Agilent
FieldFox
RF Analyzer

N9912A

User's Guide

Agilent Technologies

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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 146.

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

What's New in this Release

For customers upgrading to FieldFox firmware Rev. 4.0, the following is a list of new features.

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 ▪ 2 MHz to 4 GHz (Option 104) ▪ 2 MHz to 6 GHz (Option 106) **Measurements:** ▪ 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 21
Transmission Measurement (Option 110)	CAT Mode on page 21 NA Mode on page 39
QuickCal (Option 111) Built-in cal kit. Industry first!	Cal on page 49
Spectrum Analyzer (SA) Mode General purpose measurements for basic monitoring and troubleshooting. ▪ 100 kHz to 4 GHz (Option 230) ▪ 100 kHz to 6 GHz (Option 231) ▪ Preamplifier for Spectrum Analyzer (Option 235) ▪ Interference Measurements (Option 236)	SA Mode on page 55 On page 60 On page 81
Power Meter Mode (Option 302) Use with Agilent External USB Power Sensors	Power Meter Mode on page 89
Network Analyzer (NA) Mode (Option 303) ▪ 2 MHz to 4 GHz (Option 104) ▪ 2 MHz to 6 GHz (Option 106) ▪ Vector 1-port (Standard) ▪ Scalar 2-port (Option 110) **Measurements:** ▪ S11 Reflection (several formats) ▪ S21 Transmission (several formats) (Option 110) ▪ A receiver ▪ R receiver	NA Mode on page 39
Vector Voltmeter (VVM) Mode (Option 308) Measure electrical length **Measurements:** ▪ 1-Port Cable Trimming (Mag and Phase)	VVM Mode on page 95

▪ 2-Port Transmission (Magnitude only)	
Designed for Field Environment	
▪ 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 113
▪ Expands internal storage	
▪ Useful for file transfer	
▪ Flash Drive and mini SD Card not included	
▪ FieldFox release 4.0 supports mini SDHC (high-capacity) Card	
Battery or AC Power	On page 147.
▪ Rechargeable Li-Ion battery with ~4 hr life	
▪ Easily removable battery	
▪ AC/DC adapter	
▪ External battery charger (N9910X–872)	
FieldFox Data Link Software	On page 127
▪ Included on CD	
▪ Easily manage files and compile reports	
▪ Reads data from the FieldFox and plots traces	
▪ 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 121
▪ Menus localized to 7 languages	

Accessories

The following accessories are included with every FieldFox. 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	Data Link Software CD

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 150.
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)
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, included with shipment.

- **Quick Reference Guide** – Printed copy with laminated pages for outdoor use. included with shipment.

- **FieldFox Data Link Software and Help** – Included on CD. Free download 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 146.

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.**

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 Unite 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 more about the lithium-ion battery on page 146.

Battery charge status is viewable:

- 84% 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. 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. When the relative battery charge drops about 20%, the FieldFox will power off to preserve 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 111.

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 which preserves measurement accuracy and maintains 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.

NOTE   Measurement speed specifications do NOT apply in Temperature Control Mode.

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 shut down.

Avoid 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**

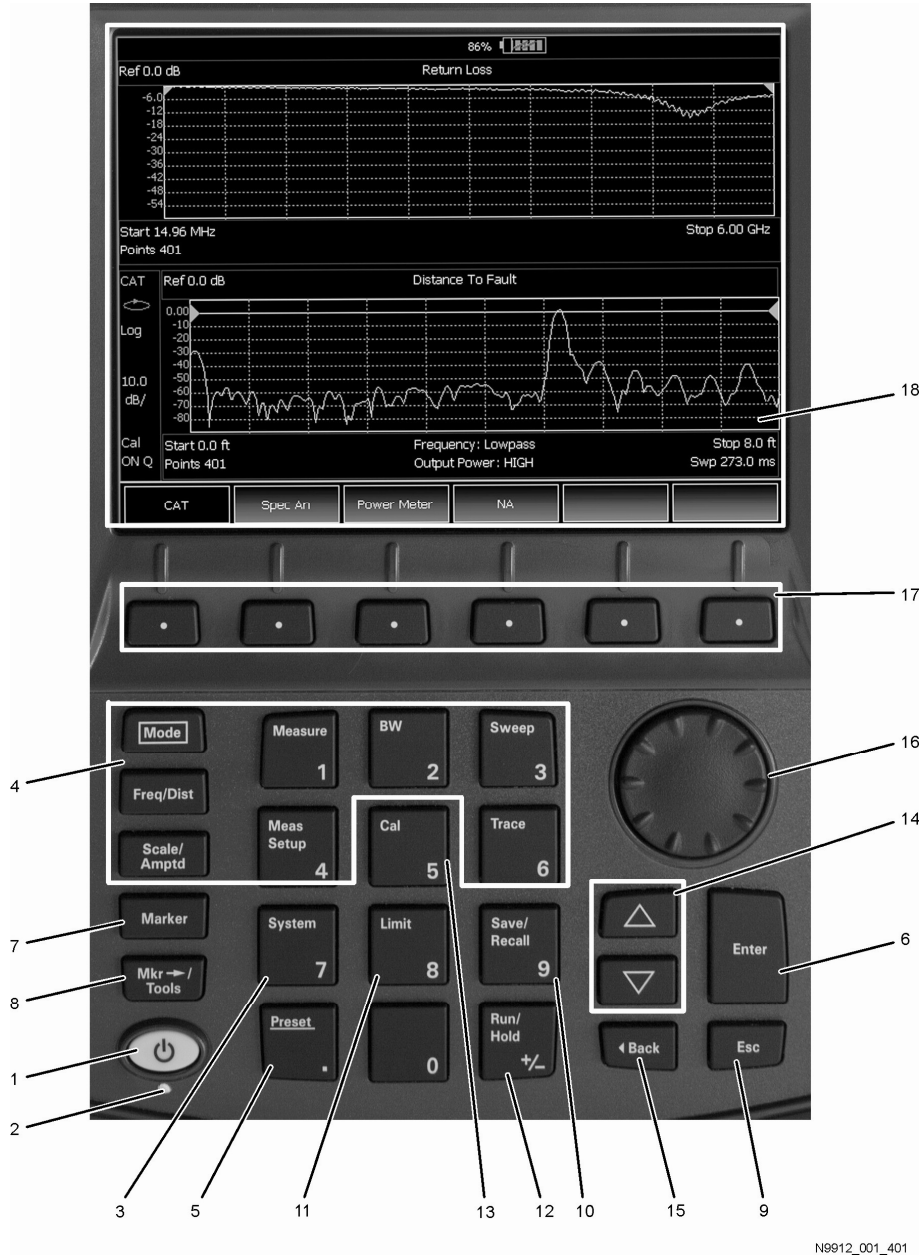**NOTE**   Very often, coaxial cables and antennas build up a static charge, which, if allowed to discharge by connecting to the FieldFox, may damage the instrument input circuitry. To avoid such damage, it is recommended to dissipate any static charges by temporarily attaching a short to the cable or 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).	14
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	14
3	**System**	Displays a submenu for system setup	119
4	Function keys	Includes: **Freq/Dist**, **Scale/Amptd**, **BW**, **Sweep**, **Trace**, **Meas Setup**, **Measure**, and **Mode**	Refer to specific Mode.
5	**Preset**	Returns the analyzer to a known state	119
6	**Enter**	Confirms a parameter selection or configuration	--
7	**Marker**	Activates marker function	101
8	**Mkr→/Tools**	Displays a submenu for marker functions	104
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	111
11	**Limit**	Sets limit lines for quick Pass/Fail judgment	106
12	**Run/Hold**	Toggles between free Run and Hold/Single operation.	119
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.	120 - Display settings 19 - 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 21 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 123
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 55

Side Panel

Caption	Description	Learn More
LAN	Ethernet cable connector to read trace data using the FieldFox Data Link Software.	On page 127
	Reserved for future use.	
Power	DC power connector used to connect to the AC/DC adapter. Maximum: 19 VDC, 4 ADC.	On page 13
Mini SD	Mini Secure Digital slot. Use to extend the memory of the FieldFox.	File locations on page 111
	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 111
	Audio output jack for use with SA Mode Tune and Listen.	On page 71

Screen Tour
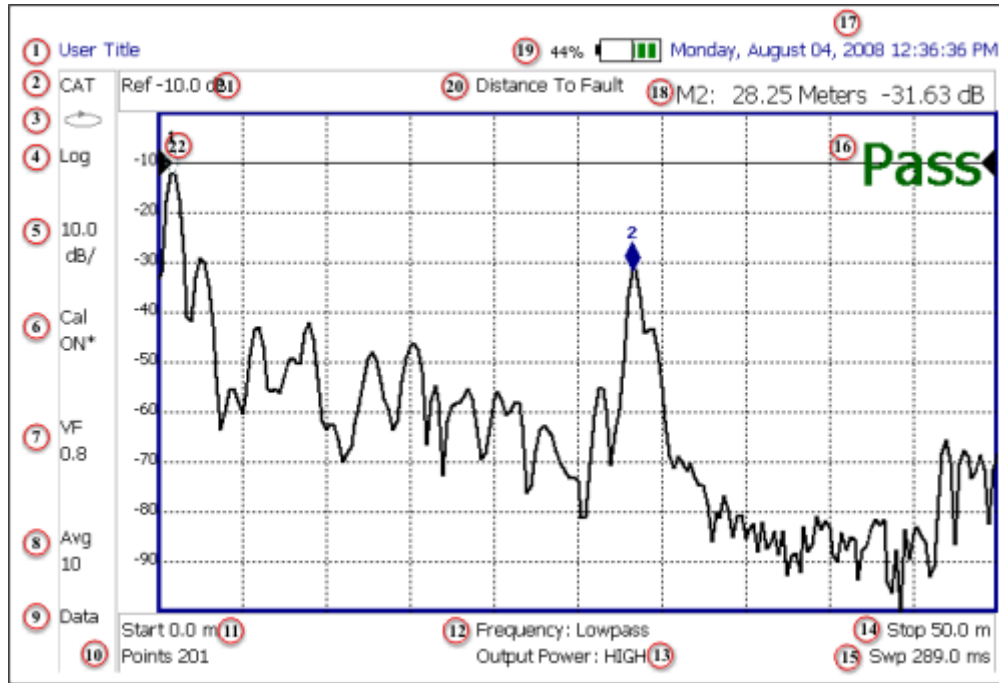
Caption	Description	Learn More on Page:
1	Title – write your own text here	121
2	Current Mode	
3	Run / Hold	119
4	Display Format	140
5	Scale/division	Mode dependent
6	Calibration Status (CAT and NA) Detection Method (SA)	47
7	Velocity Factor (Fault Meas)	34
8	Averaging Status and Count	Mode dependent
9	Data / Mem Display (CAT and NA) Step / FFT (SA)	108- Trace Math 61 - Res BW
10	Resolution Setting	Mode dependent
11	Measurement Start Freq or Distance	Mode dependent
12	Bandpass / Lowpass setting (Fault Meas) IF BW in NA Mode	34
13	Output Power Level (CAT and NA)	26
14	Measurement Stop Freq or Distance	Mode dependent
15	Actual Sweep Time	Mode dependent
16	Limit Line Status	106
17	Time and Date	124

Caption	Description	Learn More on Page:
18	Marker Readout	101
19	Battery Status	147
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
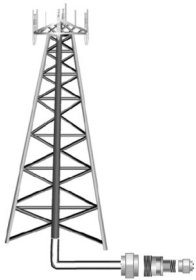
CAT Mode is typically used to test an entire transmission system, from the transmitter to the antenna. This process is sometimes referred to as Line Sweeping.

CAT Mode is similar to NA (Network Analyzer) Mode. Learn more in the Tutorials chapter on page 139.

CAT Mode **Distance to Fault** measurements are discussed on page 31.

In this Chapter

Procedures

See Also

CAT Mode Settings

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

How to select CAT Mode

- Press Mode .
- Then CAT .

<mark>Measurement Selection</mark>

How to select a CAT Mode Measurement

Learn more about the following measurements in the Tutorials Chapter on page 127.

- Press Measure   1 .

- Then choose one of the following: These softkeys also appear after CAT Mode is selected.

   o 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 31.

   o 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 33.

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 on page 36.

   o 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 27.

   o 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 141.

   o DTF (VSWR) Distance to Fault in VSWR format.

   o 1-Port Cable Loss 1-port reflection measurement that displays the loss of a transmission line. Learn more on page 27.

o **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 29.

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 48.

How to set Frequency Range

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

- o **Start** and **Stop** frequencies - beginning and end of the sweep.
- o **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.

  - o After using the keypad, select a multiplier key. Learn about multiplier abbreviations on page 20.
  - o 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:

   - o **Scale** Manually enter a **scale per division** to view specific areas of the trace.
   - o **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.
   - o **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.

   - o **Top** to set the value of the Top graticule.
   - o **Bottom** to set the value of the Bottom graticule.
   - o Enter a negative value by pressing **Run/Hold (+/-)** either before or after typing a value.

	User Title
Scale annotation on the FieldFox screen Reference Line = red arrow **Ref Level** = 40 dB **Ref Position** = 1 **Scale** = 5 dB per division	CAT Ref 40.0 dB **Hold** Log 45.0 5.0 dB/ 50.0 55.0 Cal 60.0 ON 65.0

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.

Single or Continuous Measure

This setting determines whether the FieldFox measures 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.

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

How to set Single or Continuous

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

o **Single**   Automatically sets Continuous OFF and causes FieldFox to make ONE measurement, then hold for the next Single key press. When a data trace is displayed, the entire trace is measured, then holds. The **Hold** annotation changes to an arrow **-->** while the measurement occurs.

o **Continuous**   Makes continuous measurements. This is the typical setting when battery power is not critical.

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

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 48.

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 144.

The actual sweep time is shown on the FieldFox screen. See the Screen Tour on page 19. 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.

NOTE   Measurement speed specifications do NOT apply in Temperature Control Mode. Learn more on page 15.

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 20.

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.

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 29 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 26), and Averaging. (page 25).

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 144.
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 51.

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 51.
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 26. Learn why in the Tutorials chapter on page 144.

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 21.

In this Chapter

Optional settings

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 known 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 **DTF 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.

11. Press **Meas Setup   4** then **Settings** then **Next Page**. If the **Alias-free Range** setting is **False**, then you may see Alias faults on the screen. Learn more on page 37.

DTF Measurement Settings

You can set and view all of the DTF settings, including some calculated values, on the DTF Settings page. Learn more on page 36.

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 Frequency Mode [Bandpass] 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 between the start distance and **5 km** (or 16,404 ft.) 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 DTF units

▪ With a DTF measurement present, press **Freq/Dist**.

▪ Then **DTF Units**.

▪ The current selection is underlined **m (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).

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

How to set Frequency Mode

With a DTF measurement present,

- Press **Meas Setup 4**

- Then **Frequency Mode**

- Choose one of the following:

  - **Lowpass Mode** The frequency range of a DTF measurement is set automatically based on the Start and Stop Distances. Use Lowpass mode when the DUT is a cable ONLY.

  - **Bandpass Mode** (Default setting) The frequency range of a DTF measurement is set manually. Use Bandpass mode when the DUT contains a diplexer or other filtering device which does not pass some frequencies.

Typically, you will set the frequency range of the measurement to the passband of the filter. However, you may also want to test the ability of the filter to **reject** unwanted frequencies. In this case, set the frequency range to include those frequencies which the filter may not be adequately rejecting.

When the DTF frequencies are set manually, they may not be the optimum frequencies for measuring the distance to fault. The distance may no longer be alias-free. Learn more about alias-free range on page 37.

How to manually set Frequencies in Bandpass Mode

- Press **Freq/Dist**

- Then **Min Start Freq** and type the start of the frequency range to use for the DTF measurement.

- Then **Max Stop Freq** and type the stop frequency to use for the DTF measurement.

OR

- Press **More**

- Then **Max Freq Span** and type the frequency range to use for the DTF measurement.

- Then **Center Frequency** and type the center frequency of the range to use for the DTF measurement.

These settings specify the minimum and maximum frequencies to be used for the DTF measurement. These exact frequencies may not be used, but a narrower frequency range may be used that will still pass through the bandpass filter.

To see the frequencies that are used in the DTF measurement, press **Meas Setup 4** then **Settings** then **Next Page**. The calculated Start and Stop frequencies determine the exact frequency range being used.

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 loose 10 dB of power (100 m * .1dB/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 33.

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**.

How to 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 127.

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:

  o **Sort By Cable Name** Sorts all pages of the cable list by Cable Name

  o **Sort By Date** Sorts all pages of the cable list by Date. This is the date that the file was created or modified.

  o **Next Page** View the following page of the list.

  o **Previous Page** View the previous page of the cable list.

  o **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 press **▲|▼** arrows to move to the Window row.

- Then press **Edit**.

- Then press **Window** repeatedly and choose from the following:

  o **Maximum – Optimized for dynamic range,** the noise floor is lowered to provide the ability to measure low-level responses. (Default setting)

  o **Medium** – Compromise between Min and Max window settings.

  o **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 33.

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, select a multiplier key. Learn about multiplier abbreviations on page 20.

DTF Settings Page

You can set and view all of the DTF settings, including some calculated values, on the DTF Settings page.

- Press **Meas Setup 4**.
- Then **Settings**.
- Then press **▲|▼** arrows to move to a setting. If the setting can be changed, the **Edit** key is available.

Calculated DTF values

Press Next Page to view the following **calculated values**:

c - **Start Frequency** – Start frequency that is used to calculate DTF.

c - **Stop Frequency** – Stop frequency that is used to calculate DTF.

c - **Range Resolution**. Indicates the accuracy of the distance to fault measurement. For example, with range resolution of 500 mm, if the distance to fault is 10 meters, this value could be inaccurate by +/- 500 mm or between 9.5 to 10.5 meters. This value is calculated from frequency span / resolution (points).

Response Resolution, not displayed, indicates the distance that could be between two faults and still show as separate faults. Learn more in Window Settings on page 35.

c – **Maximum Distance**. The distance that could be viewed with the current settings. Defined by: Vf*c*Points/(2*Bandwidth) where:

- Vf = velocity factor

- c = speed of light

- Points = resolution

- Bandwidth = frequency range

c – **Alias-free Range** (True/False)

- True = No Alias images

- False = Alias images may appear in the response.

About Alias Faults

An alias fault is not a true device response. An alias fault appears because of the method used to convert frequency to time.

On the DTF Settings page (above) the **c - Alias-free Range = False** setting indicates alias images MAY appear on the screen.

Shorter stop distances (less than 10 meters) and a higher resolution (1001 points) will be **more** likely to result in **Alias-free Range = False**.

When the Alias-free Range = False, the following procedure will help to determine if a response is true:

1. Put a marker on the response in question and note the distance to the fault.

2. Change the start or stop distance.

A true fault response will not move in distance. That is, if a true fault is present at 10.3 meters, changing the stop distance from 15 m to 20 m will not move the fault; the fault will remain at 10.3 meters. However, an alias response will appear to move.

An un-terminated cable (with NO perfect load at the end) will show faults that appear to be beyond the end of the cable. These are NOT alias faults. These faults appear as the signal reflects off the open at the end of the cable and travels back down the cable toward the connection at the FieldFox. Re-reflections are measured at the FieldFox as mirror images of the original faults. The largest fault is the open end of the cable. To avoid confusion, set the Stop distance shortly after that fault.

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NA (Network Analyzer) Mode

CAT Mode is very similar to NA (Network Analyzer) Mode. Learn more in the Tutorials chapter on page 139.

In this Chapter

See Also

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** 1-port reflection measurement.

o **S21** 2-port transmission measurement. Requires Opt 110. Learn how to make this measurement on page 45.

o **A** Measurement of the A receiver.

o **R1** Measurement of the R receiver.

Learn about A and R receiver measurements in the Tutorials chapter on page 139.

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:
  o Use the **▲|▼** arrows to highlight a setting.
  o Then press **Edit**. The current setting changes to **yellow**.
  o 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.
  o When finished changing a value, press **Done Edit**.
  o 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 140.

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 141.
  - **More** then **Polar** (S11 Only) Displays magnitude and phase of the reflection coefficient.

In Smith and Polar formats, markers can be changed to display (Mag & Phase) or (Real + Imaginary). Learn how to create markers on page 101.

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 48.

