
SignalHawk™

Operations Manual

Model SH-36S, SH-361S,
SH-362, & SH-362S

This is a preliminary manual. Specifications, limits, and text are subject to change without notice. The information within this manual was as complete as possible at the time of printing. Bird Electronic Corporation is not liable for errors.

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Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

WARNING

Keep Away From Live Circuits

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

WARNING

Shock Hazard

Do not attempt to remove the RF transmission line while RF power is present.

WARNING

Do Not Service Or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING

Safety Earth Ground

An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

WARNING

Resuscitation

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING

Remove Power

Observe general safety precautions. Do not open the instrument with the power on.

Safety Symbols

WARNING

Warning notes call attention to a procedure, which if not correctly performed, could result in personal injury.

CAUTION

Caution notes call attention to a procedure, which if not correctly performed, could result in damage to the instrument.

 **Note:** *Calls attention to supplemental information.*

Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel, and are repeated here for emphasis.

WARNING

When using the AC adapter, connect the AC plug only to a properly grounded receptacle. Serious injury or death can occur if not properly grounded.

See page 8.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.
Leaking RF energy is a potential health hazard.

See page 103.

WARNING

Care should be taken when handling batteries.
Keep out of the reach of children.
Do not heat or dispose of batteries in fire. May burst or release toxic materials.
Avoid forced discharge.
Do not short circuit.
Restrict charging current and time to the recommended value.
Do not solder the battery directly.
Do not disassemble, apply excessive pressure or deform.
Avoid placing the battery in reverse polarity.
Battery disposal method should be in accordance with local and state regulations.

See page 118.

Caution Statements

The following equipment cautions appear in the text and are repeated here for emphasis.

CAUTION

When using a Bird 5011 or 5011-EF, do not exceed 2 W average or 125 W peak power for 5 μ s.
Doing so will render the sensor inoperative.

See page 8.

CAUTION

Airflow is essential for proper unit operation. Do not obstruct the unit or soft case exhaust ports!

See page 9.

CAUTION

+20 dBm (100 mW) max. input for Spectrum Analyzer,
+22 dBm (160 mW) max. input for Vector Network Analyzer.
Do not apply high-power RF to the RF In test port. Exceeding the maximum input will damage the SignalHawk.

See page 9 and 99.

CAUTION

Vector Network Analyzer has a
+22 dBm (160 mW) max. RF input.
Exceeding the maximum input will damage the SignalHawk. If unsure of power levels, measure the test connection with a power sensor before using the SignalHawk.

See page 18.

CAUTION

Spectrum Analyzer has a +20 dBm (100 mW) max. RF input.
Exceeding the maximum input will damage the SignalHawk. If unsure of power levels, measure the test connection with a power sensor before using the SignalHawk.

See page 20.

CAUTION

SignalHawk testports are not used for power measurement. Always use an external sensor!

See page 99.

CAUTION

Always turn off the SignalHawk before connecting or disconnecting a sensor.

See page 99.

CAUTION

Harsh or abrasive detergents, and some solvents, can damage the display unit and information on the labels.

See page 117.

Safety Statements

USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERLO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL.

ZUR VERMEIDUNG GEFÄHRLICHER, ELEKTRISCHER SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRETIEN

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

UNITS ARE EQUIPPED WITH RECHARGEABLE BATTERIES.

THESE ARE TO BE REPLACED BY AUTHORIZED SERVICE PERSONNEL ONLY!!!

LAS UNIDADES VIENEN EQUIPADAS CON BATERIAS RECARGABLES.

¡¡¡Y SOLAMENTE EL PERSONAL DE SERVICIO AUTORIZADO PUEDE REEMPLAZARLAS!!!

GERÄTE SIND MIT WIEDER AUFLADBAREN BATTERIEN BESTÜCKT.

BATTERIEN SIND NUR VON QUALIFIZIERTEM SERVICE PERSONAL AUSZUWECHSELN!!!

CES DISPOSITIFS SONT ÉQUIPÉS DE BATTERIES RECHARGEABLES.

SEUL LE PERSONNEL D'ENTRETIEN AUTORISÉ EST HABILITÉ À LES REMPLACER !

LE UNITÀ SONO DOTATE DI BATTERIE RICARICABILI,

CHE DEVONO DA COME SPECIFICATO DAL PRODUTTORE LA PROTEZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

USE CORRECT VOLTAGE SETTING AND FUSE - SEE MANUAL.

UTILISER UNE TENSION ET UN FUSIBLE CORRECTS - CONSULTER LE MODE D'EMPLOI.

USE LA INSTALACION Y FUSIBLE DE VOLTAJE CORRECTO - VEA EL MANUAL.

**AUSSCHLIESSLICH VORSCHRIFTSMÄSSIGE
WECHSELSPANNUNGS-EINSTELLUNG UND SICHERUNG
BENUTZEN - SIEHE DAZU HANDBUCH.**

UTILIZZARE TENSIONE E FUSIBLE ADATTI - FARE RIFERIMENTO AL MANUALE.

BE SURE THE 115/230V AC VOLTAGE SELECTOR IS SET TO THE PROPER LINE VOLTAGE, AND THE CORRECT AC LINE FUSE IS INSTALLED BEFORE AC POWER IS APPLIED.

S'ASSURER QUE LE SÉLECTEUR DE TENSION 115/230V C.A. EST BIEN RÉGLÉ POUR LA TENSION DU RÉSEAU ET QUE LE FUSIBLE DE LIGNE C.A. CORRECT EST EN PLACE AVANT DE METTRE SOUS TENSION C.A.

CERCIORESE QUE EL SELECTOR DE VOLTAJE DE 115/230V CA ESTE COLOCADO A LA LINEA DE VOLTAJE APROPIADA Y QUE EL FUSIBLE ESTE INSTALADO A LA LINEA CA ANTES DE APLICAR LA CORRIENTE ALTERNA.

VOR EINSCHALTEN DER WECHSELSTROMZUFUHR SICHERSTELLEN, DASS DER 115/230V WECHSELSPANNUNGS-SELEKTOR AUF DIE VORSCHRIFTSMÄSSIGE LEITUNGSSPANNUNG EINGESTELLT UND DIE RICHTIGE WECHSELSTROM-HAUPTSICHERUNG EINGESETZT IST.

PRIMA DI EROGARE CORRENTE, ASSICURARSI CHE IL SELETTORE DI VOLTAGGIO 115/230 V.C.A. SIA REGOLATO CORRETTAMENTE E CHE IL FUSIBLE ADATTO ALLA LINEA DI ALIMENTAZIONE C.A. SIA INSTALLATO.

**RF VOLTAGE MAY BE PRESENT IN RF ELEMENT SOCKET - KEEP
ELEMENT IN SOCKET DURING OPERATION.**

**DE LA TENSION H.F. PEUT ÊTRE PRÉSENTE DANS LA PRISE DE
L'ÉLÉMENT H.F. - CONSERVER L'ÉLÉMENT DANS LA PRISE LORS
DE L'EMPLOI.**

**HF-SPANNUNG KANN IN DER HF-ELEMENT-BUCHSE ANSTEHEN -
ELEMENT WÄHREND DES BETRIEBS EINGESTÖPSELT LASSEN.**

**PUEDO HABER VOLTAJE RF EN EL ENCHUFE DEL ELEMENTO RF -
MANTENGA EL ELEMENTO EN EL ENCHUFE DURANTE LA
OPERACION.**

**IL PORTAELEMENTO RF PUÒ PRESENTARE VOLTAGGIO RF -
TENERE L'ELEMENTO NELLA PRESA DURANTE IL
FUNZIONAMENTO.**

About This Manual

This manual covers the operating and maintenance instructions for the following models:

SH-36S	SH-361S
SH-362	SH-362S

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Solon, Ohio factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

Literature Contents

Start-up Instructions

The Start-up Instructions contains minimum operational steps and the order they should be performed. Use this manual for reference or if further explanation of any step is required.

Operations Manuals

Chapter Layout

Introduction — Describes the features of the Bird SignalHawk, lists equipment supplied and optional equipment, and provides power-up instructions.

Vector Network Analysis Settings — Describes how to connect SignalHawk to the user's system, describes the vector network analyzer measurements, and provides quick start steps for each measurement.

Vector Network Analysis Measurements — Describes the power measurement feature, lists compatible power sensors, describes how to connect SignalHawk to the user's system, and provides quick start steps to make power measurements.

Vector Network Analysis PC Tool - Describes how to use the SignalHawk's PC Tool for the Vector Network Analysis function and how to transfer readings from the SignalHawk to the computer and back again.

Spectrum Analyzer Settings — Describes how to connect SignalHawk to the user's system, describes the spectrum analyzer measurements, and provides quick start steps for each measurement.

Spectrum Analyzer Measurements — Describes the power measurement feature, lists compatible power sensors, describes how to connect SignalHawk to the user's system, and provides quick start steps to make power measurements.

Spectrum Analysis PC Tool - Describes how to use the SignalHawk's PC Tool for the Vector Network Analysis function and how to transfer readings from the SignalHawk to the computer and back again.

Power Measurements — Describes the Menu key and Soft key functions for setting up power measurements.

Utilities — Describes built-in instrument utility features and how to use them.

Maintenance — Lists routine maintenance tasks as well as troubleshooting for common problems. Specifications and parts information are also included.

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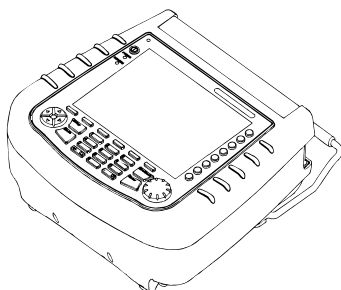
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The SignalHawk is a multifunction test instrument for use in the installation and maintenance of Radio Frequency (RF) and wireless systems. The model number is identified on the unit and also on the display screen at the end of the power-on sequence. The frequency range is dependant on the model:

- Models SH-362S:
 - Spectrum Analyzer 100 kHz - 3.6 GHz
 - 2 Port Vector Network Analyzer 325 MHz - 3.6 GHz
- Models SH-361S:
 - Spectrum Analyzer 100 kHz - 3.6 GHz
 - 1 Port Vector Network Analyzer 325 MHz - 3.6 GHz
- Models SH-362:
 - 2 Port Vector Network Analyzer 325 MHz - 3.6 GHz
- Models SH-36S:
 - Spectrum Analyzer only - 100 kHz - 3.6 GHz.

The SignalHawk also can control and display readings from Bird power sensors 5010B, 5011, and 5012.

The firmware installed on the SignalHawk is updated on a regular basis. The operator's manual covers the most recent upgrade to the firmware up to the date listed on the manual. Not all SignalHawk models have the current revision of the firmware. Please upgrade the firmware to obtain the most current revision. Upgrades can be downloaded at the site listed below.

<http://www.bird-technologies.com/sh>

Items Supplied

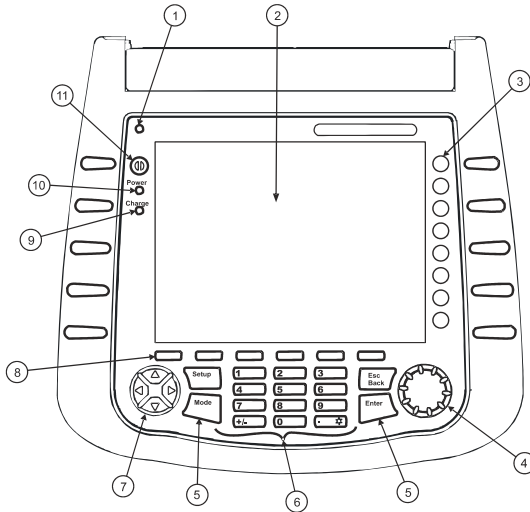
Figure 1 Hardware and Software Supplied



Item	Description
1	SignalHawk, with Li-Ion battery pack installed. Stand on back can be rotated to four positions, and can also be used as a carry handle.
2	DB-9 RS-232 serial communications cable
3	Cigarette lighter adapter
4	USB cable
5	1 GB USB memory drive
6	AC power adapter with detachable cord
7	Audio head set
8	CD with manuals and PC Tool software. 7002A840 - Vector Network Analysis PC Tool Software 7002A210 - Spectrum Analysis PC Tool Software
9	Soft carry case, featuring connector weather covers, carry handles, detachable accessory pouch, and detachable shoulder strap
---	Not shown are the Start-up Instructions, Operations Manual, and rain flap (which can be installed on unit when not using the soft carry case).

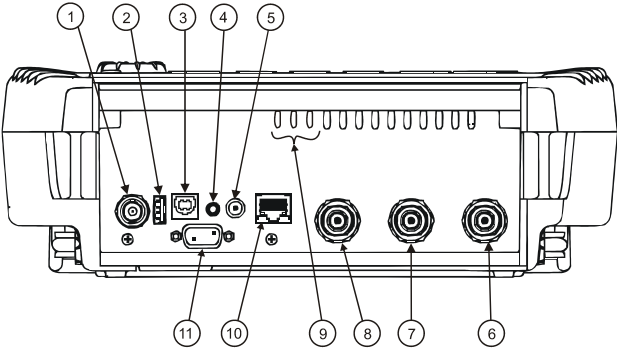
Looking at the SignalHawk

Figure 2 Controls and Indicators



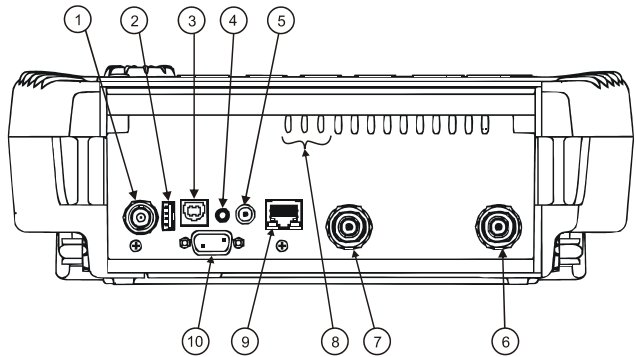
Item	Description
1	Light sensor. Do not cover when using backlight in automatic mode.
2	Display screen
3	Eight blue “soft keys.” Press to activate the function or option displayed in the label next to it on the display. Label and key function will change depending on which menu is active.
4	Thumbwheel, used to move in lists, choose options, and increase or decrease numbers.
5	Green “Special” keys. Setup, Mode, Esc/Back and Enter. Setup: Go to the Setup Menu. In setup, pre-defined measurement parameters can be selected and loaded. Factory setups cannot be changed. User-defined setups can be created, changed, and deleted. Mode: Go to the Start Menu. Esc/Back: Cancel data entry or return to the previous screen. Enter: Select an item or complete entering a number.
6	Numeric keypad, used to enter values
7	Arrow keys (up, down, left, right), used to move in lists, choose options, and increase or decrease numbers.
8	Six yellow “menu keys”. A label is displayed just above each key on the display. Press to change the soft keys to the functions associated with this menu.
9	Amber “Charge” LED Off when not connected to external ac On continuously when battery is fully charged Blinks slowly when battery is charging Blinks rapidly when a battery problem exists
10	Green “Power” LED On while the unit is turned on.
11	Power ON/OFF switch

Figure 3 Connector Panel - SH-362S



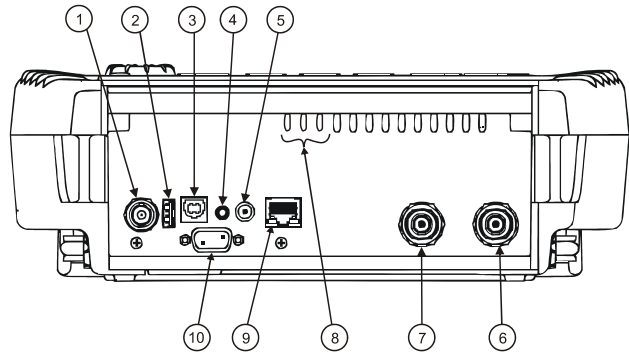
Item	Description
1	BNC(F) external trigger input, 5V TTL
2	USB Type A for USB drive and accessories
3	USB Type B for PC connection
4	3.5mm mini-headphone jack
5	2.5mm DC jack for external power supplies
6	VNA Thru Port
7	VNA Test Port
8	Spectrum Analyzer Port, N(F) RF input, +20 dBm max.
9	Internal Speaker and air inlet ports. There is also an air exhaust on the back of the unit. Do not block the inlet or exhaust.
10	RJ-45 LAN Jack  Note: Ethernet connections are not currently supported.
11	RS-232 dB-9(F) connector for power sensors

Figure 4 Connector Panel - SH-361S

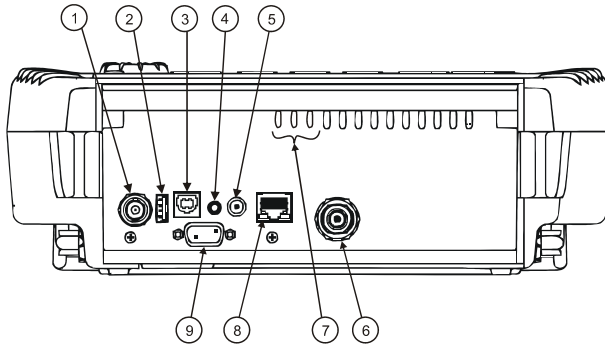


Item	Description
1	BNC(F) external trigger input, 5V TTL
2	USB Type A for USB drive and accessories
3	USB Type B for PC connection
4	3.5mm mini-headphone jack
5	2.5mm DC jack for external power supplies
6	VNA Test Port
7	Spectrum Analyzer Port, N(F) RF input, +20 dBm max.
8	Internal Speaker and air inlet ports. There is also an air exhaust on the back of the unit. Do not block the inlet or exhaust.
9	RJ-45 LAN Jack  Note: <i>Ethernet connections are not currently supported.</i>
10	RS-232 dB-9(F) connector for power sensors

Figure 5 Connector Panel - SH-362



Item	Description
1	BNC(F) external trigger input, 5V TTL
2	USB Type A for USB drive and accessories
3	USB Type B for PC connection
4	3.5mm mini-headphone jack
5	2.5mm DC jack for external power supplies
6	VNA Thru Port
7	VNA Test Port
8	Internal Speaker and air inlet ports. There is also an air exhaust on the back of the unit. Do not block the inlet or exhaust.
9	RJ-45 LAN Jack  Note: <i>Ethernet connections are not currently supported.</i>
10	RS-232 dB-9(F) connector for power sensors

Figure 6 Connector Panel - SH-36S

Item	Description
1	BNC(F) external trigger input, 5V TTL
2	USB Type A for USB drive and accessories
3	USB Type B for PC connection
4	3.5mm mini-headphone jack
5	2.5mm DC jack for external power supplies
6	Spectrum Analyzer Port, N(F) RF input, +20 dBm max.
7	Internal Speaker and air inlet ports. There is also an air exhaust on the back of the unit. Do not block the inlet or exhaust.
8	RJ-45 LAN Jack  Note: <i>Ethernet connections are not currently supported.</i>
9	RS-232 DB-9(F) connector for power sensors

Power Supply

Internal Battery

The SignalHawk has an internal, rechargeable, lithium-ion battery pack that will operate the unit for a minimum of 3 hours of continuous use. Recharging time, from a full discharge, is approximately 4 hours. When running the unit on battery power, the % battery life remaining is displayed in the lower right corner of the screen.

 **Note:** *When the unit is shipped from the factory, the battery may not be fully charged. Use an AC adapter when you operate the unit for the first time.*

Power Adapters

WARNING

When using the AC adapter, connect the AC plug only to a properly grounded receptacle. Serious injury or death can occur if not properly grounded.

The SignalHawk can be operated using the supplied AC adapter or a 12V automobile cigarette lighter adapter. Using these adapters will also charge the internal battery.

Getting Started With The SignalHawk

CAUTION

Airflow is essential for proper unit operation. Do not obstruct the unit or soft case exhaust ports!

CAUTION

+20 dBm (100 mW) max. RF input for the Spectrum Analyzer and +22 dBm (160 mW) max. RF input for the Vector Network Analyzer.

Exceeding the maximum input will damage the SignalHawk. If unsure of power levels, measure the test connection with a power sensor before using the SignalHawk.

Press the Power button to turn on the unit. The screen will show the Bird Technologies Group logo and then boot the SignalHawk software. During bootup, the unit will perform an automatic self-test. After about 30 seconds, the unit will display the Start Menu (see Figure 8) and be ready for use.

Start Menu, Menu Keys

Menu keys are the six rectangular yellow keys located below the display screen. Press a menu key to move the highlight selection bar to the menu list with the same name as the key you pressed. When using a menu list, use the selection dial or the up- and down-arrow keys to move the highlight bar through the list. Use the left- and right-arrow keys to move to a different list box.

Spec Analysis Menu Key

Press this key to move the highlight selection bar into the Spectrum Analyzer list box.

Power Meter Menu Key

Press this key to move the highlight selection bar into the Power Meter list box.

Utilities Menu Key

Press this key to display the Utility Menu main screen. The Utilities menu provides information about the instrument software, amount of available memory, battery charge status, system date and time, and how to contact Bird Technologies Group.

Help Menu Key

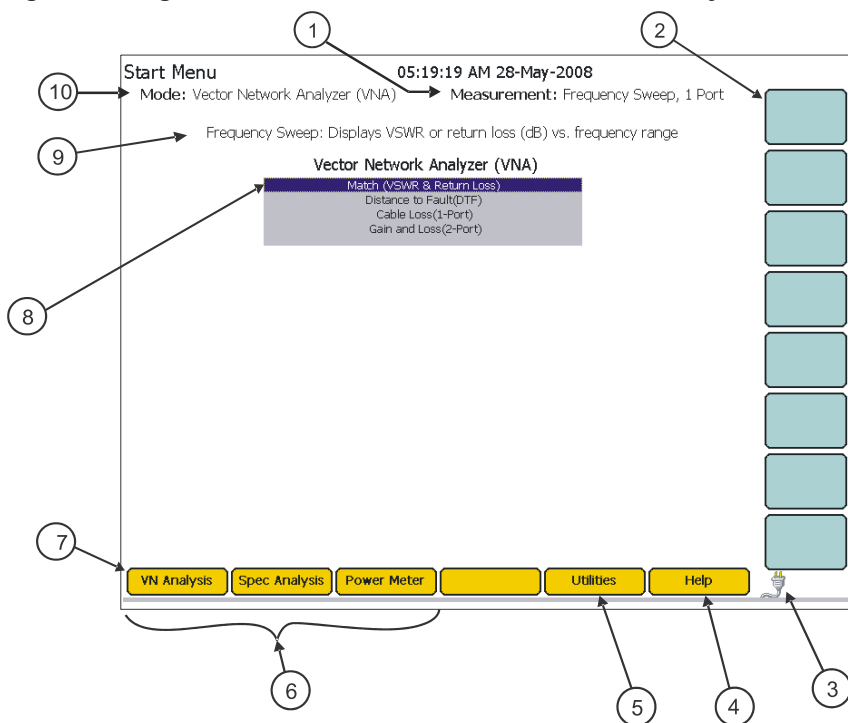
Displays the Help soft keys but does not exit the current screen. Press the Back... soft key to display the default soft keys for the current menu.

Operations Manual (Quick Start Guide) - This manual contains quick start steps for measurements and for the Menu keys.

Menu List - displays the list of all measurements available in the active operating mode. This list can be expanded and collapsed to reveal or hide more detail about the measurement, such as setup parameters and custom configurations.

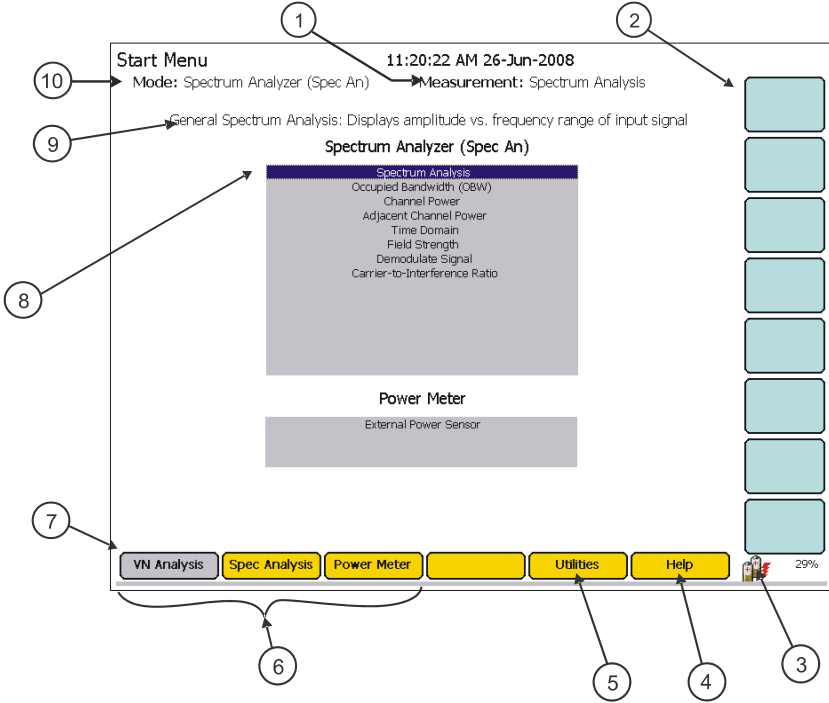
Reference Manual (User Manual) - This manual expands upon the information in the Operations Manual to include complete descriptions of features, measurement setup parameters, and system setup options.

Back... - This soft keys exits Help and returns to the features for the currently active menu.

Figure 7 SignalHawk Start Menu - Vector Network Analyzer

Item	Description
1	Name of measurement being used
2	Soft keys
3	Power source icon (AC, battery, or battery charging)
4	Go to the Help menu. Press Esc/Back to return here. There are two functions in the help menu. <i>Quick Start Guide:</i> Help file with just enough information to get you started making measurements. Press the menu key above the Esc/Back button to return. <i>User Manual:</i> Displays the Quick Start Guide.
5	Go to the Utilities menu. See "Utilities" on page 113.
6	Select a measurement mode list window.
7	Menu keys
8	Selected measurement (highlighted)
9	Name and brief description of highlighted measurement
10	Current active operating mode

Figure 8 SignalHawk Start Menu - Spectrum Analyzer



Item	Description
1	Name of measurement being used
2	Soft key labels
3	Power source icon (AC, battery, or battery charging)
4	Go to the Help menu. Press Esc/Back to return here. There are two functions in the help menu. <i>Quick Start Guide:</i> Help file with just enough information to get you started making measurements. Press the menu key above the Esc/Back button to return. <i>User Manual:</i> Displays the Quick Start Guide.
5	Go to the Utilities menu. See Chapter 8, page 113.
6	Select a measurement mode list window.
7	Menu key labels
8	Selected measurement (highlighted)
9	Name and brief description of highlighted measurement
10	Current active operating mode

Set-Up Menu

The Setup Menu allows access to saved setups and settings used previously on the SignalHawk. Press the Setup button to access the menu.

Figure 9 Setup Menu

Setup Menu 07:36:57 AM 18-Aug-2008

Mode: Spectrum Analyzer (Spec An) Measurement: Adjacent Channel Power

Setup: 870.292500-873.982500 MHz, RBW: 10 kHz, VBW: 3 kHz

Adjacent Channel Power: Measure the ratio of leakage power in the adjacent power channel

Previous Setup:

General VNA(08-

Setup Label:	Backup SA
File Path:	\\FlashFX Disk\\My Setups\\Backup
File Size:	0 bytes
Setup:	Spectrum Analysis Adjacent Cha
Setup Type:	Custom
Creation Date:	02:37:45 PM 14/08/2008
Change Date:	02:37:45 PM 14/08/2008
Date Last Used:	02:37:45 PM 14/08/2008
History:	
Favorites:	No
Auto Start:	No
Start Freq:	870.292500 MHz
Stop Freq:	873.982500 MHz
Center Freq:	872.137500 MHz
Freq Span:	3.690000 MHz
Amplitude Offset:	0.000 dBm
Resolution Bandwidth:	10 kHz Auto Mode
Video Bandwidth:	3 kHz Auto Mode
RBW to VBW Ratio:	3
Frequency Span to RBW Ratio:	300
Reference:	-3.2 dBm

Setup has changed

Setup Label - Internal name assigned by operator.

Next Setup:

Backup VNA

Label & Save Setup

Recall Setup

Delete

Top of List

Bottom of List

View Next Setup

View Previous Setup

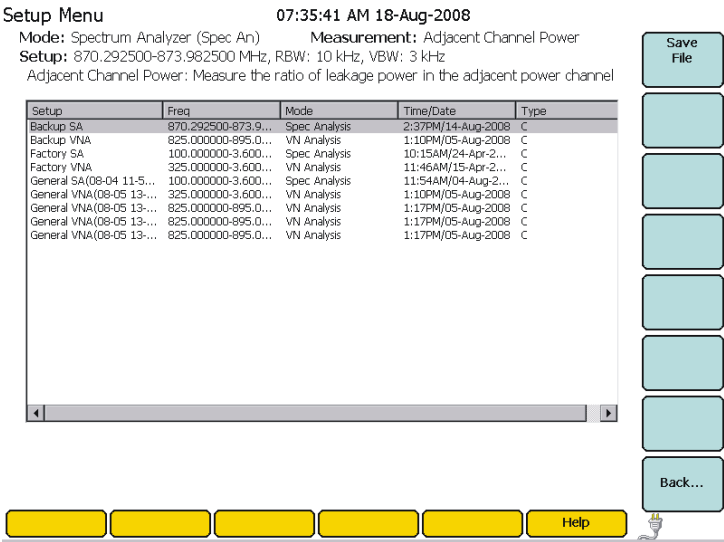
Help

Quick Save Setup

The saved settings are stored as a file in the internal flash drive of the instrument. Each quick save is stored in a separate file that is named using the date-time file naming format *PwrYYYYM-MDDH-MMSS.csv* where YYYY is the year, the first MM is the month, DD is the day, HH is the hour, the second MM is the minute, and SS is the second of the time when the file was saved.

Label & Save Setup

Figure 10 Setup Menu - Save



Labels and saves the settings for a setup for future use.

To save a Setup:

1. Press the Save Trace softkey.
2. Enter a file name using the thumbwheel and arrow keys.

Note: Up-and-down arrow keys to move vertically and the wheel to move horizontally along the Input Panel. Use the right-and-left keys to toggle between the text fields (Name, Title, etc.)

Recall Setup

Recalls a saved setup and sets the instrument parameters to run the recalled setup.

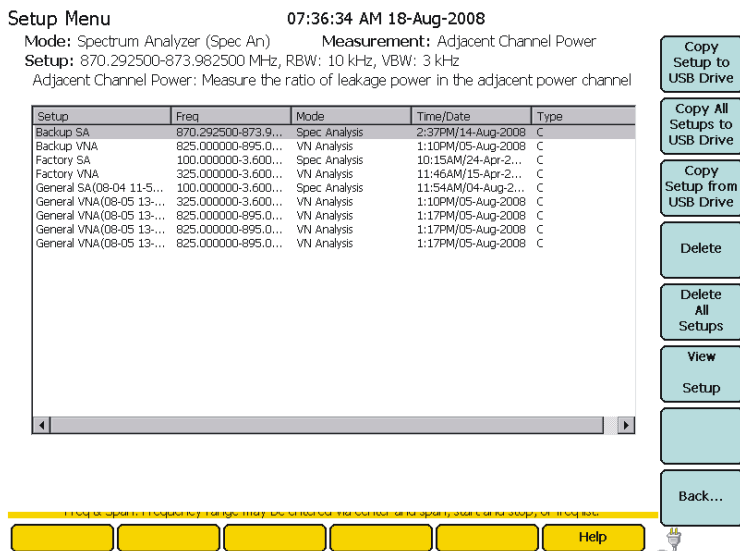
Recall Default Setup

Recalls the factory default setup and sets the instrument parameters to run this setup.

Manage Setup Files

Allows access to the file management of the saved Setups.

Figure 11 Setup - Manage Setup Files



Copy Setup to USB Drive

Copies the selected Setup on the list to a connected USB network drive.

Copy All Setups to USB Drive

Copies the all the Setups on the list to a connected USB network drive.

Copy Setup from USB Drive

Copies a saved Setup from a connected USB network drive.

Delete

Deletes the selected Setup on the list.

Delete All Setups

Deletes all of the Setups on the list.

View Setup

See “View Setup” on page 16 in the Setup Menu.

View Setup

Displays the properties of a selected saved Setup on the list.

Figure 12 Setup - View Setup



Label & Save Setup

Labels and saves the settings for a setup for future use.

See “Label & Save Setup” on page 14.

Recall Setup

Recalls a saved setup and sets the instruments parameters to run the recalled setup.

Delete

Deletes the displayed Setup.

Top of List

Displays the Setup from the top of list of saved Setups.

Bottom of List

Displays the Setup from the bottom of list of saved Setups.

View Next Setup

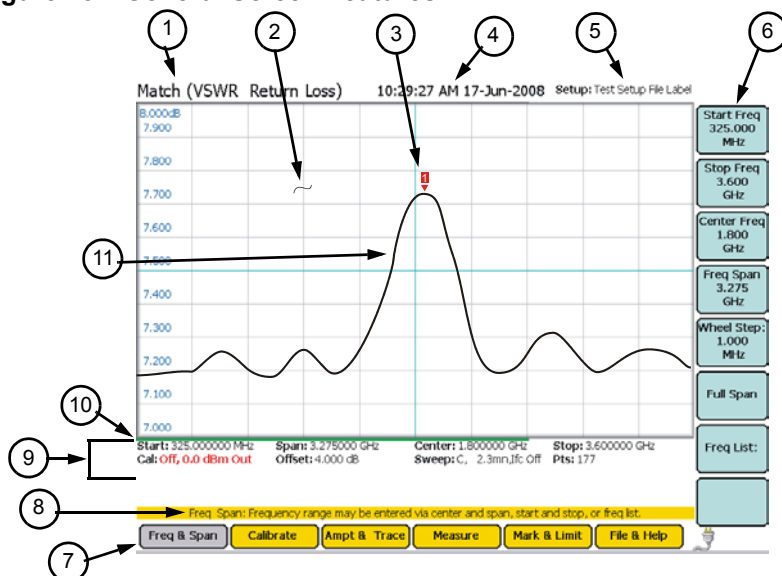
Displays the next Setup on the list of saved Setups.

