

Agilent FieldFox RF Analyzer

N9912A

User's Guide

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Contacting Agilent

Assistance with test and measurements needs and information on finding a local Agilent office are available on the Web at: <http://www.agilent.com/find/assist>

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

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

Safety and Regulatory Information

The safety and regulatory information pertaining to this product is located on page 117.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about Agilent's FieldFox, including firmware upgrades and application information, please visit the following URL:

<http://www.agilent.com/find/fieldfox>

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Overview

Options and Features

The FieldFox may be ordered to include the following options and features:

Options and Features	Learn more
Cable and Antenna Test (CAT) Mode <ul style="list-style-type: none">• 2 MHz to 4 GHz (Option 104)• 2 MHz to 6 GHz (Option 106) Measurements: <ul style="list-style-type: none">▪ Distance-to-fault (DTF)▪ DTF & Return Loss▪ Return Loss (dB)▪ VSWR▪ DTF (VSWR)▪ Cable Loss (1-Port)▪ Insertion loss (2-Port) (Option 110)	CAT Mode on page 23
Transmission Measurement (Option 110)	CAT Mode on page 23 NA Mode on page 39
QuickCal (Option 111) Built-in cal kit. Industry first!	Cal on page 49
Spectrum Analyzer (SA) Mode <ul style="list-style-type: none">• 100 kHz to 4 GHz (Option 230)• 100 kHz to 6 GHz (Option 231) General purpose measurements for basic monitoring and troubleshooting	SA on page 53
Preamplifier for Spectrum Analyzer (Option 235)	On page 56
Power Meter Mode (Option 302) Agilent External USB Power Sensors	Power Meter Mode on page 67
Network Analyzer Mode (Option 303) <ul style="list-style-type: none">• 2 MHz to 4 GHz (Option 104)• 2 MHz to 6 GHz (Option 106)• Vector 1-port (Standard)• Scalar 2-port (Option 110) Measurements: <ul style="list-style-type: none">▪ S11 Reflection (several formats)▪ S21 Transmission (several formats) (Option 110)▪ A receiver▪ R receiver	NA Mode on page 39
Designed for Field Environment <ul style="list-style-type: none">• Lightweight 6.2 lbs (2.8 kg) including battery• Rugged, weather resistant shell with no fan/vents• Daylight viewable 6.5" (16.5 cm) color LCD• Backlit keys for night use	

-
- Integrated kickstand
 - Configurable hand and shoulder straps
 - Softcase for carrying all gear
 - Quick Reference Guide with laminated pages
-

Slots for removable USB Flash Drive and mini SD Card

Save / Recall on page 85

- Expands internal storage
 - Useful for file transfer
 - Flash Drive and mini SD Card not included
-

Battery or AC Power

On page 99

- Rechargeable Li-Ion battery with ~4 hr life
 - Easily removable battery
 - AC/DC adapter
 - External battery charger (N9910X-872)
-

FieldFox Data Link Software

- Included on CD
 - Easily manage files and compile reports
 - Reads data from the FieldFox and plots traces - includes many useful analysis tools
 - Help file included with the software installation
 - Download the latest version of the software at <http://www.agilent.com/find/fieldfox>
-

Additional Features

Languages on page 93

- Menus localized to 6 languages
-

Accessories

The FieldFox includes the following standard accessories. Spare accessories can be ordered at any time.

Accessory Part Number	Description
N9910X-873	AC/DC Adapter
N9910X-870 alternate part: 1420-0891	Lithium-Ion Battery
N9910X-880	Softcase w/ Backpack & Shoulder Strap
N9910X-884	Instrument Shoulder Strap
N9910X-890	User's Guide (printed copy)
N9910X-891	Quick Reference Guide (printed copy)
N9912-10001	CD (contains User's Guide, Quick Reference Guide, and Data Link software)

The following accessories are NOT included, but can be ordered at any time.

Accessory Part Number	Description
N9910X-874	External bias tee, 2.5 MHz to 6 GHz, 1 W, 0.5 A
0950-4776 -or- N9910X-872	External Dual-Bay Battery Charging Unit 3A US Power cord. For more information, see page 120.
N9910X-870	Extra Lithium-Ion Battery
N9910X-881	Hard transit case
N9910X-860	Attenuator, 40 dB, 50W, Type-N (m-f)
0955-1458 -or- N9910X-861	Attenuator, 40 dB, 100W, Type-N (m-f)
N9910X-821	Antenna Telescopic Whip 70-1000 MHz 10W 50 ohm
N9910X-820	Antenna Directional Multi-band 800–2500 MHz 10 dBi
RF Cables	
8120-8862	Cable Type-N(m) to Type-N(m)
N9910X-813	Rugged Phase Stable Cable 12 ft, 8 GHz, Type-N(m) to Type-N(f)
N9910X-812	Rugged Phase Stable Cable 12 ft, 8 GHz, Type-N(m) to Type-N(m)
N9910X-811	Rugged Phase Stable Cable 60 inches, 8 GHz, N(m) to N(f)

RF Cables (cont.)	
N9910X-810	Rugged Phase Stable Cable 60 inches, 8 GHz, N(m) to N(m)
Calibration Kits	
N9910X-803	7/16 (f) Open-Short-Load 50 ohm Tee DC to 6 GHz
N9910X-802	7/16 (m) Open-Short-Load 50 ohm Tee DC to 6 GHz
N9910X-801	Type-N (f) Open-Short-Load 50 ohm Tee DC to 6 GHz
N9910X-800	Type-N (m) Open-Short-Load 50 ohm Tee DC to 6 GHz
Adapters	
1250-3422	Adapter Type-N (f to-f)
1250-2908	Adapter Type-N (f) to 7/16 (m)
N9910X-843	Adapter, Type N (m) to 7/16 DIN(f)
1250-0780	Adapter, Type-N (m) to BNC (f)
1250-2810	Adapter, Type-N (f) to 7/16 (f)

About the FieldFox Manuals

Documentation Map

The following manuals and software are available for your FieldFox. For the very latest version, please visit our website at:

<http://www.agilent.com/find/fieldfox>. Check the manual revision on the first page of each manual.

- **User's Guide** – this manual. Electronic file on CD.
- **Quick Reference Guide** – Printed copy and electronic file (on CD) included with shipment; printed copy has laminated pages for outdoor use.
- **FieldFox Data Link Software and Help** – Included on CD. Free download available with the software at <http://www.agilent.com/find/fieldfox>.
- **Service Guide** – free download available at <http://www.agilent.com/find/fieldfox>.

Conventions that are used in the manual

- **Hardkey** indicates a front panel button. The functionality of these buttons does not change.

The six Softkey menus change dynamically and follow these color conventions:

- **Softkey** Blue indicates an available setting.
- **Softkey** Green indicates a change in menu level when selected.
- **Softkey** Black indicates the default or selected setting.

- **Softkey** Yellow indicates an active entry in process.
- **Softkey** Grey indicates a key that is NOT available.

Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument. More pertinent safety notes for using this product are located in “Safety Considerations” on page 117.

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 product**. Do not proceed beyond a caution notice 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.

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Preparing for Initial Use of Your New FieldFox

Check the Shipment

When you receive your FieldFox, check the shipment according to the following procedure:

1. Inspect the shipping container for damage. Signs of damage may include a dented or torn shipping container or cushioning material that indicates signs of unusual stress or compacting. If not damaged, **save the packaging material** in case the FieldFox needs to be returned.
2. Carefully remove the contents from the shipping container, and verify that the standard accessories and your ordered options are included in the shipment according to the Box Contents List.
3. For any question or problems, refer to Contacting Agilent on page 2.

Meeting Power Requirements for the AC/DC Adapter

Voltage: 100 VAC to 250 VAC

Frequency: 50 Hz to 60 Hz

Current: 1.25 – 0.56 A

The AC/DC adapter supplied with the analyzer is equipped with a three-wire power cord, in accordance with international safety standards. The power cable appropriate to the original product shipping location is included with the FieldFox.

Various AC power cables are available from Agilent that are unique to specific geographic areas. You can order additional AC power cables that are correct for use in different areas. The AC Power Cords table provides a list of the available AC power cables, the plug configurations, and identifies the geographic area in which each cable is typically used.

Plug Type	Cable Part Number	Plug ^a Description	For use in Country & Region
 250V 10A	8121-1703	BS 1363/A	Option 900 United Kingdom, Hong Kong, Singapore, Malaysia
 250V 10A	8120-0696	AS 3112:2000	Option 901 Australia, New Zealand
 250V 16A	8120-1692	IEC 83 C4	Option 902 Continental Europe, Korea, Indonesia, Italy, Russia
 125V 10A	8120-1521	CNS 10917-2 /NEMA 5-15P	Option 903 United States, Canada, Taiwan, Mexico
 250V 10A	8120-2296	SEV 1011	Option 906 Switzerland
 230V 15A	8120-4600	SABS 164-1	Option 917 South Africa, India
 125V 15A	8120-4754	JIS C8303	Option 918 Japan
 250V 16A	8120-5181	SI 32	Option 919 Israel
 250V 10A	8120-8377	GB 1002	Option 922 China

AC Power Cords Table

Install the Lithium-Ion Battery



Step	Notes
1. Open the battery door.	Push the button on the battery compartment door while sliding the door outward.
2. Insert the battery.	The terminals end of the battery is inserted into the compartment.
3. Close the battery door.	Slide the battery compartment door upwards until it latches.

Battery Usage


When you receive your FieldFox, the lithium-ion battery is not installed, and it is partially charged to approximately 40% to preserve battery life. A lithium-ion battery has no memory effect, so it can be used partially charged, as shipped.

A fully charged battery will power your FieldFox for about four hours, so if you plan to use it for this long, you should fully charge the battery.

NOTE The FieldFox will shut down to prevent the battery from discharging to a level that is damaging. If this occurs, charge the battery either internally or externally.

Learn all about the Lithium Ion battery on page 117.

Battery charge status is viewable:

-  In the upper-right corner of the screen.
- On the Battery screen. To access the screen, select **System**, **Service**, **Diagnostics**, and **Battery**.
- On the battery. If you have the Tyco battery, remove it from the FieldFox to view the battery LED. If you have the Inspired Energy battery, open the FieldFox battery compartment door to view the battery LCD.

To conserve battery power:

- Use **Run/Hold** to single-trigger a measurement when needed. **Hold** is shown on the display.
- Press **System** then **Display** then **Brightness**. Use the **▲|▼** arrows, the rotary knob, or numeric keypad to adjust the brightness to dim the FieldFox display as much as possible.
- Briefly press the power button to switch to Stand By mode when the FieldFox is not being used. Press again to restore power - all current settings are preserved.

NOTE When powered by the battery only, the FieldFox can stay in Stand By mode for a maximum of four hours and then it powers off automatically. If the relative battery charge is less than 20%, it powers off sooner to preserve half of the remaining charge.

To recharge a battery:

Use ONLY a FieldFox charger to recharge a battery.

- The battery can be fully charged while in the FieldFox in about 4 hours with the FieldFox either ON or OFF.
- It can be fully charged externally using the external battery charger (Opt 872) in about 4 hours.

When the battery is removed, the FieldFox can still be powered by the AC/DC adapter.

FieldFox ON/OFF Settings

- To turn power **ON**, briefly press the power button. The LED is green. Boot-up takes about 1 minute.
- To switch to **Stand By** mode (low battery drain), briefly press the power button. The LED is orange and blinks. To turn power ON, briefly press the power button. Power and settings are restored instantly. See the Note above concerning Stand By mode.
- To turn Power **OFF** (very low battery drain), press and hold the power button until power is OFF - about 4 seconds. The LED is off.
- Data and instrument state are NOT automatically saved when the FieldFox is powered OFF. Learn how to save data and instrument state on page 83.

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 Stand By mode.

How to monitor the internal FieldFox temperature:

- Press **System**, then **Service Diagnostics**.

- Then [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 73 °C, the FieldFox enters Temperature Control mode by reducing display intensity and measurement speed. This should decrease the internal temperature and preserve measurement accuracy and maintain the long-term reliability of the FieldFox.

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

When the temperature drops to approximately 71°C, normal operating settings are restored.

High-Temp Shutdown

In extreme situations, Temperature Control mode may not stop an increase in the FieldFox internal temperature. At approximately 75°C, High-Temperature Shutdown will engage and turn OFF the FieldFox.

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

Avoiding Overpowering the FieldFox

The FieldFox can be damaged with too much power or voltage applied. Exceeding the maximum RF power levels shown below will cause an **ADC Over Range** message to appear on the screen.

WARNING

Maximum Input Voltages and Power:

- **RF OUT Connector: ±50 VDC,
+23 dBm RF**
- **Exter Trig/Ref Connector: 5.5 VDC**
- **RF IN: ±50 VDC,
+27 dBm RF**
- **DC Input: 19 VDC,
4 ADC**
- **Power Sensor Input: +25 dBm (320 mW) average
+33 dBm peak (2 W) <10µs
+ 5 VDC**

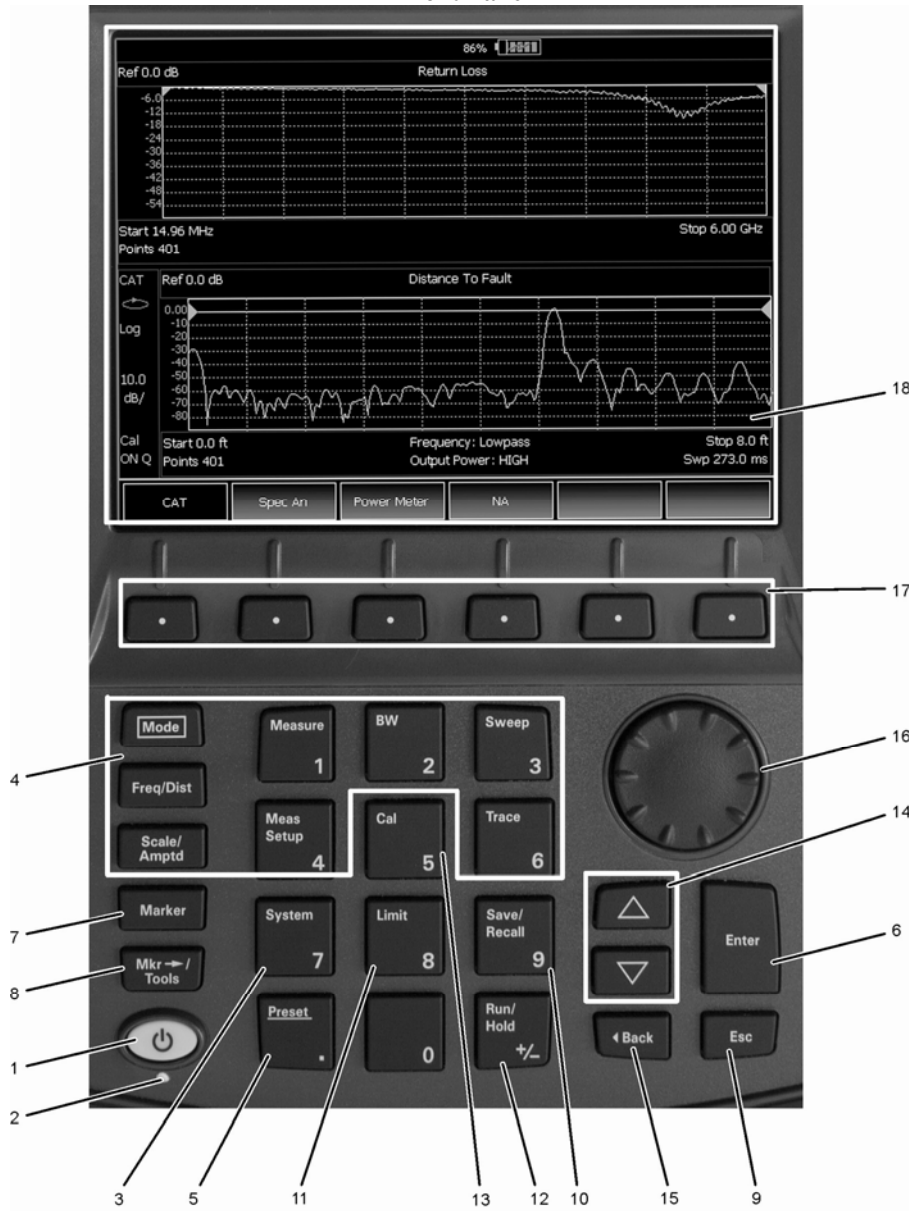
NOTE Very often, coaxial cables and antennas build up a static charge, which, if allowed to discharge by connecting to the FieldFox, may damage the instrument input circuitry. To avoid such damage, it is recommended to dissipate any static charges by temporarily attaching a short to the cable or antenna prior to attaching to the FieldFox.

Take the FieldFox Tour

Top Panel



Front Panel



Side Panel



N9912_001_401




Front Panel

No.	Caption	Description	Learn More on Page:
1	Power	ON: press momentarily. STAND BY: with FieldFox power ON, press briefly. OFF: press and hold until the FieldFox shuts off (about 4 seconds).	16
2	LED	Not lit: FieldFox OFF, not charging Green: FieldFox ON. Charging status indicated by battery icon on screen Orange, flashing: FieldFox STAND BY Orange, intensity increasing, flashing slowly: FieldFox OFF, charging	16
3	System	Displays a submenu for system setup	91
4	Function keys	Includes hardkeys: Freq/Dist , Scale/Amptd , BW , Sweep , Trace , Meas Setup , Measure , and Mode	Mode dependent.
5	Preset	Returns the analyzer to a known state	91
6	Enter	Confirms a parameter selection or configuration	--
7	Marker	Activates marker function	73
8	Mkr→/Tools	Displays a submenu for marker functions	76
9	Esc	Exits and closes the dialog box or clears the character input	--
10	Save/Recall	Saves the current trace or recalls saved data from memory	83
11	Limit	Sets limit lines for quick Pass/Fail judgment	78
12	Run/Hold	Toggles between free Run and Hold/Single operation.	27
13	Cal	Displays a submenu for calibration functions	47
14	Arrow keys	Increases or decreases a value or setting.	--
15	◀Back	Returns to the previous menu selection.	--
16	Rotary knob	Highlights an item for selection, or enables incremental changes to values.	--
17	Softkeys	Allows selection of settings for configuring and performing measurements, and for other FieldFox functions.	--
18	Screen	Transflective screen, viewable under all lighting conditions. If you are using your FieldFox in direct sunlight, you do not need to shield the display from the sunlight. In bright lighting conditions, the display is brighter and easier to read when you allow light to fall directly on the screen. Alternative color modes exist that maximize viewing in direct sunlight conditions, as well as other conditions such as nighttime work. Note: Clean the Transflective screen with gentle and minimal wiping using Isopropyl alcohol applied to a lint-free cloth.	92 - Display settings 21 - Screen Tour

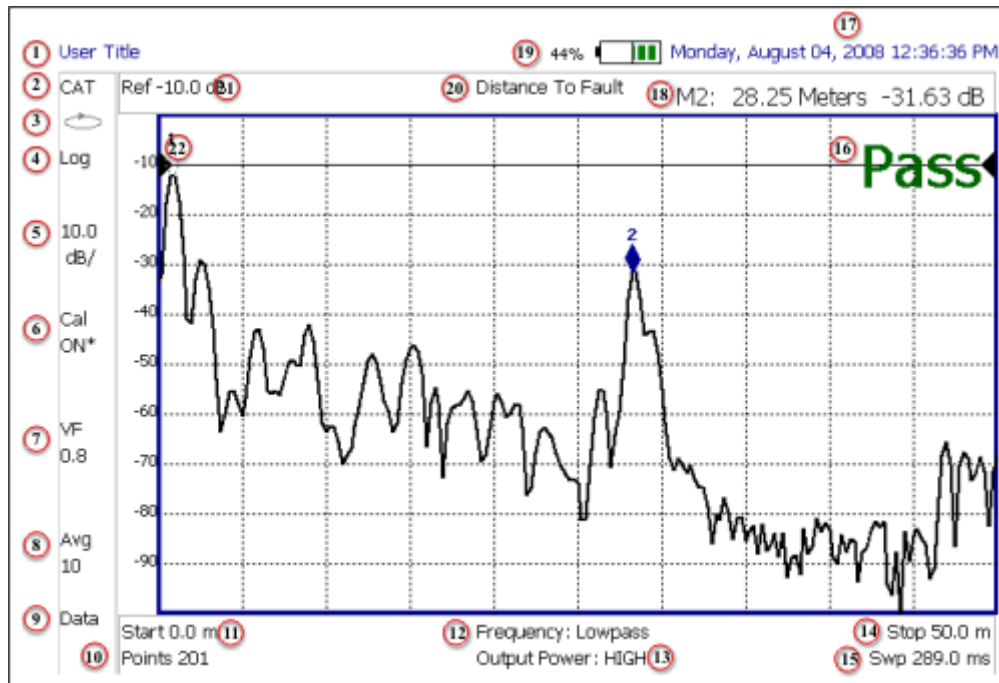
Top Panel

Caption	Description	Learn More
RF OUT	For CAT and NA measurements, use to make reflection measurements. Maximum: ± 50 VDC, +23 dBm RF	CAT Mode on page 23 NA Mode on page 39
Ext Trig/Ext Ref	External Reference connector to connect to an external frequency reference. Maximum: 5.5 VDC. External Triggering is provided for future use.	Ext Ref on page 95
RF IN	For CAT and NA mode, use to make transmission measurements. For SA use to make all measurements. Maximum: ± 50 VDC, +27 dBm RF.	SA Mode on page 53

Side Panel

Caption	Description	Learn More
LAN	Ethernet cable connector to read trace data using the FieldFox Data Link Software.	On page 99
	Reserved for future use.	
Power	DC power connector used to connect to the AC/DC adapter. Maximum: 19 VDC, 4 ADC.	On page 15
Mini SD	Mini Secure Digital slot. Use to extend the memory of the FieldFox.	File locations on page 83
	Standard USB connector used to connect a power sensor for Power Meter Mode. Also used to save files to a USB flash drive. Use of Keyboard and Mouse is NOT supported.	File locations on page 83
	Audio output jack. Currently there is NO audio capability other than the beep indicator.	

Screen Tour



Caption	Description	Learn More on Page:
1	Title – write your own text here	93
2	Current Mode	
3	Run / Hold	91
4	Display Format	112
5	Scale/division	Mode dependent
6	Calibration Status (CAT and NA) Detection Method (SA)	47
7	Velocity Factor (Fault Meas)	35
8	Averaging Status and Count	Mode dependent
9	Data / Mem Display (CAT and NA) Step / FFT (SA)	80- Trace Math 57 - Res BW
10	Resolution Setting	Mode dependent
11	Measurement Start Freq or Distance	Mode dependent
12	Bandpass / Lowpass setting (Fault Meas)	35
13	Output Power Level (CAT and NA)	28
14	Measurement Stop Freq or Distance	Mode dependent
15	Actual Sweep Time	Mode dependent
16	Limit Line Status	78
17	Time and Date	95
18	Marker Readout	73

Caption	Description	Learn More on Page:
19	Battery Status	117
20	Measurement Type (CAT and NA)	
21	Reference Level	Mode dependent
22	Reference Position	Mode dependent

How to Enter Numeric Values

Many settings on the FieldFox require the entry of numeric values.

How to enter numeric values

Use any combination of the following keys:

- Numeric 0-9 keys, along with the polarity (**+/-**) key.
- Up/Down arrow keys to increment or decrement values.
- Rotary knob to scroll through a set of values.
- **Back** erases previously entered values.
- **Esc** exits data entry without accepting the new value.

To complete the setting:

- Press **Enter** or a different **softkey** or **hardkey**.

Multiplier Abbreviations

Many times after entering numeric values, a set of multiplier or suffix softkeys are presented. The following explains the meaning of these abbreviations.

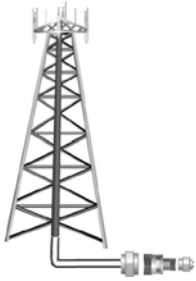
Select Frequency multipliers as follows:

- **GHz** Gigahertz (1e9 Hertz)
- **MHz** Megahertz (1e6 Hertz)
- **kHz** Kilohertz (1e3 Hertz)
- **Hz** Hertz

Select Time multipliers as follows:

- **s** Seconds
- **ms** milliseconds (1e-3)
- **us** microseconds (1e-6)
- **ns** nanoseconds (1e-9)

CAT (Cable and Antenna Test) Mode



CAT Mode is typically used to test an entire transmission system, from the transmitter to the antenna. This process is sometimes referred to as Line Sweeping.

CAT Mode is similar to NA (Network Analyzer) Mode. Learn more in the Tutorials chapter on page 111.

CAT Mode **Distance to Fault** measurements are discussed on page 33.

In this Chapter

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2-Port Insertion Loss Measurement	31
Distance to Fault Measurements	33

See Also

All about Calibration	47
Set Markers	73
Use Limit Lines	78
Use Trace Math.....	80

CAT Mode Settings

Select **CAT Mode** before making any setting in this chapter.

How to select CAT Mode

- Press **Mode**.
- Then **CAT**.

Measurement Selection

How to select a CAT Mode Measurement

Learn more about the following measurements in the Tutorials Chapter on page 99.

- Press **Measure 1**.
- Then choose one of the following: These softkeys also appear after CAT Mode is selected.
 - **Distance to Fault** 1-port reflection measurement that uses Inverse Fast Fourier Transform (IFFT) calculations to determine and display the distance to, and relative size of, a fault or disruption in the transmission line. Units are in return loss format, expressed as a positive number in dB, unless the measurement selected is DTF (VSWR). Learn more about DTF Measurements on page 33.

Return Loss & DTF Displays a Return Loss measurement in the top plot and a Distance to Fault measurement in the bottom plot. Use this format to display the frequency settings that are used to make the DTF measurement. Learn more about Bandpass Mode on page 34.

NOTE All plot settings, such as Scale, Markers, and so forth, are made to the DTF (bottom) plot, NOT to the Return Loss (top) plot. However, the frequency range of the Return Loss plot can be changed using the **Alternate Sweep** setting. Learn more on page 37.

- **Return Loss** 1-port reflection measurement that displays the amount of incident signal energy MINUS the amount of energy that is reflected. The higher the trace is on the screen, the more energy being reflected back to the FieldFox. Learn how to measure Return Loss on page 29.
- **VSWR** (Voltage Standing Wave Ratio – also known as SWR) 1-port reflection measurement that displays the ratio of the maximum reflected voltage over the minimum reflected voltage. The higher the trace is on the screen, the more energy being reflected back to the FieldFox. Learn more about SWR on page 113.
- **DTF (VSWR)** Distance to Fault in VSWR format.
- **1-Port Cable Loss** 1-port reflection measurement that displays the loss of a transmission line. Learn more on page 29.

- **2-Port Insertion Loss** (Option 110 ONLY) 2-port transmission measurement that accurately displays the loss through a cable or other device in dB. Both ends of the cable must be connected to the FieldFox. NO phase information is included in this measurement. Learn more on page 31.

Quick Settings

Both CAT and NA Modes allow you to view and change most relevant settings from a single location. All of these settings are discussed in this chapter and, unless otherwise noted, ALL of these settings can also be made using the standard softkey menus.

How to view and change Quick Settings

- Press **Meas Setup 4**.
- Then **Settings**.
- Press **Next Page** and **Previous Page** to view all settings. If these softkeys are NOT available, then all available settings fit on one page.
- To change a setting:
 - Use the **▲▼** arrows to highlight a setting.
 - Then press **Edit**. The current setting changes to **yellow**.
 - Some settings require you to press a softkey to change the value. Otherwise, use the numeric keypad, **▲▼** arrows, or rotary knob to change the value.
 - When finished changing a value, press **Done Edit**.
 - When finished changing settings, press **Done**.

Use knob. Press [Edit] to make changes. Press [Done] to exit.

Setting	Value
Start Frequency	1.000000000 GHz
Stop Frequency	6.000000000 GHz
Center Frequency	3.500000000 GHz
Frequency Span	5.000000000 GHz
Resolution	201
Output Power	High

The Quick Settings menu. The resolution is being edited.

Frequency Range

Set the range of frequencies over which you would like to make CAT Mode measurements.

When the frequency range is changed after a calibration is performed, the cal becomes interpolated. Learn more on page 47.

How to set Frequency Range

- Press **Freq/Dist**.
- Then choose from the following:

- **Start** and **Stop** frequencies - beginning and end of the sweep.
- **Center** and **Span** frequencies – the center frequency and span of frequencies (half on either side of center).
- Follow each setting by entering a value using the numeric keypad, **▲▼** arrows, or the rotary knob.
 - After using the keypad, then select a multiplier key. Learn about multiplier abbreviations on page 22.
 - After using the **▲▼** arrows or the rotary knob, press **Enter**. The amount of frequency increment is based on the current span and can NOT be changed in CAT Mode.

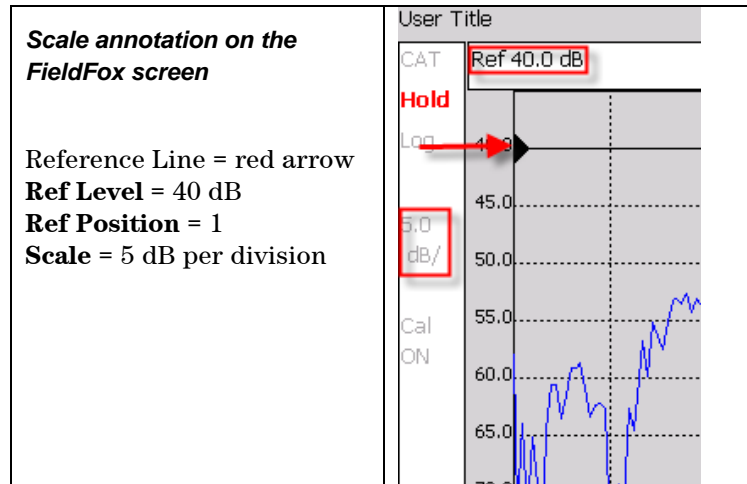
Scale Settings

Adjust the Y-axis scale to see the relevant portions of the data trace. The Y-axis is divided into 10 graticules.

This setting can be changed at any time without affecting calibration accuracy.

How to set Scale

- Press **Scale / Amptd**.
- Then choose from the following three methods:
 1. **Autoscale** Automatically adjusts the Y-axis to comfortably fit the Min and Max amplitude of the trace on the screen.
 2. Set Scale, Reference Level, and Reference Position:
 - **Scale** Manually enter a **scale per division** to view specific areas of the trace.
 - **Ref Level** Manually set the value of the reference line. Enter a negative value by pressing **Run/Hold (+/-)** either before or after typing a value.
 - **Ref Position** Manually set the position of the reference line. Values must be between **0** (TOP line) and **10** (BOTTOM line)
 3. Set Top and Bottom graticule values. The scale per division is calculated.
 - **Top** to set the value of the Top graticule.
 - **Bottom** to set the value of the Bottom graticule.
 - Enter a negative value by pressing **Run/Hold (+/-)** either before or after typing a value.



Averaging

Trace Averaging helps to smooth a trace to reduce the effects of random noise on a measurement. The FieldFox computes each data point based on the average of the same data point over several consecutive sweeps.

Average Count determines the number of sweeps to average. The higher the average count, the greater the amount of noise reduction.

An average counter is shown in the left edge of the screen as **Avg N**. This shows the number of previous sweeps that have been averaged together to form the current trace. When the counter reaches the specified count, then a 'running average' of the last **N** sweeps is displayed. Average Count = 1 means there is NO averaging.

This setting can be changed at any time without affecting calibration accuracy.

How to set Trace Averaging

- Press **BW 2**.
- Then **Average N** where **N** is the current count setting.
- Enter a value using the numeric keypad. Enter 1 for NO averaging.
- Press **Enter**.
- While Trace Averaging is in process, press **Sweep 3** then **Restart** to restart the averaging at 1.

Sweep Type

Sweep Type determines whether the FieldFox sweeps continuously or only once each time the **Single** button is pressed. Use **Single** to conserve battery power or to allow you to Save or analyze a specific measurement sweep.

This setting can be changed at any time without affecting calibration accuracy.

How to set Sweep Type

- Press **Sweep 3**.
- Then choose one of the following:

- **Single** Automatically sets Continuous OFF and causes FieldFox to make ONE measurement sweep, then hold for the next Single key press.
 - **Continuous** Makes continuous sweeps. This is the typical setting when battery power is not critical.
- You can also use **Run / Hold +/-** to toggle between Single and Continuous sweep.

Resolution (Number of Data Points)

Data points are individual measurements that are made and plotted across the X-axis to form a trace. Select more data points to increase measurement resolution. However, more data points require more time to complete an entire measurement sweep.

When the Resolution is changed after a calibration is performed, the cal becomes interpolated. Learn more on page 47.

How to set Resolution

- Press **Sweep 3**.
- Then **Resolution**.
- Then choose one of the following: **101 | 201 | 401 | 601 | 801 | 1001**.

Sweep Time

The fastest possible sweep time is always used as the default setting. Use the **Min Swp Time** setting to slow the sweep time when measuring long lengths of cable. Learn more in the tutorials section on page 115.

The actual sweep time is shown on the FieldFox screen. See the Screen Tour on page 21. To increase the sweep time, enter a value that is higher than the actual sweep time. The increase will not be exactly the amount that you enter, as the actual sweep time is the composite of many factors.

How to set Sweep Time

- Press **Sweep 3**.
- Then **Min Swp Time**.
- Enter a value using the numeric keypad.
- Press a multiplier key. Learn about multiplier abbreviations on page 22.

