

SABLE

Iridium Satellite Beacon with GPS location

User Manual

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Contents

1	General Description	1
2	Theory of Operation.....	1
3	Operating Instructions.....	2
3.1	Setting up your Iridium Account.....	2
3.2	On/Off Modes and Testing.....	3
3.3	Communicating with the Sable	4
3.3.1	Attaching Email Command Files.....	4
3.3.2	Received Messages	5
3.3.3	XeosOnline	6
3.3.4	Commands	8
3.4	Watch Circle.....	12
3.4.1	Watch Circle Operation	12
3.4.2	Watch Circle Defaults.....	12
3.4.3	Watch Circle Commands	13
3.5	Power Supply and Consumption	14
3.6	Opening the Housing.....	14
3.7	Replacement of Battery Pack	15
3.8	Field Installation.....	17
	Appendix A - Technical Specification.....	18

1 General Description

The Sable Subsurface Iridium Satellite Mooring Location Beacon continuously monitors for unplanned or accidental release of subsurface instrument moorings. Sable makes use of the bi-directional, global, real time Iridium satellite Short Burst Data (SBD) network in combination with GPS position location. Sable's sleek tubular design allows it to be easily retrofitted into subsurface flotation such as syntactic foam.

Inside Sable is an aluminum chassis, 9601-D-I Iridium satellite Short Burst Data core radio transceiver, a specialized low power Xeos digital controller with GPS, Iridium antenna, GPS antenna and an alkaline battery package.

Sable is intended for subsurface deployments. Xeos Technologies Inc. (Xeos) manufactures other specific products for surface applications. See www.xeostech.com for details or call (902) 444-7650.

2 Theory of Operation

The Sable is intended for instantly and accurately locating and recovering high value, free drifting assets at sea. After being activated, the Sable is submerged (to a maximum depth of 5000 meters), where it enters an 'Underwater Mode'. Here, it monitors water conductivity between the top disk and the bulkhead for up to 2 years. Shortly after reaching the surface, the Sable can then report its GPS location for a further year.

Once it reaches the surface, the Sable will enter an 'Alarm Mode' and send 3 consecutive messages to the iridium satellite. The first message is an iridium check. The second message is a Status Message which contains the GPS and Iridium timing settings. The third message contains the GPS position. The Sable will transmit a position message every 10 minutes for 1 hour. After the 1 hour 'Alarm Mode', the Sable will enter a 'Surface Mode' or 'Normal Mode', where it will transmit its position based on the timing settings.

Operators can communicate with the surfaced Sable via Iridium using email commands. Status information can be obtained, including the health of the GPS system and battery voltage. Timings are settable and should be changed within the first hour of power-up or surfacing. The default timings are 3 hours, thus the user will have to wait 3 hours for the Sable to receive any command messages once it has entered 'Normal Mode'.

The surfaced Sable will continue to send position messages based on the timings, until it is manually turned off, the battery pack drops below the minimum voltage requirement of 7v, or the Sable is re-submerged.

3 Operating Instructions

3.1 *Setting up your Iridium Account*

Sable makes use of the Iridium satellite system's (www.iridium.com) Short Burst Data (SBD) service for the 9602 transceiver. This service is a global, two-way, real-time, email-based data delivery service that has a maximum outbound (from beacon) message size of 340 bytes and a maximum inbound (to beacon) message size of 270 bytes.

Sable end users must set up an approved data delivery account with their preferred service provider. This is can be done by providing Xeos Technologies with the Equipment Identity (IMEI) number, along with up to five (5) unique e-mail addresses. Please contact Darren Penney at darren@xeostech.com with any questions regarding modem activation.

Sable makes use of a simple and robust, text-based email protocol. Any email application can be used to send and receive messages to the Sable. Web-based email providers such as Gmail offer a free service and plenty of memory storage to act as a backup in case your primary address is not accessible. Web-based services are also not subject to commercial or government mail server firewalls that may, at times, prevent email attachments from arriving.

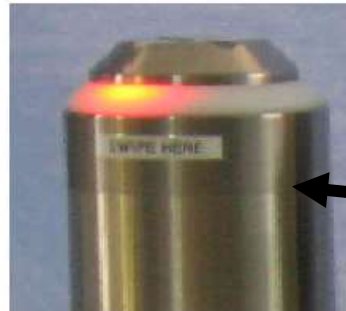
3.2 On/Off Modes and Testing

The Sable beacon is turned ON and OFF through the use of an external magnet near an internal magnetic reed switch, and operation can be identified by viewing an LED optical pipe.

To turn Sable ON, swipe the magnet back-and-forth quickly across the exterior label "ON/OFF SWIPE HERE". Watch the LED port near the top of the Sable. You will notice that at first the LED port appears red. This is an indication of its current OFF status. Once turned ON, the LED port turns green.

Note: It is important that the beacon has a good view of the sky during any test, so it is necessary to test the beacon outside of a building.

**ON/OFF
Magnetic
Switch**



**Red LED
= OFF**

A flashing green LED indicates the device is in the process of powering up, continue to swipe the magnet until you see a solid green LED. A solid green LED indicates that the device is powered and operational.



**Green LED
= ON**

To turn the Sable OFF, repeat the above procedure with the magnet on the "SWIPE" label and watch the LED port change from green to red. A red flashing LED indicates the device is powering down, continue to swipe the magnet until you see a solid red LED. A solid red LED indicates that the device is turned OFF.

At any time the magnet can be wiped across the "SWIPE" label *once* to see which mode the beacon is currently in. A red LED indicates the device is turned OFF. A green LED indicates the device is turned ON.

Note: It is important to let all LEDs stop illuminating before initiating another action.

Note: Cycling power for any reason, for example by using the switch to turn OFF/ON or by removing battery power, will cause the beacon to lose its existing configuration and return to the default configuration. It will also start the above-water Alarm Mode.

3.3 Communicating with the Sable

Special email commands are used to communicate with the Sable when it is above water. These commands are sent as email *attachments*. Commands can configure the Sable before deployment and can also be used to remotely reconfigure or update status with Sable. There are four attachment files that serve separate functions. All commands are given “over the air” and the Sable must have a good view of the sky to receive these commands.

