 RF assembly. If there are any 508 Synthesizer Unlock, 512 Reference Unlock, or 515 Reference Missing error messages resolve them before continuing with this procedure.

Before replacing the A2 Vector BBG assembly be sure to see the "Pre Repair Procedures" section in Chapter 16, "Pre and Post-Repair Procedures"

100 MHz Reference Signal

The A2 Vector BBG assembly requires a 100 MHz reference signal from the A3 RF assembly. This signal is provided by cable W6, which connects A3 J5000 to A2 P500, as shown in Figure 12-2.

Figure 12-2 100 MHz Reference Signal Connections



If the 100 MHz reference signal is missing the instrument will give many error messages when the instrument is powered on. These will be errors such as:

-240,"Hardware error;BBG clock generator error: Internal VCO is unlocked"

-240,"Hardware error;BBG clock generator error: Internal 800 MHz clock missing"

-310,"System error;The 656 option cannot be configured. Required hardware is missing."

+617,"Configuration Error;BBG memory configuration does not match model number: required 4 GB was not found."

The instrument will also not be able to identify the A2 Vector BBG assembly in the Installed Board Info screen if the 100 MHz signal is missing.

To isolate the cause of a 100 MHz reference signal issue:

1. Verify that there are no Reference or Synthesizer Unlocked error messages. If there are any, see "Unlocked Issues" in Chapter 6, "Troubleshooting," and resolve that issue before continuing here.
2. Referring to Figure 12-2, remove W6 and connect a spectrum analyzer to A3 J5000.
3. Configure the spectrum analyzer with the following settings:
   - Center Frequency = 100 MHz
   - Span = 10 MHz
   - Reference Level = +10 dBm
4. The 100 MHz reference signal level should be 0 dBm, +/-3 dB.
   - If the signal level does not meet the requirement, replace the A3 RF assembly.
   - If the signal level does meet the requirement, inspect and replace W6 if necessary. If W6 is not at fault, replace the A2 Vector BBG assembly.

Waveform Memory Issues

The A2 Vector BBG assembly has two 240 pin DIMM slots on it for BBG waveform memory. Each slot has an A2A1 2 GB memory module in them (only one for N5166B and N5172B instruments). If there are any error messages related to the BBG memory at power up, such as the following, replace the A2A1 Vector BBG Assembly Memory modules:

+617,"Configuration Error;BBG memory configuration does not match model number: required 4 GB was not found."

RF Signal Path Level Issues

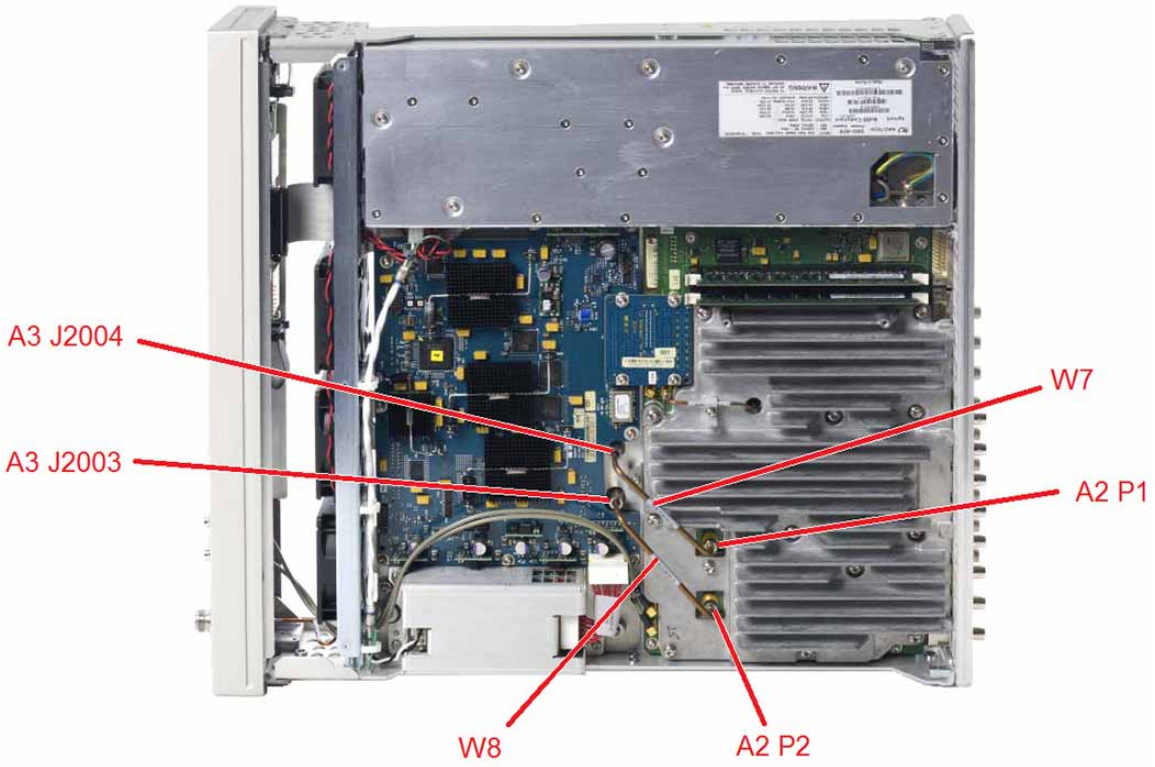
The troubleshooting information in this section is assuming that there is no problem with the RF power level when not using digital modulation, the problem only exists when digital modulation is turned on. If this is not the case, resolve any power level issue with the digital modulation turned off before continuing with this procedure.

If the instrument is having a problem with the RF signal path when using digital modulation, it will need to be determined whether the problem is with the A2 Vector BBG assembly, the A3 RF assembly, or with an adjustment that is needed. Before performing any troubleshooting for an issue such as this, restore the calibration data to the factory values in case there is any overwriting data in the A5 CPU assembly. See the "Calibration Data Restore" section in Chapter 3, "Instrument Information and Calibration Data," for instructions on how to do this.

To isolate a power level issue when using digital modulation use the following procedure, which will require the use of a spectrum analyzer:

1. Return the instrument to a known state by pressing **Preset**.
2. Turn both the output power and modulation on by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
3. Referring to Figure 12-3, remove semi-rigid cable W7.

Figure 12-3 A2 Vector BBG RF Signal Path Connections



4. Tune the instrument to a frequency that exhibits the power level issue when using digital modulation.
5. Connect a spectrum analyzer to A3 J2004.
6. Configure the spectrum analyzer with the following settings:
   - Center Frequency = Frequency of signal generator
   - Span = 10 MHz
   - Reference Level = +10 dBm
7. Turn the digital modulation path on by pressing **I/Q**, **I/Q On**.
8. The power level of the signal at A3 J2004 should be at a fixed level of 0 dBm, +/-6dB.
   - If the power level measured is not 0 dBm, +/-6 dBm, replace the A3 RF assembly since there are no adjustments for this power level.
   - If the power level measured is 0 dBm, +/-6 dB, proceed to step 9.
9. Referring to Figure 12-3, remove W8.
10. Connect the spectrum analyzer to the RF output connector of the instrument.
11. Connect a short RF cable between A3 J2004 and A3 J2003.
12. Set the power level to 0 dBm by pressing **AMPTD**, **0 dBm**.
13. The power level of the signal on the spectrum analyzer should measure 0 dBm, +/-1 dB plus the loss of any cables and connector used.
    - If the power level is not correct, the problem is with the A3 RF assembly or an IQ related adjustment for it. Replace the cables that were removed and run all the "I/Q Related Adjustments" discussed later in this chapter. If this does not resolve the issue replace the A3 RF assembly.
    - If the power level is correct, the problem is with the A2 Vector BBG assembly. Replace the cables that were removed and run all the "I/Q Related Adjustments" discussed later in this chapter. If this does not resolve the issue replace the A2 Vector BBG assembly.

Unleveled Conditions

If there are any unlevel conditions that only exist when using digital modulation see "I/Q Modulator Unlevel" in Chapter 6, "Troubleshooting"

I/Q Calibration Failures

Many times, user experienced I/Q calibration failures can be difficult to reproduce. It is best to know what calibration type the user was having failures with – DC, User, or Full. If DC or User was used, the settings that they were using will also need to be known. The difference between the calibration types are:

DC

Calibrates the I/Q offset, gain, and quadrature error at the current instrument frequency. This calibration requires that I/Q modulator be turned On and the I/Q Correction Optimized Path must be RF Output.

User

Calibrates the I/Q offset, gain, and quadrature error over a range of frequencies defined by the user on the I/Q Calibration menu.

Full

Calibrates the I/Q offset, gain, and quadrature error over the full frequency range of the instrument.

Troubleshooting

If an instrument is experiencing I/Q calibration failures try the following before replacing any hardware:

- Make sure that the I/Q Source is not set to External, it must be Internal, or the calibration will fail.
- Restore the factory I/Q Calibration data by pressing **I/Q**, **I/Q Calibration**, **Revert to Default Cal Settings**.
- Restore the factory calibration data for the instrument. See the "Calibration Data Restore" section in Chapter 3, "Instrument Information and Calibration Data," for instructions on how to do this.
- Install the latest instrument software version (B.01.80 or later).
- Verify that the power level coming to the A2 Vector BBG assembly is the correct level by following the procedure in the "RF Signal Path Level Issues" section in this chapter.
- Run the I/Q related adjustments with the performance verification and adjustment software. See "I/Q Related Adjustments" later in this section.

If the I/Q Calibration failure persists after trying all the above, the most likely cause of the failure is the A2 Vector BBG assembly.

I and Q Input Issues

Since there is no performance verification test for the I and Q inputs this procedure will provide a method for verifying the functionality of these inputs when the user reports a failure with them. This procedure will require the use of a function generator and a spectrum analyzer.

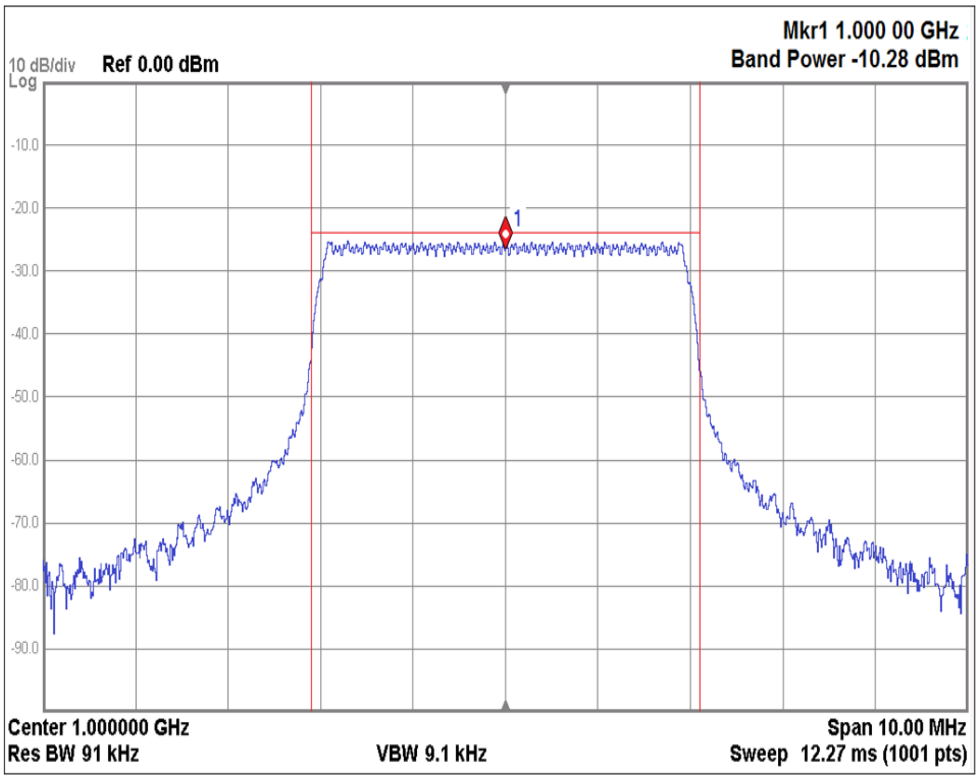
CAUTION The I and Q Inputs have an input impedance of 50 ohms and a damage level of 1 Vrms.

This procedure will use the arbitrary waveform output of a function generator to drive the I and Q inputs to verify the functionality of the two inputs.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the RF output to the input of a spectrum analyzer.
3. Tune the instrument to 1 GHz by pressing **FREQ**, **1 GHz**.
4. Turn both the output power and modulation on by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
5. Set the power level to -10 dBm by pressing **AMPTD**, **-10 dBm**.
6. Setup the spectrum analyzer with the following settings:
   - Center frequency = 1 GHz
   - Span = 10 MHz
   - Reference level = 0 dBm
7. Setup the function generator with the following settings:
   - Function = Arb
   - Waveform = Sinc
   - Amplitude = 1 VP-P
   - Frequency = 100 kHz
   - Offset = 0 V
8. Turn the I/Q modulator on by pressing **I/Q**, **I/Q On**.
9. At this point the signal on the spectrum analyzer screen should be a CW signal at a very low level, and the signal generator will be displaying the UNLEVEL indicator.
10. Connect the function generator output to the I Input.
11. The signal on the spectrum analyzer should now resemble that shown in Figure 12-4 and the UNLEVEL indicator should be off.
12. Move the function generator output to the Q Input.

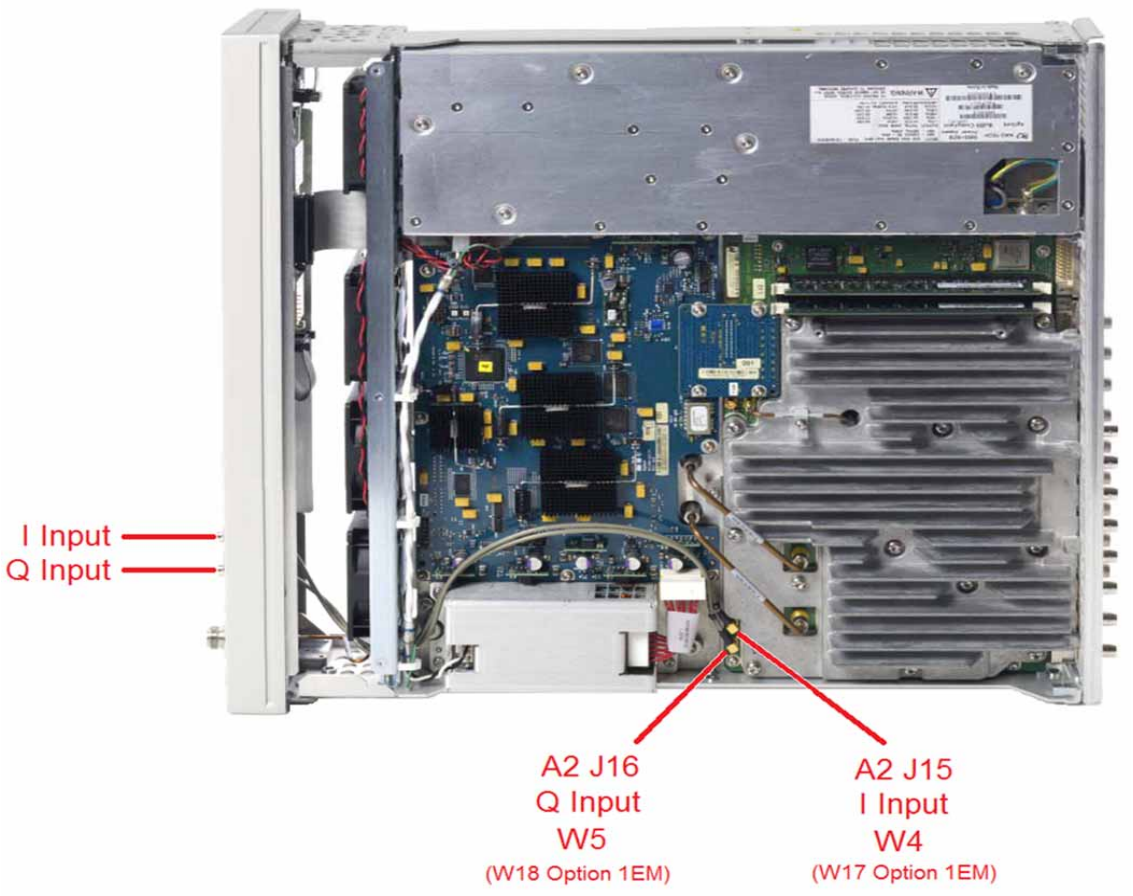
13. Again, the signal on the spectrum analyzer should now resemble that shown in Figure 12-4 and the UNLEVEL indicator should be off.

Figure 12-4 I and Q Inputs Modulated



14. If either input does not appear to be working, verify that the cables connecting the inputs to the A2 Vector BBG assembly are properly connected and not damaged, as shown in Figure 12-5. (For option 1EM see Figure 14-21).

Figure 12-5 I and Q Input Connections – Front Panel



Rear Panel BNC Connectors

There are multiple rear panel BNC connectors on the A2 Vector BBG assembly. For these to be functional one of the baseband generator options must be installed in the instrument (653, 655, 656, 657). The I bar and Q bar outputs also require that option 1EL be installed. The BB TRIG 1, BB TRIG 2, EVENT 1, and PAT TRIG connectors are all bidirectional. To verify the functionality of these connectors, follow the procedures below:

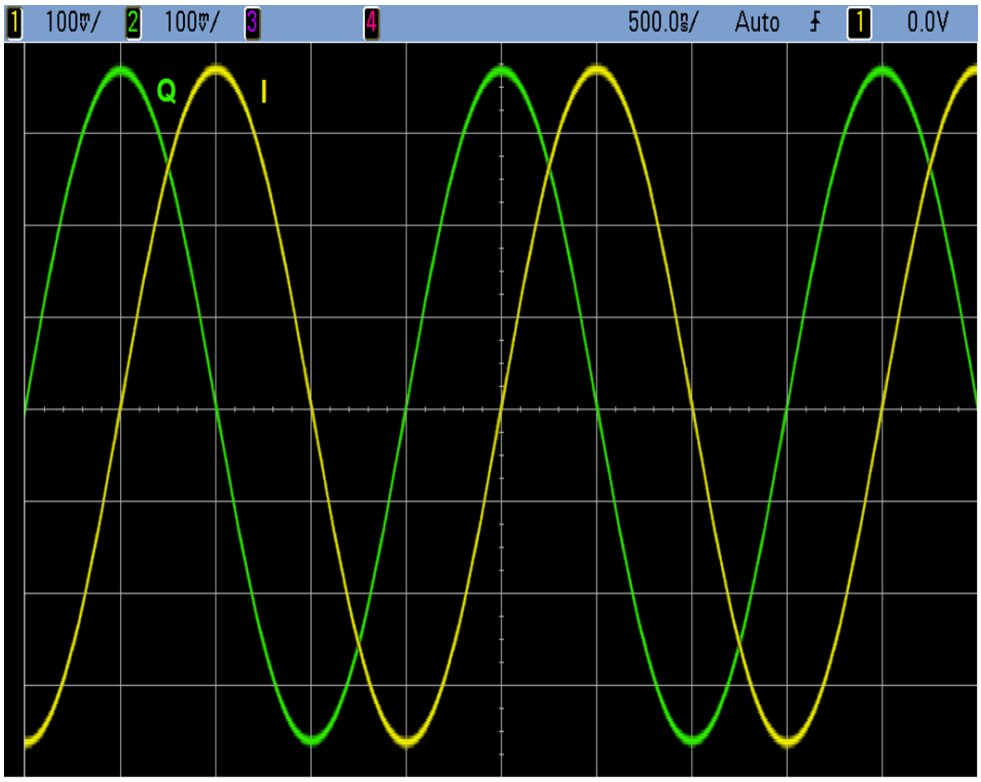
I OUT and Q OUT

To verify the functionality of the I and Q outputs use the following procedure, which will require the use of an oscilloscope:

1. Return the instrument to a known state by pressing **Preset**.
2. Connect I OUT and Q OUT to channels 1 and 2 of an oscilloscope.
3. Setup the oscilloscope with the following settings:
   - All Channels volts per division = 100 mV
   - Horizontal scale per division = 500 ns

4. On the signal generator press **Mode**, **Dual ARB**, **Select Waveform**.
5. Highlight SINE_TEST_WFM and press **Select Waveform**.
6. Turn the Arb on by pressing **Arb On**.
7. The I and Q output signals on the oscilloscope should resemble that seen in Figure 12-6. If either of the signals does not look like that shown, replace the A2 Vector BBG assembly.

Figure 12-6 I and Q Outputs



I bar OUT and Q bar OUT

The I bar and Q bar outputs are only active if option 1EL, Differential I/Q Outputs is installed.

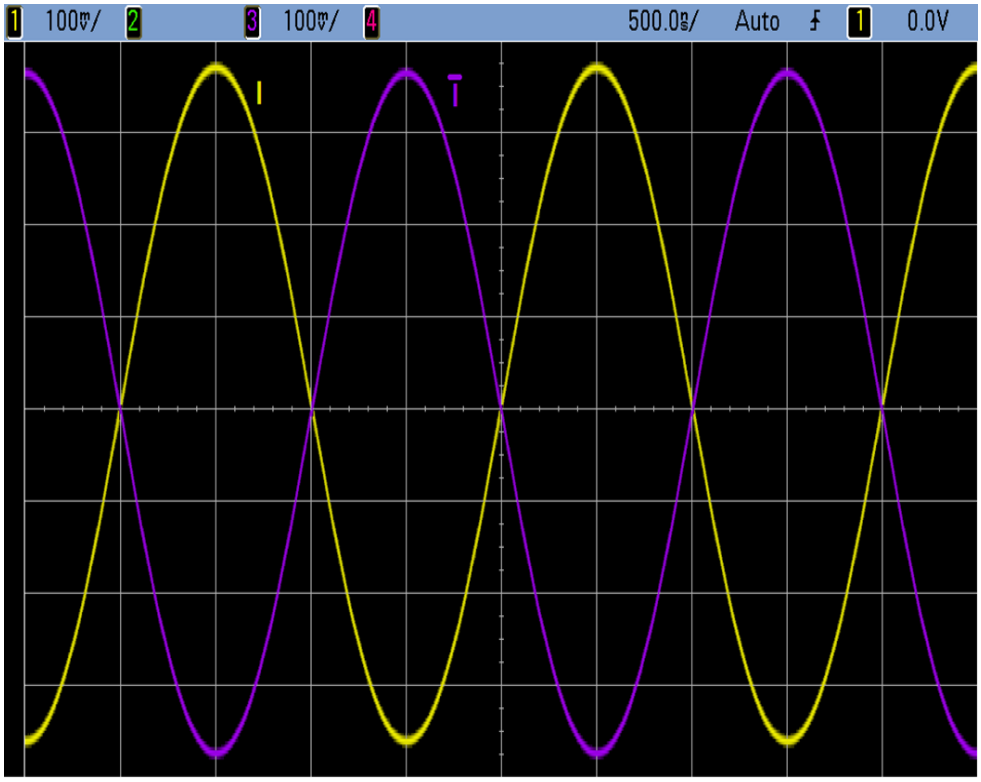
The I bar and Q bar outputs are each 180 degrees out of phase from the I and Q outputs. To verify the functionality of the I bar and Q bar outputs we will compare them to the I and Q outputs. This procedure will require the use of an oscilloscope.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the rear panel outputs to the oscilloscope as follows:
   - I OUT to Channel 1
   - Q OUT to Channel 2

- I Bar OUT to Channel 3
- Q Bar OUT to Channel 4

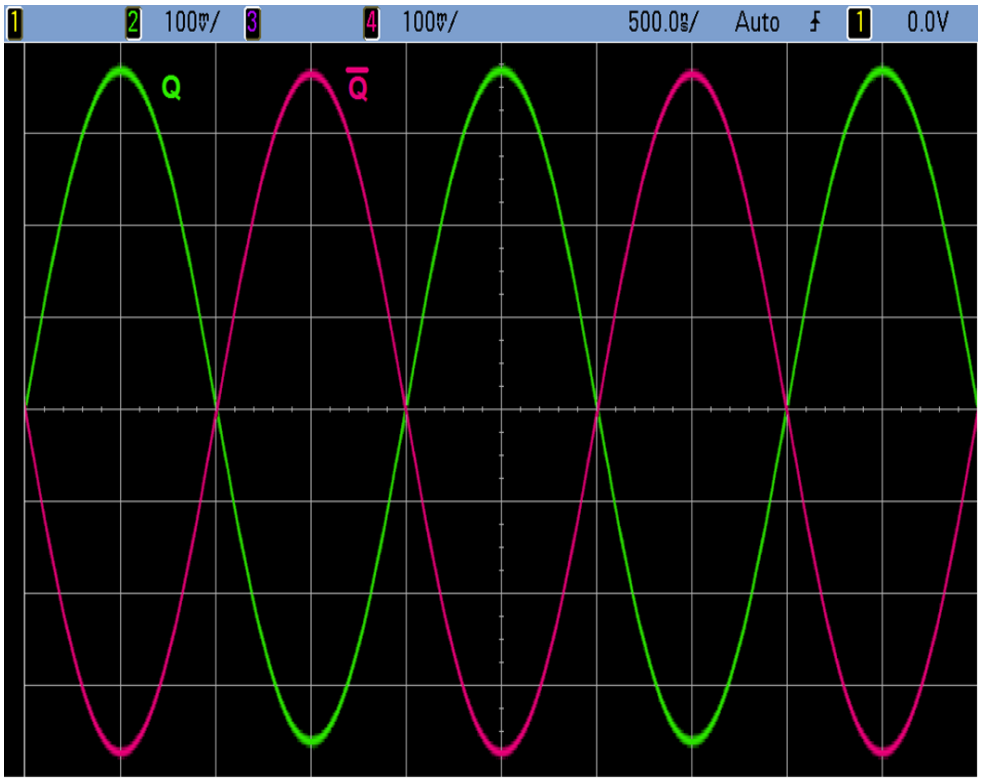
3. Setup the oscilloscope with the following settings:
   - All Channels volts per division = 100 mV
   - Horizontal scale per division = 500 ns
4. On the oscilloscope turn channels 1 and 3 on, and channels 2 and 4 off.
5. On the signal generator press **Mode**, **Dual ARB**, **Select Waveform**.
6. Highlight SINE_TEST_WFM and press **Select Waveform**.
7. Turn the Arb on by pressing **Arb On**.
8. The I and I bar signals should resemble that seen in Figure 12-7, with the I bar signal being 180 degrees out of phase with the I signal.

Figure 12-7 I OUT versus I Bar OUT



9. On the oscilloscope turn channels 2 and 4 on, and channels 1 and 3 off.
10. The Q and Q bar signals should resemble that seen in Figure 12-8, with the Q bar signal being 180 degrees out of phase with the Q signal.

Figure 12-8 Q OUT versus Q Bar OUT



11. If any of the signals do not look like that shown, replace the A2 Vector BBG assembly.

BB TRIG 1, BB TRIG 2, EVENT 1, PAT TRIG

All four of these connectors can be used as either an input or an output, so the functionality of both will need to be verified.

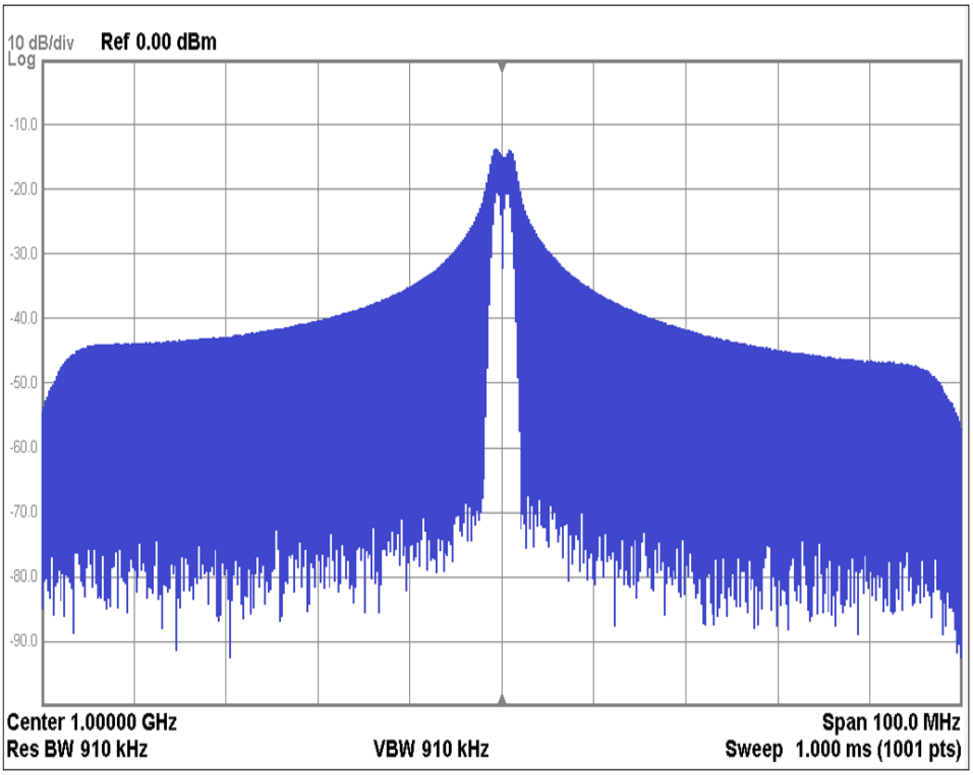
Inputs

The following procedure will gate the playing of a waveform with the square wave output of a function generator applied to each of the four BNC connectors, one at a time. This will verify that each is functioning as an input. This procedure will require the use of a function generator and a spectrum analyzer.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the signal generator RF output to the input of a spectrum analyzer.
3. Setup the spectrum analyzer with the following settings:
   - Center frequency = 1 GHz
   - Span = 100 MHz
   - Reference level = 0 dBm

4. Setup the function generator with the following settings:
   - Function = Square wave
   - Frequency = 1 Hz
   - Amplitude = 1 VP-P
   - Offset = +0.5 V
5. Tune the signal generator to 1 GHz by pressing **FREQ**, **1 GHz**.
6. Turn both the output power and modulation on by pressing **RF On/Off** and **Mod On/Off** so that the LEDs below them come on.
7. Set the power level to -10 dBm by pressing **AMPTD**, **-10 dBm**.
8. On the signal generator press **Mode**, **Dual ARB**, **Select Waveform.**
9. Highlight RAMP_TEST_WFM and press **Select Waveform**.
10. Set the trigger type by pressing **Trigger Type**, **Gated**, **Active High**.
11. Set the trigger source by pressing **Trigger Source**, **Trigger Source**, **EXT**.
12. Turn the Arb on by pressing **Mode**, **Dual ARB**, **Arb On**.
13. At this point the ARMED indicator should be displayed on the screen and the spectrum analyzer should be displaying a CW signal at the center of the screen at -10 dBm.
14. Select the PATT TRIG input by pressing **Trigger Source**, **Ext Source**, **Patt Trig 1 BNC Source**, **Patt Trig**.
15. Connect the function generator output to the PAT TRIG connector.
16. The signal on the spectrum analyzer should now be alternating between the CW signal and the playing of the waveform file shown in Figure 12-9 at a rate equal to the frequency of the function generator.

Figure 12-9 BNC Inputs Gated Waveform



17. Select the EVENT 1 input by pressing **Patt Trig 1 BNC Source**, **Event 1**.
18. Connect the function generator output to the EVENT 1 connector.
19. The signal on the spectrum analyzer should now be alternating between the CW signal and the playing of the waveform file shown in Figure 12-9 at a rate equal to the frequency of the function generator.
20. Select the BB TRIG 1 input by pressing **Patt Trig 1 BNC Source**, **BB Trigger 1.**
21. Connect the function generator output to the BB TRIG 1 connector.
22. The signal on the spectrum analyzer should now be alternating between the CW signal and the playing of the waveform file shown in Figure 12-9 at a rate equal to the frequency of the function generator.
23. Select the BB TRIG 2 input by pressing **Patt Trig 1 BNC Source**, **BB Trigger 2**.
24. Connect the function generator output to the BB TRIG 2 connector.
25. The signal on the spectrum analyzer should now be alternating between the CW signal and the playing of the waveform file shown in Figure 12-9 at a rate equal to the frequency of the function generator.
26. If any of the inputs are not gating the playing of the waveform, replace the A2 Vector BBG assembly.

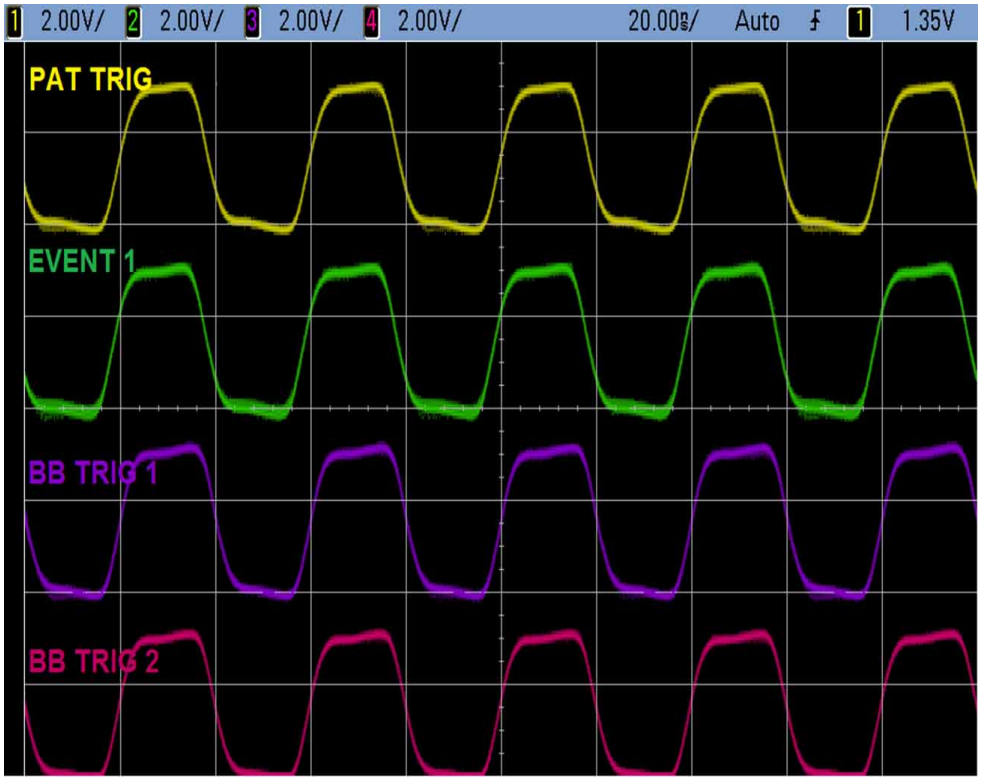
Outputs

The following procedure will play a waveform file, route a marker output to all four of the BNC connectors, and display the signal from each output on an oscilloscope. This will verify that each is functioning as an output. This procedure will require the use of an oscilloscope.

1. Return the instrument to a known state by pressing **Preset**.
2. Connect the four rear panel BNC connectors to the oscilloscope as follows:
   - PAT TRIG to Channel 1
   - EVENT 1 to Channel 2
   - BB TRIG 1 to Channel 3
   - BB TRIG 2 to Channel 4
3. Setup the oscilloscope with the following settings:
   - All Channels volts per division = 2 V
   - Horizontal scale per division = 20 ns
4. Turn the modulation on by pressing **Mod On/Off** so that the LED below it comes on.
5. On the signal generator press **Mode**, **Dual ARB**, **Select Waveform**.
6. Highlight RAMP_TEST_WFM and press **Select Waveform**.
7. Change the sample rate to 50 MHz by pressing **Arb Setup**, **Arb Sample Clock**, **50 MHz**.
8. Turn the Arb on by pressing **Mode**, **Dual ARB**, **Arb On**.
9. Go to the marker selection menu by pressing **More**, **Marker Utilities**, **Set Markers**.
10. Verify that RAMP_TEST_WFM is highlighted and **Marker 1** is selected on the top softkey.
11. Turn on marker 1 for every other waveform sample by pressing **Set Marker On Range of Points**, **# Skipped Points**, **1**, **Enter**, **Apply To Waveform**, **Return**, **Return.**
12. Route marker 1 to all the BNC connectors by pressing **Route To Baseband BNCs**, then:
    - **Route To BB TRIG 1 BNC**, **Marker 1**
    - **Route To BB TRIG 2 BNC**, **Marker 1**
    - **Route To EVENT 1 BNC**, **Marker 1**
    - **Route To PATT TRIG BNC**, **Marker 1**

13. The signals on the oscilloscope for all four BNC outputs should be as shown in Figure 12-10.

Figure 12-10 BNC Outputs Marker 1



14. If any of the outputs do not look like that shown, replace the A2 Vector BBG assembly.

Self Tests

There are a series of Self Tests related directly to the A2 Vector BBG assembly. They are the 700, 800, and 900 series tests. See Chapter 4, "Self Test," for a description of each of the tests.

When one of the self tests for this assembly fails the most likely cause of the failure will be the A2 Vector BBG assembly. However, there could be other assemblies that affect these test results. For example, if the supply voltages to the assembly are lower than required the 701 BB Board Voltages Test could fail, along with other tests. Or, if the RF signal level to the assembly is lower than required the 901 Prelevel DAC Test could fail, along with subsequent RF tests. So, a little analysis of the Self Test results may be required before replacing the A2 Vector BBG assembly when a related self test fails.

Before replacing an A2 Vector BBG assembly for a Self Test failure be sure to run the "I/Q Related Adjustments" listed later in this section. Also, be sure to verify the power supply voltages by seeing the "Power Supply Status Quick-Check" section in Chapter 8, "Power Supply"

I/Q Related Adjustments

There are eight I/Q related adjustments in the performance verification and adjustment software. They are:

1. IQ Abus Calibration

   Corrects the imperfections in the internal ABUS on the A2 Vector BBG assembly. This should be run before running any I/Q related adjustments.

2. IQ Prelevel Calibration

   Adjusts the LO drive level to the I/Q modulator. This adjustment requires that the RF power level coming from the A3 RF assembly to the A2 Vector BBG assembly be at the correct level.

3. IQ VBLO Calibration

   Adjusts the bias level for the mixers within the I/Q modulator. This is done to minimize distortion in the mixers within the modulator.

4. IQ Calibration

   Minimizes imperfections in the IQ System to deliver optimal performance at the RF output connector and the baseband IQ output connectors. It also provides a calibrated input at the IQ input connectors and calibrates the IQ System impairments.

5. IQ Channel Flatness Coarse Calibration
6. IQ Skew Calibration SA
7. IQ Channel Flatness Fine Calibration
8. IQ Channel Flatness Calibration PM

These last four adjustments all have the same goal and should always be run as a set. They are used to generate the IQ magnitude and phase correction data required to flatten the frequency response of the system from the output of the IQ DACs, through the analog IQ baseband system, through IQ Modulator inputs, to the RF output connector.

A7 Real-Time BBG Assembly Troubleshooting

Troubleshooting of the A7 Real-Time BBG assembly is going to be very limited due to the nature of the assembly. This will be limited to the following, and should normally be performed in this order:

1. Assembly Identification
2. Power Supply Verification
3. Self Tests

There are no adjustments for the A7 Real-Time BBG assembly.

Assembly Identification

When an A7 Real-Time BBG assembly is properly identified by the instrument it will appear on the Installed Board Info screen, as shown in Figure 12-1, as the **RT App** assembly. There are different reasons why the A7 Real-Time BBG assembly will not identify itself properly. A few of these are:

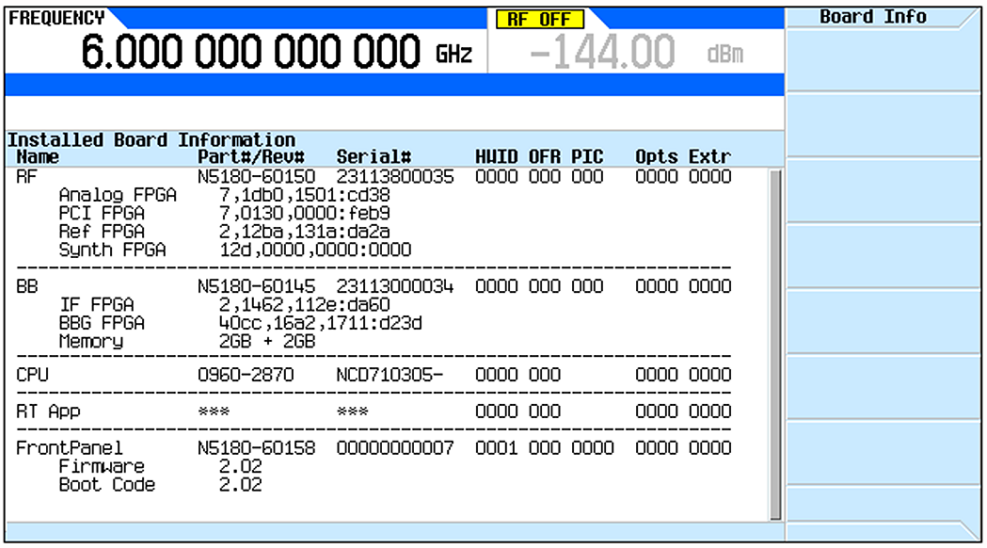
- The A2 Vector BBG assembly is not properly connected to the A3 RF assembly.
- The A8 Real Time BBG Jumper board is not properly aligned with either the A2 Vector BBG assembly or the A7 Real-Time BBG assembly.
- There is no active baseband generator option in the instrument (653, 655, 656, 657).
- Faulty A7 Real-Time BBG assembly.

NOTE

When an assembly has just been replaced and the instrument serial number has been lost, all instrument options will also be inactive, even if there are licenses in the instrument for them. If this is the case, restore the instrument serial number and the licenses before investigating an A7 Real-Time BBG assembly that is not identifying properly.

If any of these are the case the A7 Real-Time BBG assembly will either be partially identified, or not at all. When it is partially identified it will appear in the Installed Board Info screen as shown in Figure 12-11.

Figure 12-11 A7 Real-Time BBG Assembly Partial Identification



If this is seen the assembly will not function properly or pass the associated Self Tests. Determine which of the possible reasons listed above are causing the assembly to not identify properly before continuing.

Power Supply Verification

The A7 Real-Time BBG assembly is powered by the A7A1 Real-Time Aux. Power Supply. It receives +12 VDC from this supply and regulates it to multiple other DC voltages needed by the different sections of the assembly.

To verify the power supply voltages:

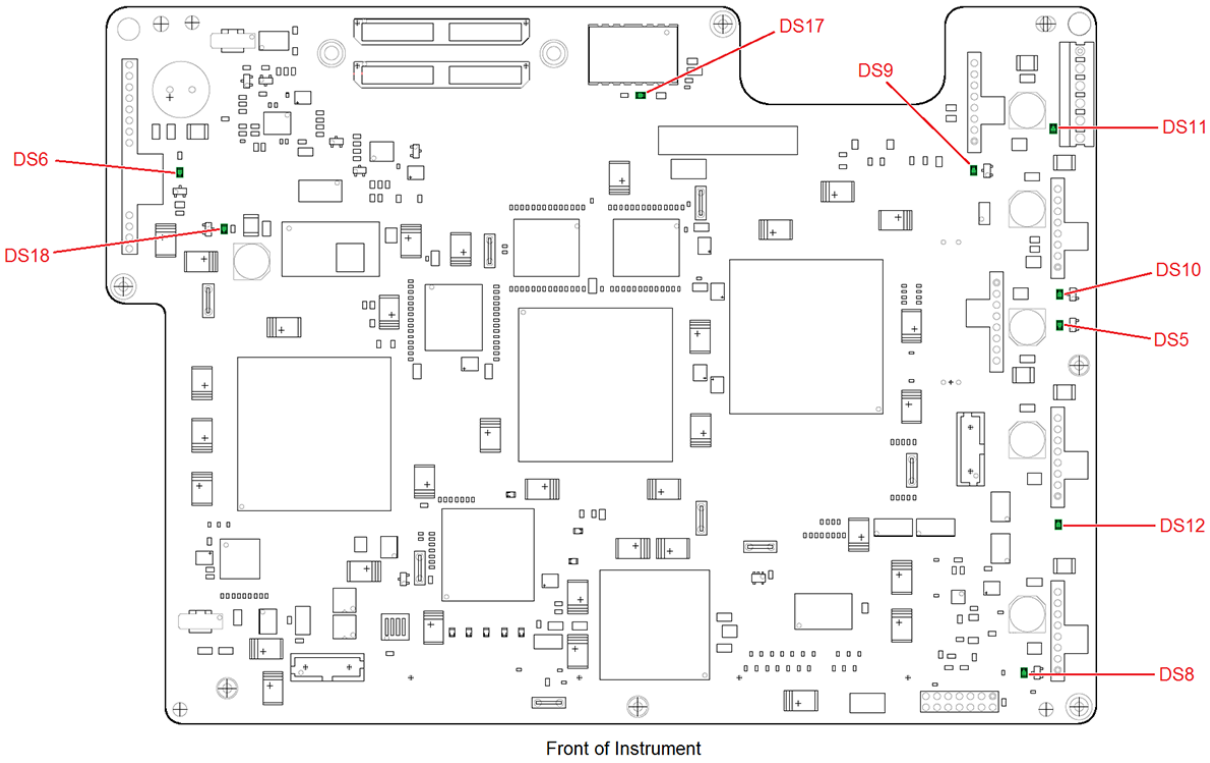
1. Turn the instrument power on.
2. Referring to Figure 12-12, first verify that DS11 is on. This LED indicates that the +12 VDC power supply to the assembly from the A7A1 Real-Time Aux Power Supply is present.
   - If DS11 is not on see the "A7A1 Real-Time Aux. Power Supply Troubleshooting" section in this chapter.
   - If DS11 is on proceed to step 2.
3. Verify that the rest of the power supply LEDs shown in Figure 12-12 are on.

   LED DS17 is not a power supply LED, it is a lock indicator for the 100 MHz reference on the assembly. It phase locks to a 100 MHz LVDS reference signal from the A2 Vector BBG assembly. This LED should also always be on.
   - If any of the power supply LEDs are off, while DS11 is on, replace the A7 Real-Time BBG assembly.

– If all the power supply LEDs, as well as DS17, are on, proceed to the next troubleshooting procedure.

– If DS17 is off, replace the A7 Real-Time BBG assembly.

Figure 12-12 A7 Real-Time BBG Assembly Power Supply LED Locations



Self Test

There are a series of Self Tests for the A7 Real-Time BBG assembly. If the previous troubleshooting procedures in the section have already been performed and no fault was found, run the 1500 series Self Tests. For information on running the instrument Self Tests see Chapter 4, “Self Test”

If any of the 1500 series Self Tests fail, and the previous troubleshooting procedures found in this section have not found a fault, the most probable cause of these failures is the A7 Real-Time BBG assembly.

A7A1 Real-Time Aux. Power Supply Troubleshooting

WARNING

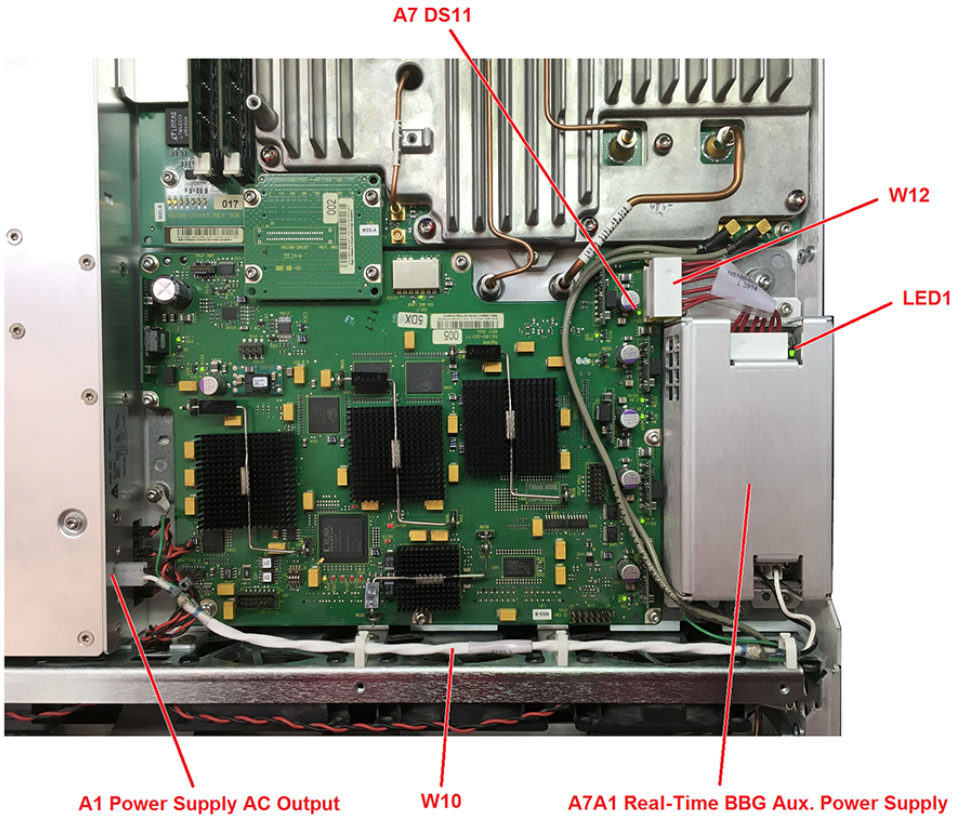
The AC power source from the A1 Power Supply assembly that powers the A7A1 Real-Time Aux. Power Supply is on whenever there is AC power supplied to the instrument, whether it is turned on or not. Do not attempt to remove any of the cables to or from either supply when an AC power cord is attached to the instrument.

The following troubleshooting procedure assumes that A7 DS11, as shown in Figure 12-12, is not on when AC power is applied to the instrument. If it is, see the "A7 Real-Time BBG Assembly Troubleshooting" procedure.

1. Turn the instrument off, but do not remove the AC power from the rear panel of the instrument.
2. Referring to Figure 12-13, verify that LED1 is on:
   - If LED1 is on there is either a problem with W12 or its connection at either end.
   - If LED1 is off, proceed to step 3.
3. Remove the power cord from the rear of the instrument.
4. Inspect the connections at both ends of W10 to verify that it is properly connected. Remove W10 and inspect it, as well as inspecting the connectors on both power supplies if necessary.

   If there is no problem with W10 or the connections, replace the A7A1 Real-Time Aux. Power Supply. If the problem persists after replacing it, replace the A1 Power Supply assembly.

Figure 12-13 A7A1 Real-Time Aux. Power Supply LED and Cables



13 Block Diagrams

What You Will Find in This Chapter

This chapter contains block diagrams of the major assemblies in the instrument as well as the interconnections between them and expected power levels.

Overview on page 274

Block Diagram Symbols on page 275

This chapter contains the following block diagrams:

MXG A3 RF Assembly (503 / 506)

CXG/EXG A3 RF Assembly (501 / 503 / 506)

MXG A3 RF Assembly (513 / 520 / 532 / 540)

EXG A3 RF Assembly (513 / 520 / 532 / 540)

MXG / EXG A7 Microdeck Assembly (513 / 520)

MXG / EXG A7 Microdeck Assembly (532 / 540)

A2 Vector BBG Assembly (N5166B / N5172B / N5182B)

Overview

The objective of the block diagrams is to provide a functional overview of the signal generator hardware. Becoming familiar with this information before starting to service the product will be of great benefit.

