



Owner's Manual

Revision 1.2



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1. Safety Instructions

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Follow all CAUTION notices to reduce the risk of personal injury, prevent damage to Sabre, accessories, and devices (computers, cameras, flashes, etc). Failure to follow all CAUTION notices may void your warranty. CAUTION may also indicate a potentially hazardous situation which, if not avoided, may result in personal injury.

The safety alert symbol  precedes a general CAUTION or WARNING statement.

The electrical hazard symbol  precedes an electric shock hazard CAUTION or WARNING statement.

 **CAUTION:** Only use the AD/DC power adapter (cube) that was included with your Sabre. Use of other power adapters or non-Cognisys equipment may damage the sensor and/or attached equipment.

Sabre is a laser range-finder that emits laser radiation. This Laser Product is designated Class 1 during all procedures of operation. This means that the laser is safe to look at with the unaided eye. However, it is advisable to avoid staring into the beam.

CLASS 1 LASER PRODUCT

CLASSIFIED EN/IEC 60825-1 2007

Complies with US FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

 **CAUTION:** No user should modify Sabre or operate it without its housing or optics. The operation of Sabre without a housing and optics or modification of the housing or optics that exposes the laser source may result in direct exposure to laser radiation and the risk of permanent eye damage. Removal or modification of the diffuser in front of the laser optic may result in the risk of permanent eye damage.

2. Getting Started

The latest version of this manual is available at

<https://www.cognisys-inc.com/downloads/sabre/SabreManual.pdf>.

The sections included in this manual may not be identical to the software that you are running. Improvements and adjustments to the software may happen prior to an updated version of the manual. You'll see several screen-shots in this manual. The screen may look different on the device/operating system you are using.

Not big on reading manuals? (We worked hard on this you know!) We have a few real world walk-throughs on our website, including some of the more difficult subjects to photograph:

<https://cognisys-inc.com/learn-how-to/tag/Sabre>

You can always come back to the technical details if you get stuck.

2.1 How It Works

There are several different infrared technologies out there to detect objects. We'll go through a quick discussion of their pros and cons.

Passive Infrared Detector (PIR/PID):

PIR sensors look for a change in temperature from the field of view they're currently looking at. The temperature change could be warmer or colder, causing the sensor to trigger.

Pros: Inexpensive

Cons: Slow response time, temperature based, poor performance through glass, no absolute distance (just that some temperature changed in its field of view), sensitive to sudden temperature changes (direct sunlight, followed by clouds).

Infrared Triangulation:

Infrared Triangulation uses a high-powered infrared LED transmitter (flashlight) and a sensitive infrared receiver (think of it as its eyeball). The transmitter sends out a pulse of infrared energy and then the receiver measures the angle of the reflected light. With a little trigonometry you can determine the distance an object is away from the sensor.

Pros: Absolute distance can be measured, fairly fast, not temperature sensitive

Cons: Maximum range and returned distance can be affected by sunlight, range is limited using IR LED's, the transmitter "fan-out" makes it difficult to detect small objects at a distance.

Laser Time of Flight (LIDAR):

This is the technology that Sabre incorporates. A high-powered (but eye-safe!) infrared laser is turned on and off rapidly (500 billionths of a second in Sabre's case). Sabre then measures the *time* it takes for that laser beam to get to the target and be reflected back to its detector. If you're a techno-geek, we can tell your ears have just perked up a bit. For the rest of you – this is really cool! The speed of light is *fast* -- 300 million meters per second, or 186,000 miles per second. The nice thing is that in our application, the speed of light is constant. So *if* you can measure how long it takes to get from the Sabre and back to it, you'll know the distance (since distance is: speed × time). The tricky bit is trying to measure something that fast – but we have that covered! To maintain the accuracy, over a hundred measurements are used for every “sample” that is used to determine the distance. Typical measurement accuracy is ±2.5cm/1in up to 15 meters/50 ft (5% worst-case). Also, because a laser is used instead of an infrared LED, the beam width/fan-out is quite small. At one meter (3.3ft), the beam is about 1cm/0.4in. At 10 meters (33ft), it is about 10cm/3.9in.

Pros: Accurate, long range, sunlight tolerant, temperature independent, fast response time

Cons: Expensive (sorry about that!)

2.2 Cleaning and Care

We want your Sabre to last – so here are some brief steps to keep your sensor happy!

2.2.1 Cleaning

For cleaning the housing and optical opening you can use a slightly dampened micro-fiber cloth. Do not spray water directly into the sensor. Do not use a flammable liquids or cleaning agents on the sensor – just a micro-fiber cloth (dampened).

It is important to keep the two optical openings clear of dust and debris. A burst of air might be all it needs to get dust free. Sabre needs to “see” in order to work!

2.2.2 Care and storage

Sabre is a precision piece of electronics. It's designed to handle normal wear and tear but there are some things to avoid:

- Do not submerge in water.
- Do not drop the unit.
- Protect the optical openings from damage. They are recessed to reduce debris and damage but a sharp object could still scratch the lens and potentially make the unit non-functional.
- Store Sabre with its battery charged (but not charging). Avoid storing with a completely discharged battery as this can significantly decrease the battery life.
- Periodically “top off” the battery if it will be stored for months.

2.3 The Sabre Sensor



Figure 1 – Sabre Sensor

Sabre has the following connectors/openings/buttons from top to bottom:

1. Laser Transmitter Opening (left)
2. Laser Receiver Opening (right)
3. Power On/Off
4. Mode Indicators
5. Set distance – Manual mode
6. Shutter active indicator
7. Wifi On/Off
8. Change Mode

On the bottom:

9. Solar/Auxiliary power connector (3-pin)
10. Dual-beam / Auxiliary shutter connector (4-pin)
11. Shutter / DC Power connector (5-pin)

2.4 Connection Diagram

Sabre uses weather-resistant connectors and cables. If the sensor will be used outside during the rain or condensing humidity, be sure to have the connectors locked in place (including the included connector caps). The 3.5mm and 2.1mm connectors must be kept dry.



Figure 2 - Connection Diagram

For alternative power connections (including solar) please see our website:

<https://cognisys-inc.com/learn-how-to/sabre-external-batt>

2.5 Connecting Power

Sabre uses a 12V DC power adapter to charge its internal battery as well as to operate. If Sabre is plugged into 12V DC it will automatically start charging the internal battery. You do not need to worry about “over-charging” the battery – it will automatically stop charging when fully charged. Sabre will charge its battery while either on or off. If it is on, you will see the power indicator fade in/out while charging. You can then continue to operate off of the DC power or remove it and run from battery.

To attach the power adapter to Sabre, simply plug it into the 2.1mm jack on the included 3.5mm/2.1mm interface cable.

2.6 Battery charging

Simply plug in the included 12V DC power adapter into the interface cable to begin charging. Sabre can be charged with power on or off. If Sabre is on, the power LED (above the power button) will show the current state of charging:

on – Fully charged or running from battery

fade in/out – Battery is charging

flashing – The temperature is out of range or the battery needs service (valid temperatures for charging are 0-40C / 32-104F)

The charge time is approximately six hours for a fully depleted battery when using the included 12V AC/DC adapter. The battery does not need to be fully charged in order to use Sabre, but it should **not** be stored when completely discharged (this is true of all Li-Ion batteries). Sabre may become slightly warm during the charging process. This is completely normal.