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, select a multiplier key. Learn about multiplier abbreviations on page 20.
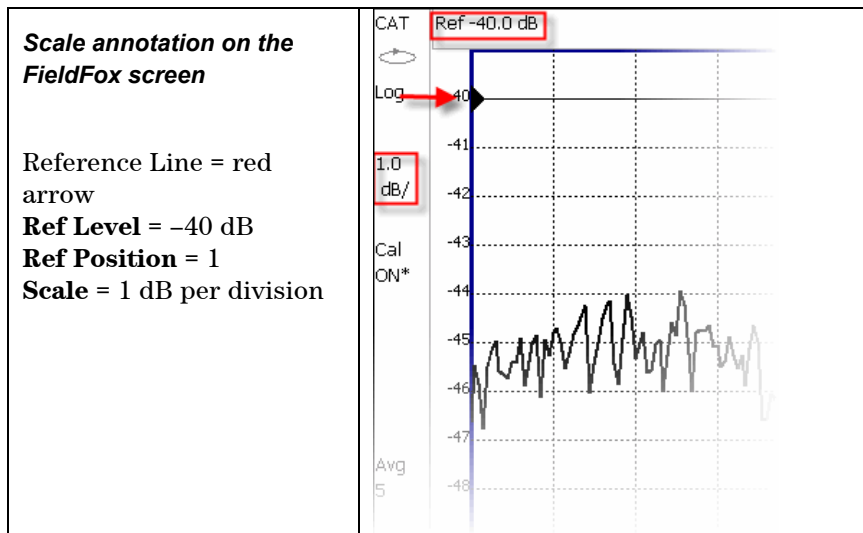
Scale Settings

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

   o **Scale** Manually enter a **scale per division** to view specific areas of the trace.

   o **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.

   o **Ref Position** Manually set the position of the reference line. Values must be between 0 (TOP line) and 10 (BOTTOM line)

Scale annotation on the FieldFox screen Reference Line = red arrow **Ref Level** = –40 dB **Ref Position** = 1 **Scale** = 1 dB per division	

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.

IF Bandwidth

The FieldFox converts the received signal from its source to a lower intermediate frequency (IF). The bandwidth of the IF bandpass filter is adjustable. Reducing the IF receiver bandwidth reduces the effect of random noise on a measurement. However, narrower IF bandwidths cause longer sweep times.

How to set IF BW

▪ Press **BW 2**.

▪ Then **IF BW**

▪ Then choose from the following: **300 Hz | 1 kHz | 3 kHz | 10 kHz | 30 kHz**

Single or Continuous Measure

This setting determines whether the FieldFox measures 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.

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

How to set Single or Continuous

▪ Press **Sweep 3**.

▪ Then choose one of the following:

○ **Single** Automatically sets Continuous OFF and causes FieldFox to make ONE measurement, then hold for the next Single key press. When a data trace is displayed, the entire trace is measured, then holds. The **Hold** annotation changes to an arrow **-->** while the measurement occurs.

○ **Continuous** Makes continuous measurements. This is the typical setting when battery power is not critical.

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

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 48.

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 144.

The actual sweep time is shown on the FieldFox screen. See the Screen Tour on page 19. 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.

NOTE   Measurement speed specifications do NOT apply in Temperature Control Mode. Learn more on page 15.

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 20.

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.

System Impedance (Z0)

To accurately view data presented in Smith Chart format, first set the System Impedance.

Learn how to select Smith Chart format on page 40.

Learn how to make 75Ω measurements on page 142.

How to set System Impedance

- Press `Meas Setup   4`.
- Then `System Z0 [current setting]`.
- Then choose from the following:
  - `50` 50Ω
  - `75` 75Ω

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 51.
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 26. Learn why in the Tutorials chapter on page 144.

Calibration for CAT, NA, and VVM 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 all of these Modes.

In this Chapter

See Also

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 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 (also known as CalReady)

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. It can be used to check the integrity of the jumper cable.

`Cal ON` is shown on the screen when powered ON or Preset.

When measuring a DUT using a jumper cable or adapter - NOT a direct connection to the RF Out connector – then a QuickCal or O,S,L 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, NA, or VVM Mode, press `Cal  5`.
- Then (if necessary) press `Calibration Type` to see `[QuickCal]`.
- Then `Start Cal`.
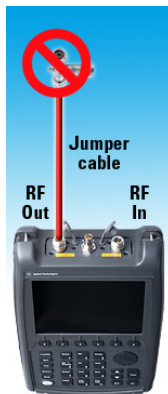
Step 1

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`.
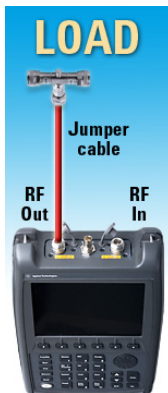
Step 2

Attach and measure Load when:

▪ A jumper cable or adapter is used to connect the DUT to the FieldFox.

▪ Measuring a DUT with good match (return loss > 15 dB).

1. 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.
2. Then press `Measure Load`

▪ Otherwise, and when making DTF measurements, press `Skip Load` This step does little to improve accuracy.

- 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 127.

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 is used to calibrate 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. Therefore, 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.

NOTE   A Normalization cal will NOT 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.

Because CAT, NA, and VVM modes are very similar, a 1-port or 2-port calibration that is performed in one mode can automatically be applied in the other modes. This occurs ONLY when modes have the same frequency data points as those that were calibrated, and have the same Power (Hi or Low) and IF BW. CAT and VVM mode IF BW is 30 kHz and is NOT selectable.

Typically, a 1-port calibration and a 2-port normalization can NOT be maintained at the same time. The most recently performed calibration will usually overwrite the other.

- In CAT mode, the 1-port measurement is Return Loss or DTF, and the 2-port measurement is Insertion Loss.

- In NA mode, the 1-port measurement is S11, and the 2-port measurement is S21.

However, a 1-port calibration CAN coexist with a 2-port normalization ONLY when **BOTH** of the following conditions occur:

1. A 1-port Cal already exists, then a Normalization Cal is performed. They can NOT be performed in the reverse order.

2. The Frequency Range, Resolution, Power (Hi/Low), and IF BW (in NA Mode) settings of the two calibrations are identical.

When **both** conditions occur, you can switch between the 1-port and the 2-port measurements, and both will remain fully calibrated.

In a DTF measurement, the frequency range over which the calibration is made can be viewed using the calculated Start and Stop Frequency on the Settings page. Learn how to see this on page 36.

Save the Calibration

After performing any type of calibration, you can save the FieldFox settings along with the calibration into a STATE (*.sta) file. These settings and calibration can then be recalled as necessary. To learn how, see **Saving and Recalling Files** on page 111.

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,** a new QuickCal or O,S,L 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.

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SA (Spectrum Analyzer) Mode

SA Mode measures signals at the RF IN port. The RF OUT connector is NOT used.

General purpose Spectrum Analyzer measurements and are available with Option 230 or 231. In addition,

SA measurements require NO calibration.
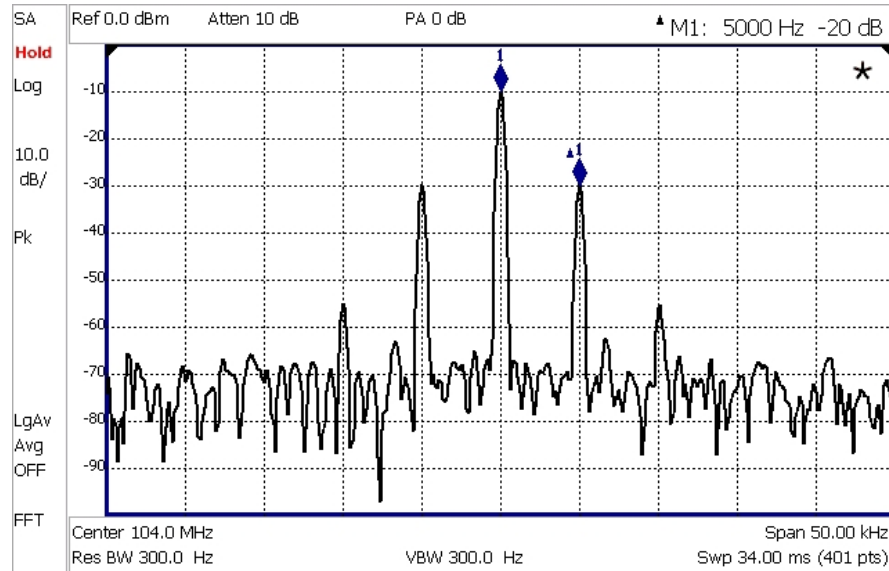
SA display with markers
Carrier with 5 kHz frequency modulation and deviation of 1 kHz

In this Chapter

      ◦ Channel Power

      ◦ Occupied Bandwidth

      ◦ Adjacent Channel Power Ratio

Interference Analyzer (Opt 236)

Optional settings

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

The X-axis frequency range determines the frequencies that are measured for each sweep. 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 signals that may be present.

The frequency range of the measurement can be changed using the following methods:

▪ Set Center and Span frequencies

▪ Set Start and Stop frequencies

▪ Toggle between Zero and Last selected span

▪ Set Full Span of the FieldFox

▪ Using Channel selection. Learn how on page 58.

▪ Using Marker -> Center (frequency). Learn how on page 104.

How to set Frequency Range

▪ Press **Freq/Dist**.

▪ Then choose from the following:

- o **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.
- o **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, select a multiplier key. Learn about multiplier abbreviations on page 20.

Two more ways to change the frequency range

- Press **Freq/Dist**.

- Then choose from the following:

- o **Zero/Last Span** Each key press toggles the frequency span between 0 Hz and the last specified frequency span.

- o **More**

- o 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**

- o **Auto** Each press of the **▲|▼** arrows increments or decrements the value by $1/10^{th}$ (one division) of the current frequency span. **Note:** To change this setting from **Man** to **Auto**, press **CF Step** twice.

- o **Man** Type a step size value using the numeric keypad, then select a multiplier key. Learn about multiplier abbreviations on page 20.

Radio Standard

A Radio Standard is a collection of settings that are applied to the FieldFox for specific cell phone protocols. When a Radio Standard is applied, the FieldFox frequency range, Res BW, and other relevant settings change to that of the standard.

By default, the FieldFox locates the center frequency of the standard in the middle of the screen and sets the frequency span to cover all of the Uplink and Downlink frequencies. The selected Radio Standard name appears in the center of the screen below the X-axis.

After a Radio Standard has been selected, the frequency range can be changed by selecting channel numbers rather than frequency.

The application of a Radio Standards will not always change the center frequency of a Channel Measurement. Learn more on page 73.

How to select a Radio Standard

- Press `Measure   1` OR `Freq/Dist` then `More`

- Then `Radio Standard`

- Then select a standard using the `▲|▼` arrows or rotary knob and press `Enter`.

Channel Selection

After a Radio Standard has been selected, the frequency range can be changed by selecting channel numbers rather than frequency. Once enabled, the channel number is appended to the X-axis frequency range.

How to enable Channel selection

- Press `Freq/Dist`

- Then `More`

- Then `Unit   Freq Chan`

How to change the Channel Number of the measurement

With Unit = `Chan` the FieldFox will NOT allow you to specify channels outside of the selected Radio Standard.

- Press `Freq/Dist`

- Then choose from the following:

  o `Center Channel` Places the center frequency of the specified channel in the middle of the X-axis.

  o `Start Channel` Places the lowest frequency of the specified channel at the beginning of the X-axis.

  o `Stop Channel` Places the highest frequency of the specified channel at the end of the X-axis.

  o `Freq Span` Changes the span of frequencies while the center frequency remains unchanged.

  o Follow each of the above settings by entering a value using the numeric keypad or the rotary knob.

  o Use the `▲|▼` arrows to increment the channel number by an amount specified by the Channel Step value (see below).

  o Then press `Enter`.

Select either Uplink or Downlink Frequencies

Press **Chan Direction** to toggle between **Uplink** and **Downlink**. If either of these selections is not available, then the selected Radio Standard does not contain those frequencies.

Channel number X-axis annotation
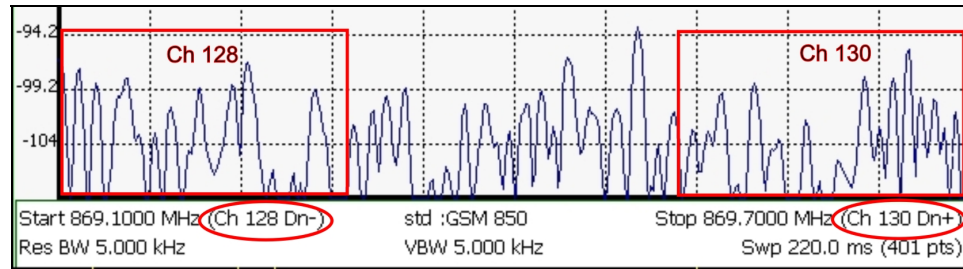
- **Dn** indicates **Downlink** frequencies.
- **Up** (not shown) indicates **Uplink** frequencies
- **(−)** indicates that the lowest frequency in the channel (128) is at the left edge of the screen.
- **(+)** indicates that the highest frequency in the channel (130) is at the right edge of the screen.
- When Center Channel or Freq Span is specified, the X-axis shows the Center Freq (Channel) and Frequency Span.
- When Start or Stop Channel is specified, the X-axis shows the Start Freq (Channel) and Stop Freq (Channel).

Change Channel Step Size (Optional)

This setting allows you to use the ▲|▼ arrows to increment the channel number by the specified value.

- Press **Channel Step**
- Enter a step value using the numeric keypad, the ▲|▼ arrows, or the rotary knob. Then press **Enter**.

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:

- **Scale Type [current setting]**
  - **Log** Logarithmic scale. Units are dB or dBm.

- o **Lin** Linear scale. Units are Volts.

- ▪ **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.

  - o **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. Then press **Enter**.

  - o **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.**

  - o **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**.
- Then **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.

- Man 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.

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 153.

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 in a 1-to-1 ratio.

  - Man 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 Res BW/Video BW ratio exceeds 10,000, a Meas UNCAL warning may appear to indicate that the Video BW filter has reached the maximum capacity for averaging.

In Zero Span, the maximum Res BW/ Video BW ratio is 100.

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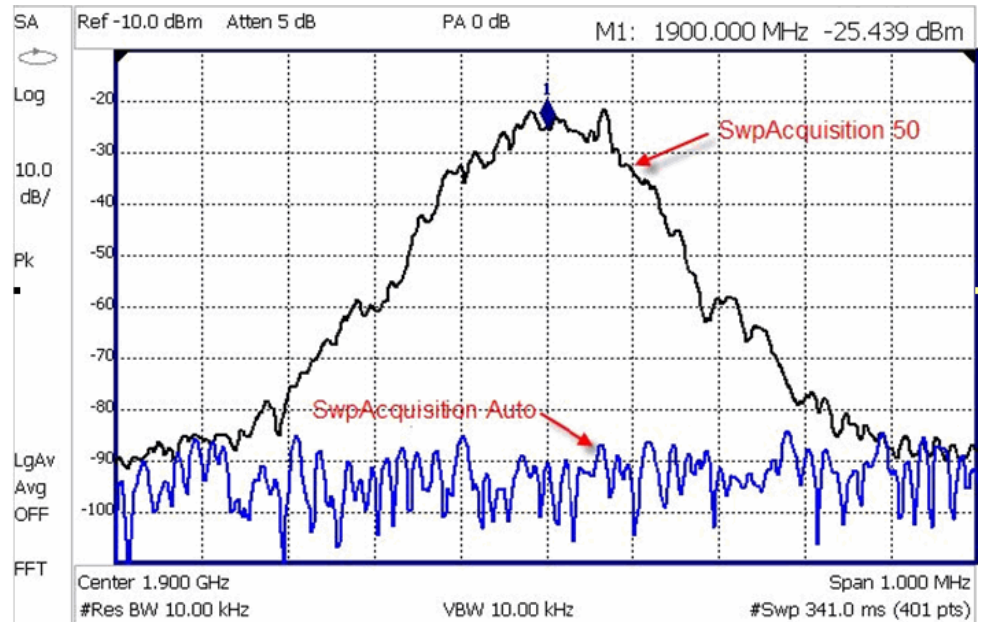
A GSM signal in a framed data format; timeslot zero ON; all others OFF;
PRF = 218Hz, Duty Cycle = 12.5%. The pulsed signal becomes visible on every sweep update with SwpAcquisition = 50.

How to set Sweep Acquisition Parameter

- Press `Sweep  3`.
- Then `SwpAcquistion Auto Man`.
- Then choose from the following:
    - `Auto` Sweep is set to the fastest sweep possible with the current settings.
    - `Man` 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.

NOTE   Measurement speed specifications do NOT apply in Temperature Control Mode. Learn more on page 15.

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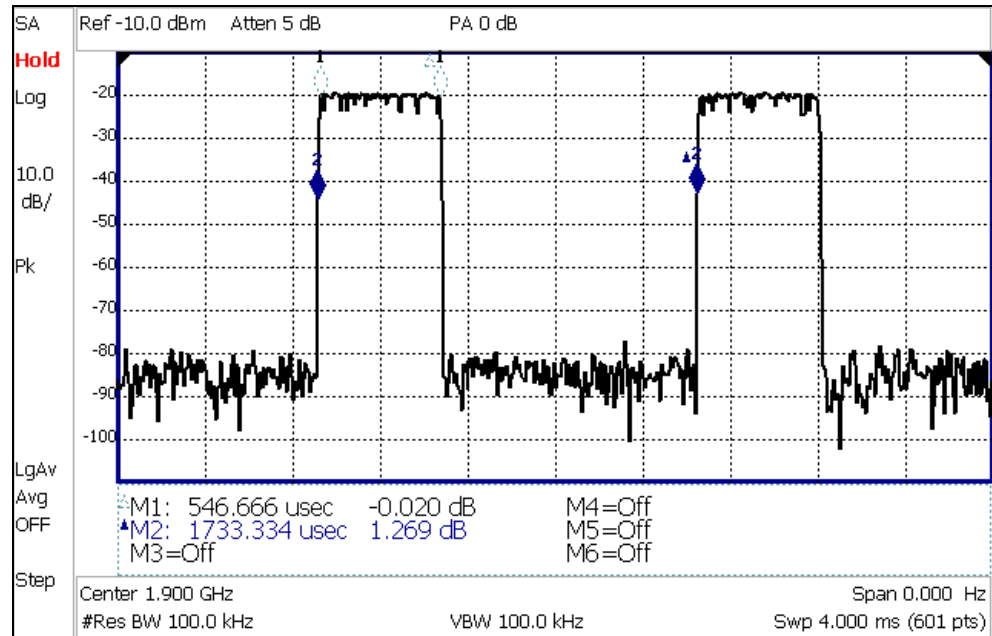
GSM signal, framed data format, timeslot 0 and 3 on. Sweep Time is set to approximately the frame interval. Press Single several times until the waveform section of interest is viewable and stable. Then markers can be used to measure the timeslot width and interval as shown.

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.

How to change Sweep Time in Zero Span.

- Press `Sweep  3`
- Then `SweepTime`
- Enter a value using the numeric keypad.
- Then select a multiplier key. Learn about multiplier abbreviations on page 20.

When the sweep time is longer than can be acquired with the current available memory, `Meas UNCAL` is displayed on the screen. Learn more on page 71.

Four times the amount of memory is available with the FieldFox A.04.00 release, allowing longer sweep times in Zero Span.

Triggering

External and Video triggering allows you to start a FieldFox sweep which is initiated by an external event such as a signal burst.

External and Video triggering can be used in either Zero Span (time domain) or frequency span measurements. However, Video triggering in frequency domain sweeps is limited to cases where Res BW is less than or equal to 200 kHz.

FFT Gating is available for non-zero span measurements. Learn more about FFT Gating at http://na.tm.agilent.com/fieldfox/ .

Trigger Type

- Press **Sweep 3**
- Then **Trigger Settings**
- Then **Trig Type**
- Then choose from the following:
  - **Free Run** Triggering is provided by the FieldFox internal circuitry. A new sweep begins when the previous sweep ends.
  - **External** A sweep is triggered on an external TTL signal at the External Trigger connector. External trigger is available only after first setting **BNC Connector Use** to **Trigger**. Learn how on page 123.
  - **Video** A sweep is triggered on a signal at the RF IN connector when the amplitude of the incoming signal exceeds the settable Trigger Level. This setting is called Video trigger because the signal that initiates the trigger appears on the display.

Trigger Slope

Trigger Slope determines which edge of an External or Video trigger signal initiates a sweep.

- Press **Sweep 3**
- Then **Trigger Settings**
- Then **Trig Slope**
- Then choose from the following:
  - **Pos** Sweep is triggered by the rising (positive) edge of signal.
  - **Neg** Sweep is triggered by the falling (negative) edge of signal.

Trigger Delay

After a valid External or Video trigger signal is received, the sweep begins after the specified Trigger Delay time. Only positive values are allowed.

To see the rising edge of a repetitive signal which is triggered on that edge, use trigger delay to clearly view the **subsequent** signal one period later.

- Press **Sweep 3**
- Then **Trigger Settings**
- Then **Trig Delay**

- Enter a value using the numeric keypad, the ▲|▼ arrows, or the rotary knob.
- Then select a multiplier key or press **Enter**. Learn about multiplier abbreviations on page 20.

Trigger Level

Used with Video triggering, an incoming signal with this amplitude or higher (for positive slope) will initiate a sweep. The Units depend on the Scale Type setting: (Log or Linear). Learn more on page 59.

The Video Trigger Level is a Time Domain (Zero Span) signal level comparison. Therefore, the sweep will trigger close to the displayed level in Zero Span measurements. In frequency span measurements, the sweep will appear to trigger at levels that are lower than the trigger level setting. Therefore, in frequency span measurements, you may need to set the trigger level higher than the displayed level.

- Press **Sweep 3**
- Then **Trigger Settings**
- Then **Trig Level**
- Enter a value using the numeric keypad, the ▲|▼ arrows, or the rotary knob.
- Then select a multiplier key or press **Enter**. Learn about multiplier abbreviations on page 20.