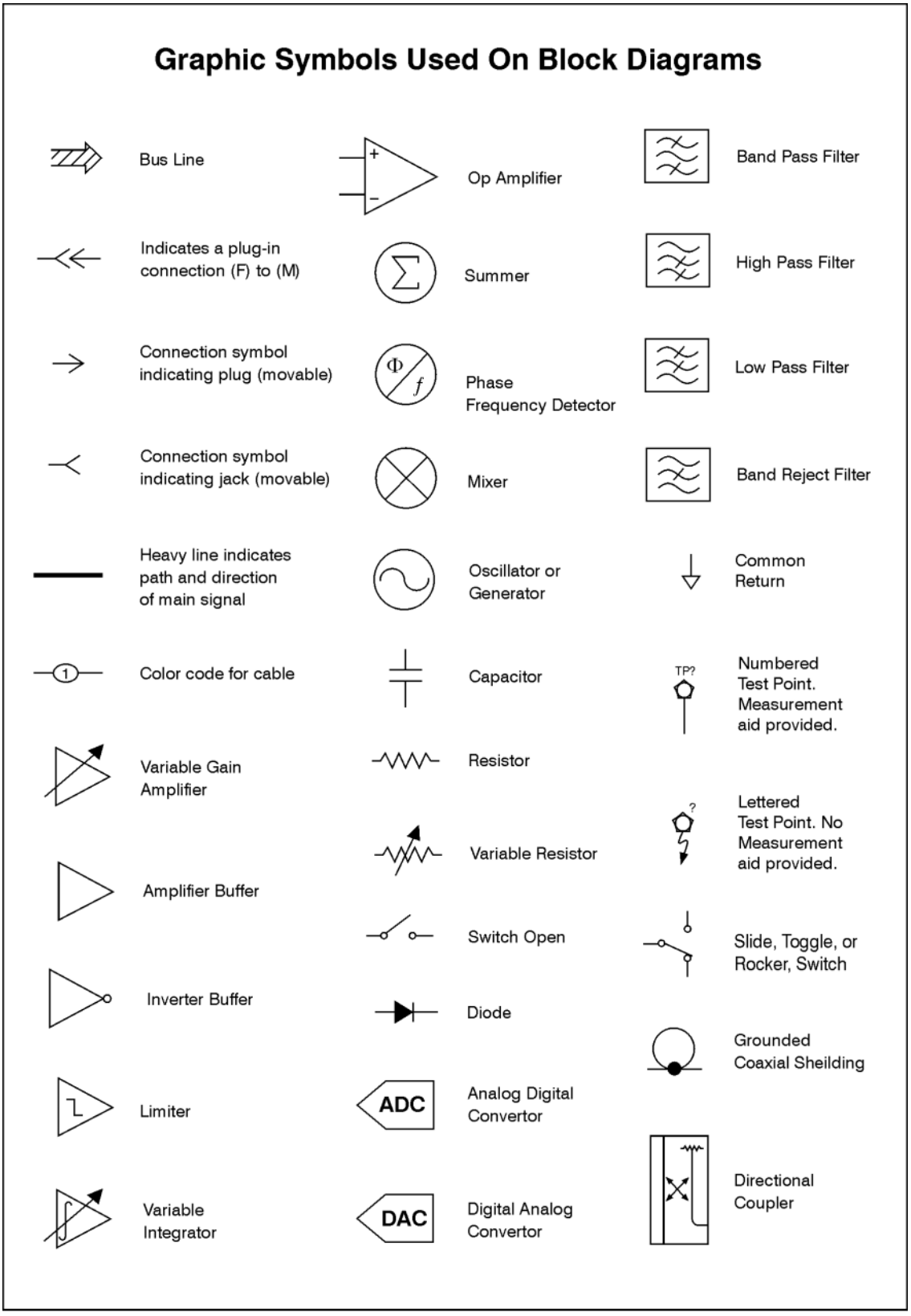
For a detailed description of the main functionality of the assemblies covered in the block diagrams see the information found in the associated chapter for each.

While the block diagrams in this chapter cover all frequency range options, of course the frequency option of any given instrument will determine the actual frequency range achievable.

The block diagrams for the following components are not covered in this chapter, but their functionality is described in the associated chapter for each.

- A1 Power Supply Assembly
- A5 CPU Assembly
- A6 Front Panel Assembly
- A7 Real Time BBG Assembly

Block Diagram Symbols



MXG A3 RF Assembly

N5181B, N5182B – Option 503 & 506

100 MHz
0 dBm +/-3 dB

A3 RF Assembly

W6 To A2 P500

J5000

Reference

10 MHz OCXO

dac

10 MHz

Signal Conditioning x2, x5 Multiplier Chain

100 MHz

÷2

50 MHz

100 MHz VCXO

X2

1 GHz

REF IN

J5003

80 MHz LPF

Detector

1 – 50 MHz

Flexible Reference FPGA

10 MHz OUT

J5002

10 MHz

+4 dBm +/-3 dB

10 MHz

÷10

100 MHz

X5

0.5 GHz

Synthesizer

FracN Loop

FM

FracN Divider

FM

1 – 2 GHz

÷16

62.5 – 125 MHz

1 GHz

Sum Loop

FM

Pretune

0.75 – 1.5 GHz

3.0 to 6.0 GHz

Sum Loop Atten.

0 – 31.75 dB

320 MHz LPF

2.76 GHz HPF

Offset Loop

1500 MHz BPF

500 MHz LPF

÷8

62.5 MHz or 187.5 MHz

3.0 to 6.0 GHz

Shock Line

V_{Bias}

Diplexer

HP

LP

200 MHz LPF

Pretune

3.0 to 6.0 GHz

Synthesizer Multiplier / Divider

First Doubler Path

1.5 – 3.0 GHz

X2

2.4 – 3.0 GHz

1.9 – 2.4 GHz

1.5 – 1.9 GHz

Second Doubler Path

3.0 – 6.0 GHz

X2

4.8 – 6.0 GHz

3.8 – 4.8 GHz

3.0 – 3.8 GHz

3.0 – 6.0 GHz

0.25 – 6.0 GHz

1.5 – 3.0 GHz

Divider Path

0.75 – 1.5 GHz

÷N

950 MHz – 1500 MHz

600 – 950 MHz

375 – 600 MHz

250 – 375 MHz

0.25 – 1.5 GHz

Multiplier Atten.

0 – 31.75 dB

Detector

0.25 – 6.0 GHz

J2004

W7 To A2 P1[1,2]

+0 dBm +/-6 dB

J2003

W8 From A2 P2[1]

RF Output

0.25 – 6.0 GHz

Pulse Modulator

Modulator Control

Pulse From LF Function Generator

High Band

>3.0 – 6.0 GHz

ALC Control

2.76 GHz HPF

6.4 GHz LPF

Detector

Low Band

0.25 – 3.0 GHz

ALC Control

Switched HPF

250 MHz

5 MHz – 3.0 GHz

Detector

1.005 – <1.250 GHz

Het Band

5 – <250 MHz

1 GHz

1 GHz BPF

350 MHz LPF

350 MHz LPF

ALC Detector and Temperature Control

Op-Amp Band

9 kHz – <5 MHz

Atten 1

-40 dB -10 dB -5 dB

Atten 2

-20 dB

Atten 3

-40 dB -10 dB -5 dB

Limiter & RPP Sense

RF OUT

J4000

Function Generator / Trigger Control

TRIG 1

J302

TRIG 2

J301

EXT 1

J9002

EXT 2

J9001

Trigger Interface

Sweep Out Interface

SWEEP OUT

J300

PULSE

J303

LF OUT

J9000

LF Function Generator

adc

adc

Pulse

FM

LF

AM

dac

Automatic Level Control

Pre Amp

Log Amp

Unlevel Detector

Reference

dac

Temp Sense

Temp Comp

dac

Linear

Exponential

20, 200, 2k Hz LPF

[1] Not used for N5181B

[2] W14 to Rear Panel LO OUT with Option 012

CXG / EXG A3 RF Assembly

N5166B, N5171B, N5172B – Option 501, 503, & 506

100 MHz
0 dBm +/-3 dB

A3 RF Assembly

W6 To A2 P500 J5000

100 MHz

Reference

10 MHz TCXO

dac

REF IN

J5003

80 MHz LPF

Detector

1 – 50 MHz

Flexible Reference FPGA

100 MHz VCXO

÷2

50 MHz

10 MHz OUT

J5002

10 MHz

+4 dBm +/-3 dB

10 MHz

÷10

100 MHz

X5

X2

1 GHz

Synthesizer

FM

FracN Divider

FM

0.75 – 1.5 GHz

Synthesizer Multiplier / Divider

First Doubler Path

1.5 – 3.0 GHz

X2

2.4 – 3.0 GHz

1.9 – 2.4 GHz

1.5 – 1.9 GHz

Second Doubler Path

3.0 – 6.0 GHz

X2

4.8 – 6.0 GHz

3.8 – 4.8 GHz

3.0 – 3.8 GHz

3.0 – 6.0 GHz

0.25 – 6.0 GHz

1.5 – 3.0 GHz

Divider Path

0.75 – 1.5 GHz

÷N

950 MHz – 1500 MHz

600 – 950 MHz

375 – 600 MHz

250 – 375 MHz

0.25 – 1.5 GHz

Multiplier Atten.

0 – 31.75 dB

Detector

0.25 – 6.0 GHz

J2004

W7 To A2 P1[1,2]

+0 dBm +/-6 dB

J2003

W8 From A2 P2[1]

RF Output

0.25 – 6.0 GHz

Pulse Modulator

Modulator Control

Pulse From LF Function Generator

High Band

>3.0 – 6.0 GHz

ALC Control

2.76 GHz HPF

6.4 GHz LPF

Detector

Low Band

0.25 – 3.0 GHz

ALC Control

Switched HPF

250 MHz

5 MHz – 3.0 GHz

Detector

1.005 – <1.250 GHz

Het Band

5 – <250 MHz

1 GHz

1 GHz BPF

350 MHz LPF

350 MHz LPF

ALC Detector and Temperature Control

Op-Amp Band

9 kHz – <5 MHz

Atten 1

-40 dB -10 dB -5 dB

Atten 2

-20 dB

Atten 3

-40 dB -10 dB -5 dB

Limiter & RPP Sense

RF OUT

J4000

Function Generator / Trigger Control

TRIG 1

J302

TRIG 2

J301

EXT 1

J9002

EXT 2

J9001

Trigger Interface

Sweep Out Interface

SWEEP OUT

J300

PULSE

J303

LF OUT

J9000

LF Function Generator

adc

adc

Pulse

FM

LF

AM

dac

Automatic Level Control

Pre Amp

Log Amp

Reference

dac

Temp Sense

Temp Comp

dac

Linear

Exponential

Unlevel Detector

20, 200, 2k Hz LPF

[1] Not used for N5171B

[2] W14 to Rear Panel LO OUT with Option 012

MXG A3 RF Assembly

N5183B – Option 513, 520, 532, & 540

100 MHz
0 dBm +/-3 dB
J5000

A3 RF Assembly

Reference

10 MHz OCXO
dac
10 MHz
Signal Conditioning x2, x5 Multiplier Chain
100 MHz
÷2
50 MHz
100 MHz VCXO
REF IN
J5003
80 MHz LPF
1 – 50 MHz
Flexible Reference FPGA
Detector
X2
1 GHz
10 MHz OUT
J5002
10 MHz
+4 dBm +/-3 dB
10 MHz
÷10
100 MHz
X5
0.5 GHz

Synthesizer

FracN Loop
FM
FracN Divider
FM
1 – 2 GHz
÷16
62.5 – 125 MHz
1 GHz
Sum Loop
FM
Pretune
0.75 – 1.5 GHz
3.0 to 6.0 GHz
Sum Loop Atten.
0 – 31.75 dB
320 MHz LPF
2.76 GHz HPF

Offset Loop
1500 MHz BPF
500 MHz LPF
÷8
62.5 MHz or 187.5 MHz
3.0 to 6.0 GHz
Shock Line
V_{Bias}
Diplexer
HP
LP
200 MHz LPF
3.0 to 6.0 GHz
Pretune

Synthesizer Multiplier / Divider

First Doubler Path
1.5 – 3.0 GHz
X2
2.4 – 3.0 GHz
1.9 – 2.4 GHz
1.5 – 1.9 GHz

Second Doubler Path
3.0 – 6.0 GHz
X2
4.8 – 6.0 GHz
3.8 – 4.8 GHz
3.0 – 3.8 GHz
3.0 – 6.0 GHz
0.25 – 6.0 GHz

1.5 – 3.0 GHz

Divider Path
0.75 – 1.5 GHz
÷N
950 MHz – 1500 MHz
600 – 950 MHz
375 – 600 MHz
250 – 375 MHz
0.25 – 1.5 GHz

Multiplier Atten.
0 – 31.75 dB
Detector
0.25 – 6.0 GHz
J2004
W21 To A7A2 J1
+0 dBm +/-6 dB

RF Output

0.25 – <3.2 GHz
Pulse Modulator
Modulator Control
Pulse From LF Function Generator

W20 To A7A3 J3
J2002
9 kHz – <3.2 GHz

Low Band
0.25 – <3.2 GHz
Switched HPF
250 MHz
ALC Control
5 MHz – <3.2 GHz
Detector

1.005 – <1.250 GHz

Het Band
5 – <250 MHz
1 GHz
1 GHz BPF
350 MHz LPF
350 MHz LPF

ALC Detector and Temperature Control

Op-Amp Band
9 kHz – <5 MHz

Function Generator / Trigger Control

TRIG 1
J302
TRIG 2
J301
EXT 1
J9002
EXT 2
J9001
Trigger Interface
Sweep Out Interface
SWEEP OUT
J300
PULSE
J303
LF OUT
J9000
LF Function Generator
adc
adc
dac
Pulse
FM
LF
AM

Automatic Level Control

Pre Amp
Linear
Exponential
To P3 Pin 5
20, 200, 2k Hz LPF
J6000
J7
W23 From A7A1 J18
W22 To A7A1 J11

EXG A3 RF Assembly

N5173B – Option 513, 520, 532, & 540

100 MHz
0 dBm +/-3 dB
J5000

A3 RF Assembly

Reference

10 MHz OCXO
dac
10 MHz
Signal Conditioning x2, x5 Multiplier Chain
100 MHz
100 MHz VCXO
÷2
50 MHz
1 – 50 MHz
Flexible Reference FPGA
80 MHz LPF
Detector
REF IN
J5003
10 MHz OUT
J5002
10 MHz
+4 dBm +/-3 dB
10 MHz
÷10
100 MHz
X5
X2
1 GHz

Synthesizer

FM
FracN Divider
FM
0.75 – 1.5 GHz

Synthesizer Multiplier / Divider

First Doubler Path
1.5 – 3.0 GHz
X2
2.4 – 3.0 GHz
1.9 – 2.4 GHz
1.5 – 1.9 GHz

Second Doubler Path
3.0 – 6.0 GHz
X2
4.8 – 6.0 GHz
3.8 – 4.8 GHz
3.0 – 3.8 GHz
3.0 – 6.0 GHz
0.25 – 6.0 GHz

1.5 – 3.0 GHz

Divider Path
0.75 – 1.5 GHz
÷N
950 MHz – 1500 MHz
600 – 950 MHz
375 – 600 MHz
250 – 375 MHz
0.25 – 1.5 GHz

Multiplier Atten.
0 – 31.75 dB
Detector
0.25 – 6.0 GHz
J2004
W21 To A7A2 J1
+0 dBm +/-6 dB

RF Output

0.25 – <3.2 GHz
Pulse Modulator
Modulator Control
Pulse From LF Function Generator

W20 To A7A3 J3
J2002
9 kHz – <3.2 GHz

Low Band
0.25 – <3.2 GHz
Switched HPF
250 MHz
ALC Control
5 MHz – <3.2 GHz
Detector

1.005 – <1.250 GHz

Het Band
5 – <250 MHz
1 GHz
1 GHz BPF
350 MHz LPF
350 MHz LPF

ALC Detector and Temperature Control

Op-Amp Band
9 kHz – <5 MHz

Function Generator / Trigger Control

TRIG 1
J302
TRIG 2
J301
EXT 1
J9002
EXT 2
J9001
Trigger Interface
Sweep Out Interface
SWEEP OUT
J300
PULSE
J303
LF OUT
J9000
LF Function Generator
adc
adc
dac
Pulse
FM
LF
AM

Automatic Level Control

Pre Amp
Linear
Exponential
To P3 Pin 5
20, 200, 2k Hz LPF
J6000
J7
W23 From A7A1 J18
W22 To A7A1 J11

EXG / MXG A7 Micro-Deck Assembly

N5173B, N5183B – Option 513 & 520

A7 Micro-Deck Assembly

2.5 – 5 GHz
+0 dBm +/-5 dB

From A3 J2004

W21

J1

A7A2 20 GHz Frequency Multiplier

2.5 – 5.0 GHz

Multi. 1st Atten.

0 – 31.5 dB

5 GHz LPF

Detector

4 – 5 GHz

X2

8 – 10 GHz

8.0 – 10 GHz

2.5 – 4 GHz

X2

5 – 8 GHz

6.4 – 8.0 GHz

5.0 – 6.4 GHz

Multi. 2nd Atten.

0 – 31.5 dB

3.2 – 10 GHz

3.2 – 5 GHz

5 – 10 GHz

X2

16 – 20 GHz

12.8 – 16 GHz

10 – 12.8 GHz

10 – 20 GHz

3.2 – 10 GHz

3.2 – 10 GHz

3.2 – 20 GHz

20 GHz LPF

Detector

J3

Control Interface

Gain

3.2 – 20 GHz
+17 dBm +/-5 dB

J2

W24

J1

A7A3 Mod-Filter

5 dB

ALC Modulator

Pulse Modulator

2 GHz HPF

5 dB

2 dB

10 – 20 GHz

J4

13 – 20 GHz

8 – 13 GHz

5 – 8 GHz

3.2 – 5 GHz

9 kHz – 3.2 GHz

9 kHz – 20 GHz

J2

24 GHz LPF

Control Interface

J6

J7

J10

J3

W20

From A3 J2002

9 kHz – <3.2 GHz

W34

W30

W29

W35

W25

Rear Panel
ALC IN

W32

J12

From A3 J7

W22

J11

J10

J14

A7A1 Microwave ALC

EXT Det

LB Det

HB Det

HB Det Bias

Log Amp

Unlevel Detector

HB MOD Driver

LB MOD Driver

J16

J18

W23

To A3 J6000

Reference

dac

TP 40

AM

Pulse

J15

J5

J4

J9

J8

Controller Interface

J3

J2

From A3 P2 & P3

Z Axis Out

J19

Rear Panel Z Axis Out

A7A5 Directional Coupler

W28

A7AT1 Step Attenuator

-5 dB

-10 dB

-20 dB

-40 dB

-40 dB

Control

To RF Output

W9*

*W19 if Option 1EM

A7A7 HB
Detector Bias

A7A6 HB
Detector

W31

W33

EXG / MXG A7 Micro-Deck Assembly

N5173B, N5183B – Option 532 & 540

A7 Micro-Deck Assembly

2.5 – 5 GHz
+0 dBm +/-5 dB
From A3 J2004
W21
J1

A7A2 20 GHz Frequency Multiplier

2.5 – 5.0 GHz
Multi. 1st Atten.
0 – 31.5 dB
5 GHz LPF
Detector
4 – 5 GHz
X2
8 – 10 GHz
8.0 – 10 GHz
2.5 – 4 GHz
X2
5 – 8 GHz
6.4 – 8.0 GHz
5.0 – 6.4 GHz
3.2 – 5 GHz
Multi. 2nd Atten.
0 – 31.5 dB
3.2 – 10 GHz
5 – 10 GHz
X2
16 – 20 GHz
12.8 – 16 GHz
10 – 12.8 GHz
10 – 20 GHz
3.2 – 10 GHz
3.2 – 20 GHz
20 GHz LPF
Detector
J3
Control Interface
Gain
3.2 – 10 GHz
3.2 – 10 GHz
J2
W24
3.2 – 20 GHz
+17 dBm +/-5 dB

A7A3 Mod-Filter

J1
5 dB
ALC Modulator
Pulse Modulator
2 GHz HPF
5 dB
2 dB
Control Interface
10 – 20 GHz
J4
13 – 20 GHz
8 – 13 GHz
5 – 8 GHz
3.2 – 5 GHz
9 kHz – 3.2 GHz
9 kHz – 20 GHz
24 GHz LPF
J2
J6
J7
J10
J3
W20
From A3 J2002
9 kHz – <3.2 GHz

W34
W30
W29
W35
W26
W25

A7A1 Microwave ALC

Rear Panel
ALC IN
W32
J12
From A3 J7
W22
J11
J10
J14
EXT Det
LB Det
HB Det
HB Det Bias
Log Amp
Unlevel Detector
HB MOD Driver
LB MOD Driver
J16
J18
W23
To A3 J6000
Reference
dac
TP 40
AM
Pulse
J15
J3
J2
From A3 P2 & P3
J5
J4
J9
J8
Controller Interface
Z Axis Out
J19
Rear Panel Z Axis Out

A7A4 40 GHz Doubler

J3
9 kHz – 20 GHz
10 – 20 GHz
J1
X2
32 – 40 GHz
26 – 32 GHz
20 – 26 GHz
20 – 40 GHz
9 kHz – 40 GHz
J2
P1
Control Interface

W27

A7AT1 Step Attenuator

-5 dB
-10 dB
-20 dB
-40 dB
-40 dB
Control
To RF Output
W9*
*W19 if Option 1EM

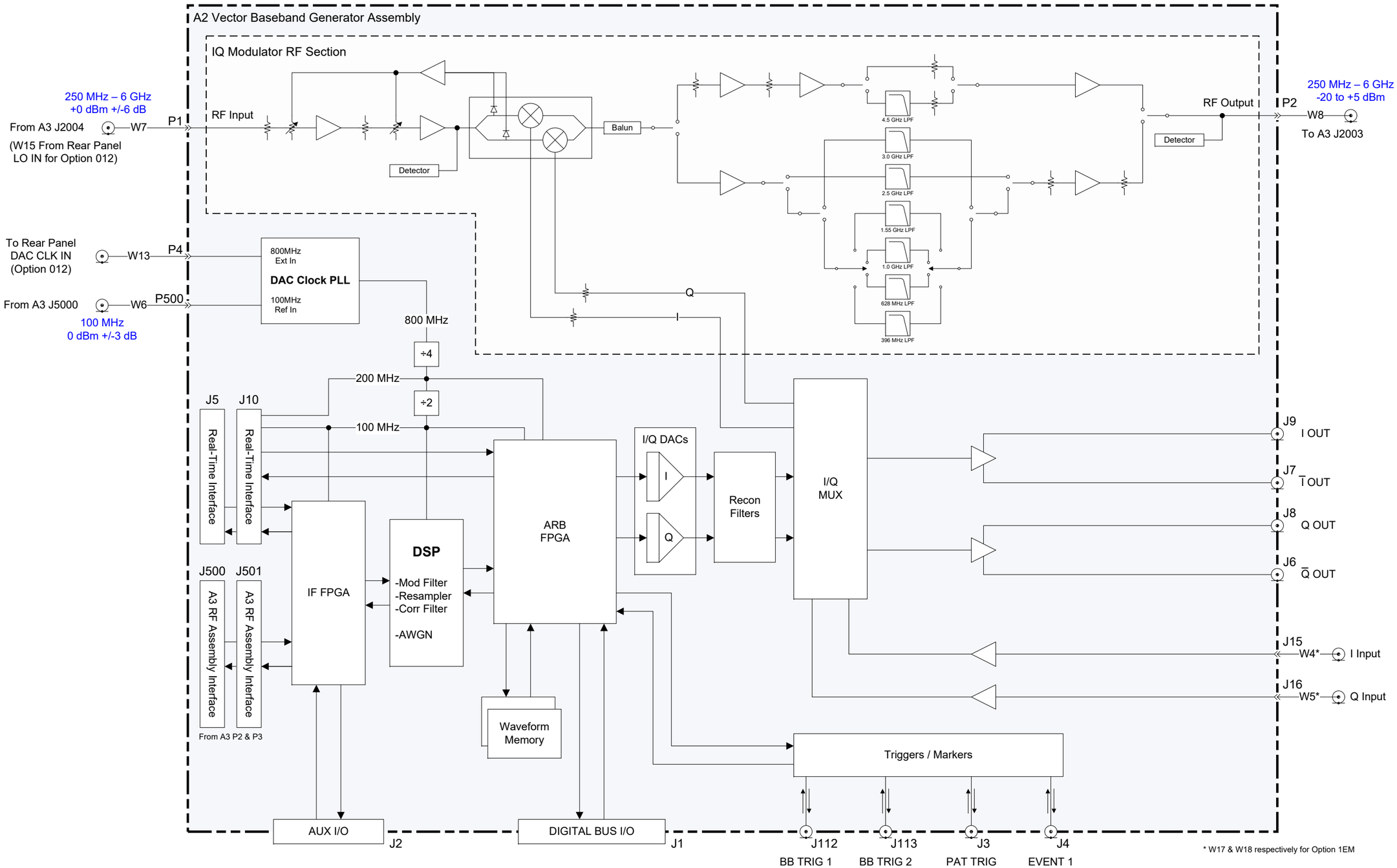
A7A5 Directional Coupler
W28

A7A7 HB Detector Bias
A7A6 HB Detector

W36
W31
W33

A2 Vector BBG Assembly

N5166B, N5172B, N5182B



14 Replacement Parts

What You Will Find in This Chapter

This chapter provides information on the following:

How to Order Parts on page 284

Shipping a Defective Assembly Back to Keysight Technologies on page 285

Assemblies, Cables, and Hardware on page 286

Hardware on page 301

Assemblies and Cables on page 310

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

Shipping a Defective Assembly Back to Keysight Technologies

1. When you receive the rebuilt/exchange assembly, be careful not to damage the box and shipping hardware in which it was shipped. You will use that box and shipping hardware to return the defective assembly. The box you receive should contain the following:

   —the rebuilt assembly

   —an exchange assembly failure report

   —a return address label

2. Complete the failure report.
3. Place the failure report and the defective assembly in the box. Be sure to remove the enclosed return address label.
4. Seal the box with tape.

   If you are inside the United States, stick the pre-printed return address label over the label that is already on the box and return the box to Keysight Technologies. (Keysight Technologies pays postage on boxes mailed within the United States.)

   If you are outside the United States, do not use the return address label; instead, address the box to the nearest Keysight Technologies sales and service office.

Assemblies, Cables, and Hardware

NOTE In early 2016 Keysight introduced a new instrument design platform that uses the Keysight color palette of darker colors for the external parts. Parts in this chapter that are referred to as "Dark color" are for this new color palette, while the "Light color" parts are for the older color palette.

Table 14-1 Assemblies, Chassis, and Cables

Description		Part Number
A1 Power Supply Assembly		N5180-60414
A2 Vector BBG Assembly N5166B, N5172B, N5182B	New Exchange	N5180-60415 N5180-69415
A2A1 Vector BBG Waveform Memory (N5166B, N5172B - 1 required, N5182B - 2 required)		1819-0590
A2MP1 Connector Preload Bracket w/ Foam N5166B, N5172B, N5182B		N5180-60246
A3 RF Assembly		See
CXG		Table 14-3
EXG		Table 14-4
MXG		Table 14-4
A3A1 Rear Panel SD Memory Card Option 006		1819-1250
A3BT1 Battery 3V 620 ma-HR Ll Manganese Dioxide		1420-0533
A4 Solid State Disk Drive Assembly N5166B, N5172B, N5182B		N5180-60426
A5 CPU Assembly and Thermal Pad		N5180-60427
A5MP1 CPU Heatsink and Thermal Pad		N5180-60443
A6 Complete Front Panel Replacement Kit		
N5166B	Light color Dark color	n/a n/a
N5171B	Light color Dark color	N5180-60439 N5180-60468
N5172B	Light color Dark color	N5180-60440 N5180-60469
N5173B	Light color Dark color	N5180-60262 N5180-60466

Table 14-1 Assemblies, Chassis, and Cables

Description		Part Number
N5181B	Light color	N5180-60441
	Dark color	N5180-60470
N5182B	Light color	N5180-60442
	Dark color	N5180-60471
N5183B	Light color	N5180-60263
	Dark color	N5180-60467
A6A1, PCA, Front Panel Interface		N5180-60428
A6A2, USB Interface Assembly PCA, USB Interface W2, Ribbon Cable, USB Interface		N5180-60411
A6A3, Power Switch Assembly PCA, Power Switch Keypad, Power Switch W38, Cable Harness, Power Switch		N5180-60410
A6A4, PCA, Keyboard		W1312-63118
A6A5, Display LCD Assembly Display LCD W37, Ribbon Cable, LCD Input		N5180-60412
A6MP1, Main Keypad	Light color	N5180-40011
	Dark color	N5180-40018
A6MP2, Overlay, Front Panel Main Keypad		
N5171B, N5181B, (N5172B, N5182B Option 1EM)	Light color	N5180-80043
	Dark color	N5180-80077
N5166B, N5172B, N5182B (Without Option 1EM)	Light color	N5180-80042
	Dark color	N5180-80076
N5173B, N5183B	Light color	N5180-80059
	Dark color	N5180-80086
A6MP3, Overlay, Front panel left side	Light color	N5180-80033
	Dark color	N5180-80071
A6MP4, Display Mount and Filter Assembly Filter EMI Display Display Boot Display Hold Down Compression Spring		N5180-60413

Table 14-1 Assemblies, Chassis, and Cables

Description		Part Number
A6MP5, Knob, RPG Large	Light color	W1312-40017
	Dark color	W1312-40179
A6MP6, Front Panel Display Bracket		W1312-00124
A6MP7, Display Side Support		W1312-20216
A6MP8, RFI Gasket, Front Frame		8160-0660
A7 Real Time BBG Assembly N5172B, N5182B, Option 660 only		N5180-60429
A7A1 Real Time Aux Power Supply N5172B, N5182B, Option 660		N5180-60430
A7A1MP1 Real Time BBG Aux Power Supply Cover N5172B, N5182B, Option 660		N5180-60431
A7 Micro-Deck Assembly (N5173B, N5183B)		
Option 513, 520 Front Panel Output	New	N5180-60460
	Exchange	N5180-69460
Option 532, 540 Front Panel Output	New	N5180-60463
	Exchange	N5180-69463
Option 1EM, Type-N Output Connector	New	N5180-60462
	Exchange	N5180-69462
Option 1EM, 3.5 mm Output Connector	New	N5180-60461
	Exchange	N5180-69461
Option 1EM, 2.4 mm Output Connector	New	N5180-60464
	Exchange	N5180-69464
A7A3A1 50 ohm Termination, Option 513, 520		1810-0118
A7AT1 Step Attenuator, 115 dB (N5173B, N5183B)		33328-60006
A8 Real Time BBG Jumper Board N5172B, N5182B, Option 660		N5180-60432
A8 BNC Bypass Board N5173B, N5183B		E8251-63665
B1 thru B4 Fan Assembly (each)		N5180-60433
J1 Front Panel RF Output Connector		
Type-N Female		1250-3968
3.5 mm Female		08673-60040
2.4 mm Female		5063-1700

Table 14-1 Assemblies, Chassis, and Cables

Description	Part Number
Front Panel RF Output Connector Bracket	
Type-N Output Connector	N5180-20114
3.5 mm Output Connector	N5180-20115
2.4 mm Output Connector	N5180-20116
Front Panel RF Output Connector Spacer	
Type-N Output Connector	N5180-20056
3.5 mm Output Connector	E8251-20068
2.4 mm Output Connector	None
J1 Rear Panel RF Output Connector	
Type-N Female	1250-3968
3.5 mm Female	08673-60040
2.4 mm Female	5063-1700
Rear Panel RF Output Connector Adapter (N5173B, N5183B)	
Type-N Output Connector	N5180-20062
3.5 mm Output Connector	N5180-20061
2.4 mm Output Connector	N5180-20060
Rear Panel RF Output Connector Spacer	
Type-N Output Connector	N5180-20056
3.5 mm Output Connector	E8251-20068
2.4 mm Output Connector	None
Rear Panel LO IN Connector (Option 012)	1250-1666
Rear Panel LO OUT Connector (Option 012)	1250-1666
Rear Panel DAC CLK IN Connector (Option 012)	1250-1666
Main Chassis	W1312-00125
Rear Panel	
N5171B, N5181B	N5180-00020
N5166B, N5172B, N5182B	N5180-00019
N5173B, N5183B	N5180-00018
Chassis Inside Top Cover	W1312-00126
Chassis Inside Bottom Cover	W1312-00127
Rear Panel SD Memory Card Cover (Option 006)	N5180-00027

Table 14-1 Assemblies, Chassis, and Cables

Description		Part Number
RFI Gasket, LCD		8160-1801
Chassis Corner Nuts		W1312-20038
Cable Clamp, Fan Power Cables to Main Chassis		1400-3140
Cable Clamp, W10 Wire Harness to Main Chassis (Option 660)		1400-3357
Cable Clamp, W6 Semi-Rigid Cable to A2 Vector BBG Assy (N5166B, N5172B, N5182B)		1400-3461
Cable Clamp, W19 Semi-Rigid Cable to A3 RF Assy (Option 1EM)		1400-1265
Hole Plug, Front Panel RF Output (Option 1EM)		6960-0517
Hole Plug, Rear Panel RF Output		6960-0517
Hole Plug, Rear Panel I and Q Output (N5166B, N5172B, N5182B)		6960-0507
Hole Plug, Rear Panel LO IN, LO OUT, and DAC CLK IN (N5166B, N5172B, N5182B)		6960-0076
Hole Plug, Rear Panel (N5173B, N5183B)		6960-0095
Instrument Outer Cover	Light Color	W1312-00128
	Dark Color	N5180-00038
Strap Handle Assembly	Light Color	W1312-60097
	Dark Color	N5180-60287
Hole Plug, Instrument Cover Side (1 each, 2 required)	Light Color	W1312-40024
	Dark Color	N9020-40014
Rear Panel Foot (1 each, 4 required)	Light Color	5041-9611
	Dark Color	5041-7903
Bottom Foot (1 each, 4 required)	Light Color	5041-9167
	Dark Color	5041-7906
Tilt Stand (1 each, 2 required)		1460-1345
Hole Plug, Bottom Feet (1 each, 4 required)	Light Color	W1312-40032
	Dark Color	N9020-40007
Front Panel Side Trim (1 each, 2 required)	Light Color	5041-9170
	Dark Color	5042-8425
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10		N5180-60183
W2, Ribbon Cable, A6A1 Front Panel Interface J15 to A6A2 USB Board J3		N5180-60186
W3, Ribbon Cable, A6A1 Front Panel Interface J5 to A6A4 Keyboard J1		8121-1382
W4, Coaxial Cable, A6 Front Panel I Input to A2 Vector BBG Assy J15		N5180-60435

Table 14-1 Assemblies, Chassis, and Cables

Description	Part Number
W5, Coaxial Cable, A6 Front Panel Q Input to A2 Vector BBG Assy J16	N5180-60435
W6, Semi-Rigid Cable, A3 RF Assy J5000 to A2 Vector BBG Assy P500	N5180-60436
W7, Semi-Rigid Cable, A3 RF Assy J2004 to A2 Vector BBG Assy P1	N5180-20187
W8, Semi-Rigid Cable, A2 Vector BBG Assy P2 to A3 RF Assy J2003	N5180-20188
W9, Semi Rigid Cable, A3 RF Assy J4000 to RF Output	
N5166B, N5171B, N5172B, N5181B, N5182B	N5180-20175
W9, Semi Rigid Cable, A7AT1 Atten Output to RF Output	
N5173B, N5183B - Type-N Output Connector	N5180-20217
N5173B, N5183B - 3.5 mm Output Connector	N5180-20215
N5173B, N5183B - 2.4 mm Output Connector	N5180-20212
W10, Cable Harness, A1 Power Supply to A7A1 Real Time BBG Aux. Power Supply Input	N5180-60437
W11, Ribbon Cable, Rear Panel GPIB to A3 RF Assy P4	N5180-60185
W12, Cable Harness, A7A1 Real Time BBG Aux. Power Supply Output	N5180-60181
W13, Semi-Rigid Cable, A2 Vector BBG Assy P4 to Rear Panel DAC CLK IN	N5180-20176
W14, Semi-Rigid Cable, A3 RF Assy J2004 to Rear Panel LO OUT	N5180-20186
W15, Semi-Rigid Cable, Rear Panel LO IN to A2 Vector BBG Assy P1	N5180-20144
W16, Semi-Rigid Cable, Rear Panel LO OUT to Rear Panel LO IN	N5180-20178
W17, Coaxial Cable, Rear Panel I Input to A2 Vector BBG Assy J15	N5180-60458
W18, Coaxial Cable, Rear Panel Q Input to A2 Vector BBG Assy J16	N5180-60458
W19, Semi-Rigid Cable, A3 RF Assy J4000 to Rear Panel RF Output (Option 1EM)	
N5171B, N5172B, N5181B, N5182B	N5180-20106
W19, Semi-Rigid Cable, A7AT1 Atten Output to Rear Panel RF Output (Option 1EM)	
N5173B, N5183B - Type-N Output Connector	N5180-20218
N5173B, N5183B - 3.5 mm Output Connector	N5180-20216
N5173B, N5183B - 2.4 mm Output Connector	N5180-20213
W20, Semi-Rigid Cable, A3 RF Assy J2002 to A7A3 Mod-Filter J3	N5180-20219
W21, Semi-Rigid Cable, A3 RF Assy J2004 to A7A2 20 GHz Multiplier J1	N5180-20208
W22, Coaxial Cable, A3 RF Assy J7 to A7A1 ALC Control J11	8121-1468
W23, Coaxial Cable, A7A1 ALC Control J18 to A3 RF Assy J6000	8121-1578
W24, Semi-Rigid Cable, A7A2 20 GHz Multiplier J2 to A7A3 Mod-Filter J1	N5180-20209

Table 14-1 Assemblies, Chassis, and Cables

Description	Part Number
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A4 40 GHz Doubler J3 (532/540)	N5180-20211
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A5 Coupler Input (513/520)	N5180-20285
W26, Semi-Rigid Cable, A7A3 Mod-Filter J4 to A7A4 40 GHz Multiplier J1 (532/540)	N5180-20210
W27, Semi-Rigid Cable, A7A4 40 GHz Doubler J2 to A7A5 Coupler Input (532/540)	N5180-20044
W27, Semi-Rigid Cable, A7A4 40 GHz Doubler J2 to A7A5 Coupler Input (532/540) (Option 1EM)	N5180-20047
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (513/520)	N5180-20283
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (513/520) (Option 1EM)	N5180-20284
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (532/540)	N5180-20045
W29, Coaxial Cable, A7A1 ALC Control J15 to A7A3 Mod-Filter J7	8121-1468
W30, Coaxial Cable, A7A1 ALC Control J16 to A7A3 Mod-Filter J6	8121-1468
W31, Coaxial Cable, A7A6 Detector Output to A7A1 ALC Control J10	8121-2775
W32, Coaxial Cable, Rear Panel ALC IN to A7A1 ALC Control J12	8121-0859
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1	N5180-60245
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1 (Option 1EM)	N5180-60244
W34, Ribbon Cable, A7A1 ALC Control J5 to A7A2 20 GHz Multiplier J3	N5180-60242
W35, Ribbon Cable, A7A1 ALC Control J8 to A7A3 Mod-Filter J10	8121-1469
W36, Ribbon Cable, A7A1 ALC Control J9 to A7A4 40 GHz Doubler Control	N5180-60243
W37, Ribbon Cable, A6A1 Front Panel Interface J7 to LCD Input	8121-1902
W38, Cable Harness, A6A1 Front Panel Interface J6 to A6A3 Power Switch J1	8121-1383

Table 14-2 CXG A3 RF Assemblies

Frequency Option	Description	New Assembly Part Number	Exchange Assembly Part Number
N5166B			
All	All Options - Front Panel Output	N5180-60473	N5180-69473

Table 14-3 EXG A3 RF Assemblies

Frequency Option	Description	New Assembly Part Number	Exchange Assembly Part Number
N5171B			
All	Option UNM - Front Panel Output	N5180-60416	N5180-69416
	Option 1EM - Rear Panel Output	N5180-60420	N5180-69420
N5172B			
503	Option UNM - Front Panel Output	N5180-60417	N5180-69417
506	Option UNM - Front Panel Output All option configurations **except** any of the following: 099, 1EA, UNV, UNZ	N5180-60418	N5180-69418
	Option UNM - Front Panel Output All option configurations	N5180-60419	N5180-69419
All	Option 1EM - Rear Panel Output	N5180-60420	N5180-69420
N5173B			
All	All Options	N5180-60173	N5180-69173

Table 14-4 MXG A3 RF Assemblies

Frequency Option	Description	New Assembly Part Number	Exchange Assembly Part Number
N5181B			
503	Option UNM - Front Panel Output	N5180-60456	N5180-69456
506	Option UNM - Front Panel Output	N5180-60457	N5180-69457
All	Option 1EM - Rear Panel Output	N5180-60425	N5180-69425
N5182B			
503	Option UNM - Front Panel Output All option configurations **except** any of the following: 099, 1EA, 1EQ, UNV, UNX, UNY, UNZ	N5180-60421	N5180-69421
	Option UNM - Front Panel Output All option configurations	N5180-60422	N5180-69422
506	Option UNM - Front Panel Output All option configurations **except** any of the following: 1EA, 1EQ, UNV, UNX, UNY, UNZ, or 099	N5180-60423	N5180-69423
	Option UNM - Front Panel Output All option configurations	N5180-60424	N5180-69424
All	Option 1EM - Rear Panel Output	N5180-60425	N5180-69425
N5183B			
All	All Options	N5180-60151	N5180-69151

Table 14-5 Accessories

Description		Part Number
Front Panel Impact Cover	Light color	N5180-40016
	Dark color	N5180-40019
Rack Mount Flange Kit	Light color	1CM010A
	Dark color	1CM110A
Handle Kit	Light color	1CN006A
	Dark color	1CN106A
Rack Mount Kit with Handles	Light color	1CP004A
	Dark color	1CP104A
Rack Slide Kit		1CR112A

Table 14-6 Attaching Hardware

Attach	To	Qty	Part Number	Type	Size	Tool	Torque
A1 Power Supply Assembly	Main Chassis	6	0515-1715	Pan Head	M3 x 0.5 (40 mm)	T-10	9 in-lbs
A2 Vector BBG Assembly	Main Chassis	4	0515-0374	Pan Head	M3 x 0.5 (10 mm)	T-10	9 in-lbs
A2MP1 Connector Preload Bracket	Main Chassis	2	0515-0666	Pan Head	M3 x 0.5 (18 mm)	T-10	9 in-lbs
Cable Clamp, W6 to A2 Vector BBG Assembly	A2 Vector BBG Assembly	1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A3 RF Assembly	Main Chassis	10	0515-0664	Pan Head	M3 x 0.5 (12 mm)	T-10	9 in-lbs
A3 RF Assembly Top Shield	A3 RF Assembly Bottom Shield	29	0515-0383	Pan Head	M4 x 0.7 (16 mm)	T-20	21 in-lbs
Cable Clamp, Rear Panel Output Cable (Option 1EM)	A3 RF Assembly	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A4 Solid State Disk Drive	Disk Drive Bracket	4	0515-1946	Flat Head	M3 x 0.5 (6 mm)	T-10	5 in-lbs
Solid State Disk Drive Interface Board	Disk Drive Bracket	2	0515-0430	Pan Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
Disk Drive Bracket	A3 RF Assembly	4	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
A5 CPU Assembly	A3 RF Assembly	4	0515-2141	Pan Head	M2.5 x 0.45 (14 mm)	T-8	6 in-lbs
A6 Front Panel Assembly	Main Chassis	4	0515-5844	Flat Head	M4 x 0.7 (8 mm)	T-20	21 in-lbs
A6A1, PCA, Front Panel Interface	A6 Front Panel Assembly	7	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A6A2, USB Interface Assembly	A6 Front Panel Assembly	1	0515-0374	Pan Head	M3 x 0.5 (10 mm)	T-10	9 in-lbs

Table 14-6 Attaching Hardware

Attach	To	Qty	Part Number	Type	Size	Tool	Torque
A6A3, Power Switch Assembly	A6 Front Panel Assembly	2	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
A6A4 PCA, Keypad	A6 Front Panel Assembly	9	0515-0430	Pan Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
A6MP6, Front Panel Display Bracket	A6 Front Panel Assembly	8	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A6MP7, Display Side Support	A6 Front Panel Assembly	3	0515-0665	Pan Head	M3 x 0.5 (14 mm)	T-10	9 in-lbs
W4 & W5 I/Q Input BNC Cables	A6 Front Panel Assembly	2	2950-0035	Hex Nut	n/a	9/16"	21 in-lbs
		2	2190-0102	Lock Washer	n/a	n/a	n/a
A7 Real Time BBG Assembly	Main Chassis	8	0515-0664	Pan Head	M3 x 0.5 (12 mm)	T-10	9 in-lbs
Real Time BBG Mounting Bracket	Main Chassis	2	0515-0664	Pan Head	M3 x 0.5 (12 mm)	T-10	9 in-lbs
A7A1 Real Time Aux. Power Supply	Real Time BBG Mounting Bracket	4	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A7A1 Real Time Aux. Power Supply Cover	Real Time BBG Mounting Bracket	4	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
W10 Real Time Aux. Power Supply Cable Grounds	Real Time BBG Mounting Bracket	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A7 Micro-Deck Assembly	Main Chassis	6	0515-0664	Pan Head	M3 x 0.5 (10 mm)	T-10	9 in-lbs
A7A1 ALC Control Board	A7 Micro-Deck Assembly	8	0515-0374	Pan Head	M3 x 0.5 (10 mm)	T-10	9 in-lbs
	Main Chassis	3	0515-0374	Pan Head	M3 x 0.5 (10 mm)	T-10	9 in-lbs
A7A2 20 GHz Multiplier	A7 Micro-Deck Assembly	6	0515-0383	Pan Head	M4 x 0.7 (16 mm)	T-20	21 in-lbs

Table 14-6 Attaching Hardware

Attach	To	Qty	Part Number	Type	Size	Tool	Torque
A7A3 Mod-Filter Assembly	A7 Micro-Deck Assembly	3	0515-1410	Pan Head	M3 x 0.5 (20 mm)	T-10	9 in-lbs
A7A4 40 GHz Doubler	Attenuator Bracket	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
A7A5 Coupler (Option 513, 520)	Coupler Bracket	2	2190-0583	Lock Washer	n/a	n/a	n/a
		2	0520-0128	Pan Head	2-56 (0.25"")	POZI	9 in-lbs
A7A5 Coupler (Option 532, 540)	Coupler Bracket	2	2200-0103	Pan Head	4-40 (0.25"")	POZI	9 in-lbs
A7A6 Detector Bias Board	Attenuator Bracket	2	0515-0430	Pan Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
A7AT1 Attenuator	Attenuator Bracket	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
Coupler Bracket	A7AT1 Attenuator	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
Attenuator Bracket	A7 Micro-Deck Assembly	7	0515-0430	Pan Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
W32 ALC IN Cable	Rear Panel	1	00310-48801	Washer	n/a	n/a	n/a
		1	2190-0102	Lock Washer	n/a	n/a	n/a
		1	2950-0035	Hex Nut	n/a	9/16"	21 in-lbs
A8 Real Time Jumper Board	A2 Vector BBG Assembly	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	A7 Real Time BBG Assembly	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
Front Panel Output Connector Bracket	Main Chassis	3	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs

Table 14-6 Attaching Hardware

Attach	To	Qty	Part Number	Type	Size	Tool	Torque
Rear Panel GPIB Connector	A3 RF Assembly	2	0380-4993	Standoff	M3 x 0.5 (17.5 mm)	7 mm	9 in-lbs
		2	2190-0586	Lock Washer	n/a	n/a	n/a
Rear Panel	A3 RF Assembly	2	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
		1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	A2 Vector BBG Assembly	4	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	Main Chassis	2	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	A1 Power Supply Assembly	1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	Chassis Inner Top Cover	1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	Chassis Inner Bottom Cover	1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
	A2 Vector BBG Assembly DIGITAL BUS and AUX I/O Connectors	4	0515-0366	Pan Head	M2.5 x 0.45 (6 mm)	T-8	6 in-lbs
	A3 RF Assembly BNC Connectors	9	2950-0054	Hex Nut	n/a	5/8"	21 in-lbs
		9	2190-0068	Lock Washer	n/a	n/a	n/a
	A2 Vector BBG Assembly BNC Connectors	8	2950-0054	Hex Nut	n/a	5/8"	21 in-lbs
		8	2190-0068	Lock Washer	n/a	n/a	n/a
	A7A1 ALC Control Z Axis Out	1	2950-0054	Hex Nut	n/a	5/8"	21 in-lbs
		1	2190-0068	Lock Washer	n/a	n/a	n/a

Table 14-6 Attaching Hardware

Attach	To	Qty	Part Number	Type	Size	Tool	Torque
Rear Panel Ground	n/a	1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
Rear Panel	A7 Micro-Deck Assembly	2	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
		1	0515-0372	Pan Head	M3 x 0.5 (8 mm)	T-10	9 in-lbs
LO OUT Connector	Rear Panel	1	3050-1013	Washer	n/a	n/a	n/a
LO IN Connector	Rear Panel	1	3050-1013	Washer	n/a	n/a	n/a
DAC CLK IN Connector	Rear Panel	1	3050-1013	Washer	n/a	n/a	n/a
Chassis Inner Top Cover	Main Chassis	9	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
	A2 Vector BBG Assembly	2	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
Chassis Inner Bottom Cover	Main Chassis	11	0515-1227	Flat Head	M3 x 0.5 (6 mm)	T-10	9 in-lbs
Chassis Corner Nut	Main Chassis	4	0361-1894	Pop Rivet	n/a	n/a	n/a
Rear Panel Foot	Main Chassis	4	0515-1619	Pan Head	M4 x 0.7 (25 mm)	T-20	21 in-lbs
Hole Plug - Instrument Cover	Main Chassis	2	0515-0708	Flat Head	M5 x 0.8 (12 mm)	T-20	21 in-lbs

Hardware

This section shows the hardware and other instrument parts in your signal generator.