Output Power

Set the power level out of the FieldFox to either High power or Low power. Generally, the high power level (default setting) is more accurate because the receivers are measuring farther from the noise floor. However, some devices are sensitive to high power levels. Use the Low power setting when measuring amplifiers.

NOTE To help prevent damage to your DUT, when Output Power is changed in CAT Mode, it is changed to the same value in NA Mode.

How to set Output Power

- Press **Meas Setup 4**.
- Then **Output Power High Low** The underlined value is the current setting.
 - **High** Sets output power to approximately +5 dBm.
 - **Low** Sets output power to approximately -25 dBm.

Interference Rejection

Use this setting when you suspect that other signals in the area are interfering with a measurement. Interference may look like a spike or lack of stability in the measurement trace. While monitoring a measurement at a specific frequency, toggle this setting between ON and OFF. If the measurement result decreases while ON, then there is an interfering signal in the area. Continue to make measurements with Interference Rejection ON. However, this will slow the measurement speed.

Once enabled, up to SIX sweeps may be required before the interfering signal is neutralized.

This setting can be changed at any time without affecting calibration accuracy.

How to set Interference Rejection

- Press **Meas Setup 4**.
- Then **Interference Rejection [current setting]**.
- Then choose from the following:
 - **Off** No interference rejection and fastest possible sweep speed.
 - **Minimum** The lowest level of Interference rejection.
 - **Medium** The medium level of Interference rejection.
 - **Maximum** The highest level of Interference rejection.

Return Loss Measurements

Return loss can be thought of as the absolute value of the reflected power as compared to the incident power.

When measuring an OPEN or SHORT, all incident power is reflected and approximately 0 dB return loss is displayed.

When measuring a LOAD, very little power is reflected and values of 40 dB to 60 dB are displayed.

The minus sign is usually ignored when conveying return loss. For example, a component is said to have 18 dB return loss, rather than -18 dB.

How to measure Return Loss

- Connect the cable or any adapter used to connect the device under test (DUT).
- Select **Preset** then **Preset** Returns the FieldFox to known settings.
- Select **Mode** then **CAT** (Cable and Antenna Test)

- Then **Return Loss** (Default measurement).
- Press **Freq/Dist** and enter **Start** and **Stop** frequency values of the measurement.
- Press **Meas Setup 4** then **Settings** to make appropriate settings before calibrating.
- Disconnect the cable or DUT and press **Cal 5** then follow the calibration prompts.
- Reconnect the cable or DUT.
- The return loss trace is displayed on the FieldFox screen.

NOTE If the DUT just measured is a cable, and if you are now going to perform a 1-port cable loss measurement, save the return loss measurement data to memory. Doing this allows you to omit steps 10 and 11 on page 31 in the procedure for making a 1-port cable loss measurement.

1-Port Cable Loss Measurements

While all cables have inherent loss, weather and time will deteriorate cables and cause even more energy to be absorbed by the cable. This makes less power available to be transmitted.

A deteriorated cable is not usually apparent in a Distance to Fault measurement, where more obvious and dramatic problems are identified. A Cable Loss measurement is necessary to measure the accumulated losses throughout the length of the cable.

A 2-port Insertion Loss measurement is usually more accurate than a 1-port Cable Loss measurement. However, to perform a 2-port Insertion Loss measurement, both ends of the cable must be connected to the FieldFox, and the FieldFox must have option 110 installed.

NOTE In high-loss conditions, a Cable Loss measurement becomes ‘noisy’ as the test signal becomes indistinguishable in the FieldFox noise floor. This can occur when measuring a very long cable and using relatively high measurement frequencies. To help with this condition, use High Power (page 28), and Averaging. (page 27).

How to make a 1-port Cable Loss Measurement

1. Press **Preset** then **Preset**.
2. Then **More** then **Cable Loss (1-Port)**.
3. Connect the cable to be tested.
4. Press **Freq/Dist** and enter **Start** and **Stop** frequency values of the measurement.
5. Press **Sweep 3** then **Min Swp Time**. Increase the Sweep Time until a stable trace is visible on the screen. The amount of time that is required increases with longer cable lengths. Learn more in the tutorials section on page 115.
6. Remove the cable to be tested.
7. Press **Cal 5**, then **QuickCal** or **OSL**.
8. Follow the prompts to perform calibration at the end of the jumper cable or adapter. Learn more about Calibration on page 49.

9. Connect the cable to be tested.
10. Connect a LOAD at the end of the cable to be tested. This limits the reflections to faults that are located in the cable under test. These reflections are visible on the screen as ‘ripple’ or low-level standing waves and obscure the actual loss of the cable.
11. Press **Trace 6** then **Data->Mem** to store the trace into Memory.
12. Remove the LOAD and leave the end of the cable to be tested open.
13. Press **Data Math** then **Data – Mem**. The ripple in the measurement is removed. These minor imperfections in the cable should not be considered in the Cable Loss measurement.
14. Use Averaging to remove random noise from high-loss measurements. Press **BW 2** then **Average**.

The displayed trace shows the Cable Loss values in one direction through the cable. A Return Loss measurement would show the loss for both down the cable and back. Therefore, a Cable Loss measurement is the same as a Return Loss measurement divided by 2.

The average Cable Loss across the specified frequency range is shown on the screen below the graticules.

2-Port Insertion Loss Measurements

A 2-port Insertion Loss measurement, available with option 110, is used to measure the loss through a DUT (device under test) – or cable – over a specified frequency range. The FieldFox signal source is transmitted out the RF OUT connector, through the DUT, and into the RF IN connector. Both ends of the DUT must be connected to the FieldFox, either directly or indirectly using the cable used in the normalization cal.

‘Insertion’ loss simply means **loss** through a device, usually expressed in dB. It is exactly the same measurement as “S21 Transmission” in NA Mode.

2-port Insertion Loss measurements are generally more accurate than 1-port Cable Loss measurements.

NOTE A Normalization Cal is REQUIRED for making accurate 2-port CAT or NA measurements. Learn how on page 50.

For highest accuracy, when measuring the DUT also attach any cable or adapter that was used in the normalization cal.

How to make a 2-port Insertion Loss Measurement

1. Press **Mode** then **CAT**.
2. Then **More** then **Insertion Loss (2-Port)**.
3. Press **Freq/Dist** and enter **Start** and **Stop** frequency values of the measurement.
4. Press **Sweep 3**, then select a **Resolution** setting.
5. Press **Cal 5**, then press **Normalization**. Perform normalization as explained on page 50.
6. Connect the DUT and view the insertion loss measurement results.

When measuring very long lengths of cable, it may be necessary to increase the sweep time. Learn how on page 28. Learn why in the Tutorials chapter on page 115.

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DTF (Distance to Fault) Measurements

CAT Mode **Distance to Fault** (DTF) measurements are generally used to locate problems, or faults, in a length of cable or transmission line. In this chapter, the cable to be tested is referred to as the DUT (Device Under Test).

Settings that are NOT unique to DTF measurements are documented in the CAT Mode chapter on page 23.

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Trace Math is NOT available in DTF Measurements.	

How to make DTF Measurements

Before starting, you may need the following:

- Jumper cable or adapter to connect the beginning of the DUT to the FieldFox.
 - LOAD with correct connector type and gender to terminate the end of the DUT (if possible).
 - The length and cable type of the DUT. If the cable type is not known, then the Cable Loss (dB/Meter) and Velocity Factor of the DUT are required.
1. Connect any necessary jumper cable or adapter to the FieldFox RF OUT port. Do NOT connect the DUT.
 2. Press **Preset** then **Preset** to return the FieldFox to the default settings.
 3. Then **Mode** then **CAT**.
 4. Then **DTF**.
 5. Press **Freq/Dist**, then **Stop Distance** and enter the length of the DUT. You can optionally set the **Start Distance**.
 6. Press **Cal 5** and follow the Cal prompts. Learn all about Calibration on page 47.
 7. Disconnect any components or antenna that should NOT be measured and connect a LOAD at the end of the DUT.
 8. Press **Meas Setup 4** then **Cable Specifications**.

9. Either press **Recall Coax Cable**, or enter the **Velocity Factor** and **Cable Loss** of the DUT.
10. Connect the start end of the DUT to the FieldFox.

DTF Measurement Settings

DTF Start and Stop Distance

In DTF measurements, you set the physical length of cable or other device to be tested. The FieldFox calculates the frequency range of the measurement from this distance. The longer the cable to be tested, the lower the frequencies that are used. You can also set the frequencies manually using the Bandpass Mode setting.

How to set Start and Stop Distance

- With a DTF measurement present, press **Freq/Dist**.
- Then choose from the following:
 - **Start Distance** Enter a value using the numeric keypad, the **▲▼** arrows, or the rotary knob, then **Enter**. By default, the Start Distance is set to **0** Meters. This means that the measurement will display faults starting at the point at which calibration standards are connected.
 - **Stop Distance** Enter a value using the numeric keypad, the **▲▼** arrows, or the rotary knob, then **Enter**.

DTF Units

By default, X-axis units for DTF measurement settings are displayed in Meters.

How to change units to Feet

- With a DTF measurement present, press **Freq/Dist**.
- Then **DTF Units**.
- The current selection is underlined **Meters Feet**.

NOTE In CAT mode, Y-axis units are displayed in return loss format, expressed as a positive number in dB, unless the measurement selected is DTF (VSWR).

Bandpass Mode

All DTF measurements are made with frequency settings and, using Inverse Fast Fourier Transform (IFFT), the time and distance to faults are calculated.

By default, the frequency range of a DTF measurement is set automatically based on the Start and Stop Distances. This setting (Bandpass Mode OFF) is the best setting when the DUT is a cable. However, if the DUT is a component that contains a diplexer or other filtering device which does not pass some frequencies, then set the frequency range manually.

- To test the ability of the filter to pass the intended frequencies, set the center frequency to the center of the filter passband and set a narrow frequency span.

- To test the rejection of the filter, set the center and span to those frequencies which the filter may not be adequately rejecting.

How to set Bandpass Mode ON

- With a DTF measurement present, press **Freq/Dist**.
- Then **More**.
- Then **Bandpass Center Freq** and type the center of the frequency range to use for the DTF measurement.
- Then **Bandpass Max Span** and type the frequency span to use for the DTF measurement.
- Then **Bandpass Mode ON OFF** to switch Bandpass Mode On and Off.

To confirm the frequency range being used for the DTF measurement, press **Measure 1**, then **Return Loss & DTF**. The frequency range is annotated on the Return Loss measurement when Alternate Sweep is OFF. Learn more about Alternate Sweep on page 37.

Cable Specifications

By default, the FieldFox does NOT compensate DTF measurements to account for the inherent loss of a cable. However, to make more accurate DTF measurements, the cable loss and velocity factor can be entered using one of the following methods:

- Select a cable type from a list which contains the cable loss in dB/meter and velocity factor.
- Manually enter cable loss and velocity factor for the measurement.

The following is an example showing how DTF cable correction works:

The DUT is a 100 meter transmission cable. The specification file for the cable shows .1 dB/meter loss at 300 MHz. This means that a signal traveling ONE WAY through the cable will lose 10 dB of power ($100 \text{ m} * .1\text{dB/m}$). Because the FieldFox performs this measurement with 1 port, the test signal travels down the cable and then back, for a total loss of 20 dB.

After a calibration has been performed, for the purpose of illustrating this point, connect an OPEN to the end of the cable – a maximum-sized fault - for 100% reflection of the 300 MHz test signal.

Without compensation for the loss of the cable, a -20 dB response would be visible at 100 meters, which is the OPEN at the end of the DUT. This is from 10 dB of loss through the cable in each direction.

With compensation for the loss using the manufacturer's specification, the FieldFox compensates the trace as though the signal traveling through 100 meters was increased by +20 dB. Therefore the response will show 0 dB for 100% reflection.

Manually specify Velocity Factor and Cable Loss

Velocity Factor is a property of the physical material of a cable. A VF of 1.0 corresponds to the speed of light in a vacuum, or the fastest VF possible. A polyethylene dielectric cable has $VF = 0.66$ and a cable with Teflon dielectric has $VF = 0.7$.

Cable Loss is specified in dB/meter. In addition to the length of the cable, loss is also directly proportional to the frequency of the signal that passes through the cable.

When entered manually, only one Loss value can be used for the entire frequency range of the measurement. The frequency range is set using the Start and Stop Distance. Learn more on page 34.

With a DTF measurement present:

- Press **Meas Setup 4**.
- Then **DTF Cable Specifications**.
- Select **Cable Corr Auto Man** to switch to manual entry.
- Then choose from the following:
 - **Velocity Factor** Using the numeric keypad, enter a value between 0.01 and 1. Then press **Enter**.
 - **Cable Loss** Using the numeric keypad, enter a positive cable loss value, then press **Enter**.

Recall and use a Coax Cable File

The FieldFox includes many predefined cable files with the manufacturer's specifications. You can edit these files or create new cable files using the FieldFox Data Link Software. Learn more on page 99.

A predefined or custom cable file can contain several Frequency / Loss pairs to define the cable loss characteristics.

With a DTF measurement present:

- Press **Meas Setup 4**.
- Then **Cable Specifications**.
- Then **Recall Coax Cable**.
- Then using the **▲▼** arrows or the rotary knob, highlight a cable, then press **Recall File**. You can view the cable properties after it is recalled.
- Or choose from the following:
 - **Sort By Cable Name** Sorts all pages of the cable list by Cable Name
 - **Sort By Date** Sorts all pages of the cable list by Date. This is the date that the file was created or modified.
 - **Next Page** View the following page of the list.
 - **Previous Page** View the previous page of the cable list.
 - **Cancel** Closes the cable list without recalling a file.

Cable Corr Auto Man is displayed to indicate that a file is in use to compensate the DTF measurement.

Press **View Cable Data** when a file is recalled to view the cable specifications.

Window Settings

Window settings provide the ability to choose between optimizing DTF measurements for resolving closely-spaced faults or for the ability to measure low-level faults.

How to select Window settings

- Press **Meas Setup 4**.
- Then **Settings**.
- Then **Next Page**.
- Then press **▲▼** arrows to move to the Window row.
- Then press **Edit**.
- Then press **Window** repeatedly and choose from the following:
 - **Maximum – Optimized for dynamic range**, the noise floor is lowered to provide the ability to measure low-level responses. (Default setting)
 - **Medium** – Compromise between Min and Max window settings.
 - **Minimum – Best Response Resolution**, providing the ability to resolve between two closely-spaced responses.
- Then press **Done Edit**.
- Again press **Done**.

Alternate Sweep

Available ONLY in a **Return Loss & DTF** measurement.

With Alternate Sweep ON, two independent sweeps are performed:

- Return Loss measurement sweep (Top plot).
- DTF measurement sweep (Bottom plot).

With Alternate Sweep OFF, only one sweep is made for both the Return Loss and DTF measurement.

How to set Alternate Sweep

- Press **Mode** then **CAT**.
- Then **Return Loss & DTF**.
- Then **Meas Setup 4**.
- Then **Alternate Sweep ON OFF**.

With Alternate Sweep ON, the Start and Stop frequency settings can be changed from the settings that are required to make the DTF measurement. However, the DTF measurement continues to be made using the frequencies that are dictated by the **DTF Bandpass Mode** setting. Learn more on page 34.

If a calibration is performed, it is applied to both sweeps.

How to set Start and Stop Frequency with Alternate Sweep ON

- Press **Freq/Dist**.
- Then **Start Frequency** and **Stop Frequency**.
 - Follow each by entering a value using the numeric keypad, **▲▼** arrows, or the rotary knob.
 - After using the **▲▼** arrows or the rotary knob, press **Enter**. The increment setting of the arrows is based on the current span and can NOT be changed in CAT Mode.
 - After using the keypad, then select a multiplier key. Learn about multiplier abbreviations on page 22.

NA (Network Analyzer) Mode

CAT Mode is very similar to NA (Network Analyzer) Mode. Learn more in the Tutorials chapter on page 111.

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NA Mode Settings

Select NA Mode before making any setting in this section.

How to select NA Mode

- Press **Mode**.
- Then **NA**.

Measurement Selection

How to select a NA Measurement

- Press **Measure 1**.
- Then choose from the following:
 - **S11 Reflection** 1-port reflection measurement.
 - **S21 Transmission** 2-port transmission measurement. Requires Opt 110. Learn how to make this measurement on page 45.

- **A** Measurement of the A receiver.
- **R** Measurement of the R receiver.

Learn about A and R receiver measurements in the Tutorials chapter on page 111.

Quick Settings

Both CAT and NA Modes allow you to view and change most relevant settings from a single location. All of these settings are discussed in this chapter and, unless otherwise noted, ALL of these settings can also be made using the standard softkey menus.

How to view and change Quick Settings

- Press **Meas Setup 4**.
- Then **Settings**.
- Press **Next Page** and **Previous Page** to view all settings. If these softkeys are NOT available, then all available settings fit on one page.
- To change a setting:
 - Use the **▲▼** arrows to highlight a setting.
 - Then press **Edit**. The current setting changes to **yellow**.
 - Some settings require you to press a softkey to change the value. Otherwise, use the numeric keypad, **▲▼** arrows, or rotary knob to change the value.
 - When finished changing a value, press **Done Edit**.
 - When finished changing settings, press **Done**.

Use knob. Press [Edit] to make changes. Press [Done] to exit.

Setting	Value
Start Frequency	1.000000000 GHz
Stop Frequency	6.000000000 GHz
Center Frequency	3.500000000 GHz
Frequency Span	5.000000000 GHz
Resolution	201
Output Power	High

The Quick Settings menu. The resolution is being edited.

Format

Select the display format in which to present measurement results. Learn more about Format on page 112.

This setting can be changed at any time without affecting calibration accuracy.

How to select a NA Format

- Press **Measure 1**.
- Then **Format [current setting]**.

- Then choose from the following:
 - **Log Magnitude** Displays magnitude in dB
 - **Linear** Displays positive values only. Y-axis: Unitless (U) for ratioed measurements; Watts (W) for unratioed measurements.
 - **VSWR** (S11 and Fault Location Only) Displays unitless reflection data.
 - **Phase** (S11 Only) Displays phase in degrees. The trace ‘wraps’ every 360 degrees, from +180 to -180, for easy scaling.
 - **Smith** (S11 Only) Displays series resistance and reactance. See tutorial on page 113.

Frequency Range

Set the range of frequencies over which you would like to make measurements. When the frequency range is changed after a calibration is performed, the cal becomes interpolated. Learn more on page 47.

How to set Frequency Range

This can be done in two ways:

- Press **Freq/Dist**
- Then choose from the following:
 1. **Start** and **Stop** frequencies – Specify the beginning and end of the sweep.
 2. **Center** and **Span** frequencies - Specify the center frequency and span of frequencies (half on either side of center).
- Follow each by entering a value using the numeric keypad, the **▲▼** arrows, or the rotary knob.
- After using the **▲▼** arrows or the rotary knob, press **Enter**. The increment setting of the arrows is based on the current span and can NOT be changed in NA Mode.
- After using the keypad, then select a multiplier key. Learn about multiplier abbreviations on page 22.

Scale Settings

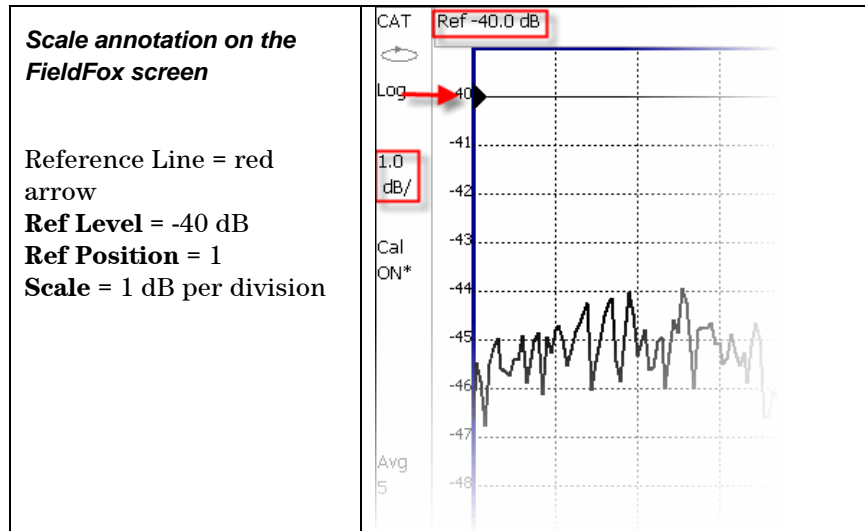
Adjust the Y-axis scale to see the relevant portions of the data trace. The Y-axis is divided into 10 graticules.

This setting can be changed at any time without affecting calibration accuracy.

How to set Scale

- Press **Scale / Amptd**.
- Then choose from the following methods:
 1. **Autoscale** Automatically adjusts the Y-axis to comfortably fit the Min and Max amplitude of the trace on the screen.
 2. Set Scale, Reference Level, and Reference Position
 - **Scale** Manually enter a **scale per division** to view specific areas of the trace.

- **Ref Level** Manually set the value of the reference line. Enter a negative value by pressing **Run/Hold (+/-)** either before or after typing a value.
- **Ref Position** Manually set the position of the reference line. Values must be between 0 (TOP line) and 10 (BOTTOM line)



Averaging

Trace Averaging helps to smooth a trace to reduce the effects of random noise on a measurement. The FieldFox computes each data point based on the average of the same data point over several consecutive sweeps.

Average Count determines the number of sweeps to average. The higher the average count, the greater the amount of noise reduction.

An average counter is shown in the left edge of the screen as **Avg N**. This shows the number of previous sweeps that have been averaged together to form the current trace. When the counter reaches the specified count, then a 'running average' of the last **N** sweeps is displayed.

Average Count = 1 means there is NO averaging.

This setting can be changed at any time without affecting calibration accuracy.

How to set Trace Averaging

- Press **BW 2**.
- Then **Average N** where **N** is the current count setting.
- Enter a value using the numeric keypad. Enter **1** for NO averaging.
- Press **Enter**.
- While Trace Averaging is in process, press **Sweep 3**, then **Restart**, to restart the averaging at 1.

Sweep Type

Sweep Type determines whether the FieldFox sweeps continuously or only once each time the **Single** button is pressed. Use **Single** to conserve battery power or to allow you to Save or analyze a specific measurement sweep.

This setting can be changed at any time without affecting calibration accuracy.

How to set Sweep Type

- Press **Sweep 3**.
- Then choose one of the following:
 - **Single** A Makes one measurement sweep, then Holds. Press **Single** again to take another measurement sweep. This setting automatically sets Continuous to **OFF**. The **Hold** annotation changes to a green arrow --> while the sweep occurs.
 - **Continuous** Makes continuous sweeps. This is the typical setting when battery power is not critical.
- You can also use **Run / Hold +/-** to toggle between Single and Continuous sweep.

Resolution (Number of Data Points)

Data points are individual measurements that are made and plotted across the X-axis to form a trace. Select more data points to increase measurement resolution. However, more data points also takes more time to complete an entire measurement sweep.

When the Resolution is changed after a calibration is performed, the cal becomes interpolated. Learn more on page 47.

How to set Resolution

- Press **Sweep 3**.
- Then **Resolution**.
- Then choose from the following: **201 | 401 | 601 | 801 | 1001**.

Sweep Time

The fastest possible sweep time is always used as the default setting. Use the **Min Swp Time** setting to slow the sweep time when measuring long lengths of cable. Learn more in the tutorials section on page 115.

The actual sweep time is shown on the FieldFox screen. See the Screen Tour on page 21. To increase the sweep time, enter a value that is higher than the actual sweep time. The increase will not be exactly the amount that you enter, as the actual sweep time is the composite of many factors.

How to set Sweep Time

- Press **Sweep 3**.
- Then **Min Swp Time**.
- Enter a value using the numeric keypad.
- Press a multiplier key. Learn about multiplier abbreviations on page 22.

Output Power

Set the power level out of the FieldFox to either High power or Low power. Generally, the high power level (default setting) is more accurate because the receivers are measuring farther from the noise floor. However, some devices are sensitive to high power levels. Use the Low power setting when measuring amplifiers.

NOTE To help prevent damage to your DUT, when Output Power is changed in NA Mode, it is changed to the same value in CAT Mode.

How to set Output Power

- Press **Meas Setup 4**.
- Then **Output Power High Low**.
 - **High** Sets output power to approximately +5 dBm.
 - **Low** Sets output power to approximately -25 dBm.

Interference Rejection

Use this setting when you suspect that other signals in the area are interfering with a measurement. This may look like a spike or lack of stability in the measurement trace. While monitoring a measurement at a specific frequency, toggle this setting between ON and OFF. If the measurement result decreases while ON, then there is an interfering signal in the area. Continue to make measurements with Interference Rejection ON. However, this will slow the measurement speed.

Once enabled, up to SIX sweeps may be required before the interfering signal is neutralized.

This setting can be changed at any time without affecting calibration accuracy.

How to set Interference Rejection

- Press **Meas Setup 4**.
- Then **Interference Rejection [current setting]**.
- Then choose from the following:
 - **Off** No interference rejection and fastest possible sweep speed.
 - **Minimum** The lowest level of Interference rejection.
 - **Medium** The medium level of Interference rejection.
 - **Maximum** The highest level of Interference rejection.

S21 Transmission Measurements

An S21 Transmission measurement, available with option 110, is used to measure the loss through a DUT – or cable – over a specified frequency range. The FieldFox signal source is transmitted out the RF OUT connector, through the DUT, and into the RF IN connector. Both ends of the DUT must be connected to the FieldFox.

An S21 measurement is exactly the same measurement as “2-Port Insertion Loss” in CAT Mode.

NOTE A Normalization Cal is REQUIRED when making 2-port CAT or NA measurements.

For highest accuracy, when measuring the DUT also attach any cable or adapter that was used in the normalization cal.

How to make an S21 Transmission Measurement

1. Press **Mode** then **NA** then **S21 Transmission**.
2. Press **Freq/Dist** and enter **Start** and **Stop** frequency values of the measurement.
3. Press **Sweep 3** then select a **Resolution** setting.
4. Press **Cal 5** then press **Normalization**. Perform normalization as explained on page 50.
5. Connect the DUT and view the transmission measurement results.

When measuring very long lengths of cable, it may be necessary to increase the sweep time. Learn how on page 28. Learn why in the Tutorials chapter on page 115.

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Calibration for CAT and NA Modes

Calibration is required in both CAT and NA Modes. The FieldFox performs a calibration automatically when powered ON and when Preset is performed. In addition, calibration can be performed manually. Key presses are identical in both Modes.

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Definitions

DUT (Device Under Test) is the cable, antenna, transmission line, or anything else that is connected to the FieldFox that is to be measured.

OPEN, SHORT, and LOAD are calibration standards. These are precision components that are used during calibration and to terminate a DUT during some measurements. When an RF signal ‘hits’ these components, the signals are reflected in a predictable manner.

- A SHORT and OPEN standard both cause 100% of an RF signal to be reflected. The difference between these two standards is what happens to the phase of the reflected signal, which is beyond the scope of this discussion. Although an OPEN standard is a precision component, simply leaving **nothing** connected at the end of a cable can be a reasonable substitute for an OPEN.
- A LOAD standard completely absorbs the incident signal and NO signal is reflected back to the source.

Calibration Reference Plane is the point at which cal standards are connected during a calibration. This can be either the FieldFox RF OUT connector, or at the end of a jumper cable or adapter.

The Calibration Process

There are very well defined and understood systematic errors that are measured and calculated during the calibration process. These errors are caused by leakage and frequency response of the signals traveling to the internal receivers and by the internal reflections that interact with the DUT. After calibration, these errors are removed from subsequent CAT and NA mode measurements.

Interpolation

Highest measurement accuracy is achieved when the measurement type, frequency range, power level, and resolution settings remain the same during the measurement as when the FieldFox was calibrated. If these settings change after a calibration, the FieldFox will interpolate the calibration so that VERY accurate measurements continue to be made.

Interpolated Calibrations are only **slightly less accurate** than a calibration performed at the measurement settings. For example, if frequency settings change after a Preset Calibration is performed, the Preset Calibration is only slightly less accurate. Learn more about the relative accuracy of FieldFox calibrations on page 52.

When a calibration is being interpolated, an asterisk is added to the screen annotation as follows: **Cal ON***

For highest accuracy: a new cal should be performed when the temperature changes more than about 10°F (5°C), or when the connection to the DUT requires a different jumper cable or adapters.

How to turn Error Correction OFF

“Error Correction” is applying the results of a calibration to a measurement. Error Correction is automatically turned ON after a calibration. You could turn Error Correction OFF in order to see the effects of a calibration on the measurement.

- Press **Cal 5** then **Error Correction ON OFF**.
- Then **Exit** or **Esc**.
- **Cal OFF** is shown on the screen when Correction is OFF.
- **Cal OFF*** is shown on the screen when switching from a 1-port measurement to a 2-port measurement or vice-versa. Calibration for the current measurement has NOT been performed.

Cal ON ? – Questionable Accuracy

If a change made by the user to the output power setting, or a change made automatically by the FieldFox firmware makes accurate calibration interpolation questionable, a question mark is added to the screen annotation for all calibration states (Ex: **Cal ON ?**). The resulting measurement accuracy depends on how much the setting has changed. For optimum accuracy, recalibrate using the new settings.

Preset Calibration

Every FieldFox is factory calibrated at the RF Out connector. This CalReady condition allows you to start using your FieldFox immediately if you are measuring a device that is directly connected to the RF Out test port. CalReady applies to the entire frequency range of the FieldFox. **Cal ON** is shown on the screen when powered ON or Preset. It can be used to check the integrity of the jumper cable.

When measuring a DUT using a jumper cable or adapter - NOT a direct connection to the RF Out connector – then a QuickCal or OSL Cal is recommended.

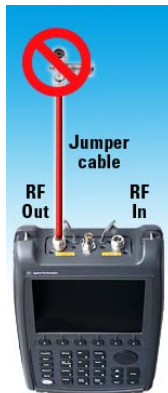
QuickCal

QuickCal (option 111) is ideal for making DTF and 1-Port Cable Loss measurements at the end of a jumper cable or adapter. QuickCal corrects for phase shift, time delay, and loss, of adapters or jumper cables.

How to perform a QuickCal

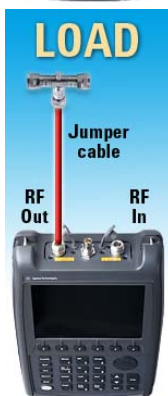
Press **Esc** at any time during the QuickCal to stop the calibration.

- In CAT or NA Mode, press **Cal 5**.
- Then (if necessary) press **Calibration Type** to see **QuickCal**.
- Then **Start Cal**.



Step 1

1. Disconnect the DUT from the FieldFox.
2. If a jumper cable or adapter is required to connect the DUT to the FieldFox, connect **those** components to the FieldFox RF Out connector NOW. The effects of those components will be measured and removed during the calibration, and only the effects of the DUT will be displayed in the measurement results. **These should be high-quality components!**
3. Do NOT connect anything at the point where the DUT connects.
4. Then press **QuickCal**.



Step 2

1. If a jumper cable or adapter is used, then connect a LOAD standard at the point where the DUT will be connected. This improves measurement accuracy by removing the reflections from the added length of cable or adapter. Then press **Measure Load**.
 2. Press **Skip Load** when making DTF measurements. This step does little to improve accuracy.
 - **Do NOT Skip Load** when measuring a DUT with good match (return loss > 15 dB)
- Press **Finish**.
 - **Cal ON Q** is shown on the screen when a QuickCal is correcting the measurement.

O,S,L Cal

An OPEN, SHORT, LOAD Cal is performed using discrete standards from a Cal Kit. (Cal Kits are available from Agilent – see page 10 for part numbers.) Built into the FieldFox are definitions for both Male and Female Type-N Cal Kits, and 7/16 Cal Kits. Other Cal Kits can be added using the FieldFox Data Link Software. Learn more on page 99.

O,S,L Cal is extremely accurate when performed using the recommended Cal Kits with standards that are in clean and good repair, and when using correct connection procedures.

CAL ON U is shown on the screen when an O,S,L Cal is correcting the measurement.

How to perform:O,S,L Cal

Before performing an O,S,L Cal, set the Measurement type, Frequency Range, Power Level, and Resolution of the measurement. The calibration will remain highly accurate until these settings change, or the physical connection to the FieldFox changes.

- Disconnect the DUT from the FieldFox.
- If a jumper cable or adapter is required to connect the DUT to the FieldFox, then connect **those** components to the FieldFox RF Out connector NOW. The effects of those components will be measured and removed during the calibration, and only the effects of the DUT will be displayed in the measurement results. **These should be high-quality components!**
- In CAT or NA Mode, press **Cal 5**.
- Then (if necessary) press **Calibration Type** to choose **[O,S,L]**.
- Then (if necessary) press **Connector Type**.
- Then select the connector type and gender of your DUT. This will determine the type and gender of cal kit to use. For example, if a Type-N Male connector is used on the DUT, then the Type-N Male standards (OPEN, SHORT, AND LOAD) will ALL be connected in place of the DUT during the calibration.

NOTE Calibration kit definitions are unique to each connector type and connector sex. They must be correctly applied to obtain the most accurate calibration.

- Then press **Start Cal**.
- Press **Open**, **Short**, and **Load** in any order.
- Connect the corresponding standard at the point where the DUT will be connected, then press **Measure**.
- Measure each of the three standards. Standards can be measured again at any time if you feel a standard was not connected securely.
- Press **Finish** to complete the O,S,L calibration.

Normalize

Normalize is used with a **2-port Insertion Loss** measurement (CAT Mode) and a **S21 Transmission** measurement (NA Mode).

