



Resilient User Manual

SURFACE IRIDIUM / GPS BEACON



Shipped From



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Specifics

This manual version is written with respect to RoverWGMS firmware build 6058. If you wish to acquire the latest firmware for your device, contact support@xeostech.com

Version History

Version No.	Date	Description
1.0	Oct 2017	Base Document
1.1	Jan 2018	Added details to Watch Circle Info
2.0	Jan 2020	Overhaul

Regular checks for the latest manual are suggested. Be sure to check [Xeos Technologies' manuals page](#) to compare versions and download the latest version.

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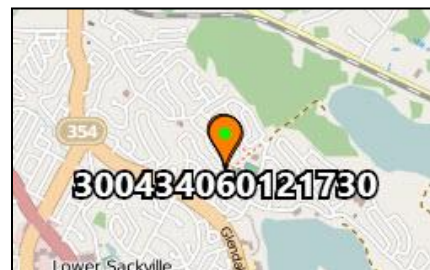
General Description

The Resilient Surface Iridium satellite mooring location beacon continuously monitors location for mobile surface assets and/or instrument moorings. Resilient makes use of the bi-directional, global, real time Iridium satellite Short Burst Data (SBD) network in combination with GPS position location. Resilient's sleek tubular design and internal dual Iridium/GPS antennas located at each end cap allow it to be easily retrofitted into a variety of surface mounts. Even surface installations which capsize may be able to transmit location information.

Inside the Resilient is a 9603 Iridium satellite Short Burst Data core radio transceiver, a specialized low power Xeos digital controller with GPS, Iridium antenna and GPS antennas.

Resilient is intended for surface deployments and should not be deployed in situations which exceed 100m in depth. Xeos Technologies Inc. (Xeos) manufactures other specific products for either surface, or subsurface applications to depths of 11,000 m.

See www.xeostech.com for details or call (902) 444-7650.



Theory of Operation

The Resilient is intended for providing regular location information on high value assets at the surface, drifting or moored. After being activated, the Resilient is deployed at the surface and begins sending location messages as per the user settings. The internal battery pack provides over 1500 messages or up to a 2-year deployment.

Operators can communicate with the surface deployed Resilient via Iridium using commands sent through WGMS. Status information can be obtained, including the health of the GPS system and battery voltage. Timings are settable, and the default is one message every 12 hours. If you need to make a change to settings, the Resilient will receive the command to change the timing the next time it checks for messages, as much as 12 hours after the command is sent.

The Resilient will continue to send position messages based on the timings, until it is manually turned off or the battery pack drops below the minimum voltage requirement of 7V.

Due to the location of dual Iridium/GPS antennas at **both** ends of the enclosure, the Resilient will continue to try and send position messages when inverted or capsized.

Preliminary Setup

Outside Diagram



1	The LEDs of the Resilient are located here. LEDs illuminate on magnet contact, power-up and Bluetooth connection
2	The top Iridium and GPS antennae of the Resilient are located here
3	The magnet switch for turning the Resilient on and off is located behind the label
4	The 15-digit IMEI of the Resilient's Iridium modem and factory serial number is displayed
5	A QR code is available to scan to download the manual on new devices
6	Two sealing O-rings are located in the middle of the Resilient. This is where the device is opened to install batteries and may have an extended enclosure.
7	The bottom Iridium and GPS antennae of the Resilient are located here, used when inverted

Setting up an Iridium Account

Resilient makes use of the Iridium Satellite Systems' Short Burst Data (SBD) service for the 9603 transceiver. This service is a global (including the Polar Regions), two-way, real-time and email-based data delivery service with a maximum outbound (from beacon) message size of 340 bytes and a maximum inbound (to beacon) message size of 270 bytes.

Resilient end users must set up an approved data delivery account with their preferred service provider. This can only be done once Xeos has provided the user with an International Mobile Equipment Identity (**IMEI**) number. Each 9603 modem has a unique IMEI that must be registered with the preferred service provider. For a list of service providers in your area please contact Iridium for recommendations. Xeos Technologies is also able to provide Iridium SBD data service and accounts. Please contact activations@xeostech.com for more information.

Each IMEI number is capable of being associated with up to five (5) unique email addresses (this may vary between service providers). When registering an IMEI number, please provide the service provider with a temporary Xeos testing account email address.

This account is: **xeosbeaconb@gmail.com**

This temporary email testing account can be deleted or replaced at any time after delivery of the Resilient. Once the SBD account has been activated, please contact your Xeos representative and confirm this.

Resilient makes use of a simple and robust binary email protocol as the default outgoing message format. Any email application can be used to send and receive messages to or from the Resilient, however, the messages from the Resilient in this format are not human-readable. [XeosOnline](#) is a web-based monitoring system which allows users to view and manage information from the Resilient on a mapping system, as well as view the messages in a human-readable format. XeosOnline also allows for the creation of multiple kinds of message forwarders which can forward certain (or all) messages to a group of email addresses in a human-readable form.

Sending messages and changing configuration can be completed through XeosOnline. See www.xeostech.com or your account manager for more information.

Quickstart

Before using the Resilient

- Ensure the IMEI of your device is activated through your chosen Iridium provider and intended message recipients are added to its account ahead of deployment.

Power-Up

Battery Installation

The Resilient automatically turns on once all batteries are installed. The device must be turned off via magnet or battery removal.

Magnet

- Swipe the magnet **slowly** along the “**SWIPE ON/OFF HERE**” label horizontally until the flashing **GREEN LED** on the top of the device remains solid. The green LED will flash again while the device completes power-up.



Confirm Transmission

- Turn the device on and place it outside in view of as much of the sky as possible.
- The unit will transmit a power-up message, and transmit one GPS fix every 10 minutes at default settings within 5 minutes of power-up for one hour.
- Confirm that these messages are being received by your email and/or XeosOnline.



Operation

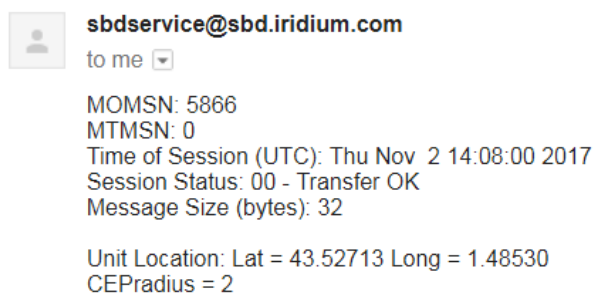
- When deploying the unit, power it up by swiping the magnet.
- Once the unit is confirmed to be on, it is ready to be deployed.
- Turn the Resilient **OFF** using the same magnet method as turning **ON**, with the **RED LED** in place of the green.

