



RAILHAWK RF TEST SET

OPERATION MANUAL

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.



The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area.

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

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.

On page 48.

Caution Statements

The following safety cautions appear in the text where there is danger of damage to equipment, and are repeated here for emphasis.

CAUTION

Do not exceed +22 dBm (100 mW) RF Power input at the measurement port.
Damage to the unit's RF module will result.

On pages 30 and 36.

CAUTION

Do not connect the unit to a PC USB port.
File transfer must be done using a USB Drive.

On pages 38, 43 and 81.

CAUTION

Do not touch the center pin of the Antenna Test Port with bare hands, water, or emery cloth. Otherwise, damage may occur to the connectors surface.

On page 74.

CAUTION

Only use the supplied AC adapter to charge the unit.
The unit cannot be charged through a USB port (i.e. from a laptop).
Charging from a power source other than the supplied charger may damage the battery.

On page 74.

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 GEFÄHRLICHE, ELEKTRISCHE 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.

About This Manual

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

7003A005-X Test Set with RailHawk

Changes to this Manual

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

Chapter Layout

- RailHawk Introduction** — Lists the components included in the RF Test Set.
- RailHawk Basic Operation** — Provides brief information on commonly used settings for the RailHawk.
- Calibration** — Provides a procedure for calibrating the RailHawk prior to making measurements.
- Measure Match Mode** — Details the use of the Measure Match Mode, includes instructions for performing the test and provides instruction for interpreting measurement.
- Fault Location Mode** — Details the use of the Distance-to-Fault measurement, includes instructions for performing the test and provides instruction for interpreting measurement.
- Data Save and Export** — Instructs the user on methods for saving RailHawk generated data and methods for exporting the data to external devices.
- RF Power Measurement** — Provides instruction on the use of the Bird RF Meter App and the Wideband Power Sensor, includes instructions for utilizing the RF power measurement capabilities of the power sensor.
- Maintenance** — Includes maintenance procedures for the RF Test Set.
- Specifications** — Includes specifications for the equipment contained in the RF Test Set.
- Automated Operation** — Provides an introduction to the RailHawk user interface.

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The RailHawk RF Test Set is designed to aid Signal and Telecom maintenance technicians in quickly diagnosing and resolving problems with communications systems.

The RailHawk RF Test Set simplifies the following tasks:

1. VSWR testing.
2. Manual Measure Match function to determine if there is a problem with your system's cabling or antenna.
3. Manual Distance-to-Fault measurement to locate the source of the problem.
4. RF power measurements using the Bird Power Sensor.

Note: *This manual is meant as a general guide to operation and is not meant to provide specific instructions for any communications system. Always refer to your official maintenance manual or diagnostic procedure for exact test instructions.*

Items Supplied

Figure 1 RailHawk RF Test Set



There are several variations of RailHawk RF Test Set, the contents of each test set will vary. The following list is an example of the equipment commonly found in a RailHawk RF Test Set.

- RailHawk Analyzer
- Power Sensor
- Termination, 25 Watt or 50 Watt
- Coax cable and adapter kits
- RF cable, DC-6 GHz, 1 meter
- Calibration Combination (Cal Combo), DC - 6 GHz
- Hard carrying case
- USB cable, 10 ft.
- USB adapter
- USB drive
- AC adapter (12VDC)
- Touch pen (stylus)

RailHawk Analyzer

The RailHawk is a multifunction test instrument for use in installation and maintenance of RF communications systems.

The unit has a frequency range of 1 MHz to 6 GHz. Additional RailHawk specifications can be found in the specifications chapter, See ["Specifications" on page 83](#).

Antenna systems are tested by using a RailHawk Analyzer to measure Match (VSWR) and Distance-to-Fault conditions. Data points measured across a user-specified frequency band or distance range are graphed on a 1280 x 720 pixel touch screen display area.

Measurement Capability

- Fast measurement speed
- Seven user-selectable trace capture options: 51, 101, 201, 401, 801, 1601, or 3201 data points per sweep
- Adjustable Pass/Fail limit with visual indicator
- 16 GB of internal flash memory for storing thousands of traces and setups
- X and Y scales and units are user adjustable
- Six markers, direct or difference measurement
- Measure relative to limit line or recalled trace
- Measurement hold to temporarily store a trace
- Frequency Start/Stop or Center/Span frequencies

Return Loss [dB], Cable Loss [dB], SWR [ratio], DTF SWR [ratio] or DTF Return Loss [dB].

Measuring RF Power

The RailHawk includes an RF power meter application. The Bird RF Meter is an Android App which allows the RailHawk to be used with the Bird Power Sensor available in the RailHawk RF Test Set. To measure transmitter RF power, connect the power sensor to the RailHawk. RF Power measurements verify and monitor the condition of a transmitter system. See ["RF Power Measurement" on page 48](#) for details on how to use the Bird RF Meter App.

Wideband Power Sensor

Bird Power Sensors may be used with the Bird RailHawk by launching the Bird RF Power Meter App. See ["RF Power Measurement" on page 48](#).

Termination

Bird's RF termination is a high-quality, robust termination. The load is made of non-magnetic materials. The load included in the kit is rated to 4 GHz, and depending on the model, is rated to 25 or 50 Watts.

Measurement Interface

The RailHawk measurement interface consists of a measurement display area, menus and control options. The user taps the screen to access menus, change settings, perform measurements and save results. See [Table 1 on page 6](#) for explanations.

Note: *The displays used in this manual are shown with the RailHawk in the horizontal position, some menus may display differently if accessed with the unit in a vertical position. Display options can be controlled via the settings menu on the home screen.*

Figure 2 User Interface Description (Match Measurement Mode)

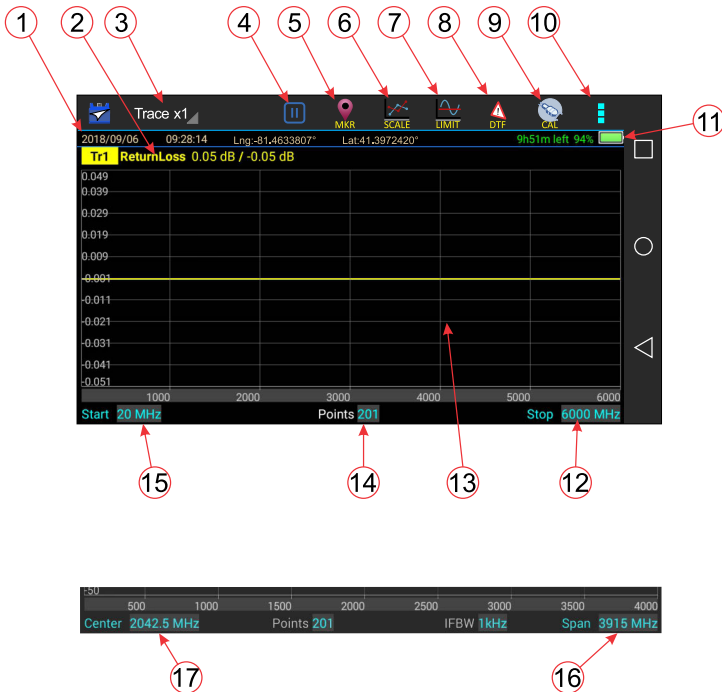


Table 1 User Interface Description Explanation

Item	Description
1	Current Date and Time, latitude and longitude. Note: <i>Location services must be set to On for the RailHawk to display latitude and longitude data. See "Accessing Communication Services" on page 47.</i>
2	Measurement Mode, press to display Measurement Mode menu.
3	Trace Selection, press to choose number of traces to display.
4	Pause icon, when pressed pauses data acquisition. When data acquisition is paused a play icon is displayed.
5	MKR icon, press to display the Marker menu.
6	SCALE icon, press to display the scale menu.
7	LIMIT icon, press to display the limit menu.
8	DTF icon, press to display the Distance to Fault menu.
9	CAL icon, press to display the calibration menu.
10	Menu icon, press to display additional utility menus: MEM, FREQ, RESET, FILE, PNG, SYS.
11	Battery charge remaining in time, percentage, and visual indicator.
12	Stop Frequency, press the data field to change the value, or press the label to change to frequency Span (16).
13	Sweep display area.
14	Points, press the data field to choose the number of measurement points.
15	Start Frequency, press the data field to change the value, or press the label to change to Center Frequency (17).
16	Span displays the current frequency span. Press the data field to change the value, or press the label to change to Stop Frequency (12).
17	Center Frequency, press the data field to change the value, or press the label to change to Start Frequency (15).

Note: *When a Fault Detection mode is selected, Start, Stop, and DTFMax fields are also displayed below the sweep display area.*

RailHawk Default Settings

Description	Default Setting
Touchstone Data Format	RI - Real-Imaginary
Allocation of Channels	1
Active Channel Number	1
Marker Value Identification Capacity (Stimulus)	8 digits
Marker Value Identification Capacity (Response)	5 digits
Vertical Divisions	10
Traces per Channel	1
Active Trace Number	1
Number of Sweep Points	201
Stimulus Start Frequency	1 MHz
Stimulus Stop Frequency	6 GHz
Stimulus IF Bandwidth	1 kHz
Sweep Range Setting	Start / Stop
Trigger Mode	Continuous
Table of Calibration	Coefficients Empty
Error Correction	ON
Trace Scale	10 dB/division
Reference Level Value	0 dB
Reference Level Position	5 Div
Phase Offset	0°
Trace Display Format	Return Loss (dB)
Maximum Distance	1.49 m
Time Domain Kaiser Window	Normal
Number of Markers	0

Setting the Measurement Frequencies

Frequencies can be set manually. Frequency range should be greater than the normal range of the antenna.

Example - For a 450 MHz antenna, set the start frequency at 400 and the stop frequency at 500 MHz, for an 800 MHz antenna, set the start frequency at 700 and the stop frequency at 1,100 MHz.

Note: Changing the frequency settings will automatically turn calibration off. Always set the frequency before calibrating the unit.

Note: If a frequency that is outside of the range of the RailHawk is entered, the RailHawk will override the entry and set the minimum or maximum frequency of the model.

There are two methods available to change the start, stop, center frequencies and frequency span; display screen entry and FREQ menu entry.

Changing Measurement Frequency on the Display

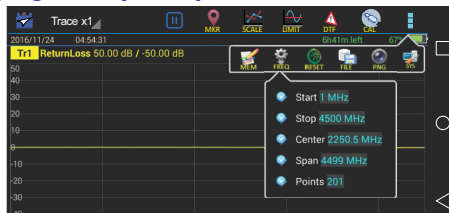
1. Press the data field of the frequency to change.
2. Type the new value using the number pad.
3. Press Enter.

Changing Measurement Frequency on the FREQ Menu

1. Press the Menu icon. See [Figure 3 on page 8](#).
2. Press FREQ on the menu.
3. Press the data field of the frequency to change.
4. Type the new value using the number pad.
5. Press Enter.
6. Tap outside of the menu to close.

Note: If Stop and Start frequencies are entered, the unit will automatically update the Center and Span frequency. If Center or Span is entered, the frequency setting will update automatically.

Figure 3 Changing Sweep Frequencies



Setting the Measurement Data Points

Select the number of data points to take during a measurement. There are seven data point options:

- 51 points
- 101 points
- 201 points
- 401 points
- 801 points
- 1601 points
- 3201 points

Increasing the number of data points increases the measurable distance in Distance-to-Fault measurements and increases the detail in Measure Match mode measurements. When saving a trace, the number of data points collected are saved.

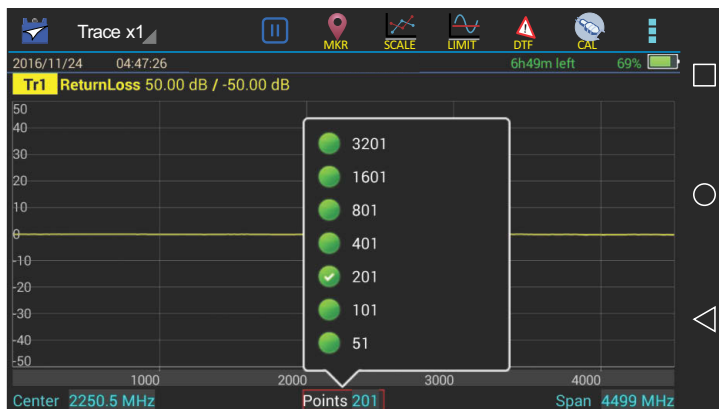
A progress bar, just below the x-axis, will indicate the progress of the sweep.

When the number of measurement data points are changed, the current trace is erased and the Save softkey is disabled until the sweep finishes and the screen displays the first new trace.

Changing the Number of Measurement Data Points

1. Press the Points data field on status bar
2. Select desired data point option.

Figure 4 Changing the Number of Measurement Data Points



Setting the Distance Units and Cable Values (DTF Menu)

The trace can display the entire length (distance) of the cable system being measured or a smaller portion of the length for better detail.

If it is suspected that there might be a fault at a known distance along a cable, set the display to show only that area by using the start and stop distance. Think of this as zooming in on a section of the cable. Both the start distance (where to begin the trace display) and the stop distance (where to end the trace display) can be set.

Distance Unit

1. Select DTF.
2. Unit Select units settings.

Note: *The system default unit m, optional unit ft.*

Start Distance

1. Select the input box.
2. Set start distance.

Stop Distance

1. Select the input box.
2. Set stop distance.

Windowing

Windowing is an option on the RailHawk that will digitally average the data on the displayed trace, in effect, making the trace appear smoother. In some situations, it will make individual problems easier to spot, but in others it may mask details that are needed. Experimentation is the key word.

1. Select the Window.
2. Select the corresponding window style.

Note:

- *Default is Normal*
- *Minimum - will show all the detail in the trace. In some situations it can be difficult to spot individual problems.*
- *Maximum - will add the most digital averaging of the display and can make some problems "disappear" or actually test as passing.*

Velocity

1. Select Velocity.
2. Set speed value.

Note: *Manually enter cable velocity value or select the cable type from the cable list.*

Cable Loss

1. Select CableLoss.
2. Set cable loss values.

Note:

- *Manually enter cable loss value or select the cable type from the cable list.*
- *If manually entering the CableLoss (or Attenuation value), it must be entered in dB/ft, or dB/meter. The manufacturer generally gives these values as dB/100ft or dB/100meters.*

Cable List

The Cable List contains known cable values for a variety of cable types. The Cable List may be edited to add or delete cables. ["Edit Cable List" on page 76.](#)

1. Select CableList.
2. Set cable type.
3. Select a certain cable type.

Note: *Each cable type in the cable list has the fixed values for cable velocity and cable loss. Selecting a cable from the cable list will automatically populate the cable velocity and cable loss data fields.*

Trace Settings

The number of traces displayed and the minimum and maximum grid scale values can be manually changed.

Note: *RailHawk is capable of displaying up to 4 traces.*

1. Press the Trace name (e.g. Tr1) to select the active trace. See [Figure 5 on page 12](#).

Note: *The Trace name will be highlighted to indicate the active Trace.*

2. Trace Count Setting

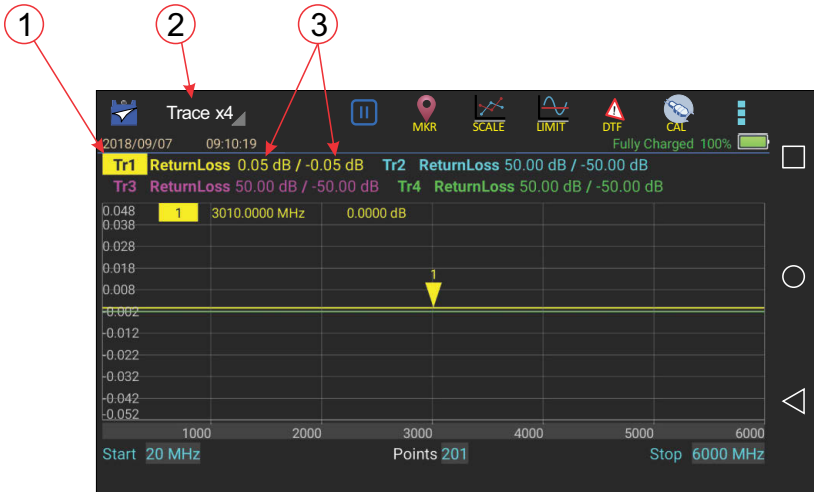
- a. Press the Trace icon on the menu bar.
- b. Choose the number of traces to display x1, x2, or x4.

Note: *Every trace has a name: Tr1, Tr2, Tr3, or Tr4, the name cannot be changed.*

3. Change one or both trace limits to change the grid scale for the trace:

- Set the maximum value
 - a. Press the maximum value to open the Top value dialog.
 - b. Enter a maximum value.
- Set the minimum value
 - a. Press the minimum value to open the Bottom value dialog.
 - b. Enter a minimum value.

