

Keysight FieldFox Handheld Analyzers

This manual provides documentation for the following models:

N9913A, N9914A, N9915A, N9916A, N9917A, N9918A
N9925A, N9926A, N9927A, N9928A
N9935A, N9936A, N9937A, N9938A
N9950A, N9951A, N9952A
N9960A, N9961A, N9962A

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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/Fieldfox>

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/fieldfoxsupport>

Contacting Keysight

Assistance with test and measurements needs and information on finding a local Keysight office are available on the Web at:

<http://www.keysight.com/find/assist>

If you do not have access to the Internet, please contact your Keysight field engineer.

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1 Safety and Regulatory Information

Information in This Chapter

This chapter provides safety information that will help protect you and your network analyzer. It also contains information that is required by various government regulatory agencies.

Section Title	Summary of Content	Start Page
Safety Symbols	Descriptions of CAUTION and WARNING symbols used throughout this manual.	page 10
General Safety Considerations	A list of safety points to consider when servicing your network analyzer.	page 10
Electrostatic Discharge Protection	A discussion of electrostatic discharge (ESD) and related recommendations and requirements for ESD protection.	page 15
Regulatory Information	Definitions of instrument markings. Instructions for disposing of the analyzer's lithium battery.	page 17

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.

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.

General Safety Considerations

Safety Earth Ground

WARNING

This is a Safety Class I 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 instrument, will make the instrument dangerous. Intentional interruption is prohibited.

CAUTION

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

AC/DC Adapter

WARNING

Use Keysight supplied power cord when AC/DC power adapter is connected.

WARNING

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

External Battery Charger (N9910X-872)

CAUTION

If charging batteries externally, use the optional external charger available from Keysight, or another SMBus charger of level II or higher.

Never use a non-SMBus charger because the battery issues commands over the SMBus to the charger to control the charge rate and voltage.

Never use a modified or damaged charger.

Battery

Lithium battery packs may get hot, explode, or ignite and cause serious injury if exposed to abuse conditions.

This section contains the following:

- “High Capacity Lithium-Ion Battery (N9910X-876)”
- “Standard Capacity Battery (N9910X-870)”

High Capacity Lithium-Ion Battery (N9910X-876)

Lithium-ion battery (High Capacity): N9910X-876 (battery Keysight part number: 1420-0937) is used to provide power to a family of portable microwave test instruments produced by Keysight Technologies. Be sure to follow these safety warnings:

WARNING

Lithium-ion batteries:

- Must not be exposed to high temperatures (>70°C) or fire.
 - Must be kept away from children.
 - Must not be short circuited.
 - Must be replaced only with Keysight qualified Li-ion batteries.– If replaced or charged improperly, there is a danger of explosion.
-

WARNING

Do not connect the positive terminal and negative terminal of the battery to each other with any metal object (such as wire).

WARNING

Do not carry or store the battery with necklaces, hairpins, or other metal objects.

WARNING

Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.

WARNING

Do not solder directly onto the battery.

WARNING

Do not expose the battery to water or salt water, or allow the battery to get wet.

WARNING

Do not disassemble or modify the battery. The battery contains safety and protection devices, which if damaged, may cause the battery to generate heat, explode, or ignite.

WARNING

Do not place the battery in direct sunlight, or use or store the battery inside cars in hot weather. Doing so may cause the battery to generate heat, explode, or ignite. Using the battery in this manner may also result in a loss of performance and a shortened life expectancy.

WARNING

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type of battery recommended. Discard used batteries according to manufacturer's instructions.

WARNING

If you are charging the batteries internally, even while the FieldFox is powered off, the FieldFox may become warm. Allow for proper ventilation.

Do NOT run the FieldFox with the vents blocked or in the carrying case.

WARNING

Do not discharge the battery using any device except the FieldFox or the external battery charger (N9910X-872). When the battery is used in a device other than those specified, it may damage the battery or reduce its life expectancy. If the device causes an abnormal current to flow, it may cause the battery to become hot, explode, or ignite and cause serious injury.

The external battery charger discharges during recalibration.

Standard Capacity Battery (N9910X-870)

WARNING

Lithium-ion batteries:

- Must not be exposed to high temperatures (>70°C) or fire.
 - Must be kept away from children.
 - Must not be short circuited.
 - Must be replaced only with Keysight qualified Li-ion batteries.– If replaced or charged improperly, there is a danger of explosion.
-

WARNING

Do not connect the positive terminal and negative terminal of the battery to each other with any metal object (such as wire).

WARNING

Do not carry or store the battery with necklaces, hairpins, or other metal objects.

Safety and Regulatory Information

General Safety Considerations

WARNING

Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.

WARNING

Do not solder directly onto the battery.

WARNING

Do not expose the battery to water or salt water, or allow the battery to get wet.

WARNING

Do not disassemble or modify the battery. The battery contains safety and protection devices, which if damaged, may cause the battery to generate heat, explode, or ignite.

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Do not place the battery in direct sunlight, or use or store the battery inside cars in hot weather. Doing so may cause the battery to generate heat, explode, or ignite. Using the battery in this manner may also result in a loss of performance and a shortened life expectancy.

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If you are charging the batteries internally, even while the FieldFox is powered off, the FieldFox may become warm. Allow for proper ventilation.

Do NOT run the FieldFox with the vents blocked or in the carrying case.

WARNING

Do not discharge the battery using any device except the FieldFox or the external battery charger (N9910X-872). When the battery is used in a device other than those specified, it may damage the battery or reduce its life expectancy. If the device causes an abnormal current to flow, it may cause the battery to become hot, explode, or ignite and cause serious injury.

The external battery charger discharges during recalibration.

Before Applying Power

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

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1:2001 and 664 respectively.

CAUTION

The measuring terminals on this instrument are designed to be used with external signals described in Measurement Category I, but NOT with external signals described in Categories II, III, and IV. The input of this instrument cannot be connected to the mains.

Servicing

WARNING

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

WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to local ordinances and/or manufacturer's instructions.

WARNING

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

WARNING

For continued protection against fire hazard, replace line fuse only with same type and rating. The use of other fuses or material is prohibited.

WARNING

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

WARNING

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

WARNING

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

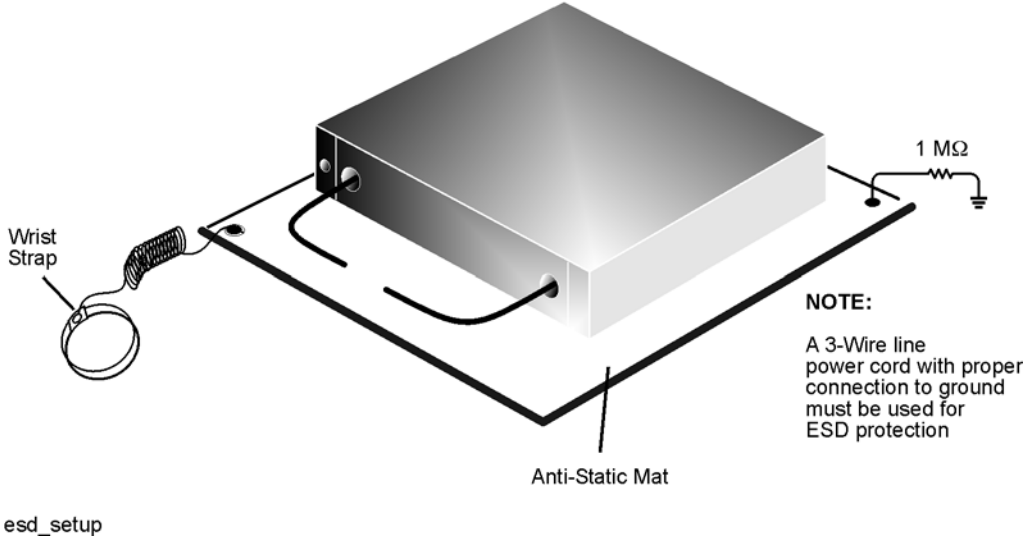
Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- **always** have a grounded, conductive table mat in front of your test equipment.
- **always** wear a grounded wrist strap, connected to a grounded conductive table mat, having a 1 M Ω resistor in series with it, when handling components and assemblies or when making connections.
- **always** wear a heel strap when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- **always** ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- **always** ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:
 1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
 2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
 3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 1-1 shows a typical ESD protection setup using a grounded mat and wrist strap. Refer to **“ESD Supplies” on page 106** for part numbers.

Figure 1-1 ESD Protection Setup



Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings



The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.



The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)



The CSA mark is a registered trademark of the Canadian Standards Association.

ICES/NMB-001

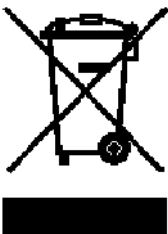
This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

ISM1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.



This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see <http://about.keysight.com/en/companyinfo/environment/> for more information.

Battery Disposal

If either the primary power battery, or the RTC (real time clock) battery (on the A3 front panel interface board) needs to be disposed of, dispose of it in accordance with your country's requirements. If required, you may return the battery to Keysight Technologies for disposal. Refer to **“Contacting Keysight” on page 30** for assistance.



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

For instructions on removing and replacing the primary power battery, refer to **“Removing and Replacing the Main Battery” on page 111**.

For instructions on removing and replacing the RTC (real time clock) battery located on the A3 front panel interface board, refer to **“Replacing the A3 Front Panel Interface Board (FPIB)” on page 136**.

2 General Product Information

Information in This Chapter

Section Title	Summary of Content	Start Page
Documentation Map	A list of the documentation available for the FieldFox.	page 20
Maintenance	Cleaning instructions for the external surfaces of your analyzer. Information about electrical maintenance of your FieldFox.	page 21
FieldFox Models	A list of the models available for the FieldFox.	page 21
FieldFox Options	A list of the options available for the FieldFox.	page 22
Keysight Support, Services, and Assistance	The Internet address (URL) for Keysight assistance. Service and support options available. Calibration options available. Important information about shipping your FieldFox to Keysight for service or repair.	page 29

Documentation Map

This Service Guide is available only on the Web via an Internet connection. It contains information for testing, adjusting, troubleshooting, and repairing your FieldFox analyzer.

The User's Guide, included with the product, helps you to quickly familiarize yourself with the analyzer. Procedures are provided for preparing, configuring, and making measurements with the analyzer.

The Quick Reference Guide, included with the product, is an abbreviated form of the User's Guide containing some of the most commonly referred to information. The pages of the Quick Reference Guide are laminated with clear plastic to resist damage when used outdoors.

Maintenance

WARNING

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

Physical Maintenance

Clean the FieldFox case using a dry or slightly damp cloth only.

Electrical Maintenance

Refer to **“Contacting Keysight” on page 30** and to **Chapter 3, “Tests and Adjustments.”**

FieldFox Models

Max Freq (GHz)	N991xA Combo	N992xA VNA	N993xA SA	N995xA Combo	N996xA SA
4	N9913A	X	X	X	X
6.5	N9914A	X	X	X	X
9	N9915A	N9925A	N9935A	X	X
14	N9916A	N9926A	N9936A	X	X
18	N9917A	N9927A	N9937A	X	X
26.5	N9918A	N9928A	N9938A	X	X
32	X	X	X	N9950A	N9960A
44	X	X	X	N9951A	N9961A
50	X	X	X	N9952A	N9962A

FieldFox Options

Below is a list of options that effect hardware for the FieldFox at the time of initial product release. Additional options will be added as product features are enhanced. Go to <http://www.keysight.com/find/Fieldfox> for information on currently available upgrade options.

Table 2-1 Options

Option	Description	13A	25A	35A	50A	60A
		14A	26A	36A	51A	61A
		15A	27A	37A	52A	62A
		16A	28A	38A		
		17A				
		18A				
010	[N991xA] Vector Network Analyzer Time Domain	Y	Y		Y	
	[N992xA] Time Domain	Y	Y		Y	
030	Remote Control Capability	Y	Y	Y	Y	Y
100	3.5 mm APC Connectors			38A only	Std	Std
112	QuickCal	Y	Y			
208	USB Power Sensor Measurements versus Frequency	Y	Y	Y	Y	Y
209	Extended Range Transmission Analysis (ERTA)	Y		Y	Y	Y
210	VNA Transmission/Reflection	Y	Base		Base	
211	[N991xA, N995xA] VNA Full 2-Port S-Parameters	Y	Y		Y	
	[N992xA] Full 2-Port S-Parameters	Y	Y		Y	
212	1-Port Mixed-Mode S-Parameters	Y	Y		Y	
215	TDR Cable Measurements	Y	Y		Y	
220	Full-Band Tracking Generator	1		Y	1	Y
233	Spectrum Analyzer	Y		Base	Base	Base
235	Preamplifier	Y		Y	Y	Y
236	Interference Analyzer and Spectrogram	Y		Y	Y	Y
238	Spectrum Analyzer Time Gating	Y		Y	Y	Y
302	USB Power Sensor Support	Y	Y	Y	Y	Y

General Product Information
FieldFox Options

Table 2-1 Options

Option	Description	13A	25A	35A	50A	60A
		14A	26A	36A	51A	61A
		15A	27A	37A	52A	62A
		16A	28A	38A		
		17A				
		18A				
305	Cable and Antenna Analyzer	Base	Y	2	Base	2
307	GPS Receiver	Y	Y	Y	Y	Y
308	Vector Voltmeter	Y	Y		Y	
309	DC Bias Variable-Voltage Source	Y	Y	Y	Y	Y
310	Built-In Power Meter	Y	Y	Y	Y	Y
312	Channel Scanner	Y		Y	Y	Y
320	Reflection Measurements (Return Loss, VSWR, Scalar Measurement)	Base		Y	Base	Y
320	Reflection Measurements (Return Loss, VSWR, Scalar Measurement)	3	3	Y	3	Y
330	Pulse Measurements	Y	Y	Y	Y	Y
355	AM/FM Metrics	Y		Y	Y	Y

Option Descriptions

Option 010, Vector Network Analyzer Time Domain

With Option 010 or time domain, FieldFox computes the inverse Fourier transform of the frequency-domain data to display reflection or transmission coefficients versus time. Time domain gating can be used to remove unwanted responses such as connector mismatch or cable discontinuities, and the results can be displayed in either time or frequency domain.

- Fully error-corrected time domain reflection or transmission response
- Gating available to remove unwanted responses
- View time and frequency domain data simultaneously
- Transform frequency domain to the time domain or time domain to the frequency domain

Option 030, Remote Control Capability

Option 030 adds remote control capability to FieldFox for iDevices.

- User must supply iPad, iPhone, or iPod.
- User must download free FieldFox app from App store.

Option 100, 3.5 mm APC Connectors

Option 100 provides 3.5 mm input and output connectors. Available on N9938A model only (26.5 GHz) at initial purchase.

Option 112, QuickCal

Option 112 provides a calibration that is performed automatically using calibration standards that are built-in to the FieldFox. Calibration standards are automatically switched in as needed. QuickCal is ideal for making quick DTF and cable loss measurements without taking the time to perform a full O,S,L Cal.

Option 208, USB Power Sensor Measurements versus Frequency

Option 208 enables a power measurement versus frequency. The power is measured using a USB power sensor. FieldFox's source frequency can be set independently from the power sensor (receiver) frequency. The frequency of both the source and receiver are swept, and the two track each other. The offset frequency can be negative, zero, or positive.

Option 209, Extended Range Transmission Analysis (ERTA)

ERTA can be used to measure the scalar transmission gain or loss of an RF system. It is useful when measuring long lossy cables where the two ends cannot easily be brought together, such as those bolted in on ships or aircrafts. It is also useful in measuring the insertion loss of waveguide systems, or using the frequency-offset feature, devices such as mixers and converters.

ERTA measurements are based on two FieldFoxes; one at each end of the measured DUT. One FieldFox is the source and reference receiver (R), while the other is the measurement receiver (B). The two FieldFoxes are synchronized using hardware triggering. By taking advantage of FieldFox's InstAlign technique, ERTA can be used to make accurate gain or loss measurements.

Option 210, Vector Network Analyzer Transmission/Reflection

A base combination analyzer includes a cable and antenna analyzer. Available on N991xA Combination models. Base option available for N992xA models only.

Option 210 adds:

- A vector network analyzer mode with transmission/reflection or S21 and S11 measurements, both magnitude and phase. Available calibrations are CalReady, one-port OSL, response and enhanced response.
- Insertion loss measurement to the base cable and antenna analyzer or CAT mode.
- 2-port transmission measurement to the vector voltmeter mode, available as Option 308.
- Tracking capability to the spectrum analyzer independent source, available as Option 233 (source and spectrum analyzer set to sweep a frequency range, in sync)

Option 211, Vector Network Analyzer Full 2-Port S Parameters

For the N991xA Combination models of FieldFox, Option 211 provides transmission/reflection or S21 and S11 measurement capabilities, along with one-port and enhanced response calibrations. Additionally for the N991xA Combination models and the N992xA VNA models, Option 211 provides all four S-parameters - forward and reverse (S11, S21, S12, S22), and full 2-port calibration. Full 2-port calibration is the most accurate calibration available with FieldFox network analyzers.

Option 211 also adds A/B and B/A measurement capabilities to the vector voltmeter mode, available as Option 308.

- Adds reverse measurements to the VNA
- All four S-parameters (S21, S11, S12, S22), magnitude and phase

Option 212, 1-Port Mixed-Mode S-Parameters

Option 212 enables mixed-mode S-parameter reflection measurements in FieldFox's network analyzer mode. Mixed-mode S-parameters are also known as balanced measurements.

Measurements:

- Scc11: common mode reflection
- Sdd11: differential mode reflection
- Scd11: differential mode stimulus, common mode response
- Sdc11: common mode stimulus, differential mode response

FieldFox's mixed-mode S-parameter measurements require the use of the default factory calibration or a user 2-port calibration.

Option 215, TDR Cable Measurements

Option 215 adds time domain reflectometry (TDR) measurements to CAT mode. The measurements include TDR (linear rho) and TDR impedance (ohm).

TDR measurements are useful in not only identifying the location of faults along cables, but also the nature of the fault. Resistive, inductive and capacitive faults will each have a different response. These differences help line-sweep technicians in the trouble-shooting process.

Option 220, Tracking Generator - Full Band

Option 220 allows easy and accurate scalar stimulus/response measurements on active and passive components, cables, connectors and antennas. The full-band tracking generator source can also be decoupled to act as a stand-alone source that can be used to stimulate an active or passive component, optionally using the spectrum analyzer for measurement.

Option 233, Spectrum Analyzer

Option 233 adds a high performance, full-band spectrum analyzer including four traces, different detector types, radio standard selection and flexible limit lines. The option offers channel power measurements, AM/FM tune and listen, field strength measurements, antenna factors and frequency counter markers. Also included is a full-band tracking generator.

Option 235, Preamp for Spectrum Analyzer

Option 235 increases the spectrum analyzer sensitivity, reducing the DANL to -155 dBm.

Option 233 is prerequisite.

Option 236, Interface Analyzer and Spectrogram

Option 236 provides quick and accurate identification of interfering signals using the spectrogram or waterfall display. Record and playback allows signal capture and offline processing.

Option 233 is prerequisite.

Option 238, Spectrum Analyzer Time Gating

- Adds FFT.
- Gate sources: External, RF Burst, and Video.
- Option 233 is a prerequisite for Option 238

Option 302, External USB Power Sensor Support

Option 302 allows the use of an external USB controllable power sensor. All Keysight U2000x Series USB power sensors are supported with FieldFox. Visit: www.keysight.com/find/u2000 for an up-to-date listing.

Option 305, Cable and Antenna Analyzer

Option 305 provides fast and accurate diagnosis of cables, connectors, and antennas with DTF (dB, linear, VSWR), return loss and DTF, 1-port cable loss, 2-port insertion loss, and CalReady.

Option 307, GPS Receiver

Option 307 enables the built-in GPS receiver. Requires a GPS antenna such as N9910X-825.

Option 308, Vector Voltmeter (VVM)

Option 308 includes S11 or one-port cable trimming.

Option 309, DC Bias Variable-Voltage Source

Option 309 adds an integrated built-in variable voltage DC bias source to the FieldFox analyzer. The source provides 1 to 32 VDC with maximum current of 650 mA and 7 watts maximum power. The DC bias source can provide DC power to amplifiers under test and bias tower mounted amplifiers (TMA) when engineers need to sweep through the TMA to reach the antenna. The bias-tee is available separately. The DC output has an SMB (m) connector.

Option 310, Built-In Power Meter

Option 310 provides the functionality to make user-definable channel power measurements such as transmitter output power. By leveraging InstAlign technology, FieldFox is able to make very accurate channel power measurements.

Option 312, Channel Scanner

Option 312 provides the functionality to measure and display channel power vs frequency for up to 20 channels simultaneously.

Option 320, Reflection Measurements (Return Loss, VSWR, and Scalar Measurement)

Measurement of VSWR and return loss can be made on active and passive devices, cables, connectors and antennas. Option 220 is prerequisite.

Option 330, Pulse Measurements

Option 330 enables pulse measurements on FieldFox using Keysight's USB peak power sensors. The pulse measurement mode can be used to characterize RF pulses such as those used in radar and electronic warfare systems.

Frequency of operation, dynamic range, minimum pulse width and other performance specifications depend on the sensor.

Measurements include:

- Average power, peak power, and peak to average ratio
- Analog gauge display and digital display, dBm and watts
- Relative/absolute measurements, dB or %, minimum and maximum limits
- Trace graph for pulse profile viewing with gating
- Rise time, fall time, pulse width, pulse period, pulse repetition frequency

Option 355, AM/FM Metrics (Analog Demodulation)

Using FieldFox's analog demodulation, users maintaining AM/FM radio systems can demodulate and characterize AM and FM signals. They can tune to the signal and listen to the audio tones using FieldFox's built-in speakers or a headphone. They can also display the RF spectrum, the demodulated waveform and AM/FM metrics such as carrier power, modulation rate, and SINAD.

AM/FM Metrics enables you to make the following measurements:

AM Measurements: – AM Measurements: Carrier power, AM rate, AM modulation index

FM Measurements: – FM deviation (peak and RMS), Modulation Rate, Carrier power, Demodulated voltage, SINAD, THD (total harmonic distortion)

AM/FM Metrics can be enabled/disabled simultaneously with Tune and Listen.

Keysight Support, Services, and Assistance

Information on the following topics is included in this section.

- [“Service and Support Options”](#)
- [“Calibration Options”](#)
- [“Contacting Keysight”](#)
- [“Shipping Your Analyzer to Keysight for Service or Repair”](#)

Service and Support Options

The analyzer’s standard warranty is a **one-year return to Keysight Technologies** service warranty.

NOTE

There are other repair and calibration options available from Keysight Technologies. Contact Keysight for additional information on available service agreements for this product. Refer to [“Contacting Keysight” on page 30](#).

Calibration Options

Commercial Calibration Certificate with Test Data

A complete set of measurements that test the analyzer to the manufacturer’s published specifications. It includes a calibration label, a calibration certificate, and the corresponding calibration data report. This calibration conforms to ISO 9001.

ISO 17025 Standards Compliant Calibration

A complete set of measurements that test the analyzer to the manufacturer’s published specifications. It includes a calibration label, an ISO 17025 calibration certificate, and the corresponding calibration data, measurement uncertainties, and guardbands on all customer specifications. This calibration conforms to ISO 17025 and ISO 9001.

This calibration option is available at the time of purchase or can be obtained later by sending your analyzer to Keysight for calibration. Refer to [“Shipping Your Analyzer to Keysight for Service or Repair”](#).

ANSI Z540 Standards Compliant Calibration

A complete set of measurements that test the analyzer to the manufacturer’s published specifications. It includes both pre- and post-adjustment data with measurement uncertainty information compliant to the ANSI/NCSL Z540 standard.

This calibration option is available at the time of purchase or can be obtained later by sending your analyzer to Keysight for calibration. Refer to [“Shipping Your Analyzer to Keysight for Service or Repair”](#).

Contacting Keysight

Assistance with test and measurements needs and information on finding a local Keysight office are available on the Web at:

<http://www.keysight.com/find/assist>

If you do not have access to the Internet, please contact your Keysight field engineer.

NOTE

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

Shipping Your Analyzer to Keysight for Service or Repair

IMPORTANT

Keysight Technologies reserves the right to reformat or replace the internal flash drive in your analyzer as part of its repair. This will erase all user information stored on the drive. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's flash drive before shipping it to Keysight for repair.

If you wish to send your network analyzer to Keysight Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Keysight for instructions on where to ship your analyzer. Refer to **“Contacting Keysight” on page 30.**

3 Tests and Adjustments

Information in This Chapter

This chapter contains procedures to help you check, verify, and adjust your FieldFox analyzer.

- The checks verify the operation of the assemblies in your analyzer.
- The adjustments allow you to tune your analyzer for maximum response.

NOTE

The Keysight N7841A software package is required to test and adjust your analyzer. This software package must be purchased separately. It can be downloaded from the Internet and a license purchased on-line, or it can be ordered on a CD-ROM.

Go to www.keysight.com/find/calibrationsoftware for further information.

The help file for the N7841A software package is also available at this URL.

Section Title	Summary of Content	Start Page
Before You Begin	Items to consider or procedures to perform before testing is begun: <ul style="list-style-type: none">– Verify the operating environment.– Protect Against Electrostatic Discharge (ESD)– Allow the Analyzer to Warm Up– Review the Principles of Connector Care	page 32
Service Test Equipment	A list of additional equipment recommended for servicing the FieldFox analyzer.	page 34
Before Returning an Instrument to a Customer	A list of things to do before returning an instrument to a customer after servicing is completed.	page 35
Operational Check	An operation check that should be performed before returning an instrument to a customer.	page 36
Performance Tests (Keysight N7841A Software Package)¹	A list of performance tests included in the Keysight N7841A software package.	page 38
Adjustments (Keysight N7841A Software Package)¹	A list of adjustments included in the Keysight N7841A software package.	page 40

1. The Keysight N7841A software package must be purchased separately. Go to www.keysight.com/find/calibrationsoftware for information.

Before You Begin

Before checking, verifying, or adjusting the analyzer, refer to the following paragraphs to:

- Make sure the operating environment is within 19 to 27 °C and 5 to 95% humidity.
- Make sure that proper electrostatic discharge (ESD) protection is provided.
- Review the principles of connector care.

Protect Against Electrostatic Discharge (ESD)

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

CAUTION

To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in **“Electrostatic Discharge Protection” on page 15** for all of the procedures in this chapter.

Allow the Analyzer to Warm Up

Before testing or adjusting the FieldFox analyzer, allow it to warm up as described under “DUT Warmup” in the “Getting Started” section of the N7841A help file.

Review the Principles of Connector Care

Proper connector care and connection techniques are critical for accurate and repeatable measurements. Refer to **Table 3-1** for tips on connector care.

Prior to making connections to your analyzer, carefully review the information about inspecting, cleaning, and gaging connectors. Refer to the calibration kit documentation for detailed connector care information.

For course numbers about additional connector care instruction, contact Keysight Technologies. Refer to **“Contacting Keysight” on page 30**.

Table 3-1 Connector Care Quick Reference Guide

Handling and Storage			
Do	– Keep connectors clean	Do Not	– Touch mating-plane surfaces
	– Extend sleeve or connector nut		– Set connectors contact-end down
	– Use plastic end-caps during storage		– Store connectors or adapters loose
Visual Inspection			
Do	– Inspect all connectors carefully	Do Not	– Use a damaged connector - ever
	– Look for metal particles, scratches, and dents		
Connector Cleaning			
Do	– Try compressed air first	Do Not	– Use any abrasives
	– Use isopropyl alcohol ¹		– Get liquid into plastic support beads
	– Clean connector threads		
Gaging Connectors			
Do	– Clean and zero the gage before use	Do Not	– Use an out-of-specification connector
	– Use the correct gage type		
	– Use correct end of calibration block		
	– Gage all connectors before first use		
Making Connections			
Do	– Align connectors carefully	Do Not	– Apply bending force to connection
	– Make preliminary connection contact lightly		– Over tighten preliminary connection
	– Turn only the connector nut		– Twist or screw any connection
	– Use a torque wrench for final connection		– Tighten past torque wrench “break” point

1. Cleaning connectors with alcohol shall only be done with the instrument’s power cord removed, and in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the instrument.

Service Test Equipment

The test equipment required for the TME based N7841A test and adjustment software is listed in the N7841A help file.

The following additional test equipment is recommended when servicing the FieldFox analyzer:

- Main Battery—Required if the analyzer is returned for service without a battery. Refer to the **“Miscellaneous Parts”** table on **page 104** for part numbers.
- USB flash drive—Used for firmware upgrades, option installation, etc. Also known as USB memory stick. Must be 128 MB or larger.
- Small, free-standing fan—Used to cool the analyzer if internal temperature is too high. See “DUT Warmup” in the “Getting Started” section of the N7841A help file for usage instructions. Generic small office fan of approximately six inches in diameter is sufficient.
- Cal kit—Cal kit compatible with port connectors.
- Mini SD flash card—Required to re-load firmware onto the A6 SOM board. A “mini” sized Secure Digital (SD) flash memory card is between “standard” and “micro” sizes. The memory size must be at least 64 MB and not greater than 2 GB. This card is not available from Keysight. To identify a supplier, search the Web for “mini sd card”.
- Stereo headphones or ear buds—May be used to troubleshoot sound output if there is a problem with the internal speaker.

Before Returning an Instrument to a Customer

When finished servicing an FieldFox analyzer, perform the following before returning the unit to the customer:

- Set the Display Colors to Indoor and the display Brightness to 80% via System (7) > Preferences > Preferences, etc.
- Perform an Operational Check as described in the following section.
- Connect and disconnect the external battery charger while the FieldFox is operating and confirm that the power cord icon is displayed appropriately at the top of the display.
- Charge the battery to 80% or higher.
- Connect FieldFox to the internet.
- Press **System > System Configuration > More > update time using Internet.**

Operational Check

This operational check exercises only very basic measurement functionality.

Required Equipment

A short compatible with the port connector type on the FieldFox.

A load compatible with the port connector type on the FieldFox.

(Both are typically available in a compatible cal kit.)

Procedure

1. Press **Preset > Preset (Factory)**. The top-left corner of the FieldFox display indicates the active measurement type following the preset.
2. If the active measurement is SA then skip to step 5 below.
If the active measurement is S11 or CAT then complete this step below:
 - Connect a short to Port 1.
 - Displayed trace should be within ± 4 dB of zero.
 - Connect a load to Port 1.
 - Displayed trace should approximate the value of load, typically it will be below -20 dB (20 dB for CAT mode).
3. Press **Mode**. If NA is not available, skip to step 5 below.
If NA is available then continue at step 4 below.
4. Press **NA** then press **Measure (1)**. If S22 is not available then skip to step 5 below.
If S22 is available then continue this step below:
 - Connect a short to Port 2.
 - Press **S22**
 - Displayed trace should be within ± 4 dB of zero.
 - Connect a load to Port 2
 - Displayed trace should approximate the value of load, typically it will be below -20 dB.

5. Press Mode. If SA is available then continue below, otherwise the operational check is complete.

- For this step Port 2 should be unconnected or connected to a short or load.
- Press **SA**.
- The measurement trace should be below the following limits:

For N991xA, N992xA, and N993xA models:

Up to 4 GHz: limit = –45 dBm

Up to 6.5 GHz: limit = –42 dBm

Up to 9 GHz: limit = –39 dBm

Up to 14 GHz: limit = –33 dBm

Up to 18 GHz: limit = –28 dBm

Up to 26.5 GHz: limit = –18 dBm

For N995xA, and N996xA models:

Up to 4 GHz: limit = –45 dBm

Up to 6.5 GHz: limit = –44 dBm

Up to 9 GHz: limit = –43 dBm

Up to 14 GHz: limit = –42 dBm

Up to 18 GHz: limit = –40dBm

Up to 26.5 GHz: limit = –39 dBm

Up to 33 GHz: limit = –37 dBm

Up to 44 GHz: limit = –30 dBm

Up to 50 GHz: limit = –27 dBm

- The general slope of the trace should trend upward. A flat trace indicates an uncalibrated condition that requires adjustments.
- If a segment of the trace is offset by more than 10 dBm from the general slope of the trace, this indicates a hardware failure that requires service.

Performance Tests (Keysight N7841A Software Package)

The performance tests section of the Keysight N7841A software package verifies the electrical performance of your FieldFox analyzer. The software automatically configures your analyzer to execute the performance tests.

The N7841A software package is not included with the analyzer; it must be ordered separately. It can be downloaded from the Internet and a license purchased on-line, or it can be ordered on a CD-ROM. Go to www.keysight.com/find/calibrationsoftware for further information.

There are seventeen performance verification tests that test for the general functionality of the analyzer and the SA (spectrum analyzer) specific functionality.

Total test time may be up to 3 hours depending upon model and options installed.

Details for these tests and recommended troubleshooting information can be found in the N7841A help file.

Performance Verification Tests

- Error Terms Test – Note that the associated adjustment should be performed every 12 months.
See **“Adjustments (Keysight N7841A Software Package)” on page 40.**
- Frequency Accuracy Test
- Displayed Average Noise Level Test
- Frequency Readout and Count Accuracy Test
- IF Frequency Response Test
- Noise Sidebands Test
- Total Abs Amp Accy Low Freq Test
- Total Abs Amp Accy Low Freq Preamp On Test
- Total Abs Amp Accy High Freq Test
- Total Abs Amp Accy High Freq Preamp On Test
- Third Order Intermodulation Distortion Test
- Absolute Amplitude Accuracy Test
- Dynamic Accuracy Test
- System Dynamic Range Test
- Receiver Compression
- Trace Noise Test
- GPS Function Test
- DC Bias Source Test
- Source Power Test

Adjustments (Keysight N7841A Software Package)

The adjustments section of the Keysight N7841A software package may be used to fine-tune your analyzer.

The N7841A software package is not included with the analyzer; it must be ordered separately. It can be downloaded from the Internet and a license purchased on-line, or it can be ordered on a CD-ROM. Go to www.keysight.com/find/calibrationsoftware for further information.

There are nine adjustments that are used to adjust the general functions of the analyzer and the SA (spectrum analyzer) specific functions.

Total adjustment time may be up to 5 hours depending upon models and options installed.

If multiple adjustments are to be performed, perform them in the order listed by the N7841A software.

Details for these adjustments, and recommended troubleshooting information, can be found in the N7841A help file.

Adjustments

- Max Power and IF Overload Adjustment
- Source Power Adjustment
- Error Terms Adjustment– See **“Performance Tests (Keysight N7841A Software Package)” on page 38**. This adjustment should be performed every 12 months. It refreshes the definition of the preset calibration.
- Frequency Accuracy Adjustment
- LO Feedthru Adjustment
- Absolute Amplitude Adjustment
- Frequency Response Adjustment
- Attenuator Slope Adjustment
- IF Frequency Response Adjustment

4 Troubleshooting

Information in This Chapter

The information in this chapter helps you:

- Identify the portion of the analyzer at fault.
- Locate the specific troubleshooting procedure to identify the assembly or peripheral at fault.

The sections in this chapter are arranged in a logical troubleshooting order. The following table lists the sections and a brief summary of what to look for in that section.

Section Title	Summary of Content	Start Page
Protect Against Electrostatic Discharge (ESD)	Information pertaining to ESD protection.	page 42
FieldFox High-Temperature Protection	Information about monitoring internal temperatures and temperature control modes in FieldFox.	page 43
Getting Started with Troubleshooting	A starting point to begin troubleshooting.	page 44
Power Up Troubleshooting	Power-up problems:	page 46
Front Panel Group Troubleshooting	Problems with the front panel assemblies of the analyzer. <ul style="list-style-type: none">– Does the display appear correct?– Is the sound working?– Do the front panel keys function properly?– Does the front panel USB and SD card connection function properly?	page 47
Measurement Group Troubleshooting	Problems with the measurement group assemblies of the analyzer.	page 49
– Problems in NA Mode	VNA Specific Troubleshooting <ul style="list-style-type: none">– Checking the A, B, R1, and R2 signals	page 49
– Problems in SA Mode	SA Specific Troubleshooting <ul style="list-style-type: none">– Checking source power	page 51

Protect Against Electrostatic Discharge (ESD)

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

CAUTION

To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in **“Electrostatic Discharge Protection” on page 15**, for all of the procedures in this chapter.

Assembly Replacement Sequence

After identifying the problem requiring an assembly to be replaced, follow these steps:

- Step 1.** Order a replacement assembly. Refer to **Chapter 6, “Replaceable Parts.”**
- Step 2.** Replace the faulty assembly and determine what adjustments are necessary. Refer to **Chapter 7, “Repair and Replacement Procedures.”**
- Step 3.** Perform the necessary adjustments. Refer to **Chapter 3, “Tests and Adjustments.”**
- Step 4.** Perform the necessary performance tests. Refer to **Chapter 3, “Tests and Adjustments.”**

FieldFox High-Temperature Protection

The following features prevent degradation or damage in the event of high internal temperatures in the FieldFox.

NOTE

Do NOT store the FieldFox in the softcase while powered ON or in Standby mode.