Understanding Position Information

There are two types of position information which will be sent via the Iridium Gateway.

Iridium Doppler position

The Iridium Gateway calculates the Iridium transceivers' position on earth when it receives a transmission, using Doppler technology. As a result, it is often very inaccurate. This location is only visible to users getting emails directly from the Resilient, as opposed to emails forwarded by Xeos Online. An example of a "raw" Iridium message via email is below and will always have the IMEI of the device in the subject line, regardless of its name on XeosOnline.



sbdservice@sbd.iridium.com	All messages from Iridium devices come from this address.
MOMSN: 5866	Mobile Originating Message Serial Number; each individual message has its own incrementing serial number. A mobile originating message is one that comes from the Iridium device.
MTMSN: 0	Mobile Terminating Message Serial Number; like the MOMSN, messages to Iridium devices (like commands) also have an incrementing serial number. Since the message in the example is from an Iridium device, the MT number is zero.
Time of Session (UTC)	The time the message arrived at the Iridium Gateway
Session Status	Each message will have a code determined by how well the message was received; codes 00, 01 and 02 are acceptable

	and will always have their code name (ex. Transfer OK) next to this number.
Message Size (bytes)	The size of the actual message sent by the Iridium device, which is in the attachment in the email.
*Unit Location	The Doppler position of the device as estimated by Iridium's network. It is NOT the GPS position measured by the device.
*CEPradius = 2	The numerical value of how accurate the above position is; with a value of 2, This means that using the Lat/Long that the body has supplied, Iridium is 80% confident (always 80%) that the device sending the message is within a circle, 2 kilometers in radius, with the Lat/Long given as the centre of that circle. The higher the CEPradius value, the larger the circle and therefore the less accurate that position.

*These items can be enabled/disabled by your Iridium provider if desired.

Global Positioning System

Location information generated by the device itself is embedded in the SBD attachment sent via the Iridium Gateway and can only be seen through the Xeos Online system or situations where the position information is sent in a plain-text format (XeosOnline message forwarder or using the **\$msgenable** command). This position information is accurate to within several feet of the true position.

Timestamp: 2018-04-11T19:20:10.001Z, BatteryV: 10.38, Latitude: 44.714227, Longitude: -63.604954, Vul: 11.88

On/Off Modes

Using the Magnet

The Resilient beacon is turned ON and OFF using an external magnet near an internal magnetic reed switch, and operation can be identified by viewing the LED through the top of the Resilient.

To turn the Resilient ON, begin swiping the magnet slowly up and down at the location of the reed switch. The reed switch is located directly behind the Swipe On/Off Here label.



To turn the Resilient OFF, repeat the above procedure with the magnet and watch the LED 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 placed against the location of the reed switch **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.

If the batteries are low, or if some of the batteries have been inserted incorrectly, the Resilient will sound a quick intermittent beep and flash the red LED at the top for 5 minutes, or until the batteries have been corrected or replaced. If this behavior persists even if the batteries are full and oriented correctly, this indicates a **SELF-TEST FAILURE**. Contact support@xeostech.com if this occurs.

- It is important to let all LEDs stop illuminating before initiating another action.
- Cycling power for any reason, for example by using the switch to turn OFF/ON or by removing battery power, will initiate the Startup Mode.

LED Indicators

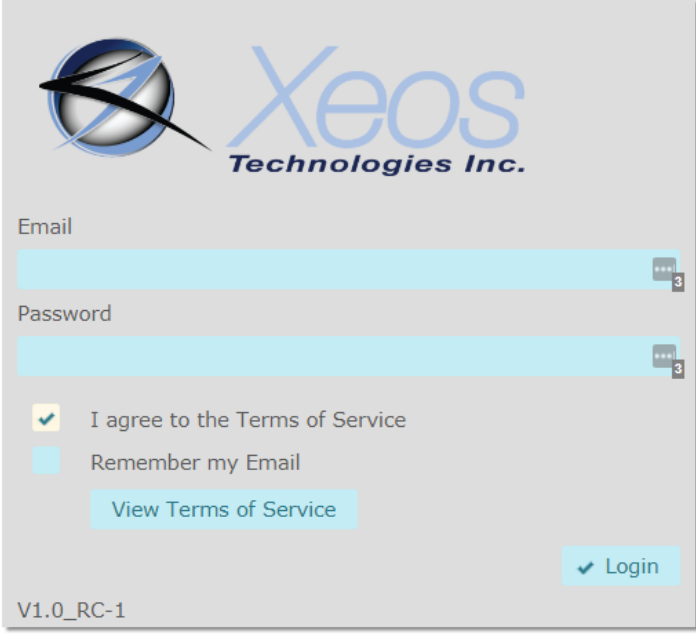
The top of the Resilient (and bottom of ROBY) use red and green LEDs to show their on/off status. It is also to be used as an indicator for when the magnetic switch is used to turn the device on/off. This same LEDs are also used during self-test failure or Bluetooth connection.

Unit Status Indicators	
Action: Turn On	Swipe Magnet back and forth across topside until LED is solid green
Action: Turn Off	Swipe magnet back and forth across topside until LED is solid red
Check Status	Swipe magnet once across topside (red is off, green is on)
Other Indicators	
Flashing 4 Hz on power-up	Device powering up, performing self-test
Flashing 0.5 Hz after power-up	Self-test failure
Flashing 4 Hz on Bluetooth Connection	Device acknowledging Bluetooth is connected