Figure 5 Tracing Settings



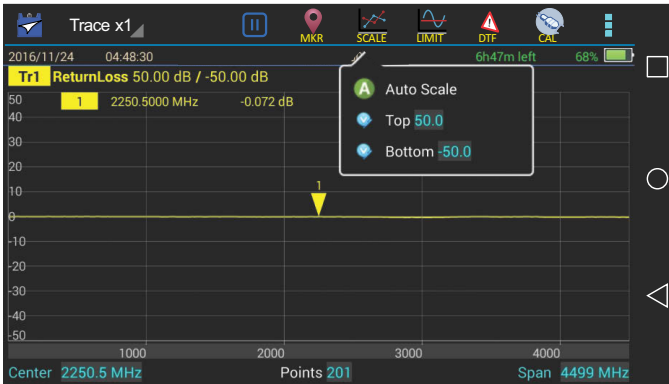
Adjusting the trace within the selected scale

Note: Scale settings only affect the active trace, if more than one trace is currently displayed, select the desired trace before changing scale.

1. Press SCALE icon. See [Figure 6 on page 13](#).
2. Select one of the following from the menu:
 - a. For Manual Operation:
 - Press Top to change upper limit of the display
 - Press Bottom to change the lower limit of the display
 - b. For Auto Scale:
 - Press Auto Scale for the system to choose the best fit for the active trace.

Note: The scale can also be dynamically changed by pressing and dragging the trace up or down in the display window.

Figure 6 Adjusting the Trace



Limit Line

The limit line helps to set off those parts of a trace that are outside of the acceptance (limit) values. It appears as a red horizontal line at the limit line value. The part of the trace that is not acceptable will display in white. Additionally, identification of signals falling outside acceptable limits can be visually and audibly enhanced using a failure flag and alarm.

Note: Limit lines are available in any measurement mode.

Setting Limit Lines

1. Press LIMIT icon.

Figure 7 Limit Menu



2. Select from the following limit options.

Limit (On/Off)

Press to toggle limit line on and off.

Style (Max/Min)

Press to toggle maximum or minimum limit line.

Note: When the Style is set to Max, anything above the Limit Line will be flagged as Fail. When the Style is set to Min, anything below the limit line will be flagged as Fail.

Value

Sets the position of the limit line on the vertical scale (Y axis). Press the field to enter a value.

Step

Sets the numerical value the limit line will move when the Move UP or Move Down button are pressed. Press the field to enter a value.

Move Up

Press to move limit line up the vertical scale. Each press will move the limit line the value in the Step field.

Move Down

Press to move limit line down the vertical scale. Each press will move the limit line the value in the Step field.

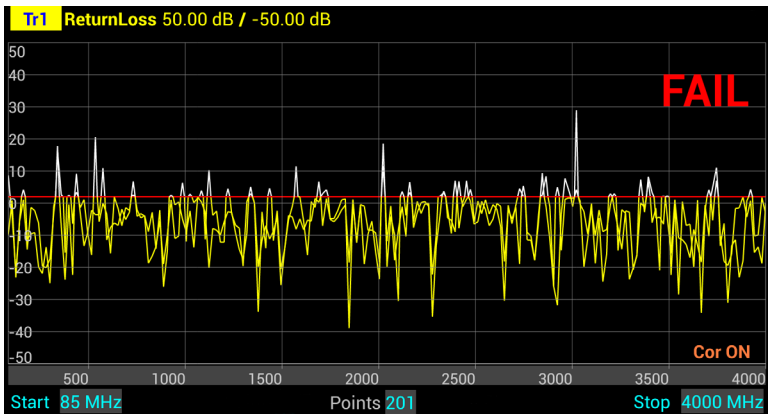
FailFlag (On/Off)

Press to toggle fail flag on and off. The words **PASS** or **FAIL** will be displayed in the sweep display area to indicate if the active signal is within or outside the limits set by the limit line.

FailAlarm (On/Off)

Press to toggle fail alarm on and off. An audible alarm will sound if the active signal is outside the limits set by the limit line.

Figure 8 Example Limit Line



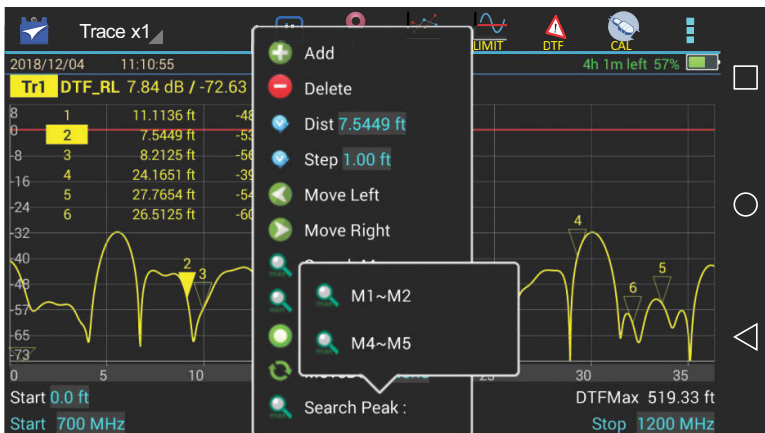
Markers

Each marker is displayed as a triangle pointer. Up to six markers can be used with each trace to visually indicate the trace value at specific frequency points. Only markers for the active trace are displayed. The RailHawk analyzer displays the frequency and signal value for each marker at the top of the screen. The difference (delta) in frequency between two markers can also be displayed. Markers indicate SWR to 0.01, and Return Loss or Cable Loss to 0.1 dB.

Setting Markers

1. Press the MKR icon.

Figure 9 Marker Menu



2. Select from the following marker options:

Add

Press Add to add a marker.

Delete

Pressing Delete will delete the active marker. If deleting a marker, select the marker before opening the marker menu. Pressing Delete will delete the active marker and shift the remaining markers up.

For example: If 6 markers are turned on and the active marker is marker 4, deleting marker 4 will shift markers 5 and 6 to the marker 4 and 5 position.

Freq

Indicates the current frequency position of the active marker. Press the Freq field to enter a new position/frequency for the marker.

Note: Any marker position can be dynamically changed by pressing and dragging the marker left or right on the display screen.

Step

Sets the frequency value the active marker will move when the Move Left or Move Right buttons are pressed. Press the Step field to enter a value.

Moves the position of the marker left or right by the step entered.

Move Left

Press to move the active marker to the left. Each press will move the active marker the value in the Step field.

Move Right

Press to move the active marker to the right. Each press will move the active marker the value in the Step field.

Search Max

Press to move the active marker to the maximum value position on the trace.

Search Min

Press to move the active marker to the minimum value position on the trace.

DeltaMarker

Press to toggle delta marker function on and off.

MoveDelta

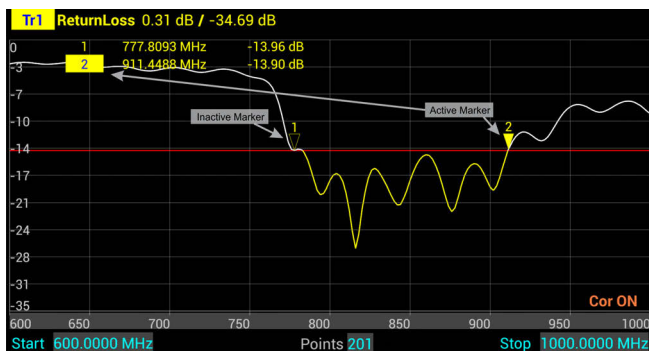
Press to move the delta marker indicator to highlight a specific delta marker.

Search Peak: M1~M2, M4~M5

Press **M1~M2** to move marker 3 to the peak signal between marker 1 and marker 2.

Press **M4~M5** to move marker 6 to the peak signal between marker 4 and marker 5.

Figure 10 Marker Examples



Using Delta Markers

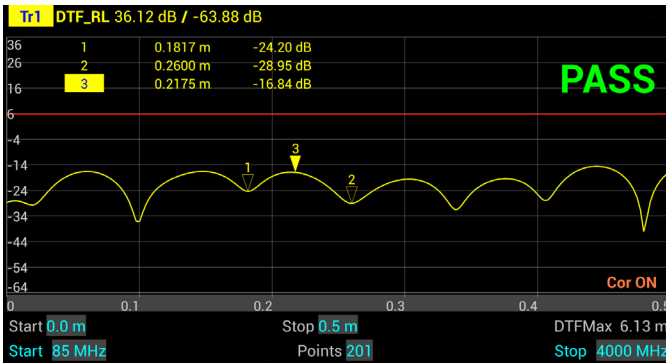
The delta marker feature displays the difference (delta) in both frequency (or distance) and value between the active marker and all other markers. All markers follow the current trace only.

Note: The Delta marker compares points on one trace and at least two markers must be displayed for the Delta Option to work.

1. Select the marker on the screen to be the active marker.

Note: In [Figure 11](#), marker 3 is the active marker, marker 1 and 2 are turned on.

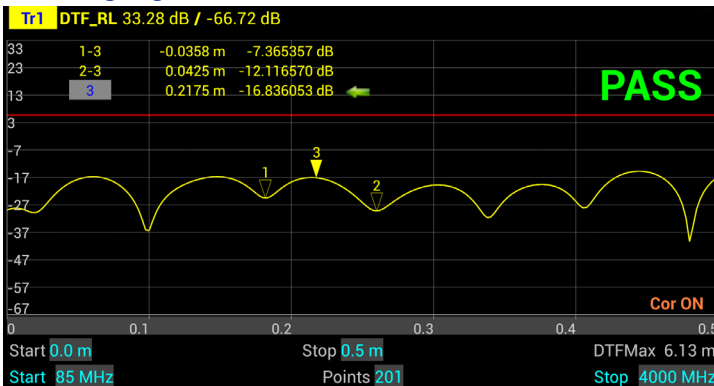
Figure 11 Active Marker



2. Press MKR icon, and select DeltaMarker.

Note: In [Figure 12](#), marker 3 is highlighted, markers 1 and 2 are now delta markers 1-3 and 2-3. Delta markers 1-3 and 2-3 display values that are the difference between their positions and the position of marker 3.

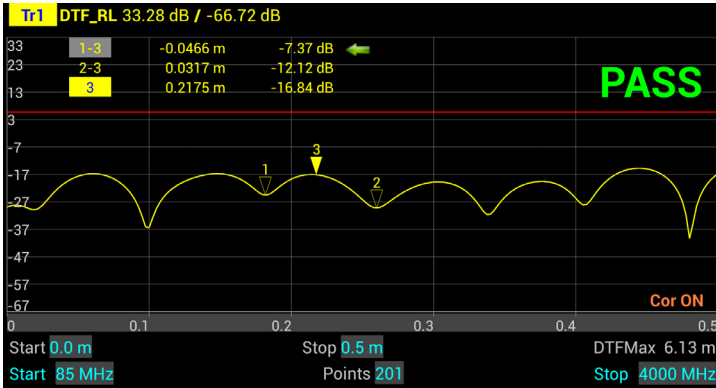
Figure 12 Highlighted Markers



3. Press MKR icon, and select MoveDelta.

Note: [Figure 13](#) shows Marker 1-3 is now highlighted.

Figure 13 Highlighted Delta Marker



Peak Search Between Markers

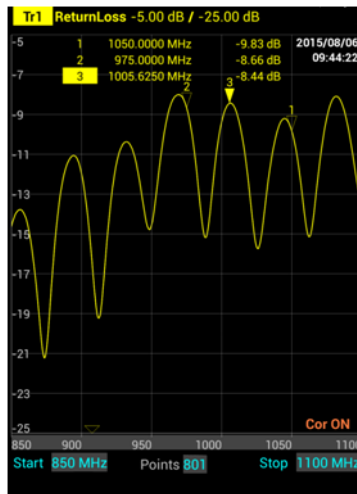
The peak search between markers feature causes a marker to find the peak between two other markers. M1 ~ M2 selection causes marker 3 to move to the peak signal between marker 1 and marker 2 positions. M4 ~ M5 selection causes marker 6 to move to the peak signal between marker 4 and marker 5 positions. All markers follow the current trace only.

Note: A minimum of three markers must be displayed for the peak search between markers to work. Marker 3 will always find the peak between marker 1 and 2, regardless of how many other markers are displayed, and marker 6 will always find the peak between marker 4 and 5.

1. Press MKR icon, and Add markers 1, 2, and 3. If desired add markers 4, 5, and 6 also.
2. Move marker 1 and 2 to the upper and lower limit for the peak search. If desired, move markers 4 and 5 to a second area of interest.
3. Press MKR icon, and select Search Peak:
4. Select either **M1 ~ M2** or **M4 ~ M5**

Note: [Figure 14](#) shows marker 3 at the peak signal position between marker 1 and marker 2.

Figure 14 Marker 3, Peak Search: M1~M2

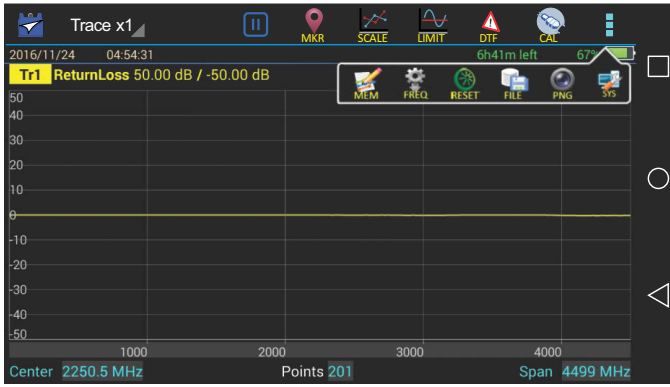


Utility Menus

Pressing the Menu icon will display the utility menus: MEM, FREQ, RESET, FILE, PNG, SYS. See [Figure 15](#).

These menus are described in this section with the exception of the FREQ menu, the FREQ menu is described in "[Setting the Measurement Frequencies](#)" on [page 8](#).

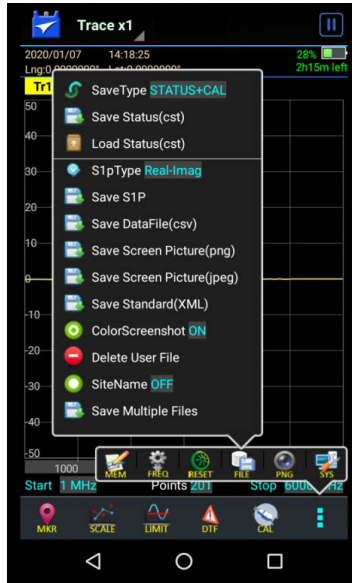
Figure 15 Utility Menus



FILE Menu

Pressing the FILE icon will display the file menu. See [Figure 16](#).

Figure 16 File Menu



Saving and Recalling Traces

Traces and measurement data can be saved and recalled from either the unit's internal memory or an external USB thumb drive. See ["Data Save and Export" on page 38](#).

Screenshots

Screenshots can be saved by using the Save Screen Picture options on the File menu, or by pressing the PNG Icon. The current time is added to all screen shots. The site name may be added as an option.

Save Screen Picture (png)

Saves a PNG file of the current Sweep Display Area, press the menu option and a save dialog is displayed allowing the user to enter a file name or use the default file name.

Note: *If the Site Name option is set to ON an Edit SiteName dialog box will be displayed each time screen shot is taken.*

Save Screen Picture (jpeg)

Saves a JPEG file of the current Sweep Display Area, press the menu option and a save dialog is displayed allowing the user to enter a file name or use the default file name.

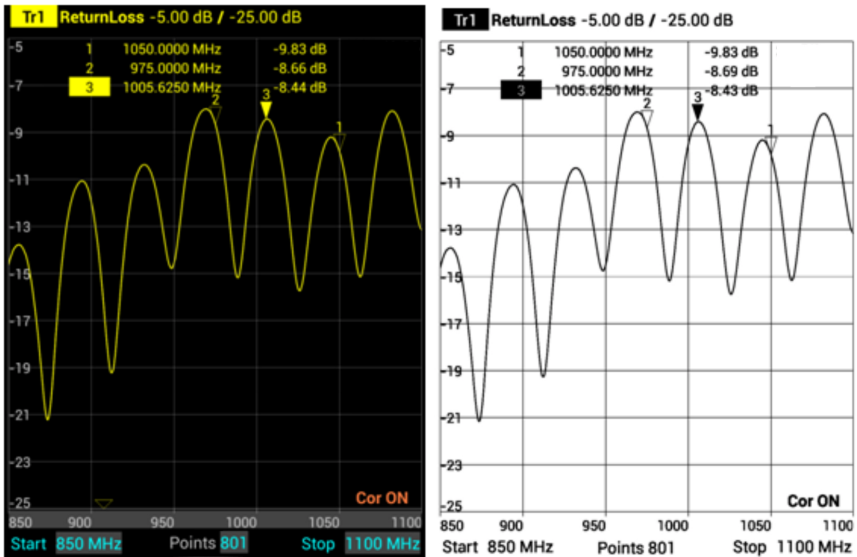
Note: *If the Site Name option is set to ON an Edit SiteName dialog box will be displayed each time screen shot is taken.*

Color Screen Shot

Press to toggle screen shots in color or black and white. When set to OFF screen shots will be black and white, when set to ON screen shots will be in color. See [Figure 17](#)

Note: *The default setting for Color Screen Shot option is OFF. If the reset function is executed on the RailHawk, the Color Screen Shot option is reset to OFF.*

Figure 17 Screen Shots in Color or Black and White

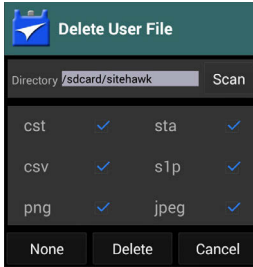


Delete User File

Press to display the Delete User File dialog box. The Delete User File dialog box allows any one file type or all file types to be deleted from the RailHawk. See [Figure 18](#).

