



SIGNALHAWK  
SPECTRUM ANALYZER

MODEL SH-60S

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 applied.

## 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

Leaking RF energy is a potential health hazard. Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

See page 6.

## Caution Statements

---

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

**CAUTION**

Do not exceed maximum input power levels.  
Exceeding the maximum input will damage the SignalHawk.  
If unsure of power levels, measure the test connection with a power sensor  
before using the SignalHawk.

See page 6.

**CAUTION**

Do not block airflow to fan or air vents.  
Unit will overheat if the fan is not circulating air through the unit.

See page 8.

**CAUTION**

Replace battery pack with OEM part only, do not use any other battery.

See page 48.

## **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 EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

## About This Manual

---

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

SH-60S-TC

SH-60S-AOA

## Changes to this Manual

---

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

## Chapter Layout

---

**Introduction** — Describes the functions and features of the SH-60S. There is a description of the units controls and a list of items supplied with the unit.

**Setup** — Describes the power requirements, provides example test setup connections, as well as power on, viewing a signal, and power off.

**User Interface** — Describes the touch screen user interface and provides instructions on various data entry and control features. A description of system settings such as startup state, custom configurations and language support are also covered.

**Operation** — This section provides details about important spectrum analyzer settings frequently used to assist in identifying signals of interest.

**Measurements** — The SH-60S includes a number of preprogrammed measurement functions designed to aid in system optimization.

**Maintenance** — Lists routine maintenance tasks as well as battery replacement and file system operations.

**Specifications** — Provides the device characteristics and signal analysis specifications.

# TABLE OF CONTENTS

|   |           |
|---|-----------|
| <b>Safety Precautions</b> .....                     | <b>i</b>  |
| Safety Symbols .....                                | ii        |
| Warning Statements .....                            | ii        |
| Caution Statements .....                            | iii       |
| Safety Statements .....                             | iv        |
| <b>About This Manual</b> .....                      | <b>vi</b> |
| Changes to this Manual .....                        | vi        |
| Chapter Layout .....                                | vi        |
| <b>Chapter 1 Introduction</b> .....                 | <b>1</b>  |
| Functions and Features .....                        | 1         |
| Items Supplied .....                                | 2         |
| External Controls, Connectors, and Indicators ..... | 3         |
| Power Supply .....                                  | 4         |
| Internal Battery .....                              | 4         |
| External AC Power Supply .....                      | 4         |
| <b>Chapter 2 Setup</b> .....                        | <b>5</b>  |
| Unpacking and Inspection .....                      | 5         |
| Preparation for Use .....                           | 5         |
| Power Requirements .....                            | 5         |
| Charge the Battery .....                            | 5         |
| RF Connections .....                                | 6         |
| Maximum Signal Levels .....                         | 6         |
| Test Connection Setup .....                         | 6         |
| Power On .....                                      | 8         |
| Start SignalHawk App .....                          | 8         |
| Exit SignalHawk App .....                           | 8         |
| Viewing a Signal .....                              | 9         |

|   |           |
|---|-----------|
| Display Options .....                         | 9         |
| Using a USB Device .....                      | 10        |
| Power Off .....                               | 10        |
| Normal Power Off .....                        | 10        |
| Forced Power Off .....                        | 10        |
| <b>Chapter 3 User Interface .....</b>         | <b>11</b> |
| User Interface .....                          | 11        |
| Data Entry/Display Controls .....             | 16        |
| Menu Selection .....                          | 16        |
| Rotary Dial Adjustments .....                 | 16        |
| Selection List Adjustments .....              | 18        |
| Direct Data Entry Adjustments .....           | 19        |
| System Settings .....                         | 20        |
| Reset to Factory Default .....                | 20        |
| Save/Recall .....                             | 22        |
| GPS .....                                     | 22        |
| Startup State .....                           | 23        |
| Screen Copy .....                             | 23        |
| Languages .....                               | 23        |
| <b>Chapter 4 Operation .....</b>              | <b>25</b> |
| Automatic/Coupled Settings .....              | 25        |
| Resetting coupled settings to auto .....      | 26        |
| Resolution Bandwidth .....                    | 27        |
| Pre-Amplification for low level signals ..... | 28        |
| Detector Settings .....                       | 29        |
| <b>Chapter 5 Measurements .....</b>           | <b>30</b> |
| Adjacent Channel Power Measurement .....      | 30        |
| ACPR Setup .....                              | 31        |
| Channel Power Measurement .....               | 32        |

|                                      |           |
|--------------------------------------|-----------|
| Channel Power Setup .....            | 32        |
| Occupied Bandwidth Measurement ..... | 33        |
| Occupied Bandwidth Setup .....       | 33        |
| N dB BW Measurement .....            | 34        |
| N dB BW Setup .....                  | 34        |
| Field Strength Measurement .....     | 35        |
| Field Strength Setup .....           | 36        |
| FM Measurement .....                 | 37        |
| FM Setup .....                       | 37        |
| AoA Locate Measurement .....         | 39        |
| AoA Locate Setup .....               | 39        |
| RF Signal Triangulation .....        | 40        |
| GPS Signal Quality Measurement ..... | 42        |
| GPS Signal Quality .....             | 42        |
| Spectrum Mask Measurement .....      | 44        |
| Spectrum Mask Setup .....            | 44        |
| Phase Noise Measurement .....        | 46        |
| Phase Noise Setup .....              | 46        |
| Power Measurements .....             | 47        |
| <b>Chapter 6 Maintenance .....</b>   | <b>48</b> |
| Cleaning .....                       | 48        |
| Troubleshooting .....                | 48        |
| Repair .....                         | 48        |
| Battery Replacement .....            | 48        |
| File System .....                    | 50        |
| Transfer files .....                 | 50        |
| Delete Files .....                   | 53        |
| Firmware Updates .....               | 54        |
| Customer Service .....               | 55        |

|   |           |
|---|-----------|
| <b>Chapter 7 Specifications</b> .....     | <b>56</b> |
| Signal Analysis Specifications .....      | 56        |
| Device Characteristics .....              | 57        |
| Physical characteristics .....            | 57        |
| Software Characteristics .....            | 58        |
| <b>Chapter 8 Data File Examples</b> ..... | <b>59</b> |
| Antenna Gain Data File Example .....      | 59        |
| Spectrum Mask File Example .....          | 60        |
| <b>Limited Warranty</b> .....             | <b>62</b> |

The SignalHawk model SH-60S is a hand-held, fully functional spectrum analyzer designed for use in the installation and maintenance of Radio Frequency (RF) and wireless systems.

## Functions and Features

---

- Analysis of radio frequency spectrum from 9 kHz to 6 GHz. Measures intended and interfering signals. Allows setup of parameters such as frequency, amplitude and markers. Graphically displays signals amplitude vs. frequency and provides the ability to save traces.
- Predefined Measurements to reduce the length of setup time, see [Table 1](#).
- Internal Preamplifier.
- Selectable sensitivity to adjust for varied input power levels.
- Battery powered operation up to five hours.
- Touchscreen interface.
- Precision Power Measurement using Bird Power Sensors and the Bird RF Meter App.

**Table 1** *Predefined measurements*

| <b><i>Measurement</i></b>           | <b>SH-60S-TC</b> | <b>SH-60S-AOA</b> |
|-------------------------------------|------------------|-------------------|
| Occupied Bandwidth (OBW)            | ✓                | ✓                 |
| Channel Power (CH Power)            | ✓                | ✓                 |
| Adjacent Channel Power Ratio (ACPR) | ✓                | ✓                 |
| N dB BW                             | ✓                | ✓                 |
| Field Strength                      | ✓                | ✓                 |
| GPS Signal Quality                  | ✓                | ✓                 |
| Spectrum Mask                       | ✓                | ✓                 |
| Angle of Arrival (AoA) Locate       |                  | ✓                 |

**Figure 1 SH-60S SignalHawk Spectrum Analyzer**

## Items Supplied

| Description                  | Part Number    |
|------------------------------|----------------|
| Hard Carrying Case           | 7002A218-2     |
| Soft Carrying Case           | 7002A219-1     |
| AC Adapter (12 VDC)          | SK05T-1200300Z |
| Touch Pen (stylus)           | SK-TP-112      |
| USB Adapter (USB-C to USB-A) | SK-CONN-OTG-2  |
| USB Drive                    | 5A2745-1       |
| Lithium Ion Battery          | SK-BTY-7468    |
| Instruction Manual           | 920-SH-60S     |

## External Controls, Connectors, and Indicators



| Item | Description   |
|------|---|
| 1    | RF input connector, female N-type, 50 Ohms  |
| 2    | Air vent, a vent is located on each side of the unit  |
| 3    | Power Switch  |
| 4    | Fan and air exhaust port  |
| 5    | USB-C connector<br><b>Note:</b> The Spectrum Analyzer will not continue to measure RF signals while a USB device is connected. Exit the SignalHawk application prior to connecting a USB device to the SH-60S.<br><b>Note:</b> Spectrum Analyzer battery will not charge from the USB port. Use the supplied charger & adjacent charging port (item 6). |
| 6    | Charging port, 12 V, 3.0 A  |
| 7    | Charge indicator, illuminates when charger is connected, red indicates charging, green indicates full charge.   |
| 8    | Display Screen, touch interaction, 5.5 inch, 1280 x 720.  |

## **Power Supply**

---

### **Internal Battery**

---

The SH-60S has an internal, rechargeable, lithium-ion battery pack that will operate the unit for 5 hours of continuous use. Recharging time, from a full discharge, is approximately 6 hours.

### **External AC Power Supply**

---

The AC to DC Power Supply (12 VDC, 3.0 A) is capable of charging the batteries in approximately 6 hours.

## Unpacking and Inspection

---

1. Carefully inspect shipping container for signs of damage.
  - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Technologies.
  - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
2. Inspect unit for visual signs of damage.

**Note:** *If there is damage, immediately notify the shipping carrier and Bird Technologies.*

## Preparation for Use

---

### Power Requirements

---

The SignalHawk's battery charger requires AC input power of 100-240 V, 1.5 A, 50-60 Hz. The unit may be operated while connected to the charger.

### Charge the Battery

---

It is recommended that the batteries be charged before initial use.

1. Connect the battery charger to the SignalHawk.
2. Plug the battery charger into an AC outlet.

The SignalHawk will operate for 5 hours on a fully charged battery. The battery's level of charge is indicated on the Spectrum Analyzer display, see [Charge Indicator on page 12](#).

## RF Connections

### Maximum Signal Levels

#### CAUTION

Do not exceed maximum input power levels.  
Exceeding the maximum input will damage the SignalHawk.  
If unsure of power levels, measure the test connection with a power sensor before using the SignalHawk.