Tracking with XeosOnline

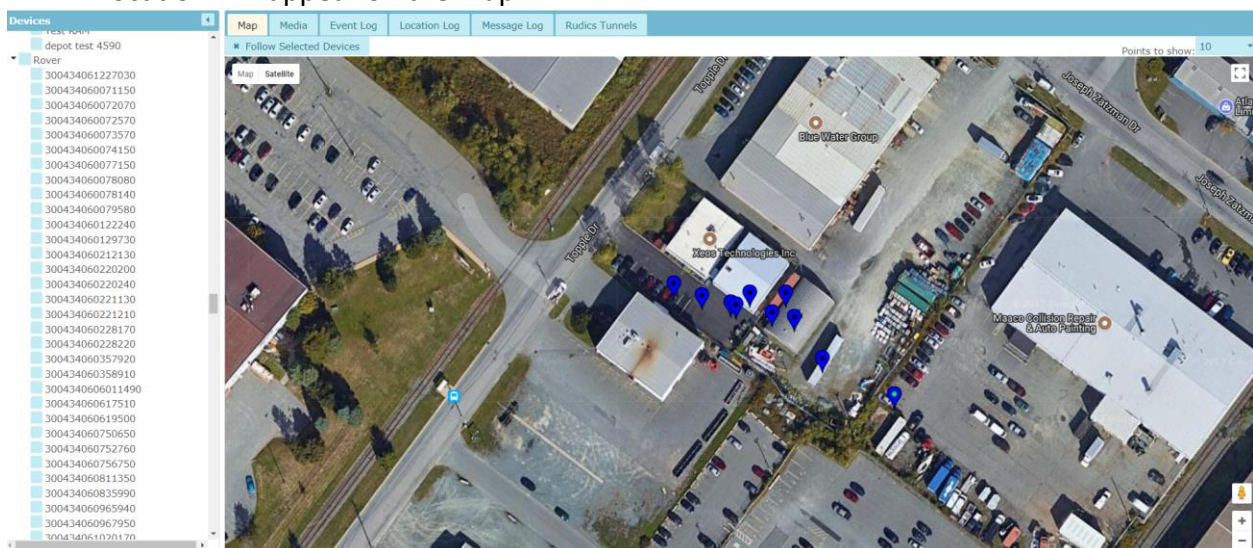
Setting up your company, usernames and devices in XeosOnline is covered in the Xeos Online User Manual and Xeos Organizational Administrator Manual. If you do not already have a copy, please contact support@xeostech.com

1. Using your web browser, go to <http://online.xeostech.com>
2. Login to Xeos Online



The login form features the Xeos Technologies Inc. logo at the top. Below the logo are two input fields for 'Email' and 'Password', each with a small 'x' icon to the right. Under the password field is a checkbox labeled 'I agree to the Terms of Service' and another checkbox labeled 'Remember my Email'. A 'View Terms of Service' button is positioned below the first checkbox. At the bottom right is a 'Login' button with a checkmark icon. The version 'V1.0_RC-1' is displayed at the bottom left of the form.

3. From the map view, click on your Resilient in the left hand side column. The last known location will appear on the map



- To view messages, click on the Message Log tab above the map

Map	Media	Event Log	Location Log	Message Log	Rudics Tunnels
Refresh					
(1 of 10) 1 2 3 4 5 6 7 8 9 10 50					
ID	Device	Date Processed	SBD Date	Direction	
2351331	300434060074150	Nov 9 2016 11:20:31.472 AM	Nov 9 2016 11:20:30.000 AM	Incoming	Capsized Event: true, Timestamp: 2016-11-09T15:20:07.000Z, BatteryV: 12.75, Latitude: 44.714253, Longitude: -63
2351173	300434060074150	Nov 9 2016 11:10:30.926 AM	Nov 9 2016 11:10:30.000 AM	Incoming	Capsized Event: true, Timestamp: 2016-11-09T15:10:06.000Z, BatteryV: 12.72, Latitude: 44.714147, Longitude: -63
2351071	300434060074150	Nov 9 2016 11:04:35.048 AM	Nov 9 2016 11:04:33.000 AM	Incoming	Capsized Event: true, Timestamp: 2016-11-09T15:00:06.000Z, BatteryV: 12.78, Latitude: 44.714227, Longitude: -63
2350791	300434060074150	Nov 9 2016 10:50:43.483 AM	Nov 9 2016 10:50:36.000 AM	Incoming	Timestamp: 2016-11-09T14:50:06.000Z, BatteryV: 12.78, Latitude: 44.714173, Longitude: -63.604993, SNR: 43, Ev
2350581	300434060074150	Nov 9 2016 10:40:39.043 AM	Nov 9 2016 10:40:38.000 AM	Incoming	Timestamp: 2016-11-09T14:40:06.000Z, BatteryV: 12.75, Latitude: 44.714180, Longitude: -63.605000, SNR: 42, Ev
2350448	300434060074150	Nov 9 2016 10:31:20.426 AM	Nov 9 2016 10:31:19.000 AM	Incoming	Timestamp: 2016-11-09T14:30:00.000Z, BatteryV: 12.78, Latitude: 44.714207, Longitude: -63.604960, SNR: 40, Ev
2350444	300434060074150	Nov 9 2016 10:31:11.250 AM	Nov 9 2016 10:31:10.000 AM	Incoming	Timestamp: 2016-11-09T14:31:10.000Z
2321855	300434060074150	Nov 7 2016 01:20:30.615 PM	Nov 7 2016 01:20:29.000 PM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T17:20:06.000Z, BatteryV: 12.72, Latitude: 44.714387, Longitude: -63
2321730	300434060074150	Nov 7 2016 01:10:37.281 PM	Nov 7 2016 01:10:36.000 PM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T17:10:05.000Z, BatteryV: 12.72, Latitude: 44.714400, Longitude: -63
2321595	300434060074150	Nov 7 2016 01:00:30.251 PM	Nov 7 2016 01:00:29.000 PM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T17:00:06.000Z, BatteryV: 12.72, Latitude: 44.714387, Longitude: -63
2321487	300434060074150	Nov 7 2016 12:50:28.429 PM	Nov 7 2016 12:50:27.000 PM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T16:50:05.000Z, BatteryV: 12.72, Latitude: 44.714373, Longitude: -63
2321379	300434060074150	Nov 7 2016 12:40:38.255 PM	Nov 7 2016 12:40:37.000 PM	Incoming	Timestamp: 2016-11-07T16:40:06.000Z, BatteryV: 12.72, Latitude: 44.714353, Longitude: -63.604900, SNR: 42, Ev
2321310	300434060074150	Nov 7 2016 12:33:01.545 PM	Nov 7 2016 12:33:00.000 PM	Incoming	Timestamp: 2016-11-07T16:31:36.000Z, BatteryV: 12.75, Latitude: 44.714373, Longitude: -63.604913, SNR: 42, Ev
2321308	300434060074150	Nov 7 2016 12:32:53.389 PM	Nov 7 2016 12:32:52.000 PM	Incoming	Timestamp: 2016-11-07T16:32:52.000Z
2321115	300434060074150	Nov 7 2016 12:13:26.328 PM	Nov 7 2016 12:13:25.000 PM	Incoming	Timestamp: 2016-11-07T16:13:25.000Z, Message Check: true
2321025	300434060074150	Nov 7 2016 12:03:32.845 PM	Nov 7 2016 12:03:31.000 PM	Incoming	Timestamp: 2016-11-07T16:03:31.000Z, Message Check: true
2320933	300434060074150	Nov 7 2016 11:53:54.089 AM	Nov 7 2016 11:53:53.000 AM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T15:50:06.000Z, BatteryV: 12.75, Latitude: 44.714433, Longitude: -63
2320796	300434060074150	Nov 7 2016 11:40:28.409 AM	Nov 7 2016 11:40:27.000 AM	Incoming	Capsized Event: true, Timestamp: 2016-11-07T15:40:06.000Z, BatteryV: 12.78, Latitude: 44.714473, Longitude: -63
2320675	300434060074150	Nov 7 2016 11:30:49.536 AM	Nov 7 2016 11:30:48.000 AM	Incoming	Timestamp: 2016-11-07T15:30:06.000Z, BatteryV: 12.78, Latitude: 44.714360, Longitude: -63.605000, SNR: 45, Ev
2320545	300434060074150	Nov 7 2016 11:20:36.791 AM	Nov 7 2016 11:20:36.000 AM	Incoming	Timestamp: 2016-11-07T15:20:06.000Z, BatteryV: 12.78, Latitude: 44.714427, Longitude: -63.604920, SNR: 42, Ev
2320512	300434060074150	Nov 7 2016 11:18:00.195 AM	Nov 7 2016 11:17:59.000 AM	Incoming	Timestamp: 2016-11-07T15:13:59.000Z, BatteryV: 12.81, Latitude: 44.714433, Longitude: -63.604927, SNR: 44, Ev
2320482	300434060074150	Nov 7 2016 11:14:45.647 AM	Nov 7 2016 11:14:43.000 AM	Incoming	Timestamp: 2016-11-07T15:14:43.000Z