NOTE A Normalization Cal is REQUIRED to make accurate 2-port Transmission or Insertion Loss measurements.

How to perform a Normalization

- Select **CAT** Mode, then **More**, then **2-port Insertion Loss** or **NA** Mode, then **S21 Transmission**.
- Connect a short, high-quality, phase stable cable between the FieldFox **RF OUT** and **RF IN** connectors.

NOTE All subsequent insertion loss measurements are made relative to the insertion loss of this cable. For example, if you use a Normalization cable with 1 dB of loss, then after pressing **Normalize**, the display will show 0 dB of loss with this cable in place.

For highest accuracy, when measuring the DUT also attach the cable that was used in the normalization cal.

- Press **Cal 5**.
- **Calibration Type [Normalize]** should appear.
- Press **Start Cal** then **Thru** then **Measure**. The trace is automatically stored to Memory.
- Press **Finish**.
- Connect the DUT between the **RF OUT** and **RF IN** connectors.

A Normalization cal will be interpolated if the Resolution or Frequency range changes.

CAL ON U is shown on the screen when a Normalization Cal is correcting the measurement.

Save the Calibration

After performing any type of calibration, you can save the FieldFox settings along with the calibration. These settings and calibration can then be recalled as necessary. To learn how, see **Saving and Recalling Files** on page 83.

Verifying Calibration and Jumper Cable Integrity

After calibrating, it is important to verify that the calibration is good. When using a jumper cable, also verify that the cable is of high quality.

Verify a Calibration

- Connect a LOAD standard at the calibration reference plane (where calibration standards were connected). This may be at the end of the jumper cable or at FieldFox RF OUT connector.
- In CAT Mode, select a Return Loss measurement.
- In NA Mode, select a S11 Reflection with Log Mag format.
- Observe the trace on the FieldFox screen:
 - Lower than 40 dB indicates a GOOD calibration.
 - Higher than 30 dB indicates that you should recalibrate.

Test the Jumper Cable

With the LOAD standard still connected, move the jumper cable while observing the trace.

- If the measurement trace is relatively stable, the jumper cable is of good quality.

- If you observe significant movement in the peaks of the measurement trace when moving the cable (>5 dB), the jumper cable may need to be replaced.

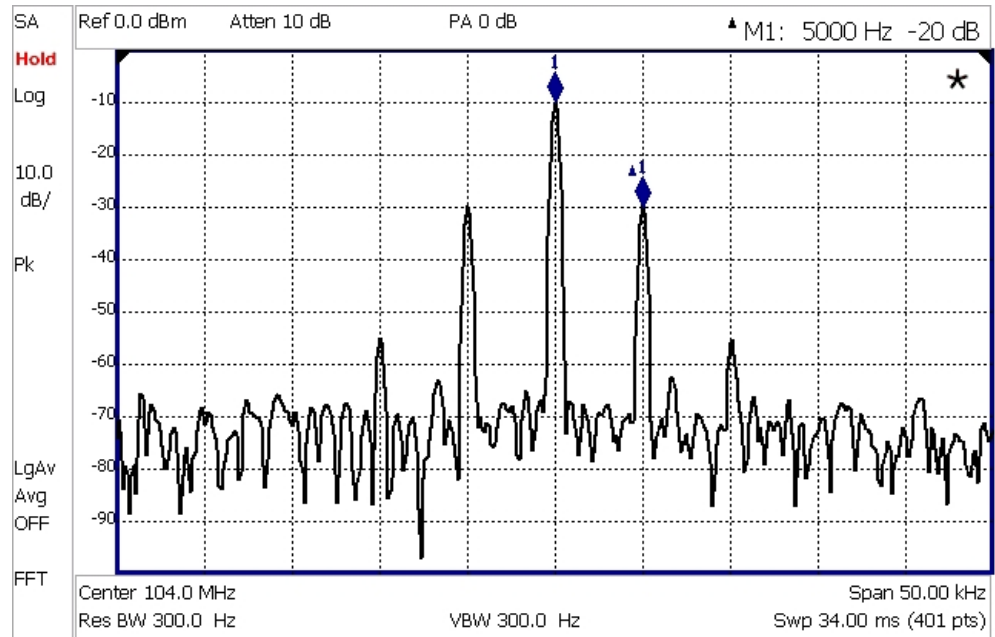
Calibration Method Summary

- **O,S,L** is ALWAYS the most accurate Cal method. The quality of an O,S,L Cal is completely dependent on the quality of the OPEN, SHORT, LOAD standards. Use high quality standards to ensure the most accurate calibration.
- **QuickCal** is ideal for DTF measurements. QuickCal should be performed when good accuracy is required and when using a jumper cable or adapter.
 - During QuickCal, do NOT 'Skip Load' when measuring a DUT with good match (Return Loss better than 15 dB).
- **Preset Cal** is ONLY useful for DUT connections made at the RF Out port and most accurate at room temperature.
- **For highest accuracy with ALL methods**, a new cal should be performed:
 - when the temperature changes more than about 10°F (5°C)
 - when the connection to the DUT requires a different jumper cable or adapters.

SA (Spectrum Analyzer) Mode

General purpose Spectrum Analyzer measurements are available with Option 230 or 231. SA Mode measures signals at the RF IN port - the RF OUT connector is NOT used.

SA measurements require NO calibration.



SA display with markers
Carrier with 5 kHz frequency modulation and deviation of 1 kHz

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SA Mode Settings

Select SA Mode before making any setting in this chapter.

Because there is no calibration, these settings can be made in any order.

How to select SA Mode

- Press **Mode**.
- Then **SA**.

Frequency Range (X-axis)

The X-axis frequency range determines the frequencies that are measured for each sweep. The frequency range of the measurement is usually entered in two ways: Center/Span and Start/Stop.

The center frequency can also be changed using Marker -> Center. Learn more on page 76.

The default Start frequency is 0 Hz. However, the Start frequency can be set as low as -100 MHz. The internal LO of the FieldFox can be seen at 0 Hz, which will mask input signals that may be present.

How to set Frequency Range

- Press **Freq/Dist**.
- Then choose from the following:
 - **Center** and **Freq Span** frequencies. This is the most common method of entering frequency range. Enter the frequency of interest. The Center frequency is at the exact center of the X-axis. The Frequency Span places half of the frequency range on either side of center. When the Center and Frequency Span values are entered, then the X-axis annotation on the screen shows the Center and Span frequencies.
 - **Start** and **Stop** frequencies. Start is the beginning of the X-axis and Stop is the end of the X-axis. When the Start and Stop frequencies are entered, then the X-axis annotation on the screen shows the Start and Stop frequencies.
- Follow each of these by entering a value using the numeric keypad, the **▲▼** arrows, or the rotary knob.
- When using the **▲▼** arrows, press **Enter**. The increment setting of the arrows is based on the current span. This can be changed in SA Mode. See **How to change frequency step size** below.
- After using the keypad, then select a multiplier key. Learn about multiplier abbreviations on page 22.

Two more ways to change the frequency span

- Press **Freq/Dist**.
- Then choose from the following:

- **Zero/Last Span** Each key press toggles the frequency span between 0 Hz and the last specified frequency span.
- **More**
- then **Full Span** Selects the entire frequency span of the FieldFox. The Center frequency is set automatically.

How to change frequency step size

When using the **▲▼** arrows to change any of the frequency settings, the size of the frequency step can be changed.

- Press **Freq/Dist**
- Then **More**
- Then **CF Step Auto Man**
 - **Auto** Each press of the **▲▼** arrows increments or decrements the value by 1/10th (one division) of the current frequency span. **Note:** To change this setting from **Man** to **Auto**, press **CF Step** twice.
 - **Man** Type a step size value using the numeric keypad, then select a multiplier key. Learn about multiplier abbreviations on page 22.

Scale

Adjust the Y-axis scale to see the relevant portions of the data trace.

The Y-axis is divided into 10 graticules. A Reference Level is shown on the screen as a solid horizontal bar that can be placed at any graticule.

When RF Attenuation set to **Auto**, the RF Attenuation is coupled to Reference Level.

How to set Scale

- Press **Scale / Amptd**.
- Then choose from the following:
 - **Autoscale** Automatically adjusts the Y-axis to comfortably fit the Min and Max amplitude of the trace on the screen.
 - Manually set Scale, Reference Level, and Reference Position.
 - **Scale** Manually adjust the scale per division to view specific areas of the current trace. Enter a value using the numeric keypad, the **▲▼** arrows, or the rotary knob. The press **Enter**.
 - **Ref Level** Manually set the value of the reference line. Enter a negative value by pressing **Run/Hold (+/-)** either before or after typing a value. This can also change the RF Attenuation setting. See **Attenuation Control – Auto**.
 - **Ref Position** Manually set the position of the Reference Level. Values must be between 0 (TOP line) and 10 (BOTTOM line). Default position is zero (top).

Attenuation Control

Both the RF Attenuation and Pre Amp functions control the power level into the SA.

When too much power is present at the RF IN port, **ADC Over Range** appears on the FieldFox screen. This does not necessarily mean that damage has occurred, but that the measurement is probably compressed.

When high power levels are present at the RF IN connector, internal attenuation can be switched in to keep the FieldFox receiver from compressing. At extremely high power levels, use external attenuation to protect the internal circuitry from being damaged.

WARNING

The FieldFox can be damaged with too much power.

RF Damage Level: +27 dBm

DC Damage Level: ±50 VDC

The displayed power level is automatically adjusted for RF Attenuation. As the attenuation value changes, the displayed power level should NOT change.

How to set Attenuation

The default Attenuation setting is 10 dB. This value can be changed from 0 to 31 dB in 1 dB steps.

- Press **Scale/Amptd**.
- Then **RF Atten Auto Man**.
- **Auto** RF Attenuation is set by adjusting the Reference Level. As the Reference Level is lowered, for example from -10 dB to -30 dB, the FieldFox assumes that you are looking at low-level signals. The RF Attenuation value is automatically lowered in 5 dB steps to allow low-level signals to be viewed. The RF Attenuation value is never automatically lowered below 5 dB.
- **Man** RF Attenuation is set manually. Enter a value using the numeric keypad, the **▲|▼** arrows, or the rotary knob. Values less than 5 dB must be typed using the numeric keypad. Then press **Enter**

#Atten xx dB is shown at the top of the screen. (#) means manual setting.

Preamplifier Control (Opt 235)

When **very low-level** signals are analyzed, an internal preamplifier can be used to boost the signal level by approximately 22 dB. The displayed signal level is automatically adjusted for the increase in system gain.

How to control the Preamp

By default, the preamp is OFF.

- Press **Scale/Amptd**.
- Then **Preamp ON OFF** The underlined setting is the current setting.

The approximate gain of the preamp (**PA 22 dB**) is shown at the top of the screen. 22 dB of gain is not a measured value, but an approximate value.

Check for Compressed Measurements

Compression occurs when too much power into an amplifier causes it to no longer amplify in a linear manner. When too much power goes into the FieldFox RF IN connector, the amplifiers in the SA receiver compress and signal power will not be displayed accurately. This can occur even if **ADC Over Range** is not displayed. Increase the RF Attenuation value to prevent the SA receiver from being compressed.

How to Check for a Compressed Measurement

- Using a marker at the signal peak, make note of the signal power level.
- Increase the RF Attenuation level by 5 dB.
 - If the signal level does **NOT** change, then NO compression exists. This indicates that the signal is in the linear region of the FieldFox receiver.
 - If the signal level **DOES** increase, then the receiver was compressed. Set the RF Attenuation value at the setting when further increases no longer result in an increase in the displayed power level.

Resolution Bandwidth (Res BW)

In SA Mode, the Res BW provides the ability to resolve, or see closely spaced signals. The narrower (lower) the Res BW, the better the spectrum analyzer can resolve signals. In addition, as the Res BW is narrowed, less noise is measured by the spectrum analyzer ADC and the noise floor on the display lowers as a result. This allows low level signals to be seen and measured. However, as the Res BW is narrowed, the sweep speed becomes slower.

How to set Res BW

- Press **BW 2**.
- **Res BW Auto | Man.**
 - **Auto** Res BW is coupled to the frequency span. As the frequency span is narrowed, the Res BW is also narrowed providing increased ability to resolve signals.
To change this setting from **Man** to **Auto**, press **Res BW** twice.
 - **Manual** Enter a Res BW value using the numeric keypad, the **▲|▼** arrows, or the rotary knob. Then press a multiplier if necessary or press **Enter**.

The current Res BW setting is shown at the bottom of the screen.

#Res BW x.xx XHz (#) means manual setting.

NOTE When the Res BW is set to 200 kHz and below, **FFT** is displayed in the lower-left corner to indicate that Fast Fourier Transform calculations are being used to process the measurement most efficiently.

Frequency **Step** mode is used above 200 kHz.

This setting could impact the accuracy of the measurement. See Specifications on page 123.

Video Bandwidth (Video BW)

Video BW is a smoothing operation that is performed after measurement data is acquired. The trace data is effectively smoothed so that the average power level of the displayed noise is the same, but the peaks and valleys of adjacent data points are smoothed together. More smoothing occurs as the Video BW is set lower. However, as the Video BW is narrowed, the sweep speed becomes slower.

How to set VBW

- Press **BW 2**.
- Then **Video BW Auto Man**.
 - **Auto** Couples Video BW to the ResBW. As ResBW is narrowed, Video BW is also narrowed providing increased data smoothing.
 - **Manual** Enter a Video BW value using the numeric keypad, the **▲▼** arrows, or the rotary knob. Then press a multiplier if necessary or press **Enter**.

NOTE To change this setting from **Man** to **Auto**, press **Video BW** twice.

The current Video BW setting is shown at the bottom of the screen.

VBW x.xx XHz (#) means manual setting.

When the ResBW/VBW ratio exceeds 10,000, a Meas UNCAL warning may appear to indicate that the VBW filter has reached the maximum capacity for averaging.

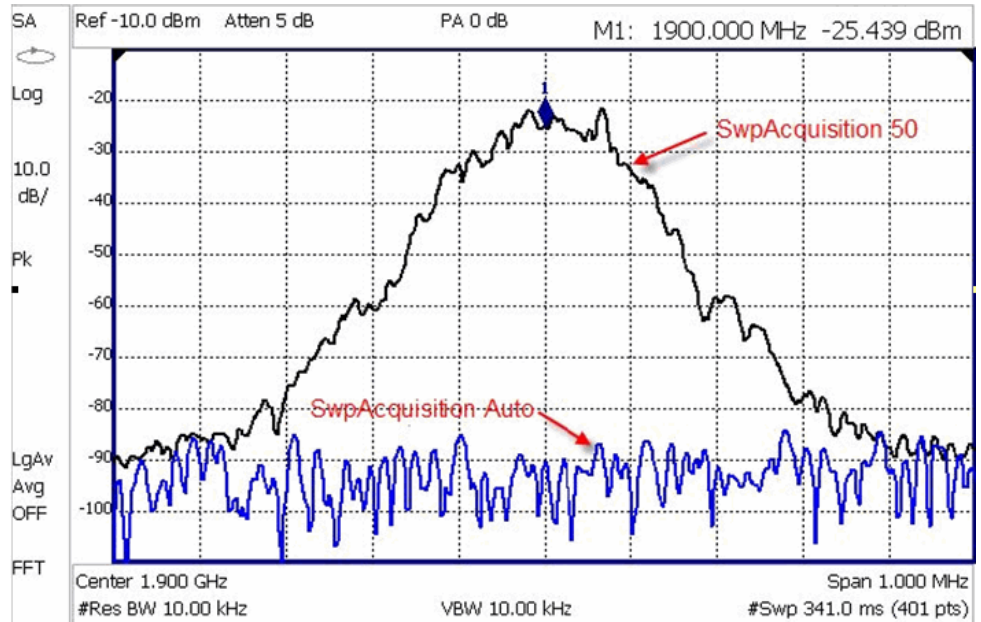
Sweep Acquisition

When set to Auto, Sweep Acquisition is set to the minimum value required with the current settings in order to achieve amplitude accuracy when measuring CW signals yielding the fastest sweep update rate.

However, you can adjust this setting in order to increase the probability of intercepting and viewing pulsed RF signals.

For example, with **SwpAcquisition set to Auto** a pulsed GSM signal is NOT visible on the FieldFox screen, as shown in a blue trace in the following image.

However, while watching the trace, increase the SwpAcquisition value until the pulse spectrum rises out of the noise and reaches its maximum level. Increasing the SwpAcquisition value beyond this point only slows the update rate (increases the actual Sweep time readout) but does not improve measurement quality.



A GSM signal in a framed data format; timeslot zero ON; all others OFF; PRF = 218Hz, Duty Cycle = 12.5%. The pulsed signal becomes visible on every sweep update with SwpAcquisition = 50.

How to set Sweep Acquisition Parameter

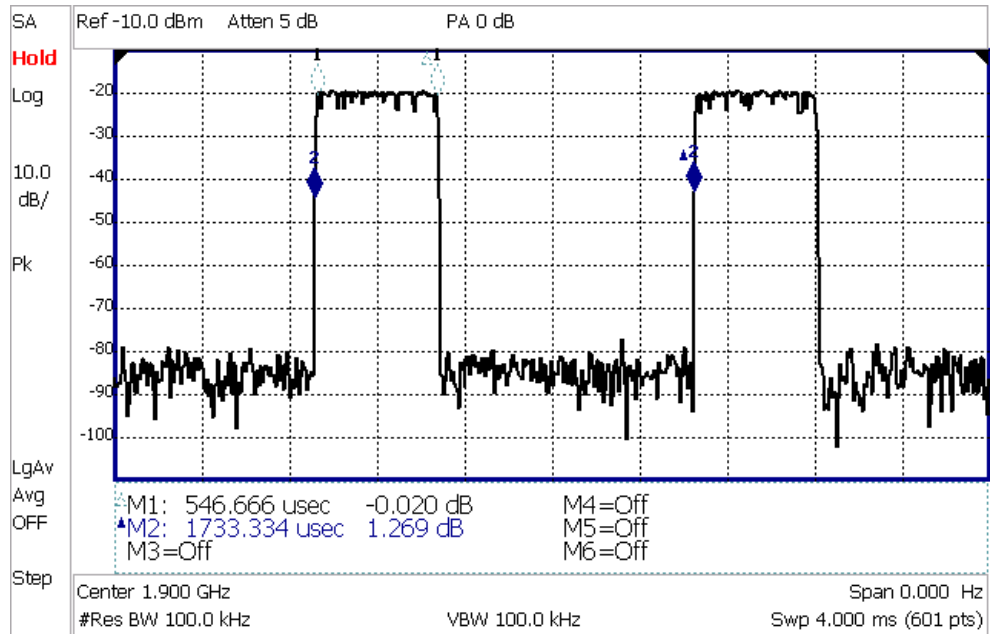
- Press **Sweep 3**.
- Then **SwpAcquisition Auto Man**.
- Then choose from the following:
 - **Auto** Sweep is set to the fastest sweep possible with the current settings.
 - **Manual** Enter a relative acquisition value between **1** and **5000**, where:
 - 1 = Fastest sweep possible
 - 5,000 = Slowest sweep possible
 - # is shown in front of the actual sweep time to indicate a manual setting.

Some Detector and Video Bandwidth settings will raise the Auto Sweep Acquisition value greater than 1. In these cases, manually setting Sweep Acquisition lower than the Auto value may have NO effect.

Zero Span Measurements

When setting the frequency span to Zero, there is NO spectrum of frequencies to display, so the X-axis units becomes Time. The SA becomes like a tunable oscilloscope, with the center frequency being the frequency of interest. This capability is useful for analyzing modulation characteristics, such as pulsed measurements.

VBW is automatically coupled to Res BW when in Zero Span and can NOT be changed. Learn more about these settings on page 57.



GSM signal, framed data format, timeslot 0 and 3 on. Sweep Time is set to approximately the frame interval. Press Single several times until the waveform section of interest is viewable and stable. Then markers can be used to measure the timeslot width and interval as shown.

How to set Zero Span

- Set **Center** to the frequency of interest
 - then set **Span** to 0 Hz
 - or select **Zero/Last Span**. Each key press toggles the frequency span between 0 Hz and the last specified frequency span.

You can change the measurement time in Zero Span.

NOTE The FieldFox currently has **ONLY** Free Run triggering capability. (No External triggering.) Therefore, press **Run/Hold** to stop the display for viewing and measuring the time waveform.

- Press **Sweep 3**.
- Then **SweepTime**.
- Enter a value using the numeric keypad.
- Then select a multiplier key. Learn about multiplier abbreviations on page 22.

Sweep Type

Sweep Type determines whether the FieldFox sweeps continuously or only once, then Holds. Use **Single** to conserve battery power or to allow you to analyze a specific measurement sweep.

How to set Sweep Type

- Press **Sweep 3**.

- Then choose from the following:
 - **Single** Makes one measurement sweep, then Holds. Press **Single** again to take another measurement sweep. This setting automatically sets Continuous to **OFF**. The **Hold** annotation changes to a green arrow --> while the sweep occurs.
 - **Continuous ON OFF**. Select **ON** to make the FieldFox make continuous sweeps. This is the typical setting when battery power is not low.
 - **Restart** When Trace Averaging is ON, restarts the averaging process. When Continuous is OFF (Single), measurement sweeps do not stop until the Averaging Count is reached. Learn about Trace Averaging on page 62.

Resolution

Resolution is the number of displayed data points across the X-axis. The higher number of data points, the better the ability to resolve closely spaced signals and the slower the sweep speed.

How to set Resolution

- Press **Sweep 3**.
- Then **Resolution [current setting]**.
- Then choose from: **101|201|401|601|801|1001**.

Trace Display States

In SA Mode you can display up to four of the following types of traces. All SA settings are applied to all displayed traces.

How to display Trace types

- Press **Trace 6**.
- Then **Trace 1,2,3,4** repeatedly to select a trace number to display. Traces are displayed in the following colors:
 - Trace 1 – **Yellow** Trace 2 – **Blue**
 - Trace 3 – **Orange** Trace 4 – **Red**
- Then **State [current setting]**.
- Then choose from the following trace types:
 - **Clr/Wr** (Clear/Write) Displays the actual measured data.
 - **MaxHold** Displays the maximum response of the input signal over multiple sweeps.
 - **MinHold** Displays the minimum response of the input signal over multiple sweeps.
 - **Average** Each data point is averaged over multiple sweeps as set by the Average Count setting.
 - **View** Displays and then holds the last complete measurement trace on the screen.

- **Blank** Displays no trace.
- Press **Default All** to return all traces to their default settings: Trace 1 (Clear/Write); all other traces (Blank).

Averaging Type

In SA Mode, there are three different processes in which Averaging is performed:

- Trace Averaging
- Detection Method Averaging
- Noise Marker Averaging

There are two types of mathematical averaging that can be performed. Select ONE of these types and it is used for all of the above averaging processes.

How to set Averaging Type

- Press **Meas Setup 4**.
- Then choose from the following:
 - **Auto** - The FieldFox chooses the most appropriate type of averaging for the current settings. When Detection Method is set to Average or a Noise Marker is present, **Power Average** is ALWAYS selected. Otherwise, **Log Average** is selected.
 - **Log** Averaging – Best for displaying Trace Averaging. **LgAv** is shown on the left side of the FieldFox screen when selected.
 - **Power** (Linear) Averaging – Best for measuring true power levels. Used in Detection Average and Noise Marker Average. Mathematically, the trace is 2.5 dB higher than when using Log Average. **PAvg** is shown on the left side of the FieldFox screen when selected.

Trace Averaging

Trace Averaging helps to smooth a trace to reduce the effects of random noise on a measurement. The FieldFox computes each data point based on the average of the same data point over several consecutive sweeps.

When Trace Averaging is selected, then the Average Count setting is also available. Average Count determines the number of sweeps to average. The higher the average count, the greater the amount of noise reduction.

An average counter is shown in the left edge of the screen as **Avg N**. This shows the number of previous sweeps that have been averaged together to form the current trace. When the counter reaches the specified count, then a ‘running average’ of the last **N** sweeps is displayed.

How to set Trace Averaging

- Press **Trace 6**.
- Then **State [current setting]**.
- Then **Average**.
- Then **Average Count**.

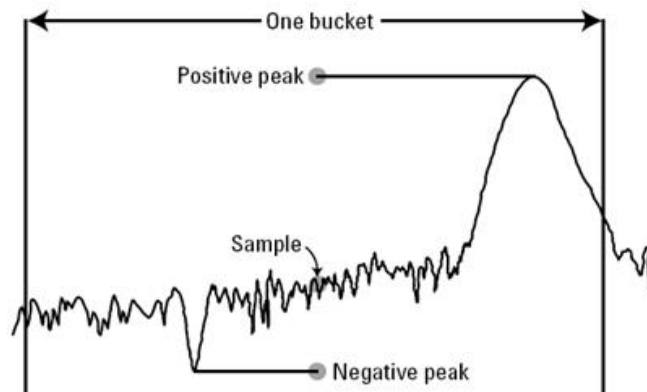
- Enter a value from 1 to 100 using the **▲▼** arrows or the numeric keypad.
- Press **Enter**.
- When Trace State is set to Average, press **Sweep 3**, then **Restart**, to restart the averaging at 1.

Detection Method

In SA Mode, the X-axis is comprised of data points, also known as “buckets”. The number of data points is specified using the Resolution setting. Learn how on page 61.

No matter how many data points are across the X-axis, each data point must represent what has occurred over some frequency range and, although we usually do not think in terms of time when dealing with a spectrum analyzer, over some time interval.

From the frequency span of the measurement, the span of each data point is calculated as (frequency span / data points). The detection method allows you to choose how the measurements in each bucket are displayed.



One bucket showing the results using three different Detection methods.

How to set Detection Method

The current Detection method is labeled on the left edge of the screen. When a method is selected manually, a # precedes the label. For example: # **Nrm** means that **Normal** was selected from the softkeys.

- Press **Trace 6**.
- Then **Detector**.
- Then choose from the following:
 - **Auto** Displays the most appropriate Detection method based on other settings. [# is NOT shown]
 - **Normal** [**Nrm**] Provides a better visual display of random noise than **Positive peak** and avoids the missed-signal problem of the **Sample** Mode. Should the signal both rise and fall within the bucket interval, then the algorithm classifies the signal as noise. An odd-numbered data point displays the maximum value encountered during its bucket. An even-numbered data point displays the minimum value encountered during its bucket.

- **Positive Peak [Pk]** Displays the maximum value of all the measurements in each bucket. This setting ensures that no signal is missed. However, it is not a good representation of the random noise in each bucket.
- **Negative Peak [NPk]** Displays the minimum value of all the measurements in each bucket.
- **Sample [Smp]** Displays the center measurement of all the measurements in each bucket. This setting gives a good representation of the random noise in each bucket. However, it does not ensure that all signals are represented.
- **Average [Avg]** Displays the Root Mean Squared (RMS) average power of all the measurements in each bucket. This is the preferred method when a Noise Marker is used. Learn more on page 78.

Noise Marker

For comparison purposes, electronic noise measurements are often displayed as though the measurement was made in a 1 Hz Res BW. However, making an actual measurement at a 1 Hz Res BW is impossible, and at 10 Hz, extremely slow.

A Noise Marker, unique to SA Mode, mathematically calculates the noise measurement as though it were made using a 1 Hz bandwidth.

Several data points (or ‘buckets’) are averaged together to calculate the Noise Marker readout. To accurately measure noise, the Noise Marker should NOT be placed on, or too close to, a signal. The distance from a signal depends on several factors. To know if an accurate reading is being made, move the Noise Marker until consistent measurements are displayed in adjacent data points.

In addition, when a Noise Marker is displayed, the Detection method is automatically switched to Average and **PAvg** is shown on the FieldFox screen. This occurs only when Detection is set to Auto. Learn more on page 63.

With a Noise Marker present, the Res BW can be changed and the displayed noise floor will also change, but the Noise Marker readout will remain about the same.

Noise Markers can be used like regular markers. A Noise Marker is distinguished from a regular marker by **(1Hz)** after the marker readout value. Learn more about regular markers on page 73.

How to create a Noise Marker

- Press **Marker**.
- Then **More**.
- Then **Marker Noise ON OFF**.

Meas UNCAL Error

Meas UNCAL appears in the lower-left corner of the screen when the FieldFox can NOT display accurate measurement results with the current settings. Usually, the part of the trace that is inaccurate is shown at -200 dB.

The following situation can produce **Meas UNCAL**:

- In Zerospan, when Sweep Time is set too high for the current Res BW. Leave Res BW in Auto and lower the Sweep Time setting.
- When the ResBW/VBW ratio exceeds 10,000, causing the VBW filter to reach the maximum capacity for averaging.

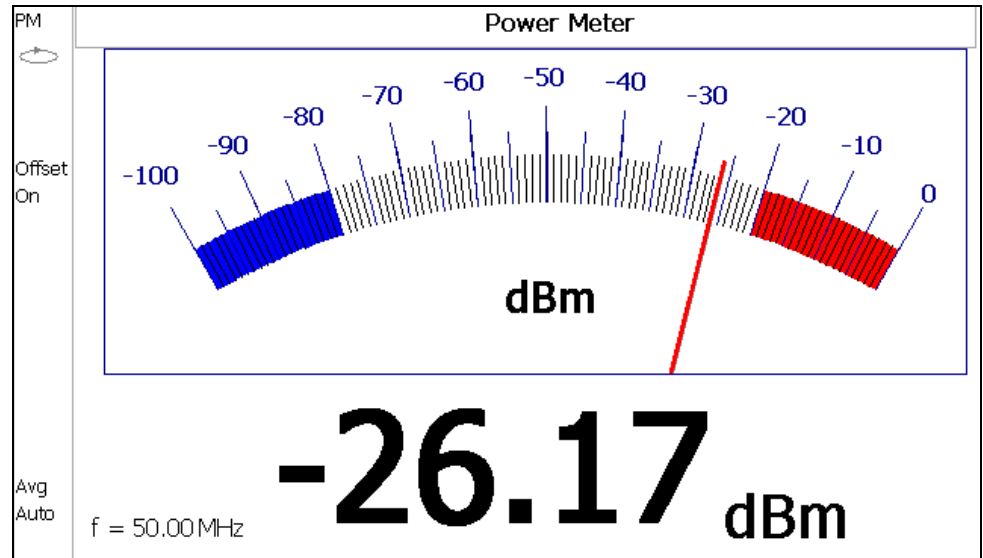
Old Data Indicator (*)

In SA mode, when the current trace does not exactly match the annotation that is on the screen, an asterisk is displayed in the upper-right corner of the screen graticule area. This would occur, for example, when the frequency setting is changed while in sweep Hold mode. The annotation is changed immediately, but the trace is not updated until the next sweep occurs. Therefore, the current data trace does not match the frequency annotation. See the asterisk on page 53.

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Power Meter Mode

Power Meter measurements, available with Option 302, are made with Agilent U2000 Series USB power sensors. Power readings are displayed on the FieldFox screen.



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Supported Power Sensors

Power Meter measurements are made using the following **Agilent USB Power Sensors**.

Model	Freq Range	Connector
U2000A	10 MHz to 18 GHz	Type N (m)
U2001A	10 MHz to 6 GHz	Type N (m)
U2002A	50 MHz to 24 GHz	3.5 mm (m)
U2004A	9 kHz to 6 GHz	Type N (m)

CAUTION Please observe the damage level of your U2000 Series Power Sensor. Typical damage levels of the U2000 Series Power Sensor are:

- +25 dBm (320 mW) average
- +33 dBm peak (2 W) <10µs
- +5V

How to Connect the Power Sensor

Connect your U2000 Series Power Sensor to one of the USB ports.

NOTE Use an attenuator between the DUT and the power sensor when measuring power levels that are higher than +20 dBm. The attenuator value can be subtracted from the measurement using the Offset feature, discussed on page 70.

A sequence of status lights are displayed on the base of the power sensor.

- **Green blinking** light indicates the power sensor is communicating or self-tests are being performed. Because the FieldFox is usually communicating with the power sensor when it is connected, this is the normal mode of operation.
- **Amber light** indicates Internal Zeroing is being performed.
- **Red light** indicates an error has occurred with the power sensor. Refer to power sensor documentation.
- **No light** indicates the FieldFox is not communicating with the power sensor. This is the case when NOT in Power Meter Mode.

Power Meter Settings

Select Power Meter Mode before making any setting in this section.

How to select Power Meter Mode

- Press **Mode**.
- Then **Power Meter**.

Zeroing

The Agilent USB Power Sensors perform Internal Zeroing automatically. Because the U2000 series power sensors have an internal switch, Internal Zeroing does NOT require that the power source be turned OFF.

For highest measurement accuracy, when measuring power levels below -30 dBm, External Zeroing should be performed.

During External Zeroing, the power source MUST be turned OFF or the power sensor disconnected from the power source (device under test). Power is OFF when power sensor measurements are below -60 dBm. When power higher than this is detected at the sensor, a warning message is shown on the FieldFox and External Zeroing will not proceed.

How to perform External Zeroing

- Press **Cal 5**.
- Then **External Zero**.

While either Internal or External Zeroing is being performed, “**Zeroing...**” is shown on the FieldFox screen. While this message is present, do NOT make any changes to the FieldFox.

In addition, once External Zeroing has started, the power source must be OFF for the entire time that the Zeroing message is present. Otherwise, the calibration will be compromised but NO warning is shown.

Frequency

A table of correction factors versus frequency is stored within the Agilent U2000 Series Power Sensors. The frequency of the power to be measured is entered in the FieldFox so that the appropriate correction factor can be used.

The frequency of the power measurement is NOT limited by the frequency range of the FieldFox, but the frequency range of the power sensor, which can be much wider.