How to monitor the internal FieldFox temperature:

- Press **System**, then **Service Diagnostics**.
- Press **Internal Temperatures**.
- The temperature at which the following events occur is the average of the RF1, RF2, SB1, SB2 temperatures. These temperatures come from internal sensors embedded within FieldFox.

Temperature Control Mode

At approximately 75°C, the FieldFox enters Temperature Control mode by reducing display intensity, switching to Outdoor Sun display colors, and reducing measurement speed. This should decrease the internal temperature which preserves measurement accuracy and maintains the long-term reliability of the FieldFox. When this occurs, the following message is displayed on the FieldFox screen:

The system is entering Temperature Control Mode due to high internal temperature.

When entering Temperature Control mode, save your instrument state and data that you want to keep.

When the temperature drops to approximately 73°C, a message is displayed indicating that the FieldFox is leaving Temperature Control Mode and normal operating settings are restored.

NOTE

Measurement speed specifications do NOT apply in Temperature Control Mode.

High-Temp Shut down

In extreme situations, Temperature Control mode may not stop an increase in the FieldFox internal temperature. At approximately 78°C, High-Temperature Shut down will engage and turn OFF the FieldFox.

Just prior to shut down, the FieldFox will display a warning of imminent shut down.

Getting Started with Troubleshooting

Where you begin troubleshooting depends upon the symptoms of the failure. **If a performance test or adjustment fails, refer to the troubleshooting recommendations in the N7841A TME Help.** For other failures, start by checking the basics as outlined in the following section. Also review the flowchart in **Figure 4-1 on page 45**. You should then be able to determine where in the troubleshooting procedure to begin, to locate the failed assembly.

Check the Basics

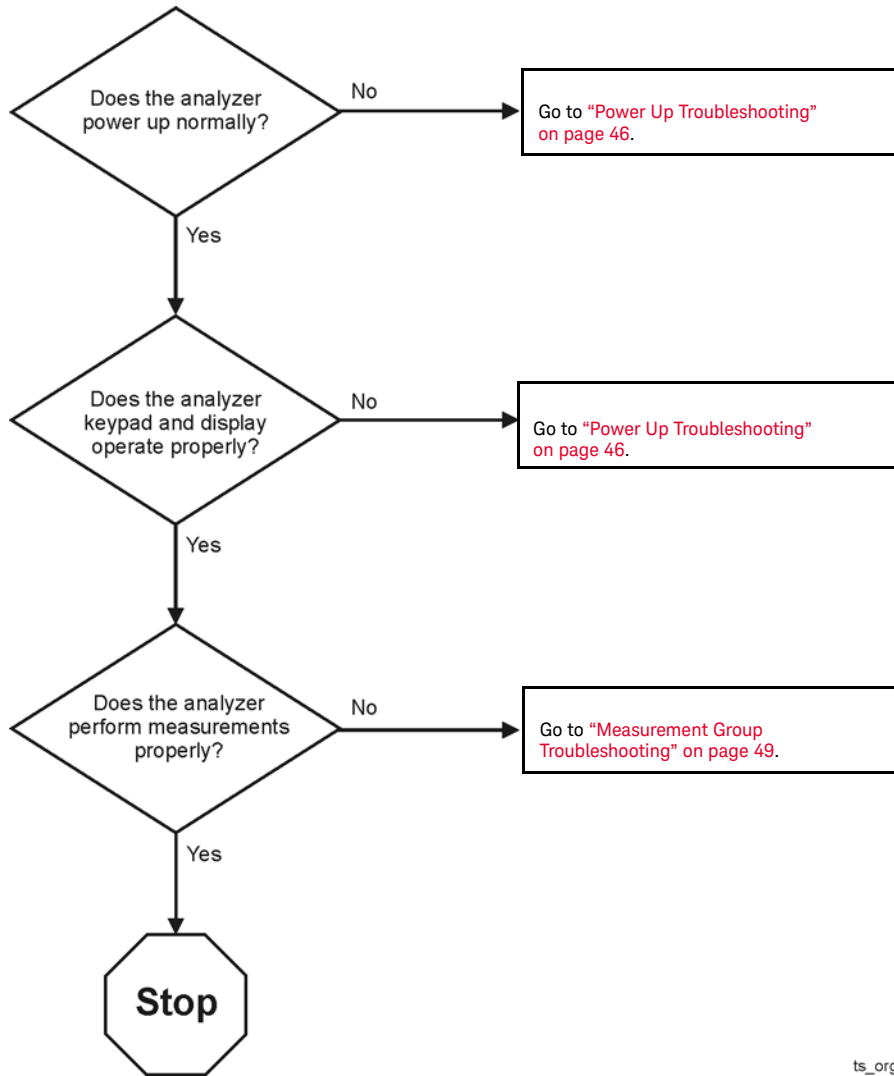
A problem can often be solved by repeating the procedure you were following when the problem occurred. Before calling Keysight Technologies or returning the instrument for service, please perform the following checks:

1. Does the analyzer have power available? It is recommended that the battery is installed and the AC power adapter is also connected.
2. Does the analyzer turn On and Off when the On/Off Button is pressed? When the unit is on, the green LED below the button should light.
3. Does the analyzer power up normally into its default mode? If not, see **“Power Up Troubleshooting” on page 46**.
4. If other equipment, cables, and connectors are being used with the analyzer, make sure they are clean, connected properly and operating correctly.
5. Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct? If not, correct them.
6. If the analyzer is not functioning as expected, return it to a known state by pressing the **Preset** key.
7. If the problem is thought to be due to firmware, check to see if the instrument has the latest firmware before starting the troubleshooting procedure. Refer to **“Firmware Upgrades” in Chapter 8** for instructions.

Troubleshooting Organization

Follow the flowgraph in **Figure 4-1** to help direct you to the correct section for troubleshooting the analyzer.

Figure 4-1 Troubleshooting Organization Flowchart



ts_org

Power Up Troubleshooting

If the display is operational but the unit does not boot up successfully:

- Make sure there is sufficient power for the unit to operate.
- Try re-installing firmware using the firmware upgrade process described in **Chapter 8**.
- Assume corrupted firmware on the A6 SOM board, follow the **“Install Firmware from SD Card”** near the end of **Chapter 7**.

If the display is dark but the unit may have booted successfully:

- Wait for three minutes to make sure the boot process has completed, then press any front panel key.

If the boot process has completed successfully, the keypad will flash when a key is pressed.

Front Panel Group Troubleshooting

Checking Display Brightness and Sound

If the display is dark (no backlight)

- Press **System, 7**
- Select **Preferences**
- Select **Preferences**
- Use the arrow keys to select **Brightness**, press **Edit**, then use the arrow keys to change the display brightness.
- If the A2 LCD display assembly is determined to be faulty, replace it. Refer to **“Replacing the A2 LCD, the LCD Shield, and LCD Cables” on page 134.**
- Use the arrow keys to select **Volume**, press **Edit**, then use the arrow keys to change the volume. A beep should occur each time the value is changed.
- Plug headphones into the unit if there is no sound from the internal speaker. The internal speaker is disabled when headphones are plugged in.
- If the audio is still not heard, the System board may be faulty. Refer to **“Replacing the A5 System Board” on page 150.**

Checking the Front Panel Keys

To check the front panel keys, push each labeled key and compare with the specific functions.

- If all the key names are correct, then the front panel keypad is working.
- If some of the keys are not working, suspect a faulty keypad. To replace the keypad, refer to **“Replacing the Front Case (including the A1 Keypad)” on page 126.**
- If none of the keys are working correctly, suspect a faulty A3 Front Panel Interface board. To replace the A3 Front Panel Interface board, refer to **“Replacing the A3 Front Panel Interface Board (FPIB)” on page 136.**

USB and SD Card Slot Ports

To verify proper operation of any rear USB ports or SD Card port:

- Connect a known good USB flash memory or SD memory card.
- Wait 15 seconds for the analyzer to verify the device connection, and then check the operation of the USB flash memory or SD memory card by performing the recall function **Save/Recall**.
- If the device performs correctly, the USB or SD Card port is functioning properly.
- If the device does not perform correctly, the System board is faulty. Refer to **“Replacing the A5 System Board” on page 150**

Measurement Group Troubleshooting

- Make sure the unit is warmed up for at least 30 minutes.
- Make sure the correct cal kit definition is being used; erase user data to force use of factory cal kit definitions (see [Chapter 8](#) for information on the “[Erase User Data Utility](#)”).

Problems in NA Mode

Every FieldFox contains a factory calibration that was performed at the port 1 and port 2 connectors over the entire frequency range of the FieldFox using a number of data points that allows reasonable interpolation over the FieldFox frequency range.

This calibration, known as CalReady, allows you to immediately make accurate measurements for a DUT that is connected directly at the test ports (PORT 1 and/or PORT 2). CalReady corrects measurements when the FieldFox is turned ON, when Preset is pressed, and when a measurement is created with no other correction in place.

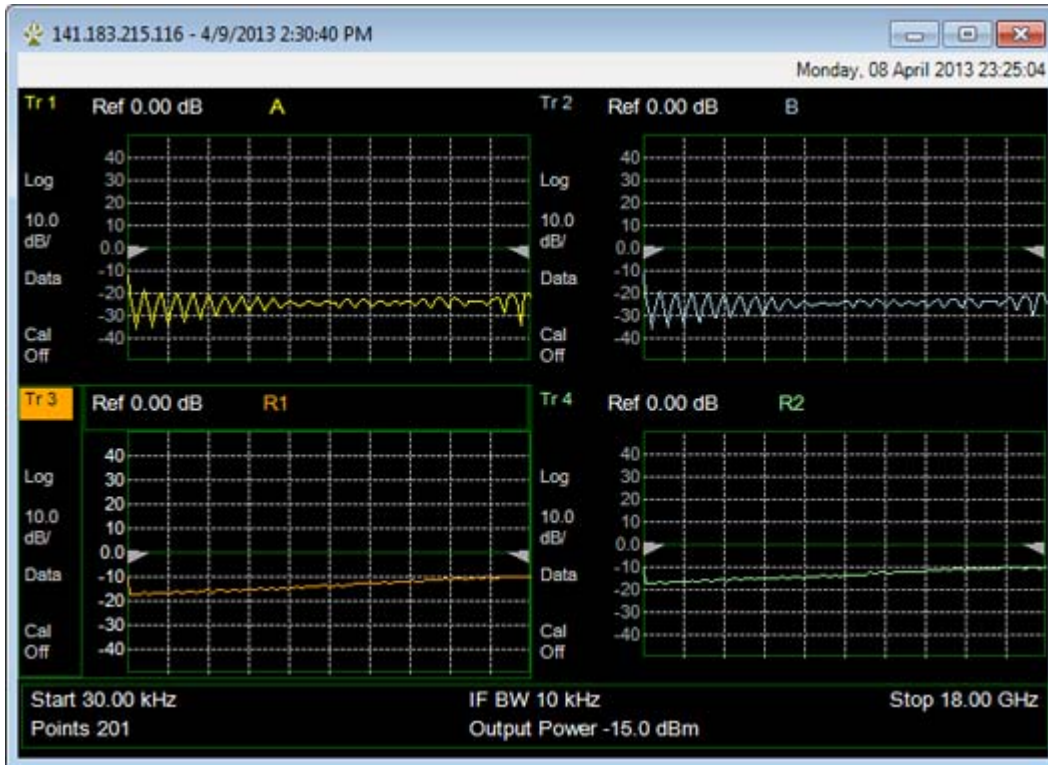
If you are seeing a problem at Preset, perform the standard S-parameter test set troubleshooting procedure, starting with the following procedure: [“Checking the A, B, R1, and R2 Signals \(NA Mode\)”](#).

Checking the A, B, R1, and R2 Signals (NA Mode)

The first step is to verify that the A, B, R1, and R2 traces are present and that they are approximately level:

- To access this:
 1. Press **Trace, 3**
 2. Select <Num of Traces>
 3. Choose <x4>
 4. Select <Trace 1>
 5. Press **Measure, 1**
 6. Choose <Advanced>
 7. Select <A>
 8. Repeat Steps 1, 4, 5, 6, and 7 for Receivers B, R1, and R2.
- Traces A, B, R1, and R2 are displayed in four separate data windows as shown in [Figure 4-2 on page 50](#). Identifying discrepancies of the traces in these windows can help you to isolate the faulty assembly.

Figure 4-2 Typical Four Channel Display



- If all traces are present and are similar to the traces in **Figure 4-2**, then there are no major problems with the analyzer's VNA measurement system. There may, however, be a minor failure in the analyzer.
- To test further:
 1. Go to **Chapter 3, "Tests and Adjustments."** and perform all the tests indicated in the N7841A TME software.
 2. If a problem still exists, contact Keysight. Refer to **"Contacting Keysight" on page 30**.

If any of the traces are not present, are noisy or distorted, or are at an incorrect level, then there is a problem with the analyzer's measurement system and requires repair, contact Keysight. Refer to **"Contacting Keysight" on page 30**.

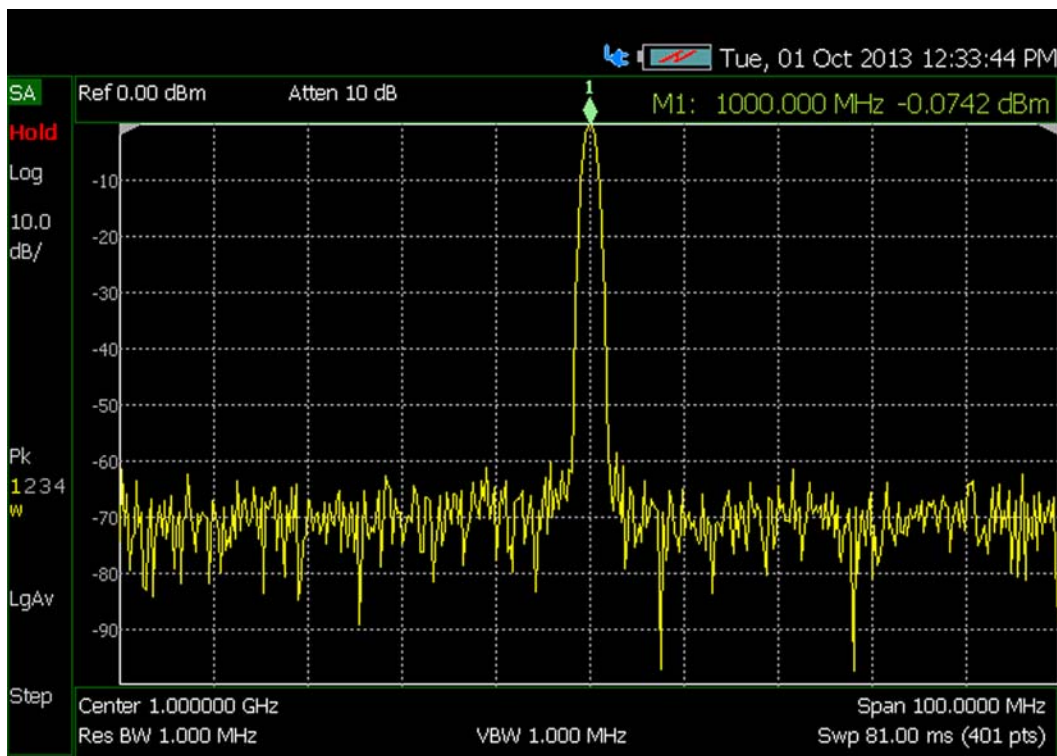
Problems in SA Mode

The instrument's unique signal analyzer blocks that are located on the A4, RF Board can be verified using a signal source and a functioning spectrum analyzer capable of measuring a 33.75 MHz signal.

Verifying the 33.75 MHz I.F. Output

Set the signal source for a 1 GHz, CW signal at 0 dBm. If possible verify the signal source output frequency and power level are correct by using a functioning spectrum analyzer as illustrated in [Figure 4-3](#)

Figure 4-3 1 GHz CW Signal



Inject that 1 GHz CW signal into the Port 2 SA RF Input connector on the instrument as illustrated in **Figure 4-4**. From an instrument preset, tune the instrument to 1 GHz, 0 Span. Verify that the input attenuator (Atten) is set to 10 dB. On the side of the instrument near the RPG tuning knob, there is a spring door. Open that spring door and locate the IF Out SMB (m) connector. Connect one end of a test cable to the IF Out connector on the side of the instrument. Connect the other end of the test cable to the functioning spectrum analyzer. Tune the functioning spectrum analyzer to 33.75 MHz. The I.F. Out signal level should measure 33.75 MHz at approximately -16 dBm as illustrated in **Figure 4-5**.

Figure 4-4 33.75 MHz I.F. Output Test Setup

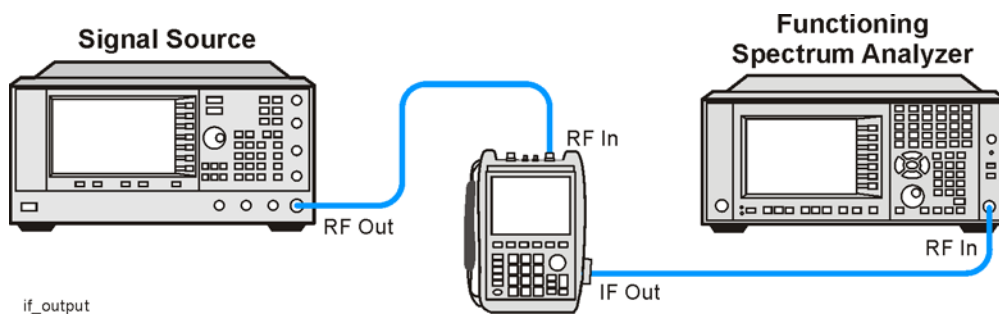
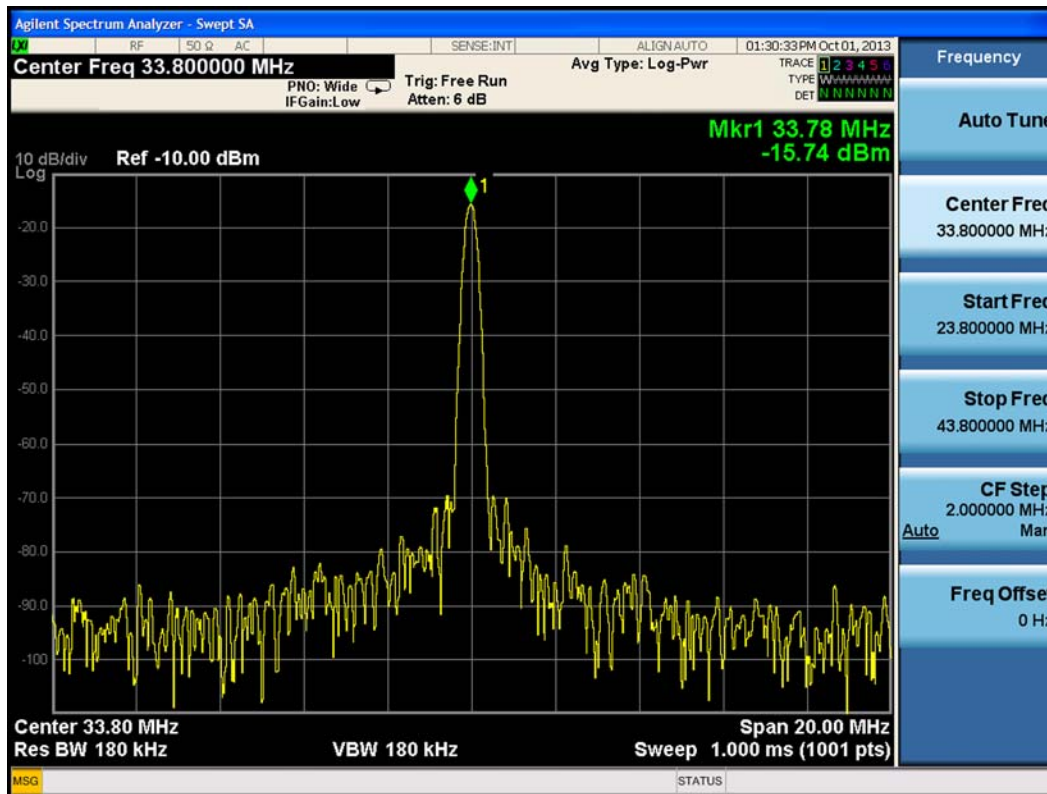


Figure 4-5 33.75 MHz I.F. Output Signal



Since the input attenuator is set to 10 dB, there should be 6 dB of conversion loss from the RF input connector to the I.F. Out connector.

NOTE

The 1 GHz test signal was set to 0 dBm. The input attenuator on the analyzer was set to 10 dB. If the A4 R.F. Board had 0 dB of conversion loss, the 33.75 MHz I.F. output would measure -10 dBm, but it measured -16 dBm because the A4, R.F. Board has 6 dB of conversion loss.

If the input attenuator is changed from 10 dB to 0 dB, the signal will change by 10 dB to -6 dBm. You can verify the input attenuator performance referencing the table below.

Input Attenuator Setting (dB)	33.75 MHz I.F. Output Level (dBm)
0	-6
5	-11
10	-16
15	-21
20	-26
25	-31
30	-36

If the 33.75 MHz I.F. Output level is not correct or the input attenuator performance is out of tolerance, the most likely cause is the A4, R.F. Board.

Troubleshooting
Measurement Group Troubleshooting

5 Theory of Operation

Information in This Chapter

This chapter provides a general description of the operating theory of the FieldFox analyzer.

- Theory of operation is explained to the assembly level only.
- Component-level circuit theory is not provided.
- Simplified block diagrams are included for each functional group.

Section Title	Summary of Content	Start Page
Analyzer System Operation	A summary of the theory of operation for the analyzer. A summary of the operation of the major functional groups of the analyzer.	page 56
Front Panel Group	Operation of the assemblies associated with the front panel group of assemblies.	page 58
Measurement Group	Operation of the assemblies associated with the measurement group of assemblies.	page 60
Operation in Modes	Description of the different operating modes and what hardware is used in each mode.	page 80
Temperature Related Information	Information about temperature sensors and how the analyzer responds to temperature information gathered.	page 84
User Calibration in CAT, NA, and VVM Modes	Descriptions of one port and two port calibrations for the CAT and NA modes of operation.	page 85
Firmware Related Information	Information about firmware and firmware upgrades.	page 87

Analyzer System Operation

The FieldFox analyzer is capable of both network analyzer (NA) and spectrum analyzer (SA) functions.

- Full two port NA functions are supported by the hardware. Model and option combinations determine available functionality.
- SA functions are supported by the hardware on Port 2. Model and option combinations determine available functionality.
- A temporary CFG option is available to enable full functionality when needed for service operations. Details on the CFG option are provided in the N7841A TME help.

See **Figure 5-1** for a simplified block diagram of the overall RF analyzer system.

All FieldFox analyzers covered by this manual have the same hardware. Options to increase functionality are enabled via licenses, additional hardware is not required.

Functional Groups of the Analyzer

The operation of the analyzer can be separated into two major functional groups. Each group consists of assemblies that perform distinct functions. Some of the assemblies are related to more than one group, and both groups, to some extent, are interrelated and affect each other's performance.

The major functional groups are:

- **Front Panel Group**
- **Measurement Group**

Front Panel Group

The front panel group consists of the following:

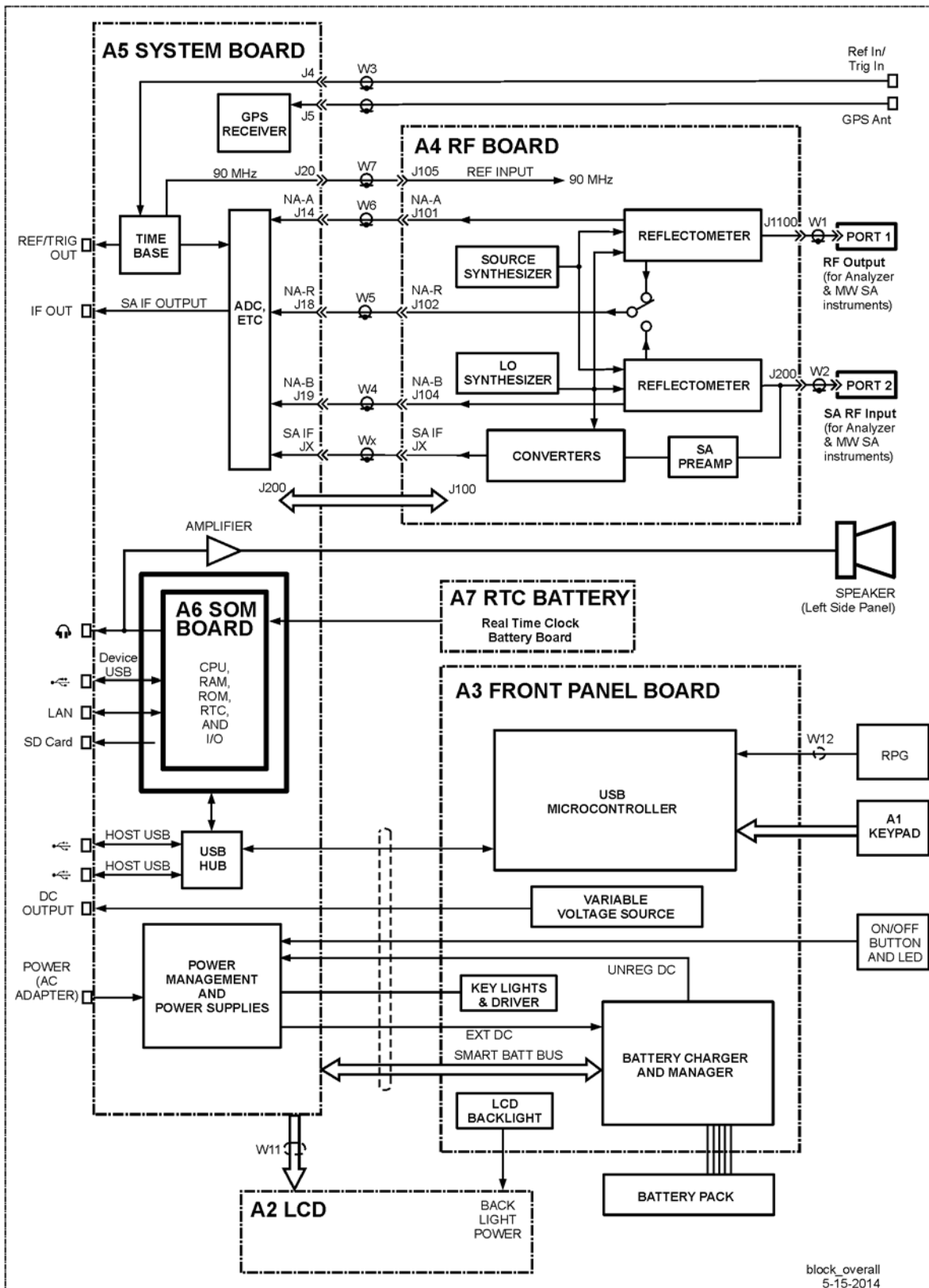
- **A2 LCD Assembly**
- **A3 Front Panel Interface Board**

Measurement Group

The measurement group consists of the following:

- **A4 RF Board**
- **A5 System Board**
- **A6 SOM Board**
- **A7 Real Time Clock Board**
- **Main Battery**

Figure 5-1 Overall Block Diagram



Front Panel Group

The front panel group consists of the following assemblies:

- **A3 Front Panel Interface Board**
- **A2 LCD Assembly**

Refer to **Figure 5-1** for a simplified overall block diagram which includes the front panel group.

A3 Front Panel Interface Board

The main function of the A3 Front Panel Interface board is to support the user interface but it also contains the digital power supplies.

USB Microcontroller

The USB Microcontroller senses the keypad keys and the RPG (rotary pulse generator) knob on the front panel. The USB Microcontroller communicates with the A5 System board via a USB interface.

There is no separate ID EPROM on the A3 Front Panel Interface board. All ID information is stored in the USB Microcontroller.

Keypad Lights and ON/OFF Button

The power for the keypad LED's generated on the A3 Front Panel Interface board is derived from the +5 V digital supply. The keypad LED's are turned on for a few seconds following each key press. This function is controlled by the firmware on the A6 SOM board.

The On/Off LED is controlled by a signal from the A5 System board. The connections for the On/Off Button and LED are direct to the A5 System board.

LCD Backlight

Power for the backlight on the A2 LCD assembly is generated on the A3 Front Panel Interface board. Digital 5 volts is converted to approximately 25 volts. The actual voltage determines the brightness of the backlight. Two control lines from the A5 System board control on/off and intensity functions. These control lines are driven by the system monitor microcontroller on the A5 System board.

Battery Charger and Manager

This circuitry controls charging of the battery based on a battery charger IC. This IC is powered by a digital output on the System Monitor. The System Monitor has the capability to reset the IC, if required, by recycling the power to the IC.

This circuitry also controls the source of the Unreg DC: Batt or Ext DC. It reads the battery pack information via the Smart Batt Bus. Batt Neg is connected to the A5 ground plane.

There is an input inrush current control circuit on the Ext DC input that limits inrush current to 4 amps.

Variable Voltage Source

This circuitry provides a constant voltage intended to bias circuits under test.

The user interface for controlling this function may be accessed via **System > System Configuration**.

A2 LCD Assembly

The A2 LCD assembly contains a 6.5-inch, 640 x 480 TFT color LCD with associated drive circuitry and backlight inverter.

The LCD backlight is created by LED's connected in parallel stacks. Backlight brightness is a function of the backlight power that ranges from 22 to 27 volts. Refer to **"LCD Backlight" on page 58** for more information.

The backlight LED's are arranged along the top and bottom edges of the display. There are three stacks on each edge.

Measurement Group

The measurement group produces a stable output signal by phase locking a synthesized voltage-controlled oscillator (VCO).

The measurement group consists of the:

- **A4 RF Board**
- **A5 System Board**
- **A6 SOM Board**
- **A7 Real Time Clock Board**
- **Main Battery**

A simplified RF block diagram is provided in **Figure 5-2**.

A simplified system block diagram is provided in **Figure 5-4**.

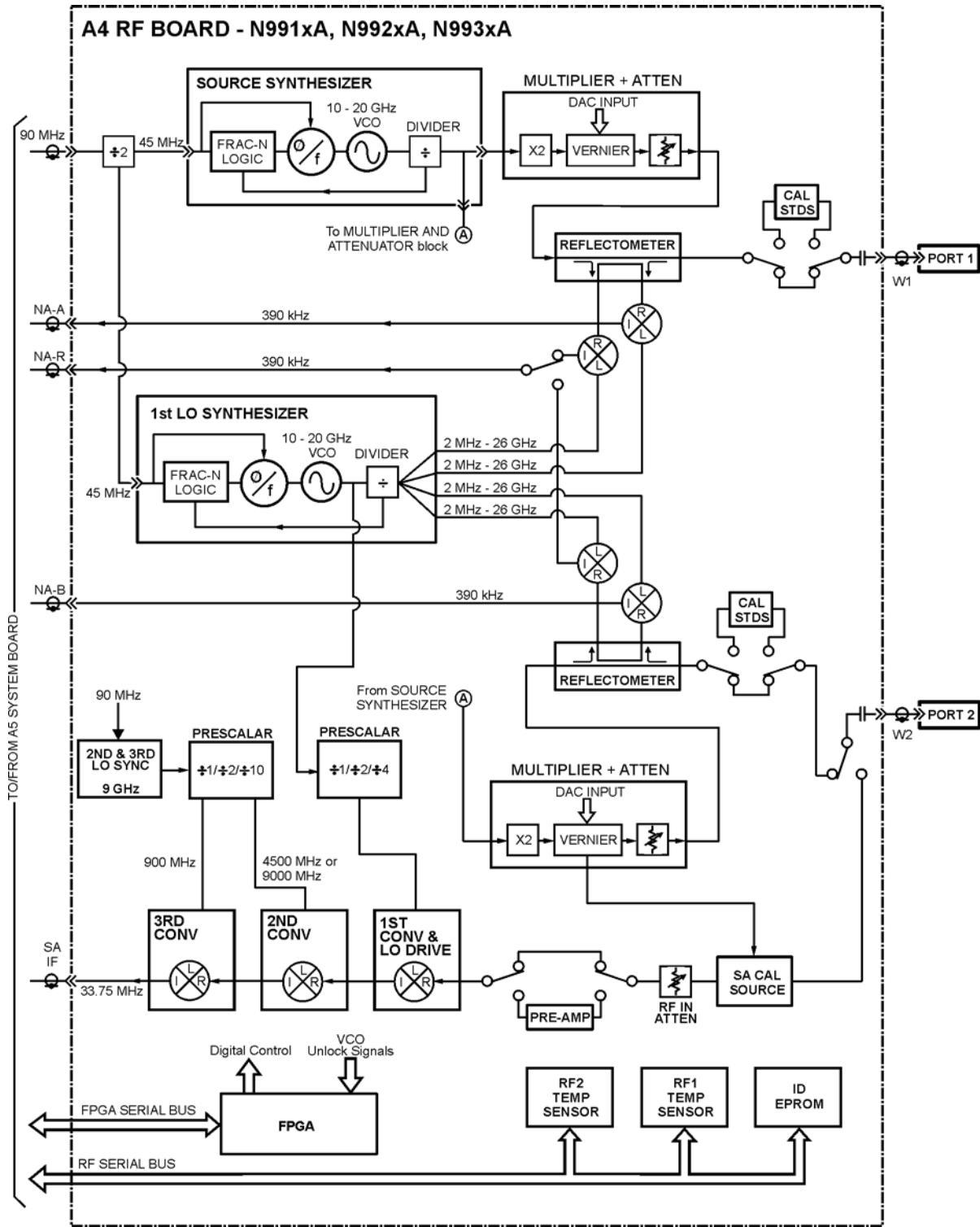
A4 RF Board

A basic function of the A4 RF board is to provide a signal source and receivers for the analyzer functions.

There are two sections to the A4 RF board:

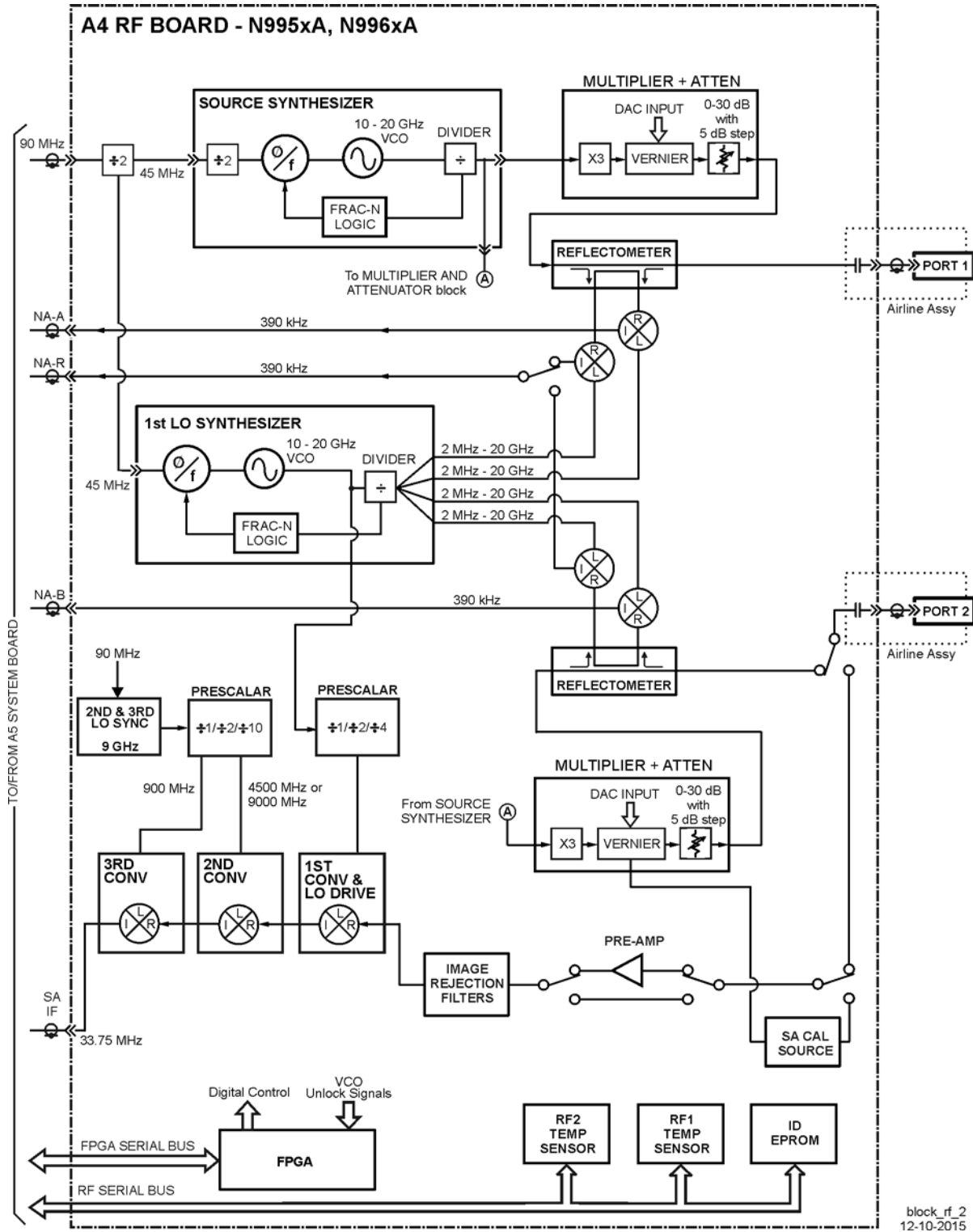
- NA RF section
- SA RF section

Figure 5-2 Simplified RF Block Diagram - N991xA, N992xA, N993xA



block_rf_1
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Figure 5-3 Simplified RF Block Diagram - N995xA, N996xA



NA RF Section

An LO synthesizer produces a single LO signal from the 90 MHz time base located on the A5 System board. The LO output is delivered to the NA mixers of both ports. The LO frequency is always above the measured frequency. The IF is 390 kHz.

