Xeos Technologies Inc.

Apollo User Manual

SUBMERSIBLE IRIDIUM / GPS / LED FLASHER

Version 3.2
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Shipped From

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Specifics

This manual version is written with respect to Apollo firmware build 5490. If you wish to acquire the latest firmware for your device, contact support@xeostech.com

Version History

Version No.	Date	Description
1.0	May 2015	Base document
1.2	Oct 2015	Formatting
1.3	Dec 2016	Added information on the ION
1.4.0	Jan 2017	New section for Hades version
1.4.1	Aug 2017	Updated power supply specifications
1.5.0	Sept 2017	Document overhaul
1.6.0	Dec 2017	SBD and Bluetooth Sections Standardized
1.6.1	Dec 2017	Added Relay 8-pin Connector
1.7	Jan 2018	Added Watch Circle Info
1.8	Feb 2018	Added more Watch Circle Info, more Bluetooth App details
1.9	Apr 2018	Color-coded commands, more position information
2.0	June 2018	Added I, P and S type messages, rewrote Appendix A
2.1	Aug 2018	Expanded Apollo Remote Head
2.2	Oct 2018	BT App separate doc, relay/Hades pinout standardized
2.2.1	Nov 2018	Added more current draws for Apollo Relay
3.0	Apr 2019	Overhaul; Strobe turnoff, new Apollo RH picture
3.0.1	May 2019	Minor fix to Specifications
3.0.2	May 2019	Removed Ion, new Firmware build number
3.1	July 2019	Added new Fresh Water deployment details
3.2	Aug 2019	Bluetooth internal details

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

Table of Contents

Overview

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 meters below sea level. Xeos Technologies Inc. (Xeos) manufactures other specific products for surface applications as well as sub-surface applications at varying depths.

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

Preliminary Setup

Outside Diagram

The Apollo has several items of note to help identify a specific device. Shown below are key sections of the Apollo.

1	The LED of the Apollo is located here. The titanium sections above and below the glass must be shorted to trigger the water sense
2	The magnet switch for turning the Apollo on and off is located directly below the glass
3	The meeting point of the electronics head and battery chamber is torqued and should not be opened. A sealing O-ring is installed here.
4	The 15-digit IMEI of the Apollo's Iridium modem as well as factory serial number is labelled on the battery tube. On the Mono, this is on the head.
5	A QR code is available to scan to download the manual. On the Mono, this is on the head.
6	The bottom end cap contains a sealing O-ring and allows for battery installation

Setting up an Iridium Account

Apollo 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.

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 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 Apollo. Once the SBD account has been activated, please contact your Xeos representative and confirm this.

Apollo 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 Apollo, however, the messages from the Apollo in this format are not human-readable. **XeosOnline** is a web-based monitoring system which allows users to view and manage information from the Apollo 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.

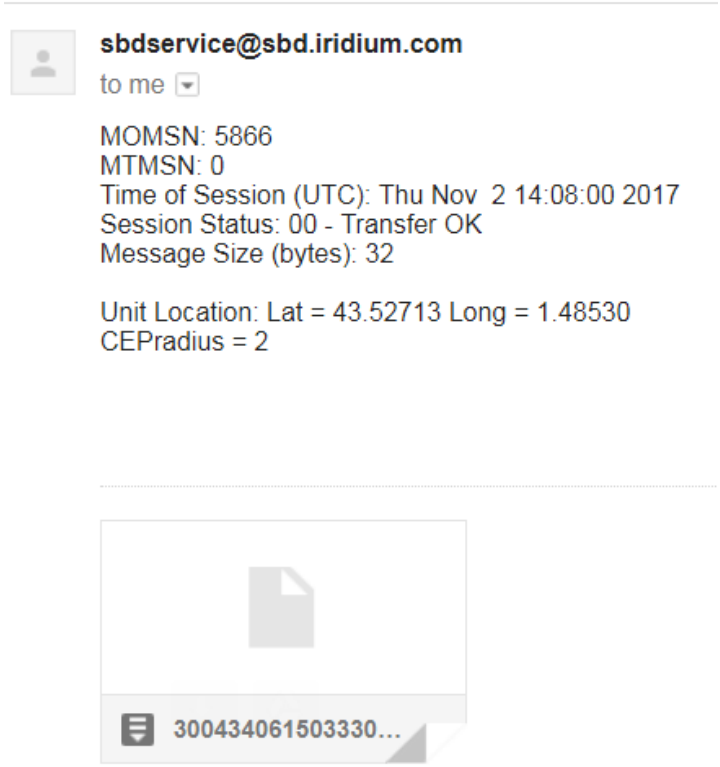
Sending messages and changing configuration can be completed through XeosOnline. See www.xeostech.com or your account manager for more information.