- Multiple targets can be viewed on the map simultaneously by clicking on all the devices you wish to monitor on the left hand list.

Remote Configuration of the Resilient

Unlike other Xeos Iridium beacons, Resilients must be sent commands via Liquid Robotics' WGMS service. To learn how to send commands using WGMS, please contact [Liquid Robotics](#).

Note: Change to configuration only takes place once the Resilient **receives** the message. That means that if the Resilient is set to check messages hourly, it will not change its operational behavior until it has checked at its scheduled time for changes.

Xeos Beacon Bluetooth App

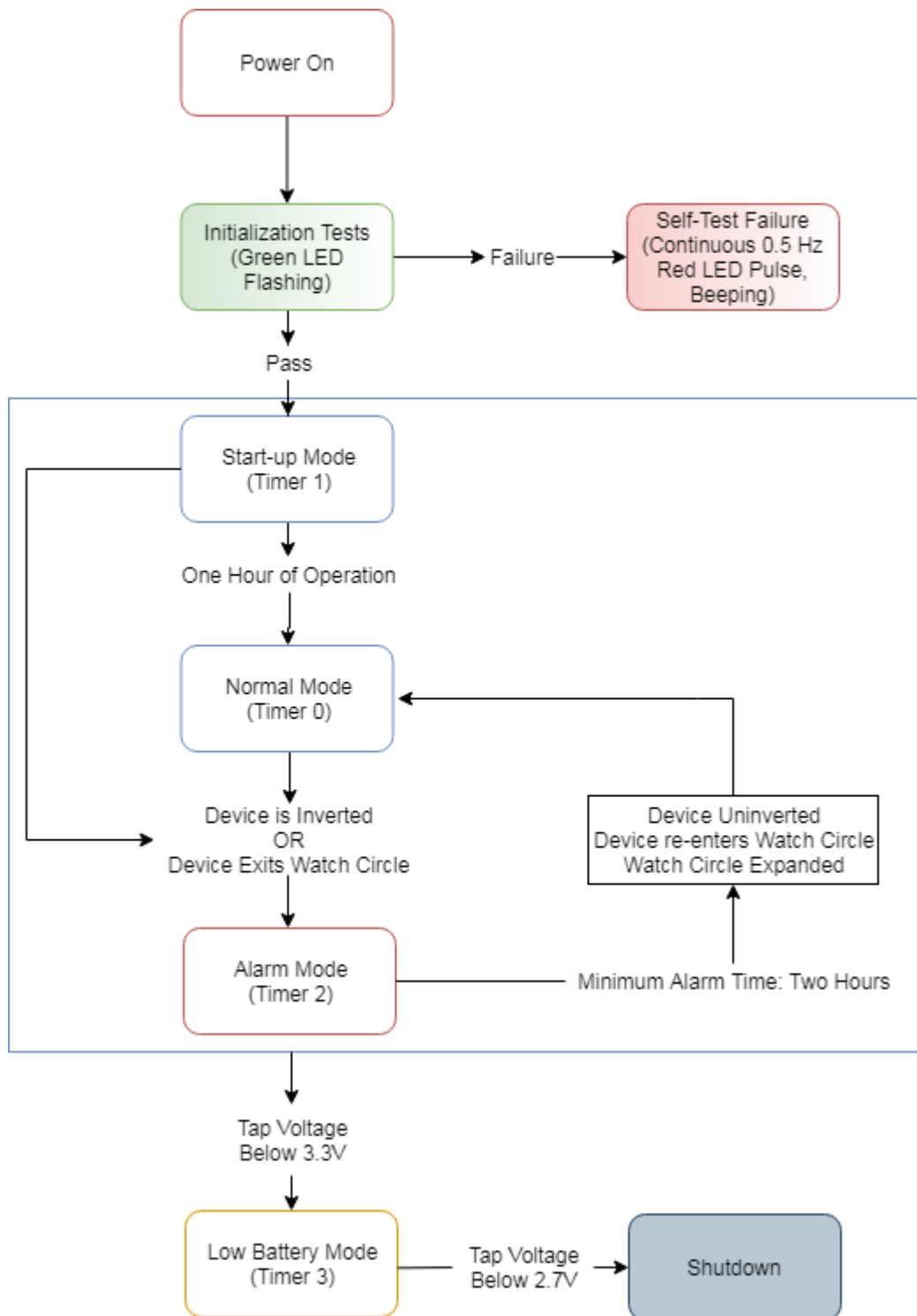
Select Xeos products can be configured locally using the [Xeos Beacon Android App](#). This method of communication requires no disassembly.

The Bluetooth app allows for communication, configuration, logging and firmware updates. A detailed document on how to use the application can be found [here](#).

See the [Bluetooth](#) section for Bluetooth functionality as it pertains to the Resilient.

Configuration of the Resilient

The Resilient has a combination of preset behaviors and configurable parameters. Below is an outline of its normal/default behavior:



Resilient Timer Intervals

The following are the parameters for each mode:

Timer	T0	<T1>	T2	T3	T4	Min-Max
SBD	12h	10m	10m	1d	12h	5m – 1d
GPS	12h	10m	5m	1d	12h	5m – 1d

Legend	
SBD	SBD (Iridium) transmission interval
GPS	GPS acquisition interval
T0 – T7	Timer number
<T#>	Timer currently in use
#s/m/h/d	Interval in seconds/minutes/hours/days
Min	Minimum allowed interval for this timer
Max	Maximum allowed interval for this timer

Timers		
Timer 0	Normal	Used if none of the following modes are triggered
Timer 1	Start-up	Used for the first hour after the unit is powered on
Timer 2	Alarm	Used once the unit is inverted or exits its watch circle
Timer 3	Low Battery	Used when there is a low battery
Timer 4	No GPS Fix	Used when the GPS module fails to acquire a fix

The default timer settings of the Resilient are suitable for most use cases.