The LO output is switched between the NA mixers and the SA first converter depending on the function being used. At any instant in time, either the NA receivers or the SA receiver may be active, but not both at the same time.

The 90 MHz time base is also used to generate a source signal in the source synthesizer that covers the frequency range of 10 MHz to 26.5 GHz. The source signal is generally rich in harmonic content. This is acceptable because the signal is used with tuned receivers.

The frequency bands for the NA circuitry on the RF board are listed below:

Table 5-1 **Frequency Bands - NA RF Section**
N991xA, N992xA, N993xA

Band	Instrument	
	Start	Stop
P1	0.030	2.035
2	2.035	2.425
3	2.425	4.500
4	4.500	4.850
5	4.850	9.350
6	9.350	9.700
7	9.700	19.100
8	19.100	19.500
9	19.500	38.800
10	38.800	78.000
11	78.000	156.250
12	156.250	312.500
13	312.500	625.000
14	625.000	1250.000
15	1250.000	2500.000
16	2500.000	5000.000
17	5000.000	10000.000
18	10000.000	15000.000

Table 5-1 Frequency Bands - NA RF Section
N991xA, N992xA, N993xA

Band	Instrument	
	Start	Stop
19	15000.000	20000.000
20	20000.000	26500.000

Table 5-2 Frequency Bands - NA RF Section
N995xA, N996xA

Band	Instrument	
	Start	Stop
P1	0.010	2.034
1	2.035	2.425
2	2.425	4.500
3	4.500	4.850
4	4.850	9.350
5	9.350	9.700
6	9.700	19.100
7	19.100	19.500
8	19.500	38.800
9	38.800	78.000
10	78.000	156.250
11	156.250	312.500
12	312.500	625.000
13	625.000	1250.000
14	1250.000	2500.000
15	2500.000	5000.000
16	5000.000	10000.000
17	10000.000	20000.000
18	20000.000	30000.000
19	30000.000	36000.000
20	36000.000	41000.000
21	41000.000	50000.000

The RF Out attenuator between the source and the reflectometer has three settings: nominal values of 0 dB, 35 dB or user input value. The setting is determined by the High, Low or Manual power setting on the user interface. And beginning from firmware A.06.18, the default output power level is -15 dBm.

The reflectometer performs three functions:

- It passes the source output signal to either PORT 1 or PORT 2.
- It samples the source output to either PORT 1 or PORT 2.
- It samples the incoming signal at either PORT 1 or PORT 2.

The sampled signals are mixed with the LO signal to produce three 390 kHz IF signals, NA-A, NA-B and NA-R.

The reflectometer dissipates up to 1.5 watts when active.

Each port (PORT 1 and PORT 2) has a DC isolation capacitor.

SA RF Section

An external RF input signal can be analyzed when connected to the Port 2 SA RF Input connector. Before the input signal is mixed, the signal will go through the input attenuator and optional internal preamplifier.

The input attenuator default setting from the factory is 10 dB. The input attenuator is used to control the amount of power at the input of the 1st converter. Changing the input attenuator value can improve the dynamic range of the instrument and reduce internally generated distortion products.

When the optional internal preamplifier is turned on, the displayed average noise level of the instrument is improved. This occurs because the noise figure of the overall system is improved. Improving the displayed average noise level of the system enables the user to analyze low level input signals.

The 1st, 2nd and 3rd converters are used to downconvert the input signal to a final I.F. of 33.75 MHz. That I.F. is fed to the ADC on the A5, System board. This final I.F. on the input of the ADC can be measured at the IF Out SMB (m) connector on the side of the instrument. Refer to **“Verifying the 33.75 MHz I.F. Output” on page 51.**

The frequency bands for the SA circuitry on the RF board are listed below:

Table 5-3 Frequency Bands - SA RF Section
N991xA, N992xA, N993xA

Band	Instrument	
	Start	Stop
1	0.030	15.000
2	15.000	500.000
3	500.000	1366.250
4	1366.250	2600.000
5	2600.000	3900.000
6	3900.000	7500.000
7	7500.000	9500.000
8	9500.000	12300.000
9	12300.000	15700.000
10	15700.000	16300.000
11	16300.000	19500.000
12	19500.000	23000.000
13	23000.000	23734.000
14	23734.000	25500.000
15	25500.000	26500.000

Table 5-4 Frequency Bands - SA RF Section
N995xA, N996xA

Band	Instrument	
	Start	Stop
1	0.030	15.000
2	15.000	500.000
3	500.000	1366.250
4	1366.250	2600.000
5	2600.000	3900.000
6	3900.000	7500.000
7	7500.000	9500.000
8	9500.000	12300.000
9	12300.000	15700.000
10	15700.000	16300.000
11	16300.000	19500.000
12	19500.000	23000.000
13	23000.000	26000.000
14	26000.000	29000.000
15	29000.000	32500.000
16	32500.000	36000.000
17	36000.000	39500.000
18	39500.000	43000.000
19	43000.000	46200.000
20	46200.000	50000.000

Power Management Circuitry

The circuitry on the A4 RF board has five special sections that may be powered down for the purpose of power management. These sections may be selectively powered down (via “load switching”) when not required for the current operating mode of the analyzer.

The sections that may be selectively powered down are:

- Source—most of the source synthesizer circuitry
- LO—most of the LO synthesizer circuitry
- SA—most of the first, second, and third converter circuitry
- Reflectometer—put into a low power state
- High-Band Pre-amp—high band section of the pre-amp turned off

The load switching for the Source and LO sections is accomplished on the A5 System board via the Analog Linear Regulators and Load Switching circuitry.

The load switching for the Reflectometer and High-Band Preamp is accomplished on the A4 RF board.

Other Circuitry

The FPGA (Field Programmable Gate Array) communicates with the FPGA on the A5 System board via FPGA Serial Bus. It provides the digital control for the functions on the A4 RF board. It also reads the VCO unlock signals.

RF Serial Bus allows the System Monitor on the A5 System board to read a temperature sensor and the ID EPROM for the A4 RF board.

A5 System Board

The A5 System board controls all of the functions of the analyzer and digitizes the RF IF signals (NA-R, NA-A, NA-B, and SA IF) from the A4 RF board.

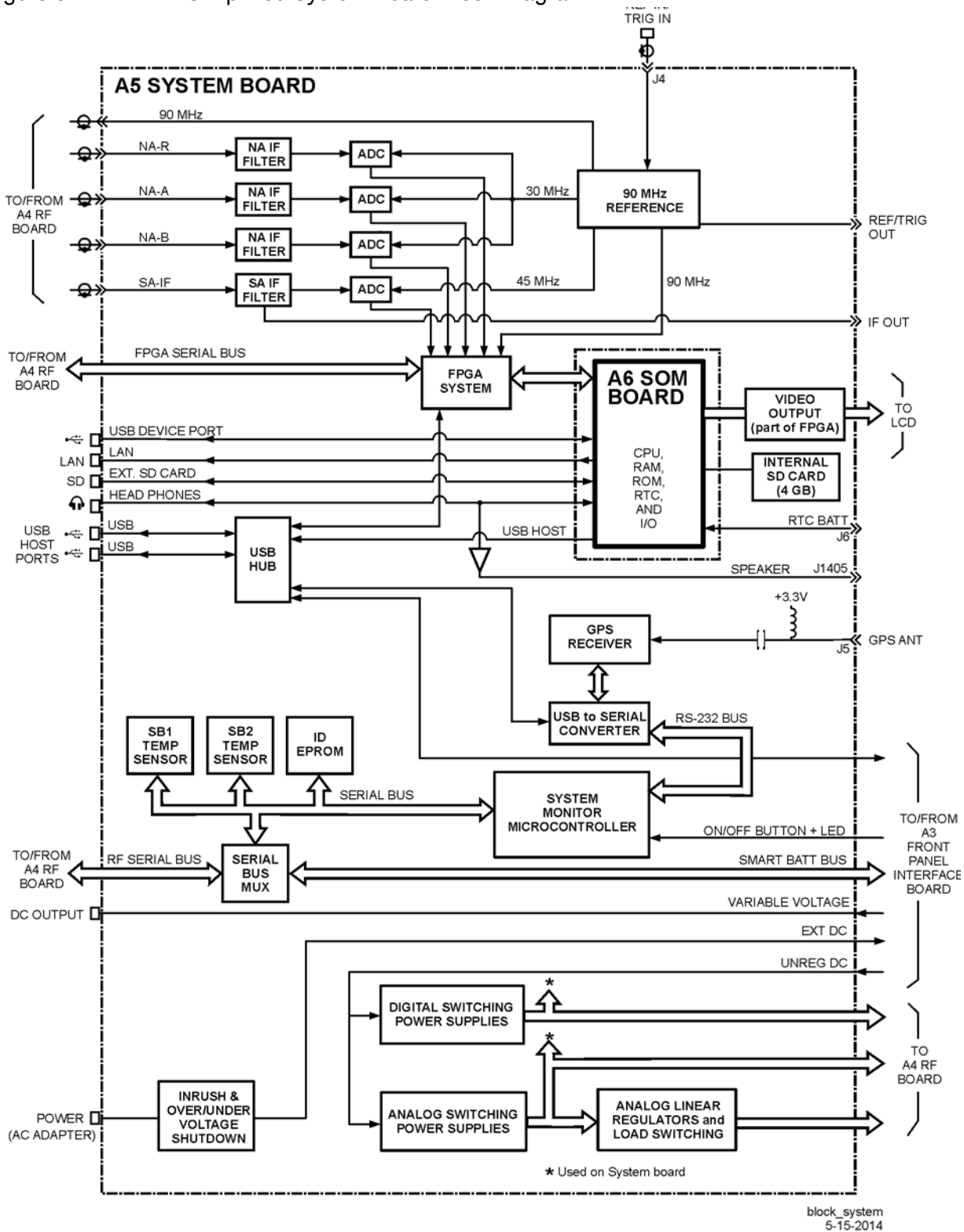
The A6 SOM (System on Module) board is mounted directly on the A5 System board.

All external connections for the analyzer come through the A5 system board except for the PORT 2 and PORT 1 ports.

The A5 System board also controls the power switching and power management.

The instrument model number and serial number are stored on the A5 System board.

Figure 5-4 Simplified System Board Block Diagram



System Monitor (SM) Microcontroller

This is the heart of the analyzer. It is active whenever there is DC power available. The microcontroller has ultra-low power dissipation. It is sometimes referred to as the “MSP 430”.

The following is a list of some of the functions performed by the SM.

- It monitors the On/Off button on the front panel and responds appropriately.
- It controls the on/off functions of the various power supplies in the analyzer.
- It drives the On/Off button LED.
- It reads battery pack information via the Smart Batt Bus.
- It communicates with the battery charger IC via the Smart Batt Bus.
- It interfaces to the Battery Charger and Manager circuit.
- It interfaces to the Serial Bus for communication with the temperature sensors and ID EPROM's on the printed circuit boards.
- It communicates to the A6 SOM board CPU via a serial port, UART.
- It stores the instrument model number and serial number.

USB Hub

This circuitry expands the number of USB ports available to the FieldFox firmware.

Power Management and Power Supplies

Seven different analog supply voltages are generated from the Unreg DC. All of these are used on the A4 RF board and some are used on the A5 System board.

Some sections of the circuitry on the A4 RF board may be switched to low power modes to conserve power and minimize heat. This is accomplished through load switching. See **“Power Management Circuitry” on page 68** for more information.

The System Monitor controls the on/off functions of the analog power supplies. All are on or off together except for power sequencing.

This circuitry also monitors the Ext DC input and, if below 10.8 volts or above 21 volts, it disconnects this input from the Unreg DC.

FPGA

This FPGA:

- provides the interface between the A6 SOM board and the ADC,
- provides miscellaneous interfaces for circuitry on the A4 RF board, and
- communicates with the CPU via the USB interface.

Time Base

The Time Base is an internal TCXO that produces 90 MHz signals for use throughout the analyzer.

A 10 MHz signal at the Ref In/Trig input may be used to provide an external time base. The external time base function is controlled via the user interface. Refer to the “Frequency Reference Source” section of the FieldFox Analyzer User’s Guide (Part Number N9927-90001) for additional information.

The internal 10 MHz frequency reference is available from the Ref/Trig Out connector on the right-side panel. Use this signal as a common frequency reference when making measurements using external equipment

Filters, MUX, and ADC’s

The three Filters filter the IF signals in preparation for the ADC. Filter characteristics are fixed (not programmable).

The ADC’s digitize each of the IF signals received from the A4 RF board. The input to one of the ADC’s is multiplexed between the NA-A and NA-B input signals.

The 14-bit ADCs sample at a rate of 30 mega samples per second.

Each ADC may be put into a low power mode when not active.

Temperature Sensors

The SB1 Temp Sensor is located on the A4 RF board side of the A5 System board near the headphone jack (J3).

The SB2 Temp Sensor is on the A4 RF board side of the A5 System board near the edge of the board against the battery compartment. This temperature sensor is not under a shield.

Audio Output

The speaker is located on the left side panel of the case. Left and right audio signals from the A6 SOM board go to the headphone jack on the A5 System board. These signals are then combined to create a single mono signal for the speaker. An amplifier drives the speaker. Plugging in the headphones disables the speaker output.

LAN Connector

The LAN connector supports the LAN interface on the A6 SOM board. See [“LAN Interface” on page 89](#) for more details.

SOM Connector

Refer to [“A6 SOM Board” on page 72](#) for information on SOM (System on Module) functions.

A6 SOM Board

The A6 SOM (System on Module) board plugs directly into the A5 System board as a daughter board and contains:

- the CPU
- Flash ROM:
 - 64 MB (N991xA, N992xA, N993xA)
 - 128 MB (N995xA, N996xA)
- RAM:
 - 128 MB (N991xA, N992xA, N993xA)
 - 2 GB (N995xA, N996xA)
- real time clock
- I/O interface

The interfaces on the SOM are:

- UART to the System Monitor on the A5 System board
- LCD interface
- Left and right audio outputs
- SD card bus
- USB host interface
- Interface to USB hub
- LAN interface:
 - 10/100 base T (N991xA, N992xA, N993xA)
 - 1 GBE (N995xA, N996xA)
- General purpose interface lines

The A6 SOM board is powered by the 3.3 volt digital supply.

Licenses which enable instrument options are stored in the A6 SOM flash ROM.

A7 Real Time Clock Board

The battery for the RTC (real time clock) on the A7 RTC is connected to the A6 SOM board via the A5 System board. The battery powers the RTC when the FieldFox is powered off.

Chapter 7 provides instructions for replacing the battery on the A7 RTC board.

Main Battery

The battery is a rechargeable 10.8 V lithium-ion type. Refer to **“Battery Disposal” on page 18** for important information about replacing and disposing of this battery.

Refer to **“Battery Related Information” on page 78** for details on the main battery.

Grounding and Power

Grounding

Each printed circuit board has a single ground plane. The ground planes on the A4 RF board and A5 System board are connected via the common shields at multiple points. The ground plane on the A3 Front Panel Interface board is connected to the ground plane on the A5 System board.

There are no separate grounds in the analyzer. There is no “star” ground point in the analyzer.

Batt Neg and Ext DC neg are connected to the A5 System board ground plane.

The A2 LCD assembly has two separate grounding circuits: the LCD power and control circuits and the backlight LED's.

- The LCD power and control circuits share a ground that is connected to the ground plane on the A5 System board.
- The ground for the backlight LED's is connected to the ground plane on the A3 Front Panel Interface board.

Voltages and Power Supplies

The following power supplies exist within the analyzer:

- **Digital 5 volts**
Generated from Unreg DC on the A3 Front Panel Interface board, controlled by the System Monitor on the A5 System board, and used on the A3, A4, and A5 boards.
- **Digital 3.3 volts**
Generated from Unreg DC on the A3 Front Panel Interface board, on/off functions controlled by the System Monitor on the A5 System board, and used on the A2 LCD assembly and A3, A4, A5, and A6 boards.
- **Analog supply voltages**
Seven separate voltages generated from Unreg DC on the A5 System board, on/off functions controlled by the System Monitor on the A5 System board.
- **LCD backlight voltage**
Generated on the A3 Front Panel Interface board from the digital 5 volt supply voltage.
- **Power for the System Monitor circuit**
+3.3 volt circuit powered from Ext DC or Batt +, whichever is greater. Used on A5 System board only.
- **Unreg DC**
From Ext DC or Batt +, 21 volts max.
- **Ext DC**
From external Power AC Adapter, nominal 15 volts, acceptable up to 19 volts.
- **Batt +**
From main battery, nominal 12 volts.
- **+10 DC (N995xA, N996xA only)**
Provides supply voltage to the nano switch on the RF board.
- **-10 DC (N995xA, N996xA only)**
Provides supply voltage to the nano switch on the RF board.

All voltages except Ext DC, Batt +, and the System Monitor power can be turned on/off within the analyzer. Refer to **“Power Management Circuitry” on page 68** for more information.

Power Control and Management

Power States

The On/Off Button is used to switch between On, Off, and Standby power states:

Off

Only the System Monitor and battery control circuits are powered up (if power is available from the battery or external power).

If the battery is charging, the LED below the On/Off Button slowly flashes orange with increasing intensity, otherwise this LED is off.

Some battery power is required in the “Off” state. A fully charged battery will discharge completely in four to six weeks when left in the analyzer.

On

This is normal operation. The On/Off Button LED is steadily lit green.

Standby

Only the digital power supplies are on. The CPU is in a low power state, maintaining RAM content. The On/Off Button LED flashes yellow briefly every two seconds.

During normal operation, unexpectedly disconnecting power to the analyzer (such as removing the main battery when the analyzer is not connected to external power) should not cause any problems. Simply re-apply power. No firmware problems are expected. Of course, this does not apply during a firmware upgrade.

Smart Power Management

The analyzer uses extensive “load switching” to minimize power dissipation. This is termed Smart Power Management (SPM). There are two motivations for power management:

- to extend battery run time
- to prevent overheating

NOTE

For N991xA, N992xA, and N993xA the default state for the Smart Power Management is ON.

For N995xA and N996xA the default state for the Smart Power Management is OFF.

Sections of the circuitry are selectively powered down via “load switching”, depending on the operating mode of the analyzer. Five different sections of the circuitry on the A4 RF board may be controlled via “load switching”. These sections are as follows:

Theory of Operation
Grounding and Power

- Source—switched off during SA mode, switched off between sweeps during CAT or NA modes.
- LO—switched off when data is not being taken by receivers.
- SA—switched off when in one port CAT or NA modes, on all the time in two port mode.
- Reflectometer—switched to low power through state when RF OUT port receivers are inactive.
- High-Band Pre-amp—switched off when not required.

On the A5 System board, each of the ADC's may be individually switched to a low power mode when not active.

Load switching is generally transparent to the user. One obvious exception is the that the source turns off during “retrace” in the CAT and NA modes.

Battery Related Information

Battery Description and Operation

The main battery is an SBS (Smart Battery System) compliant pack of lithium ion cells.

Refer to **“Battery Disposal” on page 18** for important information about replacing and disposing of this battery.

The nominal voltage of the battery is 10.8 volts and normally varies from 9 to 12 volts.

The battery has built-in sensors, a processor, and control circuitry. This is referred to as the Smart Battery circuitry.

The Smart Battery circuitry communicates battery condition and history information digitally via a digital Smart Batt Bus. The Smart Battery circuitry is read-only.

Both the battery charging circuit and the System Monitor read battery information over the Smart Batt Bus.

The battery temperature reported by the analyzer is based on a sensor inside the battery. Temperature information is available over the Smart Batt Bus. The thermistor connection (T) on the battery is not used.

The Smart Battery circuit may shut down the battery when the temperature is out of the acceptable range or when the battery charge is too low.

See the “Working with the Lithium-Ion Battery” section of the FieldFox User’s Guide for additional information on:

- built in charge level gauge
- the battery information screen
- battery care

Battery Information Screen

Refer to the FieldFox User’s Guide for information on how to access this screen.

Most of the items displayed on the screen come directly from the battery via the Smart Batt Bus. Only the first three items are influenced by the analyzer.

Battery Charging Management

The battery pack determines when the battery needs charging and requests a charge over the Smart Batt Bus.

The Battery Charger and Manager circuit on the A5 System board responds by charging the battery if there is sufficient voltage on the Ext DC line. A minimum of approximately 15 volts is required to charge the battery.

The System Monitor on the A5 System board monitors the battery's temperature and, if too high or too low, disables charging of the battery.

How to tell if the battery is charging:

- If the analyzer is On, the lightening bolt is displayed in the battery icon.
- If the analyzer is Off, the LED below the On/Off Button slowly flashes orange with increasing intensity.
- If the analyzer is in Standby, turn the analyzer on and observe the battery icon.

The battery charges much faster up to 70% of its full charge than it does above 70% of full charge.

Battery Life

When a battery is new, an instrument should operate for about four hours on a fully charged battery. The actual time will depend on operating mode and temperature.

As a battery goes through charge/discharge cycles, its capacity will decrease. A typical battery will have more than 70% of its initial capacity after 200 full discharge cycles when operating at 20 to 30 °C ambient temperature.

Operation in Modes

The FieldFox User’s Guide describes the various modes of operation and describes the user interface for each mode. The following information describes how the hardware is used in the various modes to make measurements.

There are seven basic modes of operation:

- CAT/TDR - Cable and Antenna Test
- NA - Network Analyzer
- SA - Spectrum Analyzer
- VVM - Vector Voltmeter
- PM - Power Meter (USB Sensor)
- CPM - Channel Power Meter
- ERTA - Extended Range Transmission Analysis

CAT, NA, and VVM modes have similar capabilities but are separate modes of operation.

The basic modes listed above represent how the hardware may be used to make basic measurements.

Additional modes will provide customized user interfaces but will not change how the basic measurements are performed.

The following table indicates various modes in FieldFox analyzers and the option dependencies. See the **“Service Related User Operations”** section of **Chapter 8** for more details.

Modes	CAT/TDR	NA	SA	VVM	Power Meter (USB Sensor)	Power Meter (Built In)
	Standard	Option 210	Option 210	Option 210	Option 210	Option 210
CAT Measure	Distance To Fault (dB)	Return Loss & DTF	Return Loss (dB)	VSWR	DTF (VSWR)	More
	Standard					
	Cable Loss (1-Port)	Insertion Loss (2-Port)	DTF (Lin)	TDR (Lin rho)	TDR (ohm)	TDR & DTF
	Standard	Option 210	Standard	Option 215	Option 215	Option 215
NA Measure	S11	S21	S12	S22	Format (Log Mag)	
	Option 210		Option 211		Standard	

Theory of Operation
Operation in Modes

Modes	CAT/TDR	NA	SA	VVM	Power Meter (USB Sensor)	Power Meter (Built In)
NA Meas Setup	Settings	Calibration Settings	Power Level	Output Power High Low Man	Port Extensions	Transform
	Standard	Standard	Standard	Standard	Standard	Option 010
CAT or NA Cal	Response Cal	QuickCal	Mechanical Cal	Cal OFF ON	View Cal	
	Standard	Option 112	Standard	Standard	Standard	
VVM Measure	1-Port Cable Trimming	2-Port Transmission	B/A	A/B		
	Option 308	Option 308 & 210	Option 308 & 210 & 211	Option 308 & 210 & 211		
SA Measure	Radio Standard	Channel Measurements	Tune & Listen	Interference Analysis	Source	
	Option 233	Option 233	Option 233	Option 236	Option 233 & 210	
SA Source	Source Enable OFF ON	Source Mode (CW)	Normalize OFF ON	Source Power	Source CW Freq	
	Source Mode Tracking	Source Mode CW	Source Mode Coupled CW			
	Option 233 & 210	Option 233	Option 233	Standard	Standard	
SA Scale/Amptd	Autoscale	Unit dBm	Corrections	External Gain	Preamp OFF ON	
	Standard	Standard	Standard	Standard	Option 235	
SA Trace	Trace 1 2 3 4	State (Clr/Wr)	Default All	Detector (Auto)	Record Playback Setup	Recorder Player
	Standard	Standard	Standard	Standard	Option 236	Option 236
ERTA Measure	LEAD ERTA Partnership	Input Power R	Input Power B	Gain or Loss B/R	Source	
	Option 209 & 233	Option 209 & 233	Option 209 & 233	Option 209 & 233	Option 209 & 233	

Modes	CAT/TDR	NA	SA	VVM	Power Meter (USB Sensor)	Power Meter (Built In)
ERTA Source	Source Enable OFF ON	Source Mode (CW)	Normalize (OFF ON)	Source Power	Source CW Freq	
	Option 209 & 233	Option 209 & 233	Option 209 & 233	Option 209 & 233	Option 209 & 233	

For a given mode, the analyzer “remembers” the most recent state of the current mode when you change to another mode.

For most screens under System 7 key, the current measurement mode continues to operate while the screen is displayed. For instance, while the battery information screen is displayed, the measurement mode remains active.

There are two exceptions to this:

- the “Options (Licensing)” screen
- “Error Log” screen

When either of these screens is displayed, the firmware is in a special monitor mode and measurements are suspended.

CAT, NA, and VVM Modes

CAT, NA, and VVM modes have some similar capabilities but are still separate operating modes.

Measurement similarities:

- Return Loss = S11 magnitude
- Insertion Loss = S21 magnitude

Unlike S11 and S21, the values displayed below zero for Return Loss and Insertion Loss are not negative.

There is user control of output power level, which is high, low or manual setting on the RF Out Atten, 35 dB in or out.

SA and CPM Mode

SA Mode measures signals at the SA RF IN connector.

SA Mode measurements require NO calibration.

The signal path for SA mode is the same as the input path for two port CAT/NA modes.

The RF In Atten can be set from 0 through 30 dB in 5 dB steps. The Attenuator Slope Adjustment determines the correction factors for each step in each frequency band.

The RF In Atten can be controlled manually or automatically. When in auto mode, the Reference Level setting determines the attenuator setting.

The Pre-amp can be in or out. Nominal gain of the pre-amp is 22 dB.

The “Attn” and “PA” indicators in the display header give current status. The Scale/Amptd hard key provides access to control for them.

The displayed measured value for a given signal is automatically compensated for in the current Attn and PA settings. For instance, if an incoming signal is measured at -70 dBm with the RF IN Atten set to 5 dB and PA “out”, changing to PA “in” will give a measured value of approximately -70 (+/- because the 22 dB for the PA is only nominal). The difference seen in the trace will be that the noise floor of the trace will be lowered by approximately 22 dB. If the RF In Atten is changed from 5 dB to 15 dB, the measured value will not change significantly (still approximately -70 dBm) but the noise floor will raise by 10 dB.

SA has two basic modes: step and FFT.

Step mode reads a narrow slice of the spectrum and the LO steps for each slice. In this mode, a trace on the display is composed from multiple slices. Generally spans greater than 100 kHz operate in step mode.

FFT mode reads a wide slice of the spectrum and the LO is fixed. In this mode, a trace on the display is based on a single LO setting.

The LO minimum step size is 2 MHz; this restriction limits spurs.

The hardware operation of the A/D's is essentially the same for both step and FFT modes. The difference is the digital signal processing.

The SA adjustments generally correct the gain with 11 frequency bands. See [page 5-66](#) for a listing of the 11 bands. See the TME help file for details on SA adjustments.

Power Meter Mode

All measurement circuitry is switched to the low power state during PM (power meter) mode. This is the mode with the lowest power dissipation.

The analyzer has no power output capability in this mode. The analyzer essentially functions as a display for a USB power sensor.

Temperature Related Information

Five temperature sensors are in the analyzer: two on the A4 RF board, two on the A5 System board, and one in the battery pack.

- RF1—on the A4 RF board
- RF2—on the A4 RF board
- SB1—on the A5 System board
- SB2—on the A5 System board
- Battery pack—inside the battery pack

The battery pack has its own internal temperature sensor. The battery pack will shut itself down in the case of extreme temperatures.

See [Chapter 8](#) for instructions on viewing temperature readings.

See the FieldFox Analyzer User's Guide (Part Number N9927-90001), "FieldFox High-Temperature Protection" section, for information about operation at high temperature.

During normal operation, as each SA measurement is taken, the current RF2 temperature reading is compared to the temperature stored for the Frequency Response adjustment. A delta temperature is calculated. Each SA measurement is adjusted to compensate for the delta temperature.

The internal temperature of the unit is critical when executing the TME based software for tests and adjustments. See the TME help for detailed information.

Under typical bench top (indoor) conditions, the internal temperature of the unit will be about 20 °C above ambient once the internal temperature has stabilized. It will typically take 60 to 90 minutes for the internal temperature to stabilize when a "cold" unit is turned on.

NOTE

The FieldFox internal temperature will run 2° C - 5° C cooler with the Battery Saver on (the temperature range is dependent on the ambient temperature).

User Calibration in CAT, NA, and VVM Modes

There are three types of calibrations for the CAT, NA and VVM modes: CalReady, QuickCal and Mechanical Cal. See the **FieldFox Analyzer User's Guide** (Part Number N9927-90001) "Calibration for CAT, NA and VVM Modes" section for specific instructions for performing these calibrations. Because NA, CAT, and VVM modes are very similar, a calibration that is performed in one mode can also be applied in the other modes.

When a user calibration is performed, the full frequency range of the analyzer is calibrated even though the current state of the analyzer may be less than the full range. This allows a calibration to be "interpolated" beyond the frequencies set at the time of calibration (an asterisk "*" on the display indicates interpolation).

Do not leave cal standards connected to the PORT 2 or PORT 1 ports for more than three minutes. Heat in the port connectors may affect the accuracy of the standards.

Factory Calibration (CalReady)

When the analyzer is adjusted at the factory or during annual calibration, a preset calibration is stored in the analyzer (CalReady).

The preset calibration covers the full frequency range of the analyzer. The preset calibration is active whenever "CalRdy" is displayed on the left side of the screen. Presetting the analyzer activates the preset calibration.

The preset calibration provides very good measurement performance at the PORT 1 and Port 2 connectors when the analyzer has thermally stabilized at room temperature.

The preset calibration should be re-characterized every 12 months to maintain accuracy. This is accomplished via the Error Terms adjustment in the TME. Refer to **Chapter 3**.

QuickCal – N991xA, N992xA, N993xA only

The QuickCal function mathematically “extends” the preset calibration to the end of a cable or adapter. It is a firmware only function; it does not involve analyzer hardware.

Table 5-5 Cal Status Indicators

Indicator	Meaning	Additional Indicators
CalRdy	Preset (factory) calibration is active	* = interpolation active ? = Measurement conditions have changed.
Cal ON Q	QuickCal calibration is active	* = interpolation active ? = Measurement conditions have changed.
Cal ON U	User calibration is active	* = interpolation active ? = Measurement conditions have changed.
Cal OFF	Calibration is inactive	
Cal OFF*	No calibration available to activate for this measurement.	

Mechanical Calibration

Mechanical Calibration is performed using discrete standards from a Cal Kit. Several Cal Kit definitions are built into the FieldFox.

Mechanical Cals are extremely accurate when performed using the correct Cal Kits with standards that are clean and in good repair, and when using correct connection procedures.

Firmware Related Information

General Description

The analyzer is based on the Windows CE operating system. This is a closed system; no direct user access to the desktop of general operating system functions is provided.

The file system for Windows CE is maintained in flash memory on the A6 SOM board. There is limited access to the file system. Most memory is in a protected region and not directly accessible by the user.

The user accessible memory is under UserData. See the “File Management” section of the FieldFox Analyzer User’s Guide (Part Number N9927-90001) for instructions on saving, recalling, and managing files in the unprotected memory.

User Accessible Files

- Directory structure below UserData in the A6 SOM board flash memory.
- External USB flash memory plugged in the analyzer.
- External SD memory card plugged into the analyzer.

NOTE: When copying files, a “Copy_....” directory is created at the root of the destination device as the destination for the copied file(s). This characteristic generally makes it impossible to copy a file into the desired directory under UserData in the A6 SOM board flash memory. This limits the usefulness of copying files to or within UserData.

Operational Files

- Results from adjustments performed under TME (see **Chapter 3**)—not directly available to user.
- File resulting from CAT/NA/VVM user calibration—not directly available to user.
- Cal kit definition files—stored in UserData\calkits.
- Cable definition files—stored in UserData\Cables.
- Error log—not directly available to user. See “**Error Log**” further on in this section for accessing error log information.

Erase User Data Utility

A utility to erase all directories and files in the UserData directory is available. After the flash memory is erased, the boot process returns the UserData directories and files to the state as shipped from the factory.

The System Information screen indicates the time and date of the most recent erase.

See **Chapter 8** for instructions on executing the Erase User data utility.

Error Log

See **Chapter 8** for instructions on viewing the error log.

The error log is cleared each time the analyzer is powered off.

Generally, an entry in the error log is created whenever an error message is displayed.

EXAMPLE: Attempting to set the frequency to a value of "." (a decimal point), will generate an entry in the error log.

Firmware Upgrades

Firmware upgrades are available on the Internet. Refer to instructions in the "Update FieldFox Firmware" section of the FieldFox Analyzer User's Guide (Part Number N9927-90001) for details.

See **Chapter 8** for instructions on viewing the current firmware revision.

The following information will be included in the display.

- Firmware Release = FieldFox application firmware revision
- FPGA Rev = code revision for FPGA
- SBM Boot Rev = revision of boot code for System Microcontroller
- SBM Main Rev = revision of main code for System Microcontroller

A firmware upgrade includes three sections:

- the FieldFox application firmware and the Windows CE operation system on the A6 SOM board.
- the firmware in the System Monitor Microcontroller on the A5 System board.
- the FPGA code on the A5 System board.

The System Monitor firmware update and the FPGA code update are executed only if not up-to-date.

It is important to maintain power to the analyzer during the update process.

After unplugging the USB flash memory stick during the firmware upgrade process, wait for the analyzer to enter its default operating mode before operating the analyzer.

LAN Interface

See the “System Configuration” section of the FieldFox Analyzer User’s Guide (Part Number N9927-90001) for details on reviewing and configuring LAN settings.

The LAN interface supports Auto MDIX. When a LAN cable is connected to the FieldFox, if the other end of the cable supports Auto MDIX, there is no need for a cross-over cable.

There are two LEDs on the LAN connector. When there is successful communication over a LAN cable, both LEDs are active. If both LEDs are not active, consider using a cross-over cable.

LAN LEDs (N995xA and N996xA only)

When FieldFox is connected to the LAN, the flashing LAN LEDs have the following definitions:

Green: Flashing indicates packets are being transferred.

Yellow:

- Flash, pause = 10 Mbit link speed
- Flash, flash, pause = 100 Mbit link speed
- Flash, flash, flash, pause = 1 GBit link speed

6 Replaceable Parts

Information in This Chapter

This chapter:

- identifies the replaceable parts for the FieldFox analyzer.
- includes several tables and illustrations to assist you in identifying the correct part for your analyzer.
- contains ordering information for new assemblies and rebuilt-exchange assemblies.

Section Title	Summary of Content	Start Page
Ordering Information	How to order a replaceable part from Keysight Technologies.	page 92
Assembly Replacement Procedure	The correct sequence for determining the failure of and replacing a defective assembly.	page 93
Replaceable Parts Listings	Tables with illustrations that list all replaceable parts in your analyzer:	page 94

Ordering Information

To order a part listed in the replaceable parts lists:

- include the part number
- indicate the quantity required
- Contact Keysight Technologies for instructions on where to send the order.
Refer to
“Contacting Keysight” on page 30.

To order a part **that is not listed** in the replaceable parts lists:

- include the instrument model number and complete instrument serial number
- include the description and function of the part
- indicate the quantity required
- Contact Keysight Technologies for instructions on where to send the order.
Refer to
“Contacting Keysight” on page 30.

The replaceable parts are required to be supplied by Keysight Technologies.