Auto Trigger Time

If an External or Video trigger signal is not received before the specified Auto Trig Time, a sweep will occur automatically.

Enter **0** to set Auto Trigger **OFF**. When Auto Trigger is OFF, the FieldFox does NOT sweep unless a valid External or Video trigger signal is received.

- Press **Sweep 3**
- Then **Trigger Settings**
- Then **AutoTrig Time [current setting]**
- Enter a Auto Trig Time using the numeric keypad.
- Then select a multiplier key. Learn about multiplier abbreviations on page 20.

Single or Continuous Measure

NOTE   The following behavior is unique to SA Mode.

This setting determines whether the FieldFox measures continuously or only once each time the **Single** or **Run / Hold +/-** button is pressed. Use **Hold / Single** or to conserve battery power or to allow you to save or analyze a specific trace.

How to set Single or Continuous

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

- o **Continuous ON** Causes the SA to make continuous sweeps. This is the typical setting for making measurements. Each **Run / Hold +/-** press causes the SA to toggle between continuous sweep and Hold.

- o **Single** Automatically sets Continuous OFF and causes the SA to make ONE sweep, then Hold.

- o **Continuous OFF** Causes the SA to Hold. Each **Run / Hold +/-** or **Single** press causes the SA to make ONE sweep, then Hold. The **Hold** annotation changes to an arrow **-->** while the sweep occurs.

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.

A color-coded legend for displayed traces is visible in the left pane of the SA mode screen:

W = Clear/Write; **M** = MaxHold; **m** = MinHold; **A** = Average; **V** = View

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:
  - o Trace **1** – Yellow   Trace **2** – Blue
  - o Trace **3** – Orange   Trace **4** – Red
- ▪ Then **State [current setting]** .
- ▪ Then choose from the following trace types:
  - o **Clr /Wr** (Clear/Write) Displays the actual measured data for each sweep.
  - o **MaxHold** Displays the maximum response of the input signal over multiple sweeps.
  - o **MinHold** Displays the minimum response of the input signal over multiple sweeps.
  - o **Average** Each data point is averaged over multiple sweeps as set by the Average Count setting. Learn more in following **Trace Averaging** section.

- o **View** Displays and then holds the last complete measurement trace on the screen.

- o **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 four different processes in which Averaging is performed:

- Trace Averaging

- Detection Method Averaging

- Noise Marker Averaging

- Video BW filtering (for non-Zero Span measurements)

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:

  - o **Auto** - The FieldFox chooses the most appropriate type of averaging for the current settings. When Detection Method is set to Average, a Noise Marker is present, or a Channel measurement is active, then **Power Average** is ALWAYS selected. Otherwise, **Log Average** is selected.

  - o **Log** Averaging – Best for displaying Trace Averaging. **LgAv** is shown on the left side of the FieldFox screen when selected.

  - o **Power** (Linear) Averaging – Best for measuring true power levels. Used in Detection Average and Noise Marker Average. Mathematically, trace noise 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 **Meas Setup   4**

- Then **State [current setting]**

- Then **Average**

- Then **Average Count**

- Enter a value from 1 to 10,000 using the numeric keypad, the ▲|▼ arrows, or the rotary knob.

- Press **Enter**

- When Trace State is set to Average, press **Sweep 3**, then **Restart**, to restart the averaging at 1.

- When Continuous sweep is OFF, a **Restart** will perform N sweeps, then Hold.

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 67.

Regardless of how many data points are across the X-axis, each data point must represent what has occurred over some frequency range and time interval.

From the frequency span of the measurement, the span of each data point is calculated as (frequency span / (data points-1)). The detection method allows you to choose how the measurements in each bucket are displayed.
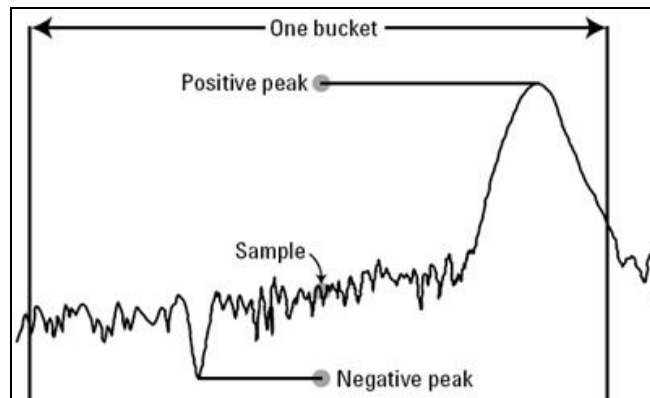
One bucket showing Positive peak, Sample, and Negative peak Detection methods.

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]**

o **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. If the signal is NOT classified as noise (does NOT rise and fall) then Normal is equivalent to Positive Peak.

o **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.

o **Negative Peak** **[NPk]** Displays the minimum value of all the measurements in each bucket.

o **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.

o **Average** **[#RMS]** Displays the Root Mean Squared (RMS) average power of all the measurements in each bucket. This is the preferred method when making power measurements. Learn more on page 106.

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 69.

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 101.

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. Lower the Res BW or 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 Res BW 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 screen annotation. See the asterisk on page 55.

Tune & Listen (AM/FM)

The Tune & Listen feature can be used to identify an interfering AM or FM signal.

The demodulated AM or FM signal can be heard through the internal speaker or through headphones using the 3.5 mm jack located on the FieldFox side panel.

The Tune & Listen tuner is separate from the SA display. This allows you to listen to one frequency while displaying a different range of frequencies. The Tune & Listen measurement alternates between normal SA sweeps for the display and performing audio demodulation at the Tune Frequency. See the Listen Time setting for more information.
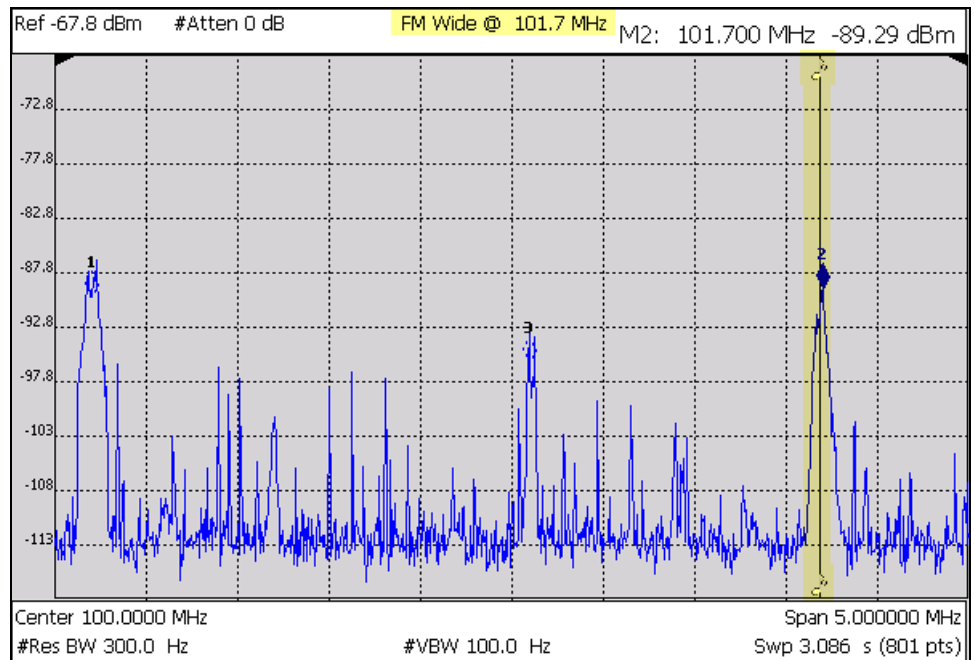
Tune & Listen ON with Tune Frequency indicated by a vertical bar (highlighted).

How to select Tune & Listen

- Press `Measure   1`

- Then `Tune & Listen`

- Then choose a demodulation type. Select a setting based on the type of interfering signal you suspect is being broadcast.

  - `None` Turns Tune & Listen OFF

  - `AM` Amplitude Modulation

  - `FM Narrow` Frequency Modulation; Narrow bandwidth. Choose when interfering transmission consist of voice or data.

  - `FM Wide` Frequency Modulation; Wide bandwidth. Choose for high quality music transmissions of FM broadcast radio.

Tune Frequency

The Tune & Listen tuner is separate from the SA display. This allows you to listen to one frequency while displaying a different range of frequencies.

Set the Tune Frequency using one of three methods:

1. Selecting Preset, Mode Preset, or Meas Preset sets Tune Frequency to 3.0 GHz.

2. Specify Tune Frequency:

- Press `Meas Setup  4`

- Then `Tune Freq`

- Enter a value using the numeric keypad, `▲|▼` arrows, or the rotary knob. Then select a multiplier key. Learn about multiplier abbreviations on page 20.

3. Using **Mkr->Tune Freq**

- Create a normal marker at the frequency of interest. Learn how on page 101.

- Press `Mkr->/Tools`

- Then `Mkr->Tune Freq` to change the Tune Frequency to that of the marker.

Tip   To improve sound quality, try increasing power by reducing the Attenuation setting and, if available, turn ON the Preamplifier. Learn how on page 60.

Listen Time

While Tune & Listen is actively demodulating a signal, the SA does not sweep and update the display. Listen Time sets the amount of time that the FieldFox demodulates, then stops to perform a single sweep and update the display, then again demodulates.

To select Listen Time:

- Press `Meas Setup  4`

- Then `Listen Time`

- Enter a value using the numeric keypad, `▲|▼` arrows, or the rotary knob. Then select a multiplier key. Learn about multiplier abbreviations on page 20.

Volume Control

To increase or decrease the Volume of the demodulated signal:

- Press **Meas Setup 4**

- Then **Volume**

- Enter a value in percent between 0 and 100 (loudest) using the numeric keypad, ▲|▼ arrows, or the rotary knob.

Demod ON and OFF

To quickly stop the audio demodulation and perform only the normal SA sweeps, select the following:

- Press **Meas Setup 4**

- Then **Demod ON OFF**

Channel Measurements

The following Channel Measurements are offered in SA Mode:

The following four sections (Radio Standards and Channel Measurements, Measurement Preset, Averaging, and Traces) are relevant for ALL Channel Measurements.

Radio Standards and Channel Measurements

To tune the frequency range of any of the Channel Measurements using channels instead of frequency, first select a Radio Standard, then select Units = CHAN. Learn how to select a Radio Standard and channels on page 57.

When you **first select a Radio Standard**, then select **a Channel Measurement**:

- With Units = FREQ selected, the center frequency and span will ALWAYS change to the full frequency range of that standard (Uplink and Downlink) to allow for a quick scan of energy. The X-axis annotation indicates the frequency range.

- With Units = CHAN selected, the FieldFox chooses either the uplink or downlink band, and displays that range of frequencies. You can then tune within that Standard using Start CHAN, Stop CHAN, or Center CHAN. The X-axis annotation indicates the frequency range.

When you **first select a Channel Measurement**, then select **a Radio Standard**, the BW, Offset, RRC, Integration BW, and Span settings are changed to those of the standard. However, center frequency is NOT changed unless you first select Units = CHAN.

Measurement Preset

Measurement Preset allows you to easily reset any of the channel measurements to its default settings. The Center Frequency, Preamp ON|OFF, RF Attenuation, Markers, Limits, and Radio Standard settings are NOT reset.

To select Measurement Preset:

- Press **Preset** then **Meas Preset**

Averaging

By default in ALL Channel measurements, averaging is enabled and set to display the average of the last 15 measurements . When enabled, this average setting is automatically making the following 'averaging' settings in order to provide the most accurate power measurements:

- Averaging Type is set to Power.

- Trace State is set to Average.

- Detector is set to Average.

- Count is set to 15.

Any of these settings can be changed manually during a Channel measurement. Learn more about these settings starting at page 68.

To change Averaging:

- Press **Meas Setup   4**.

- Then **Average Enable ON OFF** OFF effectively sets the Average Count to 1.

- Then **Average Count**

- Enter a value between 1 and 10,000 using the numeric keypad, **▲|▼** arrows, or the rotary knob.

- Press **Enter**.

Traces

Only one measurement trace can be displayed in Channel Measurements.

Channel Power (CHP)

Channel Power measures total power over the specified Integrated BW. The Integration Bandwidth (IBW) can be adjusted to measure the power over multiple channels.
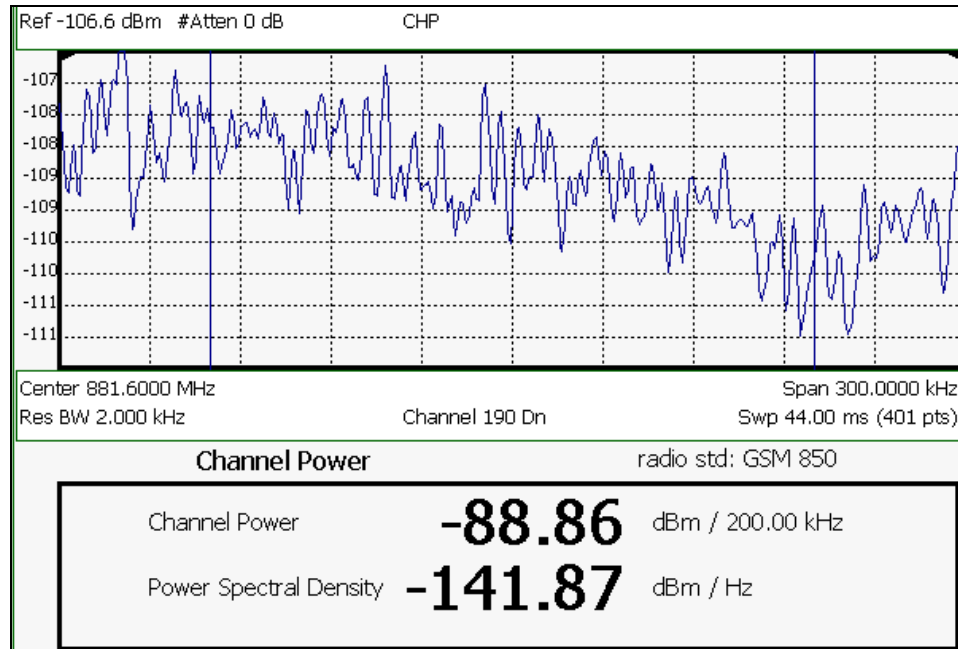
Channel Power measurement; Chan 190 Downlink; GSM850 Radio Standard

The following two Channel Power levels are displayed:

- **Channel Power** - measures total power over the specified Integrated BW.

- **Power Spectral Density** – same measured power, but mathematically normalized to a 1 Hz bandwidth using the same algorithm as Noise Marker. Learn more about the Noise Marker on page 70.

How to select Channel Power

- Press **Measure__1**
- Then **Channel Measurements**
- Then **Channel Power**

When Channel Power is selected, the following settings are maintained from a previous measurement: Center Frequency, Preamp ON|OFF, and RF Attenuation.

Integration Bandwidth

When Channel Power is selected, vertical posts appear on the display to mark the current Integration Bandwidth setting. The displayed Channel Power and Power Spectral Density values are measured and calculated over the specified Integration Bandwidth.

By default, the displayed frequency span is automatically coupled to the Integration Bandwidth. As you change the Integration Bandwidth, the frequency span is adjusted so that the vertical posts appear to NOT move. However, when you manually change the frequency span, the Integration Bandwidth is no longer coupled to the frequency span.

When a Radio Standard is selected, the appropriate Integration Bandwidth is set automatically. Learn more about Radio Standards on page 57.

To change Integration Bandwidth:

- Press **Meas Setup   4**

- Then **Integrating BW**

- Enter a value between 100 Hz and 100 MHz using the numeric keypad, **▲|▼** arrows, or the rotary knob.

- Press **Enter**

Other Channel Power Settings

All relevant FieldFox settings are made automatically to ensure the highest accuracy, such as ResBW, VideoBW, and sweep (SwpAcquisition) speed. These, and all other SA Mode settings, can be changed manually in a Channel Power measurement.

- Learn about Measurement Preset on page 74.

- Learn about Averaging on page 74.

- Learn about RRC Weighting on page 80.

Occupied Bandwidth

Occupied Bandwidth measures the power of the displayed frequency span and displays vertical posts at the frequencies between which the specified percentage of the power is contained. The frequency span between the two vertical posts is the Occupied Bandwidth. The Occupied Power, the power that is contained between the two posts, is also displayed in dBm.
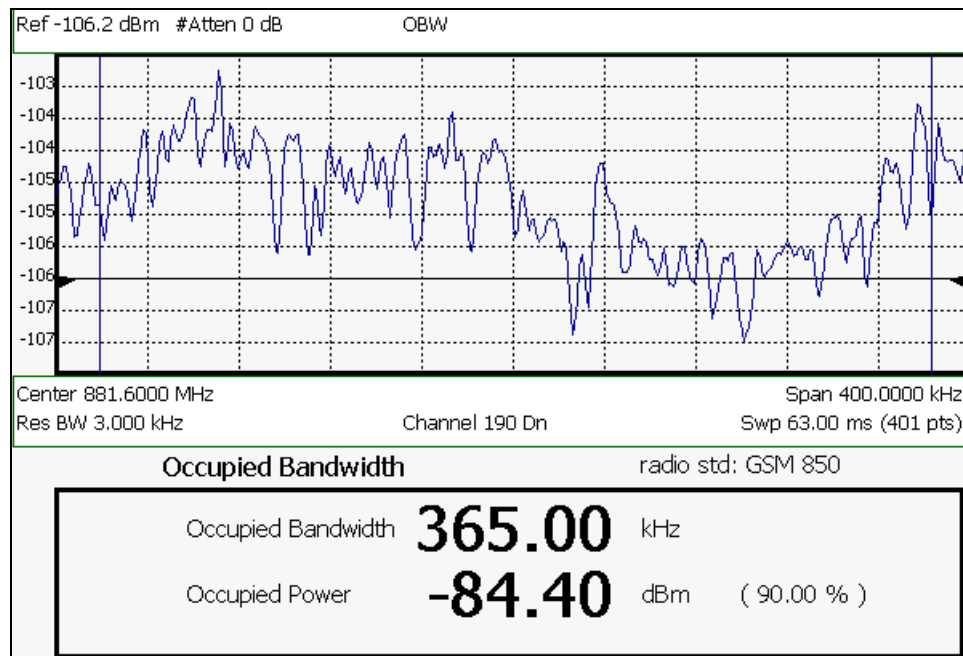
OBW measurement; Chan 190 Downlink; GSM850 Radio Standard

How to select Occupied Bandwidth

- Press **Measure   1**

- Then **Channel Measurements**

▪ Then **Occupied BW**

When Occupied Bandwidth is selected, the following settings are maintained from a previous measurement: Center Frequency, Preamp ON|OFF, and RF Attenuation.

Frequency Span

Occupied BW is calculated from power that is measured over the entire displayed Frequency Span. The frequency span can be entered using arbitrary frequencies or by using a Radio Standard in conjunction with channel numbers. Learn how to select a Radio Standard and channels on page 57.

To change Frequency Span:

▪ Press **Freq/Dist**

▪ Then **Freq Span**

▪ Enter a value using the numeric keypad, **▲|▼** arrows, or the rotary knob.

▪ Press **Enter**

Power Percent

This setting specifies the percentage of total measured power to display between the vertical posts. The measurement defaults to 99% of the occupied bandwidth power. The remaining power (1% of default setting) is evenly distributed; .5% of the power on the outside of each side of the vertical posts.

To change Power Percent:

▪ Press **Meas Setup   4**

▪ Then **Power Percent**

▪ Enter a value between 10 and 99.99 using the numeric keypad, **▲|▼** arrows, or the rotary knob.

▪ Press **Enter**.

Other Occupied Bandwidth Settings

All relevant FieldFox settings are made automatically to ensure the highest accuracy, such as ResBW, VideoBW, and sweep (SwpAcquisition) speed. These, and all other SA Mode settings, can be changed manually in a Occupied Bandwidth measurement.

▪ Learn about Measurement Preset on page 74.

▪ Learn about Averaging on page 74.

Adjacent Channel Power Ratio(ACPR)

ACPR measures the power of a carrier channel and the power in its adjacent (offset) channels. The measurement results can help you determine whether the carrier power is set correctly and whether the transmitter filter is working properly.

You can measure the channel power in one, two, or three adjacent (offset) channels on the low frequency and high frequency side of the center channel.

Limits can be used to quickly see if too much power is measured in the adjacent channels.
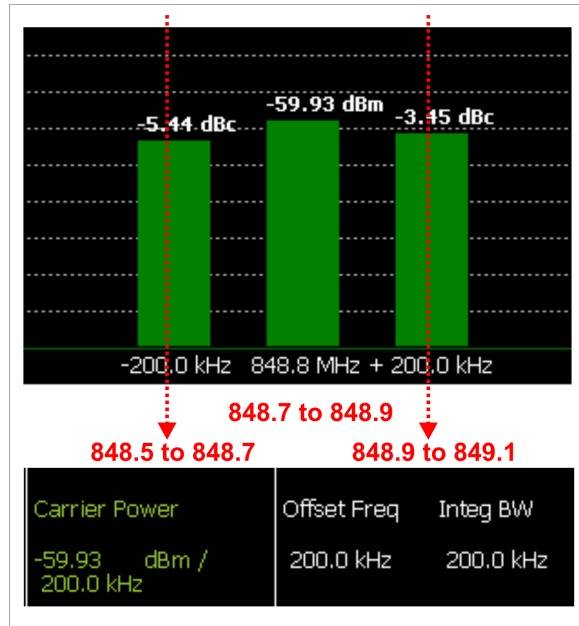
GSM 850-Ch 251-Up with one Offset.