Timers 5 - 7 are not used in the Resilient.

Timer Command

The **\$timer** command will return the timer intervals all configurable settings. The response will also be returned when timers are changed:

```
Ascii: Tmr:SBD,20m,5m,5m,5m,5m,1h,1h,1h Tmr:GPS,20m,5m,5m,5m,5m,1h,1h,1h
```

The timer string returned includes a summary of all timers. The first five timers (0 – 4) are used.

Changing the Timers

Iridium and GPS intervals can be changed to suit the user's requirements through the use of the \$timer command:

\$timer SYSTEM TIMER-MODE INTERVAL

The GPS and Iridium interval timers can be set independently of each other, but there are several things to keep in mind. The Resilient has by default a limit of 12 GPS fixes per Iridium message and will retain a maximum of 24 unsent fixes (all fixes are saved in internal flash memory). This puts a practical limit on the ratio of GPS fixes to Iridium checks.

Regardless the method being used to communicate with the Resilient, timer commands are always the same format:

Example 1	\$timer SBD 2 10m	Changes the SBD interval of Alarm Mode to 10 minutes
Example 2	\$timer SBD 0 1d	Changes the SBD interval of Normal Mode to 1 day
Example 3	\$timer GPS 0 6h	Changes the GPS interval of Normal Mode to 6 hours

After combining the setup of both Example 2 and Example 3, the user would receive 1 message every day containing 4 GPS fixes. These messages would be sent at approx. 00:00 UTC.

As with all other settings aside from watch circle centres, all timers are retained through resets and will be employed at the next power-up.

Watch Circle

The watch circle functionality allows users to monitor the position of their mooring by receiving alarm messages when it exits a user-defined circle. This feature aids in the recovery of moorings that could break free from their planned position.

Recognition of a watch circle exit is tied to the GPS interval of the device in Normal Mode (**Timer 0**); once a GPS position is logged that shows the device is outside the circle, the device immediately transitions to Alarm Mode (**Timer 2**) and transmits according to Alarm Mode timer intervals.

Enabling the Watch Circle

The watch circle is disabled by default, but can be enabled by the following command:

\$WCenable 1

The device will respond with a Switch message in ASCII showing watch circle (component C) is moved to the Y (yes) column.

Ascii: Switch: Y = GC, N = MO

Once functionality is enabled, the specifics of the user's circle can be implemented.

Setting the Watch Circle

The watch circle parameters can be set by sending the **\$setcircle** command using this format:

\$setcircle Latitude Longitude Radius

The minimum Radius is 50 meters, while the maximum is 15000 meters.

Example:

\$setcircle 47.56989 -53.55682 100

- a) **\$setcircle** is the command
- b) Latitude is set to **47.56989**
- c) Longitude is set to **-53.55682**
- d) Radius is set to **100** meters

Note:

If a watch circle is not set by command, but functionality is enabled, the Resilient will place its centre on the average locations so far acquired. The device will create a Watch Circle using the 48-hour average as its centre and the default radius of 100m.

Upon implementing the watch circle, the Resilient will return an **S-Type message** (see below):

Ascii: 10011801,S,Status / Value Change: Mode = OK gps = 15Mns lrd = 15Mns ctr=44.71453/-63.60513 rad = 500m, Sched hr = 0

Once the watch circle is set, the unit will operate normally until it approaches the watch circle radius, at which point the device will send a warning message. Once the device exits the watch circle radius, it will begin sending alarm messages with GPS coordinates every 10 minutes (**Timer 2**) until the unit re-enters the watch circle, the radius is expanded via command, or is turned off.

Notes

- A maximum of 24 GPS positions can be included in a single SBD transmission. Unlike other settings, the watch circle's details are erased at each power up.
- Watch circle alert, watch circle warn and inverted mode use the same timer.
- You can adjust the Watch Circle's radius alone by setting the latitude and longitude parameters to 0, followed by the new radius.

Encryption

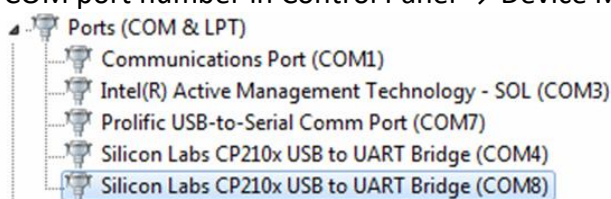
The Resilient has some security features enabled by default, such as an unlock codes for receiving commands. As of build 4170, users can also enable end-to-end 256 bit AES encryption between their device and XeosOnline for an additional layer of security. Messages are zero-padded to fill out the 32 byte blocks.

Generating your Key

The first step is to provide the Resilient with a passphrase over its serial connection.

Getting Your COM Port

1. Connect the Resilient to the Android app or the internal USB port (requires removal from enclosure to reach USB port)
2. Take note of the COM port number in Control Panel → Device Manager



In this case: COM8

Connect Using Terminal Emulator

1. Download terminal emulator software
2. Connect to the Resilient using the following settings:

Baud Rate	57.6k
Parity	None
Data Bits	8
Stop Bits	1

3. Enter your encryption passphrase by entering

\$aky PASS PHRASE

- **The pass phrase must be exactly 32 characters long.**
- **Note:** This step **cannot** be done through Iridium.

Connect Using Bluetooth App

4. Download the Xeos Beacon Bluetooth App (Android)
5. Connect to the Resilient and navigate to the Terminal Tab
6. Enter your encryption passphrase by entering

\$aky PASS PHRASE

- **The pass phrase must be exactly 32 characters long.**
- **Note:** This step **cannot** be done through Iridium.