View Previous Setup

Displays the previous Setup on the list of saved Setups.

Looking At The Screen

Figure 13 General Screen Features



Item	Description
1	Name of selected measurement (Match in this case)
2	Sweep display area
3	Marker
4	Date and time
5	Name of setup file being used
6	Soft key labels
7	Menu key labels
8	Help tips for the current screen
9	Measurement settings
10	Sweep progress bar
11	Data trace

Vector Network Analyzer Quick Start

CAUTION

Vector Network Analyzer has a
+22 dBm (160 mW) max. RF input.

Exceeding the maximum input will damage the
SignalHawk. If unsure of power levels, measure the
test connection with a power sensor before using the
SignalHawk.

1. Measure the output power, or signal power, at the system's test port using a power meter, service monitor, or equivalent.

 **Note:** *Ensure the outlet power is less than +22 dBm (160 mW).*

2. Power up the SignalHawk.
3. In the Start Menu, use the arrow keys to highlight the desired measurement, and press Enter.
4. In the Freq & Span Menu, set the frequency range (See "Freq & Span Menu" on page 54).
5. Do one of the following:
 - **For Match or Cable Loss Measurement:**
 - a. Select either the Match or Cable Loss measurement.
 - b. Press Calibrate
 - c. Select Open, Short, or Load (soft keys) on RF Out corresponding with a calibrated open, short, or load frequency on the RF Out port.
 - d. Connect the cable and antenna to the RF Out test port.

 **Note:** *Maximum input is +22 dBm (160 mW).*

- **For Distance-to-Fault (DTF) Measurement:**
 - a. Press Measure then Measure: Match and then DTF (soft keys).
 - b. Press Ampt & Trace then Units (soft key) then select VSWR or Rtn Loss dB.
 - c. Press Measure then select either Meter or Feet in Distance Units (soft key).
 - d. Press DTF Wizard (soft key), follow instructions displayed, then skip to step 9.

 **Note:** For Manual setup of DTF, follow steps e to m.

- e. Connect the cable and antenna to the RF Out test port.

 **Note:** Maximum input is +22 dBm (160 mW).

- f. Press Cable then Cable List (soft keys).

- g. Scroll to desired cable and press Select or Enter.

 **Note:** May also manually enter cable Vp and Loss.

- h. Press Ampt & Trace then Autoscale (soft key) to view trace on display OR manually adjust scale with Max and Min Level settings.

- i. Press Sweep then Data Points (soft keys).

- j. Adjust data points until stop distance is just greater than the length of cable.

 **Note:** If needed, repeat steps 7 and 8.

- k. Press Calibrate

- l. Select Open, Short, or Load (soft keys) on RF Out corresponding with a calibrated open, short, or load frequency on the RF Out port.

- m. Connect the cable and antenna to the RF Out test port.

 **Note:** Maximum input is +22 dBm (160 mW).

- 14. Press Amplitude then Units (soft key) select VSWR or Rtn Loss dB.

- 15. Press Autoscale (soft key) to view trace on display OR manually adjust scale with Max and Min Level.

- 16. Wait for one sweep, then go into the Amplitude Menu and press Autoscale (see “Ampt & Trace Menu” on page 64).

- 17. In the File & Help Menu, press Quick Save Trace to save the data (see “File & Help Menu” on page 69).

Spectrum Analyzer Quick Start

CAUTION

Spectrum Analyzer has a +20 dBm (100 mW) max. RF input.

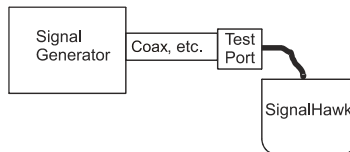
Exceeding the maximum input will damage the SignalHawk. If unsure of power levels, measure the test connection with a power sensor before using the SignalHawk.

1. Measure the output power, or signal power, at the system's test port using a power meter, service monitor, or equivalent.

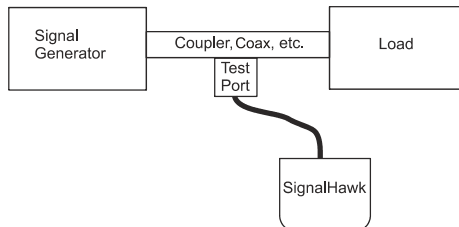
Note: *Ensure the outlet power is less than +20 dBm (100 mW).*

2. Connect the SignalHawk's "RF Input" connector:

- **For low-power connections**, connect to the test port connected directly to the signal generator. See the below graph:



- **For high-power connections**, connect to the test port connected directly to the coupler between the signal generator and load. See the below graph:



3. Power up the SignalHawk.
4. In the Start Menu, use the arrow keys to highlight the desired measurement, and press Enter.
5. In the Freq & Span Menu, set the frequency range (See "Freq & Span Menu" on page 54).

6. Wait for one sweep, then go into the Amplitude Menu and press Autoscale (see “Ampt & Trace Menu” on page 64).
7. In the Measurement menu, select the desired measurement.
 - "Spectrum Analysis Measurement" on page 74.
 - "Occupied Bandwidth Measurement" on page 75.
 - "Channel Power Measurement" on page 77.
 - "Adjacent Channel Power Measurement" on page 79.
 - "Field Strength Measurement" on page 81.
8. Turn on markers or limit lines if needed (see “Marker On/Off” on page 66 and "Limit Lines" on page 67).
9. Make a sweep.
10. In the File & Help Menu, press Quick Save Trace to save the data (see “File & Help Menu” on page 69).

Chapter 2 Vector Network Analyzer Settings

The proper settings are very important to obtaining the most accurate information possible. The SignalHawk can be configured in various ways, allowing for a wide range of measurement capabilities.

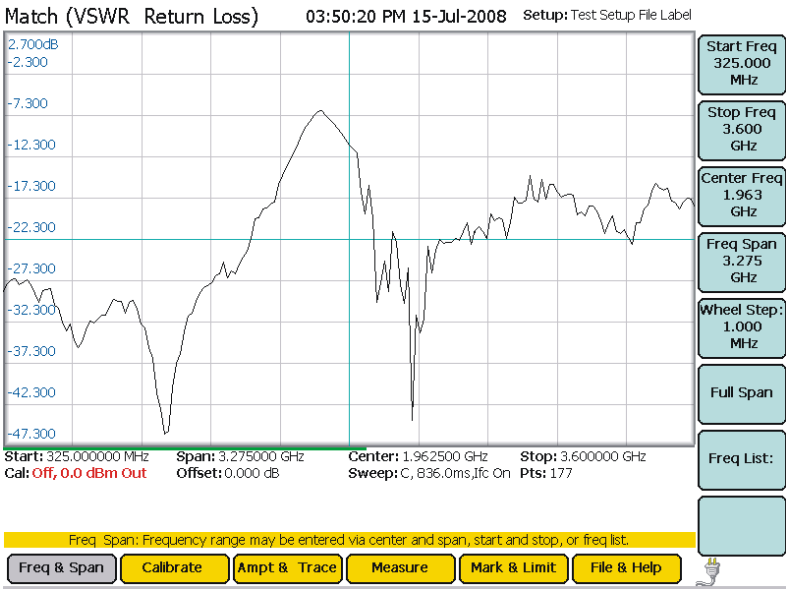
Core Soft Key Functions

“Soft Keys” serve multiple functions on the SignalHawk. There are four core functions that these keys serve:

1. **On/Off Button** - Push to move switch a function on or off.
2. **Pop-Up Menu Button** - Push to pop-up lists and drop menus. Use the arrow key, wheel, etc. to select from the pop-up (e.g. Freq list).
3. **Highlight Button** - Push to highlight selectable variants (e.g. Freq).
4. **Trigger Event Button** - Push to start a function (Full Span).

Freq & Span Menu

Figure 14 Freq & Span Menu



In the Freq & Span Menu the range of frequencies to sweep are specified. The SH-361S can sweep frequencies between 325 MHz and 3.6 GHz.

Frequencies can be selected at spans from 1 kHz up to the entire range of the instrument. These frequencies can be set to sweep by one of the following methods:

- Set the Center Freq and Freq Span.
- Set the Start Freq and Stop Freq.
- Select the Full Span of the instrument.
- Select a band from the Freq List.

The most common of these methods is to set the center frequency and a frequency span (a range) and let the SignalHawk calculate the start and stop frequencies for the sweep. Reducing the span will usually provide more detail and lower the noise floor. For many measurements, set the center frequency to the center of the signal being tested.

Start / Stop Freq and Center / Span

Both pairs of these settings control which range of frequencies are swept. “Center / Span” are used in this manual, but using “Start / Stop Freq” achieves the same results. After pressing the softkey, it indicates what is active by highlighting it. Then the following can be performed:

- **Up/Down Arrow Keys:** Increase and decrease frequencies in small steps. Increase and decrease span by a factor of 10.
- **Left/Right Arrow Keys:** Increase and decrease frequencies in large steps. Increase and decrease span by a factor of 2.
- **Thumbwheel:** Each click of the thumbwheel changes the frequency or span by the value of the “Wheel Step” softkey.
- **Number Keys:** Press any key except +/- to open a box to type the new frequency into. In cases of a mistake, press “Esc/Back”. When done, press enter (to keep the same frequency units) or press the correct units softkey.

Wheel Step

When another frequency function is active and the thumbwheel is turned, the value will change in steps of the “Wheel Step”. After pressing the “Wheel Step” softkey to highlight it, the following is enabled:

- **Up/Down Arrow Keys and Thumbwheel:** Change the step value by a small amount.
- **Left/Right Arrow Keys:** Change the step value by a large amount.
- **Number Keys:** Press any key except +/- to open a box to type the new frequency into. If a mistake is made, press esc/back. When done, press enter (for value in GHz, unless the default is not in GHz), or press the correct units softkey.

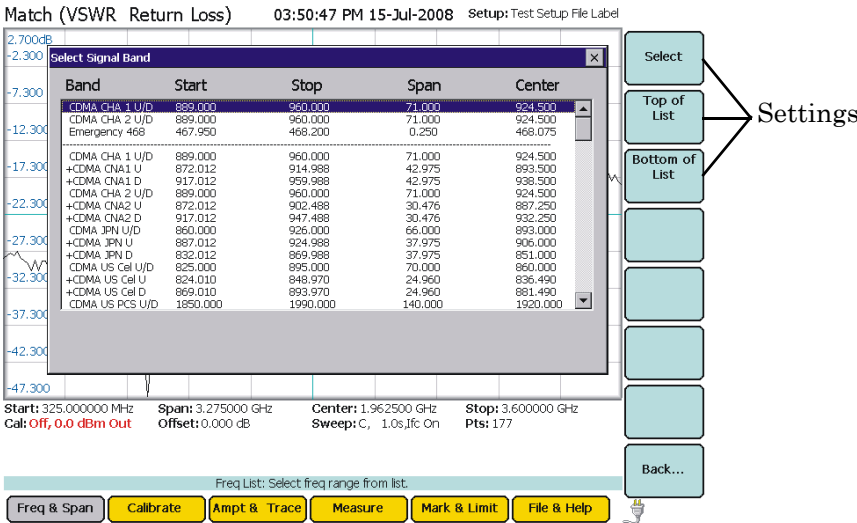
Full Span

Press this to set the Start Freq to 325 MHz, and the Stop Freq to the max freq of the unit, currently 3.6 GHz.

Freq List

Pressing this opens up a list of predefined frequency bands. Use the up/down arrows and thumbwheel to scroll to the desired band, then press the “Select” softkey to use it. Recently used bands are displayed at the top of the list.

Figure 15 Example, Freq List



Calibrate Menu

Ensure that the calibration is done properly. For the best results, use a Bird calibration kit. If calibration is not done properly, the readings from the VNA will be wrong.

 **Note:** *Set any parameters that the calibration may depend on BEFORE starting the calibration of the unit.*

 **Note:** *If the SignalHawk is not calibrated before taking measurements, readings will be wrong. Calibrating should be done after setting everything else, and before making measurements.*

 **Note:** *Many factors play a key role in proper calibration. Be sure to mind the internal temperature of the unit as well as length of time between calibrations. Also, many setting changes, especially changing the frequency setting, can turn calibration off.*

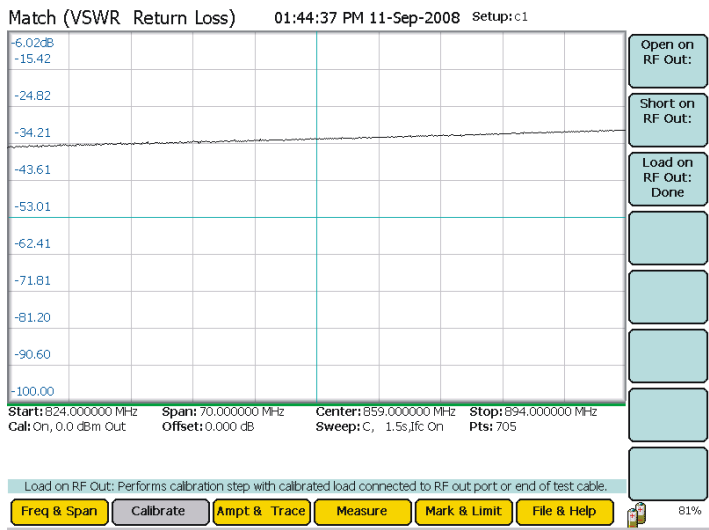
1. Connect one of the following to the RF connector:
 - Open
 - Short
 - Load (the “calibration standard”)
 - Cable From RF Out to RF In (2-Port measurement only)
2. Press the corresponding button in the calibrate menu.
3. Wait for the sweep to finish: the button will un-highlight and “Done” will appear in the label.

 **Note:** *If the key is pressed again, it will re-take that sweep.*

4. Remove calibration standard, put a different one on.
5. Repeat steps 1 to 4 until all calibration types are done.
6. Wait while the unit processes the information. When ready, the unit will exit the Calibrate menu and read “Cal On.”

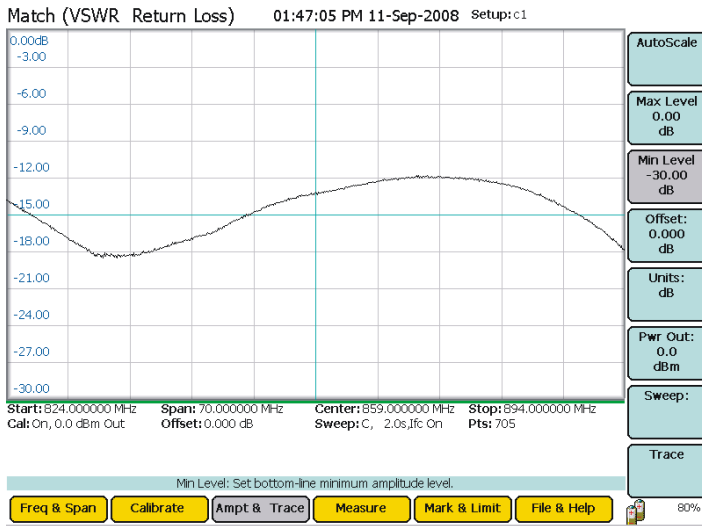
 **Note:** *If the unit is operating uncalibrated, the cal area of the status bar will be red, and say “Off”. If it has a calibration then that area is black, and says “On”.*

Figure 16 Example, Calibrate Menu



Ampt & Trace Menu

Figure 17 Example, Ampt & Trace Menu



Autoscale

This resizes the graph to fit the whole trace on the screen. This function will change the reference and scale of a trace.

Max Level

This will set the view to the top of the screen.

Min Level

This will set the view to the bottom of the screen.

Offset

This will shift the signal to correct for external attenuation or gain from the signal measured to obtain a true signal level reading as a result of external attenuators, directional couplers or amplifiers.

1. Measure the total amount of loss for all attached signal devices.
2. Enter the measured amount as the Offset value or gain.

Example - The system has 10 dB of loss due the use of a coupler, enter the value of 10 in the Offset). Offset range is -100 to +100.

Units

VSWR

$$[1 + \sqrt{P_r / P_f}] / [1 - \sqrt{P_r / P_f}]$$

Return Loss

$$(dB) = 10 \times \log (P_r / P_f)$$

rho

$$\sqrt{P_r / P_f}$$

Match %

$$100\% \times (1 - P_r / P_f)$$

Reflection %

$$100\% \times (1 - P_r / P_f)$$

Pwr Out

This controls the power level of the signal that is sent out to the RF port. The VNA then measures the power that comes back. Defaults to 0 dBm. Can be set from -20 to +10 in 1 dB steps. This should be set as high as possible without overpowering the system.

 **Note:** For most measurements, the output should be set to 0dBm or lower.

 **Note:** For systems with good match (low reflected power) set the output higher to improve the signal to noise ratio.

 **Note:** For increasing mis-match, set the output power lower.

Sweep

This sets the parameters of the sweep for the VNA.

Cont/Single

Toggles the sweep setting from a single sweep (selecting this will enable a manual trigger soft key that starts the sweep when pressed) to a continuous cycle of sweeping and recording.

Data Points

This controls the sweep speed and level of detail. The range can go from 12 to 11265 points per sweep.

 **Note:** Increasing the number of data points increases the measurable distance in distance-to-fault measurements and increases the detail in Measure Match mode measurements. Use a smaller number of points when frequency resolution is not critical & a faster sweep time is desired. Use more points for a more accurate display of finer frequency divisions.

- If there are less points than screen pixels, the unit will interpolate between them.

 **Note:** *Once the unit is calibrated, reducing the number of points below 1409 does not require re-calibration.*

- If there are more points, the unit will draw multiple datapoints in each column.

Interference Immunity

This controls the discrimination between interfering signals from the system being tested. If there are other signals in the system being tested, this function will enable the unit to ignore the extraneous signals better, and record a more accurate measurement.

 **Note:** *This featured should be enabled at all times, except when testing long lengths of cable.*

IFBW

This increases and decreases the internal filtering of the measurement. It can be thought of as a smoothing function. When measuring very low return losses, it can also function as a smoothing effect. Reducing the IFBW (towards 100 Hz) reduces the noise amplitude of the display. The range is from 100 Hz to 1 MHz. Lower IFBW settings result in longer sweep times, and increase the effectiveness of the interference immunity.

Trace

This opens a submenu with the various parameters for the trace.

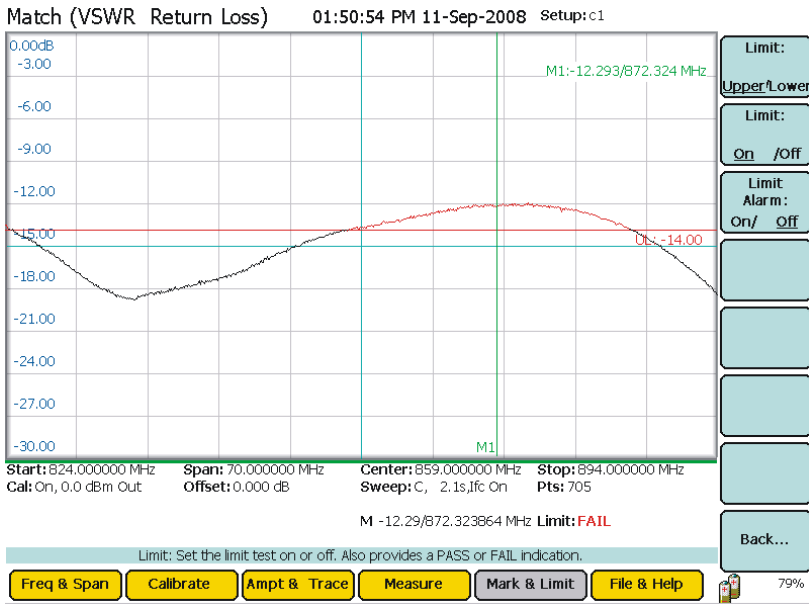
- **Clear Write** - Switches off the Average and Max Hold functions.
- **Max Hold** - Holds and displays the highest trace data points.
- **Average** - Displays the running average of multiple readings.

 **Note:** *This may be used to smooth a trace.*

- **Average Readings** - Sets the number of readings to be averaged. The valid range is from 2 to 1024.
- **Reset Average** - Resets the current running average of multiple readings.

Mark & Limit Menu

Figure 18 Example, Mark & Limit Menu



Select marker

Changes the active marker. There are six markers to chose from (measurements that use some of the markers for data display have less selectable markers). Pressing the soft key will cycle through each of the six markers.

Marker On/Off

Turns active marker ON and OFF.

Marker to Max Peak

Moves the active marker to **the highest point on the trace**.

Marker to Next Peak

Cycles the active marker through the points on the trace from highest to lowest.

Marker to Min Valley

Moves the active marker to **the lowest point on the trace**.

Marker to Next Valley

Cycles the active marker through the points on the trace from lowest to highest.

Marker More

Sets the properties of active markers through the following setable attributes:

- **Marker Delta** - Turns On/Off and displays the delta of the one to five markers.
- **Marker Type** - Sets the marker to be either a line or an icon.
- **Marker Display** - Turns On/Off and sets the location of the delta display into one of the four corners of the screen.
- **All Markers Set to Peak** - Sets all the markers to the peaks displayed on the trace.
- **All Markers Set to Min Valley** - Sets all the markers to the lowest point displayed on the trace.
- **All Markers Off** - Turns off all the markers on the display.

Limit Lines

Limit lines give notification of when a signal has reached or gone over a set measurement amount.

Enables one of the following:

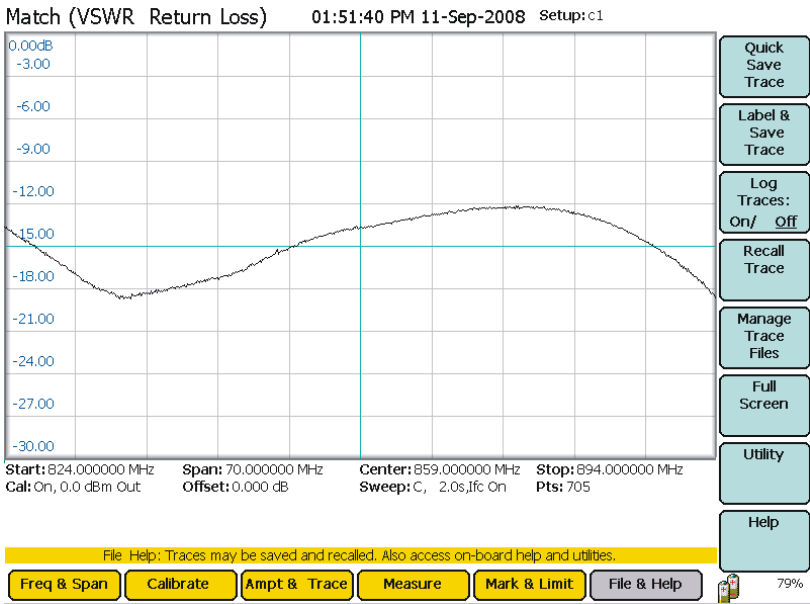
- Pick between upper & lower limit line.
- Pick between that line on or off.
- Pick whether a limit line fail makes the unit beep.

Limit lines can be moved with arrow keys.

 **Note:** *All valid traces are black, and any part of any trace that is outside of a limit is red. Red indicates a failed limit.*

File & Help Menu

Figure 19 Example, File & Help Menu



Quick Save

Saves the trace that is displayed on the screen.

To save the trace:

1. Press the File & Help menu key
2. Press the Quick Save Trace soft key.

The trace is stored as a file in the internal memory of the instrument. Each quick save is stored in a separate file that is named using the measurement and date-time file naming format: *Measurement name(MM-DD HH-MM-SS).shf*. Where the first MM is the month, DD is the day, HH is the hour, the second MM is the minute, and SS is the second of the time when the file was saved.

The PCTool utility (supplied on the CD that ships with the instrument), enables copying and/or moving stored files from the internal memory to an external storage device.

Note: *The Spectrum Analyzer PC tool cannot be used to view VNA files. For viewing of VNA files, a Site Analyzer PC tool must be used.*

Label & Save Trace

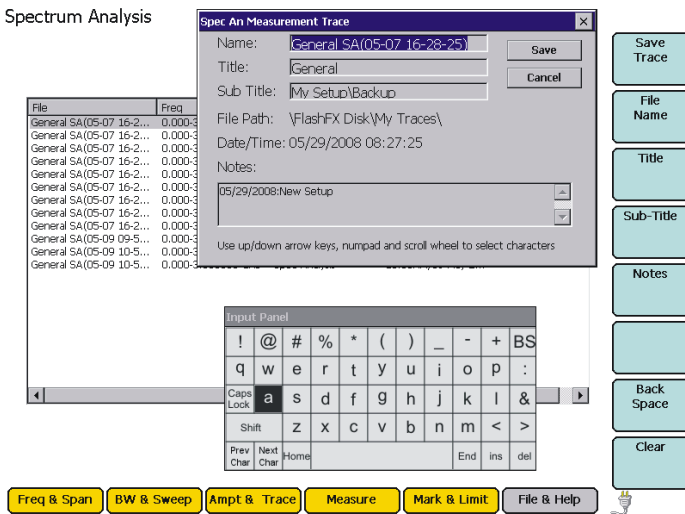
Labels and saves the settings for a setup for future use.

To save a Setup:

1. Press the Save Trace softkey.
2. Enter a file name using the thumbwheel and arrow keys.

 **Note:** Up-and-down arrow keys to move vertically and the wheel to move horizontally along the Input Panel. Use the right-and-left keys to toggle between the text fields (Name, Title, etc.)

Figure 20 Example, Save Trace



Log Traces

Press the soft key to turn this function on. Once on, it saves a sweep every 60 seconds.

Recall Trace

Opens up a submenu with three options:

- Recall Trace
- Recall & Compare
- Clear Recalled Trace

Displays a trace on the screen.

Manage Trace Files

Copy trace files to and from a thumb drive, and delete traces.

Full Screen

Enlarges the graph area to the size of the whole screen. Press escape to go back to regular screen.

Utilities

See “Utility Main Menu” on page 114.

Help

Enables various Help sections that can be accessed via the soft keys. The Help sections are listed below:

- VNA Help (with Match, DTF, and Cable Loss sections)
- Spectrum Analyzer Help
- Power Meter Help
- Custom Help

 **Note:** *The DTF section of the VNA help is also accessible in the DTF measurement screen.*

***Chapter 3* Vector Network Analyzer Measurements**

Measuring both magnitude and phase of components is important for several reasons. First, both measurements are required to fully characterize a linear network and ensure distortion-free transmission. To design efficient matching networks, complex impedance must be measured. Engineers developing models for computer-aided-engineering (CAE) circuit simulation programs require magnitude and phase data for accurate models.

In the Vector Network Analyzer mode, the following measurements can be made:

- "Match Measurement" on page 38.
- "Distance to Fault (DTF) Measurement" on page 41.
- "Cable Loss (1 Port) Measurement" on page 50.
- "Gain and Loss (2 Port) Measurement" on page 51.

Match Measurement

This measurement displays the result how well-matched to a 50 ohm characteristic impedance the system being measured. Return loss is a measure of impedance mismatch between two or more circuits.

$$\Gamma = \left| \frac{1 - VSWR}{1 + VSWR} \right|$$

The SignalHawk can calculate the system match as VSWR, Return Loss, reflection coefficient, Match efficiency % and % reflection.

$$RL = -20\log|\Gamma|$$

1. Measure the output power, or signal power, at the system's test port using a power meter, service monitor, or equivalent.

Note: *Ensure the outlet power is less than +22 dBm (160 mW).*

2. Power up the SignalHawk.
3. In the Start Menu, use the arrow keys to highlight the desired measurement, and press Enter.
4. In the Freq & Span Menu, set the frequency range. See "Freq & Span Menu" on page 54.
5. Select either Match or Cable Loss measurement.
6. Press Calibrate and press Open, Short, and Load (soft keys) on RF Out with calibrated open, short, and load on RF Out port.
7. Connect the cable and antenna to the RF Out test port.

Note: *Maximum input is +22 dBm (160 mW).*

Figure 21 Example Match Measurement - VSWR

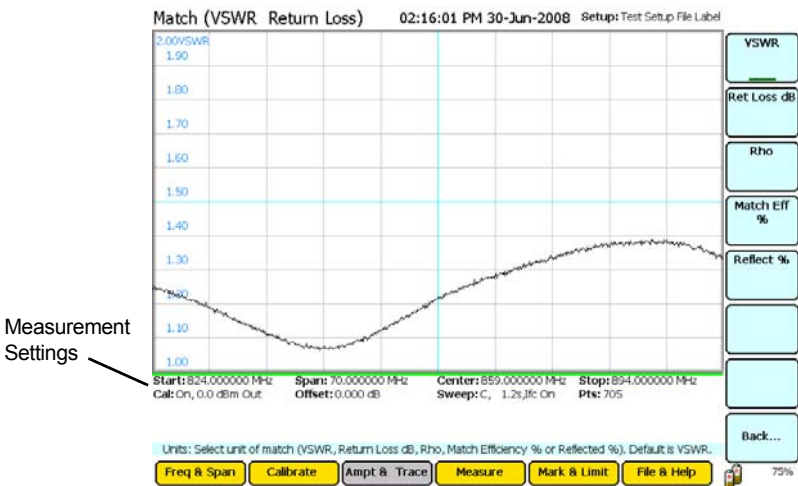


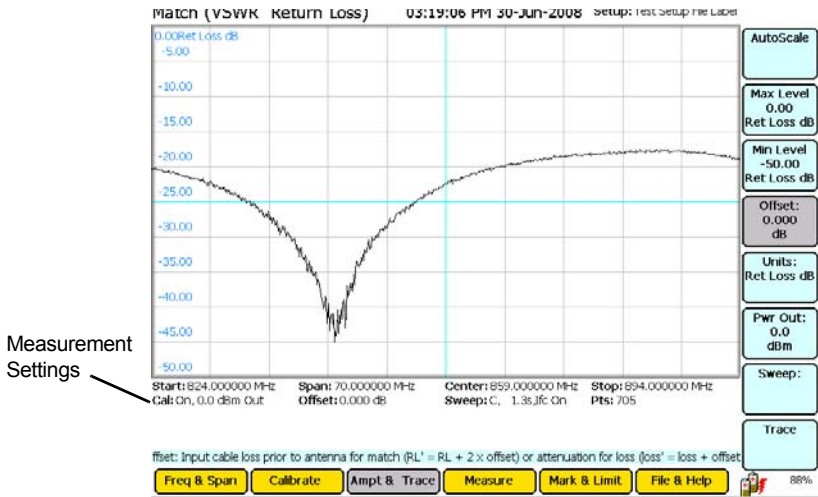
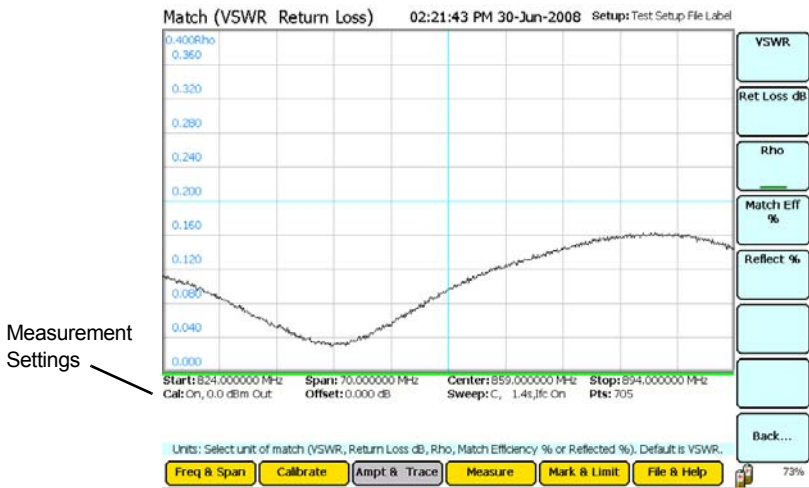
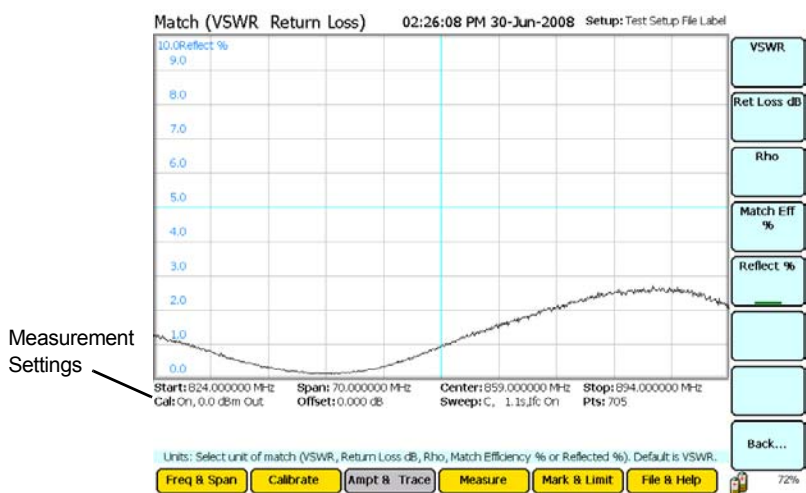
Figure 22 Example Match Measurement - Return Loss**Figure 23 Example Match Measurement - Rho**

Figure 24 Example Match Measurement - Efficiently Percent**Figure 25 Example Match Measurement - Reflected Percent**

Distance to Fault (DTF) Measurement

This measurement will display the distance to a fault in a given length of cable. The standard settings for this measurement are setting the Start & Stop Distances, selecting the Distance Units (meter vs. feet), setting the Cable Velocity Prop & Loss, and Smoothing the signal. All these settings can be adjusted using either the thumbwheel or keypad.