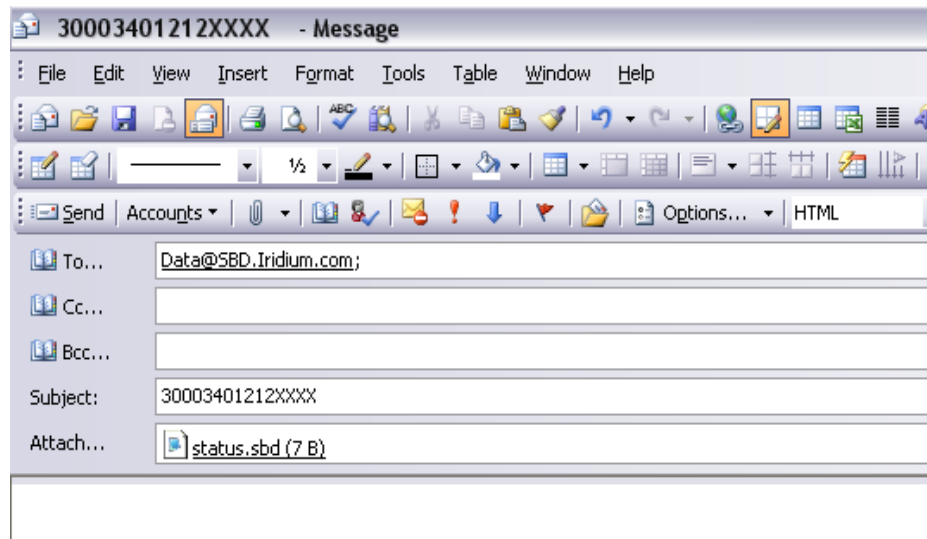
3.3.1 Attaching Email Command Files

All command messages must be sent to the following email address:

Data@sbd.iridium.com

- All messages must have **only** the unique IMEI number of the Sable in the *Subject line*.
- All command files must be sent to Sable as an *attachment* to a regular email message.
- Text in the body of the message will be ignored.

Your message is sent to the Iridium Gateway in Arizona, USA:



A confirmation is immediately returned from the Gateway to let you know that your message has been received and is in the queue. This message is received from the address:

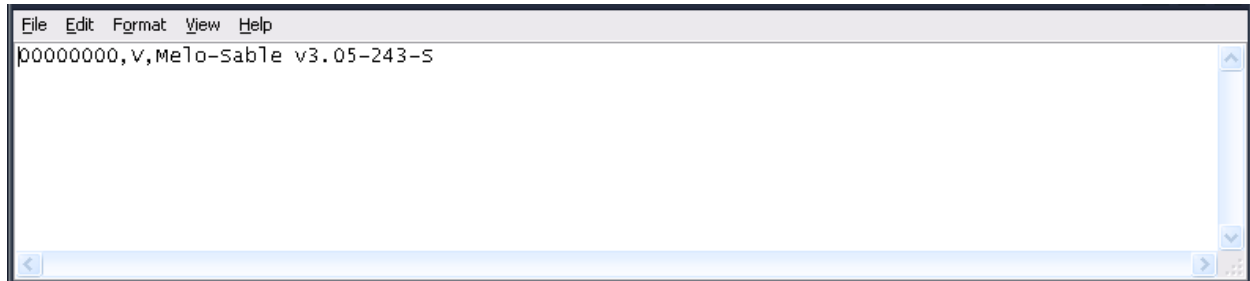
sbdservice@sbd.iridium.com

If your Sable is above water and working, it will receive your command message the next time it does an Iridium Message Check (dependant on timings).

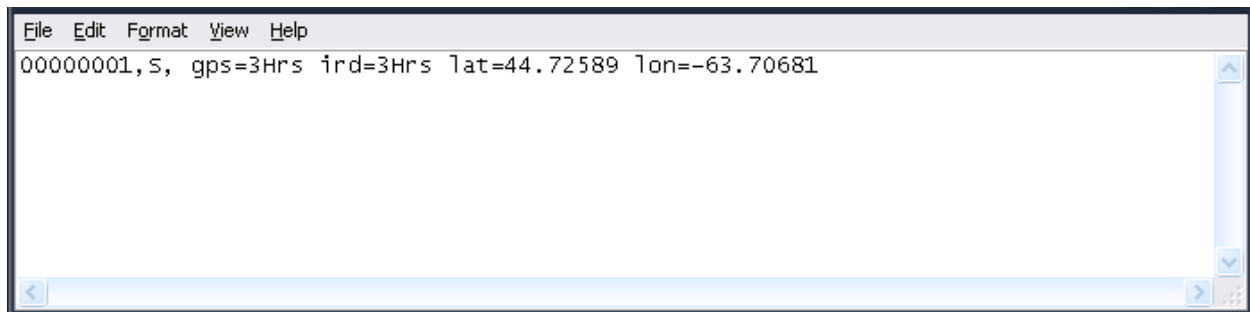
Note: It is important to keep in mind that the “sent to” and “received from” addresses are not the same.

3.3.2 Received Messages

Messages received from Sable such as GPS messages or responses to Status requests arrive as email *attachments* to all of the email accounts that the Sable was setup with. When the unit is first turned on it will send out three messages (pictured below) and will enter startup mode.



The first you will receive simply indicates the Firmware Version. The letter 'V' in the message indicates that this is a version message.



The second message is a status message. The letter 'S' in the message indicates that this is a status message. This message shows the current timing settings configured to the device. The GPS timing interval indicates the interval of GPS checks. The IRD timing interval indicates the interval at which the Sable communicates with the Iridium satellite. The Sable will check for command messages as well as send a position message every time it communicates with the Iridium satellite. This message also contains the latest GPS reading obtained by the Sable.



The third message is a position message. The letter 'P' in the message indicates that this is a position message. Time and date are displayed in UTC (08261429 would be Aug 26th at 2:29pm UTC). The most recent GPS position obtained by the Sable is also displayed in the position message as well as the highest GPS signal level during the most recent GPS fix (snrMx). The battery voltage is displayed in hundredths of a volt (ie. If BV = 1445, that means 14.45V on the battery).

