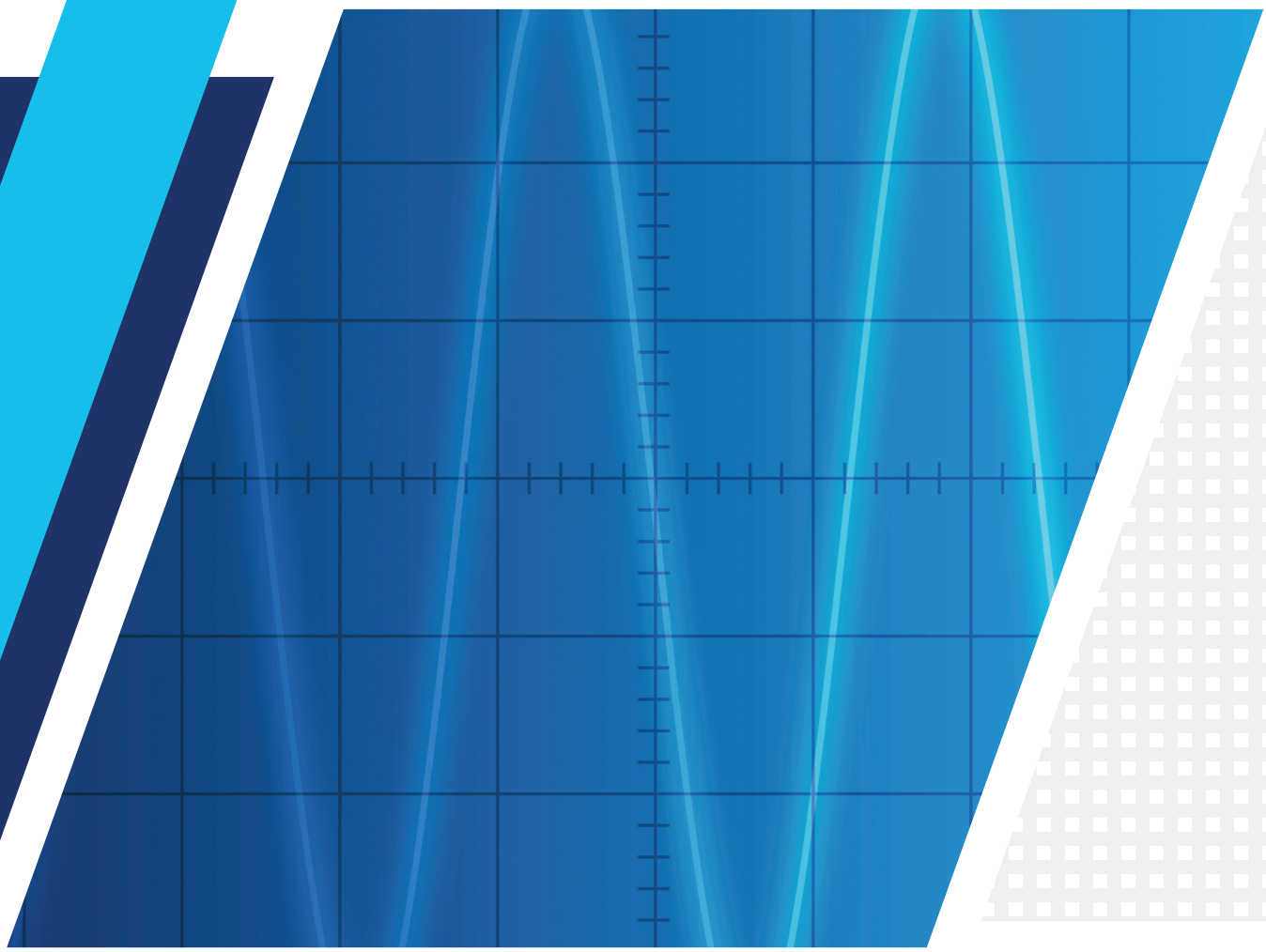
APPLICATION NOTE



RF Interference Hunting

Find, locate, and eliminate problems

RF Interference Hunting

Triangulation with Bird's SignalHawk SH-60S-AOA

Have you ever heard stories on the news or experienced yourself having issues with garage door openers? Maybe not operating at certain times of the day? What about those times your key fobs were not operating and you know the battery is good?

Maybe you have heard of the local police department complaining about their 2-way radios being taken down occasionally?