For procedure to delete files see "[Data Save and Export](#)" on page 38.

Figure 18 Delete User File dialog box



Site Name

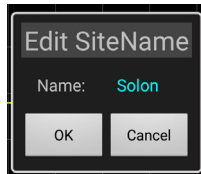
Press to toggle ON or OFF, when set to ON the site name will be included on all screen shots.

After Site Name is set to ON, an Edit SiteName dialog box will be displayed each time a screen shot is taken. See [Figure 19](#).

The site name must be entered the first time a screen shot is saved.

Note: The default setting for the Site Name option is OFF. If the reset function is executed on the RailHawk, the Site Name option is reset to OFF.

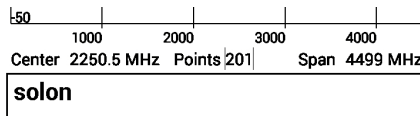
Figure 19 Site Name Dialog Box



The site name will appear at the bottom of the sweep display screen shot. See [Figure 20](#).

If no site name was entered NULL will appear in place of the site name.

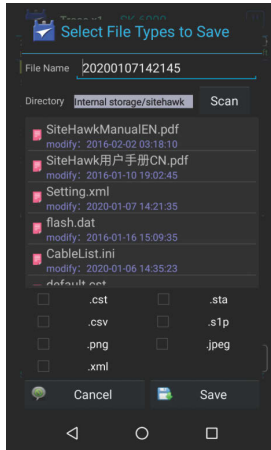
Figure 20 Site Name Screenshot



Save Multiple Files

The Save Multiple Files menu allows several file types to be saved in one operation, using the same file name for each file type. The menu contains file type selection boxes and file name option. For more details, see ["Saving Files" on page 39](#).

Figure 21 Save Multiple Files



RESET Icon

The reset menu will reset the RailHawk to default settings. All current data is cleared including calibration, and all menus are reset to default. Saved data is not affected by a reset.

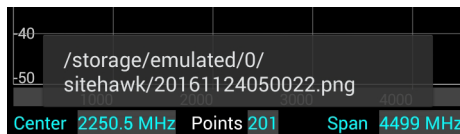
1. Press the Menu icon.
2. Press RESET. A Reset dialog will open, click OK to confirm reset.

PNG Icon

Pressing PNG will save the current sweep display area as an image with a PNG file type extension. The save path and filename will briefly be displayed at the bottom of the screen. See [Figure 22](#).

Note: If the Site Name option is set to ON an Edit SiteName dialog box will be displayed each time screen shot is taken. See [Figure 19](#).

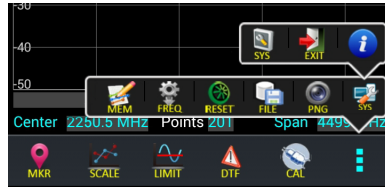
Figure 22 PNG Screenshot



SYS Menu

SYS menu is accessed by pressing the Menu icon, then pressing the SYS icon.

Figure 23 SYS Menu



System Settings

Press the SYS icon on the SYS menu to open the System Settings dialog. The System Settings dialog allows the user to change system display settings. The full menu is best viewed with the RailHawk in the vertical position.

User options include:

- Change Trace color
- Change limit Line color
- Change font size
- Change line widths
- Toggle Full Screen on and off
- Toggle display of GPS coordinates on and off
- Adjust the volume
- Select Language

Note: GPS coordinates, when selected, will appear on the display along with the date and time, see "[Measurement Interface](#)" on page 5.

Note: Location services must be set to **On** for the RailHawk to display latitude and longitude data. See "[Accessing Communication Services](#)" on page 47.

Figure 24 System Settings



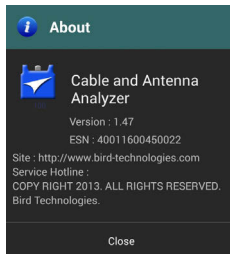
EXIT

Press the exit icon on the SYS menu to close the RailHawk application.

About Screen

Press the information icon on the SYS menu opens the About Screen. The About screen displays the software version and the device serial number.

Figure 25 System About



Calibrating the RailHawk Analyzer

For best results, set the frequency and calibrate the Bird Site Analyzer immediately before taking measurements.

Note: Use a precision open, short, load (OSL) calibration standard or “Calibration Combo” for accurate measurement results.

Note: If an extension cable is needed use the supplied RF Test Cable. Calibrate to the end of the RF Test Cable.

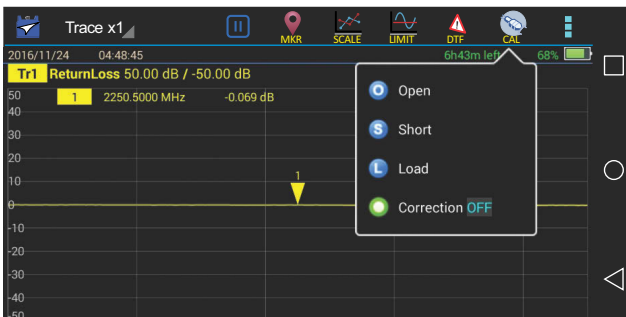
Note: Changing frequency settings will automatically turn calibration off. Always set the frequency before calibrating the unit.

1. Press the Calibrate icon. See [Figure 26](#).
2. Connect the Cal Combo “Open” connector to the unit antenna port.
3. Press the Open softkey.
4. Wait for the unit to sweep and a Green Check to display.
5. Connect the Cal Combo “Short” connector to the unit antenna port.
6. Press the Short softkey
7. Wait for the unit to sweep and a Green Check to display.
8. Connect the Cal Combo “Load” connector to the unit antenna port.
9. Press the Load softkey
10. Wait for the unit to sweep and a Green Check to display.

Note: During calibration, the color of the icon display is yellow.

Note: After calibration, the display will resemble [Figure 26](#) and Correction will be set to On.

Figure 26 Calibration Display Screen



Match measurement verifies and monitors the match conditions in the antenna system at various frequencies. The results are shown on an x-y graph. Frequency is shown on the x-axis and Return Loss or SWR is shown on the y-axis.

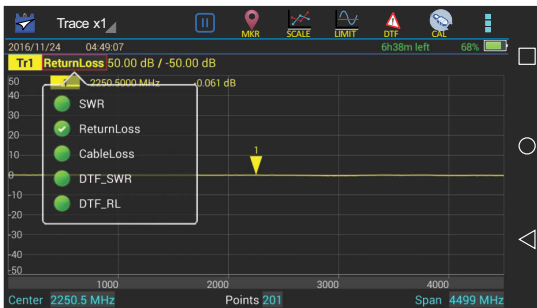
Before making a Match Measurement, be sure to have a Calibration Combination (Cal Combo), all necessary cables with adapters of the correct size and connector type.

Selecting Measure Match Modes and Measurement Units

1. Press trace measurement field to display menu.
2. Select one of the following from the Measurement Mode menu:
 - ReturnLoss
 - SWR

Note: When making a match measurement, select units for the Y (vertical) scale: SWR for standing wave ratio or Return Loss for dB.

Figure 27 Selecting the Measure Match Mode



3. Select the number of Data Measurement points.
4. Set the Frequency range.

Note: Frequency range should be greater than the normal range of the antenna.

Example - For a 450 MHz antenna, set the start frequency at 400 and the stop frequency at 500 MHz, for an 800 MHz antenna, set the start frequency at 700 and the stop frequency at 1,100 MHz.

5. Calibrate the RailHawk. See "[Calibration](#)" on page 28.

CAUTION

Do not exceed +22 dBm (100 mW) RF Power input at the measurement port. Damage to the unit's RF module will result.

Note: Antenna systems can build up a static charge large enough to damage the RailHawk, if discharged through the device. It is recommended a load or attenuator be used to bleed off any static charge prior to connecting the RailHawk to the system.

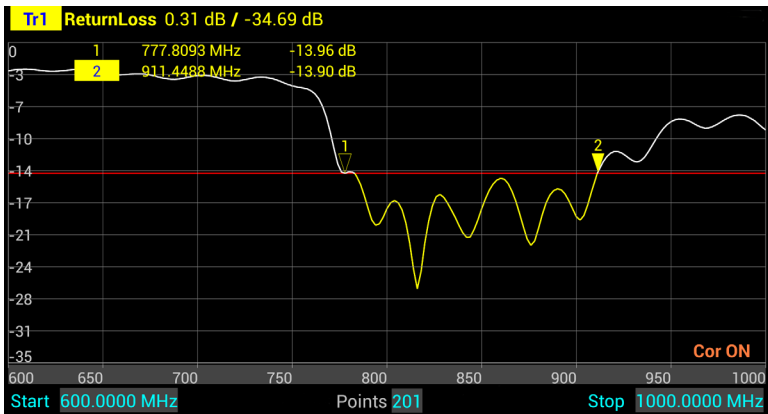
Note: Changing frequency settings will automatically turn calibration off. Always set the frequency before calibrating the unit.

- 6. Connect the RailHawk to the device under test.
- 7. Wait 10 Seconds for the sweep to update.

Interpreting the Measurement

The graph below shows a typical Match Measurement of an antenna.

Figure 28 Interpreting Match Measurement



The graph contains the following elements:

- Vertical grid scale (y axis) displays dB and ratio data values.
- Horizontal grid scale (x axis) displays frequency, time or distance data values.
- The measured value of the Markers (1 and 2 in this example).
- Trace number (Tr1) and color is used identify the trace.
- When scanning duration is more than 1 second, a current position indicator will appear.

Cable Loss Measurement

Ensure that the cable being tested is unterminated (not connected to anything at the far end).

Note: Ensure the cable is disconnected from any RF power source.

Note: Ensure the frequency band of the system is known.

Performing a Cable Loss Measurement

1. Press trace measurement field to display Measurement Mode menu.
2. Press CableLoss in the Measurement Mode menu.

Figure 29 Selecting Cable Loss Measurement



3. Set the frequency start and stop to a range that is greater than the normal range of the antenna.

Example - For a 450 MHz antenna, set the start frequency at 400 and the stop frequency at 500 MHz. For an 800 MHz antenna, set the start frequency at 700 and the stop frequency at 1,100 MHz.
4. Connect supplied RF Test Cable to the RailHawk Analyzer antenna test port.
5. Calibrate the RailHawk Analyzer. ["Calibration" on page 28.](#)

Note: After Calibration, with the load still connected, the Output must be below -25 dB. If not, there may be an issue.

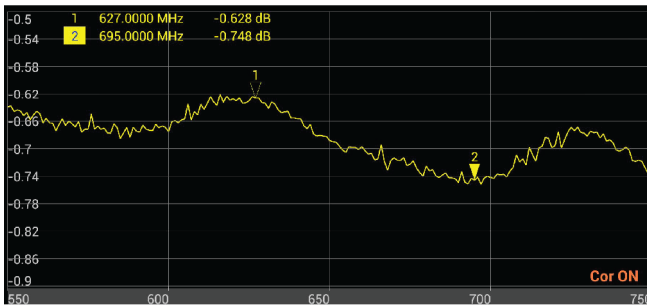
6. Remove the Cal Combo unit from the cable.
7. Connect supplied RF Test Cable to one end of the cable under test.
8. Connect the Short connection on the Cal Combo unit to the other end of the cable under test.
9. Wait at least 10 seconds to allow the trace to update.
10. Place a marker (mark 1) at the minimum loss point within the frequency band on the trace. ["Markers" on page 16.](#)

11. Place a marker (mark 2) at the maximum loss point within the frequency band on the trace.
12. Save and label the trace, if appropriate. "[Recall Trace Data](#)" on page 41.

Interpreting a Cable Loss Measurement

The graph below shows a typical cable loss measurement. Note that the scale is greatly reduced to show the cable's variation across frequency.

Figure 30 *Interpreting Cable Loss Measurement*



1. Marker 1 and Marker 2 indicate the minimum and maximum loss for the cable under test.
2. Take the average of M1 and M2.
Note: *This is the average cable loss across the frequency band.*
3. Compare the loss with the manufacturer's specified loss for a cable of this length.

Note: *If they do not correspond, measure the cable loss again, then check the cable for problems.*

Fault location identifies the position of impedance discontinuities (reflections) within the antenna system. The measurement results are displayed on an x-y graph. Distance from the RailHawk Analyzer is shown on the x-axis, while relative magnitude of the discontinuity is shown on the y-axis.

Before making a fault location measurement, ensure that the following items and information are present:

- Calibration Combination (Cal Combo) calibration unit
- All necessary cables and adapters of the correct size and connector type
- The velocity of propagation for the cable type being measured (obtain from the cable manufacturer)
- Number of data points to use in making the distance-to-fault measurement (user choice)

Frequency Span and Max Distance

Frequency span, the velocity of propagation of the cable (V_p) and the number of measured data points determine the maximum distance tested during fault location test.

Max Distance

The maximum measurable distance can be calculated by RailHawk based on the specified frequency span, or the maximum distance can be entered manually instead of entering the frequency span. If the maximum distance being measured is entered instead of the frequency span; the RailHawk calculates the frequency span.

If a maximum distance is manually entered, select the data points before entering the max distance.

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.*

Note: *If a maximum distance less than the total length of the cable system is selected, the trace will not show the end of the cable system (antenna). To display the full cable system 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

Increasing the number of data points increases the measurable distance (401 points results in twice the distance of 201 points, and 801 points results in four times the distance of 201 points). When changing the number of data points measured, the software automatically recomputes the new maximum measurable distance. If a maximum distance is entered manually, be sure to select the data points before entering the max distance. Changing data points does not turn calibration off.

Note: *Changing data points does not turn calibration off.*

Frequency Span

The larger the frequency span, the shorter the measurable distance. Narrowing the frequency span increases the measurable distance.

Velocity of Propagation

The velocity of propagation (V_p) is a characteristic of the cable and is expressed as a percentage. Consult the cable manufacturer's specifications to get the velocity of propagation value for the cable being used.

The RailHawk RF Test Set includes a pre-installed cable list that includes parameters for a wide variety of RF cables.

Calculating the Frequency Span

$$\Delta T = \frac{1}{\Delta F} = \frac{N-1}{F_{max} - F_{min}}$$

Note: N = Test points

F_{min} = Start frequency

F_{max} = End frequency

This max distance value can be recalculated as the max distance for the DTF test.

$$DTF_{max} = \frac{C \cdot V_p \cdot \Delta T}{2} = \frac{C \cdot V_p \cdot (N-1)}{2 \cdot (F_{max} - F_{min})}$$

Note: C = Speed of light

V_p = Velocity of Propagation (cable)

Example - For a cable with a dielectric constant of 1, the velocity percentage is 100% and 201 data points are chosen, then the RailHawk Analyzer should be set to a frequency span of 0.1 MHz (85MHz to 85.1MHz). The maximum distance of fault will be 299,792.458 meters.

Selecting Fault Location Mode

1. Press trace measurement field to display Measurement Mode menu.
2. Press to select one of the following from the Measurement Mode drop down menu:
 - DTF_SWR
 - DTF_RL

Note: When making Distance-to-Fault measurement, select units for the Y (vertical) scale: DTF_SWR for standing wave ratio or DTF_RL for return loss in dB.

Figure 31 DTF Mode Select



3. Press the Points data field and enter the number of Data Points.
4. Enter start and Stop frequencies.
5. Press Start distance field and enter the start value.
6. Press the Stop distance field and enter the stop value.
7. Press DTF Menu.
8. Press Window selection to change the display to the desired value.
9. Enter Cable data using one of the following methods
 - a. Press velocity and enter the cable velocity. Press cable loss and enter the cable loss value.
 - b. Press cable list, select the cable type from the list, cable values will be automatically entered for testing.
10. Press the Menu icon, then Press MEM menu icon. Verify Trigger is set to CONTINUE, Press HOLD to toggle to CONTINUE if required.
11. Calibrate the RailHawk. ["Calibration" on page 28.](#)

CAUTION

Do not exceed +22 dBm (100 mW) RF Power input at the measurement port. Damage to the unit's RF module will result.