2.7 Buttons

There are four buttons on Sabre:



This button turns on Sabre. Press and hold for one second to turn Sabre off. A quick press of this button has other features. See “Shot Limit” (section 5.13) and “Always On” (section 5.18.5) for more details.



Wifi Button. This turns on and off Wifi. The Blue LED above this button will light when Wifi is enabled. Wifi will automatically turn off after 10 minutes of inactivity to preserve battery life.



Pressing the “Mode” button will cycle through the five modes (or settings). “User 1 – 3” are custom operating modes and you can adjust all settings. Auto and Manual only allow some settings to be changed.



“Set” will immediately set you to “Manual” mode, and use the distance of the object you’re currently pointing Sabre at as the maximum distance to detect. Anything that distance or closer will trigger your camera.

2.8 LED Indicators

There are several LED's on Sabre's keypad.

- Power LED: Indicates if Sabre is on, or charging the battery.
- Wifi LED: When Wifi is turned on, this LED will illuminate blue.
- Mode LEDs: There are three "mode" LED's to indicate which of the five modes Sabre is operating in. "User 2" will light the upper two LED's, where "User 3" will light the bottom two LED's.
- Shutter Active LED: Indicates when the shutter output is on. Flashes when the shutter output has been deactivated due to excessive triggering.

2.9 Camera connection

Sabre supports 3.5mm shutter cables. We have a selection available on our web-site. Plug the 3.5mm cable end into the included 3.5mm/2.1mm cable, and then the other end to your camera. If you have a RCA shutter cable for one of your other Cognisys products we have adapters available to use these shutter cables as well. Just keep in mind when using an RCA shutter cable you will not have the ½ press functionality.

2.10 Dual-beam connection

Sabre supports advanced dual-beam triggering that allows you to connect multiple Sabre's together. It requires the optional "Dual Beam Sabre Cable", and that both sensors are connected to each other using the cable. This allows for the following additional modes:

dual-beam: (pin-point) spots in space or other advanced setups to trigger

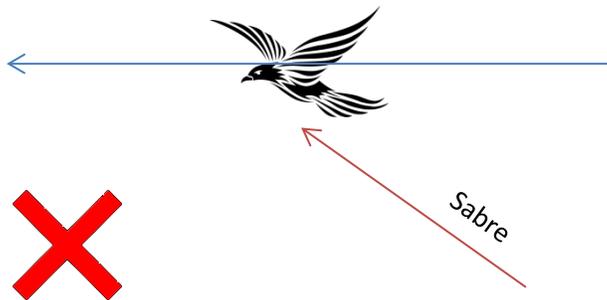
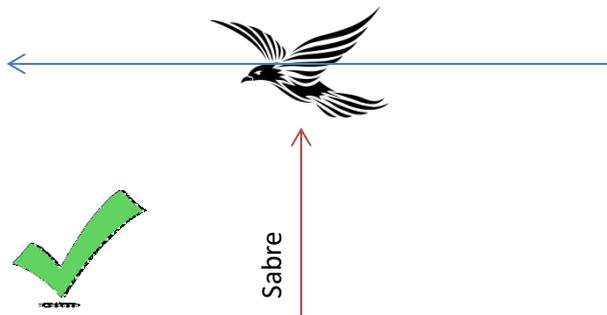
directional: Only trigger when a subject is moving one direction but not the other.

3. Basic Use

In this section we'll go into the basics of using Sabre. For these modes you use the buttons on the sensor to adjust any settings. No programs or apps required!

3.1 Physical Setup

Because Sabre transmits a beam of invisible light, it is best to position the sensor so that it will receive the maximum amount of reflected light. This usually means it should be perpendicular to the subject that you're shooting. This will result in the highest returned signal strength. This isn't to say it *has* to be perpendicular, it's just the best way to have the sensor set up.



Avoid shooting through glass. If that is unavoidable, make sure that Sabre is pushed directly to the glass. Otherwise the distance measured can drift between the glass and what is outside the glass, causing false triggers.

Also, avoid having a pool of water down-range from Sabre (where its beam will reach the water). This can cause erroneous measurements as the beam reflects off of the water, potentially causing false triggers.

3.2 Auto Mode

“Auto Mode” is the ideal instant-on point-and-shoot mode for Sabre. In this mode it is constantly measuring the maximum distance that it “sees”. It averages these measurements over a period of time (five seconds is the default) in order to account for slight movement in the maximum distance. When a subject crosses within a “Detection %” (75% is the default – that distance or closer), it will trigger your camera. Since the detection range is a percentage, you don’t have to worry about an absolute distance or forget to adjust it. Just point and go!

If you move Sabre while in “Auto Mode”, it may trigger your camera as the maximum distance it detects falls within the “Detection %”. Within a few seconds though, it will average and adjust to the new distance and wait for the next subject.

It is generally a good idea to not have variable-distance backgrounds for automatic mode. Because the laser beam is so small, it can easily pass between leaves as they move in the wind, potentially causing false triggers. If this is how you need to operate, consider using “Manual Mode” instead.

Avoid using “Auto Mode” at very close ranges (a 0.3m/1ft. or closer). This is due to the accuracy of the measurements – 2.5cm of variation could falsely trigger your camera.

3.3 Manual Mode

“Manual Mode” requires that you set the maximum distance you would like to detect. This could be the ground, a tree, or a bird feeder. Simply point Sabre at the object and press the “Set” button. It will take a measurement and set that as the maximum distance. If you weren’t already in “Manual Mode”, the mode indicator LEDs will change to “Manual”.

You can also enter “Manual Mode” by press the “Mode” button until the mode indicator LEDs are next to (and only next to) “Manual”. This will use the previously stored distance.

This mode is great if you are trying to shoot up against a stationary object. When you press the “Set” button, the measured distance will be backed off by 5% in order to prevent immediate triggering (if the distance is two meters away and we didn’t do that, it would immediately see something at two meters!).

When using this mode, make sure to account for your background moving. Example: If you press the “Set” button when pointing at a tree one meter away, Sabre will think that anything

that shows up between 0m and 0.95m is what you want to photograph. That only leaves 5cm of movement – along with the 2.5cm of measurement accuracy – so your down-range background had best not move more than 2.5cm, or one inch. If it's windy out your tree trunk could easily move that far. The simple solution is to just move the sensor slightly further away from the object to give you more of a safety margin.

4. Sabre Software

You do not need to install this software to use Sabre's basic functions, such as auto-mode or manual mode. If, however, you want to adjust some of the advanced settings in the sensor, you will need this software for your computer. We provide the computer versions (Mac and PC) software at no charge. Phone/Tablet software is also available for a small fee. Please see our website for additional details: <https://cognisys-inc.com/triggering-systems/sabre/sabre.html>

4.1 Installation

Whether you use Windows or OS X, you will **need** Oracle's Java installed for the Sabre app to properly load. You can download it here: <http://java.com/download>

Cognisys also offers applications (apps) for Android and iOS for a small fee. These apps are compatible with most phones and tablets on the market. Additional information regarding these apps can be found at <https://www.cognisys-inc.com/products/sabre/sabre.php>.