 **Note:** *Changing the frequency span or the max distance will automatically turn calibration off. Always set the frequency span or max distance before calibrating the unit. The maximum distance you can measure is determined by the frequency span, the velocity of propagation of the cable (V_p), and the number of data points to measure these factors are discussed in the following paragraphs.*

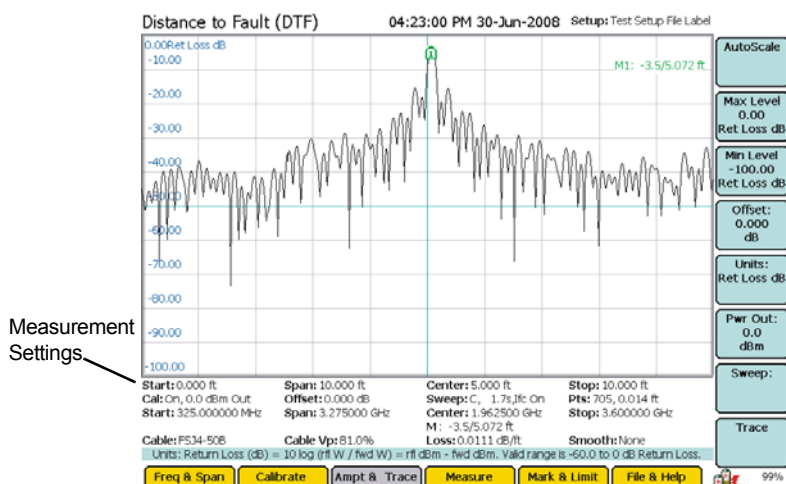
Max Distance - When a frequency span is specified, the SignalHawk calculates the maximum measurable distance. To get the maximum distance to be measured, enter it instead of the frequency span; the SignalHawk calculates the frequency span. If the maximum distance is entered manually, be sure to select the data points before entering the max distance.

 **Note:** *If a maximum distance less than the total length of the cable system is selected, the trace might show a spike that is not a fault, but rather an echo from the portion of the cable that is beyond the length chosen. Such a spike is known as an alias. To avoid aliasing, always set the maximum distance to a value that is a few feet or meters greater than the entire length of the cable system.*

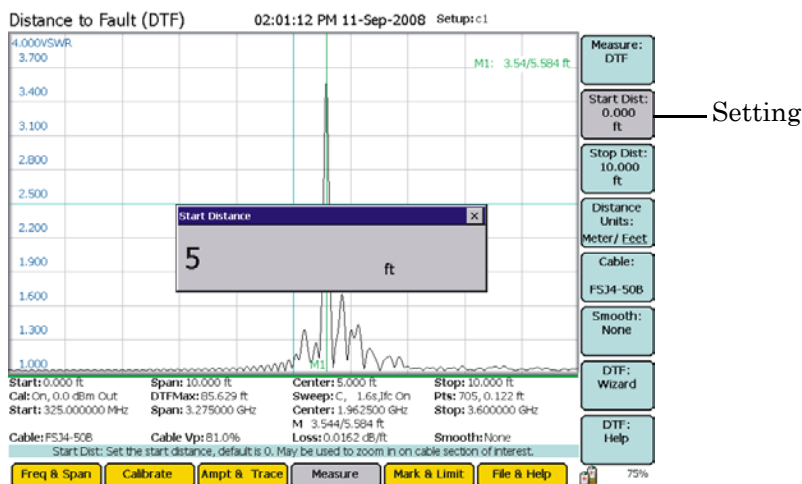
Data Points - See “Example, Distance-to-Fault - Stop Distance Setting” on page 43.

Frequency Span - If the frequency span narrows, the measurable distance increases.

Velocity of Propagation - The velocity of propagation is a characteristic of the cable and is expressed as a percentage. Contact the cable manufacturer to get the velocity of propagation value for the cable being used.

Figure 26 Example, Distance-to-Fault**Start Distance**

Sets the starting distance for the cable being measured.

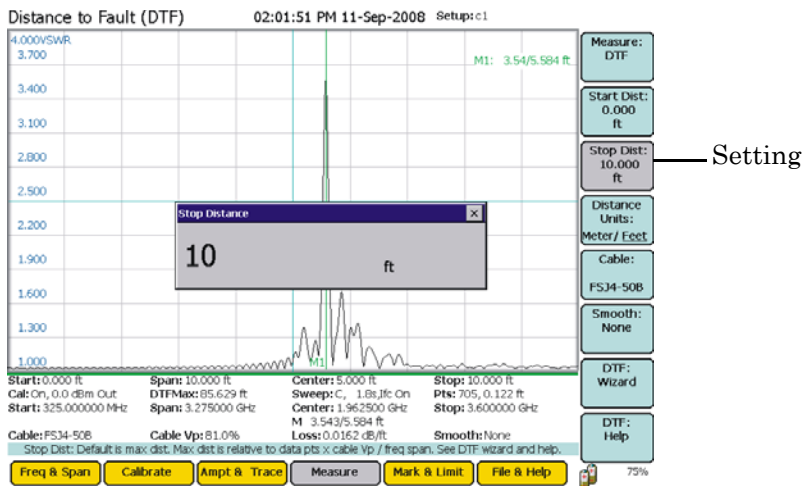
Figure 27 Example, Distance-to-Fault - Start Distance Setting

Stop Distance

Sets the stop distance for the cable being measured.

Note: *If a maximum distance less than the total length of the cable system is selected, the trace might show a spike that is not a fault, but rather an echo from the portion of the cable that is beyond the length chosen. Such a spike is known as an alias. To avoid aliasing, always set the maximum distance to a value that is a few feet or meters greater than the entire length of the cable system.*

Figure 28 Example, Distance-to-Fault - Stop Distance Setting



Data Points

If the number of data points increase, the measurable distance increases (475 points results in twice the distance of 238 points, and 949 points results in four times the distance of 238 points) (refer to Equations, page 146). When the number of data points being measured changes, the software automatically recomputes the new maximum measurable distance. If a maximum distance is entered, be sure to select the data points before entering the max distance. Changing data points does not turn calibration off.

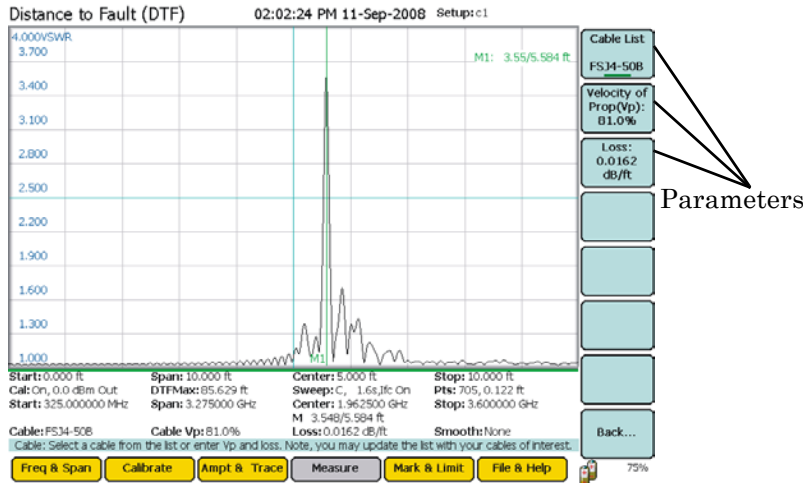
Distance Units

Sets the measurement units. Toggles between Meters and Feet.

Cable

Sets the parameters of the cable being tested via another set of soft keys.

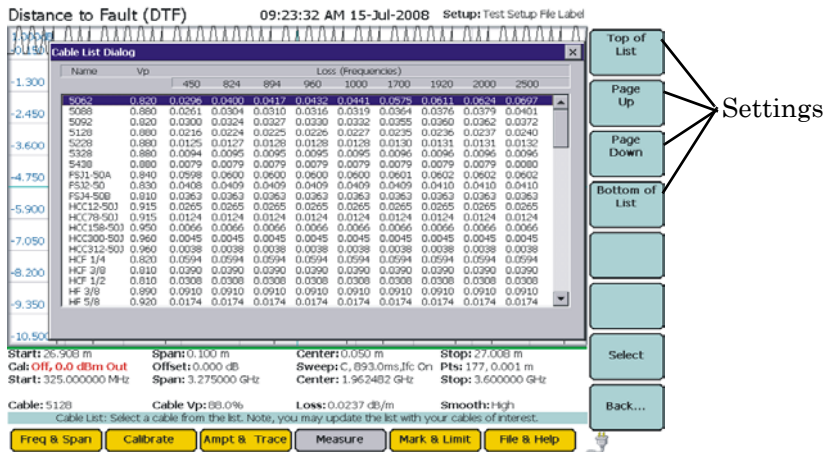
Figure 29 Example, Distance-to-Fault - Cable Setting



Cable List

Select a specific cable from list.

Figure 30 Example, Distance-to-Fault - Cable Setting - Cable List

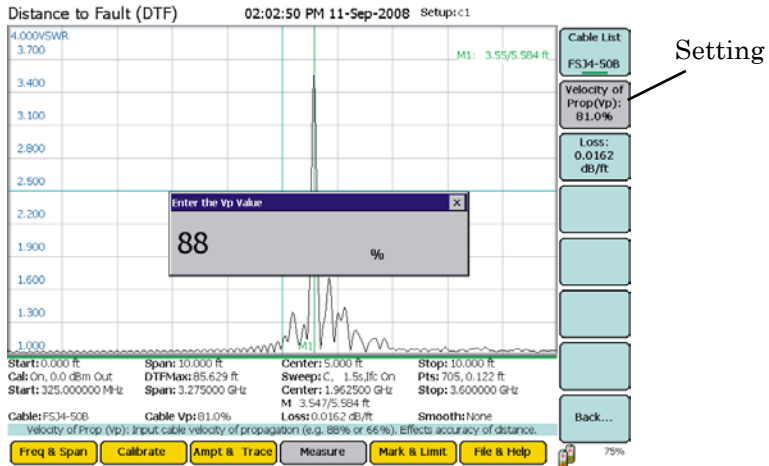


Velocity

Sets the speed of the signal going through the cable being measured.

Note: Changing this setting will reset the cable selected setting to “None.”

Figure 31 Example, Distance-to-Fault - Cable Setting - Velocity

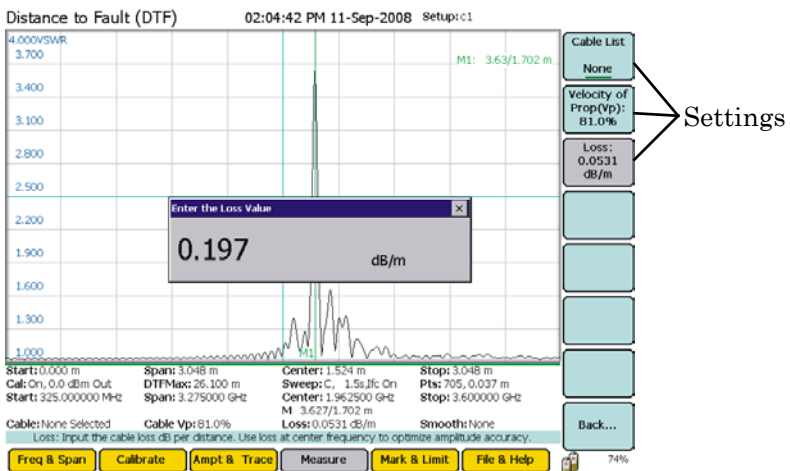


Cable Loss

Sets the compensation level due to cable loss of the signal being used.

Note: Changing this setting will reset the cable selected setting to “None.”

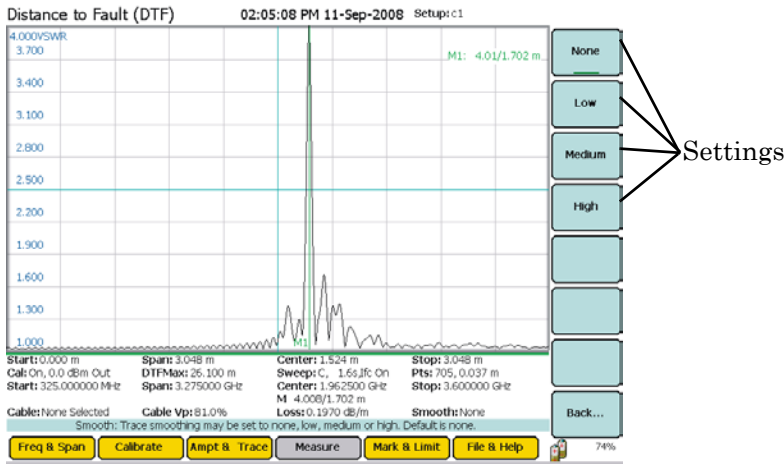
Figure 32 Example, Distance-to-Fault - Cable Setting - Cable Loss



Smooth

Smooths the trace line on the display. It can be set to one of four tolerances: High, Medium, Low, and None.

Figure 33 Example, Distance-to-Fault - Smooth



DTF Wizard

Note: Maximum allowed distance and resolution per point is a complex function of the cable and frequency settings. Use the DTF wizard if the SignalHawk is having issues resolving these functions.

When the DTF Wizard softkey is pressed, a window with a set of adjustable variables will open in the display. Left/right arrow keys change the fields, up/down arrow keys, the thumbwheel, and the number pad change each field's value.

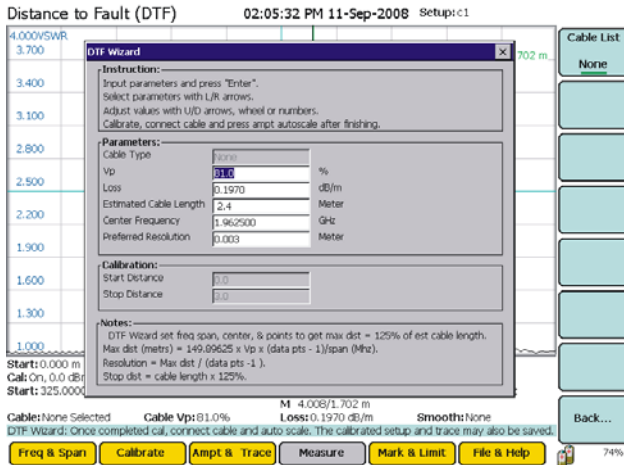
The DTF Wizard takes the guess work out of setting up a fault-location measurement by requiring knowledge of the type of cable used in the system, the antenna's frequency range, total length to the antenna and the desired accuracy of the location of the fault. The DTF Wizard automatically calculates and sets the best parameters of stop distance points and frequency settings.

A Cable List softkey is available. Pressing this will display a series of cables to choose from. The settings for the selected cable will then be displayed in the variable fields. The variables are:

Vp (Velocity)

Sets the speed of the signal going through the cable being measured.

Figure 34 Example, Distance-to-Fault - DTF Wizard - VP

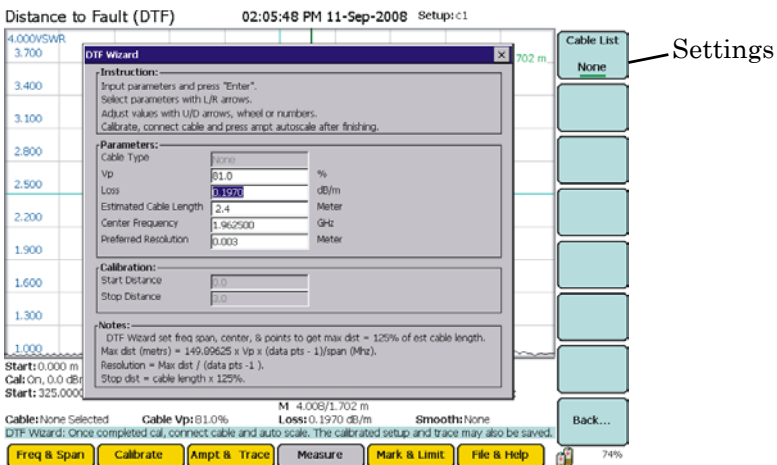


Note: The wizard will automatically apply velocity and loss to their fields.

Loss

Sets the compensation level due to cable loss of the signal being used. Using the softkeys, this can be set in both dB/m or dB/ft.

Figure 35 Example, Distance-to-Fault - DTF Wizard - Loss



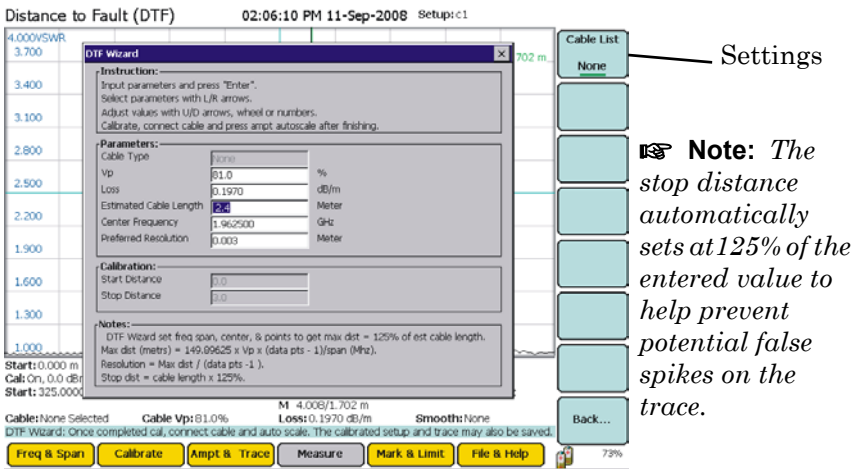
Note: The wizard will automatically apply velocity and loss to their fields.

Cable Length

Sets the length of the cable being tested. Using the softkeys, this can be set in both Meter and Feet units.

Note: *Estimate cable length is not it is not known. For tower measurements, take the height of the tower and add an additional 25% of the height.*

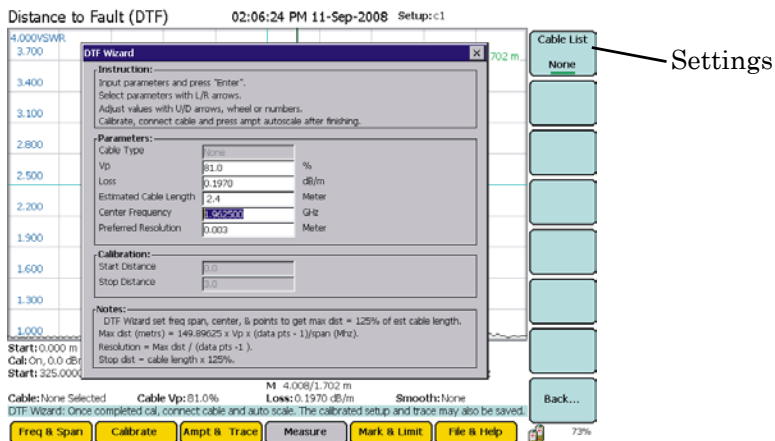
Figure 36 Example, Distance-to-Fault - DTF Wizard - Cable Length



Center Frequency

Sets the center frequency of the trace to allow for the most accurate reading as possible, weather testing antennas, filters and the like. Using the softkeys, this can be set in Hz, kHz, MHz, and GHz.

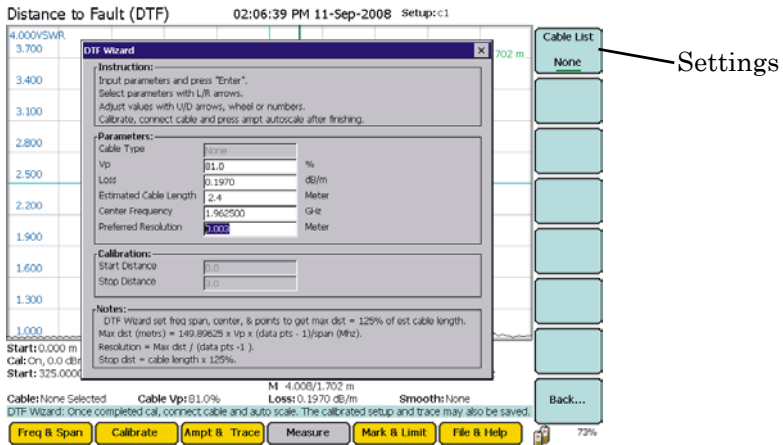
Figure 37 Example, Distance-to-Fault - DTF Wizard - Center Frequency



Preferred Resolution

Sets the desired resolution, or distance each pixel of the display covers, of the signal being tested. Using the softkeys, this can be set in Meters and Feet.

Figure 38 Example, Distance-to-Fault - DTF Wizard - Preferred Resolution



Once all variables are set, press the enter key to begin Calibration. See "Calibrate Menu" on page 27.

Cable Loss (1 Port) Measurement

This one-port reflection measurement measures the insertion loss of a cable. To measure cable loss, make sure that the cable being tested is unterminated (not connected to anything at the far end).

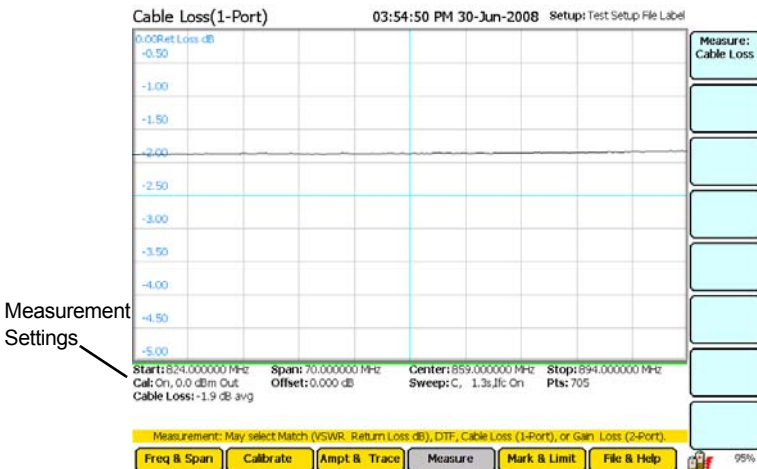
1. Check the power of cable to be tested (refer to Determine the Power of the Component Being Tested.).

Note: *Make sure that the cable does not have power greater than +22 dBm.*

2. Ensure that the correct adaptors, connectors and a Bird Calibration Combination (cal combo) is used. Also the frequency band of the system will be needed.
3. If necessary, connect a phase-stable cable to the test port and connect a Cal Combo to the other end of the cable.
4. Calibrate the SignalHawk. See “Calibrate Menu” on page 27.
5. Remove the Cal Combo unit from the cable.
6. Connect the cable to be tested to the phase stable cable or test port.
7. Connect Short calibration standard or Short connection on the Cal Combo unit to the other end of the cable being tested.

Note: *The cable loss as a function of frequency is displayed on the average cable loss displayed in the footer*

Figure 39 Example Cable Loss



Gain and Loss (2 Port) Measurement

This two-port reflection measurement is used to test the insertion gain and loss of a cable. To run this measurement, connect the transmitter of the device being tested to Port 1 and the receiver of the device to Port 2. Transmission loss or gain will be negative when the device has a loss, and positive when the device has a gain. Transmission coefficient equals incident voltage divided by the transmitted voltage using this equation:

$$y = \frac{V_{Transmitted}}{V_{Incident}}$$

Bias Tee Voltage

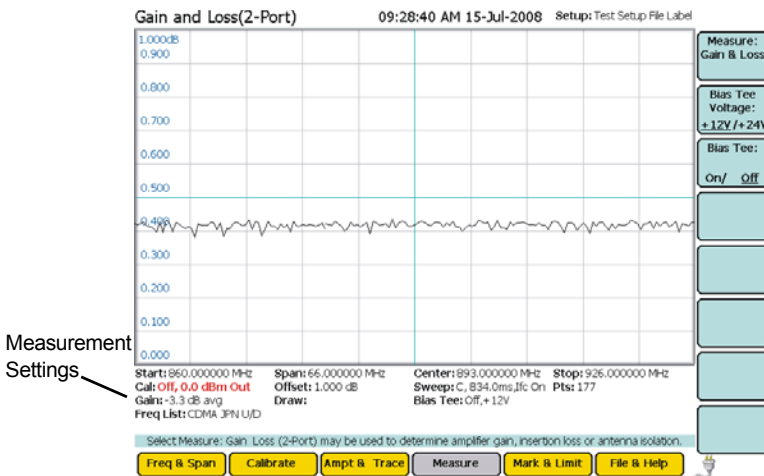
Adjusts the reading to compensate for any added DC voltage from a bias tee attached to the RF line being tested. The SignalHawk puts a 12V or 24V power supply voltage onto the RF line, so the same line is carrying RF data & power. Then it measures how much current is being drawn from the line.

Bias Tee

Turns the Bias Tee compensator on and off. When this is on, it will display the current draw from the bias tee on the bottom of the display.

Note: Overdrawing from the bias tee will cause an automatic shut down of the bias tee. The current overdraw limit is 1,000 mA.

Figure 40 Example Gain and Loss



Note: Upon setting this measurement, it will exit to the Calibration menu with additional Calibration settings "Cable From RF Out-In" and "Isolation." See "Calibrate Menu" on page 27.

Chapter 4

Spectrum Analyzer Settings

The proper settings are very important to obtaining the most accurate information possible. The SignalHawk can be configured in various ways, allowing for a wide range of measurement capabilities.

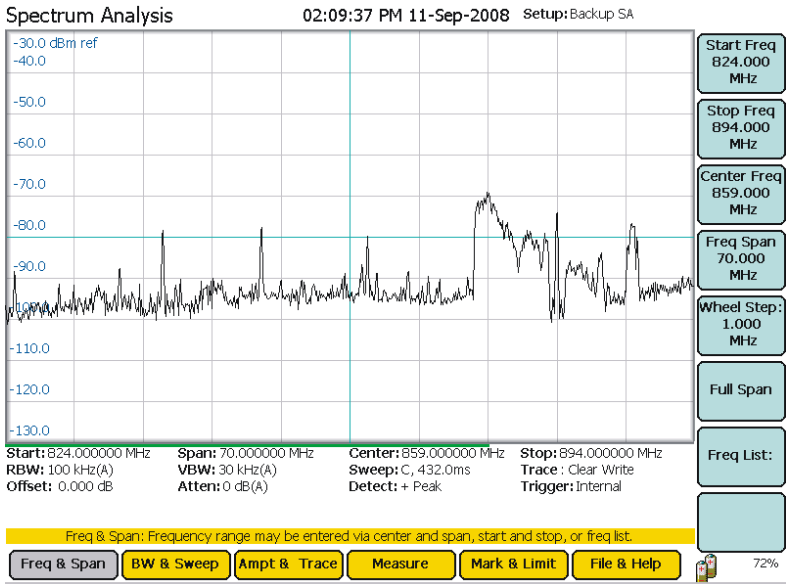
Core Soft Key Functions

“Soft Keys” serve multiple functions on the SignalHawk. There are four core functions that these keys serve:

1. **On/Off Button** - Push to move highlight (toggle between one setting and the other).
2. **Pop-Up Menu Button** - Push to pop-up lists and drop menus. Use the arrow key, wheel, etc. to select from the pop-up (e.g. Freq list).
3. **Highlight Button** - Push to highlight number editable variants (e.g. Freq).
4. **Trigger Event Button** - Push to start a function (Full Span).

Freq & Span Menu

Figure 41 Freq & Span Menu



In the Freq & Span Menu the range of frequencies to sweep are specified. The SH-36S and SH-361S can sweep frequencies between 100 kHz and 3.6 GHz.

Frequencies can be selected at spans from 1 kHz up to the entire range of the instrument. These frequencies can be set to sweep by one of the following methods:

- Set the Center Freq and Freq Span.
- Set the Start Freq and Stop Freq.
- Select the Full Span of the instrument.
- Select a band from the Freq List.

The most common of these methods is to set the center frequency and a frequency span (a range) and let SignalHawk calculate the start and stop frequencies for the sweep. Reducing the span, by default (i.e. with RBW and VBW all on auto modes) will usually speed up the sweep, provide more detail, and lower the noise floor. Unless specified otherwise, set the center frequency to the center of the signal being measured.

Start / Stop Freq and Center / Span

Both pairs of these settings control which range of frequencies are swept. “Center / Span” are used in this manual, but using “Start / Stop Freq” achieves the same results. After pressing the softkey, it indicates what is active by highlighting it. Then the following can be performed:

- **Up/Down Arrow Keys:** Increase and decrease frequencies in small steps.
- **Left/Right Arrow Keys:** Increase and decrease frequencies in large steps.
- **Thumbwheel:** Each click of the thumbwheel changes the frequency or span by the value of the “Wheel Step” softkey.
- **Number Keys:** Press any key to open a box to type the new frequency into. In cases of a mistake, press “Esc/Back”. When done, press enter (to keep the same frequency units) or press the correct units softkey.

Wheel Step

When another frequency function is active and the thumbwheel is turned, the value will change in steps of the “Wheel Step”. After pressing the “Wheel Step” softkey to highlight it, the following is enabled:

- **Up/Down Arrow Keys and Thumbwheel:** Change the step value by a small amount.
- **Left/Right Arrow Keys:** Change the step value by a large amount.
- **Number Keys:** Press any key to open a box to type the new frequency into. If a mistake is made, press esc/back. When done, press enter, or press the correct units softkey.

Full Span

Press this to set the Start Freq to 0, and the Stop Freq to the max freq of the unit, currently 3.6 GHz.

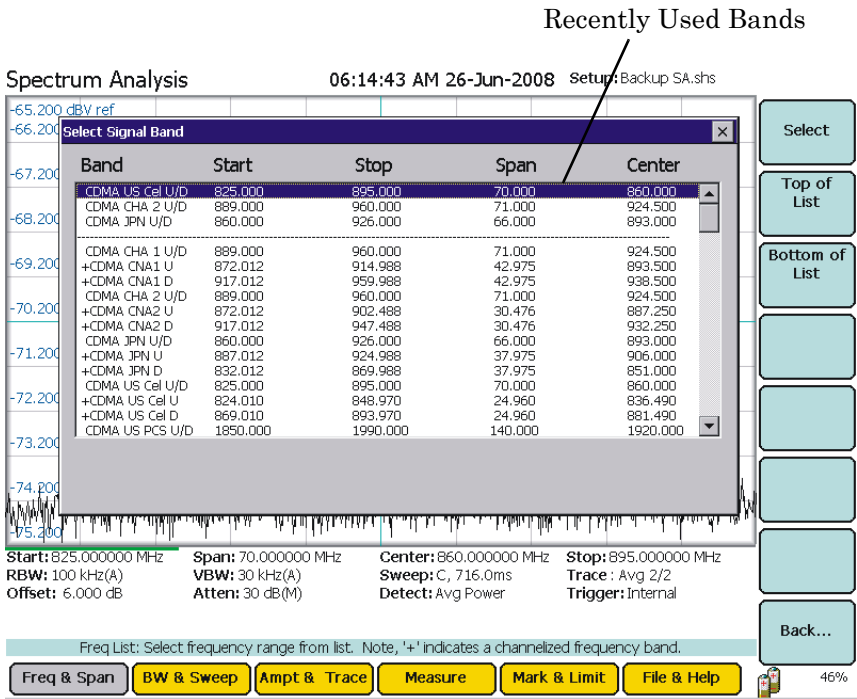
 **Note:** *The start frequency can be set to 0 as a convenience. However, the accuracy spec does not apply below the minimum freq of the unit (100 kHz).*

Freq List

Pressing this opens up a list of predefined frequency bands. Use the up/down arrows and thumbwheel to scroll to the desired band, then press the “Select” softkey to use it. Recently used bands are displayed at the top of the list.

 **Note:** *Channelized bands are denoted on the Frequency List by a plus sign; “+”.*

Figure 42 Example, Freq List

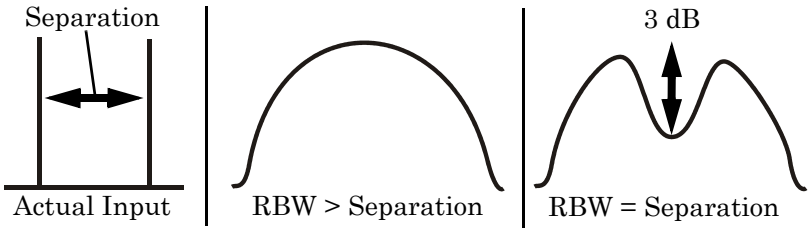


BW & Sweep Menu

The bandwidth menu includes functions that control sweep speed and accuracy, and has the interface for customizing sweep triggers.

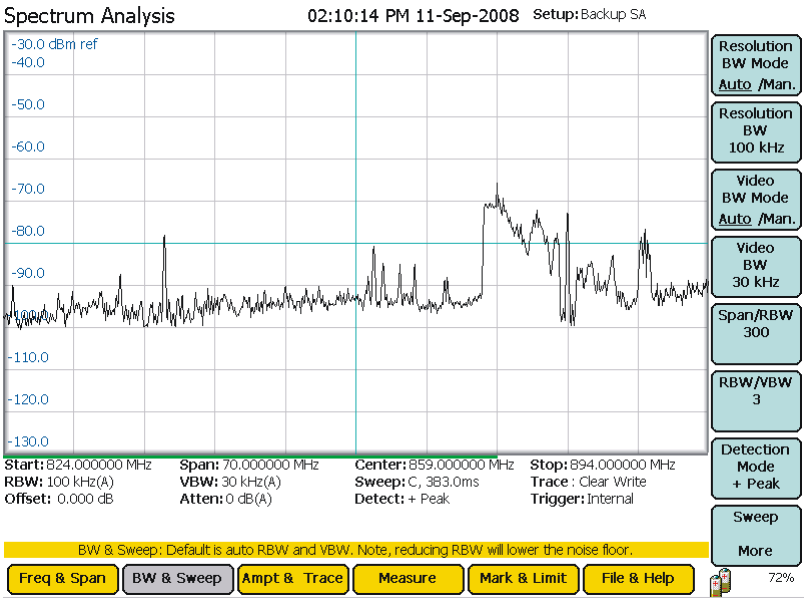
When two signals are separated by a freq distance equal to the Resolution BW, a 3 dB dip between them will appear on the screen. This is the minimum resolvable frequency spacing. The soft key legend displays the current value.

Figure 43 Singal Representation



Lowering the RBW will lower the noise floor, which can make low-power signals easier to see, and makes readings close to the noise floor more accurate.