Assembly Replacement Procedure

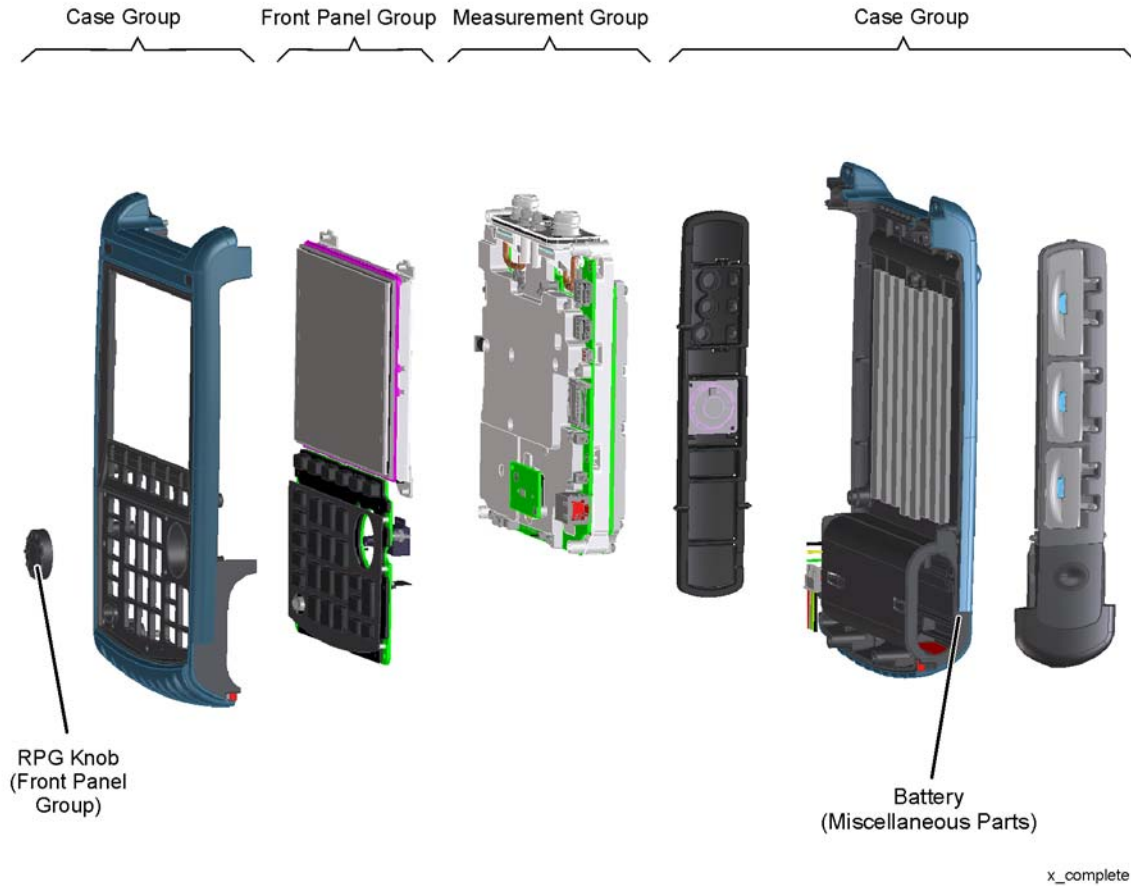
The following steps describe how to replace an assembly in the analyzer.

- Step 1.** Identify the faulty group. Begin with [Chapter 4, “Troubleshooting.”](#) Follow up with the appropriate troubleshooting chapter that identifies the faulty assembly.
- Step 2.** Order a replacement assembly. Refer to this chapter for part numbers and ordering information.
- Step 3.** Replace the faulty assembly and determine what adjustments and performance tests are necessary. Refer to [Chapter 7, “Repair and Replacement Procedures.”](#)
- Step 4.** Perform the necessary adjustments. Refer to [Chapter 3, “Tests and Adjustments.”](#)
- Step 5.** Perform the necessary performance tests. Refer to [Chapter 3, “Tests and Adjustments.”](#)

Replaceable Parts Listings

Entire Analyzer

Figure 6-1 Entire Analyzer, Exploded View



Descriptions and part numbers for the assemblies and parts in each group shown in the above illustration can be found at the following locations:

- **“Front Panel Group” on page 95**
- **“Measurement Group” on page 97**
- **“Case Group” on page 102**

Miscellaneous parts and accessories not illustrated in any of these groups are listed under:

- **“Miscellaneous Parts” on page 104**

Front Panel Group¹

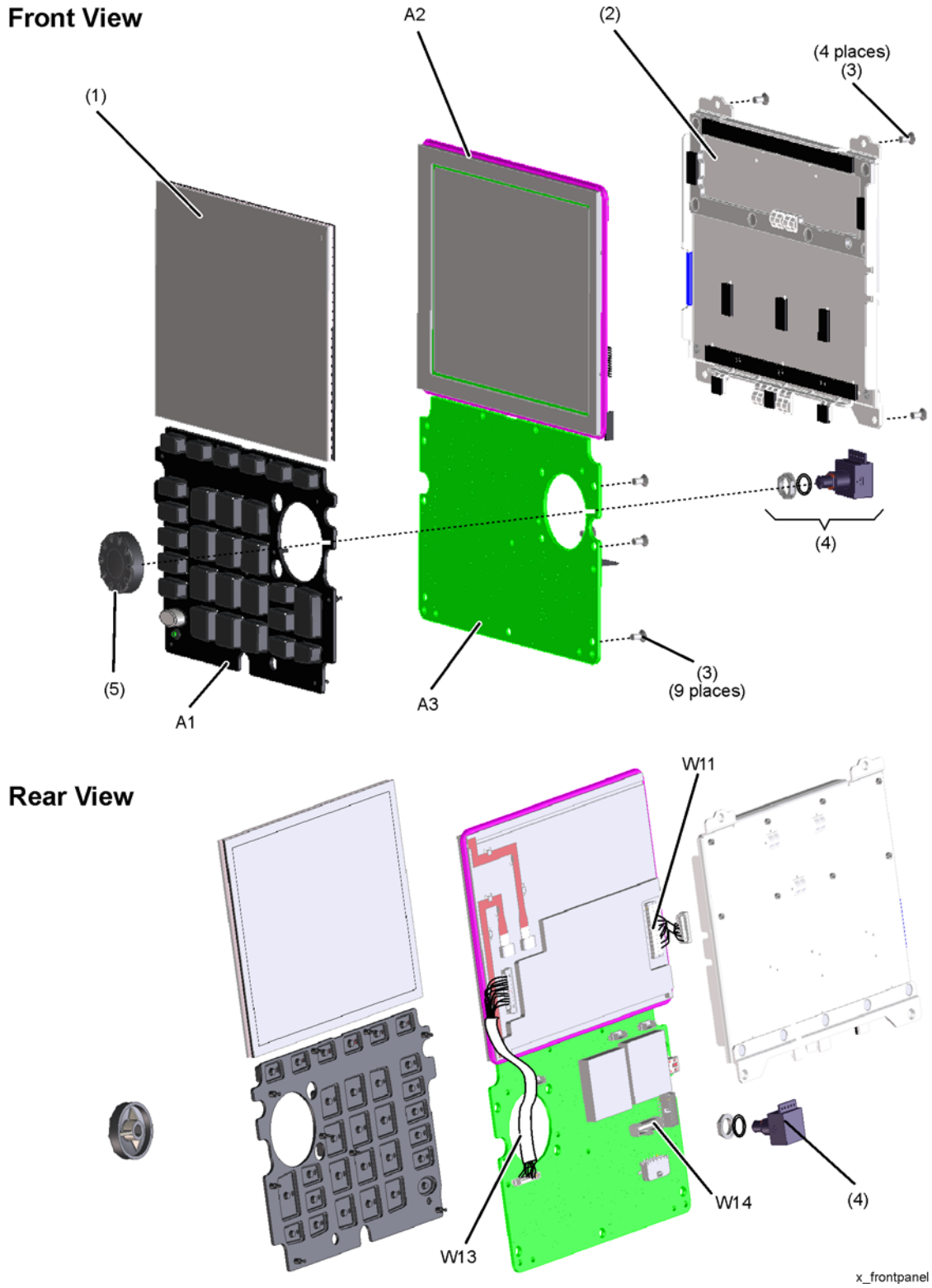
Refer to **Figure 6-2** for part locations.

Reference Designator	Part Number	Qty	Description
Replacement Assemblies			
Front Panel Assembly	N9950-60004 ¹	1	Front Panel Assembly- Includes: Front Enclosure Assembly, LCD Assembly, Keypad Assembly, Front Panel Board Assembly, RGP knob Assembly
A3 Front Panel Board Assembly	N9927-60110	1	Front Panel Board Assembly—Includes: A3 front panel interface board
Separately Replaceable Individual Parts and Assemblies			
A1	N9912-40001	1	Keypad assembly
A2	N9927-60118	1	LCD assembly, 6.5-inch TFT VGA
W11	N9927-60007	1	Cable, A2 LCD to A5 System board
W13	N9927-60005	1	Cable, A2 LCD to A3 Front Panel Interface board
W14	N9927-60009	1	Cable, ribbon, A3 Front Panel Interface board to A5 System board
(1)	1000-1485	1	LCD lens filter
(2)	N9927-60011	1	LCD Bracket assembly (model numbers N991xA, N992xA, N993xA)
	N9927-60029	1	LCD Bracket assembly (model numbers N995xA, N996xA)
(3)	0515-1946	13	Screw, machine, 90-deg flat head, Torx T10, M3.0 x 6 mm
(4)	1990-3613	1	RPG (Rotary Pulse Generator). Includes cable W12, nut, and washer.
(5)	W1312-40066	1	RPG knob

1. Nameplate is not included in Front Panel Assembly, please order accordingly. Refer to combination of nameplate set under section **“Case Group” on page 102**.

1. Each time the FieldFox case is opened for any reason, you must order a **Repair and Re-assembly Kit**. See **“Miscellaneous Parts” on page 104**.

Figure 6-2 Front Panel Group, Exploded View



Measurement Group

NOTE

Each time the FieldFox case is opened for any reason, you must order a **“Repair and Re-assembly Kit”**. See **“Miscellaneous Parts”** on page 104.

Refer to **Figure 6-3** for part locations.ok

Reference Designator	Part Number	Qty	Description
Replacement Assemblies			
A4 RF Assembly	N9927-60111	N9918A N9928A N9938A	1 RF Assembly—Includes: A4 RF board Cable W1, semi-rigid, RF OUT (NA port) Cable W2, semi-rigid, RF IN (SA port) O-Ring gasket, 8160-0963, qty 2 (8) Adapter coaxial straight, female Type-N to female 3.5 mm, qty 2 (9) Insulator, qty 2 (10) EMI ring, N9927-20064, qty 2 (11) Shield, top, RF (19) Shield, bottom, RF (21) Screw, 26 places (22)
	N9927-60200	N9913A	
	N9927-60201	N9914A N9915A N9925A N9935A	
	N9927-60202	N9916A N9917A N9926A N9927A N9936A N9937A	
	N9950-60100	N995xA N996xA	RF Assembly—Includes: A4 RF board 2.4 mm Right Angle Connector, qty 2 Jam Nut, qty 4 Restrainer, qty 2 O-Ring gasket, qty 2 (8) Shield, top, RF Shield, bottom, RF Screw, 28 places SMP Bullet, qty 5
A5 System Board Assembly *Obsoleted*	N9927-60112 ¹	N991xA N992xA N993xA	1 System Board Assembly—Includes: A5 system board, N9927-63002 Screw, 19 places, 0515-5511 (13) Screw, 2 places, 0515-0430 (14) Screw, 4 places, 0515-1940 (18)
A5 System Board Assembly	N9927-60150 ²	N991xA ³ N992xA N993xA N995xA N996xA	1 System Board Assembly—Includes: A5 Pre-Programmed system board, N9927-60212 Screw, 19 places, 0515-5511 (13) Screw, 2 places, 0515-0430 (14) Screw, 4 places, 0515-1940 (18)

Replaceable Parts
Replaceable Parts Listings

Reference Designator	Part Number		Qty	Description
RF Top Panel Assembly	N9927-60115	N991xA N992xA N993xA	1	RF Top Panel Assembly—Includes: Connector cover (tethered cap), for Type-N connector, qty 2 (1) Connector cover, for SMA connector (W3 & W4), 1401-0245, qty 2 Screw, 0515-2349, 6 places (2) Overlay, RF (5) Panel, RF, machined, N9927-20013 (6) Gasket, RF (7)
	N9950-60115	N995xA N996xA	1	RF Top Panel Assembly—Includes: Connector cover (tethered cap), for 2.4 mm connector, qty 2 (1) Screw, 0515-6119, 8 places (2) Overlay, RF (5) Panel, RF, machined (6) Gasket, RF (7)
Separately Replaceable Individual Parts and Assemblies				
A6	1150-8023	N991xA N992xA N993xA	1	SOM Board, 532 MHz processor, 128 MB-SDRAM
	N9927-60100	N991xA ³ N992xA N993xA N995xA N996xA	1	Pre-programmed CPU Board (CPU2)
A7	N9927-60121		1	RTC Battery Board Assembly
W1	N9927-20028		1	Cable, semi-rigid, Port 1 / RF Output (N991xA, N992xA, N993xA only)
W2	N9927-20029		1	Cable, semi-rigid, Port 2 / SA RF Input (N991xA, N992xA, N993xA only)
W3	8121-2029		1	Cable, SMA-MCX, Ref In/Trig In, incl. nut (3) and washer (4)
W4	8121-2029		1	Cable, SMA-MCX, GPS Ant, incl. nut (3) and washer (4)
W17	N9927-60010		1	Cable, RTC Battery board
(1)	W1312-40069		2	Connector cover (tethered cap), for Type-N connector
	N9927-40013		2	Connector cover (tethered cap), for 3.5 mm connector
(7)	N9912-40004		2	Gasket
(8)	8160-0963		2	O-Ring gasket

Replaceable Parts
Replaceable Parts Listings

Reference Designator	Part Number	Qty	Description
(9)	N9927-60123	2	Type-N Adapter assembly (N991xA, N992xA, N993xA only)
	N9927-60122	2	3.5 mm Adapter assembly (N9938A only)
	N9950-60140 ⁴	2	2.4mm Test Port Connector Assembly (N995xA, N996xA only)
(10)	0515-0372	4	Screw, machine w/crest cup washer, pan head, Torx T10, M3.0 x 0.5, 8 mm (used for Type-N connectors) (N991xA, N992xA, N993xA only)
(10)	0515-1035	4	Screw, machine, flat head, Torx T10, M3.0 x 0.5, 8 mm (used for 3.5 mm connectors) (N9938A only)
(11)	N9912-20033	2	Insulator, w/pad (N991xA, N992xA, N993xA only)
(12)	N9927-20069	2	EMI ring (N991xA, N992xA, N993xA only)
(14)	0515-1946	2	Screw, machine flat head, Torx T10, M3.0 x 0.5, 6 mm
(15)	1420-0905	1	Battery, Lithium-ion (For Real Time Clock (RTC) backup.)
(16)	N9927-60113	1	(25) System board top shield
	N9927-60151	1	(25) System board top shield (2nd generation)

1. N9927-60112 is obsoleted. In order to replace N9927-60112, please order the upgrade kits below.
 N9910-60101: CPU and System board upgrade kit for N9913/4/5/6/7A
 N9910-60102: CPU and System board upgrade kit for N9925/26/27A
 N9910-60103: CPU and System board upgrade kit for N9935/36/37A
 N9910-60104: CPU and System board upgrade kit for N9918/28/38A
 Refer to **“Processor Upgrade Procedures” on page 169**
2. Recommended to also order N9927-60151, System Top Shield Assembly (2nd generation)
3. For FieldFox Analyzer with serial number prefix starting with MY5607/SG5607/US5607.
4. If only one connector need to be replaced, order N9950-60140 (one connector and one screw kit). If two connectors need to be replaced, order N9950-60141 (two connectors and one screw kit)

Figure 6-3 Measurement Group, Exploded View - N991xA, N992xA, N993xA

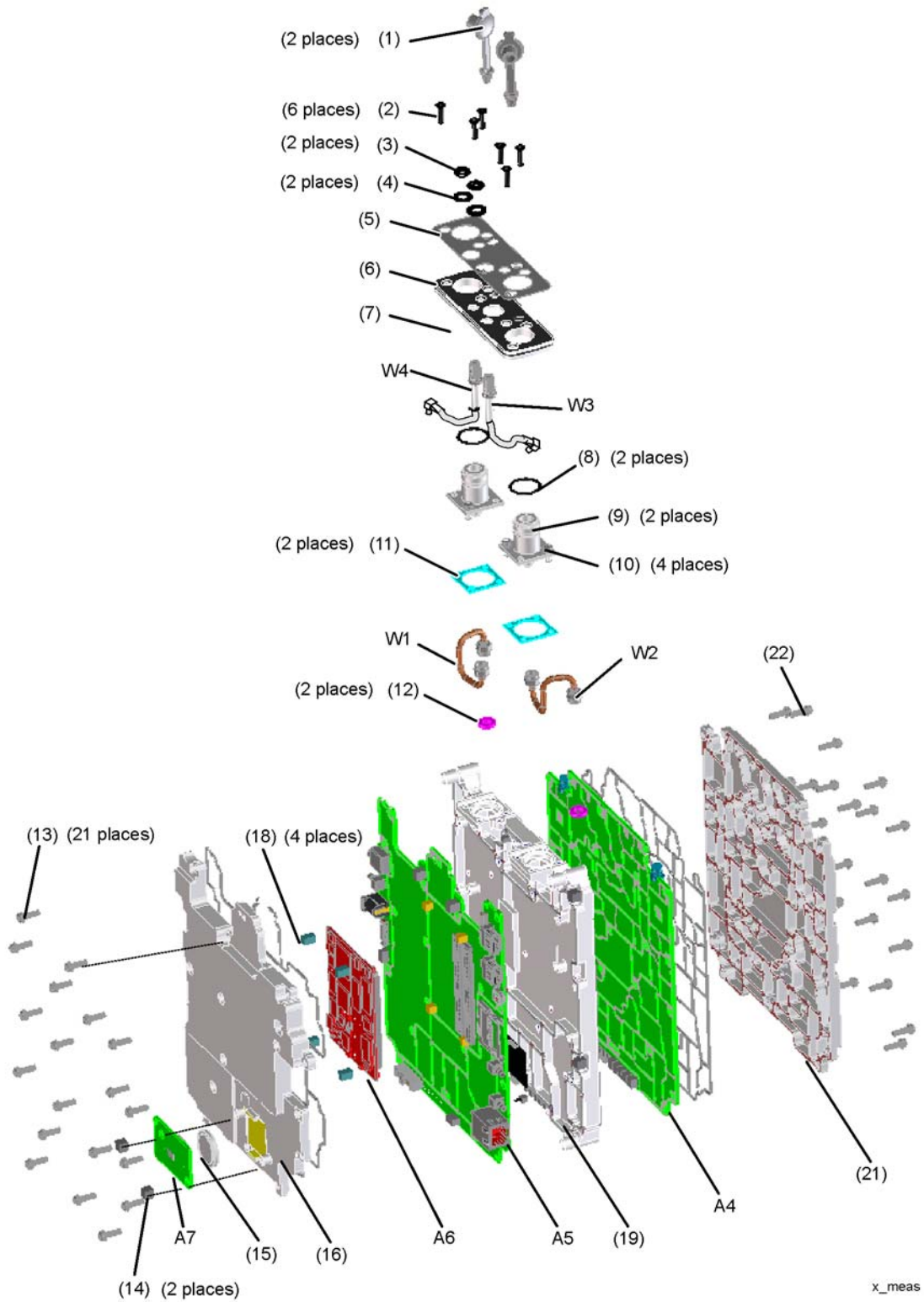
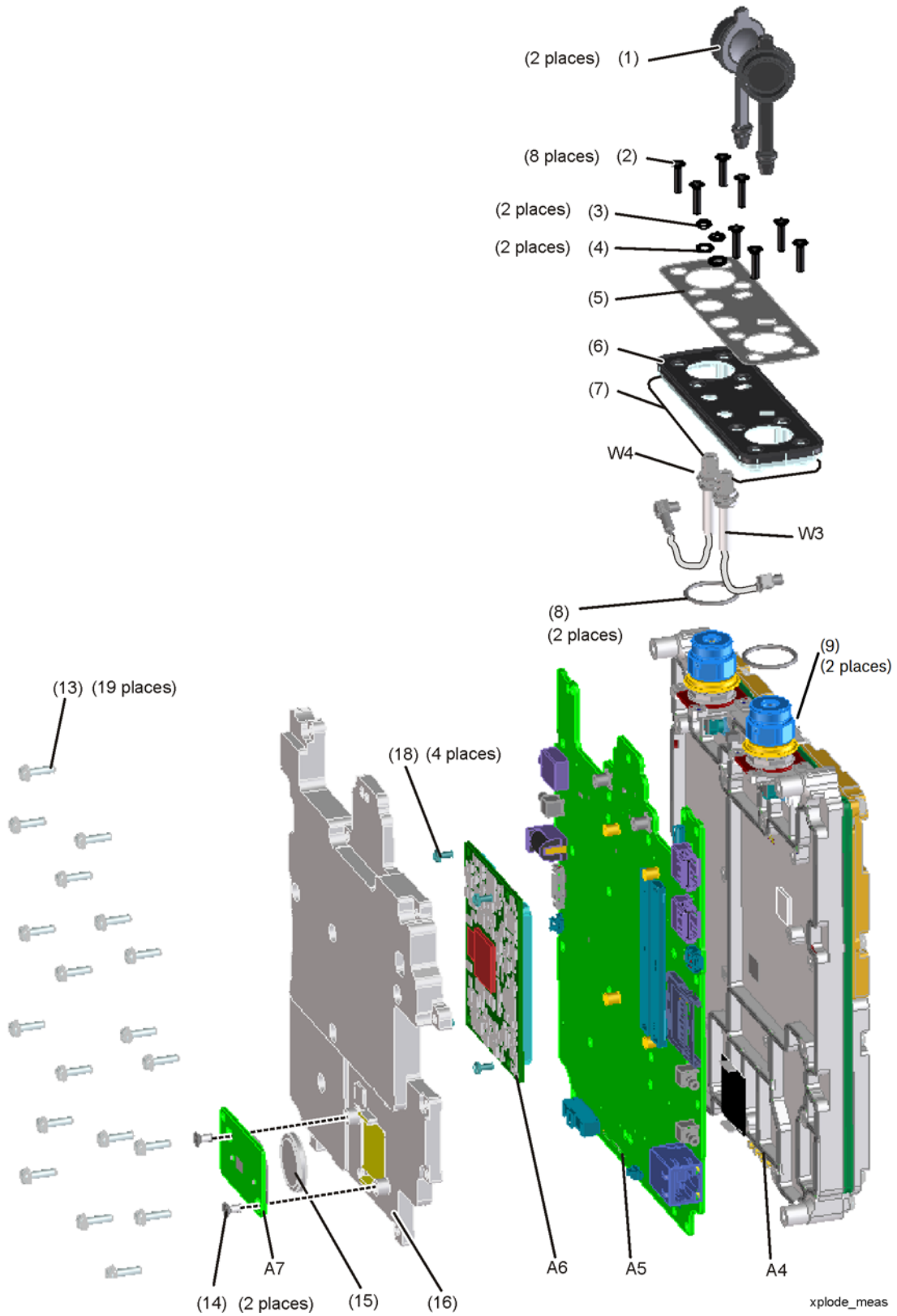


Figure 6-4

Measurement Group, Exploded View - N995xA, N996xA



Case Group¹

Refer to **Figure 6-5** for part locations.

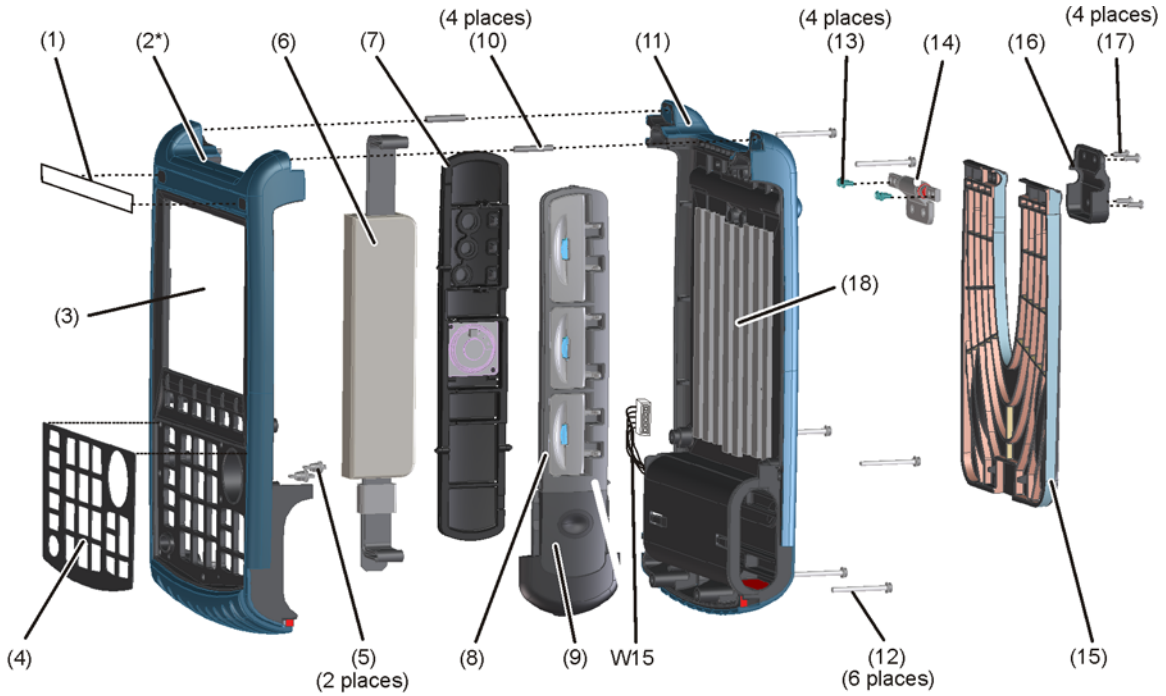
Reference Designator	Part Number	Qty	Description
Replacement Assemblies			
(2)	N9927-60116	1	Front Enclosure Assembly—Includes: Front case, W1312-40049, with A1 keypad installed (2) LCD lens filter (3) Keypad overlay, N9912-80005 (4)
(7)	N9927-60119	1	Left Side I/O Panel Assembly—Includes: Speaker
(8)	N9927-60120	1	Right Side I/O Panel Assembly -- Includes: Doors (USB, SD, LAN)
(11)	N9927-60117	1	Rear Enclosure Assembly—Includes: Rear case (11)
(15)	N9912-60028	1	Kick Stand Assembly—Includes: Kickstand, W1312-40065 (15) Friction hinge and spacer (14) Screw (for hinge), qty 4 (13) Hinge cover (16) Screw (for hinge cover), qty 4 (17)

1. Each time the FieldFox case is opened for any reason, you must order a **Repair and Re-assembly Kit**. See **"Miscellaneous Parts"** on page 104.

Replaceable Parts
Replaceable Parts Listings

Reference Designator	Part Number	Qty	Description
Separately Replaceable Individual Parts and Assemblies			
(1)	Combination Nameplate Set		
	N9927-80021	1	Nameplate, N9913A, 4 GHz
	N9927-80022	1	Nameplate, N9914A, 6.5 GHz
	N9927-80013	1	Nameplate, N9915A, 9 GHz
	N9927-80014	1	Nameplate, N9916A, 14 GHz
	N9927-80015	1	Nameplate, N9917A, 18 GHz
	N9927-80016	1	Nameplate, N9918A, 26.5 GHz
	N9950-80002	1	Nameplate, N9950A, 32 GHz
	N9950-80003	1	Nameplate, N9951A, 44 GHz
	N9950-80004	1	Nameplate, N9952A, 50 GHz
	VNA Nameplate Set		
	N9927-80011	1	Nameplate, N9925A, 9 GHz
	N9927-80012	1	Nameplate, N9926A, 14 GHz
	N9927-80009	1	Nameplate, N9927A, 18 GHz
	N9927-80010	1	Nameplate, N9928A, 26.5 GHz
	SA Nameplate Set		
	N9927-80017	1	Nameplate, N9935A, 9 GHz
	N9927-80018	1	Nameplate, N9936A, 14 GHz
	N9927-80019	1	Nameplate, N9937A, 18 GHz
	N9927-80020	1	Nameplate, N9938A, 26.5 GHz
	N9950-80005	1	Nameplate, N9960A, 32 GHz
	N9950-80006	1	Nameplate, N9961A, 44 GHz
	N9950-80007	1	Nameplate, N9962A, 50 GHz
(5)	N9912-40006	2	Hole plugs
(6)	N9910-80002	1	Strap handle
(9)	W1312-40060	1	Battery door cover
(10)	1480-0793	4	Dowel pins
(12)	0515-5153	6	Screw, machine w/flat washer, pan head, Torx T10, M3.0 x 0.5, 35 mm
(13)	0515-1940	4	Screw, machine w/patch lock, pan head, Torx T8, M2.5x0.45, 6 mm
(14)	3110-0654 N9912-00003	1	Friction hinge Spacer
(16)	W1312-40068	1	Hinge cover
(17)	0515-2217	4	Screw, machine, button head, Torx T8, M3.0 x 8 mm
(18)	N9927-20062	8	Gap Pad Strips
W15	N9927-60006	1	Cable assembly, battery

Figure 6-5 Case Group, Exploded View



* The front case (2) comes with the A1 keypad installed.

x_case

Miscellaneous Parts

Description	Model or Part Number
Repair and Re-assembly Kit	
<p>IMPORTANT This kit is required each time the FieldFox case is opened for any reason. The kit includes the following items, some or all of which are necessary to re-assemble the internal assemblies and the case, depending upon the depth of the repair.</p>	

Replaceable Parts
Replaceable Parts Listings

Description	Model or Part Number
Repair and Re-assembly Kit for N991xA, N992xA, N993xA Includes the following items:	N9927-60130
Screw, machine, 90-deg flat head, Torx T10, M3 x 0.5, 8mm; qty 4	0515-1035
Screw, machine, 90-deg flat head, Torx T10, M3 x 0.5, 6 mm; qty 17	0515-1946
Screw, machine w/patch lock, pan head, Torx T8, M2.5 x 0.45, 6 mm; qty 4	0515-1940
Screw, machine w/crest cup washer, pan head, Torx T10, M3.0 x 0.5, 8 mm; qty 4	0515-0372
Screw, machine, 90-deg flat head, Torx T10, M3 x 0.5, 14 mm; qty 6	0515-2349 / 0515-6119
Screw, machine, button head, Torx T8, M3 x 0.5, 8 mm; qty 4	0515-2217
Screw, machine w/flat washer, pan head, Torx T10, M3 x 0.5, 35 mm; qty 6	0515-5153
Screw, machine W/Crest-Cup-Con-Washer Pan-HD Torx-T10, M3x0.5, 35mm; qty 6	0515-1038
Screw, machine W/Crest-Cup-Con-Washer/Light Patch-Lock Pan-HD Torx-T10, M3x0.5, 12mm; qty:20	0515-5511
Screw, machine W/Crest-Cup-Con-Washer Pan-HD Torx-T10, M3x0.5, 6mm; qty:2	0515-0430
Rectangular Laser Address Label	7121-8321
O-STRIP RFI Hollow 0.060 in OD, 0.020 in ID; qty 1	8160-1725
Tape, 1/4-inch x 1-inch, for LCD ribbon cable; qty 4	N9912-20043
Gasket, Blank Panel, qty 1	N9912-40002
Gasket, I/O Panel, qty 1	N9912-40003
Cover, hinge	W1312-40068
Repair and Re-assembly Kit for N995xA, N996xA Includes the following items:	N9950-60130
Screw, machine, 90-deg flat head, Torx T10, M3 x 0.5, 6 mm; qty 6	0515-1946
Screw, machine w/flat washer, pan head, Torx T10, M3 x 0.5, 35 mm; qty 6	0515-5153
Screw, machine, 90-deg flat head, Torx T10, M3 x 0.5, 14 mm; qty 8	0515-6119
Screw, machine, 90-deg-flat head, TORX-T10, M3 x 0.5, 5mm; qty 6	0515-6120
Screw-machine W/Crest-Cup-Con-Washer/Light Patch-Lock Pan-HD Torx-T10,M3x0.5, 12mm LG SST Passivated; qty 20	0515-5511
Screw-machine W/Crest-Cup-Con-Washer Pan-HD Torx-T10 M3X0.5, 6mm-LG SST-300 Passivated; qty 2	0515-0430
Screw-machine with Patch-Lock Pan-HD Torx-T8 M2.5X0.45, 6mm-LG SST-300 Passivated; qty 4	0515-1940
Black Protective Cap, .24-ID .277-OD; qty 2	1401-0245
Rectangular Laser Address Label; qty 1	7121-8321
Tape, 1/4-inch x 1-inch, for LCD ribbon cable; qty 4	N9912-20043
Bolt, M1.6 SHC tall head; qty 8	N9950-20047
Nut Ring, test port; qty 2	N9950-40006
Overlay, screw cap; qty 6	N9950-80012
Ferrite Cores	
Kit containing ferrite cores for use on external LAN cable and headphones cable.	N9927-60028 (N991xA, N992xA, N993xA only)
Service Tools	
T-8 TORX driver; set to 6 in-lb	N/A
T-10 TORX driver; set to 9 in-lb	N/A

Replaceable Parts
 Replaceable Parts Listings

Description	Model or Part Number
5/16 inch, open-end torque wrench; set to 10 in-lb	N/A
7/16 inch, hex nut wrench or “nut driver”; set to 9 in-lb	N/A
9/16 inch, open-end torque wrench; set to 21 in-lb	N/A
Tools and Wrenches for N995xA and N996xA Repair	
5/8 inch, open-end torque wrench; 3.95 N-m (35 lbf-in)	8710-2792
5/8 inch, open-end torque wrench; 113 N-m (16 ozf-in)	8710-2793
5/16 inch, flare deep socket torque screwdriver; 1.13 N-m (10 lbf-in)	8710-2794
Tool - hand nut starter	8710-2795
Documentation	
Users' Guide. Can also be printed from the Keysight Web site.	N9927-90001
Quick Reference Guide	N9927-90002
Service Guide. (Not available in printed form. Part number is for reference only. Must be printed from the Keysight Web site.	N9927-90003
ESD Supplies	
Adjustable antistatic wrist strap	9300-1367
Antistatic wrist strap grounding cord (5 foot length)	9300-0980
Static control table mat and earth ground wire	9300-0797
ESD heel strap	9300-1126
Battery¹	
Battery- Rechargeable Li Ion 11.1V 4.6A-HR	1420-0908

1. Refer to **“Battery Disposal” on page 18** for instructions on disposing of the old battery.

7 Repair and Replacement Procedures

Information in This Chapter

This chapter contains procedures for removing and replacing the major assemblies of your Keysight Technologies FieldFox analyzer.

Section Title	Summary of Content	Start Page
Personal Safety Warnings	Warnings and cautions pertaining to personal safety.	page 108
Electrostatic Discharge (ESD) Protection	Information pertaining to ESD protection.	page 108
Assembly Replacement Sequence	A step-by-step procedure for how to identify the faulty assembly, replace it with a new one, and re-adjust your analyzer when done.	page 109
Table of Removal and Replacement Procedures	A table of removal and replacement procedures and the corresponding page number where they are located.	page 110
Removal and Replacement Procedures	The actual procedures for removing and replacing the major assemblies in your analyzer. The procedures occur in assembly reference designator numerical order.	See Table 7-1 on page 110 for specific procedures.
Post-Repair Procedures	A table of the proper tests, verifications, and adjustments to perform on your analyzer after repair.	page 167
Processor Upgrade Procedures	The procedures for removing and replacing the new CPU processor and System Board for CPU2 Upgrade Kit.	page 169

Personal Safety Warnings

WARNING

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

WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.

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

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

Safety Earth Ground

WARNING

This is a Safety Class I 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 instrument, will make the instrument dangerous. Intentional interruption is prohibited.

CAUTION

Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate grounding by not using this cord may cause product damage.
Use Keysight supplied power cord when AC/DC power adapter is connected.

Electrostatic Discharge (ESD) Protection

CAUTION

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

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in **“Electrostatic Discharge Protection” on page 15**, for all of the procedures in this chapter.

Assembly Replacement Sequence

The following steps show the sequence that you should follow to replace an assembly in the FieldFox analyzer.