4.2 Windows Installation

Download and run the Sabre installation program available here:
<https://cognisys-inc.com/triggering-systems/sabre/sabre.html>

Once the installation is complete you will have a "Start Menu" folder called Cognisys. Underneath that you will find the Sabre icon.



To communicate with Sabre, you **may** need to temporarily disable your firewall or (preferably) add Sabre as an accepted network. Please consult your firewall provider for this process (Sabre functions just like a new router).

4.3 OS X Installation

The Sabre app requires Java 1.8 or later from Oracle. This version of Java requires that your OS X version be 10.7.3 (Lion) or above. It has not been tested with older versions of Java or earlier versions of OS X and is not supported. This is due to Apple no longer developing/supporting newer versions of Java and transitioning to Oracle's version.

Download and run the Sabre installation program available here:

<https://cognisys-inc.com/triggering-systems/sabre/sabre.html>

Once installation completes you will have a "Sabre" icon on your Launch Pad:



4.4 Connecting to Sabre

Sabre functions just like a wireless router. To enable Wifi on Sabre, press the Wifi button so the blue LED above the button illuminates.

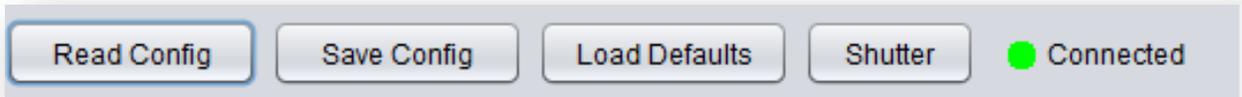
The method to connect varies on different operating systems. The process is identical to connecting to any other router. By default, Sabre will not have any security turned on. Simply connect up to it! Your Sabre will have a name of "Sabre-", followed by a few letters and numbers. Those letters and numbers uniquely identify your Sabre.

Once connected, your operating system may indicate that Sabre has limited connectivity (or show "connecting" for a duration). This is because Sabre does not have internet access.

Next is to launch the Sabre app!

4.5 Control Buttons

At the top of the Sabre app you will see four buttons and then a “Connected” indicator.



4.5.1 Connected

The first (and important!) thing to look at is the color of the “Connected” indicator. Green indicates that the Sabre app is talking with your Sabre. Red means there is a problem. If you see a red indicator, make sure that your computer is connected to your Sabre device (See section 4.4 above). Depending on your firewall security settings, you may have to add your Sabre as a “safe” network.

4.5.2 Read Config

“Read Config” will read all the settings from Sabre and display them in the app. You do not have to press this button for each tab – all the information will be read with one button press.

4.5.3 Save Config

“Save Config” will send all of the current settings in the app to Sabre. Also, if you are currently on the Auto, Manual, or User 1-3 tabs, it will change Sabre’s current mode to the mode that is selected.

Pressing this button will permanently save the settings to the sensor.

Note: As you change settings in the app, the settings will be sent to Sabre – they just won’t be saved between power-cycles. Be sure to press the “Save Config” to permanently save them if desired.

4.5.4 Load Defaults

We’ve all been there before. You made a change to one of the settings and now things are acting wonky. Good thing there is a big button at the top to get you back to the factory settings! “Load Defaults” will do exactly that.

Note: You can also load the default settings directly from the sensor. With Sabre turned off, press and hold the power button until the red power LED goes out (about five seconds). Release the button. The factory defaults will be loaded.

4.5.5 Shutter

This will activate the shutter outputs on Sabre. It will use whatever settings you have programmed into it (# pics, duration, etc. See section 5.18 for details on the settings).

This button will also turn red when Sabre detects a subject – provided you are currently connected to it.

4.6 Auto/Manual/User 1-3 Tabs

There are five groups of settings that can be adjusted in the app. The first two, “Auto” and “Manual” have their mode set to “Auto” and “Manual”, respectively. In those tabs you can adjust any of the settings that would be used in those modes. For the tabs “User 1”, “User 2”, and “User 3”, you have complete control over the settings. Not all of the settings will be visible on the screen at once – you will have to scroll down to access the rest of them. Below is a composite screenshot of the auto tab.

Sabre

File

Read Config Save Config Load Defaults Shutter ● Connected

Auto-Range Manual User 1 User 2 User 3 Wifi Global Measure

Mode: Auto Range

I/O Mode: Normal

Units: Meters

Sample Rate: 0.02 sec

Filter Time: 5.00 sec

Detection %: 75.00

Trigger Distance: 2.00 Measure

Distance Min: 1.00 Measure

Distance Max: 2.00 Measure

Timeout: 1.00 sec

Bulb Refresh: 30.00 sec

Bulb Off: 0.50 sec

Shot Limit: 0 (0 = disabled)

Limit Window: 60.00 sec

Limit Timeout: 60.00 sec

Brightness: 10

Drive mode: Single

Shutter Half-press

pics: 1

Delay: 0.00 sec

On Time: 0.50 sec

Off Time: 0.50 sec

Always On:

Review Timeout: 30.00 sec

Shutter Full-press

pics: 1

Delay: 0.00 sec

On Time: 0.50 sec

Off Time: 0.50 sec

Shutter 2 / Aux

pics: 1

Delay: 0.00 sec

On Time: 0.50 sec

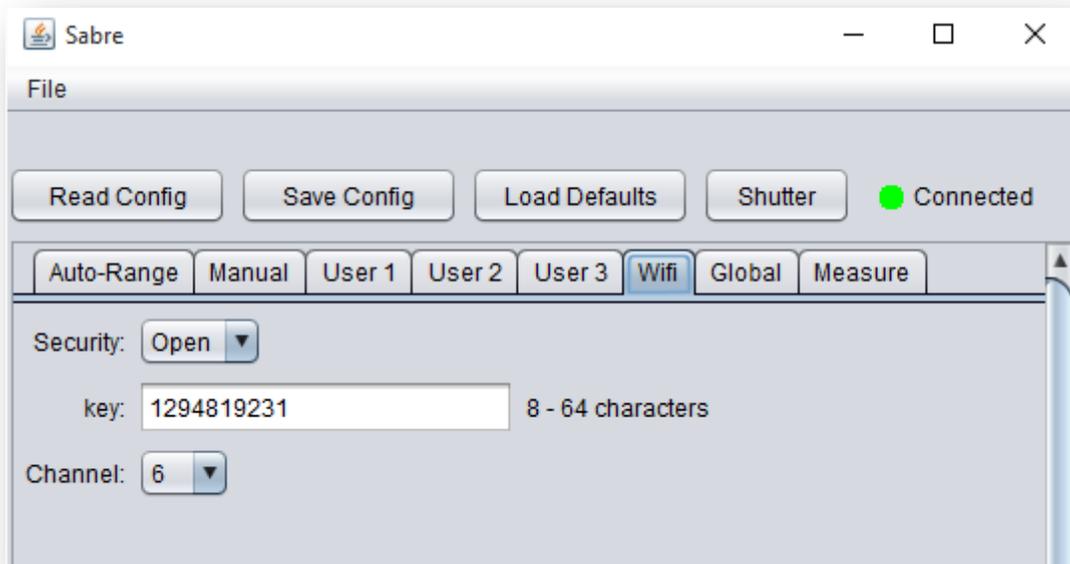
Off Time: 0.50 sec

As you can see there are a lot of settings available! We discuss them in detail in section 5.