Enabling Encryption

1. Using XeosOnline or an SBD email message, send the command **\$aenbl 1**
2. To disable encryption, send the command: **\$aenbl 0**

Setting Up Encryption on XeosOnline

1. Log in to XeosOnline and click on the Admin button at the top of the screen.

 Home Admin

2. Ensure that your organization is selected in the Organization List

 Xeos Testing

3. Find your device and click the edit device button 
4. Enter the Resilient's passphrase into the appropriate text boxes and press **Save**

Encryption Key

AAAABBBBCCCCDDDDDEEEEEFFFFGGGGHHHH

Decryption Key

AAAABBBBCCCCDDDDDEEEEEFFFFGGGGHHHH

Flash Memory

The Resilient comes equipped with internal flash memory, used to store logged events and GPS positions over the lifetime of the product. This information can be retrieved for data collection or troubleshooting purposes. Since the Resilient comes equipped with Bluetooth for configuration with the [Xeos Beacon Android App](#), this method of communication requires no

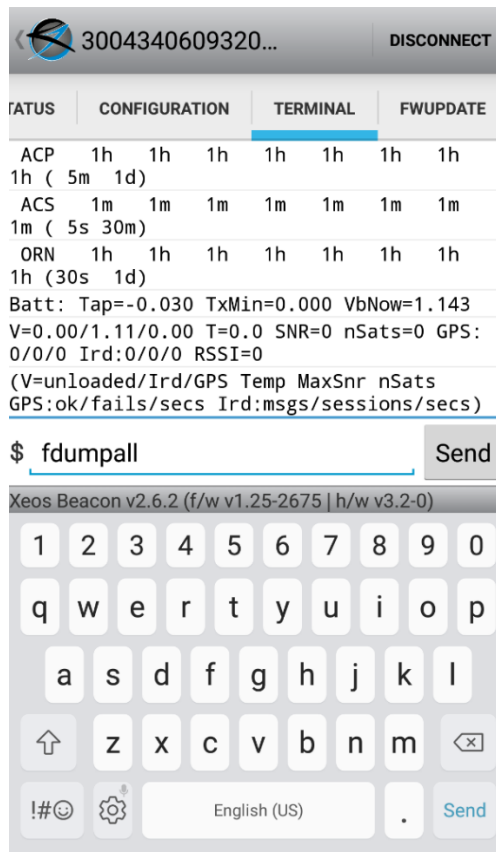


disassembly.

Refer to the [Bluetooth App Guide](#) for more information on the app itself.

Dumping the Flash Memory

- Connect to the Resilient using the Bluetooth App for Android. If The device does not appear as advertising on the main page do one of the following:
 - Power cycle the device with a magnet or temporary battery removal
 - Send the device the following command over Iridium: **\$btpwr 1**
- Navigate to the **terminal page**
- Use the terminal page to send the flash dump command: **\$fdumpall**
- The entire memory log of the device will begin outputting into the terminal tab. When the output slows, the dump is complete.
- Output from the Terminal page can be saved to your device in the form of a text file by tapping the diagnostic output, and tapping **Save Output**.
- The saved file will appear in the Android device's Downloads directory.



Deleting the Flash Memory

The Resilient's memory does not automatically erase. While the Resilient can hold several thousand GPS positions it is prudent to clear the flash memory after extended deployments.

To delete the flash records, send the command: **\$flashereraseuserdata**

The deleting process can take up to 30 seconds, after which the device will reset. Current settings in the Resilient will not be changed by this process.

Erasing of the flash memory can be done over Iridium if necessary.

Bluetooth

The Resilient has integrated Bluetooth hardware to facilitate local communication with the user for configuration, flash memory dumps and firmware upgrades via the Xeos Beacon Android App.

The Resilient's Bluetooth will advertise after a successful self-test pass using a Bluetooth name set at the factory. By default, advertisement will only run for the **first 5 minutes** after power-up or reset. After this time, the device will need to either be reset, or the Bluetooth power-on command (**\$btpwr 1**) must be sent to the device through Iridium for Bluetooth to resume advertising.

If the Bluetooth power-on command is received, the Resilient will **always** advertise its name for connection until the Bluetooth power-off (**\$btpwr 0**) command is received.

If the Resilient is turned off via magnet within the 5 minute advertising window at start-up, the Resilient will advertise **even in an off state**. This can be used to turn the Resilient on remotely via a Bluetooth-sent **\$resetnow** command using the app's terminal tab.

Other Commands

Below is a list of other commands that can be sent via Iridium or Bluetooth to acquire additional information, or configure the Resilient. Remember to add the \$ symbol ahead of any commands.

Command	Parameters	Description
ver	---	Show hardware and firmware versions.
Status	---	Show operating status
sysInf	---	GPS/Ird summary
FactoryDefaults	---	Reset all to defaults and reset.
btPwr	0/1	Bluetooth power On/Off
btTOut	Insert Name	Bluetooth timeout (Minutes)
btName	X	Set Bluetooth name for the Resilient
btcycle	---	Power cycle Bluetooth
batt	---	Show battery status
settings	---	Show all settings.
stats	---	Show statistics (since last powerup/reset)
statsL	---	Show Lifetime Statistics
switch	X 0/1	Switch component X on/off. No parameter lists components
MsgEnable	timer# m1,m2,etc	Set & Show which messages are enabled for each Timer.
ReportHour	Hour (0 – 23)	Set/Show Daily Reporting Hour offset from UTC
RepMinute	Minute	Minutes offset past the hour for GPS/Iridium
WCEnable	1/0	Watch Circle Enable/Disable
WCInner	[x]	Watch Circle percent of radius for elevated GPS monitoring
ResetNow	---	Restarts the system. The effect is the same as restarting via the magnet

Troubleshooting

Red LED/blinking

Indicative of a self-test failure. As of build 6058 Bluetooth turns on during a self-test failure.

Using the **\$status** command will show what failure code is present.

i - Iridium - Modem cannot communicate with CPU of Resilient; contact Xeos

f - Flash - Flash error is showing as a full chip; erasing the chip may resolve this issue

t - Battery taps - Batteries are either oriented incorrectly, or a tap is too low.

- Using the **\$taprv** command shows voltages of all 6 taps. Taps lower than 3.6 Volts show as a failure.

TapRV response:

Battery taps (averages=4 delay=1000 uS limit=3.60)

Str0: T0=12.03(4.08) T1=7.95(4.02) T2=3.93(3.93) OK

Str1: T0=12.15(4.02) T1=8.13(4.08) T2=4.05(4.05) OK

No Iridium messages (assuming no self-test failure)

- Determine the nature of the issue (antenna-related, system related or location-related)
 - Ensure the device's Iridium IMEI is active on the Iridium network with your service provider.
 - Ensure the device is provisioned to send messages where intended.
 - Flip the Resilient to use the bottom Iridium antenna to check the RSSI level (greater than zero). The Status page of Bluetooth app shows most recent occurrence of these stats.
 - Change the location of the device; place the device in an area with as much total view of the sky as possible.
- Dumping the flash memory will display all Iridium sessions that occurred, regardless of success.

Messages are not readable (in binary)

Messages are in compressed binary format by default; use the **\$msgenable** command to change the format to ASCII. The format used is timer-dependent, so all timers need to be changed to the intended format.