– Front Panel View on page 302
– Rear Panel View on page 303
– Rear Panel Cable Connectors - Option 012 on page 305
– Main Chassis with Inside Covers on page 306
– Chassis Corner Nuts on page 307
– External Parts on page 308

Front Panel

Figure 14-1 Front Panel View

frontpanel

Item	Description	Part Number
1	A6MP3, Overlay, Front Panel left	
	light color	N5180-80033
	dark color	N5180-80071
2	Nameplate	n/a
3	A6MP5, RPG Knob	
	light color	W1312-40017
	dark color	W1312-40179
4	A6MP1, Main Keypad	
	light color	N5180-40011
	dark color	N5180-40018
5	A6MP2, Overlay, Main Keypad	see Table 14-1
6	RF Connector	see Table 14-1
7	Nut-Hex	2950-0035
8	Washer	2190-0102
9	A6A3, Power Switch	N5180-60410
10	A6A2, USB Board	N5180-60411

Rear Panel

Figure 14-2 Rear Panel View

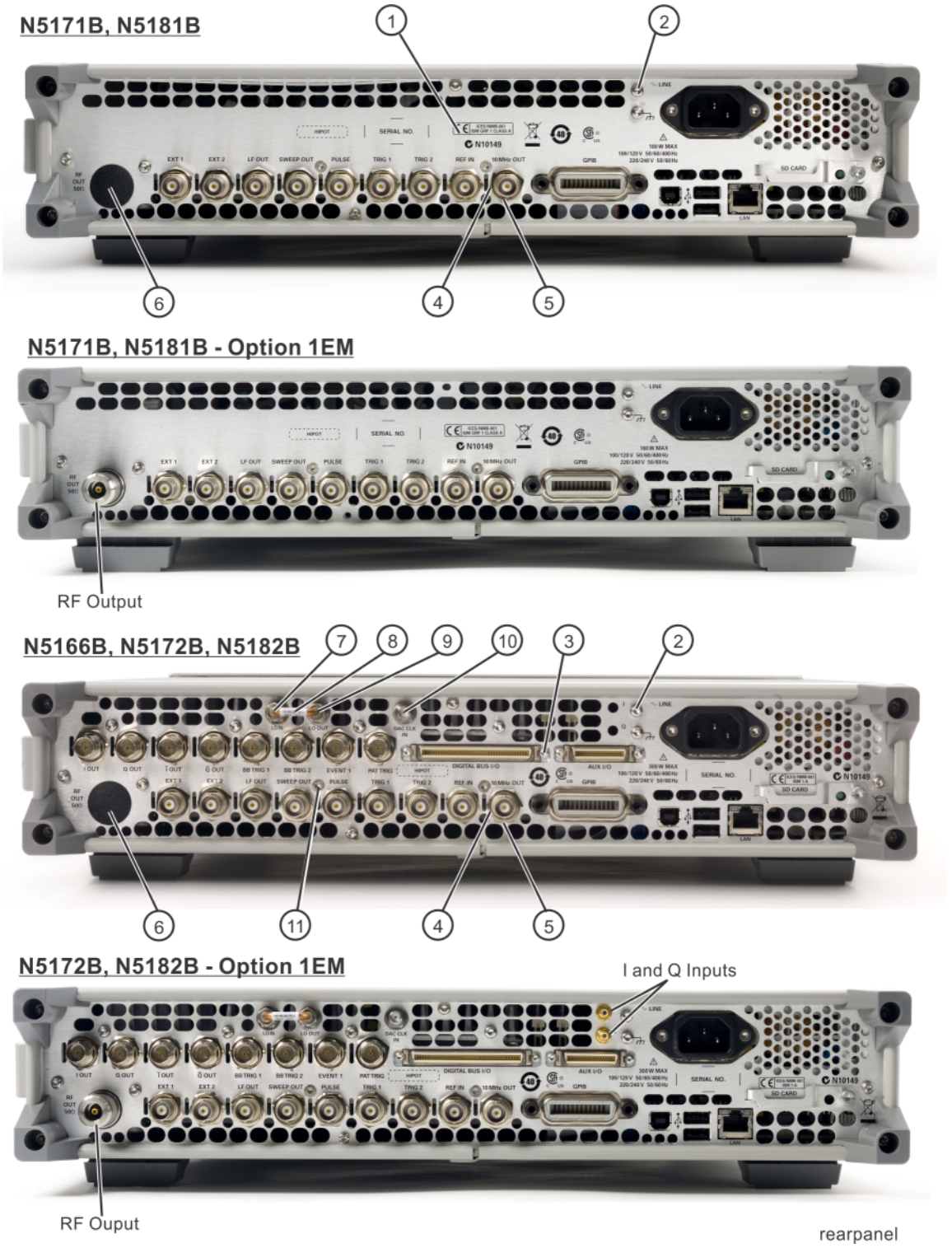
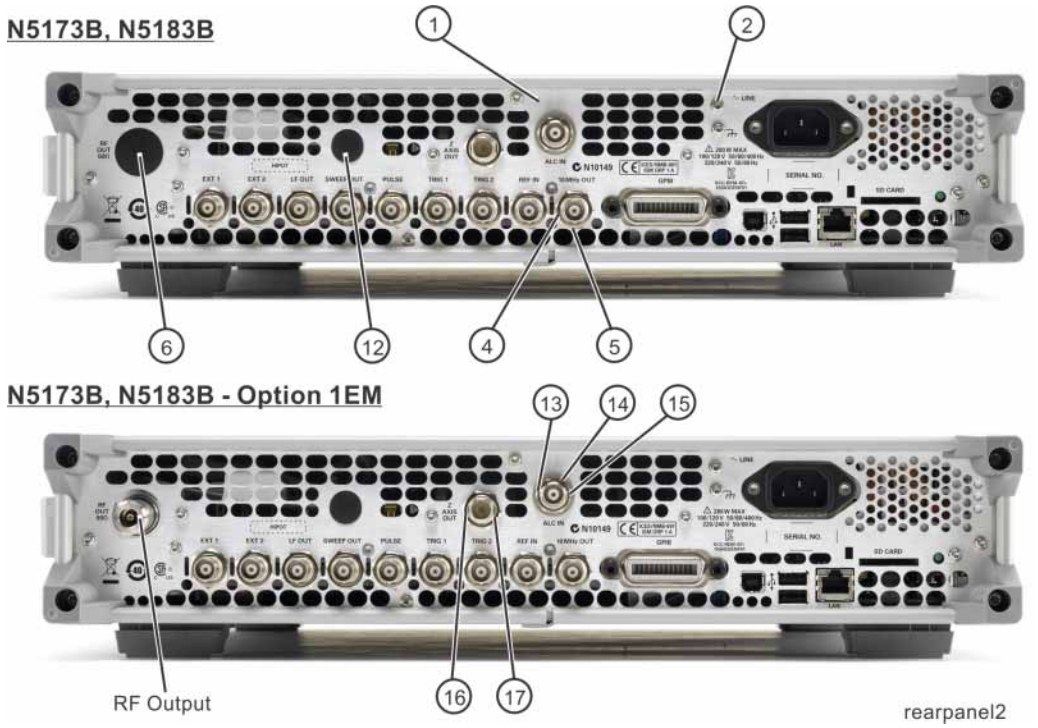
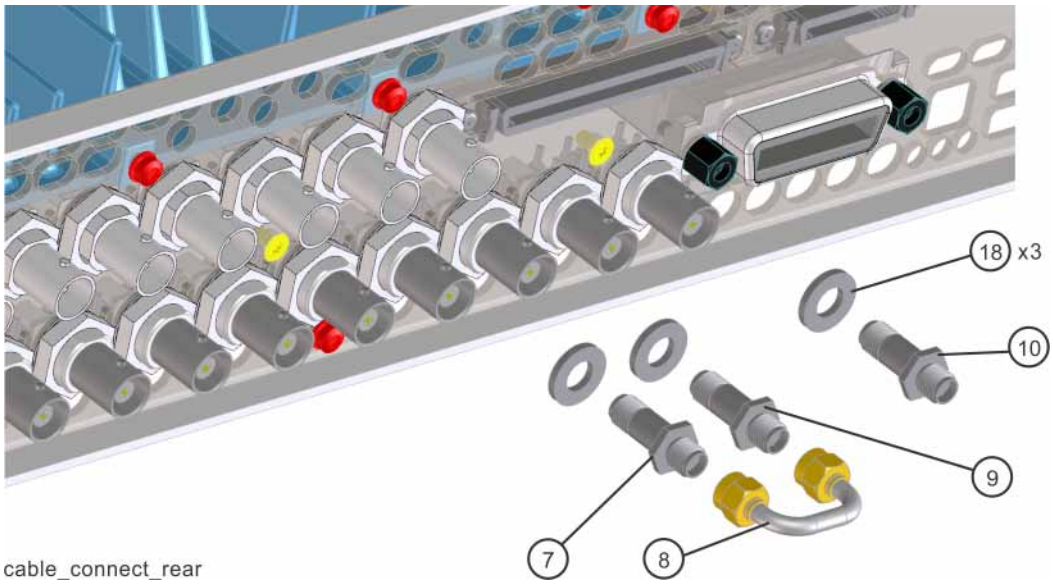


Figure 14-3 Rear Panel View - N5173B/83B



Item	Description	Part Number
1	Rear Panel	see Table 14-1
2	Screw, machine M3.0 x 8	0515-0372
3	Screw-Machine Pan-HD Torx-T8 M2.5 x 0.45 6mm-LG (N5166B/N5172B/N5182B only)	0515-0366
4	Lock washer	2190-0068
5	Hex nut	2950-0054
6	Rear Panel Hole Plug	6960-0517
7	LO IN Rear Panel Connector assembly (Option 012)	1250-1666
8	W16 LO OUT to LO IN Semi-Rigid Jumper Cable (Option 012)	N5180-20178
9	LO OUT Rear Panel Connector assembly (Option 012)	1250-1666
10	DAC CLK IN Rear Panel Connector assembly (Option 012)	1250-1666
11	Screw, machine 90-DEG-FLT-HD Torx-T10 M3 x 0.5 6mm-LG	0515-1227
12	Rear Panel Hole Plug	6960-0095
13	Washer	00310-48801
14	Lock Washer	2190-0102
15	Hex Nut	2950-0035
16	Washer	2190-0068
17	Hex Nut	2950-0054

Figure 14-4 Rear Panel Cable Connectors - Option 012



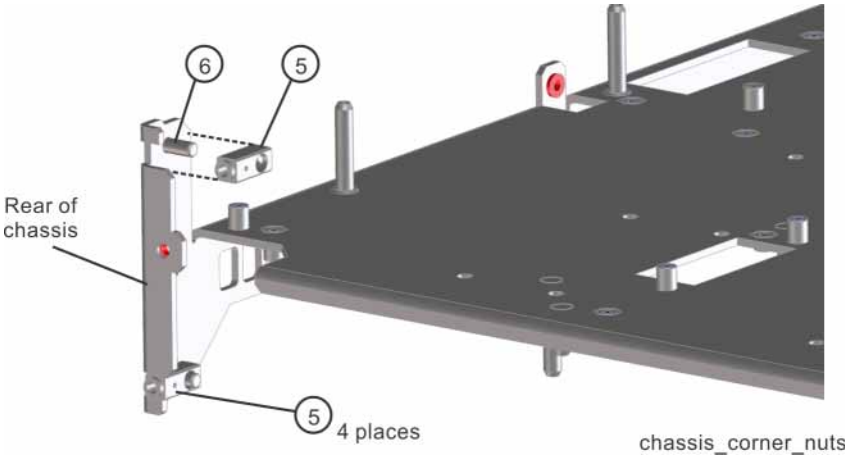
Item	Description	Part Number
7	LO IN Rear Panel Connector assembly	1250-1666
8	W16 LO OUT to LO IN Semi-Rigid Jumper Cable	N5180-20178
9	LO OUT Rear Panel Connector assembly	1250-1666
10	DAC CLK IN Rear Panel Connector assembly	1250-1666
18	Flat Washer	3050-1013

Main Chassis with Inside Covers

Figure 14-5 Main Chassis with Inside Covers

Item	Description	Part Number
1	Main Chassis Inside Top Cover	W1312-00126
2	Main Chassis Inside Bottom Cover	W1312-00127
3	Screw - machine M3.0 x 08 FL-TX	0515-1227
4	Screw - machine M3.0 x 08 PN-TX	0515-0372

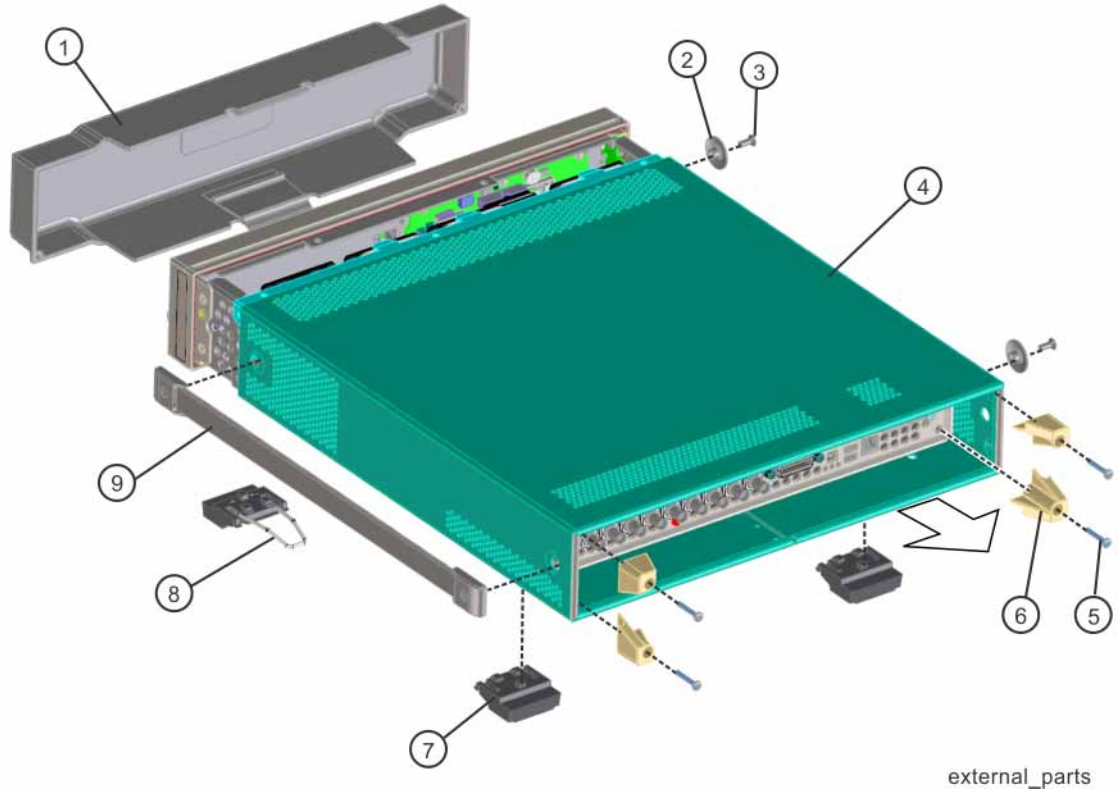
Figure 14-6 Chassis Corner Nuts



Item	Description	Part Number
5	Chassis Corner Nut	W1312-20038
6	SST PoP-Rivet	0361-1894

Outer Instrument Cover and Associated Parts

Figure 14-7 External Parts



Item	Description	Part Number
1	Front Panel Impact Cover	
	light color	N5180-40016
	dark color	N5180-40019
2	Hole Plug, Instrument Cover Side	
	light color	W1312-40024
	dark color	N9020-40014
3	Screw, Flat Head, M5 x 0.8, Torx T-20	0515-0708
4	Instrument Outer Cover	
	light color	W1312-00128
	dark color	N5180-00038
5	Screw, Pan Head, M4 x 0.7, Torx T-20	0515-1619
6	Rear Panel Feet	
	light color	5041-9611
	dark color	5041-7903

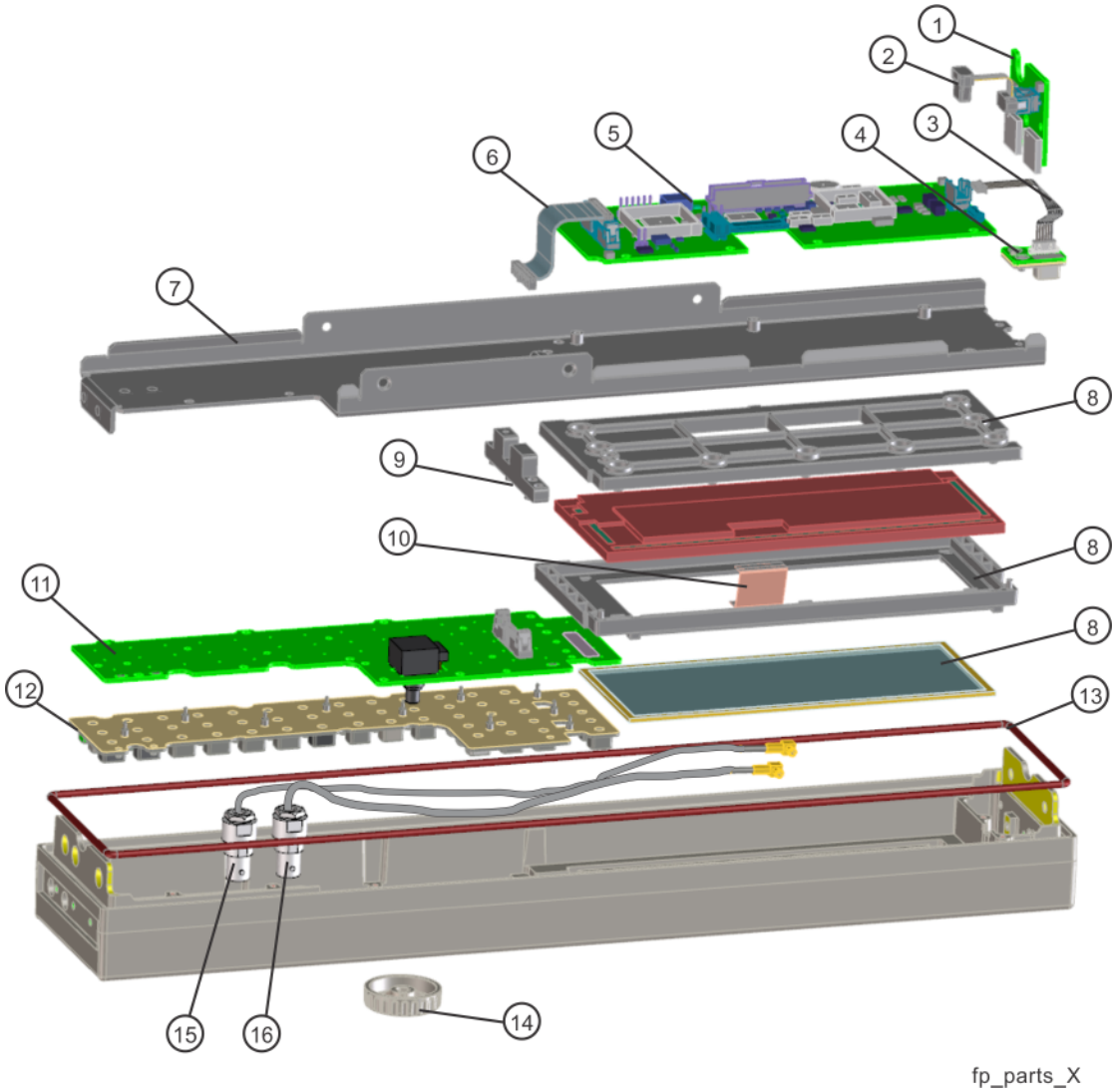
Item	Description	Part Number
7	Bottom Feet	
	light color	5041-9167
	dark color	5041-7906
8	Tilt Stand	1460-1345
9	Strap Handle assembly	
	light color	W1312-60097
	dark color	N5180-60287
not shown	Hole Plug, Bottom Feet	
	light color	W1312-40032
	dark color	N9020-40007

Assemblies and Cables

This section shows the assemblies and cables in your signal generator.

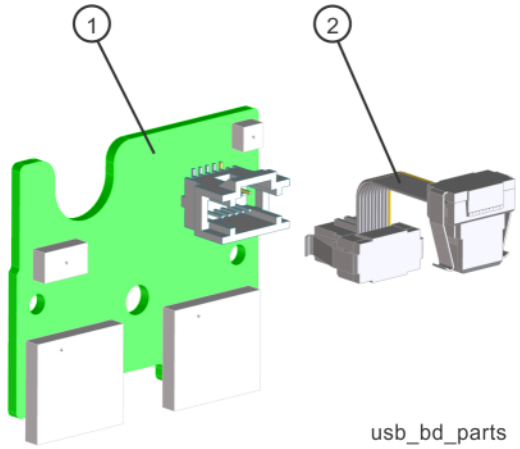
- Front Panel Assemblies on page 311
- A6A2 USB Interface Assembly Parts on page 313
- A6A3 Power Switch Assembly Parts on page 313
- A6A5 Display LCD Assembly Parts on page 314
- A6MP4, Display Mount and Filter Assembly on page 315
- Front Panel RF Connector/Spacer/Bracket w/ W9 Semi-Rigid Cable Assembly Parts on page 316
- Assemblies Top View - N5166B, N5171B/72B/81B/82B on page 317
- Assemblies Top View - N5173B/83B (Options 513/520) on page 319
- Assemblies Top View - N5173B/83B (Options 513/520, 1EM) on page 321
- Assemblies Top View - N5173B/83B (Options 532/540) on page 323
- Assemblies Top View - N5173B/83B (Options 532/540, 1EM) on page 325
- Assemblies Bottom View - All Models (N5182B shown) on page 327
- A3 RF Assembly, A4 SSD, A5 CPU on page 328
- Rear Panel I/Q Cables - N5172B/82B Option 1EM on page 329
- Rear Panel RF Connector/Spacer w/ W19 Semi-Rigid Cable Assembly Parts N5171B/72B/81B/82B on page 330
- Location of W19 and 1EM Rear Panel RF Connector-N5171B/72B/81B/82B on page 330
- Rear Panel RF Connector/Spacer w/ W19 Semi-Rigid Cable Assembly Parts N5173B/83B on page 331
- Rear Panel Cables - Option 012 on page 332
- A2 Vector BBG Assembly Parts - N5166B/N5172B/N5182B on page 333
- A7 Real Time BBG Assembly on page 334
- B1 Through B4 Fan Assembly Parts - N5180-60433 on page 335
- A3A1 Rear Panel SD Memory Card (Option 006) on page 336

Figure 14-8 Front Panel Assemblies



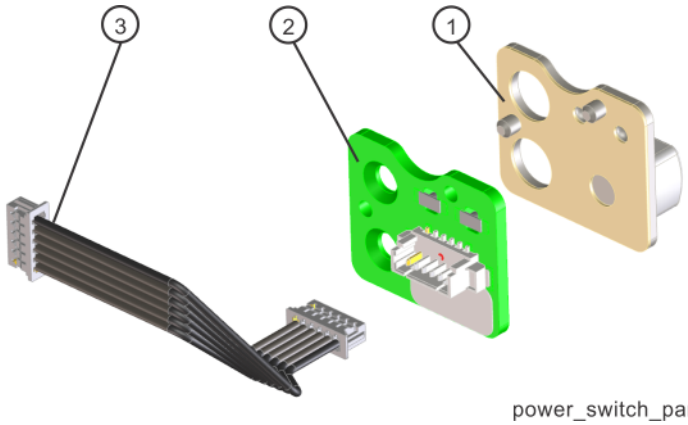
Item	Description	Part Number
1	A6A2, USB Interface Assembly (includes W2)	N5180-60411
2	W2, Ribbon Cable, A6A1 Front Panel Interface J15 to A6A2 USB Board J3	N5180-60186
3	W38, Cable Harness, A6A1 Front Panel Interface J6 to A6A3 Power Switch J1	8121-1383
4	A6A3, Power Switch Assembly PCA, Power Switch Keypad, Power Switch W38, Cable Harness, Power Switch	N5180-60410
5	A6A1, PCA, Front Panel Interface	N5180-60428
6	W3, Ribbon Cable, A6A1 Front Panel Interface J5 to A6A4 Keyboard J1	8121-1382
7	A6MP6, Front Panel Display Bracket	W1312-00124
8	A6MP4 Display Mount and Filter Assembly	N5180-60413
9	A6MP7, Display Side Support	W1312-20216
10	W37, Ribbon Cable, A6A1 Front Panel Interface J7 to LCD Input	8121-1902
11	A6A4, PCA, Keyboard	W1312-63118
12	A6MP1, Main Keypad	
	light color	N5180-40011
	dark color	N5180-40018
13	A6MP8, RFI Gasket, Front Frame	8160-0660
14	A6MP5, Knob, RPG Large	
	light color	W1312-40017
	dark color	W1312-40179
15	W5, Coaxial Cable, A6 Front Panel Q Input to A2 Vector BBG Assy J16	N5180-60435
16	W4, Coaxial Cable, A6 Front Panel I Input to A2 Vector BBG Assy J15	N5180-60435

Figure 14-9 A6A2 USB Interface Assembly Parts



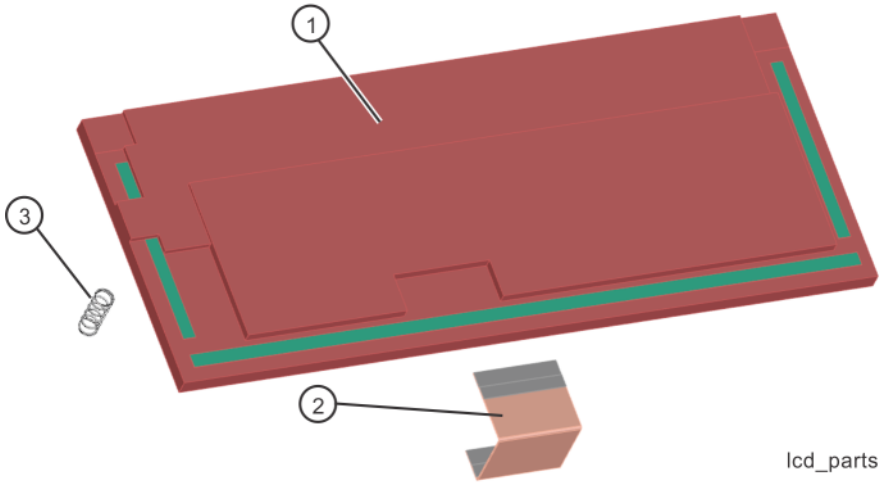
Item	Description	Part Number
	A6A2 USB Interface Assembly	N5180-60411
1	USB Board	n/a
2	W2, Ribbon Cable, A6A1 Front Panel Interface J15 to A6A2 USB Board J3	N5180-60186

Figure 14-10 A6A3 Power Switch Assembly Parts



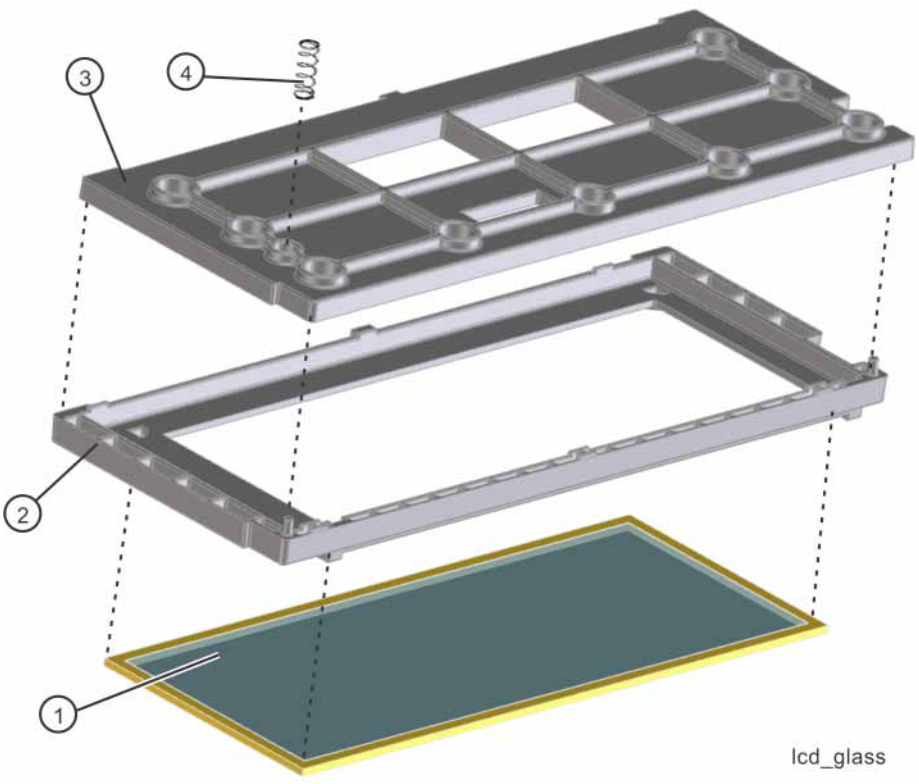
Item	Description	Part Number
	A6A3 Power Switch Assembly	N5180-60410
1	Keypad, Power Switch	n/a
2	Power Switch PC Board	n/a
3	W38, Cable Harness, A6A1 Front Panel Interface J6 to A6A3 Power Switch J1	8121-1383

Figure 14-11 A6A5 Display LCD Assembly Parts



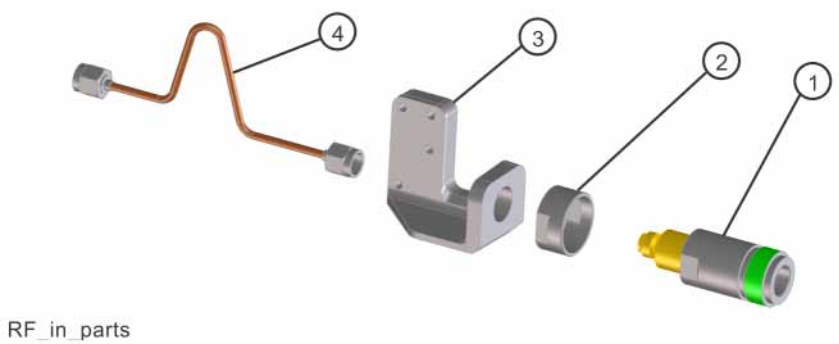
Item	Description	Part Number
	A6A5 Display LCD Assembly	N5180-60412
1	LCD Display	n/a
2	W37, Ribbon Cable, A6A1 Front Panel Interface J7 to LCD Input	8121-1902
3	Compression Spring	n/a

Figure 14-12 A6MP4, Display Mount and Filter Assembly



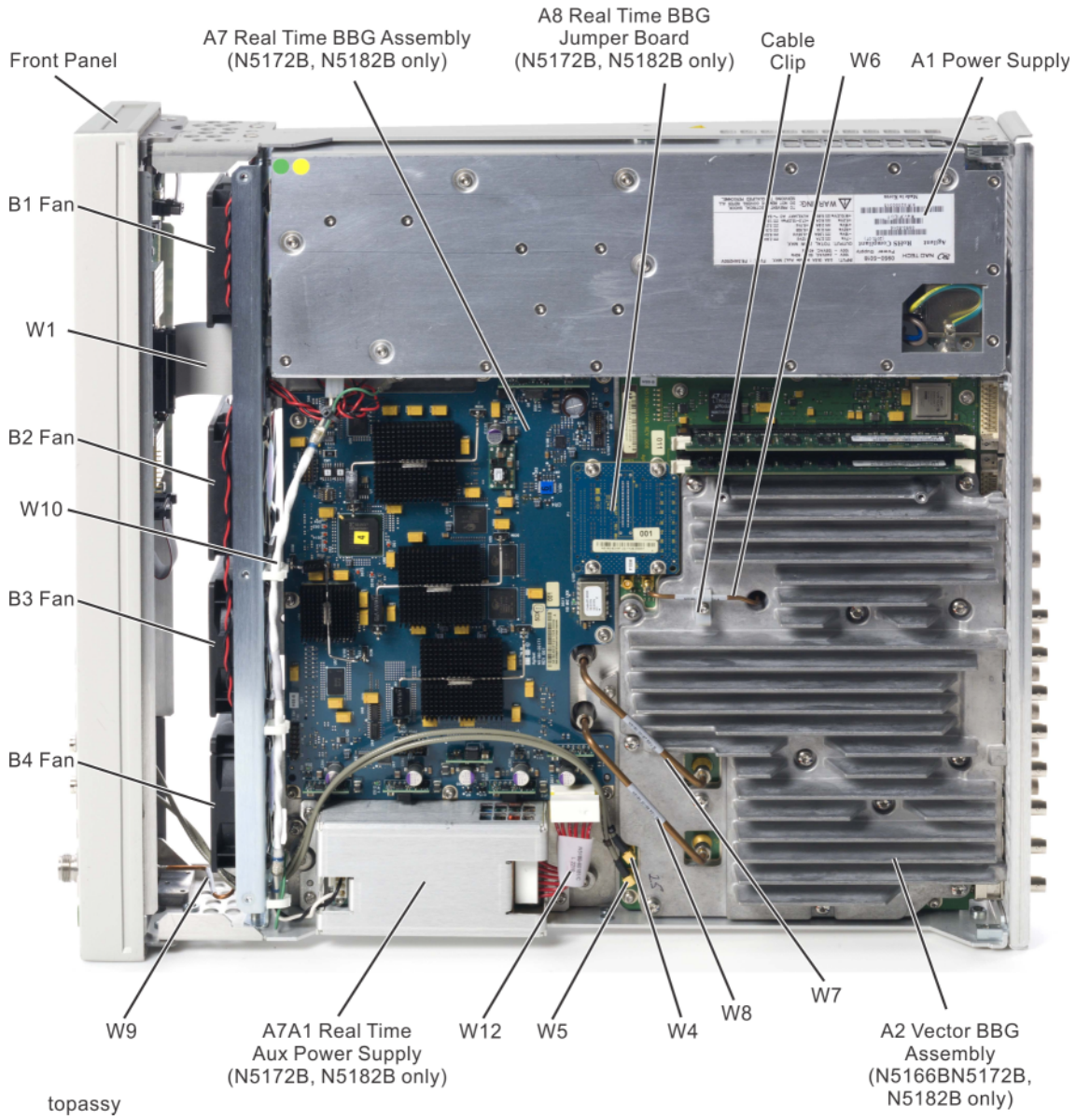
Item	Description	Part Number
	A6AMP4 Display Mount and Filter Assembly	N5180-60413
1	Filter - LCD Glass	n/a
2	Display Boot	n/a
3	Display Hold-Down Boot	n/a
4	Compression Spring	n/a

Figure 14-13 Front Panel RF Connector/Spacer/Bracket w/ W9 Semi-Rigid Cable Assembly Parts



Item	Description	Part Number
1	J1 Front Panel RF Output Connector	
	Type-N Female	1250-3968
	3.5 mm Female	08673-60040
	2.4 mm Female	5063-1700
2	Spacer	
	Type-N Output Connector	N5180-20056
	3.5 mm Output Connector	E8251-20068
	2.4 mm Output Connector	None
3	Bracket	
	Type-N Output Connector	N5180-20114
	3.5 mm Output Connector	N5180-20115
	2.4 mm Output Connector	N5180-20116
4	W9, Semi Rigid Cable, A3 RF Assy J4000 to RF Output	
	N5166B, N5171B, N5172B, N5181B, N5182B	N5180-20175
	N5173B, N5183B - Type-N Output Connector	N5180-20217
	N5173B, N5183B - 3.5 mm Output Connector	N5180-20215
	N5173B, N5183B - 2.4 mm Output Connector	N5180-20212

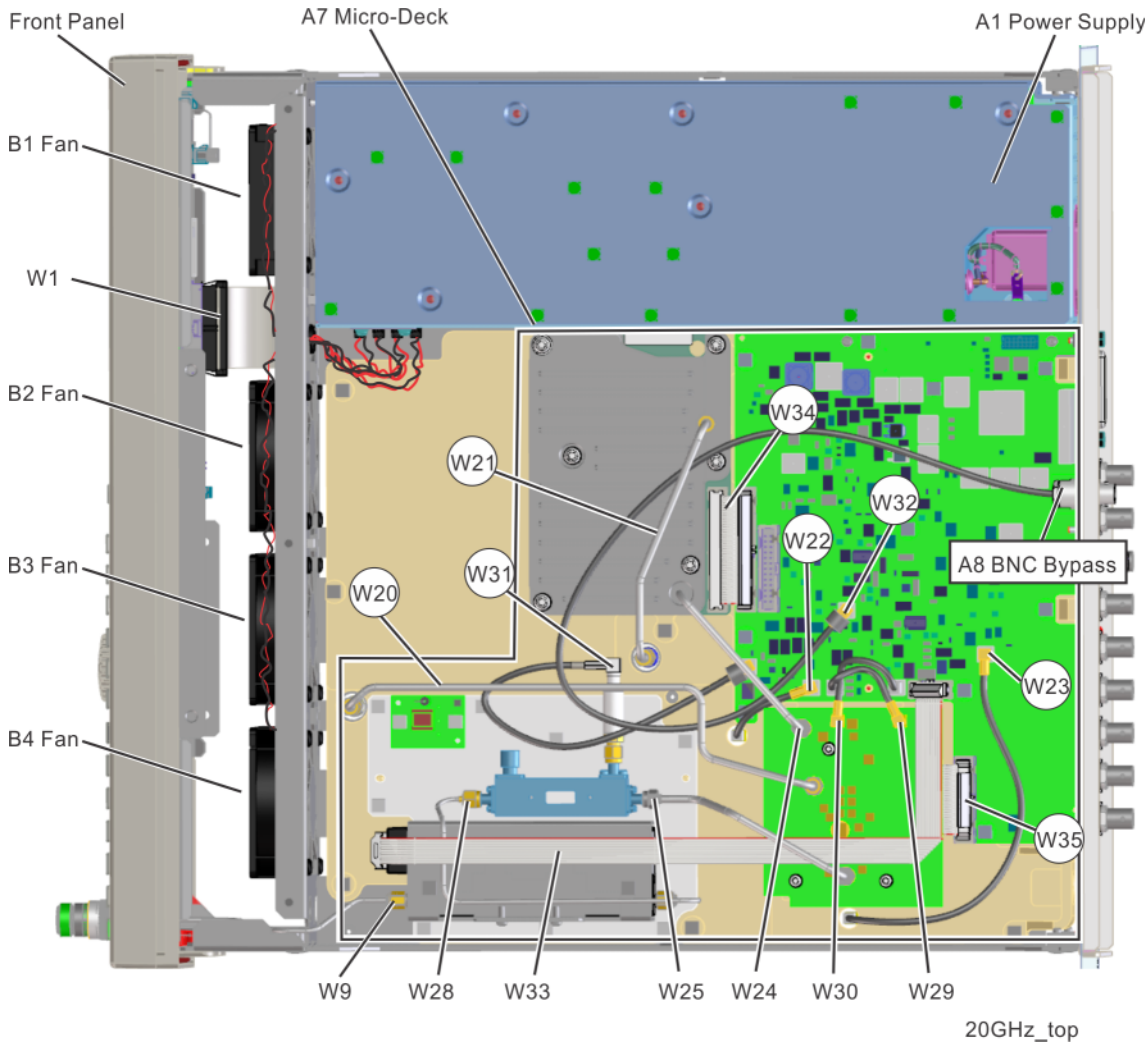
Figure 14-14 Assemblies Top View - N5166B, N5171B/72B/81B/82B



Description	Part Number
Front Panel	see Table 14-1
A1 Power Supply Assembly	N5180-60414
A2 Vector BBG Assembly N5166B, N5172B, N5182B	N5180-60415
A7 Real Time BBG Assembly N5172B, N5182B, Option 660 only	N5180-60429
A7A1 Real Time Aux Power Supply N5172B, N5182B, Option 660	N5180-60430
A8 Real Time BBG Jumper Board N5172B, N5182B, Option 660	N5180-60432
B1 thru B4 Fan Assembly (each)	N5180-60433

Description	Part Number
Cable Clamp, W6 Semi-Rigid Cable to A2 Vector BBG Assy (N5166B, N5172B, N5182B)	1400-3461
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W4, Coaxial Cable, A6 Front Panel I Input to A2 Vector BBG Assy J15	N5180-60435
W5, Coaxial Cable, A6 Front Panel Q Input to A2 Vector BBG Assy J16	N5180-60435
W6, Semi-Rigid Cable, A3 RF Assy J5000 to A2 Vector BBG Assy P500	N5180-60436
W7, Semi-Rigid Cable, A3 RF Assy J2004 to A2 Vector BBG Assy P1	N5180-20187
W8, Semi-Rigid Cable, A2 Vector BBG Assy P2 to A3 RF Assy J2003	N5180-20188
W9, Semi Rigid Cable, A3 RF Assy J4000 to RF Output	see Table 14-1
W10, Cable Harness, A1 Power Supply to A7A1 Real Time BBG Aux. Power Supply Input	N5180-60437
W12, Cable Harness, A7A1 Real Time BBG Aux. Power Supply Output	N5180-60181

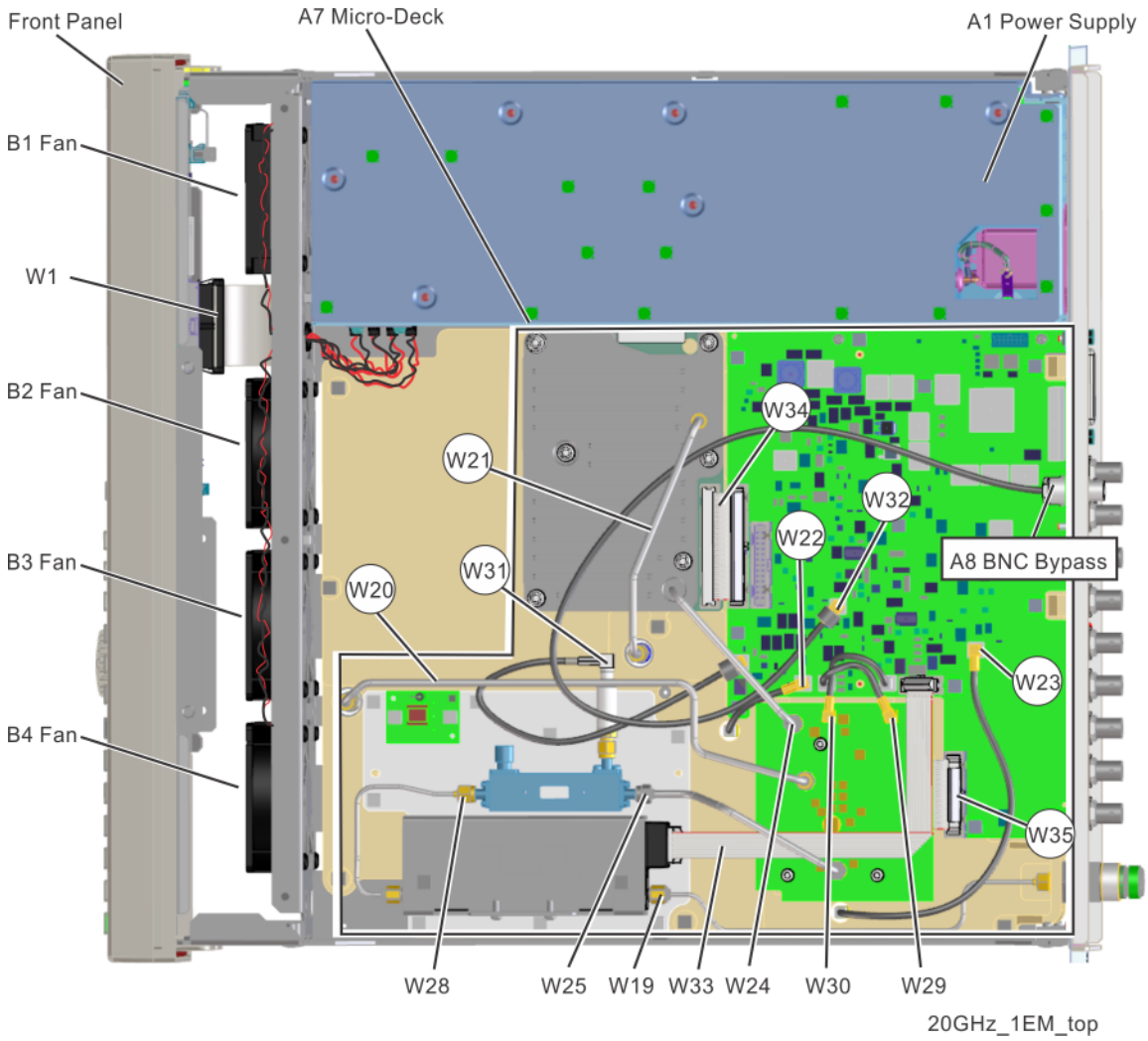
Figure 14-15 Assemblies Top View - N5173B/83B (Options 513/520)



Description	Part Number
Front Panel	see Table 14-1
A1 Power Supply Assembly	N5180-60414
A7 Micro-Deck Assembly (N5173B, N5183B)	see Table 14-1
A8 BNC Bypass Board N5173B, N5183B	E8251-63665
B1 thru B4 Fan Assembly (each)	N5180-60433
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W9, Semi Rigid Cable, A3 RF Assy J4000 to RF Output	see Table 14-1
W20, Semi-Rigid Cable, A3 RF Assy J2002 to A7A3 Mod-Filter J3	N5180-20219

Description	Part Number
W21, Semi-Rigid Cable, A3 RF Assy J2004 to A7A2 20 GHz Multiplier J1	N5180-20208
W22, Coaxial Cable, A3 RF Assy J7 to A7A1 ALC Control J11	8121-1468
W23, Coaxial Cable, A7A1 ALC Control J18 to A3 RF Assy J6000	8121-1578
W24, Semi-Rigid Cable, A7A2 20 GHz Multiplier J2 to A7A3 Mod-Filter J1	N5180-20209
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A5 Coupler Input (513/520)	N5180-20285
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (513/520)	N5180-20283
W29, Coaxial Cable, A7A1 ALC Control J15 to A7A3 Mod-Filter J7	8121-1468
W30, Coaxial Cable, A7A1 ALC Control J16 to A7A3 Mod-Filter J6	8121-1468
W31, Coaxial Cable, A7A6 Detector Output to A7A1 ALC Control J10	8121-2775
W32, Coaxial Cable, Rear Panel ALC IN to A7A1 ALC Control J12	8121-0859
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1	N5180-60245
W34, Ribbon Cable, A7A1 ALC Control J5 to A7A2 20 GHz Multiplier J3	N5180-60242
W35, Ribbon Cable, A7A1 ALC Control J8 to A7A3 Mod-Filter J10	8121-1469

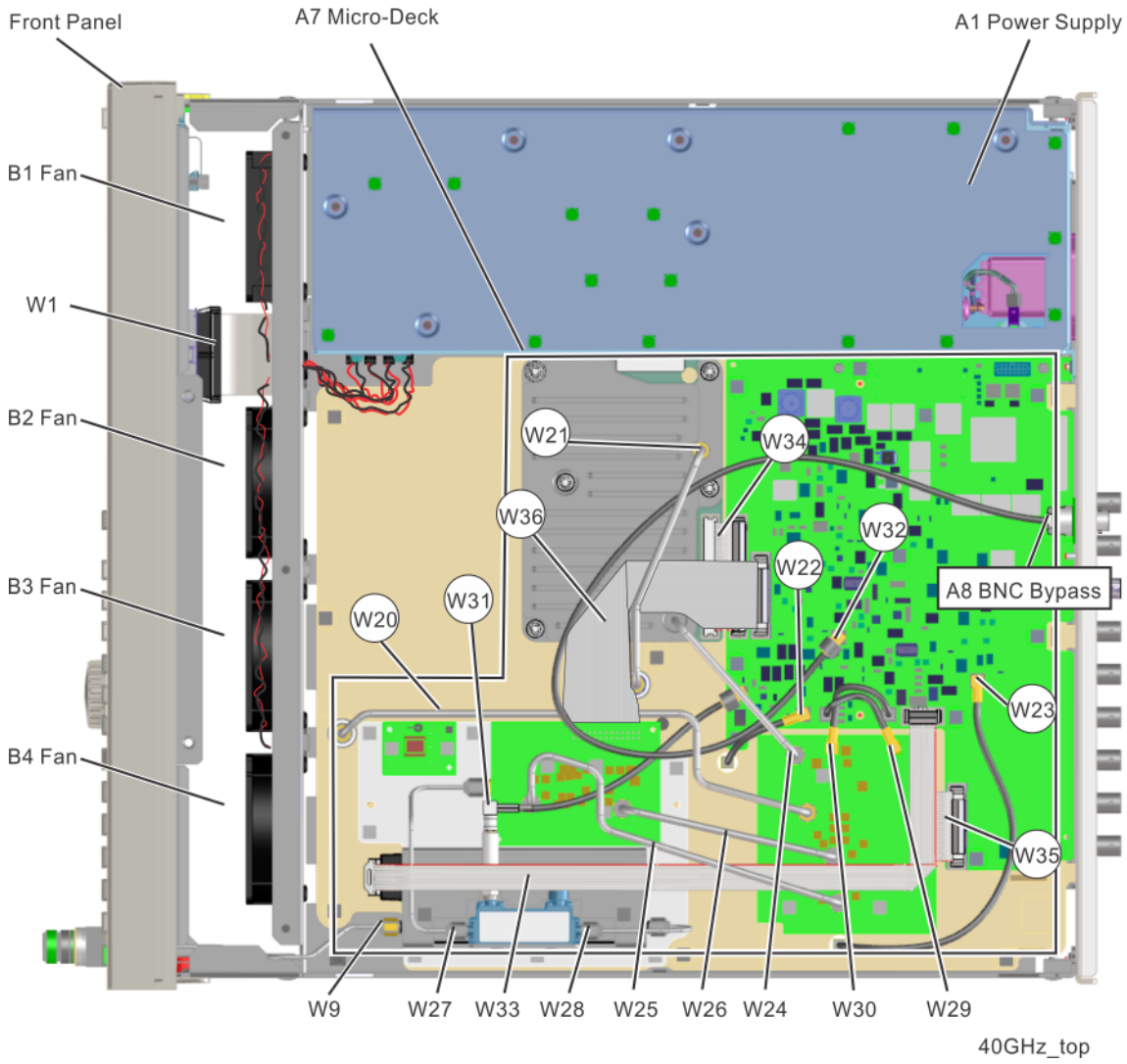
Figure 14-16 Assemblies Top View - N5173B/83B (Options 513/520, 1EM)



Description	Part Number
Front Panel	see Table 14-1
A1 Power Supply Assembly	N5180-60414
A7 Micro-Deck Assembly (N5173B, N5183B)	see Table 14-1
A8 BNC Bypass Board N5173B, N5183B	E8251-63665
B1 thru B4 Fan Assembly (each)	N5180-60433
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W19, Semi-Rigid Cable, A3 RF Assy J4000 to Rear Panel RF Output (Option 1EM)	see Table 14-1
W20, Semi-Rigid Cable, A3 RF Assy J2002 to A7A3 Mod-Filter J3	N5180-20219
W21, Semi-Rigid Cable, A3 RF Assy J2004 to A7A2 20 GHz Multiplier J1	N5180-20208
W22, Coaxial Cable, A3 RF Assy J7 to A7A1 ALC Control J11	8121-1468

Description	Part Number
W23, Coaxial Cable, A7A1 ALC Control J18 to A3 RF Assy J6000	8121-1578
W24, Semi-Rigid Cable, A7A2 20 GHz Multiplier J2 to A7A3 Mod-Filter J1	N5180-20209
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A5 Coupler Input (513/520)	N5180-20285
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (513/520) (Option 1EM)	N5180-20284
W29, Coaxial Cable, A7A1 ALC Control J15 to A7A3 Mod-Filter J7	8121-1468
W30, Coaxial Cable, A7A1 ALC Control J16 to A7A3 Mod-Filter J6	8121-1468
W31, Coaxial Cable, A7A6 Detector Output to A7A1 ALC Control J10	8121-2775
W32, Coaxial Cable, Rear Panel ALC IN to A7A1 ALC Control J12	8121-0859
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1 (Option 1EM)	N5180-60244
W34, Ribbon Cable, A7A1 ALC Control J5 to A7A2 20 GHz Multiplier J3	N5180-60242
W35, Ribbon Cable, A7A1 ALC Control J8 to A7A3 Mod-Filter J10	8121-1469

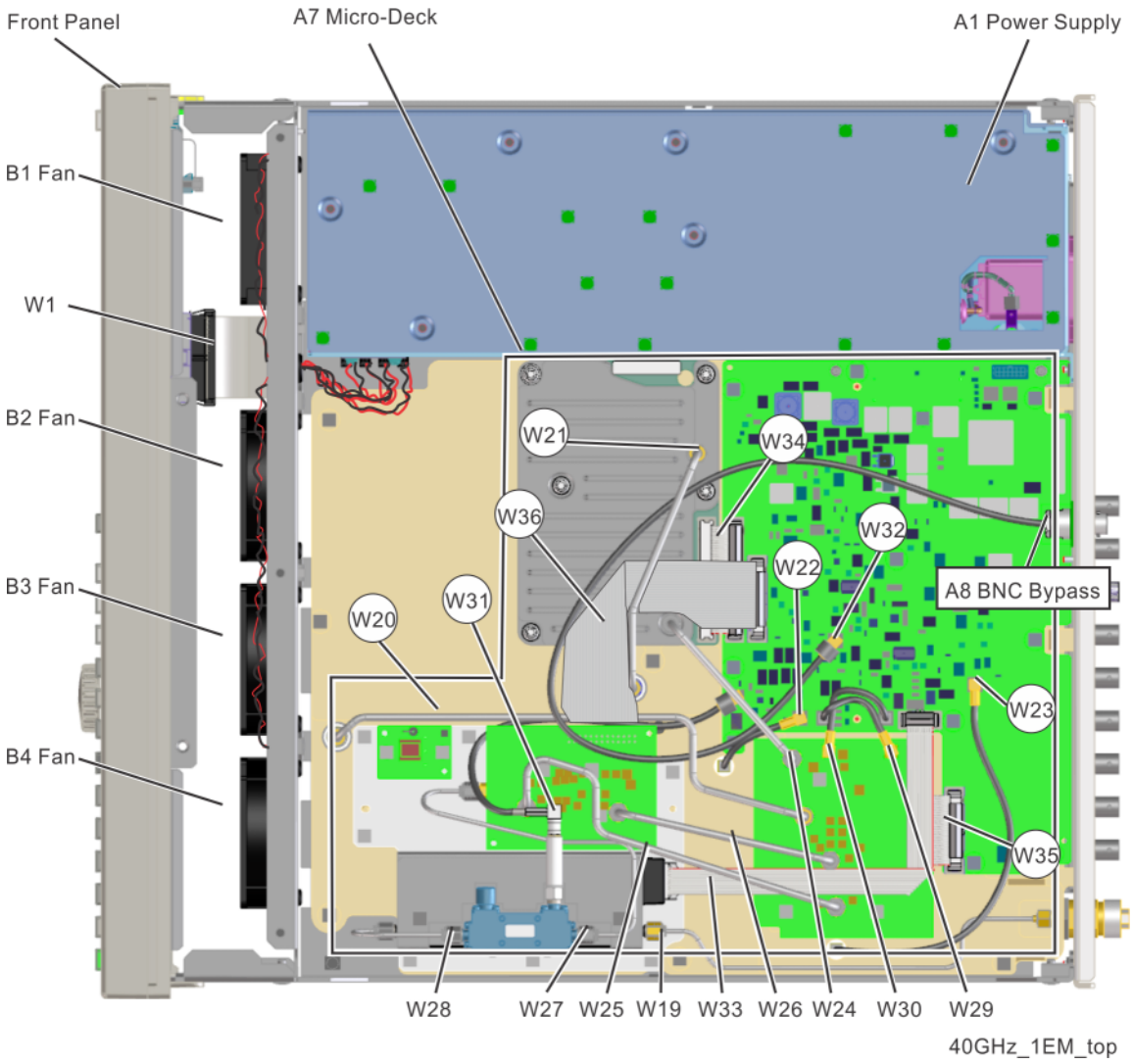
Figure 14-17 Assemblies Top View - N5173B/83B (Options 532/540)