Red Freqs (Mhz) added to illustrate Offset and Integ BW.

Data in the ACPR graphical chart is always presented in dBm for the carrier, and dBc (dB below the carrier) for the offsets. This can NOT be changed. Use the **Meas Type** setting (next page) to change how the data is presented in the table below the graph.

How to select ACPR

- Press Measure__1
- Then Channel Measurements
- Then Adjacent Channel Power

When ACPR is selected, the following settings are maintained from a previous measurement: Center Frequency, Preamp ON|OFF, and RF Attenuation.

Frequency Range/Channel

When a Radio Standard is selected, the appropriate center frequency or channel and span is set automatically. The frequency or channel number can then be changed from the Freq/Dist menu. Learn how to select a Radio Standard and channels on page 57.

The frequency range of an ACPR measurement can also be entered using arbitrary frequencies.

When a Radio Std is NOT selected, the center frequency of a previous measurement is maintained when ACPR is selected.

Integration Bandwidth

The Integration Bandwidth of the carrier and offsets is the frequency span over which power is measured.

To change Integration Bandwidth:

- Press **Meas Setup   4**
- Then **Integrating BW**
- Enter a value between 100 Hz and 100 MHz using the numeric keypad, **▲|▼** arrows, or the rotary knob.
- Press **Enter**

How to define adjacent (Offset) channels

An offset represents a range of frequencies over which power is measured. You can specify up to three offsets. The frequency range for each offset is specified with an Offset Freq and Integ BW. Each offset that is created has a Lower (carrier MINUS Offset Freq) and Upper (carrier PLUS Offset Freq) set of frequencies.

- Press **Meas Setup   4**
- Then **Offsets**
- Press **Offset 1 2 3** to select an offset.
- Then **Offset State** to set that offset ON or OFF.
- Select **Offset Freq** This is the difference between the **carrier center frequency** and the **center frequency of the offset channel**. Then enter a value using the numeric keypad.
- Select **Offset Integ BW** This is the frequency range over which power is measured in that offset; half of the range below and half above the Offset Freq.

How to set limits for adjacent channels

You can set a unique threshold power for each of the offsets that will cause a FAIL indication (RED bar). This occurs when the calculated **dBc** power (on top of the offset bar) is ABOVE the specified level.

To set limits, with an ACPR measurement on the screen:

- Press **Limit   8**
- Then **Set Limits (1,2, or 3)**
- Then choose from the following:
- **Lower Offset** Sets a limit for the lower-frequency offset.
- **Upper Offset** Sets a limit for the higher-frequency offset.
- Then enter a value using the numeric keypad, **▲|▼** arrows, or the rotary knob.
- Then **Limit Test ON OFF**

Measurement Type

This setting determines how the measured carrier and offset power levels in the **table** are presented. (Data in the graphical chart is always presented in dBm for the carrier and dBc for the offsets.)

To select Meas Type:

- Press **Meas Setup   4**.

- Then **More**

- Then **Meas Type**

- Then choose from the following:

  - **Total Pwr Ref** – Integrated carrier power is represented in dBm, and relative powers between offsets and carrier are represented as dBc (dB below the carrier).

  - **PSD Ref** (**Power Spectral Density**) – Integrated carrier power is normalized to a 1 Hz density as dBm/Hz using a similar algorithm as Noise Marker. Learn more about the Noise Marker on page 70.

For both Meas Types, choose the reference for the offset data.

- **Auto** – dB or dBc value is computed by subtracting the measured carrier power from the measured offset power.

- **Man** – dB or dBc value is computed by subtracting the entered RefValue from the measured offset power.

  - Press **Ref Value**

  - Then enter a value to be used to reference the data using the numeric keypad, **▲|▼** arrows, or the rotary knob.

Other ACPR Settings

All relevant FieldFox settings are made automatically to ensure the highest accuracy, such as ResBW, VideoBW, and sweep (SwpAcquisition) speed. These, and all other SA Mode settings, can be changed manually in a ACPR measurement.

- Learn about Measurement Preset on page 74.

- Learn about Averaging on page 74.

RRC Weighting

RRC, or Root-Raised-Cosign weighting, is offered with Channel Power and ACPR measurements.

When RRC Weighting is applied to transmitted and received power, the edges of the channel are 'smoothed' to help prevent interference. To accurately measure a channel that has RRC weighting, set the same value of RRC weighting as that used in the transmitter and receiver.
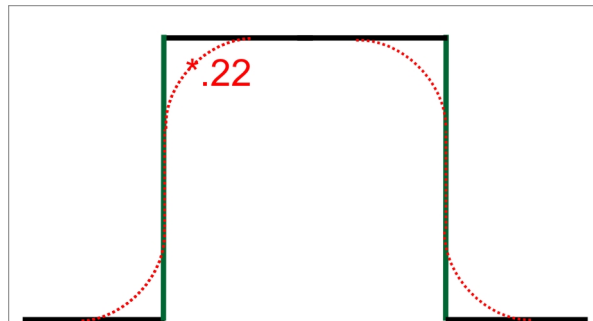
Channel power measurement with .22 RRC applied

This value is set and enabled automatically when included in a selected radio standard.

To set and enable RRC Weighting:

- Press **Meas Setup 4**

- Then **RRC Weighting ON OFF**

- Then **More**

- Then **RRC Alpha [current setting]**

- Enter a value between 0 (no smoothing) and 1 (most smoothing) using the numeric keypad, **▲|▼** arrows, or the rotary knob. A standard level of filtering is .22.

- Press **Enter**

Interference Analyzer (Option 236)

Option 236 provides Spectrogram display, Waterfall display and Record/Playback. Learn more about Record/Playback on page 86.

Spectrogram and Waterfall displays provide a visual history of the measured spectrum. Each display type can be used to locate intermittent signals or to view signal levels over time.

Spectrogram is a single horizontal line of color-coded power while Waterfall uses a 3-D color-coded display.   The functional difference between these two displays is that Spectrogram provides less trace detail than Waterfall display. However, it also allows more traces to be viewed.

These two displays can NOT be used with Channel Measurements.

NOTE: Although this document refers to past traces as 'records' these traces are not saved in Spectrogram and Waterfall displays. They are only drawn on the FieldFox screen.

Spectrogram Display

Spectrogram draws the most recent trace record at the top of the stack of previously-drawn trace records. Drawing the live trace on the display is optional.
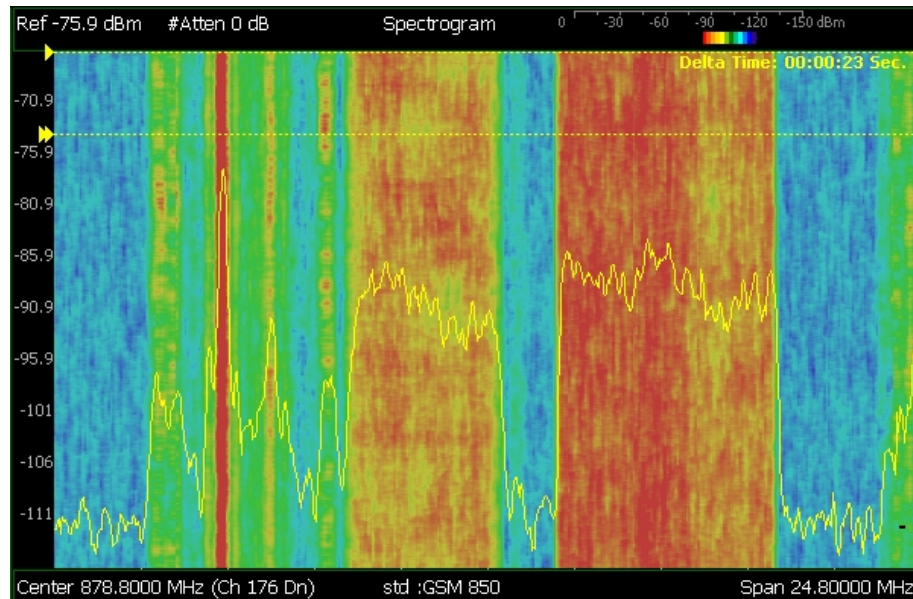
Spectrogram display- Overlay view- with time markers 23 seconds apart.

The following settings all contribute to the sweep time of an individual trace, and therefore, the total elapsed time that can appear on the screen in Spectrogram display:

▪ Frequency Range. Learn more on page 56.

▪ Resolution BW and Video BW. Learn more on page 61

▪ Sweep Time (Acquisition). Learn more on page 62.

▪ Resolution (Number of Points). Learn more on page 67.

How to select Spectrogram

▪ Press **Meas 1**

▪ Then **Interference Analysis**

▪ Then **Spectrogram**

How to modify the Spectrogram

You can change how the spectrogram is displayed relative to the data trace. This setting affects the total number of trace records that can be displayed.

▪ Press **Meas Setup 4**.

▪ Then **Spectrogram Settings**

▪ Then **Spectrogram View**

▪ Then choose from the following:

   ○ **Overlay** Displays the data trace over the spectrogram with NO graticules. Total trace records: 340.

   ○ **Full Screen** Displays the spectrogram with NO data trace. Total trace records: 340.

   ○ **Top** Displays the data trace above the spectrogram. Total trace records: 130.

○ **Bottom** Displays the data trace below the spectrogram. Total trace records: 130.

How to Restart the Spectrogram

Press **Sweep   3** then **Restart**

Averaging

Averaging can be enabled on the underlying measurement. Press **Trace   6** then **State [Average]**. Learn more on page 67.

Common Settings for Waterfall and Spectrogram

Set Red and Blue Limits

The colors displayed on the Waterfall and Spectrogram represent the various measured power levels:

▪ Red = Highest power levels

▪ Blue = Lowest power levels

NOTE:	The full Red-to-Blue color spectrum is visible only with Indoor display colors. Learn more on page 120

Adjust the Red and Blue limits to the power levels that you expect to measure.

▪ Press **Meas Setup   4**.

▪ Then **Spectrogram / Waterfall Settings**

▪ Then choose from the following:

At least 20 dB of power **MUST** separate the Red and Blue limits. Therefore, the order in which the Red and Blue settings may be critical. For example, to lower the default settings (-20 and -90) to (-80 and -100), first lower the Blue to -100, then the Red to -80.

○ **Red Limit** Using the **▲|▼** arrows , rotary knob, or keypad, select the HIGHEST power level that you expect to measure. This power level, and those measured higher than this level, appear Red.

○ **Blue Limit** Using the **▲|▼** arrows , rotary knob, or keypad, select the LOWEST power levels that you expect to measure. This power level, and those measured lower than this level, appear Blue.

Time Markers

Use Time Markers to determine the elapsed time between any two displayed records.

NOTE:	Spectrogram displays the most recent record at the top of the screen. Waterfall displays the most recent record at the bottom.

To create Time Markers:

▪ Press **Meas Setup   4**

▪ Then **Time Markers**

▪ Then **Time**

- Then enter a value from 0 (the most recent sweep record) to the maximum value, using the numeric keypad, **▲|▼** arrows, or the rotary knob. A **▶** indicates the Time Marker.

- Then **Delta**

- Then enter a value from 0 (the most recent sweep record) to the maximum value, using the numeric keypad, **▲|▼** arrows, or the rotary knob. A **▶▶** indicates the Delta Marker.

- At the current sweep speed, the difference in time between these two markers appears at the upper-right corner of the view as **Delta Time:** hh:mm:ss **Sec.**

- An invalid (very large number) appears when a trace record is not available at one or both of these markers.

How to Restart the Spectrogram

Press **Sweep   3** then **Restart**

Averaging

Averaging can be enabled on the underlying measurement. Press **Trace   6** then **State [Average]**. Learn more on page 67.

Measurement Preset

Measurement Preset resets ONLY the Spectrogram and Waterfall display settings. It does not reset the measurement settings.

- Press **Preset**
- Then **Meas Preset**

Waterfall Display

The live trace is always drawn on a Waterfall display. Older trace records scroll up from the displayed trace and eventually off the screen. Because of this, locate the live trace on the bottom of the screen using the scale and reference settings. Learn more on page 59.

Note: Although this document refers to past traces as 'records' these traces are not saved. They are only drawn on the FieldFox screen.
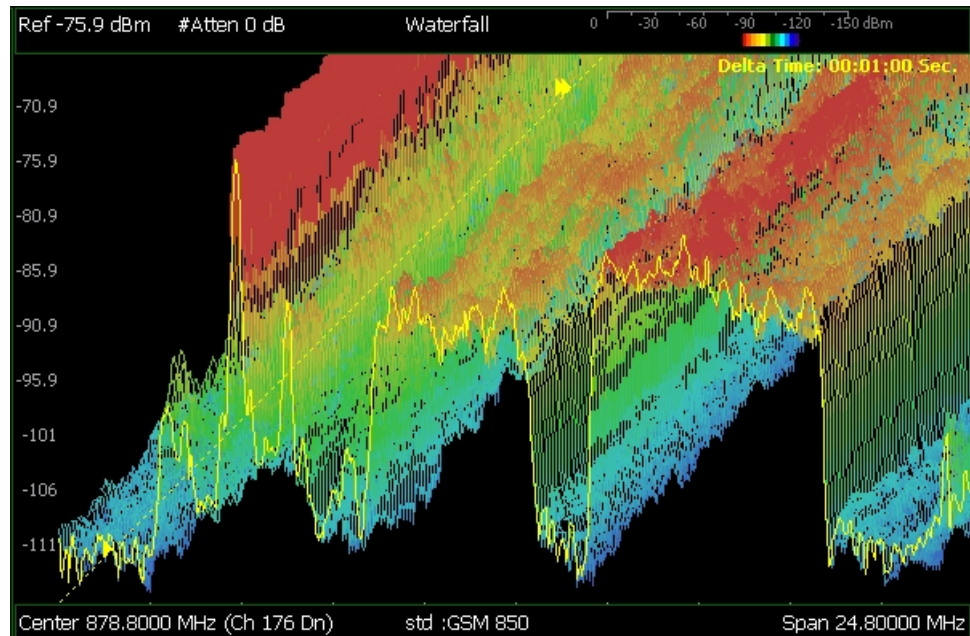
Waterfall display- moderate angle- with time markers 1 minute apart.

The following settings all contribute to the sweep time of an individual trace, and therefore, the total elapsed time that can appear on the screen in Waterfall display:

▪ Frequency Range. Learn more on page 56.

▪ Resolution BW and Video BW. Learn more on page 61

▪ Sweep Time (Acquisition). Learn more on page 62.

▪ Resolution (Number of Points). Learn more on page 67.

Waterfall Angle

This setting allows you to show more or less detail. More detail provides fewer (time) records.

▪ Press **Meas Setup   4**

▪ Then **Spectrogram Settings**

▪ Then **Waterfall Angle**

▪ Then choose from the following:

   ○ **Moderate** Compromise between detail and number of records.

   ○ **Steep** Least detail with highest number of records.

   ○ **Gradual** Most detail with lowest number of records.

   ○ **Wide Angle** Moderate angle with increased space between records.

Learn how to set **Red and Blue Limits** and **Time Markers** on page 83.

Record Playback (DEMO VERSION – very limited capability)

- Record Playback allows you to record up to **100 SA trace sweeps** and play them back at a later time.

- Only one recording can be made. The recording is saved to internal memory and can ONLY be accessed using the playback function. The record buffer is cleared before a new recording begins.

- Preset erases the current recording. Mode Preset does NOT erase the recording.

Playback

- Trace sweeps are played back as fast as the trace can be drawn on the screen.

- Playback can be paused during playback to view individual recorded traces by using **Run/Hold +/-**. Learn how on page 66.

- No frequency or other settings are stored with the data. If SA mode settings are changed between record and playback, the annotation on the screen may be an incorrect representation of the data being played back. The settings under which the data was recorded are not recalled.

To Record Trace Sweeps

- Press **Trace 6**
- Then **Record Playback**
- Then **Prototype control**
- Then choose from the following:
  - **Rec** Immediately start recording.
  - **OFF** Immediately stop recording or playing.
  - **Play** Immediately start playing recorded traces. If no recorded traces are in memory, **Play 0/100** will be displayed.

Record Interval

Sets the amount of time between trace recordings.

To set Record Interval:

- Press **Trace 6**
- Then **Record Playback**
- Then **Record Interval**
- Enter a value in seconds between 0 (no delay) and 1,000,000 using the numeric keypad, **▲|▼** arrows, or the rotary knob.
- Press **Enter**

Record Source

The simplest way to use Record Playback is to record **RawMeas** data, which is then played back into all of the current Trace States.

However, for more complicated processing, refer to the following diagram. This illustrates where data is recorded and played back in the FieldFox data chain.
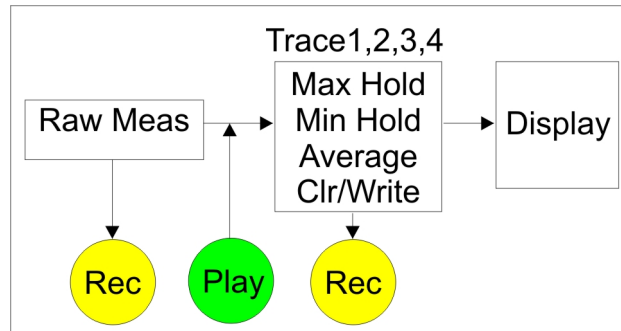
FieldFox Record/Playback data points

▪ Data can be recorded at the Raw Meas point where the data is acquired, or from a specific trace (1,2,3,4).

▪ Recorded data from a Clear/Write trace is exactly the same as Raw Meas data.

▪ Data is ALWAYS played back as though it were Raw Meas data, through the current Trace State, and onto the display.

To set Record Source:

▪ Press **Trace 6**

▪ Then **Record Playback**

▪ Then **Record Source**

▪ Then choose from the following:

   ○ **RawMeas** Records raw measurement data.

   ○ **Trace 1,2,3,4** Records data from the corresponding trace in its current state.

Record Playback Example

The following "Interval Recording" example shows how you can record spectral activity over a longer period of time with less trace storage.

▪ Press **Trace 6** then, with **Trace** = 1, press **State** then **Max Hold**

▪ Press **Record Playback**

▪ Press **Record Source** to Trace1

▪ Press **Record Interval Sec** to 10.

At the end of each 10 second record interval, the Max Hold trace is recorded and the Max Hold processing is reset for the next 10 second record interval.

This session can be played back into any Trace State.

▪ Into a Crl/Write trace, the play shows the "Max Hold" activity of each record interval.

▪ Into a Max Hold trace, the play shows the accumulation of "Max Hold" activity over the entire recording.

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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.
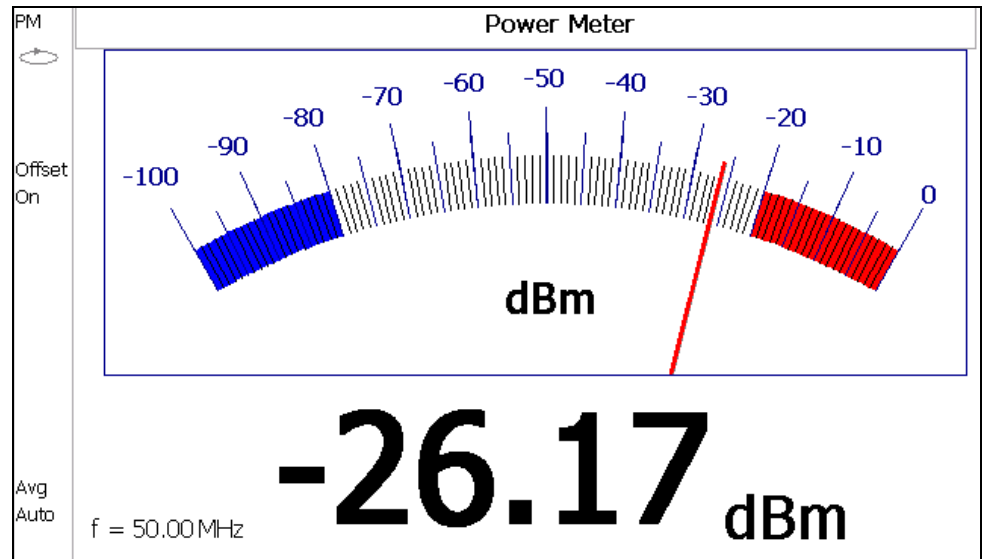
In this Chapter

Supported Power Sensors

Power Meter measurements are made using any of the **Agilent U2000 Series USB Power Sensors.**

NOTE   The FieldFox does NOT support the following U2000 Series features: External Triggering (Time Gated Burst Power Measurement), Power Sweep Operation, and Frequency Sweep Operation.

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 92.

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 20.