Note: It is recommended that Sable users consider using a back-up email service (such as Gmail) as well as their primary provider.

Each Sable IMEI account can be set up by an Iridium SBD service provider usually with up to five (5) email addresses. Web-based email providers such as Gmail offer a free service and plenty of memory storage to act as a backup in case your primary address is not accessible. Web-based services are also not subject to commercial or government mail server firewalls that may, at times, prevent email attachments from arriving.

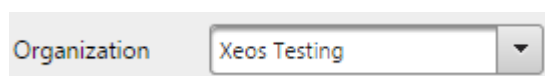
3.3.3 XeosOnline

3.3.3.1 Sending Commands with XeosOnline

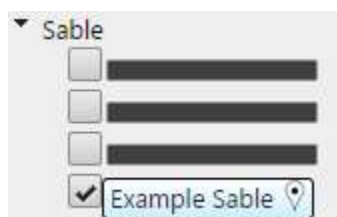
Navigate to [XeosOnline](#) and log in

The image shows the XeosOnline login interface. At the top left is a logo consisting of a blue sphere with a white lightning bolt. To its right is the word "Xeos" in a large, light blue font, with "ONLINE" in a smaller, black font below it. In the top right corner, the word "BETA" is written in red. Below the logo and text are two input fields: "Email" with the placeholder text "user@xeostech.com" and "Password" with a masked password "*****". Below these fields are two checkboxes, both of which are checked: "Remember my email address" and "Keep me logged in this session". At the bottom right of the form is a "Login" button with a checkmark icon.

Find your organization in the organization dropdown menu

The image shows a dropdown menu for selecting an organization. The label "Organization" is on the left. The dropdown box contains the text "Xeos Testing" and a downward-pointing arrow on the right side.

The left panel will display a list of your devices, your Sable will appear on this list.

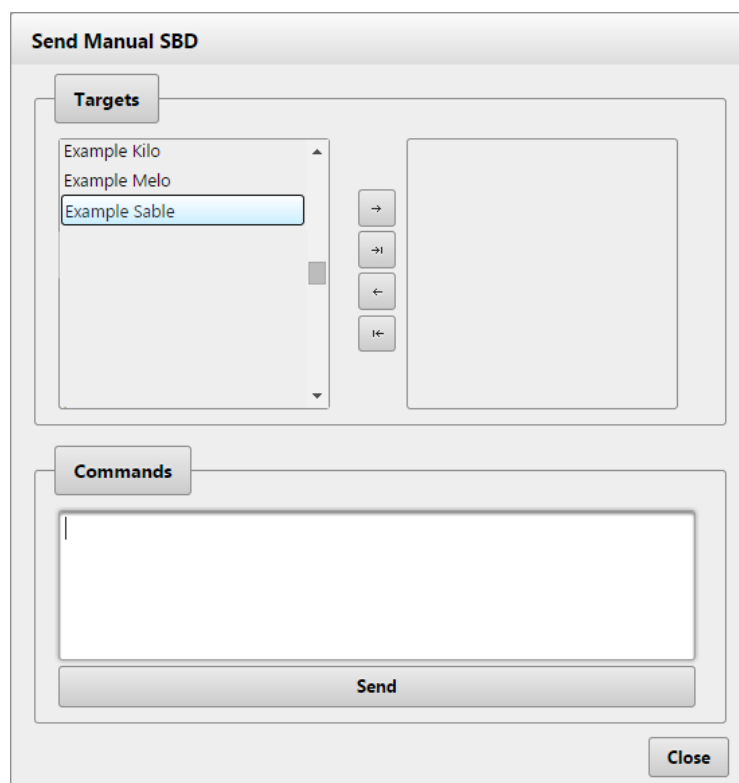
The image shows a list of Sable devices. The list is titled "Sable" with a downward arrow. There are four entries, each with a checkbox on the left and a text field on the right. The first three entries have their checkboxes unchecked and their text fields are empty. The fourth entry has its checkbox checked and its text field contains the text "Example Sable".

3.3.3.2 Issuing a Command

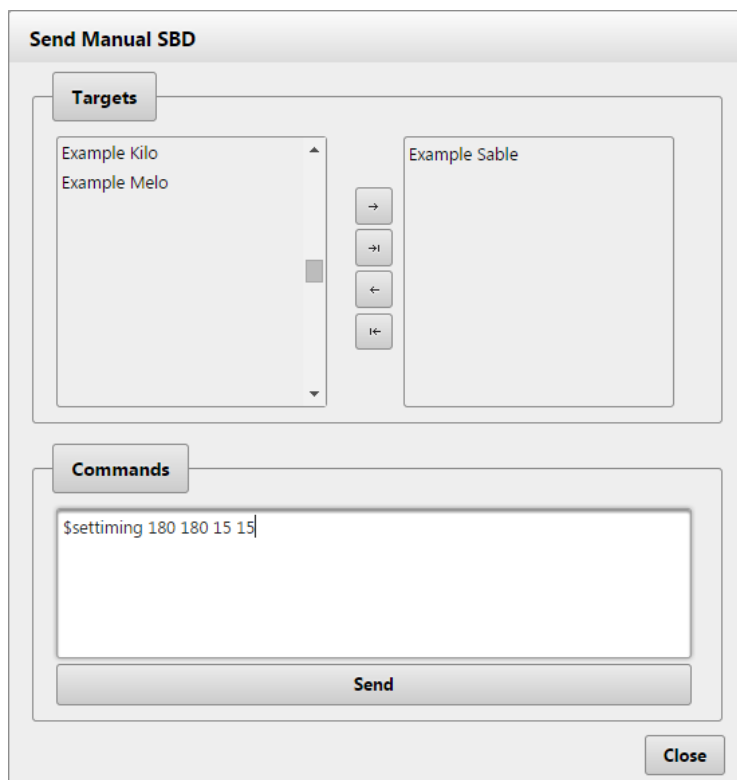
Click on the options button at the top of the page. Select **Send Manual SBD**



Select the device from the list of targets and click the Add button 

A screenshot of a dialog box titled 'Send Manual SBD'. The dialog has two main sections: 'Targets' and 'Commands'. The 'Targets' section contains a list of three items: 'Example Kilo', 'Example Melo', and 'Example Sable'. 'Example Sable' is selected. To the right of the list are four buttons: a right arrow, a right arrow with a plus sign, a left arrow, and a left arrow with a minus sign. The 'Commands' section contains a large text input field. Below the input field is a 'Send' button. At the bottom right of the dialog is a 'Close' button.