How to Enter Frequency of the Power Measurement

- Press **Freq/Dist** or **Meas Setup 4**.
- Then **Frequency**.
- Then type a value using the numeric keypad. The default frequency is 50 MHz.
- Then press a multiplier key. Learn about multiplier abbreviations on page 22.

The current frequency is shown on the FieldFox screen.

Scale

The scale of the Power Meter display can be set manually or automatically. The major and minor ticks are set automatically and can NOT be changed. Although the scale settings are limited, you can view measurements beyond these settings by performing Autoscale.

How to Scale the Power Meter display

Manually

- Press **Scale / Amptd**.
- Then choose from the following:
 - **Scale Min** Sets the low power level of the power meter display. Type a number and select the units or press **Enter**. This value is limited to -100 dBm.
 - **Scale Max** Sets the high power level of the power meter display. Type a number and select the units or press **Enter**. This value is limited to 100 dBm.

Autoscale

Using Autoscale, the current reading is used for the center of the scale, and Min and Max values are set accordingly.

- Press **Scale / Amptd**.
- Then **More**.

- Then **Autoscale**.

Relative and Offset Power Measurements

Power measurements can be made that are relative to another reading or that are offset by a fixed value.

- Use Relative to measure the difference between power levels.
- Use Offset to account for components or a long length of cable that is used before the power sensor. For example, if using a 10 dB attenuator to protect the FieldFox, enter an Offset Value of 10 to read the power as it would appear without attenuation. If using a 10 dB amplifier, enter an Offset Value of -10 to read the power as it would appear without amplification.

How to set Relative and Offset Power Measurements

- Press **Scale / Amptd**.
- Then choose from the following:
 - **Relative On Off** When switched to ON, the FieldFox measures and stores the current power level. Subsequent power measurements display a power level which is relative to the stored value. When relative is ON, the units change from dBm to dB or from Watts to %.
 - **Offset On Off** Toggles ON and OFF the displayed power level using the Offset value.
 - **Offset Val** Value by which the power meter display is offset. A positive value compensates for a component with loss. A negative value compensates for a component with gain. Offset values are limited to +/- 100 dB.

Display Units

Sets the Power Meter display to dBm or Watts. When making relative power measurements, these change to dB and %.

How to set Power Meter display units

- Press **Meas Setup 4** or **Scale / Amptd**.
- Then **Unit**.
- Then choose from the following:
 - **dBm (dB)** Sets Power Meter display to dBm or dB.
 - **Watt (%)** Sets Power Meter display to Watts or %.

Resolution

Sets the number of digits to display after the decimal point on the digital power meter display.

How to set Resolution

- Press **Scale / Amptd**.

- Then **More**.
- Then choose from **0**, **1**, **2**, or **3**.

Averaging

Power Meter Averaging is used to improve measurement accuracy in low power or noisy power situations. Increased averaging improves measurement accuracy, but also reduces measurement speed.

How to set Power Meter Averaging

- Press **BW 2** or **Meas Setup 4**.
- Then choose from the following:
 - **Averaging Auto Man Off**
 - **Auto** Allows the USB Power Sensor to use its Auto Averaging settings. See the USB Power Sensor documentation for details.
 - **Man** Manually enter an averaging count by setting **Num Averages**.
 - **OFF** Performs NO averaging.
 - **Num Averages** Sets the number of Power Meter readings to be averaged before a valid reading is displayed. When a number is entered, **Averaging** is automatically set to Man

Sweep Type

Sweep Type determines whether the FieldFox sweeps continuously or only once each time the **Single** button is pressed. Use **Single** to conserve battery power or to allow you to store or analyze a specific measurement sweep.

How to set Sweep Type

- Press **Sweep 3**.
- Then choose one of the following:
 - **Single** Automatically sets Continuous OFF and causes FieldFox to make ONE measurement sweep, then hold for the next Single key press.
 - **Continuous ON OFF** Makes continuous sweeps. This is the typical setting when battery power is not critical.

You can also use **Run / Hold +/-** to toggle between Single and Continuous sweep.

Limits

In Power Meter Mode, Minimum and Maximum limits set a visible range of acceptable readings between these two values. Readings that are below the minimum or above the maximum are clearly visible on the power meter display.

How to set Limits

- Press **Limit 8**.
- Then choose from the following:

- **Min Limit On Off** Toggles the display of the Minimum limit ON and OFF.
- **Min Limit Value** Sets the Minimum limit power value. Power reading lower than this will exceed the limit.
- **Max Limit On Off** Toggles the display of the Maximum limit ON and OFF.
- **Max Limit Value** Sets the Maximum limit power value. Power reading higher than this will exceed the limit.

Data Analysis Features

The following features can be used after a measurement to analyze the results.

In this Chapter

All about Markers	73
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All about Markers

Markers move along the X-axis range of the measurement trace to provide a numerical readout of each measured data point. Markers also allow you to search for specific Y-axis values.

A trace can contain up to six markers.

The marker readout on the FieldFox screen displays X and Y-axis information for the current active marker ONLY.

A Marker Table can be displayed that allows you to simultaneously view X and Y-axis information for all markers.

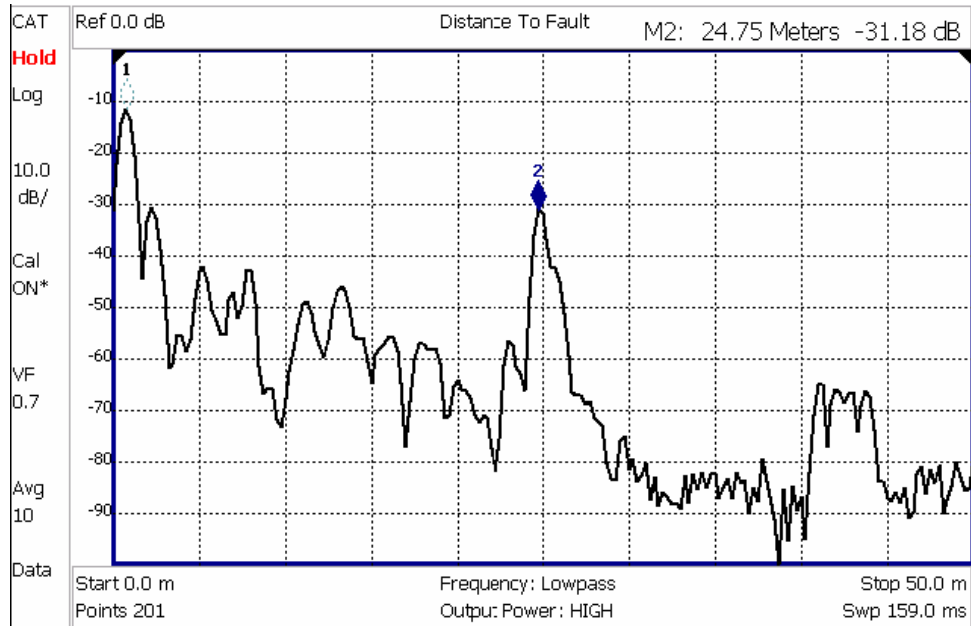
Markers can be used in **CAT**, **SA**, and **NA** Modes.

How to create Markers

- Press **Marker**.
- Then **Markers 1..6** to select a marker to activate.
- Then **Normal** to activate that marker. A marker is created on the trace in the middle of the X-axis. That marker is now **active**.
- Then move the marker using the rotary knob, the **▲|▼** arrows, or by entering an X-axis position with the number keys.
- Then press **Enter**.

How to move a Marker after it is created

- Press **Marker**.
- Then **Markers 1..6** repeatedly until the marker of interest is selected. The OFF, Normal, or Delta softkey is black to indicate the current setting of each marker.
- Then move the marker as when it was first created.
- Markers can also be moved using one of the marker search functions. Learn more on page 76.



Marker 2 is Active, marker 1 is NOT active.

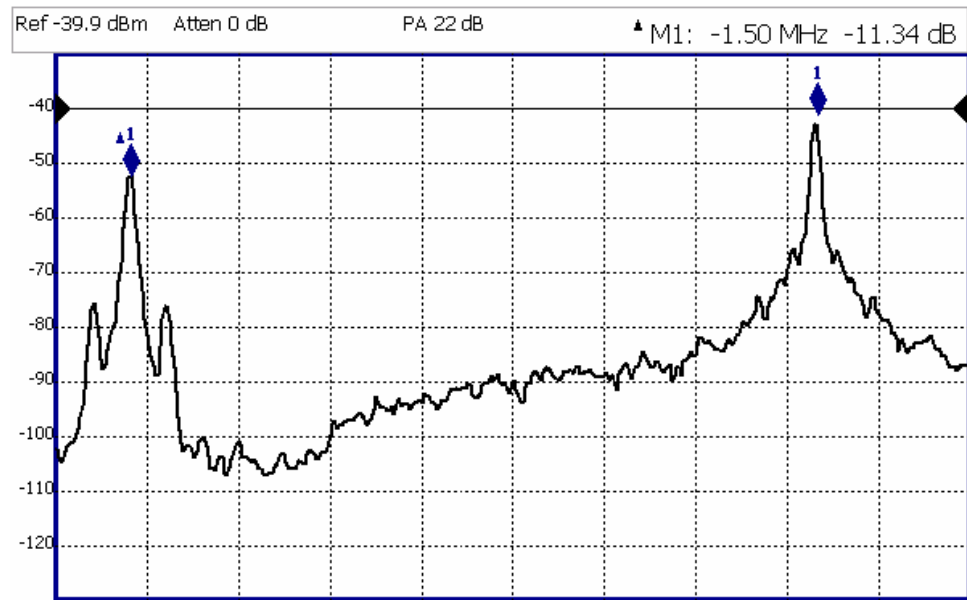
About Delta Markers

A delta marker provides X-and Y-axis readout information that is **relative** to a 'reference' marker.

A Delta marker is created with a ▲ (delta symbol) to distinguish it from the reference marker.

All six markers can be a Delta marker pair.

Peak search functions can be performed using delta markers.




A Delta marker and its associated reference marker. The marker readout shows the difference between the two markers in frequency and amplitude.

How to Create a Delta Marker

- Create a **Normal** marker and move it to the reference position.
- Press **Delta**. The marker becomes the reference marker and fixed in its X-Axis position.

NOTE In SA Mode, the reference marker is also fixed in its **Y-axis** position as shown in the previous image.

- Move the Delta marker using the numeric keypad, the  arrows, or the rotary knob.
- Press **Enter** when finished.

How to move the Reference marker

- Press **Delta** to turn the Delta marker OFF.
- Move the marker to the new position.
- Then press **Delta** again, to turn the Delta marker back ON.

Marker Table

The Marker Table, displayed at the bottom of the FieldFox screen, is used to simultaneously display information for ALL markers. The Marker table “squeezes” the graticule area when activated.

Marker table can be captured in screenshot even if it is not visible on the screen.

How to enable the Marker table

- Press **Marker**.
- Then **Marker Table On Off**.

Marker Trace

Both CAT and NA Modes can display a ‘live’ data trace and a memory trace. Learn more on page 80.

SA Mode can display up to four traces. Learn more on page 61.

By default, markers are assigned to Trace 1 or the live trace. However, once created, you can move a marker to any currently-displayed trace.

How to move a marker to a displayed trace

First create the trace to get the marker.

- Then press **Marker**.
- Then **More**.
- Then select the Marker to move using **Marker 1,2,3,4,5,6**.
- Then select the trace to receive the selected marker using **Marker Trace 1,2,3,4**.
- As each trace is selected, the marker moves to the same X-axis location on the specified trace.

- If a trace is not already created, the Marker Trace can not be selected.

Marker Search Functions

Marker Search functions are used to move markers to various locations on the trace, and also to change frequency range or distance settings to the frequency or distance of the active marker.

How to use Marker Search Functions

- Activate the marker to move.
- Then press **Mrk ->/Tools**.
- Then choose one of the following:
 - **Peak** Moves the active marker to the HIGHEST amplitude data point of the trace. Peak Excursion value is ignored. In SA Mode, the LO feed-through signal (0 Hz) is also ignored.
 - **Next Peak** Moves the active marker to the next highest amplitude peak from where it currently resides.
 - **Peak Left** Moves the active marker to the next data point to the left that meets the 'Peak' criteria. When no data points to the left meet the 'Peak' criteria, the marker does not move.
 - **Peak Right** Moves the active marker to the next data point to the right that meets the 'Peak' criteria. When no data points to the right meet the 'Peak' criteria, the marker does not move.
 - **Marker -> Center** (Not available in DTF) The center frequency of the measurement becomes the value of the active marker. The frequency span is adjusted accordingly.
 - **More** then **Min Search** (Not available in DTF) Moves the active marker to the LOWEST amplitude data point of the trace.

DTF Measurements ONLY

- **More 1 of 2**.
- **Marker=>Start Distance** The Start Distance of the measurement becomes the value of the active marker. Markers that would no longer appear on the screen are moved to the new Start Distance.
- **Marker=>Stop Distance** The Stop Distance of the measurement becomes the value of the active marker. Markers that would no longer appear on the screen are moved to the new Stop Distance.
- **Track Peaks ON OFF** When Track Peaks is ON, markers will find the new peak with every sweep. While in this Mode, the markers can NOT be turned OFF or moved.
- **Find 3 Peaks** Three markers are created and find the highest peaks (faults) on the trace.

What Is a 'Peak'

You define what the FieldFox considers a "peak" by setting the Peak **Threshold** and Peak **Excursion**.

These two peak criteria settings apply to all markers, and are set individually for CAT, SA, or NA Modes.

These settings remain through an instrument preset, but are reset to the default values when the FieldFox power is shutdown.

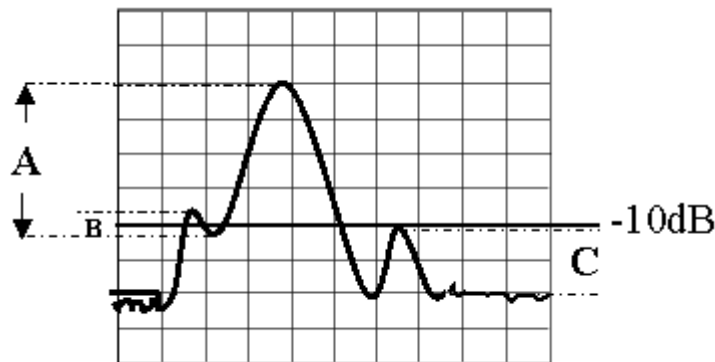
NOTE Peak Threshold and Excursion are NOT available in DTF measurements. However, peaks below -50 dB will NOT be found and this can NOT be changed.

How to set Peak Criteria

- Press **Mrk ->/Tools**.
- Then **More**.
- Then select the following:
 - **Peak Threshold** Minimum amplitude (dB). To be considered valid, the peak must be **above** the threshold level. The valley on either side can be below the threshold level. Default = -190 for CAT and NA Modes; -90 for SA Mode.
 - **Peak Excursion** The vertical distance (dB) between the peak and the valleys on both sides. To be considered a peak, data values must "fall off" from the peak on both sides by the excursion value. Default = 0.5 dB for CAT and NA Modes; 6 dB for SA Mode.

For example, the settings for the trace in the following image are:

- Threshold: -10 dB
- Excursion: 1 dB
- Scale = 1 dB / Division.



Peak A = **Valid Peak** (Above Threshold and Excursion Settings)

Peak B = **Invalid Peak** (Below 1 dB Excursion Setting)

Peak C = **Invalid Peak** (Below -10 dB Threshold Setting)

SA Noise Marker

For comparison purposes, electronic noise is often displayed as though the measurement was made in a 1 Hz Res BW. However, making an actual measurement with the FieldFox at a 1 Hz Res BW is impossible, and at 10 Hz, extremely slow.

A noise marker mathematically calculates the noise measurement as though it were made using a 1 Hz bandwidth.

Several data points (or ‘buckets’) are averaged together to calculate the Noise Marker readout. To accurately measure noise, the Noise Marker should NOT be placed too close to a signal. The distance from a signal depends on several factors. To know if an accurate reading is being made, move the Noise Marker until consistent measurements are displayed in adjacent data points.

In addition, when a Noise Marker is displayed, the Detection method is automatically switched to **Average**. This occurs when Detection is set to Auto. Learn more on page 63.

With a Noise Marker present, the Res BW can be changed and the noise floor will also change, but the Noise Marker readout will remain about the same.

All about Limit Lines

Limit Lines are available in CAT Mode, NA Mode, and SA Mode. Power Meter Mode uses different Limit settings. Learn more on page 71.

Limit Lines are visual representations on the FieldFox screen of the specified limits for a measurement. With this capability, you can easily compare measured data versus specifications. In addition, you can enable an audible beep and display **Pass or Fail** information for each measurement.

You can have up to **10 Limit Lines** for each measurement trace allowing you to test all aspects of your measurements.

Limit Lines can be saved and recalled with an *.sta file. Learn more about *.sta files on page 83. They can also be saved and recalled independently from the Limit softkeys. Learn more on page 79.

Although allowed, Limit Lines and Limit testing are NOT useful with **Smith Chart** display format in NA Mode.

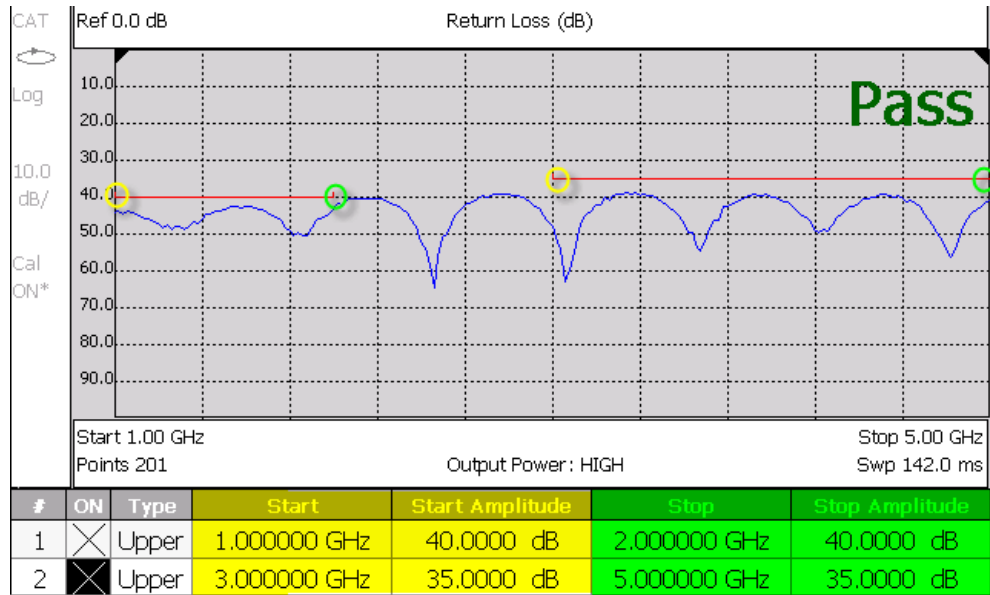
How to Create Limit Lines

In CAT, NA, or SA Mode

- Press **Limit 8**.
- Then **Edit**.
- A Limit Line Table appears. Use **Left** and **Right** softkeys, and Up / Down hardkeys to create Limit Lines.
- **On** Press **Enter** to toggle the display of the limit line ON (X) and OFF (clear).
- **Type** Press **Enter** to toggle the line Upper or Lower. An **Upper** limit will FAIL any measured data point **ABOVE** the line. A **Lower** limit will FAIL any measured data point **BELOW** the line .

Each Limit Line is constructed by setting the X/Y-coordinates for both the beginning and end of line, as in the following image. The X-axis values for two lines can overlap.

- **Start Frequency/Distance** X-axis value for start of line.
- **Start Amplitude** Y-axis value for start of line.
- **Stop Frequency/Distance** X-axis value for stop of line.
- **Stop Amplitude** Y-axis value for stop of line.



Limit table with two Upper limit lines. Warning ON. Yellow circles and shading shows Start of lines. Green circles and shading shows Stop of lines.

How to set Limit Options

- Press **Exit** if the Limit Table is visible.
- Then **Options**.
- Then choose from the following:
 - **Beep On Off** Audible beep sounds when each sweep fails.
 - **Warning On Off** Shows **Pass** or **Fail** indication on the display with each sweep. Data points that fail are highlighted.

How to Save and Recall Limits

In addition to saving and recalling Limits with an *.sta file, Limit Lines can also be saved and then recalled independent of the current mode or measurement. Use this feature to recall and apply existing limit lines to measurements with different settings or even a different frequency range.

Limit Line files can be loaded into the FieldFox Data Link Software. Learn how in the help file that is included in the Data Link software.

How to Save and Recall Limits

- Press **Save/Recall** then **Select Device** to set the Device (Internal, mini SD card, or USB flash drive) to be used for the Save or Recall. Learn more on page 85.

- Then press **Limit**.
- Then choose from the following:
 - **Save Limits** After Limit Lines have been defined, this saves the line definition to a file on the specified device.
 - **Recall Limits** Recalls a Limit Line definition from the specified device.

All about Trace Math

Trace Math is available ONLY in CAT and NA Modes, but not in DTF measurements.

A trace is a series of measurement data points that are connected to form a line. This 'live' trace is displayed in yellow and is updated as data points are measured.

A memory trace is a live trace that has been stored in the FieldFox volatile memory. A memory trace is displayed in blue. It is static, meaning it is not updated with measurements. It can be displayed on the screen by itself, or with a live trace for comparison purposes.

ONE live trace and ONE memory trace can be displayed simultaneously in CAT and NA Modes.

How to display 'live' and memory traces

- Press **Trace 6**.
- Then **Data->Mem** to store the current live trace into memory. A 'beep' sounds to confirm the data trace has been saved to memory. There is no display annotation that indicates that the memory trace has been stored.
 - Press **Data** to view only the live trace, displayed in yellow.
 - Press **Memory** to view only the memory trace, displayed in blue.
 - Press **Data & Memory** to view both the live trace and the stored memory trace.

How to perform Trace Math

Trace math is performed between a live trace and a memory trace. When one of the following math operations are selected, the yellow data trace displays the current measurement with the selected trace math applied. The math operation symbol indicated below in [brackets] is displayed on the lower left corner of the screen.

- Press **Trace 6**.
- If not already stored, press **Data->Mem** to store the current live trace into memory.
- Then **Data Math**.
- Then choose one of the following:
 - **Data + Memory** [D+M] Current measurement data is added to the data in memory.

- **Data – Memory** [D-M] Current measurement data is subtracted from the data in memory.
- **Data / Memory** [D/M] Current measurement data is divided by the data in memory.
- **Math Off** [Data] Displays trace data with NO math applied.

About Math Operations

Data / Memory and **Data - Memory** math operations are performed on complex linear data before it is formatted. Because data is often viewed in log format, it is not always clear which of the two math operations should be used. Remember: dividing linear data is the same as subtracting logarithmic data. The following illustrates, in general, when to use each operation.

Use **Data / Memory** for normalization purposes, such as when comparing traces "before" and "after" a change is made or when measuring trace noise. In the following table, the Data/Mem values intuitively show the differences between traces. It is not obvious what Data-Mem is displaying.

Values to compare	Data/Mem	Data-Mem
0.5 dB and 0.6 dB	0.1 dB	-39 dB
0.5 dB and 0.7 dB	0.2 dB	-33 dB

Use **Data - Memory** to show the relative differences between two signals. Use for comparison of very small signals, such as the S11 match of two connectors.

In the following table, Data/Mem shows both pairs of connectors to have the same 2 dB difference. However, the second pair of connectors have much better S11 performance (-50 and -52) and the relative significance is shown in the Data-Mem values.

Values to compare	Data/Mem	Data-Mem
-10 dB and -12 dB	2 dB	-24 dB
-50 dB and -52 dB	2 dB	-64 dB

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File Management

The FieldFox can save any of the following types of files:

- Current settings and calibration
- Trace data (*.csv and *.S1P)
- Picture of the FieldFox screen

In addition, files can be saved to the internal memory, a USB Flash drive, or a mini SD card.

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Manage Files	86
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Saving and Recalling Files

Save Files

It is necessary to first specify a **File Type** to save and **Device** (Internal, USB Flash, or mini SD card) to which the file is saved. Learn how on page 85.

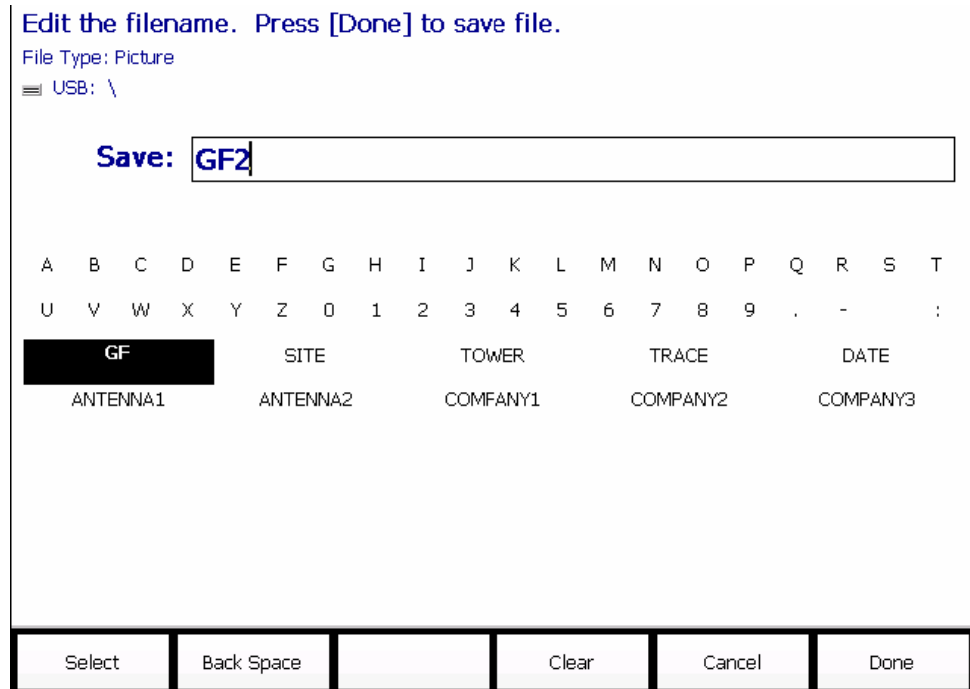
How to Save a File

- Press **Save/Recall 9**.
- Then **Save**.
- Then use the labeler to specify a filename.

How to name files


The labeler is used to edit or change the current filename. It is also used to create a title, prefix, and keyword to display on the FieldFox screen. Learn about Titles on page 93.

- Press **Select** to add the cursor character to the end of the existing filename.
- Press **Backspace** to erase the last character from the current filename.
- Press **Clear** to erase the current filename.
- The preselected keywords (File, Site, and so forth) can be selected just like a single character. These keywords can also be edited. See **Edit Keywords** on page 86.



*The FieldFox labeler. The current filename is **GF2**. The cursor is on the custom **GF** keyword.*

How to move the cursor

- Use the rotary knob to move cursor on the same row. The cursor will change rows when it comes to a row end.
- Use the  arrows to move the cursor up and down the rows.

When the current filename is complete

- Press **Done** to save the file to the specified filename. If the filename already exists, a warning is displayed.
- Press **Cancel** to close the labeler without saving a file.
- If the filename already exists, you are prompted to choose from the following:
 - Press **Yes** to overwrite the existing file.
 - Press **Cancel** to edit the filename.

Recall Files

State files and Trace + State files (*.sta) are the only file type that can be recalled by the FieldFox.

ALL FieldFox instrument settings for ALL Modes are saved and recalled in a *.sta file. If error correction is ON in CAT or NA Mode, then calibration data is also saved and recalled.

How to Recall an *.sta File

NOTE Before recalling a file, first set **File Type** to State or Trace + State, and also **Select Device** from which the file will be recalled.

- Press **Save/Recall 9**.
- Then **Recall**.
- Navigate to the file to be recalled using the Up/Down arrow keys.
- Then **Recall File** or **Enter**.

Set File Type and Select Device

The following File TYPE and DEVICE settings are used to determine the type of file to save, and the location to be used for all file operations.

These two settings remain through an instrument preset, but are reset to the default values when the FieldFox power is shutdown.

Select Device (location of File Save/Recall)

- Press **Save/Recall 9**.
- Then **Select Device** to set the **LOCATION** where the file is to be saved. Choose from the following:
 - **Internal** Saves/Recalls files to/from the FieldFox internal memory. To specify a folder, first select Manage Folders (on page 87). The Data Link software will read data **ONLY** from the \UserData folder. Learn more about Data Link software on page 99.
 - **SD Card** Saves/Recalls files to/from the mini SD card (not included), inserted in the card slot. See FieldFox Tour on page 15. Only the root folder is available.
 - **USB** Saves/Recalls files to or from a USB Flash drive (not included) that is inserted in one of the USB connectors. Only the root folder is available.

NOTE Insert only ONE USB Flash Drive in the FieldFox when saving or copying files.

Set File Type

State files are the only file type that can be recalled by the FieldFox.

- Press **Save/Recall 9**.
- Then **File Type**. Choose one of the following:
 - **State** Saves ALL FieldFox instrument settings for ALL Modes to a *.sta file. If a calibration is ON in CAT or NA Mode, calibration data is also saved. This file can be opened **ONLY** by a FieldFox.
 - **Trace + State** Saves the current trace and instrument settings to a *.sta file. In SA Mode, all traces are saved. This file can be opened **ONLY** by a FieldFox. When recalled, the FieldFox sweep is set to Hold.
 - **Picture** Saves a 640 x 453 pixel image of the FieldFox screen to a *.png file. The picture does **NOT** include the softkeys.
 - **Data (SnP)** Saves **CAT** and **NA** Mode trace data to an *.S1P file.
 - In CAT Mode, S1P files are always Linear Mag / Angle format.
 - In NA Mode, S1P files are Linear Mag / Angle for all formats except Smith Chart which saves Real / Imaginary format.

- **Data (csv)** Saves trace data from the current Mode to a *.csv file. This format can be imported into spreadsheet software such as Microsoft Excel.
 - In **SA Mode**, all visible data traces are saved. Each trace is saved to a separate column that is labeled with the Trace State.
 - In **CAT and NA Modes**, only the data trace is saved – not the memory trace.
 - In **Power Meter Mode**, NO data is saved.

	A	B	C	D	E
1	! FILETYPE CSV				
2	! VERSION 1				
3	! TimestamI 24 June 2008 13:14:56				
4	! NAME Agilent Technologies				
5	! MODEL N9912				
6	! DATA Freq	SA Clear-Write	SA Max Hold	SA Min Hold	SA Average
7	! FREQ UNIT Hz				
8	! DATA UNIT dB				
9	BEGIN				
10	0	-0.119247593	-0.09389364	-0.13572734	-0.1107232
11	15000000	-86.62706485	-75.5567264	-101.81957	-85.785432
12	30000000	-63.17858645	-60.2945464	-66.7374236	-63.460433

*Image of header information and three rows of data from a *.csv file saved in SA mode with 4 traces visible. Column A is always the frequency at which the data is measured.*

Manage Files

Files that are stored in the FieldFox internal memory, mini SD card, and USB Flash drive, can be copied to another device or deleted.

For **Copy File** and **Copy All** operations, files are always copied to the root directory of the destination device. They can NOT be copied to other folders. To get a file to another folder, it must be saved to the specified folder.

How to Manage files

- Press **Save/Recall 9**.
- Then **Select Device** to select the location (Internal, USB, or mini SD Card) of the file to copy or delete.

NOTE If selecting **Internal**, it may also be necessary to first select **Manage Folders** to specify an active folder which contains the files to copy or delete.

- Then **More**.
- Then **Manage Files**.
- Then choose from the following:
 - **Copy File** Select a file to copy. Then select a destination to copy the file to. Choose from **Internal**, **USB** (must be inserted), or **SD Card** (must be inserted). The file is copied to the root directory of the destination device.

- **Copy All Files** All files that appear will be copied. Then select a destination to copy the files to. All of the displayed files are copied to a new folder at the root directory of the destination device. The new folder name is the current date-time.
- **Delete File** The **selected** file is deleted after a warning prompt is displayed.

NOTE Insert only ONE USB Flash Drive in the FieldFox when saving or copying files.

Manage Folders

You can create new folders, delete old folders, and select the active folder to which files can be saved. The Parent folder [..] is listed when not in the root directory.

How to Manage Folders

- Press **Save/Recall 9**.
- Then **More**.
- Then **Manage Folders**.
- Then choose from the following:
 - **Change Folder** The active device and current folder is displayed at the top of the screen. Use the **▲▼** arrows to highlight a folder within the current folder. Each time the **Change Folder** softkey is pressed, the highlighted folder becomes the active folder.
 - **Create Folder** A new folder is created in the current folder. Select a name for the new folder from one of the displayed keywords: You can change these keywords using the following **Edit Keywords** function.
 - **Delete Folder** The **selected** folder and its contents are deleted after a warning prompt is displayed. A “Parent” folder or system folder can NOT be deleted.

Edit Keywords

The preselected keywords (FILE, SITE, and so forth) can be edited to meet your specific needs. Your keywords will remain in the FieldFox until you change them. Keywords are limited to 30 characters.

How to edit keywords

- Press **Save/Recall 9**.
- Then **More**.
- Then **Edit Keywords**.
- Then **Next Page** and **Previous Page** to view all keywords.
- Use the **▲▼** arrows to select a keyword to edit.
- When a keyword is selected, then press **Edit**.
- Then choose from the following:
 - Press **Select** to add the cursor character to the end of the selected keyword.