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

Single or Continuous Measure

This setting determines whether the FieldFox measures 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.

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

How to set Single or Continuous

- Press **Sweep 3**.

- Then choose one of the following:

  - **Single**   Automatically sets Continuous OFF and causes FieldFox to make ONE measurement, then hold for the next Single key press. When a data trace is displayed, the entire trace is measured, then holds. The **Hold** annotation changes to an arrow **-->** while the measurement occurs.

  - **Continuous** Makes continuous measurements. This is the typical setting when battery power is not critical.

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

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.

VVM (Vector Voltmeter) Mode

VVM Mode (Option 308) measures the electrical length of cables and other devices. The 1-Port Cable Trimming application displays the electrical length in both Magnitude and Phase. The 2-Port Transmission measurement displays Magnitude ONLY.
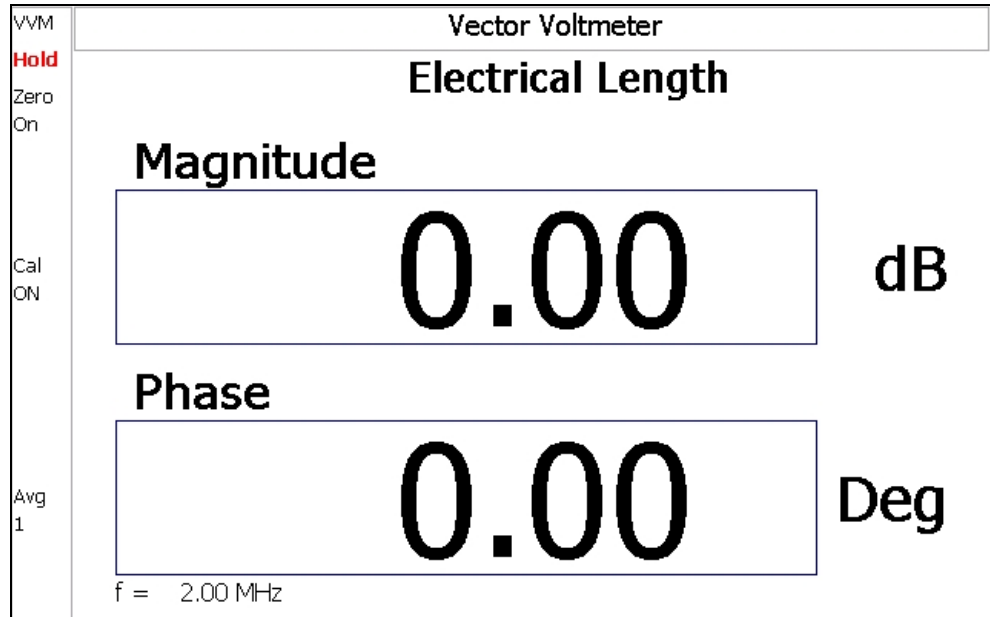
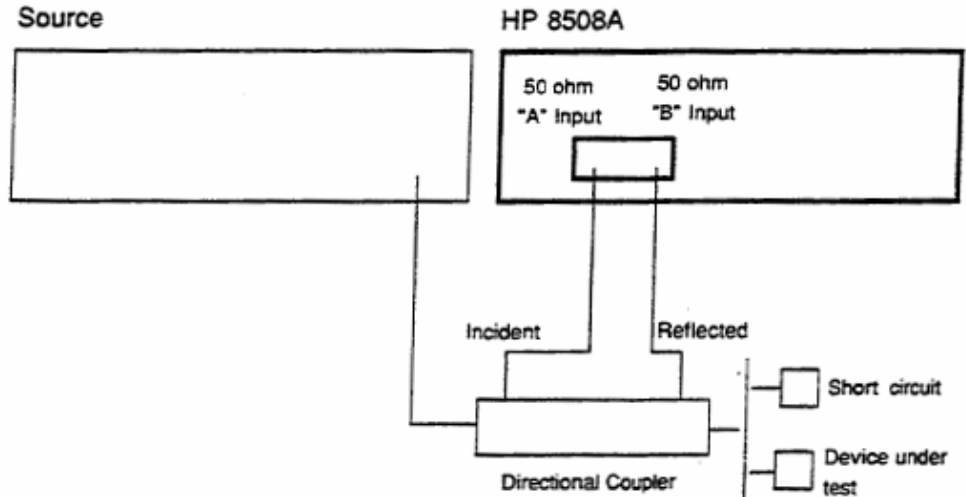*Display for the 1-Port Cable Trimming measurement*

In this Chapter

Procedures

Overview

In the FieldFox, both 1-port and 2-port measurement types use a different configuration setup from the HP/Agilent 8508A Vector Voltmeter.

Typical 8508A measurement configuration – taken from the 8508A manual.

The above block diagram requires an external source and directional coupler to measure the electrical length of a DUT or cable to be trimmed. Separate paths are used to measure the Incident signal (A) and Reflected signal (B). To measure the ratio of the Reflected / Incident signals, you were required to select B/A for both the Magnitude and Phase display.

In the following FieldFox block diagram, the source and directional coupler are inside the instrument. This allows you to connect the DUT to ONLY the FieldFox RF Out port, with NO external instruments, in order to make Cable Trimming measurements.
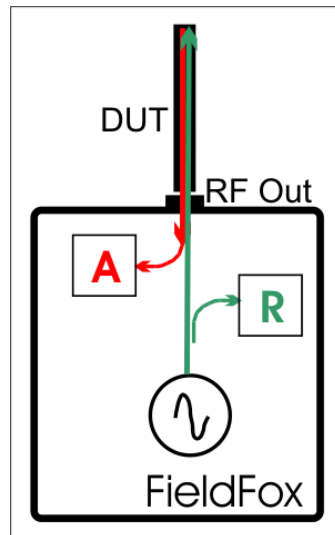
FieldFox block diagram

▪ The **R** receiver measures incident signal (green line) out of the source.

▪ The **A** receiver measures reflected signal (red line) from the end of the DUT (black line).

▪ In VVM mode, the display ALWAYS shows ratioed (A/R) measurements which is the electrical length of the DUT.

In VVM Mode, calibration is performed in the same manner as in CAT and NA Modes. In summary, a Preset Cal is sufficient when the DUT is connected directly to the FieldFox RF Out test port. When using an adapter or jumper cable to connect the DUT, first perform a QuickCal + Load or OSL Cal before making measurements. Learn more about these FieldFox calibrations on page 47.

To make an accurate measurement, set Zero OFF before calibrating.

VVM Mode Settings

Select VVM Mode before making any setting in this section.

NOTE In VVM Mode, the power level out of the internal FieldFox source is always approximately +5 dBm and can NOT be changed. See the specifications for power level under CAT Mode - Output Power - HIGH on page 154.

How to select VVM Mode

▪ Press Mode

▪ Then VVM

Measurement Selection

How to select a VVM Measurement

▪ Press Measure   1

▪ Then choose from the following:

  ○ 1-Port Cable Trimming   1-port reflection measurement. Learn how to make this measurement on page 99.

  ○ 2-Port Transmission 2-port transmission MAGNITUDE ONLY measurement. Learn how to make this measurement on page 100.

Frequency Selection

VVM measurements are made at a single CW frequency.

How to set Frequency

▪ Press Freq/Dist

▪ Then Frequency

▪ Enter 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 VVM Mode.

▪ After using the keypad, select a multiplier key. Learn about multiplier abbreviations on page 20.

Averaging

Averaging helps to reduce the effects of random noise on a measurement. The FieldFox computes the displayed value over several consecutive readings.

Average Count determines the number of readings 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 readings that have been averaged together. When the counter reaches the specified count, then a 'running average' of the last **N** readings 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 Averaging

- Press **Meas Setup   4**
- Then **More**
- 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 Averaging is in process, press **Meas Setup   4**, then **More**, then **Restart** to restart the averaging.

Single or Continuous Measure

This setting determines whether the FieldFox measures 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.

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

How to set Single or Continuous

- Press **Sweep   3**.
- Then choose one of the following:
  - **Single** Automatically sets Continuous OFF and causes FieldFox to make ONE measurement, then hold for the next Single key press. When a data trace is displayed, the entire trace is measured, then holds. The **Hold** annotation changes to an arrow **-->** while the measurement occurs.
  - **Continuous** Makes continuous measurements. This is the typical setting when battery power is not critical.
- You can also use **Run / Hold +/-** to toggle between Single and Continuous.

When performing a Cable Trimming operation, one cable is compared to another. After measuring the first, shorter cable, pressing Zero performs the same operation as Data->Memory, then Data/Mem, also known as Normalization. All subsequent electrical length measurements are relative to the stored measurement.

To make an accurate measurement, set **Zero OFF** before calibrating.

How to select Zeroing

- Press **Meas Setup   4**
- Then **Zero**
- Press **Zero Off** to turn zeroing off.

1-Port Cable Trimming Measurements

A 1-Port Cable Trimming measurement is used in a cable fabrication procedure to validate proper electrical length. Read the **Overview** section in this chapter to learn more about this measurement and the calibration process.

How to make a 1-Port Cable Trimming Measurement

1. Press **Mode** then **VVM** then **1-Port Cable Trimming**.
2. Press **Freq/Dist** and enter the frequency needed for the measurement.
3. Press **Meas Setup   4** then **Zero OFF**.
4. If using an adapter or jumper cable to connect the cables to the FieldFox, press **Cal   5** then select **Calibration Type**,then either **QuickCal** (+ Load) or **OSL Cal**. Follow the FieldFox calibration prompts.
5. You can perform the following **optional Measurement Verification** procedure to ensure that the FieldFox is properly calibrated.

NOTE	This measurement verification procedure is suitable for low frequency measurements. However, for high frequency measurements, a more sophisticated procedure is required.

    a. Connect a short standard to the RF Out calibration plane (the location where the calibration was performed).

    b. Press **Meas Setup   4** and press **Zero**.

    c. Connect the open standard to the FieldFox RF OUT connector.

    d. Confirm that magnitude measurement is less than –0.1 dB and that the phase value reads 180 degrees.

6. Attach the shortest cable to the FieldFox RF OUT connector. This cable is the reference cable. Leave the end of the reference cable open (unterminated).
7. Press **Meas Setup   4** then press **Zero**.
8. Remove the reference cable from the FieldFox RF OUT connector.
9. Connect an unterminated, longer cable to the FieldFox RF OUT connector.
10. Observe the displayed phase difference between the reference cable and the attached cable.
11. Carefully trim the cable until the phase shift reads zero. **The attached cable's electrical length is now matched to the reference cable.**

12. Repeat steps 9 through 11 for the remaining cables to be trimmed.

2-Port Transmission Measurements

A 2-Port Transmission measurement is used for measuring electrical length, insertion loss, gain, or isolation of a device. 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.

**NOTE**   Only Magnitude, NOT Phase, is displayed.

In the following image, the gain of an amplifier is being measured.
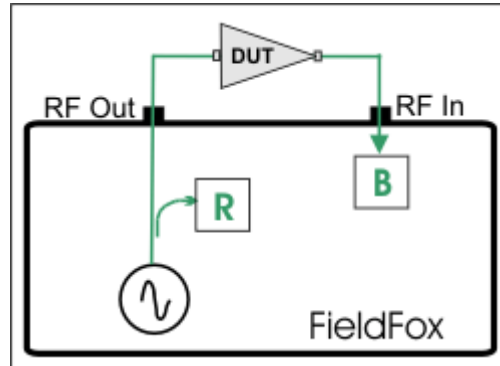
2-Port Transmission measurement of an amplifier

How to make a 2-Port Transmission Measurement

1. Press **Mode** then **VVM** then **2-Port Transmission**.
2. Press **Freq/Dist** and enter the measurement frequency.
3. Connect the RF Out and RF In test port cables to form a Thru connection as in the image below. If an adapter is needed to make the connection, the measurement results will be in error by the amount of loss in that adapter.
4. Press **Meas Setup   4** then **Zero**.
5. Connect the DUT as in the diagram above.
6. The displayed magnitude value is the gain of the amplifier. To measure isolation of the amplifier, reverse the connection to the amplifier (RF Out to the amplifier output).
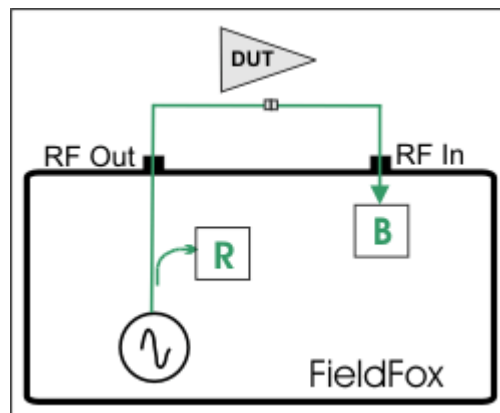
RF Out and RF In test port cables attached to form a Thru connection

Data Analysis Features

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

In this Chapter

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 104.
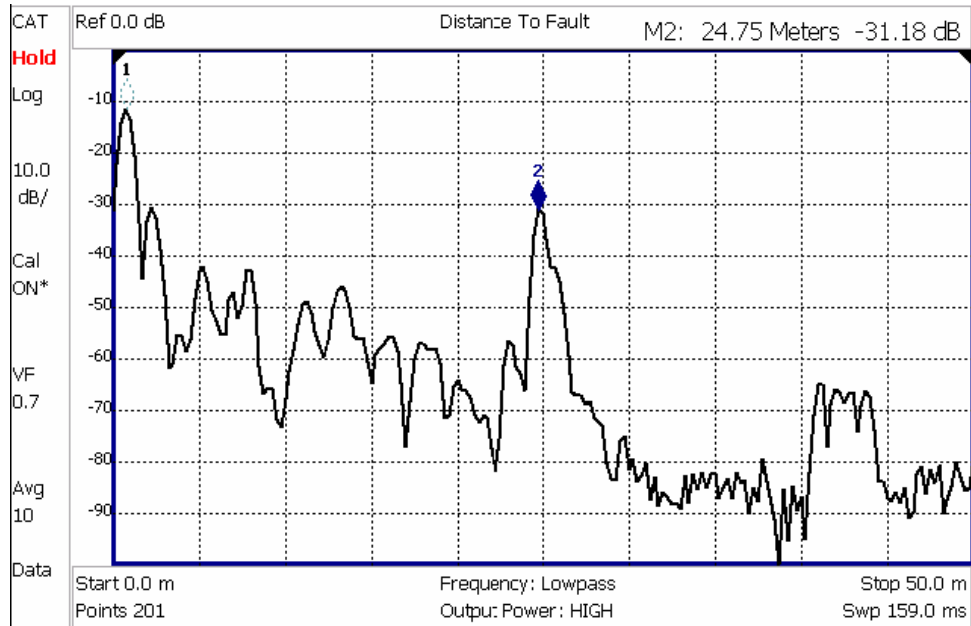
Marker 2 is Active, marker 1 is NOT active.

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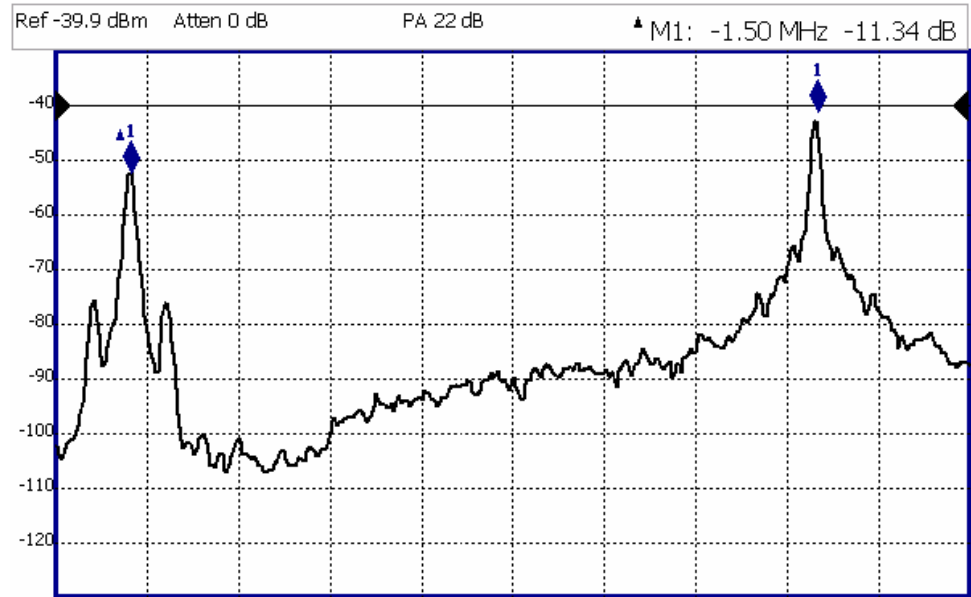
A Delta marker and its associated reference marker. The marker readout shows the difference between the two markers in frequency and amplitude.

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 108.

SA Mode can display up to four traces. Learn more on page 67.

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 that will host 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 Format

Available in NA Mode in either Smith Chart or Polar format. Choose the format of the marker readout (upper right corner of screen). Learn more about Smith Chart and Polar display on page 141.

How to choose marker format

▪ Press **Marker**

▪ Then **More**

▪ Then **Marker Format**

▪ Then choose from the following:

▪ **Mag & Phase** Magnitude and Phase

▪ **Real + Imag** Real and Imaginary

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 or SA mode with zero span) 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.

The following applies to 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.
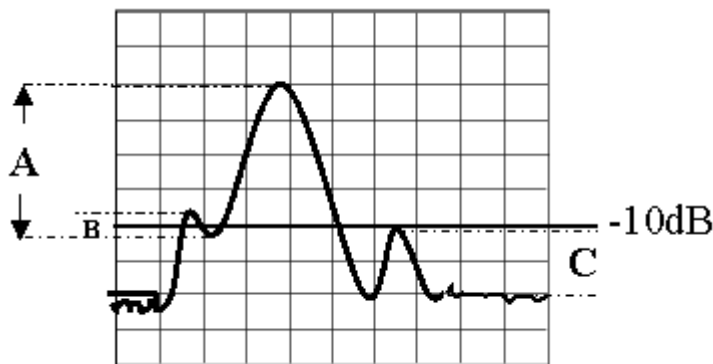
Peak A = **Valid Peak** (Above Threshold and Excursion Settings)

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 69.

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 93.

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 111. They can also be saved and recalled independently from the Limit softkeys. Learn more on page 108.

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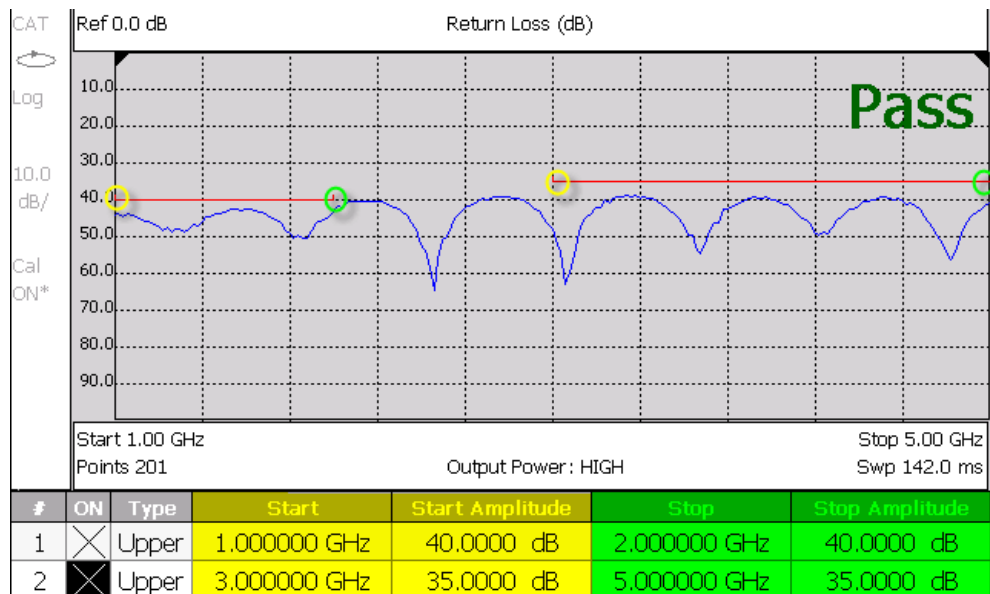
Limit table with two Upper limit lines. Warning ON.
Yellow circles and shading shows Start of lines.
Green circles and shading shows Stop of lines.

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 113.
- 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.