Type in a command using the same syntax as email SBD messages



The image shows a 'Send Manual SBD' dialog box. It has a title bar 'Send Manual SBD'. Inside, there are two main sections: 'Targets' and 'Commands'. The 'Targets' section has a list box on the left containing 'Example Kilo' and 'Example Melo', and a text box on the right containing 'Example Sable'. Between them are four buttons: a right arrow, a right arrow with an 'I', a left arrow, and a left arrow with an 'I'. The 'Commands' section has a large text box containing the command '\$settiming 180 180 15 15'. Below the text box is a 'Send' button. At the bottom right of the dialog is a 'Close' button.

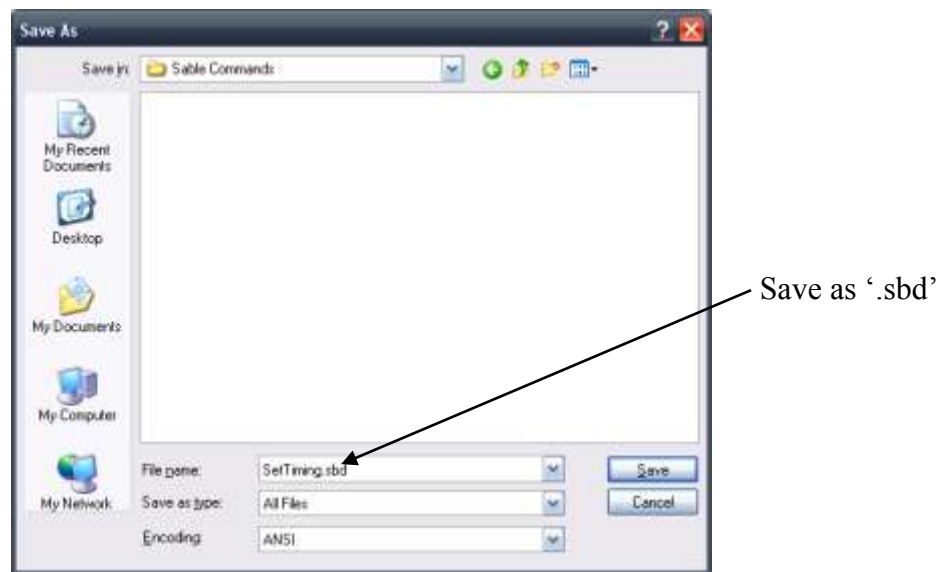
Click the **Send** button to issue the command.

3.3.4 Commands

There are four commands that are sent to the Sable over the Iridium network *when the Sable is above water*:

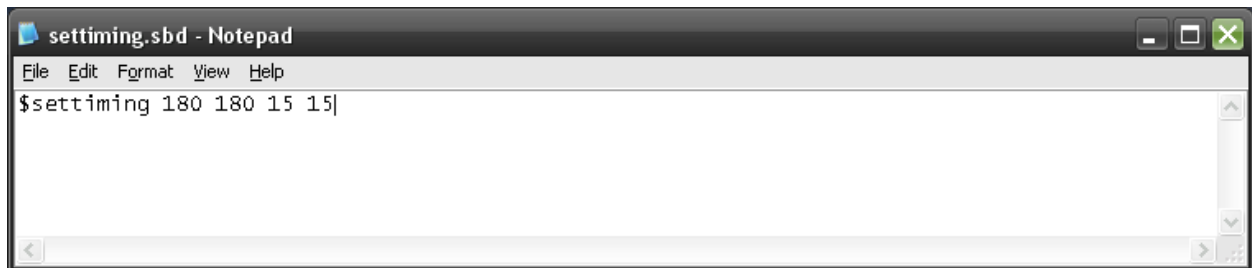
1. **SETTIMING**
2. **STATUS**
3. **POSITION**
4. **RESET**

The commands are always sent as an email attachment. Command attachment files can easily be created using Notepad. Simply open a new Notepad and type in the command exactly how it is displayed in this manual. Save the Notepad with a name that corresponds to the command. Save the file's extension name as '.sbd'. It is recommended that all command files are saved in one location for ease of access.



3.3.4.1 SETTIMING

The set timing command (\$SetTiming) is used to set 4 timer parameters in Sable, the GPS check and the Iridium check in normal mode and the GPS and Iridium Check in Alarm mode. The timing values are stored in minutes. The set timing file should be set up like the file below. The default timing settings are 180 minutes (3 hours) normal, and 15 minutes alarm mode.



180 = Normal GPS Check interval is the number of minutes between Sable's GPS location acquisition after the first hour of power up and before it goes underwater

180 = Normal IRD Check interval is the number of minutes between Sable's message checks, and GPS transmissions after the first hour of power up and before it goes underwater. The Sable will wake up and check for messages (new instructions) at the Iridium Gateway based on this setting.

15 = Alarm GPS Check interval is the number of minutes between Sable's GPS location acquisition after the first hour of a surface event

15 = Alarm IRD Check interval is the number of minutes between Sable's message checks, and GPS transmissions after the first hour of a surface event. The Sable will wake up and check for messages (new instructions) at the Iridium Gateway based on this setting.

These values are the *default* settings. When power is cycled on the beacon, the unit will return to these settings. Users can change these settings by opening the "set timing.sbd" file, changing the individual numbers (within the limits), then emailing the altered file to the Sable as an attachment.