The maximum input power level will vary with the selected pre-amp setting. The SH-60S has the following pre-amp settings:

| <i>Pre-amp Setting</i> | <i>Gain</i> | <i>Upper Measurement Range Level</i> | <i>Maximum Input Power Level (Damage Level)</i> |
|------------------------|-------------|--------------------------------------|---|
| Off                    | N/A         | +20 dBm                              | 30 dBm  |
| 1 On                   | 20 dB       | -20 dBm                              | 0 dBm   |
| 2 On                   | 40 dB       | -40 dBm                              | -20 dBm   |

### Test Connection Setup

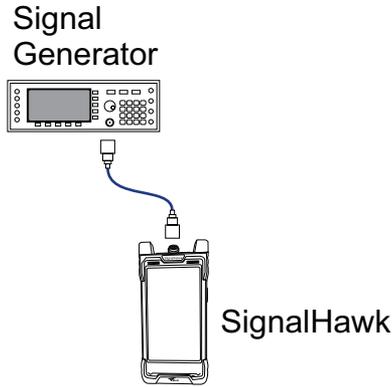
#### WARNING

Leaking RF energy is a potential health hazard. Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

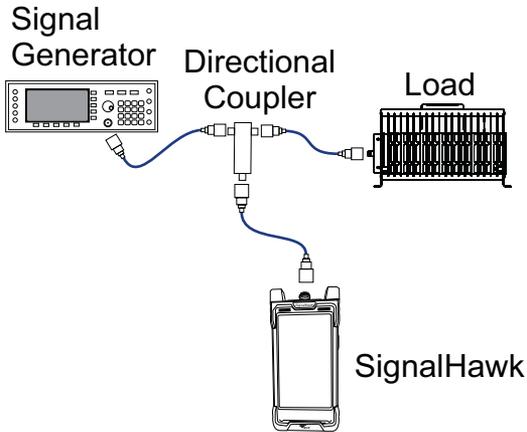
1. Measure the output power of the system being tested, or signal power, at the system's test port using a power meter, service monitor, or equivalent.
 

**Note:** *Ensure the output power is less than the maximum power for the selected sensitivity setting.*
2. Connect the SignalHawk's "RF Input" connector:
  - For low-power applications, connect directly to the output of the signal source. See [Figure 2 on page 7](#).
  - For high-power applications, use a directional coupler or attenuator to reduce the output level of the signal source. See [Figure 3 on page 7](#).

**Figure 2 Low Power Connection Example**



**Figure 3 High Power Connection Example**



## Power On

Power on the unit by pressing the power button for about three seconds.



### CAUTION

Do not block airflow to fan or air vents.  
Unit will overheat if the fan is not circulating air through the unit.

Verify the fan is operating after the unit is powered on.

## Start SignalHawk App

When the Signal Hawk is initially powered-on the SignalHawk app will automatically start. If the SignalHawk app is stopped it must be restarted manually.

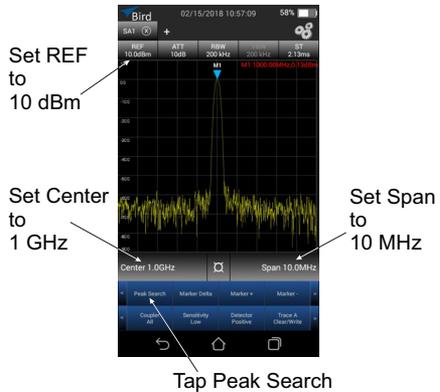
To start the SignalHawk App, tap the icon  on the home screen

## Exit SignalHawk App

To exit the SignalHawk App, Tap the back button  at the bottom of the screen.

## Viewing a Signal

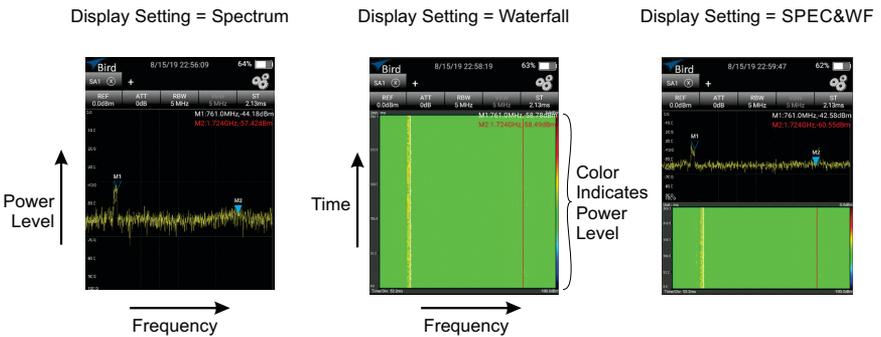
1. Connect Signal Generator to the SH-60S. See [RF Connections on page 6](#).
2. Set signal generator to generate a CW signal at 1 GHz and 0.0 dBm
3. Tap **REF** and select 10 dBm with the rotary dial, then tap OK.
4. Tap **Center** and type 1, select GHz, then tap OK.
5. Tap **Span** and type 10, select MHz, then tap OK.
6. Tap **Peak Search** to display Marker 1 at the top of the signal peak.



## Display Options

In addition to displaying the RF Signal is the typical spectrum display, the SignHawk is capable of displaying the RF signal in a waterfall display, allowing the user to view the signal in the time dimension as well as frequency and power dimension. See [Figure 4](#).

**Figure 4 Display Types**



---

## Using a USB Device

---

The Spectrum Analyzer will not continue to measure RF signals and the application may “hang up” while a USB device is connected. Exit the SignalHawk application prior to connecting a USB drive to the SH-60S. See [Exit SignalHawk App on page 8](#).

If a USB device was connected while the SignalHawk app was operating, the app will cease spectrum measurement. Once the USB device is disconnected, exit the app, restart the SignalHawk app from the home screen. See [Start SignalHawk App on page 8](#).

---

## Power Off

---

### Normal Power Off

---

1. Press and hold the power button for 4 seconds.
2. Tap the shutdown icon on the display.
3. Tap the confirmation icon on the display.

### Forced Power Off

---

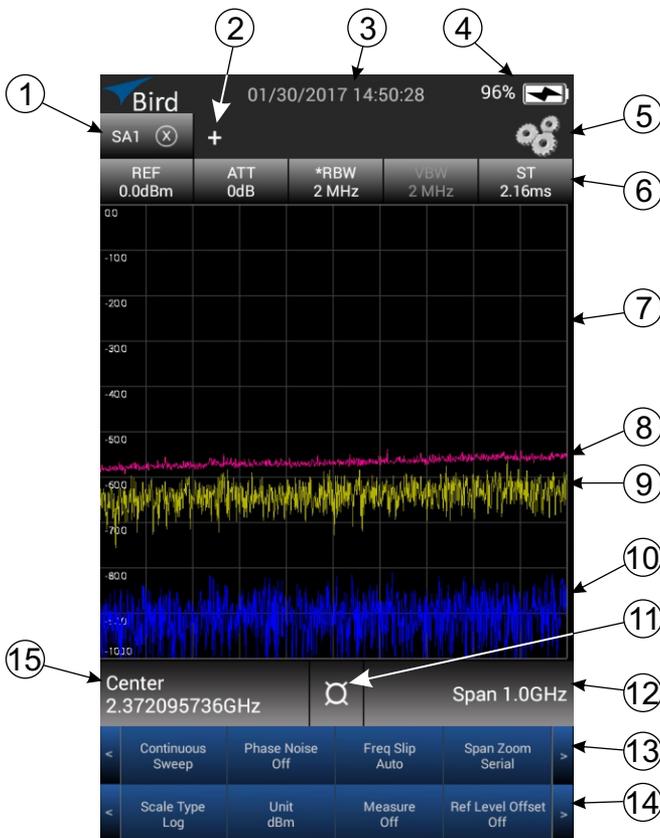
1. Press and hold the power button for 15 seconds.
2. Tap the confirmation icon on the display.

The SH-60S operates on the Android Operating System, the Spectrum Analyzer launches as soon as the unit is powered on, this section describes the elements of the [User Interface](#), explains the methods used for [Data Entry/Display Controls](#), and provides details about the Spectrum Analyzer’s [System Settings](#).

## User Interface

The SignalHawk SH-60S user interface consists of a touch screen interface. The user taps the screen to access menus, change settings, perform measurements and save results.

**Figure 5 User Interface Description**



| <b>Item</b> | <b>Control</b>       | <b>Description</b>   |
|-------------|----------------------|--|
| 1           | SA Tab               | The SH-60S is capable of displaying four Spectrum Analyzer tabbed windows. Each tab can be configured independently of the other tabs. Tabs are added by tapping the Add Tab symbol (+), see item 2. Tap the tab of the SA window you want to view.  |
| 2           | Add Tab              | When tapped, adds a new Spectrum Analyzer tabbed window. Each tab is numbered SA1, SA2, etc. Up to four windows can be added to the display.   |
| 3           | Date & Time          | Date and Time, press to change time or format.   |
| 4           | Charge Indicator     | The charge indicator provides a visual indication of remaining battery charge. When the charger is connected the indicator contains a charging symbol to indicate the battery is charging.   |
| 5           | System Settings      | System Settings menu provides access to options such as loading presets, saving and recalling settings, screen shots, printing, service, and device information. See <a href="#">"System Settings" on page 20</a> .  |
| 6           | Reference Level      | Sets the value at the top of the y-axis of the graph.  |
|             | Attenuation          | Controls the built-in attenuator on the signal input. It reduces the amplitude of a high-powered signal. The attenuation can be set to Auto, or at levels from 1 to 30 dB, at 1 dB steps. The reported value of the signal is automatically corrected for the selected attenuation.<br><b>Note:</b> An Astrix (*) by this value indicates a manual setting, and no longer Auto-Coupled, see Coupler (14).  |
|             | Resolution Bandwidth | Provides selection of automatic resolution bandwidth (RBW) or manual control of RBW.<br>In automatic, RBW is based on the current frequency span. When the frequency span is reduced, the RBW will also be reduced accordingly.<br>If the RBW is manually changed, the mode will switch to manual. See <a href="#">"Resolution Bandwidth" on page 27</a> .<br><b>Note:</b> An Astrix (*) by this value indicates a manual setting, and no longer Auto-Coupled, see Coupler (14). |
|             | Video Bandwidth      | Displays the value of the Video Bandwidth setting. This is not user settable, but will update with changes to RBW.   |
|             | Sweep Time           | Specifies the sweep time used in measuring the power.<br><b>Note:</b> An Astrix (*) by this value indicates a manual setting, and no longer Auto-Coupled, see Coupler (14).  |
| 7           | Display area         | Sweep display area.  |

| <b>Item</b> | <b>Control</b>             | <b>Description</b>  |
|-------------|----------------------------|---|
| <b>8</b>    | Trace C                    | Optional trace, may be displayed alone or with other traces also displayed.   |
| <b>9</b>    | Trace A                    | Default trace, automatically displayed when the Spectrum Analyzer is started. Two additional traces may be displayed, see item 8 and 10.  |
| <b>10</b>   | Trace B                    | Optional trace, may be displayed alone or with other traces also displayed.   |
| <b>11</b>   | Frequency Display Selector | When tapped, changes the displayed frequency values to or from Center/Span or Start/Stop.   |
| <b>12</b>   | Span/Stop Frequency        | Displays either the Frequency Span or the Stop Frequency depending on the selection made by the frequency display selector (11).<br>The frequency may be changed by tapping the value and entering a new value in the dialog. |