In this Chapter
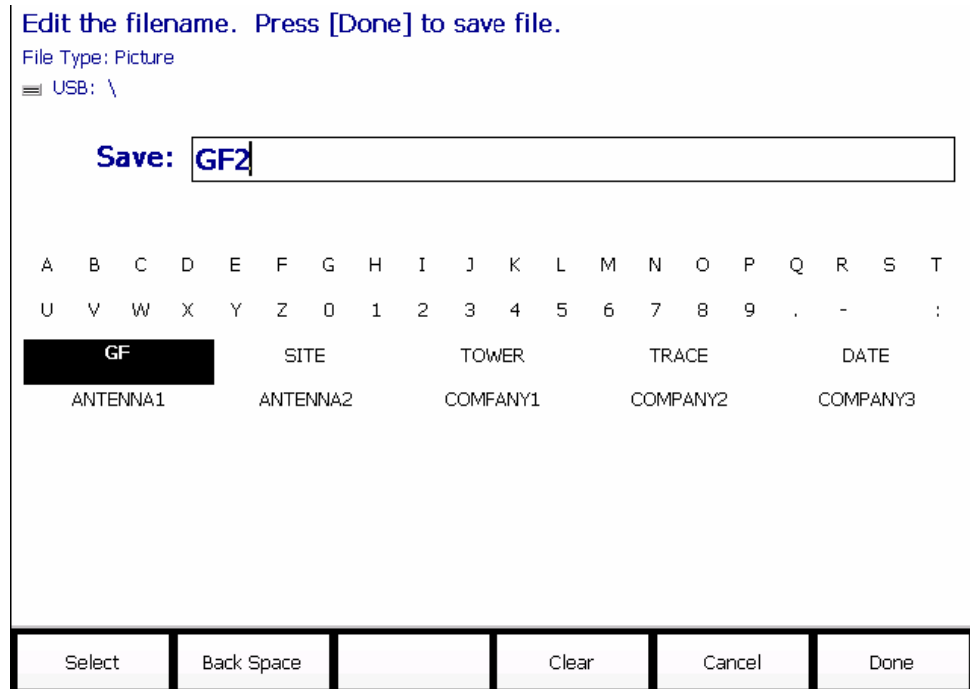
Saving and Recalling Files

Save Files

How to Save a File

- Press **Save/Recall   9**.
- Then **Save**.
- At the top of the current 'labeler' screen (see following image) check the **File Type** to save and **Device** (Internal, USB, Storage Card) to which the file is saved. Learn how to change these settings on page 113.
- 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 121.

- 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. Learn more on page 115.

Edit the filename. Press [Done] to save file.
File Type: Picture
USB: \

Save: GF2

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T |
| U | V | W | X | Y | Z | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | . | - | | : |

| **GF** | SITE | TOWER | TRACE | DATE |
| ANTENNA1 | ANTENNA2 | COMFANY1 | COMPANY2 | COMPANY3 |

| Select | Back Space | | Clear | Cancel | Done |

*The FieldFox labeler. The current filename is **GF2** . The cursor is on the custom **GF** keyword. The file will be saved to USB (flash drive). File Type is "Picture".*

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

- 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 (learn how on page 115). The Data Link software will read data ONLY from the \UserData folder. Learn more about Data Link software on page 127.

  - `SD Card` Saves/Recalls files to/from the mini SD card (not included), inserted in the card slot. See FieldFox Tour on page 16. 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.

How to 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.

o In NA Mode, S1P files are Linear Mag / Angle for all formats except Smith Chart which saves Real / Imaginary format.

o **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.

  o In **SA Mode**, all visible data traces are saved. Each trace is saved to a separate column that is labeled with the Trace State.

  o In **CAT and NA Modes**, only the data trace is saved – not the memory trace.

  o In **Power Meter and VVM Mode**, NO data is saved.

	A	B	C	D	E
1	! FILETYPE CSV				
2	! VERSION 1	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   When 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:

  o **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** Changes the active folder to which files can be saved. 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.
- Press **Exit** when finished.

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.

How 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 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

In this Chapter

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 49.

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.

To cause the display brightness and color settings to remain through a FieldFox Preset and shutdown, save the display settings as Preferences. Learn how on page 122.

NOTE   Clean the transflective 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`.

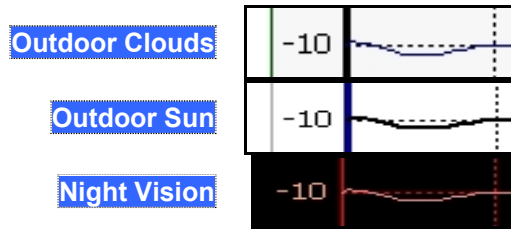- Use the `▲|▼` arrows, the rotary knob, or numeric keypad to enter a value between 0 and 100%.

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:

Outdoor Clouds -10

Outdoor Sun -10

Night Vision -10
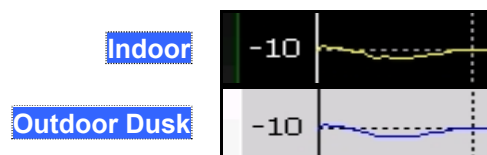
Title

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 19.

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 111.
- 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 115.

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 120.
- 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.

BNC Connector Use

Configure the BNC connector on the FieldFox top panel for use as an External Frequency Reference or as an External Trigger input. See image of this connector on page 16. This must be done before settings for either of these functions can be made.

- Press **System   7**

- Then **System Configuration**

- Then **Freq Ref / Trig Input**

- Then **BNC Connect Use** The underlined keyword is the current selection.

  - **Ref** Use the BNC connector for an external frequency reference. Learn more in the following section.

  - **Trigger** Use the BNC connector for an external trigger source in SA Mode. Learn more on page 65.

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 **Freq Ref / Trig Input**

- Then **BNC Connect Use 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 conditions 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.

NOTE   Although allowed during entry, year settings higher than 2088 will not be changed on the screen.

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 127.

NOTE   ONLY LAN 100Base-T connections are supported.

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** 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
    - **Static 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** Choose from:
        - **Power Up** The above settings take effect when the FieldFox is started.
        - **Now** The above settings take effect immediately.

NOTE   To make the LAN settings persist after power up, toggle **Apply Settings** to **Now** then back to **Power Up**. You should see a message indicating that the LANconfig file was saved.

- 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

The following 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 8.
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 133.

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.

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

NOTE   Use a 100Base-T connection to connect the FieldFox to a PC. A slower 10Base-T connection may cause problems.
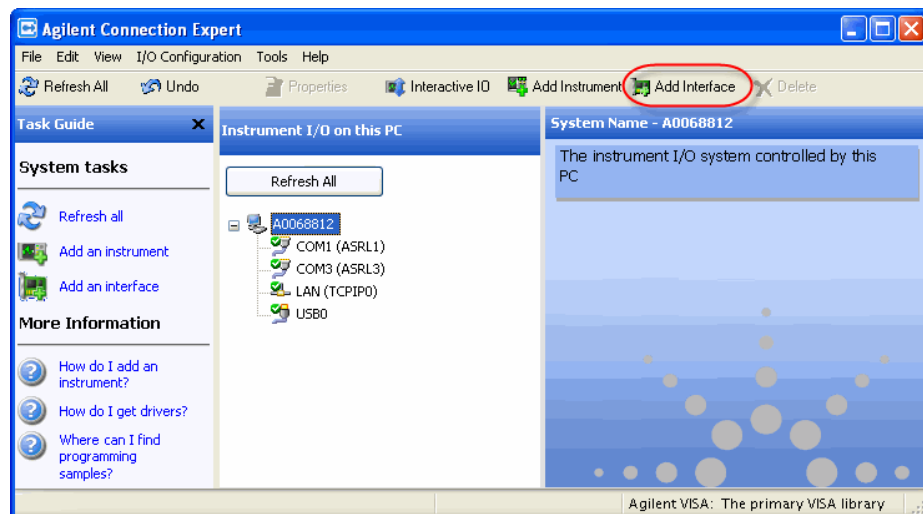
On the FieldFox

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.

NOTE   To make the LAN settings persist after power up, toggle **Apply Settings** to **Now** then back to **Power Up**. You should see a message indicating that the LANconfig file was saved.

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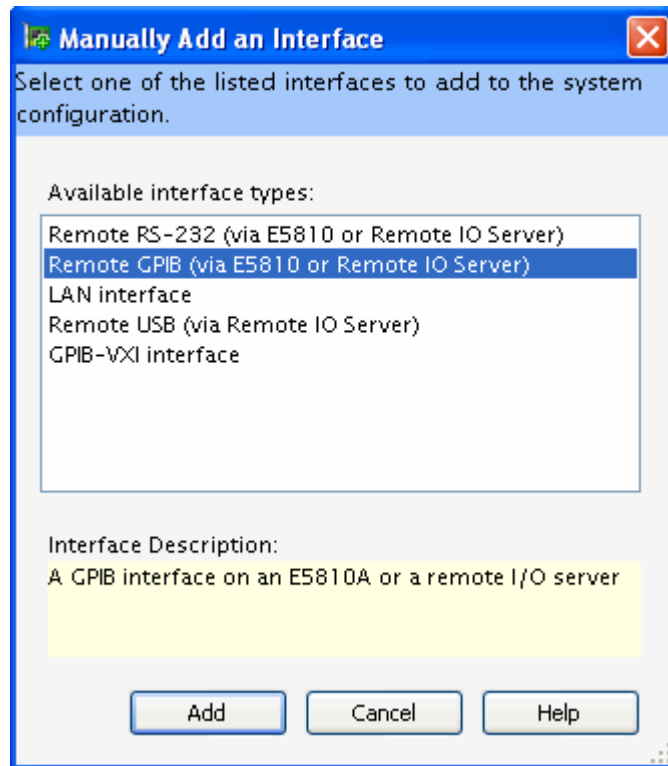
4. In the above dialog, click **Remote GPIB(via E5810 or Remote IO Server)** then click **Add**
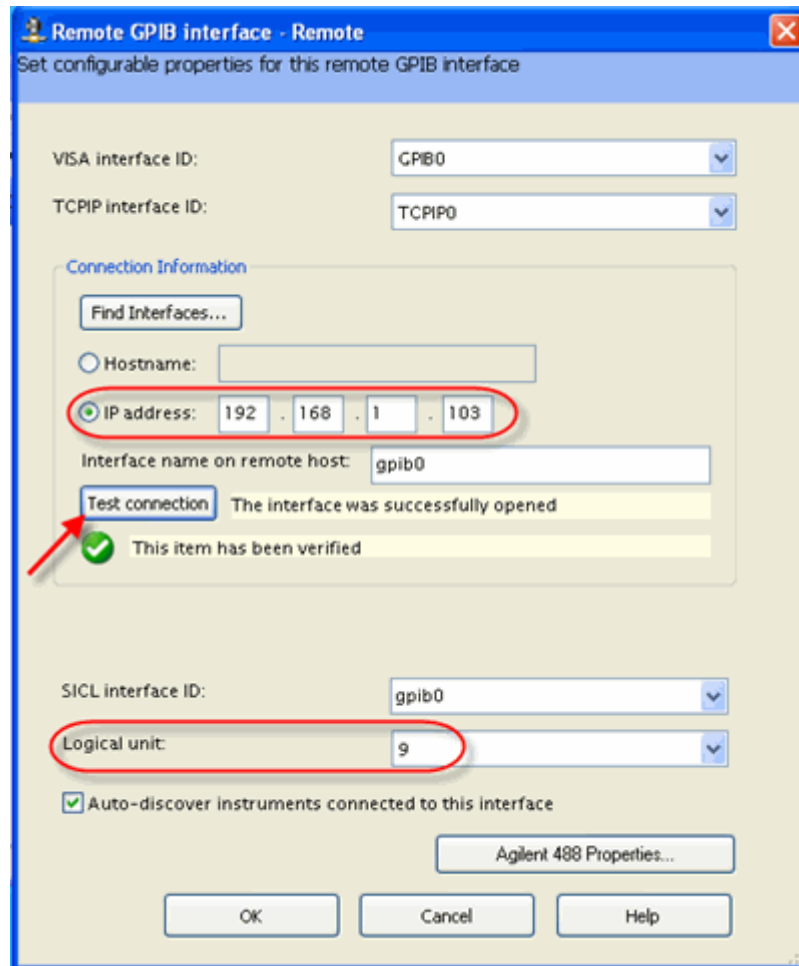
In the above dialog:

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 128.

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**.
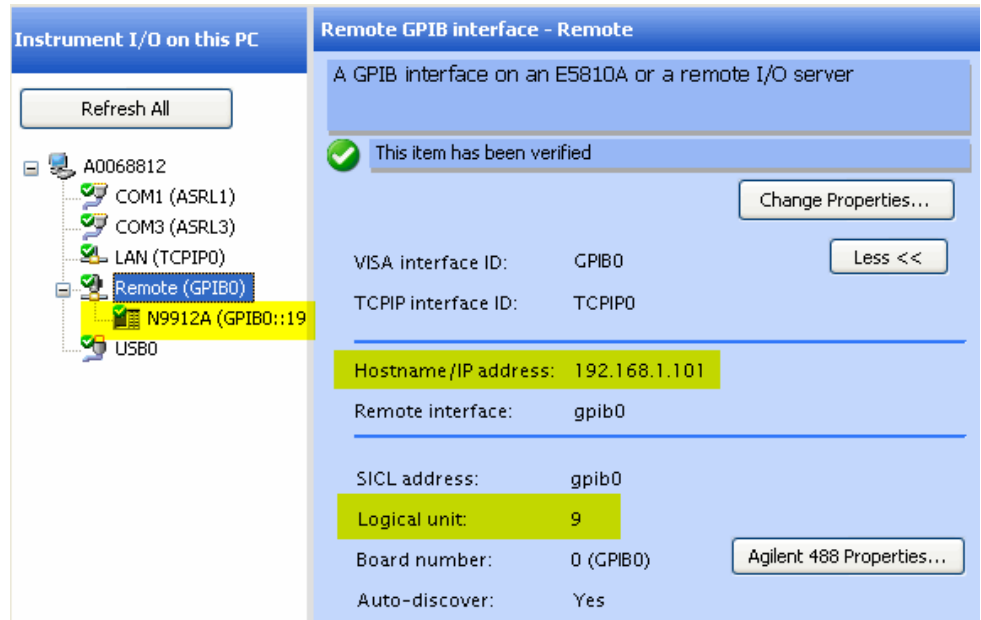
The ACE dialog will look like the above image.

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

When a LAN cable is connected between the FieldFox and the PC, both LEDs on the FieldFox LAN connector should be active. IF the LEDs are NOT active, use a LAN crossover cable. This may be necessary when using an older PC. **In most cases, a crossover cable is NOT necessary.**

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 125)
- 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**

NOTE	To make the LAN settings persist after power up, toggle **Apply Settings** to **Now** then back to **Power Up**. You should see a message indicating that the LANconfig file was saved.

- Click **OK** and close dialogs

In Agilent IO Libraries

- Follow the procedure starting on page 128. (**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 133.

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** as raw data. There is NO file type associated with the data yet.

- Data Link software reads traces that have been saved to the FieldFox **internal memory** as ***.csv or *.s1p files**. These file types are also saved onto a USB Flash drive or mini SD card, and then can be Imported into Data Link software.

- Once data has been read, the Data Link software Saves and Recalls data as *.dut files. 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.

The files to be transferred must already be on the removable device. Learn how to save these files on page 111.

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 Data Link Welcome screen, click **Cancel**.

4. Click **File**, then **Import**.
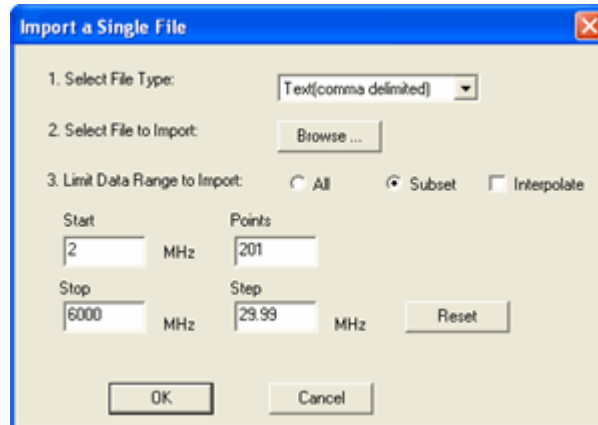
- To import *.csv files, select **Text (comma delimited)**.

- To import *.s1p 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**.
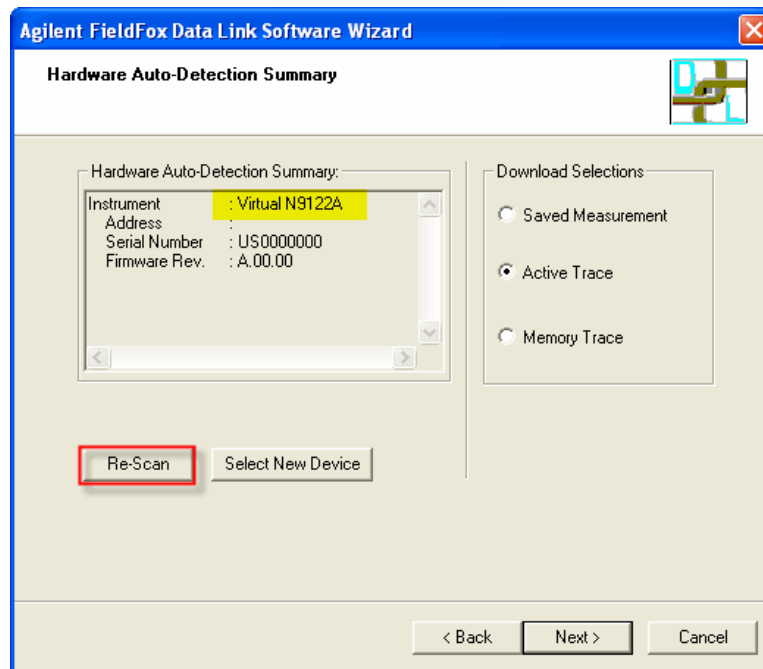
3. Each time you connect to the FieldFox , **Virtual N9122A** appears. Click **Re-Scan** to make a connection to the FieldFox.

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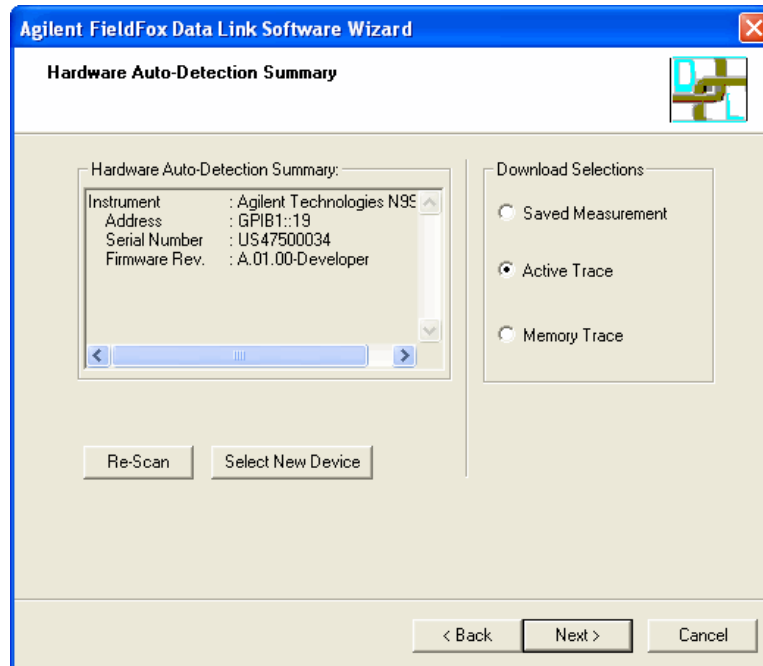
5.   Click a **Download Selection**, the click **Next**.

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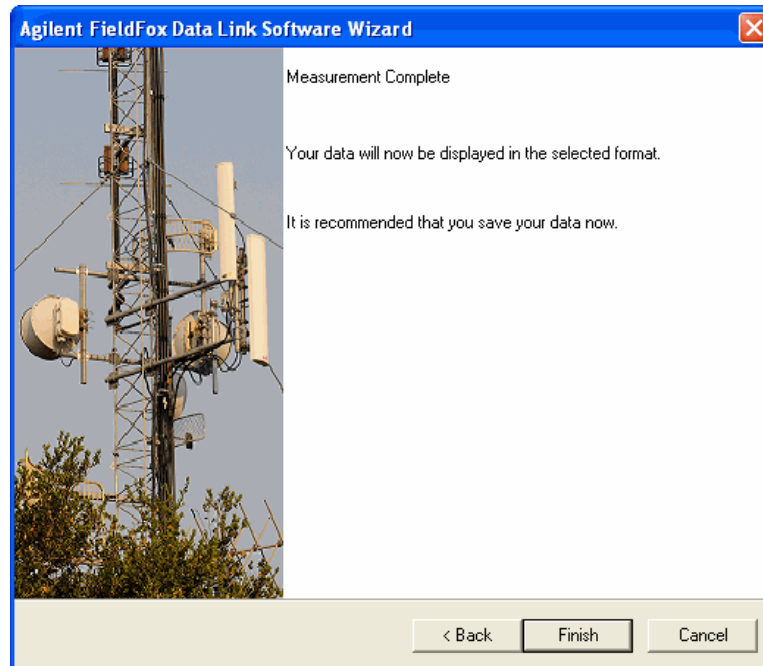
When a trace is already in the FieldFox Data Link Software, this dialog appears to allow you to first save the trace to a *.dut file.

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 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. Do NOT copy the N9912A.zip file to the 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 14.

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. The FieldFox will shut down and restart automatically.