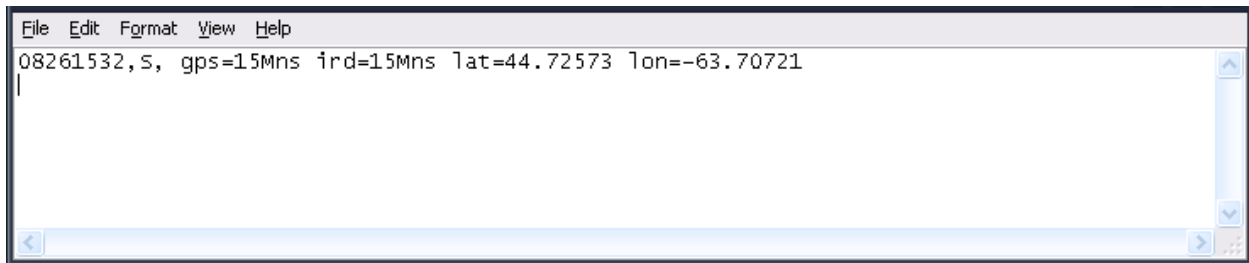
Timer Limits:

GPS	15 to 360 minutes (6 hrs)
IRD	15 to 43200 minutes (30 days)

Values set outside these limits will be ignored.

The Setup command can be sent to the Iridium gateway at any time and will take effect as soon as the Sable wakes up and connects with the Iridium Gateway.

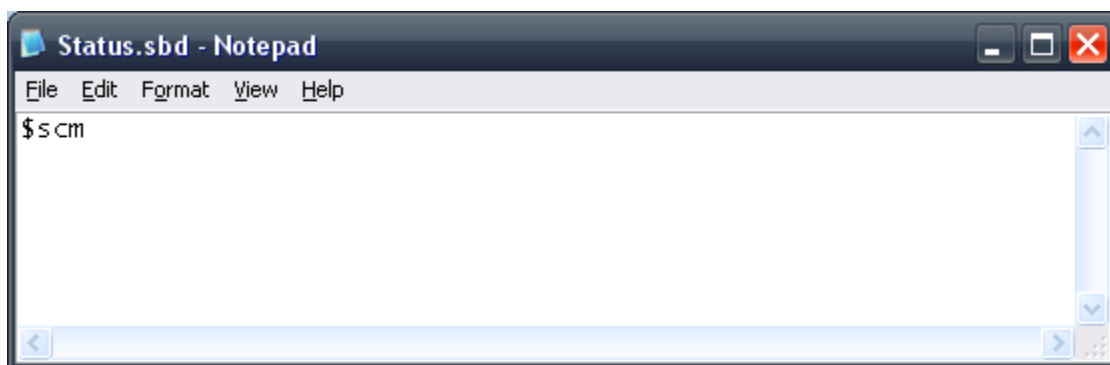
Once the Sable receives a SetTiming command, it will change the timing configuration and send back a status message, indicating the new timing configurations.



A screenshot of a Notepad window with a menu bar (File, Edit, Format, View, Help). The text area contains the command: 08261532,S, gps=15Mns ird=15Mns lat=44.72573 lon=-63.70721. The window has a scroll bar on the right and a status bar at the bottom.

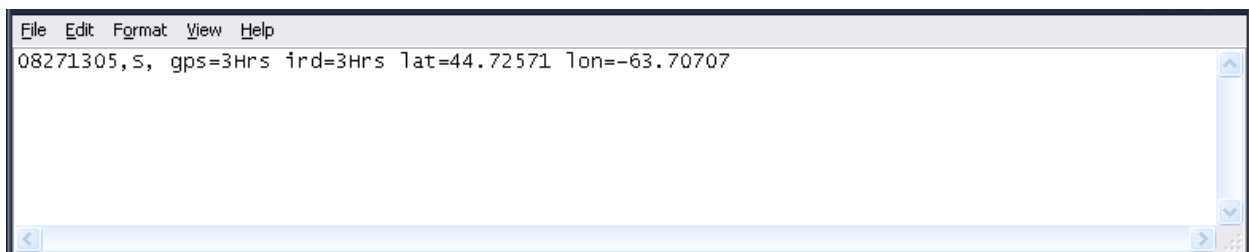
3.3.4.2 Status

The status command (\$scm) is used to retrieve Sable's current settings and beacon status. There is no need to configure this message. The Status command message file should look like the one below.



A screenshot of a Notepad window titled "Status.sbd - Notepad". The menu bar (File, Edit, Format, View, Help) is visible. The text area contains the command: \$scm. The window has a scroll bar on the right and a status bar at the bottom.

The 'answer' to a status request is a returned email attachment similar to this:



A screenshot of a Notepad window with a menu bar (File, Edit, Format, View, Help). The text area contains the response: 08271305,S, gps=3Hrs ird=3Hrs lat=44.72571 lon=-63.70707. The window has a scroll bar on the right and a status bar at the bottom.

The example above contains the following information:

- **08271305** This is the date and time (UTC) in MMDDhhmm (M=Month, D=Day, h= hour, m=min). This will be the date and time of the most recent GPS fix.
- **S** This means the message is a 'Status Message'
- **gps=3Hrs** Checks the GPS position every 3 hours (this is the default).
- **ird=3Hrs** Checks the Iridium Gateway every 3 hours (default). This is when the unit receives commands and sends messages.
- **lat=44.72571** Indicates GPS latitude position of unit, according to most recent GPS fix, and is expressed in decimal degrees.
- **lon=-63.70707** Indicates GPS longitude position of unit, according to most recent GPS fix, and is expressed in decimal degrees.