- Step 1.** Identify the faulty group. Begin with [Chapter 4, “Troubleshooting.”](#)
- Step 2.** Order a replacement assembly. Refer to [Chapter 6, “Replaceable Parts.”](#)
- Step 3.** Replace the faulty assembly and determine what adjustments are necessary. Refer to [“Post-Repair Procedures”](#) in this chapter.
- Step 4.** Perform the necessary adjustments. Refer to [Chapter 3, “Tests and Adjustments.”](#)
- Step 5.** Perform the necessary performance tests. Refer to [Chapter 3, “Tests and Adjustments.”](#)

Removal and Replacement Procedures

Table 7-1 **List of Procedures**

Reference Designator or Name	Assembly Description	Location
Main battery	Primary power battery	page 111
Case parts	All enclosure case parts	page 113
A1	Keypad	page 126
RPG	RPG (part of front panel group)	page 132
A2	LCD	page 134
A3	Front panel interface board	page 136
Measurement Group	Measurement Group Assemblies as One Unit	page 138
RF Top Panel	RF Top Panel Assembly	page 140
RF Connectors and Cables	RF Connectors and Cables - N991xA, N992xA, N993xA	page 142
	2.4mm Connectors - N995xA, N996xA	page 144
RTC battery	Backup battery for real time clock (Located on RTC board attached to the A5 System board shield.)	page 146
A6	SOM board	page 147
A5	System board	page 150
A4	RF board - N991xA, N992xA, N993xA	page 155
	RF Assembly - N995xA, N996xA	page 159

Removing and Replacing the Main Battery

Tools Required

None

IMPORTANT

Refer to **“Battery Disposal”** on **page 18** for important instructions on disposing of the old battery.

Replacing the Main Battery

1. Disconnect the power cord.
2. Refer to **Figure 7-1**. Remove the battery compartment door by pushing in on the detent and then sliding the door downwards.
3. Note the orientation of the battery for installation of the replacement.
4. Remove the old battery and install the new battery in the battery compartment.
5. Reinstall the battery compartment door by aligning it in position and then sliding it upwards until an audible click is heard.

Figure 7-1 Replacing the Main Battery



Removing and Replacing the Case Group Parts

Tools Required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 9 in-lb)
- Isopropyl alcohol (Use only in a well ventilated area.)
- **Repair and Re-assembly Kit**. Refer to **“Miscellaneous Parts” on page 104**.

WARNING

Before beginning any repair, disconnect the power cord.

Replacing the Kickstand, Hinge Cover, and Hinge

1. Refer to **Figure 7-2**. Remove, and discard, the four screws **(1)** from the kickstand hinge cover. New screws are provided in the **Repair and Re-assembly Kit**.

Figure 7-2 Replacing the Kickstand and Hinge Cover



- 2.** To replace the entire kickstand assembly:
 - a.** Lift the kickstand assembly off of the rear case and discard it.
 - b.** Place the new kickstand assembly on the rear case.
 - c.** Place the new hinge cover in position and secure it with four new screws. A new hinge cover and new screws are provided in the **Repair and Re-assembly Kit**.
- 3.** To replace the hinge cover:
 - a.** Position the new hinge cover in place and install four new screws. New screws are provided in the **Repair and Re-assembly Kit**.

4. To replace the hinge:
 - a. Refer to **Figure 7-3**. Lift the kickstand assembly off of the rear case.
 - b. Remove and discard the four hinge attachment screws (2).
 - c. Place the new hinge in position and install with four new screws. New screws are provided in the **Repair and Re-assembly Kit**.
 - d. Place the kickstand assembly in place on the rear case and reinstall the hinge cover with new screws provided in the **Repair and Re-assembly Kit**.

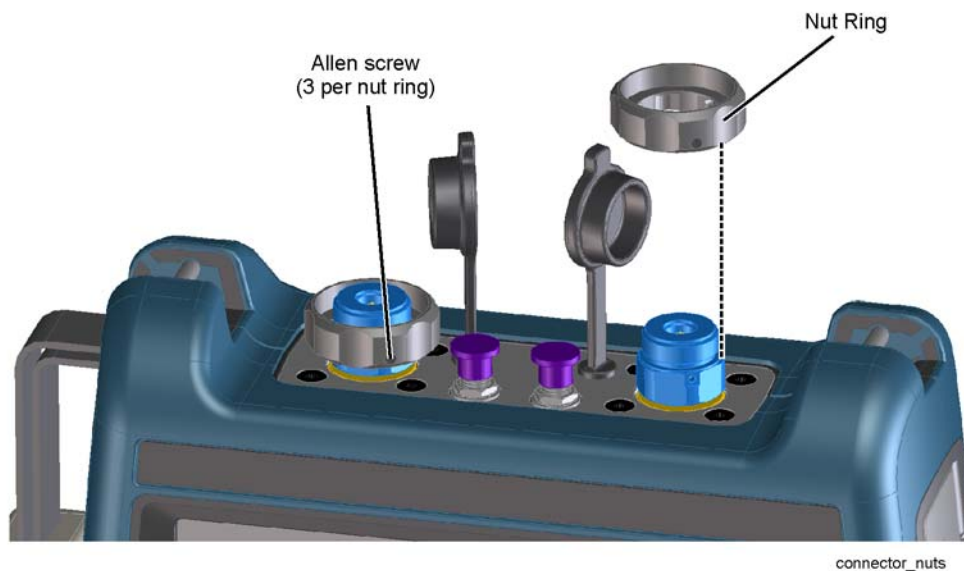
Figure 7-3 Replacing the Hinge



Separating the Front and Rear Cases

1. Remove the battery. Refer to **“Removing and Replacing the Main Battery”** on page 111.
2. For N995xA, N996xA, N9918B and N9938B opt 100 models only. Refer to **Figure 7-4**. To access the screws that secure the top panel, it is necessary to remove the two nut rings from the RF connectors. Using a 1.5 mm Allen screwdriver, loosen the 3 Allen screws on each nut ring. The nut ring can be lifted up off of the connector.

Figure 7-4 Remove Nut Rings



3. Refer to **Figure 7-5**. Loosen the six or eight screws (3) that secure the RF top panel (depending on the version of System board installed). It should not be necessary to remove these screws, just loosen them.
4. Remove, and discard, the six screws (4) that secure the rear case to the front case. New screws are provided in the **Repair and Re-assembly Kit**.
Refer to **Figure 7-6**. The N995xA and N996xA models have an additional six screws that must be removed. Loosen the six screws (1) including two that are behind the kickstand.

Figure 7-5 Separating the Front and Rear Cases (1)

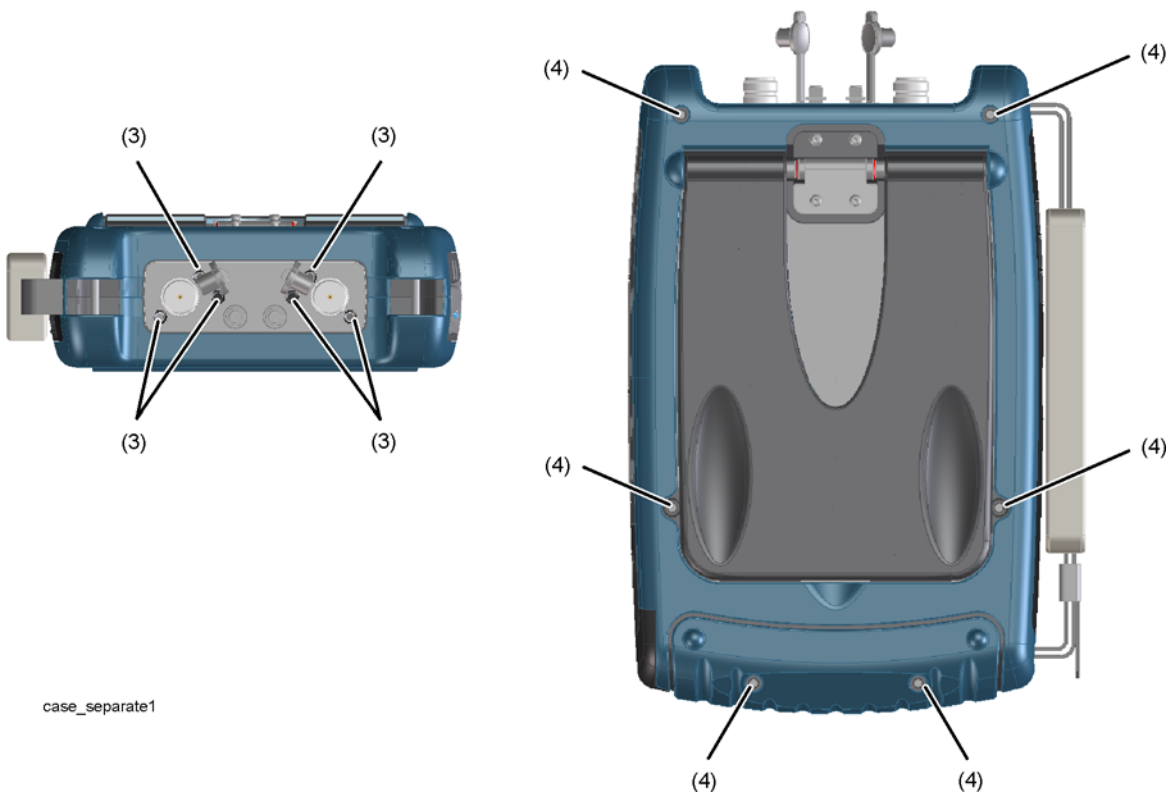
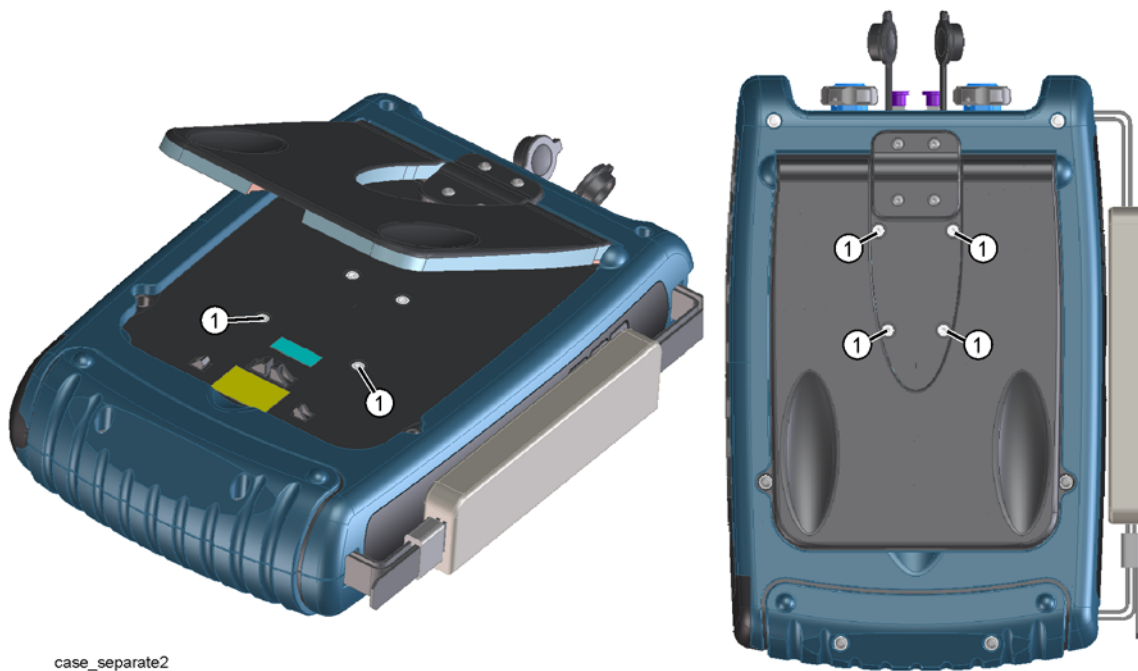
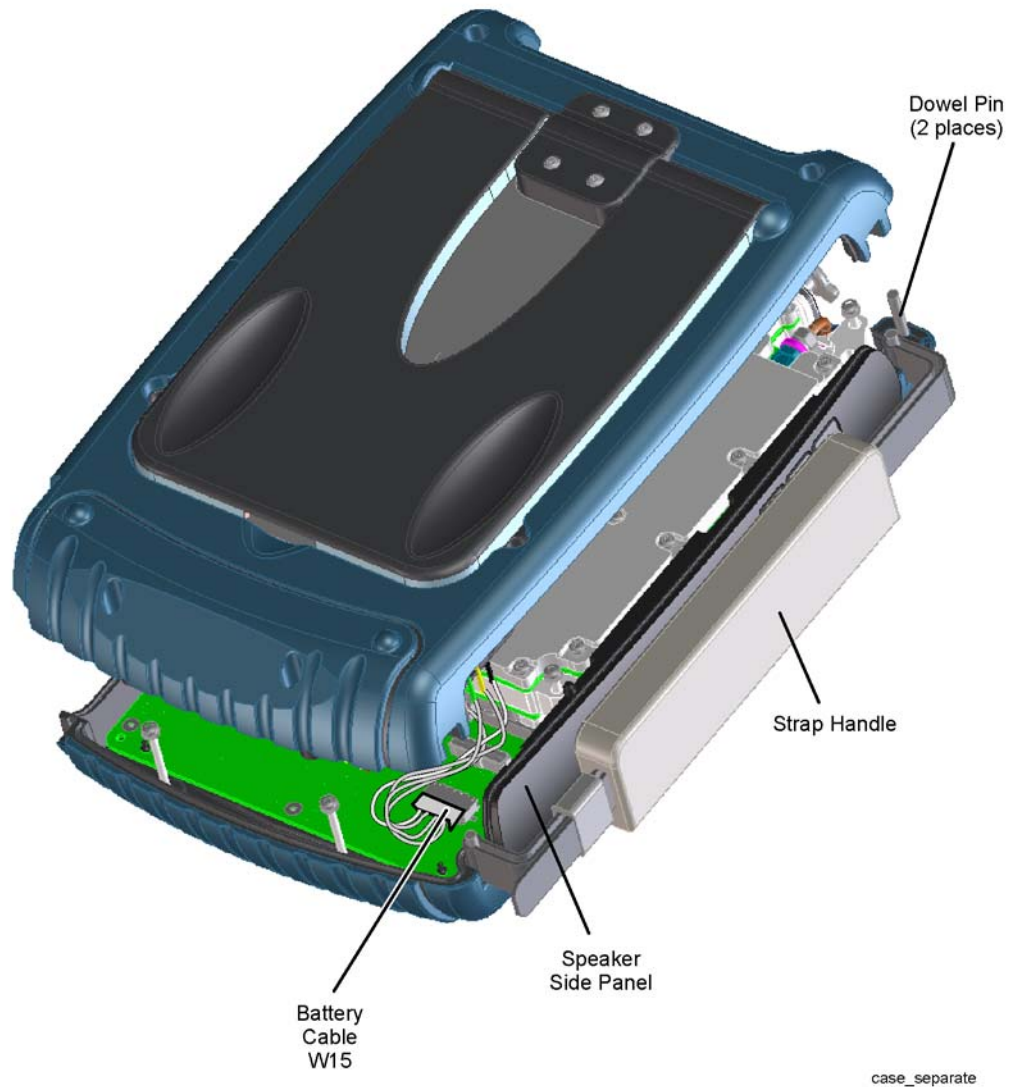


Figure 7-6 Separating the Front and Rear Cases (N995xA, N996xA)



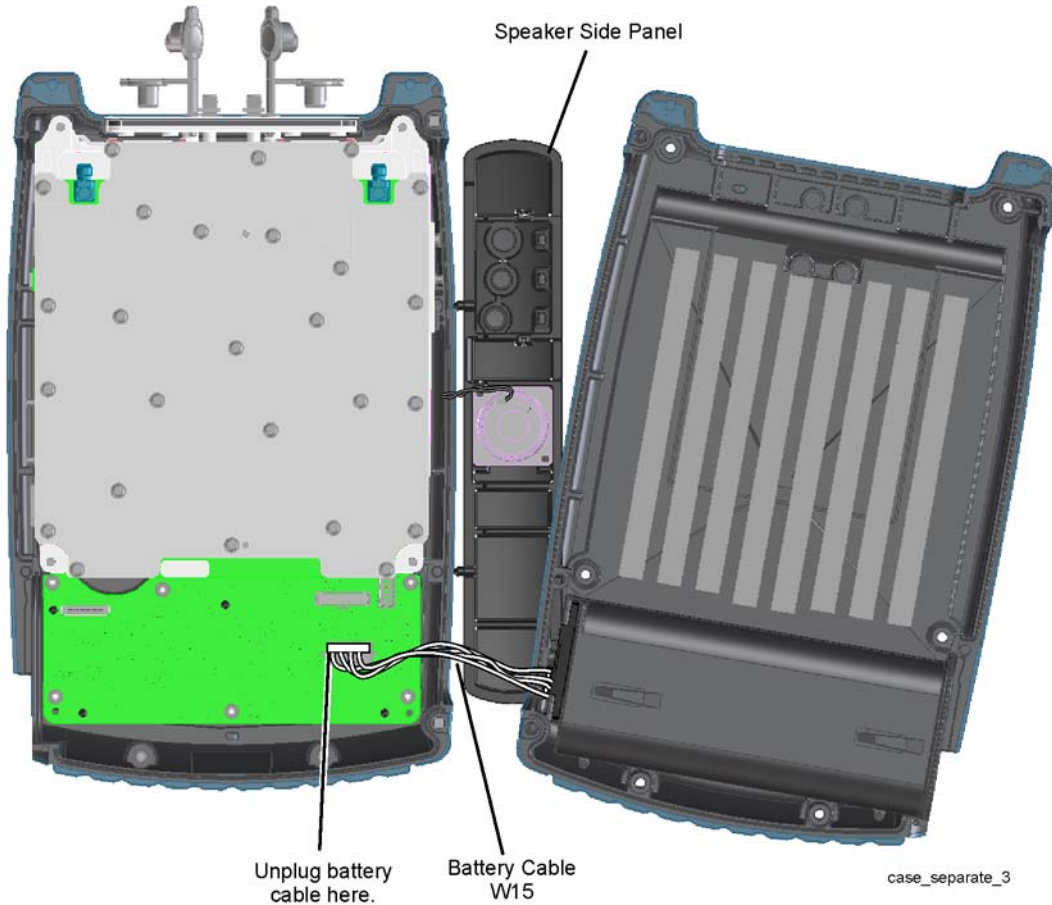
5. Separate the cases and position the rear case to one side, as shown in **Figure 7-7**, to allow access to the speaker side panel and strap handle.
6. Remove the strap handle from the two dowel pins.
7. Remove the speaker side panel from the groove in the front case.

Figure 7-7 Separating the Front and Rear Cases (2)



8. Position the cases side-by-side as shown in **Figure 7-8**.
9. Unplug the battery cable, W15, from the A5 System board at the location indicated.
10. The front and rear cases are now completely separated.

Figure 7-8 Separating the Front and Rear Cases (4)



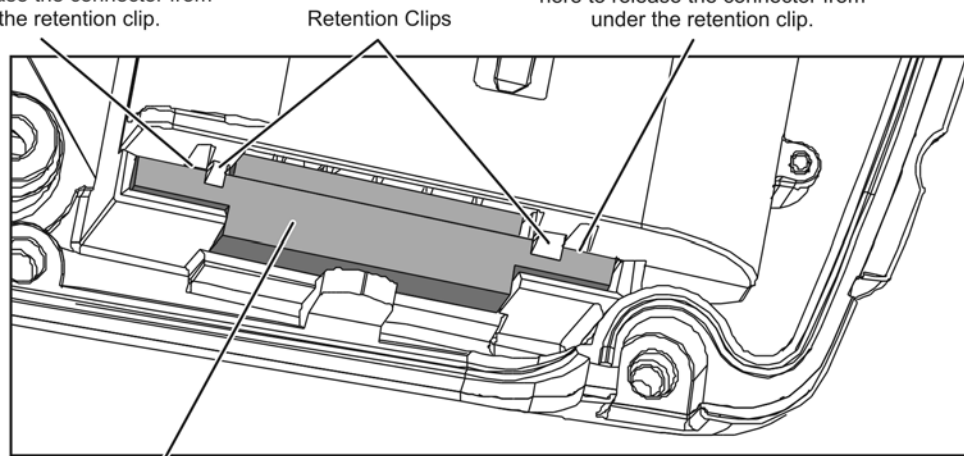
Replacing the Battery Cable

1. Separate the front and rear cases. See [“Separating the Front and Rear Cases” on page 117](#).
2. Refer to [Figure 7-9](#). Note the orientation of the cable for installation of the new cable, then, using a small flat-blade screwdriver to move the cable connector, release the retention clips on the cable connector and remove the cable from the rear case.

Figure 7-9 Replacing the Battery Cable

Use a small flat-blade screwdriver here to release the connector from under the retention clip.

Use a small flat-blade screwdriver here to release the connector from under the retention clip.



Battery Cable Connector

n9912_90003_707

3. When installing the new battery cable, make sure that the connector snaps into place.
4. Reinstall the rear case onto the front case. See [Combining the Front and Rear Cases](#).

Replacing the Rear Case

1. Separate the front and rear cases. See [Separating the Front and Rear Cases](#).
2. Carefully remove the serial number label and the Windows CE label from the back of the old rear case and apply the labels to the new rear case.
3. Remove the kickstand assembly from the old rear case and install it on the new rear case. See [Replacing the Kickstand, Hinge Cover, and Hinge](#).
4. Remove the battery cable from the old case and install it in the new case. See [Replacing the Battery Cable](#).
5. Install the new rear case onto the front case. See [Combining the Front and Rear Cases](#).

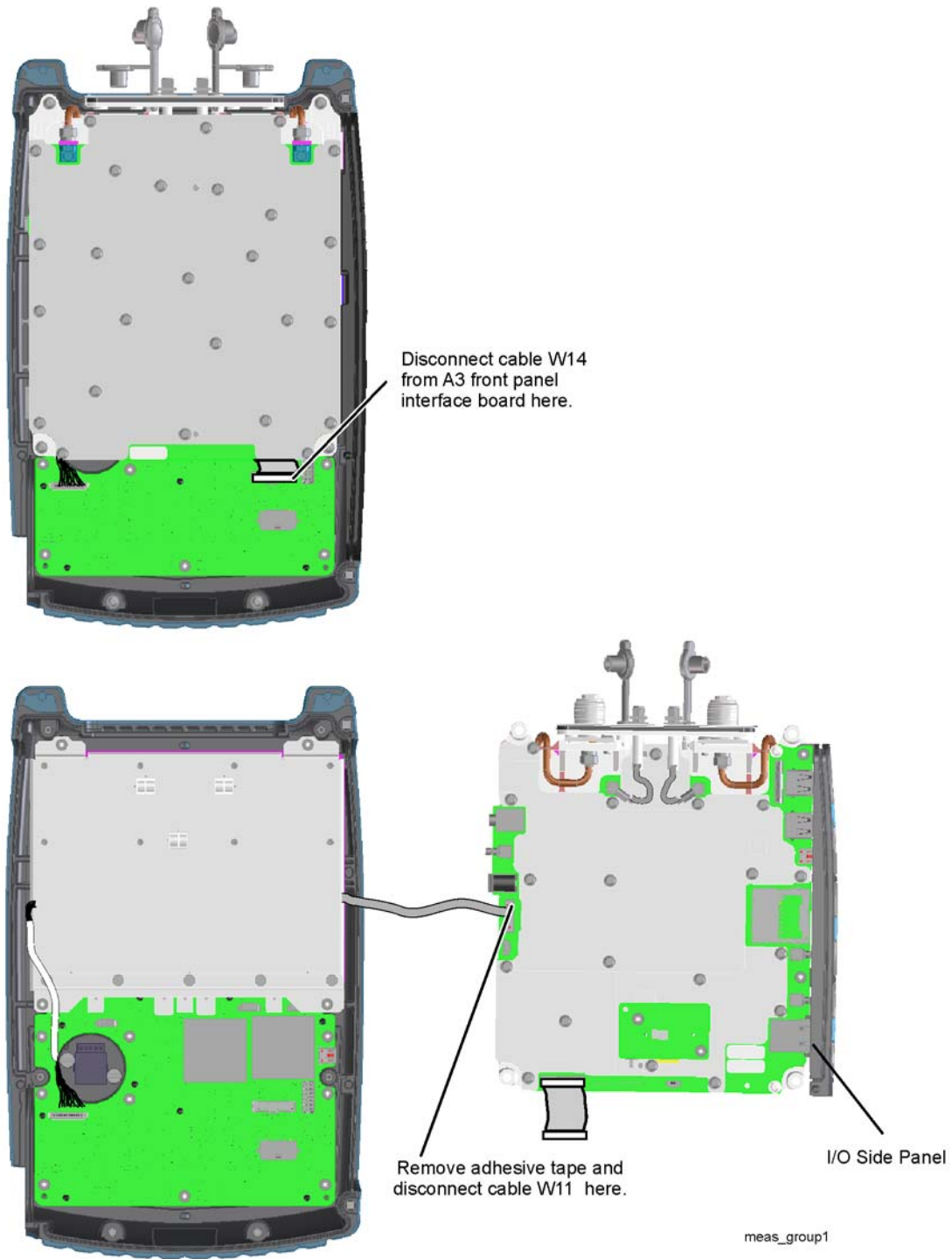
Replacing the Strap Handle

1. Separate the front and rear cases to the positions shown in [Figure 7-7](#). See [Separating the Front and Rear Cases](#).
2. Note the orientation of the strap handle, then lift it off of the dowel pins at each end.
3. Slip the new strap handle over the dowel pins.
4. Reinstall the rear case onto the front case. See [Combining the Front and Rear Cases](#).

Replacing the I/O Side Panel, Doors, and Gasket

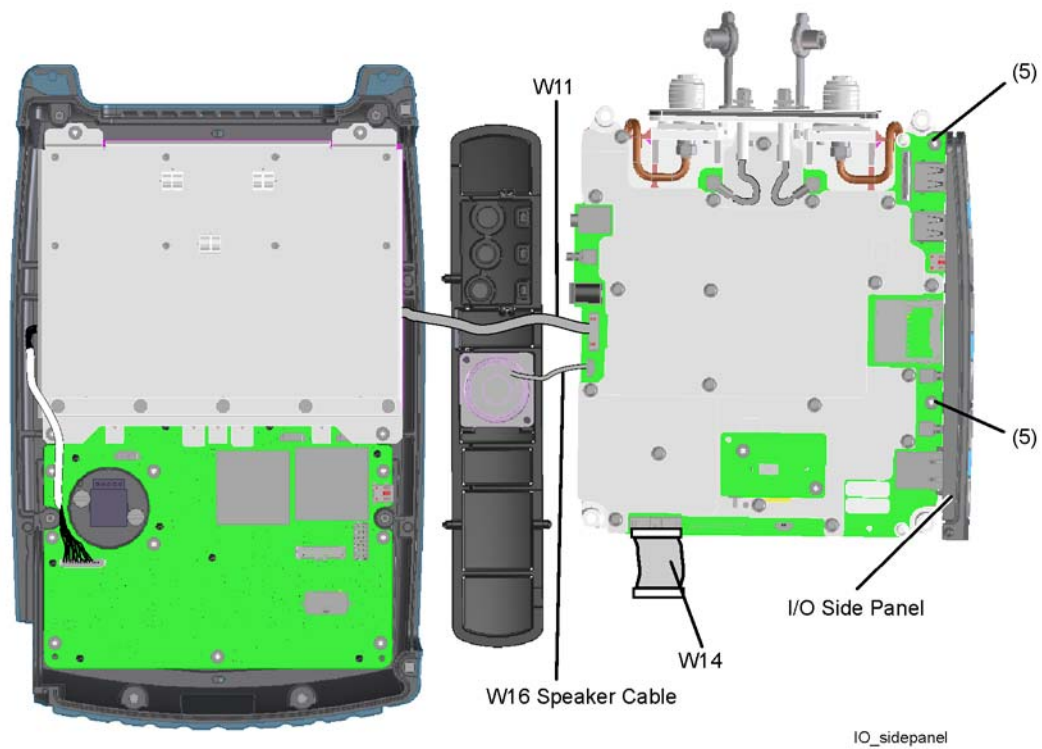
1. Separate the front and rear cases. See [“Separating the Front and Rear Cases” on page 117](#).
2. Refer to [Figure 7-10](#). Disconnect the A5 System board to A3 FPIB cable, W14, at the A3 FPIB connector. If replacing this cable, disconnect both ends.

Figure 7-10 Removing All Measurement Group Assemblies as One Unit



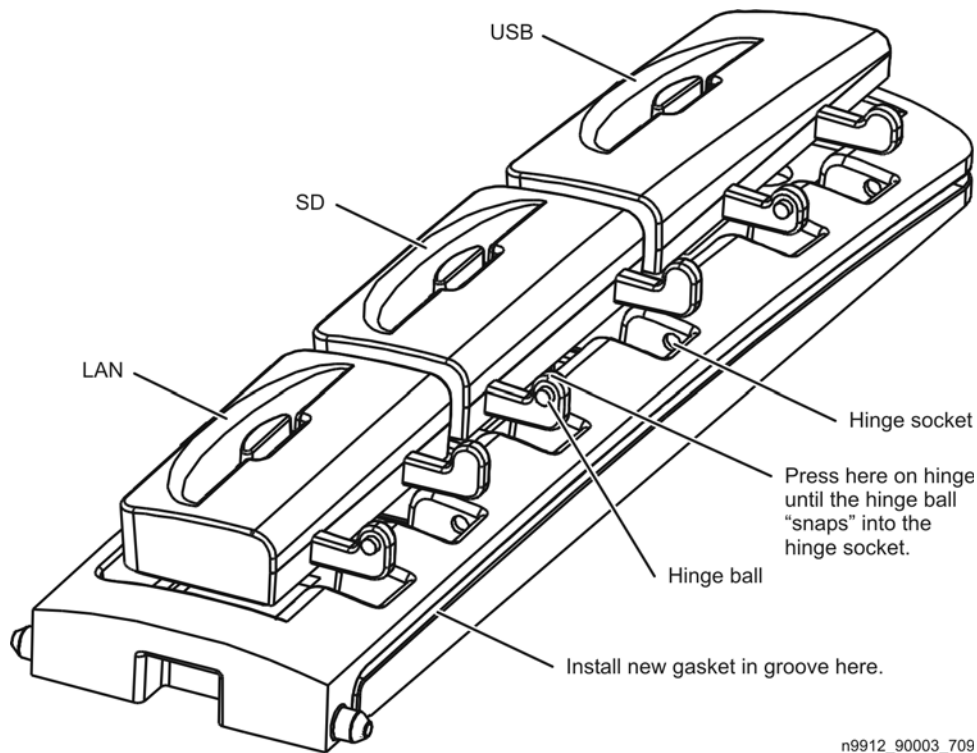
3. Remove the measurement group assemblies (RF top panel assembly, A4 RF board, A5 System board, and A6 SOM board) as one unit with the I/O panel attached, but do not disconnect cable W11 from between the A2 LCD and the A5 System board. Refer to **“Removing and Replacing the Measurement Group Assemblies”** on page 138.
4. Refer to **Figure 7-11**. Remove the two screws (5) that secure the I/O side panel to the A5 System board and remove the I/O side panel.

Figure 7-11 Replacing the I/O Side Panel



5. Refer to **Figure 7-12**. Remove the three doors from the old I/O side panel:
 - a. Open each door to its stopping point, then GENTLY force it beyond its stopping point to separate it from the panel.
6. Install the three doors in the new I/O side panel:
 - a. Place each door in its respective opening with the hinges aligned with the hinge slots in the side panel.
 - b. Press the hinges into their slots until they snap into place.

Figure 7-12 Replacing the I/O Side Panel Doors and Gasket



7. Before installing the new I/O side panel, or when reinstalling the existing I/O side panel, install a new gasket in the groove around the perimeter of the panel.

If an old gasket must be removed, use tweezers being careful not to damage the groove.

Start in the groove near the flat end of the side panel. Be careful not to stretch or damage the gasket in any way. Also, make sure there is no slack in the gasket. A new gasket is provided in the **Repair and Re-assembly Kit** (see [page 104](#)). It is the smaller of the two gaskets provided in the kit.

8. To install the new I/O side panel, place it in position on the A5 System board and reinstall the two attachment screws. See **Figure 7-11**.

9. Reinstall the measurement group assemblies (RF top panel assembly, A4 RF board, A5 System board, and A6 SOM board) as one unit with the new I/O panel attached.
10. Reinstall the rear case onto the front case. See [Combining the Front and Rear Cases](#).

Replacing the Front Case (including the A1 Keypad)

1. Separate the front and rear cases. See [Separating the Front and Rear Cases](#).
2. Remove the measurement group assemblies (RF top panel assembly, A4 RF board, A5 System board, and A6 SOM board) as one unit with the I/O panel attached. Refer to [“Removing and Replacing the Measurement Group Assemblies”](#) on page 138.
3. Remove the front panel group assemblies (A2 LCD, A3 front panel interface board, and RPG). Refer to [“Removing and Replacing the Front Panel Group Assemblies”](#) on page 132.

Figure 7-13 Replacing the Front Case

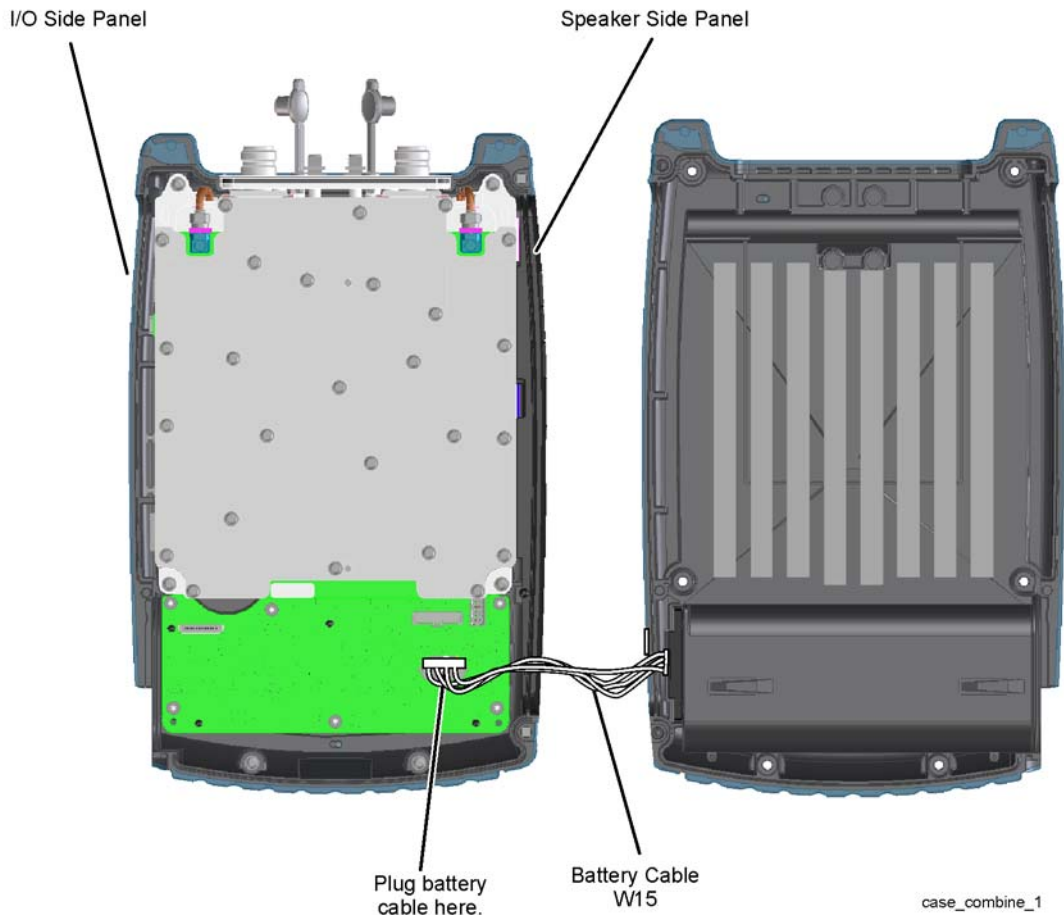


4. Carefully remove the serial number label from the inside bottom of the old front case and apply the label to the new front case.
5. Refer to **Figure 7-13**. Choose the appropriate model number nameplate overlay for your analyzer, remove the protective backing to expose the adhesive, and adhere it in the location shown.
6. Remove the dowel pins (**5**) from the old front case and install them in the new case. The other two dowel pins should already be installed in the case.
7. Make sure that the gaskets (**6**) are all in place in the grooves, that there are no gaps, and that they are not damaged in any way.
8. Refer to **“Removing and Replacing the Front Panel Group Assemblies” on page 132** to reinstall the front panel group assemblies removed in **step 3**.
9. Refer to **“Removing and Replacing the Measurement Group Assemblies” on page 138** to reinstall the measurement group assemblies removed in **step 2**.
10. Reinstall the rear case onto the front case. Refer to **“Combining the Front and Rear Cases” on page 128**.