- Press **Backspace** to erase the last character from the end of the selected keyword.
- Press **Clear** to erase the selected keyword.

To move the cursor:

- Use the rotary knob to move the cursor along the same row. The cursor will change rows when it comes to a row end.
- Use the **▲|▼** arrows to move the cursor up and down between rows.

When the selected keyword is complete:

- Press **Done** to save all keywords and close the Edit Keywords labeler. These keywords will exist on the FieldFox until changed.
- Press **Cancel** to close the labeler without saving changes.

Prefixes for Filenames

A prefix is used as a default filename to which characters can be added. The prefix can be customized, and quickly enabled or disabled. When enabled, the current prefix is automatically entered as the start of a filename when performing a Save operation.

How to enable and disable the current Prefix

- Press **Save/Recall 9**.
- Then **More**.
- Then **Prefix ON OFF**. The current selection is underlined.

How to edit the current Prefix

- Press **Save/Recall 9**.
- Then **More**.
- Then **Prefix**.
- Then choose from the following:
 - Press **Select** to add the cursor character to the end of the Prefix.
 - Press **Backspace** to erase the last character from the end of the Prefix.
 - Press **Clear** to erase the Prefix.
 - The preselected keywords (File, Site, and so forth) can be selected just like a single character. These keywords can also be edited. See **Edit Keywords**.

How to move the cursor

- Use the rotary knob to move cursor on the same row.
- Use the **▲|▼** arrows to move the cursor up and down the rows.

When the Prefix is complete

- Press **Done** to save the Prefix and close the labeler. This Prefix will exist on the FieldFox until it is changed.

- Press **Cancel** to close the labeler without saving changes.

Printing

You can NOT print the measurement results display directly from the FieldFox to a printer. You can save a Picture file to a USB Flash Drive or mini SD card and then print from any computer. Measurements can also be printed using the FieldFox Data Link software.

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System Settings

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Run/Hold

The **Run/Hold** key determines whether the FieldFox sweeps continuously or does NOT sweep, but holds the display results of the last sweep that was performed.

Use **Hold** to conserve battery power or to allow you to save or analyze the results of a specific measurement sweep.

The current sweep mode is shown on the screen as:

-  Continuous
- **Hold** Hold
-  is displayed while a single sweep occurs.

How to perform a single sweep while in Hold

- Press **Sweep 3**.
- Then choose one of the following:
 - **Single** Automatically sets Continuous OFF (Hold) and causes FieldFox to make ONE measurement sweep, then hold for the next Single key press.
 - **Continuous** Makes continuous sweeps. This is the typical setting when battery power is not critical.

Preset

The Preset key restores the FieldFox measurement settings to a known condition. You can preset the entire instrument, or just the current Mode (CAT, SA, Power Meter, NA.)

When Preset, the FieldFox performs a calibration for use in CAT and NA Modes. Learn more on page 48.

How to Preset the FieldFox

- Press **Preset**.
- Then choose one of the following:
 - **Preset** Returns ALL Modes to the factory default settings.
 - **Mode Preset** Returns only the current Mode to the factory default settings. The current settings for all other Modes remain.

Display Settings

You can adjust the FieldFox for optimum viewing in a wide range of lighting conditions.

NOTE Clean the transfective screen with gentle and minimal wiping using Isopropyl alcohol applied to a lint-free cloth.

Display Brightness

Change the brightness of the background.

How to set Display Colors

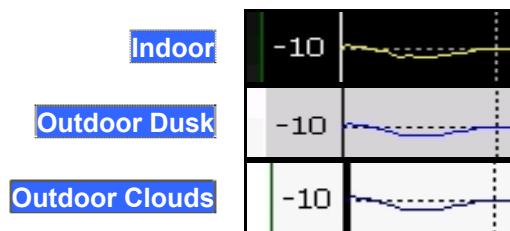
- Press **System**.
- Then **Display**.
- Then **Brightness**.
- Use the **▲/▼** arrows, the rotary knob, or numeric keypad to enter a value between 0 and 100%.

Display Colors

Change Display Colors to alter the viewing scheme.

How to set Display Colors

- Press **System**.
- Then **Display**.
- Then **Display Colors**.
- Then choose one of the following:





Title

A custom title can be made to appear in the upper-left corner of the FieldFox screen. The title can contain up to approximately 65 alpha-numeric characters. To view the Title area, see the Screen Tour on page 21.

How to add or edit a Title

- Press **System**.
- Then **Display**.
- Then **Title**.
- Then enter or edit a title using the FieldFox labeler. This is the same labeler function that is used to name files. Learn how to use the labeler on page 83.
- Then **Title ON OFF** to make the title appear and disappear from the screen.

Edit Keywords

During a file save operation, keywords can be quickly appended to other text to create unique filenames. The Edit Keywords feature allows you to create custom keywords. Learn all about Edit Keywords on page 87.

Full Screen Mode

Full Screen Mode maximizes the display of trace. The screen annotations and the soft keys are removed.

How to set Full Screen Mode

- Press **System**.
- Then **Full Screen**.

To **Exit** full screen Mode, press any key.

Preferences

Language

Choose the language in which to display FieldFox softkeys and other messages.

How to select a Language

- Press **System 7**.
- Then **Preferences**.
- Then **Language**.

- Then choose from the following:

- **English**
- **Espanol** – Spanish
- **Deutsch** – German
- **Italiano** – Italian
- **Francais** – French
- **Japanese**
- **Chinese**

Display Preferences

You can save your display settings as preferences that will remain through a FieldFox Preset and shutdown.

How to save Display Settings as Preferences

- Configure the display brightness and color as you would like it to remain. Learn how on 92.
- Press **System**.
- Then **Preferences**.
- Then **Save Current Settings** There is a beep when your display settings have been saved.
- Press **Reset Preferences** to restore the factory default display settings.

System Configuration

Options (Licensing)

You can view and install options on your FieldFox. See all available options on page 7.

How to view the Installed Options

- Press **System**.
- Then **System Configuration**.
- Then **Options(Licensing)**.
- Then **Show Options**.

The currently installed options are listed.

How to Install Options

A .lic file must already be on a USB Flash Drive. To learn how to obtain a .lic file, visit: <http://www.agilent.com/find/softwarelicense>

Insert the USB Flash Drive in the FieldFox.

- Press **System**.

- Then **System Configuration**.
- Then **Options**.
- Then **Install Options**. The FieldFox reads, validates, then installs the options.
- Press and hold the power button to shutdown, then restart the FieldFox.

For more information about Licensing, see the FieldFox Service Manual at <http://na.tm.agilent.com/fieldfox>.

External Frequency Reference

The FieldFox can phase lock with an external 10 MHz reference signal. When a high-stability 10 MHz reference signal is available, this can improve the accuracy and stability of measurements in CAT, NA, and SA Modes.

The External Reference setting will persist through a FieldFox Preset and is saved as part of the Instrument State.

How to use an External Reference

- Connect the 10 MHz External Reference to the BNC connector on the FieldFox top panel.
- Press **System 7**.
- Then **System Configuration**.
- Then **Frequency Ref**.
- Then **Freq Ref Source Int Ext**.

NOTE The FieldFox may take up to 10 seconds to lock to a valid External Reference source.

When switched to Ext, if the FieldFox does NOT find an appropriate signal with which it can lock, then **Ext Ref UNLOCKED** is displayed in the lower-left corner of the screen.

This can occur when any of the following exist:

- NO external reference signal is present.
- A low-level external reference signal is present.
- A very high-level external reference signal is present.
- The external reference is off-frequency.

For best results, the signal should be between -5 dBm and +5 dBm.

Date and Time Setting

Set the local date and time that is shown on the FieldFox screen. This setting is also used for identifying files that are saved.

How to set Date and Time

- Press **System 7**.
- Then **System Configuration**.
- Then **Date and Time**.

- Press the **▲|▼** arrows to highlight the **Date and Time** row.
- Then **Edit**.
- Use the rotary knob to highlight the field to be edited.
- Use the **▲|▼** arrows or numeric keypad to edit that field.
- Press **Cancel** or **Done** when the Date and Time is accurate.
- Press **Done** to exit the Date and time entry. The readout in the upper-right corner of the FieldFox screen will update accordingly.

How to change Time and Date Format

- Press **System 7**.
- Then **System Configuration**.
- Then **Date and Time**.
- Use the **▲|▼** arrows to highlight the **Time Format** or **Date Format** row.
- Press **Edit**.
- Use the **▲|▼** arrows to scroll through the available Time or Date formats. The Date/Time readout on the FieldFox screen updates immediately.
- Press **Done Edit** when finished.
- Press **Done** when finished making all Date/Time settings.

LAN Settings

Configure the LAN settings to be used to communicate with the Data Link Software. Learn more on page 99.

Use knob. Press [Edit] to make changes. Press [Done] to exit.	
Setting	Value
Current IP Address	192.168.1.102
Current Subnet Mask	255.255.255.0
Current Gateway	192.168.1.1
Hostname	A-N9912A-00000
Obtain IP Address using:	DHCP
Static IP Address	123.456.789.123.123
Static Subnet Mask	0.0.0.0
Static Gateway	0.0.0.0
Apply Settings at:	PowerUp

LAN Settings

How to configure the LAN settings

The first three 'Current...' settings can NOT be edited.

- Press **System 7**.
- Then **System Configuration**.
- Then **LAN**.
- Use the **▲|▼** arrows to select one of the following, then press **Edit**.

- **Hostname** Change the name that can be used to address the FieldFox if your server supports this feature. The default hostname is generated automatically.
- **Obtain IP Address using:** Choose from:
 - **DHCP IP** - Address is assigned dynamically. If your server supports this feature, the IP Address for the FieldFox is assigned each time it is started.
 - **Static** - Set the IP Address manually. The Address remains until you change it.
- **Static IP Address** - Enter the IP Address – including periods - in the format nnn.nnn.nnn.nnn
- **Subnet Mask** - Enter the Subnet Mask – including periods - in the format nnn.nnn.nnn.nnn
- **Static Gateway** - Enter the Static Gateway – including periods - in the format nnn.nnn.nnn.nnn
- **Apply Settings at:** Choose from:
 - **Power Up** The above settings take effect when the FieldFox is started.
 - **Now** The above settings take effect immediately.
- Press **Done Edit** when finished.

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FieldFox Data Link Software

The FieldFox Data Link Software allows you to connect the FieldFox to a remote PC in order to do the following:

- Read the FieldFox trace data from the screen, from the FieldFox internal memory, or from an external memory device.
- Analyze the data using one of the many analysis functions.
- Modify Cable files, Cal Kits, and Keywords for use in the FieldFox.
- Generate a report.

In this Chapter

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Connect a PC to the FieldFox.....	99
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...using a USB Flash Drive or mini SD Card ...	104
...using a LAN Cable.....	105

This information is also in the help file that is included with the Data Link software.

Install the FieldFox Data Link Software

Install the FieldFox Data Link software

1. Find the CD that was shipped with the FieldFox. If you can not find the CD, the software can be downloaded from www.Agilent.com/find/FieldFox. To order a replacement CD, see page 9.
2. Insert the CD into the PC. The CD should start automatically. If it does NOT, open the CD drive using Windows Explorer, then click **Autostart.exe**.
3. When the program is visible on the PC, click **Install FieldFox Data Link Software**.
4. Click **Next** at each dialog to accept the default settings and file locations.

Connect a PC to the FieldFox

NOTE This connection procedure is NOT necessary when using a USB Flash Drive or miniSD Card to transfer files from the FieldFox to a PC. Learn how on page 104.

There are two methods for connecting from a PC to the FieldFox in order to transfer files using the Data Link software. Both methods require that the FieldFox Data Link software be already installed on the PC.

1. Connect both the FieldFox and the PC to the Internet using a LAN cable.
2. Directly connect the FieldFox to the PC using a LAN cable. Neither are connected to the internet but only to each other.

Connect a PC to the FieldFox - both connected to the Internet

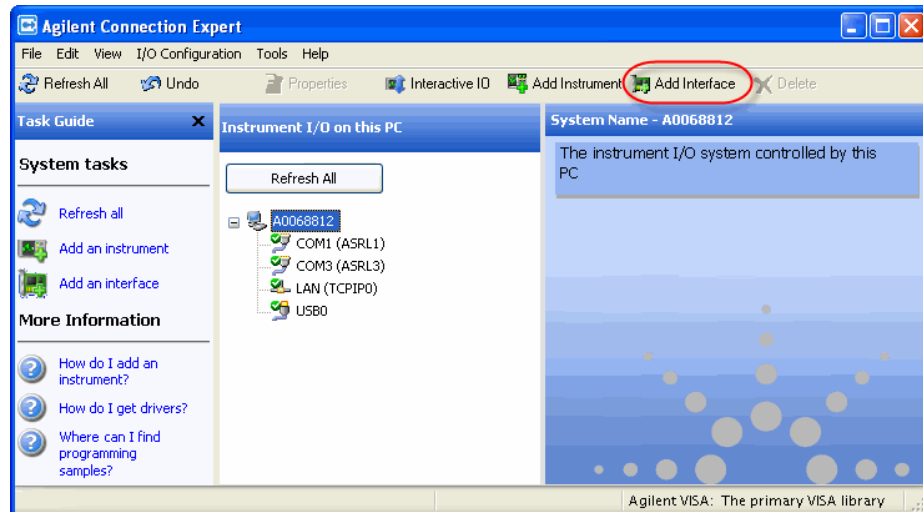
Both the FieldFox and PC must have independent connections to the Internet and have dynamically assigned (DHCP) IP Addresses.

On the FieldFox

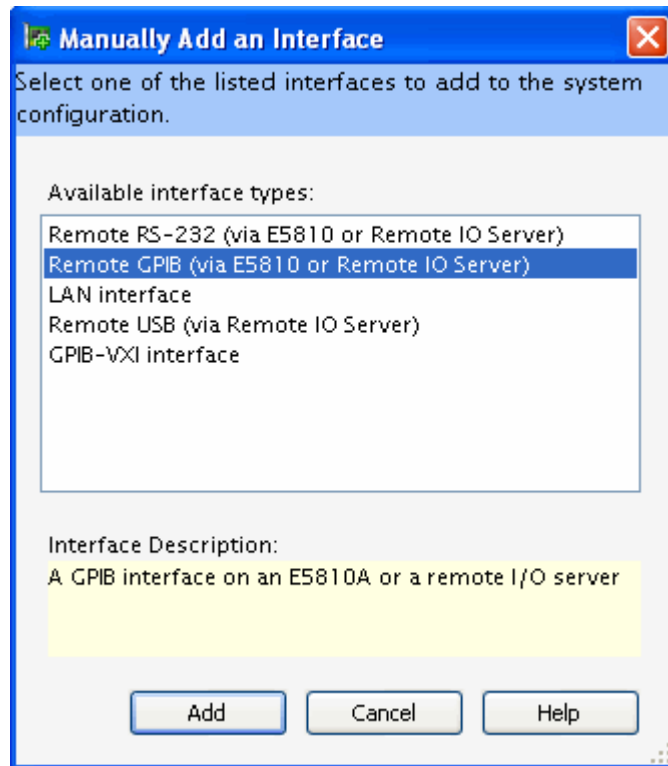
1. Press **System 7** then **System Configuration** then **LAN**
2. Confirm (or change) Obtain IP is DHCP. This allows the server to assign an IP address dynamically
3. Connect the FieldFox to the Internet using a LAN cable.
4. Shutdown, then restart the FieldFox.
5. Press **System 7** then **System Configuration** then **LAN**.
6. Record the Current IP Address.
7. If 127.0.0.1 appears, this address indicates that an IP Address has not been assigned dynamically. Use the Direct Connection method or read data using a USB flash drive or miniSD card.

On the PC – Agilent IO Libraries

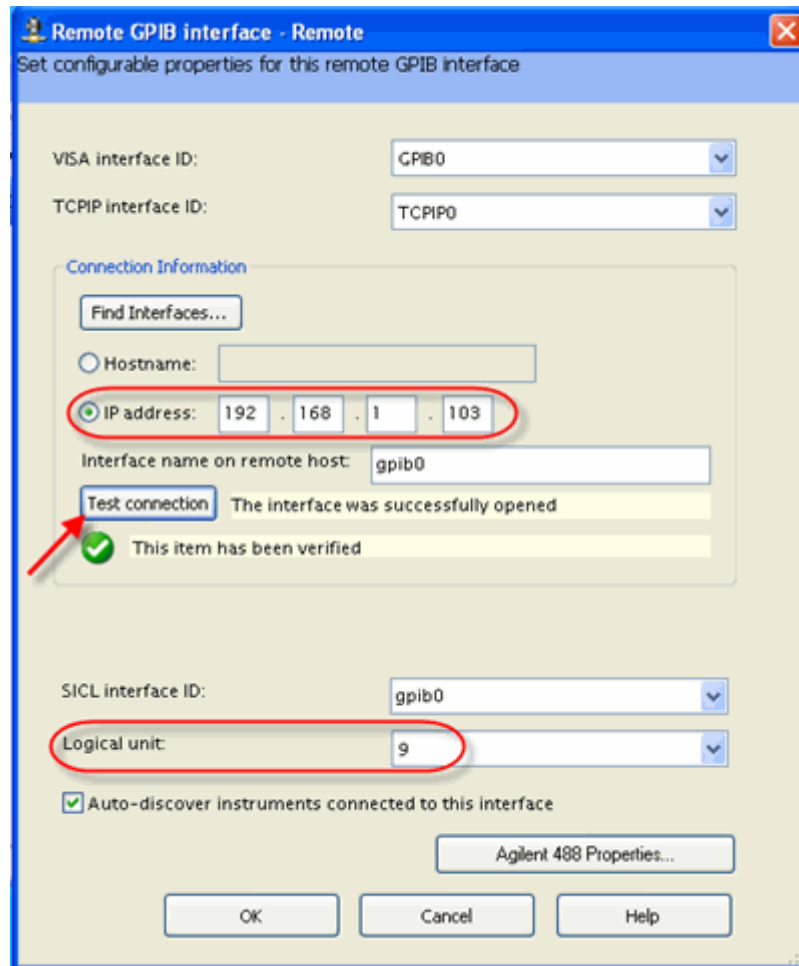
1. In the lower right corner of the PC display, double-click the Agilent IO Libraries Icon **10**. If it is not present, click **Start**, then **All Programs**, point to **Agilent IO Libraries**, then click **Agilent Connection Expert**.
2. Close the Welcome Screen



3. In the above dialog, click **Add Interface**.

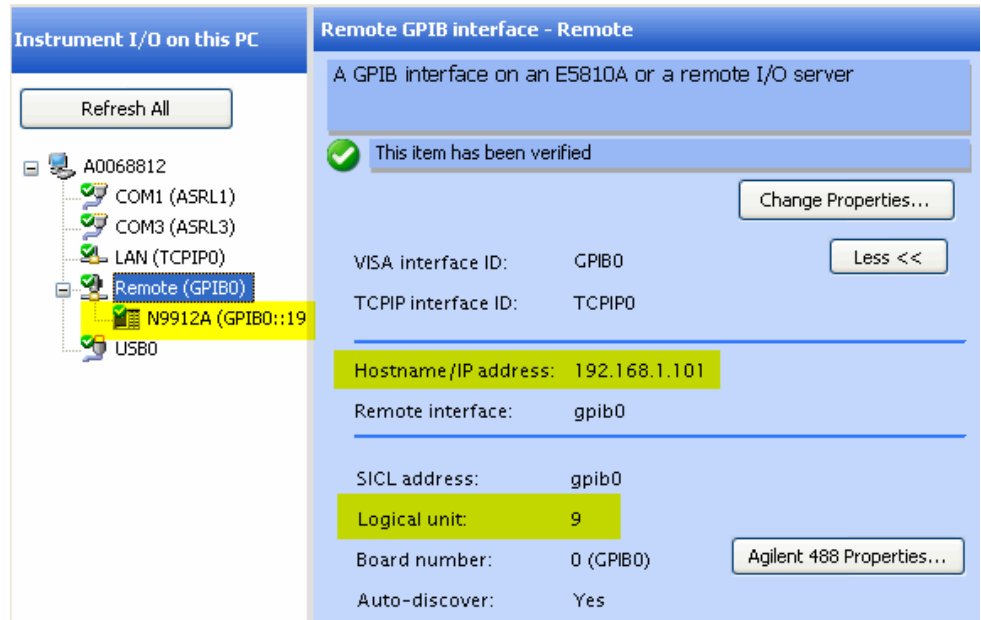


4. In the above dialog, click **Remote GPIB(via E5810 or Remote IO Server)** then click **Add**



In the above dialog:

5. Click **IP address**, then type the IP address of the FieldFox. Learn how to view the IP address in “Connect a PC to the FieldFox - both connected to the Internet” on page 100.
6. Change Logical unit to **9**.
7. Click **Test connection** to verify that the FieldFox can be found.
8. When the ‘Success’ message is displayed, click **OK**.



The ACE dialog will look like the above image.

Each time you connect the FieldFox to your PC, if your server dynamically assigns a **new** IP address, you will have to change the IP address in ACE.

To do this:

1. In the left pane, right-click **Remote (GPIB0)**
2. Click **Change Properties**, then edit the IP address.

Direct connection using a LAN cable

Use this method if an Internet connection is NOT available. This method requires that a static IP Address be assigned to both the FieldFox and the PC, and the IP Address be changed in Agilent IO libraries.

Connect a LAN cable directly from the FieldFox to the PC. The PC can NOT be connected to wireless LAN.

On the FieldFox

- Press **System** then **System Configuration** then **LAN**.
- Set **Obtain IP Address using:** to **Static**
- Set **Static IP Address** to **192.168.0.1** (Learn more on page 96)
- Set **Static Subnet Mask** to **255.255.248.0**
- Press **Done**
- Restart the FieldFox
- After restarting, return to the LAN settings and confirm the Current IP Address and Subnet Mask are what you just entered.

On the PC

- Press **Start**, then **Control Panel**, then **Network Connections**

- Right-click **Local Area Connections**
- Select **Properties**
- Select the **General** tab and scroll to **Internet Protocol (TCP/IP)**
- **Click Properties**
- Select **Use the following IP Address**, then enter **192.168.0.2**
- Enter **Subnet Mask: 255.255.248.0**
- Click **OK** and close dialogs

In Agilent IO Libraries

- Follow the procedure starting on page 100. (**On the PC – Agilent IO Libraries**)
- Enter the IP Address: **192.168.0.1**
- Change the **Logical Unit** to **9**
- Test the connection

How to Read FieldFox Data into the Data Link Software

The following two procedures show you how to read data from the FieldFox into the Data Link software. Both procedures require that the Data Link software already be installed on the PC.

- The easiest method is using a USB Flash Drive or miniSD card. See procedure below.
- To learn how to read data using a LAN cable, see page 105.

About File Types

Before learning how to read FieldFox data, here is a little information about the file types used in the FieldFox and Data Link software.

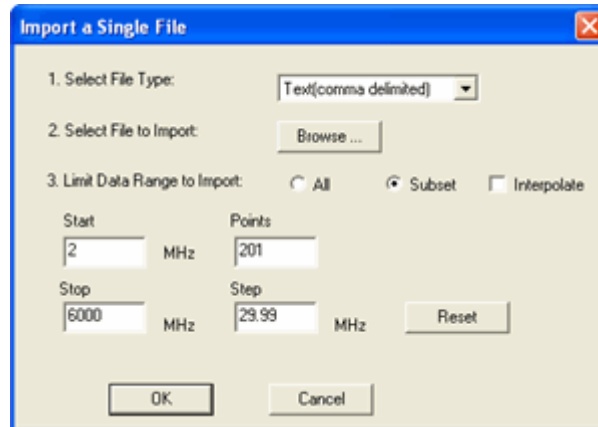
- Data Link software reads traces from the FieldFox **screen or memory** as raw data. There is NO file type associated with the data yet.
- Data Link software reads traces from the FieldFox **internal memory** as ***.csv or *.slp files**. These file types are also saved from the FieldFox onto a USB Flash drive or mini SD card, and then Imported into Data Link software.
- Once data has been read, the Data Link software Saves and Recalls files in *.dut format. These files include all of the Data Link settings, such as markers, limits, format and so forth. These files are used only by FieldFox Data Link software.

Read Data using a USB Flash Drive or mini SD Card

The files to be transferred must already be on the removable device. Learn how to save these files on page 83.

1. Start the Data Link software by double-clicking the FieldFox Data Link icon on the PC desktop.
2. Insert the USB Flash Drive or miniSD card into the appropriate drive on the PC.

3. At the Welcome screen, click Cancel.
4. Click **File**, then **Import**.

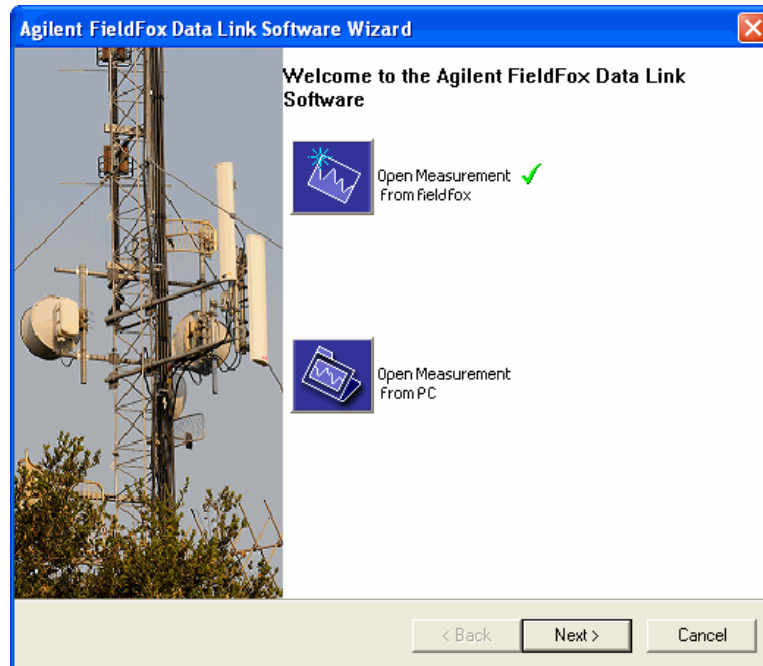


- To import *.csv files, select **Text (comma delimited)**.
 - To import *.slp files, select **sNp**.
5. Click **Browse** and navigate to the file on your PC or removable device.
 6. Click **OK**.
 7. Repeat this procedure to Import more traces,
Click **Help** in the Data Link software to learn more about Importing files.

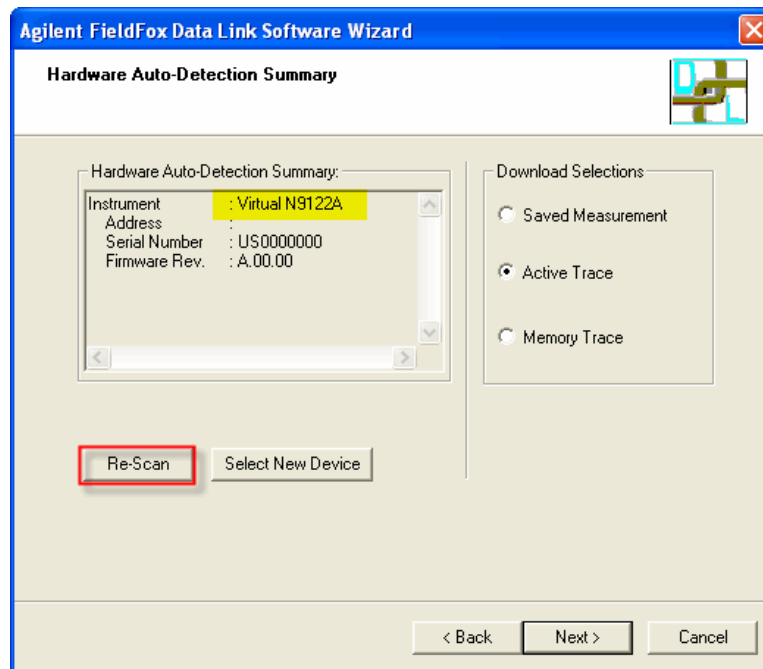
Read Data from the FieldFox using a LAN Cable

This procedure requires the following:

- The FieldFox Data Link Software must already be installed on the PC.
 - The FieldFox must already be connected to the PC using one of the previous 2 methods.
1. Start the Data Link software by double-clicking the FieldFox Data Link icon on the PC desktop.



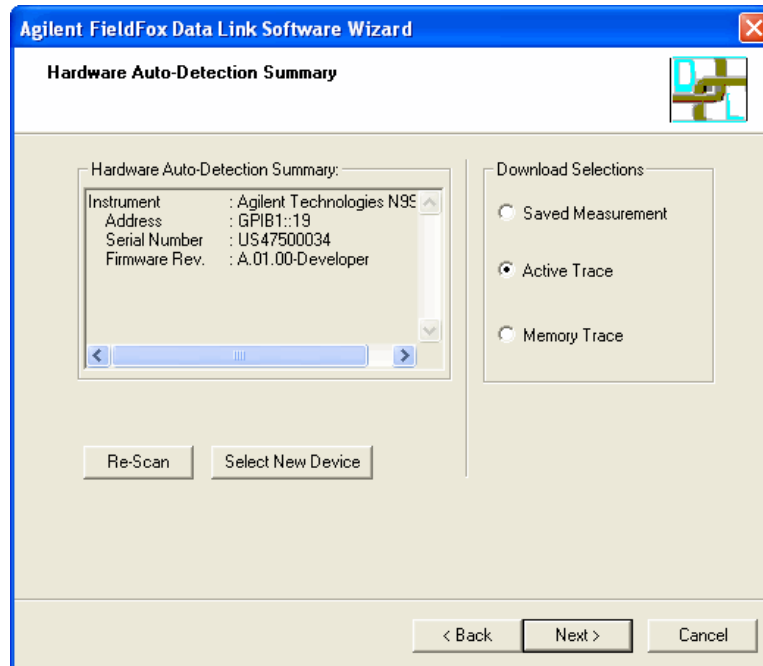
2. At the Welcome screen, click **Next** to Open (read) data from the FieldFox. To return to this Welcome screen at any time, click **File**, then **New**.



3. Each time you connect to the FieldFox , **Virtual N9122A** appears. Click **Re-Scan** to make a connection to the FieldFox.

NOTE If the FieldFox is in Power Meter mode during a connection, errors will appear on the FieldFox screen. This is because data transfer is not allowed in Power Meter mode. You can ignore the errors.

4. After finding the FieldFox, you will again see the Welcome screen above. Click **Next** to read data from the FieldFox.



5. Click a **Download Selection**, then click **Next**.

Download Selections

- **Saved Measurement** Reads a *.csv or *.S1P file from FieldFox internal memory. The Data Link software can look ONLY in the \UserData folder on the FieldFox
- **Active Trace** Reads the trace that is currently on the FieldFox screen. CAT, NA, and SA modes. In SA mode, all existing traces (1 to 4) are read.
- **Memory Trace** Reads the trace that is currently stored in Memory CAT and NA modes only. A data trace must already be stored in Memory using **Trace** **6** then **Data -> Mem**.



When a trace is already in the FieldFox Data Link Software, this dialog appears to allow you to first save the trace to a *.dut file.

However, the existing data is NOT deleted or overwritten.

To learn more about the FieldFox Data Link Software, click **Help** in the software menu.

Update FieldFox Firmware

The FieldFox is controlled by a CPU that uses Windows CE as an operating system. The FieldFox firmware is actually software that controls the instrument hardware and all other settings. The term 'firmware' is a hold-over from the past when the program was burned into integrated circuits, or 'chips'.

You can update the FieldFox firmware as new releases become available. The following procedure shows how to download and install the latest firmware on your FieldFox.

How to Update Firmware

Visit: <http://na.tm.agilent.com/fieldfox>

1. Click Firmware Update to download the N9912A.zip file to a PC. The file is less than 30 MB.
2. Right click on N9912A.zip and make the appropriate menu selection to extract the compressed file to a USB flash drive.
3. Connect the AC/DC power adapter or confirm that the battery power is greater than 30%.
4. Press and hold the FieldFox power button to turn power OFF (NOT Stand By). Learn more about power OFF on page 16.
5. Insert the USB Flash Drive in one of the FieldFox USB connectors.

NOTE Insert only ONE USB Flash Drive in the FieldFox when updating firmware.

6. Press the FieldFox power ON button. After a short wait, you should see the Upgrade Firmware screen.
7. Press **Start** to load the firmware update from the USB flash drive. Checkboxes appear on the screen as the update progresses.

Important Do **NOT** turn power OFF during the firmware update process. Use the AC/DC adapter if battery power is low.

8. When prompted, remove the USB flash drive and press **Exit**.
8. The FieldFox will shut down and restart automatically.
10. To check the new firmware revision, press **System 7** then **Service Diagnostics** then **System Information**.

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Tutorials

In this Chapter

How do CAT and NA Modes Differ	111
How 1-port Measurements are Made.....	111
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Measuring Long Cable Lengths Accurately	115

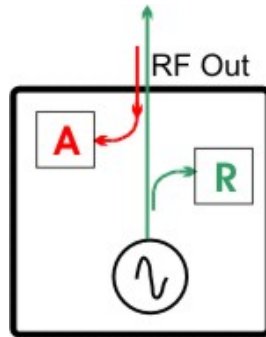
How do CAT and NA Modes Differ

CAT (**Cable and Antenna Test**) and NA (**Network Analyzer**) Modes are similar. Both perform 1-port and, with Opt 110, 2-port measurements. The main difference between CAT Mode and NA Mode is that NA Mode measures the phase of S11 measurements. Phase information is beneficial for component verification. Phase is selected in NA Mode using Format – Phase and Smith Chart.