Description	Part Number
Front Panel	see Table 14-1
A1 Power Supply Assembly	N5180-60414
A7 Micro-Deck Assembly (N5173B, N5183B)	see Table 14-1
A8 BNC Bypass Board N5173B, N5183B	E8251-63665
B1 thru B4 Fan Assembly (each)	N5180-60433
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W9, Semi Rigid Cable, A3 RF Assy J4000 to RF Output	see Table 14-1
W20, Semi-Rigid Cable, A3 RF Assy J2002 to A7A3 Mod-Filter J3	N5180-20219

Description	Part Number
W21, Semi-Rigid Cable, A3 RF Assy J2004 to A7A2 20 GHz Multiplier J1	N5180-20208
W22, Coaxial Cable, A3 RF Assy J7 to A7A1 ALC Control J11	8121-1468
W23, Coaxial Cable, A7A1 ALC Control J18 to A3 RF Assy J6000	8121-1578
W24, Semi-Rigid Cable, A7A2 20 GHz Multiplier J2 to A7A3 Mod-Filter J1	N5180-20209
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A4 40 GHz Doubler J3 (532/540)	N5180-20211
W26, Semi-Rigid Cable, A7A3 Mod-Filter J4 to A7A4 40 GHz Multiplier J1 (532/540)	N5180-20210
W27, Semi-Rigid Cable, A7A4 40 GHz Doubler J2 to A7A5 Coupler Input (532/540)	N5180-20044
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (532/540)	N5180-20045
W29, Coaxial Cable, A7A1 ALC Control J15 to A7A3 Mod-Filter J7	8121-1468
W30, Coaxial Cable, A7A1 ALC Control J16 to A7A3 Mod-Filter J6	8121-1468
W31, Coaxial Cable, A7A6 Detector Output to A7A1 ALC Control J10	8121-2775
W32, Coaxial Cable, Rear Panel ALC IN to A7A1 ALC Control J12	8121-0859
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1	N5180-60245
W34, Ribbon Cable, A7A1 ALC Control J5 to A7A2 20 GHz Multiplier J3	N5180-60242
W35, Ribbon Cable, A7A1 ALC Control J8 to A7A3 Mod-Filter J10	8121-1469
W36, Ribbon Cable, A7A1 ALC Control J9 to A7A4 40 GHz Doubler Control	N5180-60243

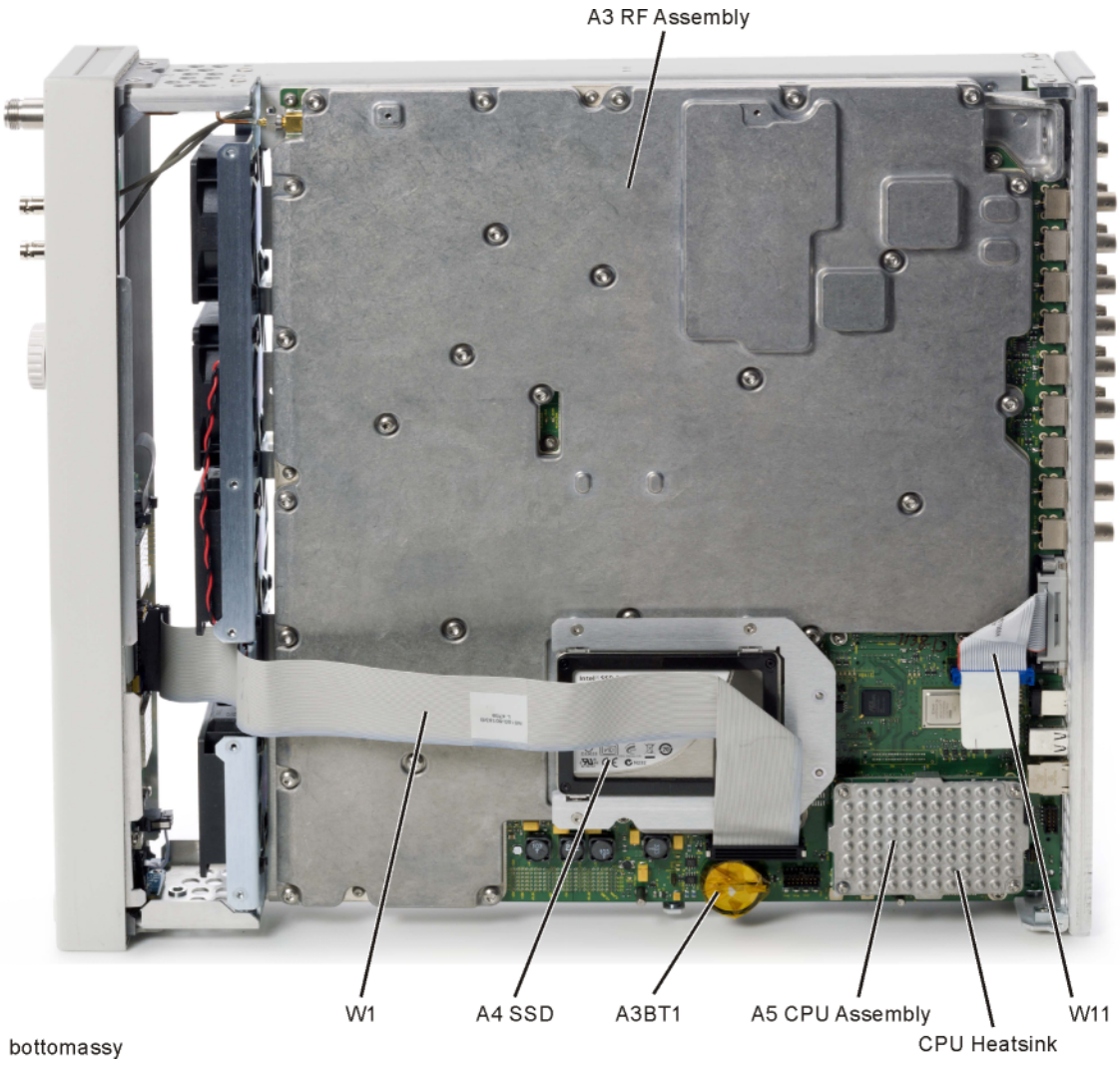
Figure 14-18 Assemblies Top View - N5173B/83B (Options 532/540, 1EM)



Description	Part Number
Front Panel	see Table 14-1
A1 Power Supply Assembly	N5180-60414
A7 Micro-Deck Assembly (N5173B, N5183B)	see Table 14-1
A8 BNC Bypass Board N5173B, N5183B	E8251-63665
B1 thru B4 Fan Assembly (each)	N5180-60433
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W19, Semi-Rigid Cable, A3 RF Assy J4000 to Rear Panel RF Output (Option 1EM)	see Table 14-1

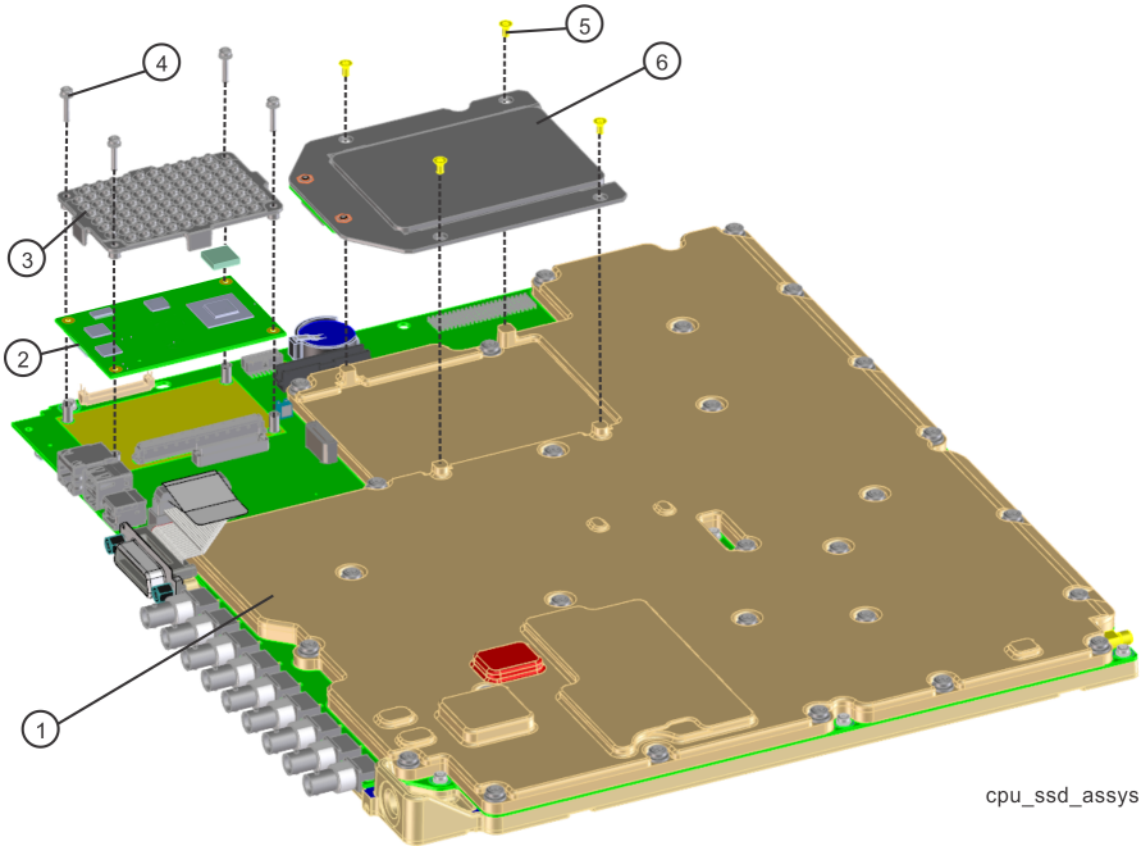
Description	Part Number
W20, Semi-Rigid Cable, A3 RF Assy J2002 to A7A3 Mod-Filter J3	N5180-20219
W21, Semi-Rigid Cable, A3 RF Assy J2004 to A7A2 20 GHz Multiplier J1	N5180-20208
W22, Coaxial Cable, A3 RF Assy J7 to A7A1 ALC Control J11	8121-1468
W23, Coaxial Cable, A7A1 ALC Control J18 to A3 RF Assy J6000	8121-1578
W24, Semi-Rigid Cable, A7A2 20 GHz Multiplier J2 to A7A3 Mod-Filter J1	N5180-20209
W25, Semi-Rigid Cable, A7A3 Mod-Filter J2 to A7A4 40 GHz Doubler J3 (532/540)	N5180-20211
W26, Semi-Rigid Cable, A7A3 Mod-Filter J4 to A7A4 40 GHz Multiplier J1 (532/540)	N5180-20210
W27, Semi-Rigid Cable, A7A4 40 GHz Doubler J2 to A7A5 Coupler Input (532/540) (Option 1EM)	N5180-20047
W28, Semi-Rigid Cable, A7A5 Coupler Output to A7AT1 Atten Input (532/540)	N5180-20045
W29, Coaxial Cable, A7A1 ALC Control J15 to A7A3 Mod-Filter J7	8121-1468
W30, Coaxial Cable, A7A1 ALC Control J16 to A7A3 Mod-Filter J6	8121-1468
W31, Coaxial Cable, A7A6 Detector Output to A7A1 ALC Control J10	8121-2775
W32, Coaxial Cable, Rear Panel ALC IN to A7A1 ALC Control J12	8121-0859
W33, Ribbon Cable, A7A1 ALC Control J4 to A7AT1 P1	N5180-60245
W34, Ribbon Cable, A7A1 ALC Control J5 to A7A2 20 GHz Multiplier J3	N5180-60242
W35, Ribbon Cable, A7A1 ALC Control J8 to A7A3 Mod-Filter J10	8121-1469
W36, Ribbon Cable, A7A1 ALC Control J9 to A7A4 40 GHz Doubler Control	N5180-60243

Figure 14-19 Assemblies Bottom View - All Models (N5182B shown)



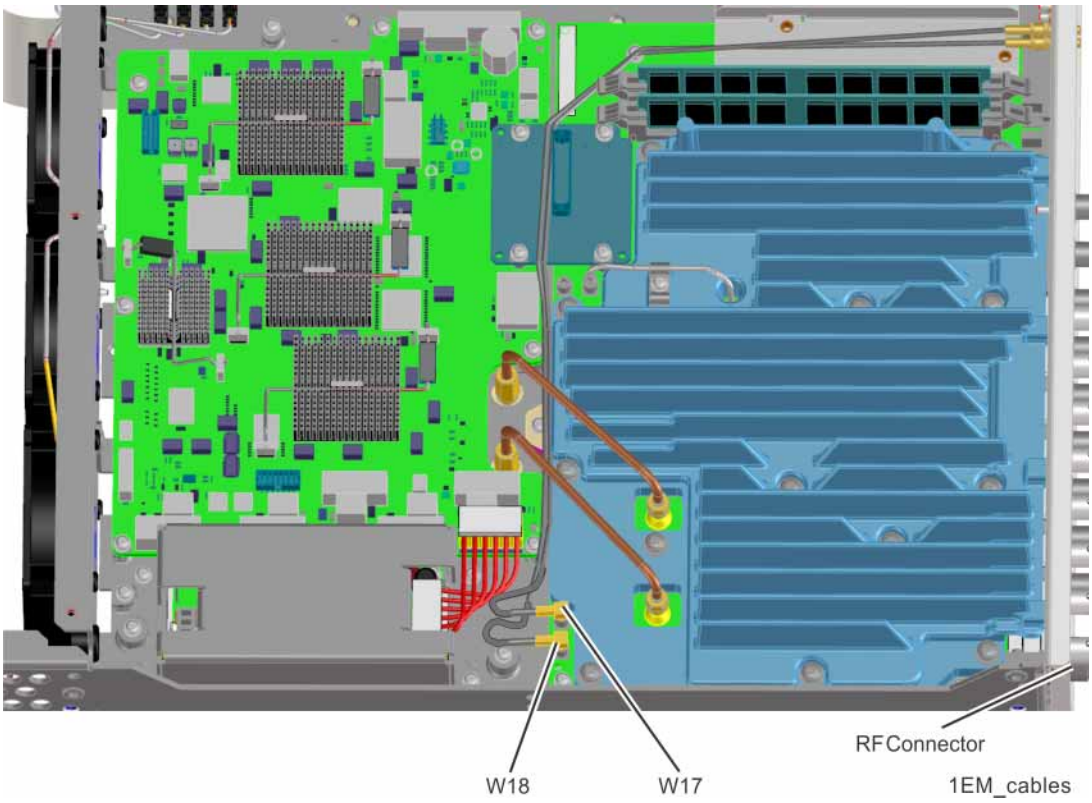
Description	Part Number
A3 RF Assembly	see Table 14-3
A3BT1 Battery 3V 620 ma-HR Ll Manganese Dioxide	1420-0533
A4 Solid State Disk Drive Assembly N5166B, N5172B, N5182B	N5180-60426
A5 CPU Assembly and Thermal Pad	N5180-60427
A5MP1 CPU Heatsink and Thermal Pad	N5180-60443
W1, Ribbon Cable, A3 RF Assy P5 to A6A1 Front Panel Interface J10	N5180-60183
W11, Ribbon Cable, Rear Panel GPIB to A3 RF Assy P4	N5180-60181

Figure 14-20 A3 RF Assembly, A4 SSD, A5 CPU



Item	Description	Part Number
1	A3 RF Assembly	see Table 14-3
2	A5 CPU Assembly and Thermal Pad	N5180-60427
3	A5MP1 CPU Heatsink and Thermal Pad	N5180-60443
4	Screw, machine, Pan Head, Torx T8, M2.5 x 0.45, 14 mm	0515-2141
5	Screw, machine, Flat Head, Torx T10, M3 x 0.5, 6 mm	0515-1227
6	A4 Solid State Disk Drive Assembly N5166B, N5172B, N5182B	N5180-60426

Figure 14-21 Rear Panel I/Q Cables - N5172B/82B Option 1EM



Description	Part Number
RF Connector	See Table 14-1
W17, Coaxial Cable, Rear Panel I Input to A2 Vector BBG Assy J15	N5180-60458
W18, Coaxial Cable, Rear Panel Q Input to A2 Vector BBG Assy J16	N5180-60458

Figure 14-22 Rear Panel RF Connector/Spacer w/ W19 Semi-Rigid Cable Assembly Parts N5171B/72B/81B/82B

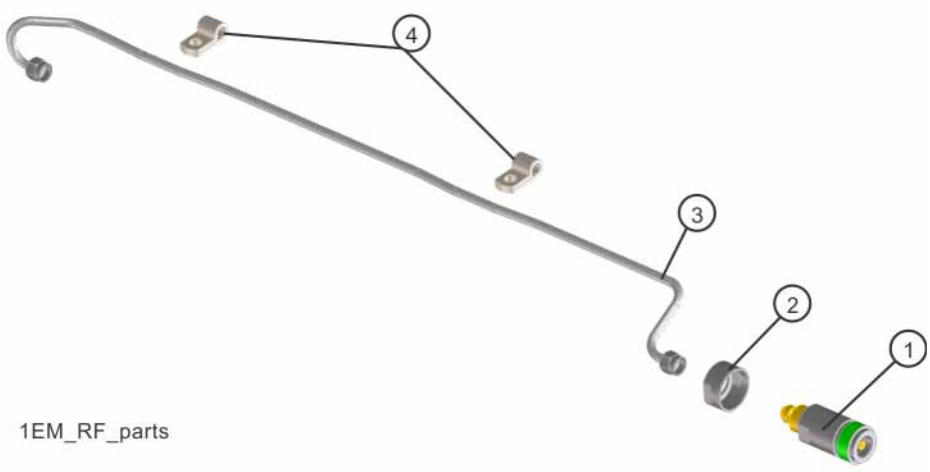
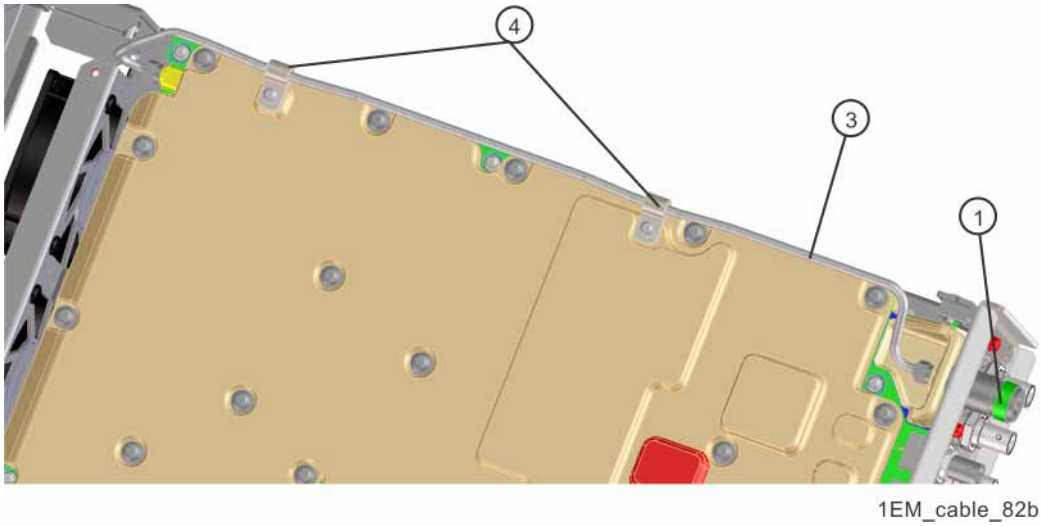
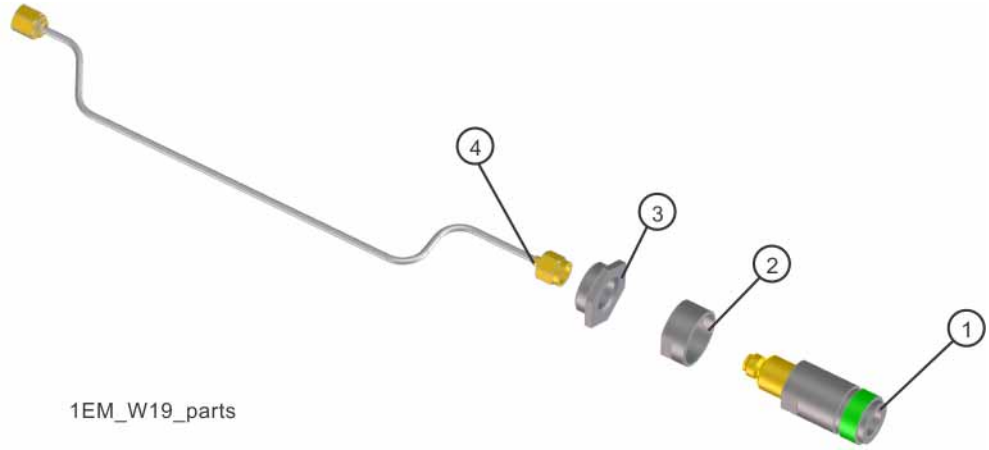


Figure 14-23 Location of W19 and 1EM Rear Panel RF Connector- N5171B/72B/81B/82B



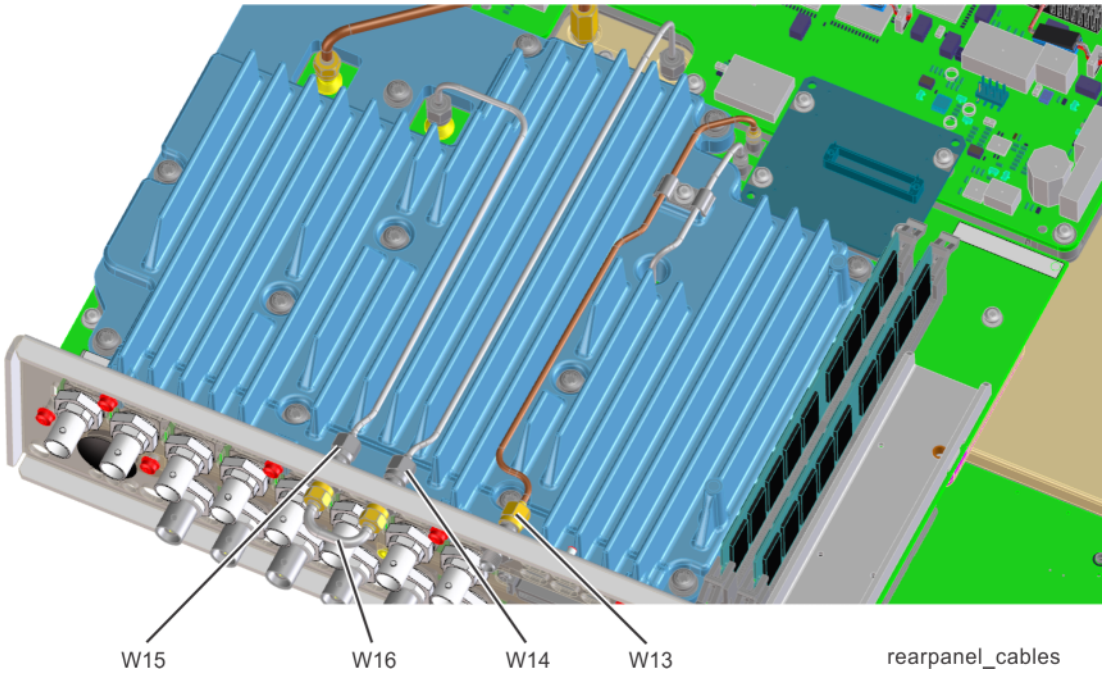
Item	Description	Part Number
1	J1 Rear Panel RF Output Connector, Type-N Female	1250-3968
2	Spacer, Type-N Output Connector	N5180-20056
3	W19, Semi-Rigid Cable, A3 RF Assy J4000 to Rear Panel RF Output (Option 1EM)	N5180-20106
4	Clamp (2)	1400-1265

Figure 14-24 Rear Panel RF Connector/Spacer w/ W19 Semi-Rigid Cable Assembly Parts N5173B/83B



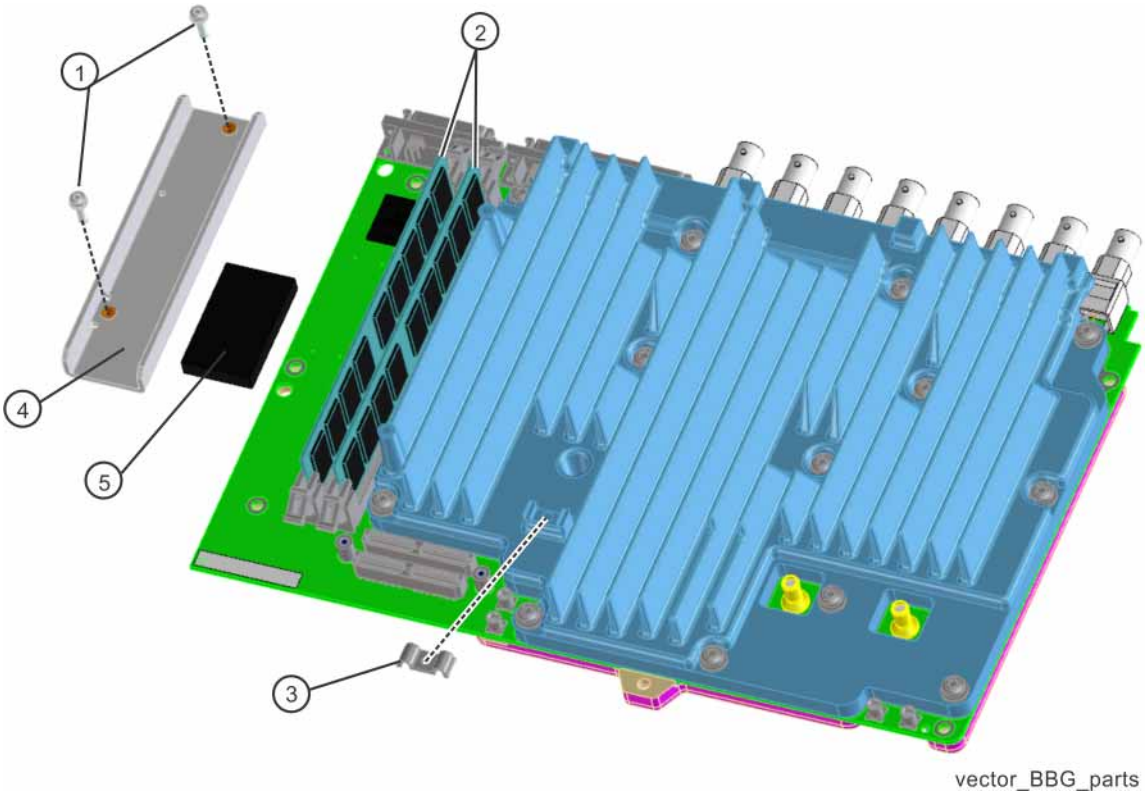
Item	Description	Part Number
1	J1 Rear Panel RF Output Connector	
	Type-N Female	1250-3968
	3.5 mm Female	08673-60040
	2.4 mm Female	5063-1700
2	Spacer	
	Type-N Output Connector	N5180-20056
	3.5 mm Output Connector	E8251-20068
	2.4 mm Output Connector	None
3	Adapter	
	Type-N Output Connector	N5180-20062
	3.5 mm Output Connector	N5180-20061
	2.4 mm Output Connector	N5180-20060
4	W19, Semi-Rigid Cable, A3 RF Assy J4000 to Rear Panel RF Output (Option 1EM)	
	N5173B, N5183B - Type-N Output Connector	N5180-20218
	N5173B, N5183B - 3.5 mm Output Connector	N5180-20216
	N5173B, N5183B - 2.4 mm Output Connector	N5180-20213

Figure 14-25 Rear Panel Cables - Option 012



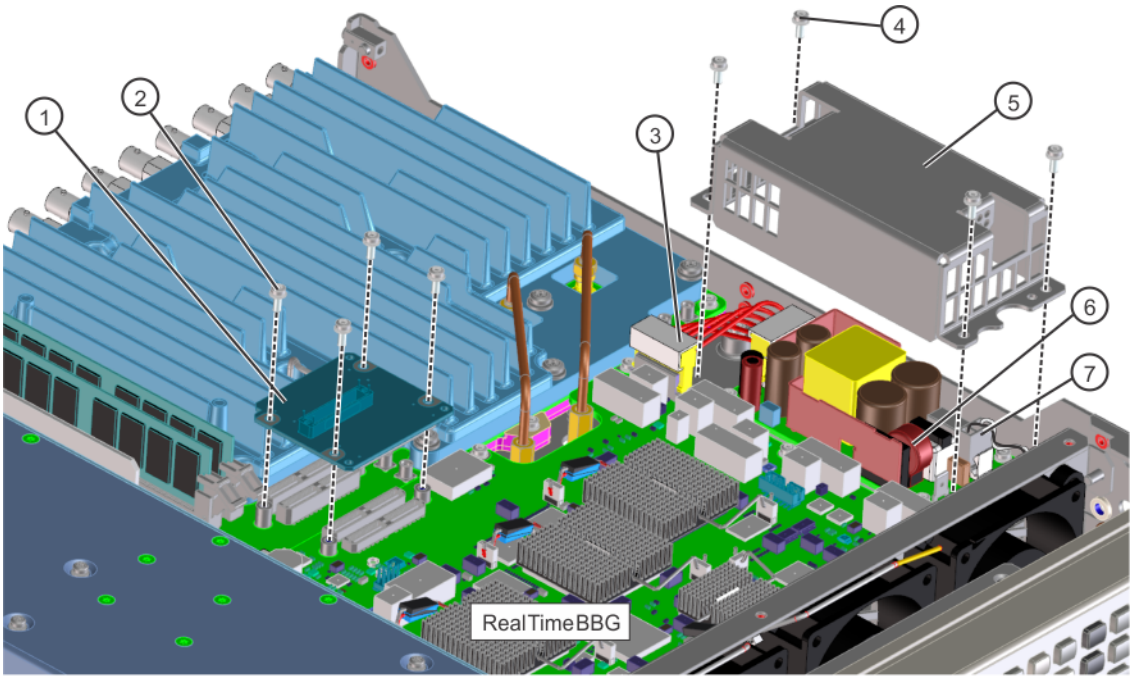
Description	Part Number
W13, Semi-Rigid Cable, A2 Vector BBG Assy P4 to Rear Panel DAC CLK IN	N5180-20186
W14, Semi-Rigid Cable, A3 RF Assy J2004 to Rear Panel LO OUT	N5180-20144
W15, Semi-Rigid Cable, Rear Panel LO IN to A2 Vector BBG Assy P1	N5180-20178
W16, Semi-Rigid Cable, Rear Panel LO OUT to Rear Panel LO IN	N5180-60458

Figure 14-26 A2 Vector BBG Assembly Parts - N5166B/N5172B/N5182B



Item	Description	Part Number
	A2 Vector BBG Assembly	N5180-60415
1	Screw, Pan Head, M3 x 0.5, T-10. 18 mm	0515-0666
2	A2A1 Vector BBG Waveform Memory (N5166B, N5172B - 1 required, N5182B - 2 required)	1819-0590
3	Cable Clamp, W6 Semi-Rigid Cable to A2 Vector BBG Assy (N5166B, N5172B, N5182B)	1400-3461
4	A2MP1 Connector Preload Bracket w/ Foam	N5180-60246
5	Foam	n/a
not shown	Screw (1 ea)	0515-0372
not shown	Screws (4 ea)	0515-0374

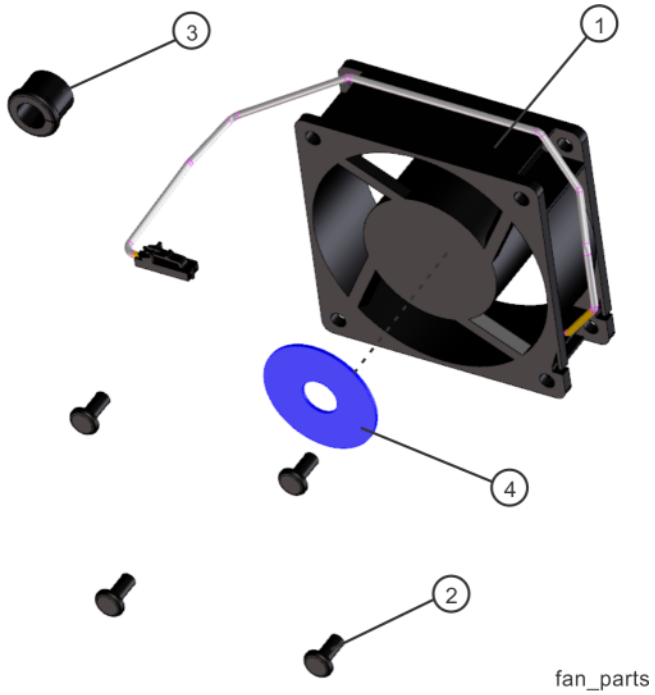
Figure 14-27 A7 Real Time BBG Assembly



realtime_bbg_parts2

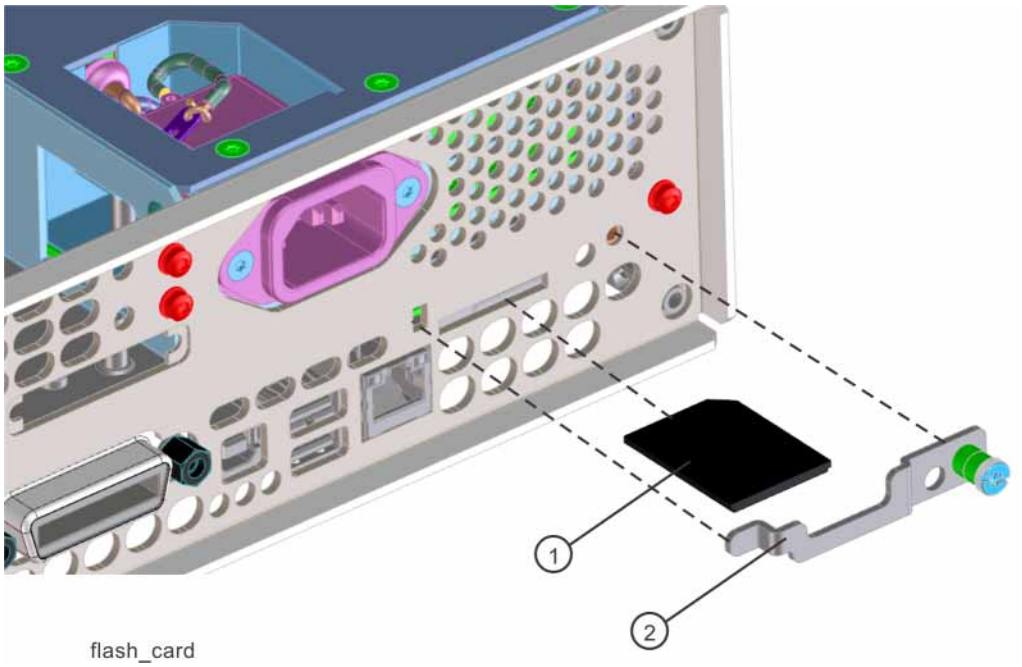
Item	Description	Part Number
	A7 Real Time BBG Assembly	N5180-60429
1	A8 Real Time BBG Jumper Board	N5180-60432
2 and 4	Screw-Machine W/Crest-Cup-Con-Washer Pan-HD Torx-T10 M3 x 0.5 8mm-LG	0515-0372
3	W12, Cable Harness, A7A1 Real Time BBG Aux. Power Supply Output	N5180-60181
5	A7A1MP1 Power Supply Cover	N5180-60431
6	A7A1 Real Time Aux Power Supply	N5180-60430
7	W10, Cable Harness, A1 Power Supply to A7A1 Real Time BBG Aux. Power Supply Input	N5180-60437

Figure 14-28 B1 Through B4 Fan Assembly Parts - N5180-60433



Item	Description	Part Number
1	Fan Assembly	n/a
2	Fan Rivet (4)	n/a
3	Grommet Snap	n/a
4	Support Fan Motor	n/a

Figure 14-29 A3A1 Rear Panel SD Memory Card (Option 006)



Item	Description	Part Number
1	IC-Flash 32 GB SD Card (Option 006)	1819-1250
2	Rear Panel SD Memory Card Cover (Option 006)	N5180-00027

15 Assembly Replacement

What You Will Find in This Chapter

This chapter provides information on the following:

Before Replacing an Assembly on page 338

After Replacing or Repairing an Assembly on page 339

Assemblies You Can Replace on page 340

Before Replacing an Assembly

Before replacing any instrument assembly, perform the related "Pre Repair Procedures" found in Chapter 16, "Pre and Post-Repair Procedures". Doing so will ensure that all required instrument information and calibration data will be properly preserved once the assembly replacement is completed.

CAUTION

Many of the assemblies in this instrument are very susceptible to damage from electrostatic discharge (ESD). Perform service procedures only at a static-safe workstation and wear a grounding strap.

See the "Hardware Versus Firmware" in Chapter 19, "Instrument Firmware and Operating System" for information on instrument firmware requirements before replacing any electronic assembly.

Be sure to review the warning and caution statements described in Chapter 1, "Overview" prior to replacing an assembly in your signal generator.

After Replacing or Repairing an Assembly

After you have permanently replaced an assembly, certain configuration steps will need to be performed. Additionally, certain performance tests may have to also be performed. Refer to Chapter 16, “Pre and Post-Repair Procedures”, on page 425, for the next steps and the list of performance tests required for each assembly.

Assemblies You Can Replace

– "Outer Cover" on page 342
– "Inner Top Cover" on page 344
– "Inner Bottom Cover" on page 346
– "Front-Panel" on page 348
– "A1 Power Supply" on page 351
– "A2 Vector BBG Assembly (N5166B, N5172B, and N5182B)" on page 353
– "A3 RF Assembly (N5171B, N5181B)" on page 357
– "A3 RF Assembly (N5166B, N5172B, and N5182B)" on page 362
– "A3 RF Assembly (N5173B, N5183B)" on page 366
– "A3BT1 Battery" on page 369
– "A4 SSD (N5166B, N5172B, and N5182B only)" on page 371
– "A5 CPU" on page 375
– "A6 Front Panel Interface Scan Assembly" on page 377
– "USB Board" on page 379
– "LCD Display" on page 381
– "Key Pad" on page 383
– "Power Switch" on page 386
– "A7 Real Time BBG Assembly (N5172B and N5182B Option 660)" on page 388
– "A7A1 Real Time Aux Power Supply" on page 390
– "RF Connector" on page 394
– "RF Connector (N5173B/83B only - Standard)" on page 396
– "A7 Micro-Deck (N5173B/83B only - Standard)" on page 398
– "A7 Micro-Deck (N5173B/83B only - Option 1EM)" on page 402
– "A7AT1 Step Attenuator (N5173B/83B Only) – Option 513/520" on page 404
– "A7AT1 Step Attenuator (N5173B/83B Only) – Option 532/540" on page 408
– "A8 Floating BNC Bypass (N5173B/83B only)" on page 412
– "B1 through B4 Fans" on page 414
– "Rear Panel (N5171B/81B)" on page 417
– "Rear Panel (N5166B, N5172B, and N5182B)" on page 419
– "Rear Panel (N5173B/83B)" on page 422

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Outer Cover

Tools Required

– T-20 driver

Removal Procedure

Refer to Figure 15-1 for this procedure.

1. Disconnect the power cord.
2. Using the T-20 driver, loosen the two screws (1) and remove the strap handle (2).
3. Using the T-20 driver, remove the two hole plugs (not shown in photo) from the opposite side of the instrument.
4. Using the T-20 driver, remove the center screws from the four rear-panel feet (3).
5. Remove the four bottom feet (4) from the cover by first removing the locking keys and then lifting the tab and sliding the foot toward the tab.
6. Place the signal generator on its side.
7. Place one hand on the front panel, use the other hand to lift the rear of the signal generator and slide the outer cover (5) off to remove it from the frame.

CAUTION The RF connector can be easily damaged. Use extreme caution to not damage the RF connector when lifting the rear of the signal generator.

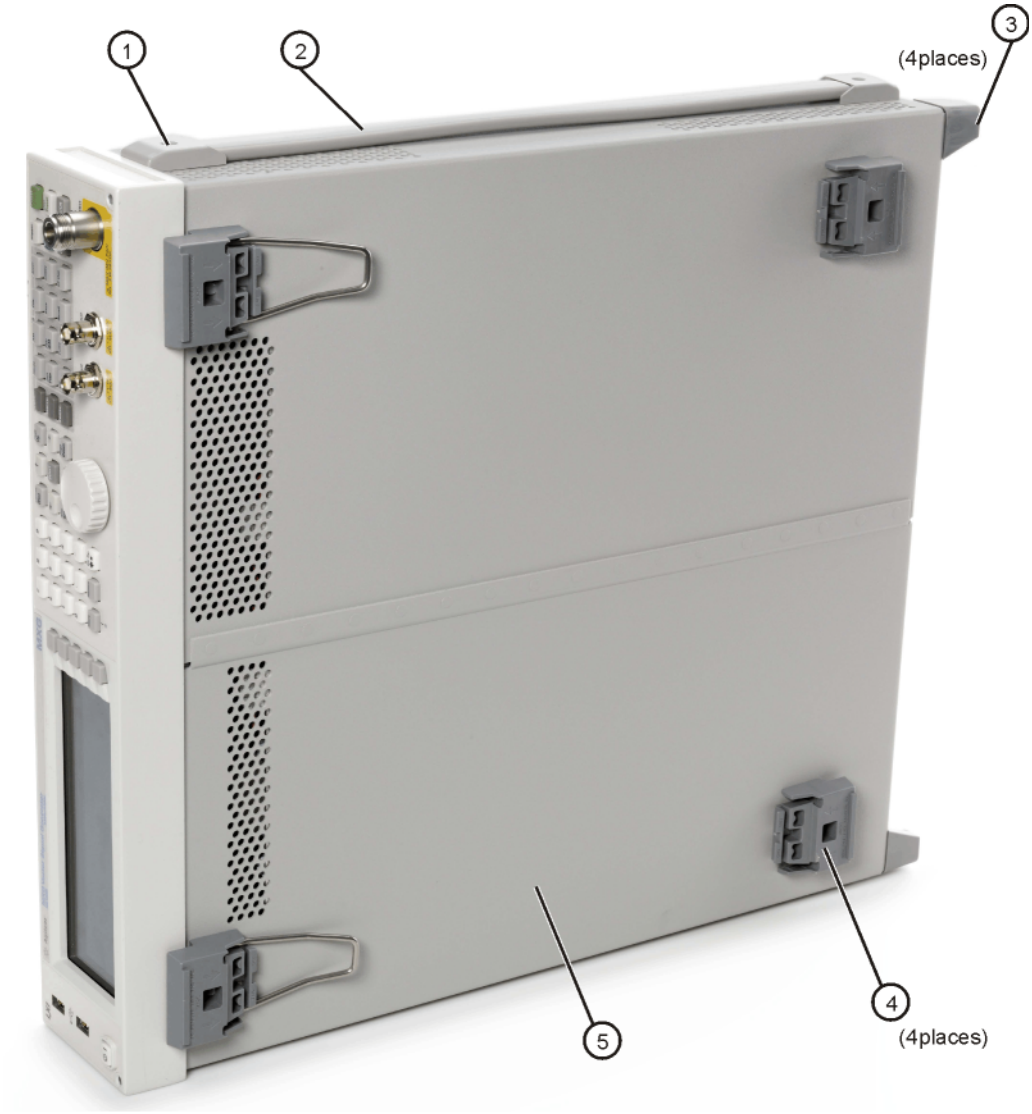
Replacement Procedure

1. Reverse the order of the removal procedures.

CAUTION When sliding the outer cover back on the signal generator keep fingers away from the back of the front panel. They can get severely pinched.

2. Recommended torque for all screws is 21 in–lbs.

Figure 15-1 Outer Cover Removal



external

Inner Top Cover

Tools Required

– T-10 driver

Removal Procedure

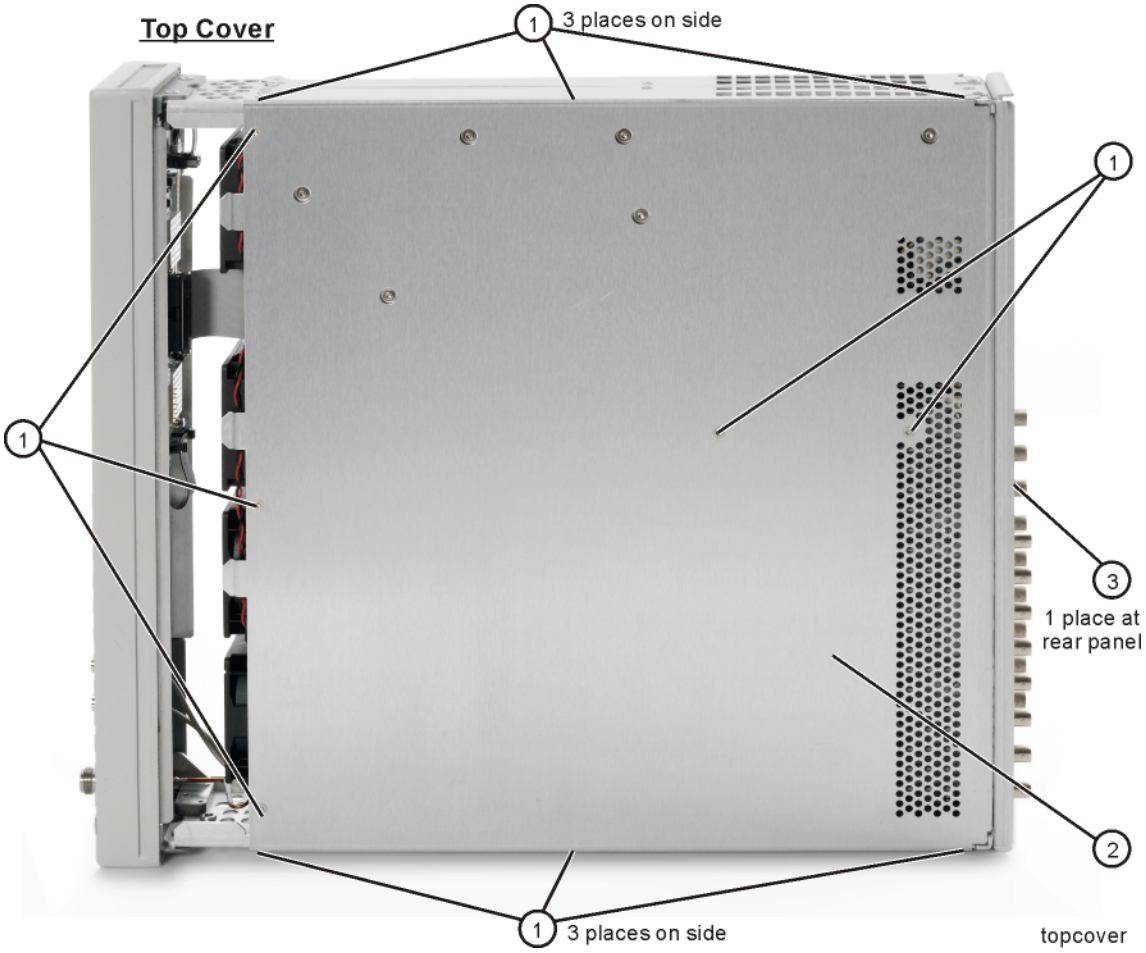
Refer to Figure 15-2 for this procedure.

1. Disconnect the power cord.
2. Remove the outer-cover from the signal generator. Refer to “Outer Cover” on page 342.
3. Place the signal generator flat with the front-panel facing you.
4. Using the T-10 driver, remove the eleven flat-top screws (1) from the inner top cover (2).
5. Using the T-10 driver, remove the screw (3) from the rear panel.
6. Remove the inner top cover.

Replacement Procedure

1. Reverse the order of the removal procedures.
2. Recommended torque for all screws is 9 in–lbs.

Figure 15-2 Inner Top Cover Removal



Inner Bottom Cover

Tools Required

– T-10 driver

Removal Procedure

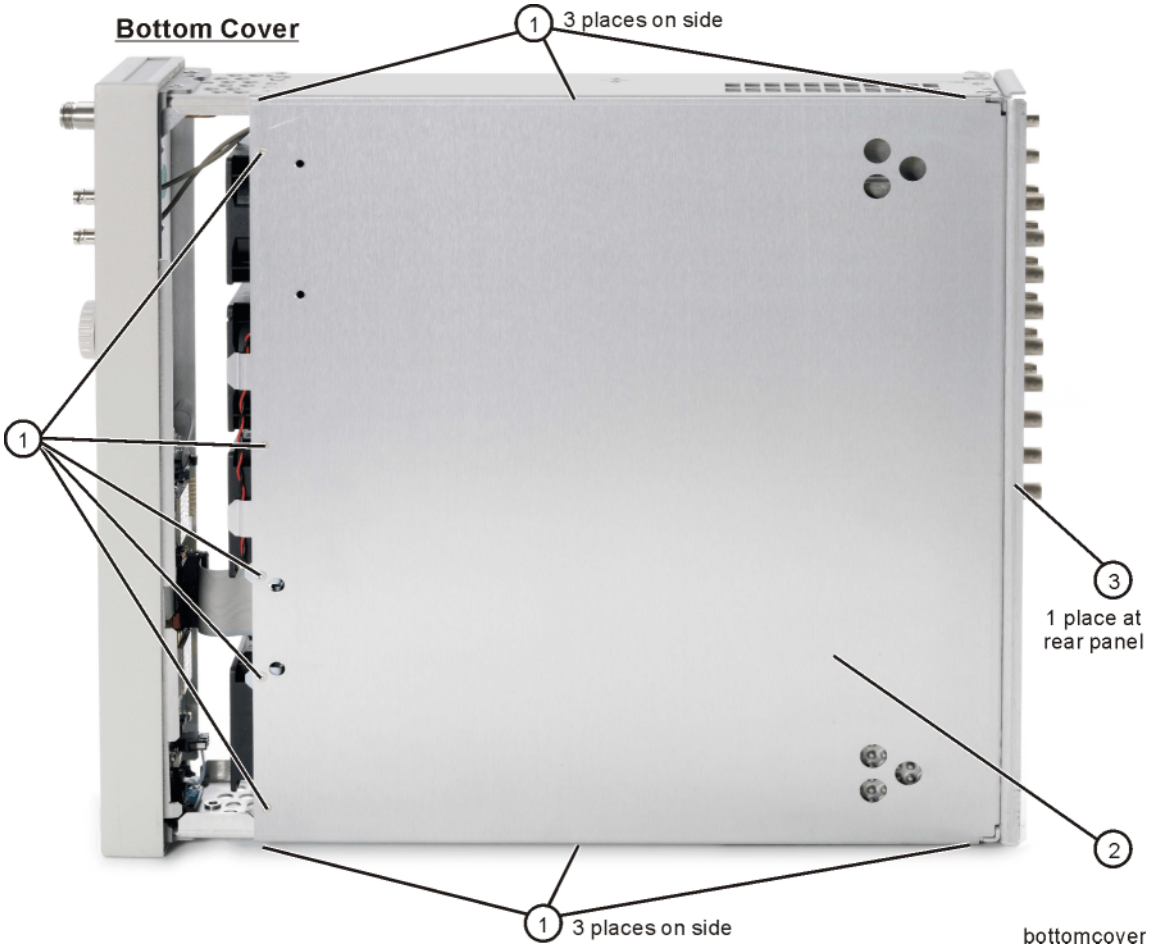
Refer to Figure 15-3 for this procedure.

1. Disconnect the power cord.
2. Remove the outer-cover from the signal generator. Refer to “Outer Cover” on page 342.
3. Place the signal generator flat with the front-panel facing you.
4. Using the T-10 driver, remove the eleven flat-top screws (1) from the inner bottom cover (2).
5. Using the T-10 driver, remove the screw (3) from the rear panel.
6. Remove the inner bottom cover.

Replacement Procedure

1. Reverse the order of the removal procedures.
2. Recommended torque for all screws is 9 in–lbs.

Figure 15-3 Inner Bottom Cover



Front-Panel

Tools Required

- T-20 driver
- needle-nose pliers

Removal Procedure

Refer to Figure 15-4 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to "Outer Cover" on page 342, "Inner Top Cover" on page 344, and "Inner Bottom Cover" on page 346.
3. With the signal generator on its side, disconnect W1 from the A3 RF assembly by squeezing the cable connector and pulling the cable away from the signal generator.
4. For N5166B, N5172B, and 82B instruments, place the signal generator flat with the A2 Vector BBG assembly facing you and use the needle-nose pliers to disconnect the following cables,
   - W3 (I Input) from A2J15
   - W4 (Q Input) from A2J16
5. Remove the chassis grommet before pulling W3 and W4 thru the chassis (N5166B, N5172B, and 82B only).
6. With the signal generator upside down and flat, use the T-20 driver to remove the four screws (1) from the sides of the chassis.