You'll notice that some of the settings are grayed out. That is because the mode, I/O mode, or other feature you've selected doesn't use that setting. It's an effort to try and trim down how many knobs you have to adjust – just showing you the ones that are important for the mode you're currently in. Also, the default settings are safe and tested. They cover most use-cases for Sabre (except for the absolute distances). Just because you *can* change a setting, doesn't mean you necessarily *should* change it!

4.7 Wifi

On this tab you can adjust all of the available Wifi settings.

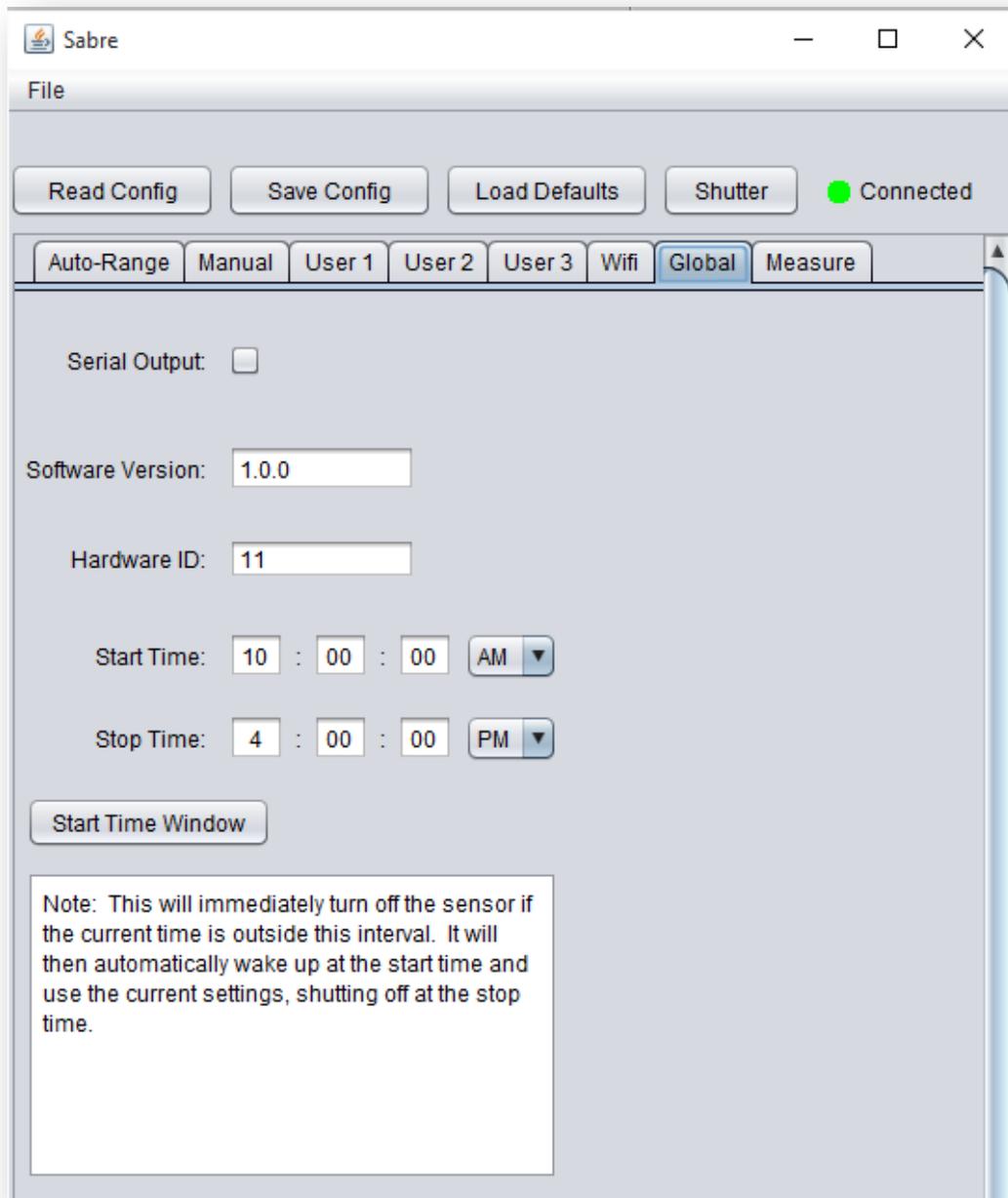


After making changes here be sure to press the "Save Config" button at top to permanently save the settings. They will not take effect until either Wifi or power is turned off and then back on. This is to prevent loss of communication immediately upon changing these values.

For details about these settings, see section 6.

4.8 Global

On the "Global" tab you will see some information about your Sabre and other settings that affect the operation of Sabre. For details, see section 7.



4.9 Measure

The "Measure" tab lets you use Sabre as a laser range finder. It will update the screen with the latest measurement (not an average). It will also indicate when it detects an object.

5. Auto/Manual/User Settings

Sabre works great for most applications right out of the box – but power users may want to customize advanced features for their particular setup. We give you a lot of knobs to turn – but don't let it overwhelm you! If you ever have a question we're more than happy to help out. Also, it's easy to load the factory defaults if things get really messed up. To load the defaults, make sure Sabre is turned off. Press and hold the power button until you see the power LED go out. Release the button and done!

To adjust these settings, you'll have to use your computer/tablet/phone running the Sabre app.

Note: be sure to press the "Save Settings" button in the app to permanently store the settings on Sabre. Otherwise the settings will be lost once the sensor is turned off.

Now let's get into all the details. The available settings are discussed below.

5.1 Mode

In the Sabre app, there are three modes to choose from. The first and second tabs are permanently set to "Auto" and "Manual", respectively. If you want to change the mode, you'll need to be in one of three "User" tabs. User modes must be configured with your computer or our mobile apps. We have mobile apps available for both iPhone and Android. Both "Manual" and "Auto" modes can be used without any additional configuration.

5.1.1 Auto Range

In "Auto Range" mode, Sabre will automatically adjust its maximum detection range depending on what it is pointed at. When it detects an object that is closer than the "Detection %" (see section 5.6), the shutter outputs will activate to fire your camera. Simply point Sabre toward where you expect your subject to be. Setup couldn't be easier! Keep in mind that if you move the sensor, it may trigger your camera as it will detect something within the "Detection %". Don't worry, though – it will quickly adjust to the new environment (the time that it averages this range is adjustable too – See section 5.5).