How 1-Port Measurements are Made

All 1-port measurements are by definition “reflection” measurements. This means that only one port (RF OUT) is used to send a signal AND measure the reflections of that signal.

There are three components in the FieldFox which are key to making 1-port reflection measurements:



1. A signal source which sends signal out the RF OUT port.
2. A “reference” (R) receiver that is used ONLY to accurately measure the “incident” signal out of the source.
3. An (A) receiver for measuring reflected signals coming back INTO the RF OUT port.

A transmission system is made up of the transmitter, the transmission cable, the antenna, and all the connectors in between. In an ideal transmission system, all of the signal power that is sent out the transmitter is completely broadcast into the air. However, in reality, as the signal encounters disruptions, such as worn connectors and cable kinks, some of the signal is reflected back toward the transmitter. The amount of reflection is directly proportional to the severity of the disruption. Any reflected signal is wasted energy and results in a weaker signal being broadcast. If the reflections are significant they could cause damage to the transmitter.

The following is a general process for making 1-port reflection measurements:

- The FieldFox is connected to the transmission system in place of the transmitter. The FieldFox internal signal source (transmitter) is of much lower power than a transmitter that is used to transmit radio, TV, and cell phone signals.
- During the calibration process, the power, frequency, and phase of the FieldFox transmitted signal is VERY accurately known. Adapters or cables that are attached to the FieldFox are measured and their effects are removed from subsequent measurements.
- As disruptions in the transmission feed system are encountered, the power and phase of the reflected signal is measured by the FieldFox 'A' receiver.
- The reflected signals are compared, or 'ratioed' to the power and phase of the 'R' receiver incident signal that was transmitted.
- From this general type of measurement, all of the FieldFox 1-port measurements can be calculated. For example, 'Fault' measurements calculate the severity and distance to all disruptions in the transmission system. For more information how the calculation is performed, see <http://cp.literature.agilent.com/litweb/pdf/5989-5723EN.pdf>
- Also, the loss in the transmission cable can be measured if the end of the transmission line is terminated in a SHORT or OPEN.

About Display Formats

Although the FieldFox in CAT Mode shows some of the following as measurements, they are all the same 1-port reflection measurement, but displayed in different formats. In NA Mode, the measurement (S11 and S21) and format are selected separately.

Return Loss in dB

The easiest way to convey reflection data is with the return loss format which is expressed in dB. Return loss can be thought of as the absolute value of the reflected power as compared to the incident power.

- When measuring an OPEN or SHORT, all incident power is reflected and 0 dB of return loss is displayed.
- When measuring a LOAD, very little power is reflected and values of 40 dB to 60 dB are displayed.

VSWR or SWR

The incident signal and the reflected signal combine in a transmission cable to create a "standing wave". The voltage of the peaks and valleys of the standing wave can be measured. Voltage Standing Wave Ratio (VSWR or SWR for short) is defined as the maximum standing wave voltage over the minimum standing wave voltage.

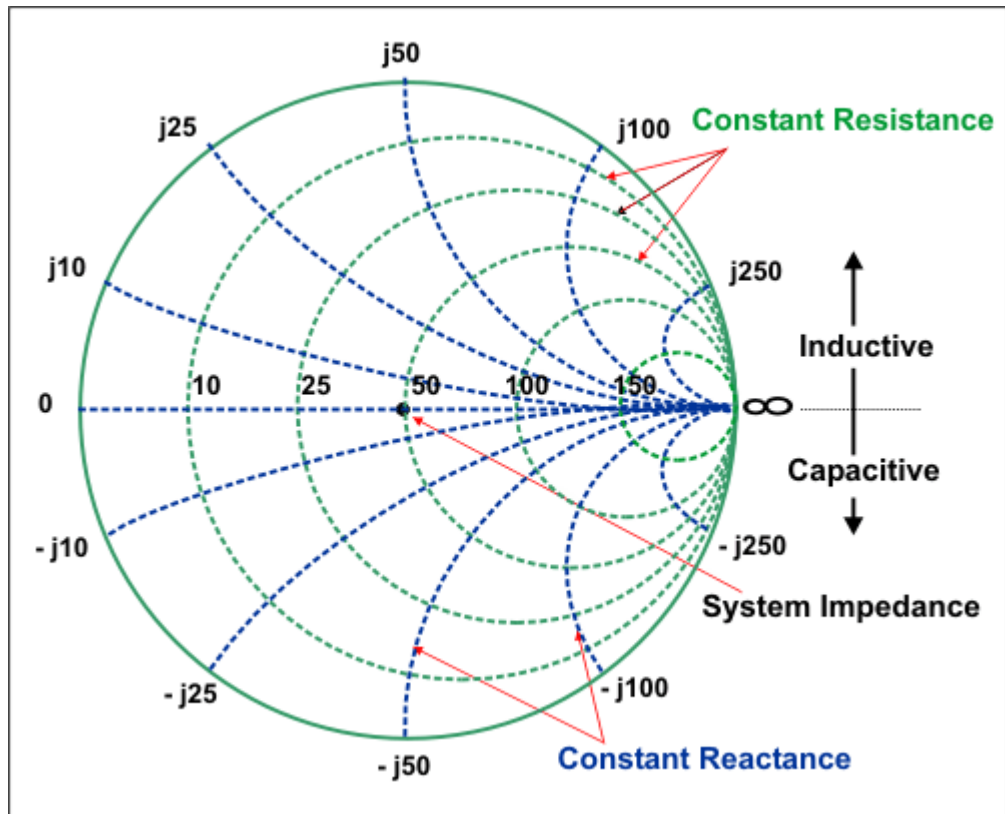
With no reflections (a perfect transmission system), there is no difference between the peaks and valleys, and the VSWR is $1/1 = 1$.

With higher reflections, the maximum might be 3 V while the minimum may be 1 V. $SWR = 3/1 = 3$. A SWR of 3 can be unacceptable in some systems.

Smith Chart

The Smith chart is a tool that maps the complex reflection coefficient (Γ) to the test device's impedance.

In a Smith chart, the rectilinear impedance plane is reshaped to form a circular grid, from which the series resistance and reactance can be read ($R + jX$).



Interpreting DTF Measurement Results

Periodic Cable Faults

CAT Mode DTF measures the reflection of incident energy that is caused by imperfections or disturbances (bumps) which are distributed throughout the cable length. These bumps may take the form of a small dent or a change in diameter of the cable. These bumps are caused by periodic effects on the cable while in the manufacturing process. For example, consider a turn-around wheel with a rough spot on a bearing. The rough spot can cause a slight tug for each rotation of the wheel. As the cable is passed around the wheel, a small imperfection can be created periodically corresponding to the tug from the bad bearing.

Each of these small variations within the cable causes a small amount of energy to reflect back to the source due to the non-uniformity of the cable diameter. Each bump reflects so little energy that it is too small to observe with fault location techniques. However, reflections from the individual bumps can sum up and reflect enough energy to be detected as Cable Loss or Return Loss. As the bumps get larger and larger, or as more of them are present, the Cable Loss or Return Loss values will also increase. The energy reflected by these bumps can appear in the loss measurement as a reflection spike at the frequency that corresponds to the spacing of the bumps. The spacing between the bumps is one half the wavelength of the reflection spike. As the sizes of the bumps, their spacing, and the number of bumps vary within the manufacturing process, varying amounts of Cable Loss or Return Loss are observed.

Discrete Cable Faults

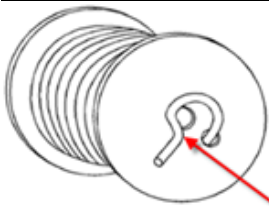
In addition to a set of periodic bumps, a cable can also contain one or more discrete faults. For this discussion, discrete imperfections will be referred to as “faults,” and periodic imperfections will be referred to as “bumps.”

Reflections from discrete faults within the cable will also increase the level of reflection that is measured. The energy reflected from a fault will sum with the energy reflected from the individual bumps and provide a higher reflection level.

A fault within the cable will provide the same type of effect as a bad connector. If the fault is present within the end of the cable nearest to the FieldFox, the effect will be noticed throughout the entire frequency range. As the fault is located further into the cable, the cable attenuation will reduce the effect at higher frequencies. The reflected energy travels further through the cable at lower frequencies where the cable attenuation per unit distance is lower.

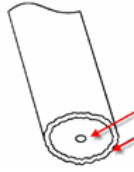
Cable Problems

The following shows potential problems with transmission cables.



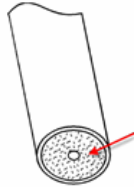
Bent Cable

Poor measurement results can occur if the cable is bent or kinked near the end of the spool.



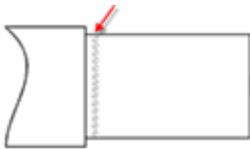
Deformed Cable

Compressing the dielectric (the gap) will produce egg-shaped or oval deformations which can cause impedance mismatches and affect the quality of the connector Model compensation. This can easily happen when using diagonal cutters to cut the cable.



Contaminated Dielectric

When a cable is cut, contamination of the dielectric can occur from cuttings or shrapnel from the outer or inner conductor. This type of contamination can cause problems and change the connector Model compensation needed.



Damaged Outer Conductor

The outer conductor may be cut or dented when the outer insulation is removed. This can cause a close-in fault.



Non-Flush Cut

Cables which require a flush cut, such as for GTC-XXX-TX-N (“Pogo”) connectors, might not actually be cut in such a way. This can cause an inconsistent connection or poor repeatability of the measurement.

Measuring Long Cable Lengths Accurately

In CAT and NA Modes, the FieldFox signal source and receiver step frequency at the same time. To make accurate reflection measurements, the signal must travel to the end of the transmission line and back to the FieldFox receiver before stepping to the next frequency. With a long cable length, the default sweep time settings may not be adequate, and inaccurate measurements occur as a result.

To make these measurements accurately, it may be necessary to slow the sweep speed allowing the signal time to return to the receiver before it steps to the next frequency.

- In CAT or NA Modes, for both Loss and DTF measurements:
- Press **Sweep 3**.
- Then **Min Swp Time**.
- Then type a value, press a multiplier softkey, and press **Enter** to change the sweep speed as desired. Learn more about **Minimum Sweep Time** on page 43.
- When the trace no longer changes as more Sweep time is added, then an accurate measurement is being made.
- For cables with high loss, add Averaging to reduce noise. Learn how on page 27.

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Working with the Lithium-Ion Battery

In this Chapter

Viewing Battery Charge Status	117
Charging the Battery	119
Reconditioning the Battery.....	121
Battery Care.....	122
Maximizing Battery Life.....	122
Battery Disposal.....	122

See Also



Installing the Battery.....	15
Conserving Battery Power.....	15
Battery Safety Considerations	149

Viewing Battery Charge Status

You can view the battery charge status in the following ways:

- Icons in the upper right of the front panel screen.
- Battery screen - select **System**, **Service Diagnostics**, and **Battery**.
- Built-in battery gauge. If you have the Tyco battery, remove it from the FieldFox to view the battery LED. If you have the Inspired Energy battery, open the FieldFox battery compartment door to view the battery LCD.

Front Panel Icons

Icon	Status
	Connected to external power through the AC/DC adapter. Battery installed and charging. The amount of charge is indicated by the number of bars shown.
	Battery not charging with 84% battery life remaining.

Service Diagnostics – Battery Screen

The Battery screen displays the following information. To access the screen, select **System**, **Service Diagnostics**, and **Battery**.

1. **Status** – Fully charged, No battery, Charging, Empty, or Discharging.
2. **External DC Supply** – true or false tells you if an external DC supply is connected.
3. **Battery Present** – true or false tells you if a battery is installed.

NOTE Items 4 through 15 are read directly from the battery. The information is based on the battery's internal sensors and memory.

4. **Battery Voltage** – measured by the battery's sensor.
5. **Current** – amount of current being consumed when operating from internal battery. If battery is charging, indicates amount of charging current.

6. **Average Current** – running average of current, as just explained in item #5 .
7. **Battery Temperature** – internal temperature of the battery as measured by a sensor embedded in the battery.
8. **Max Error** – present accuracy of the battery gauge. If the error exceeds 10%, you should recondition the battery. Learn more on page 121.
9. **Relative State of Charge** – current charge compared to actual full capacity. This number lowers with age and number of battery cycles.
10. **Absolute State of Charge** – current charge compared to designed full capacity of a new battery.
11. **Remaining Capacity** – number of amp hours remaining.
12. **Full Charge Capacity** – number of amp hours when fully charged.
13. **Present Run Time to Empty** – minutes of run time remaining based on amount of current being used now.
14. **Average Run Time to Empty** – minutes of run time remaining based on running average of current being used.
15. **Charge Cycles** – number of charge cycles battery has experienced. Charge cycle defined as $\geq 80\%$ change in relative state of charge.

Built-In Battery Gauge

Tyco Battery



Inspired Energy Battery



Each lithium ion battery has an LED or LCD gauge that displays its charge status. Each segment represents 20% of the charge capacity. The gauge is active unless the battery is in shutdown mode. To view the LED gauge on the Tyco battery, remove it from the FieldFox and momentarily press the button next to the gauge. To view the LCD gauge on the Inspired Energy battery, open the FieldFox battery compartment door.

Gauge	Charge Remaining
5 segments	≥80%
4 segments	≥60%, < 80%
3 segments	≥40%, < 60%
2 segments	≥20%, < 40%
1 segment	< 20%
(Tyco battery only) 1 segment, blinking	< 10%

Charging the Battery

When you receive your FieldFox, the lithium-ion battery is partially charged to approximately 30% to 40% to preserve battery life. Allow four hours to fully charge the battery internally, or three hours by using the external battery charger (N9910X-872). A fully charged battery will power your FieldFox for about four hours. It is NOT necessary for you to do any type of battery preconditioning before use.

The FieldFox circuitry ALWAYS prevents the battery from discharging to a level that is damaging. However, if the battery is **completely** discharged, the FieldFox may not turn ON. If this occurs, the battery can still be charged either internally or externally.

Because a lithium-ion battery has no memory effect, you can charge a battery at any time regardless of the current charge status. However, this could impair the accuracy of its internal charge-remaining indicator. When the Max Error is greater than 10%, the battery should be reconditioned. Learn more on page 121.

Internal Charging with the AC/DC Adapter

Important: Read the safety information for the AC/DC adapter on page 148.

Internal charging time for a fully depleted battery is approximately 4 hours with the FieldFox either ON or OFF.



AC/DC adapter

To charge a battery inside the FieldFox, insert the AC/DC adapter plug into the Power connector on the FieldFox side panel (middle hinged door), then plug the adapter into an AC outlet.

- **FieldFox ON:** Charging is indicated by a battery icon in the upper right of the front panel screen. The icon shows 100% when charging is done.
- **FieldFox OFF:** Charging is indicated by the FieldFox power LED glowing amber, with its intensity increasing from dim to bright every few seconds. This pattern repeats until the LED turns off when charging is done. Learn more on page 19.

Using the External Battery Charger (N9910X-872)

Important: Read the safety information for the External Charger on page 149.



External Battery Charger (N9910X-872)

The external battery charger (N9910X-872), lets you charge a fully depleted battery in approximately three hours. It is a two bay, level-3 stand-alone battery charger that is compliant with the standard Smart Battery System. The two bays are charged sequentially on a first-come, first-served basis, though a discharge can be performed in the left bay while the right bay is charging. It uses an external universal switching power supply

External Battery Charger LED	Charging Status
Green	Fully charged
Green flashing	Fast charging
Yellow flashing	Reconditioning – the accuracy of the battery’s internal LED charge gauge is being renewed. See “Reconditioning Batteries.”
Yellow/green	Battery is reconditioned
Red flashing	Error
Yellow	Standby

For more information, refer to the Instruction Manual included with the external battery charger.

Reconditioning the Battery

The battery contains electronics that monitors battery usage and tracks how much capacity is available. This function can become less accurate because of temperature fluctuations, aging, self-discharge, repeated partial charging, and other factors. Reconditioning - also known as recalibrating - restores the accuracy of the battery capacity tracking system.

Reconditioning is done by fully charging the battery, fully discharging it, recharging it again, and then verifying that the error has been corrected.

How to determine if a battery needs reconditioning

- Press **System** then **Service Diagnostics** then **Battery**.
- On the Battery screen, if the **Max Error** is greater than 10%, the battery needs to be reconditioned.
- This error will affect many of the displayed battery charge indicators.

After reconditioning, if the battery is not fully charged or continues to show more than a 10% Max Error reading, repeat the reconditioning procedure.

If the second reconditioning does not restore a full charge and give an error reading of 10% or less, the battery needs replacement.

You can recondition a battery internally, or with the External Charger (N9910X-872). The external charger process is faster and simpler.

How to perform Internal Reconditioning

- Fully charge the battery inside the FieldFox (either ON or OFF) using the AC/DC adapter.
- Confirm that the battery has a 100% relative state of charge.
- Fully discharge the battery by disconnecting the AC/DC adapter and leave the FieldFox ON for approximately four to five hours. The FieldFox will shut down when the battery is fully discharged.
- Reconnect the AC/DC adapter.
- Charge the battery and verify a full charge.
- Check the **System** then **Service Diagnostics** then **Battery** screen to verify that the Max Error is less than 10%.

How to Recondition with the External Battery Charger (N9910X-872)

- Insert a battery into the left bay of the external charger.
- Press the button labeled **Push to Recalibrate Left Battery Bay**
- The charger will charge the battery fully, discharge it completely, then recharge it fully again. The entire process can take up to 12 hours.
- Install the battery into the FieldFox.
- On the System, Battery screen, verify that the battery is fully charged and reconditioned.

Battery Care

Visually inspect the battery periodically for signs of degradation, such as swelling, cracking of the battery shell, or leakage of fluid. If degradation occurs, replace the battery and dispose of it properly. Learn how on page 122. Operation with a degraded battery could result in damage to the FieldFox. Learn more on page 149.

Maximizing Battery Life

- If AC power is continuously available (Ex: in a workbench environment), remove the battery and use the AC/DC adapter.
- If AC power is not continuously available (Ex: in a field environment), use the battery and recharge it when it holds a 20% to 50% charge, as shown on the screen's battery charge icon. At this charge level, 2 or 3 segments show on the battery gauge.
- If the FieldFox is not going to be used for more than a week, remove the battery. Best practice is to store the battery with a charge of about 50%. At this charge level, 3 segments show on the battery gauge. Batteries that remain idle eventually lose their ability to hold a charge.
- Allow a battery to warm to room temperature before charging it. Temperature shock can damage the battery chemistry and in some cases cause a short circuit.
- Store batteries in a cool, dry location, away from metal objects and corrosive gases.
Storage temperature limits (20% to 50% relative charge is recommended):
 - Transportation: -20°C to 50°C
 - Within 1 month: -20°C to 45°C
 - Within 6 months: -20°C to 40°C
 - Within 1 year: -20°C to 35°C
- Battery charging limits:
 - Charge temperature: 0°C to 45°C (<10°C slows charge on some batteries)
 - Discharge temperature: -10°C to 60°C
- Operate the FieldFox on battery power between the ambient temperatures of -10 and +50°C (-14 to +122°F). Using the battery at lower or higher temperatures can damage it and reduce operating life. Cold temperatures affect battery chemistry, reducing charge capacity, especially below 0°C (32°F).

Lithium Ion Battery Disposal

When you notice a large decrease in charge capacity after proper recharging, it's probably time to replace the battery.

Lithium-Ion batteries need to be disposed of properly. Contact your local waste management facility for information regarding environmentally sound collection, recycling, and disposal of the batteries. Regulations vary for different countries. Dispose of in accordance with local regulations.

Specifications

Definitions

Specification (spec.):

Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. The following conditions must be met:

- FieldFox has been turned on at least 90 minutes
- FieldFox is within its calibration cycle
- Storage or operation at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ range (unless otherwise stated)

Typical (typ.):

Expected performance of an average unit over a 20°C to 30°C temperature range after being at ambient temperature for two hours, unless otherwise indicated; does not include guardbands. It is not covered by the product warranty. The FieldFox must be within its calibration cycle.

Nominal (nom.)

A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty.

Calibration:

The process of measuring known standards to characterize an instrument's systematic (repeatable) errors.

Corrected (residual):

Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.

Uncorrected (raw):

Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

Cable and Antenna Analyzer

Cable and Antenna Analyzer				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
-	-	-	-	-
Frequency Range	-	-	-	-
Option 104	2 MHz to 4 GHz	-	-	-
Option 106	2 MHz to 6 GHz	-	-	-
Frequency Reference	-	-	-	-
Accuracy	±2 ppm	±2 ppm	-	-
Aging Rate	±1 ppm/yr	±1 ppm/yr	-	-
Temperature Stability	±1 ppm over -10 to 55 °C	±1 ppm	-	-
Frequency Resolution	-	-	-	-
2 MHz to 1.6 GHz	2.5 kHz	-	-	-
> 1.6 GHz to 3.2 GHz	5 kHz	-	-	-
> 3.2 GHz to 6 GHz	10 kHz	-	-	-
Data Points	101, 201, 401, 601, 801, 1001	-	-	-
Measurement Speed ¹	-	-	-	-
Return Loss:	-	-	-	1.5 ms/point (nominal)
1.75 GHz – 3.85 GHz, 1001 points, Cal ON	-	-	-	-
DTF:	-	-	-	-
0 to 500 ft, 601 points, Cal ON	-	-	-	2.4 ms/point (nominal)
Output Power (RF Out Port)	-	-	-	-
High	-	-	-	-
2 MHz to 4 GHz	-	-	-	< +8 dBm, +6 dBm (nominal)
> 4 GHz to 6 GHz	-	-	-	< +7 dBm, +2 dBm (nominal)
Low ²	-	-	-	-
2 MHz to 4 GHz	-	-	-	< -23 dBm, -25 dBm (nominal)
> 4 GHz to 6 GHz	-	-	-	< -24 dBm, -25 dBm (nominal)
Immunity to Interfering Signals	-	-	-	+16 dBm (nominal)
Directivity	-	-	-	-
Corrected with OSL calibration ³	>42 dB	>42 dB	-	-
Corrected with QuickCal (Option 111) ⁵	-	-	≥42 dB	-
Raw	-	-	-	-
2 MHz to 3.5 GHz	-	-	> 20 dB	-
> 3.5 GHz to 6 GHz	-	-	> 14 dB	-

Cable and Antenna Analyzer (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
-	-	-	-	-
Source Match	-	-	-	-
Corrected with OSL calibration ³	> 36 dB	> 36 dB	-	-
Corrected with QuickCal (Option 111) ⁵	-	-	≥35 dB	-
Raw	-	-	-	-
2 MHz to 3 GHz	-	-	> 25 dB	-
> 3 GHz to 6 GHz	-	-	> 16 dB	-
Reflection Tracking	-	-	-	-
Corrected with OSL calibration ³	±0.06 dB	±0.06 dB	-	-
Corrected with QuickCal (Option 111) ⁵	-	-	±0.15 dB	-
Reflection Dynamic Range	-	-	-	-
Reflection (RF Out port) (High power out)	-	-	-	-
2 MHz to 4 GHz	-	60 dB	-	-
> 4 GHz to 6 GHz	-	55 dB	-	-
Maximum Measurable Cable Loss Using 1-Port CAT Measurement Model ⁴	-	Reflection dynamic range/2	-	-
Transmission Dynamic Range (Option 110)	-	-	-	-
2 MHz to 2 GHz	-	72 dB	-	-
> 2 GHz to 3 GHz	-	67 dB	-	-
> 3 GHz to 5 GHz	-	58 dB	-	-
> 5 GHz to 6 GHz	-	49 dB	-	-
Return Loss	-	-	-	-
Display Range	0 to -100 dB	-	-	-
Resolution	0.01 dB	-	-	-
VSWR	-	-	-	-
Display Range	1 to 100	-	-	-
Resolution	0.01 dB	-	-	-
Cable Loss	-	-	-	-
Display Range	0 to -100	-	-	-
Resolution	0.01 dB	-	-	-

Cable and Antenna Analyzer (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
-	-	-	-	-
Distance-to-Fault	-	-	-	-
Horizontal Range	Range = [(number of points – 1) / frequency span * 2] * velocity factor * speed of light	-	-	Number of points auto coupled according to start and stop distance entered
Horizontal Resolution	Resolution = Range / (number of points – 1)	-	-	Number of points settable by user
Bandpass Mode Window Types	-	-	-	Maximum, medium, and minimum windows

¹ Measurement speed will degrade when in Temperature Control mode.

² Typically 31 dB below high power.

³ Using recommended calibration kits. See recommended cal kits on page 9.

⁴ Higher cable losses can be measured using transmission or S21 measurements. Cable losses measured in transmission mode limited by transmission dynamic range.

⁵ QuickCal is performed with the connect LOAD step. See QuickCal steps on page 49.

Figure 1: CAT Mode, Type-N Calibration Kit - Magnitude (Specification)

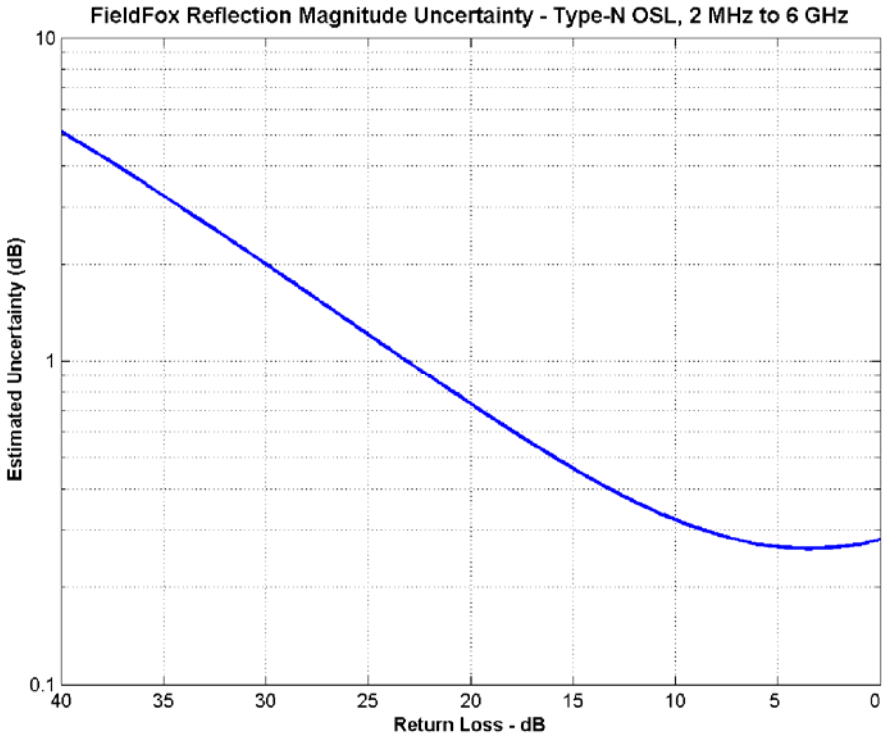


Figure 2: CAT Mode, Type-N Calibration Kit - Phase (Specification)

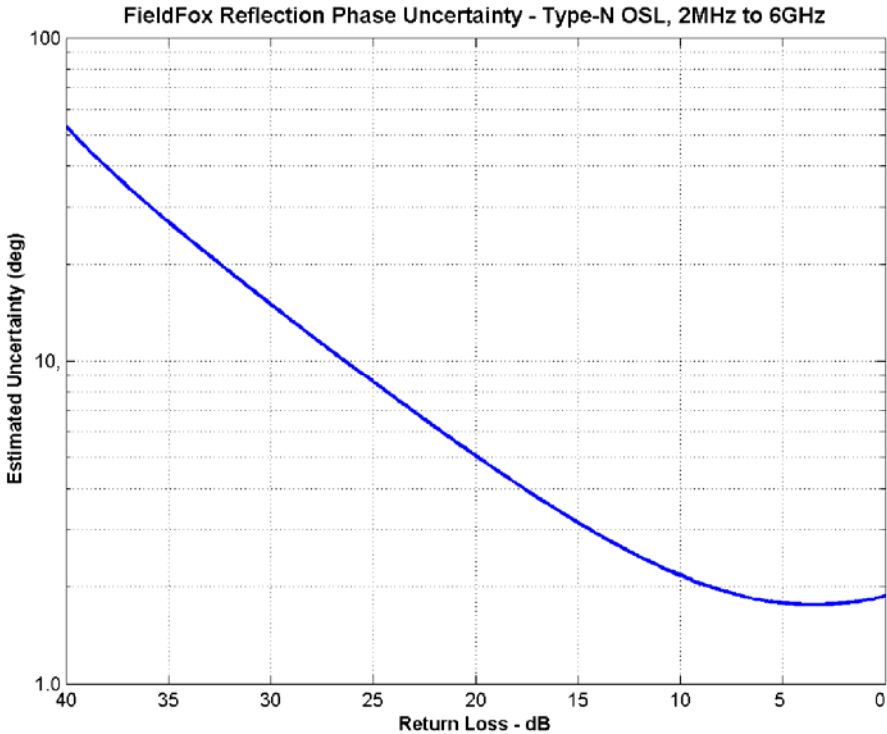


Figure 3: CAT Mode, QuickCal – Magnitude (Typical)

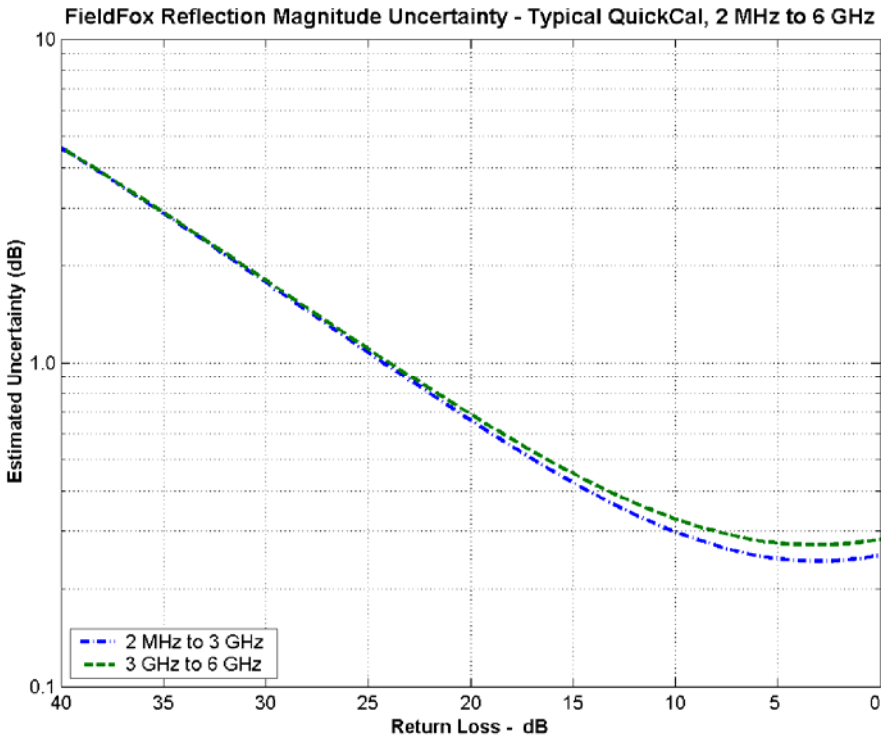


Figure 4: CAT Mode, Preset Cal - Magnitude (Typical)

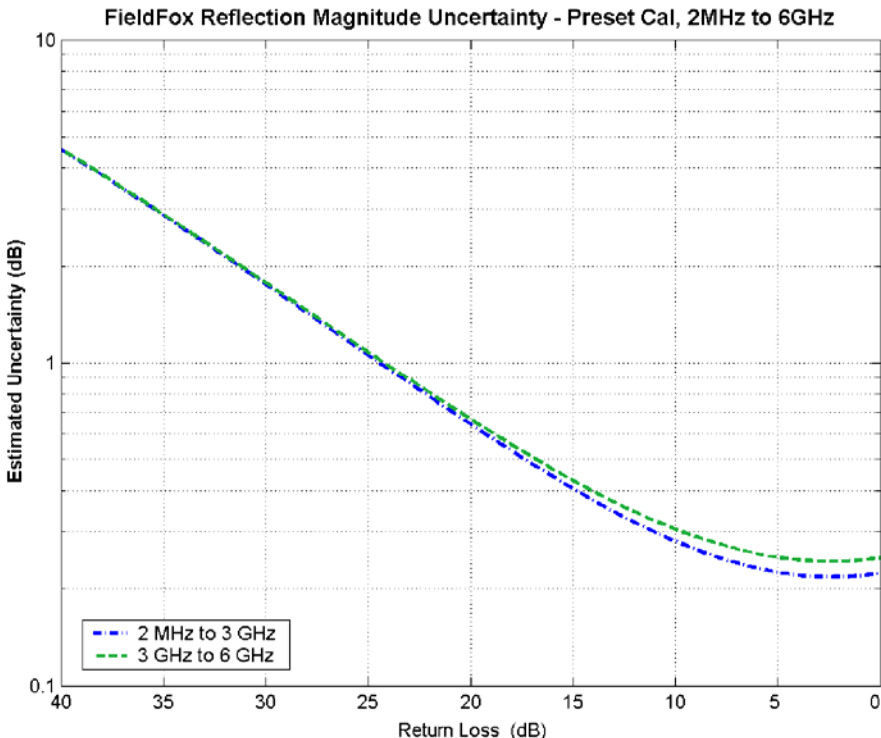
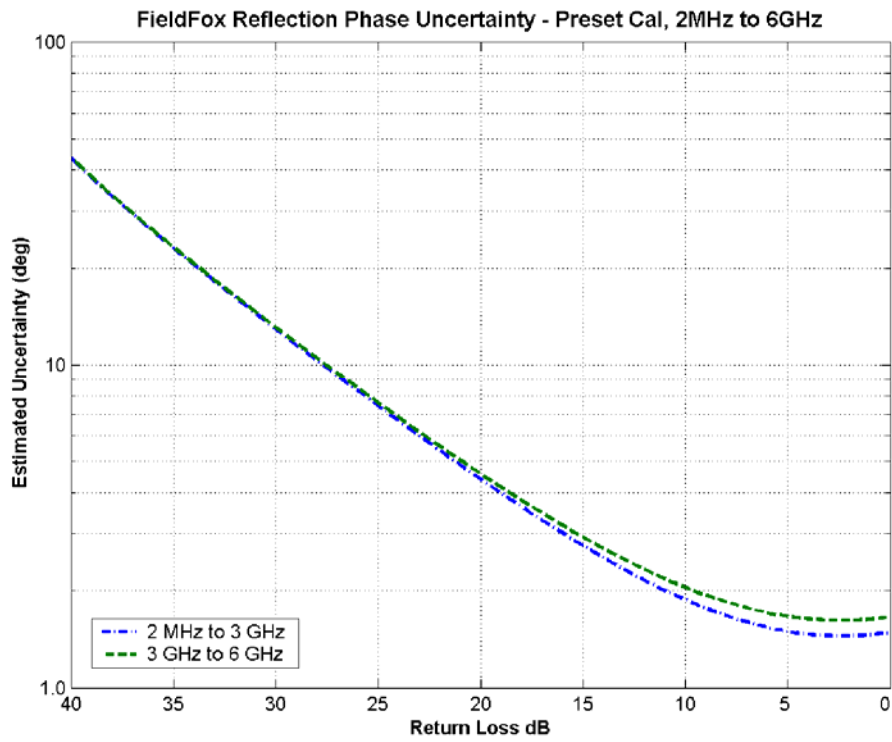


Figure 5: CAT Mode, Preset Cal - Phase (Typical)



Network Analyzer (Option 303)

The following CAT mode performance parameters apply to NA mode: frequency accuracy, frequency resolution, output power, directivity, source match, reflection tracking, and reflection and transmission dynamic range. NA mode performance that is in addition to CAT mode is listed in the table below.