| Item             | Control   | Description   |
|------------------|---|---|
| 13               | Peak Search   | When tapped, positions the active marker at the point the displayed signal has the largest signal strength. If there is not an active marker, marker 1 will be added and moved to the signal peak.  |
|                  | Next Peak   | When tapped, positions the active marker at the signal with the largest signal strength to the right of the current marker position. If there is not an active marker, marker 1 will be added at the point the displayed signal has the largest signal strength.  |
|                  | Marker Delta  | When tapped, marker 1 becomes the reference marker, and all other markers display the difference in frequency and power from marker 1.  |
|                  | Marker +  | When tapped, adds a marker to the display.  |
|                  | Marker -  | When tapped, removes the highest numbered marker from the display.  |
|                  | Single Sweep  | When tapped, performs a single sweep and displays the results on the screen. To update the display tap single sweep again, or tap <b>Continuous Sweep</b> .   |
|                  | Continuous Sweep  | When tapped, performs one sweep after another displaying each sweep on the screen.  |
|                  | Phase Noise   | Phase noise option uses delta markers to measure phase noise. The option uses a reference marker to measure signal power and a delta marker to measure noise power, the phase noise ratio is displayed in dBc. See " <a href="#">Phase Noise Measurement</a> " on page 46.  |
|                  | Freq Offset   | Freq Offset is used to set the step size, in frequency, when the display is moved (swiped) left or right. When tapped, a menu opens allowing the freq Offset to be set to <b>Auto</b> or <b>Manual</b> . When set to manual, a specific step size may be entered.   |
|                  | Span Zoom   | When tapped, toggles the Span Zoom option, between <b>Auto</b> and <b>Serial</b> . Span Zoom controls the step size of frequency span changes when screen is pinched (open or closed).<br>When set to Auto, pinching the screen (open or closed) will change the span in finite steps.<br>When set to Serial, pinching the screen (open or closed) will change the span in large increments/decrements. |
| Ref Level Offset | When tapped, toggles the Ref Level Offset, between <b>On</b> and <b>Off</b> . When set to On, the Ref Level Offset is displayed in the upper left portion of the display area.<br>The Offset value may be changed by tapping the value and rotating the dial to the desired Ref Level Offset. |   |

| Item | Control    | Description   |
|------|------------|---|
| 14   | Measure    | Allows the selection of preprogrammed measurement functions. Options include <b>ACPR</b> (Adjacent Channel Power), <b>CH Power</b> , <b>OBW</b> (Occupied Bandwidth), <b>N dB BW</b> , <b>Field Strength</b> , <b>FM</b> , <b>Aoa Locate</b> , <b>GPS Signal Quality</b> , <b>Spectrum Mask</b> . See <a href="#">"Measurements" on page 30</a> .   |
|      | Coupler    | Auto Couple function, options are <b>All</b> , <b>RBW</b> , <b>VBW</b> , <b>Sweep Time</b> , and <b>ATT</b> . Sets the selected parameter (RBW, VBW, ATT, Sweep Time, or All parameters) to auto. In auto, the parameters are automatically adjusted to optimize the measured signal. See <a href="#">"Automatic/Coupled Settings" on page 25</a> .   |
|      | Pre Amp    | Selects pre-amp operation, options are <b>All Off</b> , <b>1 On</b> , <b>All On</b> . Pre-amps should be chosen according to the power level of the measured signal. Changes to this parameter will change the maximum signal input power capability of the Spectrum Analyzer. See <a href="#">"Maximum Signal Levels" on page 6</a> and <a href="#">"Pre-Amplification for low level signals" on page 28</a> . |
|      | Detector   | Allows the selection of the detector model used by the spectrum Analyzer. The options available are <b>Positive</b> , <b>Negative</b> , <b>Sample</b> , <b>Average</b> , <b>RMS</b> . See <a href="#">"Detector Settings" on page 29</a> .  |
|      | Trace A    | Provides options for displaying Trace A, trace A defaults to <b>Clear/Write</b> . This option can be used to <b>Hide</b> Trace A, or set it to <b>MaxHold</b> , <b>MinHold</b> , or <b>Average</b> . When set to <b>Average</b> , the average sweep count is displayed and may be manually changed.   |
|      | Trace B    | Provides options for displaying Trace B, trace B defaults to <b>Hide</b> . This option can be used to <b>Clear/Write</b> Trace B, or set it to <b>MaxHold</b> , <b>MinHold</b> , or <b>Average</b> . When set to <b>Average</b> the average sweep count is displayed and may be manually changed.   |
|      | Trace C    | Provides options for displaying Trace C, trace C defaults to <b>Hide</b> . This option can be used to <b>ClearWrite</b> Trace C, or set it to <b>MaxHold</b> , <b>MinHold</b> , or <b>Average</b> . When set to <b>Average</b> the average sweep count is displayed and may be manually changed.  |
|      | Trigger    | Selects the trigger mode of the Spectrum Analyzer.  |
|      | Scale Type | Selects between Log (logarithmic) or Lin (Linear) for the Y-axis scale. When set to Log, the scale is set to dB, and each division is an equal value. When Lin is selected, the scale is set to volts, the bottom of the display is set to 0 volts and the top is set to the reference level, each division is 1/10 of full scale.  |
|      | Unit       | Selects the unit of measurement displayed on the y-axis.  |

| <i>Item</i>     | <i>Control</i>         | <i>Description</i>  |
|-----------------|------------------------|---|
| <b>14 Cont.</b> | Display                | When tapped, displays an option to select <b>Spectrum</b> in frequency domain or a <b>Waterfall</b> spectrogram display, or a split screen showing both spectrum and waterfall. See " <a href="#">Display Types</a> " on <a href="#">page 9</a> . |
| <b>15</b>       | Center/Start Frequency | Displays either the Center Frequency or the Start Frequency depending on the selection made by the frequency display selector (11).<br>The frequency may be changed by tapping the value and entering a new value in the dialog.                  |

## Data Entry/Display Controls

A variety of controls are used for adjusting settings on the SH-60S.

### Menu Selection

To navigate the menus at the bottom of the SignalHawk App, you may swipe across the menu, or tap the controls at the left and right of the menu.

**Figure 6 Menu Selection**



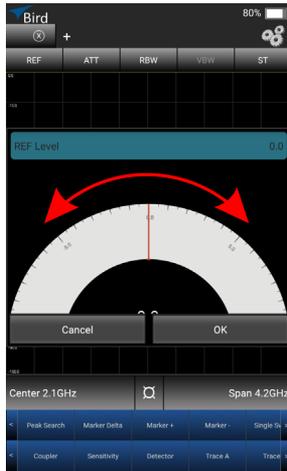
### Rotary Dial Adjustments

Rotary dials ([Figure 7](#)) are used to adjust some settings.

To change a setting:

1. Press the screen and drag the dial right or left to the desired setting, the dial will settle on the closest hash mark.  
The selected value will be shown at the top of the dialog box.
2. Tap OK to save the new setting.

**Figure 7 Rotary Dial Adjustment**



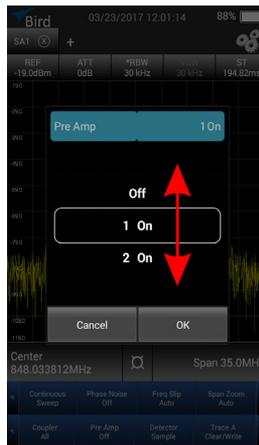
## Selection List Adjustments

Selection lists ([Figure 8](#)) are another method used to adjust settings on the SH-60S.

To change a setting:

1. swipe the list up or down until the desired setting is within the selection box at the center of the dialog.  
The selected value will be shown at the top of the dialog box.
2. Tap OK to save the new setting.

**Figure 8** Selection List Adjustments



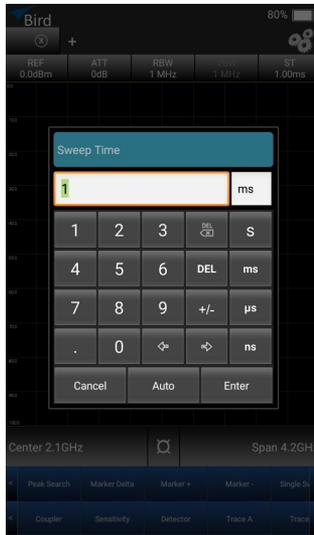
## Direct Data Entry Adjustments

Direct data entry ([Figure 9](#)) is also used in the SH-60S for adjusting settings.

To change a setting:

1. Tap the keypad to enter the desired value.
2. Select the appropriate unit for the new value.
3. Tap Enter to save the new setting.

**Figure 9** Data Entry Adjustments



## System Settings

The System Settings menu provides options for selecting language, saving and recalling presets, selecting the startup state, and creating screen captures.

**Figure 10** System settings



### Reset to Factory Default

To reset the unit to factory defaults. See [Table 2](#) for a list of the default settings.

1. Tap **Reset to Factory Default**.
2. Tap **OK**

**Table 2** Factory Default Settings

| <i>Parameter</i> | <i>Default Setting</i> |
|------------------|------------------------|
| Center Frequency | 3.0 GHz                |
| Start Frequency  | 0.0 Hz                 |
| Stop Frequency   | 6.0 GHz                |
| Span             | 6.0 GHz                |
| Reference Level  | 0.0 dBm                |
| Attenuation      | Auto (0 dB)            |
| RBW              | Auto (5 MHz)           |

| <b><i>Parameter</i></b> | <b><i>Default Setting</i></b>     |
|-------------------------|-----------------------------------|
| VBW                     | Auto (1 MHz), not user selectable |
| Sweep time              | Auto                              |
| Marker                  | All Off                           |
| Sweep Mode              | Continuous                        |
| Phase Noise             | Off                               |
| Freq Slip               | Auto                              |
| Span Zoom               | Auto                              |
| Coupler                 | All                               |
| Pre-amp                 | All Off                           |
| Detector                | Positive                          |
| Trace A                 | Clear/Write                       |
| Trace B                 | Hide                              |
| Trace C                 | Hide                              |
| Trigger                 | Free                              |
| Calibration             | On                                |
| Scale Type              | Log                               |
| Unit                    | dBm                               |
| Measure                 | Off                               |
| Reference Level Offset  | Of                                |
| Scale/DIV               | 10 dB/DIV                         |

## Save/Recall

---

### Save Menu

#### Setting (.xml)

The Save menu allows the user to save preferred settings (custom configuration) for repeated use. Custom configurations may be recalled at any time.

Preferred settings are saved in XML format in the Spec An folder on the device.