These are just a few examples of true stories where an RF Interferer caused problems with a device. Bird understands how frustrating this can be and using our SH-60S-AOA handheld spectrum analyzer can help you find, locate, and eliminate these problems. Being highly portable allows you to go to the area in question and accurately pinpoint the signal's origination.

What is Angle of Arrival (AOA)?
AOA stands for "Angle of Arrival", also known as automatic direction finding.

- **AOA** is the direction from which an RF Signal is received.
- **AOA** is used to discover the location of an interfering signal, such as an unlicensed radio transmission, or other types of generators, producing RF signals disrupting lawful transmissions.
- **AOA** measurement locates and senses the direction of the arriving transmitting signal, then calculates the relative orientation or angle
- **AOA** triangulation is when three or more measurements cross to identify the location of the unknown signal.

What are some applications of AOA?
When identifying situations where you would need the AOA functionality, here are some common interfering sources.

- Faulty or poorly shielded electronic devices that can allow energy to leak out and interfere with other RF devices. Noise can result from a tiny break in the shield or insulator that can create an inadvertent transmission and that could broadcast in unknown locations, frequencies and times.
- Electronic devices configured incorrectly.
- Electronic devices that are not compliant with local regulations.
- Jammers and Deliberate Interference.

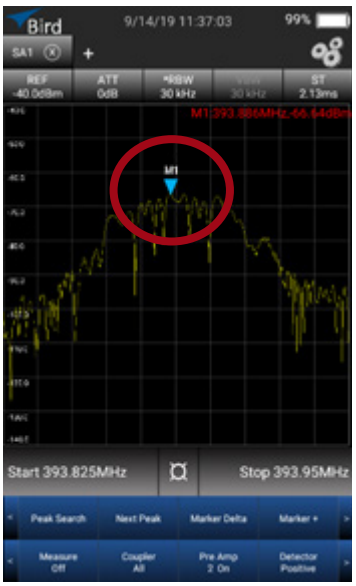
Understanding AOA
AOA uses a technique called Triangulation, where a signal strength sample is recorded in different locations, and the position is marked on a map, forming a triangle. A minimum of three or more samples, or Vectors, are recorded, and where they intersect, the interfering signal is found.

How to perform an AOA Measurement
Bird's SH-60S-AOA is an advanced model spectrum analyzer, containing interference analysis capability with mapping. Users can triangulate the location of an interferer based on power levels with a directional antenna.

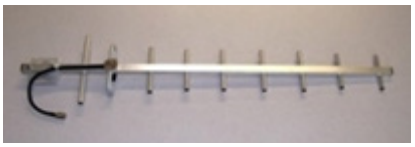
What information do I need to know besides having the SH-60S-AOA?
You will need:

- User's frequency of interest and be able to identify it on a spectrum analyzer
- GPS and Wi-Fi enabled and be connected to a Wi-Fi network
- Once GPS location is established you can download local map of the area.
- A directional antenna tuned to the interfering signal frequency.

Identify the signal



- Ensure that GPS and WiFi are enabled, and the SH-60S-AOA is connected to the internet.
- Identify the signal of interest
- Place a marker on the signal
- Zoom in and center the signal of interest by narrowing the frequency range.

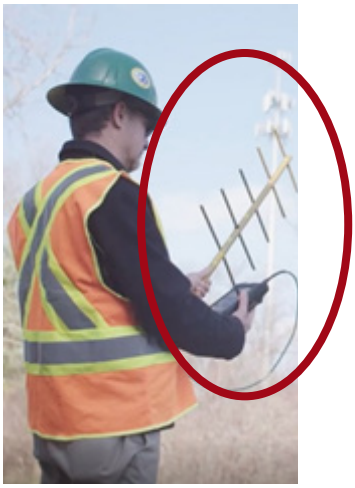


Tip:
Be sure to use a directional antenna appropriate to the frequency of interest.

Get your map

- Select "AOA Locate" from Measurements menu and wait for the SignalHawk to establish GPS position.
- SignalHawk will download a map of the surrounding area.

Align your Antenna
Keep the antenna aligned with the SignalHawk and rotate until a consistent direction (shown in red) is established. An integrated or electronic compass is inside the SH-60S-AOA. It is very important that the antenna and SH-60S-AOA be oriented in the same direction.



Save your Signal

- The direction with the strongest signal strength will be shown as a black line.
- The relative strength and vector is displayed at the top of the screen.
- The lat/long will be displayed at the bottom left.

