



APOLLO User Manual

SUBMERSIBLE IRIDIUM / GPS / LED FLASHER

Version 2.3
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Shipped From



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Version History

Version	Date	Description
1.0	May 2015	Base document
1.1	July 2015	Added Engineering Drawings
1.2	Oct 2015	Format overhaul

Overview

General Description

The APOLLO Submersible Iridium GPS-LED Flasher Mooring Location Beacon continuously monitors for unplanned or accidental release of subsurface instrument moorings.

The APOLLO makes use of the bi-directional, global, real time Iridium satellite Short Burst Data (SBD) network in combination with GPS position location and an ultra-bright LED flasher. The APOLLO's tubular design allows it to be easily retrofitted into existing subsurface flotation configurations, such as syntactic foam.

Inside the APOLLO is a 9603 Iridium Satellite Short Burst Data core radio transceiver, a specialized low power Xeos digital controller with GPS, Iridium antenna, GPS antenna, ultra-bright LED, and battery package.

The APOLLO is intended for subsurface deployments and is intended for deployments up to 11,000 m below sea level. Xeos Technologies Inc. (Xeos) manufactures other specific products for surface applications as well as sub-surface applications at varying depths.

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

Theory of Operation

The APOLLO provides notification of planned and unplanned surfacing events as well as location information on high value assets. After being activated, the APOLLO can be deployed at the depths of up to 11,000 m. The internal solid state sensor is triggered when the APOLLO. It will begin to flash and immediately send location messages as per the user settings. The internal battery pack provides over 10 years of subsurface deployment followed by up to 88 days of message transmissions.

Operators can communicate with the APOLLO once it has surfaced via Iridium using [Xeos Online](#). Optionally, email commands can be sent directly to the APOLLO. Status information

can be obtained, including the health of the GPS system and battery voltage. Timings can be changed, with defaults being one message every hour and the LED-flasher can be turned on or off. If you need to make a change to the settings, the APOLLO will receive the command on its next Iridium message check, up to 1 hour after the command is sent.

The APOLLO will continue to send position messages and flash based on its timings and settings, until it is manually turned off upon retrieval or the battery pack drops below the minimum operating voltage of 7v.

Setting up your Iridium Account

The APOLLO makes use of the [Iridium satellite systems'](#) 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.

APOLLO 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 9602 has a unique IMEI number 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 or use the online form on our website: xeostech.com

For each IMEI number it is possible to associate up to five (5) unique email addresses. This may vary between service providers. When registering your 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 APOLLO. Once the SBD account has been activated, please contact your Xeos representative and confirm this.

Quickstart

There are only a few steps required to begin using the APOLLO:

1. Contact Xeos Technologies to provision your APOLLO and set-up a Xeos Online account. Make sure to have your APOLLO's IMEI number on hand.
2. Add your APOLLO to [Xeos Online](#)
3. [Install batteries](#) by unscrewing the APOLLO's end-cap
4. Put the APOLLO in a location with a clear view of the sky, and it will begin transmitting.

On/Off Modes

Using the Magnets

The APOLLO 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 the LED through the top of the APOLLO. To turn the APOLLO ON, press the magnet against the glass ring for 1 second and then remove it for one second. Repeat this process 3 times. The APOLLO will respond by changing its LED from dim to bright.



Figure 1: APOLLO Reed Switch

To turn the APOLLO OFF, repeat the above procedure with the magnet, and watch the LED change from bright to dim.

LED Notes

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

- Cycling power for any reason, such as using the switch to the unit OFF/ON or inserting new batteries, will initiate the **Start-up mode**.
- The beacon requires a good view of the sky for any test, therefore it is necessary that any tests be done outside of a building.

Installation and Maintenance

Battery Options

The power source for the APOLLO is its internal battery pack. There are two available enclosure sizes for the APOLLO battery pack.



Figure 2: Standard Battery Tube

Standard Enclosure: Can hold 6 x D-Cell alkaline (9V nominal) batteries.

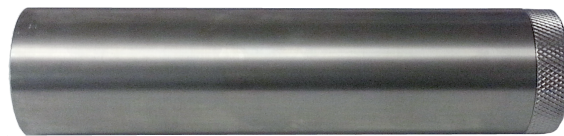


Figure 3: Short Battery Tube

Short Enclosure: Can hold 3 x D-Cell (10.8V nominal) 3.6V lithium batteries

Opening the Housing

The mechanism for installing the batteries is the same regardless of which enclosure you have. The electronics and antennas for the APOLLO are housed in the larger diameter cylinder and the batteries in the narrower, longer cylinder.

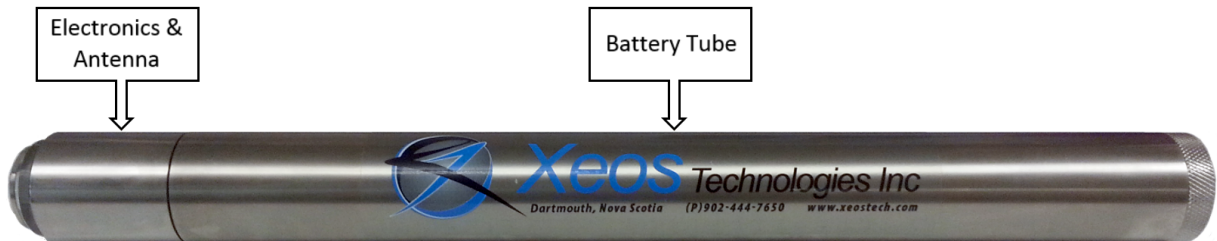


Figure 4: Labelled APOLLO

First, gently unscrew the end-cap from the battery enclosure.



Figure 5: Unscrewing the end-cap

Make sure that the clear plastic insert is inside the battery enclosure.

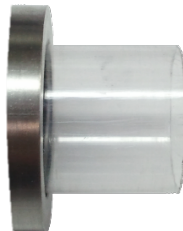


Figure 6: Plastic battery insert



The connection between the APOLLO's head and battery tube is sealed with Loctite. Users should not attempt to unscrew the head when changing batteries, as the amount of force required could damage the electronics.

O-Rings

O-Ring Locations

The Standard APOLLO has O-rings at three distinct locations:



Figure 7: Standard APOLLO O-rings

O-ring A is located at the connection between the electronics head and the battery tube. It is not recommended that user's separate the electronics head from the battery tube unless as part of long-term maintenance.

O-ring B is installed at the connection between the battery enclosure and the end-cap. When changing batteries, the end-cap should always be un-screwed.

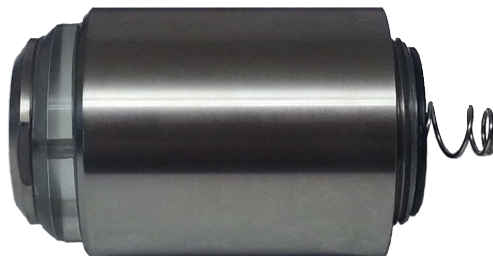


Figure 8: Electronics & Antenna Head

O-Ring Procedures

O-rings are critical to the waterproof nature of the APOLLO. The O-ring should be visually inspected to make sure it is properly seated in the groove at the base of the threads and to ensure there is no visible damage to the O-ring.