5.1.2 Manual

"Manual" mode requires you to set the maximum distance that a subject will be detected. This can be done directly on the sensor using the "Set" button, or in the app (press "Measure" next to "Trigger Distance"). If using the "Set" button on Sabre, just point it at a tree or the ground and press the "Set" button. If using the app, you can use this same process or stand in front of the sensor. Any subject at that measured distance or closer will cause the sensor to trigger your camera.

Unlike the “Auto Range” mode where it backs off the maximum range by a percent, “Manual” mode will use the actual distance measured. This is worth noting because if you do use something down-range like a tree to set your distance, you’ll want to move the sensor back a ways after setting the maximum detection distance. This will give you some safety room so measurement error (even as slight as it is) won’t cause false triggers.

5.1.3 Window

“Window” mode is similar to “Manual” mode, except the distance is a window in space. Think of it as a virtual distance floating in space that the subject will be detected. This helps reduce out of focus shots and nuisance triggers. When in this mode, you need to press the "measure" button next to the "Distance Min" to lock in the minimum distance, and likewise for the "Distance Max" setting. Don’t confuse the two though – otherwise you won’t get any triggers! The minimum distance is the closest to the sensor, while the maximum is furthest away.

In “Window” mode, two measurements are used to qualify that the subject is indeed within the desired window. This will double the response time of the sensor. (the default response time is 10 ms, so it will increase to 20 ms).

5.1.4 Timelapse

Looking for a simple intervalometer while out in the field? Sabre can do that too! It won’t use any range-finding features for this mode. You just need to set the shutter output settings for their on and off times, and then press the “Start” button in the app next to the “Timelapse” mode. Sabre will continue to take the time-lapse photos until you stop it by giving the power button a quick press.

5.2 I/O Mode

Sabre has flexible outputs depending on what you would like to do. “Normal” mode is typically used for range/beam triggering but some advanced modes are also supported.

5.2.1 Normal

In “Normal” mode, the 5-pin connector controls the full-press and half-press of your camera. When a subject is detected, it will activate these camera outputs (including the auxiliary shutter) as you have them programmed in the shutter settings (See section 5.18).

5.2.2 Dual-Beam

“Dual-Beam” means that the two sensors will be used. They can criss-cross in space to create an extremely small detection area. It requires that both sensors detect an object

(using whatever settings you have programmed in them) before it will fire a camera. They don't even have to be crossed – you could have an advanced triggering requirement. An example would be setting one sensor low to the ground, and another higher. This dual sensor setup could be used to only trigger when animals of a specific height cross the path. Their feet break the lower beam, while their head breaks the upper beam. Smaller animals would be below the top beam, while birds would only cross the top beam.

This mode requires two Sabre sensors. Using the optional Sabre dual-beam cable, attach the two sensors together using the 4-pin dual-beam connector. On the primary sensor (We'll call it "A"), change the "I/O Mode" to "Dual-Beam". On the secondary sensor ("B"), make sure the sensor has its "I/O Mode" set to "Normal". Your camera would then be plugged into the primary sensor ("A").

5.2.3 A->B

This mode also requires two Sabre sensors, connected together using the optional dual-beam cable.

On the primary sensor ("A"), change the "I/O Mode" to "A->B". On the secondary sensor ("B"), make sure the sensor has its "I/O Mode" set to "Normal". Your camera would then be plugged into the primary sensor ("A").

This I/O mode can be used as a directional trigger. The subject must move from the "A" sensor toward the "B" sensor. The "A" sensor will only activate the camera if the subject makes it from "A" to "B" within the specified "timeout" (See section 5.10). Using this with the timeout, you can set the minimum speed for the subject (it needs to get from here to there within "x" number of seconds – distance traveled in a certain amount of time). If the subject doesn't make it to the "B" sensor in time, the "A" sensor will start looking for a new subject.

5.2.4 B->A

This "I/O" mode is identical to "A->B", but the direction of travel is reversed. The subject must first cross the "B" sensor, followed by the "A" sensor. It's like physically swapping the position of the two sensors without all the work!

This mode also requires two Sabre sensors, connected together using the optional dual-beam cable.

5.2.5 Bulb

In "Bulb" mode, the half-press and full-press outputs will stay active until an object is detected. Once detected, the auxiliary output (4-pin connector) is used to fire the flash(es). Immediately after the flash is fired to expose the image, Sabre closes the camera shutter

and refreshes the frame. This mode is useful for triggering in the dark or when using our high speed shutter. See the settings "Bulb Refresh" (section 5.11) and "Bulb Off" (section 5.12) below.

5.2.6 A | B

When using the dual-beam cable to connect two Sabres, if either Sabre detects a subject the one that is configured for "A | B" (A or B) mode will activate its camera output.

This mode also requires two Sabre sensors, connected together using the optional dual - beam cable.

5.3 Units

For distances, this lets you choose what the numbers represent – Meters or feet. If the "Trigger Distance" is set to 2.0, and "Units" to "Meters", then Sabre will fire your camera up to 2.0 meters away. If you change the "Units" to "Feet", the 2.0 won't be converted to feet – it just means that Sabre will use 2.0 feet as its new trigger distance.

5.4 Sample Rate

This determines how often the sensor will "look" for an object. "0.01" means a hundredth of a second, or 10ms. Why would you want this slower? The slower you sample, the greater the battery life. If you're photographing large creatures, this could easily be set to a half a second or longer in order to improve battery life. See the specifications section 11 for details on how the sample rate affects battery life. Why would you leave it set to 10 ms? If you're photographing something fast-moving like birds, you'll want the sensor fast. 10 ms ("0.01") is the fastest that Sabre will operate.

5.5 Sensitivity

Normally you would want Sabre to respond as fast as possible when it detects a subject in its beam path. There are times, however, that you may want to decrease the sensitivity in order to ignore potential "false triggers". False triggers are in quotes because in environments where there are several large insects (bees, moths, butterflies) it is possible for Sabre to detect them – which may not necessarily be what you want! So how do you set the sensitivity? The "sensitivity" number here is the number of samples (that happens at the above set "Sample Rate") that the subject needs to be in the beam path before the shutter outputs will be activated. Here is an example:

If your sample rate is at the default 0.010 seconds (10 milliseconds), and the sensitivity is set to 10, the subject will have to be in the beam path for $0.010 * 10$ seconds (0.1 seconds total, or 100 milliseconds). This will help filter out nuisance critters if you're trying to photograph slower moving subjects. Setting the sensitivity to 0 will have Sabre respond as fast as possible.

5.6 Filter Rate

“Filter Rate” only applies to “Auto Range” mode. This is how long Sabre averages the furthest distance it detects. A larger value will help reject noisy measurements (like leaves moving in the distance). A smaller value will “lock on” to the distance faster. This does NOT affect how fast the sensor responds. The sensor will still respond as fast as your “Sample Rate” setting above. It will only use “Filter Rate” for determining the maximum down-range (not detecting anything) distance.

It is generally a good idea to not have variable-distance backgrounds for automatic mode. Because the laser beam is so small, it can easily pass between leaves as they move in the wind, potentially causing false triggers.

5.7 Detection %

“Detection %” only applies to “Auto Range” mode. This detection percent sets how close the subject must be to the sensor to trigger the camera. Example: If the background is roughly 12 feet away, and the “Detection %” is set to 75%, anything that crosses the beam 9 feet or closer will trigger the camera ($12 * 0.75 = 9$).