Note: *Antenna systems can build up a static charge large enough to damage the RailHawk, if discharged through the device. It is recommended a load or attenuator be used to bleed off any static charge prior to connecting the RailHawk to the system.*

12. Connect the RailHawk Analyzer to the cable being tested.

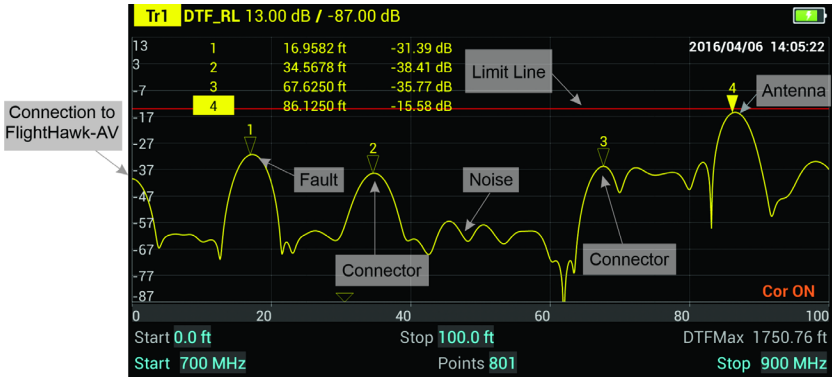
Note: *If the RailHawk Analyzer is calibrated with supplied RF Test cable connected to its antenna port, do not remove the cable. Connect it to the cable to be tested.*

13. Wait at least 10 seconds for the sweep to update.
14. Press the Menu icon, then Press MEM menu icon. Press CONTINUE and verify Trigger toggles to HOLD.

Interpreting the Fault Location Measurement

The graph below shows a typical Fault Location measurement for an antenna system. The table lists typical component return losses.

Figure 32 Interpreting Fault Location Measurement



Typical Component Return Loss	
Antenna at Resonance	-14 dB
Connector	-25 dB
Jumper	-35 dB
Lightning Protector	-25 dB
Transmission Line	-30 dB

Each connector or jumper will show as a spike. If it is larger than the typical value, check the connector for damage.

Spikes where there are no components represent faults. Note the distance and check the line at that point for damage.

The largest spike is usually due to the antenna. Typically the trace after the antenna can be ignored.

Note: If a maximum distance less than the total length of the cable system is selected, the trace will not show the end of the cable system (antenna). To display the full cable system always set the maximum distance to a value that is a few feet or meters greater than the entire length of the cable system.

A large spike (fault) near the RailHawk will mask other faults farther away. When a large spike near the RailHawk is found, fix it and then repeat the Fault Location measurement.

Saving and Recalling RailHawk Status Data

RailHawk status, calibration result, and tracing data can be saved to the instrument, and can be recalled to be displayed on the sweep display area.

The parameters for this instrument setting include: scale, trace, cursor and analysis. These parameters are saved in the status files.

CAUTION

Do not connect the unit to a PC USB port.
File transfer must be done using a USB Drive.

Trace Data in CSV File Format

RailHawk can track data of a single trace and then save the data as a comma delimited values (CSV) file. The CSV file contains a list of data separated by commas. The current format and response trajectory under the incentive value is stored in the CSV file.

Trace data is saved in the following format to the *.CSV file:

F[0],	Data1,	Data2
F[1],	Data1,	Data2
	. . .	
F[N],	Data1,	Data2

F[n] = Frequency about point N.

Data1 = Trace response value, Real part

Data2 = 0, Imaginary part

Trace Data S1p File

RailHawk can save the parameters to the S1p file. The S1p file contains the frequency value and S-parameter. S1p files are used to store a single port parameter. Only one path of data is saved to the file.

s1p files are used for importing into the SiteHawk PC Tool software. Once imported, Markers and limit lines can be added, the scaling can be modified, and reports can be generated.

The file contains a comments, title and track data lines. Comments are indicated using an exclamation "!" mark. Title of the start of the data is indicated using a pound "#" sign with the data following.

```

! Comments
# Hz S FMT R Z0
F[1]  {S11}' {S11}"
F[2]  {S11}' {S11}"
      . . .
F[N]  {S11}' {S11}"

```

Hz—frequency measurement unit (kHz, MHz, GHz)

FMT—Data Format

RI—Real part and Imaginary part

MA—Linear Amp and Phase

DB—Log Amp (dB) and Phase

Z0—reference impedance

F[n]—Frequency about point N

{...}'—{(RI) |(MA) |(DB)}

{...}"—{(RI) |(MA) |(DB)}

Save Files on RailHawk

The RailHawk Analyzer automatically names files using a time-date format, this can be changed during the save operation.

Figure 33 RailHawk File Names

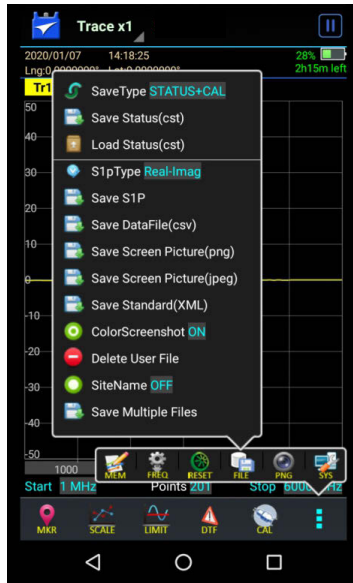
DATE	TIME
YYYYMMDD	HHMMSS
20151017	092532

.S1p

Saving Files

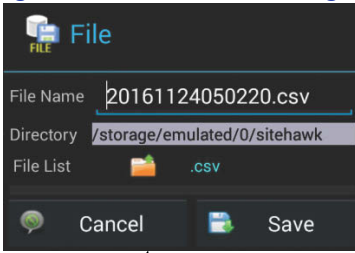
1. Press the Menu icon.
2. Press the FILE icon to display the file menu. See [Figure 34](#).

Figure 34 File Menu



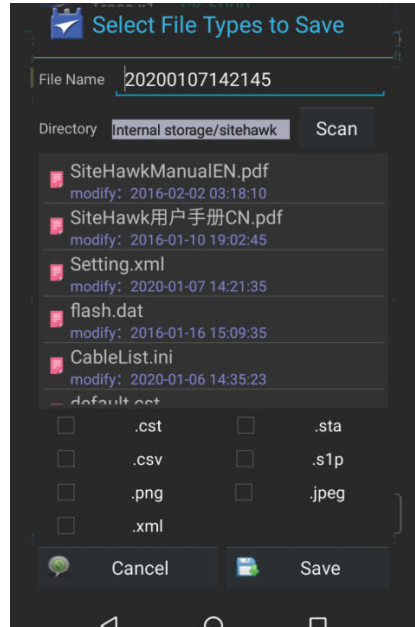
3. Select the format of the saved file:
 - Data can be saved as cst or sta trace data.
 - Data can be saved as a S1p file.
 - Data can be saved as a datafile (.csv).
 - Screenshots can be saved as .png or .jpeg.
4. Press appropriate Save icon (each save type has its own save button).

Note: *Unless a custom name is entered, a default filename will be automatically generated. This file will be saved to the internal memory of the unit.*
5. Change the file name if desired. See [Figure 35 on page 41](#).
6. If Save Multiple Files was selected, select checkboxes for all file types to save as a group.
7. Press Save.

Figure 35 File Save Dialog

Individual File
Save Dialog

Multiple Files
Save Dialog



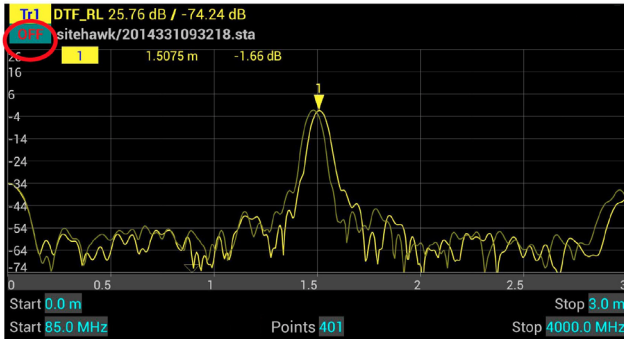
Recall Trace Data

Data in sta or cst data files can be recalled and displayed with the current data trace.

1. Press the Menu icon.
2. Press the FILE icon to display the file menu. See [Figure 34](#).
3. Press the Save Type to select file type STATUS+CAL (cst) or STATUS (sta).
4. Press Load.
5. Select the data file from the list.
6. Press Load. See [Figure 36 on page 42](#).

Note: *The active and the recalled trace data will be displayed together in the sweep display area. In the example, Tr1 is the active trace, the recalled trace data is indicated with OFF and the file name.*

Figure 36 Recall Sta Data and Running Data



7. Press OFF to remove the recalled trace data.

Deleting RailHawk Stored Data Files

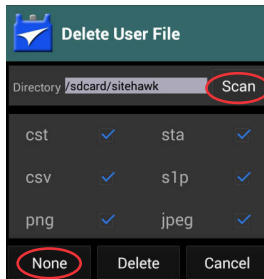
This procedure can be used to delete any data files stored by the SiteHawk App.

1. Press the Menu icon.
2. Press the FILE icon to display the file menu. See [Figure 34](#).
3. Press Delete User File.
4. Select Directory containing files to delete.

Note: The default directory (folder) displayed in the Delete User File dialog box is the default save folder, there is no need to select a different folder if the default folder was used to save files. Skip to [step 5](#)

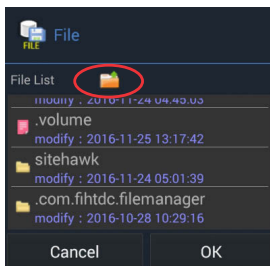
- a. Press SCAN. See [Figure 37](#).

Figure 37 Delete User File Dialog Box



- b. Select desired folder in the File List or press file folder icon to browse for the desired folder. See [Figure 38](#).

Figure 38 Directory Selection



Note: Only folders may be selected in the File List. This dialog box is used to select the folder containing the files to be deleted.

- c. Press OK.
5. Select the file types to delete.

Note: All file types are selected initially, any file type selected with a check mark when DELETE is pressed will cause ALL the files of that file type to be deleted.

- a. To deselect all file types, press NONE. See [Figure 37](#).
- b. Press the check box next to each file type to select those files for deletion.
6. Press DELETE.

Data Transfer Function

Data transfer from the RailHawk may be accomplished using a USB Drive or via Bluetooth transfer. For instructions on how to make transfers see "[Data Transfer via USB Drive](#)" on page 43 or "[Data Transfer via Bluetooth](#)" on page 46.

Data Transfer via USB Drive

Data can be transferred from or to the RailHawk internal memory with the use of an external USB drive and the USB adapter (supplied).

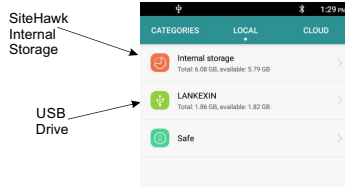
CAUTION

Do not connect the unit to a PC USB port.
File transfer must be done using a USB Drive.

1. Connect the USB drive to the USB adapter, then connect the USB adapter to the USB-C port at the bottom of the unit.
2. Press Home key on the RailHawk display.
3. Select the Files icon on the unit's home screen.

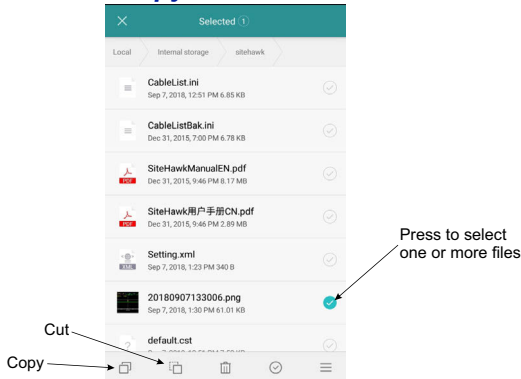
4. Select LOCAL. See [Figure 39](#).
5. Select Internal Storage.
6. Navigate to the location of the file.

Figure 39 File Selection



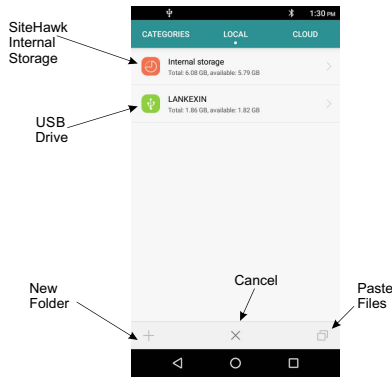
7. Press to select the file to be copied. See [Figure 40](#).
8. Press the Copy icon.

Figure 40 Select and Copy Files



9. Select LOCAL. See [Figure 41](#).
10. Select USB Storage.
11. Navigate to the directory where the file will be saved.
12. Tap the Paste icon to save the file onto the USB drive.

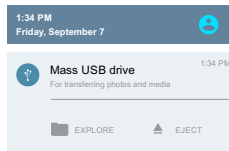
Figure 41 Paste Files



13. Exit the File Manager.

14. Pull down the notification area at the top of the display screen. See [Figure 42](#)

Figure 42 Eject USB Storage

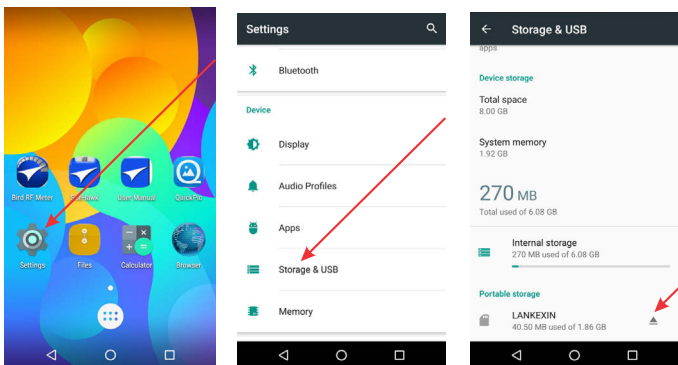


15. Tap **EJECT**.

Ejecting USB Drive from Settings Menu

1. Tap **Settings** on the Home Screen. See [Figure 43](#).
2. Tap **Storage & USB**.

Figure 43 Eject USB Storage



3. Scroll to **Portable Storage**, and tap the Eject icon.

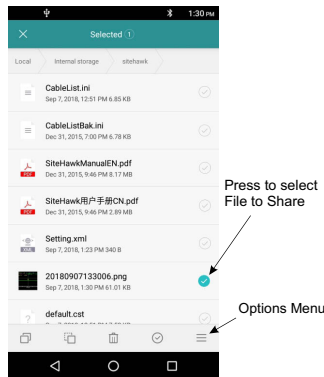
4. Wait for **Ejected** to be displayed under the USB name.
5. You may now remove the USB Drive.

Data Transfer via Bluetooth

Files may be transferred to/from the RailHawk using the following steps.

1. Press Home key on the RailHawk display.
2. Select Settings.
3. Turn on Bluetooth.
4. Press Home key.
5. Select the File Manager icon on the unit's home screen.
6. Select Phone Storage (RailHawk storage Local) in the File Manager program.
7. Navigate to the location of the file.

Figure 44 File Selection



8. Select the file to be copied. See [Figure 44](#).
9. Tap the options menu.
10. Tap **Share**.
11. Select Bluetooth option for sharing.
12. Scan for available devices.

Note: *You may need to make the destination device visible to other devices in it's setting's menu.*

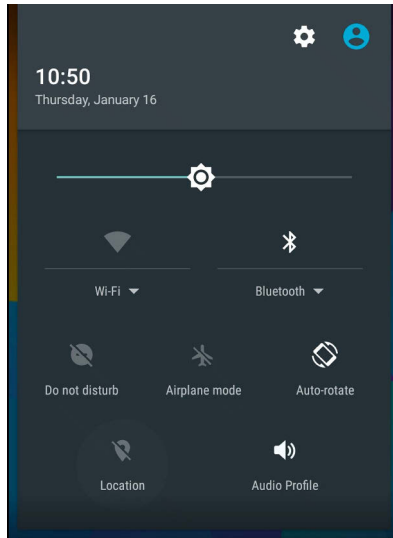
13. Select the destination device from the devices listed.
14. On the destination device, tap **ACCEPT**.
15. Verify transfer is complete.

RailHawk Communications Settings

The RailHawk utilizes WiFi, Bluetooth, and GPS to perform the various functions described in the previous sections.

These communications functions may be turned on and off using the pull-down notification area at the top of the RailHawk's display area, See [Figure 45](#).