If the O-rings pass visual inspection and have been deployed for two months or less, they do not need to be replaced.

If the O-rings fail visual inspection or have been deployed for longer than 2 months, they should be replaced prior to re-deploying the APOLLO.

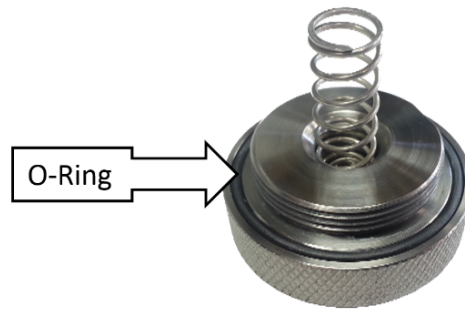


Figure 9: End-cap O-ring

To replace the O-Ring, remove the old O-ring, and clean all dirt away from the threads and grooves where it was seated using a lint-free cloth, cleaning alcohol, and a soft-brush. Apply a thin layer of O-ring lube (Molykote 111 from Dow Corning) to the new O-ring.

To install the new O-ring, gently slide it down over the threads of the electronics section of enclosure and into the O-ring groove, just above the lip of the enclosure.



It is very important to be aware of where the O-ring is sitting on the end-cap. If the O-ring is not sitting perfectly in its groove, there will not be a perfect seal which could cause fatal damage to the unit.

Replacing the Batteries

The standard internal battery pack in the APOLLO can hold only 1.5 V D-Cell Alkaline batteries (**Note:** the optional short enclosure only holds 3.6 V D-Cell lithium). The batteries are configured in a single column. Make sure to only use new batteries.

To replace the batteries, tip the old batteries out of the enclosure once the end-cap has been unscrewed. Make sure to dispose of them appropriately.

To replace the batteries, slide the first battery into the column, ensuring that the positive (+ve) terminal goes into the tube first. Then add the remaining batteries, in the same orientation. Once the enclosure is reassembled, the positive terminal will be pointing towards the electronics/antenna. **DO NOT MIX BATTERY TYPES.**



Figure 10: Inserting Batteries

Once all the batteries have been replaced the enclosure pieces can be reassembled, taking care to inspect and seat the O-ring first.

The APOLLO is now ready for testing, and/or deployment.

Power Consumption and Battery Life

The APOLLO has an internal battery pack. The batteries should be replaced after any deployment exceeding 2 months.

Current Draw

Current draws are as follows (9V nominal):

Sleep current	50uA
Underwater current	25uA
Iridium transmission	60mA (approx. 30s duration)
GPS Acquisition	25mA (approx. 1m duration)
LED Pulse	444mA (50ms flash duration)

Installation

When installing the APOLLO there are several factors that can influence performance.

1. The APOLLO's head should be pointing toward the sky.
2. Iridium and especially GPS performance may suffer if large angles of the horizon are blocked, such as if the APOLLO is next to a wall.
3. Avoid using metallic fasteners and clamps to secure the APOLLO, this will cause erroneous water sense readings.

Communicating with the APOLLO

There are 4 ways to communicate with the APOLLO:

1. Over-the-air with Xeos Online
2. Over-the-air with E-mail SBD messages
3. Locally with Bluetooth

Using Xeos Online

Before using **Xeos Online** make sure that your account has been setup and your APOLLO added to your organization. Contact for more information.

In a web-browser, navigate to **Xeos Online** and login with your username and password.

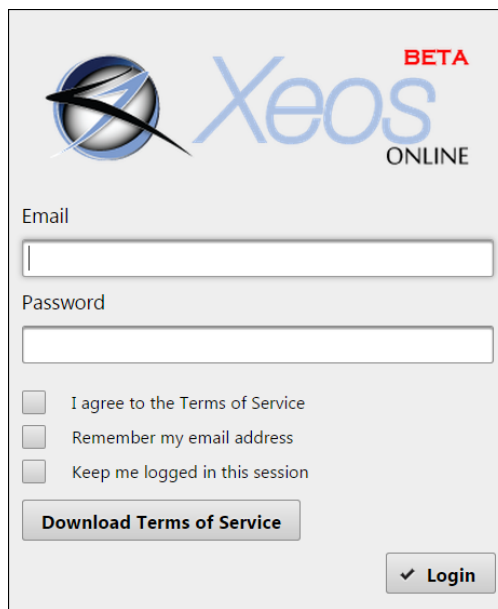
The image shows the Xeos Online login page. At the top left is a logo consisting of a blue sphere with a black swoosh. To its right is the word "Xeos" in a large, light blue font, with "ONLINE" in a smaller, black font below it. In the top right corner, the word "BETA" is written in red. Below the logo and text are two input fields: "Email" and "Password". Under the "Password" field are three checkboxes with labels: "I agree to the Terms of Service", "Remember my email address", and "Keep me logged in this session". Below these checkboxes is a button labeled "Download Terms of Service". In the bottom right corner of the form is a button labeled "✓ Login".

Figure 11: Xeos Online login page

Adding your device to Xeos Online

If you have not already setup your APOLLO as a device in **Xeos Online**, click on the **Admin tab** and then **Devices** to proceed. Select the New Device button and choose APOLLO from the device list.

Edit Device

Device: XMI

Organizations: Organizations

Enabled: ☒ Enabled

Name:

Notes:

IMEI:

Incoming SBD: Direct IP SBD

Outgoing SBD: Direct IP SBD

Encryption Key:

Decryption Key:

Cancel Save

Figure 12: APOLLO Timer Diagram

Name	Description
Device	Device type
Organization	Select any available organizations
Enabled	Enable or disable the device
Name	Give your APOLLO a descriptive name
Notes	Any additional details related to the APOLLO
IMEI	Copy and paste your APOLLO's IMEI
Other	Leave all other options as is

Tracking your APOLLO

Now that the APOLLO has been added to [Xeos Online](#), the user can send commands and track location and event data. First, make sure you have the right organization selected from the menu at the top-right of the screen.

Organization: Xeos Technologies

Figure 13: Organization Menu

Click the **Home** button at the top of the screen to get back to the main page of [Xeos Online](#). Select your device from the right-hand device area. Multiple devices may be selected.

Select **Map** to view the current location of your APOLLO, past GPS fixes and messages can be viewed at the **Location Log**, and **Message Log** tabs. [Xeos Online](#) does not refresh new

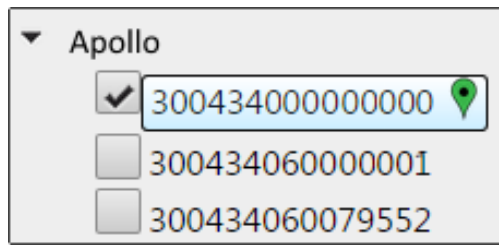


Figure 14: Device Selection

messages and locations automatically, an indicator will appear on the refresh button when new messages are available.