Figure 44 Example, BW & Sweep Menu



Press the Resolution BW soft key then use the arrow keys or the selection dial to enter the desired bandwidth. RBW goes from 100 Hz - 1 MHz, steps of 1 / 3 / 10 (e.g.: 1 kHz to 3 kHz to 10 kHz to 30 kHz, etc.)

VBW to determines how much smoothing takes place. A wide (high) setting results in fast sweep times, but can obscure signal details. A narrow (lower) setting results in better trace smoothing for signals present in high noise levels. As the VBW is reduced, longer sweep times will be necessary to obtain a measurement. To be useful, VBW must be narrower than RBW. No smoothing takes place when VBW is greater than or equal to RBW. VBW goes from 10 Hz to 300 kHz.

Resolution & Video BW Modes

Press these to toggle RBW or VBW, respectively, between automatic and manual control. In automatic, they are controlled by the current span and the values of Span/RBW and RBW/VBW. If either the RBW or VBW is changed, these will switch to manual.

Auto RBW sets the RBW based upon the frequency span. When in Auto mode, the RBW is set according to the nearest ratio as set using the Span/RBW soft key. The default ratio is 300. When the frequency span is reduced, the RBW will also be reduced accordingly.

***Example** - When the span is changed to 3600 MHz, the RBW will automatically be set to 1 MHz. When the span is reduced to 100 MHz, the RBW will automatically reduce to 300 kHz.*

Auto VBW sets the VBW based upon the RBW value. When in Auto mode, the VBW is set according to the nearest ratio as set using the VBW/RBW soft key. The default ratio is 3. As the RBW span is reduced the VBW will be reduced accordingly.

***Example** - When the RBW is changed to 1MHz, the VBW will automatically be set to 300kHz. When the RBW is reduced to 30kHz, the VBW will automatically be set to 10kHz.*

Resolution & Video BW

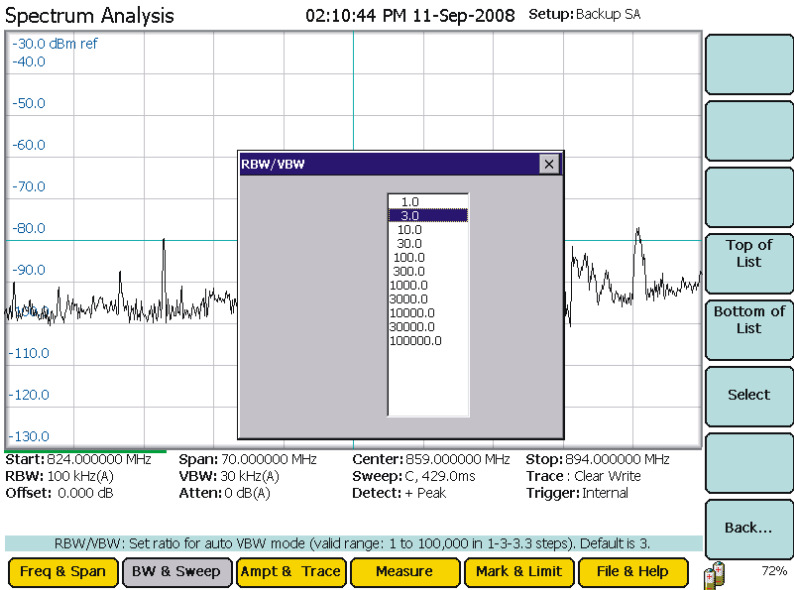
Press the key to highlight it. Then:

- **Up/Down Keys** - Change the bandwidth a little.
- **Left/Right Keys** - Change the bandwidth a lot.
- **Thumbwheel** - Change the bandwidth a little.

RBW / VBW

Pressing this key brings up a list of allowed values for RBW / VBW. When VBW is set to auto, the RBW is divided by this value and set as the VBW.

Figure 45 Example, RBW/VBW



Span/RBW

Press the Span/RBW soft key then use the arrow keys or the selection dial to enter the desired ratio. Values range from 10 to 3600 in steps of one.

The ratio of frequency span to RBW determines how the RBW tracks with frequency span when the Resolution BW mode is in Auto. This value is ignored when Resolution BW Mode is in Manual mode. The soft key legend displays the current value.

- **Up and Down Arrow Keys** - Press these keys to increase or decrease the ratio in steps of one.
- **Left and Right Arrow Keys** - Press these keys to enter the minimum ratio (left-arrow) or the maximum ratio (right-arrow).
- **Selection Dial** - Rotate the selection dial to increase or decrease the ratio in steps of one.

Detection Mode

Depending on measurement settings, many more data points are collected than there are pixels on the screen. Detection modes allow the user to choose how the collected data in each pixel is represented.

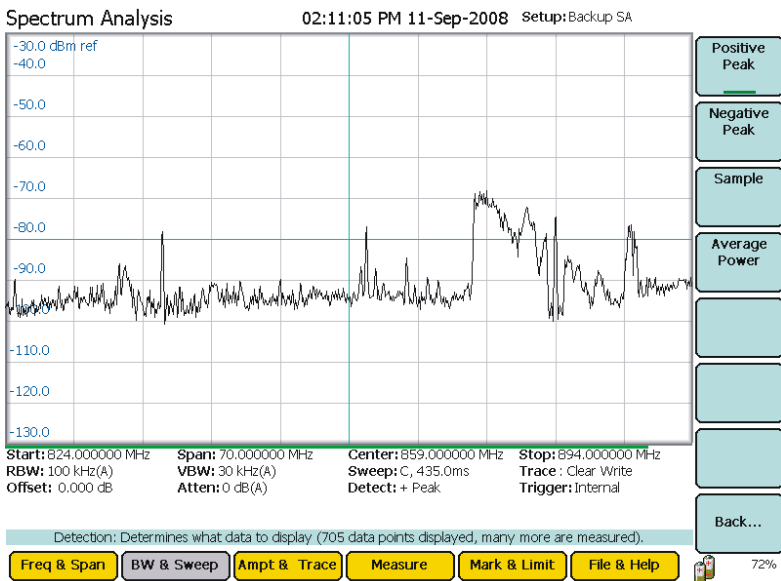
Sample Detection - Returns a sample of the data collected for each display pixel. Use this method for noise-like signals.

+ Peak Detection - Returns the maximum value of the data collected for each display pixel. Recommended for pure sine waves or narrow bandwidth signals. In zero-span mode, this mode acts like a peak detector and can be used to show AM band frequencies.

- Peak Detection - Returns the minimum value of the data collected for each display pixel. Recommended for displaying the difference between CW and pulsed signals.

Average Power - Returns the average of the data collected for each display pixel. Recommended for noise-reduction.

Figure 46 Example, Detection Mode



Sweep

Sweep sets up the properties of individual sweeps that the Signal-Hawk performs. It can set whether the sweeping is continuous or single, and the properties of video triggers (if enabled).

Figure 47 Example, Sweep More

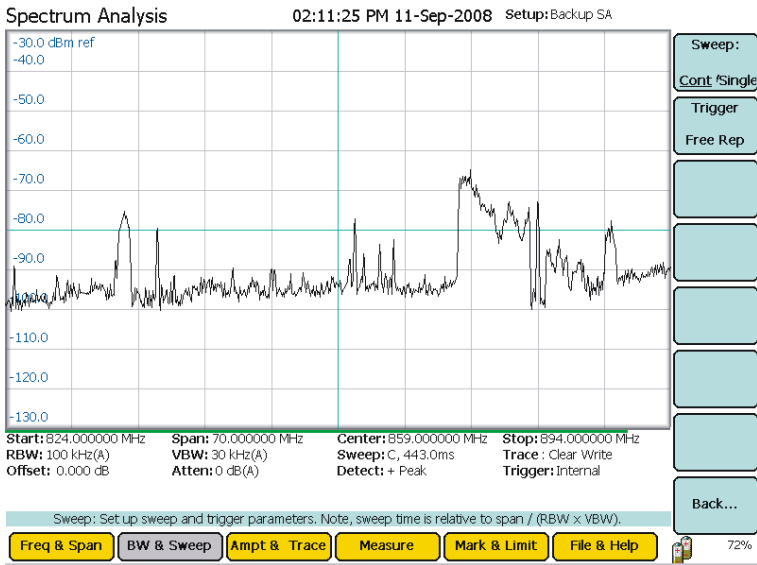
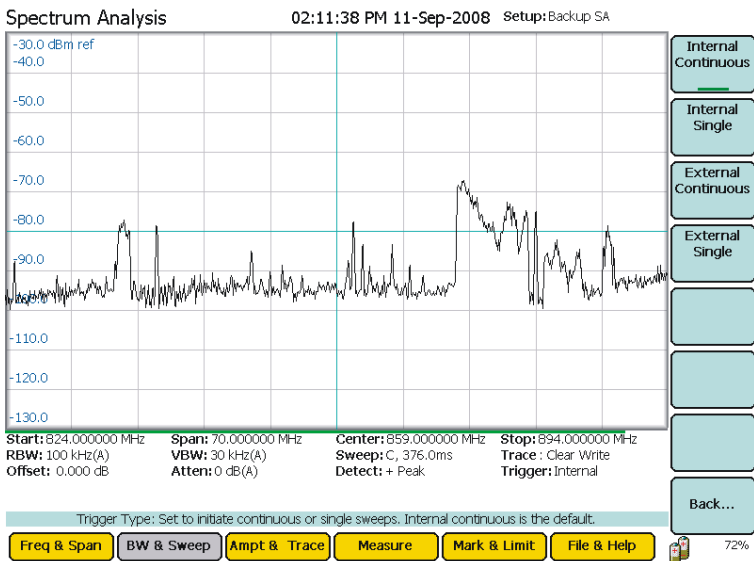


Figure 48 Example, Trigger Rep



Single

Performs a single sweep. Before a single sweep is triggered, the SignalHawk will display the previous sweep. To begin a sweep, press the Manual Trigger softkey. After the sweep finishes, it will display the results and stop sweeping.

 **Note:** *This method is useful for time-varying signals that change slow enough to trigger manually and carrier/interference ratios, where the user must take one sweep with the carrier on, then turn the carrier off and take a second sweep.*

Free Run

Performs a continuous cycle of sweeping and displaying results. Before this is triggered, the SignalHawk will display the previous sweep. Another sweep will automatically begin and display that sweep before beginning again.

Video (Zero Span Only)

 **Note:** *This can only be used if the Time Domain measurement is enabled. See “Time Domain (Zero Span)” on page 85.*

Trigger control and sweeping both happen on the radio frequency connector. Once a sweep is done, it will be displayed until a trigger condition occurs again and it performs another sweep. This is used in zero-span mode.

In order to use this function, the trigger condition needs to be set up:

1. Monitor the RF data to determine the trigger condition.
2. Set the power level at center freq.
3. Set the trigger level:
 - **High Level** - Trigger if dBm rises ABOVE the power level.
 - **Low Level** - Trigger if dBm falls BELOW the power level.
4. Enable the trigger.

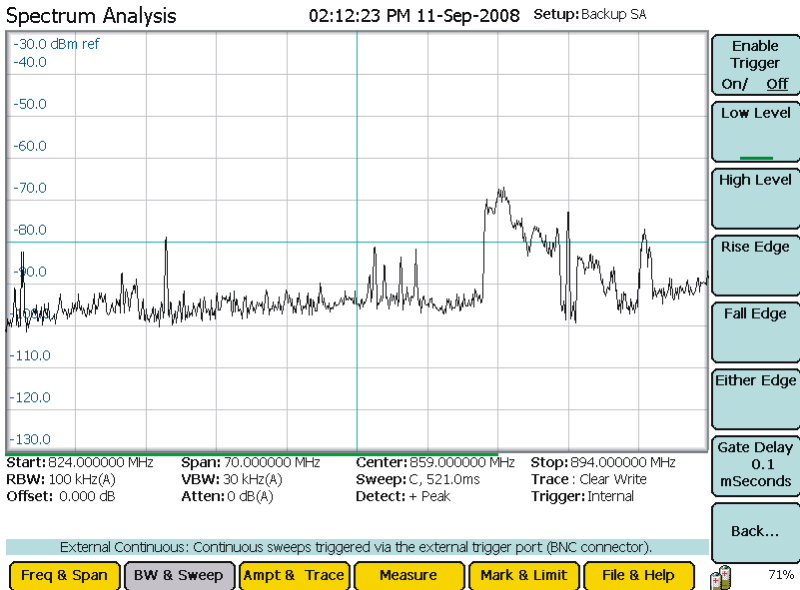
External - Low Level / High Level / Rise Edge / Fall Edge / Either Edge

- **Low Level** - Triggers if input = 0 ± 0.5 V (TTL “Low”).
- **High Level** - Triggers if input = 4.2 ± 0.8 V (TTL “High”).
- **Rise Edge** - Triggers if the input goes from “Low” to “High”.
- **Fall Edge** - Triggers if the input goes from “High” to “Low”.
- **Either Edge** - Triggers if the input goes from either “High” to “Low” OR “Low” to “High”.

Gate Delay

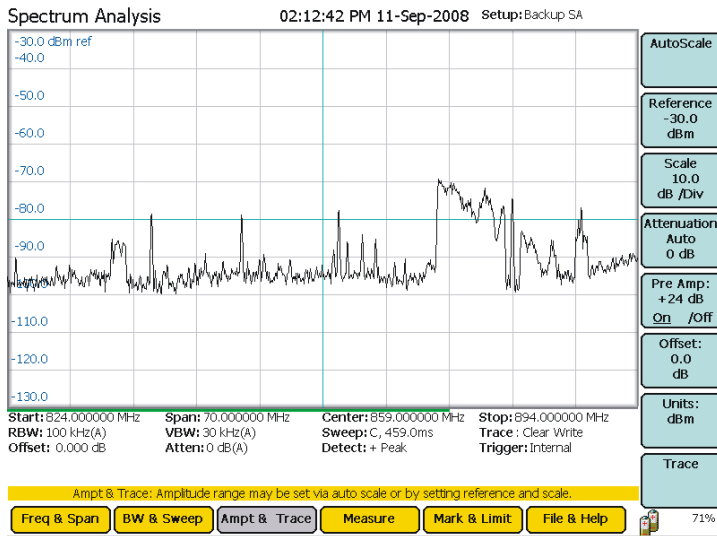
Length of wait after the trigger signal and before beginning a sweep
The range is 100 μ s to 1 s.

**Figure 49 Example, Low Level / High Level /
Rise Edge / Fall Edge / Either Edge**



Ampt & Trace Menu

Figure 50 Example, Ampt & Trace Menu



Autoscale

This resizes the graph to fit the whole trace on the screen. This function will change the reference and scale of a trace.

Reference

This is the y-axis value at the top of the drawing screen.

Scale

The screen is partitioned into 10 divisions, giving a set number of dB per division (on a scale from 1 to 15).

Note: If Volt or Watt units are picked then this key does not exist and the bottom of the screen is 0.

Attenuation

Controls the built-in attenuator on the signal input. This reduces the amplitude of a high powered signal. The attenuation can be set to Auto, or at levels of 0, 10, 20, and 30 dB. The reported value of the signal is automatically corrected for the selected attenuation.

Note: At higher reference levels, the SignalHawk will not allow for settings for lower attenuations.

Example - 21 to 30 dB reference only allow for a 30 dB attenuation.

Preamp

Controls the built-in amplifier on the signal input. This lowers the noise floor, allowing very low power signals be detected, by giving a 24 dB nominal gain boost. Attenuation is automatically disabled to 0 when Preamp is activated.

Offset

This will shift the signal to correct for external attenuation or gain from the signal measured to obtain a true signal level reading as a result of external attenuators, directional couplers or amplifiers.

1. Measure the total amount of loss for all attached signal devices.
2. Enter the measured amount as the Offset value or gain.

Example - The system has 10 dB of loss due the use of a coupler, enter the value of 10 in the Offset). Offset range is -100 to +100.

Units

dBm ($dBm = 10 \times \log [\text{Power (Watts)}] + 30 \text{ dB}$)

dBuV ($dBm = dBuV - 10 * \log 50 - 90$)

dBmV ($dBm = dBmV - 10 * \log 50 - 30$)

dBV ($dBm = dBV - 10 * \log 50 + 30$)

Volts ($dBm = 20 \times \log [\text{Power (Volts)}] + 30 \text{ dB}$)

Watts ($Watts = 10 ^ { ((dBm - 30) / 10) }$)

Trace

Open up another menu with trace type commands in it.

Clear Write

Switches off the Average and Max Hold functions.

Max Hold

Holds and displays the highest point of a any given sweep until. The point will display until Max Hold is turned off.

Average

Displays the running average of multiple readings which is used to smooth a signal and decrease noise amplitude.

Average Readings

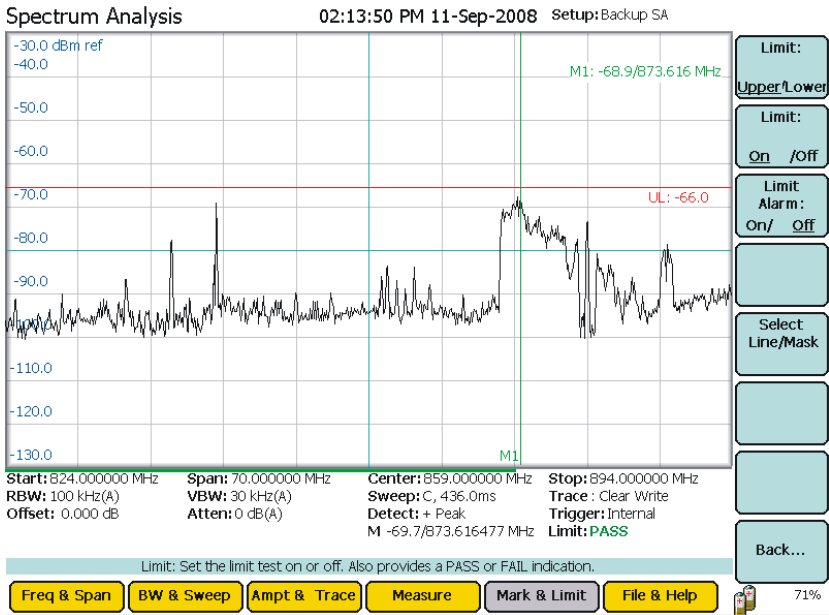
Sets the number of averaged readings. The valid range is from 2 to 1024.

Reset Average

Resets the current running average of multiple readings.

Mark & Limit Menu

Figure 51 Example, Mark & Limit Menu



Select marker

Changes the active marker. The active is indicated by a set of brackets “[]”. There are six markers to choose from (measurements that use some of the markers for data display have less selectable markers). The active marker can be moved with the arrow keys and number pad and has its info displayed in the status area. The active marker will also display in green on the trace.

Marker On/Off

Turns active marker on and off.

Marker to Max Peak

Moves the active marker to **the highest point on the trace**.

Marker to Next Peak

Cycles the active marker through the points on the trace from highest to lowest.

Marker Frequency to Center

Changes the center frequency to that of the active marker.

Marker Amplitude to Reference

Changes the reference level of the value to the y-value of the active marker. This function does not affect the scale.

Marker More

Sets the properties of active markers through the following attributes:

- **Marker Delta** - Turns On/Off and displays the delta of the markers.
- **Marker Type** - Sets the marker to be either a line or an icon.
- **Marker Display** - Turns On/Off and sets the location of the marker information area into one of the four corners of the screen.
- **Frequency Counter** - Turns the Frequency Counter on or off. Enables the frequency read out of all displayed markers to read the exact frequency of the peak within the pixel to a resolution of 1 Hz.
- **Marker Noise** - When selected, the amplitude read out of all displayed markers is compensated for the noise bandwidth of RBW filter and is in units of dBm/Hz.
- **All Markers Set to Peak** - Sets all the markers to the peaks displayed on the trace.
- **All Markers Off** - Turns off all the markers on the display.

Limit Lines

Limit lines give notification of when a signal has reached or gone over a set measurement amount.

Enables one of the following:

- Pick between upper & lower limit line.
- Pick between that line on or off.
- Pick whether a sweep failing will make the unit beep.

Limit lines can be moved with arrow keys.

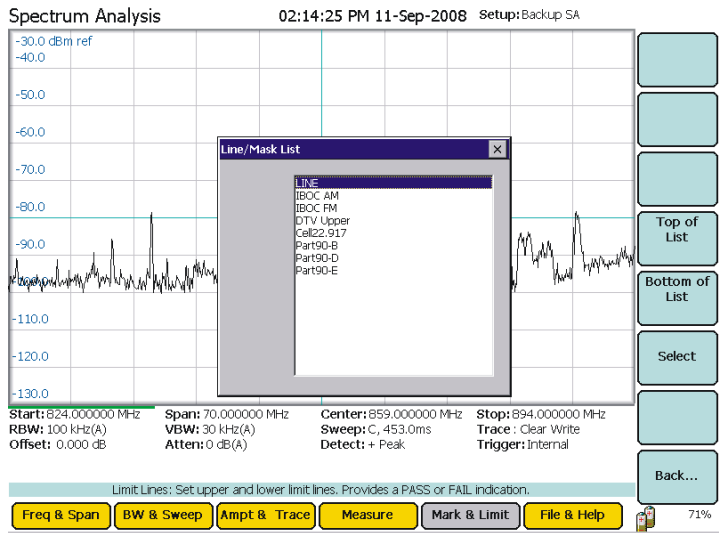
 **Note:** All valid traces are black, and any part of any trace that is outside of a limit is red. Red indicates a failed limit.

 **Note:** Pass or Fail is shown in the lower right corner.

Select Line/Mask

Creates a specific set of limit lines and presents a list of these predefined masks to choose from.

Figure 52 Example, Mask List

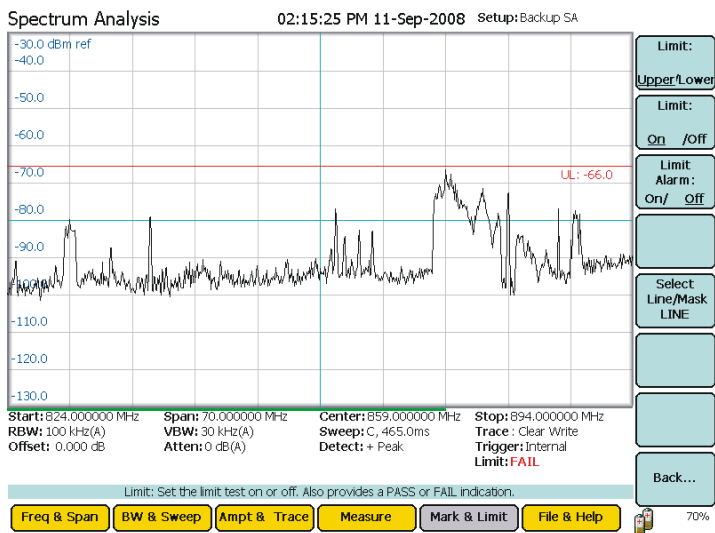


Once a mask is selected, it is controlled by the following options.

FM to Center - Positions mask relative to center the frequency of the sweep.

Freq Lock - Locks the mask onto the selected band even if the frequency is changed.

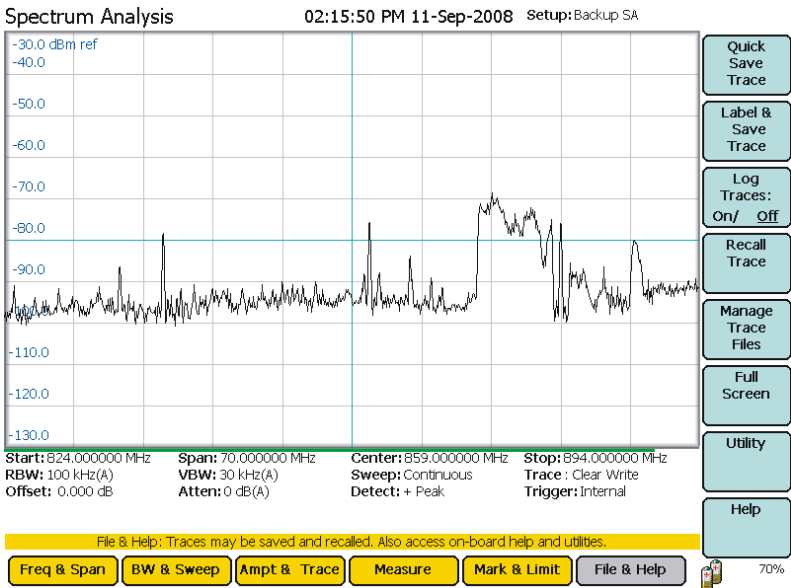
Figure 53 Example, Limit Line Mask



File & Help Menu

When the File & Help menu key is pressed, soft keys for saving the current trace, selecting the utility option, activating the logging feature, and accessing help features (Fig. 54) are enabled. A trace is saved as a file and stored in the internal memory of the instrument. Using the PCTool utility that is supplied on the CD that ships with the instrument, stored files can be copied or moved from the internal memory to an external storage device.

Figure 54 Example, File & Help Menu



Quick Save

Saves the trace that is displayed on the screen.

To save the trace:

1. Press the File & Help menu key
2. Press the Quick Save Trace soft key.

Note: The trace is stored as a file in the internal memory of the instrument. Each quick save is stored in a separate file that is named using the measurement and date-time file naming format: Measurement name(MM-DD HH-MM-SS).shf. Where the first MM is the month, DD is the day, HH is the hour, the second MM is the minute, and SS is the second of the time when the file was saved.

The PCTool utility (supplied on the CD that ships with the instrument), enables copying and/or moving stored files from the internal memory to an external storage device. When a saved trace is viewed or recalled, only the actual trace is displayed. For measurements that have calculated values (such as Occupied Bandwidth, Channel Power, etc.), the saved trace does not include the calculated values.

Label & Save Trace

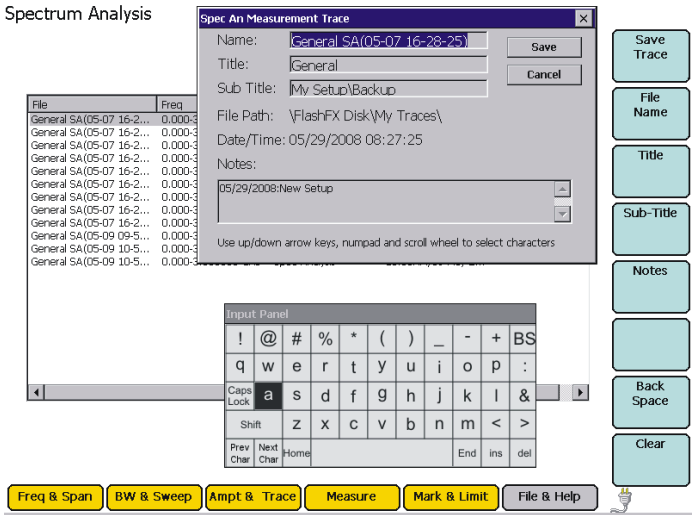
Labels and saves the settings for a setup for future use.

To save a Setup:

- 1. Press the Save Trace softkey.
- 2. Enter a file name using the thumbwheel and arrow keys.

 **Note:** Up-and-down arrow keys to move vertically and the wheel to move horizontally along the Input Panel. Use the right-and-left keys to toggle between the text fields (Name, Title, etc.)

Figure 55 Example, Save Trace



Log Traces

Saves a sweep every 60 seconds and assigns a default name to each save.

Recall Trace

Displays all recallable traces in the unit and opens up a submenu and with three options:

- Recall Trace
- Recall & Compare
- Clear Recalled Trace

Displays a trace on the screen.

Manage Trace Files

Copy trace files to and from an external thumb drive, and delete traces.

Full Screen

Enlarges the graph area to the size of the whole screen. Press escape to go back to regular screen.

Utilities

See “Utility Main Menu” on page 114.

Help

Brings up the soft keys that will enable either the Quick Start Guide or the User Manual, saved in the unit.

Chapter 5 Spectrum Analyzer Measurements

Spectrum Analysis, measuring the power at each frequency in the sweep range, is the basic measurement. The other measurements interpret that data to provide useful results.

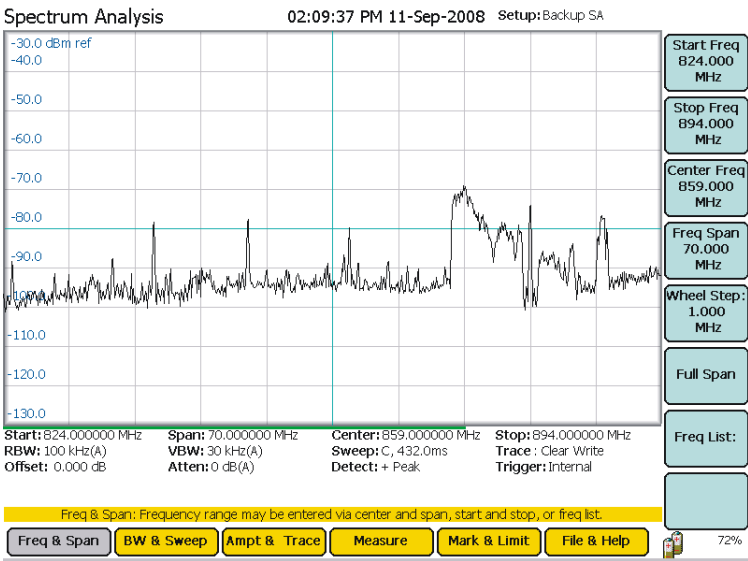
In the Spectrum Analyzer mode, the following measurements can be used:

- "Spectrum Analysis Measurement" on page 74.
- "Occupied Bandwidth Measurement" on page 75.
- "Channel Power Measurement" on page 77.
- "Adjacent Channel Power Measurement" on page 79.
- "Field Strength Measurement" on page 81.
- "Carrier-to-Interference Ratio" on page 83.
- "Time Domain (Zero Span)" on page 85.
- "Demod Signal" on page 86.
- "Out-of-Band and In-Band, Out-of-Channel Spurious" on page 87.

Spectrum Analysis Measurement

Spectrum Analysis measures the power at each frequency in the range shown on the screen. From the Spectrum Analyzer list on the Start Menu, select Spectrum Analysis then press the Enter key. For further instructions on setting parameters, see “Power Measurements” on page 97.

Figure 56 Example, Spectrum Analysis, Frequency and Span Screen



Occupied Bandwidth Measurement

Occupied Bandwidth measures the frequency bandwidth of a signal contained a total integrated power that can be defined depending on the type of modulation. Calculation of bandwidth can be defined in two ways. Both give measurement results in Hz units.

% total power - The bandwidth is calculated by the percentage of the total power in the displayed span or the occupied bandwidth calculated represents the user-specified percent of the total power in the displayed. Best for Watts power units.

dBc below carrier - The bandwidth is calculated by finding the frequencies above and below the center or carrier frequency that is the user-specified dB below the carrier level. This method is best for measuring dBm power units.

Setting Occupied Bandwidth

Note: For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.

1. Press the Occupied Bandwidth measurement type (softkey 1) on the Measurement Menu twice to turn the measurement on.
2. Select either % or dBc Threshold Mode (softkey 2), in the Measurement Menu, Occupied Bandwidth submenu.
3. Select either the % or dBc soft key (softkeys 3 and 4), depending on the measurement type.
4. Type in the desired threshold, using the keypad, then press enter.

Note: The threshold and the measured bandwidth will be displayed in the “measurement settings” area at the bottom of the display. Markers 1 and 2 will be turned on, and placed at the band edges.

Figure 57 Example, Occupied Bandwidth

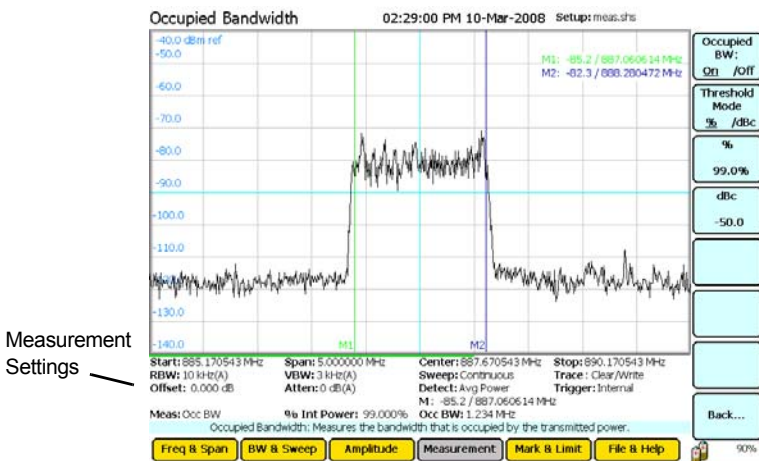
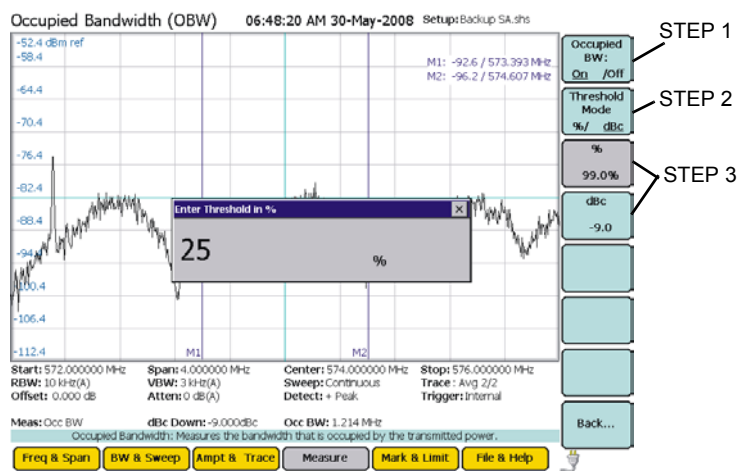
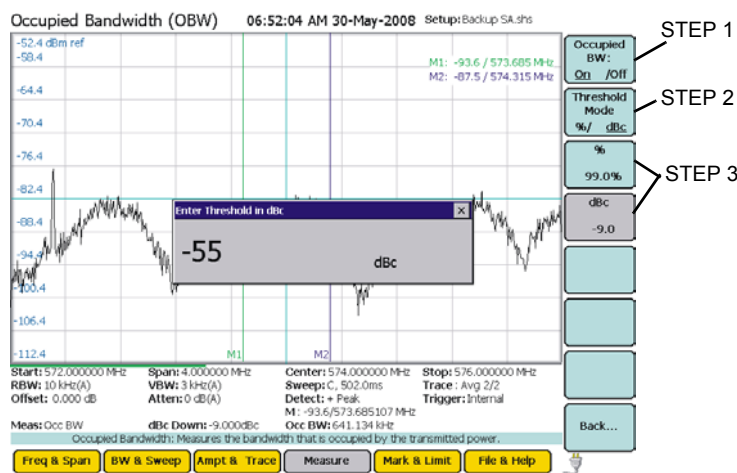


Figure 58 Example, Occupied Bandwidth - %

Note: Limit can be set without changing the Threshold Mode.