#### Save settings

To save the current configuration:

1. Tap System Settings Icon, see [Figure 10 on page 20](#).
2. Tap Save.
3. Type a filename in the Save dialog box.
4. Tap OK

#### Recall settings

To recall a custom configuration:

1. Tap System Settings Icon, see [Figure 10 on page 20](#).
2. Tap Recall.
3. Select the desired custom configuration from the displayed list.
4. Tap OK

#### Data (.txt)

The Save menu allows the user to save data. Data files cannot be recalled for viewing in the SignalHawk App.

Data is saved in txt format in the Spec An folder on the device.

#### Save data

To save the current configuration:

1. Tap System Settings Icon, see [Figure 10 on page 20](#).
2. Tap Save.
3. Type a filename in the Save dialog box.
4. Tap OK

## GPS

---

Toggles **On** and **Off** the GPS receiver.

## Startup State

---

There are two options available for the spectrum analyzer state when the system is initialized:

- Save Current Settings - the Spectrum Analyzer starts in the same configuration in use when the system was shutdown.
- Reset to Factory Default - the Spectrum Analyzer starts with factory default settings, see "[Screen Copy](#)" on page 23.

To change Startup State:

1. Tap System Settings Icon, see [Figure 10](#).
2. Tap **Startup State**.
3. Select **Save Current Settings** or **Reset to Factory Default**.

## Screen Copy

---

**Screen Copy** is used to output screen captures.

The Screen Copy option creates a full color copy of the current display.

Screen Captures are saved in PNG format in the Spec An folder on the device.

To create a screen capture:

1. Tap System Settings Icon, see [Figure 10 on page 20](#).
2. Tap Screen Copy.
3. Type a filename in the dialog box.
4. Tap OK.

## Languages

---

The System Settings menu contains an option for selecting the language displayed within the SignalHawk application.

To change the language used in the SignalHawk App:

1. Tap System Settings Icon, see [Figure 10 on page 20](#).
2. Tap Language.
3. Select the desired language.



There are a number of settings that may require adjustment to properly view and measure signals of interest. Many of these settings must be made in combination depending on the type and level of the signal. The following information is provided to aid in understanding these settings.

## Automatic/Coupled Settings

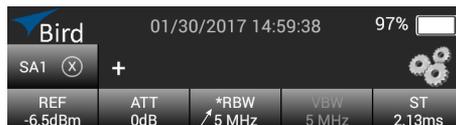
In the factory default settings, the following options are coupled together and automatically adjust when changes are made to frequency span:

- Attenuation
- Resolution Bandwidth (RBW)
- Sweep Time

When an RF signal is applied to the SH-60S, and changes are made to the frequency span, RBW and sweep time are automatically adjusted to provide a standardized view of the visible spectrum.

Manual adjustments may be required to effectively view some signals, when manual adjustments are made an asterisk (\*) will be displayed beside the setting to indicate a manual setting.

**Figure 11** Manual Setting Indicator



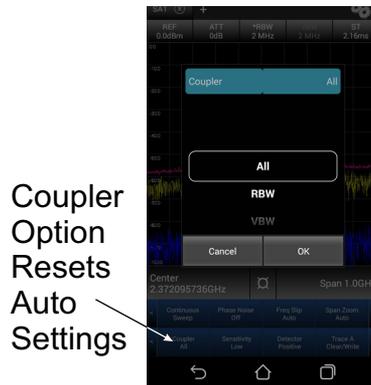
An Asterisk (\*)  
indicates a manual setting

## Resetting coupled settings to auto

If Attenuation, RBW, or Sweep time have been set manually they can be reset to automatic operation using the Coupler setting.

1. Tap Coupler
2. Select the specific setting to reset to auto or select ALL.

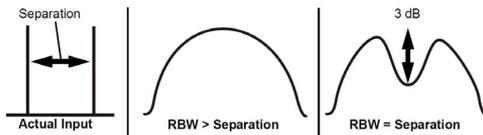
**Figure 12 Coupler Reset**



## Resolution Bandwidth

The Resolution Bandwidth (RBW) of a spectrum analyzer determines the smallest resolvable frequency separation. The easiest way to understand how RBW affects the trace shown on a spectrum analyzer is to think of RBW as the width of spectrum that is analyzed in one step. In this analogy, using a wider RBW analyzes a larger portion of spectrum at once and completes the entire sweep in less time, but will reduce trace detail. If the RBW is wider than the frequency separation of two signals, then both signals will be analyzed within the bandwidth and the spectrum analyzer will display only one apparent signal on the screen. If the RBW is equal to the frequency separation of the two signals, a 3dB dip between the two signals will appear.

**Figure 13** *Signal Resolution and RBW*



As the RBW decreases, more and more resolution between the two signals will be seen, and consequently, one full sweep over the set span will take longer to complete. It is important to note, however, that RBW can be too narrow in some instances. For example, if the RBW is not wide enough to include the sidebands of a modulated signal, the spectrum analyzer will display an inaccurate measurement.

Additionally, as RBW decreases, the amount of uncorrelated noise power decreases, and this reduces the Displayed Average Noise Level (DANL) seen on the spectrum analyzer. The DANL, or Noise Floor, of a spectrum analyzer determines the lowest possible signal level that can be measured by the unit. For example, if one is attempting to measure a signal that is -130dBm, the spectrum analyzer must have a DANL that is lower than -130dBm.

The SH-60S is capable of measuring low-level signals, however, it should be understood that the sweep time will be very long based on the settings used to obtain the DANL specification. Changing RBW in order to decrease the sweep time will also increase the DANL. In general, if the span is kept constant, sweep time will be increased by decreasing RBW and using more data points.

## Pre-Amplification for low level signals

The SH-60S includes built-in low-noise amplifiers on the signal input. Because the spectrum analyzer's internal noise is a constant and is generated by the circuitry following the pre-amps, the DANL of the unit can be lowered by amplifying the incoming signal, then compensating for the applied internal pre-amp gain.

The SH-60S has three pre-amp settings:

| <b><i>Pre-amp Setting</i></b> | <b><i>Gain</i></b> | <b><i>Upper Measurement Range Level</i></b> | <b><i>Maximum Input Power Level (Damage Level)</i></b> |
|-------------------------------|--------------------|---|--|
| Off                           | N/A                | +20 dBm                                     | 30 dBm   |
| 1 On                          | 20 dB              | -20 dBm                                     | 0 dBm  |
| 2 On                          | 40 dB              | -40 dBm                                     | -20 dBm  |

For example, a -30dBm signal is passed through the internal pre-amp having a 20 dB gain, the resulting signal would display at a level of -10 dBm without compensation. However, since the pre-amp is internal to the spectrum analyzer, this displayed signal is automatically corrected to the original -30 dBm value.

Consequently, if the internal noise of the spectrum analyzer following the pre-amp is -110dBm, it displays at a level of -134dBm once the 20 dB correction is applied.

If there is no signal injected into the spectrum analyzer, then the effective DANL is lowered by approximately the amount of internal pre-amp gain applied.

Be very careful when using the spectrum analyzer's internal pre-amps, applying too much power to the unit could cause internal damage, as shown above.

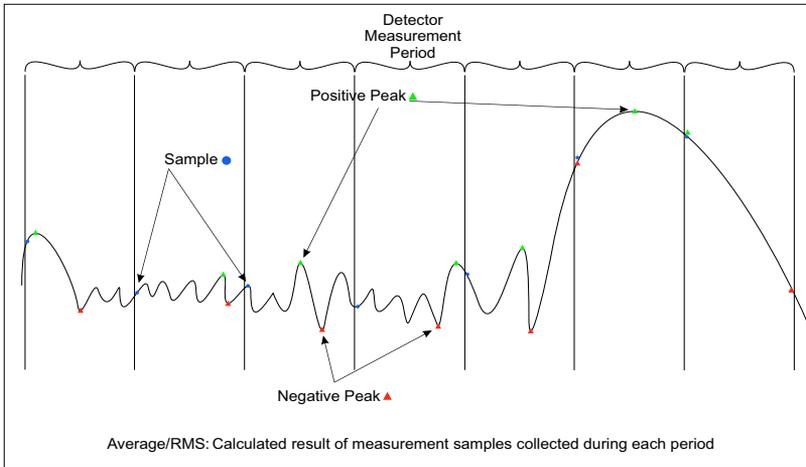
## Detector Settings

Each detector measurement period (or pixel) displayed on the trace is a measurement output of the spectrum analyzers detector.

The SH-60S has the following detector settings:

- Positive: Returns the maximum value of the data collected for each display pixel. Recommended for pure sine waves or narrow bandwidth signals.
- Negative: Returns the minimum value of the data collected for each display pixel. Recommended for displaying the difference between CW and pulsed signals.
- Sample: Returns a sample of the data collected for each display pixel.
- Average: Returns the linear average of the data collected for each display pixel. Recommended for Channel Power measurements.
- RMS: Returns the RMS average of the data collected for each display pixel. Use this method for detecting noise-like signals.

**Figure 14** *Detector Operation*



For low-level signal detection, setting the Detector to Average or RMS displays the average of the raw data collected for each display pixel. This is recommended for noise-reduction, since averaging the multiple raw data samples collected for each data point makes the resulting measurement less sensitive to noise. The number of raw data samples collected by Bird's SignalHawk is controlled by a combination of the RBW, VBW, and the frequency span settings.

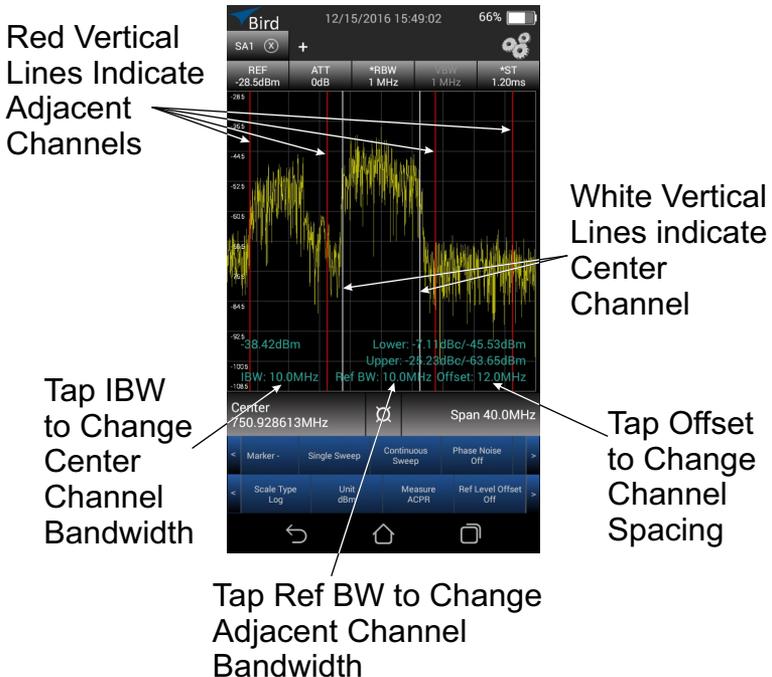
The SH-60S includes several preprogrammed measurement functions, including Adjacent Channel Power (ACPR), Channel Power (CH Power), Occupied Bandwidth (OBW), and N dB BW, Field Strength, FM, AoA Locate, GPS Signal Quality, Spectrum Mask. Phase Noise measurements may also be made automatically with the SignalHawk spectrum Analyzer.