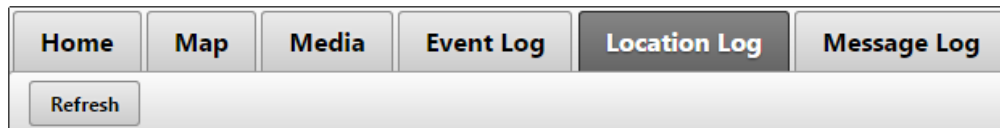


Figure 15: Home Tabs

Sending Commands

To Send commands through [Xeos Online](#), click on the **Options** button and select **Send Manual SBD**.

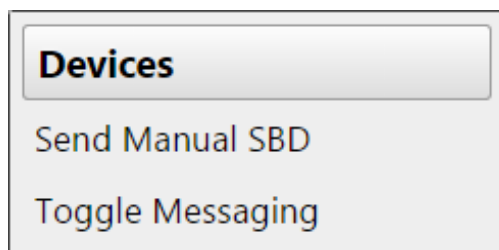


Figure 16: Send Manual SBD

The **Send SBD Dialog** will appear. Select the units you wish to target with commands and move them over to the right-hand target list. Type your command(s) into the command box and press send.

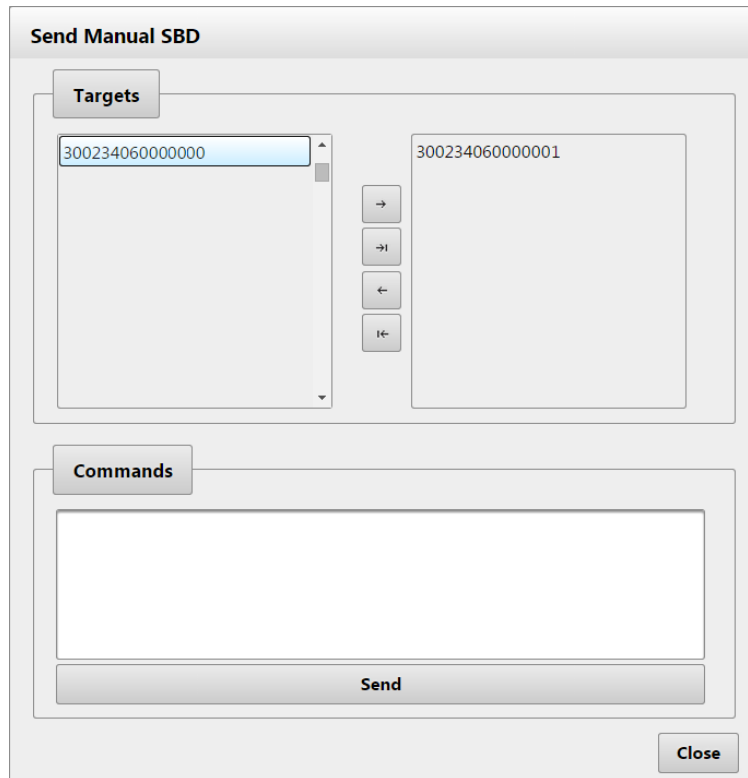


Figure 17: Send SBD Dialog

For more information on available commands, see [Timers and Settings](#)

Using E-mail

E-mail commands can also be used to communicate with the APOLLO when it is above water. These commands are sent as email attachments. Commands can configure the APOLLO remotely in the same way as commands sent by [Xeos Online](#). Available APOLLO commands are covered in [Changing Timers](#) and [Additional Settings and Commands](#).

Attaching Email Command Files

All command messages must be sent to the following email address:
data@sbdlridium.com

- Messages must have only the unique IMEI number of the APOLLO in the subject line

- Command files must be sent to APOLLO 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

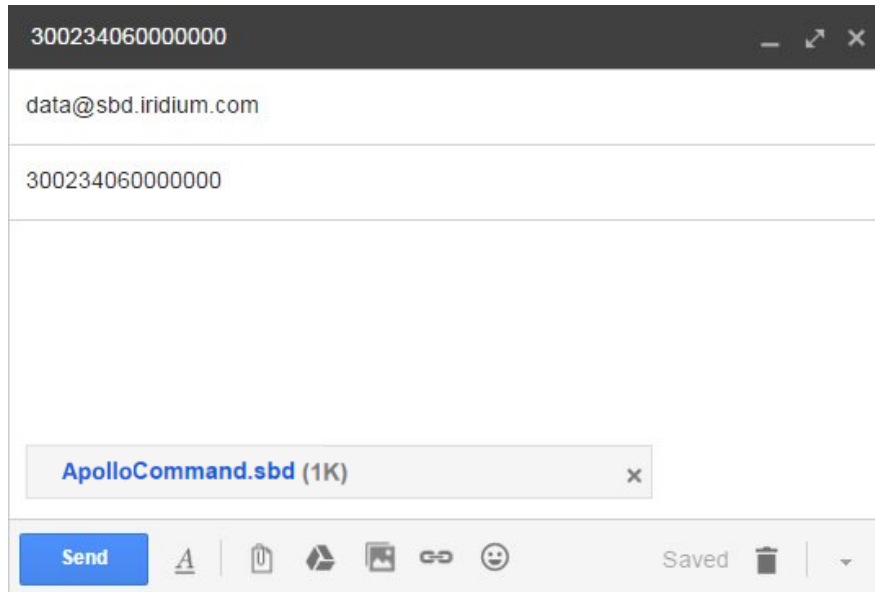


Figure 18: Sample SBD Email

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

Note that the Iridium gateway uses separate email address for commands and responses

Received Messages

Messages received from the APOLLO such as GPS messages or responses to Status requests arrive as email attachments to all of the email accounts that the APOLLO was provisioned with.

Command Format

Commands sent over E-mail must be formatted in the correct way, or they will be ignored. An unlock code must be included as the first line, see [Unlock Codes](#) for more information. Any number of commands can be included in an SBD file, but each command must be on a separate line.

When creating an SBD command file, the file must be saved with a **.sbd** file extension.