Repeat steps for Location #2
Repeat steps for Location #3

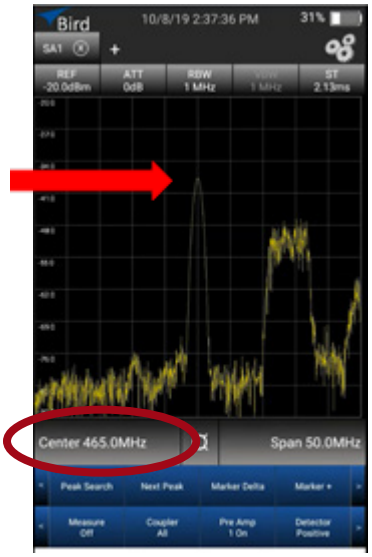
Real Life Example

Let's walk through an example with the SignalHawk that we did at our own Corporate Headquarters.

Tips:

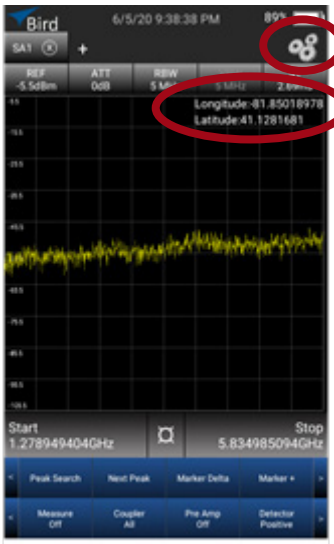
- Before using the AOA feature, be sure to download your map.
- A minimum of 3 vectors should be performed for more precise location of the area of uncertainty.
- Note: densely populated areas will be more difficult to pinpoint due to building interference.
- The result of triangulation is to help narrow down the target area.

Verify that an interferer is present



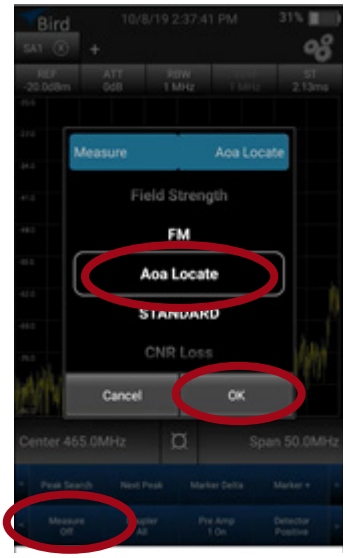
- Verify an interferer is present
- Center the interfering signal
- Zoom in on the interferer
- It appears at 465 MHz

Getting Started

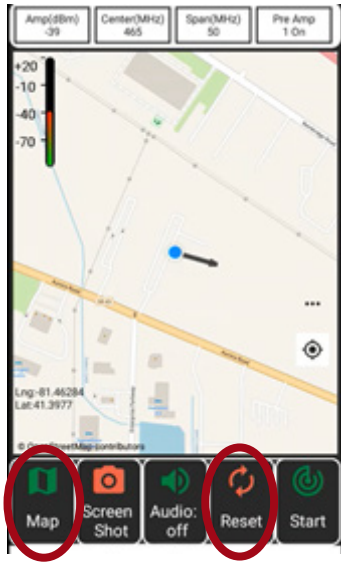


- Start by tapping gears icon
- Tap GPS to turn on
- Verify coordinates are locked
- Needs outdoor line-of-sight. (limited use indoors)
- May take 30 seconds to 2 minutes to lock