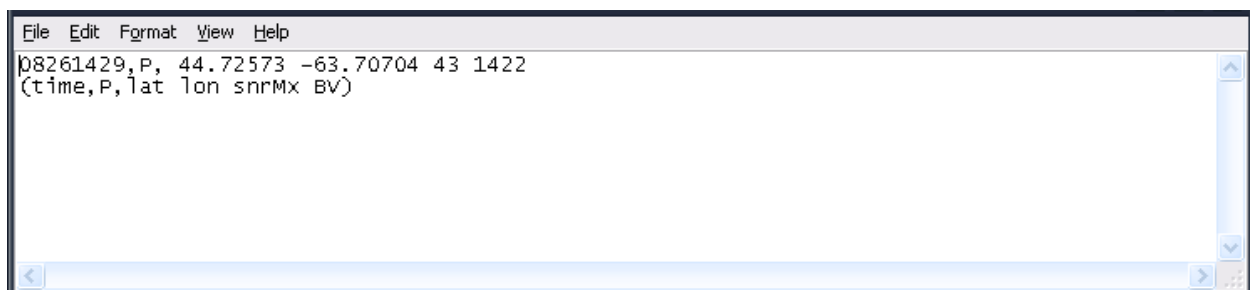
There are four cases in which the user will receive a status message. Upon initial power-up of the device, the user will receive a status message. At the end of "start-up mode" the user will receive another status message. If timings are changed, the user will receive a status message. If the manual command for a status message is received from the user.

3.3.4.3 Position

The position command (\$GetPos) file is a request for an immediate GPS location, which is answered by the Sable on its next Mail Message Check. The position command message should look like the one below.

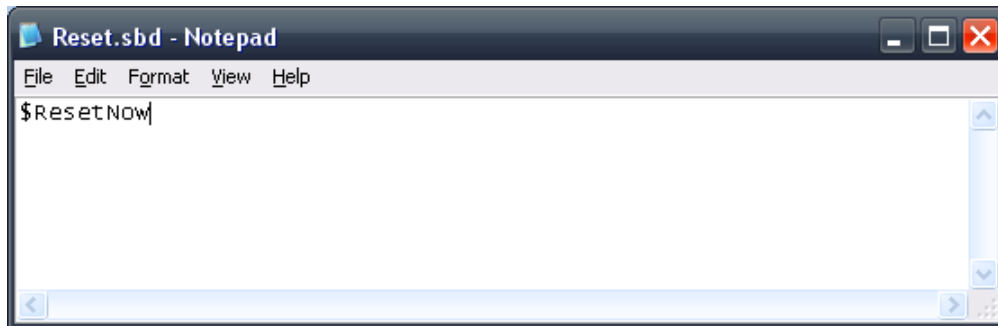


Once the Sable has received a get position command, it will return a position message, like the one below.



3.3.4.4 Reset

The reset command (\$ResetNow) does a full software reset of the Sable. This effectively will power OFF and ON the beacon. The unit will return to its default values of 3h,3h. It will also start the above-water Alarm Mode. **This command should only be used on the advice of Xeos Technologies Inc.** The reset command file should like the one below.



NOTE: You must terminate each Command with a Carriage Return OR Line Feed, or both. This is done by simply hitting the enter key at the end of the message.

3.4 Watch Circle

3.4.1 Watch Circle Operation

When you first turn the Sable on it will enter Startup Mode, and you should receive two email messages from the unit the status message indicating the unit has entered startup mode, the second is a regular message indicating time, status, position, distance from the center of the circle, time in that mode, GPS signal strength and battery voltage. The unit will stay in startup mode for two hours and broadcast messages at ten minute intervals.

⚠ Don't power the unit up for deployment until you are as close to the desired location as possible. Activating the unit prematurely will cause the center of the watch circle to be between where you turned the unit on and where it is deployed.

After the unit exits startup mode it will acquire regular GPS fixes and perform Iridium reports at the programmed intervals. If the unit leaves the watch circle the unit will enter alarm mode, in this mode the intervals for GPS fix and Iridium are reduced. The intervals are user programmable through the use of email commands.

3.4.2 Watch Circle Defaults

Watch Circle Center: The unit has the ability to learn the center of the watch circle by averaging its position over the first 48 hours of operation.

Watch Circle Radius: The radius of the watch circle is 100 meters.

⚠ You should set the radius of the circle within the first hour of deployment using the \$setcircle command. If you send the \$setcircle command and use 0 for the latitude and 0 for the longitude only the radius will be changed. Example for 100 meter radius \$setcircle 0 0 100

⚠ The minimum and maximum values for radius are 50m and 1000m.

GPS Fix Interval: For the first hour of operation 10 minutes
After the first hour of operation 1 hour

Iridium Msg. Interval: For the first hour of operation 10 minutes
After the first hour of operation 6 hours

3.4.3 Watch Circle Commands

----- *Operation Parameter Change* -----

\$ReportHour: Set Daily Reporting Hour

This command synchronizes messages with a specific hour of the day. You can enter values from 0 to 23, 0 being midnight, 23 being 11pm. The time zone used is UTC.

\$ReportHour 11 would have the transmissions synchronized with 8am in Nova Scotia

\$SetTiming: Set Timings: NrmlGPS, NrmlIRD, AlrmGPS, AlrmIRD

This sets the interval times for Iridium and GPS. The 'Alarm' values are ignored if watch circle is not enabled.

\$SetTiming 60 1440 60 720 Would give you 1 hour GPS intervals and 1 Day iridium checks for normal mode and 12 hour checks for alarm mode.

\$SetCircle: Set Watch Circle: Lat, Lon, Radius

(Set the latitude, longitude and radius(in meters) for the watch circle

it automatically sets the lat and lon based on the startup location. defaults should be ok)

\$WCEnable: Turn on (1) / off (0) Watch Circle Operation

(When watch circle is enabled extra data is included in the messages for status and distance from center)

----- *Status Values* -----

\$GetPos: Get current GPS position

\$scm: Show status change msg

\$AllTimings: Show timing for all modes

\$qi: Quick system info

\$gpss: Show gps-statistics

\$irds: Show ird-statistics

Note: Using the reset commands will set the Watch Circle back to defaults, this has the same effect as turning the unit on and off.

3.5 Power Supply and Consumption

The Sable has an internal battery pack consisting of two independent strings of nine alkaline C cells for a total of 18 cells. The nominal voltage of each string is 13.5v. The internal battery pack is not re-chargeable and should be replaced whenever the Sable is recovered.