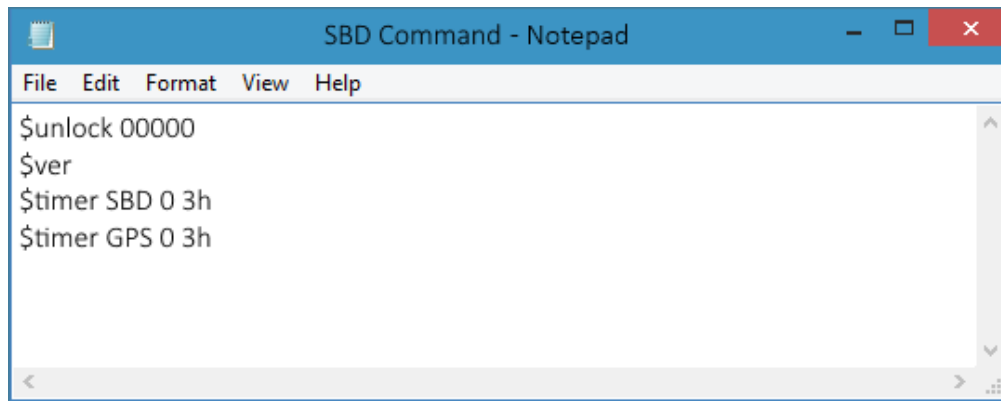


Figure 19: Sample SBD File

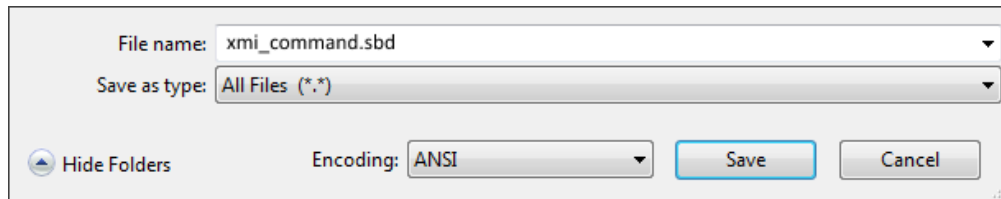


Figure 20: Saving an SBD file

Using Bluetooth

The APOLLO can also be configured locally using the Xeos Beacon Android App. Configuring your APOLLO with the App is quick, easy, and requires no disassembly.

Requirements

Using the App with your APOLLO Beacon requires a few prerequisites:

- An APOLLO beacon with Bluetooth enabled firmware. If you are unsure about this requirement, please contact with your APOLLO's serial number.
- An Android Smartphone compatible with Bluetooth Low Energy devices.
- The Xeos Beacon Android App.

Downloading and Installing the App

Not yet available for download.

Turning on Bluetooth

Before attempting to connect to your APOLLO, make sure it is powered on and Bluetooth functionality is enabled. The latter can be done in one of two ways:

1. Turn the APOLLO off and then on, using a magnet. See On/Off Modes
2. Send the APOLLO the following command over Iridium: **\$btpwr 1**

Connecting

When the Xeos Beacon App is first opened, the user is presented with the Connection Page.

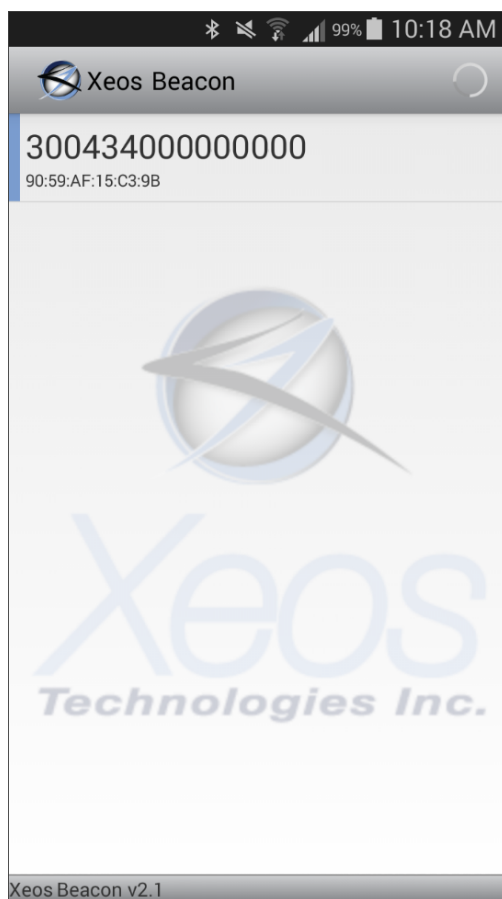


Figure 21: Connection Page

The App will list the name of any Bluetooth enabled device within range. By default the APOLLO's Bluetooth name will be its IMEI number. Tap your APOLLO's name to connect.

Status Page

When you first connect to the APOLLO, the App wil default to the **Status Page**:

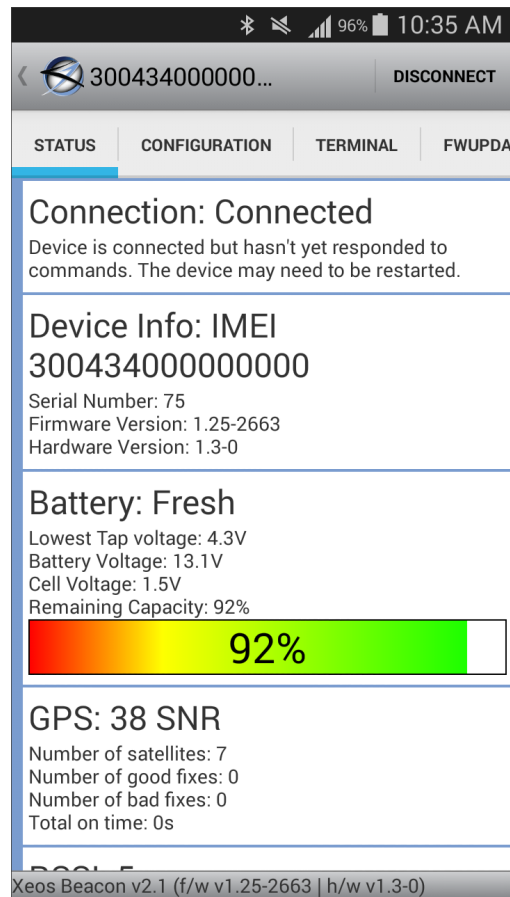


Figure 22: Status Page

The **Status Page** shows all relevant information regarding the current state of your APOLLO beacon, including:

- Current firmware information
- Detailed battery information
- GPS statistics since the last power-up
- Iridium RSSI strength

Configuration Page

Tapping the **Configuration** tab will bring up the **Configuration Page**:

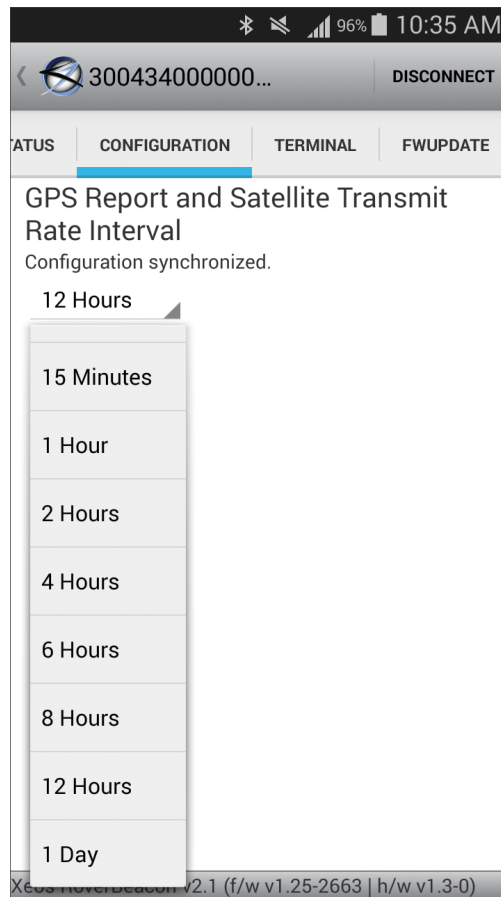


Figure 23: Config Page

Tap the **Interval List** for a drop-down menu of timings. Your selection will set the **Normal mode** timings for the GPS and Iridium reporting. Once you've made your selection, the App will update the APOLLO and report back with a **Configuration synchronized** message.