9. 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

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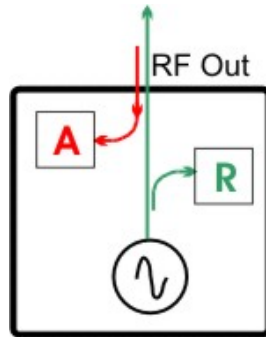
1. A signal source which sends signal out the RF OUT port.
2. A "reference" (R) receiver that is used ONLY to accurately measure the "incident" signal out of the source.
3. An (A) receiver for measuring reflected signals coming back INTO the RF OUT port.

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.

With markers, you can readout Real + Imaginary (R + jX) or Magnitude and Phase. Learn how on page 104.
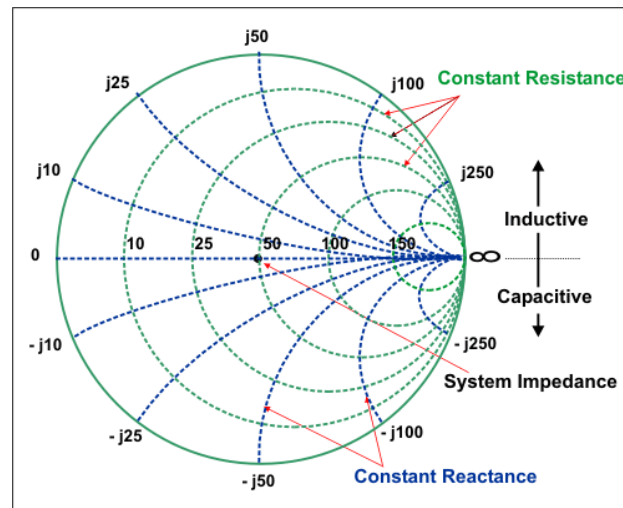
Polar

Polar format is used to view the magnitude and phase of the reflection coefficient (G) from your S11 measurement.

In Polar format, Markers display the following:

- Linear magnitude (in units)
- Phase (in degrees)

In the previous image, the dashed circles represent reflection coefficient. The outermost circle represents a reflection coefficient (Γ) of 1, or total reflected signal. The center of the circle represents a reflection coefficient (Γ) of 0, or no reflected signal.

The radial lines show the phase angle of reflected signal. The right-most position corresponds to zero phase angle, (tha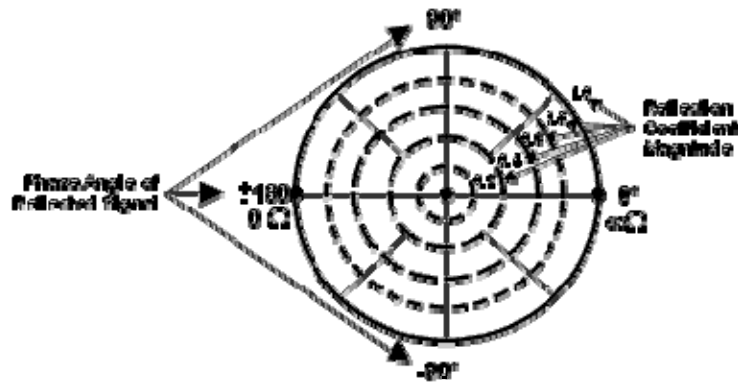t is, the reflected signal is at the same phase as the incident signal). Phase differences of 90°, ±180°, and -90° correspond to the top, left-most, and bottom positions on the polar display, respectively.

With markers, you can readout Real + Imaginary (R + jX) or Magnitude and Phase. Learn how on page 104.

Making 75Ω (ohm) Measurements

The FieldFox can be used to make 75Ω cable TV measurements. The simplest method is to use a 50Ω to 75Ω adapter such as the Agilent 1250-0597 (NOT a minimum loss pad such as the 11852B).

Perform either a QuickCal or OSL Cal at the end of the minimum loss pad or at the desired 75Ω reference plane. A Preset Cal is accurate ONLY at the test port.

- **QuickCal** – When prompted to **Measure Load**, connect a 75Ω load. There is no cal kit selection - QuickCal's math does not require the load specifications. When the load is connected, it assumes no reflections. Once your calibration is complete, you can view the return loss, DTF, or S11 data.

- **OSL Cal** - A 75Ω Cal Kit must be used to perform an OSL Cal. Agilent 85036E and 85036B are 75Ω cal kits. These Cal Kit definitions are NOT included as standard Cal Kits in the FieldFox. The Cal Kit definition must be loaded from a remote PC to the FieldFox using the Data Link Software and a LAN connection. It can NOT be done using a USB Flash drive. Learn more about connecting the FieldFox to a PC on page 127. Learn about Editing a Cal Kit by clicking Help in the Data Link software. Once the 75Ω Cal Kit is loaded, you can select it before the OSL Calibration, and then follow the Cal Wizard prompts using the 75Ω OPEN, SHORT, AND LOAD standards.

To accurately view Smith Chart data in NA Mode, first set the System Impedance to 75Ω. Learn how on page 45.

For 2-port transmission measurements, the normalization calibration is sufficient, and the displayed data is accurate.

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.

The following shows potential problems with transmission cables.
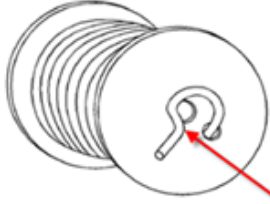
Bent Cable

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

Deformed Cable

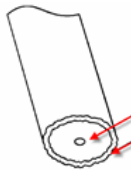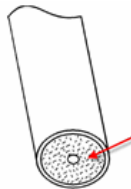Compressing the dielectric (the gap) will produce egg-shaped or oval deformations which can cause impedance mismatches and affect the quality of the connector Model compensation. This can easily happen when using diagonal cutters to cut the cable.

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.
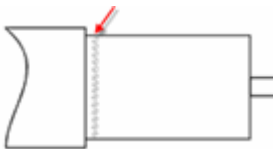
Damaged Outer Conductor

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 44.

- 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 25.

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Working with the Lithium-Ion Battery

In this Chapter

See Also

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** then **Service Diagnostics** then **Battery**.

- Built-in battery gauge. 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.
84%	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** then **Service Diagnostics** then **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 150.

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 ≥80% change in relative state of charge.

Built-In Battery Gauge

Inspired Energy Battery
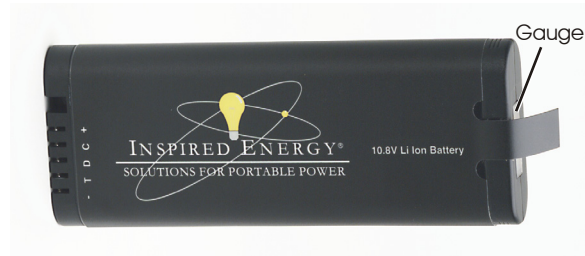
Each lithium ion battery has an LCD gauge that displays its charge status. Each segment represents 20% of the charge capacity. The gauge is active unless the battery is in shutdown mode. To view the LCD gauge on the Inspired Energy battery, open the FieldFox battery compartment door.

Gauge	Charge Remaining
5 segments	≥80%
4 segments	≥60%, < 80%
3 segments	≥40%, < 60%
2 segments	≥20%, < 40%
1 segment	< 20%

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 150.

Internal Charging with the AC/DC Adapter

Important: Read the safety information for the AC/DC adapter on page 175.

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 17.

Important: Read the safety information for the External Charger on page 176.

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 152. Operation with a degraded battery could result in damage to the FieldFox. Learn more on page 176.

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

In this Chapter

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°C ±5 °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

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 0 to 55 ºC	±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				
Return Loss				
1.75 GHz – 3.85 GHz, 1001 points, Cal ON				1.5 ms/point (nominal)
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 (Typically 31 dB below high power)				
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)

Cable and Antenna Analyzer (continued)

Description	Specification	Typical	
		10 minute warm up	**90 minute warm up**
Directivity			
Corrected with OSL calibration [1]	>42 dB	>42 dB	
Corrected with QuickCal (Option 111) [3]			≥42 dB
Raw			
2 MHz to 3.5 GHz			> 20 dB
> 3.5 GHz to 6 GHz			> 14 dB
Source Match			
Corrected with OSL calibration [1]	> 36 dB	> 36 dB	
Corrected with QuickCal (Option 111) [3]			≥35 dB
Raw			
2 MHz to 3 GHz			> 25 dB
> 3 GHz to 6 GHz			> 16 dB
Reflection Tracking			
Corrected with OSL calibration [1]	±0.06 dB	±0.06 dB	
Corrected with QuickCal (Option 111) [3]			±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 [2]			
		Refl Dyn Range /2	
Transmission Dynamic Range(Option 110)			
300 Hz IF Bandwidth			
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		
Cable Loss			
Display Range	0 to 100 dB		
Resolution	0.01 dB		

Cable and Antenna Analyzer (continued)

Description	Specification	Supplemental Information
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] Using recommended calibration kits.

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

[3] QuickCal is performed with the connect LOAD step.

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

FieldFox Reflection Magnitude Uncertainty - Type-N OSL, 2 MHz to 6 GHz
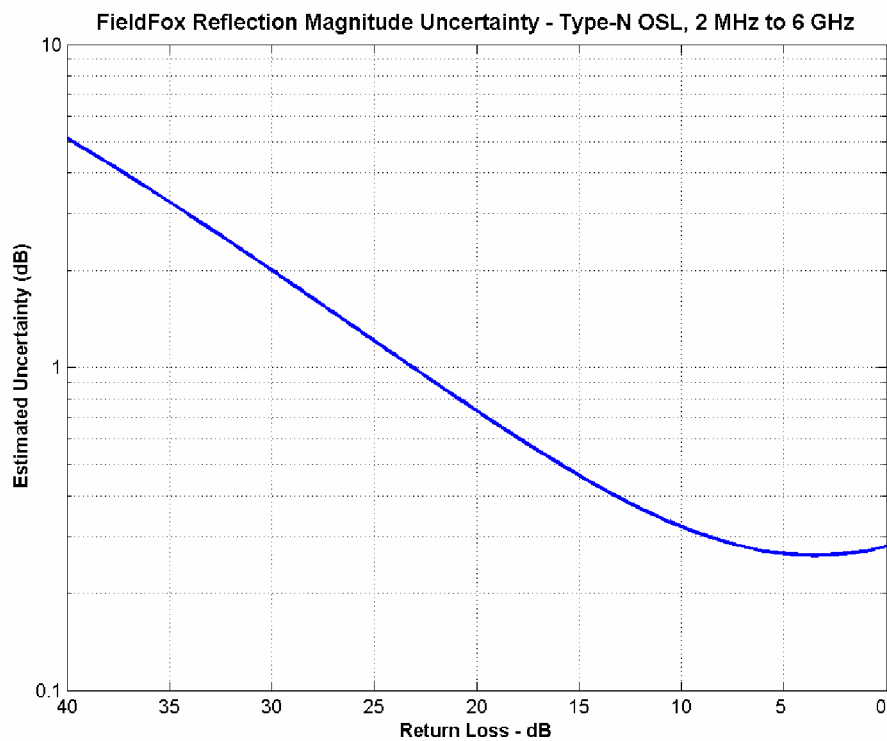
Cable and Antenna Analyzer (continued)

Figure 2: CAT Mode, QuickCal – Magnitude (Typical)

FieldFox Reflection Magnitude Uncertainty - Typical QuickCal, 2 MHz to 6 GHz
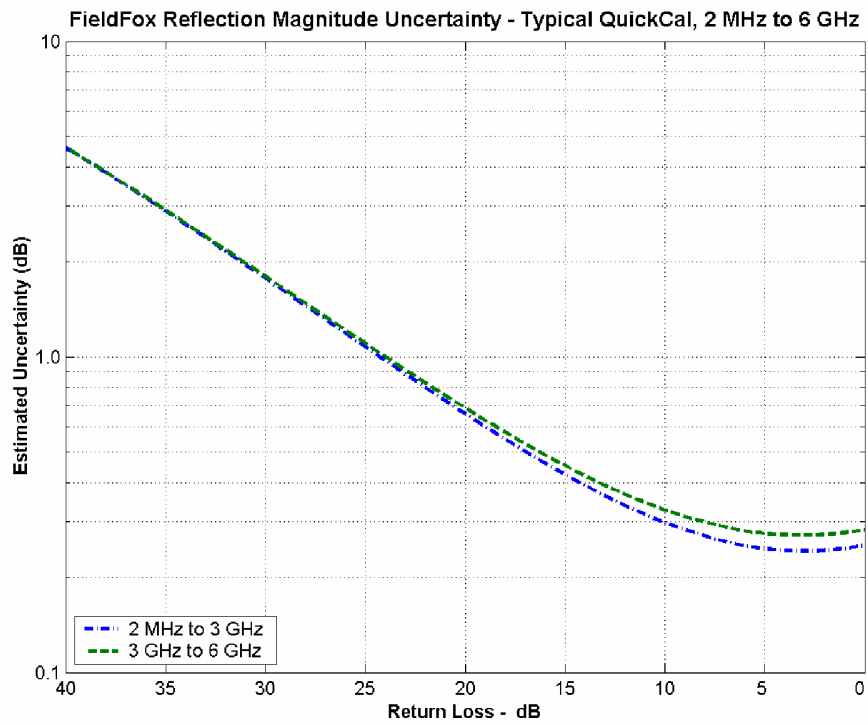
Figure 3: CAT Mode, Preset Cal – Magnitude (Typical)

FieldFox Reflection Magnitude Uncertainty - Preset Cal, 2MHz to 6GHz
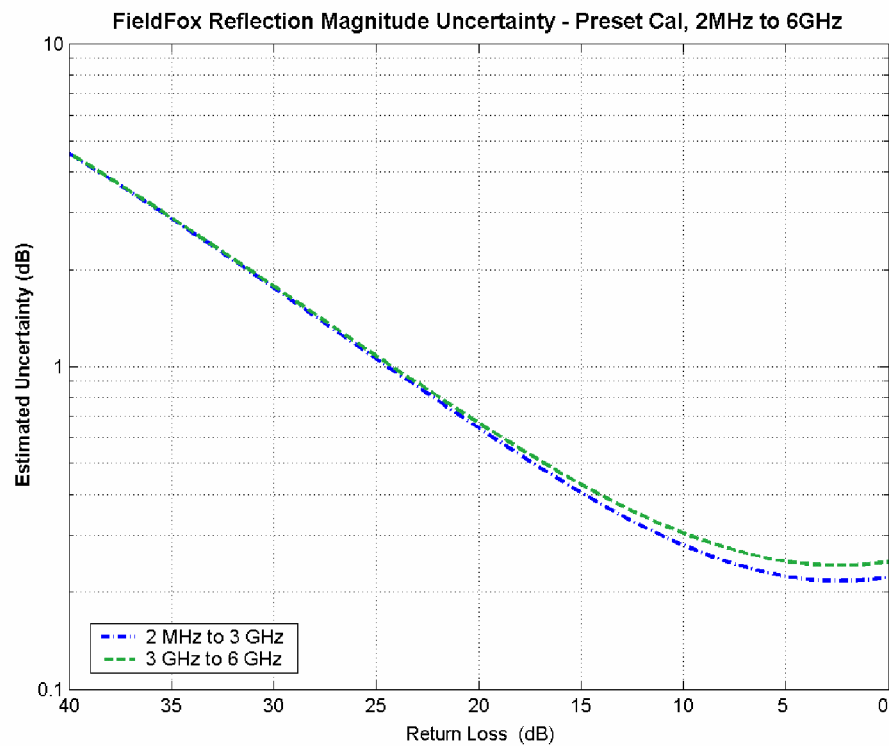
Network Analyzer (Option 303)

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.

Description	Specification	Supplemental Information
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, Polar
Measurement Speed		
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 Uncertainty[1]		
	See Figure 5 on following page	
Display Range	−180º to +180º	
System Impedance		
	50Ω (nominal)	75Ω with appropriate adapter and Cal Kit

[1] Using recommended calibration kits.

Network Analyzer (continued)

Figure 4: NA Mode, Type–N Calibration Kit – Magnitude (Specification)

FieldFox Reflection Magnitude Uncertainty - Type-N OSL, 2 MHz to 6 GHz
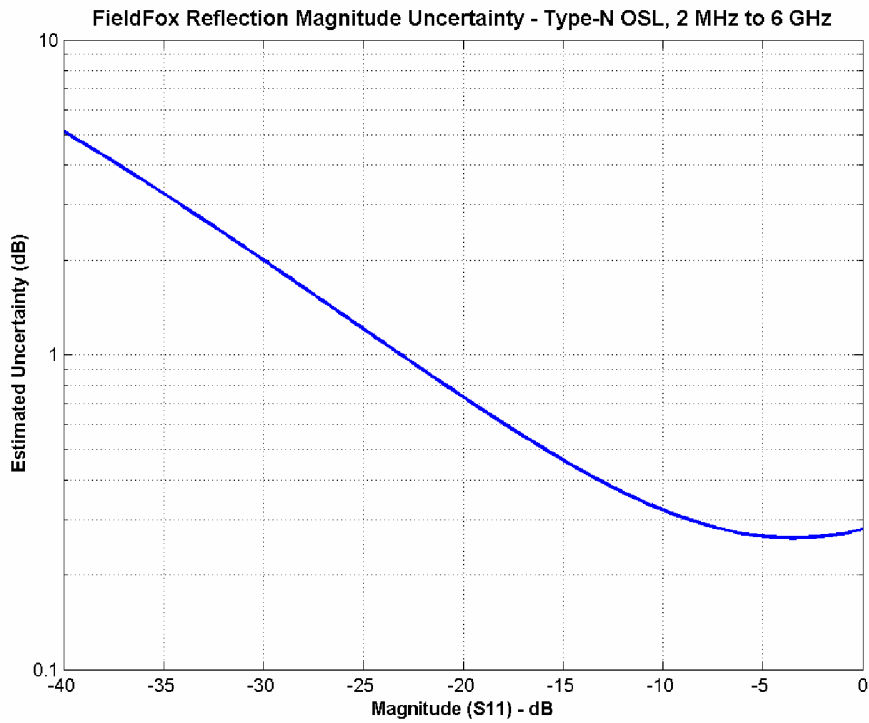
Figure 5: NA Mode, Type–N Calibration Kit – Phase (Specification)

FieldFox Reflection Phase Uncertainty - Type-N OSL, 2MHz to 6GHz

Network Analyzer (continued)

Network Analyzer (continued)

FieldFox Reflection Magnitude Uncertainty - Preset Cal, 2MHz to 6GHz

FieldFox Reflection Phase Uncertainty - Preset Cal, 2MHz to 6GHz

Spectrum Analyzer (Option 230 and 231)

Description	Specification	Supplemental Information
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	1.0 us	
Maximum		
RBW = 2 MHz	2.18 ms	
RBW = 1 MHz	3.28 ms	
RBW = 300 kHz	5.46 ms	
RBW = 100 kHz	16.38 ms	
RBW = 30 kHz	54.60 ms	
RBW = 10 kHz	163.84 ms	
RBW = 3 kHz	546.00 ms	
RBW = 1 kHz	1.64 s	
RBW = 300 Hz	2.54 s	
Resolution	100.0 ns	
Readout	Entered value representing trace horizontal scale range.	

[1]With signal at center frequency.

Spectrum Analyzer (continued)

Description	Specification	Supplemental Information
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.	
Trigger		
Trigger Type	Free Run, Video, External	
Trigger Slope	Positive, Negative edge	
Trigger Delay		
Range	0 to 10 sec	
Resolution	100 nsec	
Auto Trigger	Forces a periodic acquisition in the absence of a trigger event	
Auto Trigger Range	0 sec (OFF) to 10 sec	
Time Gating		
Gate Method	Triggered FFT	
Gate Delay Range	Same as Trigger Delay	
Trace Update		
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)	

Spectrum Analyzer (continued)

Description	Specification	Supplemental Information
Resolution Bandwidth (RBW)		
Range (–3 dB bandwidth)		
Zero Span	300 Hz to 1 MHz in 1–3–10 sequence; 2 MHz	
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

Description	Specification	Typical	
		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
Measurement Range			
	Displayed average noise level (DANL) to +20 dBm		
Input Attenuator Range	0 to 31 dB		
Resolution	1 dB steps		
Maximum Safe Input Level			
Average Continuous Power	+27 dBm (0.5 W)		
DC	±50 VDC		

Spectrum Analyzer (continued)

Description	Specification	Typical	
		10 minute warm up	**90 minute warm up**
Displayed Average Noise Level (DANL)			
Preamplifier OFF			
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		
Trace Detectors			
	Normal, Positive Peak, Negative Peak, Sample, Average		
Trace States			
	Clear/Write, Max Hold, Min Hold, Average, View, Blank		
Number of Traces			
	4		
Number of Averages			
	1 to 10,000		
Reference Level			
Range	−170 dBm to +30 dBm		
Resolution	0.1 dB		
Accuracy	0 dB		

Spectrum Analyzer (continued)

Description	Specification	Typical	
		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 –5 dBm to –50 dBm, all settings auto–coupled			
20 to 30 ºC	±0.8 dB	±0.8 dB	±0.4 dB
–10 to 55 ºC	±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 ºC:			
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 ºC:			
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 ºC:			
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 ºC:			
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 (continued)

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 [3]
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 [4]			
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)

[1] With signal at center frequency.