Figure 59 Example, Occupied Bandwidth - dBc

Note: Limit can be set without changing the Threshold Mode.

Channel Power Measurement

Channel Power measures the total power over a frequency range (the Integration Bandwidth) concentrated on the center frequency of the sweep. It is most useful for channelized (frequency-division multiplexed) signals. Results are shown in both total power in the channel (in dBm or Watts), and spectral density (dBm or Watts per Hz).

Setting Channel Power

Note: For best accuracy, set the center frequency so the signal is roughly centered before taking measurements. Also, the span should be $1\frac{1}{2}$ – 5 times as large as the desired channel width.

1. Select Channel Power, in the Measurement Menu, then, in the Channel Power submenu, press the Channel Power button (softkey 1) to turn the measurement on.
2. Select the Integration Bandwidth (IBW) function (softkey 2).

Note: The IBW is automatically set when a channelized frequency band is selected from the Frequency list.

3. Type in the desired bandwidth using the keypad.
4. Press the correct softkey for the desired unit.

Note: The default is MHz if Enter is pressed.

Note: The bandwidth, channel power, and power density will be displayed in the “measurement settings” area at the bottom of the display. Markers 1 and 2 will be turned on, and placed at the band edges.

Figure 60 Example, Channel Power

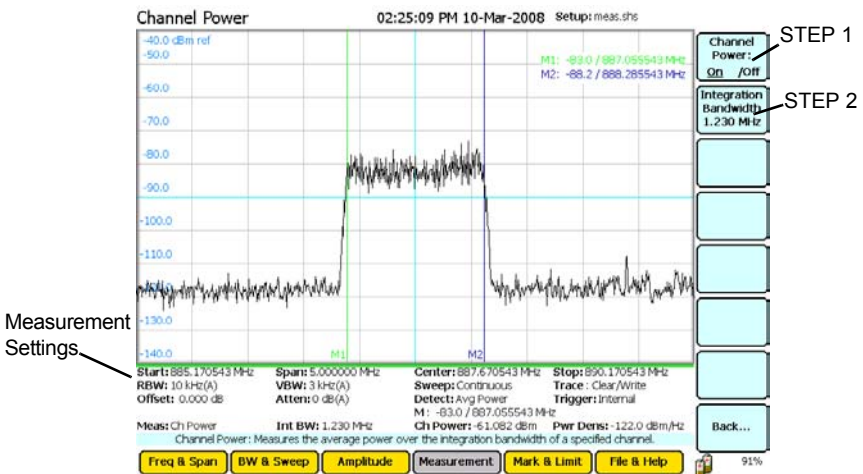
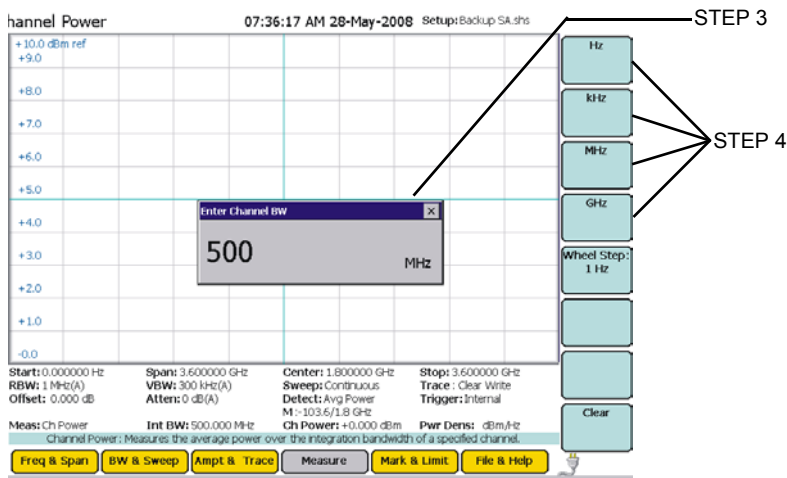


Figure 61 Example, Channel Power, Integration Bandwidth



Adjacent Channel Power Measurement

Adjacent Channel Power measures the relative power of frequency bands adjacent to the centered channel. This is often used to identify power leakage from a channel into the adjacent channels. The total power in the central (main) channel is displayed in dBm (Ch Power), and the power in the adjacent channels is displayed as dB below and above the main channel power (Dn ACPR and Up ACPR).

Setting Adjacent Channel Power

 **Note:** For best accuracy, set the center frequency so the signal is centered before taking measurements. Also set the span so the main, upper, and lower channels are all shown on the screen.

 **Note:** The main channel can be set to a different frequency width than the adjacent channels. Both adjacent channels have the same width.

 **Note:** Channel spacing is the distance from the main channel's center frequency to the adjacent channel's center frequency.

 **Note:** If there is no guardband between channels, the channel spacing should be half (channel width + adjacent channel width).

 **Note:** All 6 markers will be used to show the edges of the center, upper, and lower channels.

1. Select Adjacent Channel Power (ACPR), in the Measurement Menu, then, in the Adjacent Channel Power submenu, press the Adjacent Channel Power button (softkey 1) to turn the measurement on.
2. In the Measurement Menu, Adjacent Channel Power submenu, set the following variables:
 - a. Width of the center channel (softkey 2).
 - b. Both adjacent channels (softkey 3).
 - c. Center-to-center channel spacing (softkey 4).

 **Note:** If a channelized band is selected from the Frequency list, these parameters are automatically set.

3. In each variable, type the desired bandwidth using the keypad, then press the correct units softkey (defaults to MHz if you press Enter).

Figure 62 Example, Adjacent Channel Power

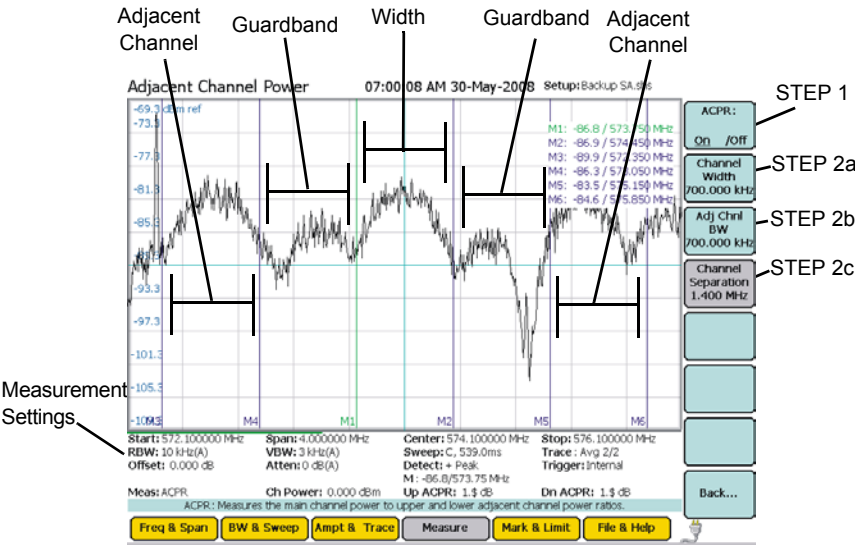
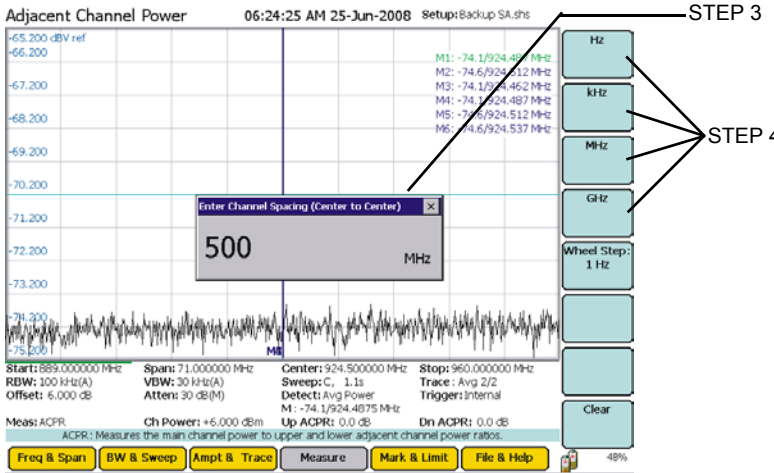


Figure 63 Example, Adjacent Channel Power, Bandwidth Settings



Field Strength Measurement

Field Strength measures the signals reaching an antenna. It automatically corrects the sweep data for the antenna's gain and frequency dependence to display in dBm / m.

Using an antenna with known gain characteristics connected to the RF In connector on the SignalHawk, measure the strength of the signal emanating from a transmission antenna (within the frequency range of the antenna connected to the RF In port).

Note: For best accuracy, set the start and stop frequencies to the measurement range of the chosen antenna.

1. Select Field Strength, in the Measurement Menu, then, in the Field Strength submenu, press the Field Strength button (softkey 1) to turn on the measurement.
2. Press the Antenna button (softkey 2) and select the antenna type from the drop down list.

Note: The antenna type, valid frequency range and gain in dB (relative to an isotropic radiator) is shown in the measurement settings area.

3. Move to various positions relative to the transmitting source and observe the signal value.

Figure 64 Example, Field Signal Strength - Before

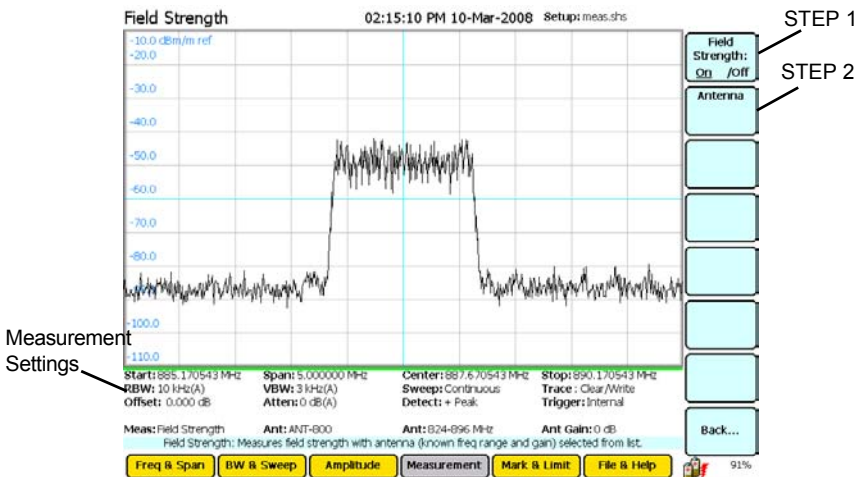
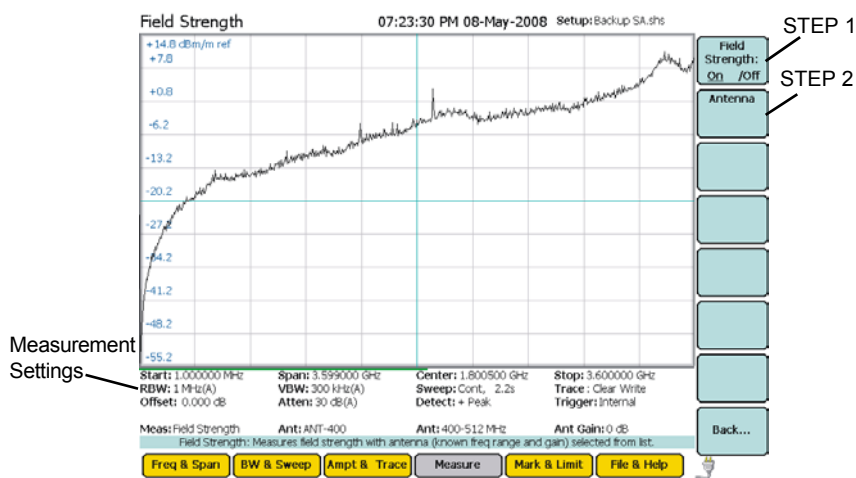


Figure 65 Example, Field Signal Strength - After

Carrier-to-Interference Ratio

This measurement calculates the ratio of the carrier signal power to the power level of the noise and interference signals. To determine the ratio, make two measurements.

Note: *Because the transmitted carrier must be turned off for the second portion of this measurement, the user must have access to the transmitter to complete this procedure.*

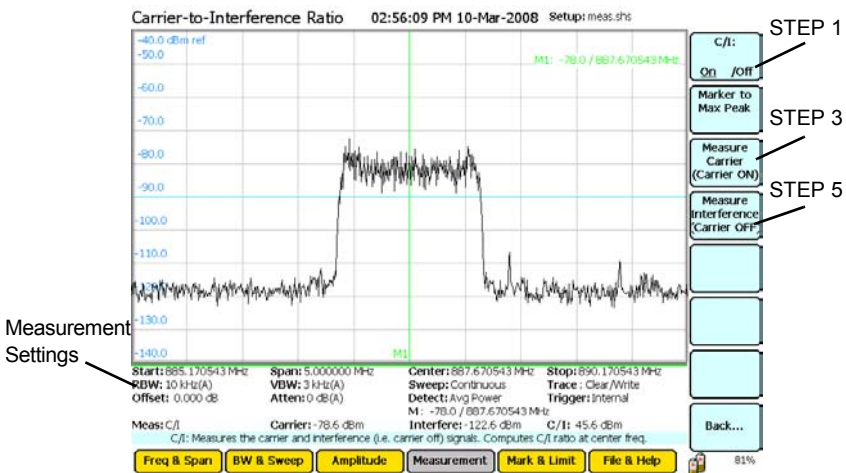
1. Select Carrier-to-Interference, in the Measurement Menu, then, in the Carrier-to-Interference submenu, press the Carrier-to-Interference button (softkey 1) to turn on the measurement.
2. Do one of the following:
 - Move marker to the desired frequency.

Note: *The default marker placement assumes the carrier to measured is the center of the frequency span. It can be moved via the arrow keys and/or wheel.*

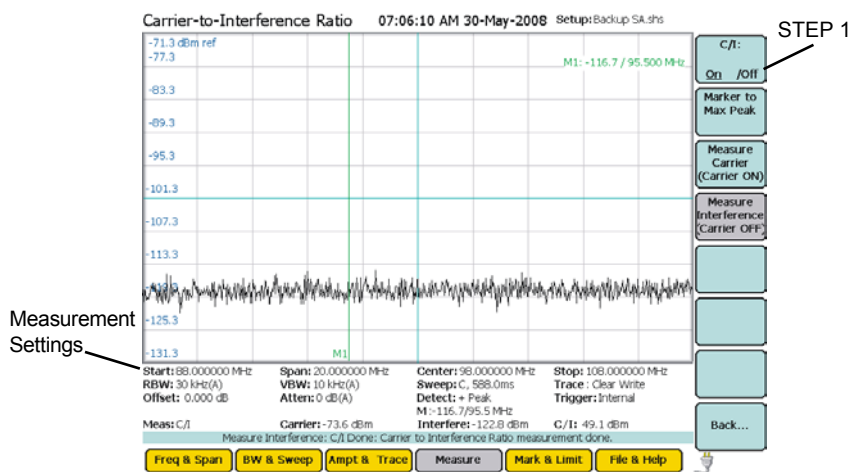
- Press Marker to Max Peak soft key to quickly identify the signal to be measured.
3. Measure the carrier signal.
 4. Turn off the transmitter.
 5. Measure the noise and interference signal levels as follows.

Note: *First sweep should be the carrier and interferer. The second sweep should be the interferer alone.*

Figure 66 Example, Carrier-to-Interference Ratio - Carrier On



Note: *In the status area, the carrier power, interferer power will be displayed in selected power units, and the ratio in dB.*

Figure 67 Example, Carrier-to-Interference Ratio - Carrier Off

Time Domain (Zero Span)

In Time Domain, the amplitude of a single frequency is displayed, rather than sweeping a range of frequencies. The SignalHawk measures and displays the amplitude of the frequency for a specified time period (sweep time). The display is refreshed during each sweep time. The Time Domain trace resembles the horizontal line display on an oscilloscope.

 **Note:** Set the center frequency to the frequency to be measured.

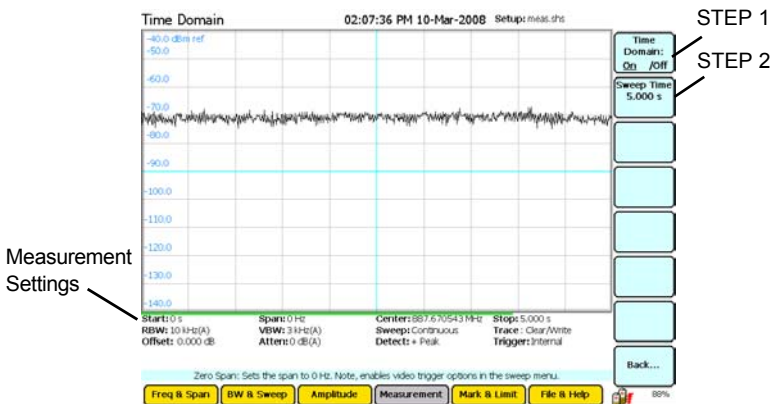
- Do one of the following:
 - Select Time Domain, in the Measurement Menu, then, in the Time Domain submenu, press the Time Domain button (soft-key 1) to turn on the measurement.
 - Set the Frequency Span to 0 Hz. See “Freq & Span Menu” on page 54.
- Press the Sweep Time soft button and enter how long a single sweep should be using one of these methods:
 - Up/Down Arrows:** Step increments of one second.
 - Right/Left Arrows:** Step increments of one millisecond.
 - Wheel:** Step increments of one second per click.
 - Number Pad:** Enter the time in seconds.

 **Note:** Time range can be set from 1 ms to 100 s.

 **Note:** There is a limited number of pixels, so longer times mean less detail in the display.

 **Note:** When Time Domain is on, the Video Trigger will be enabled in the BW & Sweep menu. To use the Video Trigger, always maintain power, only start a real sweep when power is above or below a set threshold power. See “Resolution & Video BW” on page 58.

Figure 68 Example, Time Domain

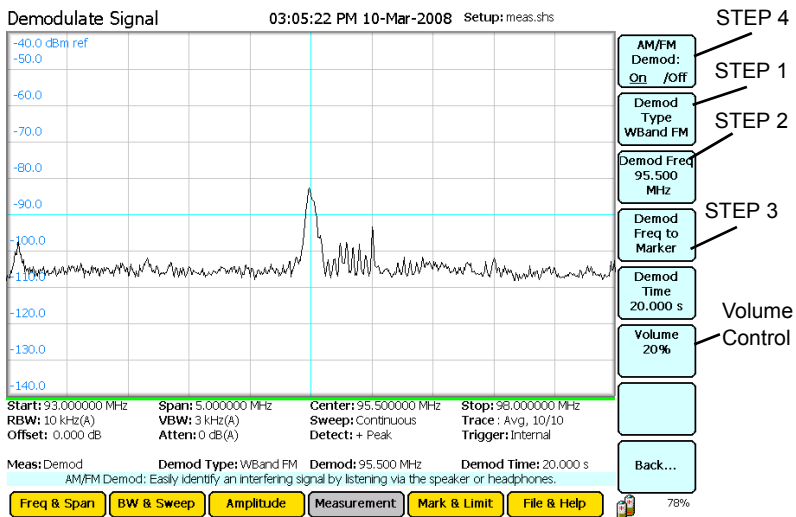


Demod Signal

The Demodulate Signal measurement removes the carrier and sends the demodulated signal to the internal speaker or head phone. The SignalHawk can demodulate AM, narrowband FM, and wideband FM signals. It can also set the specific demod frequency and volume.

1. Set the type of demodulation:
 - a. Press the Demod Type button (softkey 2).
 - b. Press the soft key for the type of demodulation desired.
2. Set the demodulation carrier frequency:
 - a. Press the Demod Freq button (softkey 3).
 - b. Enter the carrier frequency using the keypad.
 - c. Press a soft key to select the frequency units.
3. Set the time to demodulate the signal:
 - a. Press the Demod Time button (softkey 4).
 - b. Enter a value using the keypad.
 - c. Press a soft key to select the time units.
 - d. Allow audio to play for the demod time.
 - e. Do another sweep.
 - f. Play more audio for demod time.
 - g. Repeat as necessary.
4. Press Demod On/Off button (softkey 1).

Figure 69 Example, Demodulate Signal



Out-of-Band and In-Band, Out-of-Channel Spurious

 **Note:** *These two measurement methods are not listed on the interface.*

Out-of-Band & In-Band, Out-of-Channel Spurious measures the distortion and interference inside or outside a system band.

1. Press the Marker key
2. Press the Marker 1 2 3 4 5 6 soft key to select marker 1.

 **Note:** *The bracketed number indicates the active marker.*

3. Press the On/Off soft key and use the arrow keys, the keypad or knob to move the marker over one of the spurs.
4. Compare the value of the marker to the specified allowable level of Out-of-Band (In-Band, Out-of-Channel) spurious emissions for the corresponding channel transmit frequency.

Chapter 6

PC Tool

Bird's SignalHawk PCTool lets enables the use of PC to store measurement data, transfer it between units, and do individual analysis. Traces can be transferred from the SignalHawk to the PC and back. One or more saved traces can be opened and compared, copy-and-pasted into other open files, add markers and limit lines. Also, files can have labels added, and modifications saved.

Computer Requirements

The PC must meet the following minimum requirements:

- Windows 98 or later operating system
- Internet Explorer version 6 or later
- Hard disk with 30 MB of free space

Installing the Software

 **Note:** For the latest version of the PCTool (and Microsoft Activesync), download it from the Bird Technologies SignalHawk website:

<http://www.bird-technologies.com/sh/>

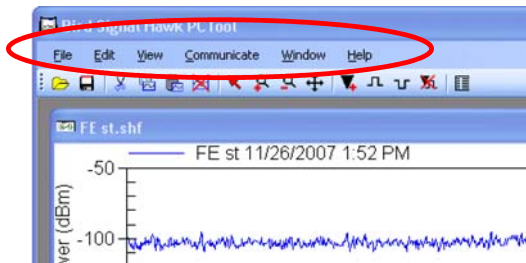
1. Download and install Microsoft ActiveSync.
2. Do one of the following:
 - If this is the first time installing the PCTool on this machine: Copy the file “SHPCTool x.xx.xx FullSetup.exe” to your PC.
 - If upgrading an older version: Use the file named “SHPCTool x.xx.xx UpgradeSetup.exe”.

 **Note:** These files are on the CD supplied with the SignalHawk, and can also be downloaded from the website.

3. On the PC, run the Setup file. Follow the instructions in the Install Wizard to complete the installation.

 **Note:** The first time the SignalHawk is connected to the PC, a window asking for a driver may pop up. If this happens, select “automatic”. If the program does not accept “automatic”, select “manual” and then select the option to find the driver. Navigate to the folder where the PCTool is installed and select the file named “wceusbsh.inf” as the driver.

Menu Bar



File

Presents commands to Open, Close, Save, Export, and Print Signal-Hawk files that are stored on the PC.

Note: By default, traces will be saved to the “My Traces” folder, which is a subfolder under the folder where the PCTool was installed.

Edit

Presents commands to copy the active trace from a graph and paste it into another graph. Traces can also be deleted from a graph.

Note: The last trace remaining on a graph cannot be removed.

View

Presents commands to manipulate the trace - zoom in, zoom out, add and delete markers and limit lines, autoscale the trace, set to normal mode, and set options. Normal mode is identified by the standard Windows “selection” cursor (arrow pointing to the upper left).

Measurement

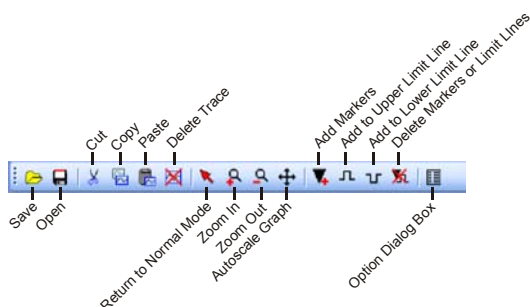
Presents the various measurement types to display the reading. The types of measurement depend on the type of trace file being read. VNA files will give Match Measurement, Distance to Fault, and Cable Loss as options. Spectrum Analysis files will give Spectrum Analysis, Occupied Bandwidth, Channel Power, Adjacent Channel Power, Field Strength, Carrier-to-Interference, Time Domain, Demod Signal, and Spurious options.

Communicate

Presents commands to get files from and/or send files to the Signal-Hawk. Also, use this function to upgrade the SignalHawk firmware.

Tool Bar

Use the tool icons to perform the tasks that are available on the Menu bar.



Save - Saves a copy of a graph.

Open - Opens a graph.

Cut - Cuts a trace from a graph.

Copy - Copies a trace from a graph.

Paste - Pastes a trace onto a graph.

 **Note:** A traces from one measurement type cannot be placed onto a graph from another measurement type (Occupied Bandwidth, Channel Power, etc). The graphs do not match.

Delete Trace - Deletes a trace from a graph.

 **Note:** The last trace on a graph cannot be deleted.

Return to Normal Mode - Returns the display back to the start menu.

Zoom In - Increases the zoom on a graph.

Zoom Out - Decreases the zoom on a graph.

Autoscale Graph - Resizes axis to fit all traces on the graph.

Add Markers - Drops a marker onto a graph.

Add to Upper Limit Line - Adds a limit line to the graph.

- First click will create a point on the graph with a highlighted line.
- Second click will create another point that connects to the first point via a line.
- Third click connects to the second, and so on.

Add to Lower Limit Line - Adds a limit line to the trace graph.

- First click will create a point on the graph with a line.
- Second click will create another point that connects to the first point via a line.
- Third click connects to the second, and so on

Delete Markers or Limit Lines - Deletes either a marker, a limit line, or a point on a limit line. When deleting points, the icon will change to an eraser graphic when the icon floats over something that is able to be deleted.

Option Dialog Box - Opens the pop up Option Dialog box.

Measurement Types - Depending on the type of file being read, the measurement types for that file will be displayed.

Options Dialog Box (View>Options)

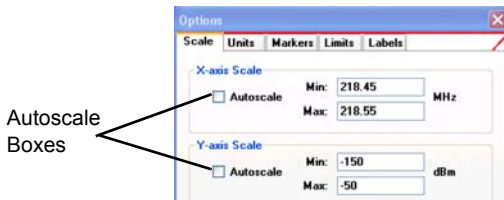
The Options dialog box contains five tabs - Scale, Units, Markers, Limits, Labels. Select a tab and enter or edit specific values for the currently active graph.

Scale Tab

1. Enter the scale for the x- and y-axis
2. Enter the y-axis offset.
3. Select the Autoscale box or manually enter values for the scales.

 **Note:** *The Offset setting for a specific trace is displayed. The setting changes when a the Trace changes.*

Figure 70 Example, Scale Tab



Units Tab

1. Select the units of measure for the y axis,
2. Set the size of text for the entire graph,
3. SET whether or not to display grid lines.

 **Note:** *Unit options are dBm, Watts, Volts, dBuV, dBmV, and dBV.*

Figure 71 Example, Units Tab



Markers Tab

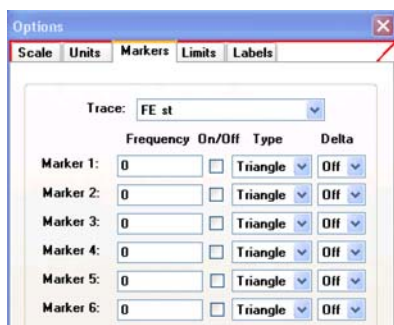
When a frequency for a marker is entered, the marker will be set to the datapoint closest to that frequency. The actual frequency of the marker will replace the value entered and will also display on the screen below the graph area.

For each marker:

1. Specify or change the frequency,
2. Specify the symbol type,
3. Specify a delta with another marker,
4. Turn a marker on or off.

Note: After turning a marker on in the Options window, the marker can be moved by clicking on the marker and dragging it to a desired location.

Figure 72 Example, Markers Tab



Limits Tab - Defines and turns on or off upper and lower limit lines.

 **Note:** *The upper limit fails any datapoints that are above the line.*

 **Note:** *The lower limit fails any datapoints that are below the line.*

Up to six points, for both upper and lower limit lines, can be set up. Using multiple points, a bracketed area may be created. If only a single point is set, the limit line will be flat across the graph at the power level specified.

For a single point:

1. Click on the line
2. Drag the line to move it up and down.

For a line with multiple points:

1. Click on a segment
2. Drag each segment at its set point to move it up or down.

 **Note:** *If a limit line point is disabled, it is removed from the list in the Options dialog box.*

Figure 73 Example, Limits Tab

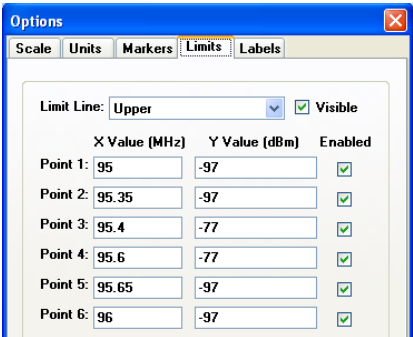
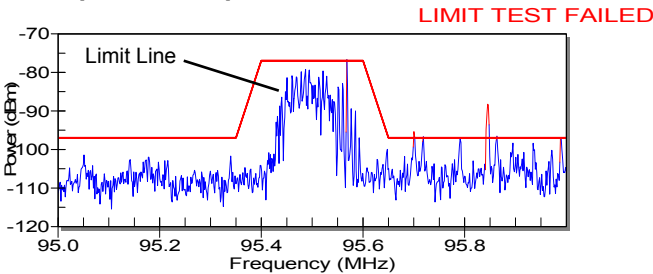


Figure 74 Multiple limit line points used to create a bracketed area.



Labels Tab

Creates a title, subtitle, and a trace name for the displayed trace.

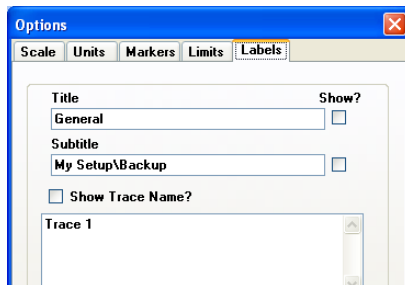
The title will be in larger letters and centered above the graph. The subtitle will be smaller.

Edit a trace name by typing in the list of traces on this tab. The trace and date will be located above the graph and on the left.

 **Note:** *If a specific trace name is not created, the PC tool will create one automatically.*

Other options are to display or hide the title, subtitle, trace name, and trace date on the graph.

Figure 75 Example, Labels Tab



Chapter 7

Power Measurements

Power measurements verify and monitor the condition of a transmitter system. To measure transmitter power, connect an external power sensor to the SignalHawk then select the Power Meter mode from the Start Menu screen. Power sensors that are compatible with the SignalHawk are the Bird 5010B, the Bird 5011, and the Bird 5012 (Figure 76).

The Power Meter mode has the following features:

- Two display formats, numerical readout and analog dial.
- Display forward power, reflected power, match efficiency, peak power, burst, and crest factor depending upon the capabilities of the sensor.
- Display power measurements in Watts or dBm.
- Display match units in either VSWR, Return Loss, or % match efficiency.

Figure 76 SignalHawk Compatible Sensors Bird 5012, Bird 5010B, and Bird 5011



Bird 5012



Bird 5010B



Bird 5011

Quick Setup - Configure Sensor and Instrument

1. With power turned off, connect a communication cable from the SignalHawk RS-232 port to an external Bird power sensor.
2. Turn the SignalHawk on, press the Power Meter menu key at the Start Menu, select External Power Sensor from the list, and press Enter.
3. After SignalHawk acquires the power sensor, press the Configure menu key.
4. Do one of the following, depending on the sensor:

For Sensor 5010B

1. Press the soft key to select the type of element.
2. Press the Forward Scale soft key then use the arrow keys, key pad, or thumbwheel to enter the watt rating of the forward element.
3. Press the F/R Scale 10:1 Ratio soft key to select ON.
4. Press the Input Offset soft key and use the key pad to enter the amount of attenuation then press the Enter key.

For Sensor 5011

1. Press the Power: Watts soft key.
2. Press the Input Offset soft key and use the key pad to enter the amount of attenuation then press the Enter key.

For Sensor 5012

1. Press the Input Offset soft key and use the key pad to enter the amount of attenuation then press the Enter key.
2. Press the soft key to select Auto Duty Cycle.
3. Press the soft key to select Auto Range.

Connecting a Sensor

CAUTION

SignalHawk testports are not used for power measurement. Always use an external sensor!

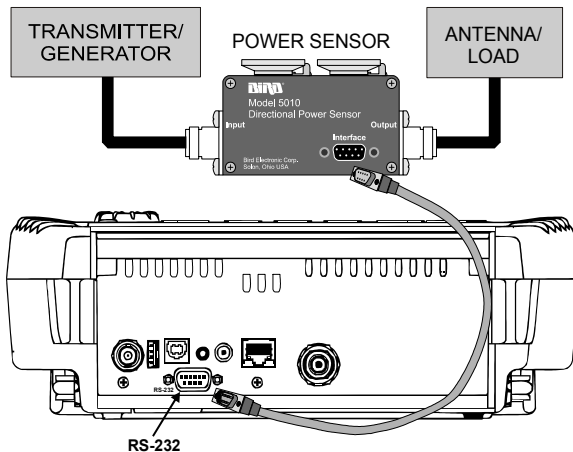
CAUTION

Always turn off the SignalHawk before connecting or disconnecting a sensor.