The Bird RF Meter App makes RF power measurement possible when a Bird power sensor is connected to the SH-60S.

### Adjacent Channel Power Measurement

Adjacent Channel Power measures the relative power of frequency bands adjacent to a central channel. This is often used to identify power leakage from the center channel into the adjacent channels. The total power in the center (main) channel is displayed in dBm and the power in the adjacent channels (Lower and Upper) are given in dBc and dBm .

Figure 15 Adjacent Channel Power



## ACPR Setup

---

1. For best accuracy, set the central frequency so the signal is centered before taking measurements.
2. Select ACPR in the Measure menu.
3. Tap IBW at the bottom of the screen to set the width of the central channel.

**Note:** *The central channel can be set to a different frequency width than the adjacent channels, but both adjacent channels have the same width.*

4. Tap Ref BW to set the width of both adjacent channels.
5. Tap Offset to set the Center-to-Center channel spacing.

**Note:** *Channel spacing is the distance from the central channel's center frequency to the adjacent channel's center frequency. If there is no guard band between channels, the channel spacing should be half (channel width + adjacent channel width).*

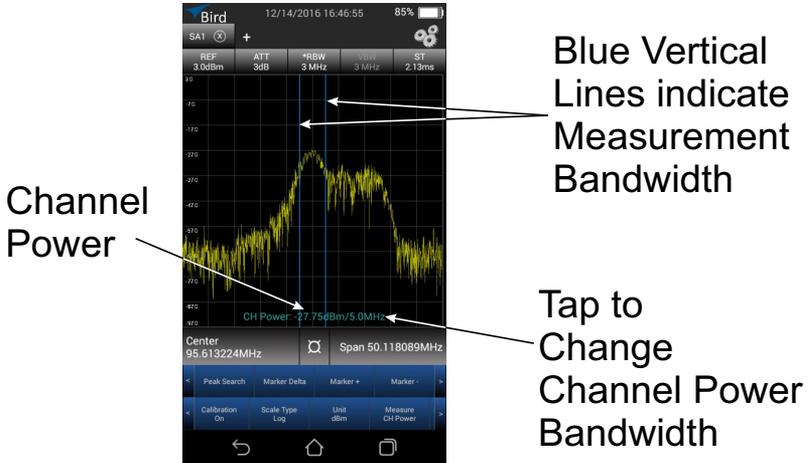
White and red vertical lines are used to mark the edges of the central, upper, and lower channels.

The Center Channel power will be displayed on the left side of the display. The power for the Lower and Upper Adjacent Channels will be displayed on the right side of the display.

## Channel Power Measurement

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

**Figure 16 Channel Power Measurement**



## Channel Power Setup

1. For best accuracy, set the center frequency so the signal is roughly centered before taking measurements. In addition, the span should be  $1\frac{1}{2}$  – 5 times as large as the desired channel width.
2. Select CH Power in the Measure menu.

The Channel Power and the measured bandwidth will be displayed in the area at the bottom of the display.

3. Tap CH Power at the bottom of the screen to change the measured bandwidth.

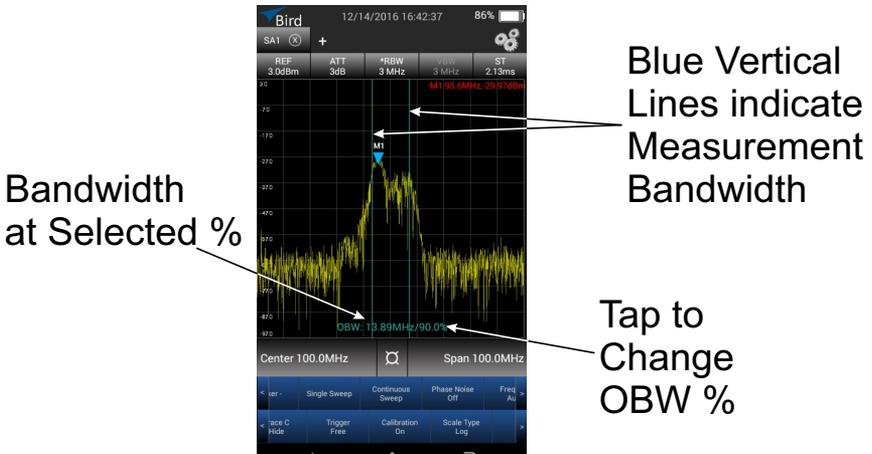
Vertical Blue lines will mark the edges of the measured band.

## Occupied Bandwidth Measurement

Occupied Bandwidth measures the frequency band bandwidth that contains a specified percentage of the total power of the signal.

It gives best results with single-peaked signals. Bandwidth measurement results are in Hz units.

**Figure 17 Occupied Bandwidth Measurement**



The calculated occupied bandwidth represents the user specified percent of the total power of the displayed span.

## Occupied Bandwidth Setup

1. For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.
2. Select OBW in the Measure menu.

The threshold and the measured bandwidth will be displayed in the area at the bottom of the display.

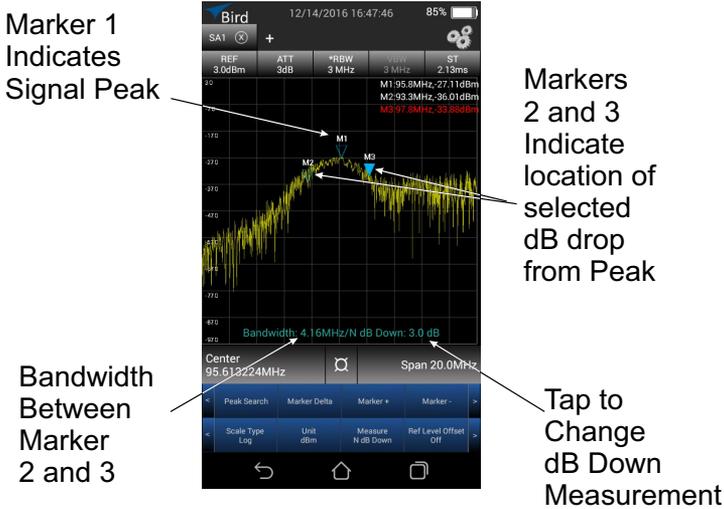
3. Tap OBW at the bottom of the display to change the percentage of signal to be measured.

Vertical Blue lines will mark the edges of the measured band.

## N dB BW Measurement

N dB BW measures the frequency bandwidth at a user selected value in decibels below the signal peak. Bandwidth measurement results are in Hz units.

**Figure 18 N dB Down Measurement**



## N dB BW Setup

1. For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.
2. Select N db BW in the Measure menu.

The threshold and the measured bandwidth will be displayed in the area at the bottom of the display.

3. Tap N db Down at the bottom of the screen to change the decibel level down from the signal peak to be measured.

Markers 2 and 3 are used to indicate the edges of the measured bandwidth.

## Field Strength Measurement

Field Strength measurement can be used to measure a single frequency (point) or a band of frequencies (the full span set on the SignalHawk), measurement results are in mV/m units.

Field strength measurements are typically used to determine the amount of RF radiation emitted by electronic equipment.

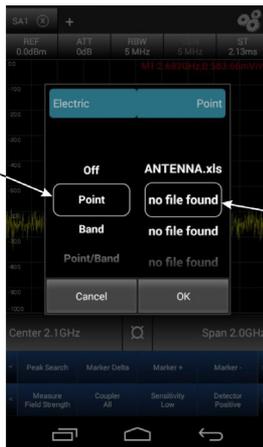
**Note:** *To maximize the accuracy of the measurement, the gain of the antenna connected to the SignalHawk should be provided in an antenna gain characterization file.*

To maximize the accuracy of the Field Strength Measurement, the SignalHawk loads a data file (.xls format), if available, containing the gain values of the connected antenna to calculate the measurement. see "[Data File Examples](#)" on [page 59](#) for information on creating antenna gain characterization files for use with Field Strength Measurement.

A marker must be used to display the results of the Field Strength Measurement.

**Figure 19** *Field Strength Measurement*

Field Strength  
Measurement  
Type Selection



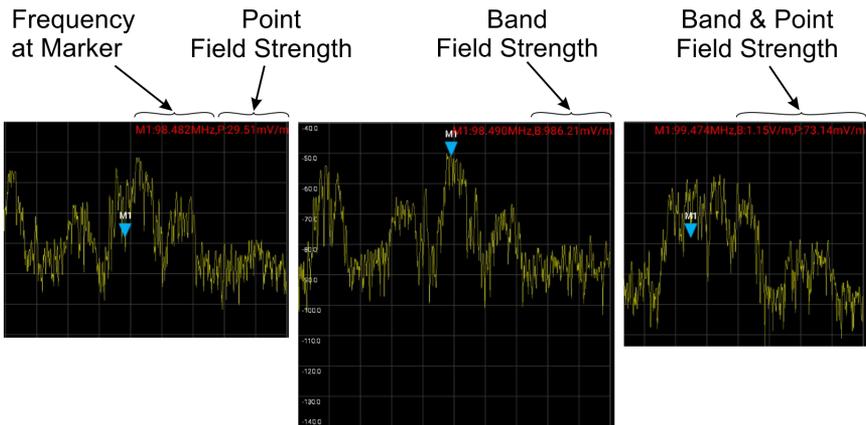
Antenna Gain  
Characterization  
File Selection

## Field Strength Setup

**Note:** Accurate Field Strength measurements require the gain of the antenna being used for the measurement. To include antenna gain in the measurement a file is selected and loaded during setup of the measurement, see "[Data File Examples](#)" on page 59 for information on creating antenna gain files.

- For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements. If Field Strength of a frequency band will be measured, set the span to the desired bandwidth.
- Select Field Strength in the Measure menu.
  - Select **point**, **band**, or **Point/Band** from the left side of the Field Strength setup dialog. See [Figure 19](#).
  - Select the appropriate file containing the antenna gain values for the antenna connected to the SignalHawk from the right side of the Field Strength setup dialog.
  - Tap OK  
A message will be briefly displayed indicating the antenna gain file loaded successfully.
- Tap **Peak Search** to display a marker indicating the Field Strength at the marker position. See [Figure 20](#) for examples of the marker displays for each Field Strength Measurement type.
- Move marker, if required for Point Field Strength Measurements.

**Figure 20** Field Strength Measurement Displays



## FM Measurement

The FM measurement may be used to demodulate a signal in the FM spectrum. When an FM signal of interest is tuned as the center frequency, the demodulated signal may be listened to through the SignalHawk's speakers or recorded (.wav) for playback later.