Figure 45 RailHawk Pull-Down Notification Menu



Accessing Communication Services

1. Swipe your finger down from the top of the display screen to access the notification area.
2. Tap the service Icon to start (or stop) the service
 - a. Location: tapping location icon turns location services off or on. A slash through the icon indicates the service is OFF as shown in [Figure 45](#).
 - b. WiFi: tapping WiFi icon turns WiFi off or on. Tap the dropdown below the icon to select a WiFi network and enter the password.
 - c. Bluetooth: tapping Bluetooth icon turns Bluetooth off or on. Tap the dropdown below the icon to select a Bluetooth device for pairing.

RF Power measurement is accomplished using the RF Meter Application on the RailHawk with the Power Sensor included in the RailHawk RF Test Set. The following section describes how to connect the RailHawk to the Power Sensor, user interface description, and measurement procedure.

Note: Always refer to your official maintenance manual or diagnostic procedure for exact test instructions.

Sensor Connection

1. Connect USB cable to Bird Power Sensor. See [Figure 47 on page 49](#).
2. Connect USB cable to USB Adapter.
3. Connect USB Adapter to RailHawk.

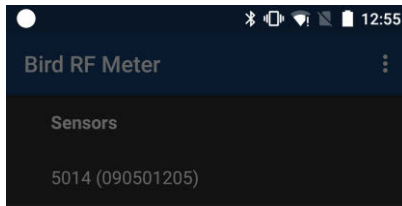
Note: Bird RF Meter App will automatically launch.

4. Check the box to select Bird RF Meter as the default app. This setting allows the Bird RF Meter App to automatically connect to this sensor in the future.

Note: The Bird RF Meter will save all sensor settings (by serial number). Sensor settings will automatically load when the sensor is connected. Settings are saved in a Session File. Session Files are saved in the Session List.

5. Tap OK.
6. The Power Sensor model number and serial number will be displayed on the Bird RF Meter device selection screen.

Figure 46 Device Selection Screen



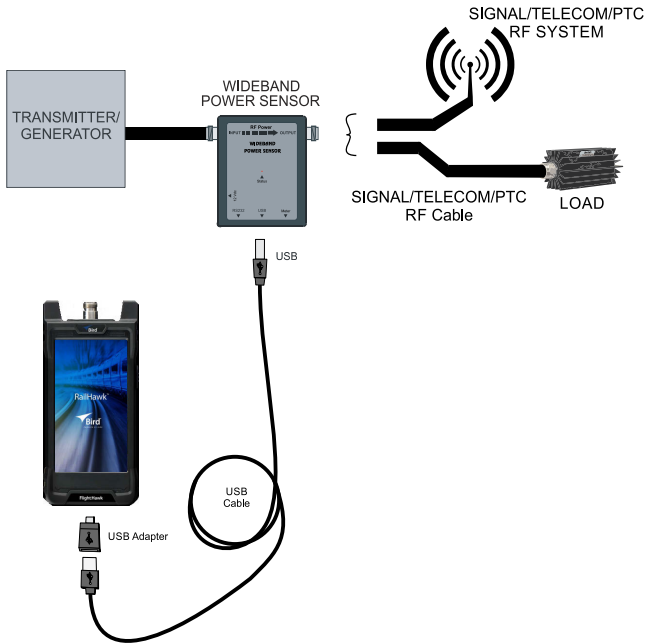
7. Tap the Power Sensor model number to connect to the Power Sensor.

WARNING

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

8. Connect RF line so that the arrow on the sensor points towards the load.

Figure 47 RF Power Measurement Setup



Note: Risk of unintentional signal transmission, broadcast or interference! Always disconnect transmit and/or receive antenna. Refer to your official maintenance manual or diagnostic procedure for exact test instructions.



For a description of displays and menus, see ["Sensor Displays and Menus" on page 52](#).

RF Power Measurements

Kits that include a power sensor are capable of direct RF power measurement using the power sensor and the RF Meter App. Depending on the sensor included in the kit, the power sensor is capable of performing some or all of these measurements:

- Forward RF Power
- Reflected RF Power
- Match Measurements (VSWR, refl. coefficient, Return Loss)
- Peak Power
- Burst Power
- Duty Cycle (only displayed when Avg is selected for Measurement Type)


Measurement procedure

1. Connect the power sensor to the cable or communications system. See ["Sensor Connection" on page 48](#).
2. Zero the Power Sensor, if applicable. See ["Zeroing a Sensor" on page 50](#).
3. Tap the [Display Controls Menu](#) 
4. Tap Configuration.
5. Enter the Offset value (total attenuation of couplers and attenuators connected to the Power Sensor, if used).
6. Enter Filter Value. See ["Video Filter" on page 72](#) for an explanation of the filter.
7. Tap the Display Controls Menu 
8. Tap Readings.

Zeroing a Sensor

Over time, the sensor's "zero value" (reading with no applied RF power) can drift, making all readings inaccurate by this value. For example, if the zero value is 0.02W, measuring a 50 W signal will give a reading of 49.98 W, a 0.04% error. Measuring a 1 W signal will give a reading of 0.98 W, a 2% error. If the drift would be a significant error, zero the sensor.

Note: *RF power must be turned off before zeroing a power sensor.*

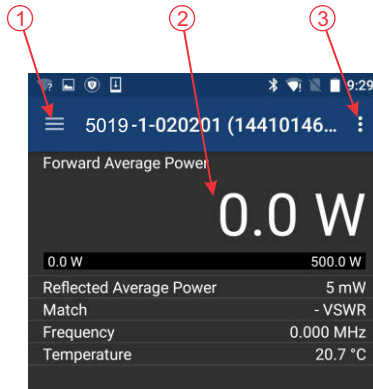
1. Ensure the sensor has reached a stable operating temperature.
2. Tap the Sensor Operation Menu 
3. Tap the Device Actions item.



4. Tap Zero Cal.
5. Verify no RF is applied to the sensor.
6. Tap OK if no RF is applied.

Note: *Calibration may take up to 40 seconds. Do not interrupt the calibration. A "Performing Zero Calibration" message will be displayed during the calibration.*

Sensor Displays and Menus

Figure 48 Power Meter Display



Item		
1	Display Controls Menu 	Used to configure the sensor and choose the format for displaying measurement data. See " Display Controls Menu " on page 54.
2	Display Area/ Readings Menu	Displays the numerical readings available/selected device readings. The information on the readings menu can also be displayed in table or graphical format. See " Display Area " on page 52.
3	Sensor Operations Menu 	Used to load Presets, select modes, send device commands, start Logging and share measurement results. See " Sensor Operations Menu " on page 62 for detailed description of the available options.

Display Area

Readings Menu

Sensor measurements are displayed on the reading menu in a list format. The top reading is enlarged to aid visibility and an analog bar meter provides visual reference of the signal level.

Graphical Displays — Any readings may be displayed in graphical or tabular format by tapping the Display Controls Menu to display the graph options and selecting a graph from the list. See Graph Displays for additional information.

Changing Units and Scale — The analog bar meter is displayed with the top sensor reading, to provide a visual display of the measurement. The Analog Bar Meter's minimum and maximum scale value can be manually adjusted. See "[Changing Readings Menu Settings](#)" on page 53.

Reorder Menu — Any of the readings may be moved to the top of the list to ease reading. See "[Arranging the Readings Menu Order](#)" on page 53.

Changing Readings Menu Settings

Note: *The Bird RF Meter will save all settings for each sensor (by serial number). Sensor specific settings will automatically load when the sensor is connected. All settings are saved in Session Files.*

The following changes can be made to any reading:

- Unit of measure
- Analog Bar Meter Scale

Changing the Unit of Measure

1. Tap the sensor reading to display the popup dialog.
2. Tap Edit Unit.
3. Tap the measurement unit and select the new unit of measure from the drop down list.

Changing the Analog Bar Meter Scale

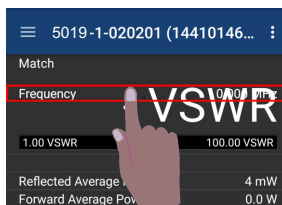
1. Tap the sensor reading to display the popup dialog.
2. Tap Edit Meter Scale.
3. Tap the drop-down list and select Custom.
4. Enter the maximum value for the bar meter in the first text field.
5. Enter the minimum value for the bar meter in the second text field.
6. Select the unit of measure from the drop-down list for the value entered.

Arranging the Readings Menu Order

The measurement type displayed at the top of the Readings Menu is selected by gesture.

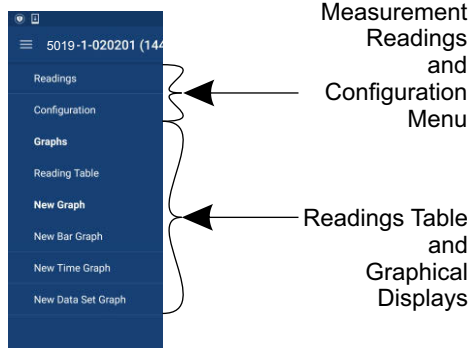
1. Press the value until red border appears.
2. Drag the value to the top position in the Readings Menu until it displaces the top value then release.

Figure 49 *Changing Readings Order*



Display Controls Menu

Figure 50 Display Controls Menu



Sensor Configuration Menu

Measurement Type — Choose the Measurement Type by tapping one of the available radio buttons in the menu.

Offset — Offset menu is used to enter the total value of all couplers and attenuators connected to the sensor (for example, the coupling factor of a directional coupler).

Tap Offset, enter the total attenuation of couplers and attenuators connected to the sensor then press OK.

Filter Value — Set filter value, this filter can be set to either 4.5 kHz, 400 kHz, or full bandwidth, see Video Filter.

CCDF Limit — Enter the threshold to be used for CCDF measurement. See CCDF

Graph Displays

Any measurement can be displayed in graphical or tabular format. Several different graph types may be displayed.

Tap the Display Controls Menu  to display the graph options.

Graph List — Default options are Reading Table, New Bar Graph, New Time Graph, and New Data Set Graph (CCDF and Time Domain modes only). Any saved graph for the current sensor/mode will also be displayed on the list. See How to Display a Graph.

Reading Table — The reading table displays all of the connected unit's measurements in a tabular format. The reading table will be displayed until a different option is selected.

How to Display the Reading Table

1. Tap the Display Controls Menu  to display the graph options.
2. Tap Reading Table.

Graph Types

Any power measurement on the readings menu may be displayed on a graph. See ["How to Display a Graph" on page 56](#). Graph setup may also be saved so frequently used settings will automatically be selected.

Note: *Graphs are saved for the mode only. If the mode is changed the saved graph will not be available, until the device/mode associated with the saved graph is reconnected. Graphs can be saved for other devices of the same type by saving a Default Preset.*

Time Graph — The time graph displays signal measurements over time. The x-axis displays the time of the reading, the y-axis displays the measurement value. The graph is limited to 2000 data collection points, once the graph reaches this limit the oldest data is discarded as new data is added, so the chart data will constantly be shifting to the left side of the screen. See ["Time Graph Controls" on page 60](#) for detailed information on interacting with Time Graphs.

Bar Graph — The bar graph displays instantaneous power levels of one or more signal measurements. The x-axis displays the name of the reading, the y-axis displays the measurement value. The graph initial setting is a single bar, but additional bars may be added. See ["Bar Graph Controls" on page 57](#) for detailed information on interacting with Bar Graphs.

Data Graph — Power CCDF and Time Domain measurements are displayed on a Data Graph. The results are displayed following a measurement and continue to be displayed until a new scan is triggered. See ["Data Graph Controls" on page 58](#) for detailed information on viewing Data Graphs.

How to Display a Graph


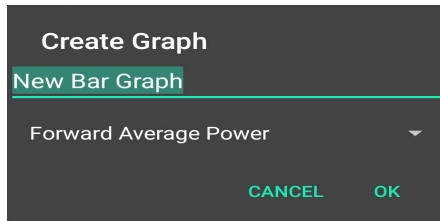

1. Tap the Display Controls Menu  to display the graph options.
2. Tap the name of graph type you wish to display (Time, Bar, Data).
Note: *It is recommended a descriptive name be used as graph names, including graph type and other distinguishing information, since multiple graphs may be saved.*
3. Tap the name of the graph in the Create Graph Dialog and replace it with a descriptive name. See [Figure 51 on page 56](#).

Figure 51 Rename New Graph




4. Select the measurement to graph from the drop-down menu.
5. Tap OK.
6. The new graph will be displayed in the Display Controls Menu below Reading Table.
7. Tap the graph's name in the menu to display the graph.
Note: *Graphs are saved for the current mode only. If mode is changed the saved graph will not be available until the mode associated with the saved graph is selected. Graphs can be saved by saving a Default Preset.*
Note: *Only the settings are saved, not the data. To save data see ["Logging" on page 63](#).*

How to delete saved graphs

1. Tap the Display Controls Menu  to display the graph options.
2. Press the name of the graph in the list until the highlighted color changes, then tap the trash can symbol in the top right corner of the screen.

Bar Graph Controls


Note: *Graph controls are located in the Sensor Operation Menu* .

Pause/Resume

When pause is tapped, graph data collection is stopped and the bar is paused. When resume is tapped, data collection begins and bar begins moving.

Graph Readings


The bar graph initially opens with only one measurement displayed, additional measurements may be displayed using this menu.

1. Tap the Sensor Operation Menu .
2. Tap Graph Readings to display the dialog.
3. Select as many of the listed measurements as desired.
4. Click OK after a check mark is displayed for all measurements you wish to display together on the graph.

Graph Unit


The graph unit of measure may be changed manually by selecting a unit from the menu.

Note: *Changing the graph unit will automatically change the scale value.*


1. Tap the Sensor Operation Menu .
2. Tap Graph Unit to display the dialog.
3. Tap the radio button for the desired unit of measure.


Graph Scale

The graph scale on the Y-axis may be changed by manually entering the minimum and maximum scale values.

1. Tap the Sensor Operation Menu .
2. Tap Graph Scale to display the dialog.
3. Tap drop-down list. Select Custom.
4. Tap the first value entry field (maximum) and enter the maximum scale value.
5. Tap the second value entry field (minimum) and enter the minimum scale value.
6. Tap the units drop-down list and select the appropriate value.
7. Click OK.

Data Graph Controls


Note: *Graph controls are located in the Sensor Operation Menu .*

- Pinch the graph to zoom in or zoom out.
- Swipe up, down, left, or right to move the trace within the graph area.
- Tap Reset Zoom on the Sensor Operation Menu  to return the graph to normal operation.

Graph Unit


The graph unit of measure may be changed manually by selecting a unit from the menu.

Note: *Changing the graph unit will automatically change the scale value.*


1. Tap the Sensor Operation Menu .
2. Tap Graph Unit to display the dialog.
3. Tap the radio button for the desired unit of measure.

Graph Scale

The graph scale on the Y-axis may be changed by manually entering the minimum and maximum scale values.


1. Tap the Sensor Operation Menu .
2. Tap Graph Scale to display the dialog.
3. Tap drop-down list. Select Custom.
4. Tap the first value entry field (maximum) and enter the maximum scale value.
5. Tap the second value entry field (minimum) and enter the minimum scale value.
6. Tap the units drop-down list and select the appropriate value.
7. Click OK.

Add Marker

1. Tap the Sensor Operation Menu .
2. Tap Add Marker.

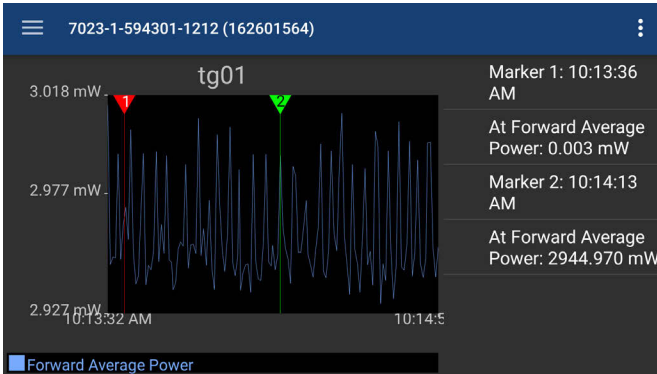
When Add Marker is tapped, a marker is added at the center point of the graph. All markers are added at the center point of the graph, newly added markers will be positioned directly "over" previous markers if the previous marker has not moved from the center point. The value of the signal at the marker position may be displayed in a list.

Marker List

1. Tap the Sensor Operation Menu .
2. Tap Marker List.

When Marker List is tapped, marker list is displayed on the screen to the right or below the chart. The marker list is removed from the screen by tapping Marker List a second time.