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 Apollo, 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

Additional Models

Apollo-3

The short tube variant of the Apollo, the Apollo-3 offers a shorter, lighter package for easier mooring.

The Apollo-3 operates in the same manner as the standard long-tube Apollo, however due to the smaller enclosure, **requires** three **Saft LSH20** Size D 3.6V lithium batteries with a nominal voltage of 10.8V.

Like its larger counterpart, the Apollo-3 has a depth rating of 11,000 meters.

Apollo MONO

The MONO is a miniature, low voltage version of the Apollo beacon. The MONO incorporates all features of the Apollo, but is certified to a depth of 6000m.

The smaller profile of the MONO **requires** one **Saft LSH20** Size D 3.6V lithium battery.

Apollo Remote Head

The Apollo-RH is a remote head variant of the Apollo line, designed for easier mooring and weight distribution. Apollo-RHs operate in the same manner as the standard Apollo, and can be ordered with long alkaline, or short lithium battery tube.

Since the Apollo-RH can also be powered externally using its included cable, it can also be powered within the range of 7 to 30VDC.

See the Apollo Remote Head section for more details.

Apollo Relay

The Apollo Relay is a remote head variant of the Apollo line, designed for interfacing with a peripheral device or AUV. The Apollo Relay can also output NMEA sentences from a dedicated serial port if commanded, as well as allow the user to send and receive Iridium messages, which are then “relayed” to or from the peripheral device. The Apollo Relay can also output a 1-PPS signal, depending on power connections and chosen bulkhead connector.

See the Apollo Relay section for more details.

Apollo Operation

Using the Magnets

The Apollo beacon is turned ON and OFF via 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 a 1/2 second and then remove it for a 1/2 second. Do this twice, and the Apollo will respond by showing a solid LED, followed by several flashes (self-test period) before strobing begins normally.

To turn the Apollo OFF, repeat the above procedure with the magnet. Contact with the magnet will cause quick flashing, and after two taps, will flash for several seconds, followed by a solid LED before turning off.

Note: If after turning the Apollo ON, the self-test period described above lasts noticeably longer than 10 seconds, this indicates a **SELF-TEST FAILURE**. Contact support@xeostech.com if this occurs.

Operational Tips

- It is important to let all LEDs stop illuminating before initiating another action.
- Cycling power for any reason, such as using the magnetic switch or removing the bottom end cap, will initiate start-up mode.
- The beacon requires a good view of the sky for any test. It is necessary that any tests be done outside of a building, far from potential obstructions.

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. Do not use conductive material at the top of the Apollo around the glass lens; this will cause the water sensor to fail.

Messages from the Apollo

There are several messages sent from the OSKER, depending on setup and conditions. Below are examples of the most common Mobile Originating messages.

Version (Type V)

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

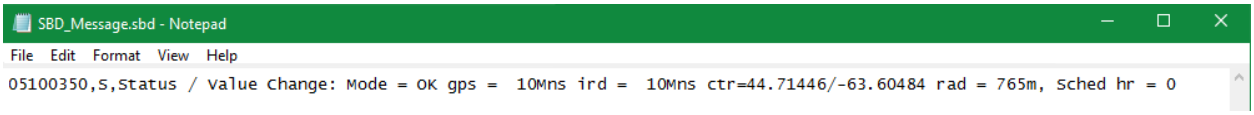
```
Ascii: 04151513,V,Apollo_A v1.26-5284. dev:4 Hw:1.5-0 SN=55 GPS: IRD:TA14001 Reset: Count=78, Current=(), Prev=(cleared)
```

Version Readout	
04151513	Timestamp in UTC (Month/Day/Hour)
V	Type of message (Version)
Firmware Version	Product; Major, minor, build of 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 modem
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

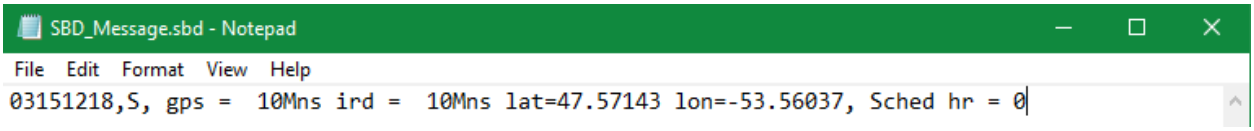
Status Change Message (Type S)

Status messages are sent from the device when there has been a change to the operation of the device, whether a timing change between modes (underwater to alarm mode, alarm mode to normal mode) or changes to the Watch Circle details. If Watch Circle is not enabled, its information is omitted. This message is always sent in ASCII format.

Note: Since this message is transmitted after surfacing, the fix information in this message could be inaccurate if the mooring drifted while underwater and the last fix was before submergence.