No GPS/poor GPS

- The Resilient's start-up message lists the firmware version of the GPS chip. If the GPS version is not displayed, the CPU is unable to communicate with the GPS chip.
- Change the location of the device; place the device in an area with as much total view of the sky as possible.
- Dumping the flash memory will display all GPS sessions that occurred, regardless of success.
 - Check the number of satellites seen (greater than 4), SNR level (greater than 38), time the GPS session was on (less than 60 seconds for first fix, less than 20 for other fixes). The status page of the Bluetooth app shows most recent occurrence of these stats.

- Flip the Resilient to use the bottom GPS antenna to determine the nature of the issue (antenna-related, system related or location-related).

Device is transmitting too frequently/not enough

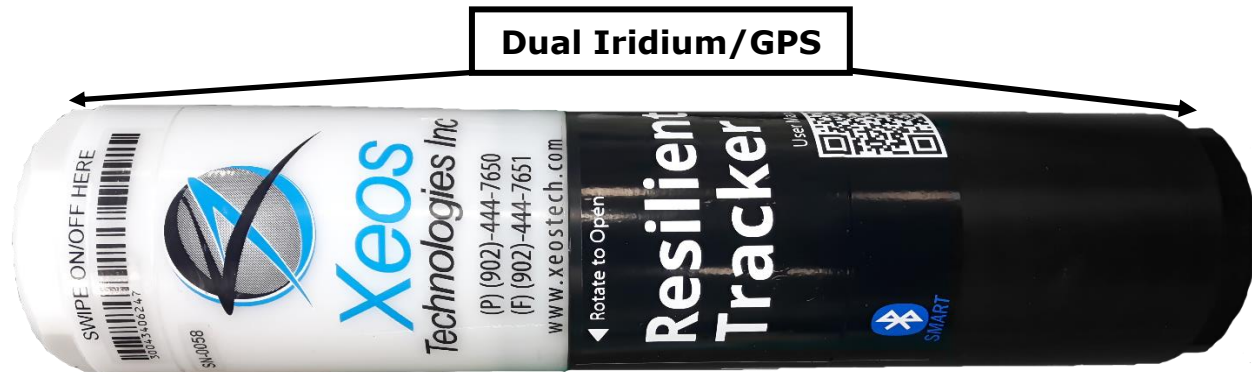
- Check timer intervals with **\$timer** command
- Check timer currently being used with the **\$status** command (Returns TMde=1)
- Change timer interval as required

Device is going into alarm when it should not (Watch Circle or Inversion)

- Watch circle centre is in the wrong location or an unsatisfactory radius
 - **\$setcircle X Y Z** to change circle and radius
 - **\$setcircle 0 0 Z** to change radius only
 - Watch circle warn can also be triggered if location is too close to the radius (default 85% of the way to the boundary)
- Inversion triggered when the device has overturned and is using a different antenna than the last time that it transmitted.
 - While the Resilient will send an Orientation Change message whenever this happens, Timer 2 will not be used if the inverted event is turned off with **\$evtconfig 2 2 n**

Deployment of the Resilient

The Resilient contains custom dual GPS/Iridium antennas, one at each end of the enclosure. It also features an internal battery pack. All you need before deployment is:



1. Resilient with Iridium service activated (using IMEI provided by Xeos)
2. Batteries installed in internal battery pack (18 AA)
3. Magnet for turning the Resilient on.

Antennas

To deploy the Resilient, ensure that one of the two cylindrical ends has a clear view of the sky. For optimal deployment, **the white end should have a clear view of the sky** since it contains the primary antennas. For a concealed deployment, the antenna surface must not be obstructed by metal or wood. Thick amounts of other materials may also cause interference. Testing of concealed installations is strongly recommended.

Power Consumption

The Resilient has an internal battery enclosure that holds 18 AA batteries, lithium or alkaline. The batteries should be replaced whenever the Resilient is recovered. The battery voltage can be monitored with the \$status command.

Current draws are as follows:

Typical sleep current	<100 μ A
Iridium Transmission Current	70 mA (approx. 30 second duration)
GPS Acquisition Current	13 mA (max 2 minute duration)

This is the amount of current the device will draw between GPS checks and Iridium transmissions. The device has a life time of up to 2 years deployment (Lithium batteries) when taking a position and transmitting every 3 hours.

Sample Power Consumption Patterns

Note: these are calculated lifespans and not testing results. Environmental factors including temperature will affect these calculations.

GPS Position Interval	Iridium Call Interval	Consumption Per Cycle	Duration (EN91 Alkaline)	Duration (L91 Lithium)
10 min (Start-up)	10 min (Start-up)	0.6913 mA	723.27 hours 30.13 days	1398.33 hours 58.26 days
30 min	30 min	0.7396 mA	2027.99 hours 84.50 days 2.82 months	3920.77 hours 163.37 days 5.45 months
60 min	60 min	0.7896 mA	3799.39 hours 158.31 days 5.29 months	7345.49 hours 306.06 days 10.20 months
3 hours	3 hours	0.9896 mA	9094.22 hours 378.93 days 12.63 months	17,582.15 hours 732.60 days 24.42 months
6 hours	6 hours	1.2896 mA	581.58 days 19.39 months 1.615 years	1,124.40 days 37.48 months 3.12 years
12 hours (Default)	12 hours (Default)	1.8851 mA	795.67 days 26.52 months 2.21 years	1538.29 days 51.28 months 4.27 years
24 hours	24 hours	3.0888 mA	971.25 days 32.38 months 2.70 years	1699.83 days 56.66 months 4.72 years

* Calculations subject to change without notice. Xeos conducts ongoing battery life and power consumption tests to provide more accurate information to customers.

Understanding the Tilt Sensor

The Resilient comes equipped with a tilt sensor which allows it to determine which antenna to use for determining GPS position and communicate with the Iridium satellite network. The Resilient will automatically switch back and forth between the two antenna arrays as the tilt sensor detects shifts in position.

The tilt axis defaults to the horizontal axis; if the Resilient is standing upright, it will operate using the custom dual antenna at the top of the enclosure. If the Resilient crosses the horizontal axis, i.e. orientated upside down, it will switch to using the dual antenna located at the bottom of the enclosure.

The tilt sensor is enabled by default. For more information please contact Xeos Technologies.

Testing Installation

Test the installation by checking the email addresses to which the Iridium account is sending notifications or Xeos Online. Xeos Online will display the last known position of the device as well as the time stamp of the GPS position.



Maintenance

Recovery and Storage

Once, the Resilient is recovered, its function is complete but it is important that it be stored and maintained properly for future deployments.