Terminal Page

Tapping the **Terminal** tab will bring up the **Terminal Page**:

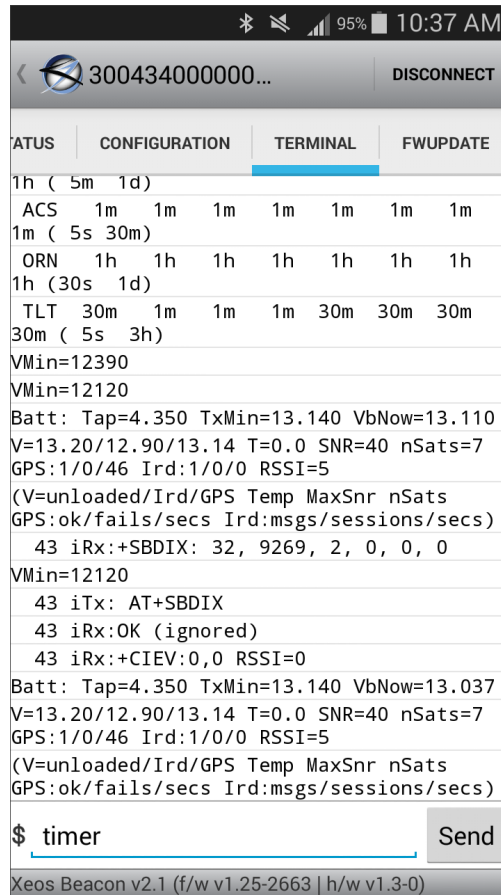


Figure 24: Terminal Page

The **Terminal Page** functions identically to a serial connection to the APOLLO. Commands can be typed at the bottom of the page. Tap **Send** to transmit the command. Auto-Scroll can be disabled by tapping the **Terminal Page** once.

Firmware Update Page

Tapping the **FWUpdate** tab will bring up the **Firmware Update Page**:

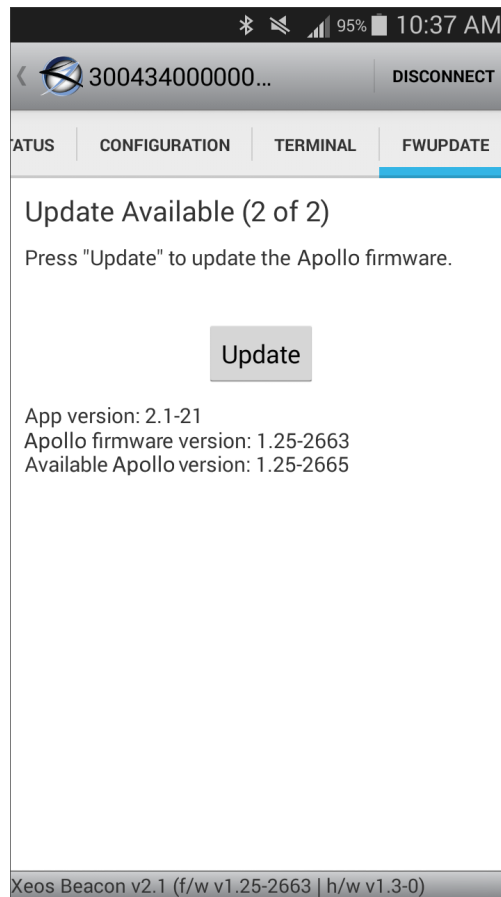


Figure 25: Firmware Update Page

If a firmware update is available for your APOLLO, you can upgrade your unit by pressing the **Update Button**. The App will upload a new firmware image at 500 bytes per second. Once the upload is complete, the APOLLO will perform a firmware upgrade on its next power-up. If the update is interrupted for any reason, simply restart the process.

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 the transmission, using Doppler technology. As a result, it is often very inaccurate. This location is only visible to users getting emails directly from the APOLLO, as opposed to emails forwarded by Xeos Online.

Global Positioning System Position

The location information is embedded in the SBD attachment sent via the Iridium Gateway. Users of the Xeos Online system will only see this location. The GPS fix is much more accurate than the Doppler position provided by Iridium.

The APOLLO's Timers

Timer Types

The APOLLO's behavior is based on multiple timed events. Understanding how these events interact is necessary to properly using the APOLLO in the field. There are four major timed events:

SBD

The APOLLO will attempt to communicate with the Iridium Gateway based on this interval. If the APOLLO successfully registers with the Iridium Satellite Constellation, it will receive any queued messages from the Iridium Gateway. Once this is finished and the received messages have been implemented, the APOLLO will transmit any messages queued for transmission.

GPS

The APOLLO will try to communicate with the GPS network and get a location fix based on this interval. Any successful GPS fixes will be queued for the next Iridium transmission. The APOLLO's clock will also be set and adjusted based on the GPS network. The GPS interval will execute before the SBD interval if they are scheduled for the same time.

WTR

The water sensor will measure for a surfacing event based on this timer. This timer is only active once the APOLLO is in underwater mode.

LIT

At default settings the APOLLO's light sensor will take a measurement every 15 seconds. This timer is not active in underwater mode.

APOLLO Timer Modes

The interval at which each timer is executed depends on the APOLLO's current mode. Each mode corresponds to external conditions interpreted by the APOLLO's logic. The following diagram shows when each mode is invoked.