Network Analyzer (Option 303)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
-	-	-	-	-
Frequency Range	-	-	-	-
	2 MHz to 4 GHz	-	-	Option 104
	2 MHz to 6 GHz	-	-	Option 106
Measurements	-	-	-	S11 magnitude and phase S21 magnitude (option 110) A receiver magnitude R receiver magnitude
Formats	-	-	-	Log magnitude, Linear magnitude, VSWR, Phase, Smith Chart
Measurement Speed¹	-	-	-	-
S11:	-	-	-	-
1.75 GHz – 3.85 GHz, 1001 Points, Cal ON	-	-	-	1.5 ms/point (nominal)
S21:	-	-	-	-
1.78 GHz – 2.06 GHz, 201 Points, Cal ON	-	-	-	1.9 ms/point (nominal)
S11 Phase Uncertainty²	See Figure 5 on following page	-	-	-
Display Range	-180° to +180°	-	-	-

¹ Measurement speed will degrade when in Temperature Control mode. Learn more on page 17

² Using recommended calibration kits. See recommended cal kits on page 9.

Figure 6: NA Mode, Type-N Calibration Kit – Magnitude (Specification)

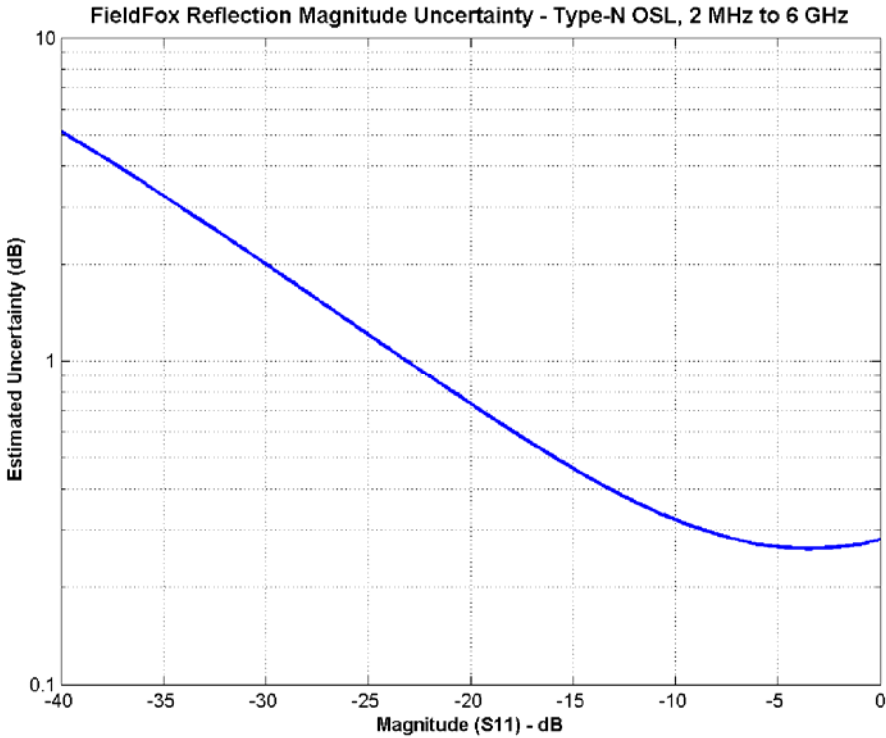


Figure 7: NA Mode, Type-N Calibration Kit – Phase (Specification)

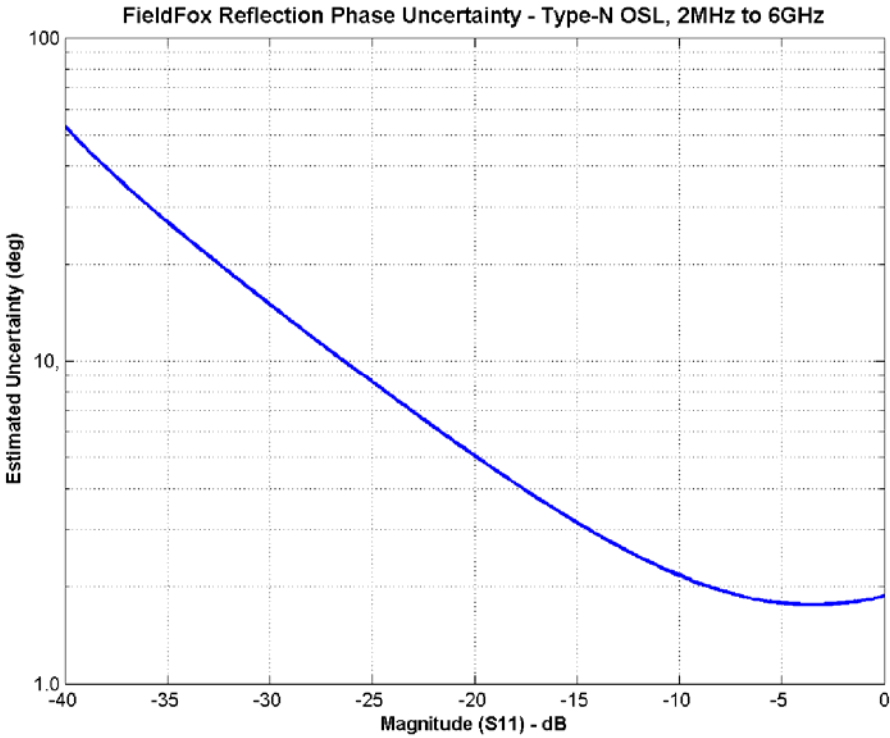


Figure 8: NA Mode, QuickCal – Magnitude (Typical)

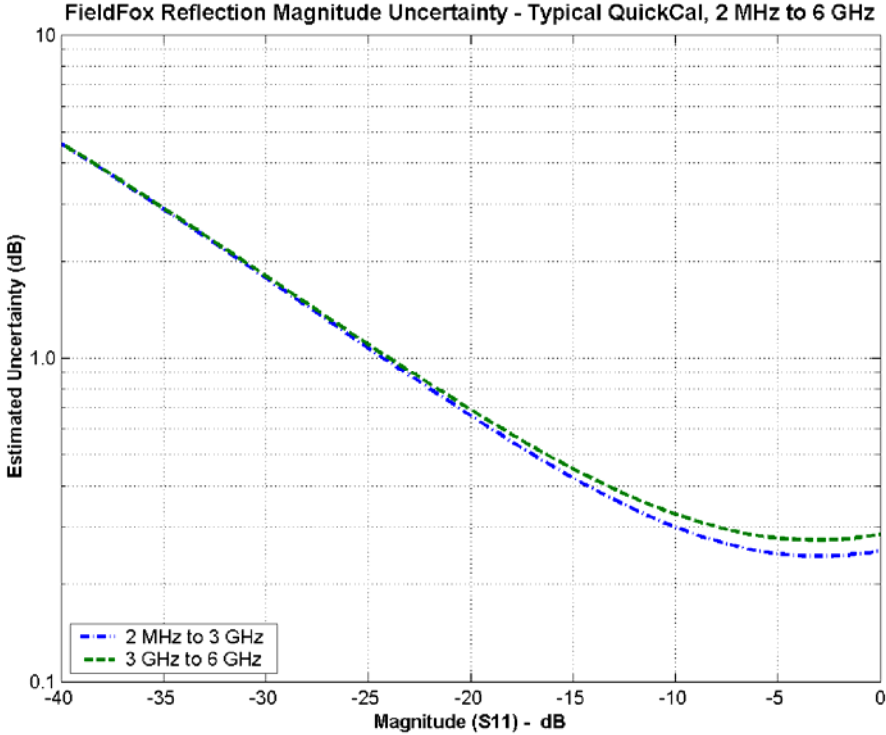


Figure 9: NA Mode, Preset Cal - Magnitude (Typical)

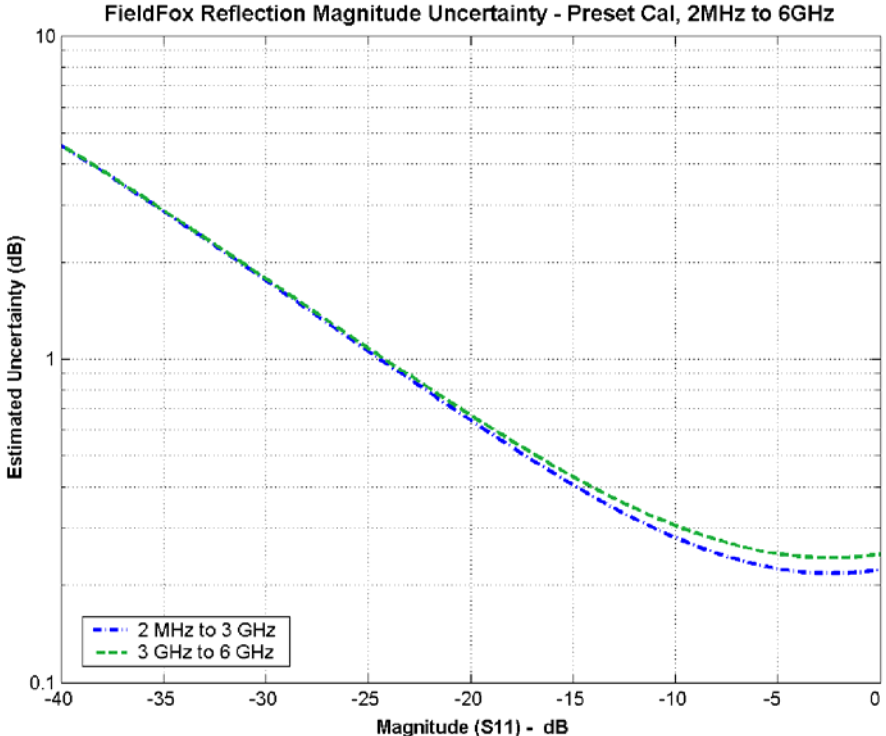
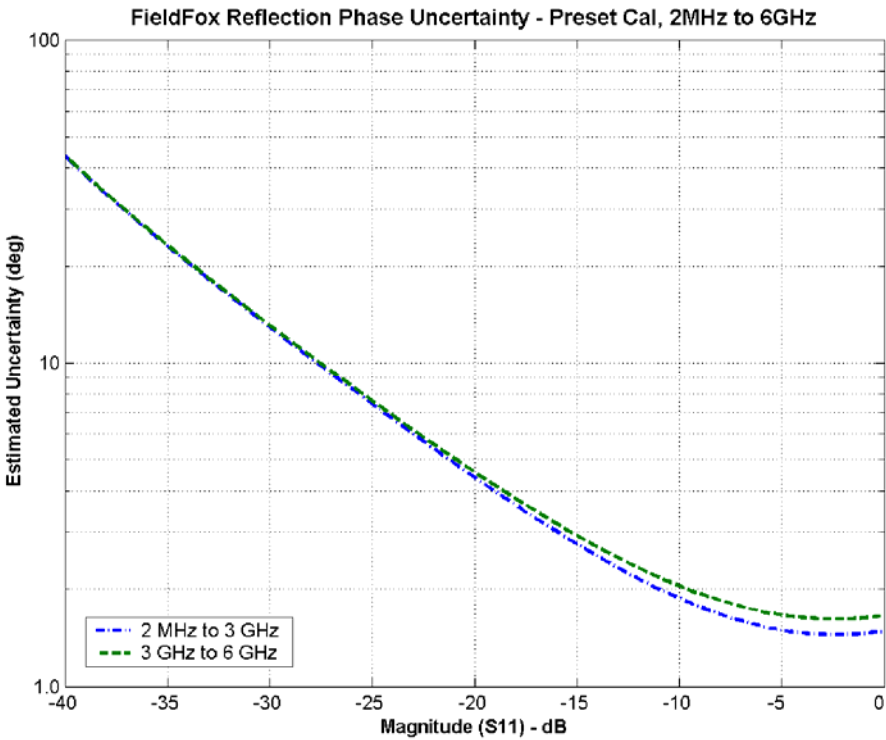


Figure 10: NA Mode, Preset Cal - Phase (Typical)



Spectrum Analyzer (Option 230 and 231)

Spectrum Analyzer (Option 230 and 231)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
FREQUENCY	-	-	-	-
Frequency Range	-	-	-	-
Option 230	100 kHz to 4 GHz	-	-	Usable to 5 kHz ¹
Option 231	100 kHz to 6 GHz	-	-	Usable to 5 kHz ¹ Tunable to 6.1 GHz
Frequency Reference	-	-	-	-
Accuracy	±2 ppm	-	-	-
Aging Rate	± 1 ppm/yr	-	-	-
Temperature Stability	± 1 ppm over -10 to 55 °C	-	-	-
Frequency Readout Accuracy (start, stop, center, marker)	± (readout frequency x frequency reference accuracy + RBW centering + 0.5 x horizontal resolution)	-	-	Horizontal resolution = span/(trace points – 1) RBW centering : 5% x RBW, FFT mode (nominal) 16% x RBW, Step mode (nominal)
Frequency Span	-	-	-	-
Range	0 Hz (zero span), 10 Hz to max freq	-	-	-
Accuracy	±(2 x RBW centering + horizontal resolution)	-	-	±(2 x RBW centering +2 x horizontal resolution) for detector = Normal
Resolution	1 Hz	-	-	-
Sweep Time, Span = 0 Hz	-	-	-	-
Range	-	-	-	-
Minimum	100.0 ns	-	-	-
Maximum	-	-	-	-
RBW = 2 MHz	546.1 us	-	-	-
RBW = 1 MHz	819.2 us	-	-	-
RBW = 300 kHz	1.365 ms	-	-	-
RBW = 100 kHz	4.096 ms	-	-	-
RBW = 30 kHz	13.65 ms	-	-	-
RBW = 10 kHz	40.96 ms	-	-	-
RBW = 3 kHz	136.5 ms	-	-	-
RBW = 1 kHz	409.6 ms	-	-	-
RBW = 300 Hz	634.8 ms	-	-	-
Resolution	100.0 ns	-	-	-
Readout	Entered value representing trace horizontal scale range.	-	-	-

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Sweep Acquisition, Span > 0 Hz	-	-	-	-
Range	1 to 5000. Number of data acquisitions per trace point. Value is normalized to the minimum required to achieve amplitude accuracy with CW signals.	-	-	Auto coupled. For pulsed RF signals, manually increase the sweep acquisition value to maximize the pulse spectrum envelope.
Resolution	1	-	-	-
Readout	Measured value representing time required to tune receiver, acquire data, and process trace.	-	-	-
Trace Update ³	-	-	-	-
Span = 20 MHz, RBW = 3 kHz	-	-	-	1.5 updates/s (nominal)
Span = 100 MHz, RBW auto coupled	-	-	-	7 updates/s (nominal)
Span = 6 GHz, RBW auto coupled	-	-	-	1 update/s (nominal)
Trace Points	101, 201, 401, 601, 801, 1001 (Defaults to 401)	-	-	-
Resolution Bandwidth (RBW)	-	-	-	-
Range (-3 dB bandwidth)	-	-	-	-
Zero Span	300 Hz to 1 MHz in 1-3-10 sequence; 2MHz	-	-	-
Non-Zero Span	10 Hz to 300 kHz in 1/1.5/2/3/5/7.5/10 sequence; 1 MHz, 2 MHz	-	-	Step keys change RBW in 1-3-10 sequence
Accuracy	-	-	-	-
1 kHz to 1 MHz	-	-	-	± 5% (nominal)
10 Hz to 100 kHz non-zero span	-	-	-	± 1% (nominal)
2 MHz	-	-	-	± 10% (nominal)
300 Hz zero span	-	-	-	± 10% (nominal)
Selectivity (-60 dB/ -3 dB)	-	-	-	4:1 (nominal)
Video Bandwidth (VBW)	-	-	-	-
Range	1 Hz to 2 MHz in 1/1.5/2/3/5/7/10 sequence	-	-	VBW ≥ RBW in zero span

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Stability	-	-	-	-
Noise Sidebands, CF = 1 GHz	-	-	-	-
10 kHz offset	< -85 dBc/Hz	-88 dBc/Hz	-88 dBc/Hz	-
30 kHz offset	-	-89 dBc/Hz	-89 dBc/Hz	-
100 kHz offset	-	-95 dBc/Hz	-95 dBc/Hz	-
1 MHz offset	-	-115 dBc/Hz	-115 dBc/Hz	-
<p style="text-align: center;">Figure 11</p>				
AMPLITUDE	-	-	-	-
Measurement Range	Displayed average noise level (DANL) to +20 dBm	-	-	-
Input Attenuator Range	0 to 31 dB	-	-	Auto coupled to the reference level or can be set manually. Defaults to 10 dB at power up. < 5 dB requires numeric keypad entry.
Resolution	1 dB steps	-	-	5 dB steps using rotary knob or up/down arrow control keys

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Maximum Safe Input Level	-	-	-	-
Average Continuous Power	+27 dBm (0.5 W)	-	-	-
DC	±50 VDC	-	-	-
Displayed Average Noise Level (DANL)	-	-	-	10 Hz RBW, 10 Hz VBW, 50 Ω termination on input, 0 dB attenuation, average detector
10 Hz RBW, 10 Hz VBW, 50Ω termination on input, 0 dB attenuation, average detector	-	-	-	-
20 to 30 °C:	-	-	-	-
10 MHz to 2.4 GHz	-	-	-130 dBm	-
> 2.4 GHz to 5.0 GHz	-	-	-125 dBm	-
> 5.0 GHz to 6.0 GHz	-	-	-119 dBm	-
Preamplifier ON (Option 235)	-	-	-	-
20 to 30 °C:	-	-	-	-
10 MHz to 2.4 GHz	< -143 dBm	-	-148 dBm	-
> 2.4 GHz to 5.0 GHz	< -140 dBm	-	-145 dBm	-
> 5.0 GHz to 6.0 GHz	< -132 dBm	-	-138 dBm	-
-10 to 55 °C:	-	-	-	-
10 MHz to 2.4 GHz	< -141 dBm	-	-	-
> 2.4 GHz to 5.0 GHz	< -138 dBm	-	-	-
> 5.0 GHz to 6.0 GHz	< -130 dBm	-	-	-
Display Range	-	-	-	-
Log Scale	Ten divisions displayed; 0.1 to 1.0 dB/division in 0.1 dB steps, and 1 to 20 dB/division in 1 dB steps	-	-	-
Reference Level	-	-	-	Reference level position settable to any y- axis graticule
Range	-170 dBm to +30 dBm	-	-	-
Resolution	0.1 dB	-	-	-
Accuracy	0 dB	-	-	-

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Absolute Amplitude Accuracy at 50 MHz	-	-	-	-
Peak detector, 10 dB attenuation, preamplifier off, RBW < 2 MHz, input signal 0 dBm to -50 dBm, all settings auto-coupled	-	-	-	-
20 to 30 °C	±0.8 dB	±0.8 dB	±0.4 dB	-
-10 to 55 °C	±1.1 dB	-	±0.8 dB	-
Frequency Response	-	-	-	-
Relative to 50 MHz, Peak detector, 10 dB attenuation, preamplifier off, RBW = 30 kHz, input signal 0 dBm to -50 dBm, all settings auto-coupled	-	-	-	-
20 to 30 °C:	-	-	-	-
2 MHz to 10 MHz	±1.1 dB	±1.0 dB	±0.5 dB	-
> 10 MHz to 3.0 GHz	±0.9 dB	±0.6 dB	±0.3 dB	-
> 3.0 GHz to 5.0 GHz	±1.3 dB	±1.1 dB	±0.5 dB	-
> 5.0 GHz to 6.0 GHz	±1.5 dB	±1.5 dB	±0.5 dB	-
-10 to 55 °C:	-	-	-	-
2 MHz to 10 MHz	±2.0 dB	-	±1.0 dB	-
> 10 MHz to 3.0 GHz	±1.5 dB	-	±0.6 dB	-
> 3.0 GHz to 5.0 GHz	±2.0 dB	-	±1.1 dB	-
> 5.0 GHz to 6.0 GHz	±2.6 dB	-	±1.5 dB	-
Preamplifier ON (Option 235)	-	-	-	-
20 to 30 °C:	-	-	-	-
2 MHz to 10 MHz	-	-	±0.7 dB	-
> 10 MHz to 3.0 GHz	-	-	±0.5 dB	-
> 3.0 GHz to 5.0 GHz	-	-	±0.7 dB	-
> 5.0 GHz to 6.0 GHz	-	-	±0.7 dB	-
-10 to 55 °C:	-	-	-	-
2 MHz to 10 MHz	-	-	±1.2 dB	-
> 10 MHz to 3.0 GHz	-	-	±0.8 dB	-
> 3.0 GHz to 5.0 GHz	-	-	±1.3 dB	-
> 5.0 GHz to 6.0 GHz	-	-	±1.7 dB	-

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Resolution Bandwidth Switching Uncertainty	-	-	-	-
RBW < 2 MHz	-	-	-	0.0 dB 0.7 dB peak-to-peak ⁴
Total Absolute Amplitude Accuracy ¹	-	-	-	-
Peak detector, 10 dB attenuation, preamplifier off, RBW < 2 MHz, input signal 0 dBm to -50 dBm, all settings auto coupled	Absolute Amplitude at 50 MHz + Frequency Response	-	-	-
20 to 30 °C:	-	-	-	-
2 MHz to 10 MHz	±1.8 dB	±1.28 dB	±0.60 dB	-
> 10 MHz to 3.0 GHz	±1.5 dB	±1.0 dB	±0.50 dB	-
> 3.0 GHz to 5.0 GHz	±1.9 dB	±1.36 dB	±0.60 dB	-
> 5.0 GHz to 6.0 GHz	±2.1 dB	±1.7 dB	±0.60 dB	-
RF Input VSWR	-	-	-	-
At all attenuation settings	-	-	-	1.5:1 (nominal)
Second harmonic distortion (SHI)	-	-	-	-
-30 dBm signal at input mixer ²	-	-	-	-
2 MHz to 1.35 GHz	-	-	-	< -70 dBc, +40 dBm SHI (nominal)
1.35 GHz to 3.0 GHz	-	-	-	< -80 dBc, +50 dBm SHI (nominal)
Third Order Intermodulation Distortion (TOI)	-	-	-	-
Two -30 dBm tones at input mixer	-	-	-	< -96 dBc, +18 dBm TOI (nominal)

Spectrum Analyzer (Option 230 and 231) (cont.)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
Residual Responses	-	-	-	-
Input terminated, 0 dB attenuation, preamplifier off, RBW ≤ 1 kHz, VBW auto coupled	-	-	-	-
20 MHz to 3 GHz	-	-	-	-90 dBm (nominal)
> 3 GHz to 6 GHz	-	-	-	-85 dBm (nominal)
Spurious Responses	-	-	-	-
Input Mixer level -30 dBm	-	-	-	-
R _{Fsig} = R _{Ftune} + 417 MHz	-	-	-	-70 dBc (nominal)
R _{Fsig} = R _{Ftune} + 1.716 GHz	-	-	-	-80 dBc (nominal)
Input Mixer level -10 dBm	-	-	-	-
First IF Image Response	-	-	-	-
R _{Fsig} = R _{Ftune} – 2 x 0.8346 GHz, for R _{Ftune} 5.7 to 6.0 GHz	-	-	-	-50 dBc (nominal)
Sidebands	-	-	-	-80 dBc (nominal) -60 dBc (nominal) when battery charging, 260 kHz offset

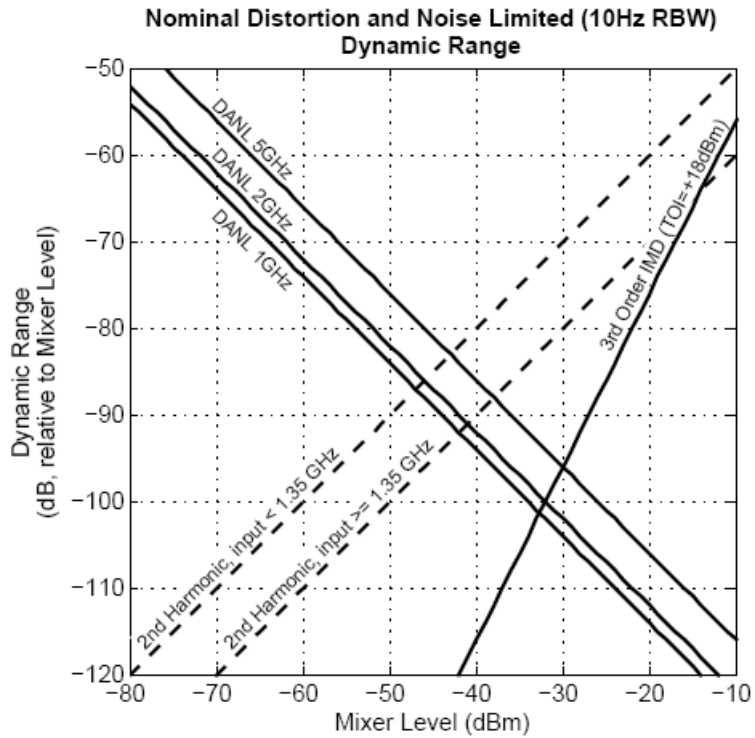


Figure 12

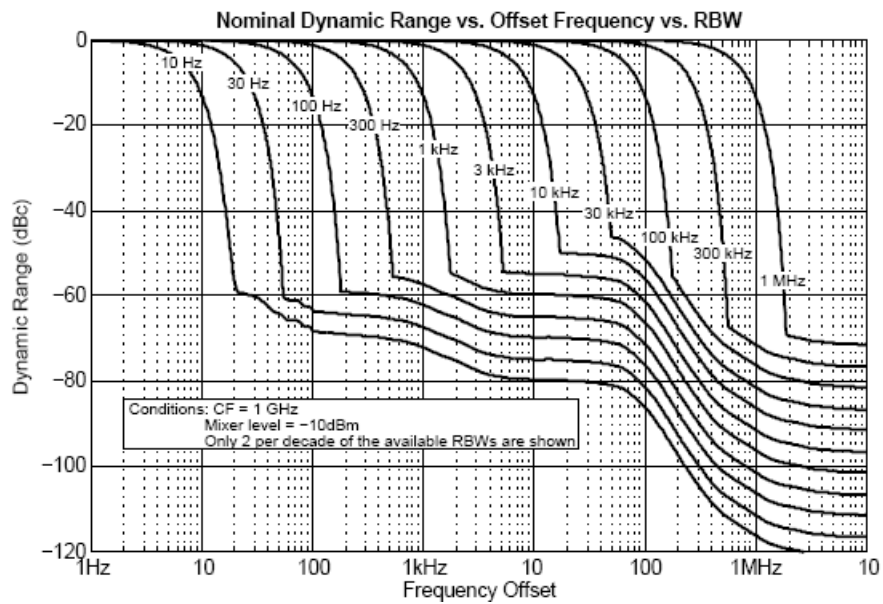


Figure 13

¹ With signal at center frequency.

² Mixer level = RF input level – input attenuation

³ Measurement speed will degrade when in Temperature Control mode. See page 17.

⁴ For signals not at center frequency.

Preamplifier (Option 235)

Preamplifier (Option 235)				
Description	Specification	Typical		Supplemental Information
		10 minute warm up	90 minute warm up	
-	-	-	-	-
Frequency Range	-	-	-	-
Option 230	100 kHz to 4 GHz	-	-	-
Option 231	100 kHz to 6 GHz	-	-	-
Gain	-	22 dB	-	-

Power Meter (Option 302)

Power Meter (Option 302) supports the Agilent Technologies U2000 Series USB Average Power Sensors. For specifications, refer to the U2000 Series USB Sensor's Data Sheet at <http://www.agilent.com/find/usbsensor>.

General Information

General Information			
Description	Specification	Typical	Supplemental Information
Calibration Cycle	1 Year	-	-
Environmental	<ul style="list-style-type: none"> ▪ Agilent Technologies Environmental Test manual (ETM) for Outdoor Equipment¹ ▪ MIL-PRF-28800F class 2 	-	-
Altitude – Operating	9,144 m (30,000 ft)	-	Under battery operation AC to DC adapter rated at 3000m
Altitude – Non-Operating	15,240 m (50,000 ft)	-	-
Temperature Range	-	-	-
Operating	-	-	-
AC Power	-10 to 55 °C	-	-
Battery	-10 to 50 °C	-10 to 55 °C	-
Storage	-51 to 71 °C	-	With the battery pack removed. The battery packs should be stored in an environment with low humidity. Extended exposure to temperature above 45 °C could degrade battery performance and life.
IP Class	3 0	-	-
EMC	-	-	-
Complies with European EMC Directive 2004/108/EC	<ul style="list-style-type: none"> ▪ IEC/EN 61326-2-1 ▪ CISPR Pub 11 Group 1, class A ▪ AS/NZS CISPR 11 ▪ ICES/NMB-001 	-	When subjected to continuously present radiated electromagnetic phenomena, some degradation of performance may occur
ESD	▪ IEC/EN 61000-4-2	-	Functional up to 20 kV test ¹
Safety	-	-	-
Complies with European Low Voltage Directive 2006/95/EC	<ul style="list-style-type: none"> ▪ IEC/EN 61010-1 2nd Edition ▪ Canada: CSA C22.2 No. 61010-1-04 ▪ USA: UL 61010-1 2nd Edition 	-	-
Power	-	-	-
Power Supply	-	-	-
External DC Input	15 to 19 VDC	-	40 W maximum when battery charging
External AC Power Adapter	-	-	Efficiency Level IV, 115 VAC
Input	100 to 250 VAC, 50 to 60 Hz, 1.25 – 0.56 A	-	-
Output	15 VDC, 4 A	-	-
Power Consumption	-	-	-
On	-	12 W	-

General Information (cont.)			
Description	Specification	Typical	Supplemental Information
Battery	10.8 V, 4.6 A-h	-	Lithium ion
Operating Time	-	4 hours	-
Charge Time	A fully discharged battery takes about 1.5 hours to recharge to 80%, 4 hours to 100%	-	-
Discharge Temperature Limits	-10 to 60 °C ² , ≤ 85% RH	-	-
Charge Temperature Limits	0 to 45 °C ² , ≤ 85% RH	-	-
Storage Temperature Limits	-20 to 50 °C ² , ≤ 85% RH	-	The battery packs should be stored in an environment with low humidity. Extended exposure to temperature above 45 °C could degrade battery performance and life
Data Storage	-	-	-
Internal	Minimum 16 MB	-	Up to 1000 instrument states and trace
External	-	-	Supports USB 2.0 compatible memory devices; Supports miniSD memory card
Display	6.5" transfective color VGA LED-backlit 640 x 480 with anti-glare coating	-	-
Weight	2.8 kg (6.2 lbs) including battery	-	-
Dimensions (H x W x D)	292 x 188 x 72 mm (11.5" x 7.4" x 2.8")	-	-
Inputs & Outputs	-	-	-
RF Out Port	-	-	-
Connector	Type-N, female	-	-
Impedance	50 Ω (nominal)	-	-
Damage Level	> +23dBm, > ±50 VDC	-	-
RF In Port	-	-	-
Connector	Type-N, female	-	-
Impedance	50 Ω (nominal)	-	-
Damage Level	> +27 dBm, > ±50 VDC	-	-
LO Emissions	-	-	-
0 dB attenuation, preamplifier off	-	-	-65 dBm (nominal)
USB	-	-	-
USB-A (2 ports)	Hi-speed USB 2.0	-	-
Mini USB (1 port)	Hi-speed USB 2.0	-	Provided for future use.
LAN	10/100 base T RJ-45 connector	-	-

General Information (cont.)			
Description	Specification	Typical	Supplemental Information
External Reference/Trigger Input	-	-	Trigger provided for future use.
Connector	BNC female	-	-
Input Frequency	10 MHz	-	-
Input Amplitude Range	-	-	-5 dBm to +10 dBm (nominal)
Impedance	-	-	50 Ω (nominal)
Lock Range	-	-	± 10 ppm of external reference frequency (nominal)

¹ Samples of this product have been type tested in accordance with the Agilent Environmental Test Manual (ETM) for outdoor equipment (OE) and verified to be robust against the environmental stresses of storage, transportation and end-use ; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions.