As soon as possible after the Resilient is recovered, all batteries should be removed and discarded. The Resilient should be cleaned and inspected for corrosion or water ingress. O-rings should be visually inspected. Any concerns should be discussed with Xeos Support (1-902-444-7650 or support@xeostech.com) prior to storage.

The Resilient should be stored as follows:

- Dry location
- Assembled, without batteries but with O-rings in place
- Ambient temperature of -40° C to +85° C
- Either horizontal or vertical storage is permitted

Battery Compartment

Source: Repair or replacement must be done by Xeos Technologies Inc. 1-902-444-7650 or support@xeostech.com

Only use new, approved batteries for deployments. In the event used batteries are for short term testing, batteries must have equivalent battery voltages to prevent reverse charge forming and subsequent battery leakage.

Visual inspection of the battery compartment should be done after each deployment to ensure there has been no leakage. Signs of corrosion, leakage or water ingress should be reported to Xeos immediately.

O-Rings

Part Number: 568-138 90D DURO BUNA (Top, White Section)

568-137 90D DURO BUNA (Bottom, Black Section)

Source: O-rings may be purchased through Xeos Technologies Inc. or from a variety of vendors. Please call for assistance if required.

Maintenance: O-rings should be visually inspected prior to each deployment, no matter how short. Any evidence of wear or stretching requires that they be replaced.

O-rings should always be replaced after a deployment of 2 months or more. O-rings should also be replaced after a series of short deployments adding up to 2 months.

Seal Lubrication

Part Number:	Molykote 111
Source:	The lube may be purchased through Xeos Technologies Inc. or from a variety of vendors. Please call for assistance if required
Maintenance:	Lube should be used each time the O-Ring is removed and resealed
Procedure:	Squeeze a thin layer of lube onto the O-Ring. Gently spread the lube around the O-Ring until it is completely coated. Follow instructions for seating the O-Ring

NOTE: It is very important to be aware of where the O-ring is sitting in the two O-Ring locations. If the O-ring is not sitting perfectly in its groove, there will not be a perfect seal and could cause fatal damage to the unit.

Firmware Updates

Source:	Firmware updates are published to the Xeos Firmware Repository . Validated users may log in and download the most up to date version as needed
Maintenance:	Prior to each deployment, the firmware version should be checked, and updates applied, if needed. Email support@xeostech.com if you need assistance determining if you should apply a firmware update. Firmware updates can be uploaded via Bluetooth. Alternative method using Micro-USB on device.
Procedure:	A detailed instruction and procedure will accompany each firmware release

Specifications

Mechanical	
Material	Polyoxymethylene (Delrin)
Dimensions	27.76 cm L x 6.35 cm D (10.93" L x 2.5" D)
Mass (Alkaline)	1205g Out of Water 378g In Water
O-rings	568-138 90D DURO BUNA (Top, White Section) 568-137 90D DURO BUNA (Bottom, Black Section)
O-ring Lube	Molykote 111

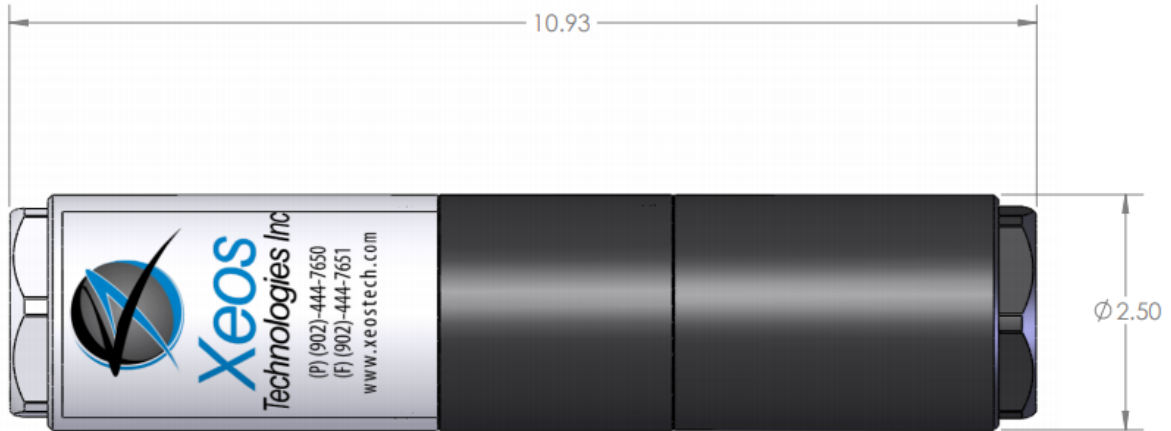
Electronics	
Digital Controller	Xeos IRDC-3
GPS Receiver	48 Channel SiRFstarIV, GSD4e GPS chip
Iridium Hardware	9603 Modem

Electrical	
Supply	18 AA batteries (Lithium or alkaline)
Operating Voltage	9 – 32V
Nominal Voltage	13.5V
Battery Capacity	3.0 Amp Hours (alkaline) 5.8 Amp Hours (Lithium)
Iridium Transmission	70mA
GPS Acquisition	13mA
Sleep Current	100uA
Off Current	15uA

Electronics	
Digital Controller	Xeos IRDC-3
GPS Receiver	48 Channel SiRFstarIV, GSD4e GPS chip
Iridium Hardware	9603 Modem

Environmental	
Operating Temperature	-40° C to +60° C (-40° F to 140° F)
Storage Temperature	-40° C to +85° C (-40° F to +185° F)

**Specifications subject to change without notice.*



	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: ONE PLACE DECIMAL ±0.05 TWO PLACE DECIMAL ±0.005 THREE PLACE DECIMAL ±0.001	Physical Properties Mass: 1205g (Includes Alkaline Batteries)	TITLE: Resilient Tracker			
	PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF XEOS TECHNOLOGIES. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF XEOS TECHNOLOGIES IS PROHIBITED		SIZE A	Rev 001	SCALE 2:3	Sheet 1 of 1

Warranty, Support and Limited Liability

Xeos Technologies Inc. warrants the Resilient Tracker to be free of defects in material or manufacturing for a period of one year following delivery. Liability is limited to repair or replacement of the defective part and will be done free of charge.

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.

CUSTOMER REMEDIES: Xeos Technologies Inc. entire liability and your exclusive remedy shall be at Xeos Technologies Inc. option, either (a) return of the price paid or (b) repair or replacement of the product that does not meet Xeos Technologies Inc. Limited Warranty and that is returned to Xeos Technologies Inc. with a copy of your receipt. This Limited Warranty is void if failure of the product has resulted from accident, abuse, or misapplication. Any replacement product will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer.

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