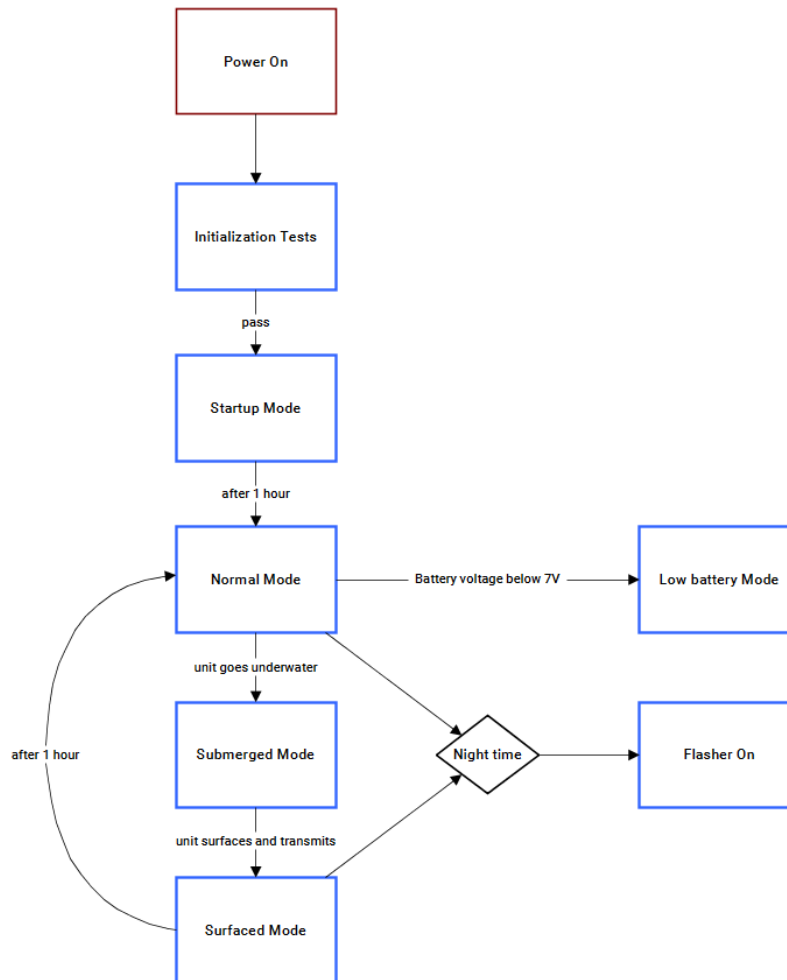


Figure 26: APOLLO Timer Diagram

Start-up Mode

Start-up mode (Timer 1) will begin when the APOLLO is turned on using magnet swipes, if power is applied to the APOLLO such as after a battery change, or if the APOLLO is reset by an SBD command. This mode will last for one hour, after which the APOLLO will enter either **Normal mode** or **Underwater mode**.

Start-up mode will always last for 1 hour. This duration cannot be changed, however the GPS and SBD intervals can be set by the user. With default settings, the APOLLO will attempt 6 successful GPS and Iridium transmissions at 10 minute intervals during **Start-up mode**.

Underwater Mode

If the APOLLO is unable to transmit successfully and fails to connect to the Iridium network after 3 attempts, it will enter **Underwater mode** (Timer 3). Once in Underwater mode, the APOLLO's GPS is disabled and the Iridium transmit interval is set to attempt a connection once per day at 00:00 UTC. The water sense will also take a reading at 1 minute intervals.

While in **Underwater mode**, if the water sense detects that the APOLLO has surfaced, an Iridium session will immediately be attempted. If the APOLLO successfully connects to the Iridium network, the APOLLO will exit **Underwater mode**.

The APOLLO will always exit **Underwater mode** if it successfully connects to the Iridium network. Once the APOLLO has exited underwater mode, **Alert mode** will begin. Since the APOLLO will only enter **Underwater mode** after a failed Iridium transmission, it can take several hours depending on the APOLLO's Iridium transmission rate.

Alert Mode

Alert mode will always begin after the APOLLO has exited **Underwater mode**. When it enters **Alert mode** the APOLLO immediately sends an SBD message to the Iridium Gateway indicating that it has surfaced, then the APOLLO will transmit 1 GPS position every 10 minutes for 1 hour. Once **Alert mode** has finished, the APOLLO will enter **Normal mode**.

Normal Mode

Once Start-up mode has finished, the APOLLO will enter **Normal mode** if it is not underwater. This is the default timer mode of the APOLLO and will be used if no other modes apply. At default settings, the APOLLO will transmit 1 GPS fix every 3 hours. If no other modes are engaged, the APOLLO will continue in **Normal mode** until its batteries are depleted or the unit powered off.

Default Settings

Mode	Timer 0	Timer 1	Timer 2	Timer 3
SBD	3h	10m	10m	1d
GPS	3h	10m	10m	1d
WTR	1m	1m	1m	1m

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

Changing the Timers

The length of the APOLLO's various modes cannot be altered. **Alert mode** and **Start-up mode** are fixed at 1 hour. However, the Iridium and GPS intervals can be changed to suit the user's requirements.

The GPS and Iridium interval timers can be set independantly of each other, but there are several things to keep in mind. The APOLLO has a limit of 24 GPS fixes per Iridium message and will retain a maximum of 40 unsent fixes. This puts a practical limit on the ratio of GPS fixes to Iridium checks.

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

	Command	Timer	Mode	Interval
Example 1:	\$timer	GPS	0	1h
Example 2:	\$timer	GPS	2	5m
Example 3:	\$timer	SBD	0	6h

Example 1 would change the GPS interval of Normal mode to every hour, while Example 3 would change the SBD message interval to 6 hours. After sending the commands from both **Example 1** and **Example 3**, the user would receive 1 message every 6 hours containing 6 GPS fixes. These messages would be sent at approx 00:00 UTC, 06:00 UTC, 12:00 UTC and 18:00 UTC.

Configuring the Flasher

There are two commands available for configuring the APOLLO's flasher, the period and the pulse count. Each pulse lasts 50 milliseconds.

The period setting determines the number of seconds between flashes. You can change this setting with the following command: **\$strobe strS "time in seconds"**.

The pulse count setting determines the number of pulses per period. You can change this setting with the following command: **\$strobe strN "number of pulses"**.

	Command	Setting	Parameter
Example 1:	\$strobe	strS	20
Example 2:	\$strobe	strN	1

Sending the commands in **Example 1** and **Example 2** would set the Flasher to pulse once for 50 ms every 20 seconds.

The APOLLO's Sensors

The APOLLO's water sensor is used to detect a change from underwater to surface. The sensor measures capacitance between the antenna and electronics head, based on the dielectric constant of either air or water.

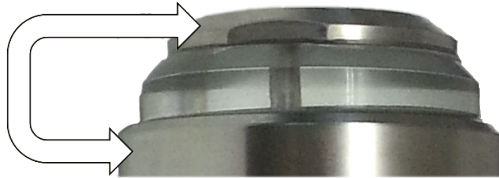


Figure 27: Sensor Measurement

Water Sensing

When the APOLLO is not underwater, the water sensor is not used. The water sensor will only begin measuring once the unit enters **Underwater mode**. Once in **Underwater mode**, the APOLLO takes water measurements every minute.

Once the water sensor measures that the APOLLO is above water, it will immediately attempt an Iridium connection. If the Iridium connection is successful, the APOLLO will immediately transmit a 'surfaced message' and enter **Alert mode** for 1 hour.

```
Timestamp: 2015-07-15T19:11:36.000Z, Ascii: Surfaced
```

Figure 28: Xeos Online Surfaced Message

Light Sensing

The APOLLO's light sensor measures illuminance every 15 seconds. If the light level is below the set threshold, the Flasher will begin flashing according to its [Strobe settings](#).