Combining the Front and Rear Cases

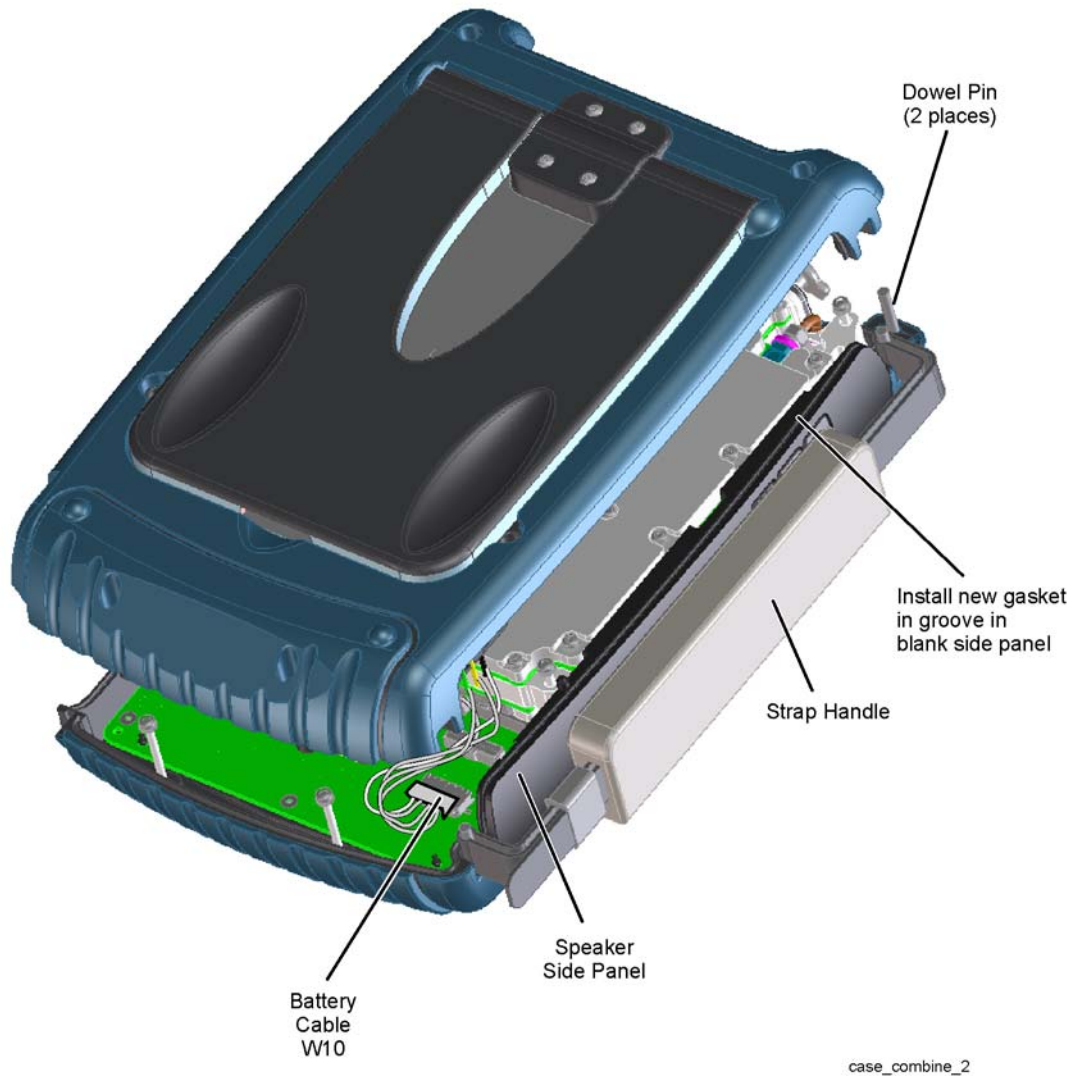
1. Install a new gasket on the speaker side panel being careful not to stretch it or to damage it in any way. Also, make sure there is no slack in the gasket. A new gasket is provided in the **Repair and Re-assembly Kit** (the speaker side panel uses the larger of the two gaskets provided). If an old gasket must be removed, carefully remove it with tweezers being careful not to damage the groove.
2. If a new gasket has not been installed on the I/O side panel, install it at this time. It will be necessary to remove the I/O side panel from the A5 System board. Refer to **“Replacing the I/O Side Panel, Doors, and Gasket” on page 122** for instructions.
3. Refer to **Figure 7-14**. Position the front and rear cases side-by-side as shown.
4. Plug the battery cable, W15 into the A5 System board as indicated.

Figure 7-14 Combining the Front and Rear Cases (1)



5. Refer to **Figure 7-15**. Position the rear case on top of the front case and to one side as shown.
6. Place the speaker side panel in the groove in the front case being careful not to damage the gasket.
7. Position the strap handle over the two dowel pins as shown.

Figure 7-15 Combining the Front and Rear Cases (2)



8. Position the rear case directly over, and aligned with, the front case and the side panels as shown.
9. Make sure the battery cable is tucked in between the measurement group assemblies and the speaker side panel and that it is not in the path of the screw hole indicated.
10. Firmly press the cases together being careful not to damage the gaskets.
11. Refer to **Figure 7-16**. Install six new screws (7) to secure the rear case to the front case. These new screws are provided in the **Repair and Re-assembly Kit**.

The N995xA and N996xA models have an additional six screws that secure the rear case. Refer to **Figure 7-17**. Install the six screws (1) including two that are behind the kickstand. Torque to 9 inch-pounds.

Torque all screws to 9 inch-pounds.
12. Refer to **Figure 7-16**. Tighten the six or eight screws (8) that secure the RF top panel. Torque to 9 inch-pounds.

Figure 7-16 Combining the Front and Rear Cases (3)

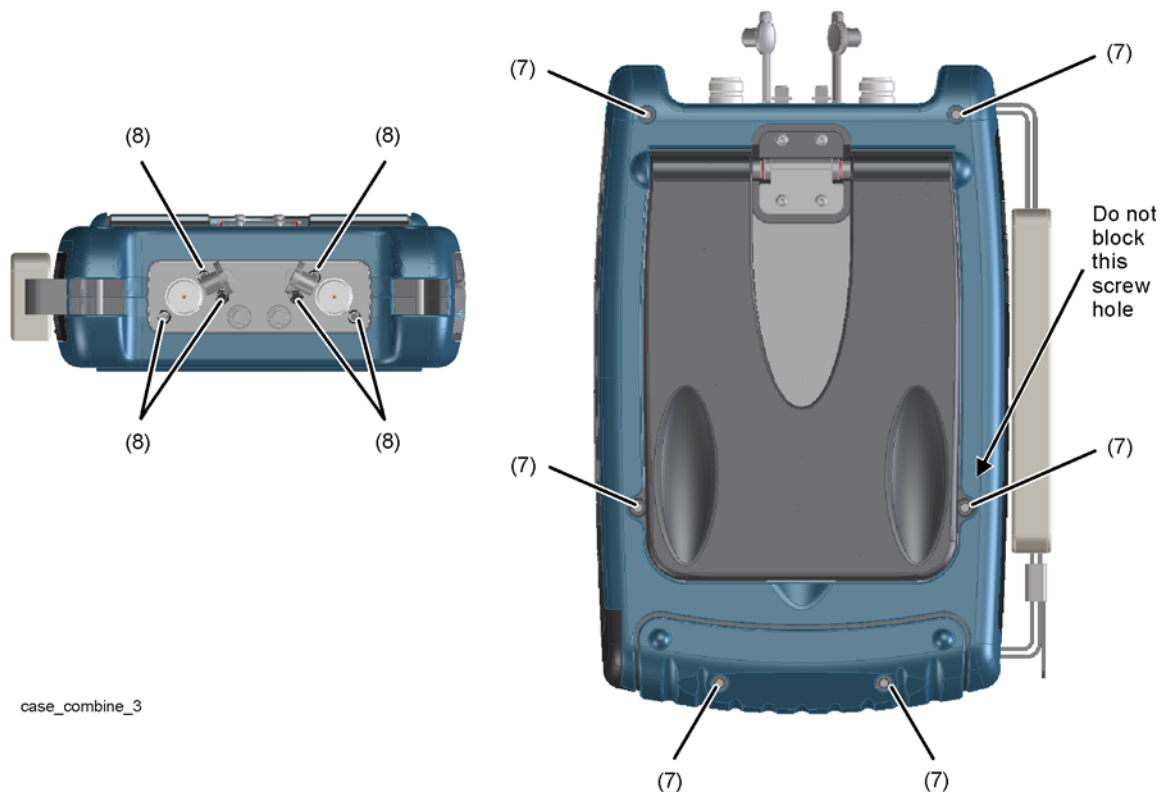
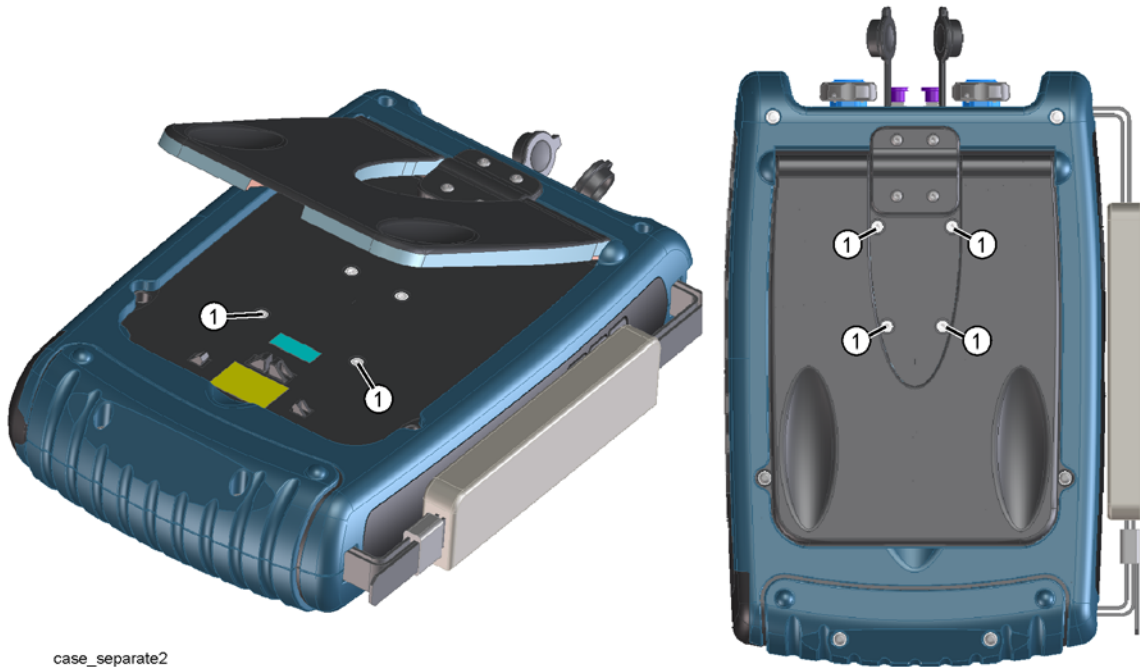


Figure 7-17 Combining the Front and Rear Cases (N995xA, N996xA)



13.For N995xA and N996xA models only. Refer to [Figure 7-4](#). Place the nut rings onto the RF connectors. Using a 1.5 mm Allen torque screwdriver, tighten the 3 Allen screws on each nut ring. Torque to 24 ozf-in.

14.Reinstall the battery. Refer to [“Removing and Replacing the Main Battery”](#) on page 111.

Removing and Replacing the Front Panel Group Assemblies

Tools Required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 9 in-lb)
- 7/16-inch hex nut wrench or “nut driver” (set to 9 in-lb)
- **Repair and Re-assembly Kit**. Refer to **“Miscellaneous Parts” on page 104**.
- Soldering tool (Required only for RTC battery replacement.)

WARNING

Before beginning any repair, disconnect the power cord.

Pre-replacement Procedure

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117**.
2. Remove the measurement group assemblies (RF top panel, A4 RF board, A5 System board, and A6 SOM board) as one unit with the I/O panel attached. Refer to **“Removing and Replacing the Measurement Group Assemblies” on page 138**.

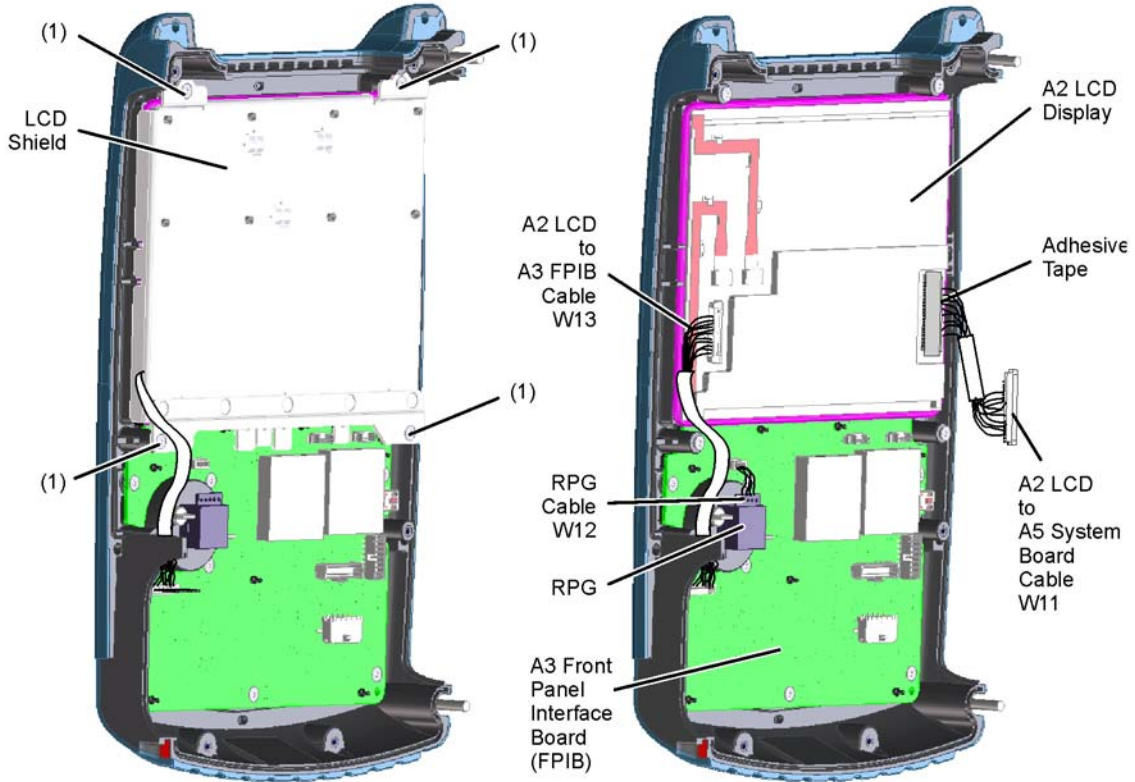
Replacing the RPG and RPG Knob

1. Refer to **Figure 7-18**. Remove the two hole plugs from the back side of the front case, next to the RPG.
2. To replace the RPG knob:
 - a. Insert a round shaft, such as a screwdriver shaft, into the exposed holes and push the RPG knob off of the RPG shaft to the front side of the front case.
 - b. Install a new knob by aligning the D-shaped detent in the knob with the D-shape on the shaft and push the knob into position.
3. To replace the RPG:
 - a. Disconnect the RPG cable, W12, from the A3 front panel interface board.
 - b. Using a 7/16-inch hex nut wrench, remove the hex nut from the RPG shaft.
 - c. Pull the RPG out the back side of the front case and retrieve the lock washer from the front side.

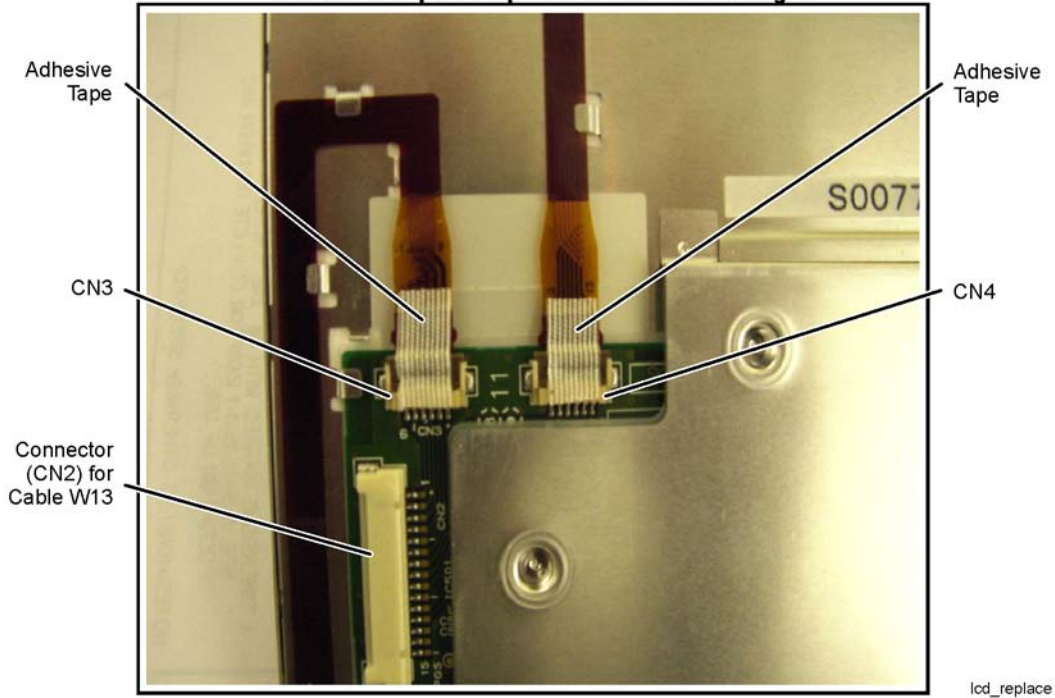
Replacing the A2 LCD, the LCD Shield, and LCD Cables

1. Perform the steps under **“Pre-replacement Procedure”** on page 132.
2. Refer to **Figure 7-19**. To replace the LCD shield:
 - a. Remove the four screws **(1)** that attach the LCD shield and discard them. New screws are provided in the **Repair and Re-assembly Kit**.
 - b. Lift the LCD shield off of the A2 LCD.
 - c. Place the new LCD shield in position on the A2 LCD and secure it with four new screws **(1)**. These screws are provided in the **Repair and Re-assembly Kit**.
3. To replace the LCD cables and the A2 LCD:
 - a. Disconnect the A2 LCD to A3 FPIB cable, W13, at the A2 LCD.
 - b. Note the location of the adhesive tape over the connector on the A2 LCD to A5 System board cable, W11. Remove the tape and disconnect the cable.
 - c. Remove the A2 LCD from the front case.
 - d. Place the new A2 LCD in position and re-connect the cables.
 - e. Place a strip of adhesive tape over the LCD connector end of the A2 LCD to A5 System board cable W11, in the same location as the old strip and as shown. A new strip of adhesive tape is provided in the **Repair and Re-assembly Kit**.
 - f. Refer to **Figure 7-19**. Connectors CN3 and CN4, near the connector for cable W13, should be covered by a strip of adhesive tape as shown. If not, cut a strip of adhesive tape (provided) in half and apply to each connector. Press down firmly on the tape to conform it to the contours of the connectors and to ensure proper adhesion.
 - g. Reinstall the LCD shield with four new screws provided in the **Repair and Re-assembly Kit**.
4. Perform the steps under **“Final Assembly Procedure”** on page 166.

Figure 7-19 Replacing the A2 LCD, the LCD Shield, and LCD Cables



**The LCD shield was removed for the photo below.
CN3 and CN4 provide power for the LCD backlight.**



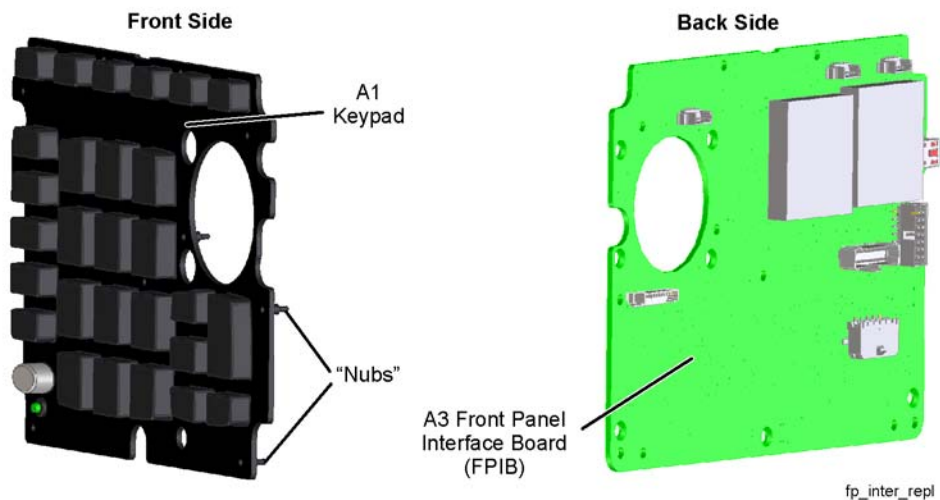
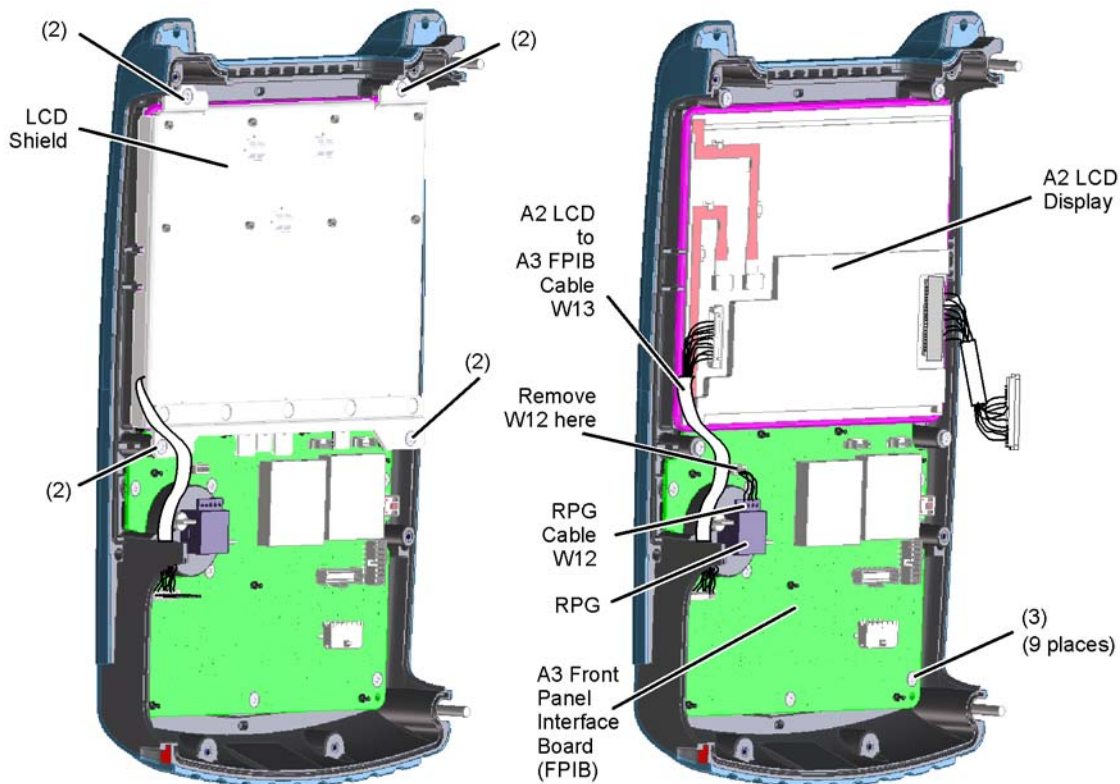
Replacing the A3 Front Panel Interface Board (FPIB)

IMPORTANT

The A3 front panel interface board contains a Lithium-ion battery. Refer to [“Battery Disposal” on page 18](#) for important instructions on disposing of this printed circuit board with the battery attached. If necessary, the battery can be removed from the printed circuit board and disposed of separately.

1. Perform the steps under [“Pre-replacement Procedure” on page 132](#).
2. Refer to [Figure 7-20](#). Remove the four screws (2) that secure the LCD shield and remove the LCD shield. Discard the four screws, new ones are provided in the [Repair and Re-assembly Kit](#). Be careful. The A2 LCD display is now loose and will fall out of the front case if the case is tipped.
3. Disconnect the RPG cable, W12, at the A3 FPIB connector as indicated.
4. Disconnect the A2 LCD to FPIB cable, W13, at the A3 FPIB connector as indicated.
5. Remove the nine screws (3) that secure the A3 FPIB to the front case.
6. Push the nine rubber “nubs” through the A3 FPIB to release the A1 keypad. The A1 keypad is permanently attached to the front case and must remain.
7. Position the new A3 FPIB in the front case over the A1 keypad and, using needle-nose pliers, pull the nine rubber “nubs” on the A1 keypad through the holes in the A3 FPIB. Make sure that all nine of the rubber “nubs” are fully extended on the back side of the A3 FPIB.
8. Secure the A3 FPIB to the front case with nine new screws (3) provided in the [Repair and Re-assembly Kit](#).
9. Re-connect the A2 LCD to FPIB cable, W13, to the A3 FPIB connector as indicated. Route the cable as shown.
10. Re-connect the RPG cable, W12, to the A3 FPIB connector as indicated, with the A2 LCD to A3 FPIB cable, W13, passing beneath it as shown. Bend the RPG cable toward the right side as shown.
11. Place the LCD shield back in position on the A2 LCD. Make sure that the A2 LCD to A3 FPIB cable, W13, is routed between, not under, the shield gaskets.
12. Secure the shield with four new screws (2) provided in the [Repair and Re-assembly Kit](#).
13. Perform the steps under [“Final Assembly Procedure” on page 166](#).

Figure 7-20 Replacing the A3 Front Panel Interface Board



Removing and Replacing the Measurement Group Assemblies

Tools Required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 9 in-lb)
- Small flat blade screwdriver
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- 9/16-inch open-end torque wrench (set to 21 in-lb)
- **Repair and Re-assembly Kit**. Refer to **“Miscellaneous Parts” on page 104**.

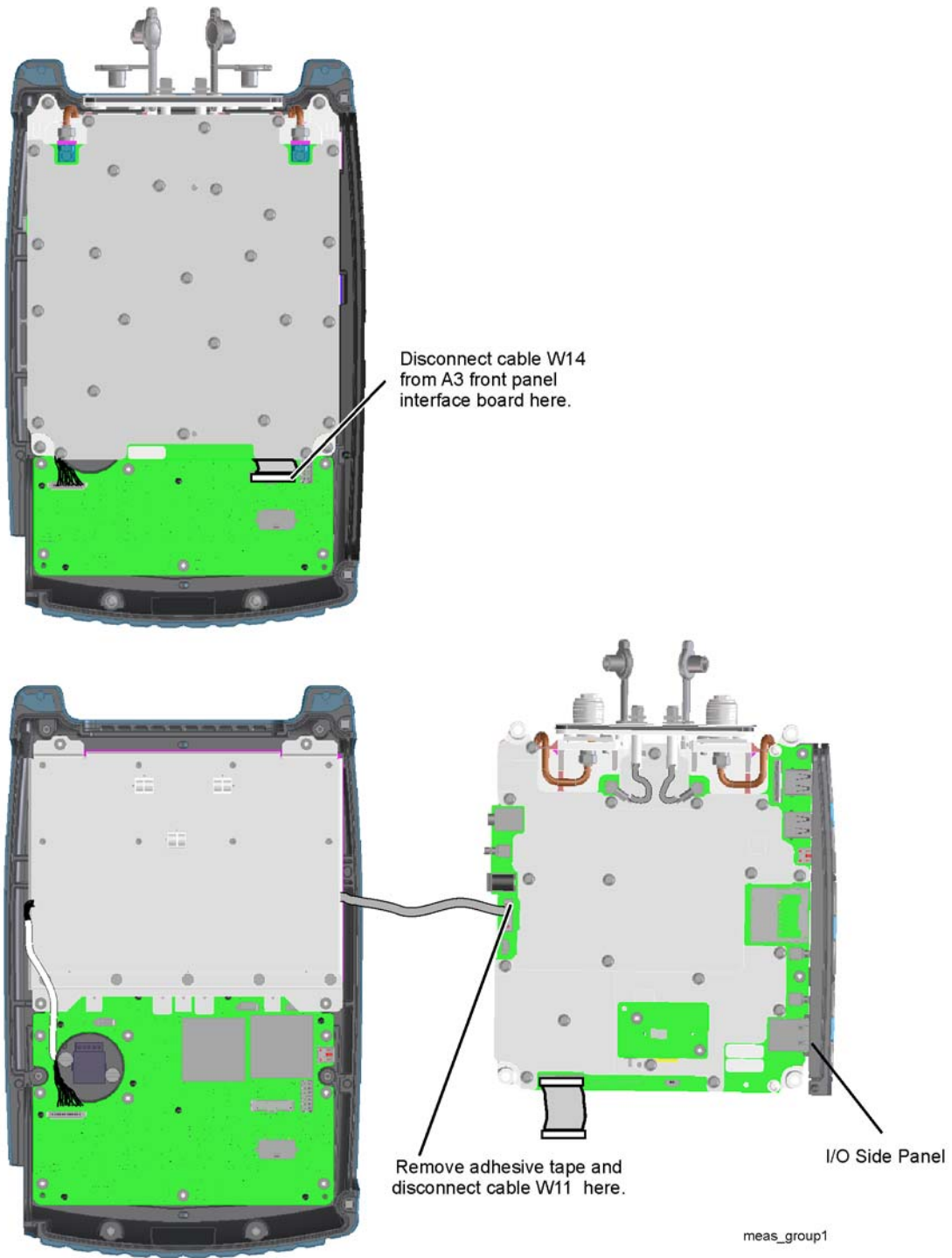
WARNING

Before beginning any repair, remove the battery and disconnect external power.

Removing All Measurement Group Assemblies as One Unit

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117**.
2. Refer to **Figure 7-21**. Disconnect the A5 System board to A3 FPIB cable, W14, at the A3 FPIB connector using the small flat blade screwdriver. If replacing this cable, disconnect both ends.
3. Lift the measurement group assemblies out of the front case and position them to the side of the front case as shown.
4. Disconnect the A2 LCD to A5 System board cable, W11, at the A5 System board connector. It is necessary to first remove the adhesive tape that is over the connector. To replace this cable, refer to **“Replacing the A2 LCD, the LCD Shield, and LCD Cables” on page 134**.
5. The measurement group assemblies are now completely separated from the analyzer.
6. To remove the I/O panel, refer to **“Replacing the I/O Side Panel, Doors, and Gasket” on page 122**.

Figure 7-21 Removing All Measurement Group Assemblies as One Unit



Removing and replacing the RF Top Panel Assembly

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. For N991xA, N992xA, and N993xA models, refer to **Figure 7-22.** Disconnect cable W3 and W4. Remove the six screws **(1)** and lift the RF top panel over the RF connectors.
4. For N995xA, N996xA models, refer to **Figure 7-23.** Disconnect cable W3 and W4. Remove the eight screws **(1)** and lift the RF top panel over the RF connectors.
5. To replace, position the RF top panel over the RF connectors and loosely reinstall the six or eight screws **(1)**. Do not tighten these screws at this time; they will be tightened after the front and rear cases have been combined.
6. Connect cable W3 and W4 to the A5 System board connectors. There should be an audible click when the connector is fully in place.
7. Position (tuck) the cables W3 and W4 into the cavity above the A5 System board to avoid interference with nearby parts.
8. Plug the two connector plugs (tethered caps) back into the RF connectors to protect the connectors.
9. Perform the steps under **“Final Assembly Procedure” on page 166.**

Figure 7-22 Replacing the RF Top Panel Assembly (N991xA, N992xA, N993xA)

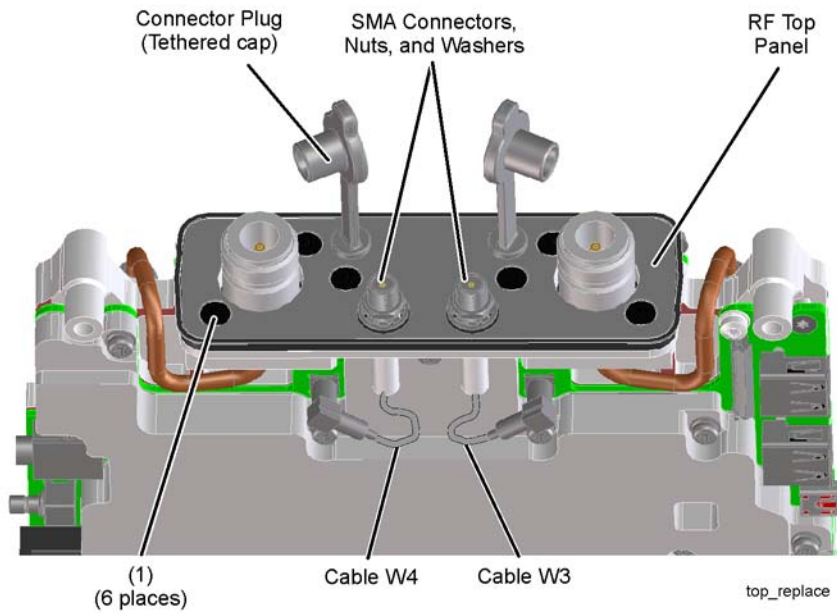
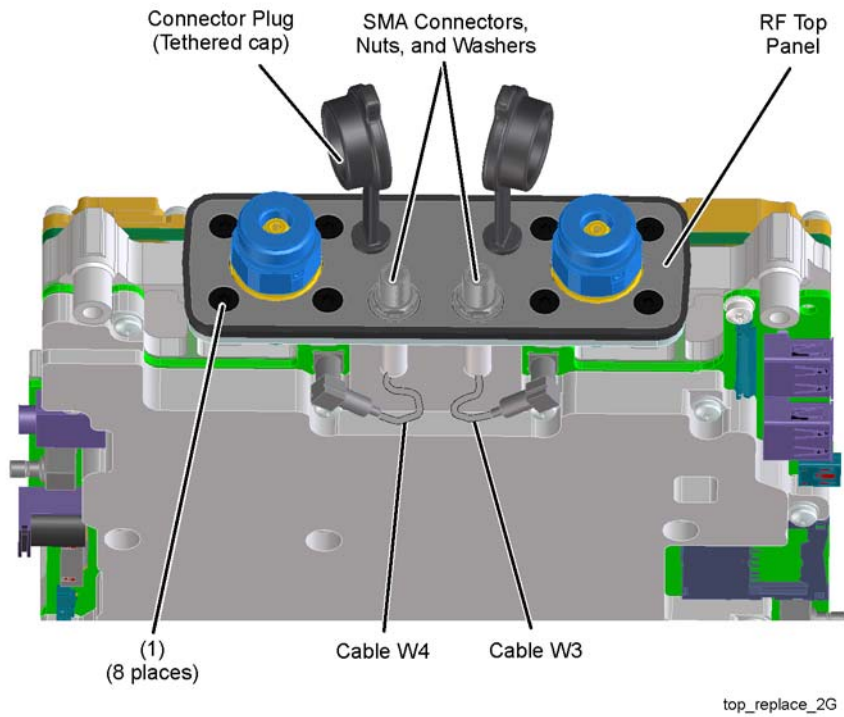


Figure 7-23 Replacing the RF Top Panel Assembly (N995xA, N996xA)

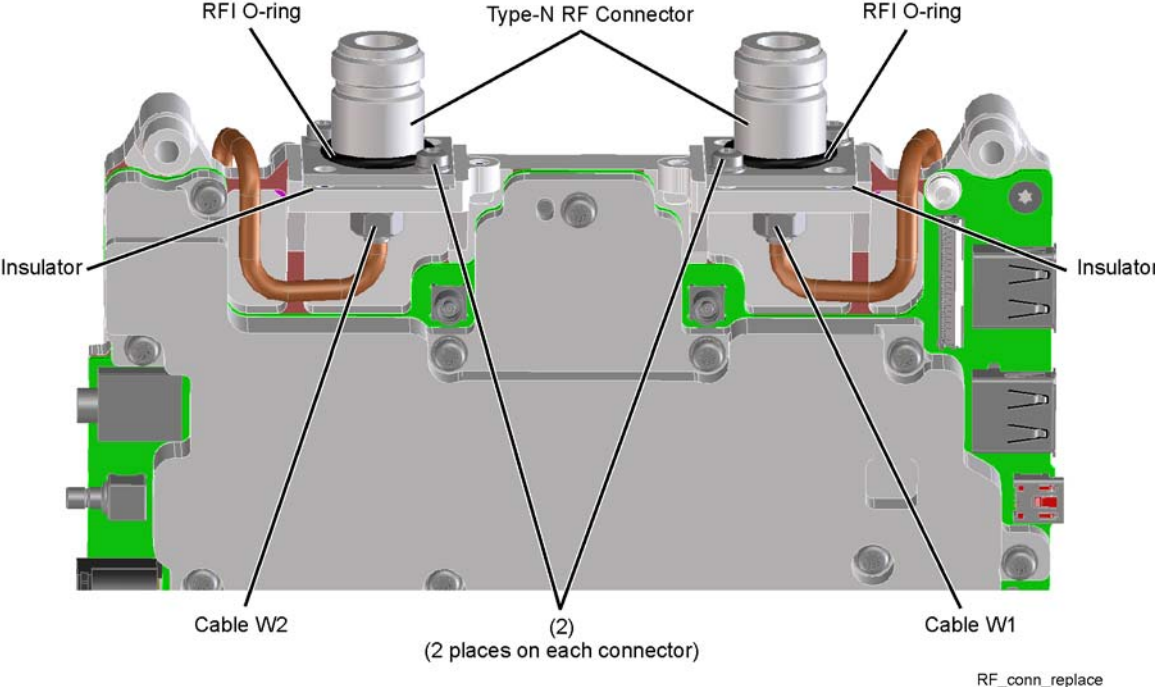


Replacing the Type-N RF Connectors and RF Cables (N991xA, N992xA, N993xA)

1. Separate the front and rear cases. See [“Separating the Front and Rear Cases” on page 117](#).
2. Remove all measurement group assemblies as one unit. Refer to [“Removing All Measurement Group Assemblies as One Unit” on page 138](#).
3. Remove the RF top assembly. Refer to [“Removing and replacing the RF Top Panel Assembly” on page 140](#).
4. Refer to [Figure 7-24](#). Disconnect the cable connector nut on cable W1 or W2, depending on which connector or cable is being replaced. Do not attempt to remove the cable, just release the connector nut.
5. Remove the two screws (2) from the type-N RF connector to be replaced.
6. Lift the type-N RF connector upwards and out of the RF bottom shield.
7. The RF input cable can now be replaced by disconnecting the other end of the cable and removing it. When installing the new cable, do not tighten either of the cable connector nuts until both of them have been installed finger tight.
8. Remove the RFI O-ring.
9. Remove the old insulator and install a new one.
10. Position the new type-N RF connector in the RF bottom shield, making sure that it aligns with the cable connector underneath. Loosely install the cable connector nut.
11. Install a new RFI O-ring over the new type-N RF connector in the position shown.
12. Loosely reinstall the two screws (2). Note the location for these two screws in the illustration. To ensure proper alignment, install two additional screws, finger tight, in the two empty holes in the type-N RF connector, then tighten the two screws that secure the connector. Remove the two alignment screws.
13. Tighten the cable connector nut(s) on cable W1 or W2.
14. Continue with [step 5](#) of the [Removing and replacing the RF Top Panel Assembly](#) procedure on [page 140](#).
15. Perform the steps under [“Final Assembly Procedure” on page 166](#).