Connect a power sensor to the SignalHawk serial port “RS-232” with a 9-pin serial cable (Figure 77). Once the sensor is connected and the SignalHawk has detected it, the display will change to the sensor screen (Figure 78).

Note: *If no power sensor is detected, the Power Meter screen displays the message “Acquiring Power Sensor.”*

Figure 77 Connecting a Power Sensor to the SignalHawk



Note: *The USB port located on the 5012 power sensor is used for direct connect to a personal computer ONLY. Do not use the USB port to connect to the SignalHawk.*

CAUTION

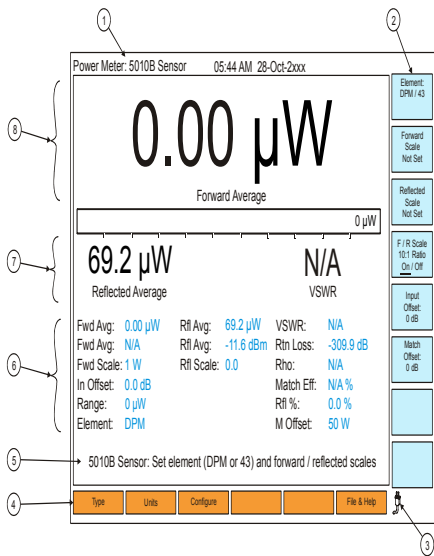
+20 dBm (100 mW) max. RF input for the Spectrum Analyzer and +22 dBm (160 mW) max. RF input for the Vector Network Analyzer. Exceeding the maximum input will damage the SignalHawk.

Looking at the Screen

When the SignalHawk is connected to an external power sensor, the available commands will vary according to the capabilities of the sensor being used. Typical functions are for selecting the type of measurement, type of element, units of measure, measurement scales, offset values, and zeroing the sensor.

When a power sensor is properly connected (and detected), the status message, located at the top of the Power Meter screen, will indicate the model number of the power sensor (i.e., Bird model number).

Figure 78 Bird 5010B Initial Screen



Item	Description
1	Model of connected power sensor
2	Softkey Labels
3	Power Supply
4	Menu Label Keys
5	Sensor Help Text
6	Sensor Readings
7	Power Display
8	Main Power Display

5010B Measurements

 **Note:** *The forward element's power rating must be entered before taking data.*

1. Connect the sensor. See “Connecting a Sensor” on page 99.
2. After the SignalHawk detects the sensor, use the soft keys to specify the type of element (DPM or type 43).
3. Press the Forward Scale soft key then use the Up and Down arrow keys to enter the wattage value of the forward element.
4. Press the Type menu key, then press the Forward Average soft key.

 **Note:** *The Forward Average value displays in large characters at the top of the screen.*

5. Select the desired measurement to display.

5011 Measurements

1. Connect the sensor. See “Connecting a Sensor” on page 99.
2. After the SignalHawk detects the sensor, zero-calibrate the sensor by pressing the “Start Zero Calibration” softkey.

 **Note:** *The 5011 should be zero-calibrated before taking measurements. Do not apply RF to the sensor during calibration. Optional if measuring higher powers.*

 **Note:** *Wait for the calibration to finish before continuing.*

3. ONLY if the 5011 is connected to the system through a coupler or attenuator, press the Input Offset soft key and use the key pad to enter the amount of attenuation.

5012 Measurements

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.
Leaking RF energy is a potential health hazard.

To connect the 5012 (WPS) to the SingalHawk, use the serial cable provided. Connect the male end of the cable to the SingalHawk and the female end to the WPS.

 **Note:** *A separate power supply for the WPS is not required when using a SingalHawk.*

Filter: Full - Press this key to select a video filter value. Narrowing the filter limits noise contributed by interference signals. Press the soft key to select one of three filter values: Full (10 MHz), Medium (400 kHz), or Low (4.5 kHz).

 **Note:** *For additional information about video filtering, refer to the owner's instruction book for the WPS.*

Duty Cycle - Press this key to measure the signal duty cycle, select Auto or Manual, the default setting is Auto.

 **Note:** *For additional information about duty cycle, refer to the owner's instruction book for the WPS.*

Manual Duty Cycle - Press this soft key then use the key pad to enter the duty cycle percent.

 **Note:** *Use this feature if the duty cycle is known and if the burst is less than 10 W.*

CCDF Limit (Complimentary Cumulative Distribution Function) - Press this soft key then use the key pad to enter a wattage limit for CCDF.

 **Note:** *Set the limit before you select the CCDF Measurement Type.*

 **Note:** *For additional information about CCDF, refer to the owner's instruction book for the WPS.*

Range Select - Press this soft key to select the range for the bar graph display. The range is from 100 μ W to 1 MW and Auto in the following sequence: Auto, 100 μ W, 1 mW, 10 mW, 100 mW, 1 W, 10 W, 100 W, 1 kW, and 10 kW.

 **Note:** *The default is Auto.*

Zero

When the Zero menu key is pressed, the Start Zero Calibration soft key which begins the zero calibration of the sensor (5011 or 5012 sensor) is Menu Keys and Associated Soft Key Features

When the SignalHawk is in the Power Meter function, one or more of the following menu keys will be available depending upon the capabilities of the sensor being used: Type, Units, Configure, Zero, File & Help.

Type

 **Note:** *Specific measurement types depend upon the power sensor being used (Figure 79, 5010B sensor or Figure 80, 5012 sensor). Not all power sensors have the Type selection option.*

When the Type menu key is pressed, the soft key functions that select the primary measurement to be made (such as forward average power, reflected average power, match) are enabled. The selected measurement will be displayed in large characters above the bar graph. The remaining measurements will display in smaller characters below the bar graph. If one of the measurements is not available or does not apply to the current application, it will be identified as N/A (not applicable).

**Figure 79 Power Meter, Digital Display, Type Screen
 (Bird 5010B sensor)**

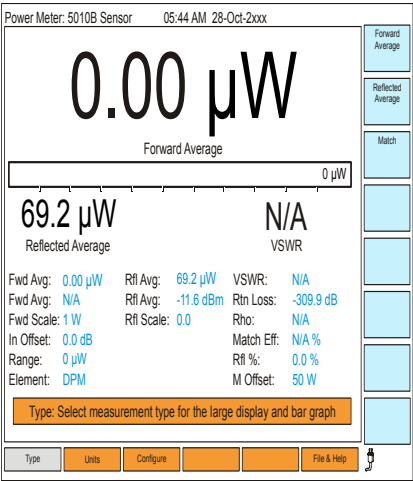
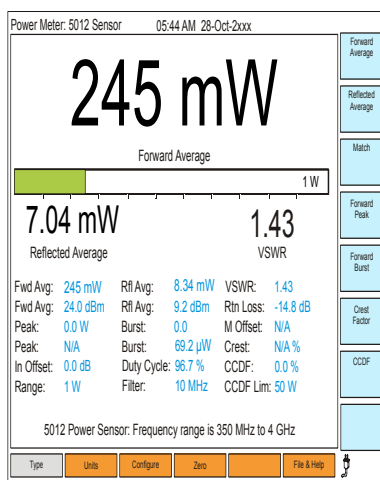
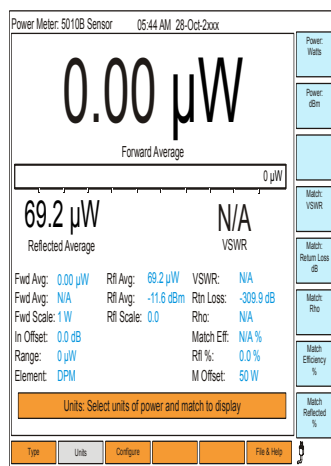


Figure 80 Power Meter, Digital Display, Type Screen (Bird 5012 sensor)

Units

When the Units menu key is pressed, the soft key functions that select the units of measure (Figure 81) are enabled. For power measurements, Watts or dBm can be selected. For match measurements, VSWR, dB, rho, and percent (%) can be selected.

Figure 81 Power Meter, Digital Display, Units Screen (soft keys are typical for all sensors, 5010B shown)

Power: Watts - Measure power in Watts.

$$Power (Watts) = 10 ^ {((dBm - 30) / 10)}$$

Power: dBm - Measure power in dBm.

$$Power (dBm) = 10 \times \text{Log} [Power (Watts)] + 30 \text{ dB}$$

Match: VSWR - Measure match, a complex ratio of reflected power to forward power expressed in VSWR.

$$VSWR = [1 + \text{Sqrt}(Pr / Pf)] / [1 - \text{Sqrt}(Pr / Pf)]$$

 **Note:** “Pr” = Reflected Power, “Pf” = Forward Power

Match: Return Loss dB - Measure match, a complex ratio of reflected average power to forward power expressed in dB.

$$Return Loss (dB) = 10 \times \text{Log} (Pr / Pf)$$

Match: Rho - Measure match, a complex ratio of reflected power to forward average power expressed in Rho.

$$Rho = \text{Sqrt} (Pr / Pf)$$

Match Efficiency % - Measure match, a complex ratio of reflected power to forward power expressed in percent efficiency.

$$Match Efficiency (\%) = 100\% \times (1 - Pr / Pf)$$

Forward average - Measure the forward average power.

$$Pf (dBm) = 10 \times \text{Log} (Pf (Watts)) + 30 \text{ dB}$$

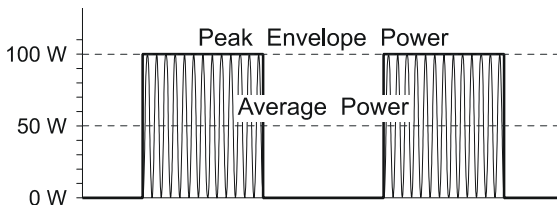
Reflected average - Measure the reflected average power.

$$Pr (dBm) = 10 \times \text{Log} (Pr (Watts)) + 30 \text{ dB}$$

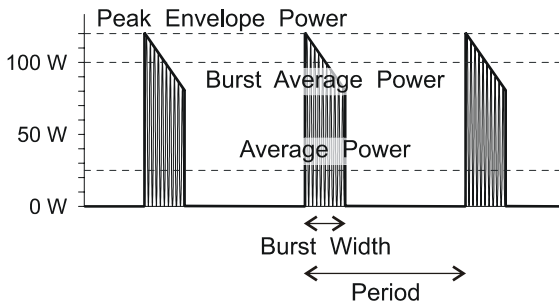
Match - Measure the match between the transmitted forward average power and the reflected average power.

$$Match Efficiency (\%) = 100\% \times (1 - Pr / Pf)$$

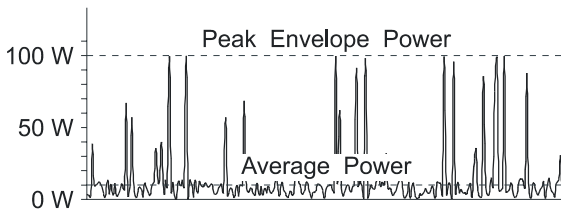
Forward Peak - Measure the transmitted forward power peak over 300 ms.



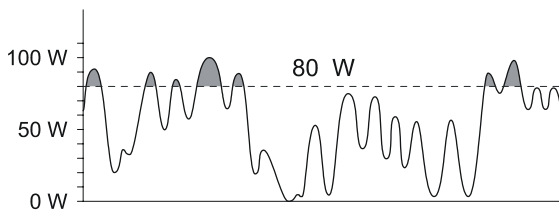
Forward Burst - Measure the average power of a transmitted pulse.



Crest Factor - Measure the difference between the peak power and the average power.



CCDF (Complimentary Cumulative Distribution Function) - Measure the amount of time that the power is above a pre-defined limit (the CCDF Limit).



Note: These features are available only with the Bird 5012 power sensor. For additional information about Forward Burst, Crest Factor, and CCDF, refer to the owner's instruction book for the Bird 5012 Wide Band Power Sensor.

Configure

 **Note:** *Specific configuration features depend upon the power sensor being used (Figure 82 5010B sensor, Figure 83 5011 sensor, Figure 84 5012 sensor).*

When the Configure menu key is pressed, the soft key functions that specify the setup information about the sensor and the measurements are enabled. What type of element in the power sensor, offsets for input and match, duty cycle, and the scale for forward and reflected power is displayed at this time.

Figure 82 Power Meter, Digital Display, Configure Screen (Bird 5010B sensor)

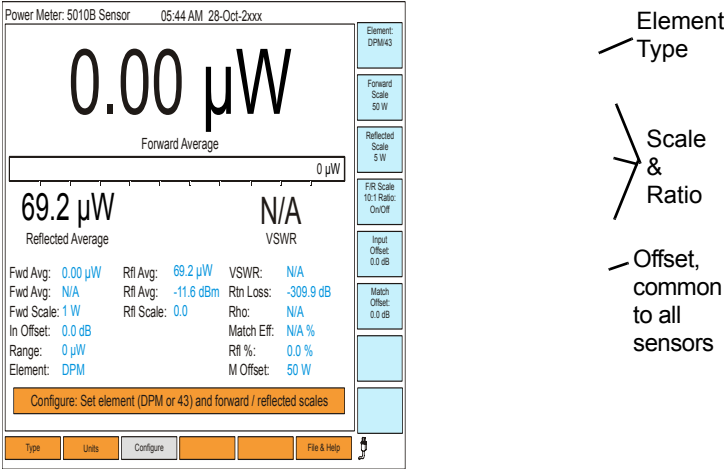


Figure 83 Power Meter, Digital Display, Configure Screen (5011)

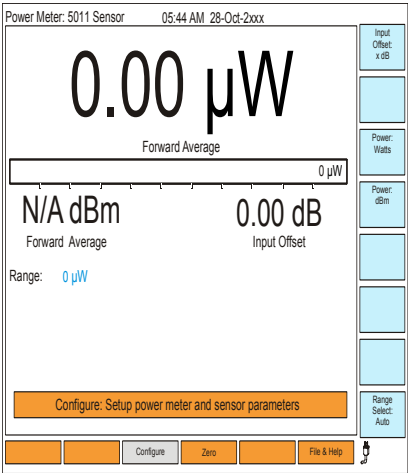
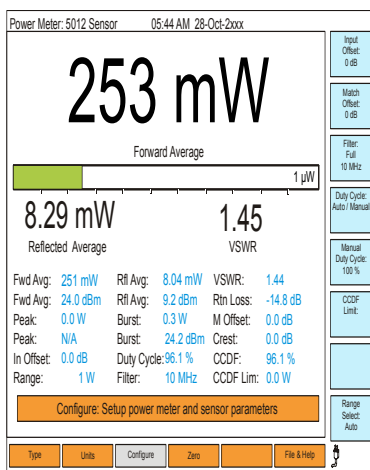
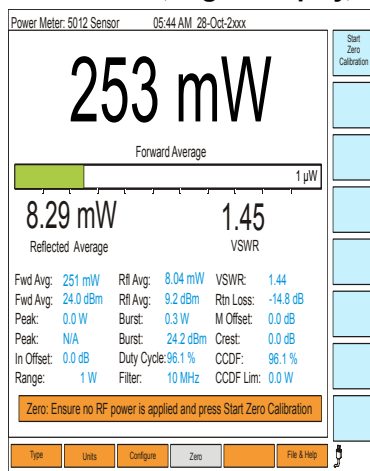


Figure 84 Power Meter, Digital Display, Configure Screen (5012)**Figure 85 Power Meter, Digital Display, Zero Screen (5012)****Quick Setup - Zero a Sensor**

1. Check that no RF is in the system.

Note: The sensor will read “~0.”

2. Press the Zero menu key.
3. Press the Start Zero Calibration soft key.

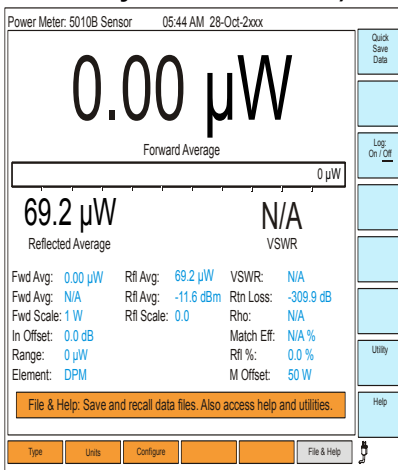
Note: Some soft key features will not be available for certain power sensors.

File & Help

When the File & Help menu key is pressed, the soft keys for saving the current trace, selecting the utility option, activating the logging feature, and accessing help features (Figure 86) are enabled.

A trace is saved as a file and stored in the internal memory of the instrument. Using the PCTool utility that is supplied on the CD that ships with the instrument, stored files can be copied or moved from the internal memory to an external storage device.

Figure 86 Power Meter, Digital Display, File & Help Screen (typical soft keys for all sensors)



Quick Save Data - Press this soft key to save the data that is displayed on the screen. The saved data is stored as a file in the internal flash drive of the instrument. Each quick save is stored in a separate file that is named using the date-time file naming format *PwrYYYYM-MDDHHMMSS.csv* where YYYY is the year, the first MM is the month, DD is the day, HH is the hour, the second MM is the minute, and SS is the second of the time when the file was saved. The data files can be viewed by any software program that can read a comma separated value (.csv) format (such as a spreadsheet).

Using the PCTool utility supplied on the CD that ships with the instrument and ActiveSync® (version 4.2 or later), you can copy or move stored files from the internal memory to an external storage device.

 **Note:** Download the latest version of ActiveSync at the Microsoft® web site.

Log: On / Off - Press this soft key to activate or deactivate the internal logging feature.

When logging is ON, a thin line appears under the word ON on the soft key text. When logging is OFF, a thin line appears under the word OFF.

Logging captures and stores the set of data that is sent from the external power sensor and displayed on the screen. While logging is ON, each set of data is stored as text on a separate line in the same computer file. The speed of the logging depends on the type of sensor being used (e.g., a 5011 will record a data every 300 ms).

Logging stops when the Log: On / Off soft key is pressed. The log file is named using the date and time file naming convention *PwrYYYYM-MDDHHMMSS.csv* where YYYY is the year, the first MM is the month, DD is the day, HH is the hour, the second MM is the minute, and SS is the second of the time when the file was saved.

When the logging feature is ON, there is a choice to log (store) every data set received or one set from a group. Press the up or down arrow keys to change the number of data sets to store:

- 1 of 1 - store every data set received
- 1 of 10 - store every tenth data set received
- 1 of 100 - store every one-hundredth data set received
- 1 of 1000 - store every one-thousandth data set received

Chapter 8

Utilities

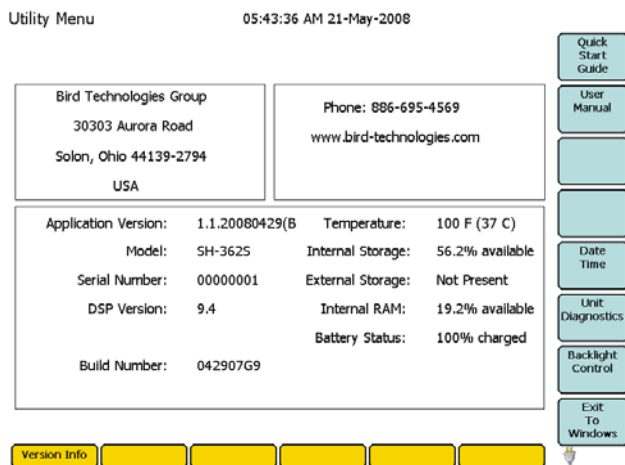
With SignalHawk's built-in utilities, information about the instrument is displayed. The Menu keys provide information about the software, hardware, and data files.

Utilities can be accessed by pressing the Utilities menu key from the Start Menu screen, or by pressing the File & Help menu key from a measurement screen then pressing the Utility soft key. To exit the Utility mode, press the Esc/Back function key to return to the previous screen, or press the Mode key to go to the Start Menu screen.

Utility

Press this soft key to leave the Power Meter function and go to the Utility Menu (Fig. 87). When the utility menu is accessed, new menu keys and soft keys for getting help, setting the date and time, performing certain unit diagnostics, adjusting the backlight brightness, and exiting to the Windows operating system are activated. The Utility Menu screen displays status information about the instrument and about the operating system.

Figure 87 Utility Menu, Main Screen, Version Info Screen



Utility Main Menu

Version Info

Press this menu key to view general information such as how to contact Bird Technologies Group (Fig. 87).

The soft keys for this menu selection provide access to user help, date and time setup, backlight settings, diagnostic software, and the Windows operating system.

Utility Main Menu Soft keys

Quick Start Guide

Press this soft key to display the SignalHawk Start-up Instructions. Press the up- and down-arrow keys or the Selection Dial to scroll through the displayed text. Press the Exit Menu key to return to the Utility Menu.

User Manual

Press this soft key to bring up an HTML version of the user's manual onto the display. Scroll through the pages using the arrow keys. This will be a future enhancement.

Date Time

- Press this soft key and the screen displays a dialog box showing the date and time (Fig. 88).
- Use the up- and down-arrow keys or the key pad to increase or decrease the selected value.
- Use the right- and left-arrow keys to move to the next or previous component of time or date.
- Use the thumbwheel to move between the Time and Date data fields.
- Press the Enter key to exit the dialog box and return to the Utility Menu screen. The new time and date is displayed at the top of the screen.

Figure 88 Utility, Set Time and Date

Utility Menu 05:44 AM 09-Jan-2006

Bird Technologies Group
30303 Aurora Road
Solon, Ohio 44139-2794
USA

Phone: 886-695-4569
www.bird-technologies.com

Application Version: 0.0.0.0.37
Model: SH-36S
Serial Number: Unknown
DSP Version: 10
Build Number: 122206DP

Temperature: 219 F
Internal Storage: 67.9% available
External Storage: Not Present
Internal RAM: 61.5% available
Battery Status: 100% charged

Buttons on the right: Quick Start Guide, User Manual, Date Time, Unit Diagnostics, Backlight Control, Exit To Windows.

Set Time & Date

Time: 2:17:04 PM
Date: 7 JAN 2007

Note: Use thumb wheel to toggle between Time and Date

Backlight Control

Press this soft key to display the backlight options (Fig. 89). Press the Esc/Back function key to return to the previous screen.

Figure 89 Utility, Backlight Options Screen

Utility Menu 05:44 AM 09-Jan-2006

Bird Technologies Group
30303 Aurora Road
Solon, Ohio 44139-2794
USA

Phone: 886-695-4569
www.bird-technologies.com

Application Version: 0.0.0.0.37
Model: SH-36S
Serial Number: Unknown
DSP Version: 10
Build Number: 122206DP

Temperature: 219 F
Internal Storage: 67.9% available
External Storage: Not Present
Internal RAM: 61.5% available
Battery Status: 100% charged

Buttons on the right: Backlight Mode, Backlight High, Backlight Medium, Backlight Low, Backlight Custom 100%, Sensor Gain 0.

Backlight Soft Key	Function
Backlight Mode Auto / Man	Set the backlight brightness Auto - adjusted by internal circuitry Man - set by user
Backlight High	Manual - Set backlight to brightest intensity.
Backlight Medium	Manual - Set backlight to middle intensity (default setting - provides approximately 5.5 hr. battery life).
Backlight Low	Manual - Set backlight to lowest intensity (provides approximately 7.5 hr. battery life).
Backlight Custom xx%	Manual - Set backlight to a specific percent intensity between 0 (off) and 100 (brightest).
Sensor Gain	For Backlight Auto mode Only: Set a threshold at which the ambient light sensor increases the backlight Low threshold - backlight intensity increases after a small change in ambient light. High threshold - Backlight intensity increases after a large change in ambient light.

Chapter 9

Maintenance

Regular maintenance is essential for proper and accurate performance of the SignalHawk. These procedures cover the basic maintenance of the SignalHawk. For more advanced issues, please contact Bird Technologies customer service.

Cleaning

CAUTION

Harsh or abrasive detergents, and some solvents, can damage the display unit and labels.

Clean the Bird SignalHawk only with a soft cloth dampened with mild detergent and water. Do not use any other type of cleaning solution.

Charging the Battery

The internal battery pack will automatically recharge when the SignalHawk is powered from the ac or cigarette lighter adapter. Recharging time, from a full discharge, is approximately 4 hours.

Upgrading the Firmware

The firmware installed on the SignalHawk is updated on a regular basis. Not all SignalHawk models have the current revision of the firmware. Upgrade the firmware to obtain the most current version.

1. Install the PCTool on a PC.
2. Download the latest firmware package from Bird's website.
3. Connect your unit to the PC
4. Run the PCTool. Select "Upgrade Firmware"

 **Note:** *Select the folder that you downloaded.*

5. Ensure the unit is connected then press okay.

 **Note:** *Wait for the download to complete.*

 **Note:** *After the PCTool completes the upgrade, the SignalHawk will turn itself off.*

6. Turn the SignalHawk on.

Replacing the Battery

WARNING

Care should be taken when handling batteries.

Keep out of the reach of children.

Do not heat or dispose of batteries in fire. May burst or release toxic materials.

Avoid forced discharge.

Do not short circuit.

Restrict charging current and time to the recommended value.

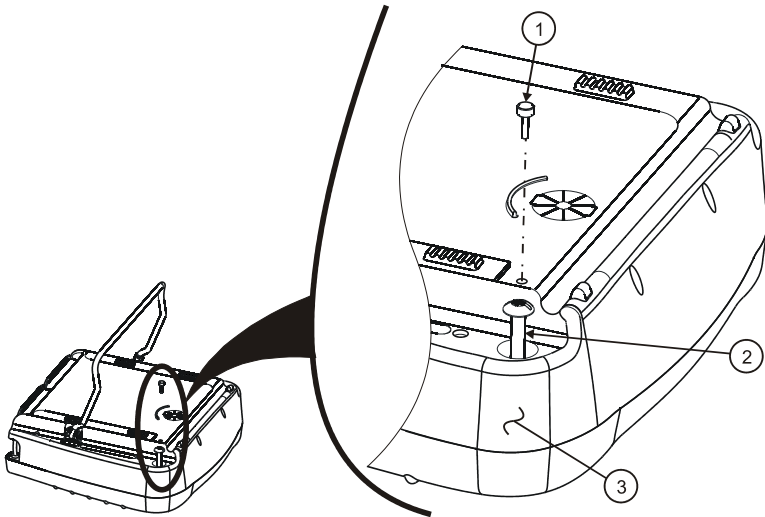
Do not solder the battery directly.

Do not disassemble, apply excessive pressure or deform.

Avoid placing the battery in reverse polarity.

Battery disposal method should be in accordance with local and state regulations.

1. Lay the instrument, display side down, on a clean non-abrasive surface.
2. Remove the two screws and the battery cover. Refer to Figure 90, page 119.
 **Note:** *The large screw in the battery cover is a captive screw that does not separate from the cover.*
3. Disconnect the battery cable connector (Figure 91, page 119) and use the pull tab to remove the old battery pack from the battery compartment (Figure 92, page 120).
4. Insert the new battery into the battery compartment then connect the battery cable.
5. Replace the battery cover and secure the two screws.
6. Connect the AC adapter to the unit.
7. Apply power to the unit and verify that it operates properly.
8. Charge the battery if needed.

Figure 90 Removing Battery Cover Screws

Item	Description
1	Battery cover screw, removable
2	Battery cover screw, captive
3	Battery cover

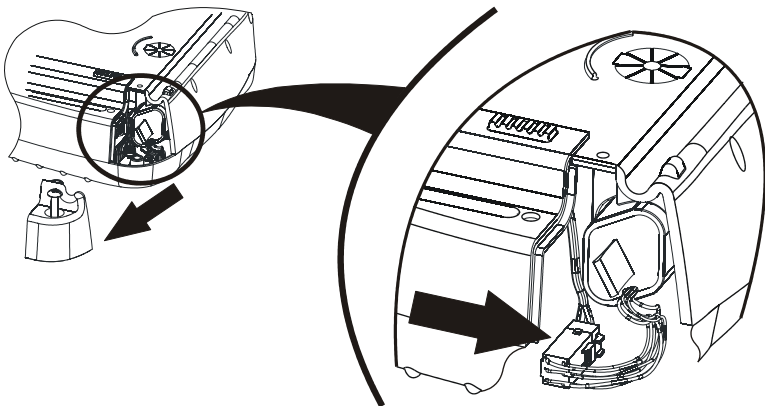
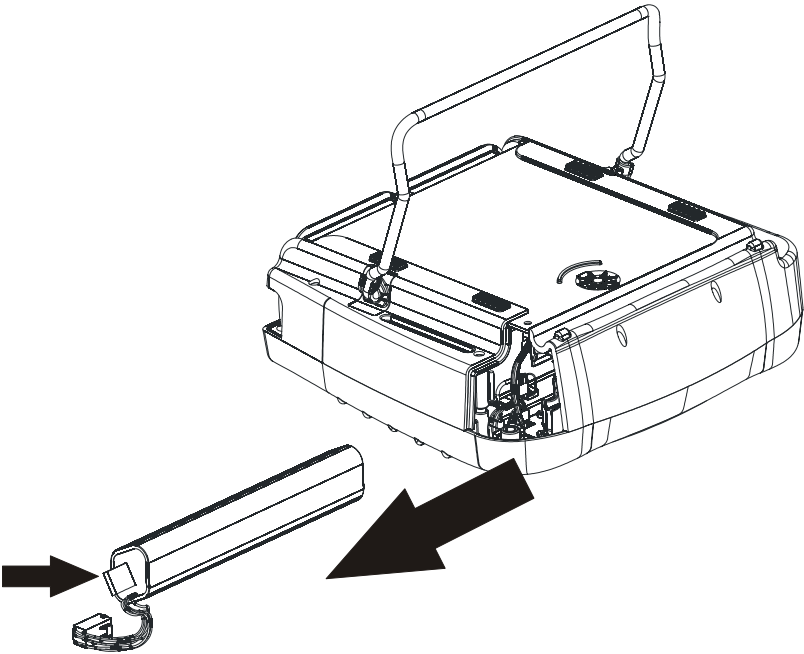
Figure 91 Battery Connector

Figure 92 Removing the Battery



Troubleshooting

Any service procedure not covered in this manual should be referred to an authorized service facility.

Locate the problem, review the possible causes, and perform the action listed. If the problem is not corrected, give us a call or return the unit for service.

For All Models

Problem	Possible Cause	Possible Correction
Unit will not power up	Battery pack drained.	Charge the battery pack. See "Charging the Battery" on page 117.
	Battery pack unable to keep a charge.	Replace battery pack. See "Replacing the Battery" on page 118.
	AC adapter is damaged.	Replace the AC adapter.
Self test fails	Error condition	Turn the unit off and then back on. If the problem persists, return the unit for service.
Keys do not respond	Unit is "Locked Up".	Turn the unit off and then back on.
Unit beeps and turns off	Internal error	Turn the unit back on and continue.
	Unit was last shut down because the battery was too low to operate the unit.	Operate the unit from the AC adapter.
Unit operates erratically	System has become unstable.	Turn off power, wait 15 seconds, then reapply power.
Unit ceases to operate (locks up)	System has become unstable.	Turn off power, wait 15 seconds, then reapply power.
Unit gives inaccurate readings below 100 kHz.	Unit can be set below 100 kHz for user convenience, but is not specified below 100 kHz.	Do not use unit below 100 kHz.
Sweep is too slow.	Bandwidth set too low.	Increase BW. See "Setting Occupied Bandwidth" on page 75.
Sweep stopped	Sweep set to single-sweep or external trigger.	Set unit to continuous sweep, free rep trigger. See "Sweep" on page 61.

For Models SH-362S and SH-361S Only

Problem	Possible Cause	Possible Correction
Fault Location trace appears incorrect.	Incorrect cable loss or velocity of propagation.	Check Cable Loss and V_p settings. See "Cable Loss" on page 45 and "Vp (Velocity)" on page 47.
Erratic antenna test measurements	Bad calibration combo.	Use a different calibration standard.
Trace drifts outside of specifications	Calibration lost	Calibrate the unit immediately before making a measurement. "Calibrate Menu" on page 27.
Sweep is too slow.	Number of points too high.	Decrease number of points. "Data Points" on page 30.