It is important to note that the APOLLO's light sensor threshold is set according to outside illuminance. Indoor light sources can be more than ten times less powerful than the sun over a given area and may not trigger the flasher off as expected.

Additional Settings and Commands

There are a number of commands that can be sent to the APOLLO, in addition to changing timers. These commands can be sent locally or remotely. However, the response from remote commands is often less detailed in order to save bandwidth. Modifying these settings **will** affect the performance of the APOLLO. The following is a summary of remote commands:

Settings

The **\$settings** command will return a truncated list of important APOLLO settings aside from timers.

```
Ascii: T/A:Td=0;Ts=100 GPS:MxOn=100;MxPr=30;Tmn=-30;Vmn=6.000;gBlk0=0,0;gBlk1=0,0;gRtyQ=2;gRtyD=20;gFRst=50;gBL=40;gFQ=24 ...
Sys:PB=2788;BtP=n;BtT=5;BtN=;LL=0;UC=0;aes=n;rHr=0;rMn=2 IrdiBlk0=0,0;Blk1=0,0;iRtyQ=2;Smx=8;MxLn=330;iWR=Y Tilt:Tt=5;Secs=120;Usec=120
```

Figure 29: Xeos Online Settings Response

System Settings

MxOn	Maximum GPS session length in seconds
MxPr	Maximum GPS session length in poor conditions
Tmn	Temperature minimum
Vmn	Voltage minimum
gBlk0	Unused
gBlk1	Unused
gRtQ	GPS retry quantity
gRtyD	GPS retry delay in seconds
gFRst	Number of GPS failures for GPS reset
gBL	Maximum saved GPS fixes
gFQ	Maximum GPS fixes per message

System Settings

PB	Firmware Build
BtP	Bluetooth on or off
BtT	Bluetooth Timeout in minutes
BtN	Bluetooth Name
LL	Diagnostic Log detail level
UC	Unlock Code
aes	Unused by the APOLLO
Hr	Hour on which timings are based(24h UTC)
rMn	SBD hour offset in minutes

Iridium Settings:

iBlk0	Iridium Blackout, Unused
iBlk1	Iridium Blackout, Unused
iRtyQ	SBD Retry Quantity
Smx	Maximum SBD attempts per session
MxLn	Maximum message length (bytes)
iWR	Wait for registration

Tilt functionality is not used by the APOLLO.

Version

The **\$ver** command will return a summary of both firmware and hardware versions.

```
Powerup: true, Firmware Version: XMI-Torch v1.22-2443. dev:4 , Hardware Revision: 2.5-0, Serial: 175, GPS Version: GSD4e_4.1.2-P1 R+ 11/15/2011 319-Nov 15 , ...
Iridium Version: TA13001, Reset Data: Count = 15, Current = (S), Prev = (cleared)
```

Figure 30: Xeos Online Version Response

Powerup	Not applicable to \$ver
Firmware Version	Major, minor, build of current firmware
Hardware Revision	Hardware revision, set during assembly
Serial	The unit's serial number
GPS Version	Firmware version of GPS chip
Iridium Version	Firmware version of Iridium chip
Reset Count	The number of resets since firmware was uploaded
Current	Cause of last power off
Previous	Cause of previous power off, not used in APOLLO

Timer

The **\$timer** command will return the timer intervals of the current mode. This response will also be returned when timers are changed.

```
Ascii: Tmr:SBD,5m,3m,1m,1m,1h,2h,1h,1h Tmr:GPS,5m,3m,20s,20s,2h,2h,1h,1h
```

Figure 31: Xeos Online Timer Response

The timer string returned includes a summary of GPS and SBD timers. The first four timers are used by the APOLLO:

Timer 0 (Normal mode), Timer 1 (Start-up mode), Timer 2 (Alert mode), Timer 3 (Underwater mode).

The last 4 timers are unused by the APOLLO and can be ignored.

Lifetime Stats

The **\$statsl** command will return various performance statistics recorded since the last firmware install as well as current statistics.

```
BatteryV: 11.15, Uptime: 10872, Power Cycle Count: 3, Watchdog Reset Count: 0, Lowest Battery Voltage: 0, ...  
Highest Battery Voltage: 13.290000000000001, Iridium Message Count: 14, Iridium Session Count: 12, ...  
Iridium On Time: 11, Iridium Send Failures Non18: 18, Iridium Send Failures Type 18: 7, Bytes TX: 962, ...  
Iridium Messages Received: 5, Bytes RX: 162, GPS Sessions: 14, GPS On Time: 6, GPS Fix Count: 10, ...  
GPS TTFF Average: 9, High Temperature: 0, Low Temperature: 0
```

Figure 32: Xeos Online Lifetime Stats Response

BatteryV	Last measured battery voltage
Uptime	Total unit uptime in minutes
Power Cycle Count	Number of power cycles
Watchdog Reset Count	Number of errors
Lowest Battery Voltage	Lowest measured battery voltage
Highest Battery Voltage	Highest measured battery voltage
Iridium Message Count	The number of SBD messages queued for sending
Irdium Session Count	Total successful Iridium connections
Iridium on Time	Total successful Iridium connections on first try
Iridium Send Failures non18	Iridium failures, excluding RF drop
Iridium Send Failures Type 18	Iridium failures due to RF drop
Bytes TX	Sum of all data sent in Bytes
Iridium Messages Received	Successfully received SBD messages
Bytes RX	Sum of all data received in Bytes
GPS Sessions	Total GPS attempts
GPS On Time	Total successful GPS fixes on first try
GPS Fix Count	Successful GPS fix count
GPS TTFF Average	Average time to fix, in seconds
High Temperature	Not used with the APOLLO
Low Temperature	Not used by the APOLLO

Stats

The **\$stats** command will return performance statistics recorded since the last power-up. The

particular statistics are similar to **\$statsl**, but exclude **Power Cycle Count** and **Watchdog Reset Count**.

Message Enable

The APOLLO has several message types that can be enabled for GPS and event messages. At factory defaults, the APOLLO will send compressed binary GPS (not human readable) and plain text event (surface and battery) messages. These message formats can be changed using the **\$msgenable** command.

The APOLLO has the following message types available:

Message Number	Message Type
0	GPS Plain Text Short
1	GPS Plain Text Long
5	Argos PDR, unused by the APOLLO
6	Sensor Binary, unused by the APOLLO
7	Event Data, unused by the APOLLO
8	Water Sense Hist, water sense event data
10	GPS Bin Compressed
11	Motion Binary, unused by the APOLLO

At factory defaults, the following message types are enabled for each mode:

Timer Mode	Message Types
0	8, 10
1	8, 10
2	8, 10
3	8, 10
4	8, 10

The **\$msgenable** must be applied to each timer. The message format must be as follows:

\$msgenable timer message types

So to enable GPS plain text short, GPS Binary Compressed, and Water Sense data on Timer 0 (**Normal mode**) you would send the following command:

\$msgenable 0 0,10,8

Any number of message types can be enabled for each timer, but for each additional message type the APOLLO will use additional Iridium data.