Setup SignalHawk

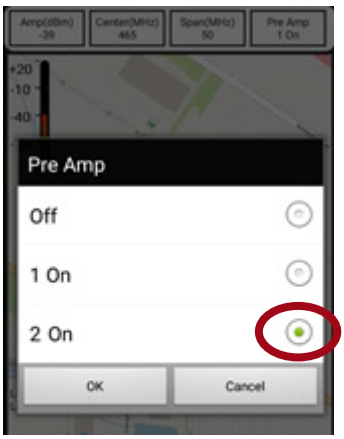


- Press Measure
- Select AOA Locate
- Press OK

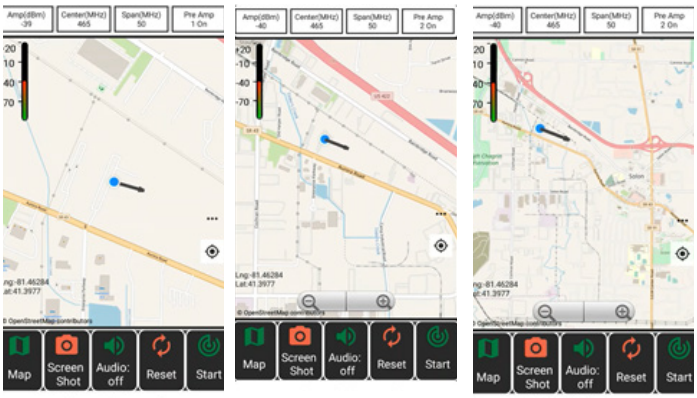


- Previously downloaded map will appear
- To update map, press Map
- To clear coordinates, press Reset
- Note: Need WIFI to dynamically load map or have maps pre-loaded
- Tip – Ensure map of your required coverage area is displayed before venturing out

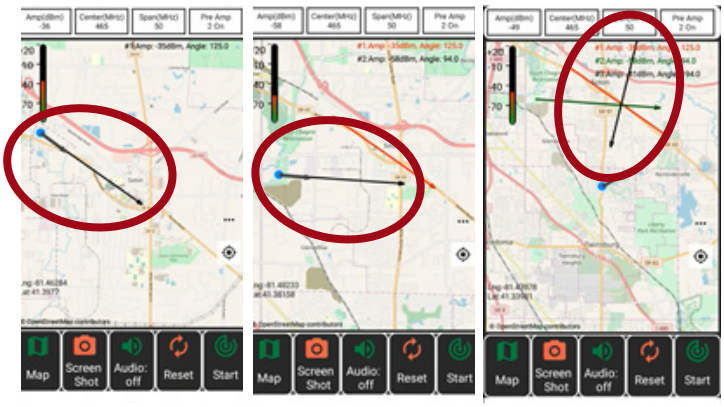
- Turn Pre-amp on to amplify the signal by tapping Pre Amp



- Select pre amp 1 or 2
- Press OK



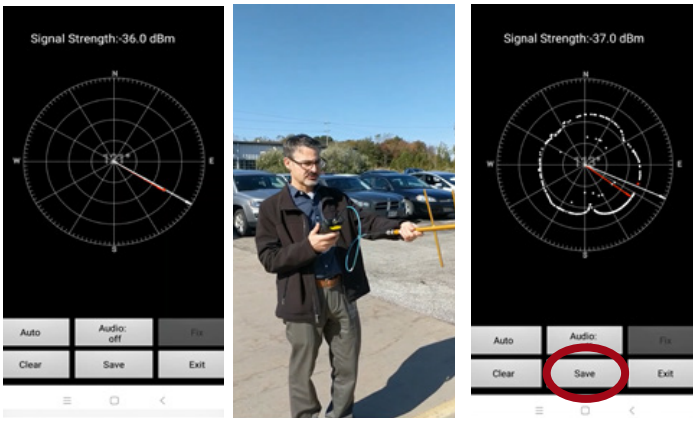
- Uses the built in GPS and a mapping program.
- Zoom in or out of map by dragging and pinching with finger and thumb.



1st vector marked

Repeat process to Mark 2nd vector

Repeat process to Mark 3rd vector

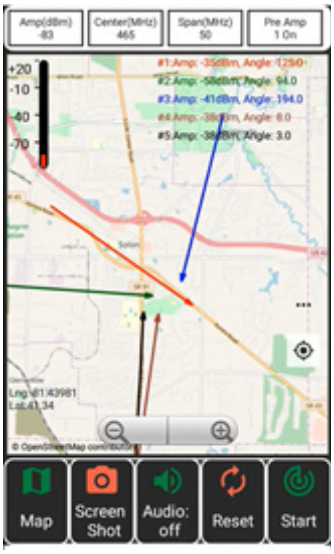


- Invoke Signal Strength Measurement by pressing Start (must have GPS Lock)
- Point Antenna and SignalHawk, while rotating in a circle, to find where the signal is strongest
- Continue pointing until circle is complete
- Mark 1st vector by pressing Save

- Triangulation is complete
- The **RED** circle is the location of the interferer

- Vector 1 is marked at -35dBm at an angle of 125°
- Vector 2 is marked at -58dBm at an Angle of 94°
- Vector 3 is marked at -41dBm at an Angle of 194°

- Walk around pointing the antenna
- Audio tone is loudest in direction of interferer
- Finally, the source of the interferer is found



- Tip – You can have more than 3 vectors
- The more vectors, the more narrowing down of the interfering signal location
- Zoom in or out by pinching the screen
- Pinpoint the source
- Invoke Audio Feedback to pinpoint source by tapping audio