The Sable incorporates a power supply that uses steering diodes. It will draw power from the stronger of the 2 independent strings until they both fall below 7 volts. The battery voltage can be monitored with the Status command.

Typical sleep current for the Sable is <200 μ A. This is the amount of current the device will draw between GPS checks and Iridium transmissions. The device has a life time of 2 years while submerged.

3.6 Opening the Housing

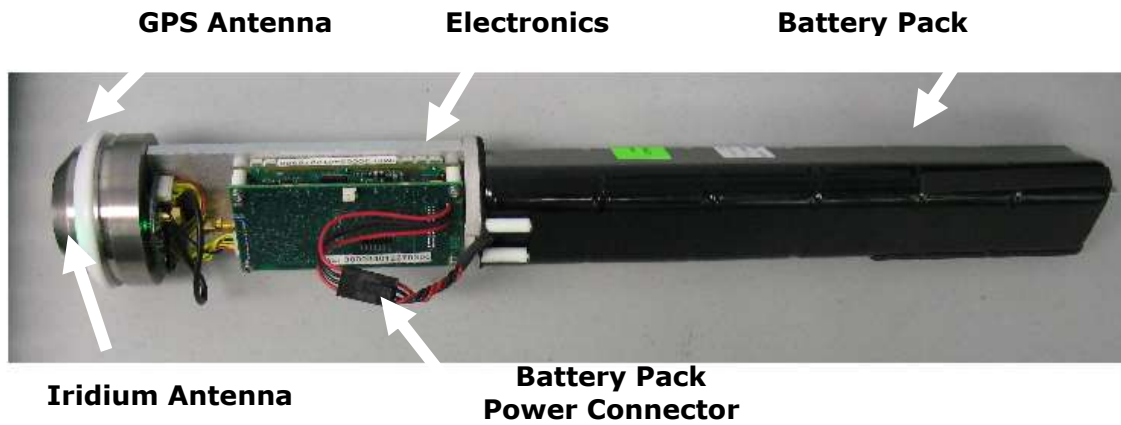
Set into the bottom of the Sable's titanium case is a titanium screw-plug with two O-rings (Parker #N1470 2-013 and Parker #N1470 2-017). After removing the plug, you can see the hex-socket-cap head of a stainless #8-32 screw which holds the chassis into the case. Remove that screw and replace it with a #8-32 screw that is 2 inches long so that it protrudes out of the titanium enclosure.



It is recommended that users make use of a vice or another stabilizing device and gently tap on the protruding screw with a rubber mallet until there is enough of the head of the sable exposed to get a firm grip on with your hands and pull the internal chassis out horizontally. Be careful not to scratch the inside of the titanium case where the O-ring seats.

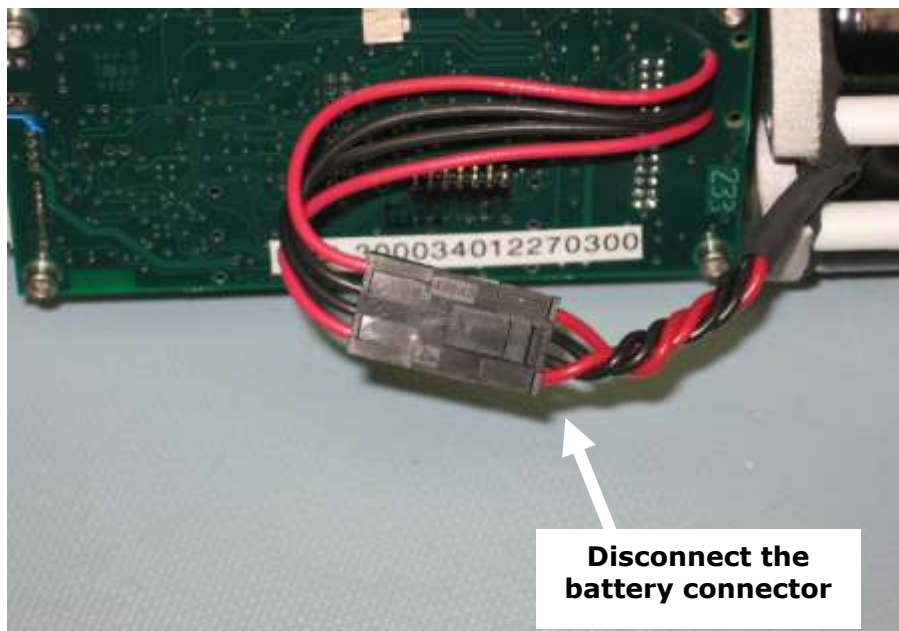
Note: When originally packaged at the factory, the chassis is stabilized in place through the use of foam strips placed vertically along the battery pack that grip the inside wall of the housing. It may require some force to pull the chassis out of its housing.

Note: It is very important to be aware of where the O-ring is sitting on the titanium screw plug. If the O-rings are not sitting perfectly in their O-ring grooves, there will not be a perfect seal and could cause fatal damage to the unit.



3.7 Replacement of Battery Pack

Disconnect the battery connector.



Remove the nuts and plate washer from the bottom of the battery pack, and carefully slide the battery pack off the center retaining rod.



**Remove nuts
and washer**

This is a good opportunity to replace the O-rings. O-rings should be replaced on an annual basis, (or at the same time as battery replacement). The Sable's head has an O-ring (Parker #N1490 2-143), and a back-up ring (Parker #N0300 8-143). Remove the old rings, clean away the old ring lube, and apply a light layer of fresh O-ring lube (Parker Super 'O').

A very thin amount of O-ring lube should be applied to the O-ring before installation. Carefully slide the new O-ring up over the electronics and into its groove in the upper titanium plate. Next, carefully slide the back-up seal (cupped side toward the O-ring, flat side toward the electronics) into place next to the O-ring.

Install the new alkaline battery pack (see specifications for battery info or contact Xeos directly). Re-install the plate washer and nuts. *Watch the LED indicator (on top of the cap) while you re-connect the battery connector.* When it shows green, you will need to use the magnet to turn OFF the Sable until it's ready for use.