**Figure 21** FM Measurement

The screenshot shows the SignalHawk app's FM Measurement screen. At the top, it displays 'Bird' and the time '8/9/19 00:44:25' with a 72% battery icon. Below this are tabs for 'SA1', 'SA2', and '+'. The main display area shows a spectrum plot with a vertical red line indicating the demodulation frequency. A red dot on the plot is labeled 'Start Recording'. At the bottom, there are buttons for 'Measure FM', 'Coupler All', 'Pre Amp 2 On', and 'Detector Positive'. Annotations with arrows point to various elements: 'Volume Control Tap to Display Slider' points to a volume control icon; 'Vertical Red Line Indicates Demod Frequency' points to the red line; 'Tap Red Dot to Record Demod Signal' points to the red dot; and 'Tap Again to Stop Recording' points to a red dot on a smaller inset of the spectrum plot.

Volume Control Tap to Display Slider

Vertical Red Line Indicates Demod Frequency

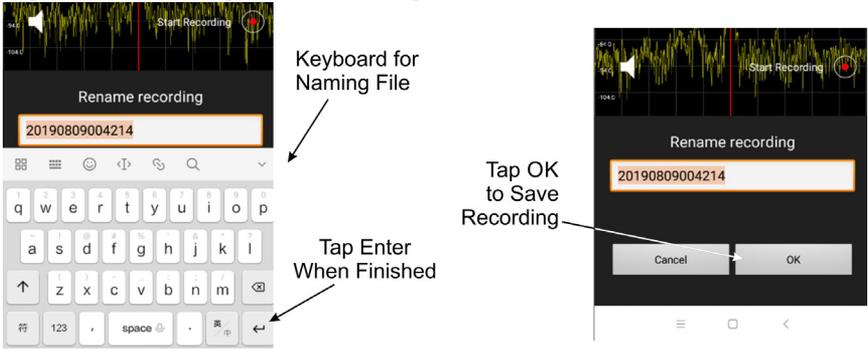
Tap Red Dot to Record Demod Signal

Tap Again to Stop Recording

## FM Setup

1. For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.
2. Select FM in the Measure menu.
3. Tap volume control to adjust volume, if required.
4. Adjust frequency, if required, for best signal.
5. Tap record button to record demodulated sound.
6. Tap record button again to stop recording.
7. Enter a name, if required, for the file.
8. Press Enter key when naming is complete.
9. Tap OK to save the file.

**Figure 22 Saving FM Recording**



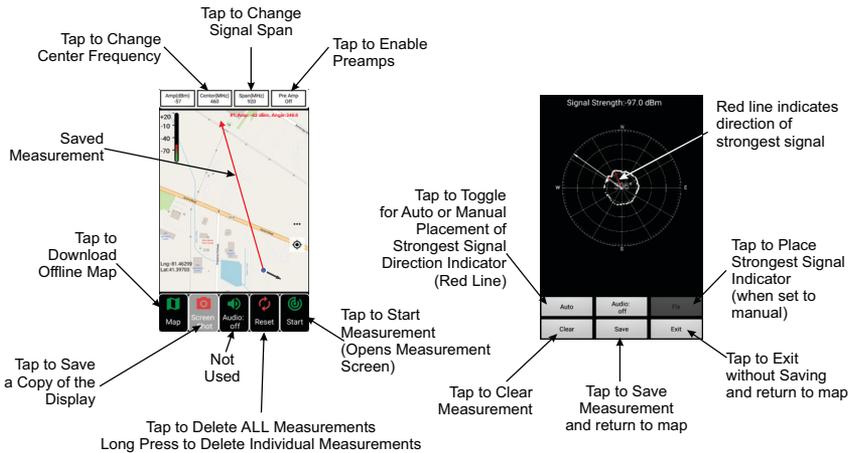
## AoA Locate Measurement

**Note:** AoA Locate is not available on the SH-60S-TC.

The Angle-of-Arrival (AoA) Locate Measurement provides the ability to locate the source of unknown and/or interfering RF signals. During the AoA locate measurement the SignalHawk senses the direction of arrival of the transmitting signal, then calculates the relative orientation or angle, see [Figure 23](#).

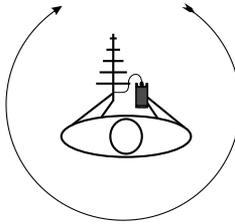
To discover the location of an unknown signal, use the SignalHawk’s AoA Locate measurement to “Triangulate” on the signal. This technique uses three or more measurements to identify the location of the unknown signal. See "[RF Signal Triangulation](#)" on [page 40](#).

**Figure 23 AoA Locate Measurement**

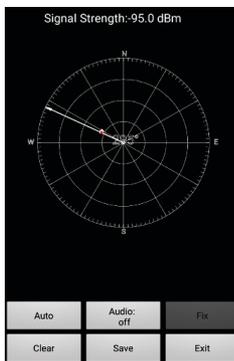


## AoA Locate Setup

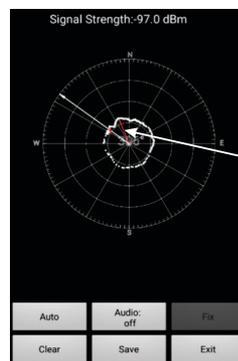
1. Turn on the SignalHawk’s WiFi and connect to a WiFi network.
2. Tap the System Settings icon: 
3. Tap the GPS button, to turn GPS ON.
4. Select the AoA Locate Measurement in the Measure menu.
5. Tap the Map button to download an offline map.
6. Connect a hand held directional antenna, tuned to the frequency of the interfering signal, to the SignalHawk.
7. In a clear area, outdoors, hold the antenna in front of you, with the direction of the antenna and the head-end of the SignalHawk facing the same direction. See [Figure 24](#).

**Figure 24 Aoa measurement**

8. Take a measurement:
  - a. Tap Start button.
  - b. Slowly rotate 360 degrees. See [Figure 24](#).
  - c. Tap Save.

**Figure 25 Measurement Interface**

Start of measurement



After complete 360° rotation

9. Move to a new location 80 to 100 degrees in azimuth away from the location of the last measurement.
10. Repeat [step 8](#) and [step 9](#) until you have completed three or more measurements and the measurements form a triangular shape near the assumed position of the emitter.

## RF Signal Triangulation

Triangulation is one technique you may use to determine the location of an RF emitter. The principle is to take three or more measurements from different locations, with each measurement location being 80 to 100 degrees in azimuth away from the location of the previous measurement. See [Figure 26](#) for an example of the triangulation technique.



## GPS Signal Quality Measurement

The GPS Signal Quality measurement is used to analyze Global Navigation Satellite System (GNSS (GPS, BeiDou)) signal quality through Carrier-to-Noise Ratio (CNR) Loss and Jammer-to-Noise Ratio (JNR).

Three measurement options are available **Single Band**, **BD**, and **GPS**.

**Single Band option** — Displays the spectrum, a power meter, and power levels for GPS Signal Quality and JNR in decibels. Each GPS and BeiDou band is selectable from the display screen.

**BD option** — The BD option, displays a power meter for each of the five BeiDou satellite bands,

**GPS option** — The GPS option, displays power meters for each of the three GPS satellite bands.

**Figure 27 GPS Signal Quality Displays**



Single Band Display

BeiDou Display

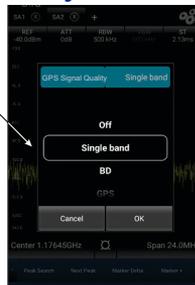
GPS Display

## GPS Signal Quality

1. Disconnect antenna or other signal source connected to the SH-60's Antenna Port.
2. Select **GPS Signal Quality** in the Measure menu.
3. Select desired measurement option: **Single Band**, **BD**, or **GPS**. See [Figure 28](#).

**Figure 28 GPS Signal Quality Measurement Type Selection**

GPS Signal Quality Measurement Type Selection



GPS Signal Quality Measurement Turns on Both Preamps



**Note:** Prior to calibrating the GPS Signal Quality measurement, disconnect antenna or other signal source.

4. Tap the Calibrate button on the GPS Signal Quality display.
5. Connect sampling antenna which has response in the GPS frequency band to antenna port on the SignalHawk.
6. Measurements for the selected Satellite band(s) will be displayed.
  - a. Single Band Measurement: Select the desired band, see [Figure 29](#).
  - b. BD and GPS displays will update each frequency individually, updating the measurement information after each band is measured.

**Figure 29** Single Band Measurement Frequency selection



Tap to Select  
Satellite Frequency Band

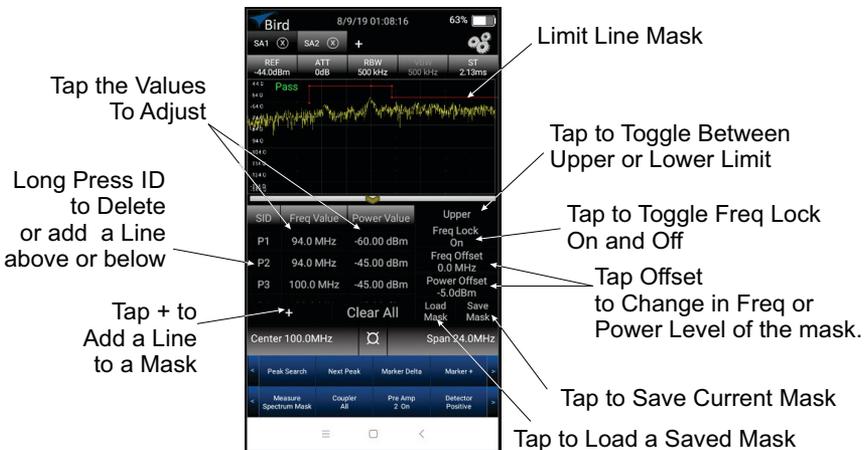
## Spectrum Mask Measurement

This allows limit lines to be placed on the display. Multiple limit lines may be added creating elaborate mask around signals of interest. Once in-place, if the signal crosses the plane of a limit line, the word **Pass** or **Fail** is displayed in the upper left corner of the display.

Limit lines may be set to upper or lower, When set to Upper, if the signal is below the limit line **Pass** is displayed, when the signal moves above the limit line **Fail** is displayed. When set to Lower, the Pass or fail criteria are reversed.

Masks may be created on the SignalHawk, using the setup procedure ("[Spectrum Mask Setup](#)" on page 44) or a mask can be created on a PC and saved as a data file (.CSV), the data file is loaded from the Spectrum Mask Measurement Screen. See "[Data File Examples](#)" on page 59 for information on creating Spectrum Mask files for use with Spectrum Mask Measurement.

**Figure 30 Spectrum Mask**



## Spectrum Mask Setup

- For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.
- Select Spectrum Mask in the Measure menu.
- Tap + to add a point.
  - Tap Freq Value, adjust frequency to the desired frequency.
  - Tap Power Value, adjust power to the desired level.
- Tap + to add a point (the new point will have the same values as the previous point).
  - Tap Freq Value, adjust frequency to the desired frequency.
  - Tap Power Value, adjust power to the desired level.