Be careful when setting this close to 100%. Small movements of the background (or error in the measurement) could cause false triggers.

5.8 Trigger Distance

In “Manual” mode, an object must pass this distance or closer to activate the shutter outputs. You can press the “Measure” button in the Sabre App to do a real-time measurement, or you can manually enter the distance. The distance is in either meters or feet depending on how you have set the “Units” setting above.

5.9 Distance Min

This setting only applies if the “Mode” is set to “Window”. This is the closest distance to the sensor that a subject will be detected. Anything closer than this distance will be ignored. You can either press the “Measure” button to the right to do a real-time measurement, or you can manually enter the distance. “Distance Min” and “Distance Max” set the range of detection for “Window” mode.

5.10 Distance Max

This setting only applies if the "Mode" is set to "Window". This is the furthest distance from the sensor that a subject will be detected. Anything further than this distance will be ignored. You can either press the "Measure" button to the right to do a real-time measurement, or you can manually enter the distance.

5.11 Timeout

When the "I/O Mode" is set to "A->B" or "B->A" (dual Sabre setup), this is the maximum time this Sabre will wait for the secondary sensor to detect an object. Once this timeout expires, this sensor will start looking for its "A" or "B" all over again. The subject must pass between the two sensors in this amount of time or else the camera will not trigger.

5.12 Bulb Refresh

When the "I/O Mode" is set to Bulb, the shutter outputs will stay active for this duration. Once an object is detected, they will no longer be active. If an object is not detected, the shutter outputs will turn off for the duration of "Bulb Off". "Bulb Refresh" should be set to something smaller than when hot pixels or noise start to appear in your frame.

5.13 Bulb Off

When the "I/O Mode" is set to "Bulb", and either an object is detected or the "Bulb Refresh" time expires, this is how long that the shutter outputs will NOT be active. This allows you camera time to save the frame. 500 ms (0.5 seconds) is acceptable for most cameras.

5.14 Shot Limit

Sometimes you can get yourself into a bad environment where things are moving around too fast and bugs (sorry entomologists) are flying around causing false triggers. Wasted frames and overheating flashes – **not** good! There is a way to tell Sabre to stop triggering the camera if it sees too many subjects flying around. Three settings come into play to adjust this. The first is "Shot Limit". This sets the maximum number of pictures that can be taken within the time set in "Limit Window". See the two other settings below.

5.15 Limit Window

This sets the time "window" for the "shot limit". If you get "shot limit" number of triggers within "limit window" amount of time, Sabre will ignore any more detections for a period of time. If you get a few pictures but it doesn't reach the "Shot Limit" within this amount of time, the number of pictures taken will be reset. See below.

5.16 Limit Timeout

This is how long Sabre will ignore anything crossing in front of the sensor. You won't have any camera triggers for this duration. Also, to indicate that the limit has been reached the shutter LED on Sabre will quickly flash. That's a lot of words. Let's put some numbers to these settings and then walk through a scenario. We'll use the defaults in this case. "Shot Limit" is set to 10, "Limit Window" is at 20, and "Limit Timeout" is at 300. Your setup is working great – you're getting some great shots of birds in flight. You leave the setup to go into town for an hour. Unfortunately a biblical swarm of cicadas appears (the horror!). Your Sabre, being very effective at detecting things in flight starts rapidly triggering. With the settings above, you'll definitely see 10 cicadas within the 20 seconds – it's a swarm after all! Once the sensor "sees" those 10 within the 20 seconds, Sabre will ignore any more for 300 seconds (5 minutes). Let's say you get back from town, shoo away the swarm (the cicada story falls apart here), but now you want to start looking for birds again. You see that the shutter LED on Sabre is flashing quickly. Simply press the power button to reset the shot limiter and it is back to normal. You could have also waited for the 300 seconds to elapse.

5.17 Brightness

This allows the adjustment of the LED brightness on Sabre for night-time photography. You can adjust it down to zero. No LED's will be lit in this case (decreases the chances of someone permanently borrowing your Sabre when deployed in the field). If you touch any button on Sabre, the LED's will resume full brightness and then return back to zero after 30 seconds.

5.18 Drive Mode

This sets the behavior of the shutter outputs when an object is detected.

5.18.1 Single

When a subject is detected, the shutter output will immediately activate and use the timing parameters for on/off/number of pictures. The subject will have to no longer be detected before the shutter outputs will activate again. This mode is useful for only getting one picture, even if the subject lingers in the path of the sensor. This is the default mode.

5.18.2 Continuous

As long as an object remains in the sensors path, the shutter outputs will stay active. This allows you to take multiple pictures when a subject is detected – as long as your camera is in continuous mode as well. As soon as the subject is no longer detected, the shutter outputs will follow their settings. This means that if the shutter full press "on time" is set to 0.5 seconds, the shutter will close 0.5 seconds after the subject moves past the sensor.

Keep in mind that if you your "Mode" is set to "Auto-Range", if a subject stays in front of the sensor long enough it will eventually no longer trigger the sensor (auto-ranged out).

5.18.3 Hybrid

Hybrid mode is a combination of continuous and single mode. In this mode, Sabre will continue to follow the shutter settings until the subject leaves the beam path. If your shutter settings are set to only take one photo then only one photo will be taken. If, however, they are set to take 100 photos, Sabre will start taking the photos and stop when either 100 are done **OR** the subject leaves the beam. This is a great way to control how often photos are taken yet still limit the maximum number.

5.18.4 Enter/Exit

In this mode Sabre will activate the shutter settings when a subject enters the beam and then when it leaves. If the object moves very quickly through the beam path you will still get two activations of the shutter outputs.

5.19 Shutter Settings

Sabre supports three outputs to control external devices. Two are intended to control the camera's half-press and full-press. The third can be used for an additional camera, flash, or other piece of equipment.

Typically you would have the half-press and full-press settings identical to each other, so the camera interprets the signals as a legitimate button press. Some creative customers, however, may find applications where the two need to be independent from each other (controlling two separate cameras as an example).

Here is a diagram showing the different settings available. In this diagram the "# Pics" is set to 2.

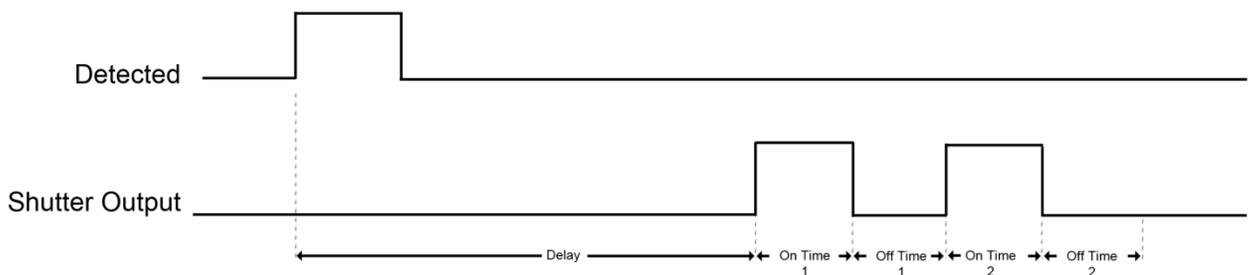


Figure 3 - Shutter Timing Diagram

Below are the available shutter settings.