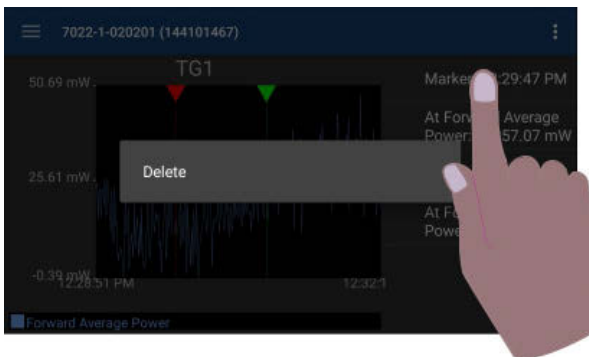
Figure 52 *Marker List*



Deleting Markers

Press the marker data in the marker list until Delete is displayed, then tap Delete.

Figure 53 *Delete Marker*





Reset Zoom

When tapped, graph will be return to default view and the trace will update as data is collected.

Time Graph Controls

Any measurement can be displayed in graphical or tabular format. See "[How to Display a Graph](#)" on page 56.

Note: *Graph controls are located in the Sensor Operation Menu .*


- Touching the graph area will stop the trace on the screen, however data will continue to be collected.
- Pinch the graph to zoom in or zoom out.
- Swipe up, down, left, or right to move the trace within the graph area.
- Tap Reset Zoom on the Sensor Operation Menu  to return the graph to normal operation.

Pause/Resume

When pause is tapped, graph data collection is stopped and the trace is paused. When resume is tapped, data collection begins and trace begins moving.

Graph Readings


The graph initially opens with only one measurement displayed, additional measurements may be displayed using this menu.

1. Tap the Sensor Operation Menu .
2. Tap Graph Readings to display the dialog.
3. Select as many of the listed measurements as desired.
4. Click OK after a check mark is displayed for all measurements you wish to display together on the graph.

Graph Unit


The graph unit of measure may be changed manually by selecting a unit from the menu.

Note: *Changing the graph unit will automatically change the scale value.*


1. Tap the Sensor Operation Menu .
2. Tap Graph Unit to display the dialog.
3. Tap the radio button for the desired unit of measure.

Graph Scale

The graph scale on the Y-axis may be changed by manually entering the minimum and maximum scale values.


1. Tap the Sensor Operation Menu .
2. Tap Graph Scale to display the dialog.
3. Tap drop-down list. Select Custom.
4. Tap the first value entry field (maximum) and enter the maximum scale value.
5. Tap the second value entry field (minimum) and enter the minimum scale value.
6. Tap the units drop-down list and select the appropriate value.
7. Click OK.

Add Marker

1. Tap the Sensor Operation Menu .
2. Tap Add Marker.

When Add Marker is tapped, a marker is added at the center point of the graph. All markers are added at the center point of the graph, newly added markers will be positioned directly "over" previous markers if the previous marker has not moved from the center point. The value of the signal at the marker position may be displayed in a list.

Marker List

1. Tap the Sensor Operation Menu .
2. Tap Marker List. See [Figure 52 on page 59](#).

When Marker List is tapped, marker list is displayed on the screen to the right or below the chart. The marker list is removed from the screen by tapping Marker List a second time.

Deleting Markers

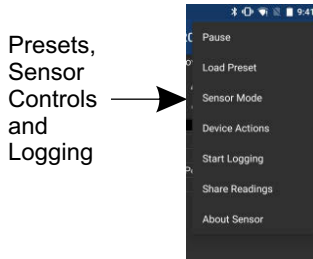
Press the marker data in the marker list until Delete is displayed, then tap Delete. See [Figure 53 on page 59](#).

Reset Zoom

When tapped, graph will be return to default view and the trace will update as data is collected.

Sensor Operations Menu

Figure 54 Sensor Operation Menu




Pause/Resume — The Pause option will stop the updates of measurement readings and graphs.

Load Preset — This option allows you to load a preset configuration file, see Session Files for details.

Device Actions — The Device Actions menu contains actions available for the connected sensor such as Zero Calibration or Alarm Reset, see Device Actions Menu.

Start Logging — The Start Logging function will log measurements to a text file.

Note: *Logging is Mode specific, if the sensor in use has multiple modes and the mode is changed, logging will automatically stop.*

1. Tap Start Logging to display the Logging Options Dialog Box, see Logging Interval and Logging Condition. The menu option will change to Stop Logging once logging is activated.
2. Once logging begins an Icon is displayed in the notification area on the android device.
3. Logging will continue until Stop Logging is tapped, on the Sensor Operations Menu .

Note: *If Logging Interval and Logging Condition are both checked. Logging will occur when the condition is met AND the interval has elapsed.*

Logging Interval — Logging Interval is used to set a repetitive time used to log all sensor measurements.

Enter a repeat time and select from seconds, minutes, or hours.

Logging Condition — Logging Condition is used to set a criteria for logging. Select a measurement and the criteria the measurement must meet or exceed for logging to take place.

Viewing Logged Data — The Log files are saved on the internal memory of the Android device. See Logging for details about the log files.

Share Readings — The Share Readings function will send a text report of the current measurement readings to a selectable destination via other Android Apps, such as notes, e-mail, or messaging. The options available vary depending on the applications installed on the Android device.

About Sensor — Displays the model number, serial number, and firmware version of the connected sensor.

Device Actions

Zero Cal — Some sensors include a zero calibration feature. For these sensors, pressing Zero Calibration will cause the sensor to be calibrated to compensate for noise in the transmission line when no RF power is actually present. RF must be removed before performing calibration. The length of time required for calibration will vary by sensor being used.

A "Performing Zero Calibration" message will be displayed during the calibration. A message will be displayed indicating a successful calibration or calibration failed. If the calibration fails, check the sensor connections and try again.

See "[Zeroing a Sensor](#)" on page 50.

Logging


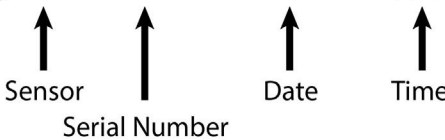
Sensor data can be logged by the Bird RF Meter App. Logging saves all the sensors active readings into a text file. Logging can be started on the Sensor Operations Menu . Logs are saved using the following file naming convention:

Figure 55 Log File Name Example

Log-5014-090501200-2015-08-28T11_50_13.log



Sensor Serial Number Date Time

Viewing Logged Data

The Log files are saved on the internal memory of the Android device.

Typical Path: SDCARD>Bird RF Meter>Logs.

The data is saved in JSON format in the log file. The data is broken into two sections and is shown below.

The data may be viewed as text in any text editor, or imported into a spreadsheet program. See Importing Logs into Excel for steps to import into Microsoft Excel.

Log File Definition

Section 1: Data Definition, often referred to as an Object. The data logged will vary according to the sensor connected when the log file is created.

Section 1 includes:

- Model, serial number, date and time log was created
- Readings definition
- Mode definition, including settings

Section 2: Data Array. The values recording in the log file are defined by the readings definition in section 1. Each array of values is prefaced by the word "results". Each log file will contain multiple data arrays, even hundreds or thousand depending on the length of time logging was allowed to run.

Section 1 Example:

Note: *The format of the data has been altered in the example for simplification, the text runs together in log files.*

```
{ "model": "BPMon002", "serialNumber": "Unknown", "created": "2015-09-09T15:55:40",
  "readings": [
    { "id": "Measurement.ForwardAveragePower", "name": "Forward Power",
      "readingType": "DoubleReading", "unit": "Unit.Watts"},
    { "id": "Measurement.ReflectedAveragePower", "name": "Reflected Power",
      "readingType": "DoubleReading", "unit": "Unit.Watts"},
    { "id": "Measurement.Match", "name": "Match", "readingType": "DoubleReading",
      "unit": "Unit.ReturnLoss"},
  ],
  "mode": "Mode.AveragePower",
  "settings": [
    { "id": "Configuration.AlarmSense", "name": "Alarm Sense",
      "value": "Configuration.Disabled"},
    { "id": "Configuration.AlarmEnable", "name": "Alarm Enable",
      "value": "Configuration.Enabled"},
    { "id": "Configuration.VSWRTripPoint", "name": "VSWR Trip Point",
      "value": "Configuration.VSWRTripPoint_1_3"},
  ]
}
```

Section 2 Example:

Note: *The format of the data has been altered in the example for simplification, the text runs together in log files.*

```
{"results": [
  { "reading": "Measurement.ForwardAveragePower", "value": 25.5,
    "maxValue": 125, "status": "Normal"},
  { "reading": "Measurement.ReflectedAveragePower", "value": 0,
    "maxValue": 12.5, "status": "Normal"},
  { "reading": "Measurement.Match", "value": 0,
    "maxValue": null, "status": "Normal"},
  "timestamp": "1441814140972"
}
{"results": [
  { "reading": "Measurement.ForwardAveragePower", "value": 25.5,
    "maxValue": 125, "status": "Normal"},
  { "reading": "Measurement.ReflectedAveragePower", "value": 0,
    "maxValue": 12.5, "status": "Normal"},
  { "reading": "Measurement.Match", "value": 0,
    "maxValue": null, "status": "Normal"},
  "timestamp": "1441814140972"
}
}
```

Importing Logs into Excel

This procedure will display each group of results on one row with each measurement and values grouped by columns.

1. Transfer the log files to a PC.
2. Open an Excel spreadsheet.
3. Select Data Tab.
4. Click From Text on the menu. The Import Text File dialog box will open.
5. Select All Files, in the drop down menu at the bottom of the dialog box. Log files have the file extension .log.
6. Navigate to the folder containing the log file to import.
7. Select the file and click Import. This will open the Text Import Wizard.
8. On step 1, Select Delimited radio button, then click Next.
9. On step 2, select Comma and Other (add { }) as the delimiters, then click Next.
10. On step 3, click finish.

Figure 56 Log File Open In Excel

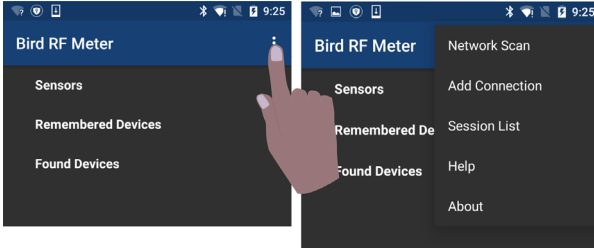
results:	reading:"Measurement.ForwardAveragePower"	value:25.5	reading:"Measurement.ReflectedAveragePower"	value:0
results:	reading:"Measurement.ForwardAveragePower"	value:25.5	reading:"Measurement.ReflectedAveragePower"	value:0
results:	reading:"Measurement.ForwardAveragePower"	value:25.5	reading:"Measurement.ReflectedAveragePower"	value:0

Note: Columns have been removed in the example for simplicity.

Preferences Menu

Tap the menu icon on the RF Meter device selection screen to display the Preferences menu.

Figure 57 *Bird RF Meter Preferences Menu*



Network Scan — This menu option scans the WiFi network the android device is connected to for any Bird devices connected to the same network.

Add Connection — The menu is used to manually connect to a Bird Device on the WiFi network the android device is connected to.

Session List — This is a list of all session files saved from connecting to Bird Power Sensors. Session files are automatically created and saved for each sensor (by serial number) connected to the Bird RF Meter App. For more information see Session Files.

Help — Displays this help documentation.

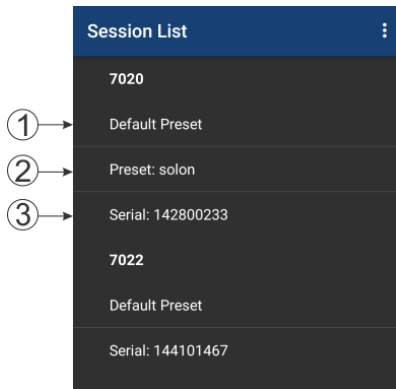
About — Displays copyright information and software source credits.

Session Files

Session List Definitions

Session files are used to initialize the Bird RF Meter App when a Bird Power Sensor is connected. The following definitions describe the different session files.

Figure 58 *Session List*



When a power sensor is connected to the Bird RF Meter the first time the Generic Session File (Default Preset if created) is used to initialize the App then a Serial Number Specific Session File is automatically created.

1. **Default Preset:** A menu option is provided that allows you to save a preferred setup as a Default Preset setup for all sensors of the same sensor type.
2. **Preset:** A Preset is similar to a Default Preset, the difference is the Preset must be manually loaded to be used.
3. **Serial Number Specific Session File:** When a power sensor is connected to the Bird RF Meter the first time the Generic Session File (Default Preset if created) is used to initialize the App then a Serial Number Specific Session File is automatically created. Any changes made to the configuration for the power sensor will be saved in the Serial Number Specific Session File (the Default Preset is NOT updated unless the menu option is used).
4. **Generic Session File:** (Generic Session Files do not appear in the Session List) The first time a Bird Power Sensor is connected to the Bird RF Meter App the generic session file for that sensor type is used to initialize the App. The App will use default settings for the power sensor type.

Open the Session List

1. Tap the menu icon on the RF Meter device selection screen to display the Preferences menu.
2. Tap Session List on the menu.

Save a Custom Configuration as a Default Preset

Note: *Your custom setup can be saved as a Default Preset session file. This allows the same custom setup to be viewed the first time you connect to the same type of Bird Power Sensor.*

1. Connect to a Bird Power Sensor.
2. Setup the User Interface to your preferred setup. The following are examples of custom setup items:
 - a. Save configurations for Graphs.
 - b. Organize the readings menu.
 - c. Configure the sensor.
 - d. Setup logging criteria.
3. Tap the menu overflow icon.
4. Tap Session List.
5. Press the session file for the device setup up above until the save menu is displayed.
6. Tap Save As.
7. Select Default Preset then tap OK.

Note: *You must delete any previous session files so your Default Preset will be used as the default Session File. This allows the same custom setup to be viewed every time you connect to the same type of Bird Power Sensor.*

Edit Session File

Once a session file has been created, you can easily edit the session file even when not connected to the sensor.

1. Tap the menu overflow icon.
2. Tap Session List.
3. Press the session file until the menu is displayed.
4. Tap Edit Session.
5. Edit any settings just as if the sensor was connected, any changes will be automatically saved in the selected session file.

Export Session File

When you connect to a Bird Power Sensor with the Bird RF Meter App a Serial Number Specific Session File is created. You can also save your settings as the default settings for your power sensor type in a Default Preset or Preset. All of these file types can be exported from the Bird RF Meter App for use on other Android devices.

1. Tap the menu overflow icon.
2. Tap Session List.
3. Press the session file for the device setup up above until the save menu is displayed.
4. Tap Export.
5. Rename the file if desired then click OK.

Exported Session Files are saved on the internal memory of the Android device and can then be transfer to a PC or another Android device.


Typical Path: SDCARD>Bird RF Meter>Sessions.

Import Session File

If you wish to import one or more Session Files onto an Android device you must first copy the files onto the Android device into the Bird RF Meter folder.

1. Transfer the desired Session Files into the following folder on the destination Android device: SDCARD>Bird RF Meter>Sessions
2. Tap the menu overflow icon.
3. Tap Session List.
4. Tap the menu overflow icon in the Session List.
5. Tap Import Session.
6. Select the files for import in the Dialog Box (if no files are visible, repeat step 1).
7. Tap OK

Load a Session File

1. Connect a sensor.
2. Tap the Sensor Operation Menu .
3. Tap load preset.
4. Tap the session file to load from the list in the dialog box.

Delete Session File

1. Open the Session List.
2. Press the Session File you wish to delete until the until the delete menu is displayed.
3. Tap Delete.

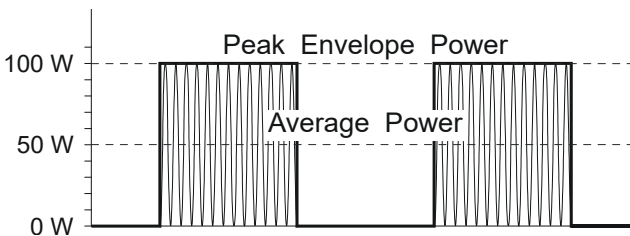
Measurement Descriptions

Average Power

Average power is a measure of the equivalent “heating” power of a signal, as measured with a calorimeter. It measures the total RF power in the system, and does not depend on number of carriers or modulation scheme. The WPS is a broadband sensor that measures power across its entire frequency range. Its diodes operate in their ‘square law’ region so that the detector output is directly proportional to the average power, without any additional error correction.

Average power is the most important measurement of any transmission system since the average power is normally specified on the operating license. It is also valuable as a maintenance tool, showing overall system health, and for calibration.