² Charge and discharge temperatures are internal temperatures of the battery as measured by a sensor embedded in the battery. The Battery screen displays temperature information. To access the screen, select **System**, **Service Diagnostics**, and **Battery**.

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Safety Considerations

Agilent has designed and tested the FieldFox in accordance with IEC Publication 61010-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and the FieldFox is supplied in a safe condition. The FieldFox is also designed for use in Installation Category II and pollution Degree 2 per IEC 61010 and IEC 60664 respectively. Read the following safety notices carefully before you start to use this FieldFox to ensure safe operation and to maintain the product in a safe condition.

For the FieldFox

WARNING

No operator serviceable parts inside except for the lithium-ion battery. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

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) when attached to the AC-DC adapter.

WARNING

The unit may be used only in the operating conditions and positions specified by the manufacturer. The Agilent N9912 Handheld Cable and Antenna Tester complies with the following standards

IEC 61010 2nd Edition/EN 61010 2nd Edition

Canada: CSA C22.2 No. 61010-1-04

USA: UL 61010-1 2nd Edition

WARNING

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to Agilent Technologies or a designated repair center for service to ensure that safety features are maintained.

WARNING

Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

WARNING

Ensure that the connections with information technology equipment comply with IEC950 / EN60950.

WARNING

Observe all ratings and markings of the instrument before connecting the instrument.

Maximum Input Voltages and Power:

RF Output Connector: 50V DC, +23 dBm RF

Ext Trig/Ref Connector: 5.5 V DC

RF Input: ± 50 VDC, +27 dBm RF

DC Input: 19VDC, 4ADC

WARNING

When performing a measurement, ensure that the right safety and performance ratings of the instrument and accessories are used.

Do not expose the circuit or operate the instrument without its cover or while power is being supplied.

Do not operate the instrument in any environment at risk of explosion.

CAUTION

The power cord and connectors shall be compatible with the connector used in the premise electrical system. Failure to ensure adequate earth grounding by not using the correct components may cause product damage and serious injury.

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.

For the AC/DC Adapter

WARNING

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

WARNING

Use only the designated AC/DC adapter supplied with the instrument.

WARNING

Use only the designated power cord supplied with the AC/DC adapter.

WARNING

No operator serviceable parts inside this product. Do not perform any unauthorized modification to the product. Return the product to Agilent Technologies or a designated repair center for service to ensure that safety features are maintained.

WARNING

Operated at an ambient temperature: 0 to 40°C; full power rating; derate linearly to 50 W at 50°C.

Maximum output rating: +15V/4.0 A.

Input rating: AC 100-240 V, 50/60Hz

WARNING

Main Plug : Use a 3-pin main plug that complies with IEC 60884-1, Plugs and Socket-Outlets for Household and Similar Purposes – Parts1: General Requirements and country specific safety authority requirements, such as UL, SA, BSI, VDE, CCC, SA, NZ, and PSE.

WARNING

Appliance Connector: Use an appliance connector certified to IEC 60320-1/EN 60320-1 requirements

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.

WARNING

When the FieldFox is connected to the AC/DC adapter, position the adapter so the power cord is readily accessible. The power cord is the disconnecting device. It removes main power to the AC/DC adapter. The FieldFox front panel switch is only for the DC power within the instrument, and not for the AC/DC adapter. Alternately, an AC switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be installed and used as a disconnecting device to remove mains power from the AC/DC adapter.

WARNING

To avoid overheating, always disconnect the FieldFox from the AC/DC adapter before storing the FieldFox in the backpack.

If you prefer to leave the FieldFox connected to the AC/DC adapter while inside the backpack, you can disconnect the AC/DC adapter from its AC power source to prevent overheating.

CAUTION

The AC/DC adapter has an auto-ranging line voltage input – be sure the supply voltage is within the specified range.

CAUTION

The AC/DC adapter is for indoor use only.

CAUTION

Never use a modified or damaged charger. Use the original AC-DC adapter ONLY.

CAUTION

The AC/DC adapter is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010 Second Edition and 664 respectively.

For the External Battery Charger (N9910X-872)

CAUTION

If charging batteries externally, use the optional external charger available from Agilent, 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.

For the Battery

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

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

Battery Protective Functions

The following protective functions are designed into the Tyco lithium-ion rechargeable battery system used in FieldFox. The Inspired Energy battery has similar, but not identical, protections.

The protective functions can be divided between two categories: active and passive. Active protection refers to the type of protection that depends on at least two or more protection devices working together to enable the protection. Passive protection refers to the type of protection that is always enabled independent of any other protection device.

Active Protection

Primary Overcharge Voltage: This prevents the battery from being charged if the voltage across any cell exceeds approximately 4.35 V per cell. Once the overcharge protection is tripped, the voltage across each cell must drop below approximately 4.15 V to reset the protection and permit charging.

Secondary Overcharge Voltage: This is a one-time, permanent protection that is triggered when the voltage across any cell exceeds approximately 4.45 V. Once this protection is tripped, the battery can no longer be used and must be replaced.

Overdischarge Voltage: This prevents the battery from discharging if the voltage across any cell drops below approximately 2.6 V. Once the overdischarge voltage protection is tripped, the voltage across each cell must be charged to approximately 3 V to reset the protection and permit discharging.

Primary Overcharge Current: This prevents the battery from being charged if the average charging current reaches or exceeds 3.5A for a time period of 120 seconds or more.

Secondary Overcharge Current: This prevents the battery from being charged if the charging current reaches or exceeds $4A \pm 20\%$ for a time period of 20 milliseconds or more.

Primary Overdischarge Current: This prevents the battery from being discharged if the average current out of the battery reaches or exceeds 5A for a time period of 120 seconds or more. This protection can be reset by removing the load.

Secondary Overdischarge Current: This prevents the battery from being discharged if the current out of the battery reaches or exceeds 6A for a time period of 20 milliseconds or more. This protection can be reset by removing the load.

Short Circuit Protection: This prevents the battery from being charged or discharged and protects against damage or lost data if the current in or out of the battery reaches or exceeds 12.5A for a time period of 183 microseconds or more. This protection can be reset by removing the load.

Overtemperature Charging: The system microcontroller prevents the battery from being charged if the cell temperature exceeds 46C. Once the overtemperature charging protection is tripped, the cell temperature has to drop to or below 45C to reset the protection and permit charging.

Overtemperature Discharging: The system microcontroller prevents the battery from being discharged if the cell temperature exceeds 65C. Once the overtemperature discharging protection is tripped, the battery is automatically shut off which results in turning off the instrument as well.

Passive Protection

Reverse Charging: A reverse protection diode prevents against damage or lost data due to a reverse charge polarity applied to the battery terminals.

Primary Overtemperature: A PTC(positive temperature coefficient) polyfuse in series between the Li-ion cells and the charging and discharging transistors will open up and limit current flow to the battery terminals as a function of very high temperatures. This protection is resettable once the overstress condition is removed.

The maximum operating temperature of this fuse is 85C.

Secondary Overtemperature: A second PTC polyfuse built into each Li-ion cell will open up and limit current flow as a function of very high temperatures.

Tertiary Overtemperature: A current interrupt device (CID) within each Li-ion cell will permanently open up when the temperature reaches 95C. As each cell fuse is permanently interrupted, overall battery performance will become severely degraded, up to and including disabling the battery.

Overcurrent Fuse: This is a one-time blow fuse with a rated current of 12A.

Batteries: Safe Handling and Disposal

Tyco Battery



MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT IDENTIFICATION

Lithium-ion Battery

MANUFACTURER

Tyco Electronics (Shanghai) Battery System
2F, 4 Building, 889 YiSan Road
CaoHeJing Hi-Tech Development Park
Shanghai, 200233 China
TEL: 86-21-54270011

2. COMPOSITION INFORMATION

A. Lithium-Ion Single Cell Matrix

Manufacture	Cell	Type	Capacity (mAh)	Lithium Weight(g)/Cell	No Cd/Pb/Hg
Panasonic	CGR18650D	Lithium Ion	2300	-----	None
N/A					

B. Battery Product Matrix

Battery Name	TEBS P/N	Customer P/N	Cell number	No Cd/Pb/Hg
Agilent	3-1000102-1	1420-0899	CGR18650D	None
N/A				

3. MSDS FOR CELL

See the Doc. below: Panasonic MSDS

Product Information Sheet

Panasonic Batteries

Panasonic Industrial Company
 A Division of Panasonic Corporation of North America
 Two Panasonic Way
 Secaucus, NJ 07094
 Toll Free: 877-728-2228
 Fax: 847-468-5750
 e-mail: oembatteries@us.panasonic.com
 Internet: www.panasonic.com/batteries

Product: Lithium-ion Batteries (Li-ion)

Applicable models/sizes: All

Revision: F; Dated 10/01/04

The batteries referenced herein are exempt articles and are not subject to the OSHA Hazard Communication Standard requirement. This sheet is provided as a service to our customers.

MSDS

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined "article" as a manufactured item other than a fluid or particle; (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees.

Because all of our batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard, hence a MSDS is not required.

The following components are found in a Panasonic Lithium Ion battery:

Component	Material	Formula
Positive Electrode	Lithium Cobalt Oxide	LiCoO ₂
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate - Solvent	C ₂ H ₄ O ₃
	Diethyl Carbonate - Solvent	C ₈ H ₁₆ O ₃
	Lithium Hexafluorophosphate - Salt	LiPF ₆

The overall reaction is: $Li_xC + Li_{1-x}CoO_2 \rightleftharpoons C + LiCoO_2$



DISPOSAL

All Panasonic Lithium Ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream. These batteries, however, do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program. Please call 1-800-8-BATTERY for information on recycling your used Lithium Ion battery or go to the RBRC website at www.rbrc.org for additional information.

TRANSPORTATION

All Panasonic lithium (primary and rechargeable) batteries are not subject to the requirements of the Department of Transportation (DOT) Subchapter C, Hazardous Materials Regulations because each of our batteries meet the exceptions under 173.185 (b). These regulations will remain in effect until October 1, 2005 when the new regulations are expected to become effective.

All Panasonic lithium batteries are exempt from the DOT Hazardous Materials Subchapter as long as they are separated to prevent short circuits and packed in strong packing for conditions normally encountered in transportation.

Effective January 1, 2003, all Panasonic lithium batteries are regulated as a Hazardous Material by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) if you transport more than 24 cells or 12 batteries in a single package. These must be transported in accordance with the requirements of Special Provision "A45".

Effective January 1, 2004, all Panasonic lithium batteries will be regulated as a Hazardous Material by the International Maritime Organization (IMO) if you transport more than 24 cell or 12 batteries in a single package. These will have to be transported in accordance with the requirements of Special Provisions 188 and 230.

If you build any of our lithium cells into a battery pack, you must also assure that they are tested in accordance with the UN Model Regulations, Manual of Test and Criteria, Part III, subsection 38.3. If you plan on transporting any untested prototype battery packs contact your Panasonic Sales Representative for regulatory information.

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation. Panasonic Industrial Company makes no warranty expressed or implied.

Inspired Energy Battery



Product Safety Data Sheet

PRODUCT NAME: Inspired Energy Rechargeable Battery Pack	Model: NF2040A22
TRADE NAME: NF2040	Volts: 10.8
CHEMICAL SYSTEM: Lithium Ion	Approximate Weight: 340 g

SECTION I – MANUFACTURER INFORMATION

Inspired Energy, Inc. 12705 N US Hwy 441 Alachua, FL 32815	Telephone: (888) 5-INSPIRE (888-546-7747) Date Prepared: Jan 13th 2003
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SECTION II – HAZARDOUS INGREDIENTS

Important Note:
The battery should not be opened or burned. Exposure to the ingredients contained within or their combustion products could be harmful.

Material Safety Data Sheet Attached:
Review cell manufacturer's MSDS

SECTION III – OPERATING PARAMETERS

Maximum Charge Voltage:	12.6 V
Minimum Charge Voltage:	7.5 V
Maximum Charge Current:	3.0 A
Maximum Discharge Current:	3.0 A
Recommended Charging Method:	Use an SMBus charger of level 2 or higher to provide a 3.0 A current limited constant voltage of 12.6 V. The charging cycle shall terminate when the average current falls below 150mA.

The information contained within is provided for your information only. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication standard requirement for preparation of a material safety data sheet. The information and recommendations set forth herein are made in good faith and are believed to be accurate as of the date of preparation. However, INSPIRED ENERGY, INC. MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS INFORMATION AND DISCLAIMS ALL LIABILITY FROM RELIANCE ON IT.

PRODUCT INFORMATION AND DATA SHEET

This product is a manufactured article as described in 29 CFR 1910.1200 and is not subject to OSHA's Hazard Communication Standard requirements for preparation of material safety data sheets (MSDS).

SANYO Batteries
 SANYO Energy (USA) Corp.
 2055 Sanyo Ave.
 San Diego, CA 92154
 Telephone No.: (619) 661-4888
www.sanyobatteries.com

Manufacturer's Name
 SANYO Electric Co., Ltd.
 Tokonabe-Cho Kasai-City
 Hyogo, 675-2332, Japan
 Telephone No.: 0790-43-2043

In case of emergency contact:
 CHEMTREC at (800) 424-9300

Section I – Product Information

Product: Lithium Ion Battery

Designated for Recharge? Yes No

Chemical System: Lithium ion

Model: Cylindrical and Prismatic Type Cells

Section II – Composition / Information on Ingredients

The ingredients are contained in a hermetically sealed case, designed to withstand temperatures and pressures encountered during normal use. As a result, during normal use, hazardous materials are fully contained inside the battery. The battery should not be opened or exposed to heat because exposure to the following ingredients contained within could be harmful under some circumstances. The following information is provided for the user's information only.

Chemical Name	CAS No.	PEL	TLV
Lithium Cobaltate (LiCoO ₂)	12190-79-3	None Established	None Established
Graphite (C)	7782-42-5	2.5 mg/m ³ (as dust)	2.5 mg/m ³ (as dust)
Organic Solvent		None Established	None Established
Lithium Salt		None Established	None Established
Polyvinylidene difluoride (PVdF)	24937-79-9	None Established	None Established

Weight of lithium per cell: 0g. There is no metallic lithium in the lithium ion battery.

Section III – Physical Data

Specific Gravity: (H₂O=1): LiCoO₂: 4.95
 Graphite: 2.09~2.2

Melting Point: (°C): LiCoO₂ about 1130 C

Appearance and Odor:
 LiCoO₂ is a black, odorless powder.
 C is a black, odorless powder.
 Organic solvent is a colorless or light yellow liquid.
 Lithium salt is a white, crystalline and odorless powder.

Section IV – Fire and Explosion Hazard Data

Extinguishing Media: Water

Flammable Limits: Not available

Section V – Health Hazard Data

Routes of Entry:

Inhalation - Yes

Skin - Yes

Ingestion - Yes

Health Hazards (Acute and Chronic):

These chemicals are contained in a sealed can. Risk of exposure occurs only if the battery is mechanically or electrically abused. The most likely risk is an acute exposure when the gas release vent works. Organic solvent has slight toxicity and can irritate skin and eyes. Lithium salt is irritating to skin, eyes and mucous membranes and should be avoided.

Carcinogenicity: NTP: None

IARC Monograph: None

OSHA Regulated: None

Medical Conditions Generally Aggravated by Exposure: An acute exposure will not generally aggravate any medical condition.

Emergency and First Aid Procedures: In case of skin contact with contents of battery, flush immediately with water. For eye contact, flush with copious amounts of water for 15 minutes. Do not inhale leaked material. If irritation persists, get medical help.

Section VI – Reactivity Data

Stability: Stable

Conditions to Avoid: Do not heat, disassemble or overcharge.

Hazardous Decomposition or By-products: N/A

Hazardous polymerization will not occur.

Section VII – Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled: The preferred response is to leave the area and allow the batteries to cool and the vapors to dissipate. Avoid skin and eye contact or inhalation of vapors. Remove spilled liquid with absorbent and incinerate.

Waste Disposal Method: Open cells should be disposed of in accordance with local regulations

Precautions to be Taken in Handling and Storing: Avoid mechanical or electrical abuse. Batteries may explode or cause burns, if disassembled, crushed or exposed to fire or high temperatures. Do not short or install with incorrect polarity.

Section VIII Control Measures

Respiratory Protection (Specify Type): Not necessary under conditions of normal use.

Ventilation: Not necessary under conditions of normal use.

Protective Gloves: Not necessary under conditions of normal use.

Eye Protection: Not necessary under conditions of normal use.

Other Protective Clothing or Equipment: Not necessary under conditions of normal use.

Date of Last Revision:
March 2006

Page 2 of 3

Section IX – Recycling and Disposal

SANYO encourages battery recycling. Our lithium ion batteries are recyclable through the Rechargeable Battery Recycling Corporation's (RBRC) *Charge Up to Recycle! Program*. For information call 1-800-8-BATTERY or see their website at www.rbrc.org. Lithium ion batteries must be handled in accordance with all applicable state and federal laws and regulations.



DO NOT INCINERATE or subject battery cells to temperatures in excess of 212 F. Such treatment can vaporize the liquid electrolyte causing cell rupture. Incineration may result in cadmium emissions.

Section X – Transportation

Sanyo lithium ion cells and batteries are not subject to the requirements of the U.S. hazardous materials regulations pursuant to 49 CFR 173.185(b), IATA Dangerous Goods Regulations pursuant to Special Provision A45, and IMDG Code pursuant to Special Provision 188. Each Sanyo cell or battery has been tested under provisions of the UN Manual of Tests and Criteria, Part III, Sub-section 38.3. **If Sanyo lithium ion cells are used to construct battery packs, the assembler of that pack is responsible to ensure the battery has been tested in accordance with the requirements contained in the UN Manual of Tests and Criteria and shipped in accordance with applicable regulations.**

Batteries must be packaged and offered for transportation in a manner that prevents the dangerous evolution of heat (for example, by the effective insulation of exposed terminals) and protects against short circuits.

The information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. SANYO ENERGY CORP. makes no warranty, expressed or implied, with respect to this information and disclaims all liabilities from reliance on it.

Environmental Requirements

Refer to the Specifications section of this document.

Electrical Requirements

The FieldFox allows you to use either the lithium-ion battery or the AC/DC adapter - both are included.

Electrostatic Discharge (ESD) Precautions

The FieldFox was constructed in an ESD protected environment. This is because most of the semiconductor devices used in this instrument are susceptible to damage by static discharge.

Static charges are generated in numerous ways, such as simple contact, separation of materials, and normal motions of persons working with the FieldFox. To prevent instrument damage, practice industry accepted techniques for handling static sensitive devices when using the FieldFox.

Very often, coaxial cables and antennas also build up a static charge, which, if allowed to discharge by connecting to the FieldFox, may damage the instrument input circuitry. To avoid such damage, it is recommended to dissipate any static charges by temporarily attaching a short to the cable or antenna prior to attaching to the instrument.

FieldFox Markings



The CE mark shows that the product complies with all relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).



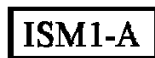
The CSA mark is a registered trademark of CSA International.



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



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



This symbol is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4)



The standby symbol is used to mark a position of the instrument power line switch.



This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).



Indicates the time period which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.



CAUTION, risk of danger, refer to safety information in manual.



Dispose of properly



Hot surface - connectors get hot during extended operation, so care must be taken when making connections and disconnections.

Battery Markings



The CE mark shows that the product complies with all relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).



The battery parts can be recycled. Consult local or country regulations.



Dispose of properly



Recycle the old battery properly. Consult local or country regulations related to disposal.



Keep battery away from excessive heat. Do not dispose of by burning.



UL recognized in Canada and the United States.

Packaging Markings



This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

AC/DC Adapter Markings



The UL Marks are registered certification marks of Underwriters Laboratories Inc. (UL). It means that UL has tested and evaluated representative samples of that product and determined that it meets UL's safety requirements. When accompanied by a 'C' and 'US', it indicates compliance to both Canadian and US requirements.



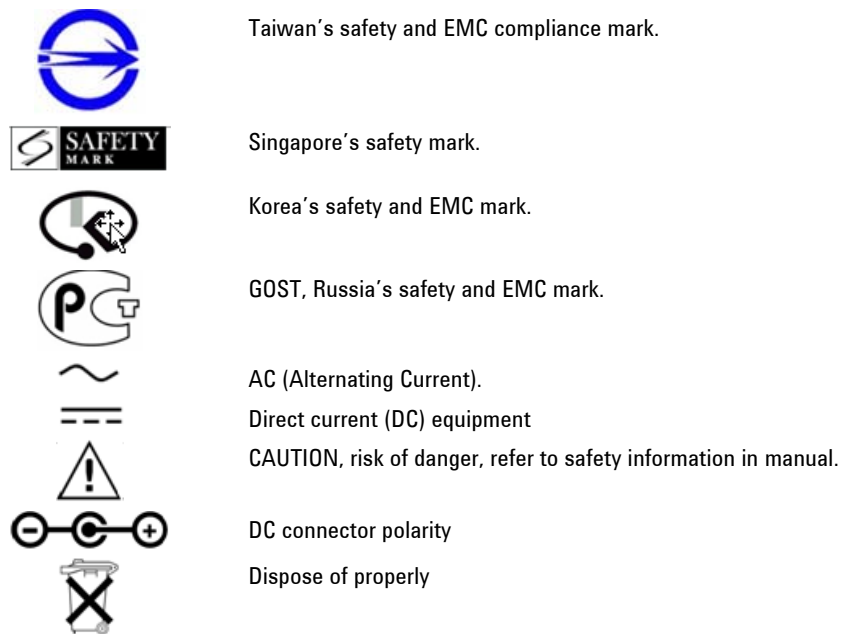
NOM Mark (Normality of Mexico) indicates that the product was tested by an accredited laboratory in Mexico and meets Mexico's safety requirements.



Japan's safety and EMC compliance mark.



China's safety and EMC compliance mark.



Taiwan’s safety and EMC compliance mark.

Singapore’s safety mark.

Korea’s safety and EMC mark.

GOST, Russia’s safety and EMC mark.

AC (Alternating Current).

Direct current (DC) equipment

CAUTION, risk of danger, refer to safety information in manual.

DC connector polarity

Dispose of properly

Certification and Compliance Statements

Certification

Agilent Technologies, Inc. certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies, Inc. further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Manufacturer’s Declaration

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Declaration of Conformity

Should the Declaration of Conformity be required, please contact an Agilent Sales Representative, or the closest Agilent Sales Office. See [Contacting Agilent](#).

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrrordnung -3. GSGV Deutschland).

Acoustic Noise Emission	Geraeuschemission
LpA <70 dB	LpA <70 dB

Operator position	am Arbeitsplatz
Normal position	normaler Betrieb
per ISO 7779	nach DIN 45635 t.19

Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.
 Cet appareil ISM est conforme a la norme NMB du Canada.

Disposal of Batteries



Do not throw batteries away – collect as small chemical waste.

Appendix A: Hardkey/Softkey Menus

This section shows the FieldFox Hardkey and Softkey menu structure.

The following conventions are used in the FieldFox and in this manual:

- **Grey** bordered indicates front panel hardkey selections. Hardkeys are dedicated keys that do not change functionality.

The following softkeys change dynamically:

- **Blue** indicates available settings.
- **Black** indicates the factory default or currently selected setting.
- **Green** indicates more settings are available at a new menu level.
- **Yellow** indicates an active entry is in process.
- **On Off** Underlined items indicate current setting. Press to toggle between settings.
- **Resolution [201]** Brackets indicate the factory default or currently selected setting. Press to select a different setting.

Mode .

CAT Cable and Antenna Test

SA Spectrum Analyzer

Power Meter Power Meter

NA Network Analyzer

Freq/Dist .

CAT	SA	Power Meter	NA Mode
All Meas except DTF Start Stop Center Span	Center Start Stop Zero/last Span Freq Span More	Frequency	Start Stop Center Span
All DTF Modes ONLY Start Distance Stop Distance DTF Units More Bandpass Center Bandpass Max Span Bandpass Mode On Off	CF Step Full Span Back		

[Back](#)

Scale/Amptd .

CAT	SA	Power Meter	NA Mode
Autoscale Scale/Div Ref Level Ref Pos Top Bottom	Autoscale Scale/Div Ref Level Ref Pos RF Atten Auto Man Preamp On Off	Relative On Off Offset On Off Offset Val Scale Min Scale Max More Unit dBm (dB) Watt (%) Back Autoscale Resolution 0 1 2 3 Back	Autoscale Scale/Div Ref Level Ref Pos

Marker

CAT	SA	Power Meter	NA Mode
Marker 1 ,2,3,4,5,6 Off Normal Delta Marker Table On Off More Marker 1 ,2,3,4,5,6 Markers (All Off) Marker Trace 1,2 Back	Marker 1 ,2,3,4,5,6 Off Normal Delta Peak More Marker 1 ,2,3,4,5,6 Markers (All Off) Marker Trace 1,2,3,4 Marker Noise On Off Marker Table On Off Back	None	Marker 1 ,2,3,4,5,6 Off Normal Delta Marker Table On Off More Marker 1 ,2,3,4,5,6 Markers (All Off) Marker Trace 1,2 Back

Mkr =>/ Tools .

CAT	SA	Power Meter	NA Mode
<p>Peak</p> <p>Next Peak</p> <p>Peak Left</p> <p>Peak Right</p> <p>All except DTF</p> <p>Marker=>Center</p> <p>More</p> <p>Min Search</p> <p>Peak Excursion</p> <p>Peak Threshold</p> <p>Back</p> <p>DTF ONLY</p> <p>More</p> <p>Marker=>Start Distance</p> <p>Marker=>Stop Distance</p> <p>Track Peaks ON OFF</p> <p>Find 3 Peaks</p> <p>Back</p>	<p>Peak</p> <p>Next Peak</p> <p>Peak Left</p> <p>Peak Right</p> <p>Marker=>Center</p> <p>More</p> <p>Min Search</p> <p>Peak Excursion</p> <p>Peak Threshold</p> <p>Back</p>	<p>None</p>	<p>Peak</p> <p>Next Peak</p> <p>Peak Left</p> <p>Peak Right</p> <p>Marker=>Center</p> <p>More</p> <p>Min Search</p> <p>Peak Excursion</p> <p>Peak Threshold</p> <p>Back</p>

Measure 1

CAT	SA	Power Meter	NA Mode
<p>Distance to Fault (DTF)</p> <p>Return Loss & DTF</p> <p>Return Loss(dB)</p> <p>VSWR</p> <p>DTF (VSWR)</p> <p>More</p> <p>Cable Loss (1-Port)</p> <p>Insertion Loss (2-Port)</p> <p>Back</p>	<p>None</p>	<p>None</p>	<p>S11 Reflection</p> <p>S21 Transmission</p> <p>A</p> <p>R</p> <p>Format</p> <p>Log Mag</p> <p>LinMag</p> <p>VSWR</p> <p>Phase</p> <p>Smith</p>

BW 2

CAT	SA	Power Meter	NA Mode
Average 1	Res BW Auto Man Video BW Auto Man	Averaging On Off Num Averages	Average 1

Sweep 3

CAT	SA	Power Meter	NA Mode
Single Continuous On Off Restart Resolution [201] 201 401 601 801 1001 MinSwpTime 0.0	Single Continuous On Off Restart Resolution [401] 101 201 401 601 801 1001 SwpTimeControl Zero Span ONLY ZSpanSweepTime	Single Continuous On Off	Single Continuous On Off Restart Resolution [201] 201 401 601 801 1001 MinSwpTime 0.0

Meas Setup 4

CAT	SA	Power Meter	NA Mode
Settings Output Power Hi Low Interference Rej. [Off] Off Minimum Medium Maximum 'DTF & Return Loss' ONLY Alternate Sweep DTF 'Settings' ONLY DTF Window DTF ONLY DTF Cable Specs Velocity Factor Cable Loss Cable Corr Auto Man Recall Coax Cable	AverageType AverageCount	Averaging On Off Num Averages Unit dBm (dB) Watt (%) Back Relative On Off Frequency	Settings Output Power Hi Low Interference Rej. [Off] Off Minimum Medium Maximum Format Log Mag LinMag VSWR Phase Smith

Cal 5

CAT	SA	Power Meter	NA Mode
See page 49	None	Ext Zero	See page 49

Trace 6

CAT	SA	Power Meter	NA Mode
<p>Data =>Mem</p> <p>Data</p> <p>Memory</p> <p>Data & Memory</p> <p>All except DTF</p> <p>Data Math</p> <p>Math Off</p> <p>Data + Mem</p> <p>Data - Mem</p> <p>Data / Mem</p> <p>Back</p>	<p>Trace 1 2 3 4</p> <p>State [Blank]</p> <p>Clr/Wr</p> <p>MaxHold</p> <p>MinHold</p> <p>Average</p> <p>View</p> <p>Blank</p> <p>Default All</p> <p>AverageCount 10</p> <p>Detector [Auto]</p> <p>Auto</p> <p>Normal</p> <p>PositivePeak</p> <p>NegativePeak</p> <p>Sample</p> <p>Average</p>	None	<p>Data =>Mem</p> <p>Data</p> <p>Memory</p> <p>Data & Memory</p> <p>Data Math</p> <p>Math Off</p> <p>Data + Mem</p> <p>Data - Mem</p> <p>Data / Mem</p> <p>Back</p>

System 7

All Modes
<p>Display</p> <p>Brightness</p> <p>Display Colors</p> <p>Indoor</p> <p>Outdoor Dusk</p> <p>Outdoor Clouds</p> <p>Outdoor Sun</p> <p>Night Vision</p> <p>Back</p> <p>Title</p> <p>Title On Off</p> <p>Edit Keywords</p> <p>Back</p>

Full Screen
Preferences
Language
Save Current Preferences
Reset Preferences
Back
System Configuration
Options (Licensing)
Show Options
Install Option
Back
Frequency Ref
Freq Ref Source Int Ext
Date and Time
LAN
Service Diagnostics
System Information
Battery
Internal Temperatures
Back

Limit 8

CAT	SA	Power Meter	NA Mode
Edit Left Right Clear Limit All Limits Off Exit Save Limits Recall Limits Options Beep (On Off) Warning (On Off) Back	Edit Left Right Clear Limit All Limits Off Exit Save Limits Recall Limits Options Beep (On Off) Warning (On Off) Back	Min Limit On Off Min Limit Value Max Limit On Off Max Limit Value	Edit Left Right Clear Limit All Limits Off Exit Save Limits Recall Limits Options Beep (On Off) Warning (On Off) Back

Save/Recall 9

All Modes
Save Shows labeler Select

- BackSpace
- Clear
- Cancel
- Done
- Recall Shows list of files
 - Recall File
 - Delete
 - Cancel
- Select Device
 - Internal
 - SD Card
 - USB
 - Back
- File Type
 - State
 - Trace
 - Picture
 - Data (S1P)
 - Data (CSV)
 - Back
- Print
- More...
 - Manage Files Shows files
 - Copy File
 - Copy All Files
 - Delete File
 - Cancel
 - Manage Folders
 - Change Folder
 - Create Folder
 - Delete Folder
 - Exit
 - Prefix Shows labeler
 - Prefix On Off
 - Edit Keywords Shows keywords
 - Edit Shows labeler
 - Cancel
 - Done

Preset .

All Modes
<ul style="list-style-type: none"> Preset Mode Preset

Run / Hold +/-

All Modes

Press to toggle between Continuous and Single sweep.

Appendix B: Connector Care Review

Proper connector care and connection techniques are critical for accurate and repeatable measurements. The following table contains for tips on connector care.

Prior to making connections to your analyzer, carefully review the information about inspecting, cleaning, and gauging connectors. For course numbers about additional connector care instruction, contact Agilent Technologies. Refer to:

Handling and Storage

Do

- Keep connectors clean
- Extend sleeve or connector nut
- Use plastic end-caps during storage

Do Not

- Touch mating-plane surfaces
- Set connectors contact-end down
- Store connectors or adapters loose

Visual Inspection

Do

- Inspect all connectors carefully
- Look for metal particles, scratches, and dents

Do Not

- Use a damaged connector - ever

Connector Cleaning

Do

- Try compressed air first
- Use isopropyl alcohol^a
- Clean connector threads

Do Not

- Use any abrasives
- Get liquid into plastic support beads

Gauging Connectors

Do

- Clean and zero the gage before use
- Use the correct gage type
- Use correct end of calibration block
- Gage all connectors before first use

Do Not

- Use an out-of-specification connector

Making Connections

Do

- Align connectors carefully
- Make preliminary connection contact lightly
- Turn only the connector nut
- Use a torque wrench for final connection

Do Not

- Apply bending force to connection
- Over tighten preliminary connection
- Twist or screw any connection
- Tighten past torque wrench “break” point

^aCleaning connectors with alcohol shall only be done with the DC power cord removed, in a well-ventilated area, and with the power to the FireFox turned OFF. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the instrument.

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