Clean away the old O-ring lube inside the top of the titanium case and apply a light layer of fresh lube. Carefully slide the Sable battery pack and chassis into the case, but don't close it up yet.

Re-apply a light layer of O-ring lube to the rings, if needed. Get the bottom retaining screw and plug ready to go, with fresh O-rings (Parker #N1470 2-013 and Parker #N1470 2-017) and lube for the plug. Next, if you have it, flush the Sable's interior air with dry nitrogen, blown in from the bottom plug hole. Push the Sable chassis into place, and screw in the bottom retaining screw and screw-plug.

Note: Do not over-tighten the bottom screw-plug, as the extra torque will cause the case bottom and battery pack to rotate, which may shear the battery cables.

Note: It is very important to be aware of where the O-ring is sitting on the titanium screw plug. If the O-rings are not sitting perfectly in their O-ring grooves, there will not be a perfect seal and could cause fatal damage to the unit.

3.8 *Field Installation*

The Sable is intended for use on marine flotation devices. It is important that the top of the Sable is located as high above the surface of the water as possible. Both the Iridium and GPS antennas are located at the top of the unit. It is recommended that users install Sable on a mast or superstructure at the top of their surface buoy or flotation device.

Care should be taken when installing to avoid putting metal bands close to the top of the unit where the antennas are located.

Appendix A - Technical Specification

Mechanical:

Material: Outside Housing: Titanium case
Inside Pull-out Chassis: Aluminum

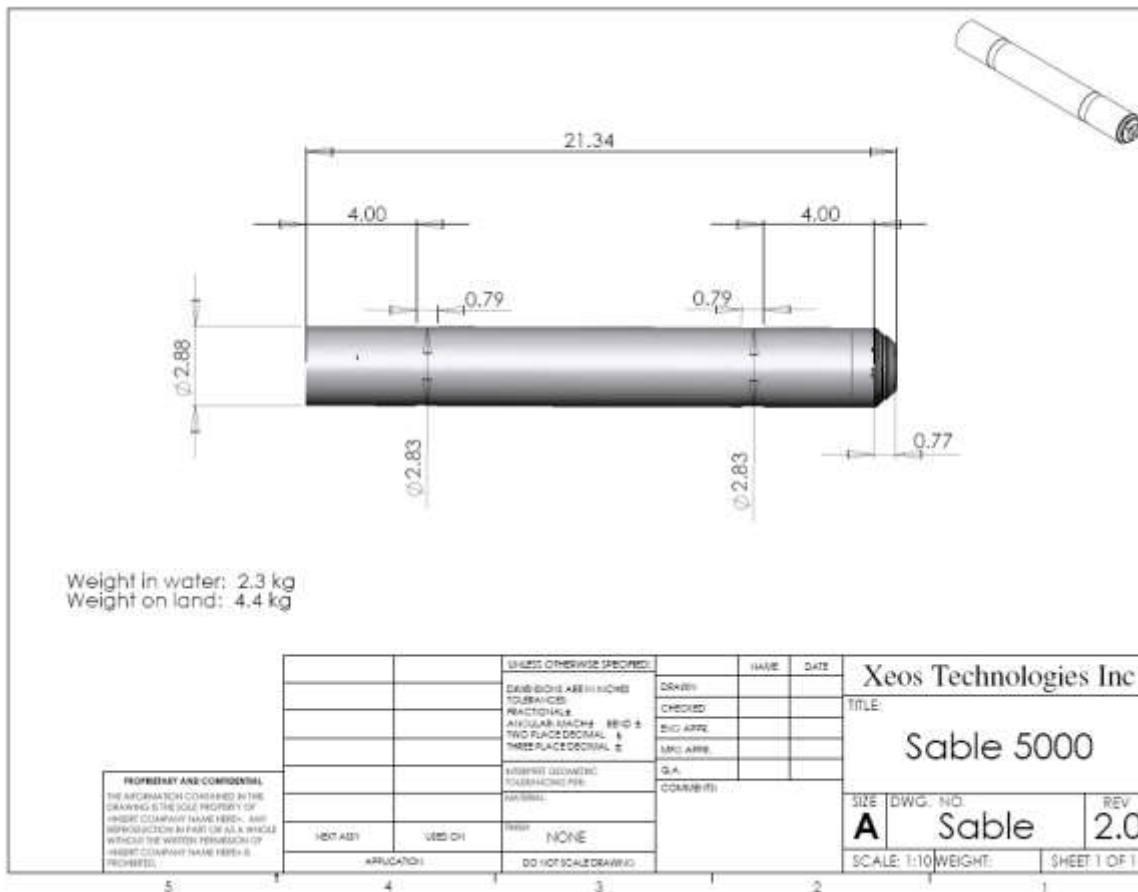
Dimensions: Length 21.34" (542mm) x 2.88" OD (73.15mm)

Weight: Out of water: 9.7 lbs (4.4 Kg)
In water: 5.0 lbs (2.3 Kg)

O-rings:

Head O-ring: Parker #N1490 2-143
Industry Standard AS568A-143
Head back-up seal: sealonline.com #8-143/N1444
Parker #N0300 8-143
Bottom titanium screw-plug: Parker #N1470 2-013 nitrile rubber
Parker #N1470 2-017 nitrile rubber
Industry Standard AS568A-013

O-Ring Lube: Parker Super 'O'



Electrical:

Power Supply

Internal Battery Supply:	2x 9 (18) Alkaline C cells
Voltage:	+13.5 volts nominal
Capacity:	20 Amp-hours
Life expectancy:	2 years sub-surface deployment, followed by 1 year surface or 2000 inbound/outbound messages

Electronics

Iridium Transceiver:	9601-D-I
Digital Controller:	Xeos IRDC-2
GPS Receiver:	AA003252-G-BLK Jupiter GPS

Environmental

Operating Temperature:	-30° C to +60° C (-22° F to +140° F)
Storage Temperature:	-40° C to +80° C (-40° F to +176° F)

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LIMITED WARRANTY: Xeos Technologies Inc. warrants that the product will perform substantially in accordance with the accompanying written materials for a period of one year from the date of receipt.

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