Specifications

SignalHawk Models

Model Number	Model Name
SH-362S	2-Port VNA (325 MHz to 3.6 GHz) and Spectrum Analyzer (100 kHz to 3.6 GHz)
SH-361S	1-Port VNA (325 MHz to 3.6 GHz) and Spectrum Analyzer (100 kHz to 3.6 GHz)
SH-362	2-Port VNA (325 MHz to 3.6 GHz)
SH-36S	Spectrum Analyzer (100 kHz to 3.6 GHz)

For Vector Network Analyzer for Model SH-362S, SH-362, and SH-361S Only

Frequency	
Range	325 MHz to 3.6 GHz
Resolution	40 kHz
Uncertainty	± 2 ppm (2σ) of measured frequency
Aging	± 2 ppm/year (2σ)
Temperature Drift	± 2 ppm/ $^{\circ}$ C (2σ)
Span	100 kHz to 3.275 GHz
Sweep Time	< 0.4s, 705 points, IFBW = 1MHz, immunity off
Data Points	705(default);12,23,45,89,177,353,705,1409,2817,5633, or 11265 user selectable Calibrated at point counts 705 and above
IF Bandwidth:	100 Hz to 3 MHz in 1, 3, 10 steps

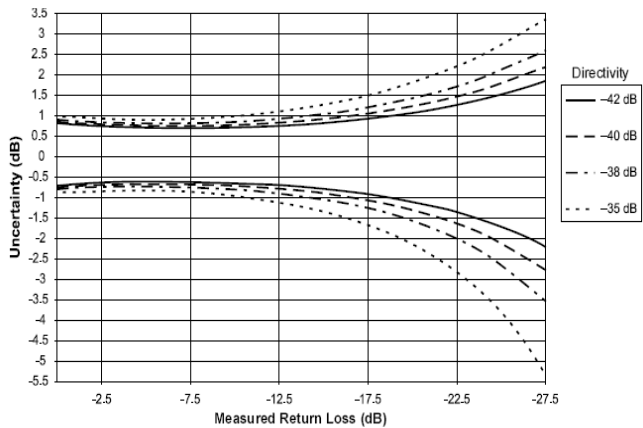
Amplitude	
Measurement Range	
Return Loss, Cable Loss	-60 to 0 dB
VSWR	1.0 to 99.99
Rho	0.0 to 1.00
Match Efficiency %	0.0 to 100.0 %
Reflected %	0.0 to 100.0 %
	$\text{Return Loss (dB)} = 10 \text{ Log (Pr / Pf)}$ $\text{VSWR} = (1 + \text{Rho}) / (1 - \text{Rho})$ $\text{Rho} = \text{Sqrt (Pr / Pf)}$ $\text{Match Efficiency \%} = 1 - (\text{Pr / Pf})$ $\text{Reflected \%} = \text{Pr / Pf}$ $\text{Pf} = \text{Forward Power}$ $\text{Pr} = \text{Reflected Power}$
Offset	Corrects for Cable Loss Masking Effect RL at Antenna = RL at Tx – (2 x CL offset)

Amplitude	
Distance to Fault (max)	Maximum Distance = 10,000 m, software limited Max Dist (ft) = $491.7796 \times V_p \times (\text{Pts} - 1) / \text{Span (MHz)}$ Max Dist (m) = $149.89625 \times V_p \times (\text{Pts} - 1) / \text{Span (MHz)}$ Resolution = Maximum Distance / (Data Points -1) Vp = Cable Velocity of Propagation Ex 1) 10,000 m (32,808') max dist, 89 cm (2.9') res with 148.582 MHz span, 88% Vp, 11265 pts Ex 2) 453 m (1,488') max dist, 4 cm (1.6") res with 3275 MHz span, 88% Vp, 11265 pts Note, DTF Wizard auto optimizes setup
Measurement Resolution Return Loss, Cable Loss VSWR, Rho Efficiency & Reflected % Distance-to-Fault (Min)	0.1 dB 0.01 0.1 % 4 cm (1.6") with 3275 MHz span, 88% Vp Resolution (m) = $149.89625 \times V_p / \text{Span (MHz)}$ Vp = Velocity of Propagation
Corrected Directivity, using Bird Calibration Kit Directivity Phase Instrumentation Open/Short Calibration	-42 dB 3° -35 dB ≤0.09 dB Based on freq range, output power, and data points
Measurement Accuracy Return, Cable Loss VSWR, Rho Distance to Fault Distance Fault	< ±1.5dB, measurements >-20dB, corrected directivity -42dB with 0 dB power output. See "Chart II - Measurement Uncertainty, 325MHz to 3.6GHz" on page 129. ± 2% of full-scale range with Vp = 1 Same as for Return Loss

Input	
Test Port	
Impedance, Nominal	50 ohms
VSWR (Max.)	< 1500 MHz 1.5:1
	1500 – 3600 MHz 2.75:1
Output Power (nominal)	0 dBm (default), –20 to +10 dBm, 10 dB steps, user-settable
Max RF Input\	+22 dBm
Immunity to Interference	+13 dBm (≤ 1 Ghz), + 10 dBm (> 1 GHz), $\geq \pm 0$ Hz from carrier (on-frequency)

Measurements	
Overview	Analyzes VSWR and Return Loss (dB) of single-port devices. Measures antenna and cable performance. Provides immunity to interference. Allows setup of parameters such as frequency, amplitude and markers. Graphically displays amplitude vs. frequency and saves traces.
Predefined Measurements	Match (VSWR & RL), Distance-to-Fault (DTF), Cable Loss.
DTF Cable List	Includes Vp and loss/freq parameters for 100+ cable types, user may update cable list as needed.
Markers	6 Markers; Modes: On/Off, Standard, Marker to Max Peak, Marker to Next Peak, Marker to Min Valley, Marker to Next Valley, Marker Delta, Marker Display, Marker Type Line/Icon, All Marker to Max Peaks, All Markers to Min Valleys, All Markers Off. Also, Marker to Max/Min Peak via Up/Down Arrow Keys, Marker Left/Right via Left/Right Arrow Keys and Wheel.

Chart I - Measurement Uncertainty, 325MHz to 3.6GHz



For Spectrum Analyzer for Models SH-362S and SH-361S

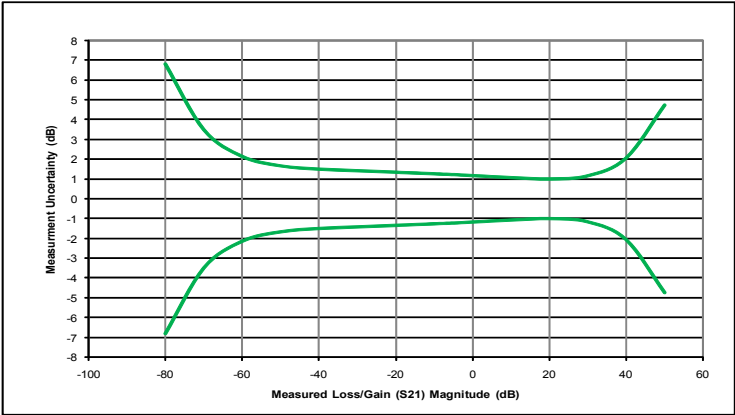
Amplitude	
Measurement	
Range, Insertion Loss & Gain	-90 to + 50 dB
Resolution	0.1 dB
Accuracy, Insertion Loss	< ± 1.5 dB, -90 to 0 dB
Accuracy, Gain	< ± 1.5 dB, -40 to +35 dB, 100Hz IFBW, corrected directivity -42dB with +10 dBm output at test-port for measurements <0dB or +10dBm input at thru-port for measurements >0dB. Refer to Chart II

Thru Port (RF In)	
Impedance, Nominal	50 ohms
VSWR (max.)	1.3
Max RF Input	+ 22 dBm
Immunity to Interference	+13 dBm (≈ 1 GHz), +10 dBm (>1 GHz), = ± 0 Hz from carrier (on-frequency)

Bias Tee (on Thru Port, RF In)	
Compliance	Meets AISG TMA DC Supply Class 1 and 2
DC Voltage, Nominal	12V or 24V, user selectable
Peak Current	1 A
Measurement Range	0 to 999 mA
Measurement Uncertainty	$\pm 5\%$ of full scale

Measurements	
Overview	Analyzes gain and insertion loss of two-port devices. Measures tower mounted amplifier (TMA) gain, antenna isolation, and cable loss. Provides immunity to interference. Allows setup of parameters such as frequency, amplitude and markers. Graphically displays amplitude vs. frequency and saves traces.
Predefined Measurements	Gain & Loss (2-Port) DC Bias Current Draw displays in footer

Chart II - Insertion Loss/Gain Uncertainty, 325 MHz to 3.6 GHz



Note: 100Hz IFBW, corrected directivity -42dB with +10 dBm output at test-port for measurements <0dB or +10dBm input at thru-port for measurements >0dB.

For Spectrum Analyzer for Models SH-362S, SH-361S and SH-36S

Frequency	
Range	100 kHz to 3.6 GHz
Resolution	1 Hz
Uncertainty	± 1 ppm (2σ) of measured frequency
Aging	± 1 ppm / year (2σ)
Temperature drift	± 1 ppm / °C (2σ)
Span	1 kHz to 3.5999 GHz; 0 Hz (zero span)
Spectral Purity, Max @ 1 GHz	
30 kHz from carrier	-85 dBc / (RBW Hz) ^{1/2}
100 kHz from carrier	-100 dBc / (RBW Hz) ^{1/2}
1 MHz from carrier	-124 dBc / (RBW Hz) ^{1/2}
Sweep Time:	2.2 to >2000 s, full span; 1 ms to 100 s, zero span (Time Domain)
Displayed Data Points	705
Resolution Bandwidth (RBW):	100 Hz to 1 MHz in 1, 3, 10 steps
Video Bandwidth (VBW):	10 Hz to 300 kHz in 1, 3, 10 steps

Amplitude	
Display Range	-150 dBm to +30 dBm
Intermodulation-Free Dynamic Range	66 dB; Third-order IM products, Two -20 dBm inputs, Reference = -10 dBm
Accuracy	± 1.5 dB max (2σ), ± 1.0 dB typical, > -50 dB ref, 15 to 35 °C, max detector
Displayed Average Noise Level (DANL)	-135 dBm; 24 dB gain, 100 Hz RBW, 10 Hz VBW, average detection
Reference Level	-140 dBm to +30 dBm
Units	dBm, dB μ V, dBmV, dBV, V, W; Field Strength: dBm/m, dB μ V/m, dBmV/m, dBV/m, V/m, W/m
Offset Range	-99 to +99 dB
Attenuator	Built-in: 0, 10, 20, 30 dB, Auto
Pre-Amp	Built-in: +24 dB
Inherent Spurious	-80 dBm, reference ≤ -10 dBm, $f > 30$ MHz, RBW ≤ 100 kHz
Input-Related Spurious	-70 dBc; mixer level ≤ -30 dBm, carrier offset ≥ 1 MHz
Resolution dB-based units W or V-based units	1 to 15 dB per division in 1 dB steps 1%, 2%, 5%, or 10% of reference level per division
Detection Modes	Positive peak, negative peak, sample, average
Trigger Modes Trigger Sources External Trigger Types External Trigger Level External Trigger Delay External Trigger Connector	Continuous, single Internal, external TTL, internal video Rising edge, falling edge, any edge, trigger on HIGH, trigger on LOW TTL Levels User-settable, 100 μ s to 1000 ms after trigger received before starting sweep BNC(F)

Input	
Connector	Precision N-F
RF Input Impedance	50 ohms, nominal
RF Input VSWR	1.8:1 typ, 2.0:1 max (internal attenuator = 10dB or greater)
Max DC Input	± 50 V
Max RF Input	+20 dBm; damage level is +30dBm for 30 sec.

Measurements	
Overview	Analyzes radio frequency spectrum. Measures intended and interfering signals. Allows setup of parameters such as frequency, amplitude and markers. Graphically displays signals amplitude vs. frequency and saves traces.
Worldwide Applications	Cellular, PCS, DCS, 2G, 3G, 4G, CDMA, cdmaOne, CDMA 2000, 1x, 1x EV-DO, GSM, GPRS, EDGE, UMTS, HSDPA, W-CDMA, TDMA, AMPS, 802.11, Bluetooth, Broadcast, Emergency, Fire, GPS, HDTV, IBOC, In-Building, Lab, Microwave, NPSPAC, Paging, Police, Private, Project 25, Public Safety, Tactical Military, Telematics, Tetra, Trunking, Utilities, WiMAX, WLAN and WLL.
Predefined Measurements	Spectrum Analysis, Occupied Bandwidth (OBW), Channel Power, Adjacent Channel Power Ratio (ACPR), Field Strength, Time Domain, AM/FM Demodulation, and Carrier-to-Interference Ratio (C/I). Emission Masks for broadcast and LMR applications. The user manual includes step-by-step procedures for these one-button measurements as well as Out-of-Band Spurious and In-Band, Out-of-Channel Spurious measurements.
Power Meter	Supports external power sensor models 5012, 5010B, 5011, 5011-EF, 5010T. Connect sensors via RS-232 port. Power sensors are optional accessories.
Markers	6 Markers; Modes: On/Off, Standard, Marker to Max Peak, Marker to Next Peak, Center Freq to Marker, Ref Level Ampt to Marker, Marker Delta, Marker Display, Marker Type Line/Icon, Marker Noise, Frequency Counter, All Marker to Peaks, All Markers Off. Also, Marker to Max/Min Peak via Up/Down Arrow Keys, Marker Left/Right via Left/Right Arrow Keys and Wheel.

General Specifications	
Model	Name: SignalHawk Model: SH-36S, SH-361S, SH-362, and SH-362S Component: Spectrum Analyzer, 1-Port Vector Network Analyzer, and 2-Port Vector Network Analyzer
Housing	PC/ABS housing, rubber over-mold and shock-mounted hardware.
Display	8.4" diagonal (34 sq in), TFT, LCD, full color, SVGA, 800 x 600 pixels, 120 dpi, dual-backlight, viewable indoors and outdoors
Ambient Light Sensor	Ambient light sensor automatically adjusts display backlight when in auto backlight mode.
Keypad	Single-piece integrated unit is sealed to protect against water. Also protects against impacts to display.
Buttons	Power On/Off, Mode, Setup, Enter, Escape/Back keys Left, right, up, and down arrow keys and rotating wheel 6 yellow soft keys along bottom of display 8 blue soft keys to right of display 12-key numeric keypad (0-9.+/-)
Power Indicator	Green LED labeled "Power". On continuously when operating.
Charge Indicator	Amber LED labeled "Charge". Slow blink rate (2.5 s) when charging battery On continuously when battery fully charged Rapid blinking when battery disconnected, failed or wall adaptor problem.
Audio	Internal speaker and external headphone
Connectors	N(F) for RF input 2.5mm DC Jack for AC adapter/charger external power USB Type A for USB drive and accessories USB Type B for PC connection RS-232 DB-9(F) for external power sensors BNC(F) for external trigger 3.5mm for mini-headphone RJ-45 LAN jack for factory diagnostics only
RF Input Impedance	50 ohms, nominal
RF Input VSWR	1.8:1 typ, 2.0:1 max (internal attenuator = 10dB or greater)
Maximum RF Input	+20 dBm; damage level is +30dBm for 30 sec
Maximum DC input	± 50 V
Lanyard Connect	Two reinforced features for attaching a lanyard and/or other quick attach/release connector. Reinforcing supports > 10 lbs.

General Specifications	
Stand	Stand can open to angles of 15°, 45°, 180° or close flat. May use as desk/bench top stand, carry handle, or hook hanger.
Soft Carry Case	Includes 2 carry handles, shoulder strap, cover flap with clear pocket (insert quick start card), zippered back pocket (insert quick start manual, etc.), 2 clear connector covers (velcro back for access and forward for weather protection, antenna may protrude between covers), and accessory pouch with 3-snap cable holder. Note: Do not block air flow intake (round opening on back).
Connector Cover	May attach to further protect connectors from weather. Not required under normal conditions. Consists of 2 flaps and a bar. Attaches with 2 screws and 4 prongs on connector panel.
AC Adapter/Charger	External DC power supply, 15 Vdc, 5 A (65 W) max, 2.5mm pin connector
Internal Battery	Rechargeable, field replaceable, lithium-ion battery. 8.8 A-hr capacity, 5.5 hours continuous operation, extends to 7.5 hours with display backlight on low, 25°C.
Warm-Up	Specifications apply after a 30 minute warm-up period at ambient temperature. Typical values are provided for reference and are not guaranteed.
Operating Temperature	0 to 50 °C (MIL-PRF-28800F, Class 3)
Storage Temperature	-20 to +80 ° Note: If storing above 60°C for prolonged periods it is recommended that the battery be stored separately.
Humidity, Max	95% non-condensing (MIL-PRF-28800F, Class 2)
Altitude, Max	4600m above sea level (MIL-PRF-28800F, Class 2)
Weight, with battery, Max	7.8 lbs
Dimensions, Max	11.5 x 10.5 x 3.8 inches (29.2 x 26.7 x 9.6 cm)
CE Compliance	61326:1997 +A1:1998 and A2:2001 - EMC 61010-1:2001 - Safety 89/336/EEC - EMC 73/23/EEC and Amendment 93/68/EEC - Low Voltage
Drop Tested	1 meter drop in most severe position per EN 61010-1
Transit Drop	10 drops on corners and faces per MIL-PRF-28800F, Class 2
Bench Handling	4 drops on each face per MIL-PRF-28800F, Class 2
Vibration	Random 10 to 500 Hz per MIL-PRF-28800F, Class 2

General Specifications

Shock, Functional	30 G half-sine shock pulse per MIL-PRF-28800F, Class 2
Drip Proof	Water flow 16 liters per hour per MIL-PRF-28800F, Class 2
Salt Exposure	Salt fog tested for 48 hours, constantly wetted with 5% salt solution at 35°C per MIL-PRF-28800F, Class 2
Fungus Resistance	5 species for 28 days at 30°C and 95% humidity per MIL-PRF-28800F, Class 2
Explosive Atmosphere	Per MIL-PRF-28800F 4.5.6.3
Available Upgrades	From any other model to SH-361S

General Measurement Features

Worldwide Applications	Cellular, PCS, DCS, 2G, 3G, 4G, CDMA, cdmaOne, CDMA 2000, 1x, 1x EV-DO, GSM, GPRS, EDGE, UMTS, HSDPA, W-CDMA, TDMA, AMPS, 802.11, Bluetooth, Broadcast, Emergency, Fire, GPS, HDTV, IBOC, In-Building, Lab, LMR, Microwave, NPSPAC, Paging, Police, Private, Project 25, Public Safety, Tactical Military, Telematics, Tetra, Trunking, Utilities, WiMAX, WLAN, and WLL.
Power Measurement	Supports optional Bird external power sensor models 5012, 5010B, 5011, 5011-EF, 5010T and 5010. Connect sensors via RS-232 port.
Averaging	Running display average, 2 to 1024 sweeps
Trace	Clear/Write, Max Hold, Average, Reset
Log Traces	Sample rate from 60 to 3600 s (1 min to 1 hr)
Internal Memory	Store 300 traces and setups
USB Drive	May store 90,000 traces and setups on 1 GB USB drive standard accessory. The contents of the internal memory can be copied to and from a removable USB drive.  Note: <i>USB drive must be Windows CE compatible.</i>
Windows CE	Includes Microsoft WordPad (full read and write) and the following viewers (read only): Word, Excel, Power Point, PDF and Image. Also, Media Player, Internet Explorer and Messenger. Use of USB mouse and hub recommended (see optional accessories).
User Interface	Reference the user manual and design specification (SH UI document) for further details.
One-Button Setup	Press the setup button and select configuration from the setup list. Setups may also be saved to the list.

General Measurement Features

Help Functions	Help menu displays on-board measurement start-up instructions. Custom Help file may be updated by the user with customized test procedures and notes for on-board display. Tip line provides helpful hints with each key stroke. Clear pocket on inside cover for start-up instruction card and test procedures. Operations manual provides additional information.
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PC Tool Software

General Features	Transfer saved traces to and from Signal Hawk and PC via USB cable or removable USB drive. Graphically display traces on the PC for further analysis. Generate printed reports with customized labels. Archive saved traces to disk or USB drive.
Communication Method	USB port
USB Drive	May store 90,000 traces and setups on 1 GB USB drive standard accessory. Note, USB drive must be Windows CE compatible.

Power Sensors Supported

Sensor	Description
5010B	Directional Power Sensor for Thruline power measurements, 2 to 2700 MHz, 12.5 mW to 10 kW. Measure forward/reflected average, VSWR, return loss (dB), and peak. Forward average power accuracy is 5% (0.2 dB). Requires two Bird DPM series elements
5010T	Directional Power Sensor for Thruline power measurements, Tetra Version, 2 to 2700 MHz, 12.5 mW to 10 kW, req elements. Measure fwd/rfl avg, VSWR, return loss (dB), and peak. Forward average power accuracy is 5% (0.2 dB).
5011	Terminating Power Sensor, 40 MHz to 4 GHz, 10 μ W to 10 mW (-20 dBm to +10 dBm). Measures forward average power. Accuracy is 5% (0.2 dB).
5011-EF	Terminating Power Sensor, 40 MHz to 12 GHz, 10 μ W to 10 mW (-20 to +10 dBm) Measures forward average power. Accuracy is 5% (0.2 dB).
5012	Wideband Power Sensor for Thruline measurement, 350 MHz to 4 GHz, 150 mW to 150 W Avg, 400 W Peak. Measure fwd/rfl avg, VSWR, return loss (dB), peak, burst avg, crest, CCDF. Fwd avg power accuracy is 4% (0.2 dB).

Parts List

Contact Bird Service Center for parts information.

Standard Accessories		
Description	Part No.	Qty
Soft Carry Case	7002A220-1	1
Operations Manual ¹	920-SH36-OPS	1
Start-Up Instructions	920-SH36-REF	1
USB Cable, 10 ft, USB 2.0 certified, USB A male to USB B male	5A2653-10	1
RS-232 Cable, 10 ft, 9-pin, male/female connectors	5A2264-09-MF-10	1
AC Adapter/Charger, input 100-240 Vac @ 50-60Hz, output +15V, 5A	5A2743-1	1
AC Line Cord for AC Adapter/Charger	4421-055	1
Car Adapter/Charger, input 12Vdc, output +12Vdc, 5 A	5A2238-3	1
Internal Lithium-Ion Battery. Rechargeable, field replaceable, 8.8 A-hr capacity, 5.5 hours continuous operation.	5A2720-2	1
Vector Network Analysis PC Tool Software and Manuals CD (SH361 Only)	7002A840	1
Spectrum Analysis PC Tool Software and Manuals CD	7002A210	1
USB Drive, 1 GB, stores 90,000 saved traces, Win CE compatible	5A2745-1	1
Headphones	5A2746-1	1
Connector Cover	7002A221	1

¹ Spare standard accessories are available as optional accessories. Manuals, software, and firmware updates are available at: www.bird-electronic.com.

Optional Accessories

General

Description	Part No.	Qty
Hard Transit Case, Watertight, Crushproof, and Dust proof	7002A225-1	1
USB Mouse, Ultra-Portable, Optical, Retractable Cable	USB-MOUSE	1
USB Hub, 4-Port, Micro	USB-HUB	1

VNA

Description	Part No.	Qty
Calibration Combo, Open/Short/Load, N (M)	CAL-MN-C	1
Calibration Combo, Open/Short/Load, N (F)	CAL-FN-C	1
Calibration Combo, Open/Short/Load, 7/16 DIN (M)	CAL-ME-C	1
Calibration Combo, Open/Short/Load, 7/16 DIN (F)	CAL-FE-C	1

Spectrum Analyzer

Description	Part No.	Qty
Field Strength Antenna, 136 to 221 MHz, Field Tunable, 0 dB Gain, SMA(M)*	ANT-100	1
Field Strength Antenna, 400 to 512 MHz, Field Tunable, 0 dB Gain, SMA(M)*	ANT-400	1
Field Strength Antenna, 824 to 894 MHz, 0 dB Gain, Articulating, SMA(M)*	ANT-800	1
Field Strength Antenna, 890 to 960 MHz, 0 dB Gain, Articulating, SMA(M)*	ANT-900	1
Field Strength Antenna, 1710 to 1880 MHz, 0 dB Gain, Articulating, SMA(M)*	ANT-1800	1
Field Strength Antenna, 1850 to 1990 MHz, 0 dB Gain, Articulating, SMA(M)*	ANT-1900	1
Field Strength Antenna, 2400 to 2500 MHz, 0 dB Gain, Articulating, SMA(M)*	ANT-2400	1
Attenuator, 100 W, 40 dB, NM/NF, 2.4 GHz	100-SA-MFN-40	1
Attenuator, 50 W, 30 dB, NM/NF, 4 GHz	50-A-MFN-30	1
Attenuator, 25 W, 30 dB, NM/NF, 4 GHz	25-A-MFN-30	1
Attenuator, 10 W, 30 dB, NM/NF, 4 GHz	10-A-MFN-30	1
Attenuator, 5 W, 20 dB, NM/NF, 4 GHz	5-A-MFN-20	1
Attenuator, 2 W, 20 dB, NM/NF, 4 GHz	2-A-MFN-20	1

 * - Recommend N(M) to SMA(F) adapter (model 4240-500-10) for field strength antennas.

External Power Sensors

Description	Part No.	Qty
Wideband Power Sensor, 350 MHz to 4 GHz, 150 mW to 150 W Avg, 400 W Peak. Measures forward and reflected average, VSWR, return loss (dB), peak, burst average, crest factor and CCDF. Forward average power accuracy is 4% (0.2 dB).	5012	1
Directional Power Sensor, 2 to 2700 MHz, 100 mW to 10 kW, requires elements. Measures forward and reflected average, VSWR, return loss (dB), and peak. Forward average power accuracy is 5% (0.2 dB).	5010B	1
Directional Power Sensor, Tetra Version, 2 to 2700 MHz, 100 mW to 10 kW, requires elements. Measures forward and reflected average, VSWR, return loss (dB), and peak. Forward average power accuracy is 5% (0.2 dB).	5010T	1
Terminating Power Sensor, 40 MHz to 4 GHz, 10 μ W to 10 mW (-20 dBm to +10 dBm). Measures forward average power. Accuracy is 5% (0.2 dB).	5011	1
Terminating Power Sensor, 40 MHz to 12 GHz, 10 μ W to 10 mW (-20 to +10 dBm) Measures forward average power. Accuracy is 5% (0.2 dB).	5011-EF	1

Test Cables and Adapters

Description	Part No.	Qty
Test Cable, Phase Stable, 1.5 m, N(M) to N(F)	TC-MNFN-1.5	1
Test Cable, Phase Stable, 3.0 m, N(M) to N(F)	TC-MNFN-3.0	1
Test Cable, Phase Stable, 1.5 m, N(M) to N(M)	TC-MNMN-1.5	1
Test Cable, Phase Stable, 3.0 m, N(M) to N(M)	TC-MNMN-3.0	1
Test Cable, Phase Stable, 1.5 m, N(M) to 7/16 DIN(F)	TC-MNFE-1.5	1
Test Cable, Phase Stable, 3.0 m, N(M) to 7/16 DIN(F)	TC-MNFE-3.0	1
Test Cable, Phase Stable, 1.5 m, N(M) to 7/16 DIN(M)	TC-MNME-1.5	1
Test Cable, Phase Stable, 3.0 m, N(M) to 7/16 DIN(M)	TC-MNME-3.0	1
Adapter, N(M) to 7/16 DIN(M)	PA-MNME	1
Adapter, N(F) to 7/16 DIN(M)	PA-FNME	1
Adapter, N(M) to 7/16 DIN(F)	PA-MNFE	1
Adapter, N(F) to 7/16 DIN(F)	PA-FNFE	1
Adapter Kit, 7/16 DIN	4240-550	
Adapter, N(F) to N(F)	4240-500-1	
Adapter, N(M) to N(M)	4240-500-2	1
Adapter, N(M) to SMA(F)*	4240-500-10	
Inter-series Adapter Kit, N/SMA/BNC/TNC/UHF	4240-401	

 * - All specifications are subject to change without notice.

ROHS

Part Name	Toxic or hazardous Substances and Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Copper Alloy	X	O	O	O	O	O
Florescent Backlight	O	X	O	O	O	O
Printed Circuit Assembly	X	O	O	O	O	O
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006. X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirements in SJ/T11363-2006.						

Appendix 1

Menu Maps

Vector Network Analyzer (VNA) Menu Maps

Figure 93 Map, Calibrate

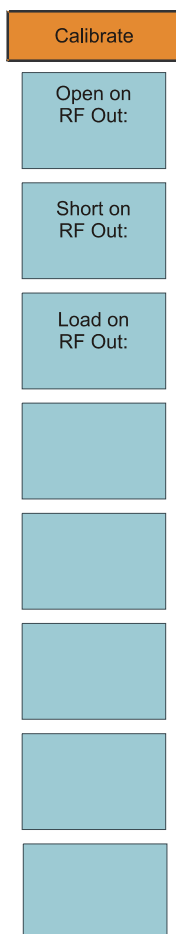


Figure 94 Map, Ampt & Trace

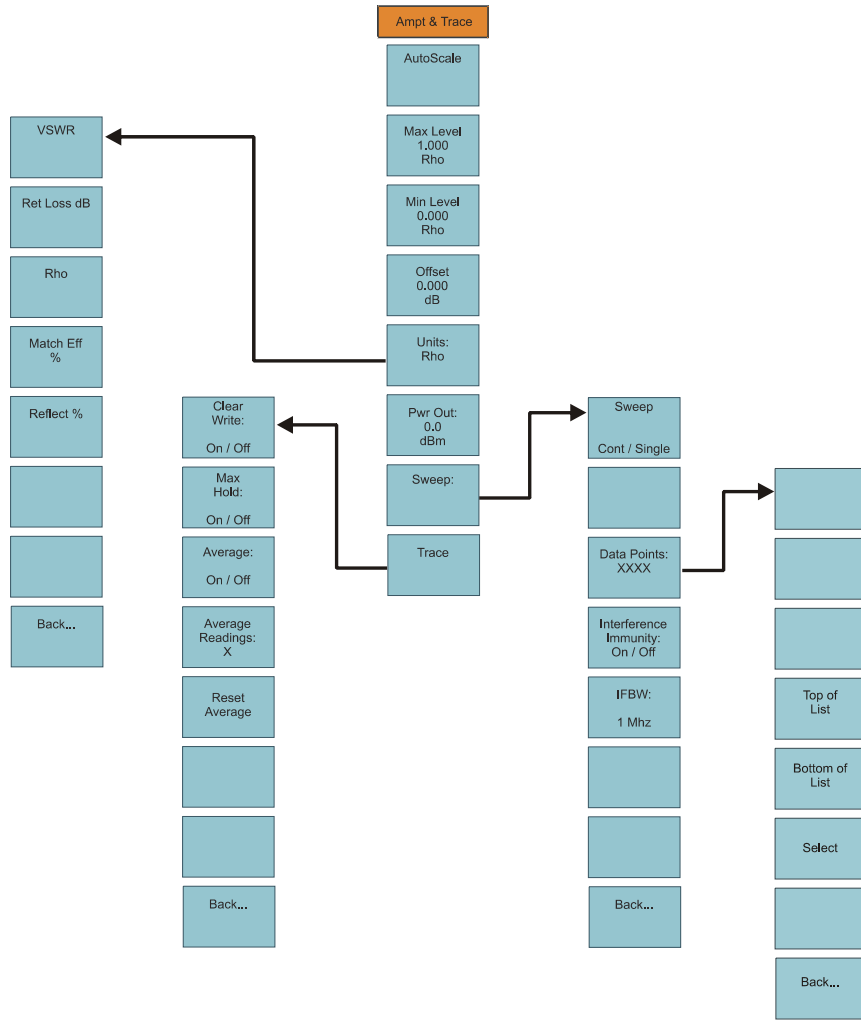


Figure 95 Map, Measurement

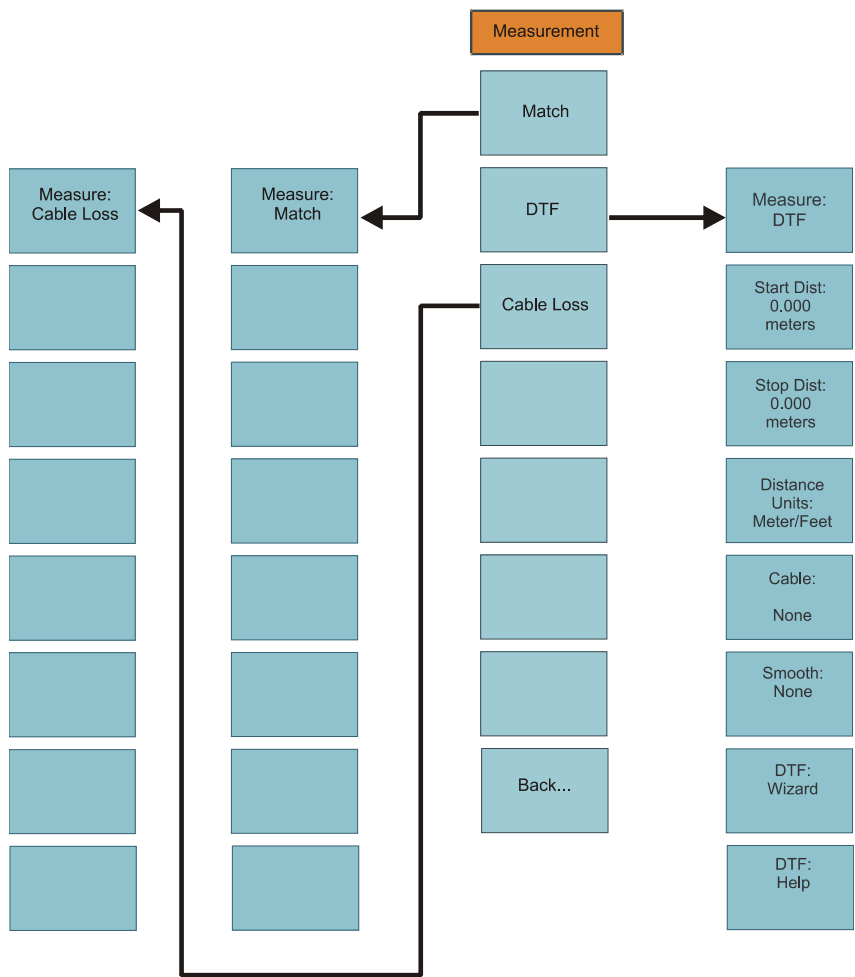


Figure 96 Map, Mark & Limit

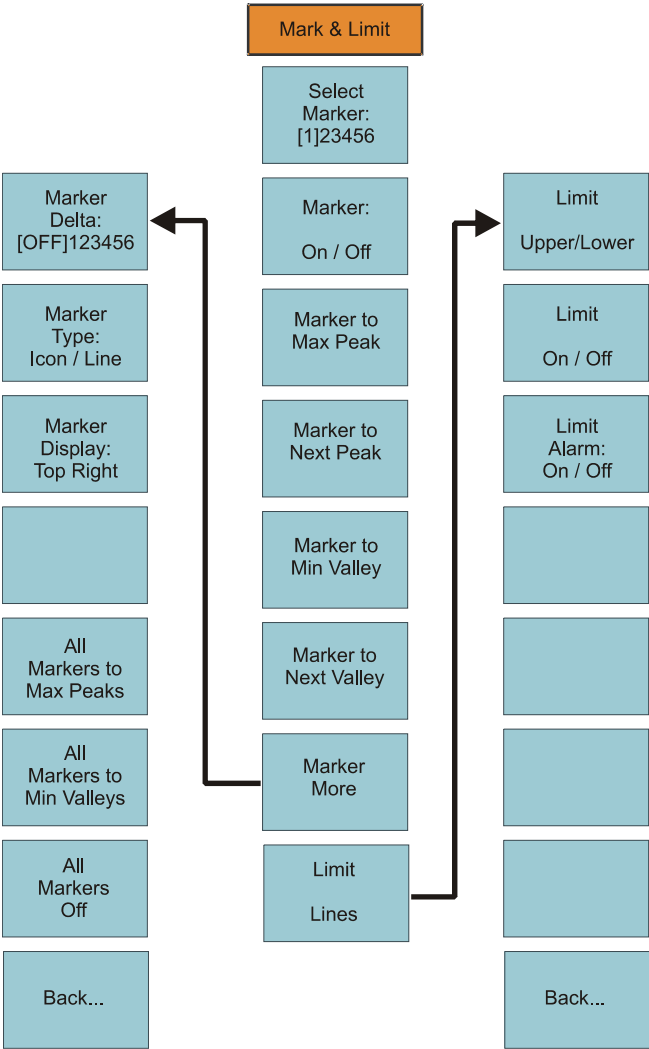


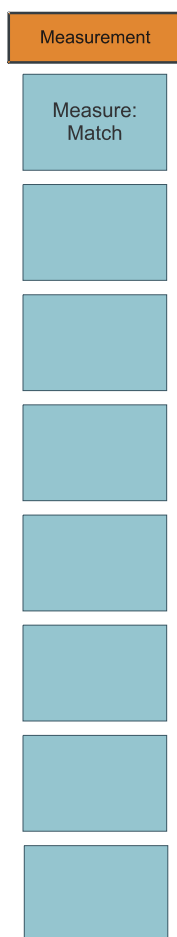
Figure 97 Map, Measurement, Match Measure