NOTE The four screws that attach the front panel to the chassis are recommended to be one-time use only hardware. These should be replaced with new screws (0515-5844).

CAUTION Before removing the front-panel from the signal generator, lift and support the front frame of the signal generator.

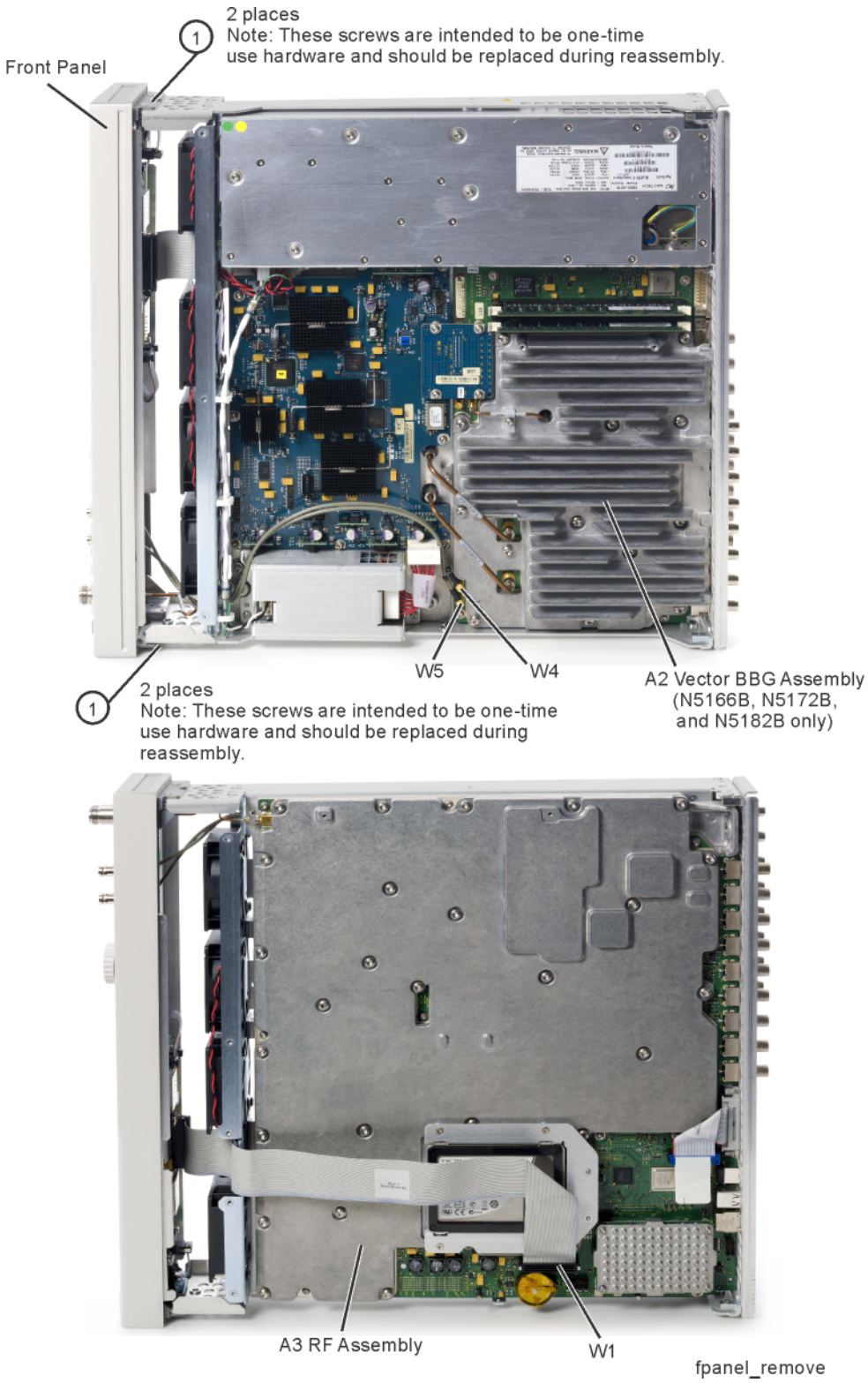
7. Slide the front-panel over the RF output connector.
8. Remove the front-panel.

Replacement Procedure

1. Reverse the order of the removal procedure.

2. Recommended torque for all four screws is 21 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-4 Front-Panel



A1 Power Supply

Tools Required

– T-10 driver

Removal Procedure

Refer to Figure 15-5 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, and “Inner Top Cover” on page 344.
3. Remove the rear panel from the signal generator. Refer to “Rear Panel (N5171B/81B)” on page 417, or “Rear Panel (N5166B, N5172B, and N5182B)” on page 419, or “Rear Panel (N5173B/83B)” on page 422.

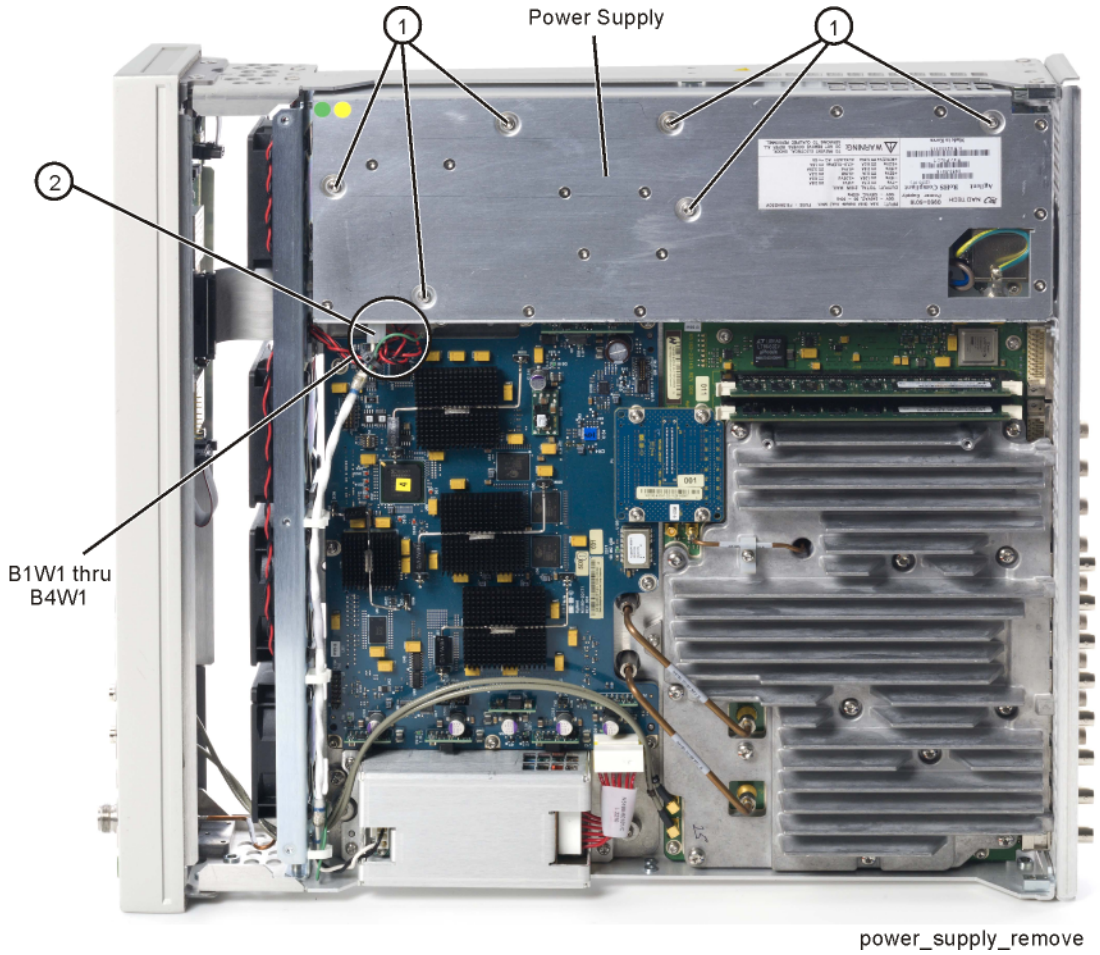
NOTE The rear panel must be removed so the power connector on the A1 Power Supply can be disconnected from the A3 RF assembly without damaging the connector pins.

4. Place the signal generator flat and upright with the front-panel facing you.
5. Using the T-10 driver, press the connector latch to disconnect B1W1 thru B4W1 from the A1 Power Supply.
6. If Option 660 is installed, disconnect the Aux Power Supply cable (2) from the A1 Power Supply.
7. Using the T-10 driver, remove the six screws (1) that secure the A1 Power Supply to the chassis.
8. Remove the A1 Power Supply.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-5 A1 Power Supply (N5182B shown)



A2 Vector BBG Assembly (N5166B, N5172B, and N5182B)

Tools Required

- T-10 driver
- 5/16” open-ended wrench
- needle-nose pliers

Removal Procedure

Refer to Figure 15-6 for this procedure.

1. Before replacing the A2 Vector BBG assembly see Chapter 16, “Pre and Post-Repair Procedures”, and perform the “Pre Repair Procedures” outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Remove the rear panel from the signal generator. Refer to “Rear Panel (N5166B, N5172B, and N5182B)” on page 419.

NOTE The rear panel must be removed to allow the pin connector on the A2 Vector BBG assembly to be disconnected from the A3 RF assembly without damaging the connector pins.

5. Place the signal generator flat with the A2 Vector BBG assembly facing up and the rear panel facing you.
6. Refer to Figure 15-6. Use the needle-nose pliers to disconnect the cables from the following locations:
   - A2J15, I Input, W4 (W17 for Option 1EM instruments).
   - A2J16, Q Input, W5 (W18 for Option 1EM instruments).
7. Remove the cable clamp and cable W6.
8. Using the 5/16” open-ended wrench, disconnect the following cables according to the instrument you have:
   - Instruments **without** Option 012: Remove cables W7 and W8.
   - Instruments **with** Option 012: refer to Figure 15-7. Remove cables W13, W14, and W15.

9. Refer to Figure 15-6. If Option 660 is installed, use the T-10 driver to remove the four screws (1) that secure the A8 Real Time Jumper Board to the A2 Vector BBG assembly and the A7 Real Time BBG assembly. Pull up on the Real Time Jumper Board to disengage from the assemblies.
10. Using the T-10 driver, remove the two screws (2) and four screws (3) that connect the A2 Vector BBG assembly to the chassis.
11. Place your thumbs under the BNC connectors and push up on the A2 Vector BBG assembly to release it from the pin connector.
12. Remove the A2 Vector BBG assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.

NOTE

If Option 660 is installed, follow these steps:

a. When plugging in the A8 Real Time Jumper Board into the A2 and A7 boards, it is important to have all boards loose in order to ensure proper connector mating.

b. It will be necessary to loosen the eight screws (1) (refer to Figure 15-30) attaching the A7 Real Time BBG assembly to the chassis before plugging in the A8 Real Time Jumper Board.

c. After the A8 Jumper board is plugged into both the A2 and A7 boards, tighten the four A8 board screws (1) first. Refer to Figure 15-6.

d. Then you can tighten the eight screws for the A7 board and the five screws for the A2 board.

2. Recommended torque for all T-10 screws is 9 in–lbs.

WARNING

The vertical SMA board connectors (on the A2 and A3 assemblies) for cables W7 and W8 can be broken loose easily.

DO NOT OVER-TORQUE THESE CONNECTORS. The recommended torque is 9 in-lbs.

NOTE

Place the cable with the long nut into place first, then connect to the A2 Vector BBG assembly.

3. Recommended torque for all BNC connector hex nuts is 21 in–lbs.
4. See Chapter 16, “Pre and Post-Repair Procedures”, and perform the “Post Repair Procedures” outlined for the replacement of this assembly.

Figure 15-6 A2 Vector BBG Assembly (Option 660)

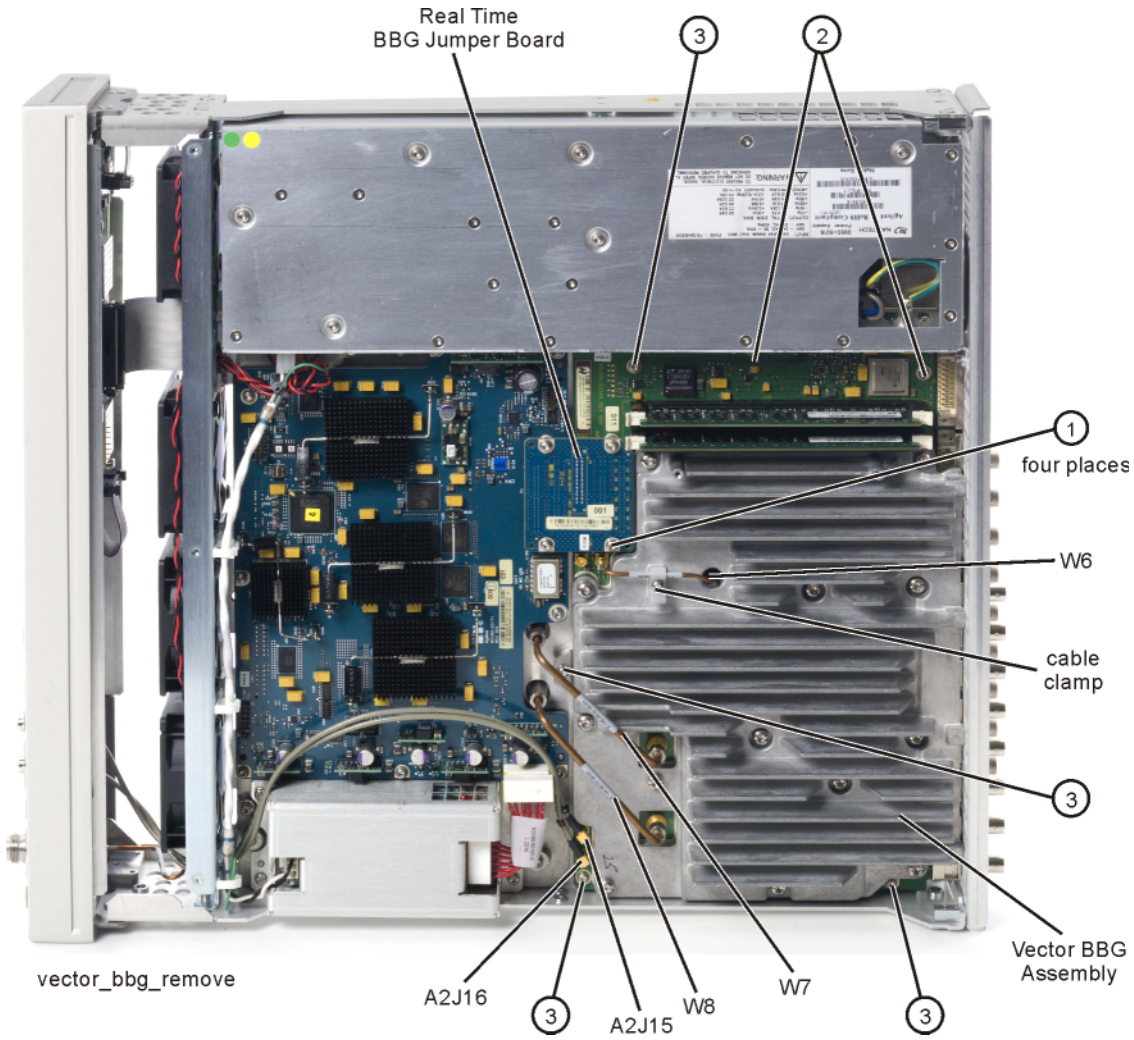
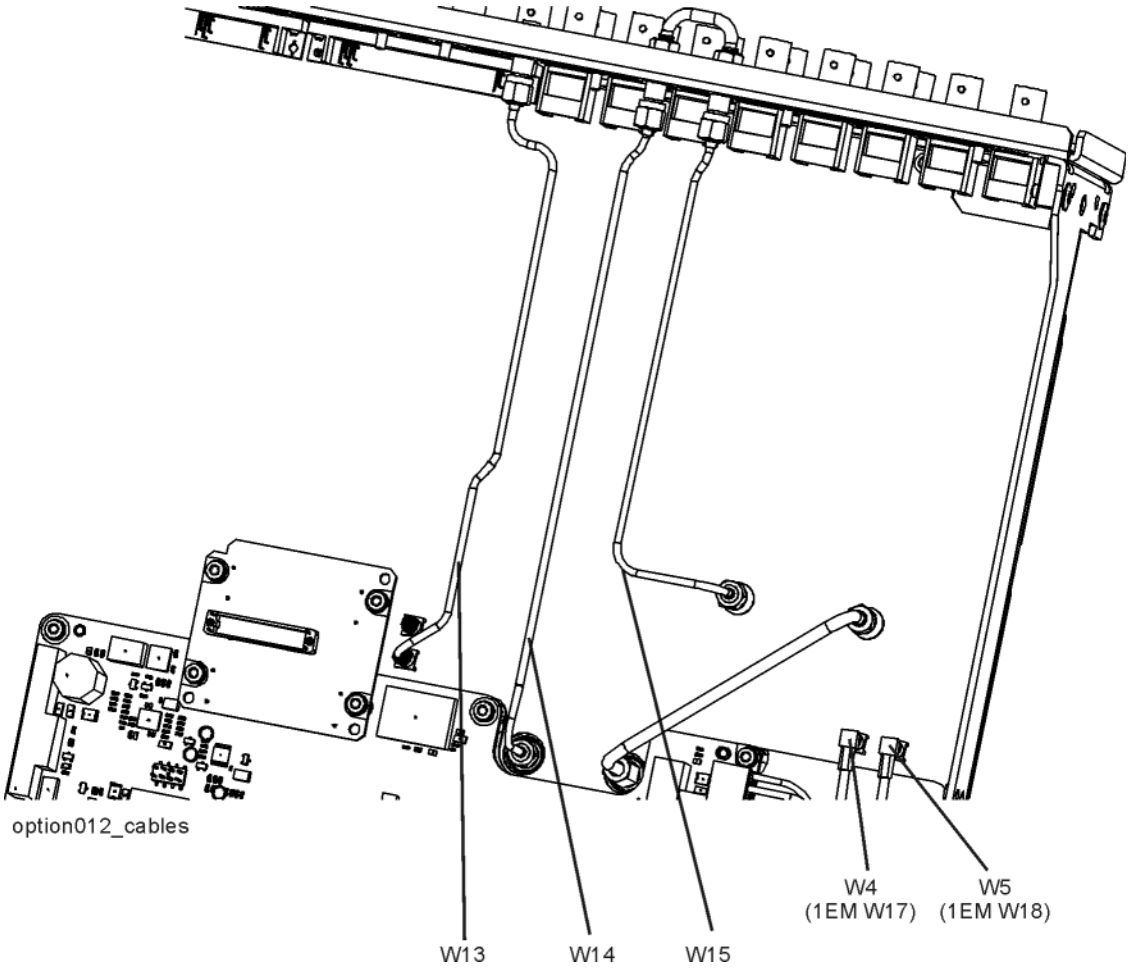


Figure 15-7 Option 012 Cables



A3 RF Assembly (N5171B, N5181B)

WARNING Do not disconnect the RF connector cable from the A3 RF assembly or the RF connector itself. Removing the cable will result in instrument failure.

Tools Required

- T-10 driver
- 5/16” open-ended wrench
- Flat-head screwdriver

Removal Procedure

NOTE Pry slots have been provided on both sides of the A3 RF assembly to aid in removing the board.

1. Before replacing the A3 RF assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the “Pre Repair Procedures” outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Place the signal generator flat with the A3 RF assembly facing up.
5. Refer to Figure 15-8. Remove ribbon cable W1.
6. Remove the following assemblies, in the order listed
   a. “A5 CPU” on page 375
   b. “Rear Panel (N5171B/81B)” on page 417
   c. “Front-Panel” on page 348
7. For Option 1EM instruments, skip to step 8. For all other instruments, refer to Figure 15-9. Using the T-10 driver, remove the 3 screws (1) that connect the RF In connector to the chassis.

CAUTION The RF Connector can be easily damaged. Use extreme caution when disconnecting and reconnecting the RF connector bracket from and to the instrument chassis.

8. Refer to Figure 15-8. Using the T-10 driver, remove the 10 screws (1) that connect the A3 RF assembly to the chassis.
9. Refer to Figure 15-10. Place the tip of a medium common screwdriver into one of the three pry slots on the A3 RF assembly and twist the screwdriver to release the board from the connector pins.
10. Repeat step 9 with the other two pry slots.
11. Remove the A3 RF assembly as shown in Figure 15-11.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for Front Panel screws is 21 in-lbs. Recommended torque for all other screws is 9 in–lbs.
3. Recommended torque for all BNC connectors is 21 in–lbs.
4. See Chapter 16, “Pre and Post-Repair Procedures” and perform the “Post Repair Procedures” outlined for the replacement of this assembly.

Figure 15-8 A3 RF Assembly - Screw locations

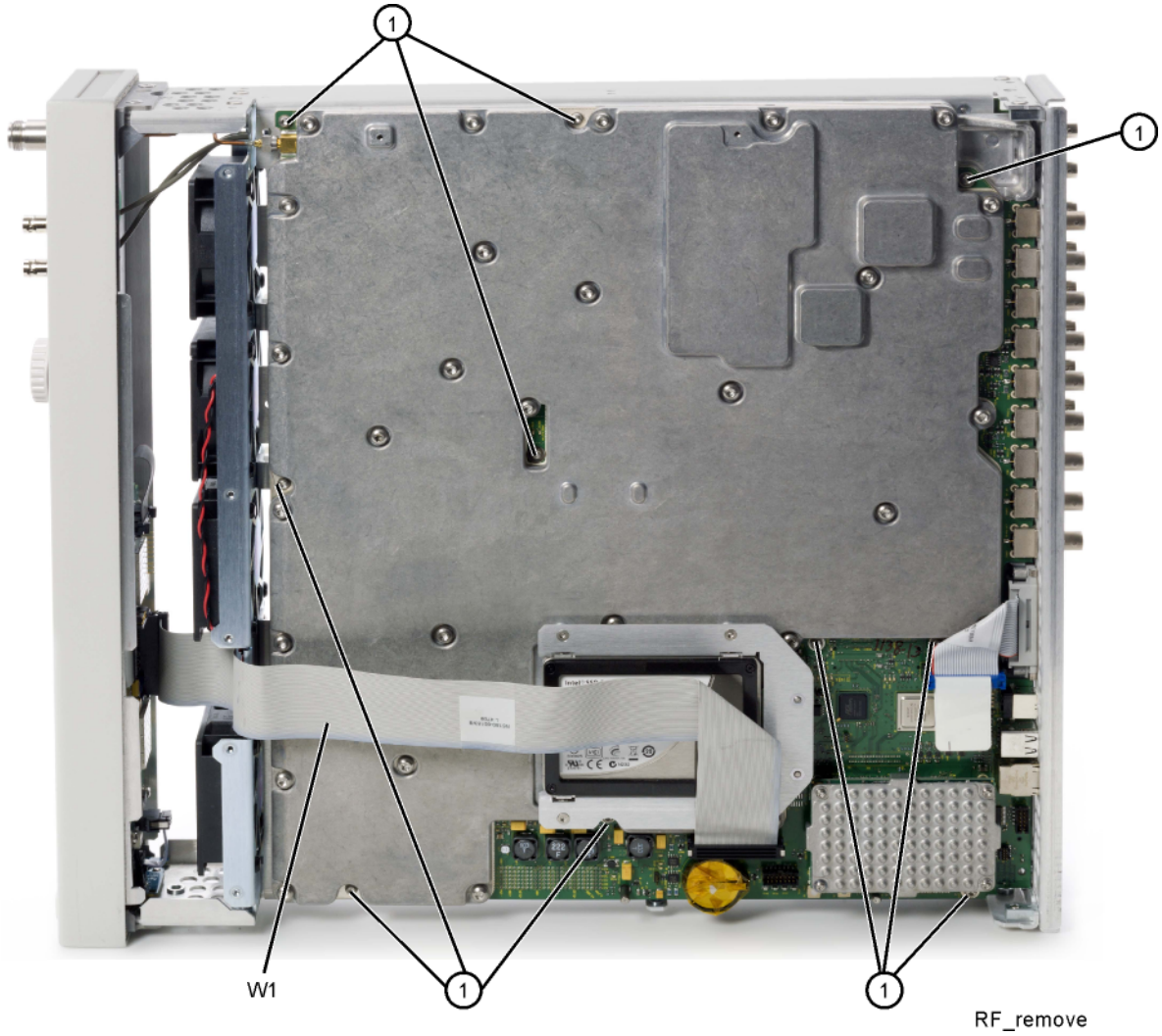


Figure 15-9 RF Connector - Screw locations (Type-N Shown)

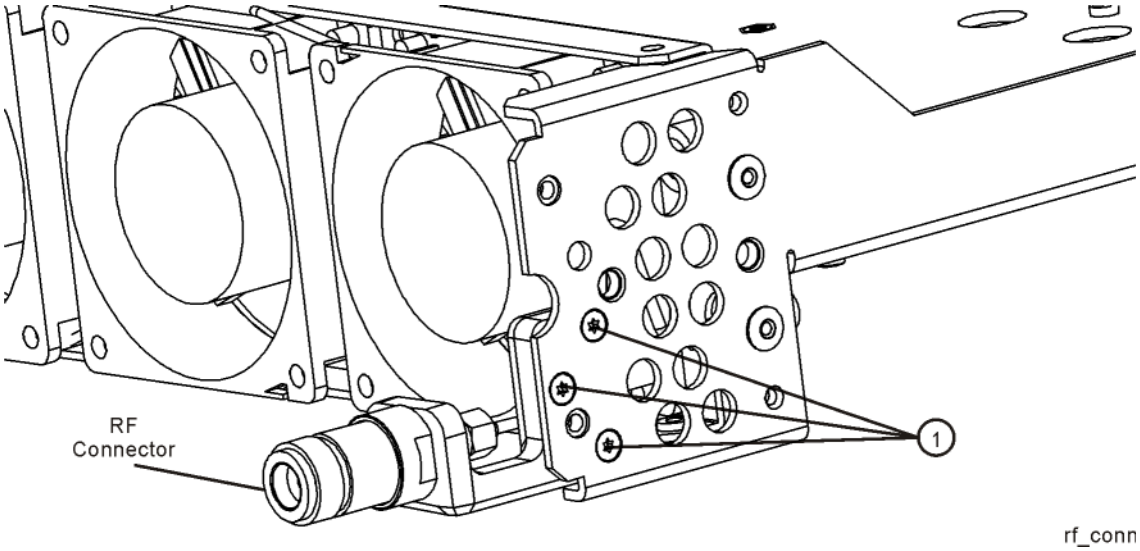


Figure 15-10 A3 RF Assembly - Removal

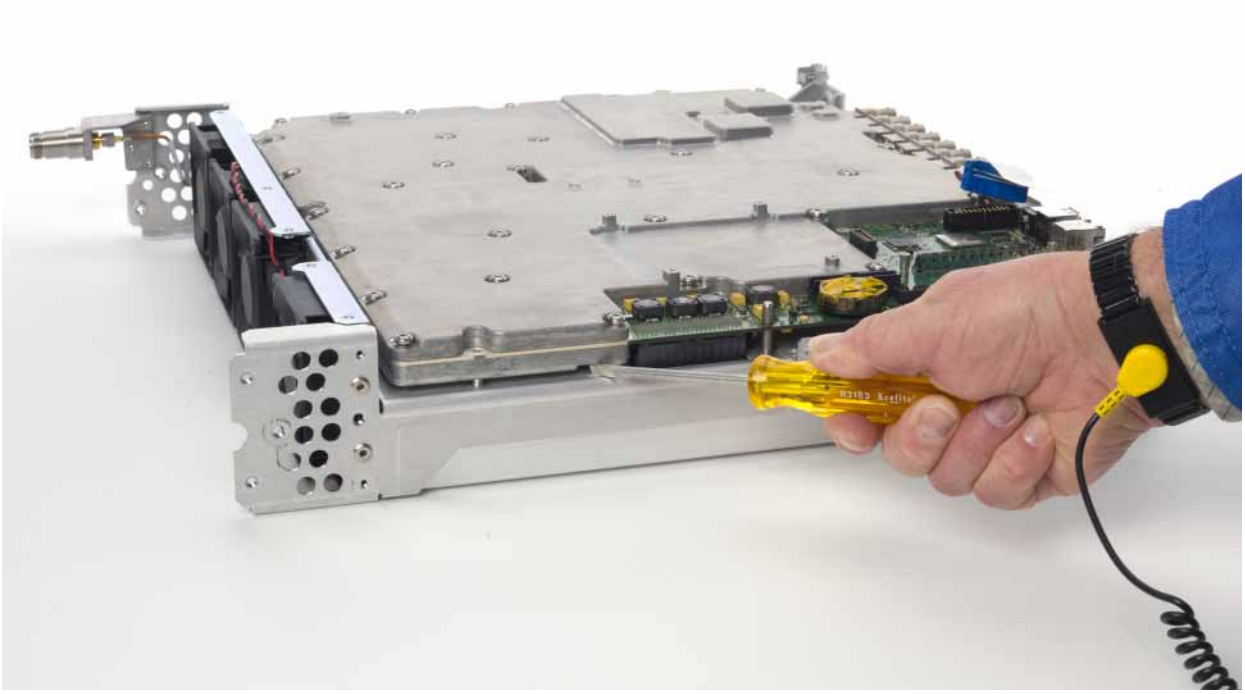
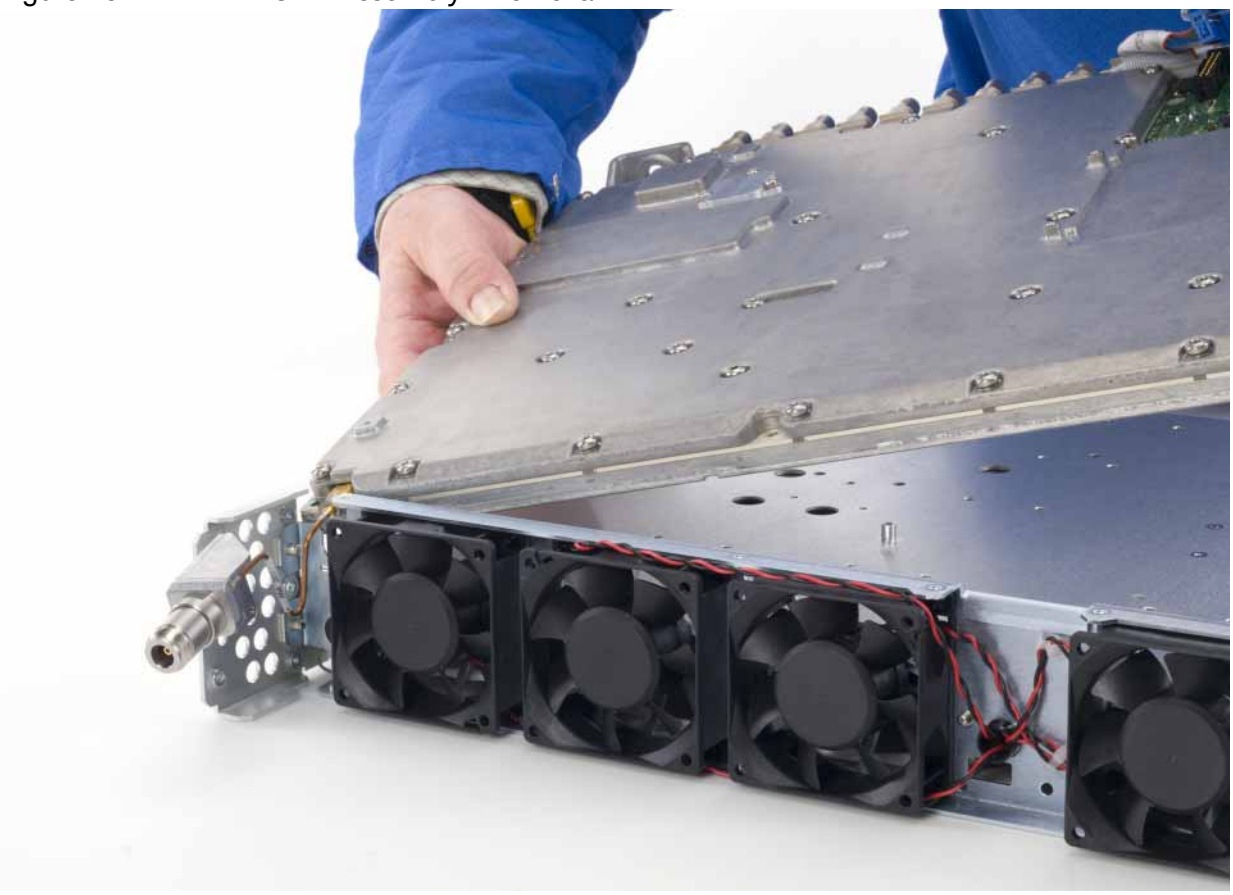


Figure 15-11 A3 RF Assembly - Removal



A3 RF Assembly (N5166B, N5172B, and N5182B)

WARNING Do not disconnect the RF connector cable from the A3 RF assembly or the RF connector itself. Removing the cable will result in instrument failure.

Tools Required

- T-10 driver
- 5/16” open-ended wrench
- Flat-head screwdriver

Removal Procedure

NOTE Pry slots have been provided on both sides of the A3 RF assembly to aid in removing the board.

1. Before replacing the A3 RF assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the “Pre Repair Procedures” outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Place the signal generator flat with the A2 Vector BBG assembly facing up and the rear panel facing you.
5. Referring to Figure 15-12, remove the Cable Clamp and cable W6.
6. Using the 5/16” open-ended wrench, disconnect the following cables according to the instrument you have.

   Instruments without Option 012 refer to Figure 15-12, remove W7 and W8.

   Instruments with Option 012 refer to Figure 15-13, remove W8 and W14.
7. Place the signal generator flat with the A3 RF assembly facing up.
8. Refer to Figure 15-8. Remove ribbon cable W1.
9. Remove the following assemblies, in the order listed
   a. “A4 SSD (N5166B, N5172B, and N5182B only)” on page 371
   b. “A5 CPU” on page 375
   c. “Rear Panel (N5166B, N5172B, and N5182B)” on page 419

d. "Front-Panel" on page 348

10. For Option 1EM instruments, skip to step 10. For all other instruments, refer to Figure 15-9. Using the T-10 driver, remove the 3 screws (1) that connect the RF In connector to the chassis.

CAUTION The RF Connector can be easily damaged. Use extreme caution when disconnecting and reconnecting the RF connector bracket from and to the instrument chassis.

11. Refer to Figure 15-8. Using the T-10 driver, remove the 10 screws (1) that connect the A3 RF assembly to the chassis.
12. Refer to Figure 15-10. Place the tip of a medium common screwdriver into one of the three pry slots on the A3 RF assembly and twist the screwdriver to release the board from the connector pins.
13. Repeat step 11 with the other two pry slots.
14. Remove the A3 RF assembly as shown in Figure 15-11.

Replacement Procedure

1. Reverse the order of the removal procedure.

NOTE When plugging in the A3 RF assembly into the A2 board, it is important to have all boards loose in order to ensure proper connector mating. Follow these steps:

a. It will be necessary to loosen the screws attaching the A2 Vector BBG assembly (and the A7 Real Time BBG assembly if Option 660 is present) to the chassis before plugging in the A3 RF assembly.

b. Refer to Figure 15-14, "Loosen A2/A7 Boards screws." Loosen the A7 Real Time BBG assembly screws (1) and the A2 Vector BBG assembly screws (2). After the A3 RF assembly is plugged into the A2 board, tighten all the screws. Torque to 9 in-lbs.

2. Recommended torque for Front Panel screws is 21 in-lbs. Recommended torque for all other screws is 9 in–lbs.
3. Recommended torque for all BNC connectors is 21 in–lbs.
4. See Chapter 16, "Pre and Post-Repair Procedures" and perform the "Post Repair Procedures" outlined for the replacement of this assembly.

Figure 15-12 Cable Removal for RF Assembly (std) - N5166B, N5172B, and N5182B

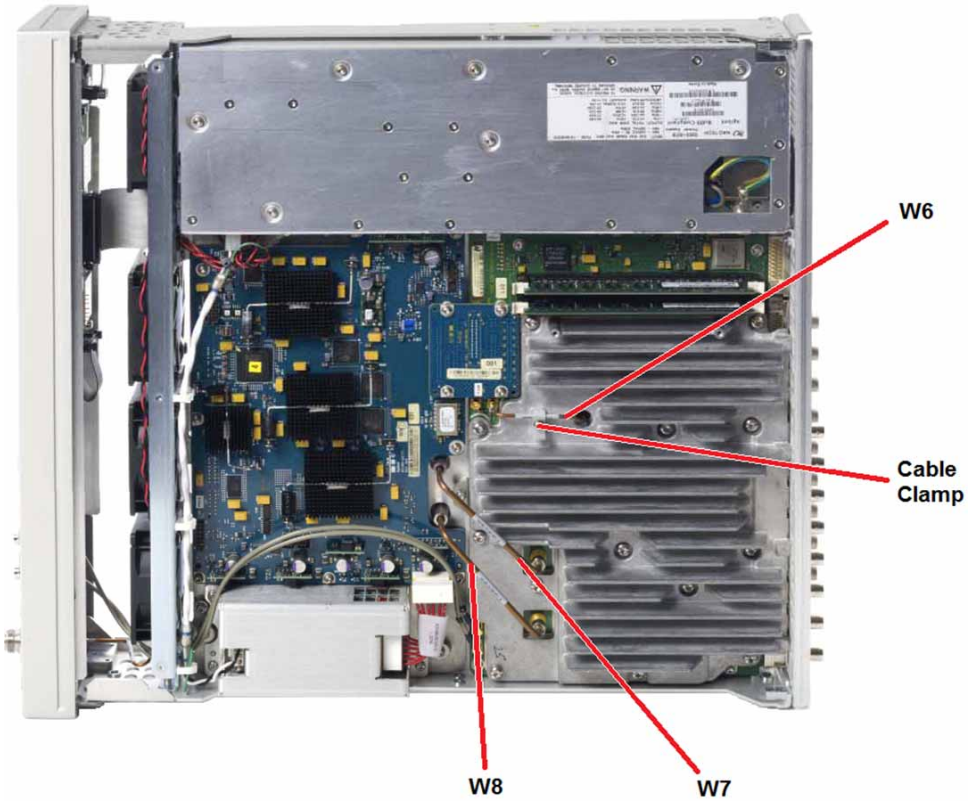


Figure 15-13 Cable Removal for A3 RF Assembly, Option 012 - N5172B and N5182B

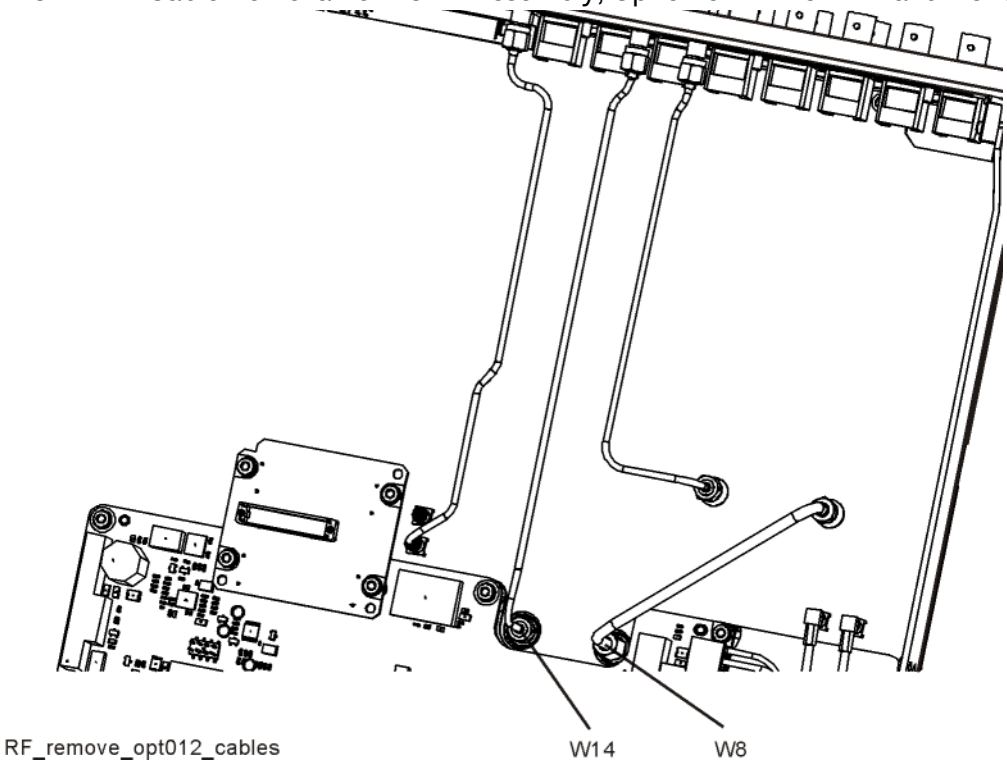
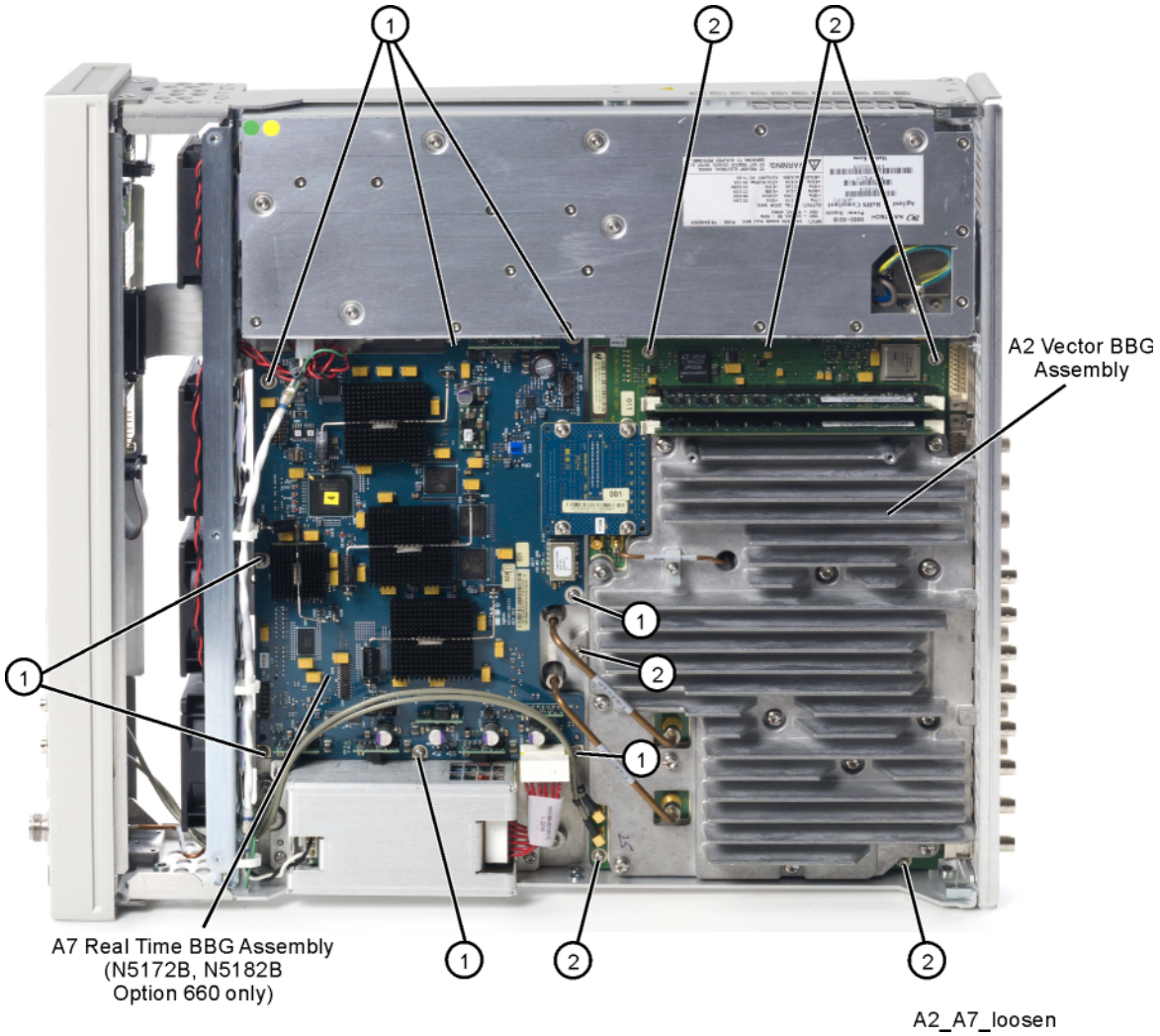


Figure 15-14 Loosen A2/A7 Boards screws



A3 RF Assembly (N5173B, N5183B)

Tools Required

- T-10 driver
- 5/16” open-ended wrench
- Flat-head screwdriver

Removal Procedure

NOTE Pry slots have been provided on both sides of the A3 RF assembly to aid in removing the board.

1. Before replacing the A3 RF assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the “Pre Repair Procedures” outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Place the signal generator flat with the A7 Micro-Deck assembly facing up and the rear panel facing you.
5. Referring to Figure 15-15, using the 5/16” open-ended wrench, disconnect the following cables:

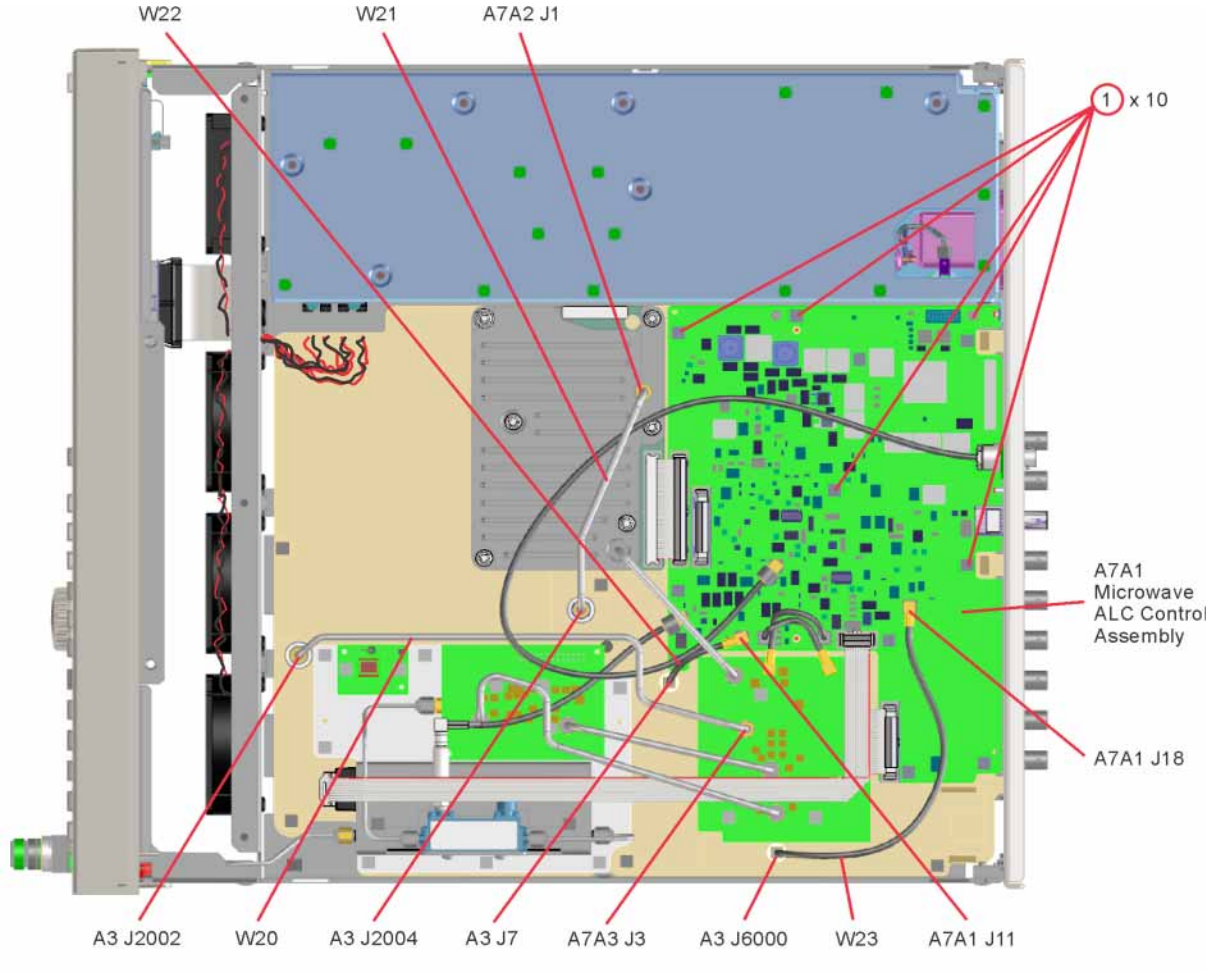
   W20 from A3 J2002 and A7A3 J3

   W21 from A3 J2004 and A7A2 J1

   W22 from A3 J7 and A7A1 J11

   W23 from A3 J6000 and A7A1 J18
6. Place the signal generator flat with the A3 RF assembly facing up.
7. Refer to Figure 15-18. Remove ribbon cable W1.
8. Remove the following assemblies, in the order listed:
   a. “A5 CPU” on page 375
   b. “Rear Panel (N5173B/83B)” on page 422

Figure 15-15 A7 Micro-Deck to A3 RF Assembly Interconnections



9. Refer to Figure 15-8. Using the T-10 driver, remove the 10 screws (1) that connect the A3 RF assembly to the chassis.
10. Refer to Figure 15-10. Place the tip of a medium common screwdriver into one of the three pry slots on the A3 RF assembly and twist the screwdriver to release the board from the connector pins.
11. Repeat step 10 with the other two pry slots.
12. Remove the A3 RF assembly as shown in Figure 15-11.

Replacement Procedure

NOTE

When plugging in the A3 RF assembly into the A7 board, it is important to have all boards loose in order to ensure proper connector mating. Follow these steps:

1. Referring to Figure 15-15, loosen the 10 screws (1) that attach the A7A1 Microwave ALC Control assembly to the A7 Micro-Deck.
2. Reverse the order of the removal procedure.
3. After the A3 RF assembly is plugged into the A7 board, tighten all the screws attaching both the A3 RF assembly and the A7A1 Microwave ALC Control assemblies. Torque to 9 in-lbs.
4. Recommended torque for all BNC connector hex nuts is 21 in–lbs.
5. See Chapter 16, “Pre and Post-Repair Procedures” and perform the Post-Repair Procedures outlined for the replacement of this assembly.

A3BT1 Battery

WARNING This battery contains lithium. Do not incinerate or puncture this battery. Do not install this battery backwards. To dispose of the battery in a safe manner. Refer to "Lithium Battery Disposal" on page 35.

NOTE The battery is part of the power off circuitry. Removing the battery will not cause any stored data to be lost.

Tools Required

- T-10 driver
- small flat-head screw driver

Removal Procedure

Refer to Figure 15-16 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to "Outer Cover" on page 342 and "Inner Bottom Cover" on page 346.
3. Place the signal generator flat with the A3 RF assembly facing up and the front-panel towards you.
4. Using the flat-head screw driver, remove the A3BT1 by carefully prying the battery out of its socket.

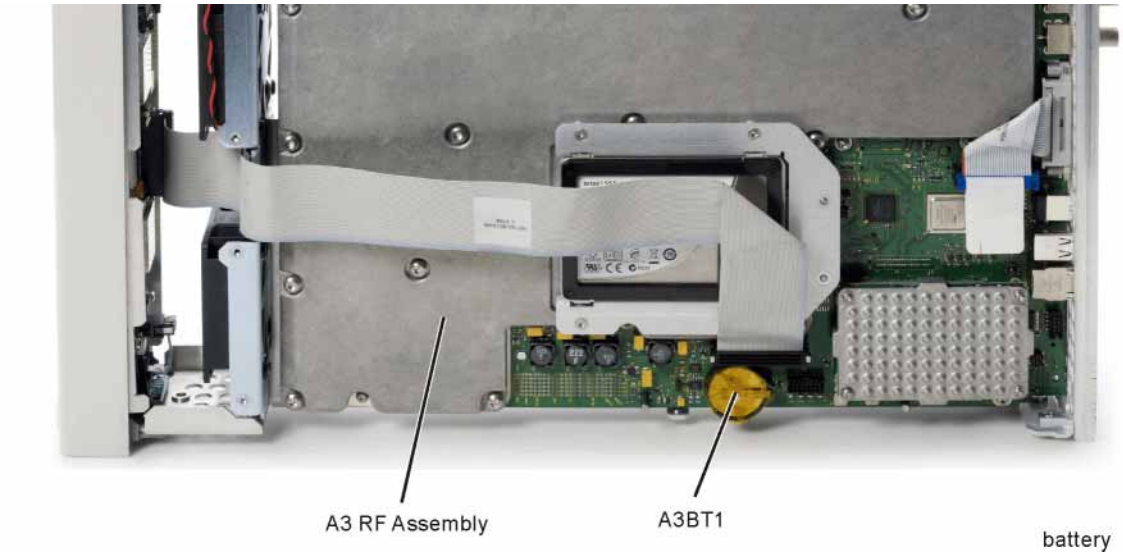
Replacement Procedure

1. Reverse the steps of the removal procedure.

NOTE To install the battery, the positive side is aligned with the positive sign on the A3 RF assembly's battery clip.

2. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, "Pre and Post-Repair Procedures."

Figure 15-16 A3BT1 Battery



A4 SSD (N5166B, N5172B, and N5182B only)

Tools Required

– T-10 driver

Removal Procedure

Refer to Figure 15-17 and Figure 15-18 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342 and “Inner Bottom Cover” on page 346.
3. Place the signal generator flat and upside down with the rear panel facing you.
4. Using the T-10 driver, remove the four screws (6) that attach the A4 SSD assembly to the A3 RF assembly.
5. Remove the A4 SSD assembly by gently rocking it side to side to release the pins.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-17 A4 SSD

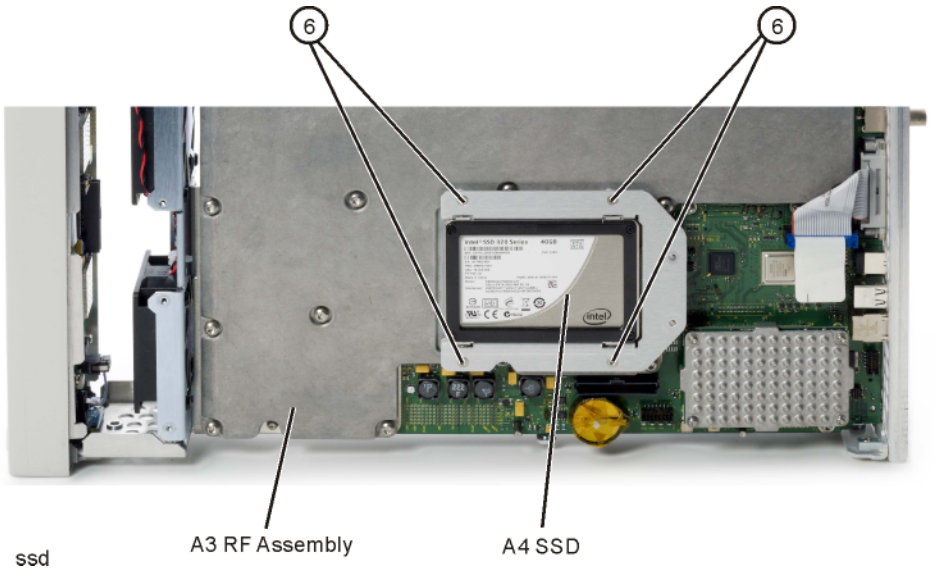


Figure 15-18 A4 SSD and A5 CPU Removal (0960-2870)

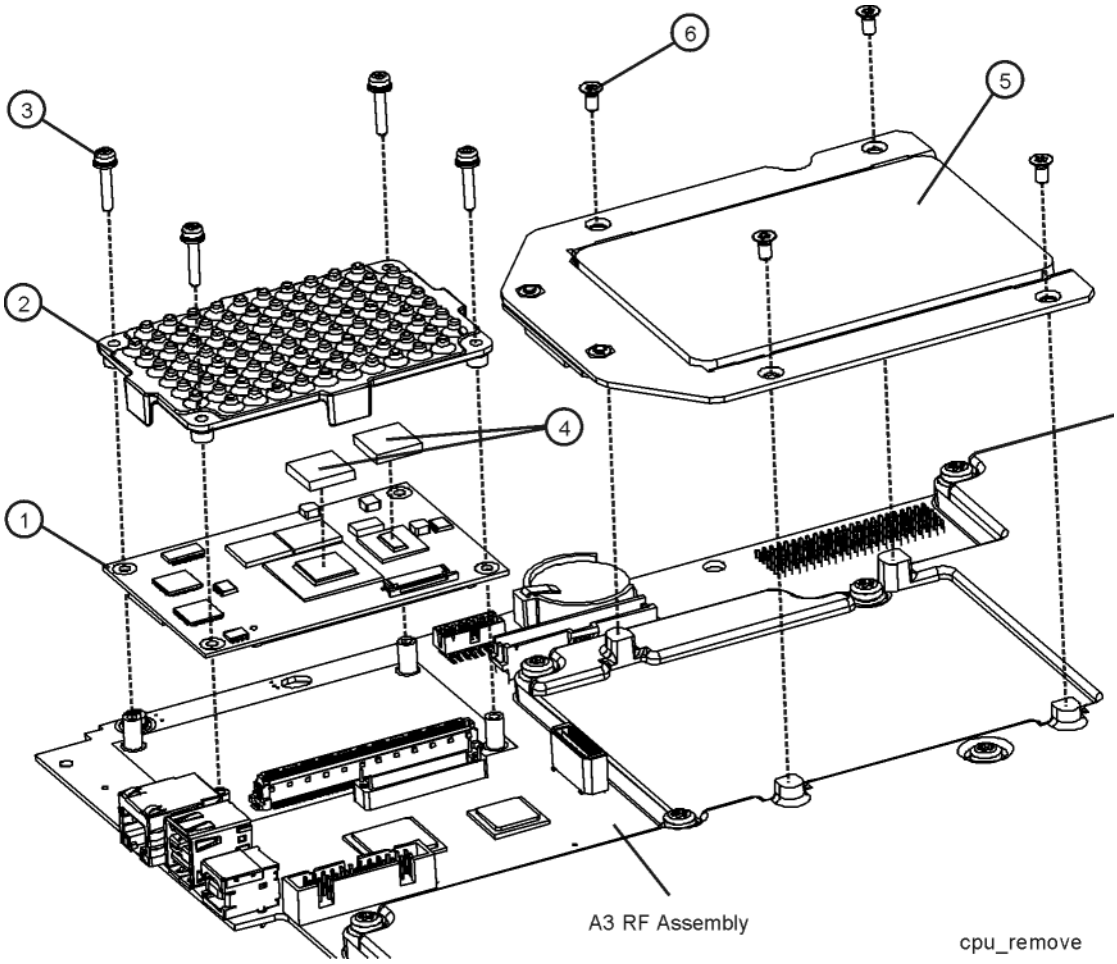
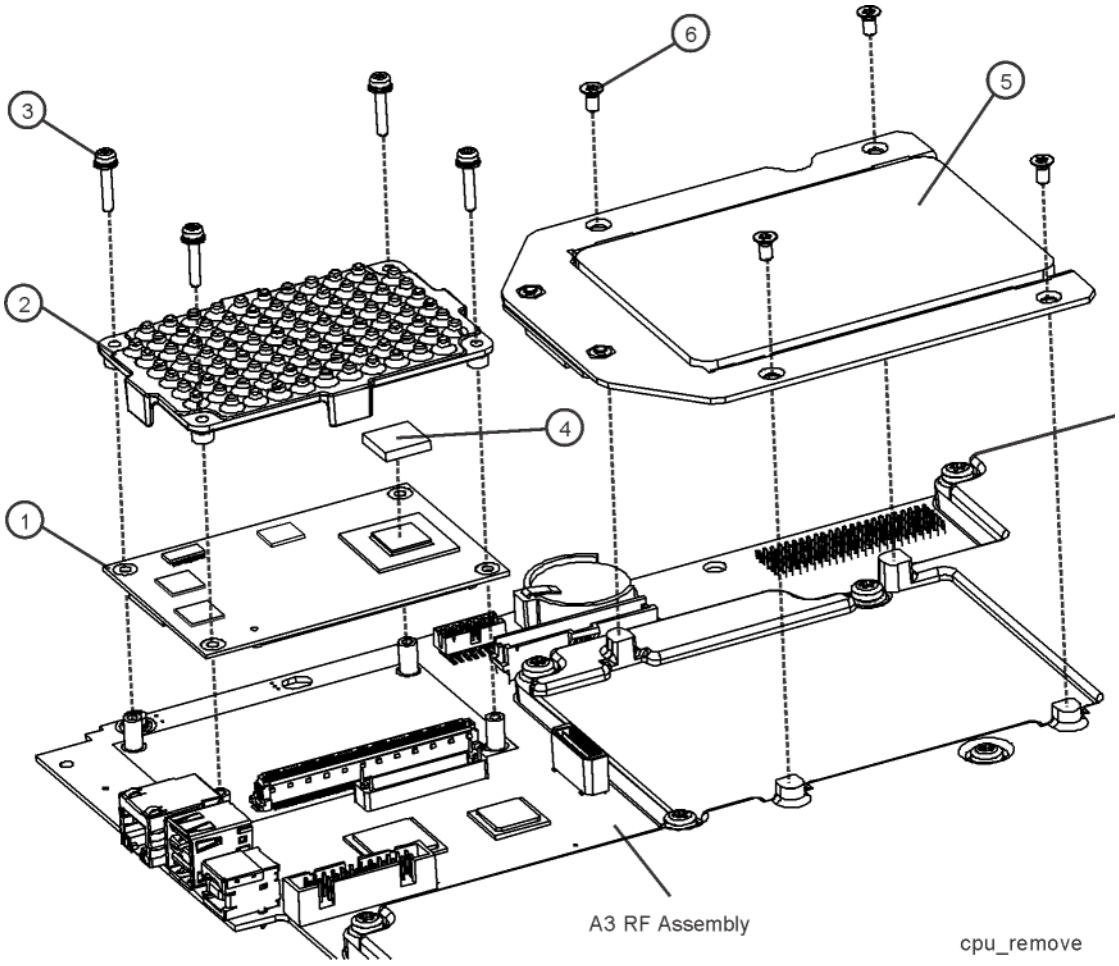


Figure 15-19 A4 SSD and A5 CPU Removal (0960-3295)



A5 CPU

Tools Required

– T-8 driver

Removal Procedure

Refer to Figure 15-18 and Figure 15-20 for this procedure.

CAUTION There is one long pin connector attaching the A5 CPU to the A3 RF assembly. It is located on the long end of the A5 CPU board, closest to the center of the instrument. Use caution when removing the A5 CPU board.

1. Before replacing the A5 CPU assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the Pre-Repair Procedures outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342 and “Inner Bottom Cover” on page 346.
4. Place the signal generator flat and upside down with the front-panel facing you.
5. Referring to Figure 15-19, using the T-8 driver, remove the four screws (3) that attach the A5 CPU (1) and heatsink (2) to the A3 RF assembly.
6. Remove the A5 CPU.
7. The thermal pads (4) should also be replaced.

NOTE There are two versions of the A5 CPU assembly. The new version requires only one thermal pad while the old version requires two. Refer to Figure 15-18 and Figure 15-19 to determine which version is being installed, how many thermal pads are required, and where they need to be located.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for the four CPU screws is 6 in–lbs.
3. See Chapter 16, “Pre and Post-Repair Procedures” and perform the Post-Repair Procedures outlined for the replacement of this assembly.

Figure 15-20 A5 CPU

A6 Front Panel Interface Scan Assembly

Tools Required

– T-10 driver

Removal Procedure

Refer to Figure 15-21 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Disconnect the LCD cable from the A6 Front Panel Interface Scan assembly. Refer to Figure 15-22. Disengage the locking tabs by sliding them in the direction shown. When reassembling, ensure the locking tabs are pushed in and engaged on both sides of the connector.
5. Disconnect the Power Switch cable from the A6 Front Panel Interface Scan assembly.
6. Disconnect the W2 ribbon cable from the A6 Front Panel Interface Scan assembly.
7. Disconnect the W3 ribbon cable from the A6 Front Panel Interface Scan assembly.
8. Using the T-10 driver, remove the seven screws (1) that secure the A6 Front Panel Interface Scan assembly to the front-panel sub-panel.
9. Remove the A6 Front Panel Interface Scan assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-21 Front Panel Interface Scan Assembly

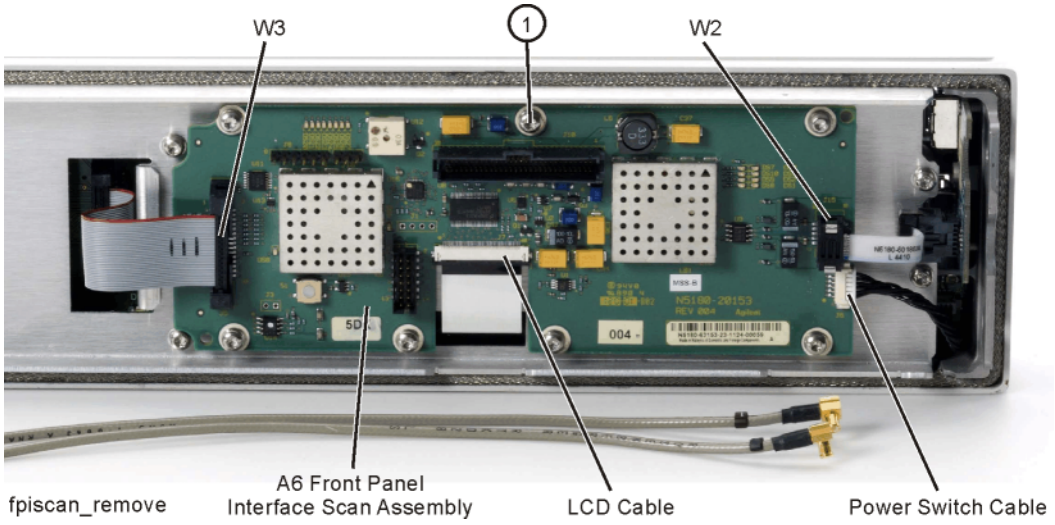
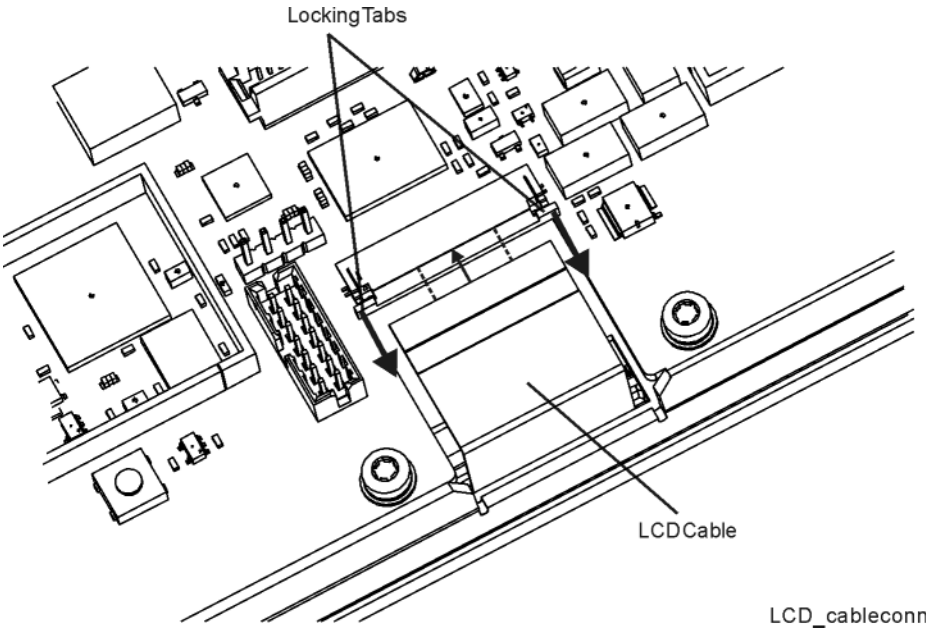


Figure 15-22 LCD Cable Locking Tabs



USB Board

Tools Required

– T-10 driver

Removal Procedure

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Refer to Figure 15-23. Disconnect W2 from the Front Panel Interface Scan assembly.
5. Carefully remove the foam trim from the side of the Front Panel.
6. Refer to Figure 15-24. Using the T-10 driver, remove the screw (1) securing the USB board to the front-panel.
7. Remove USB board

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for screw is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-23 USB Board Location

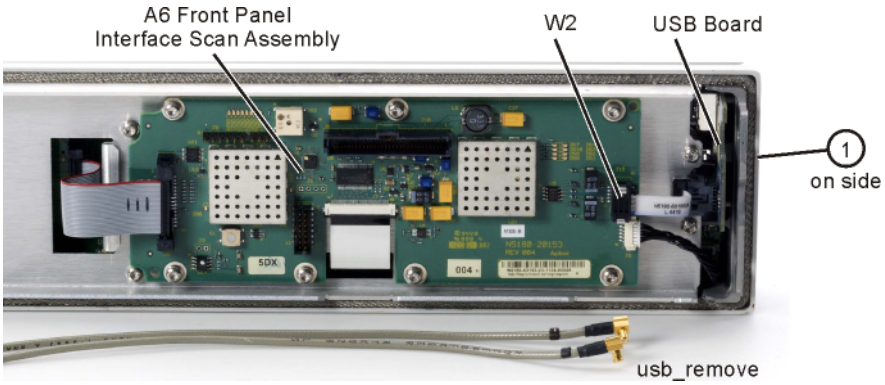
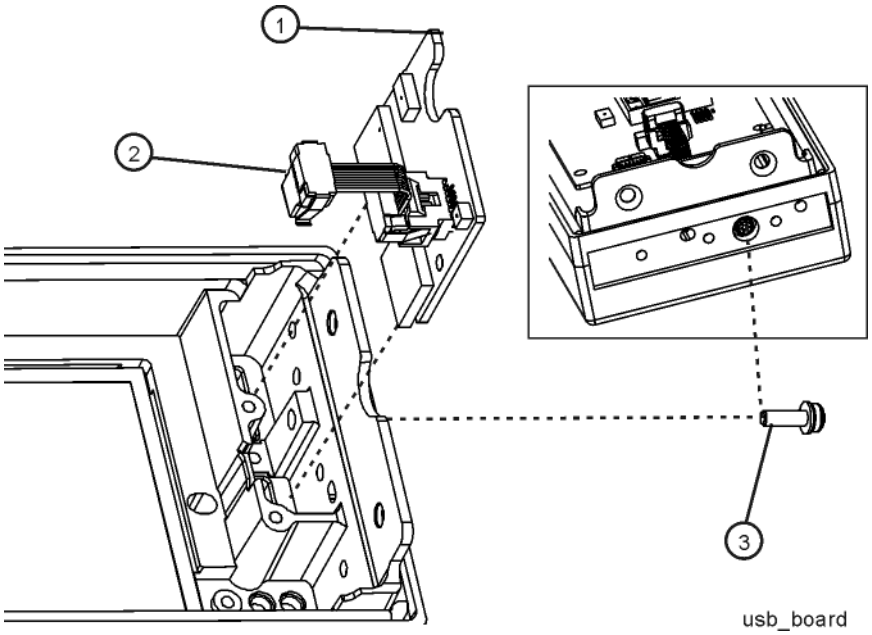


Figure 15-24 USB Board Removal



LCD Display

Tools Required

– T-10 driver

Removal Procedure

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Remove the A6 Front Panel Interface Scan assembly from the front panel. Refer to “A6 Front Panel Interface Scan Assembly” on page 377.
5. Refer to Figure 15-25. Using the T-10 driver, remove the eight screws (1) that secure the sub-panel to the front-panel.
6. Remove the sub-panel.
7. Refer to Figure 15-26. Remove the display hold-down. Take care to avoid losing the grounding spring that sits in the display hold-down.
8. Remove the LCD Display.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-25 Sub Panel

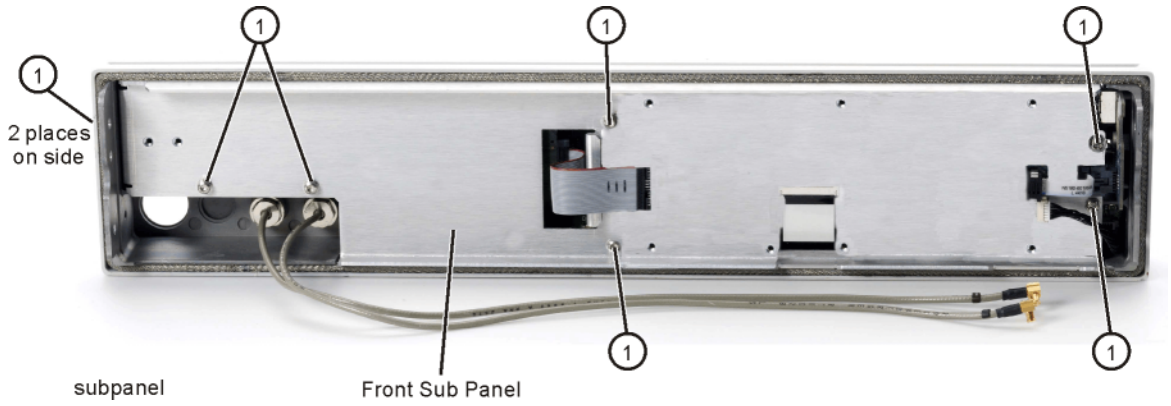
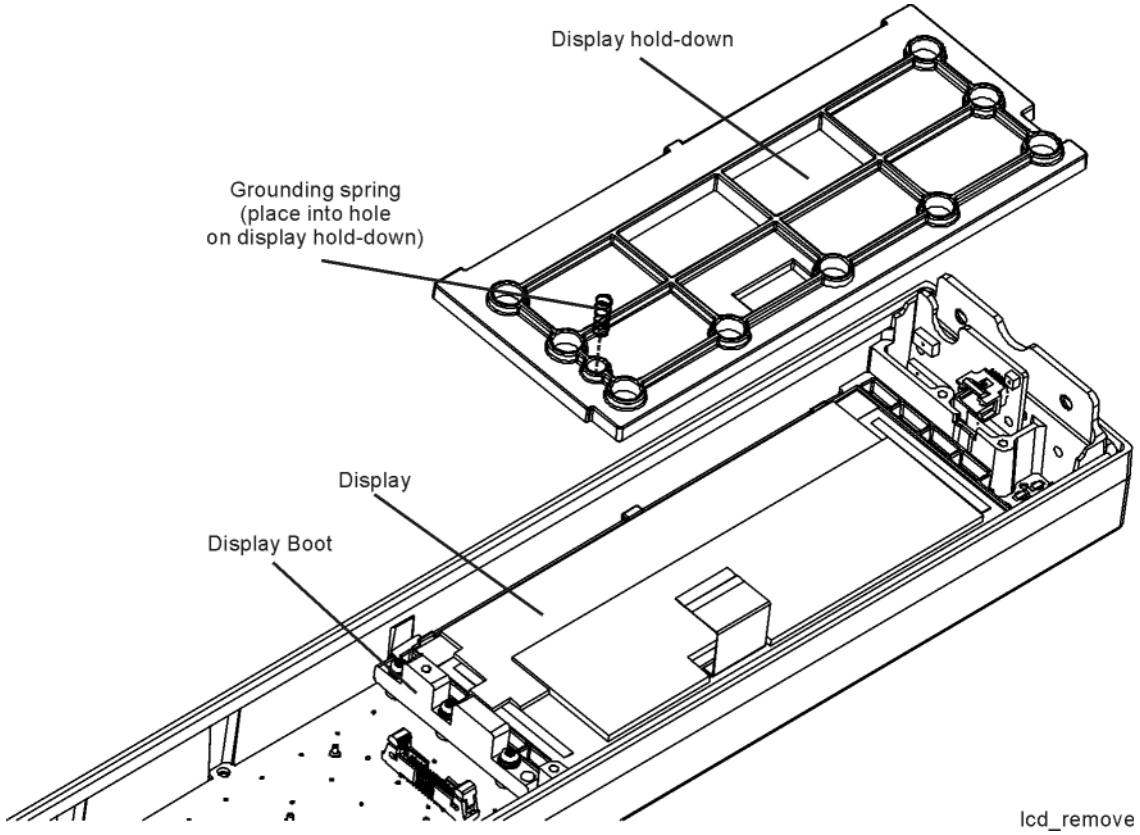


Figure 15-26 LCD Display



Key Pad

Tools Required

– T-10 driver

Removal Procedure

Refer to Figure 15-27 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the Rotary Pulse Generator (RPG) knob by carefully pulling it off the shaft of the RPG.
4. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
5. Remove the A6 Front Panel Interface Scan assembly from the front panel. Refer to “A6 Front Panel Interface Scan Assembly” on page 377.
6. Remove the LCD Display from the signal generator. Refer to “LCD Display” on page 381.
7. Using the T-10 driver, remove the three screws (1) that secure the Side Support to the front-panel frame.
8. Using the T-10 driver, remove the nine screws (2) that secure the Key Pad and Key Pad Board to the front-panel frame.
9. Remove the Key Pad and Key Pad Board.

Replacement Procedure

1. Reverse the order of the removal procedure.

NOTE

Refer to Figure 15-28, “Key Pad Screws.” Hand start the two screws labeled “A” and “B” until they are snug, then install the remaining ten screws.

2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-27 Key Pad

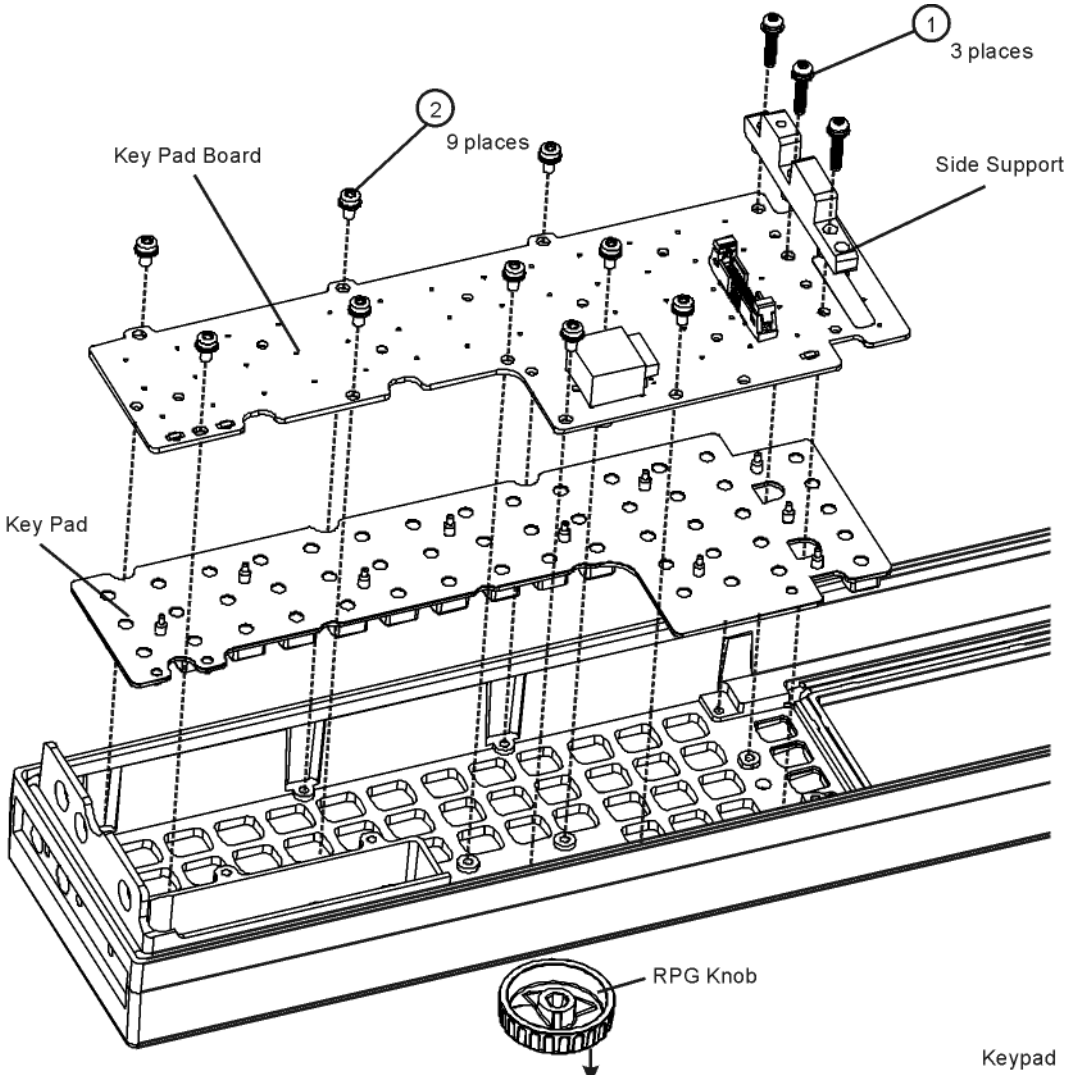
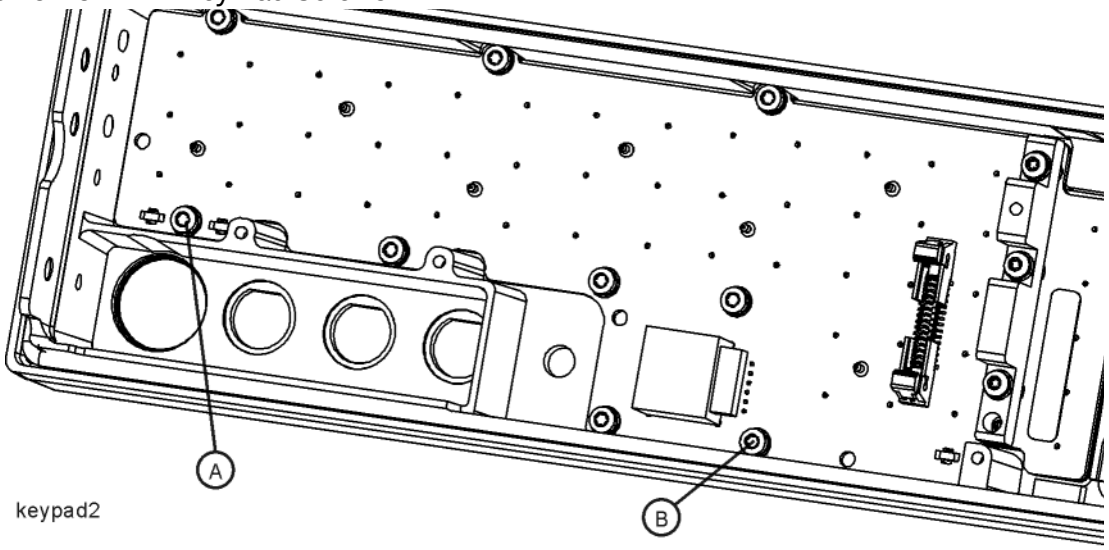


Figure 15-28 Key Pad Screws



Power Switch

Tools Required

– T-10 driver

Removal Procedure

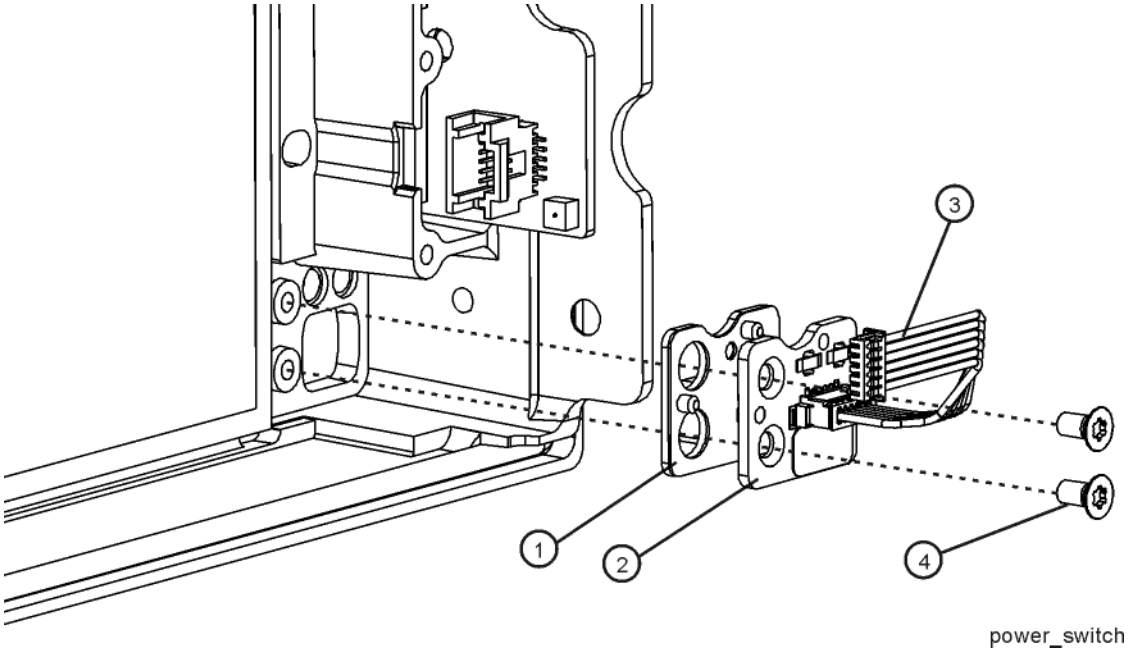
Refer to Figure 15-29 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Remove the A6 Front Panel Interface Scan assembly from the signal generator. Refer to “A6 Front Panel Interface Scan Assembly” on page 377.
5. Remove the LCD Display from the signal generator. Refer to “LCD Display” on page 381.
6. Using the T-10 driver, remove the two screws (4) that secure the Power Switch (2) to the front-panel frame.
7. Remove the Power Switch.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-29 Power Switch



A7 Real Time BBG Assembly (N5172B and N5182B Option 660)

Tools Required

- T-10 driver
- 5/16” open-ended wrench
- needle-nose pliers

Removal Procedure

Refer to Figure 15-30 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342 and “Inner Top Cover” on page 344.
3. Place the signal generator flat with the A7 Real Time BBG assembly facing up and the rear panel facing you.
4. Refer to Figure 15-30. Remove power cable W12 from the A7 Real Time BBG assembly.
5. Remove power cable W10 from the A1 Power Supply.
6. Remove the four screws (2) attaching the A8 Real Time BBG Jumper board. Unplug and remove the jumper board.
7. Refer to Figure 15-30. Using the T-10 driver, remove the eight screws (1) attaching the A7 Real Time BBG assembly to the chassis deck.
8. Remove the A7 Real Time BBG assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.

NOTE

When plugging in the A8 Real Time Jumper Board into the A2 and A7 boards, it is important to have all boards loose in order to ensure proper connector mating. Follow these steps:

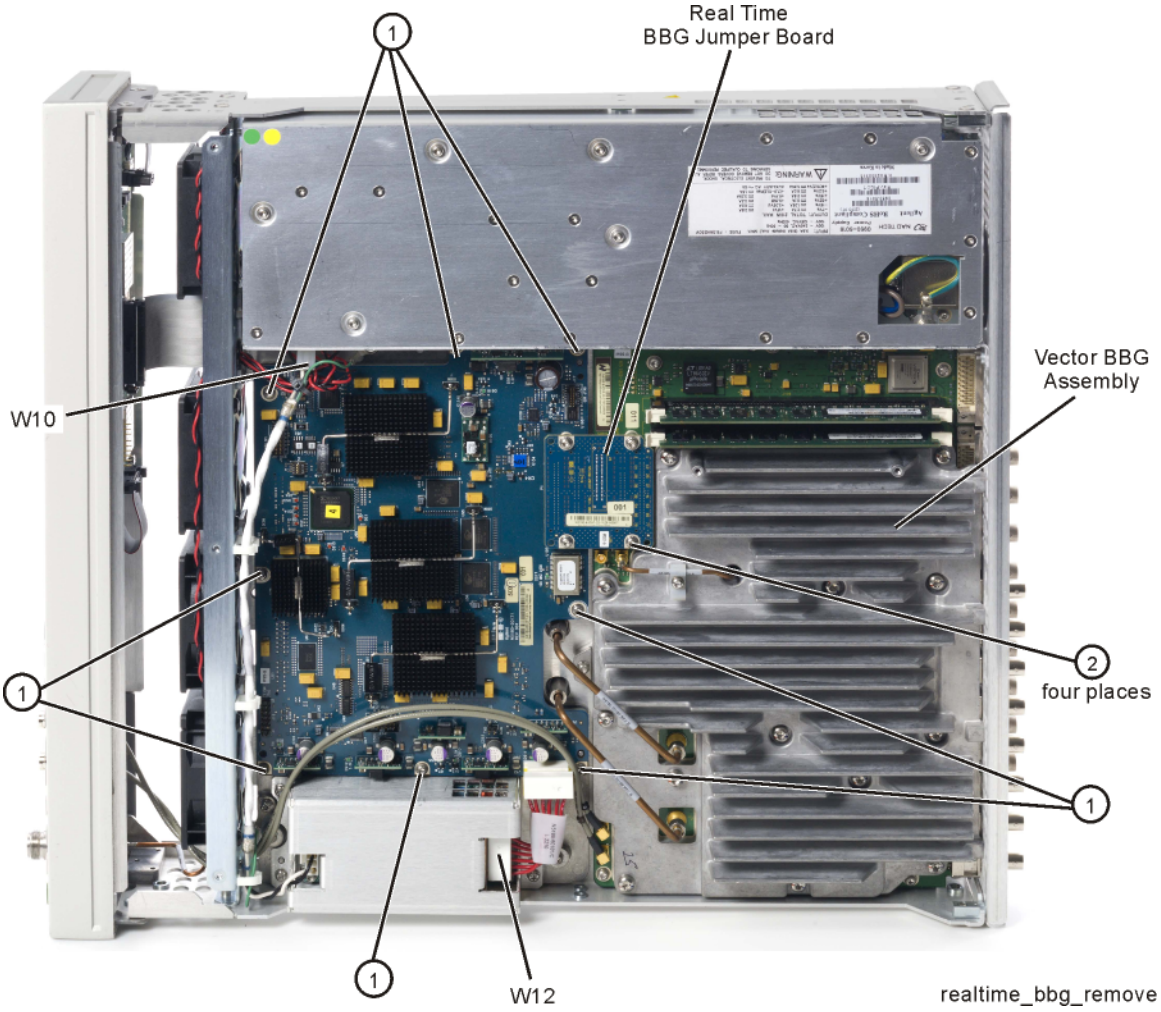
a. It will be necessary to loosen the five screws (2) and (3) (refer to Figure 15-6, “A2 Vector BBG Assembly (Option 660),”) attaching the A2 Vector BBG assembly to the chassis before plugging in the A8 Real Time Jumper Board.

b. After the A8 Jumper board is plugged into both the A2 and A7 boards, tighten the four A8 board screws (2) first. Refer to Figure 15-30, “A7 Real Time BBG Assembly (N5172B, N5182B Option 660),”.

c. Then you can tighten the eight screws for the A7 board and the five screws for the A2 board.

2. Recommended torque for all T-10 screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

Figure 15-30 A7 Real Time BBG Assembly (N5172B, N5182B Option 660)



A7A1 Real Time Aux Power Supply

Tools Required

- T-10 driver
- needle-nose pliers

Removal Procedure

Refer to Figure 15-31 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to "Outer Cover" on page 342 and "Inner Top Cover" on page 344.
3. Place the signal generator flat with the A7 Real Time BBG assembly facing up and the rear panel facing you.
4. Refer to Figure 15-31. Remove power cable W12 from the A7A1 Real Time Aux Power Supply (1).
5. Remove power cable W10 from A7A1 Real Time Aux Power Supply assembly.
6. Refer to Figure 15-32. Remove the four screws (1) attaching the A7A1 Real Time Aux Power Supply cover. Remove cover.
7. Refer to Figure 15-33. Remove the fours screws (2) attaching the A7A1 Real Time Aux Power Supply to the chassis.
8. Remove the A7A1 Real Time Aux Power Supply.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all T-10 screws is 9 in–lbs.
3. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, "Pre and Post-Repair Procedures."

Figure 15-31 A7 Real Time Aux Power Supply Cable Removal

Figure 15-32 A7 Real Time Aux Power Supply Cover

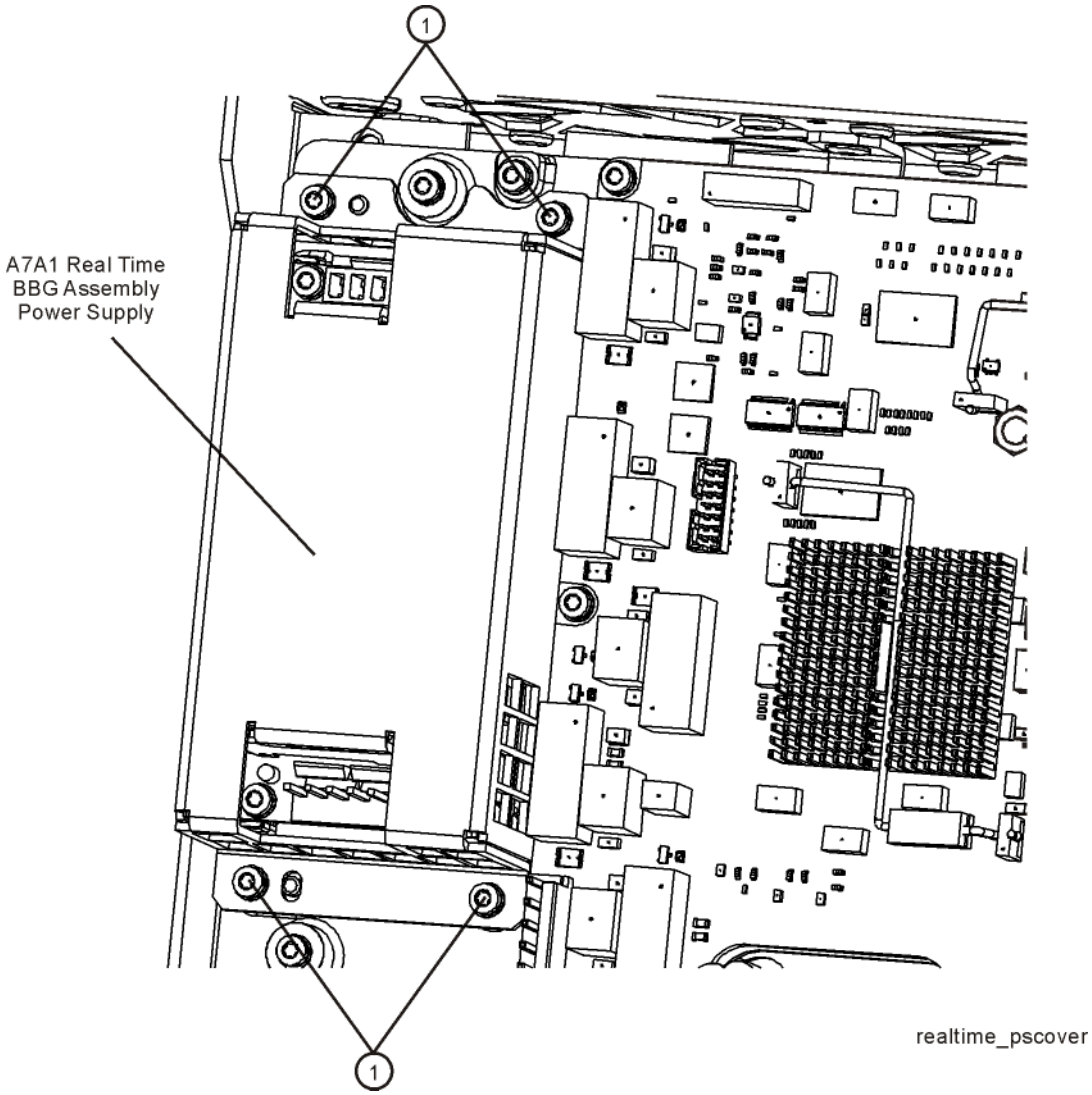
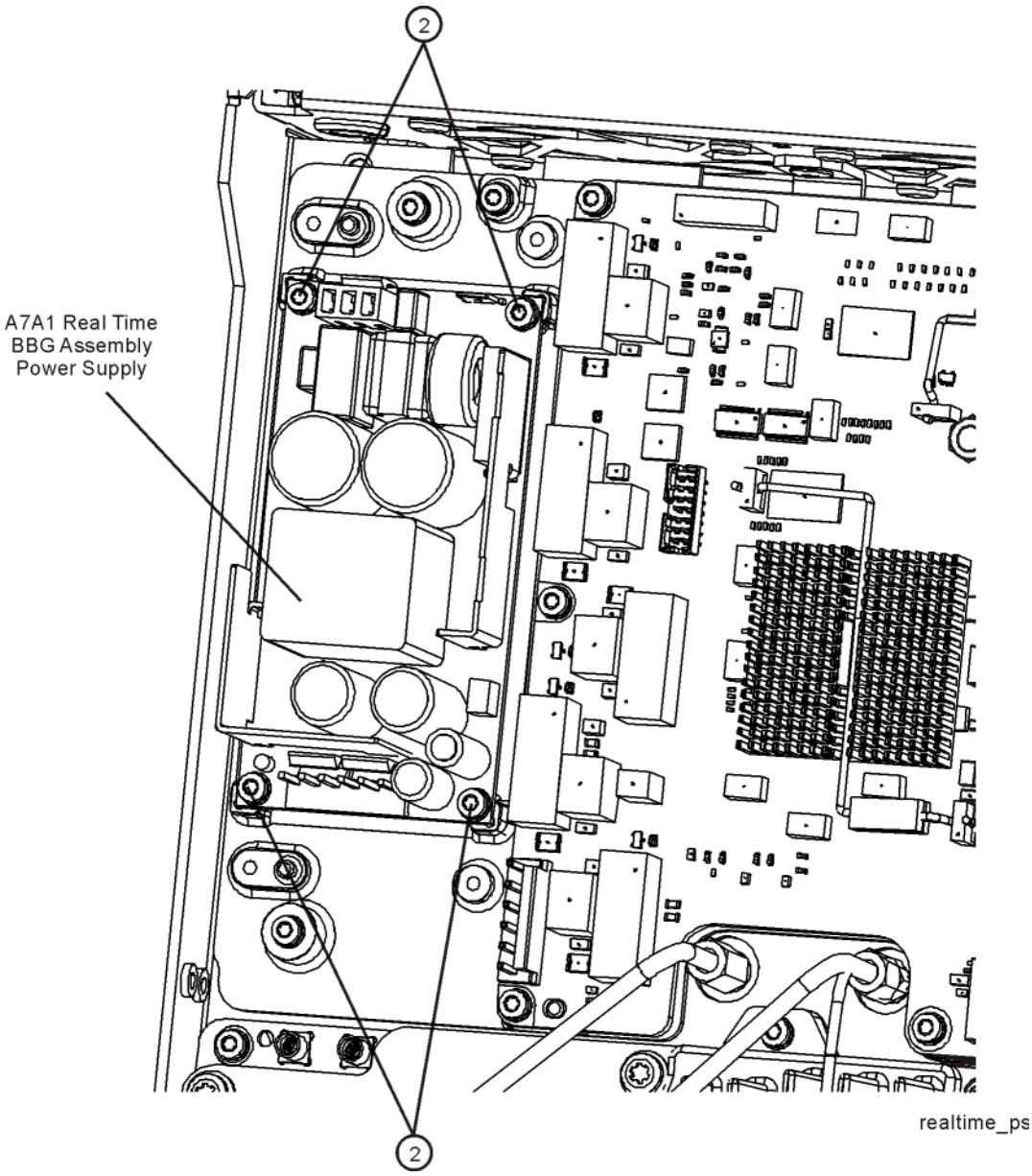


Figure 15-33 A7 Real Time Aux Power Supply



RF Connector

Tools Required

- T-10 driver
- 5/16” open-ended wrench

Removal Procedure

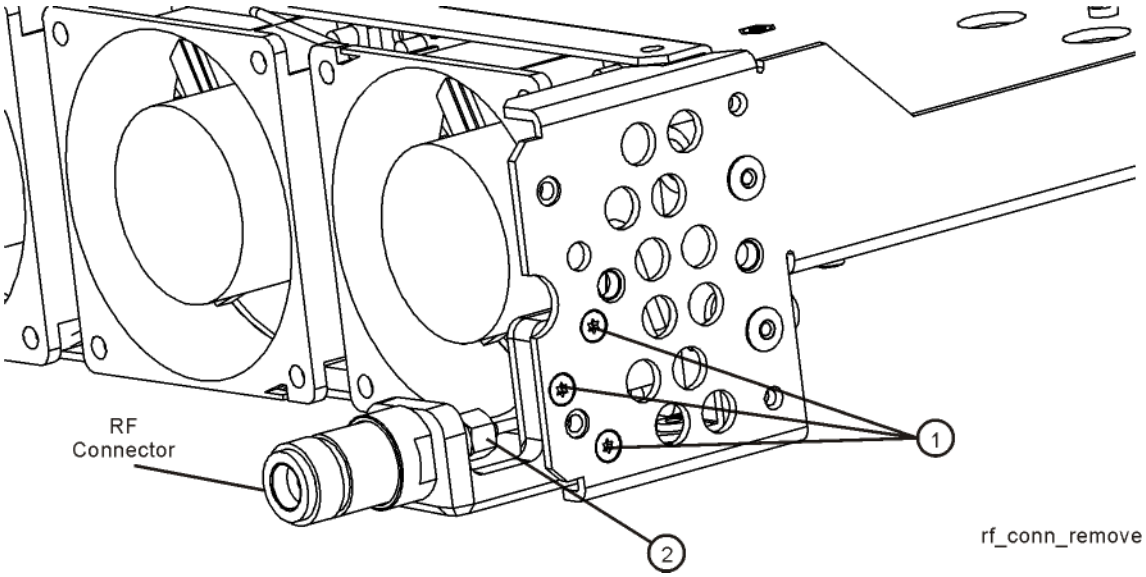
Refer to Figure 15-34 for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover from the signal generator. Refer to “Outer Cover” on page 342.
3. Remove the front panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Using the 5/16” open-ended wrench, disconnect W9 (2) from the RF connector.
5. Using the T-10 driver, remove the three screws (1) that attach the RF connector to the chassis.
6. Remove the RF connector.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for the three screws is 9 in–lbs.
3. Recommended torque for W9 cable is 9 in–lbs.

Figure 15-34 RF Connector Removal (Type-N Shown)



RF Connector (N5173B/83B only - Standard)

Tools Required

– 5/16” open-ended wrench

Removal Procedure

Refer to Figure 15-34 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Remove the front-panel from the signal generator. Refer to “Front-Panel” on page 348.
4. Using a 5/16” open-ended wrench, disconnect the following semi-rigid cable according to the signal generator you have.

   520 with a 3.5mm RF connector: W10 from the RF connector (1).