Figure 59 Average and Peak Envelope Power - Square Wave Signal



VSWR

VSWR measures the relation between forward and reflected average power. The Bird Wideband Power Sensor calculates the VSWR from the Forward and Reflected Average Power measurements. Rho and Return Loss are also the same measurement, but in different units:

Rho

$$\text{Rho}(\rho) = \sqrt{P_R/P_F}$$

VSWR

$$\text{VSWR} = \frac{1 + \rho}{1 - \rho}$$

Return Loss (dB)

$$\text{ReturnLoss}(\text{dB}) = 10\log(P_R/P_F)$$

The health of the feedline and antenna systems can be monitored using VSWR measurement under full power operating conditions. High VSWR is an indicator of feed line damage, overtightened cable or feed line clamps, or antenna changes/damage due to weather conditions, icing, or structural damage to the tower.

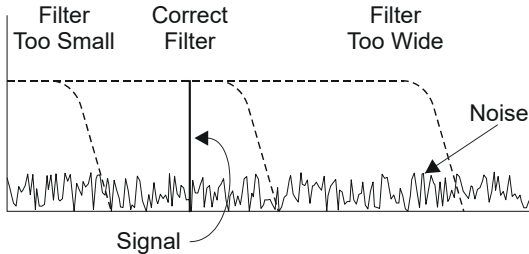
Peak Envelope Power

Peak power measurements detect amplitude changes as a signal modulates the carrier envelope. The WPS operates in an asynchronous cycle: 300 ms of waveform sampling followed by a 50 ms reset period. The peak power is then displayed and the cycle repeats. The display therefore updates about three times per second.

Transmitter overdrive can be detected with peak measurements. Common problems are overshoot at the beginning of burst packets, amplitude modulation, and excessive transients. These damage system components with excessive peak power and also cause data degradation, increasing the Bit Error Rate. For TDMA applications, Peak and Burst Power measurements are used to detect overshoot in single time slots. Other time slots must be turned off for this test.

Video Filter

Figure 60 Video Filter Settings, 300 kHz Signal

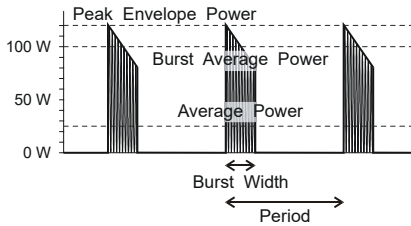


Except for average power and VSWR measurements, all WPS measurements rely on a variable video filter to improve accuracy. This filter can be set to either 4.5 kHz, 400 kHz, or full bandwidth (10000kHz). It should be as narrow as possible while still being larger than the demodulated signal bandwidth (video bandwidth). Narrowing the filter limits the noise contribution caused by interfering signals. Listed below are some common modulation schemes and the appropriate video filter.

Video Filter	Modulation Type
4.5 kHz	CW Burst (Burst width > 150 μ s), Voice Band AM, FM, Phase Modulation, Tetra
400 kHz	CW Burst (b.w. > 3 μ s), GSM, 50 kHz AM, DQPSK
Full Bandwidth 10000kHz	CW Burst (b.w. > 200 ns), CDMA, WCDMA, DQPSK, DAB/DVB-T

Burst Average Power

Figure 61 *Burst Average Power*



Burst width (BW) is the duration of a pulse. Period (P) is the time from the start of one pulse to the start of the next pulse. Duty cycle (D) is the percentage of time that the transmitter is on. To calculate the duty cycle simply divide the burst width by the period ($D = BW / P$). Low duty cycles mean that the burst width is much less than the period; a large amount of dead time surrounds each burst. For low duty cycles, the burst average power will be much larger than the average power.

After peak power is measured, a threshold of $\frac{1}{2}$ the peak is set. The sampled power crosses that threshold at the beginning and end of each burst. The time between crossings is used to calculate the duty cycle. Burst Average Power is calculated by dividing the Average Power by the Duty Cycle.

Burst power measurements provide accurate, stable measurements in bursting applications such as TDMA and radar. Accurately measuring the output signal strength is essential for optimizing radar coverage patterns. Actual transmitted power in a single time slot can be determined in TDMA. The other time slots must be off during this test.

Cleaning

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

CAUTION

Do not touch the center pin of the Antenna Test Port with bare hands, water, or emery cloth. Otherwise, damage may occur to the connectors surface.

- Clean the connector using a cotton swab dipped into an isopropyl alcohol solution.
- Ensure connectors are completely dry before making cable connections.

Charging the Battery

The internal battery pack will automatically recharge when the RailHawk Analyzer is connected to the AC adapter.

Recharging time, from a full discharge, is approximately 5 hours with the unit powered off.

CAUTION

Only use the supplied AC adapter to charge the unit.
The unit cannot be charged through a USB port (i.e. from a laptop).
Charging from a power source other than the supplied charger may damage the battery.

Replacing the Battery

The internal battery pack

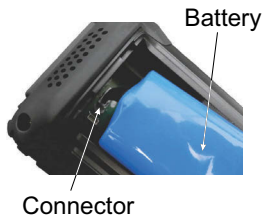
1. Remove two screws and remove battery access cover.

Figure 62 Battery Access



2. Carefully disconnect battery cable from connector on RailHawk.

Figure 63 Battery Removal



3. Connect new battery cable to connector in the battery compartment.
4. Install battery access cover and two screws to secure cover.
5. Charge the battery.

RailHawk RF Test Set Calibration

It is recommended that an instrument calibration be performed by a certified service provider at nominal two year intervals.

Contact Bird Service Center for more information. See "[Customer Service](#)" on [page 82](#).

Storage

Store the RailHawk Analyzer in an enclosed case and in an environment that does not exceed values listed in the Specifications section.

Ensure that the equipment is stored away from dust, acidic and alkaline environment, explosive gas, and other causes of corrosion.

Edit Cable List

The Cable List contains a list of known cable values. This procedure provides the steps necessary to edit the Cable List and select Cable Lists. The Cable List that is preloaded on the RailHawk is named CableList.ini.

Edit Cable List on RailHawk

Add Cable to Cable List

Note: *cables in the default list cannot be changed using this method.*

1. Press DTF icon.
2. Press CableList option to display the Cable List. See [Figure 64](#).

Figure 64 Cable List Dialog Box

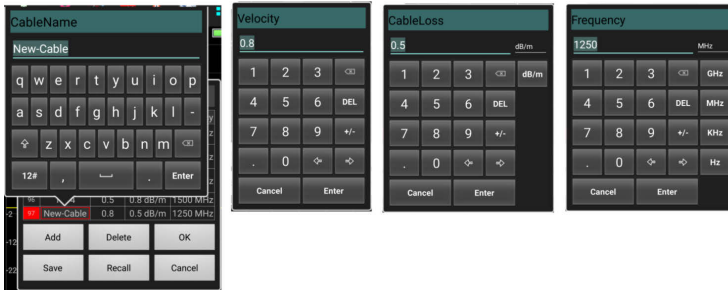


	CableName	Velocity	CableLoss dB/m	Frequency
93	WBC-500R	0.86	0.1072 dB/m	1000 MHz
94	WBC-600P	0.87	0.0285 dB/m	1000 MHz
95	WBC-600R	0.87	0.0865 dB/m	1000 MHz
96	New-Cable	1	0 dB/m	1000 MHz

Buttons: Add, Delete, OK, Save, Recall, Cancel

3. Press Add button to add new cable.
4. Scroll to the bottom of the Cable List to see the new entry. See [Figure 65 on page 77](#).
5. Press each cell for Cable name, Velocity, Cable Loss and Frequency to enter the new cables information.

Figure 65 Enter Cable Data



6. After cable information is entered press OK.

Delete Cable from Cable List

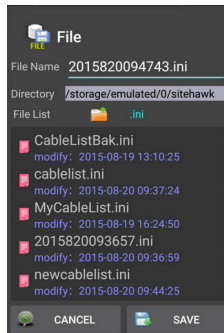
Note: Only cables added by the user may be deleted using this method.

1. Press DTF icon.
2. Press CableList option to display the Cable List. See [Figure 64](#).
3. Scroll to the bottom of the Cable List to see the cable to be deleted.
4. Select the cable to be deleted.
5. Press Delete button to delete cable.

Save Cable List

1. Press DTF icon.
2. Press CableList option to display the Cable List. See [Figure 64](#).
3. Press Save

Figure 66 Save Cable List Dialog Box



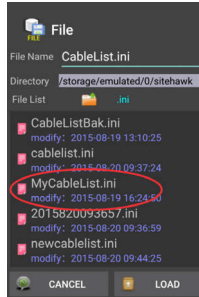
4. Press File Name to give the Cable List a unique filename.
5. Press SAVE to save the Cable List.

Recall Cable List

Note: This procedure is used to load a Cable List different from the Cable List currently displayed.

1. Press DTF icon.
2. Press CableList option to display the Cable List. See [Figure 64](#).
3. Press the Recall button. See [Figure 67](#).

Figure 67 Recall Cable List Dialog Box

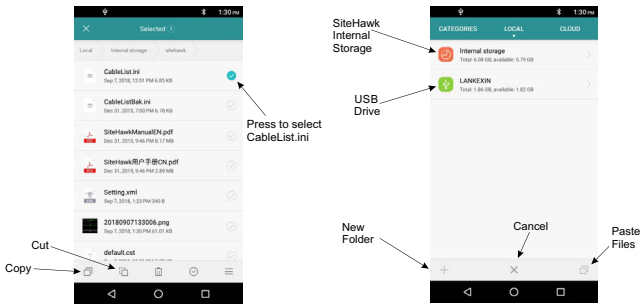


4. Select the Cable List to Recall.
5. Press LOAD.
6. Select a cable in the list and press OK.

Edit Cable List on a PC

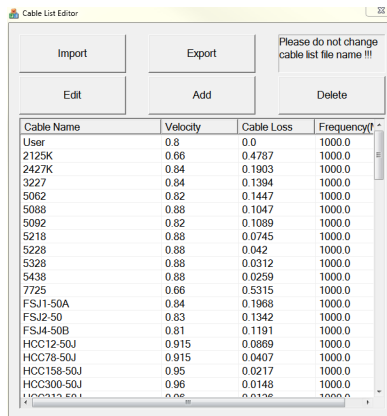
1. Download the Cable List Editor from RailHawk page on the Bird Website, and save on a PC.
2. Copy the file CableList.ini from the SiteHawk folder on the RailHawk. "[Data Transfer Function](#)" on page 43.

Figure 68 Copying Cable List



3. Save the CableList.ini file on the PC in the same folder with the Cable List Editor.
4. Double Click the CableListEditor.exe to launch the editor.
5. Click Import and select CableList.ini and click Open. See [Figure 69](#).

Figure 69 Cable List Editor

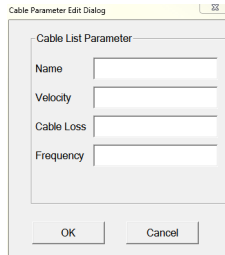


6. Click Add to add a new cable or select an existing cable to change and click Edit.

Note: Any cable may be deleted by selecting the cable in the list and clicking Delete.

7. Enter the cable information into the Cable Parameter dialog box. See [Figure 70](#).

Figure 70 Cable Parameter Edit Dialog



8. Click OK
9. Repeat [step 6](#) through [step 8](#) until all changes are complete.
10. Once all changes are complete click Export.

Note: *The Cable List name can be the same as the default or may have a unique name.*

11. Name the Cable List and click Save.
12. Copy the updated Cable List to a USB drive.
13. Exit the SiteHawk App on the RailHawk Analyzer.
14. Copy the updated CableList.ini file to the RailHawk and save in the original Cable List folder. ["Data Transfer Function" on page 43](#).
15. Launch the SiteHawk App.
16. Load the updated Cable List. See ["Recall Cable List" on page 78](#).

Firmware Update

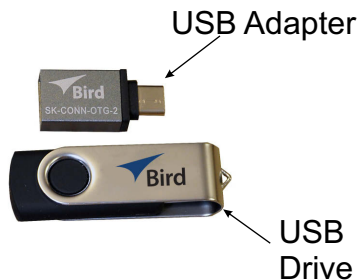
1. Go to <https://birdrf.com/Products/Test%20and%20Measurement/Analyzers/RF-Cable-Antenna-Testers/SK-6000-TC-SiteHawk-Analyzer.aspx>
2. Scroll down to **Downloads**.
3. Click on **SiteHawk App VX.XX** to download.
4. Connect the USB drive to the PC.

CAUTION

Do not connect the RailHawk to a PC USB port.
File transfer must be done using a USB Drive.

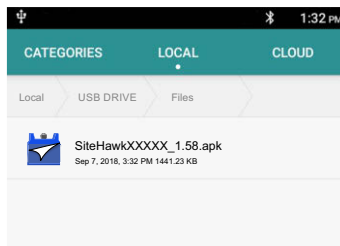
5. Transfer the SiteHawk_XXX.apk update file to the USB drive.
6. Remove the USB drive.
7. Connect the USB drive to the USB adapter. See [Figure 71 on page 81](#).
8. Connect the USB adapter to the RailHawk Analyzer.

Figure 71 USB Drive connections



9. Turn on the RailHawk Analyzer.
10. Select “File Manager”.
11. Select “External USB storage”.

Figure 72 APK file selection



12. Select SiteHawk-Firmware-XXX.apk.
13. Follow the Installation instructions on the unit.

Customer Service

Any maintenance or service procedure beyond the scope of those in this chapter should be referred to a qualified service center.

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

Bird Service Center

30303 Aurora Road
Cleveland (Solon), Ohio 44139-2794
Fax: (440) 248-5426
E-mail: bsc@birdrf.com

For the location of the Sales Office nearest you, visit our Web site at:

<http://www.birdrf.com>

RailHawk RF Test Set Calibration

The RailHawk RF Test Set includes a certificate of calibration at the time of manufacture, the calibration should be renewed at two year intervals to ensure accuracy is maintained as indicated in the following specification tables.

It is recommended that an instrument calibration be performed by a certified service provider at nominal two year intervals. Contact Bird Service Center for more information. See "[Customer Service](#)" on page 82.

Note: *Specifications for additional or alternate components not listed that may be included with a kit configuration can be found by contacting Bird: www.birdrf.com*

RailHawk Analyzer Specifications

Frequency Range	1 MHz to 6 GHz
Frequency Accuracy	±2.5 ppm
Frequency Resolution Setting	1 kHz
Output Power	-10 dBm
Reflected Amplitude Accuracy ¹	
-15 dB to 0 dB	±0.4 dB
-25 dB to -15 dB	±1.5 dB
-35 dB to -25 dB	±4.0 dB
Trace Noise Amplitude (IFBW 1kHz)	0.02 dB rms
Single Point Measure Time	1.0 ms
Data Points	51 to 3201
Measure Bandwidth	100 Hz to 30 kHz
Temperature Stability	0.01 dB/°F 0.02 dB/°C
Return Loss Measurement Range	0 dB to -60 dB
Resolution	0.01 dB
VSWR Measurement Range	1.0 to 65.0
Resolution	0.01
Cable Loss Measurement Range	0 dB to 30 dB
Resolution	0.01 dB
DTF Range	0 to 5000 ft. 0 to 1500 m.

Test Port Connector Impedance	N-type, Female 50 ohms
Connector	USB-C, USB 3.0
Dimensions (L x W x H)	7.7 x 3.6 x 2.4 in. 195 x 90 x 60 mm
Weight	1.98 lbs. 0.9 kg
Maximum Input Power	+22 dBm
Maximum Input Voltage	50 V
Operating Temperature	14° to 131° F -10° to +55° C
Storage Temperature	-40° to 176° F -40° to +80° C
Battery Charging Temperature	32° to 95° F 0 to +35° C
Altitude	Up to 15000 ft. Up to 4600 m
Humidity	95±5° max (non-condensing)
Pressure	84 to 106.7 kPa
Warm-Up Time	15 minutes
Power Measurement	Yes, with RF Meter App
Compatible Devices	Visit www.birdrf.com for a list of sensors compatible with the Bird RF Meter App.
Storage Capacity	16 GB
Immunity to Interfering Signals	+13 dBm
CE	CE compliant. EMC, Safety, and RoHS
Battery	10 hours continuous use 7.4 V, 6800 mAh
Battery Charge Time Power Off: Power On:	5 Hrs for full charge 8 Hrs for full charge
Languages	English, Chinese

1 Field calibrated

Calibration Combo Specifications

Frequency	DC - 6.0 GHz
Resistance	50 Ohm
Average Power	≤ 1 W
Connectors	
Load	
Return Loss	≤ -35 dB
VSWR	≤ 1.032
Open	
Phase Deviation	≤ ± 0.6°
Short	
Phase Deviation	≤ ± 0.6°
Operating Temperature	49° to 95° F 15° to 35° C
Storage Temperature	-40° to 167° F -40° to 75° C

RF Cable (3 Meter) Specifications

Frequency	DC - 6 GHz
Resistance	50 Ohm
VSWR	
DC- 4 GHz	1.30 max
4 GHz - 6 GHz	1.35 max
Insertion Loss @ 1 GHz	0.13 dB/ft
Velocity of Propagation	69%

7020 Power Sensor Specifications

This table shows the specifications for the 7020 series power sensors. Refer to the user manuals for other power sensors included in the RailHawk RF Test Kit.