5.19.1 # Pics

“# Pics” sets the number of times the shutter will activate using the “on time” and the “off time”.

5.19.2 Delay

Once a subject is detected, you can have an initial delay before the shutter activates. This setting could also be called the “pre-trigger” delay. It will only happen once. If the “# pics” is greater than one, this delay will still only happen before the first picture. If you want to take a picture immediately after something is detected (that’s usually the case), be sure this is set to zero.

5.19.3 On Time

This is how long the shutter button will be held down, or “active”. When set to a half a second, most cameras will have time to wake from sleep mode and successfully take a picture.

5.19.4 Off Time

The “Off Time” follows the “On Time”. During this time, Sabre will ignore anything passing in front of it. You can use this setting to prevent multiple triggers when they may not be desired. The “Off Time” also sets how long between multiple pictures if “# Pics” is greater than one.

5.19.5 Always On

This option is only available for “Shutter Half-Press”. If this checkbox is enabled, the half-press will always be held down. Why would you want to do this? Two reasons. It will keep your camera awake. It will also reduce your camera’s shutter lag. Sabre is **fast** at detecting critters – why give up that performance by letting your camera being lazy about actually getting around to taking the photograph?

As with many things in life, nothing is free. Unfortunately cameras will not let you review your photographs while the half-press is held down. No problem! If you have this setting checked and you want to review your photos, just give the power button a quick press. Sabre will release the half-press (for a duration – see below), and then automatically half-press again. While the review mode is active, the shutter LED will flash quickly until the review timeout expires.

5.19.6 Review Timeout

This option is only available for “Shutter Half-press”. If “Always On” is checked this is the amount of time after you press the power button to release the half-press before it will automatically press the half-press again.

One might ask why there is this setting... It’s because numerous times we (and some of our most successful bird photographers) have ended up with a hundred “empty” photos, simply because they forgot to turn the “always on” switch back on. No more, we say, no more! So our apologies if you don’t get a chance to review all of the photos you took in this review time. We think that you’ll thank us later. If you do find yourself being cut off from looking at the pictures, increase the duration of this timeout.

5.19.7 Keep Alive

The “Keep Alive” can be used to periodically wake up (or prime) a flash/camera. Sabre will activate the shutter output at this interval (in seconds). If set to zero, the “Keep Alive” feature will be disabled (which is the default).

5.19.8 Final Off

You have the option of disabling the final “off time”. Here are two use-cases.

- 1) The “# pics” is set to one. If “final off” is set to on, then you can use the “off time” to set how long Sabre will ignore any additional subjects walking through the beam.
- 2) The “# pics” is set to two. The first shutter activation could start a video recording. You would then set “off time” (the time between shutter activations) to how long you want to record the video (let’s say 30 seconds). Then the second shutter activation would happen (because “# pics” is set to two). But for this application, you do NOT want the final off time, because it would mean you’d be waiting another 30 seconds before Sabre would detect anything.

6. Wifi Settings

Wifi can be turned off and on using the Wifi button in the upper-right corner of Sabre. The blue LED above the Wifi indicator will light when it is on. Wifi will automatically turn off after ten minutes of inactivity (no computer/phone/tablet app communication) in order to conserve battery power.

There are only three settings, which are described below.

6.1 Security

Much like your home router, Sabre has different security modes to encrypt data sent back and forth as well as prevent “undesirables” from accessing your Sabre. Your Sabre ships with security disabled. You must “save settings” and then power-cycle your Sabre for these new settings to take effect.

6.1.1 Open

No security measures are in place. This is easiest for you to connect up to Sabre – but also for your neighbors (including squirrels with phones). Any communication is unencrypted. Of course, the “open” security is also extremely effective against intruders if Wifi is turned off.

6.1.2 WPA

This encrypts all transmissions to and from Sabre using Wifi Protected Access. This will prevent anyone from connecting to Sabre unless they know the security passphrase/key. You will need to make a note of the “key” or change it to something you will remember. If you ever forget the key, you can load the factory defaults by having Sabre turned off, press and hold the power button until the red power LED goes out, and then release the power button. The security will revert back to “Open”.

6.2 Key

This is your Wifi key or passphrase. The key must be at least eight characters/numbers and up to 64. If you change the key, you must “save settings” and then power-cycle your Sabre for the new key to take effect.

6.3 Channel

There are 12 supported Wifi channels. This setting is included for people in heavily congested Wifi areas where interference with neighbor’s routers may be a problem. Typically you will not need to adjust this setting.

6.4 Timeout

This is how long after you stop the app before Sabre will automatically turn off its Wifi (to conserve battery power). The units are in minutes. Set this to zero to disable the timeout (Wifi will always stay on).

7. Global Settings

This tab contains general/global settings and information about your Sabre.

7.1 Serial Output

If you have purchased an optional “serial output” cable, you can plug your Sabre into your computer and have the distance data sent out to a terminal program. The data is sent out once a second, along with additional information. This serial data is only sent out if this option is checked. It should **not** be checked if you do not have the cable or do not need the data. This option will slow down the sample rate, decreasing the overall performance of your Sabre.

7.2 Shutdown Voltage

If this is set to a non-zero value, Sabre will turn off if the input voltage drops below this value. This can be useful to prevent over-discharge of lead acid batteries. If the voltage increases to at least 11V, Sabre will resume operation. If you incorrectly set this value, it can cause Sabre to immediately turn off. To recover from this, you will need to restore factory defaults (See section “4.5.4 - Load Defaults” for details).

7.3 Software Version

This is the current software version on your Sabre sensor (not the version of the app software). This is used to determine what features are available and if it is time to upgrade your Sabre firmware.

7.4 Hardware ID

This identifies to the app what capabilities your hardware has (and lets the app know that it's talking to a Sabre!).

7.5 Start Time / Stop Time

For those trying to maximize the duration of operating on battery, this feature can be used to program a time window in which Sabre should operate. It will automatically turn on and off at the programmed times. This is also ideal for unsupervised shooting. If your subject only comes out at night – there isn't much point wasting battery life during the day!

If the current time (according to your laptop/cell phone/tablet) is within the Start/Stop time, Sabre will continue to operate until the "Stop Time" is reached, and then automatically turn off.

If the current time is outside of the Start/Stop time, Sabre will immediately turn off (nighty night!) and you will lose communication to it-- so be sure to make any setting changes you want and press the "Write/Save Settings" button at top prior to pressing the "Start Sleep Interval" button.

If you press the power button on Sabre to wake it from the "sleep interval", the "sleep interval" will be aborted/cancelled (it will not sleep/wake any more at the programmed time).

Wifi will be turned off when waking from the "sleep interval" to preserve battery life.

8. Measure

The measure window shows the current distance Sabre is measuring. At the top of the screen you can select whether you want the distance displayed in meters or feet.