**Note:** *Once two points have been entered a line will be displayed between the two points.*

5. Repeat [step 3](#) and [step 4](#) to create the desired mask.

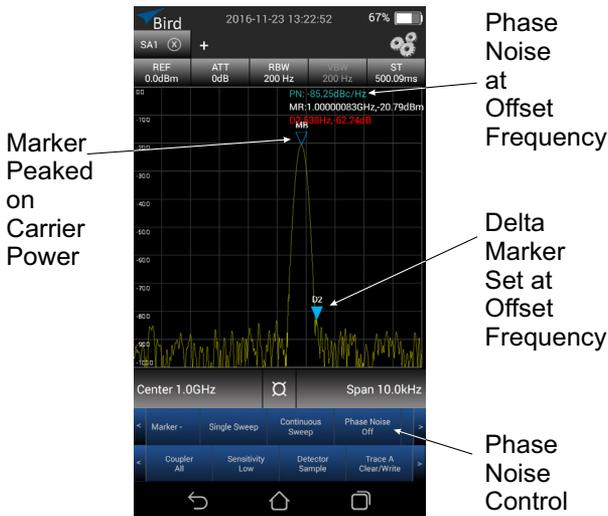
**Note:** *Long press on a point ID to delete the point or add a point above or below the selected point.*

## Phase Noise Measurement

Signal fluctuations appear as noise spreading out above and below the carrier. High Phase noise can reduce signal quality possibly increasing the communications link's error rate.

The SH-60S provides a tool to quickly measure phase noise at a user specified frequency above or below the carrier. A marker is used to measure the carrier power, a delta marker is used to display the difference in frequency and power from the carrier, and the Phase Noise is displayed in dBc/Hz at the location of the delta marker. The Phase Noise is the noise power in a 1 Hz bandwidth at the offset from the carrier.

**Figure 31 Phase Noise Measurement**



## Phase Noise Setup

1. For the best accuracy, set the center frequency so the main or carrier signal is centered on the screen before taking measurements.
2. Tap Phase Noise control to turn on the Phase Noise measurement.

The Carrier Marker and the Delta Marker will be displayed. Phase Noise and the Marker values will be displayed in the area at the top right of the display.

3. Position the markers as needed to measure Phase Noise.

## Power Measurements

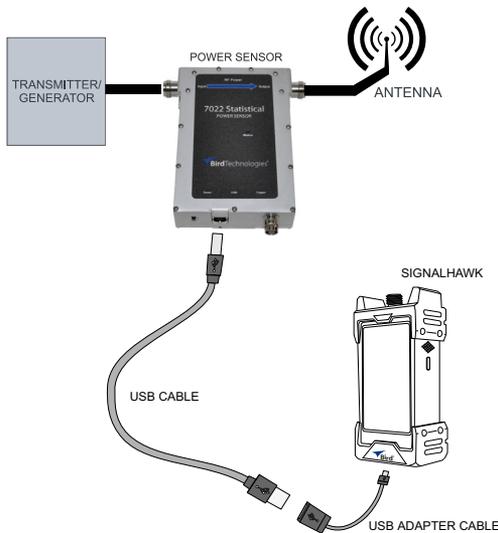
**Note:** The Spectrum Analyzer will not continue to measure RF signals while a USB Sensor is connected. Exit the SignalHawk application prior to connecting a USB Power Sensor to the SH-60S. See ["Exit SignalHawk App" on page 8.](#)

The SH-60S is capable of making RF power measurements using the Bird RF Meter App when connected to a compatible Bird Power Sensor. The SH-60S may be connected to a Bird Power sensor using the supplied USB Adapter and the USB cable supplied with the power sensor, see [Figure 32](#). Consult the RF Meter App's help content for a list of compatible sensors and measurements that are available for each sensor.

The Bird RF Meter App is included with the SH-60S and may be started from the Home screen by tapping the App's icon:



**Figure 32 Power Sensor Connections**



**Cleaning**

---

Care and cleanliness is a main factor in maintenance, clean the SH-60S with a soft cloth dampened with a mild detergent solution.

**Troubleshooting**

---

| <i>Problem</i>  | <i>Resolution</i>   |
|---|---|
| Spectrum Analyzer “hangs up” with USB device connected to the SH-60S. | Once the USB device is disconnected, exit the app, restart the SignalHawk app from the home screen. |

**Repair**

---

**Battery Replacement**

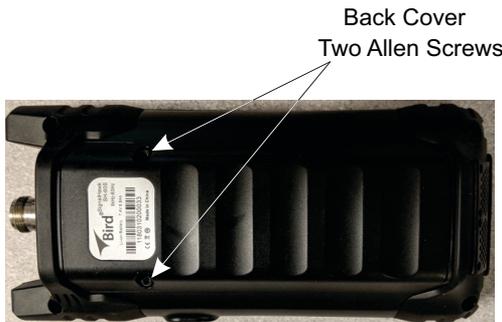
---

**CAUTION**

Replace battery pack with OEM part only, do not use any other battery.

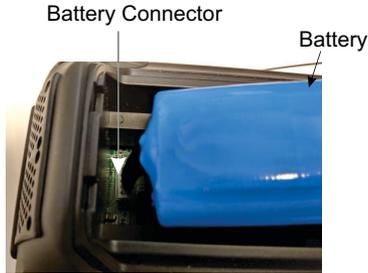
1. Power off the SignalHawk. See "[Power Off](#)" on page 10.
2. Disconnect AC Supply cable, if connected.
3. Remove two screws securing the back cover. See [Figure 33](#).

**Figure 33 Back Cover Removal**



4. Disconnect battery connector from chassis. See [Figure 34](#).

**Figure 34 Battery Connection**



5. Install replacement battery.
6. Install two screws to secure the back cover. See [Figure 33](#).
7. Charge the battery. See "[Charge the Battery](#)" on page 5.

## File System

The Spectrum Analyzer stores Screen Captures and Custom Configurations on the SH-60S internal file system.

### Transfer files

Files may be transferred to/from the SH-60S using a USB Drive or via Bluetooth transfer. For instructions on how to make transfers, see "[Data Transfer via USB Drive](#)" on page 50 or "[Data Transfer via Bluetooth](#)" on page 52.

### Data Transfer via USB Drive

**Note:** *The SH-60S will not continue to measure RF signals while a USB drive is connected. Exit the SignalHawk application prior to connecting a USB drive to the SH-60S.*

Files may be transferred to/from the SignalHawk internal memory with the use of an external USB drive and the USB adapter (supplied).

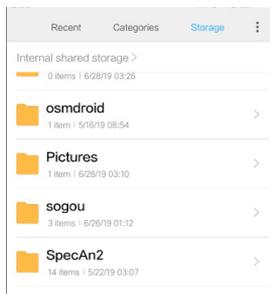
1. Connect the USB drive to the USB adapter, then connect the USB adapter to the USB-C port at the bottom of the unit.
2. Press Home key on the SignalHawk display.
3. Tap the File Manager icon on the unit's home screen.

### Figure 35 File Manager



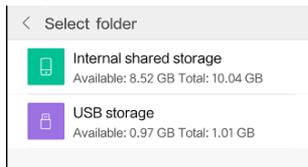
4. Tap LOCAL at the top of the File Manager window.
5. Tap Storage.
6. Scroll to the SpecAn2 folder, see [Figure 36](#).
7. Tap the SpecAn2 folder.

### Figure 36 File Selection



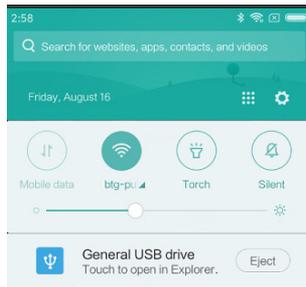
8. Tap the folder containing the file(s) to be moved.
  - Save - contains saved configuration files and MaskFile Folder.
  - Screen copy - contains screen copies from the spectrum analyzer.
  - Manual - contains pdf copies of this manual.
  - FMRecord - contains recordings saved during FM measurement.
  - Antenna - Contains Antenna Gain files, used for Field Strength measurement.
9. Long press a file to be copied.
10. Select any additional file(s) to be copied.
11. Tap the more icon: 
12. Tap **Copy**.
13. Select USB storage. See [Figure 37](#).

**Figure 37 External Storage**



14. Navigate to the directory where the file will be saved.
15. Tap **Paste** at the bottom of the screen to save the file(s) onto the USB drive.
16. Exit the File Manager.
17. Swipe down from the top of the screen to access the notification area. See [Figure 38](#).

**Figure 38 Eject USB Storage**



18. Tap Eject.
19. You may now remove the USB Drive.

## Data Transfer via Bluetooth

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

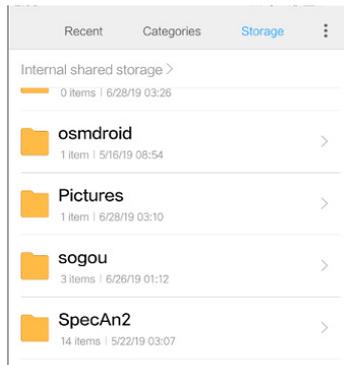
1. Tap Home key on the SignalHawk display.
2. Select Settings.
3. Turn on Bluetooth.
4. Tap Home key.
5. Tap the File Manager icon on the unit's home screen.

**Figure 39** File Manager



6. Tap Storage at the top of the File Manager window.
7. Scroll to the SpecAn2 folder, see [Figure 40](#).
8. Tap the SpecAn2 folder.

**Figure 40** File Selection



9. Long press a file to be copied.
10. Select any additional file(s) to be copied.
11. Tap Send icon:



12. Select Bluetooth option for sharing.
13. Tap Refresh for available devices.

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

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

## Delete Files

---

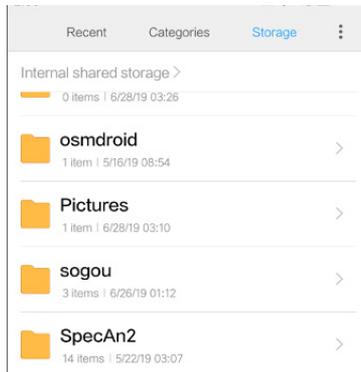
1. Press Home key on the SignalHawk display.
2. Tap the File Manager icon on the unit's home screen.

**Figure 41 File Manager**



3. Tap Storage at the top of the File Manager window.
4. Scroll to the SpecAn2 folder, see [Figure 42](#).
5. Tap the SpecAn2 folder.

**Figure 42 File Selection**



6. Tap the folder containing the file(s) to be deleted.
  - Save - contains saved configuration files and MaskFile Folder.
  - Screen copy - contains screen copies from the spectrum analyzer.
  - Manual - contains pdf copies of this manual.
  - FMRecord - contains recordings saved during FM measurement.
  - Antenna - Contains Antenna Gain files, used for Field Strength measurement.
7. Long press a file to be copied.
8. Select any additional file(s) to be copied.
9. Tap the Delete icon:   
Delete
10. Tap Delete on the "Delete this file?" popup dialog to delete the files.

## Firmware Updates

---

Occasionally Bird may update the SH-60S spectrum analyzer software, updates may be downloaded when available from [www.birdrf.com](http://www.birdrf.com).