[2] Mixer level = RF input level – input attenuation

[3] For signals not at center frequency.

[4] The specification for Total Absolute Amplitude Accuracy is less than the sum of the Absolute Amplitude Accuracy and Frequency Response specifications because redundant uncertainty is removed.

Spectrum Analyzer (continued)

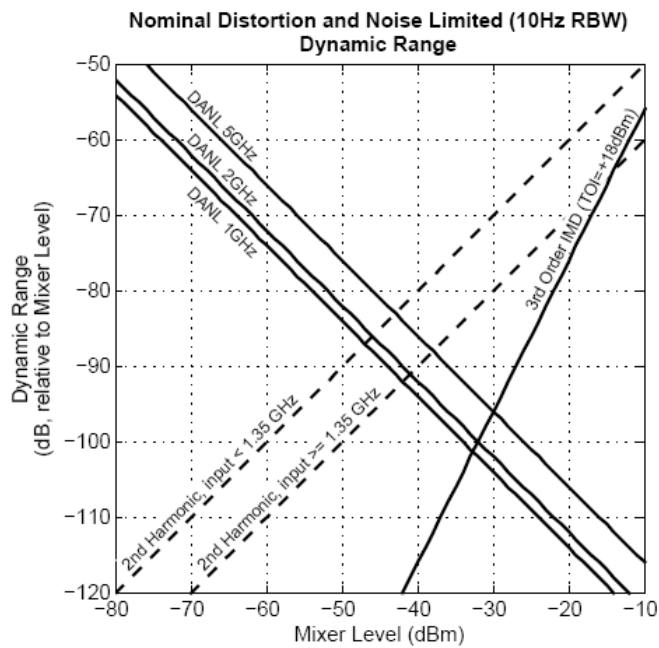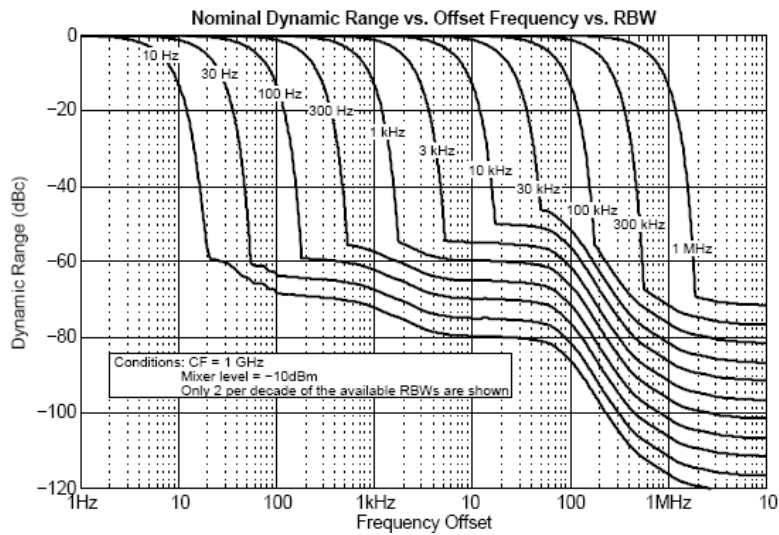| Description	Supplemental Information
Residual Responses	
Input terminated, 0 dB attenuation, preamplifier off, RBW ≤ 1 kHz, VBW auto coupled	
20 MHz to 3 GHz	−90 dBm (nominal)
> 3 GHz to 6 GHz	−85 dBm (nominal)
Spurious Responses	
Input Mixer level −30 dBm	
RFsig = RFtune + 417 MHz	−70 dBc (nominal)
RFsig = RFtune + 1.716 GHz	−80 dBc (nominal)
Input Mixer level −10 dBm; First IF Image Response	
Rfsig = Rftune − 2 x 0.8346 GHz for Rftune 5.7 to 6.0 GHz	−50 dBc (nominal)
Sidebands	−80 dBc (nominal)
	−60 dBc (nominal) when battery charging, 260 kHz offset

Spectrum Analyzer (continued)

Figure 10

Nominal Distortion and Noise Limited (10Hz RBW) Dynamic Range

Figure 11

Nominal Dynamic Range vs. Offset Frequency vs. RBW

Spectrum Analyzer (continued)

Description	Specification	Supplemental Information
AM/FM Tune and Listen		
Audio demodulation types	AM, FM Narrow, FM Wide	
Audio Bandwidth	16 kHz	
Receiver IF Bandwidth		
AM	35 kHz	
FM Narrow	12 kHz	
FM Wide	150 kHz	
Listen Time Range	0 to 100 sec.	
Radio Standards		
With a Radio Standard applied, pre-defined frequency bands, channel numbers or Uplink / Downlink selections can be used instead of manual frequency entry. The pre-defined FieldFox Radio Standards include bands such as W-CDMA, LTE, and GSM.		
FieldFox Power Suite Measurement types		
Channel Power Occupied Bandwidth Adjacent Channel Power Ratio		

Preamplifier (Option 235)

Description	Specification	Typical 10 minute warm up
Frequency Range		
Option 230	100 kHz to 4 GHz	
Option 231	100 kHz to 6 GHz	
Gain		22 dB

Interference Analyzer (Option 236)

Description	Specification	Supplemental Information
Display Types		
Spectrogram	Overlay, full screen, top, or bottom with active trace	
Waterfall		
Markers		
Time, delta time		

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

Description	Specification	Typical	Supplemental Information
Calibration Cycle			
	1 Year		
Environmental			
	▪ Agilent Technologies Environmental Test manual (ETM) for Outdoor Equipment[1] ▪ 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)		
IP Class	30		
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 ºC could degrade battery performance and life.
EMC			
Complies with European EMC Directive 2004/108/EC	▪ 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	▪ IEC/EN 61010–1 2nd Edition ▪ Canada: CSA C22.2 No. 61010–1–04 ▪ USA: UL 61010–1 2nd Edition		

General Information (continued)

Description	Specification	Typical	Supplemental Information
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	
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 ºC[2], ≤ 85% RH		
Charge Temperature Limits	0 to 45 ºC[2], ≤ 85% RH		
Storage Temperature Limits	-20 to 50 ºC[2], ≤ 85% RH		The battery packs should be stored in an environment with low humidity. Extended exposure to temperature above 45 ºC 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 and miniSDHC memory cards
Display			
	6.5″ transflective 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″)		

General Information (continued)

Description	Specification	Typical	Supplemental Information
Inputs & Outputs			
RF Out Port			
Connector	Type–N, female		
Impedance	50 Ω (nominal)		
Damage Level	> +23 dBm, > ±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)
Headphone Jack Connector	3.5 mm (1/8 inch) miniature audio jack		
USB			
USB–A (2 ports)	Hi–speed USB 2.0		
Mini USB (1 port)	Hi–speed USB 2.0		Provided for future use.
LAN	100Base-T ONLY RJ–45 connector		10Base-T is NOT supported
External Reference /Trigger Input			
Connector	BNC female		
External Reference			
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)
Trigger Input			
Impedance			10 KΩ (nominal)
Level Range			
Rising Edge			1.7 V (nominal)
Falling Edge			1 V (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

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 lithium-ion rechargeable battery system used in FieldFox.

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+/–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.

Product Information Sheet

Panasonic Batteries

Panasonic Industrial Company
A Division of Panasonic Corporation of North America
Two Panasonic Way
Secaucus, NJ 07094
Toll Free: 877-726-2228
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	$C_3H_4O_3$
	Diethyl Carbonate - Solvent	$C_5H_{10}O_3$
	Lithium Hexaflurophosphate - 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.   Telephone: (888) 5-INSPIRE (888-546-7747)
12705 N US Hwy 441
Alachua, FL 32615   Date Prepared: Jan 13th 2003

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? _X_ 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
Polyvynilidene 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: (H20=1): LiCo02: 4.95 　　　　　　　　　　　Graphite: 2.09~2.2 **Melting Point**: (°C): LiCo02 about 1130 C	**Appearance and Odor:** LiCo02 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 Mexicao 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
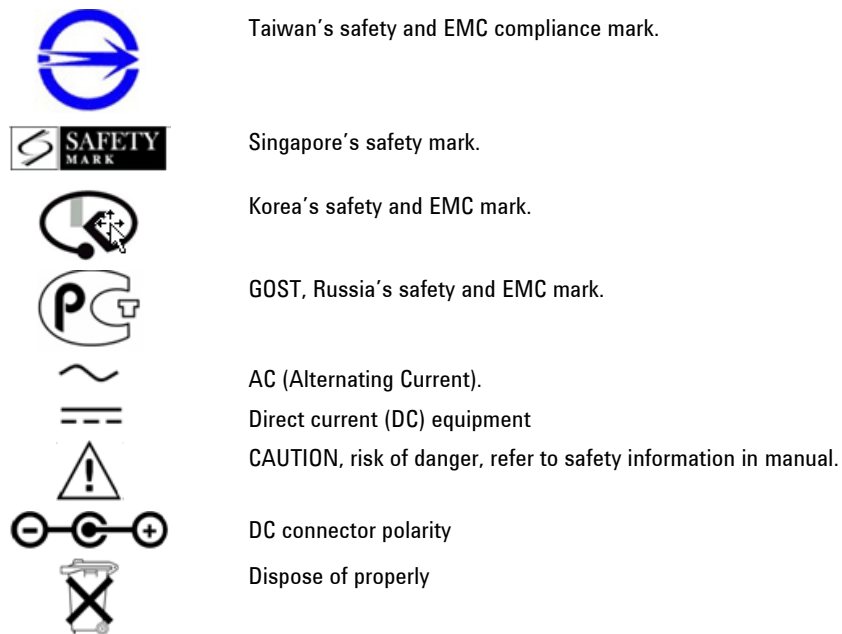
Certification and Compliance Statements

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 Maschinenlaermrerordnung –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	VVM
All Meas except DTF	Center	Frequency	Start	Frequency
Start	Start		Stop	
Stop	Stop		Center	
Center	Zero/last Span		Span	
Span	Freq Span			
	More			
All DTF Modes ONLY	Radio Standard			
Start Distance	CF Step			
Stop Distance	Full Span			
DTF Units	Back			
More				
Bandpass				
Center				
Bandpass				

Max Span
    Bandpass
Mode On Off
    Back				

Scale/Amptd .

CAT	SA	Power Meter	NA Mode	VVM

Autoscale
Scale/Div
Ref Level
Ref Pos
Top
Bottom
	Scale Type (Log Lin)
	Scale
	Ref Level
	Ref Pos
	RF Atten Auto Man
	More
	    Autoscale
	    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
				None

Marker

CAT	SA	Power Meter	NA Mode	VVM

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
				None

Mkr =>/ Tools .

CAT	SA	Power Meter	NA Mode	VVM

Peak
Next Peak
Peak Left
Peak Right
All except DTF
Marker=>Center
More
   Min Search
   Peak Excursion
   Peak Threshold
   Back
DTF ONLY
More
   Marker=>Start Distance
   Marker=>Stop Distance
   Track Peaks ON OFF
   Find 3 Peaks
   Back
	Peak
	Next Peak
	Marker=>Center
	Marker=>RefLev
	More
	   Min Search
	   Peak Excursion
	   Peak Threshold
	   Peak Left
	   Peak Right
	   Back
		None	Peak
			Next Peak
			Peak Left
			Peak Right
			Marker=>Center
			More
			   Min Search
			   Peak Excursion
			   Peak Threshold
			   Back
				None

Measure   1

CAT	SA	Power Meter	NA Mode	VVM

Distance to Fault (DTF)
Return Loss & DTF
Return Loss(dB)
VSWR
DTF (VSWR)
More
   Cable Loss (1-Port)
   Insertion Loss (2-Port)
   Back
	Radio Standard
	Channel Measurements
	   None
	   Channel Power
	   Occupied BW
	   Adjacent Channel Power
	Tune & Listen
	   None
	   AM
	   FM Narrow
	   FM Wide
	Interference Analysis (Opt 236)
	   None
	   Spectrogram
	   Waterfall
	All Meas Off
		None	S11
			S21
			A
			R
			Format
			   Log Mag
			   LinMag
			   VSWR
			   Phase
			   Smith
				1-Port Cable Trimming
				2-Port Transmission

BW 2

CAT	SA	Power Meter	NA Mode	VVM
Average 1	Res BW Auto Man Video BW Auto Man	Averaging On Off Num Averages	Average 1 IF BW	None

Sweep 3

CAT	SA	Power Meter	NA Mode	VVM
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 SwpAcquisition **Or in Zero Span** SweepTime Trigger Settings Trig Type Trig Slope Trig Delay Trig Level AutoTrigTime Back	Single Continuous On Off	Single Continuous On Off Restart Resolution [201] 201 | 401 | 601 | 801 | 1001 MinSwpTime 0.0	None

Meas Setup 4

CAT	SA	Power Meter	NA Mode	VVM
Settings Output Power High Interference Rej. Off Minimum Medium Maximum **DTF** **'Settings' ONLY**	AverageType AverageCount **In Chan Power:** Integ BW RRC Weighting More RRC Alpha	Averaging On Off Num Averages Unit dBm (dB) Watt (%) Back Relative On Off	Settings Output Power Hi Low Interference Rej. [Off] Off Minimum Medium Maximum Format	Zero Zero Off Hold Single Continuous ON OFF More Restart Avg 1 Back

DTF Window **DTF ONLY** DTF Cable Specs Velocity Factor Cable Loss Cable Corr Auto **Man** Recall Coax Cable View Cable Data Back **'DTF & Return Loss' ONLY** Alternate Sweep **DTF ONLY** Frequency Mode **Bandpass**	**In Occupied BW:** Power Percent **In ACPR:** Integ BW Offsets Offset 1,2,3 Offset State Offset Freq Offset Integ BW Back RRC Weighting More Meas Type Total Prw Ref Ref Value RRC Alpha Back	Frequency	Log Mag LinMag VSWR Phase Smith	

Cal 5

CAT	SA	Power Meter	NA Mode	VVM
See page 49	None	Ext Zero	See page 49	

Trace 6

CAT	SA	Power Meter	NA Mode	VVM
Data =>Mem **Data** Memory Data & Memory **All except DTF** Data Math **Math Off** Data + Mem Data - Mem	Trace 1 | 2 | 3 | 4 State [Blank] Clr/Wr MaxHold MinHold Average View Blank Default All Detector [Auto]	None	Data =>Mem **Data** Memory Data & Memory Data Math **Math Off** Data + Mem Data - Mem Data / Mem Back	None

Data / Mem **Back**	**Auto** **Normal** **PositivePeak** **NegativePeak** **Sample** **Average** **AverageCount 10** **Record Playback** **Prototype Control** **Record Source** **Rec Interval Sec** **Back**			

System   7

All Modes
Display
Display Colors
Outdoor Sun
Outdoor Dusk
Outdoor Clouds
Indoor
Night Vision
Back
Brightness
Title
Title On Off
Edit Keywords
Back
Full Screen
Preferences
Language
English
Espanol
Deutsch
Italiano
Francais
More
Japanese
Chinese
Back
Save Current Preferences
Reset Preferences

```
     Back
System Configuration
     Options (Licensing)
          Show Options
          Install Option
          Back
     Frequency Ref/Trig Input
          BNC Connect Use
          Freq Ref Source Int Ext
          Back
     Date and Time
     LAN
Service Diagnostics
     System Information
     Error Log
          Next Page
          Previous Page
          Clear Errors
     Battery
     Internal Temperatures
     Back
```

Limit   8

CAT	SA	Power Meter	NA Mode	VVM

Edit
   Left
   Right
   Clear Limit
   All Limits Off
   Exit
Save Limits
Recall Limits
Options
   Beep (On Off)
   Warning (On Off)
   Back
	All except ACPR:
	Edit
	   Left
	   Right
	   Clear Limit
	   All Limits Off
	   Exit
	Save Limits
	Recall Limits
	Options
	   Beep (On Off)
	   Warning (On Off)
	   Back
	
	In ACPR:
	Set Limits (1,2,3)
	   Lower Offset Limit
	   Upper Offset Limit
		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
				None

| | Back | | | |
| | Limit Test ON OFF | | | |

Save/Recall 9

All Modes

Save Shows labeler
    Select
    BackSpace
    Clear
    Cancel
    Done
Recall Shows list of files
    Recall File
    Delete
    Cancel
Device
    Internal
    SD Card
    USB
File Type
    State
    Trace
    Picture
    Data (S1P)
    Data (CSV)
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
Preset
Mode Preset
In SA Chan Meas:
Meas Preset

Run / Hold +/-

All Modes
Press to toggle between Continuous and Single sweep.
SA Mode has slightly different behavior. Learn more on page 66.

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	**Do Not**
• Keep connectors clean	• Touch mating-plane surfaces
• Extend sleeve or connector nut	• Set connectors contact-end down
• Use plastic end-caps during storage	• Store connectors or adapters loose

Visual Inspection	
Do	**Do Not**
• Inspect all connectors carefully	• Use a damaged connector - ever
• Look for metal particles, scratches,	
• and dents	

Connector Cleaning	
Do	**Do Not**
• Try compressed air first	• Use any abrasives
• Use isopropyl alcohol [a]	• Get liquid into plastic support beads
• Clean connector threads	

Gaging Connectors	
Do	**Do Not**
• Clean and zero the gage before use	• Use an out-of-specification connector
• Use the correct gage type	
• Use correct end of calibration block	
• Gage all connectors before first use	

Making Connections	
Do	**Do Not**
• Align connectors carefully	• Apply bending force to connection
• Make preliminary connection contact lightly	• Over tighten preliminary connection
• Turn only the connector nut	• Twist or screw any connection
• Use a torque wrench for final connection	• Tighten past torque wrench "break" point

[a] Cleaning 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.

Index

file management, 111
files
    managing, 114
    prefixes, 116
    printing, 117
    saving and recalling, 111
    types, 132
firmware, updating, 137
flash drive, USB, 133
FM Tune & Listen, 71
folders, 115
formats
    display, 140
        return loss, dB, 140
        Smith chart, 141
        VSWR or SWR, 141
frequency
    external reference, 123
    range, setting, 23
    step size, 57
front panel, 17

G

gauge, battery, 148
general information specifications, 171
getting started information, 11

H

hardkey/softkey menu, 189
high-temperature protection, 14
hold, 119
How 1-Port Measurements are Made, tutorial, 139
How do CAT and NA Modes Differ, tutorial, 139
how to
    add or edit a title, 121
    change
        frequency step size, 57
        time and date format, 124
        units to feet, 32
    check for a compressed measurement, 61
    connect the power sensor, 90
    control the preamp, 61
    create
        delta marker, 103
        limit lines, 107
        markers, 101
        noise marker, 70
    determine if a battery needs reconditioning, 150
    display "live" and memory traces, 108
    edit keywords, 115
    edit, enable and disable the current prefix, 116
    enable the marker table, 103
    enter

frequency of power measurement, 91
numeric values, 20
install options, 122
make
    1-port cable loss measurement, 28
    1-port cable trimming measurement, 99
    2-port insertion loss measurement, 29
    2-Port transmission measurement, 100
    DTF measurements, 31
    S21 transmission measurement, 45
manage files, 114
manage folders, 115
measure return loss, 27
monitor the internal FieldFox temperature, 14
move
    cursor, 112, 116
    marker, 101
    reference marker, 103
name files, 111
perform
    external battery reconditoning, 151
    external zeroing, 90
    internal reconditoning, 151
    normalization, 51
    O,S, L cal, 50
    QuickCal, 49
    single sweep while in Hold, 119
    trace math, 109
preset, 120
read data into Data Link software, 132
recall an *.sta file, 112
recondition battery with external battery charger, 151
save
    display settings as preferences, 122
    file, 111
save and recall limits, 108
scale the power meter display, 91
select
    CAT mode, 22
    CAT mode measurements, 22
    language, 121
    NA formats, 40
    NA measurements, 39
    NA mode, 39
    power meter mode, 90
    SA mode, 56
    VVM measurements, 97
    VVM mode, 97
    Windows settings, 35
    zeroing, 99

set
    alternate sweep, 36
    attenuation, 60
    bandpass mode ON, 33
    date and time, 124
    detection method, 69, 75, 76
    display colors, 120
    frequency range, 23, 56
    full screen mode, 121
    interference rejection, 27
    limit options, 107
    limits, 94
    output power, 27, 44
    peak criteria, 105
    power meter averaging, 93
    power meter display units, 92
    relative and offset power measurements, 92
    res BW, 61
    resolution, 26, 43
    scale, 24
    start and stop distance, 32
    start and stop frequency with alternate sweep, 36
    sweep acquisition parameter, 63
    sweep time, 26
    sweep type, 25, 43, 66, 93, 98
    trace averaging, 25
    video BW, 62
    zero span, 64
turn error correction OFF, 48
update firmware, 137
use
    external reference, 123
    marker search functions, 104
view and change Quick Settings, 23, 40
view the installed options, 122

I

icons, battery, 147
indicator (*), old data, 71
initial use, preparing for, 11
input voltages and power, maximum, 15
insertion loss measurements, 29
installing
    battery, 13
    data link software, 127
Interference Analyzer, 81
interference rejection, 27
internet, 128
Interpreting DTF Measurement Results, tutorial, 143

K

keywords, 115