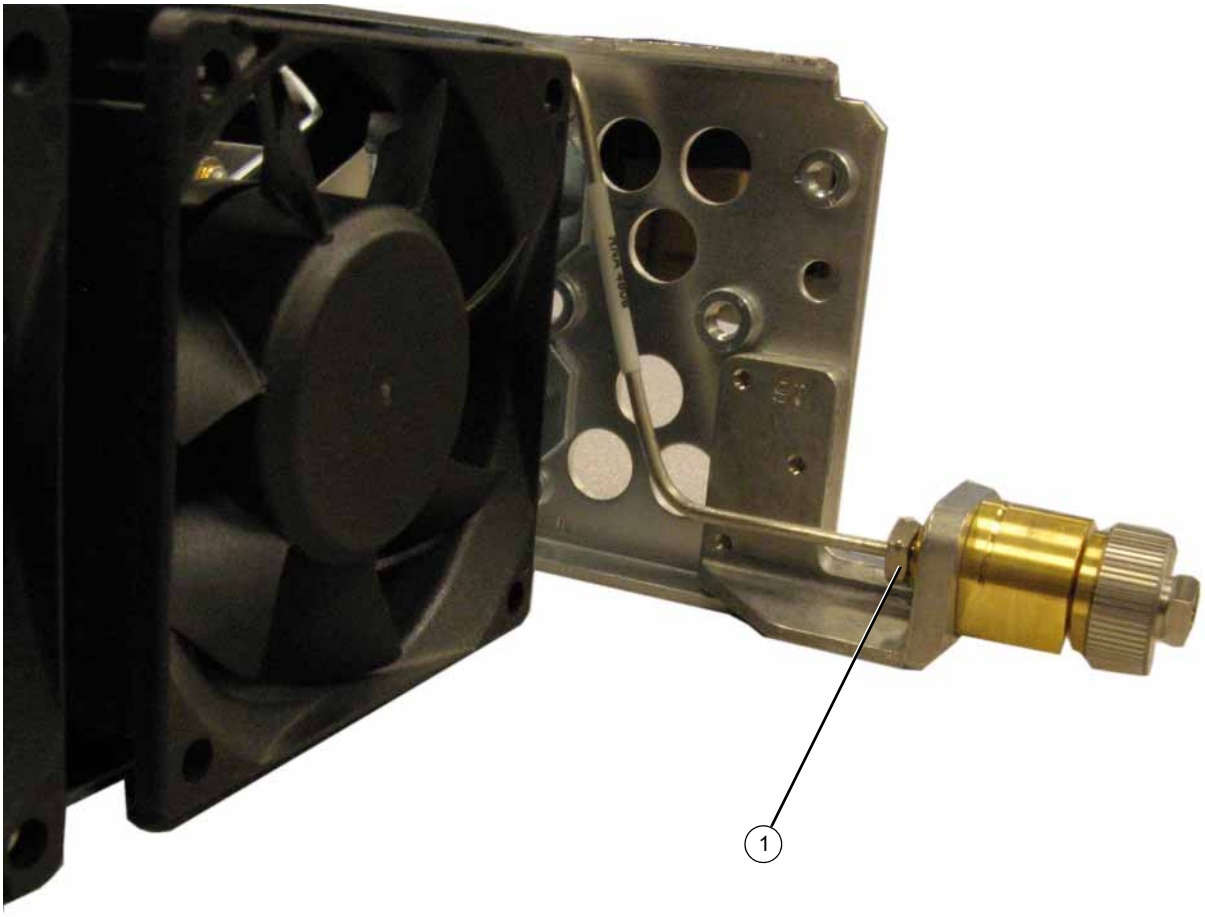
   520 with a Type-N RF connector: W11 from the RF connector (1).

   532/540: W9 from the RF Connector (1).
5. Remove the RF Connector.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Torque screw to 9 in–lbs.
3. Torque the new RF connector to 75 in–lbs.

Figure 15-35 RF Connector (2.4 mm Shown)



A7 Micro-Deck (N5173B/83B only - Standard)

Tools Required

- T-10 driver
- 5/16” open-ended wrench

Removal Procedure

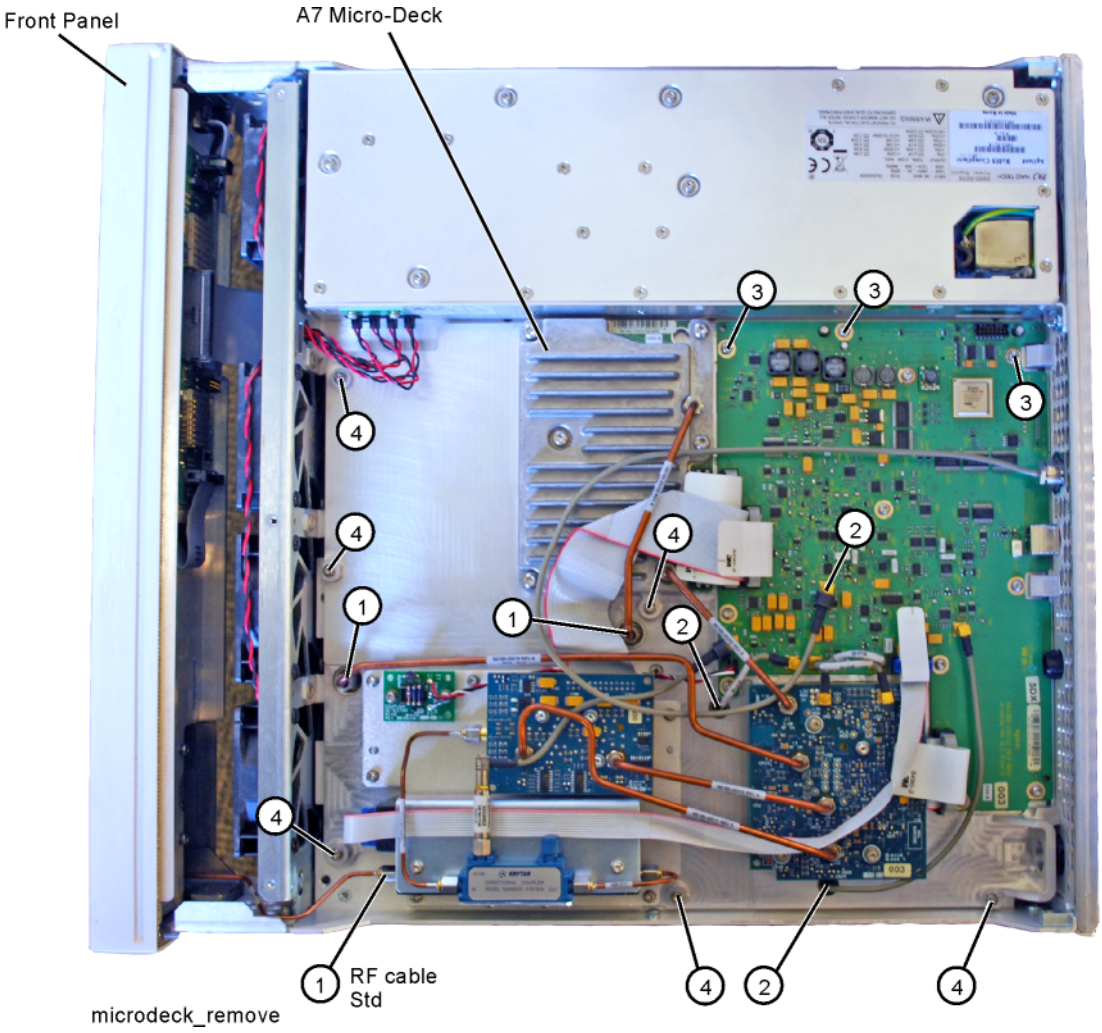
Refer to Figure 15-36 for this procedure.

1. Before replacing the A7 Micro-Deck assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the Pre-Repair Procedures outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Remove the rear panel from the signal generator. Refer to “Rear Panel (N5173B/83B)” on page 422.

NOTE The rear panel must be removed to allow the pin connector on the A7 Micro Deck to be disconnected from the A3 RF assembly without damaging the connector pins.

5. Using a 5/16” open-ended wrench, disconnect the semi-rigid cables at the locations (1) shown in Figure 15-36.
6. Unplug the flexible gray cables at the locations (2) shown.
7. Using the T-10 driver, remove the three screws (3) (0515-0374) that secure the A7 Micro Deck to the chassis.
8. Using the T-10 driver, remove the six screws (4) (0515-0664) that secure the A7 Micro Deck to the chassis.
9. Remove the A7 Micro Deck.

Figure 15-36 A7 Micro Deck (N5173B/83B only - Standard shown)



Replacement Procedure

Refer to Figure 15-37 for this procedure.

1. Using the T-10 driver, remove the eight screws (1) (five on one side, three on the other side) to remove the cover of the shipping chassis.
2. Using the T-10 driver, remove the five screws (2) that secure the replacement A7 Micro Deck to the shipping chassis.

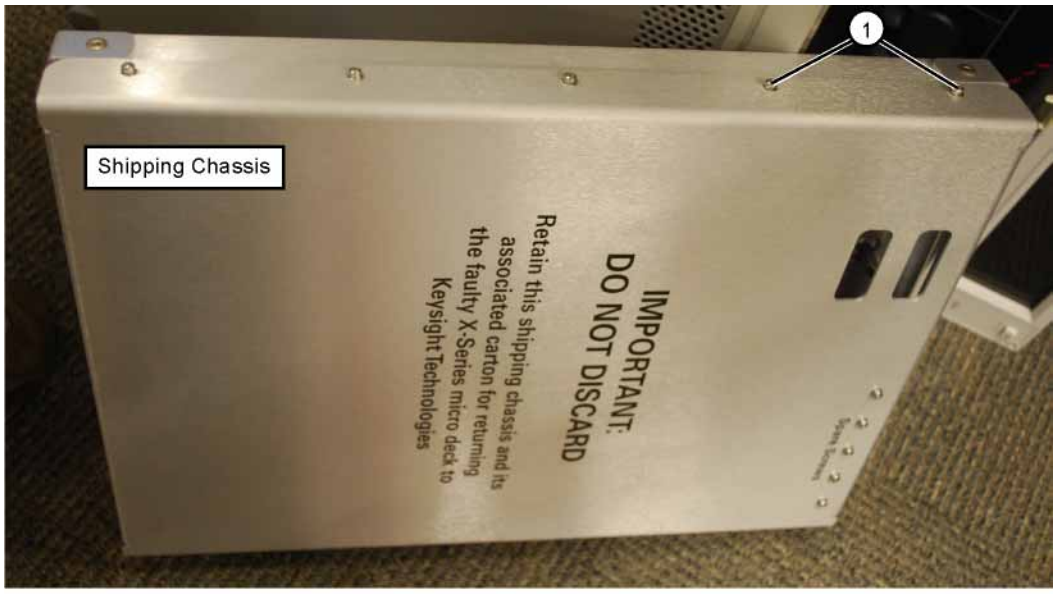
NOTE Do not mix the screws from the shipping chassis with the instrument screws.

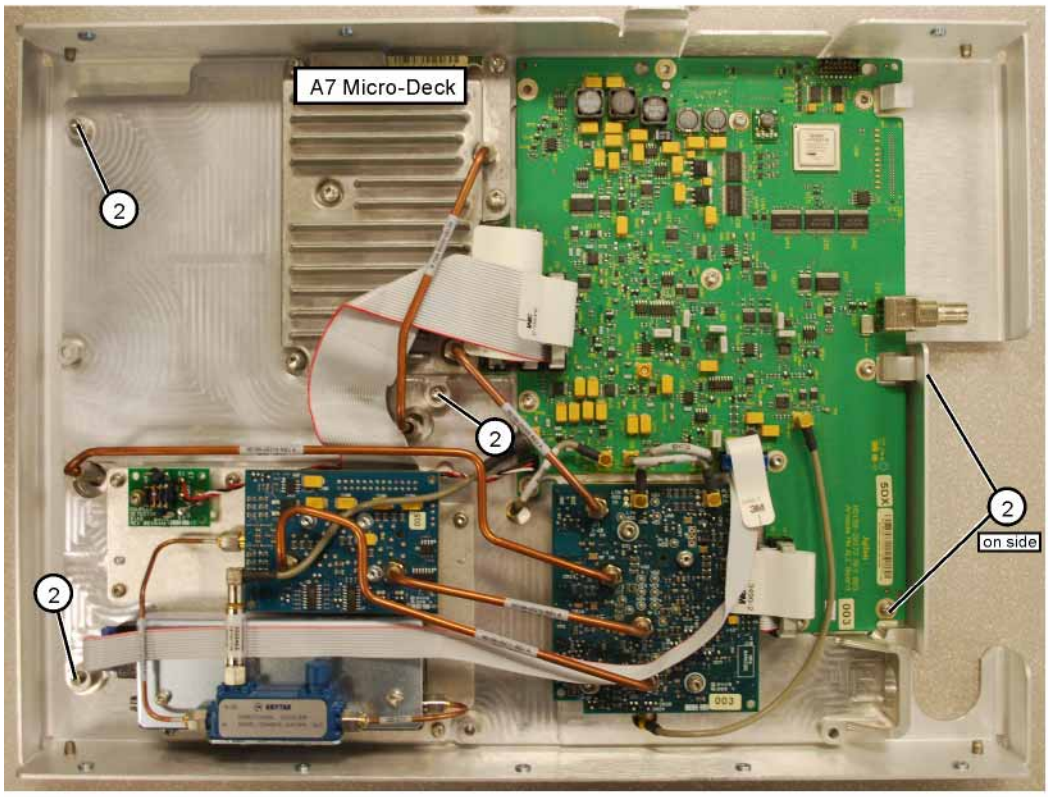
3. Carefully lift the Micro Deck out of the shipping chassis.
4. To install the new Micro Deck, reverse the order of the removal procedure.
5. Torque all screws to 9 in–lbs.
6. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”
7. Slide the old A7 Micro Deck into the shipping chassis.
8. Secure it to the shipping chassis by installing the five screws removed in step 2.

NOTE If you lose any screws there are five extra screws located on the cover of the shipping chassis.

9. Torque all screws to 9 in–lbs.
10. Replace the eight screws to secure the cover of the shipping chassis.
11. Return the A7 Micro Deck to Keysight Technologies.

Figure 15-37 A7 Micro Deck Shipping Chassis





ship_chassis

A7 Micro-Deck (N5173B/83B only - Option 1EM)

Tools Required

- T-10 driver
- 5/16” open-ended wrench

Removal Procedure

The removal procedure for the Option 1EM A7 Micro Deck is identical to the removal procedure for “A7 Micro-Deck (N5173B/83B only - Standard)” on page 398, with the exception of the one semi-rigid cable "RF cable - Std". On Option 1EM instruments this cable does not have to be removed as it is part of the Micro Deck.

1. Before replacing the A7 Micro-Deck assembly see Chapter 16, “Pre and Post-Repair Procedures” and perform the Pre-Repair Procedures outlined for this assembly.
2. Disconnect the power cord.
3. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
4. Remove the rear panel from the signal generator. Refer to “Rear Panel (N5173B/83B)” on page 422.

NOTE The rear panel must be removed to allow the pin connector on the A7 Micro Deck to be disconnected from the A3 RF assembly without damaging the connector pins.

5. Using a 5/16” open-ended wrench, disconnect the semi-rigid cables at the locations (1) shown in Figure 15-36.

NOTE It is not necessary to remove the cable "RF cable - Std" on instruments with Option 1EM. The RF cable on Option 1EM Micro Decks is shipped as part of the Micro Deck assembly.

6. Unplug the flexible gray cables at the locations (2) shown.
7. Using the T-10 driver, remove the three screws (3) (0515-0374) that secure the A7 Micro Deck to the chassis.
8. Using the T-10 driver, remove the six screws (4) (0515-0664) that secure the A7 Micro Deck to the chassis.
9. Remove the A7 Micro Deck.

Replacement Procedure

Refer to Figure 15-37 for this procedure.

1. Using the T-10 driver, remove the five screws (3) that secure the replacement A7 Micro Deck to its packaging.
2. Carefully slide the replacement A7 Micro Deck out of its packaging.
3. Reverse the order of the removal procedure.
4. Torque all screws to 9 in–lbs.
5. Perform the post-repair procedures that pertain to this replacement procedure. See Chapter 16, “Pre and Post-Repair Procedures.”

A7AT1 Step Attenuator (N5173B/83B Only) – Option 513/520

Removal Procedure

Tools Required

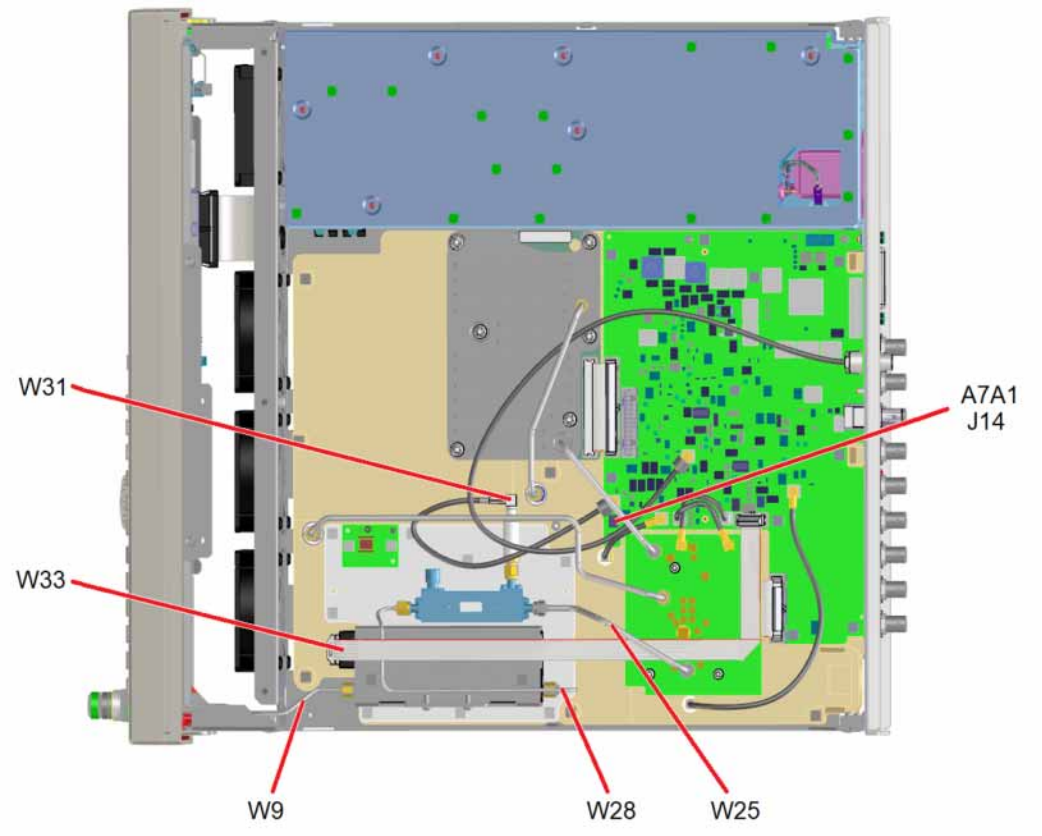
- T-10 driver
- 5/16” open-ended wrench

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342 and “Inner Top Cover” on page 344.

Front Panel Output

3. Referring to Figure 15-38, disconnect the following cables:
   - W33 ribbon cable from A7AT1 Step Attenuator P1
   - W31 coaxial cable from A7A6 HB Detector output
   - A7A7 HB Detector Bias cable from A7A1 Microwave ALC Control board J14
   - W9 from A7AT1 Step Attenuator output
   - W25 from A7A3 Mod-Filter J2 and A7A5 Directional Coupler input
   - W28 from A7A5 Directional Coupler output and A7AT1 Step Attenuator input

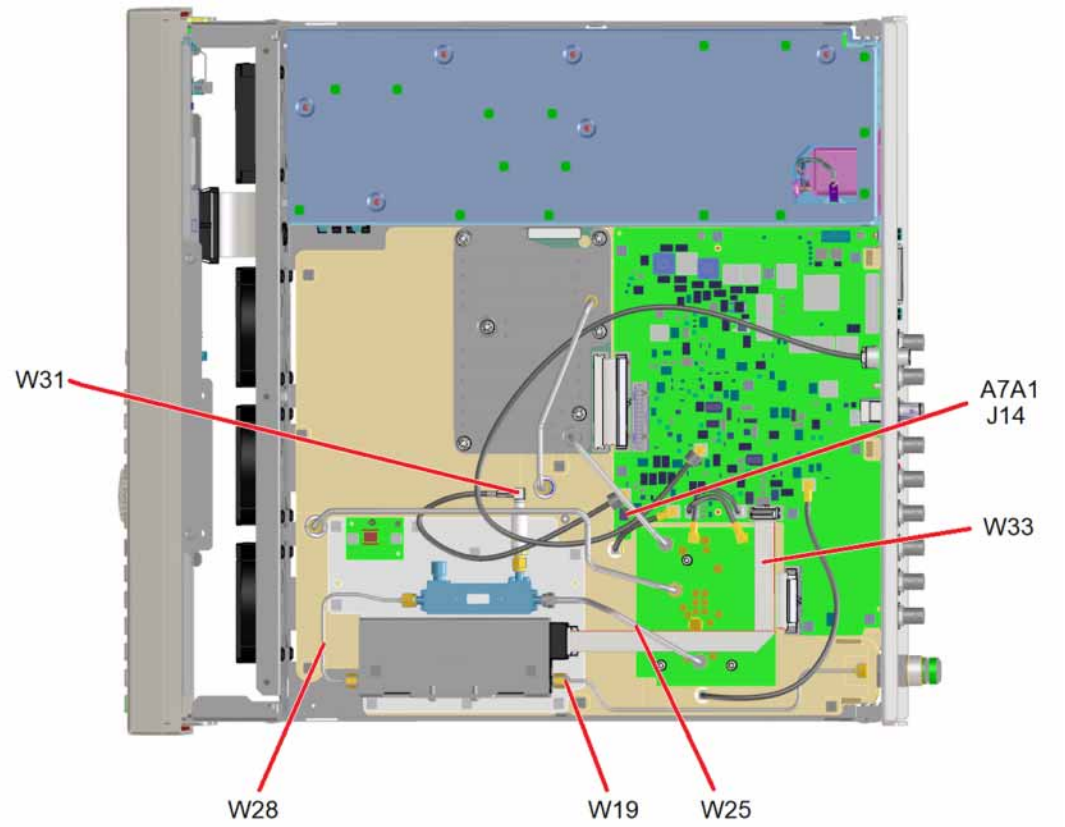
Figure 15-38 Option 513/520, Front Panel Output



Rear Panel Output

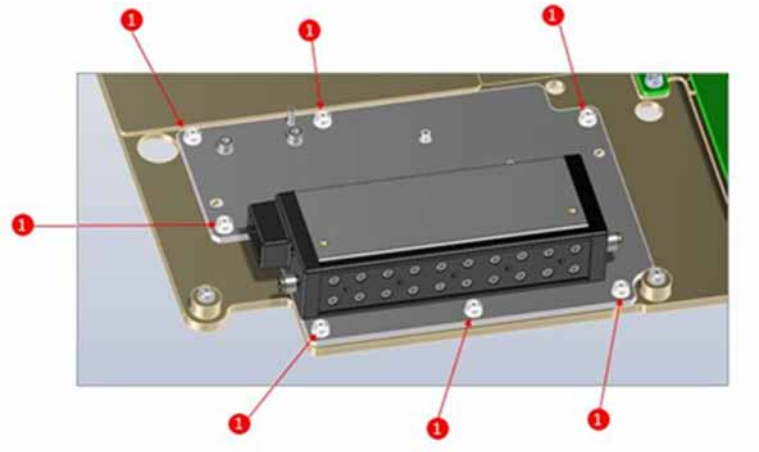
4. Referring to Figure 15-39, disconnect the following cables:
   - W33 ribbon cable from A7AT1 Step Attenuator P1
   - W31 coaxial cable from A7A6 HB Detector output
   - A7A7 Detector Bias cable from A7A1 Microwave ALC Control board J14
   - W19 from A7AT1 Step Attenuator output
   - W25 from A7A3 Mod-Filter J2 and A7A5 Directional Coupler input
   - W28 from A7A5 Directional Coupler output and A7AT1 Step Attenuator input

Figure 15-39 Option 513/520, Rear Panel Output (Option 1EM)



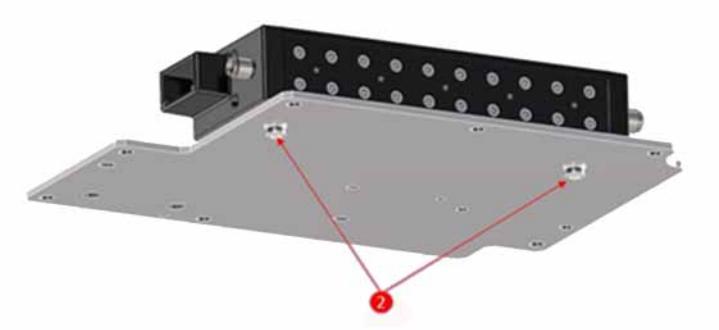
5. Referring to Figure 15-40, remove the seven screws (1) that attach the attenuator bracket to the A7 Micro-Deck assembly.

Figure 15-40 Attenuator Mounting Bracket Removal



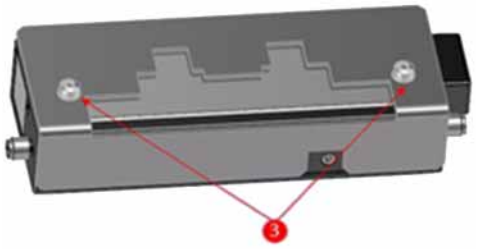
6. Remove the attenuator bracket from A7 Micro-Deck assembly.
7. Referring to Figure 15-41, remove the two screws (2) that attach the attenuator to the attenuator mounting bracket.

Figure 15-41 Attenuator Mounting Screws Removal



8. If the instrument has Option 1EM (Rear Panel Connectors), remove the two screws (3) that attach the magnetic shield to the attenuator, as seen in Figure 15-42.

Figure 15-42 Option 1EM Magnetic Shield Removal



Replacement Procedure

NOTE

When replacing the A7AT1 Step Attenuator be sure to orient it such that the RF connector next to the ribbon cable connector is the RF output of the attenuator and the RF cable that connects to it goes to the instrument RF output.

1. Reverse the order of the removal procedure.
2. Torque all T-10 screws to 9 in-lbs.
3. Torque all 5/16” connectors to 9 in–lbs.

A7AT1 Step Attenuator (N5173B/83B Only) – Option 532/540

Removal Procedure

Tools Required

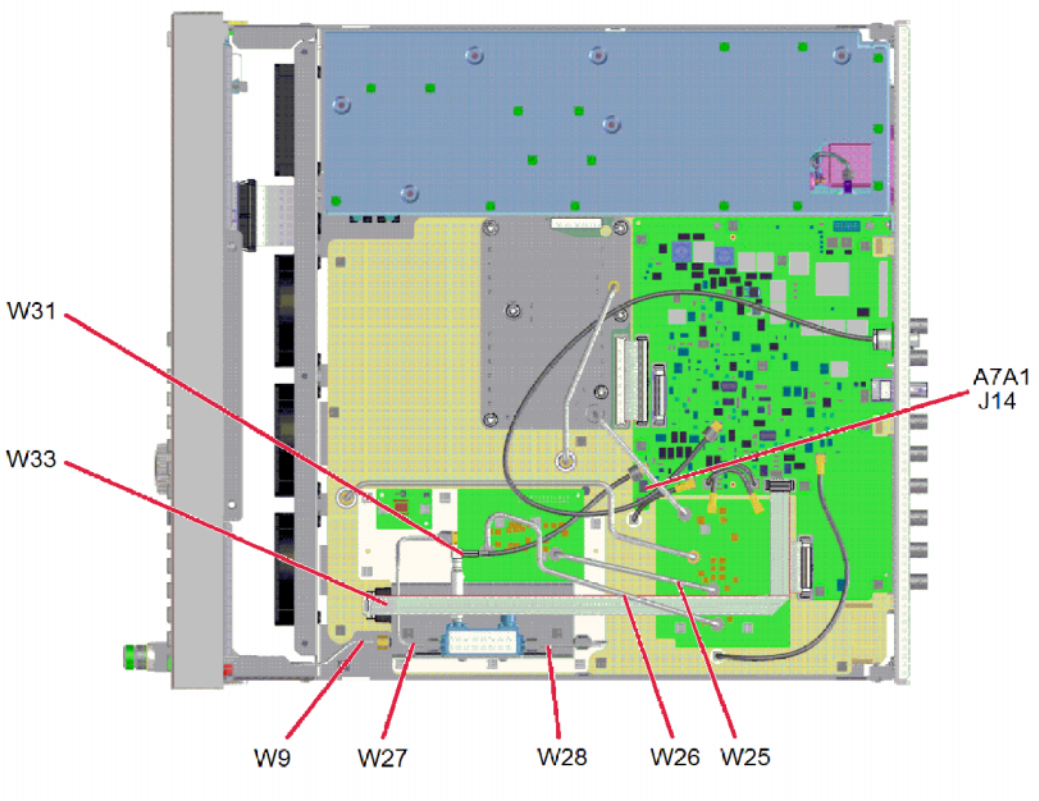
- T-10 driver
- 5/16” open-ended wrench

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342 and “Inner Top Cover” on page 344.

Front Panel Output

3. Referring to Figure 15-43, disconnect the following cables:
   - W33 ribbon cable from A7AT1 Step Attenuator P1
   - W31 coaxial cable from A7A6 HB Detector output
   - A7A7 HB Detector Bias cable from A7A1 Microwave ALC Control board J14
   - W9 from A7AT1 Step Attenuator output
   - W25 from A7A3 Mod-Filter J2 and A7A4 40 GHz Doubler J3
   - W26 from A7A3 Mod-Filter J4 and A7A4 40 GHz Doubler J4
   - W27 from A7A4 40 GHz Doubler J2 and A7A5 Directions Coupler input
   - W28 from A7A5 Directional Coupler output and A7AT1 Step Attenuator input

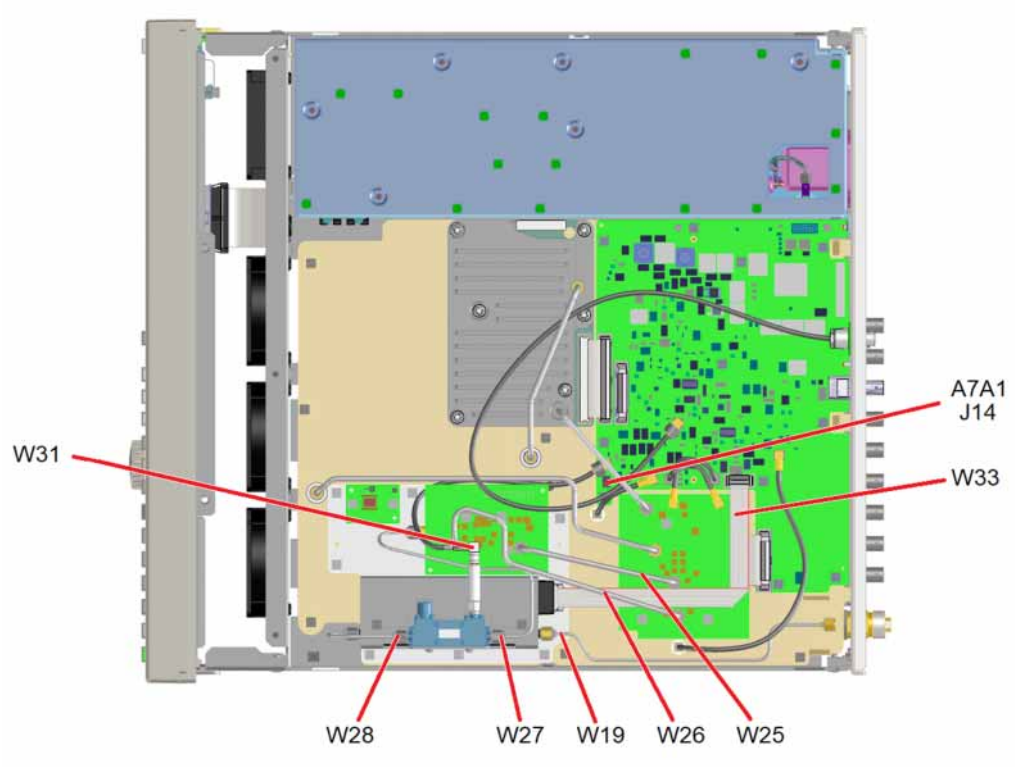
Figure 15-43 Option 532/540, Front Panel Output



Rear Panel Output

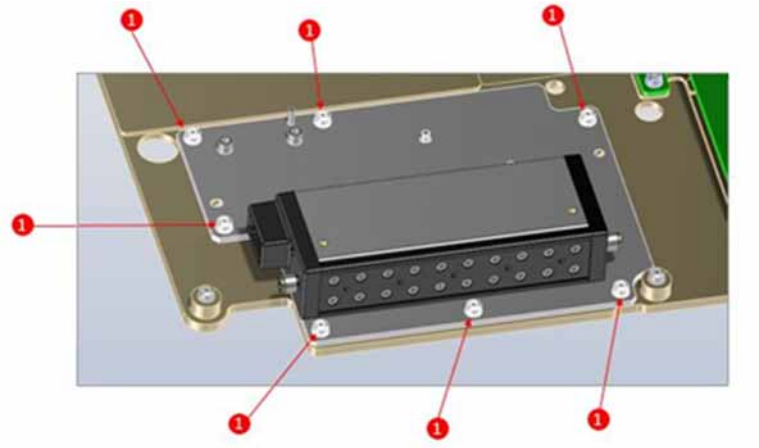
4. Referring to Figure 15-44, disconnect the following cables:
   - W33 ribbon cable from A7AT1 Step Attenuator P1
   - W31 coaxial cable from A7A6 HB Detector output
   - A7A7 Detector Bias cable from A7A1 Microwave ALC Control board J14
   - W19 from A7AT1 Step Attenuator output
   - W25 from A7A3 Mod-Filter J2 and A7A4 40 GHz Doubler J3
   - W26 from A7A3 Mod-Filter J4 and A7A4 40 GHz Doubler J4
   - W27 from A7A4 40 GHz Doubler J2 and A7A5 Directions Coupler input
   - W28 from both A7A5 Directional Coupler output and A7AT1 Step Attenuator input

Figure 15-44 Option 532/540, 1EM, Rear Panel Output



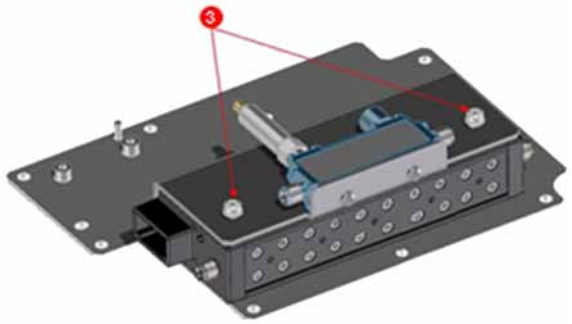
5. Referring to Figure 15-45, remove the seven screws (1) that attach the attenuator bracket to the A7 Micro-Deck assembly.

Figure 15-45 Attenuator Mounting Bracket Removal



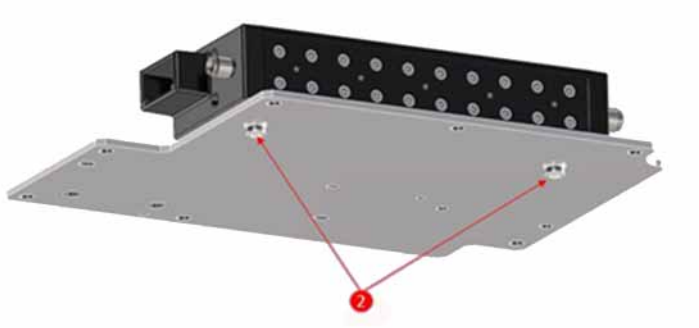
6. Remove the attenuator bracket from A7 Micro-Deck assembly.
7. Referring to Figure 15-46, remove the two screws (3) that attach the coupler bracket to the attenuator.

Figure 15-46 Coupler Bracket Removal



8. Referring to Figure 15-47, remove the two screws (2) that attach the attenuator to the attenuator bracket.

Figure 15-47 Attenuator Mounting Screws Removal



Replacement Procedure

NOTE

When replacing the A7AT1 Step Attenuator be sure to orient it such that the RF connector next to the ribbon cable connector is the RF output of the attenuator and the RF cable that connects to it goes to the instrument RF output.

1. Reverse the order of the removal procedure.
2. Torque all T-10 screws to 9 in-lbs.
3. Torque all 5/16” connectors to 9 in–lbs.

A8 Floating BNC Bypass (N5173B/83B only)

Tools Required

- 5/8” hex-nut driver
- needle-nose pliers

Removal Procedure

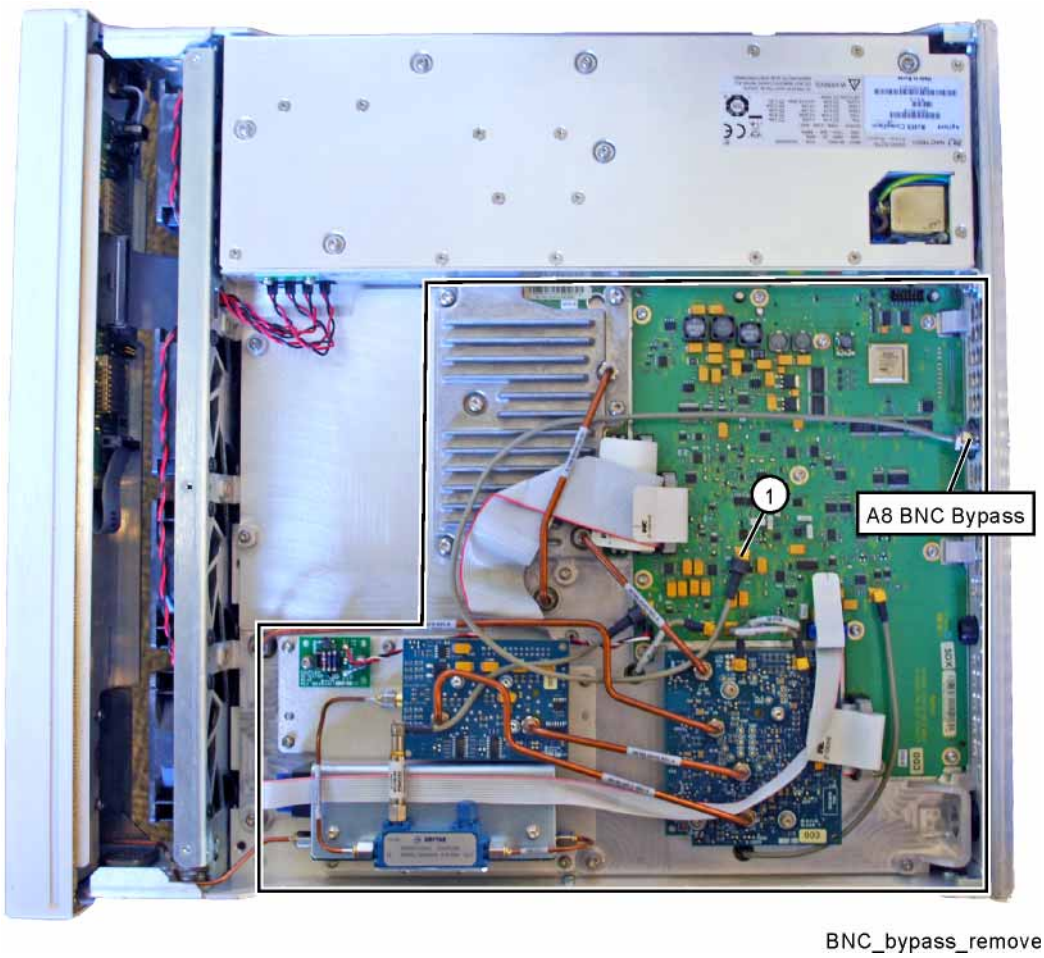
Refer to Figure 15-48 for this procedure.

1. Disconnect the power cord.
2. Remove the inner cover and outer top cover from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344.
3. Disconnect the flexible cable from the Micro Deck at the location (1) shown.
4. Using the 5/8” hex-nut driver, remove the nut and washer securing the A8 Floating BNC Bypass to the rear panel.
5. Remove the A8 Floating BNC Bypass.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Torque the nut to 21 in–lbs.

Figure 15-48 A8 Floating BNC Bypass



B1 through B4 Fans

Tools Required

- T-10 driver
- T-20 driver
- needle-nose pliers

Removal Procedure

Refer to Figure 15-49 and Figure 15-50 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to "Outer Cover" on page 342, "Inner Top Cover" on page 344, and "Inner Bottom Cover" on page 346.

NOTE If you are replacing the B1 Fan, remove the A1 Power Supply. Refer to "A1 Power Supply" on page 351.

3. Place the signal generator flat with the A2 Vector BBG assembly facing up and the front-panel facing you.
4. Remove W10 at the A1 Power Supply to gain access to the fan cables.
5. Using the T-10 driver, press the connector latch to disconnect the fan cable (1) from the A1 Power Supply.
6. Use the T-20 driver to push the rivet (2) out until you can remove it with your fingers.
7. Remove the fan, releasing the fan cable from the cable clips.

Replacement Procedure

1. Reverse the order of the removal procedure.

NOTE To re-install the rivets, use the needle-nose pliers to depress the rivet tip before inserting it into the chassis hole.

Figure 15-49 B1 thru B4 Fans (1 of 2)

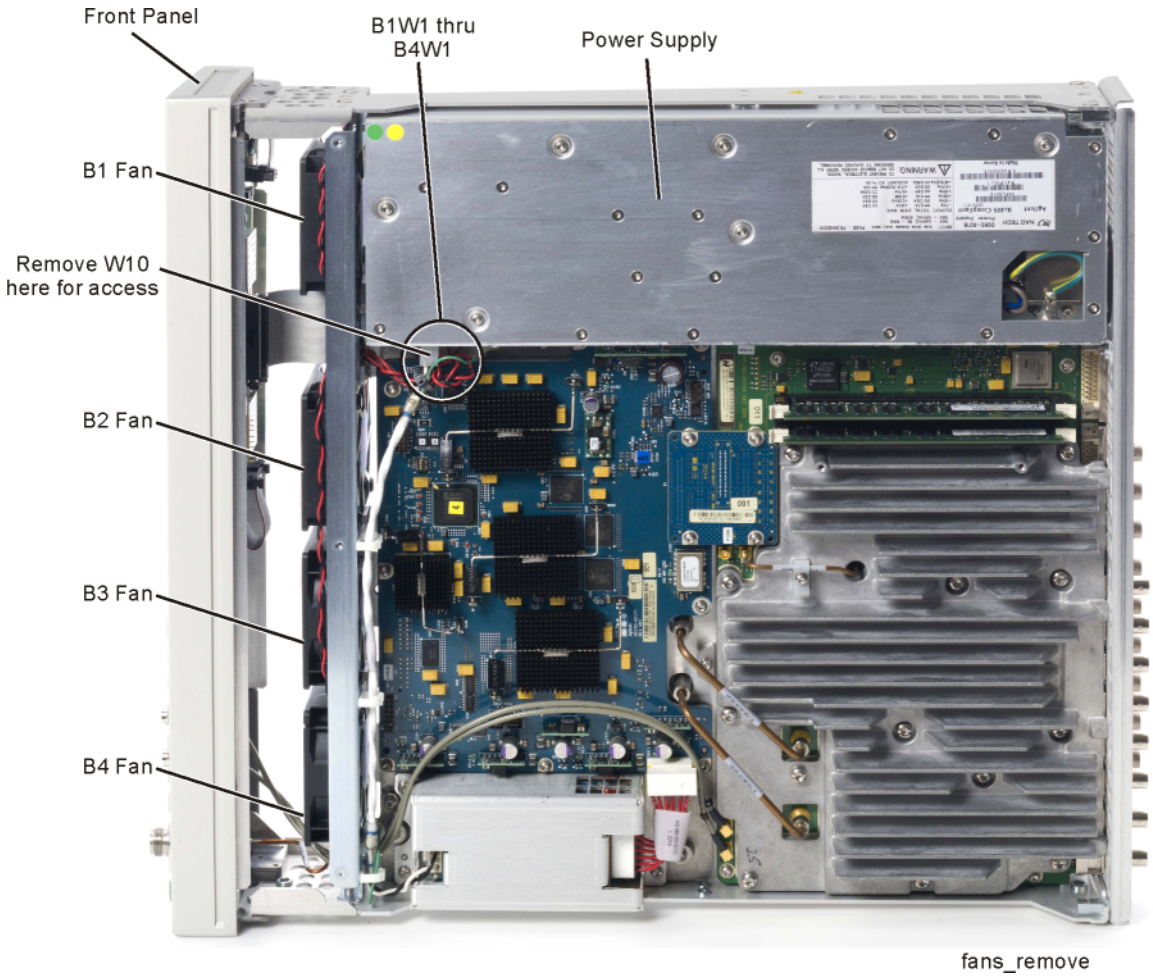
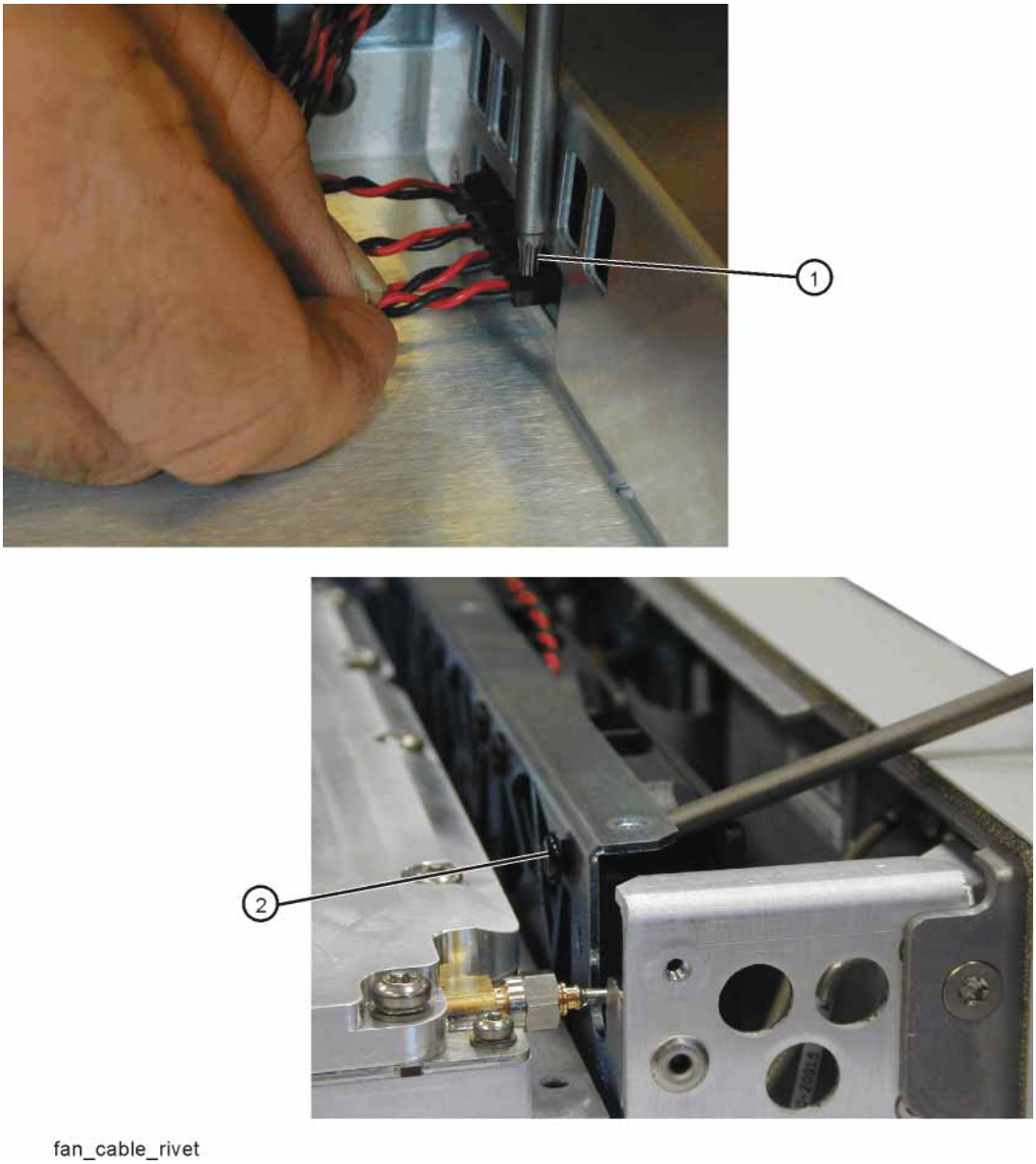


Figure 15-50 B1 thru B4 Fans (2 of 2)



Rear Panel (N5171B/81B)

Tools Required

- T-10 driver
- 5/8” hex-nut driver (p/n: 8710-2546)

Removal Procedure

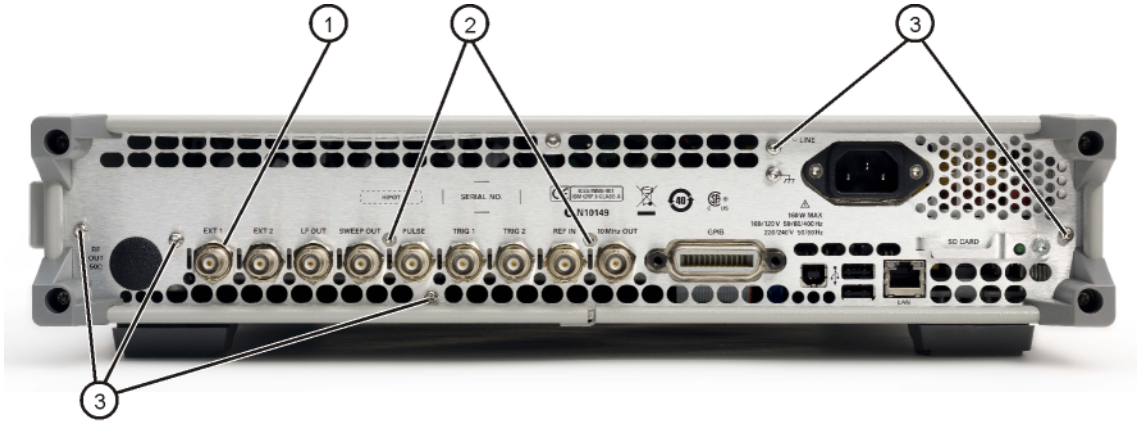
Refer to Figure 15-51 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Place the signal generator flat with the rear panel facing you.
4. If Option 006 is installed, refer to Figure 15-52. Remove the Flash Memory card (1) and cover (2).
5. Using the 5/8” hex-nut driver, remove the nuts and washers (1) securing the A3 RF assembly BNC’s to the rear panel.
6. Using the T-10 driver, remove the two screws (2) and the five screws (3) securing the rear panel to the signal generators chassis.
7. Pull the rear panel away from the signal generator’s chassis.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Recommended torque for all BNC connectors is 21 in–lbs.

Figure 15-51 N5171B/81B Rear Panel Removal



rearpanel_remove_71_81

Rear Panel (N5166B, N5172B, and N5182B)

Tools Required

- T-8 driver
- T-10 driver
- 5/8” hex-nut driver (p/n: 8710-2546)
- 5/16” open-ended wrench
- 1/4” hex-nut driver

Removal Procedure

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Place the signal generator flat with the rear panel facing you.
4. If Option 006 is installed, refer to Figure 15-52. Remove the Flash Memory card (1) and cover (2).
5. If Option 012 is installed, use the 5/16” open-ended wrench to disconnect W14, W15, and W16 from the rear panel.
6. Refer to Figure 15-53. use the 5/16” open-ended wrench to disconnect W13 from the rear panel.
7. Refer to Figure 15-54 and Figure 15-55. If Option 1EM is installed, use the 1/4” hex-nut driver to remove the two nuts and washers (2) securing the I and Q cables to the rear panel.
8. Refer to Figure 15-55. Using the 5/8” hex-nut driver, remove the seventeen nuts and washers (1) securing the A2 Vector BBG assembly and A3 RF assembly BNC’s to the rear panel.
9. Using the T-8 driver, remove the four screws (3) securing the A2 Vector BBG assembly connectors to the rear panel.
10. Using the T-10 driver, remove the two screws (4) and the eight screws (5) securing the rear panel to the signal generators chassis.
11. Pull the rear panel away from the signal generator’s chassis.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Refer to Figure 15-55. Recommended torque for the four screws (3) securing the A2 Vector BBG assembly connectors is 6 in–lbs.