1. Go to [www.birdrf.com/Products/Test and Measurement/Analyzers/Spectrum-Analyzers/](http://www.birdrf.com/Products/Test%20and%20Measurement/Analyzers/Spectrum-Analyzers/).
2. Select SH-60S.
3. Scroll down to the Downloads.
4. Click on the Firmware link.
5. Download the SignalHawk-Firmware-XXX.apk update file.
6. Connect the USB Drive to the PC.
7. Transfer the SignalHawk-Firmware-XXX.apk update file to the USB drive.
8. Remove the USB drive.
9. Connect the USB drive to the USB Adapter.
10. Connect the USB Adapter to the SignalHawk.
11. Turn on the SignalHawk.
12. Connect AC Adapter to the SH-60S or verify battery has sufficient charge.
13. Tap "File Manager" on the home screen.
14. Tap Storage at the top of the File Manager window.
15. Tap "USB storage".
16. Tap SignalHawk-Firmware-XXX.apk.
17. 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](mailto:bsc@birdrf.com)

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

<http://www.birdrf.com>

## Signal Analysis Specifications

|  |   |
|--|---|
| Frequency Range  | 10 MHz - 6 GHz  |
| Frequency Reference Aging  | ±1 ppm  |
| Frequency Span Accuracy  | ±1 %  |
| Frequency readout accuracy   | ±((readout frequency + 1 GHz) x Frequency Reference + Frequency Span Accuracy x Span)   |
| Sweep Time   | 1.2 ms - 1600 s<br>3.99 ms - 1600 s (Zero Span)   |
| Resolution Bandwidth (RBW) Range   | 10 Hz - 5 MHz   |
| RBW Accuracy   | ≥1 MHz, ±10 %<br><1 MHz, ±2 %   |
| Measurement Range  | DANL to +20 dBm   |
| Input Attenuator Range   | 0-30 dB, 1 dB step  |
| Max Safe Input Level vs. Pre-amp<br>All Amps Off<br>1 Amp On<br>All Amps On  | +20 dBm<br>-20 dBm<br>-40 dBm   |
| Reference Level Range<br>(Ref Level Offset: OFF)<br>(Ref Level Offset: ON)   | -140 dBm - +20 dBm<br>-190 dBm - +70 dBm  |
| Amplitude Accuracy<br>ATT set to 0 dB, Detector set to Positive, Sensitivity set to Low, RBW auto-coupled, all other settings auto-coupled, 23±5° C, Half hour warm-up required. | input signal -5 to -30 dBm<br>±1.5 dB   |
| RBW Switching Uncertainty  | ±0.3 dB   |
| Input Attenuator Uncertainty   | ±0.6 dB   |
| Reference Level Accuracy   | ≥-60 dBm, ±0.8 dB   |
| Display Average Noise Level (DANL)<br><br>All Amps Off - Low Power<br>1 Amp On - Medium Power<br>All Amps On - High Power  | Input terminated, Detector set to Positive, Trace Average set to 1000, Span set to 50kHz, Reference level of -100 dBm, all other settings auto-coupled, 23±5° C, normalized to 1 Hz RBW<br><br>1 GHz, -129 dBm/Hz (typical -132 dBm/Hz)<br>1 GHz, -149 dBm/Hz (typical -152 dBm/Hz)<br>1 GHz, -166 dBm/Hz (typical -168 dBm/Hz) |
| Residual Responses   | -75 dBm   |

|   |   |
|---|---|
| Input Related Responses   |   |
| 10 M-1.1 G  | <-70 dBc  |
| 1.1-1.85 G, 2.9-2.97 G  | <-41 dBc  |
| 1.85-2.9 G, 2.97-3.11 G, 3.7-5.6 G  | <-50 dBc  |
| 5.6-5.8 G   | <-45 dBc  |
| 3.11-3.70 G,5.6-6.0 G   | <-39 dBc  |
| Second harmonic distortion  | 1.6 GHz -70 dBc   |
| Third-Order Intercept (TOI)<br>(-10 dBm tones ,1 MHz apart,<br>Sensitivity LOW,<br>Reference Level -10 dBm) | +15 dBm   |
| P1dB  | +5 dBm Nominal  |
| Phase Noise (1GHz)  | -95 dBc/Hz, @10 kHz (typical -97 dBc/Hz)<br>-115 dBc/Hz, @1 MHz (typical -116 dBc/Hz) |

## Device Characteristics

---

### Physical characteristics

---

|                        |   |
|------------------------|---|
| Connectors             |   |
| RF In                  | N type, female,50 $\Omega$                |
| USB                    | USB type C                                |
| Power interface        | Slim Tip, DC 20 V, 4.5 A                  |
| Display                | 5.5 inch, 1280*720 p                      |
| Battery Type           | Li-on                                     |
| Battery Operating time | 3.5 to 6 hours                            |
| Battery Charging time  | 2 to 2.5 hours                            |
| Operating Temperature  | 0° C to 50° C                             |
| Storage Temperature    | -20° C to 70° C                           |
| Size                   | 7.8 x 3.9 x 2.6 inches (200 x 99 x 67 mm) |
| Weight                 | 2.8 lbs (1.25 kg)                         |

## Software Characteristics

|                   |   |
|-------------------|---|
| OS                | Android   |
| Languages         | English, Chinese  |
| Markers           | 8 maximum (1 reference with 7 delta markers)<br>Peak Search, Marker Delta, Marker+, Marker-                   |
| Traces            | 3 maximum: trace A, trace B, trace C<br>Trace Operation: clear/write, max hold, min hold, average, view, hide |
| Number of screens | 4 maximum   |
| Measurement       | ACPR, CH Power, OBW, N dB Down, Phase Noise   |
| Sweep             | Continuous/Single   |
| Trigger           | Free<br>Video (Zero Span)   |
| Span              | 0 Hz, 10 MHz - 6.0 GHz<br>Freq Slip, Span Zoom(1-2-5-10 Sequence, 4 GHz, 6 GHz)                               |
| Scale             | Log/Lin<br>Log : 0.1 to 1 - 0.1 step<br>1 to 10 - 1 step  |
| Unit              | dBm, dBuV, dBV, W, mW, uW, pW, V, mV, uV  |
| Sensitivity       | Low, Medium, High   |
| Detector          | Positive, Negative, Sample, Average, RMS  |
| Ref Level Offset  | -50 dB to 50 dB   |

## Antenna Gain Data File Example

---

Field Strength Measurement uses antenna gain characterization files to use when calculating an RF signal's strength.

[Figure 43](#) shows the details of the contents of this file. Should you have an antenna you will be using for Field Strength measurements, you can easily create a file for use with the signal Hawk.

**Column A** — Frequencies the antenna is designed to receive.

**Column B** — the antennas gain at the specified frequency.

**Note:** *The Antenna Gain file must be saved with a .xls file format.*

When saving the Antenna gain file to the SignalHawk, the file must be stored in the following folder:

**Internal Shared Storage/SpecAn2/Antenna**

**Figure 43** *Antenna Gain Example*

|    | A       | B            | C | D | E |
|----|---------|--------------|---|---|---|
| 1  | 7.799   | -64.19833152 |   |   |   |
| 2  | 15.299  | -47.71709028 |   |   |   |
| 3  | 22.798  | -48.99975323 |   |   |   |
| 4  | 30.297  | -50.52472445 |   |   |   |
| 5  | 37.796  | -47.69426232 |   |   |   |
| 6  | 45.295  | -47.17821808 |   |   |   |
| 7  | 52.795  | -42.17779278 |   |   |   |
| 8  | 60.294  | -46.20597976 |   |   |   |
| 9  | 67.793  | -49.13187219 |   |   |   |
| 10 | 75.293  | -46.43117471 |   |   |   |
| 11 | 82.792  | -44.00383698 |   |   |   |
| 12 | 90.291  | -45.85727609 |   |   |   |
| 13 | 97.79   | -50.68577626 |   |   |   |
| 14 | 105.29  | -48.14484947 |   |   |   |
| 15 | 112.789 | -49.93605326 |   |   |   |
| 16 | 120.288 | -57.70649768 |   |   |   |
| 17 | 127.787 | -57.46385398 |   |   |   |
| 18 | 135.286 | -61.62619216 |   |   |   |
| 19 | 142.786 | -56.64686445 |   |   |   |
| 20 | 150.285 | -57.55956437 |   |   |   |
| 21 | 157.784 | -51.71809111 |   |   |   |
| 22 | 165.284 | -47.76641258 |   |   |   |
| 23 | 172.783 | -47.80371062 |   |   |   |
| 24 | 180.282 | -49.16919705 |   |   |   |
| 25 | 187.781 | -44.39220425 |   |   |   |
| 26 | 195.28  | -38.28214306 |   |   |   |
| 27 | 202.78  | -37.79346954 |   |   |   |

## Spectrum Mask File Example

A Spectrum Mask file may be created manually for use with the Spectrum Mask Measurement on the SignalHawk.

[Figure 44](#) shows the details of the contents of this file.

**First Row** — The first row contains the heading for each column, these values must be as shown in [Figure 44](#).

**Column A** — Contains the number of points used for the mask, these must begin with the letter P followed by a number, the numbers must begin at 1 and be in numerical order.

**Column B** — The frequency value of the associated Point ID.

**Column C** — The power value (dBm) of the associated Point ID.

**Column D** — First row only, designates the mask as upper or lower limit.

**Note:** *The Spectrum Mask file must be saved with a .CSV file format.*

When saving the Spectrum Mask file to the SignalHawk, the file must be stored in the following folder:

**Internal Shared Storage/SpecAn2/Save/MaskFile**

**Figure 44 Spectrum Mask File**

|   | A     | B              | C               | D        |
|---|-------|----------------|-----------------|----------|
| 1 | Point | FreqValue(MHz) | PowerValue(dBm) | MaskMode |
| 2 | P1    | 700.1          | -45             | UPPER    |
| 3 | P2    | 800.6          | -45             |          |
| 4 | P3    | 800.6          | -65             |          |
| 5 | P4    | 900.2          | -65             |          |
| 6 | P5    | 900.2          | -45             |          |
| 7 | P6    | 980.1          | -45             |          |
| 8 |       |                |                 |          |

The Mask created above in [Figure 44](#) would display on the screen as shown in [Figure 45](#).

**Figure 45 Spectrum Mask Display**

|       |  |  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|--|
| - 34  |  |  |  |  |  |  |  |  |
| - 44  |  |  |  |  |  |  |  |  |
| - 54  |  |  |  |  |  |  |  |  |
| - 64  |  |  |  |  |  |  |  |  |
| - 74  |  |  |  |  |  |  |  |  |
| - 84  |  |  |  |  |  |  |  |  |
| - 94  |  |  |  |  |  |  |  |  |
| - 104 |  |  |  |  |  |  |  |  |
| - 114 |  |  |  |  |  |  |  |  |
| - 124 |  |  |  |  |  |  |  |  |



# Limited Warranty

The product described in this manual 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.