8.1 Distance Window

Here you will see the current distance measurement along with the returned signal strength in parenthesis. You may also see "Not connected" if you're not currently connected to Sabre, or "No signal returned" if you've exceeded the maximum range of Sabre (or whatever it is pointed at prevented a signal from being returned). It's okay to see the "No signal returned" though – it doesn't mean that things aren't working right – just that the sensor is looking far... far... away.

When an object is detected in the current mode you're using, you'll see "Detected" show up, along with its distance and signal strength.

8.2 Battery Percent

This is the current remaining battery percent for Sabre. It may show an artificially high percentage during the charging process as the charging circuit causes a higher voltage across the battery.

8.3 DC Voltage

This is the current voltage Sabre is running at. This can be used to verify that it is running from a DC supply rather than its internal battery, and also check if the solar panel is operating properly (if installed).

9. Troubleshooting

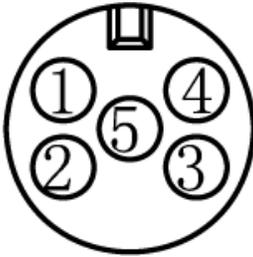
Problem	Cause	Solution
Power LED is not lit.	Battery fully discharged	Plug in the AC/DC adapter into the supplied cable to charge the battery. Be sure not to store Sabre for long durations with a discharged battery.
	Power cord is not plugged into the wall.	Plug power adapter into the wall into a known-good circuit.
	Wrong AC/DC adapter used.	Be sure to use the AC/DC adapter that was included with your Sabre. Damage may result if the wrong adapter is used.
	Power button not pressed	Press and release the power button to turn on.
	LED brightness set to zero	This is normal. If you press any button on Sabre, the LED's will return to full brightness for 30 seconds before going out.
Power LED gets bright then dims, repeats	Battery is charging	This is normal and will stop when the battery is fully charged.
Power LED is flashing on and off	Internal temperature is outside of battery charging range.	Make sure Sabre is within the battery charging temperature specification.
Shutter LED gets bright and dim rapidly	"Shot limit" was reached	See section 5.13 to adjust your shot limit settings. Press the power button to dismiss limit.
Shutter LED is flashing rapidly	In "Review" mode	This happens if you quickly press the power button when the "Always On" feature is set. See section "5.18.5 - Always On" for details.

If you cannot resolve a problem with Sabre, please contact us at support@cognisys-inc.com. We want to make sure that you are completely satisfied!

10. Connector pin-outs

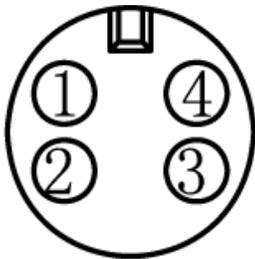
Below are the pin-outs for the three connectors. This is provided for those who wish to do custom wiring for “special” applications.

10.1 Shutter / DC Power



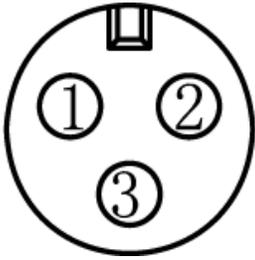
1. DC Power In (See specifications for the voltage range in section 11)
2. Shutter Ground
3. Shutter Full-Press – low-side drive
4. Shutter Half-Press – low-side drive
5. DC Ground

10.2 Dual-beam / Auxiliary Shutter



1. Reserved for future use – Bi-directional pin with low-side drive
2. Ground
3. Sensor – low side drive when an object is detected
4. Aux Shutter / Serial Output low-side drive with switchable 1k pull-up resistor

10.3 Solar / Auxiliary Power



1. Reserved – do not use
2. Ground
3. Solar/Auxiliary power (see specifications for the voltage range in section 11)

11. Specifications

Specifications are intended for reference only. The design may be modified to improve features or functionality without notice.

Specifications	MIN	NOM	MAX	UNITS
Input Voltage (DC or Auxiliary)	12	12	28	Vdc
Input Current (12Vdc in)	-	50	650	mAdc
Shutter Output Current Sink	-	-	1	Adc
Operating Temperature	-20	25	60	C
	-4	77	140	F
Charging Temperature	0	25	40	C
	32	77	104	F
Laser Wavelength		905		nm
Laser Power – Peak		1.3		W
Laser Pulse Width		500		ns
Weight		278		g

- Weatherproof
- Three shutter outputs
- Solar Charging option for long-term deployment
- All outputs are open drain (Can be used as a flash trigger or shutter trigger)
- ARM Processor
- Wireless connectivity: 802.11a/b/g/n 2.4GHz

12. Warranty

Limited Warranty

Sabre and related equipment/software is provided by Cognisys, Inc. "as is" and "with all faults." Cognisys, Inc. makes no representations or warranties of any kind concerning the safety, suitability, lack of viruses, inaccuracies, typographical errors, or other harmful components of Sabre. There are inherent dangers in the use of any product, and you are solely responsible for determining whether Sabre is compatible with your equipment and other software installed on your equipment. You are also solely responsible for the protection of your equipment and backup of your data, and Cognisys, Inc. will not be liable for any damages you may suffer in connection with using or modifying Sabre and/or its accompanying software.

All electronic products are warranted to be free from defects in materials or workmanship for two (2) years from the date of purchase. This warranty does NOT cover battery life, as misuse may significantly decrease and/or damage the internal battery. Within this period, Cognisys Inc. will, at its sole option, repair or replace any components which fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alterations or repairs.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL COGNISYS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Cognisys, Inc. retains the exclusive right to repair or replace the product or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

13. Wireless Certification

13.1 FCC Certification - USA

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate frequency energy and, if not installed and used in accordance with the instructions may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

FCC Caution:

To assure continued compliance, (example - use only shielded interface cables when connecting to computer or peripheral devices). Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

FCC & IC Radiation Exposure Statement:

This equipment complies with FCC & IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device intended only for OEM integrators under the following conditions:

FCC Identification: YOPGS2011MIZ

13.2 IC Certification – Canada

English

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation of the device

French

Cet appareil est conforme à Industrie Canada une licence standard RSS exonérés (s). Son fonctionnement est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas provoquer d'interférences
2. Cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

Important Note:

To comply with FCC & IC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

IC Certification Number: 9154A-GS2011MIZ

14. Glossary

Term	Description
LIDAR	Light detection and ranging – measuring distance with light
Load Defaults	Load the factory defaults for all the settings.
ms	Abbreviation for milliseconds. A thousandth of a second (1/1000 seconds).
Short Circuit (short)	To connect two wires together. Provide a path for current to flow with low resistance.
Trigger	To activate
Output	This is what you attach your equipment to. Sabre can control these outputs to do various tasks.
us	Abbreviation for microseconds. A millionth of a second.

15. Revision History

Revision	Date	Change
1.0	11/20/2015	Initial Release
1.1	05/25/2016	Included periodic activation of shutter outputs, review blinking shutter LED, low voltage shutdown. Changed LED brightness so zero is completely off.
1.2	08/16/2017	Added A B I/O mode, hybrid drive mode, enter/exit drive mode, sensitivity, and "final off".