Figure 98 Map, Measurement, Distance-to-Fault Measure

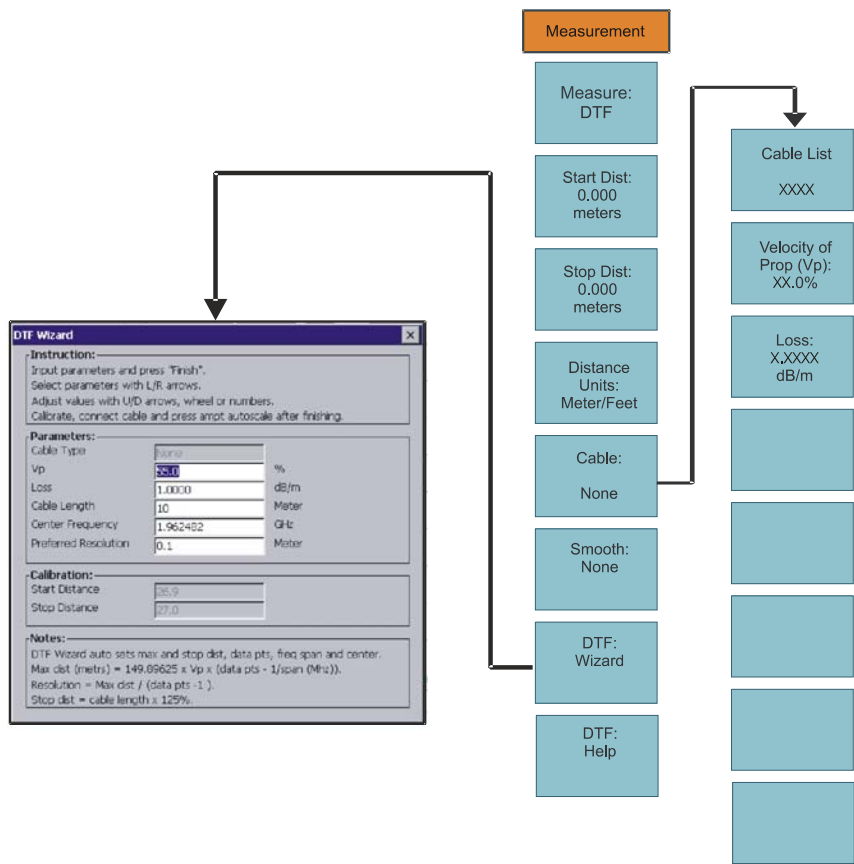


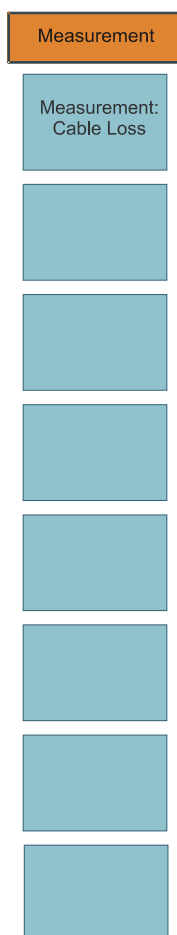
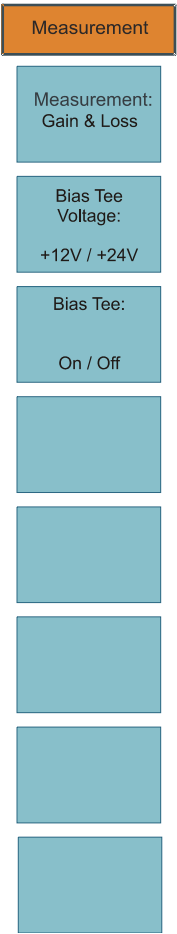
Figure 99 Map, Measurement, Cable Loss Measure

Figure 100 Map, Measurement, Gain & Loss Measure



Spectrum Analyzer Menu Maps

The illustrations in this section show the soft key options that are available when you select a measurement function.

Figure 101 Menu Map, Freq & Span Menu, All Measurements

 **Note:** If a channelized band is selected, there will be an extra soft key named *Channel* (see Fig. 102).

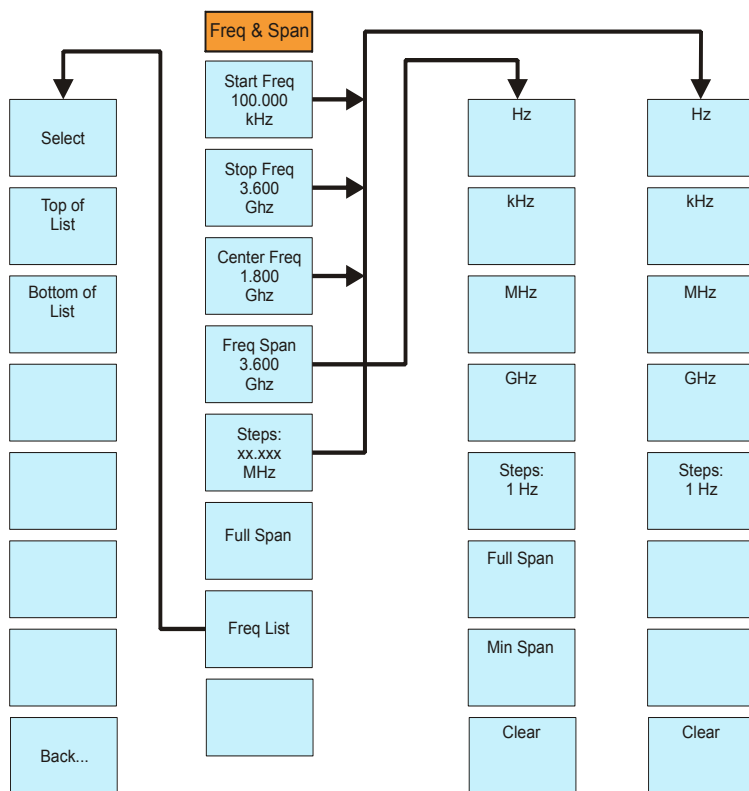


Figure 102 Menu Map, Freq/Span Menu, Channelized Band

 **Note:** *If a channelized band is selected, the system displays the Channel soft key in addition to those shown in Fig. 101.*

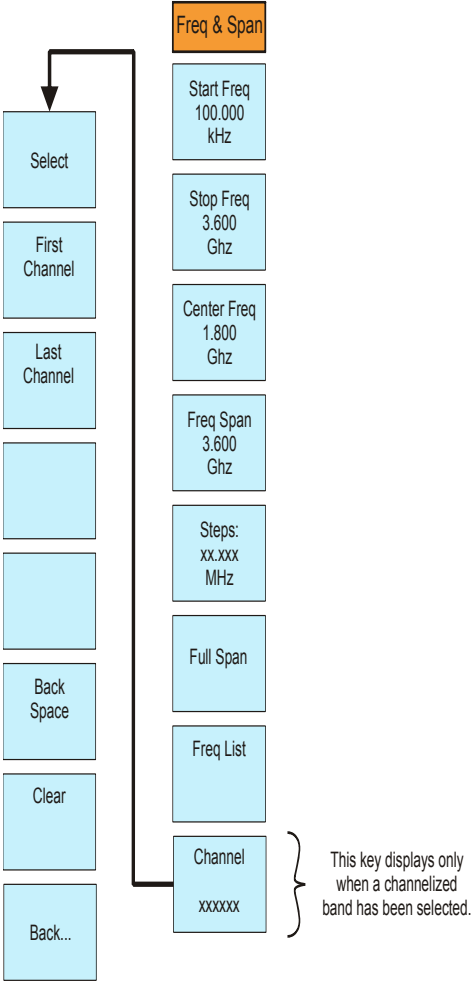


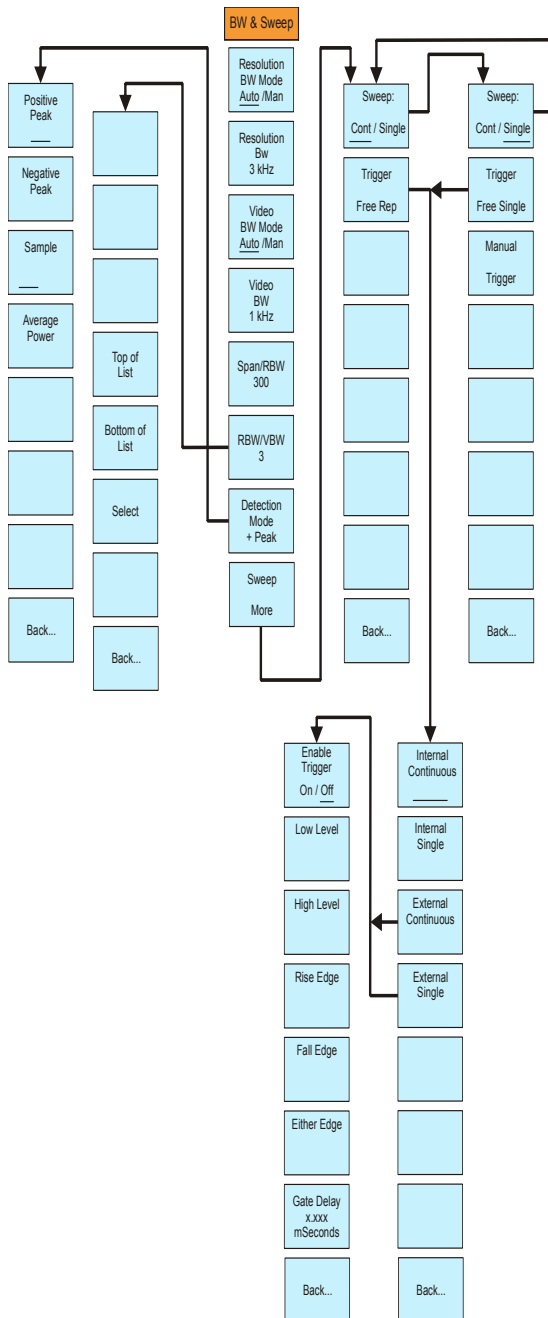
Figure 103 Menu Map, BW & Sweep Menu, All Measurements

Figure 104 Menu Map, Amplitude, All Measurements

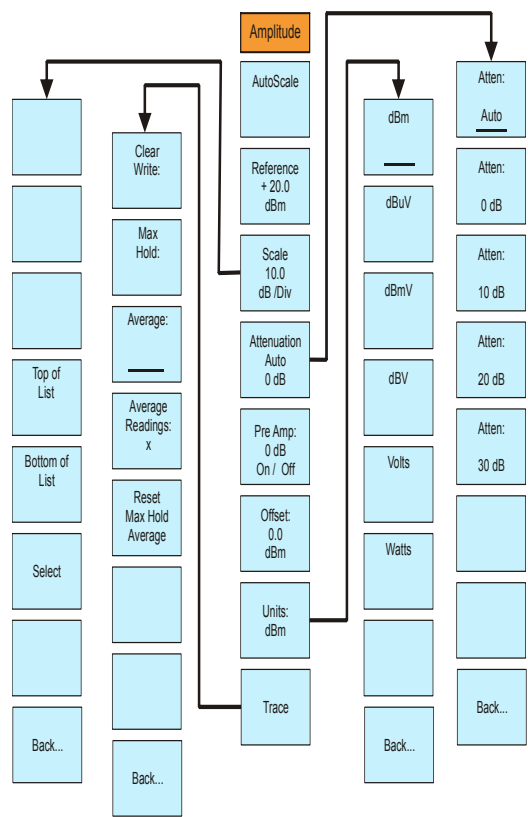


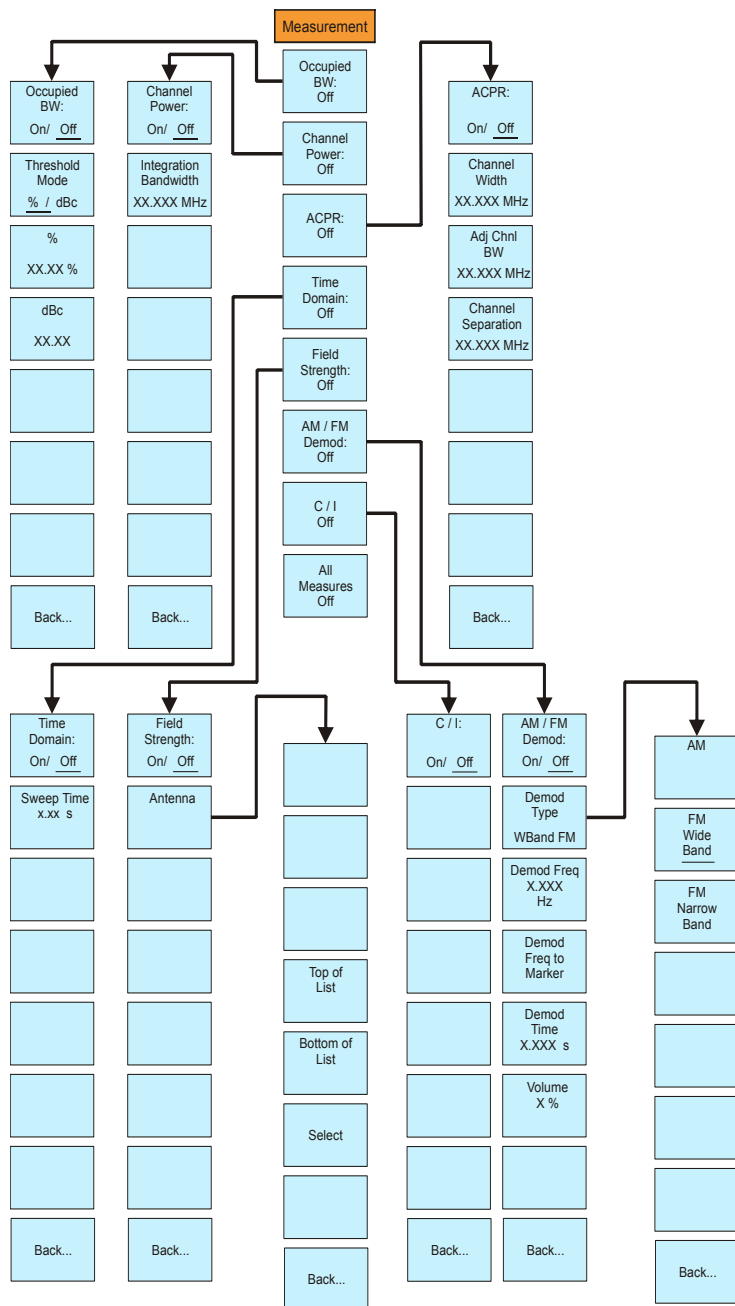
Figure 105 Menu Map, Measurement, All Measurements

Figure 106 Menu Map, Mark & Limit Menu, All Measurements

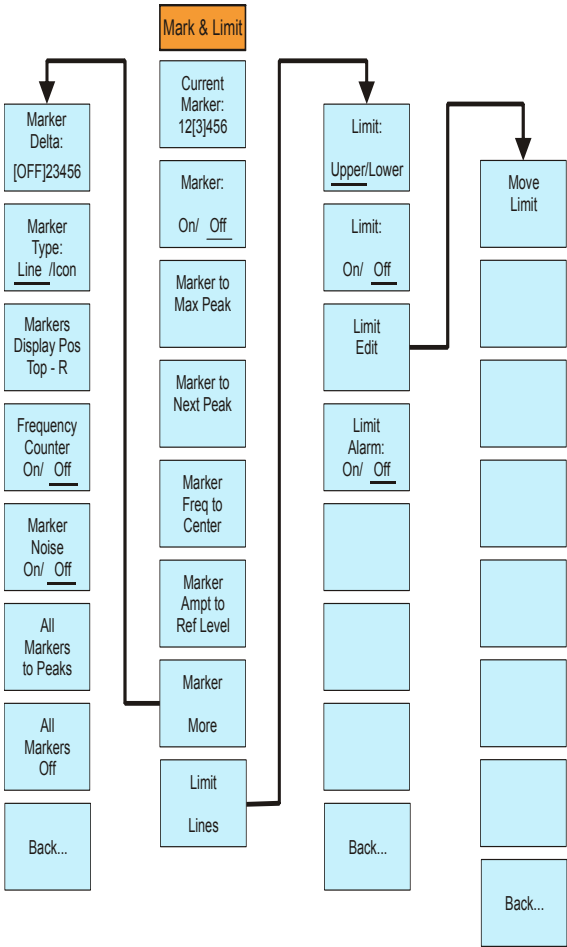
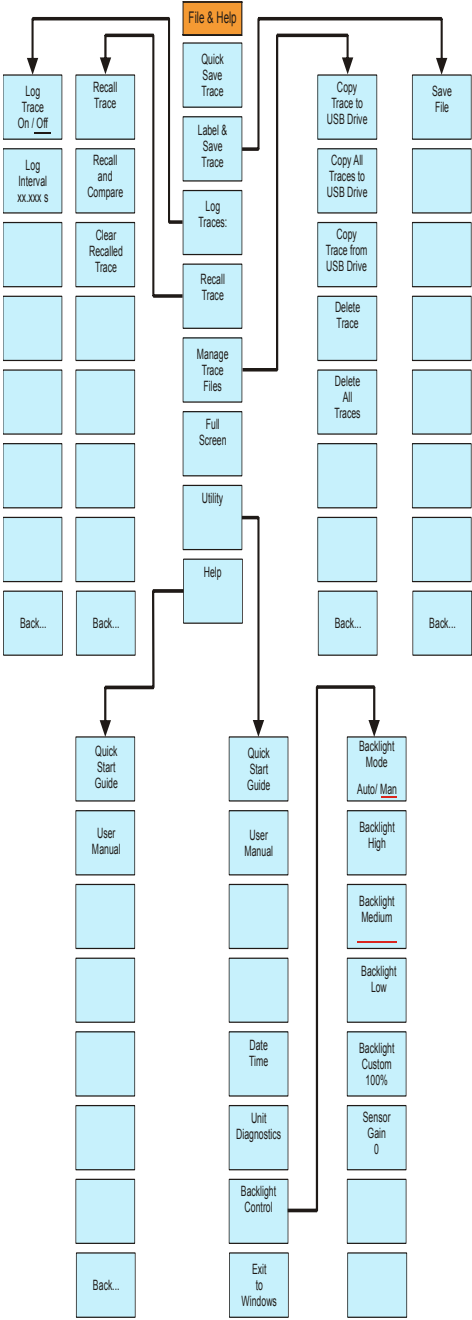


Figure 107 Menu Map, File & Help, All Measurements



Power Meter Menu Maps

Figure 108 Menu Map, Power Meter, Type (Bird 5010B sensor)

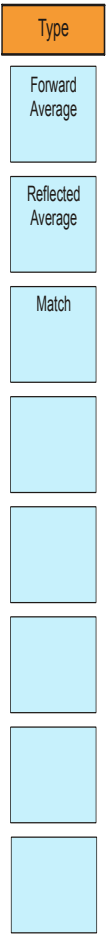


Figure 109 Menu Map, Power Meter, Type (Bird 5012 sensor)

Figure 110 Map, Power Meter, Units (Bird 5010B and 5012 sensors)

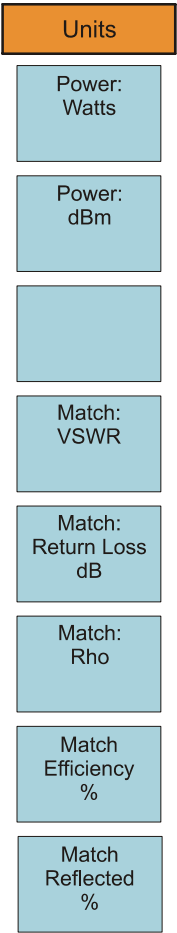


Figure 111 Map, Power Meter, Configure (Bird 5010B sensor)

Configure
Element: DPM / 43
Forward Scale 50 W
Reflected Scale 5 W
F/R Scale 10:1 Ratio: On/Off ☒
Input Offset: 0.0 dB
Match Offset: 0.0dB

Figure 112 Map, Power Meter, Configure (Bird 5011 sensor)

Configure

Input
Offset:
x.xx dB

Power:
Watts

Power:
dBm

Range
Select:
Auto

Figure 113 Map, Power Meter, Configure (Bird 5012 sensor)

The screenshot displays a vertical list of configuration options for the Bird 5012 sensor. The top option, 'Configure', is highlighted with an orange background. The remaining options are in light blue boxes. The settings shown are: Input Offset (x.xx dB), Match Offset (x.xx dB), Filter (Full, xx MHz), Duty Cycle (Auto / Manual), Manual Duty Cycle (xxx %), CCDF Limit, and Range Select (Auto). The 'Duty Cycle' and 'Manual Duty Cycle' options are currently set to 'Auto'.

Configure
Input Offset: x.xx dB
Match Offset: x.xx dB
Filter: Full xx MHz
Duty Cycle: Auto / Manual
Manual Duty Cycle: xxx %
CCDF Limit:
Range Select: Auto

Figure 114 Map, Power Meter, Zero (Bird 5011 and 5012 sensors)

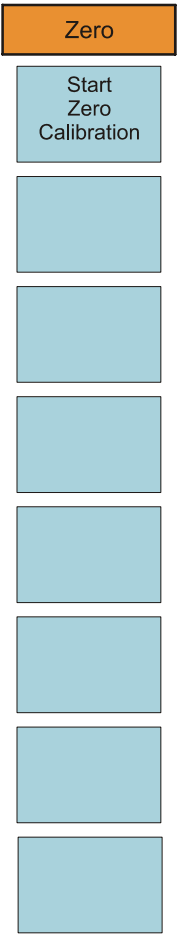
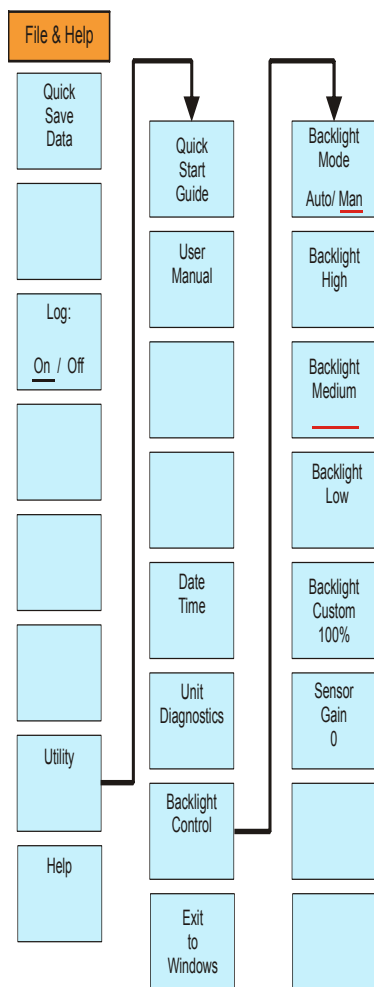
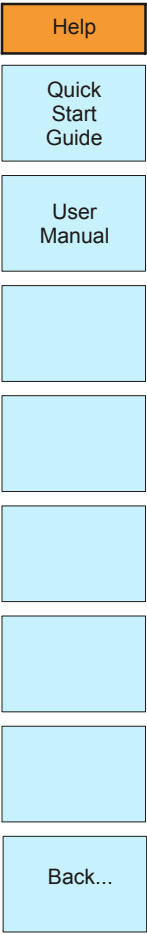


Figure 115 Map, Power Meter, File & Help (Bird 5010B, 5011, and 5012 sensors)



Start Menu, Help Menu Maps

Figure 116 Map, Start Menu, Help



Start Menu, Utilities Menu Map

Figure 117 Map, Utilities, Version Info

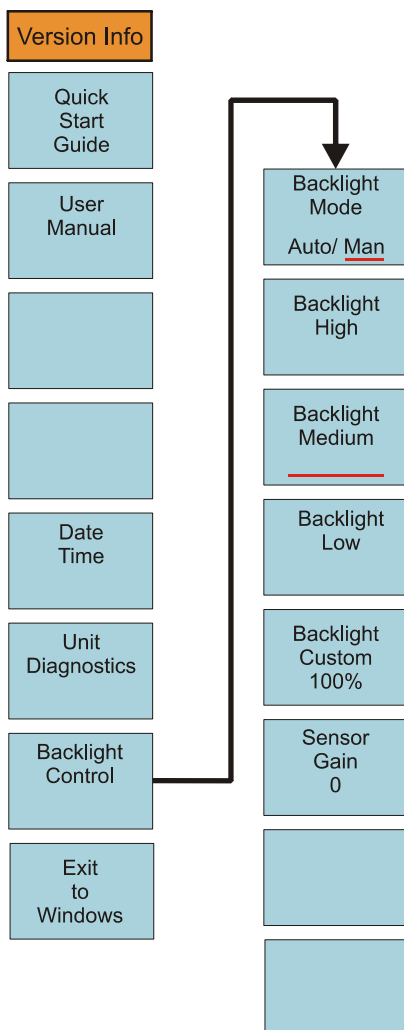


Figure 118 Map, Utilities, Device Info

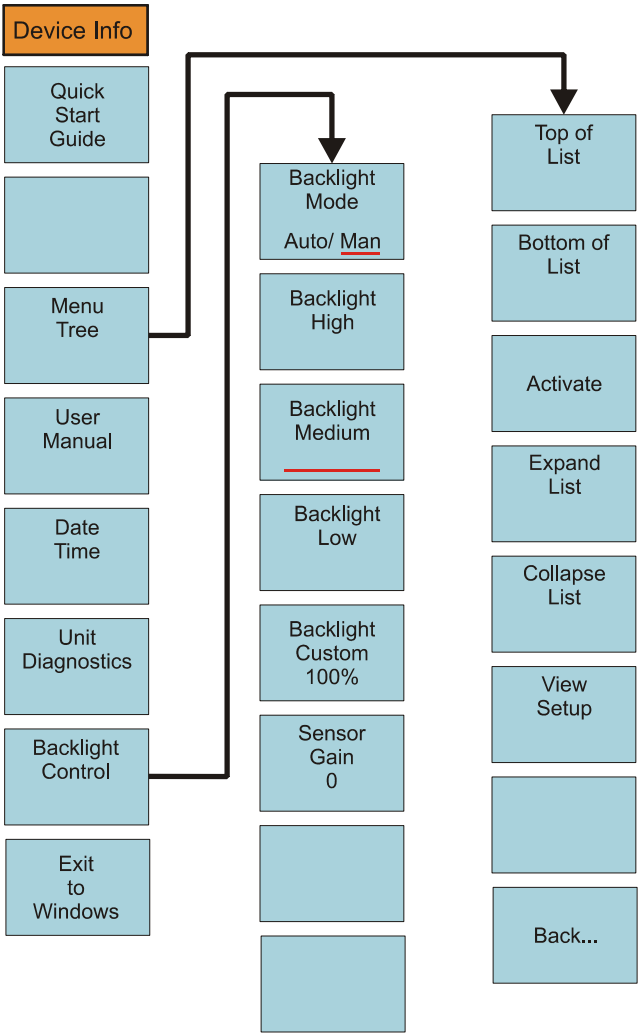


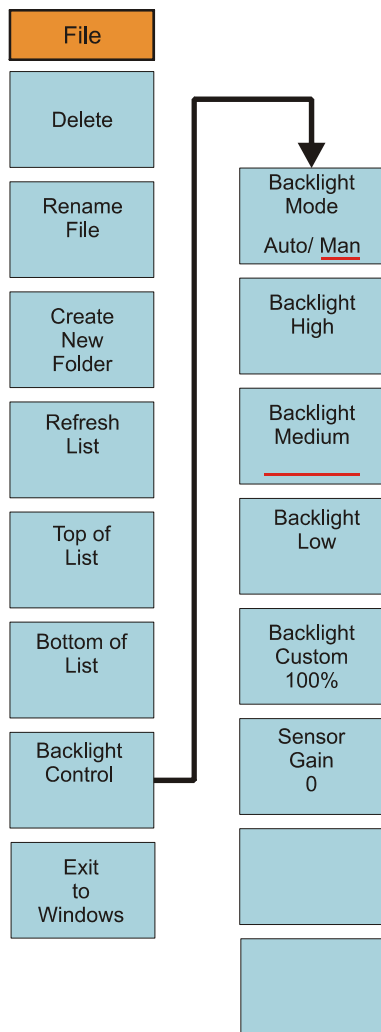
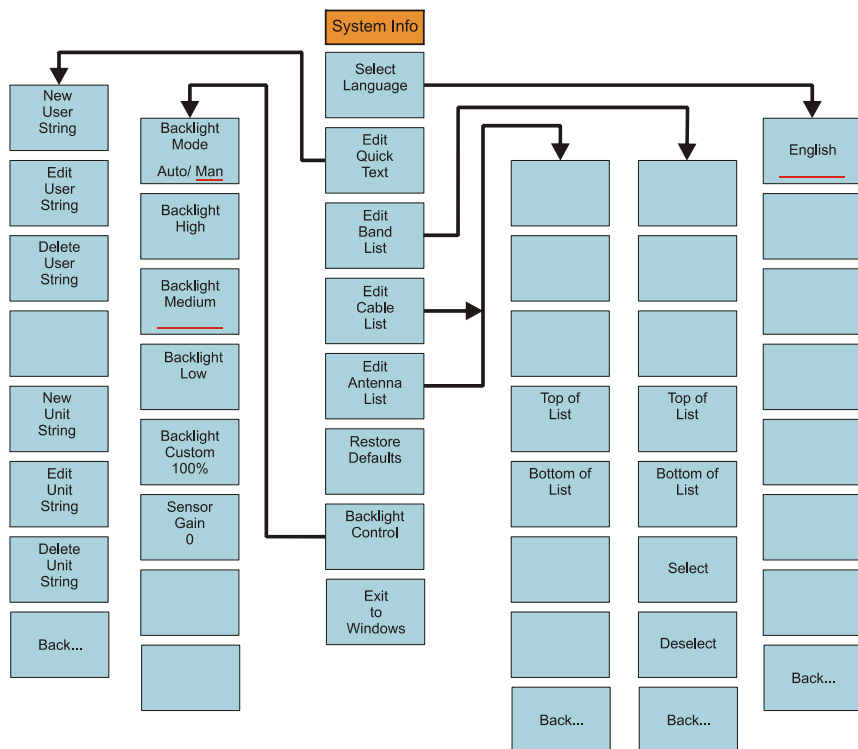
Figure 119 Map, Utilities, File

Figure 120 Map, Utilities, System Info



Setup Function Menu Maps

Figure 121 Map, Setup (Mode), Main Screen

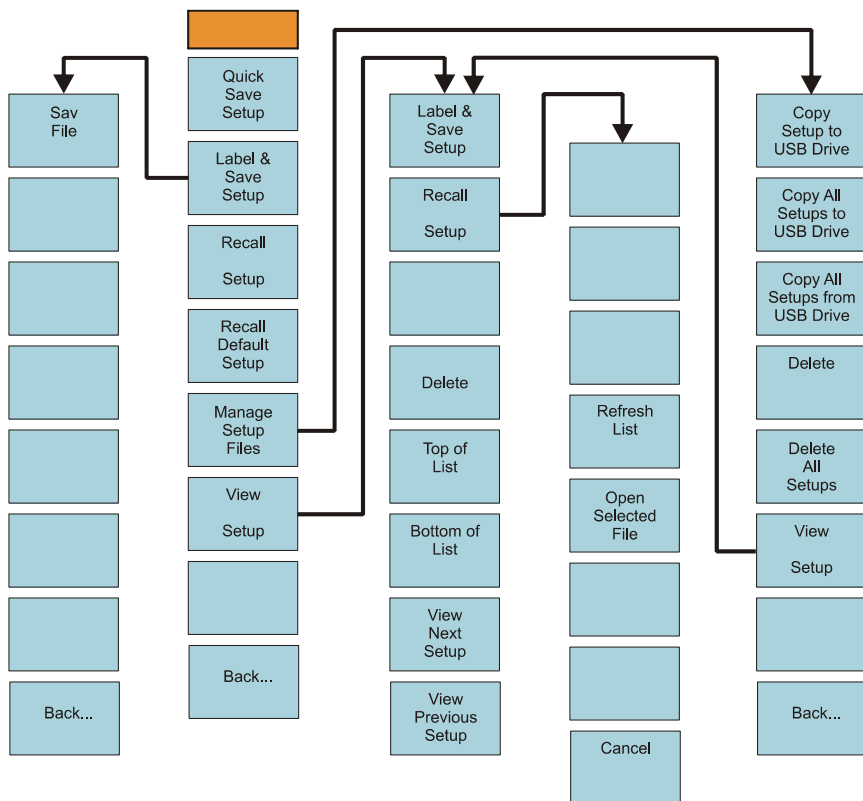


Figure 122 Map, Setup (Mode), Help



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All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

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