Unlock Codes

The APOLLO uses unlock codes as a security measure to prevent unauthorized commands. The unlock code is generated on power-up after a successful firmware upgrade, or it can be changed manually through the diagnostic port. The unlock code is sent out to all provisioned addresses associated with the APOLLO's IMEI in a plain text message exactly 18 bytes in size.

Any commands which do not include a valid unlock code as the first line will be ignored by the APOLLO, but will prompt the unit to reply with a valid unlock code to all provisioned addresses.

When using **Xeos Online**, unlock codes are generated automatically for all outgoing commands and should not be included. **Xeos Online** will also automatically update if a new unlock code should be generated. SBD commands over e-mail **must** include an unlock code.

Appendix A: Technical Specification

Mechanical APOLLO

Material All titanium with a non-permeable ceramic antenna component

Standard Enclosure

Dimensions 20.83" L x 2.00" diameter)

Weight 2562 g - in water, 3637 g - out of water (Alkaline Batteries)

Short Enclosure

Dimensions 11.15" L x 2.00" diameter

Weight 1264g - in water, 1839g - out of water (Lithium Batteries)

Electrical

Power Supply

Supply	6x D-Cell 1.5V Alkaline Batteries - Standard Enclosure 3x 3.6V D-Cell Lithium Batteries - Optional Short Enclosure
Sleep Current (9V)	50uA
Iridium Transmit (9V)	60mA
GPS Acquisition	25mA
Voltage	+9 Volts Nominal (Standard Enclosure 6 D-Cell Alkaline Batteries) +10.8 Volts Nominal (Short Enclosure 3 D-Cell Lithium Batteries)
Battery Capacity	18.5 Amp Hours (D-Cell Alkaline) 13.0 Amp Hours (D-Cell Lithium)

Electronics

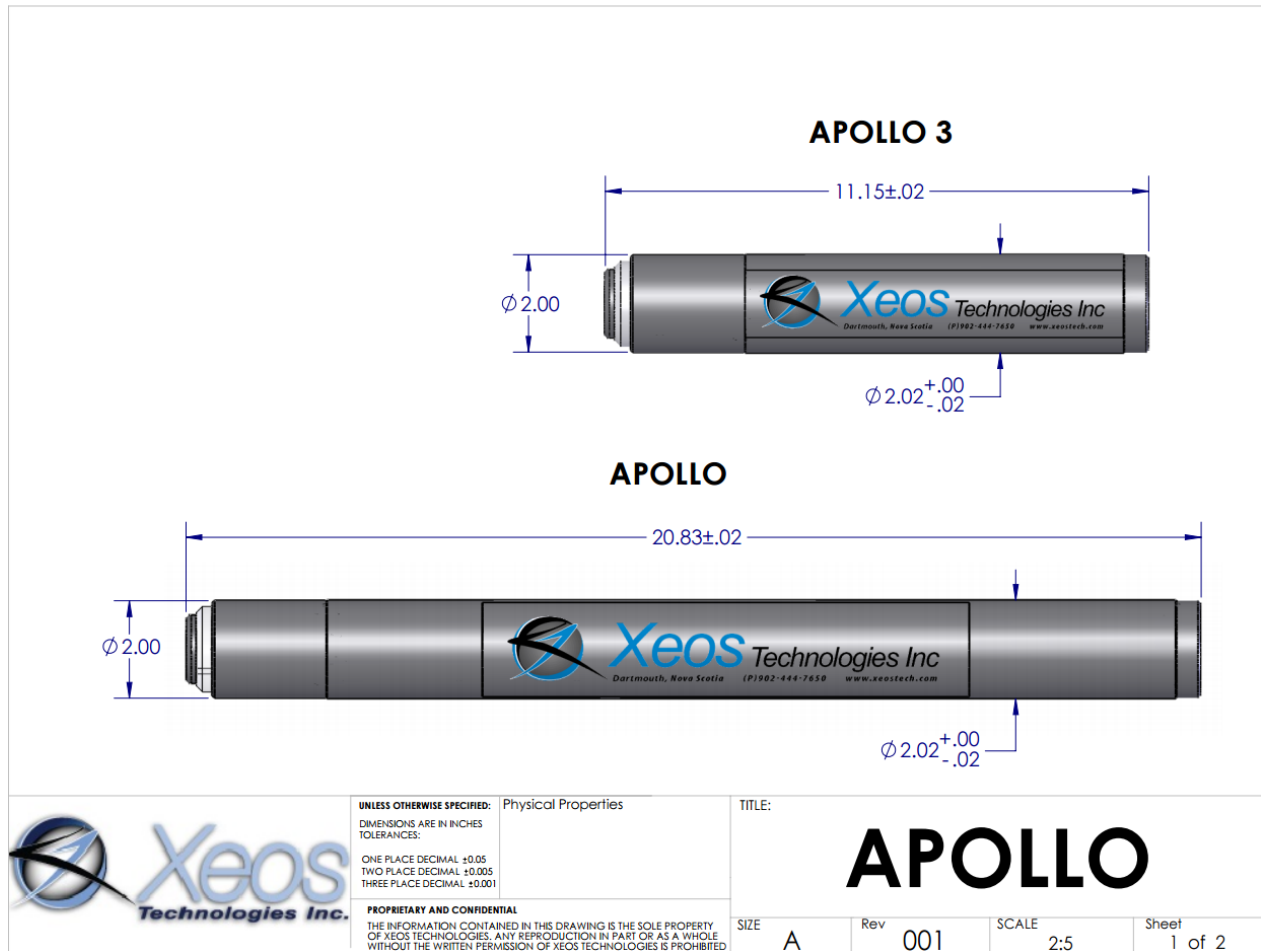
Digital Controller	Xeos IRDC-3
GPS Receiver	48 channel SiRFstarIV, GSD4e GPS chip
Iridium Modem	Iridium 9603 modem
Antenna	Xeos proprietary antenna, designed to withstand high pressure environments

Environmental

Operating Temperature	-40° c to +60° c
Depth Rating	Submersible to 36,089 feet (11,000m)

Engineering Diagrams

APOLLO with Long and Short Battery Enclosure



Warranty, Support, and Limited Liability

Xeos Technologies Inc. warrants the APOLLO Beacon 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.

NO OTHER WARRANTIES: Xeos Technologies Inc. disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose, with respect to the product or the accompanying written materials. This limited warranty gives you specific legal rights. You may have others, which vary from state to state.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES: In no event shall Xeos Technologies Inc. or its suppliers be liable for any damages whatsoever (including, without limitation, damages for loss of equipment, for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or inability to use this Xeos Technologies Inc. product, even if Xeos Technologies Inc. has been advised of the possibility of such damages.