Measurement Type	Thruline Power
Frequency Range	
7020-1-010101	350 MHz - 4.0 GHz
7020-1-030301	25 MHz - 1.0 GHz
Power Measurement Range¹	
7020-1-010101	0.15 W - 150 W
7020-1-030301	0.5 W - 500 W

Measurement Accy	+/- (4% of reading +0.05 W) Above 35° C or below 15° C, add 3%. Below -10° C add +/-0.01W
Peak/Avg Ratio	12 dB
Insertion Loss, Max	0.1 dB
Insertion VSWR	1.10 Max.
Impedance, Nominal	50 ohms
Response Time	0.1 Sec typical, 3 Sec max
VSWR Range	1.15 to 99.9
Min. Forward Power for Reflected Measurement	5.0 W
RF Connectors	N Female
Directivity, Min	28 dB
Power Supply Source Current Draw	5 VDC from USB host 35 mA Max.
Recommended Calibration Interval	Annually
Interface Protocol Connector	USB 2.0 USB Type 'B' with SeaLATCH USB connector
Mechanical and Environmental Shock Vibration Temperature Operating Storage Humidity, Max Altitude, Max	Mil-PRF-28800F Class 3 Mil-PRF-28800F Class 3 -30 to +60°C (-22 to +140°F) -40 to +80°C (-40 to +176°F) 95% (non-condensing) 4,572 m (15,000ft)
Data Logging	Bird RF Meter App Software
Dimensions, Nominal	4.8" x 2.6" x 1.3" (122mm x 66mm x 32mm)
Weight, nominal	1.0 lbs (0.45 kg)
Standards Compliance CE RoHS	European Standard EN 61326-1:2006 – Electronic Equipment for Measurement, Control and Laboratory Use – EMC Requirements in accordance with EMC Directive (2004/108/EC) Compliant
Compatible Displays	SA-XT Series, VPM3, 5000XT, Bird RF Meter App

1 500W Models: Derate maximum average power rating from 500W at 300MHz to 100W at 1 GHz linearly on a log-log scale.

Termination Specifications

The following specifications are for the 25-T-MN and the 50-T-MN.

Frequency Range	DC- 4 GHz
RF Power Range	
25-T-MN	25 W max at 40° C 30 W max at 25° C
50-T-MN	50 W max at 40° C 60 W max at 25° C
Impedance, Nominal	50 ohms
Input VSWR, Max	
DC – 1 GHz	1.10:1
1 GHz – 4 GHz	1.25:1
RF Connector	N male
Coolant	Air, Convection Cooled
Dimensions	4.7" long x 2.3" diameter
Weight	7 oz.

Limited Warranty

The FlightHawk RF Test Set is warranted to be free from defects in material and workmanship for a period of three (3) years, 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 (10) 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.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

TECHNICAL TIP (FOR INFORMATION ONLY)

Coaxial Cable & Antenna System Inspection with a Frequency Domain Reflectometer

INTRODUCTION: This Technical Tip and user instruction manual establishes the standards of operation for the personnel unfamiliar with this unit to understand it, identify its parts, and operate it in accordance with proper procedures, operating techniques, precautions and limitations.

GENERAL INTRODUCTION:

(1) This Technical Tip procedure has the steps using a frequency domain reflectometer (FDR) to locate opens, shorts, improper crimps, bends, moisture, loose connectors, and defective antenna elements that lead to weak or intermittent RF operation. You can also use the FDR to test the antenna elements from the equipment rack for troubleshooting or directly at the antenna to ensure reliable operation prior to installation.

(2) This procedure can be done on the entire Radio Frequency (RF) system's coaxial cables and antenna as a unit or on individual components.

(3) The FDR performs a Voltage Standing Wave Ratio (VSWR) or Return Loss (RL) test by transmitting a continuous RF sweep of the cables and antenna at their operating frequencies and then monitoring the absorption of the wave by the antenna. The FDR identifies standing or reflected waves due to loose connections, corrosion, moisture, defective cable, or faulty antenna which changes the system impedance resulting in a reflected or standing wave. Standing waves not only decrease output transmission, resulting in weak, intermittent operation, but may also harm the transmitter if the reflection is excessive.

The recommended FDR is an easy to use handheld tester, with a Go/No-Go function by use of a limit line and simple Distance-to-Fault measurement. It can be used to quickly identify improper connections, defective cables and faulty antennas easily from the equipment rack.

(4) Refer to the Instruction or Operation Manual of the frequency domain reflectometer for specific instructions on set-up and tests for the coaxial cable and antenna system.

(a) To do a health check of the entire coaxial cable and antenna system, you must disconnect the RF power signal source output and connect the tester directly to the cable run and/or antenna. There is no need to make any other disconnections unless the health check fails. The check will give a simple Go/No-Go indication of the health of the entire cable and antenna system. In the case of a No-Go indication, any faults may be isolated via the FDR's "Distance to Fault" function. Use the "Distance to Fault" readout and applicable system wire diagram to help isolate the failure to a specified connector, cable segment or antenna.

(b) The FDR facilitates both simple Go/No-Go testing, as well as in depth testing. Use the Instruction or Operation Manual for specific instructions to:

- 1) DATA SAVE: Stores parameters and able to upload from a USB or via Bluetooth. User can recall settings and immediately test.
- 2) CALIBRATION: Use the OSL Calibration Combo (Open, Short, 50 ohm Load 50 ohm) to calibrate prior to use.
- 3) VSWR and RETURN LOSS (RL) TESTING: Displays the readings in Return loss or VSWR, the user simply selects the display they desire.
- 4) DISTANCE TO FAULT: Displays distance in ft/in or M/cm to the VSWR or Return Loss (RL) fault without disconnecting.

PREPARATION

The RailHawk RF Test Set has been designed with a user friendly GUI “Graphical User Interface” which provides an intuitive understanding of the man/machine interaction thereby greatly simplifying the learning experience. However, we still STRONGLY RECOMMEND that the user becomes familiar with the RailHawk operations and menu structure before connecting it to a communications system and performing any tests. This procedure is described as a guideline in absence of any specification or service procedure provided by the equipment manufacturer. Particular attention should be addressed to the preliminary procedures so as to avoid erroneous test results.

WARNING: Observe equipment servicing procedures as well as safety precautions per manufacturers instructions.

Tools/Equipment:

RailHawk RF Test Set, includes RailHawk and Adaptor Kit used to adapt the RailHawk to most common connectors.

A. MEASURE MATCH MODE PROCEDURE:

(1) Prepare the applicable cable and antenna system and the frequency domain reflectometer for testing.

(a) Push the Power button for 5 seconds.

NOTE: Use operating manual for specific details on recalling previous program for RF system under test (Recall Trace Data) OR manually set the measurement (start/ stop) frequencies (Measure Match Mode) using the Max VSWR values from the table below.

(b) Press the Menu icon. Press RESET to clear all current data and settings.

(c) Recall previously saved set-up OR select “Measure Match Mode” to manually input settings.

1) RailHawk status, calibration result, and tracing data can be saved to the instrument, and can be recalled to be displayed on the sweep display area. The parameters for this instrument setting include the scale, trace, cursor and analysis. These parameters are saved in the status files. Data in .sta or .cst data files can be recalled and displayed with the current data trace.

NOTE: .cst files will save the settings and calibration if the unit was calibrated when the file was saved.

.sta files only save the setting, but not calibration.

a) Push the Menu icon.

b) Push the FILE icon to display the file menu.

c) Push the Save Type to select file type STATUS+CAL (cst) or STATUS (sta).

d) Push Load.

e) Select the data file from the list.

f) Push Load.

NOTE: The active and the recalled trace data will be displayed together in the sweep display area. In the example, Tr1 is the active trace, the recalled trace data is indicated with OFF and the file name.

g) Push OFF to remove the recalled trace data.

2) Select MEASURE MATCH MODE

a) Push trace measurement field to display menu.

b) Select SWR or Return Loss from the Measurement Mode menu.

c) Select the number of Data Measurement points (default to 201).

d) Set the Frequency range:

NOTE: Changing the frequency settings will automatically turn the calibration off. You always set the frequency before calibrating the unit. Once start/ stop frequencies are entered manually, be sure to follow instructions to calibrate prior to use.

<1> Set start and stop frequencies for the applicable RF system under test.

3) CALIBRATE: For best results, you can set the frequency and calibrate the Bird RailHawk immediately before taking measurements.

NOTE: Use a precision open, short, load (OSL) calibration standard or "Calibration Combo" for accurate measurement results.

NOTE: When using an extension cable, connect the RF test cable and the adapter (extension) and then calibrate to the end of this extension. If the cable or adapters are removed, you must calibrate again.

NOTE: Changing frequency settings will automatically turn calibration off. Always set the frequency before calibrating the unit.

a) Push the Calibrate icon.

- b) Connect the Calibration Combo “Open” connector to the end of the extension cable’s bench connector adapter.
- c) Push the Open softkey.
- d) Wait for the unit to sweep and a Green Check to display.
- e) Connect the Calibration Combo “Short” connector to the end of the extension cable’s bench connector adapter.
- f) Wait for the unit to sweep and a Green Check to display.
- g) Connect the Calibration Combo “Load” connector to the end of the extension cable’s bench connector adapter.
- h) Push the Load softkey.
- i) Wait for the unit to sweep and a Green Check to display.

NOTE: During calibration, the color of the icon display is yellow.

NOTE: Whenever the RailHawk has been calibrated, a COR ON indicator is shown in the lower right corner of the display. Anytime the frequency is changed, the calibration is turned OFF and the COR ON disappears, requiring the unit to be re-calibrated.

4) SET LIMIT LINE: The limit line helps to set off those parts of a trace that are outside of the acceptance values. It shows as a red horizontal line at the limit line value. The part of the trace that is not acceptable will display white. Additionally, identification of signals falling outside acceptable limits can be visually and audibly enhanced using a failure flag and alarm. Use Table 1 to set the limit to the Max VSWR for the RF system under test.

a) Push the Limit Icon.

b) Select Limit (On/Off). Push to toggle the limit line On and Off.

c) Set Value. Sets the position of the limit line on the vertical scale (Y axis). Push the field to enter a value. Use the Maximum VSWR or RL values in table 1.

d) Select FailFlag (On/Off). Push to toggle the fail flag On and Off. The words PASS or FAIL will be shown in the sweep display area to indicate if the active signal is within or outside the limits set by the limit line.

5) Remove the black box to facilitate testing of the cable and antenna system.

CAUTION: DO NOT TOUCH THE CONNECTOR PINS, OR OTHER CONDUCTORS. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE COMPONENTS.

(c) Connect the RailHawk to the device for the test.

1) Connect the test cable or extension cable (including the bench plug adapter) to the FDR's N-type connector.

2) Connect to the RF System's applicable coax rack connector, where the black box was installed.

3) Wait 10 Seconds for the sweep to complete the update.

(d) Interpreting the Measurement.

1) The graph contains the elements below:

a) The Vertical grid scale (y axis) shows SWR or RL data values.

b) The Horizontal grid scale (x axis) shows the frequency or distance data values.

c) Marker values. For example: If markers are set at system operating frequencies.

d) The Trace number (Tr1) and color are used to identify the trace.

2) Make sure that the entire SWR or RL measurement falls under the Max SWR or RL values in Table 1. See the “SET LIMIT LINE” in step 4 above. Press SCALE Icon and then AUTO SCALE to view waveform.

a) If the system passes, put the system back to its usual condition.

b) If the system fails, isolate by using the steps below, Distance to Fault Isolation of Coaxial Cable and Antenna System.

B. DISTANCE-TO-FAULT ISOLATION OF COAXIAL CABLE AND ANTENNA SYSTEM

(1) Select Fault Location Mode.

(a) Push trace measurement field to display Measurement Mode menu.

(b) Push to select DTF_RL from the following Measurement Mode drop down menu.

NOTE: When making Distance-to-Fault measurement, select DTF_RL units for the Y (vertical) scale.

(c) Set number of Data Points:

1) Push the Points data field and enter the number of Data Points desired (default to 201).

(d) Set Start and Stop Frequencies for the applicable RF system from Table 1.

(e) Set Start and Stop Distance:

1) Stop distance should be about 20% longer than actual length.

NOTE: If a maximum distance less than the total length of the cable system is selected, the trace will not show the end of the cable system (antenna). To display the full cable system always set the maximum distance to a value that is a few feet or meters greater than the entire length of the cable system.

(f) Select Units to m (meters) or ft (feet).

(g) Enter Cable data using one of the following methods:

NOTE: Manually enter cable velocity value and Cable Loss Value or select the cable type from the cable list.

1) Push velocity and enter the cable velocity (Table 2):

a) Select Velocity

b) Set Speed Value (V_p from Table 2).

c) Select Cable Loss

d) Set Cable Loss Value (must be dB/ft or dB/m).

Table 2. Typical Cable Probable Velocity of Propogation (Vp)

TYPE OF CABLE	PROBABLE Vp
Jelly Filled	.64
Polyethylene (PIC, PE, or SPE)	.66
PTFE (Teflon) or TFE	.70
Pulp Insulation	.72
Foam or Cellular PE (FPE)	.78
Semi-solid PE (SSPE)	.84
Air (Helical spacers)	.98

2) Push the cable list, and then select the cable type from the list. The cable values will automatically enter for testing.

NOTE: The Cable List contains known cable values for a variety of cable types. The Cable List can be edited to add or delete cables.

(h) Push the Limit icon.

1) Select Limit (On/Off). Push to toggle the limit line Off.

2) Select Fail Flag (On/Off). Push to toggle the fail flag Off.

(i) Calibrate the RailHawk. See “Calibration” above.

(j) Connect the RailHawk Analyzer to the cable and antenna system being tested.

(k) Wait for a minimum of 10 seconds for the sweep to complete the update.

(l) To see the full sweep, adjust the Scale icon and then press TOP and enter 0. Press BOTTOM and enter -70.

(2) Interpreting the Fault Location Measurement ([Figure 1](#) & [Figure 2](#))

- (a) Isolate by using the FDR's distance to the fault readout, the applicable system schematic and the wiring diagram.
- (b) Each connector or jumper will show as a spike. If it is larger than the typical value in Table 3, examine the connector for damage.
- (c) Spikes where there are no components represent faults. Record the distance and then examine the line at that point for damage.
- (d) The largest spike is usually due to the antenna. Typically the trace after the antenna can be ignored (Ghosting).

(3) Verify suspected fault location by replacing defective component with 50 ohm load (calibration combo or dummy load).

- (a) Disconnect the component (cable, connector, antenna).
- (b) Connect the 50 ohm terminator to the open end of the applicable cable.
- (c) Do the Health Check again.
 - 1) Make sure that the VSWR (Voltage Standing Wave Ratio) or Return Loss test is PASS.
 - a) If the test still does not PASS, do the Distance to Fault test and continue to move 50 ohm load to further isolate.

The graph below (Figure 1) shows a typical Fault Location measurement for an antenna system.

Figure 1 Typical Fault Location Measurement

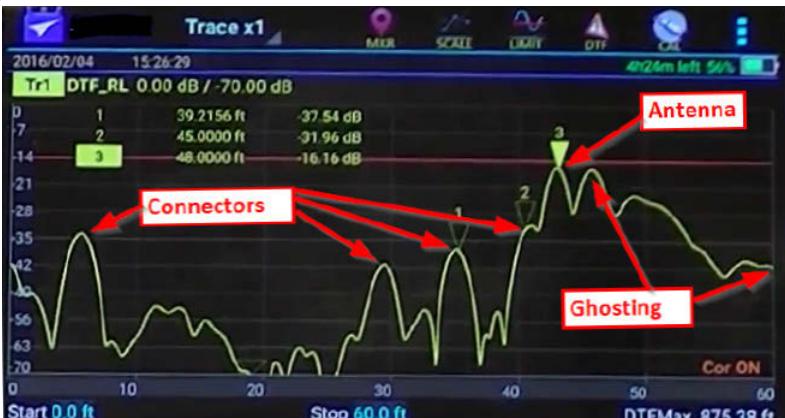


The table below (Table 3) shows typical component return loss.

Table 3. Typical Component Return Loss

Typical Component Return Loss	
Antenna at Resonance	-14 dB
Connector	-25 dB
Jumper	-35 dB
Lightning Protector	-25 dB
Transmission Line	-30 dB

Figure 2 Good Test



C. PUT THE SYSTEM BACK TO ITS USUAL CONDITION

- (1) Disconnect the TDR adapter cable.
- (2) Remove the 50 ohm terminator from the other end of the applicable cable if used for troubleshooting..
- (3) Connect any cables previously disconnected for troubleshooting.