3. Recommended torque for all other screws is 9 in–lbs.
4. Recommended torque for all BNC connectors is 21 in–lbs.

Figure 15-52 Flash Memory Card and Cover Removal

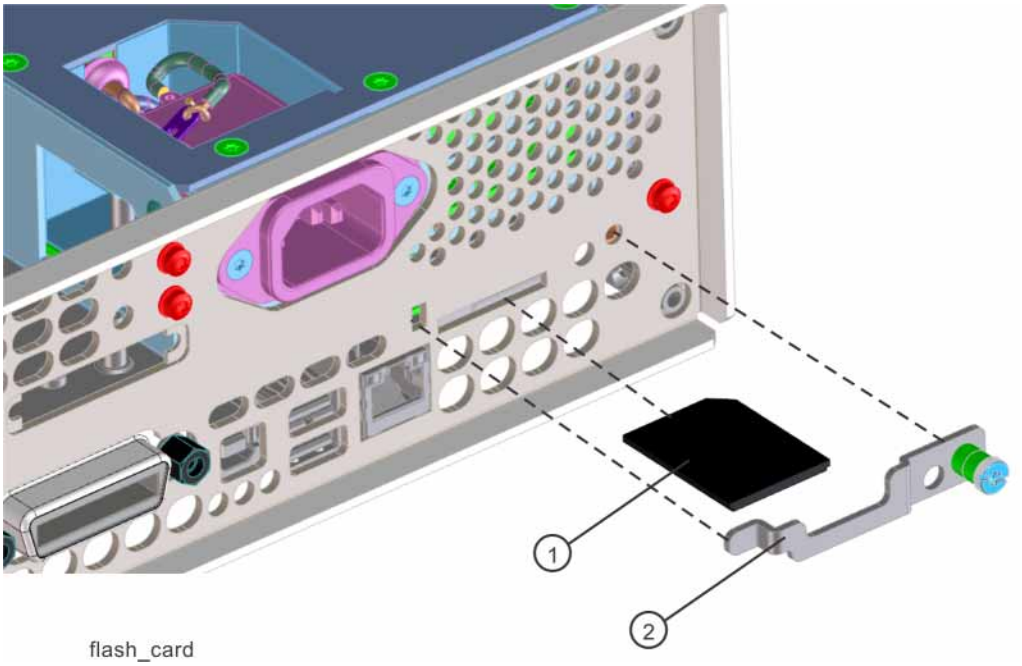


Figure 15-53 N5172B/82B Option 012 Rear Panel Cables

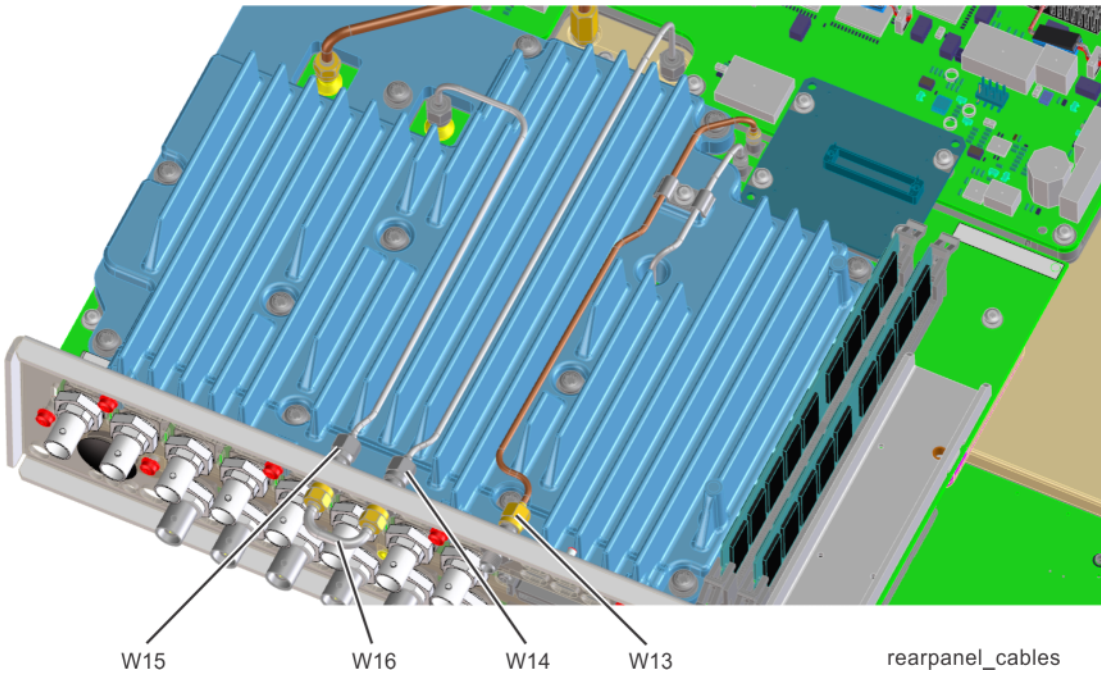


Figure 15-54 N5172B/82B Option 1EM Rear Panel I Q Connector Removal

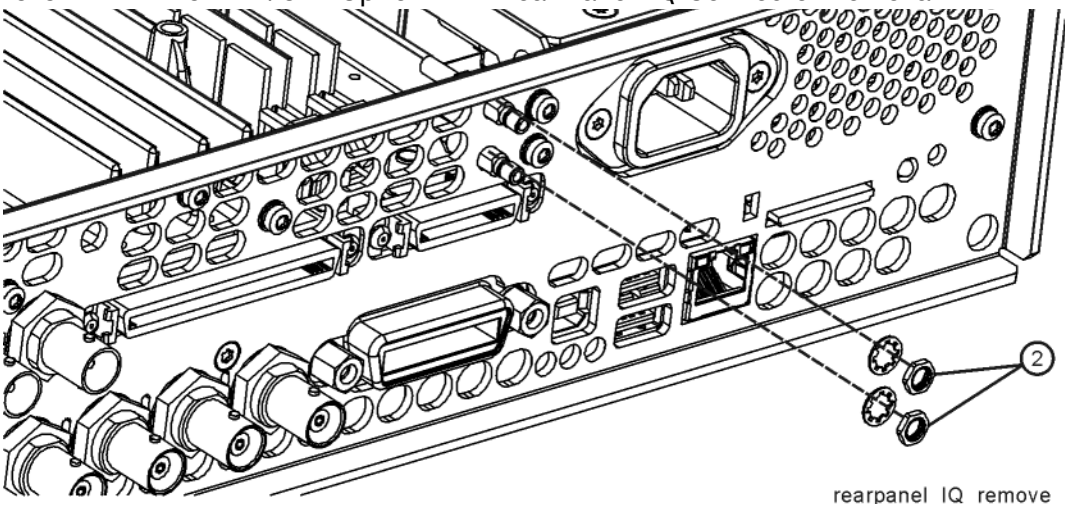
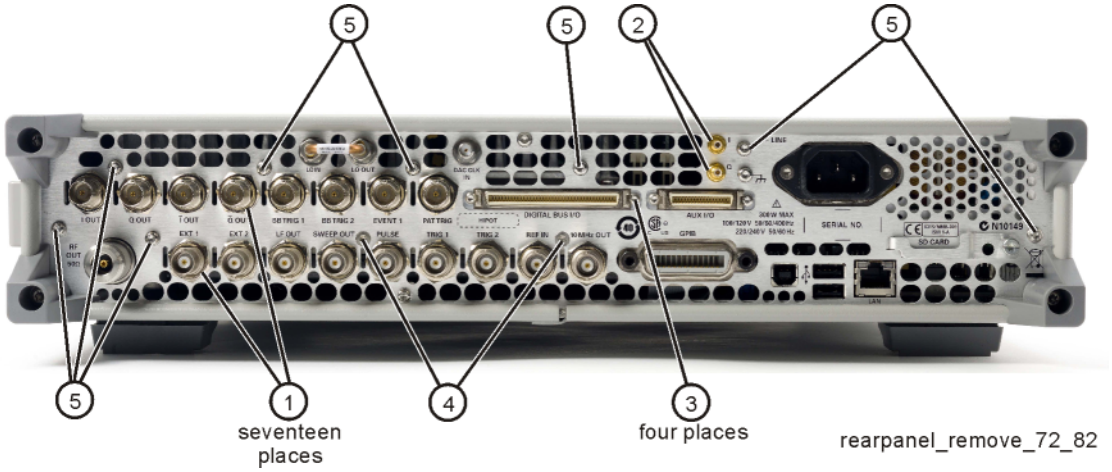


Figure 15-55 N5166B, N5172B, and N5182B Rear Panel Removal



Rear Panel (N5173B/83B)

Tools Required

- T-10 driver
- 5/8” hex-nut driver (p/n: 8710-2546)

Removal Procedure

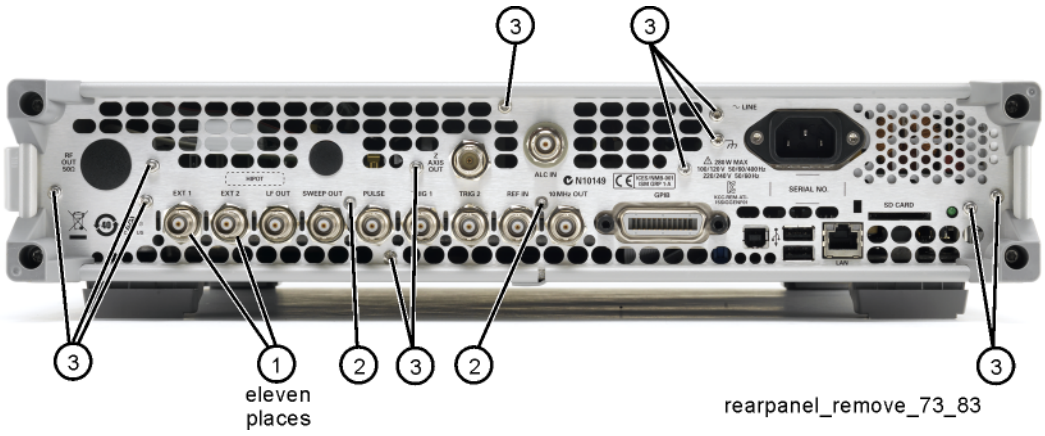
Refer to Figure 15-51 for this procedure.

1. Disconnect the power cord.
2. Remove the covers from the signal generator. Refer to “Outer Cover” on page 342, “Inner Top Cover” on page 344, and “Inner Bottom Cover” on page 346.
3. Place the signal generator flat with the rear panel facing you.
4. If Option 006 is installed, refer to Figure 15-52. Remove the Flash Memory card (1) and cover (2).
5. Using the 5/8” hex-nut driver, remove the nuts and washers (1) securing the A3 RF assembly BNC’s to the rear panel.
6. Using the T-10 driver, remove the two screws (2) (0515-1227) and the eleven screws (3) (0515-0372) securing the rear panel to the signal generators chassis.
7. Pull the rear panel away from the signal generator’s chassis.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Recommended torque for all screws is 9 in–lbs.
3. Recommended torque for all BNC connectors is 21 in–lbs.

Figure 15-56 N5173B/83B Rear Panel Removal



16 Pre and Post-Repair Procedures

What You Will Find in This Chapter

This chapter provides information on the following:

Pre Repair Procedures on page 426

Post Repair Procedures on page 428

Additional Tasks on page 433

Pre Repair Procedures

To ensure a successful assembly replacement there are steps that can be taken before an assembly is removed. These steps will help to ensure that vital instrument information will be properly transferred from the defective assemblies to the replacements.

There are four types of instrument information that one should be concerned about when an assembly is being removed and replaced. They are:

- The instrument model number.
- The instrument serial number.
- The instrument licenses.
- The instrument calibration data.

During an assembly replacement neither the model number or serial number should be lost, unless multiple assemblies are changed at the same time, which should always be avoided if possible. However, certain steps need to be taken to ensure that the licenses and calibration data are properly handled.

For information on how and where all of these are saved in the instrument, see Chapter 3, "Instrument Information and Calibration Data."

Licenses

Since the option license keys are saved on the A5 CPU assembly and backed up on the A3 RF assembly, it is important to make sure that the A3 RF backup has all the latest license keys backed up on it before the A5 CPU assembly is replaced. If this does not happen any licenses that were installed since the last backup will not be restored after the A5 CPU assembly is replaced.

Calibration Data

Factory calibration data is stored on the A2 Vector BBG assembly, the A3 RF assembly, and the A7 Micro-Deck assembly. If any adjustments have been made and saved, but have not been backed up to these assemblies, there will be calibration data for the adjustments performed on the A5 CPU assembly that will supersede the factory data. This calibration data for an assembly being replaced that is residing on the A5 CPU assembly will need to be removed so that it will not be used with the replacement assembly.

Backup Process

Backing up both the option licenses and calibration data can be done using the same procedure and needs to be performed before replacing the assemblies listed in Table 16-1. The backup routine can be found in the instrument adjustments of the performance verification and adjustment software. However, this can also be performed using the following remote command:

```
:SERVice:CALibration:BACKup
```

Once the backup has been performed the assembly being replaced can be removed. After installing the replacement assembly follow the post-repair procedures outlined in the **"Post Repair Procedures"** section of this chapter.

Of course, if an instrument is inoperative the license information and calibration data cannot be backed up prior to replacing an assembly. If this is the case, following the post repair procedures should allow for a successful recovery of most, if not all of the previous instrument functionality without further assistance from Keysight support.

Table 16-1 Pre-Repair Procedures

Pre-Repair Procedures	**A2 Vector BBG Assembly**	**A3 RF Assembly**	**A5 CPU Assembly**	**A7 Micro-Deck Assembly**
Adjustments[a]				
Backup Cal Data to Motherboard Memory	X	X	X	X

a. For further information see Chapter 18, "Performance Verification and Adjustment Software."

Post Repair Procedures

NOTE When an assembly is replaced, ignore any error messages that appear until after the Utilities and Additional Tasks listed in Table 16-2 or Table 16-3 have been completed.

NOTE Before attempting any post repair procedures, verify that the model and serial numbers of the instrument are correct. If either are not correct, see the appropriate section in Chapter 3, "Instrument Information and Calibration Data" for information on how to restore the missing information.

N5166B, N5171B/72B/81B/82B

Most replacement assemblies are fully calibrated and do not require any adjustments. The factory completes a performance test on each replacement assembly, so a comprehensive performance test is not required upon receipt and installation of an assembly. However, a manual operation verification is recommended to check basic functionality.

Table 16-2 lists the utilities, additional tasks, adjustments, and performance verification tests that need to be performed after an assembly is replaced.

N5173B/83B

Because of the interdependency between assemblies, replacement assemblies are partly calibrated and require limited adjustments to optimize performance.

Table 16-3 lists the utilities, additional tasks, adjustments, and performance verification tests that need to be performed after an assembly is replaced.

NOTE Post repair procedures listed in Table 16-2 and Table 16-3 need to be performed in the order in which they are listed in the table.

Table 16-2 Post Repair Procedures for N5166B, N5171B, N5172B, N5181B, N5182B

Post-Repair Procedures	A1 Power Supply	A2 Vector BBG Assembly	A3 RF Assembly	A3BT1 Battery	A4 Solid State Disk Drive	A5 CPU Assembly	A6A1 Front Panel Interface	A6A3 Power Switch Assembly	A6A4 Keyboard Assembly	A6A5 Display LCD Assembly	A6MP1 Main Keypad	A7 Real Time BBG Assembly	A7A1 Real Time Aux Power Supply	A8 Real Time BBG Jumper Board
Utilities[a]														
Calibration Array Restore		X	X			X								
Reset Mechanical Relays		X												
Additional Tasks[b]														
Install Instrument Firmware		X	X		X	X						X		
Set Time and Date			X	X		X								
Restore Licenses						X								
Restore Factory Waveforms					X									
Verify Factory I/Q Calibration		X	X											
Finalize RF Assembly Installation			X											
Finalize BBG Assembly Installation		X												
Backup Licenses			X											
Set Hostname						X								
Front Panel Tests							X	X	X	X	X			
Self Test[c]	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Relative Frequency Range and Accuracy Check[d]			X											
Leveled Output Power Check[d]		X	X											
Adjustments[a]														
Backup Cal Data to Motherboard Memory		X	X											
Performance Verification[a]														
Single-Sideband Phase Noise (N5181B, N5182B)			X											

a. For further information refer to Chapter 18, “Performance Verification and Adjustment Software.”
b. See the “Additional Tasks” section in this chapter for detailed instructions on these tasks.
c. For information on performing the instrument Self Tests refer to Chapter 4, “Self Test.”
d. For manual test procedures refer to Chapter 17, “Functional Tests.”

Table 16-3 Post Repair Procedures for N5173B, N5183B

Post-Repair Procedures	A1 Power Supply	A3 RF Assembly	A3BT1 Battery	A5 CPU Assembly	A6A1 Front Panel Interface	A6A3 Power Switch Assembly	A6A4 Keyboard Assembly	A6A5 Display LCD Assembly	A6MP1 Main Keypad	A7 Micro-Deck Assembly	A7AT1 Step Attenuator
Utilities[a]											
Calibration Array Restore		X		X						X	
Reset Mechanical Relays										X	X
Additional Tasks[b]											
Install Instrument Firmware		X		X						X	
Restore Licenses				X							
Backup Licenses		X									
Set Time and Date		X	X	X							
Set Hostname				X							
Front Panel Tests					X	X	X	X	X		
Self Test[c]	X	X	X	X	X	X	X	X	X	X	X
Adjustments[a]											
RF ABUS Calibration		X								X	X
MW ABUS Calibration		X								X	X
MW Multiplier Prelevel Calibration		X								X	X
MW Low Band Absolute Power Calibration		X								X	X
Op Amp Band Power Calibration		X								X	X
MW High Band Absolute Power Calibration		X								X	X
MW ALC Calibration		X								X	X
MW Open Loop Power Calibration		X								X	X
AM Calibration (Option UNT)		X								X	X
Backup Cal Data to Motherboard Memory		X								X	X
Performance Verification[a]											
Self Test		X								X	X

Table 16-3 Post Repair Procedures for N5173B, N5183B

Post-Repair Procedures	A1 Power Supply	A3 RF Assembly	A3BT1 Battery	A5 CPU Assembly	A6A1 Front Panel Interface	A6A3 Power Switch Assembly	A6A4 Keyboard Assembly	A6A5 Display LCD Assembly	A6MP1 Main Keypad	A7 Micro-Deck Assembly	A7AT1 Step Attenuator
Maximum Output Power		X								X	X
Power Level Accuracy		X								X	X
Harmonic Spurious		X								X	X
Sub-Harmonic Spurious		X								X	X
Non-Harmonic Spurious		X								X	X
AM Depth Accuracy (Option UNT)		X								X	X
AM Distortion (Option UNT)		X								X	X
FM Distortion (Option UNT)		X								X	X
FM Deviation Accuracy (Option UNT)		X								X	X
AM Frequency Response (External) (Option UNT)		X								X	X
Frequency Switching Speed (Option UNZ)		X								X	X
DCFM Carrier Offset (Option UNT)		X								X	X
Internal Pulse Modulation Level Accuracy (Option UNW)		X								X	X
Internal Pulse Modulation Rise/Fall Time (Option UNW)		X								X	X
Single-Sideband Phase Noise		X								X	X

a. For further information refer to Chapter 18, "Performance Verification and Adjustment Software."
b. See the "Additional Tasks" section in this chapter for detailed instructions on these tasks.
c. For information on performing the instrument Self Tests refer to Chapter 4, "Self Test."

Additional Tasks

This section contains information on additional post repair tasks that must be performed to return an instrument to normal functionality after certain assemblies have been replaced. See Table 16-2 or Table 16-3 for a complete list of all process that need to be performed after an assembly replacement.

Install Instrument Firmware

Whenever either the A5 CPU or any other assembly that contains FPGA code in it is replaced the instrument firmware needs to be reinstalled to make sure that all software in the instrument is correct for the version of firmware being used. Installation of the firmware, whether it is of the same version that is already in the A5 CPU assembly or of a new version, is the only way to reprogram the FPGA code in the individual assemblies.

For instructions on how to reinstall the instrument firmware, as well as firmware requirements for replacement assemblies, see Chapter 19, "Instrument Firmware and Operating System"

Set Time and Date

Since the backup battery for the instrument time and date is located on the A3 RF assembly and the real-time clock is on the A5 CPU assembly, whenever the A5 CPU is removed from the A3 RF assembly the time and date will need to be reset.

To set the time and date on the instrument press **Utility**, **Instrument Adjustments**, **Time / Date**.

For detailed information on setting the time and date see the "Instrument Adjustments" section in Chapter 5, "Service and Utility Menus"

Verify Factory I/Q Calibration

This task is for N5166B, N5172B, and N5182B instruments and may require the use of additional test equipment.

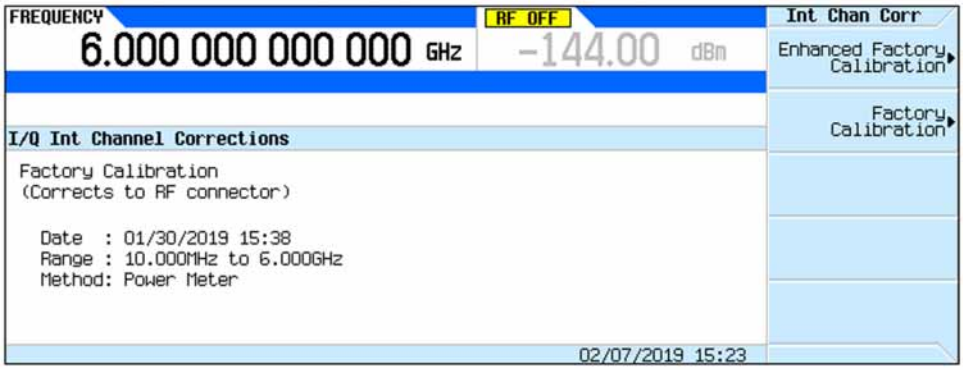
For the Finalize RF Assembly Installation or Finalize BBG Assembly Installation routines to complete successfully the status of the Factory I/Q Calibration needs to be verified first. If it has not been successfully run the Enhanced Factory Calibration will need to be run.

To verify that the Factory I/Q Calibration has been run successfully follow this procedure:

1. Press **Utility**, **More**, **Service** to enter the service menu.
2. Press **I/Q Int Channel Correction Calibration**.

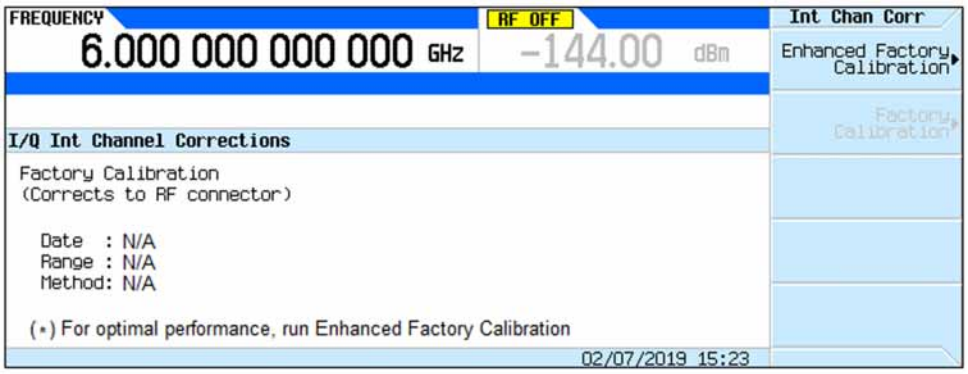
3. If there is a Date, Range, and Method on the display that the Factory Calibration was performed, as shown in Figure 16-1, the Enhanced Factory Calibration does not need to be run. Exit this procedure and continue with the next task associated with the assembly being replaced.

Figure 16-1 Factory I/Q Calibration Performed



4. If there is no Date, Range, and Method on the display that the Factory Calibration was performed, as shown in Figure 16-2, the Enhanced Factory Calibration will need to be run.

Figure 16-2 Factory I/Q Calibration Not Performed



5. Press **Enhanced Factory Calibration**.
6. Connect and configure a supported power meter and spectrum analyzer to the signal generator, or a communication bus that it supports. See Chapter 5, "Service and Utility Menus," for detailed information on configuring this equipment.
7. Once the required equipment has been connected and verified press **Execute Enhanced Int Chan Correction Cal**.

For detailed information on running the Enhanced Factory Calibration routine see Chapter 5, "Service and Utility Menus"

This procedure could take up to 1¼ hours or more to complete. Once this procedure has completed continue with the next task associated with the assembly being replaced.

Finalize RF Assembly Installation

This task is for N5166B, N5172B, and N5182B instruments and will require the use of additional test equipment.

Perform this required task by following this procedure:

1. Press **Utility**, **More**, **Service** to enter the Service menu.
2. Press **Install Assembly**, **Finalize RF Assembly Installation**.
3. Connect and configure a supported power meter to the signal generator, or a communication bus that it supports. See Chapter 5, "Service and Utility Menus," for detailed information on selecting and configuring this equipment.
4. Once the required equipment has been connected and verified press **Confirm Installation of RF Assembly**.

This procedure could take up to 1 hour or more to complete. Once this procedure has completed continue with the next task associated with the A3 RF Assembly replacement.

Finalize BBG Assembly Installation

This task is for N5166B, N5172B, and N5182B instruments and will require the use of additional test equipment.

Perform this required task by following this procedure:

1. Press **Utility**, **More**, **Service** to enter the Service menu.
2. Press **Install Assembly, Finalize BBG Assembly Installation**.
3. Connect and configure a supported power meter to the signal generator, or a communication bus that it supports. See Chapter 5, "Service and Utility Menus," for detailed information on selecting and configuring this equipment.
4. Once the required equipment has been connected and verified press **Confirm Installation of BBG Assembly**.

This procedure could take up to 1 hour or more to complete. Once this procedure has completed continue with the next task associated with the A2 Vector BBG Assembly replacement.

Restore Licenses

When the licenses for frequency range and other options are installed in the instrument they are saved in non-volatile memory on the A5 CPU assembly. When the instrument is originally shipped from the factory a backup copy of these licenses is also saved on the A3 RF assembly. If the A5 CPU assembly is replaced the licenses that are backed up on the A3 RF assembly will need to be restored to the A5 CPU assembly so that the proper functionality is restored to the instrument.

When an A5 CPU assembly is replaced the following error messages will be displayed until the licenses are restored:

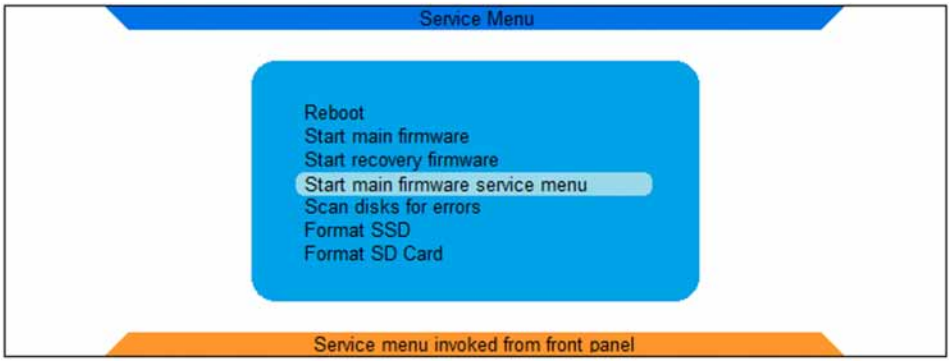
617 Configuration Error: The instrument has no frequency range option installed. Use the service procedure to recover instrument licenses from the backup.

617 Configuration Error: The backup memory contains license keys for serial number <serial number>. Use the service procedure to overwrite the backup memory.

The following procedure will restore the instrument licenses from the backup location on the A3 RF assembly to the A5 CPU non-volatile memory:

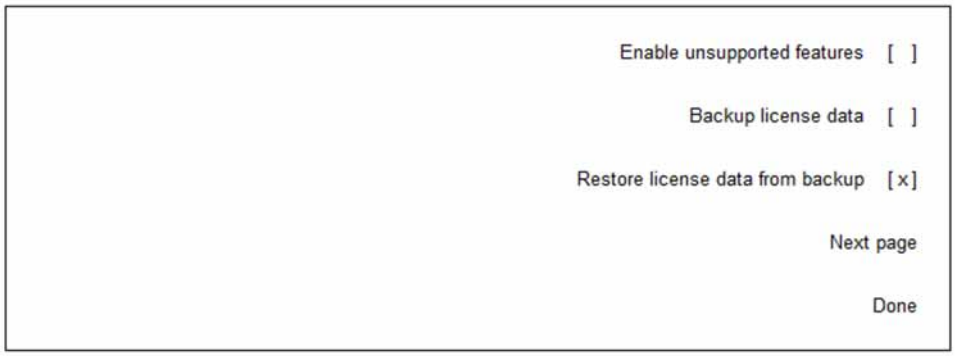
1. Turn the instrument off by using the front panel power button.
2. Once the instrument has turned off press and hold the front panel **Preset** key.
3. While holding the **Preset** key, press and release the power button to turn the instrument back on.
4. Continue to hold the **Preset** key for 10 seconds after pressing the power button, then release it.
5. After approximately 30 seconds the boot Service Menu will appear, as shown in Figure 16-3.

Figure 16-3 Service Boot Screen



6. Using the front panel arrow keys scroll down to **Start main firmware service menu** and press **Select**.
7. When the service menu warning screen is displayed press **Continue**.
8. On the main firmware service menu select **Next page** until a selection for **Restore license data from backup** is available.
9. Select **Restore license data from backup** as shown in Figure 16-4, and then select **Done**.

Figure 16-4 Restore License Data From Backup



10. The instrument will copy the licenses from the backup location on the A3 RF assembly into the A5 CPU non-volatile memory and load the instrument firmware.
11. Once the instrument completes its boot up process all the previously licensed options should be enabled.
12. If the following error is seen at this point cycle the instrument power once more and it should then be gone.

    617 Configuration Error: The backup memory contains license keys for serial number <serial number>. Use the service procedure to overwrite the backup memory.

Once this procedure has completed continue with the next task associated with the assembly being replaced.

Backup Licenses

When the licenses for frequency range and other options are installed in the instrument they are saved in non-volatile memory on the A5 CPU assembly. Before the instrument was shipped from the factory a backup copy of these licenses was also saved on the A3 RF assembly. If the A3 RF assembly is replaced, the licenses that are in the A5 CPU non-volatile memory will need to be backed up to the backup storage location in the new A3 RF assembly, so that there will be a copy of them in case the A5 CPU assembly should ever need replacement.

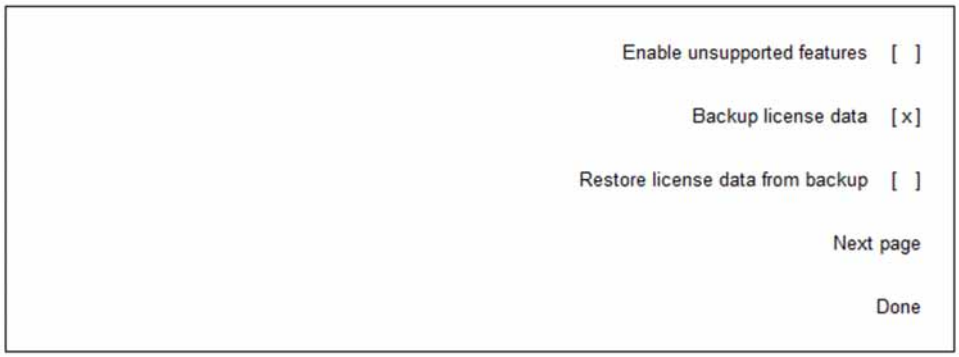
When an A3 RF assembly is replaced the following error message will be displayed until the licenses are backed up:

617 Configuration Error: Instrument licenses have not been copied to the backup storage. Use the service procedure to copy license keys to backup storage.

The following procedure will backup the instrument licenses from the A5 CPU assembly non-volatile memory to the backup memory location on the replacement A3 RF assembly:

1. Turn the instrument off by using the front panel power button.
2. Once the instrument has turned off press and hold the front panel **Preset** key.
3. While holding the **Preset** key, press and release the power button to turn the instrument back on.
4. Continue to hold the **Preset** key for 10 seconds after pressing the power button, then release it.
5. After approximately 30 seconds the boot Service Menu will appear, as shown in Figure 16-3.
6. Using the front panel arrow keys scroll down to **Start main firmware service menu** and press **Select**.
7. When the service menu warning screen is displayed press **Continue**.
8. On the main firmware service menu select **Next page** until a selection for **Backup license data** is available.
9. Select **Backup license data** as shown in Figure 16-5, and then select **Done**.

Figure 16-5 Backup License Data



10. The instrument will copy the licenses from the A5 CPU non-volatile memory to the backup location on the replacement A3 RF assembly and load the instrument firmware.
11. If the error listed above is seen at this point cycle the instrument power once more and it should then be gone.

Once this procedure has completed continue with the next task associated with the assembly being replaced.

Restore Factory Waveforms

This task is only for N5166B, N5172B, and N5182B instruments that do not have option SD0.

As shipped from the factory there are as series of waveform files installed in the user memory portion of the A4 Solid State disk drive for many of the different digital modulation formats. Replacement A4 Solid State disk drives do not come with the waveform files on them, so they will need to be downloaded and transferred to the replacement drives. Use the following procedure to do this:

1. Go to http://www.keysight.com/find/mxg_waveforms and download the latest version of the files in .zip format.
2. Format a USB flash drive with a FAT file system.
3. Unzip the contents of the downloaded file to the formatted USB flash drive.
4. Insert the USB flash drive into one of the instrument front panel USB ports.
5. When the instrument automatically catalogs the USB flash drive press **More**, **Copy All Files**, **USB to Internal Storage**.
6. When all files have been copied, remove the USB flash drive from the instrument and continue with the next task associated with the A4 Solid State disk drive replacement.

Set Hostname

Whenever the A5 CPU assembly is replaced the instrument LAN Hostname must be reset to the default value. Use the following procedure to reset it:

1. With the instrument disconnected from the local area network press **Utility**, **I/O Config**, **LAN Setup**, **Hostname**
2. Use the backspace key (Bk Sp) to delete all unwanted characters in the text entry field.
3. Enter the default Hostname using the following pattern:

   A-<*model number*>-<*last 5 digits of serial number*>

   Example: A-N5182B-12345

   If the instrument is an N5166B the pattern should be:

   K-<*model number*>-<*last 5 digits of serial number*>
4. When completed press **Enter**.

NOTE An external USB keyboard can be used to enter the hostname.

Front Panel Tests

The Front Panel Tests verify the functionality of multiple front panel operations, all of which should be verified after the instrument front panel has been repaired or replaced.

To run the Front Panel Tests on the instrument press **Utility**, **Instrument Info**, **Front Panel Tests**.

For detailed information on running the front panel test see the "Instrument Info" section in Chapter 5, "Service and Utility Menus"

17 Functional Tests

What You Will Find in This Chapter

This chapter provides information on the following:

Functional Test Versus Performance Verification on page 442

Before Performing a Functional Test on page 443

Relative Frequency Range and Accuracy Check on page 444

Leveled Output Power on page 446

Functional Test Versus Performance Verification

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).

NOTE

Functional test accuracy depends on the precision of the test equipment used. Ensure that all the test equipment is calibrated before running a functional test.

Relative Frequency Range and Accuracy Check

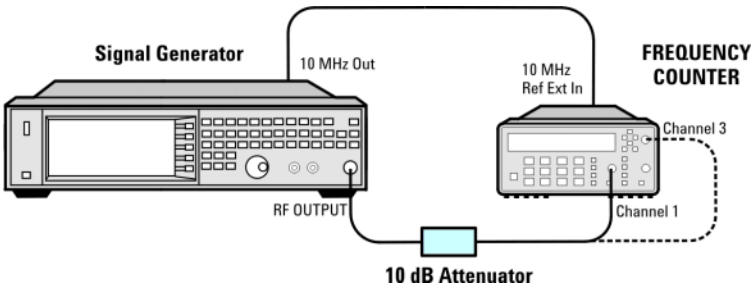
The frequency range is tested by determining the frequency accuracy relative to the timebase at the frequency limits of the signal generator. This test can be performed with a frequency counter that meets the frequency accuracy limits in Table 17-1.

Test Equipment	Recommended Model
Frequency Counter	Keysight 53131A/32A Universal Counter

Frequency Counter Procedure

Test Setup

1. Connect the equipment as shown.



2. Preset the signal generator: Press **Preset**.
3. Turn modulation off: Press the **Mod On/Off** so that the MOD On/Off LED turns off.
4. Set the amplitude:
   Press **Amplitude** and enter 0 dBm.
5. Turn RF on: Press **RF On/Off** so that the RF On/Off LED lights.
6. Verify that the frequency counter is locked to the 10 MHz external reference frequency (±1 Hz).
7. For maximum accuracy, set the gate time on the frequency counter to >5 seconds.
   (For example, press **Gate & ExtArm** twice and use the arrow keys to set the value.)
8. Set the frequency: Press **Frequency** and set the signal generator to the first frequency listed in Table 17-1.
9. Confirm that the measured frequency is within the limits listed.

10. Repeat step step 8 and step step 9 for all of the frequencies in the table that are within the frequency range of your signal generator.

NOTE

For frequencies <200 MHz, use Channel 3 on the frequency counter (press **Freq Ratio** until CH3: displays).

Table 17-1 Frequency Accuracy Limits

Frequency (MHz)	Limit (Hz)
0.01 MHz	±1
0.1 MHz	±1
200 MHz	±1
300 MHz	±1
500 MHz	±1
1000 MHz	±1
2000 MHz	±1
3100 MHz	±1
6000 MHz	±1

Troubleshooting Problems with the Frequency Accuracy Check

- Verify the cables are connected correctly.
- If you are using a frequency counter, verify that you are using the correct channel for the frequencies you are measuring.

Leveled Output Power

This test verifies that the CW output power from the signal generator is within defined limits. The following table lists the preferred equipment for this test.

Test Equipment	Recommended Model
Power Meter	Keysight E4418B or E4419A/B E-Series or equivalent
Power Sensor, Input: Type-N (m)	Keysight E9304A

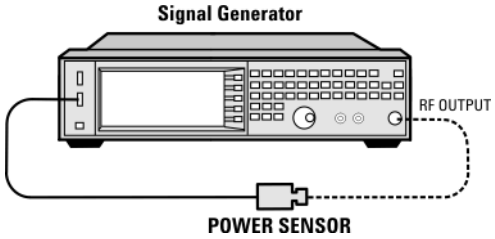
– N5171B/81B Test Procedure on page 17-446
– N5171B/81B Alternative Test Procedure on page 17-447
– N5166B, N5172B, and N5182B Test Procedure on page 17-449
– N5166B, N5172B, and N5182B Alternative Test Procedure on page 17-452

If this test fails, refer to "Troubleshooting Problems with the Output Power Check" on page 453 for further instructions.

N5171B/81B Test Procedure

Test Setup

1. Connect the equipment as shown:



2. Zero and calibrate the power sensor.

NOTE

USB U2000A Series Power Sensors do not require the sensor to be zeroed or calibrated.

3. Connect the power sensor to the RF output of the signal generator. Once the LED on the power sensor turns off, the sensor is ready to measure.
4. Preset the signal generator: Press **Preset**
5. Turn the internal power meter channel on: Press **Aux Fctn** > **Power Meter Measurements** > **Channel A On** (or **Channel B On**).
6. Turn RF on: Press **RF On/Off** so that the RF On/Off LED lights.

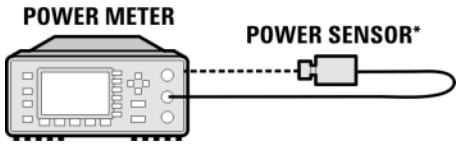
7. Turn modulation off: Press **Mod On/Off** so that the **Mod On/Off** LED turns off.
8. Set the frequency: Press **Frequency** and enter the first frequency value listed in Table 17-2.
9. Set the amplitude: Press **Amplitude** and enter the amplitude value for that frequency.
10. Measure the output power level.
11. Repeat steps 8 through 10 to measure power at each of the frequencies listed in Table 17-2.
12. Confirm that the measured power levels are within the limits listed in the table.

N5171B/81B Alternative Test Procedure

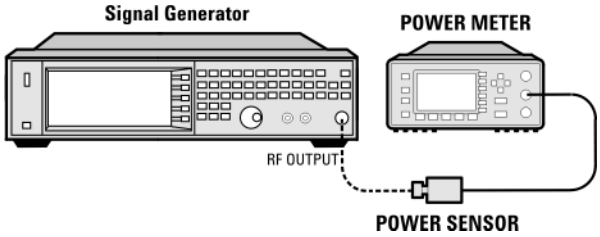
If a USB power sensor is not available, use a power meter to measure the output power of the signal generator.

Test Setup

1. Zero and calibrate the power sensor to the power meter:



2. Connect the equipment as shown:



3. Preset the signal generator: Press **Preset**.
4. Turn RF on: Press **RF On/Off** so that the RF On/Off LED lights.
5. Turn modulation off: Press **Mod On/Off** so that the Mod On/Off LED turns off.
6. Set the frequency: Press **Frequency** and enter the first frequency value listed in Table 17-2.
7. Set the amplitude: Press **Amplitude** and enter the amplitude value for that frequency.
8. Configure the power meter for the measurement.
    a. Press the **Frequency Cal Fac** button on the power meter.

b. Select a power meter channel (if applicable).

c. Use the arrow keys to enter the frequency at which to measure the power.

9. Measure the output power level.

10. Repeat steps 6 through 9 to measure power at each of the frequencies listed in Table 17-2.

11. Confirm that the measured power levels are within the limits listed in the table.

NOTE Limit values are due to power meter uncertainty.

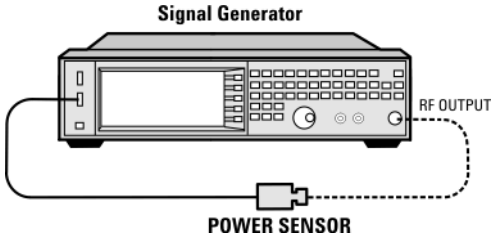
Table 17-2 Leveled Output Power Limits

N5171B/81B Output Power		
Frequency (MHz)	**Amplitude (dBm)**	**Limits (dB)**
100 kHz	7	±0.6
1 MHz	7	±0.8
50 MHz	7	±0.8
125 MHz	7	±0.8
275 MHz	7	±0.8
338 MHz	7	±0.8
425 MHz	7	±0.8
538 MHz	7	±0.6
675 MHz	7	±0.6
850 MHz	7	±0.6
1075 MHz	7	±0.6
1350 MHz	7	±0.6
1700 MHz	7	±0.6
2150 MHz	7	±0.6
2700 MHz	7	±0.6
3400 MHz	7	±0.6
4300 MHz	7	±0.6
5400 MHz	7	±0.6

N5166B, N5172B, and N5182B Test Procedure

Test Setup

1. Connect the equipment as shown:



2. Zero and calibrate the power sensor.

NOTE

USB U2000A Series Power Sensors do not require the sensor to be zeroed or calibrated.

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3. Connect the power sensor to the RF output of the signal generator. Once the LED on the power sensor turns off, the sensor is ready to measure.
4. Preset the signal generator: Press **Preset**
5. Turn the internal power meter channel on: Press **Aux Fctn** > **Power Meter Measurements** > **Channel A On** (or **Channel B On**).
6. Turn RF on: Press **RF On/Off** so that the RF On/Off LED lights.
7. Turn modulation off: Press **Mod On/Off** so that the **Mod On/Off** LED turns off.
8. Set the frequency: Press **Frequency** and enter the first frequency value listed in Table 17-3.
9. Set the amplitude: Press **Amplitude** and enter the amplitude value for that frequency.
10. Measure the output power level.
11. Repeat steps 8 through 10 to measure power at each of the frequencies listed in Table 17-3.
12. Confirm that the measured power levels are within the limits listed in the table.

Without Modulation

a. Set the signal generator frequency to the first value listed in Table 17-3:

   Press **Frequency** > **50** > **MHz**.

b. Set the amplitude to 7 dBm:

   Press **Amplitude** > **7** > **dBm**.

c. If using a power meter, configure the power meter as follows:

1. On the power meter, press the **Frequency Cal Fac** button.

2. If applicable, select a power meter channel.

3. Use the arrow keys to enter the frequency at which to measure the power.

d. Measure the output power level.

e. Repeat steps a through d for the remaining frequencies in the table, and confirm that the power level at each point is within limits.

Table 17-3 Output Power Without Modulation

Output Power Without Modulation		
Frequency (MHz)	**Amplitude (dBm)**	**Limits (dB)**
50	7	±0.6
100	7	±0.6
250	7	±0.6
338	7	±0.6
425	7	±0.6
538	7	±0.6
675	7	±0.6
850	7	±0.6
1075	7	±0.6
1350	7	±0.6
1700	7	±0.6
2150	7	±0.6
2700	7	±0.6
3400	7	±0.6
4300	7	±0.6
5400	7	±0.6

With Modulation

13. Preset the signal generator: Press **Preset**.

14. Select the factory-supplied waveform `SINE_TEST_WFM`:

a. Press **Mode** > **Dual ARB** > **Select Waveform**.

b. Highlight the `SINE_TEST_WFM` waveform.

c. Press **Select Waveform**.

15. Turn the arbitrary waveform player on: Press the **ARB** softkey to highlight **On**.

16. Set the frequency to the first value listed in Table 17-4:

Press **Frequency** > **50** > **MHz**.

17. Set the amplitude to 7 dBm:

Press **Amplitude** > **7** > **dBm**.

18. If using a power meter, configure the power meter as follows:

- **a.** On the power meter, press the **Frequency Cal Fac** button.
- **b.** Select a power meter channel (if applicable).
- **c.** Use the arrow keys to enter the frequency at which to measure the power.

19. Measure the output power.

20. Repeat steps 16 through 19 for the remaining frequencies listed in Table 17-4, and confirm that the power level at each point is within limits.

Table 17-4 Output Power With Modulation

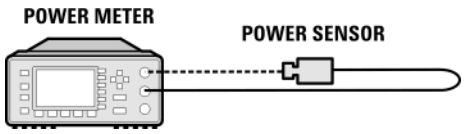
Output Power With Modulation		
Frequency (MHz)	**Amplitude (dBm)**	**Limits (dB)**
50	7	±1.05
100	7	±1.05
250	7	±1.05
323	7	±1.05
512	7	±1.05
814	7	±1.05
1275	7	±1.05
2025	7	±1.05
2750	7	±1.05
3750	7	±1.05
5250	7	±1.05

N5166B, N5172B, and N5182B Alternative Test Procedure

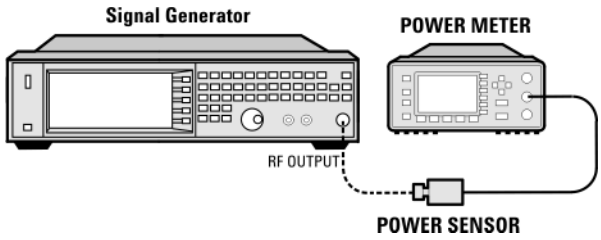
If a USB power sensor is not available, use a power meter to measure the output power of the signal generator.

Test Setup

1. Zero and calibrate the power sensor to the power meter:



2. Connect the equipment as shown below:



3. Preset the signal generator: Press **Preset**.
4. Turn RF on: Press **RF On/Off** so that the RF On/Off LED lights.
5. Turn modulation off:

   Press **Mod On/Off** so that the Mod On/Off LED turns off.
6. Continue the procedure from "Without Modulation" on page 449.
7. Continue the procedure from "With Modulation" on page 450 to complete the output power measurements of the N5172B/82B.

Troubleshooting Problems with the Output Power Check

- Verify that you are using the appropriate power sensor.
- Normally, power sensor calibration factors are automatically downloaded to the power meter when the power meter turns on. If this does not occur, manually enter the correct calibration factors for the power sensor you are using.
- Verify that the power sensor is properly calibrated to the power meter.

18 Performance Verification and Adjustment Software

What You Will Find in This Chapter

This chapter provides information on the following:

Test Software Overview on page 456

Performance Verification Tests on page 456

Adjustments on page 456

Utilities on page 456

Required Test Equipment on page 457

Test Software Overview

The X-Series Signal Generators can be fully tested and adjusted with the use of the N7822A Calibration Application software.

To download a copy of the Performance Verification & Adjustment software as well as find information on software licensing, visit the Keysight Calibration & Adjustment Software web site at:

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

Performance Verification Tests

Performance verification tests are tests designed to provide the highest level of confidence that the instrument being tested conforms to published, factory-set specifications. The tests are supplied in an automated test software package. Performance tests are designed to test an instrument operating within the operational temperature range defined by the instrument specifications.

A complete list of the performance verification tests can be found at:

http://cal.software.keysight.com/MXG/Help/MXGWebHelp.htm

Prior to running any performance verification tests be sure that there are no instrument error messages and that all Self Tests pass.

Adjustments

Adjustments are procedures designed to reset various circuit parameters or calculate correction values. The adjustments are supplied in an automated test software package. The software is designed to adjust an instrument operating within the operational temperature range defined by the instrument specifications.

Never perform adjustments as routine maintenance. Adjustments should be performed only after a repair or a performance test failure. A list of adjustments that need to be ran after an assembly is replaced can be found in Chapter 16, “Pre and Post-Repair Procedures”

A complete list of the adjustments can be found at:

http://cal.software.keysight.com/MXG/Help/MXGWebHelp.htm

Utilities

Certain utilities are provided to properly complete the servicing of an instrument. The use of these is defined in Chapter 16, “Pre and Post-Repair Procedures”

Required Test Equipment

A complete list of test equipment required to perform both the performance verification testing as well as all adjustments can be found at:

http://cal.software.keysight.com/MXG/Help/MXGWebHelp.htm

19 Instrument Firmware and Operating System

What You Will Find in This Chapter

This chapter provides information on the following:

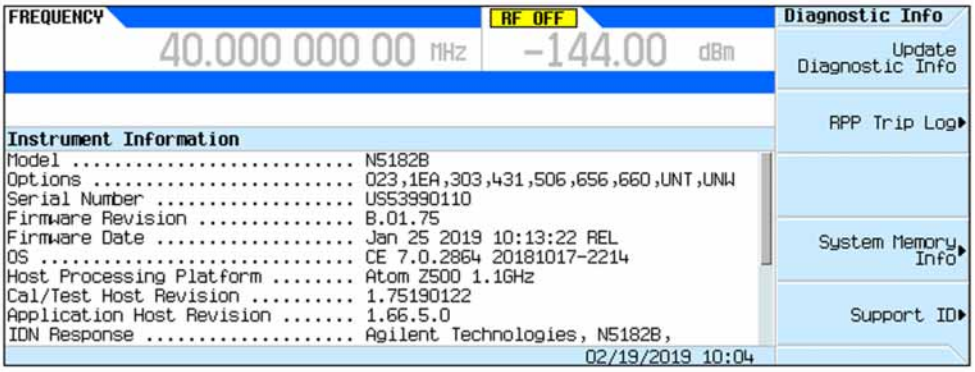
Instrument Firmware on page 460

Operating System on page 463

Instrument Firmware

The instrument firmware contains all the software required to operate all the instrument functionality. This includes the basic instrument functionality and all the optional functionality and modes. To see what version of the instrument firmware is currently being used press **Utility**, **Instrument Info**, **Diagnostic Info** on the instrument front panel. The Firmware Revision and Firmware Date will be listed on the display as shown in Figure 19-1.

Figure 19-1 Diagnostic Info Display



Hardware Versus Firmware

NOTE All N5166B instruments must have firmware version B.01.80 or newer.

While it is always advised to use the latest version of the instrument firmware that is available, there are times that an older version is required for one reason or another. However, there are certain hardware versus firmware dependencies that exist that need to be considered before using a version of the firmware other than the latest. The dependencies that existed as of the printing of this guide are shown in Table 19-1.

Table 19-1 Hardware Versus Firmware Dependencies

Assembly	Part Number[a]	Minimum Firmware
A2 Vector BBG Assembly	N5180-60280 N5180-69280	B.01.65
A3 RF Assembly	N5180-60278 N5180-69278	B.01.65
	N5180-60279 N5180-69279	B.01.65
	N5180-60296 N5180-69296	B.01.65
	N5180-60297 N5180-69297	B.01.65
A5 CPU Assembly	0960-3295	B.01.75

a. These are the part number found on the Utility, Instrument Info, Installed Board Info screen.

If there is an assembly in an instrument with a part number listed in Table 19-1 a firmware version older than that listed in the Minimum Firmware column should not be used, as it will either generate errors or not perform as intended.

FPGA Code Versus Firmware

Different firmware versions have different FPGA version dependencies, and the FPGA code in the instrument can only be updated with a firmware installation. Because of this, whenever either the A5 CPU assembly or an assembly with FPGA code on it is replaced the instrument firmware should be reloaded after the assembly replacement to make sure that all the FPGA versions are correct

for the firmware version being used. This does not have to be the latest firmware version, as long as the hardware versus firmware dependencies are being met.

Instrument Firmware Updates

The firmware and all its components are all loaded at the same time. This includes the FPGA code that resides on different assemblies in the instrument.

The latest version of the instrument firmware can be downloaded from:

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

Instructions on how to install the firmware can also be found at this location.

If the firmware appears to have somehow become corrupted and cannot be reloaded by the normal update process, try using the Recovery Firmware process. For detailed information on how to do this see"Boot Service Menu" section in Chapter 5, "Service and Utility Menus"

Operating System

The operating system used in the X-Series signal generators is Windows Compact Embedded (WinCE), which is a closed embedded operating system. Characteristics of this type of operating system are:

- Operating system and instrument SW are compiled together into a single code image.
- The user has only a limited amount of operating system functionality available to them.
- The user does not have the ability to add additional applications.
- The operating system cannot be updated separately.

The version of the operating system in an instrument can be seen as the OS entry on the **Utility**, **Instrument Info**, **Diagnostic** Info display as seen in Figure 19-1.

Operating System Updates

The operating system is not updatable on its own. Any updates to the operating system are included in the instrument firmware installation. However, not all firmware updates include an operating system update. The operating system is only updated when there are updates that are deemed necessary for the product.

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