Figure 7-24

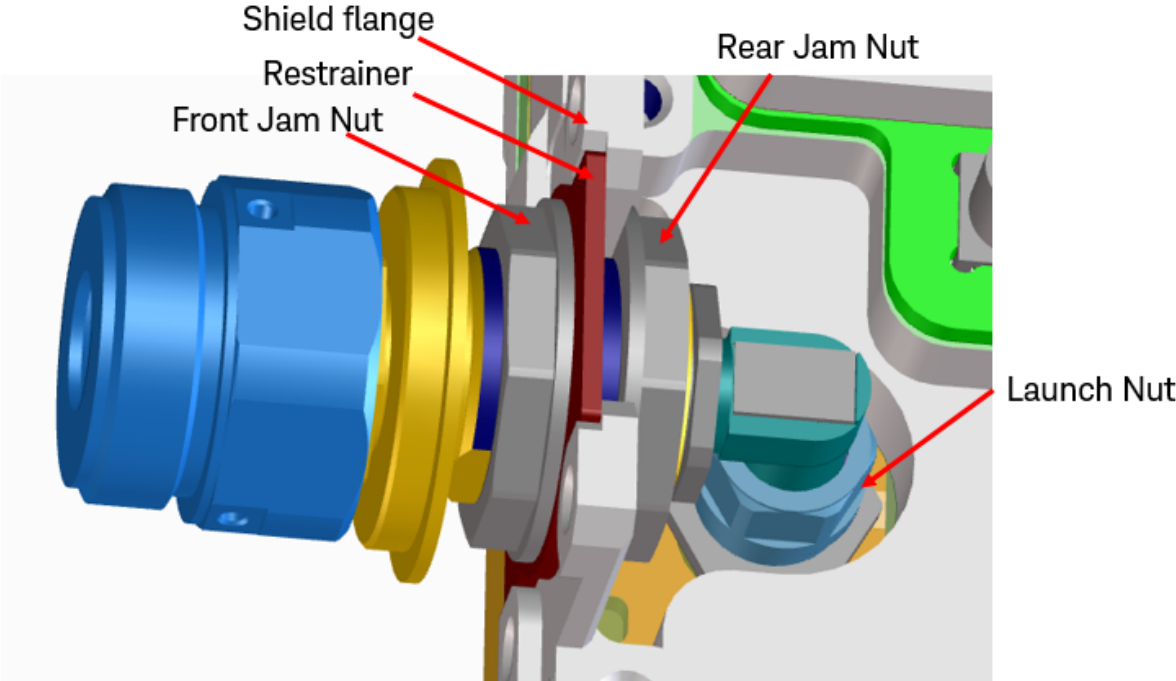
Replacing the Type-N RF Connectors and RF Cables
(N991xA, N992xA, N993xA)



Replacing the 2.4mm Test Port Connector (N995xA, N996xA)

1. Separate the front and rear cases. See **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. Remove the RF top assembly. Refer to **“Removing and replacing the RF Top Panel Assembly” on page 140.**
4. The 2.4mm test port connector can now be replaced by disassembling the nuts as below (refer to **Figure 7-25**):
 - a. Use break-over wrench, (PN: 8710-2792) to loosen front jam nut.
 - b. Use in-line torque screw driver with 5/16" deep socket (PN: 8710-2794) to loosen launch nut.
 - c. Use mini break-over wrench (PN: 8710-2793) to loosen rear jam nut.
5. Lift the 2.4mm test port connector upwards and out of the RF bottom shield.
6. Position the new 2.4mm test port connector onto the RF board and ensure restrainer is fully seated into pocket on shield flange. Follow the steps below (refer to **Figure 7-25**):
 - a. Use mini break-over wrench (PN: 8710-2793) to secure rear jam nut to 16 ozf-in.
 - b. Use in-line torque screw driver with 5/16" deep socket (PN: 8710-2794) to secure launch nut to 10 lbf-in.
 - c. Use break-over wrench, (PN: 8710-2792) to secure front jam nut to 35 lbf-in.
7. Install a new O-ring gasket over the new 2.4mm connector.
8. Continue with **step 5** of the **Removing and replacing the RF Top Panel Assembly** procedure on **page 140.**
9. Perform the steps under **“Final Assembly Procedure” on page 166.**

Figure 7-25 Replacing the 2.4mm Test Port Connectors
(N995xA, N996xA)



Replacing the Real Time Clock (RTC) Battery Located on the A5 System Board Shield

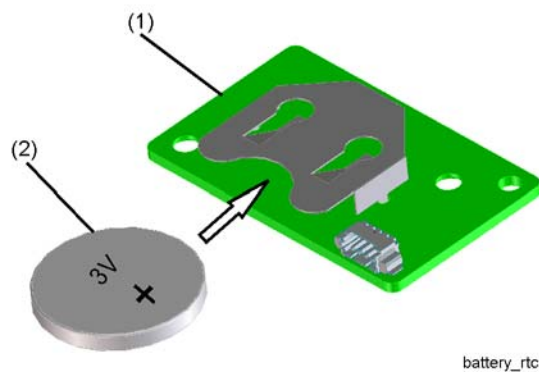
IMPORTANT

The RTC battery is a Lithium-ion battery and must be disposed of properly. Refer to [“Battery Disposal” on page 18](#) for important instructions on disposing of this battery.

1. Perform the steps under [“Pre-replacement Procedure” on page 132](#).
2. Refer to [Figure 7-27](#). Disconnect W17 from the System board.
3. Remove the two screws (2) that attach the RTC board (1) to the System board shield.
4. Refer to [Figure 7-26](#). The RTC battery slips into the carrier on the RTC board with the positive polarity side facing up.
5. Place the RTC board onto the System board shield with the battery towards the shield and secure with the two screws. Torque to 9 in-lbs.
6. Reconnect W17 to the System board.
7. Perform the steps under [“Final Assembly Procedure” on page 166](#).

Figure 7-26

Replacing the RTC Battery



Replacing the A6 SOM Board

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. To replace the A6 SOM board:
 - a. Refer to **Figure 7-27.** Remove the RTC board. Refer to **“Replacing the Real Time Clock (RTC) Battery Located on the A5 System Board Shield” on page 146.**
 - b. For N995xA and N996xA models, it is necessary to remove the top panel assembly. Refer to **“Removing and replacing the RF Top Panel Assembly” on page 140.**
 - c. Remove the System board shield by removing the 19 screws (2). Discard the screws, new ones are provided in the **Repair and Re-assembly Kit.**
 - d. Refer to **Figure 7-28.** Remove the four screws (2) that secure the A6 SOM board (1) to the A5 System board. Discard these screws; new ones are provided in the **Repair and Re-assembly Kit.**
 - e. Unplug the A6 SOM board from the A5 System board.
 - f. Plug the new A6 SOM board into the A5 System board.
 - g. Install four new screws (2) from the **Repair and Re-assembly Kit** and tighten them in the torque sequence indicated by the circled numbers (1 - 2 - 3 - 4) in the illustration.
 - h. Replace the System board shield. Refer to **Figure 7-31.** Place the System shield onto the System board by aligning the dowel pins. Replace the nineteen shield screws. Torque these screws (disregarding the two System board screws, #13 and #21) in the sequence shown by the circled numbers (1 - 21). Repeat this torque sequence one additional time. Torque to 12 in-lbs.
 - i. For N995xA and N996xA models, replace the top panel assembly. Refer to **“Removing and replacing the RF Top Panel Assembly” on page 140.**
 - j. Place the RTC board onto the System board shield and secure with the two screws. Torque to 9 in-lbs.
4. Perform the steps under **“Final Assembly Procedure” on page 166.**

Figure 7-27 Remove System Board Shield

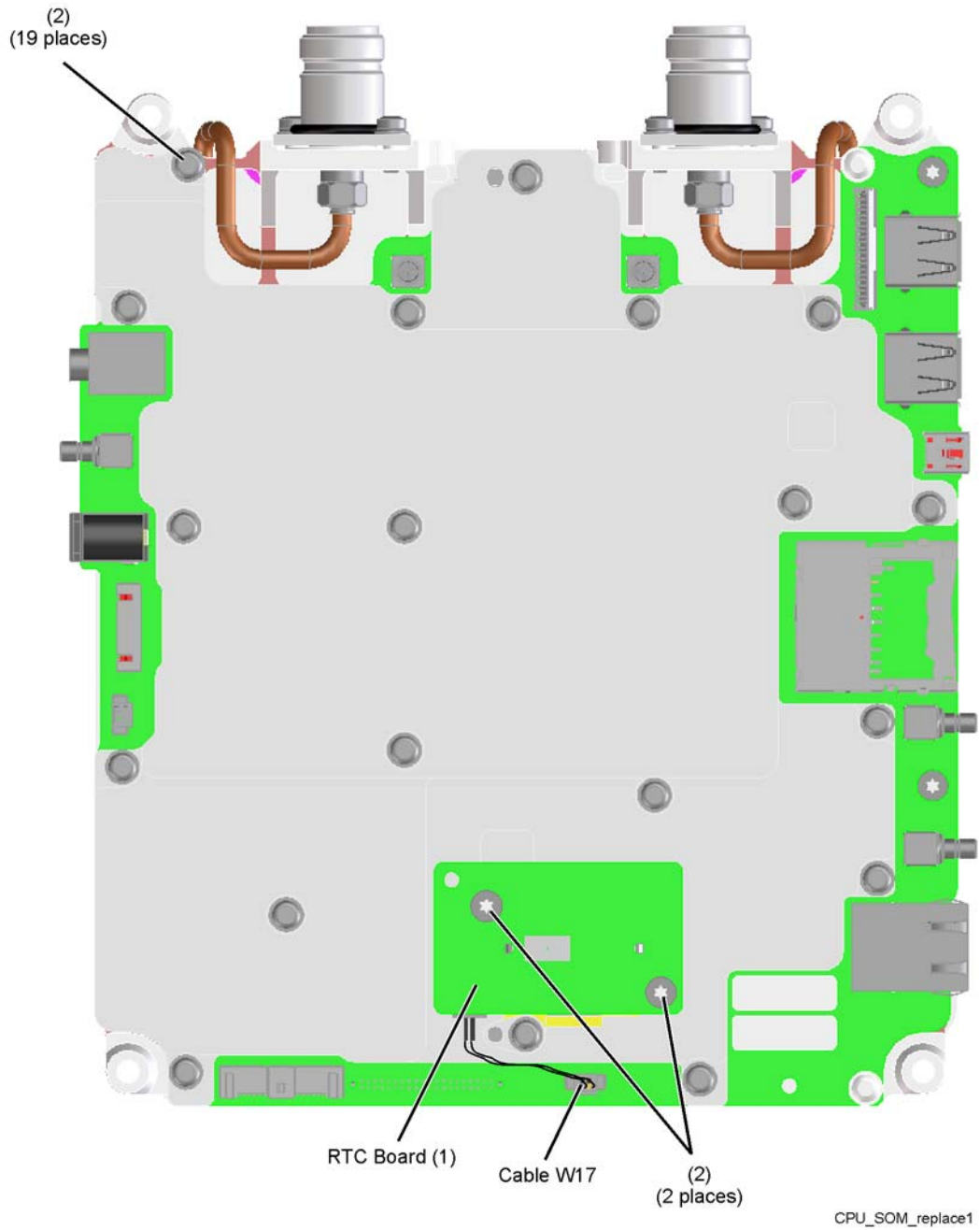
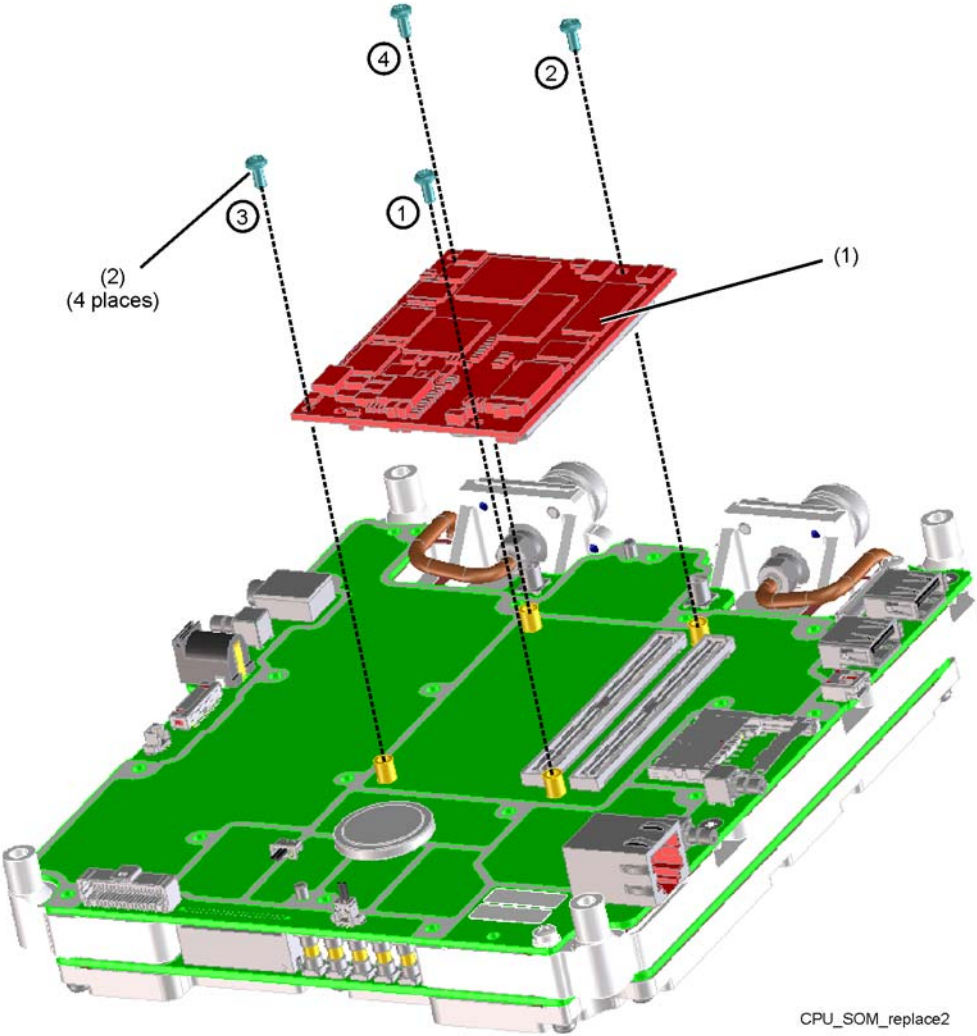


Figure 7-28 Replacing the A6 SOM Board



Replacing the A5 System Board

1. Separate the front and rear cases. See **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. Remove the I/O side panel. Refer to **“Replacing the I/O Side Panel, Doors, and Gasket” on page 122.**
4. Disconnect cable W3 and W4 from the A5 System board.
5. For N995xA, N996xA models, it is necessary to remove the top panel assembly. Refer to **“Removing and replacing the RF Top Panel Assembly” on page 140.**
6. Refer to **Figure 7-27.** Remove the RTC board. Refer to **“Replacing the Real Time Clock (RTC) Battery Located on the A5 System Board Shield” on page 146.**
7. Remove the System board shield by removing the nineteen screws **(2)**. Discard the screws, new ones are provided in the **Repair and Re-assembly Kit.**
8. Refer to **Figure 7-28.** Remove the four screws **(2)** that secure the A6 SOM board **(1)** to the A5 System board. Discard these screws; new ones are provided in the **Repair and Re-assembly Kit.**
9. Unplug the A6 SOM board from the A5 System board.
10. Refer to **Figure 7-29.** Remove the two screws **(1)** from the A5 System board, lift it up from the RF bottom shield, and unplug it from the A4 RF board connector. Discard the screws, new ones are provided in the **Repair and Re-assembly Kit.**
11. Refer to **Figure 7-30.** Plug in the new A5 System board to the A4 RF board, over the new gasket, and aligned with the three dowel pins in the RF bottom shield. Make sure the bullets are straight up when connecting the System and RF boards.
12. Refer to **Figure 7-28.** Replace the SOM board onto the System board. Install four new screws **(2)** from the **Repair and Re-assembly Kit** and tighten them in the torque sequence indicated by the circled numbers (1 - 2 - 3 - 4) in the illustration.
13. Refer to **Figure 7-31.** Place the System shield onto the System board by aligning the dowel pins. Replace the nineteen shield screws. Torque these screws (plus the two System board screws, #13 and #21) in the sequence shown by the circled numbers (1 - 21). Repeat this torque sequence one additional time. Torque to 12 in-lbs.
14. Place the RTC board onto the System board shield and secure with the two screws. Torque to 9 in-lbs.

- 15.** Remove the System board to FPIB cable (W14) from the old A5 System board and install it on the new board.
- 16.** For N995xA, N996xA models, replace the top panel assembly. Refer to [“Removing and replacing the RF Top Panel Assembly” on page 140.](#)
- 17.** Reinstall the I/O side panel. Refer to [“Replacing the I/O Side Panel, Doors, and Gasket” on page 122.](#)
- 18.** Perform the steps under [“Final Assembly Procedure” on page 166.](#)

Figure 7-29 Replacing the A5 System Board

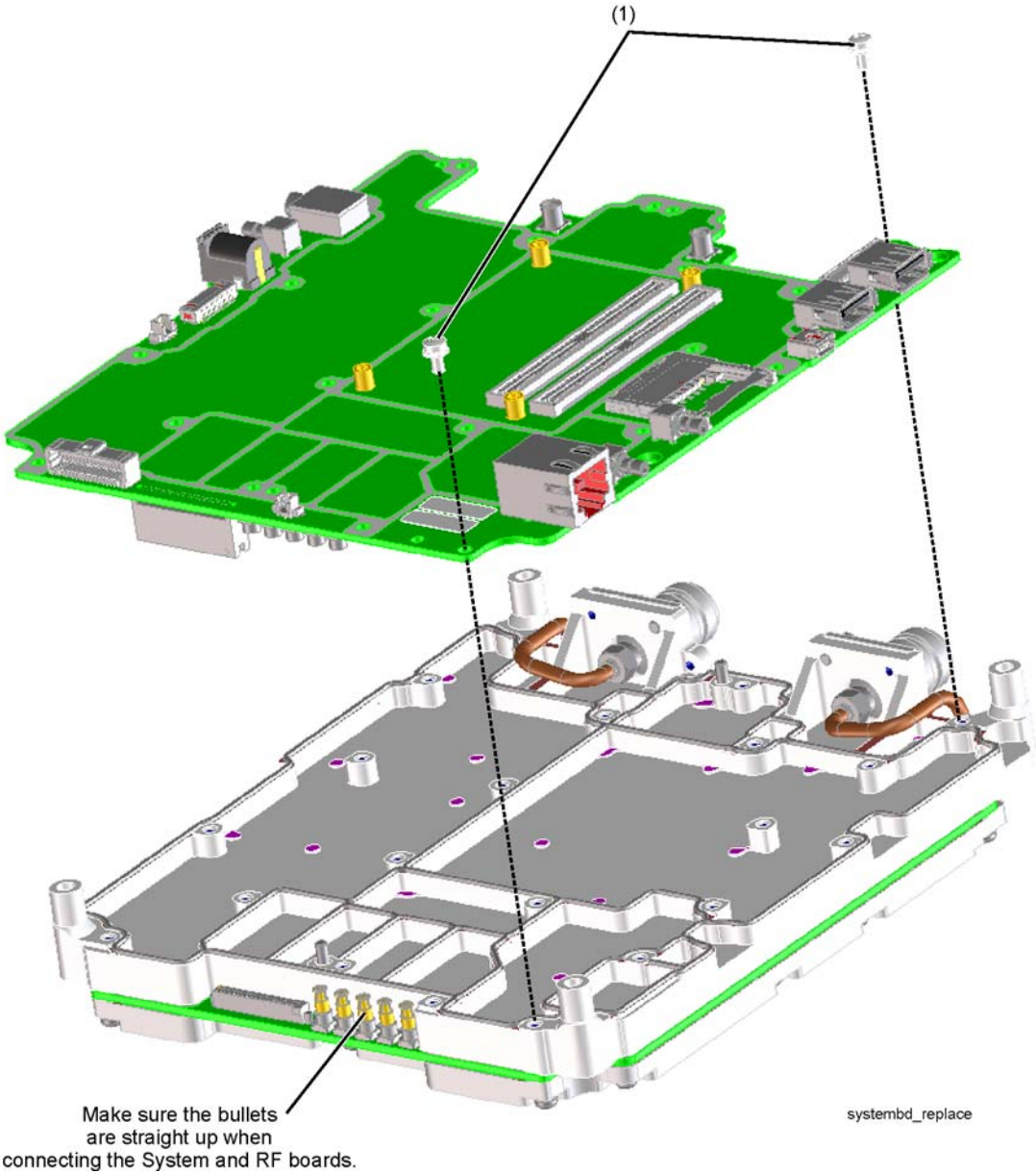


Figure 7-30 Connecting the System Board and the RF Board

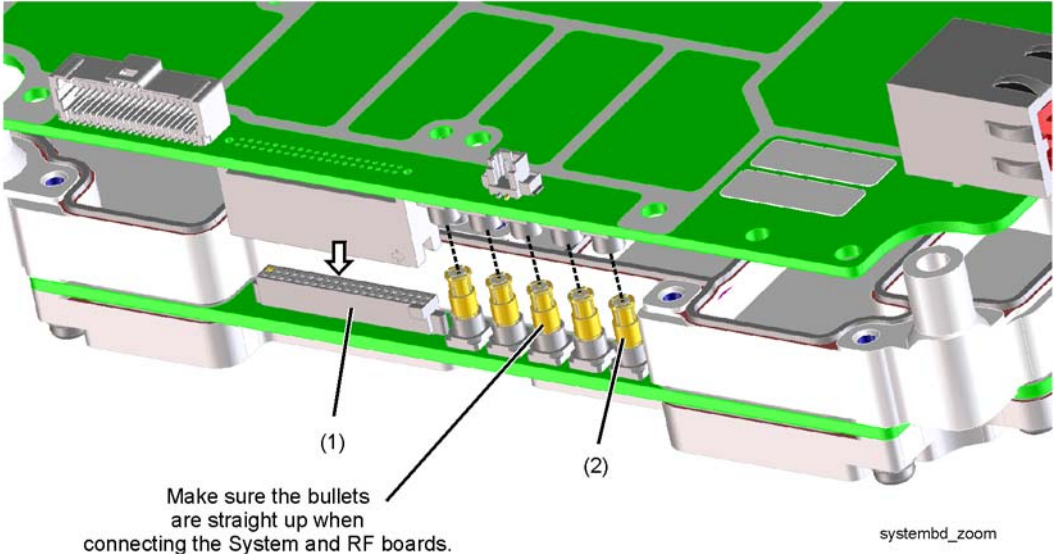
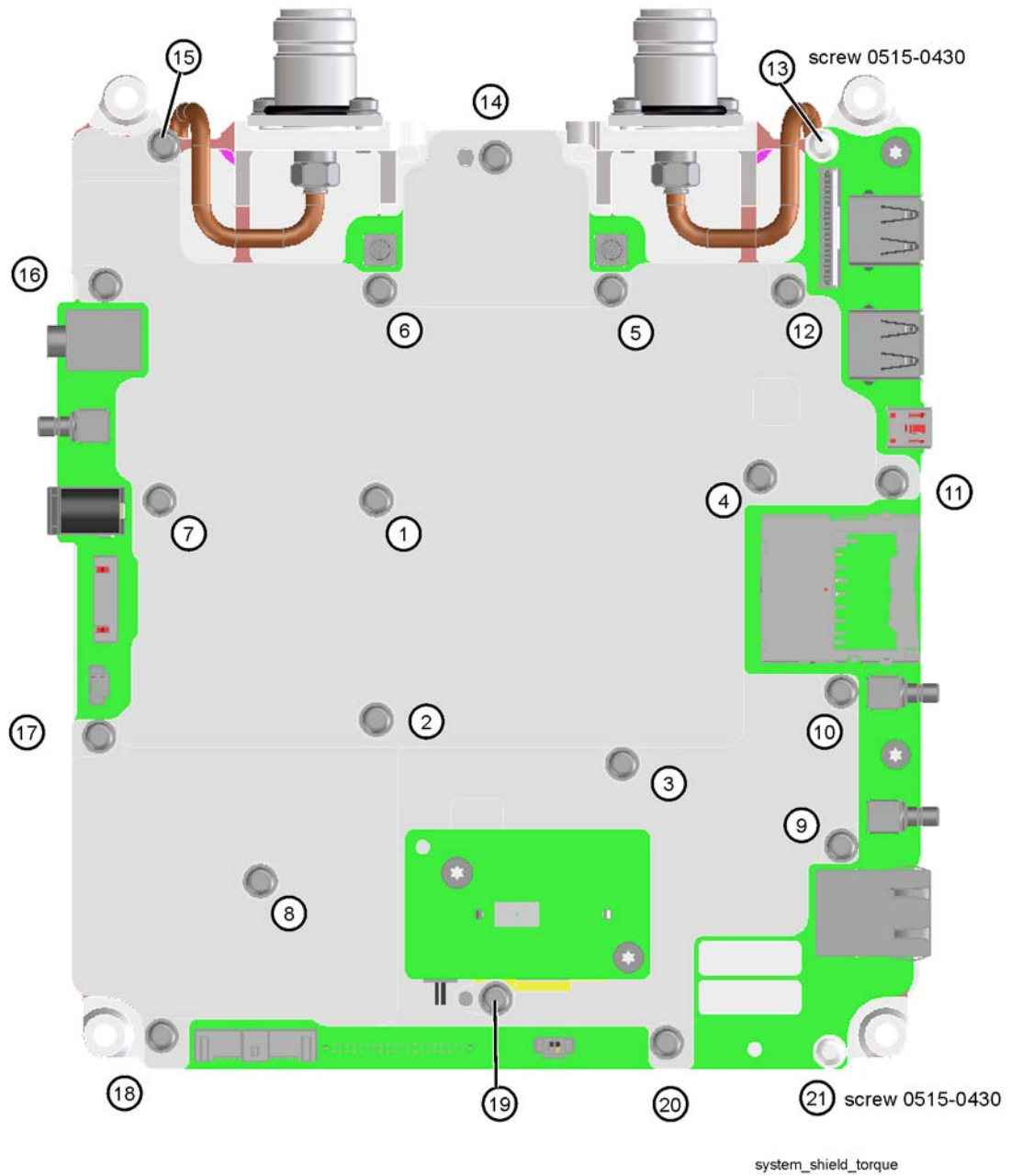


Figure 7-31 System Shield Torque Pattern



Replacing the RF Assembly Including the A4 RF Board (N991xA, N992xA, N993xA)

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. Refer to **Figure 7-24.** Remove cables W1 and W2.
4. Refer to **Figure 7-32.** Remove the twenty-six screws **(2)** attaching the RF board shield to the RF board **(1)**.
5. Refer to **Figure 7-33.** The RF board **(2)** and shield **(2)** can now be separated from the measurement assembly **(1)**.
6. Refer to **Figure 7-30.** Re-connect the A4 RF board to the A5 System board.
7. Refer to **Figure 7-34.** Replace the RF board shield by replacing the twenty-six shield screws. Torque these nineteen shield screws (plus the two System board screws, #13 and #21) in the sequence shown by the circled numbers (1 - 21). Repeat this torque sequence one additional time. Torque to 12 in-lbs.
8. Refer to **Figure 7-24.** Make sure the RFI O-rings are in the correct position on the RF connectors.
9. Perform the steps under **“Final Assembly Procedure” on page 166.**

Figure 7-32 Replacing the A4 RF Board - N991xA, N992xA, N993xA

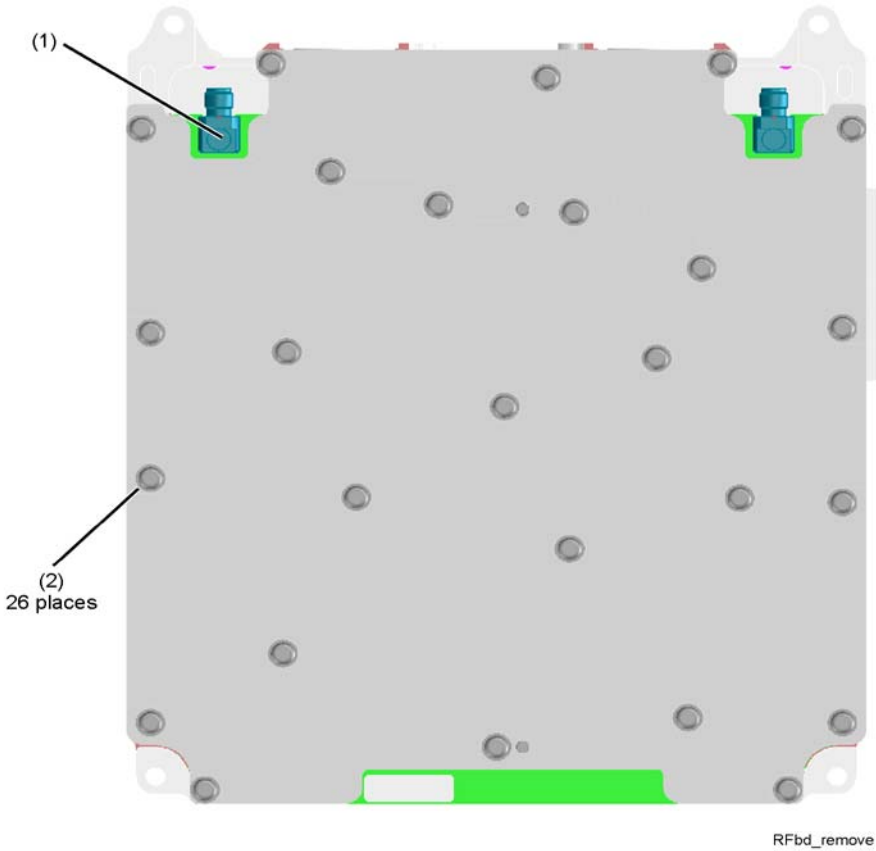


Figure 7-33 RF Board Separation - N991xA, N992xA, N993xA

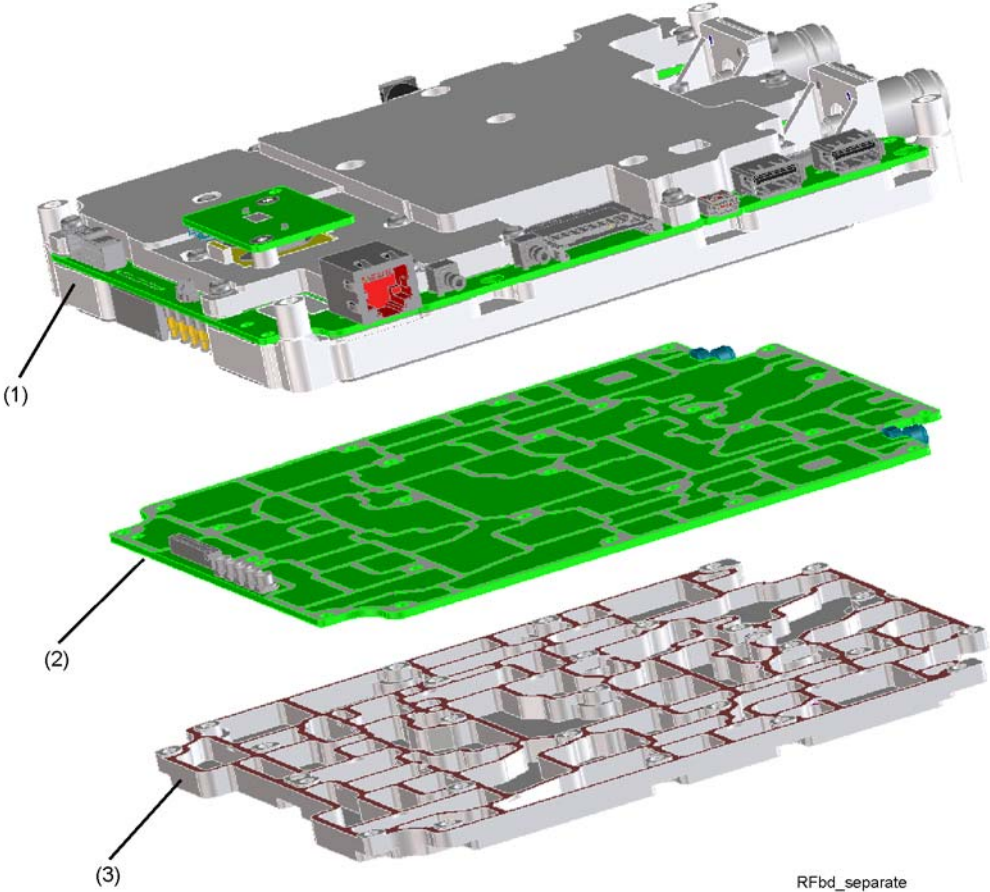
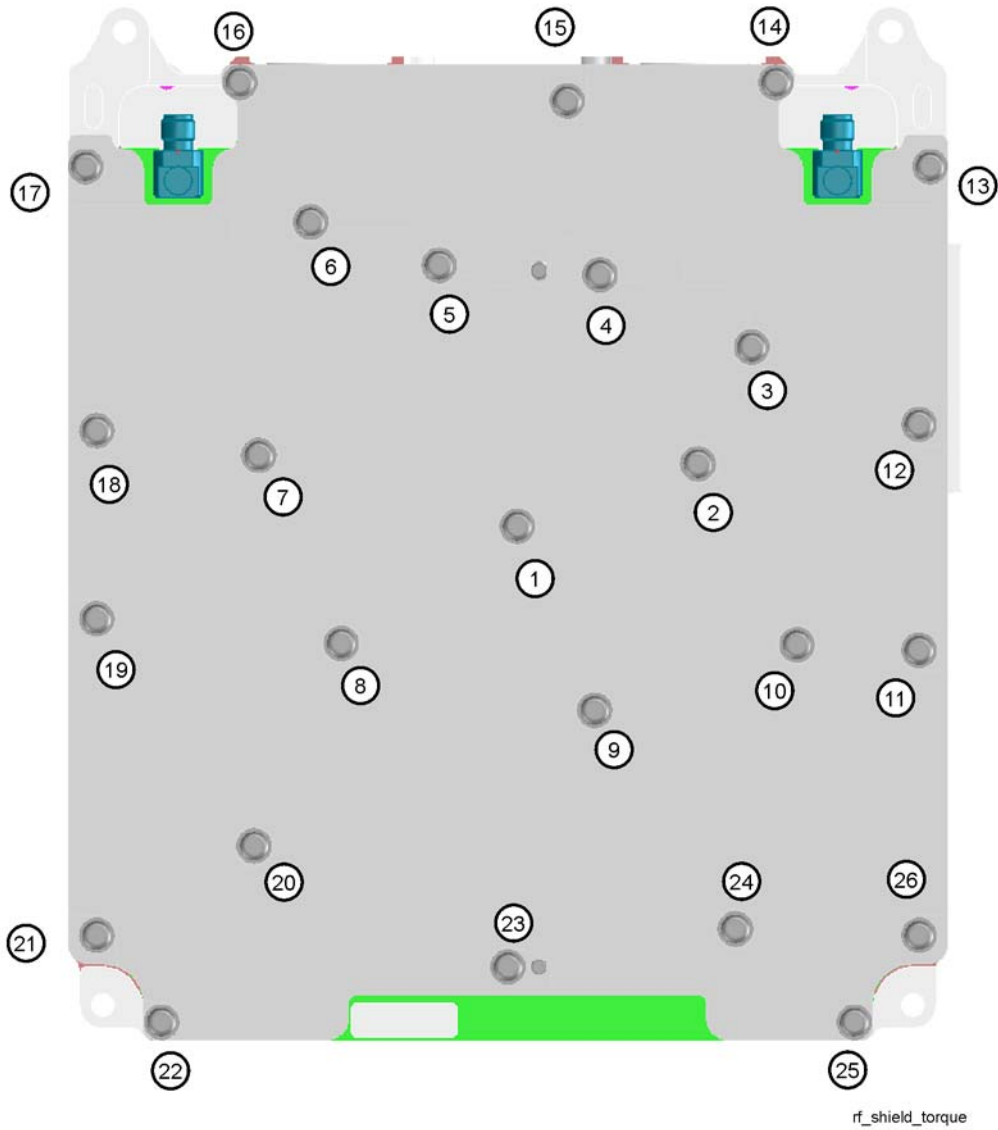


Figure 7-34 RF Shield Torque Pattern - N991xA, N992xA, N993xA



Replacing the RF Assembly Including the A4 RF Board (N995xA, N996xA)

CAUTION

Do *NOT* loosen the 2.4 mm connectors that interface the RF assembly to the airline/test ports. Doing so will invalidate the RF assembly calibration.

1. Separate the front and rear cases. Refer to **“Separating the Front and Rear Cases” on page 117.**
2. Remove all measurement group assemblies as one unit. Refer to **“Removing All Measurement Group Assemblies as One Unit” on page 138.**
3. Refer to **Figure 7-35.** Remove the two screws **(2)** attaching the RTC board **(1)** to the System shield. Unplug cable W17 and remove the RTC board.
4. Refer to **Figure 7-35.** Remove the nineteen shield screws **(3)** and the two System board screws **(4)**.
5. Refer to **Figure 7-36.** The System board and shield can now be separated from the RF assembly.
6. Place the System board on the new RF assembly. Refer to **Figure 7-37.** Plug in the A5 System board to the A4 RF board, and aligned with the three dowel pins in the RF bottom shield. Make sure the bullets are straight up when connecting the System and RF boards.
7. Refer to **Figure 7-38.** Place the System shield onto the System board by aligning the dowel pins. Replace the nineteen shield screws. Torque these screws (plus the two System board screws, #13 and #21) in the sequence shown by the circled numbers (1 - 21). Repeat this torque sequence one additional time. Torque to 12 in-lbs.
8. Place the RTC board onto the System board shield with the battery towards the shield and secure with the two screws. Torque to 9 in-lbs.
9. Reconnect W17 to the System board.
10. Perform the steps under **“Final Assembly Procedure” on page 166.**

Figure 7-35 System Board and Shield Removal - N995xA, N996xA

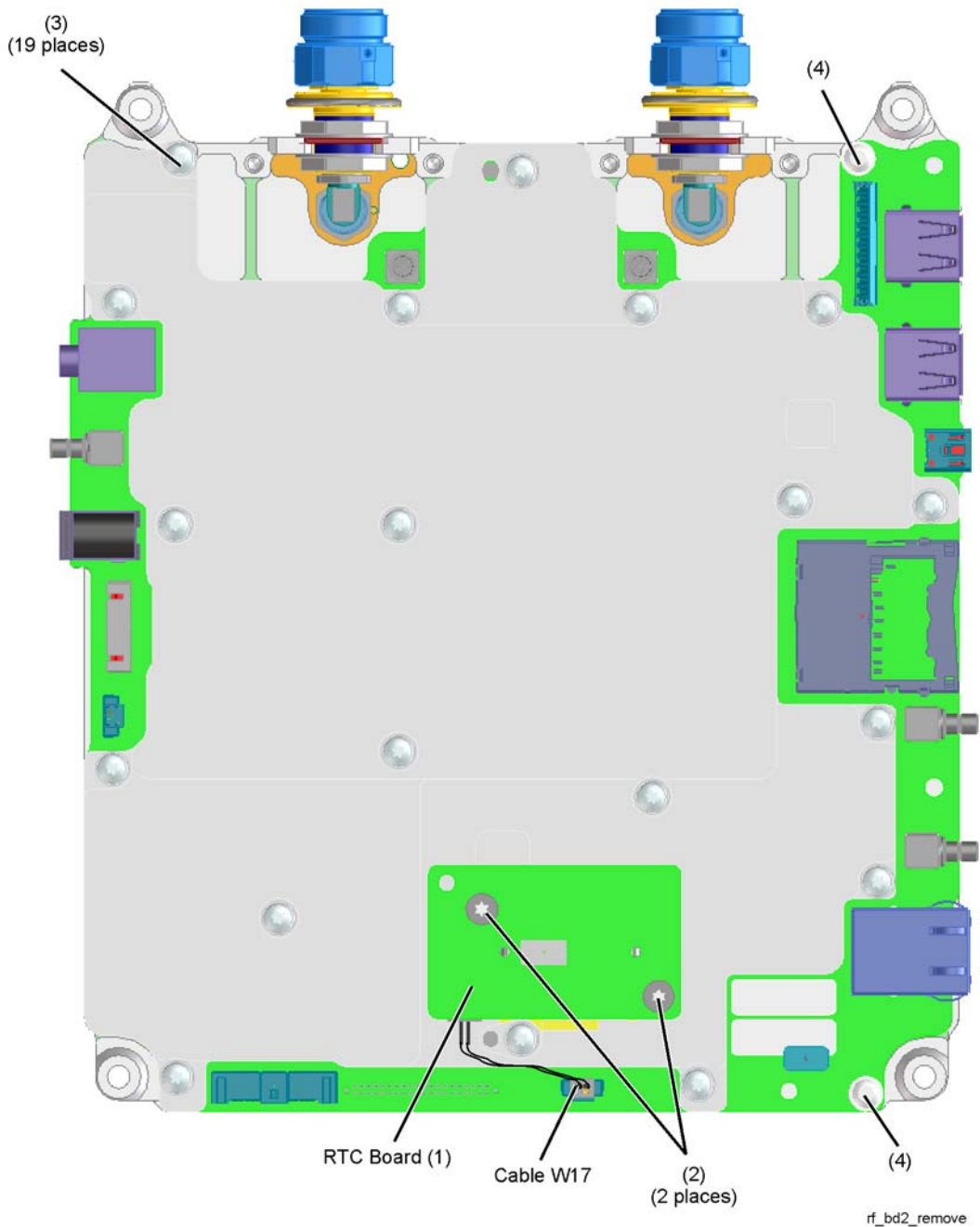


Figure 7-36 RF Assembly Separation from System Board and Shield - N995xA, N996xA

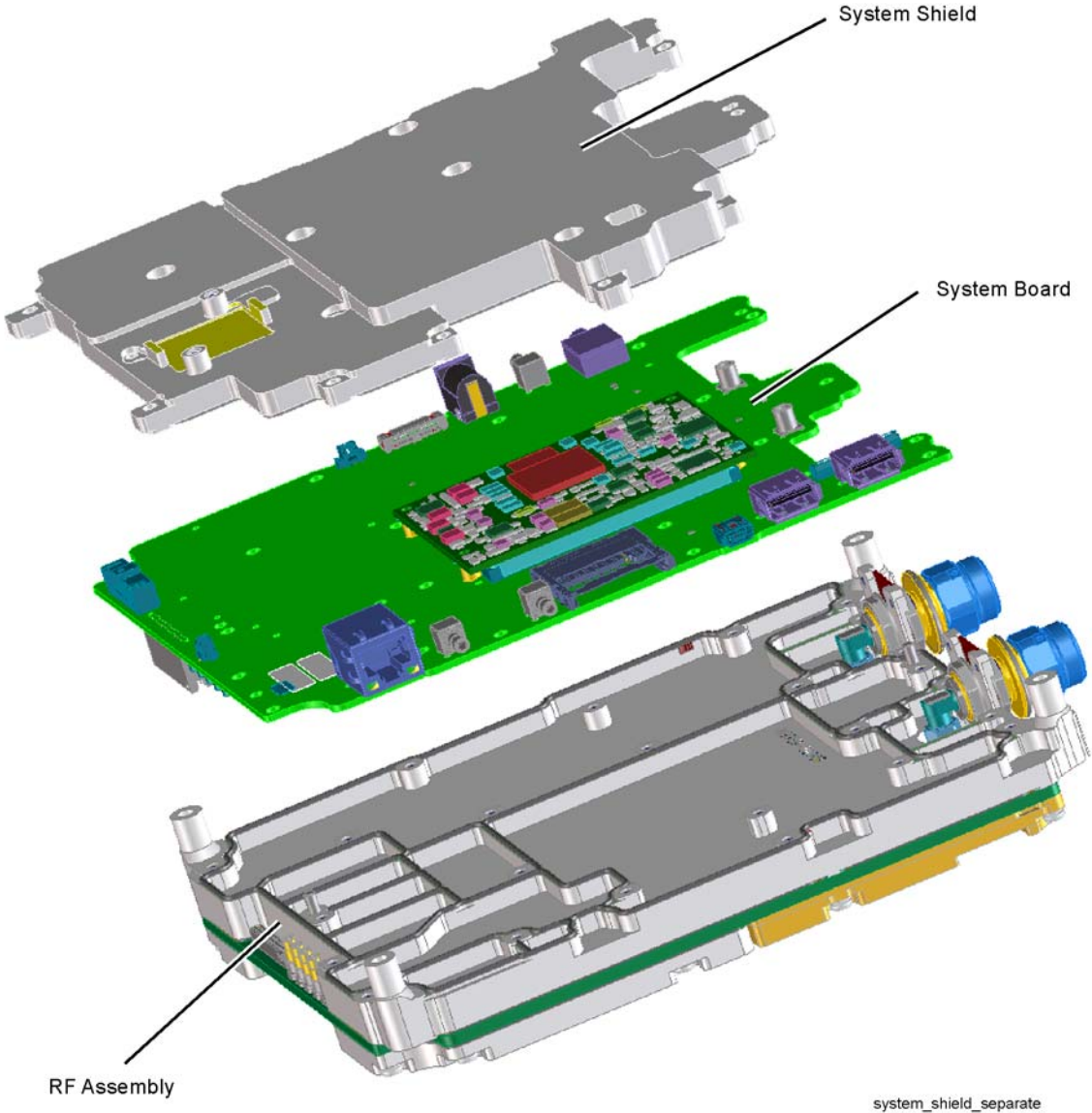


Figure 7-37 Connecting the System Board and the RF Board

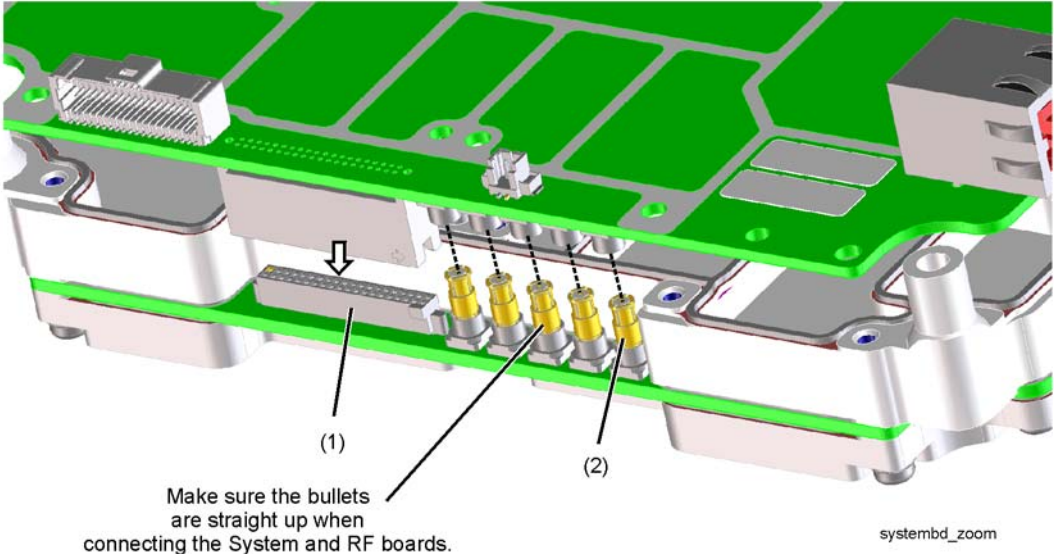
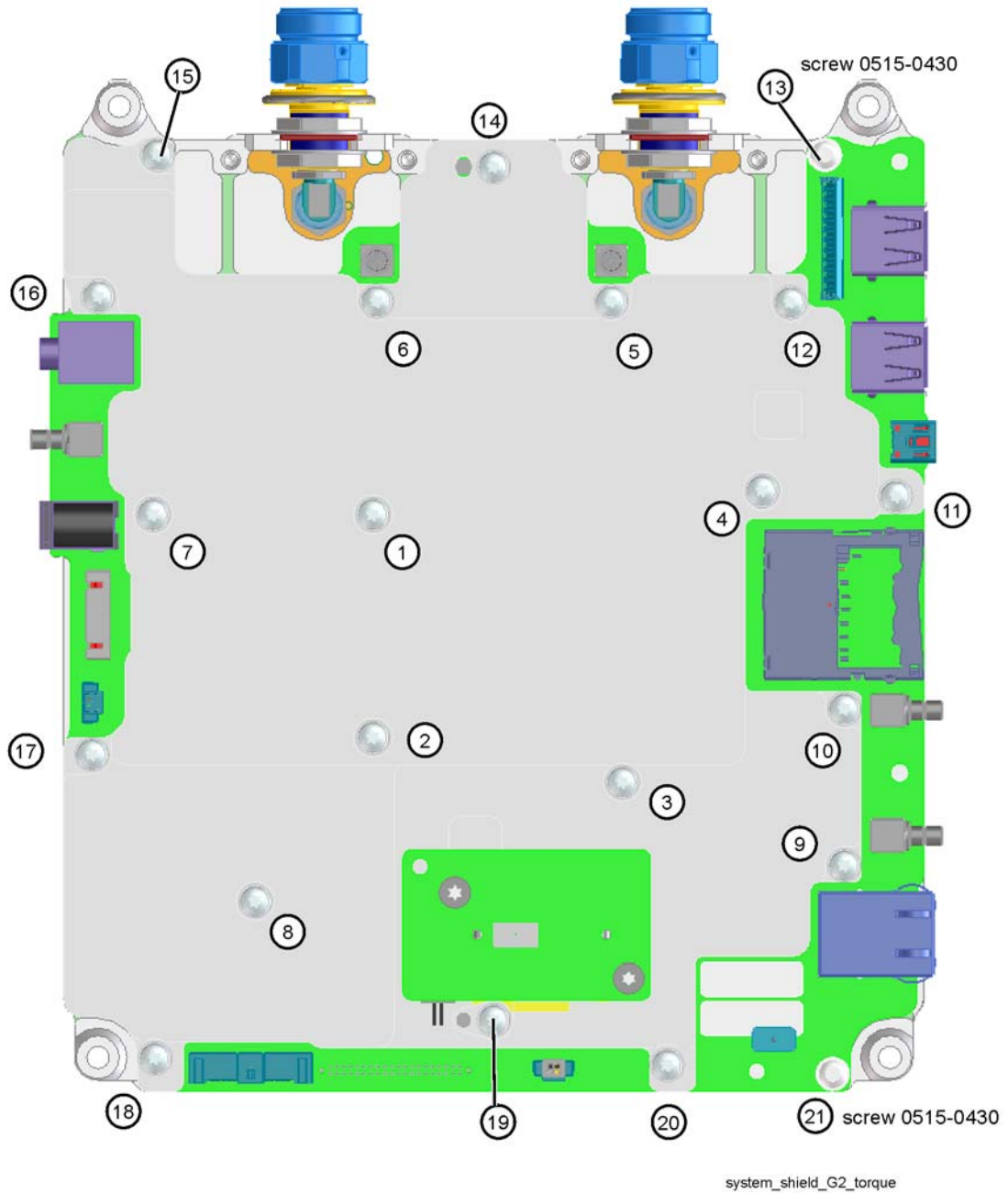


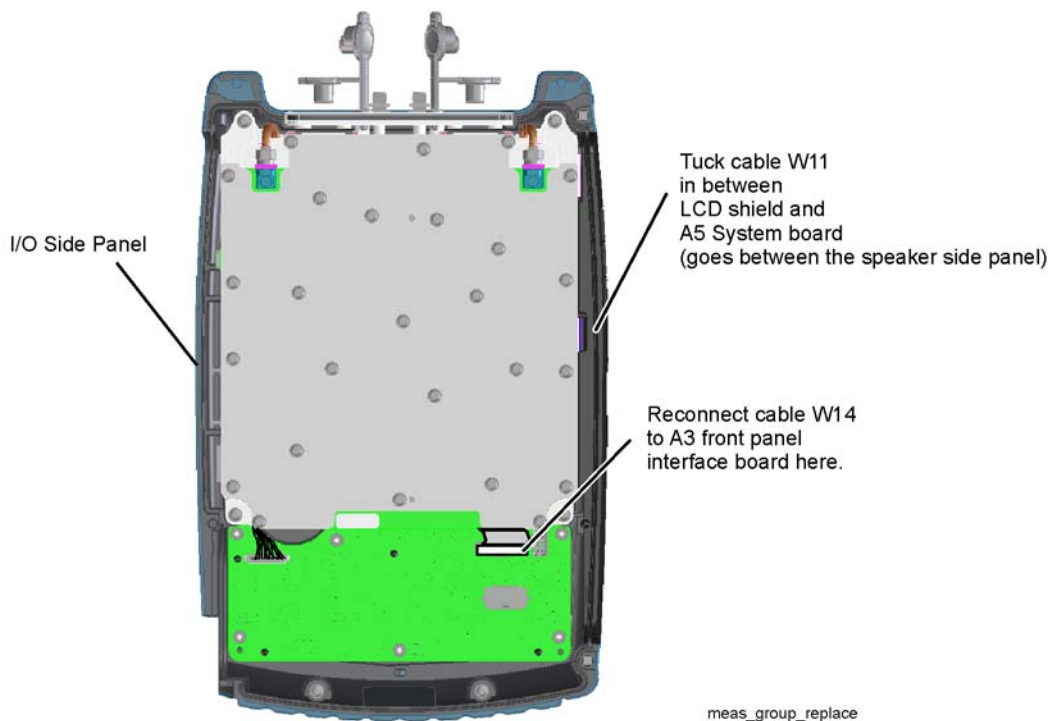
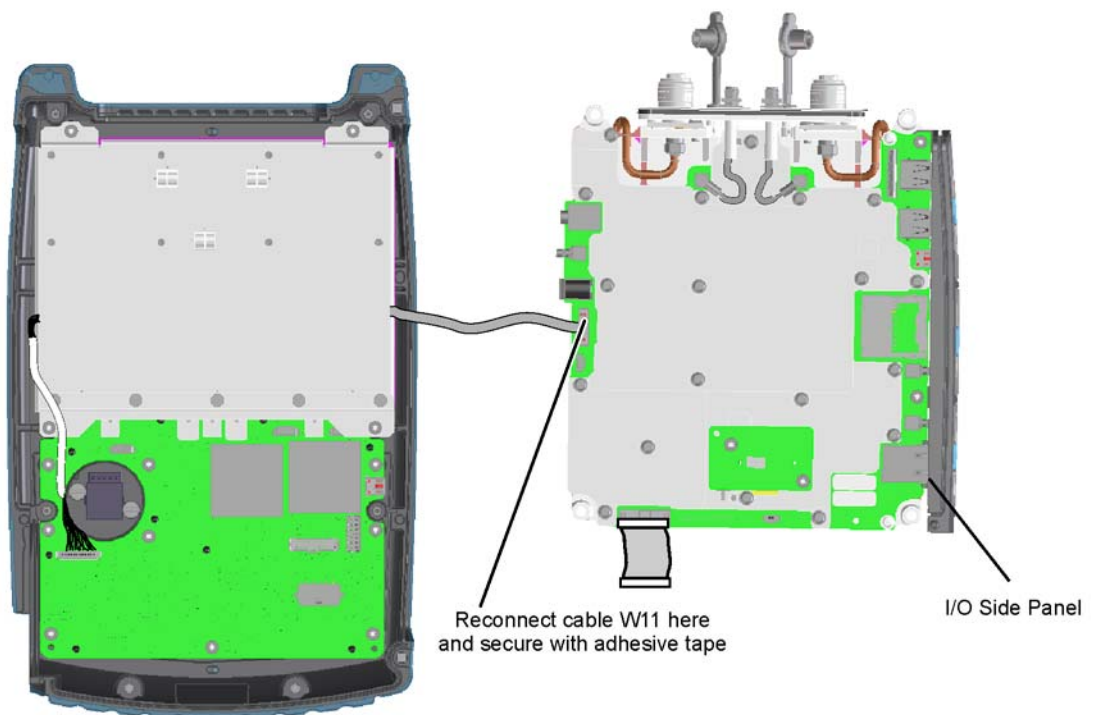
Figure 7-38 System Shield Torque Pattern - N995xA, N996xA



Reinstalling All Measurement Group Assemblies as One Unit

1. Reinstall the I/O side panel, if needed. Refer to [“Replacing the I/O Side Panel, Doors, and Gasket” on page 122.](#)
2. Refer to [Figure 7-39](#). Position the measurement group assemblies to the side of the front case.
3. Reconnect the LCD to System board cable at the System board connector and place a strip of adhesive tape over the connector to secure it. This strip of adhesive tape is provided in the [Repair and Re-assembly Kit](#). If necessary, refer to [“Replacing the A2 LCD, the LCD Shield, and LCD Cables” on page 134.](#)
4. Position the measurement group assemblies on top of the front case and align the I/O side panel in the groove in the front case being careful not to damage the gasket.
5. Position (tuck) the LCD to System board cable in between the LCD shield and the A5 System board (goes between the speaker side panel) so that it will not interfere with the cases when they are combined.
6. Reconnect the System board to front panel interface board cable at the front panel interface board connector as shown.

Figure 7-39 Reinstalling All Measurement Group Assemblies as One Unit



Final Assembly Procedure

1. If the RF Top Panel was removed, reinstall it. Refer to **“Removing and replacing the RF Top Panel Assembly”** on page 140
2. Reinstall the measurement group assemblies into the front case. Refer to **“Reinstalling All Measurement Group Assemblies as One Unit”** on page 164.
3. Combine the front and rear cases. Refer to **“Combining the Front and Rear Cases”** on page 128.

Post-Repair Procedures

After the replacement of an assembly, you must perform the service procedures in the order listed in **Table 7-2**.

Procedures referenced in this table are located in **Chapter 3, “Tests and Adjustments,”** unless specified otherwise.

Table 7-2 **Related Service Procedures**

Replaced Assembly	Adjustments, etc.	TME Tests or Other Procedures
Main battery	None needed.	None needed.
RPG	None needed.	Manual check of RPG operation.*
PORT 1 connector or associated cable (W1) replaced or disturbed.	Error Terms adjustment if applicable.	Error Terms test if applicable.
PORT 2 connector or associated cable (W2) replaced or disturbed.	Error Terms adjustment if applicable.	Error Terms test if applicable. Absolute Amplitude Accuracy Test. Total Abs Amp Accy LF Test. Total Abs Amp Accy HF Test.
Front case (including A1 keypad)	None needed.	Manual check of keyboard.*
A2 LCD	None needed.	Manual check of LCD.*
A3 front panel interface board	None needed.	Manual check of keyboard.* Check for even brightness in LCD backlight.* Check sound.*
A4 RF board	All TME based adjustments that apply to the installed option configuration.	All TME based tests that apply to the installed option configuration.
A5 System board	First, load the instrument serial number into the A5 System board.* All TME based adjustments that apply to the installed option configuration.	All TME based tests that apply to the installed option configuration.
A6 SOM board	Install firmware from SD card.* Re-install options.* All TME based adjustments that apply to the installed option configuration.	Compare serial numbers.* All tests that apply to the installed option configuration.
A7 RTC Battery	None needed.	Check time and date.*

* Refer to the following manual checks and procedures for details.

Manual Checks and Procedures

Manual Check of Keyboard

Check that each key works properly. Check that the keyboard backlight LEDs come on when a key is pressed.

Manual Check of LCD

Press Service (7) > Display, then use Display Colors and Brightness keys to exercise the display. Check for even brightness in the LCD backlight.

Manual Check of RPG Operation

Activate a marker and use the RPG to move the marker.

Load Instrument Serial Number into the A5 System Board

Instructions for this process may be accessed via the “Load serial number” link at www.keysight.com/find/fieldfoxsupport

Install Firmware from SD Card

A specially configured SD card must be used when the flash memory on the A6 SOM board is new or when the A6 SOM board memory has become corrupted.

Instructions for creating and using the SD card are available at the “SD card for installing firmware” link at www.keysight.com/find/fieldfoxsupport

Compare Serial Numbers

Compare the serial number stored in the instrument memory with the serial number tag on the back of the instrument.

To access the stored serial number, press:

System (7) > Service Diagnostics > System Information

Check Sound

See “[Checking Display Brightness and Sound](#)” on page 47.

Check Time and Date

Check the current time and date. Press **System > System Configuration > More > Update time using Internet**

Re-Install Options

See the “[Service Related User Operations](#)” section of [Chapter 8](#) for information on re-installing options.

Processor Upgrade Procedures

CPU and System Board Upgrade Procedure

1. Separate the front and rear cases. See [“Separating the Front and Rear Cases” on page 117.](#)
2. Remove all measurement group assemblies as one unit. Refer to [“Removing All Measurement Group Assemblies as One Unit” on page 138.](#)
3. Remove the I/O side panel. Refer to [“Replacing the I/O Side Panel, Doors, and Gasket” on page 122.](#)
4. Disconnect cable W3 and W4 from the A5 System board.
5. Refer to [Figure 7-27.](#) Remove the RTC board. Refer to [“Replacing the Real Time Clock \(RTC\) Battery Located on the A5 System Board Shield” on page 146.](#)
6. Remove the System board shield by removing the nineteen screws (2). Discard the screws, new ones are provided in the [Repair and Re-assembly Kit.](#)
7. Refer to [Figure 7-28.](#) Remove the four screws (2) that secure the A6 SOM board (1) to the A5 System board. Discard these screws; new ones are provided in the [Repair and Re-assembly Kit.](#)
8. Unplug the A6 SOM board from the A5 System board.
9. Refer to [Figure 7-29.](#) Remove the two screws (1) from the A5 System board, lift it up from the RF bottom shield, and unplug it from the A4 RF board connector. Discard the screws, new ones are provided in the [Repair and Re-assembly Kit.](#)
10. Refer to [Figure 7-30.](#) Plug in the new A5 System board to the A4 RF board, over the new gasket, and aligned with the three dowel pins in the RF bottom shield. Make sure the bullets are straight up when connecting the System and RF boards.
11. Refer to [Figure 7-28.](#) Place the new CPU2 SOM board onto the System board. Install four new screws (2) from the [Repair and Re-assembly Kit](#) and tighten them in the torque sequence indicated by the circled numbers (1 - 2 - 3 - 4) in the illustration.
12. Refer to [Figure 7-31.](#) Place the new System shield onto the System board by aligning the dowel pins. Replace the nineteen shield screws. Torque these screws (plus the two System board screws, #13 and #21) in the sequence shown by the circled numbers (1 - 21). Repeat this torque sequence one additional time. Torque to 12 in-lbs.
13. Refer to [Figure 7-40.](#) For N9918A, N9928A and N9938A (opt. 100), replace the 3.5mm connector with the new design 3.5mm connector with nut ring. Refer to [“Replacing the Type-N RF Connectors and RF Cables \(N991xA, N992xA, N993xA\)” on page 142.](#)

14. Place the RTC board onto the System board shield and secure with the two screws. Torque to 9 in-lbs.
15. Remove the System board to FPIB cable (W14) from the old A5 System board and install it on the new board.
16. Reinstall the I/O side panel. Refer to [“Replacing the I/O Side Panel, Doors, and Gasket” on page 122.](#)
17. Perform the steps under [“Final Assembly Procedure” on page 166.](#)
18. Change the nameplate, remove old nameplate. Refer to [Figure 7-13 on page 126.](#) Choose the appropriate model number nameplate overlay for your analyzer, remove the protective baking to expose the adhesive, and adhere it in the location shown. Refer to [Figure 7-41](#) for the new nameplate with red Keysight logo.
19. Proceed [“Post-Repair Procedures” on page 167.](#) Download and install the latest Firmware for the CPU2 from [Fieldfox Series Firmware Updates.](#)

Figure 7-40 Installing the nut ring

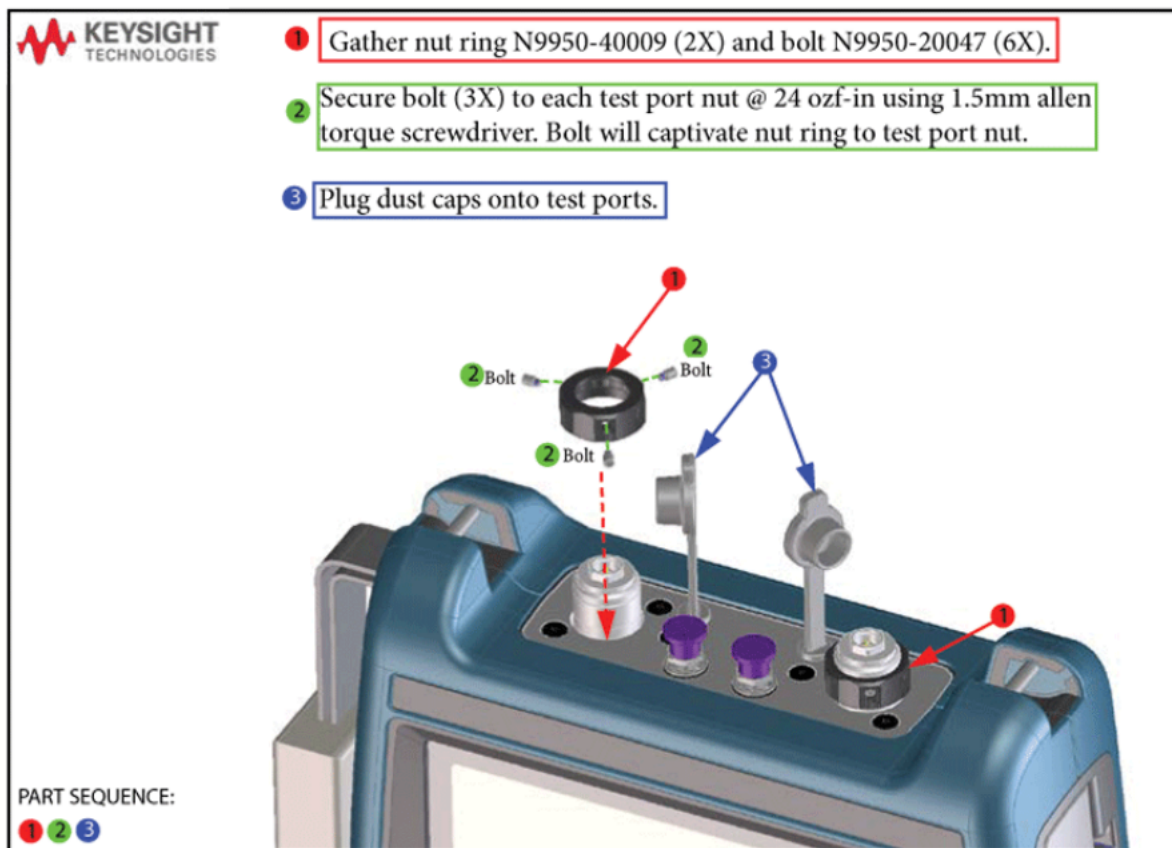


Figure 7-41 New Keysight Nameplate



8 General Purpose Maintenance and Service Procedures

Information in This Chapter

Section Title	Summary of Content	Start Page
Service Related User Operations	How to: <ul style="list-style-type: none">– view options currently installed on your analyzer– view the current firmware revision– view the error log– view temperature readings– erase user data	page 172
Options	How to: <ul style="list-style-type: none">– view the currently installed options– re-install options after repair	page 174
Firmware Upgrades	How to: <ul style="list-style-type: none">– check your analyzer's current firmware revision– where to locate additional information about firmware upgrades	page 176
Miscellaneous Service and Maintenance	Information about: <ul style="list-style-type: none">– cleaning the display– battery maintenance	page 176

Service Related User Operations

To View Currently Installed Options

- Press System(7).
- Press System Configuration.
- Press Options.
- Press Show Options.

A list of the currently installed options is displayed.

To View the Current Firmware Revision, Etc.

- Press System(7).
- Press Service Diagnostics.
- Press System Information.

The System Information screen includes the following information:

- Model Number = instrument model number
- Serial Number = instrument serial number
- Firmware Release = version of installed firmware
- Network Identity = computer name and current IP address
- RF Serial Number = serial number of RF PCA (A4)
- SB Serial Number = serial number of System Board PCA (A5)
- FP Serial Number = serial number of Front Panel PCA (A3)
- UserData Erased = the most recent date and time User Data Erase performed

To View the Error Log

- Press System(7).
- Press Service Diagnostics.
- Press Error Log.

See the **“Firmware Related Information”** section of **Chapter 5** for details on the error log.

To View Temperature Readings

- Press System(7).
- Press Service Diagnostics.
- Press Internal Temperatures.

See the **“Temperature Related Information”** section of **Chapter 5** for details.

Erase User Data Utility

- Press System(7).
- Press Service Diagnostics.
- Press Advanced.
- Press Erase User Data.
- Press Confirm Erase.

The User Data memory portion is erased, then the instrument restarts. See the **“Firmware Related Information”** section of **Chapter 5** for details on the Erase User Data utility.

Options

Installed options determine the functionality of the analyzer. There is a license associated with each option.

To View Currently Installed Options

- Press System(7).
- Press System Configuration.
- Press Options.
- Press Show Options.

A list of the currently installed options is displayed.

Re-Installing Options

If an instrument loses all of its options (i.e. it reports or “shows” no options), the only functionality available will be the base mode for the model.

When the A6 SOM board is replaced, it is necessary to re-load the license files because the license and option information is stored on the A6 SOM board.

Process for obtaining and re-installing options:

- 1. Send an email to ctd-soco_support@keysight.com with the following information.**
 - Indicate that you need previously issued licensed for a FieldFox repair.
 - Model number and serial number of the instrument.
 - Maximum frequency of the instrument from the label above the display.
 - A list of options from the serial number label on the back of the instrument.
 - A brief description of why options need to be re-installed. This information will help Keysight identify recurring problems that may need special attention.
- 2. Within two working days, you will receive an email response with a license file attached.**
- 3. Copy the license file to the root of a USB flash drive. Follow the appropriate instructions in the N9912A Upgrade Installation Instructions (N9912-90005) to install the licenses. These instructions are available by searching for “N9912-90005” on the Web at www.keysight.com.**

Additional Information About Options

For information on acquiring additional options, go to www.keysight.com/find/fieldfoxsupport. There is an installation note associated with each option upgrade that provides detailed instructions. Some combinations of options are not valid; see the web information for details.

Firmware Upgrades

To Check the Current Firmware Revision

- Press System(7).
- Press Service Diagnostics.
- Press System Information.

The current firmware version is indicated on the “Firmware Release” line.

For information on upgrading FieldFox firmware, go to www.keysight.com/find/fieldfoxsupport.

If the firmware upgrade process is interrupted, memory contents in the instrument may become corrupted. If a problem is suspected, consider doing a fresh installation of the firmware. Follow the process under “**Install Firmware from SD Card**” near the end of **Chapter 7**.

See the “**Firmware Related Information**” section of **Chapter 5** for details on what happens during the firmware update process.

Miscellaneous Service and Maintenance

Cleaning the Display

Materials: Use a soft, lint-free cloth. Use a solution with 99.5% IPA (isopropyl alcohol) or a high quality window cleaning solution.

Technique: Do not rub back and forth with a polishing motion. Use a single swipe from the soiled location to the nearest edge of the display.

Battery Maintenance

See the “Working with the Lithium-Ion Battery” section of the FieldFox User’s Guide for information on the removable battery. In particular, see “Built-In Battery Gauge” and “Reconditioning the Battery”.

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