S-Type Message with Watch Circle Enabled



S-Type Message with Watch Circle Disabled

Status Readout	
03151218	Timestamp in UTC (Month/Day/Hour)
S	Type of message (Status Change)
Status / Value Change	Indicates that a setting has been changed
gps = 10Mns	Currently used GPS repetition rate
ird = 10Mns	Currently used Iridium repetition rate
lat=47.57143	Latitude of latest fix
lon=-53.56037	Longitude of latest fix
Sched hr = 0	Timing offset of Iridium/GPS sessions from UTC, set via **$reporthour**

Position Message

Typical position messages are sent in compressed binary format (Message Type 10) to save on data usage and are parsed in XeosOnline. If XeosOnline is not used, GPS Text Short (Message Type 0) can be used to read position messages as P-Type.

Compressed Binary Position

The default format for positions is compressed to save on Iridium data usage. This binary format is parsed into a readable format by XeosOnline, placing its full contents in the Message and Location Logs.

The binary format is stackable and can transmit more than one position per Iridium transmission. In this situation, all recorded positions will be displayed in the Location Log, while the latest position will be displayed in the Message Log.

Timestamp: 2019-03-07T04:00:08.001Z, BatteryV: 10.71, Latitude: 44.714304, Longitude: -63.605024, Voltage Unloaded: 12.81

Message Log Readout	
Timestamp	Date and time in UTC of the latest position reading
BatteryV: 10.71	Loaded voltage of the power supply; minimum battery voltage observed during the previous Iridium transmission
44.714304	Latitude of fix, decimal degrees
-63.605024	Longitude of fix, decimal degrees
Voltage Unloaded: 12.81	Unloaded voltage of power supply; battery voltage data from measurement taken just prior to the turning on of the Iridium modem

Timestamp	Latitude	Longitude	Alarm	Bearing	Speed (km/h)	Speed (knots)	Altitude (m)	SNR
Oct 21 2016 01:40:12.001 PM	44.714406	-63.604947	false	0.0	0.0	0.0	0.0	42

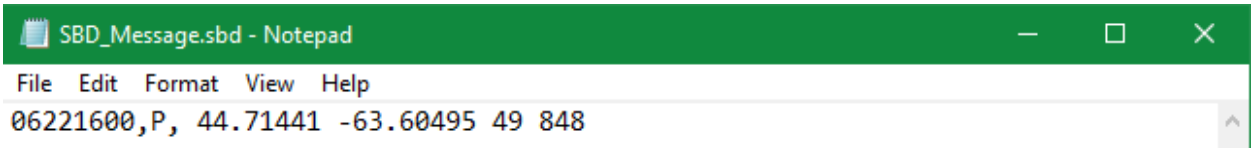
Location Log Readout	
Timestamp	Date and time in UTC of this specific position reading
44.714406	Latitude of fix, decimal degrees
-63.604947	Longitude of fix, decimal degrees
Alarm: False	Indicates if the device has determined if it is in an alarm state
Bearing	Direction of movement determined by device
Speed (km/h)	Speed measurement in kilometers per hour
Speed (knots)	Speed measurement in knots
Altitude	Not used
SNR	SNR (Signal-to-noise ratio) of GPS Fix, higher is better (>37 is good)

Each compressed message is 26 bytes in size, with an additional 11 bytes added for each additional "stacked" position.

ASCII Position (Type P)

In ASCII position format, only the most recent fix is sent at each interval, therefore it is most efficient to have GPS and Iridium intervals equal. This message also appears as it is shown below in XeosOnline.

P-type messages are approximately 39 bytes, but can be larger if Watch Circle is enabled:



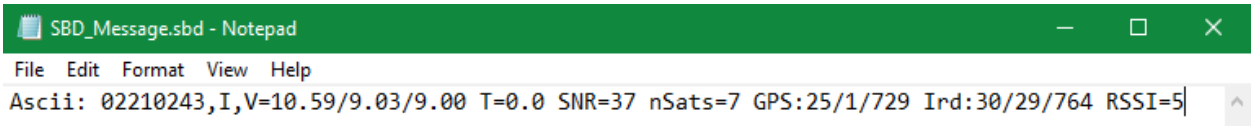
The message type used can be changed using the **$msgenable** command.

Position Readout	
06221600	Timestamp in UTC (Month/Day/Hour)
P	Type of message (Position)
44.71441	Latitude of fix, decimal degrees
-63.60495	Longitude of fix, decimal degrees
49	SNR (Signal-to-noise ratio) of GPS Fix, higher is better (>37 is good)
848	Unloaded voltage of device at the time of GPS Fix in mV

Information Message (Type I)

In situations where the device fails a GPS session through low SNR or other factor, the follow-up Iridium session will send a synopsis of the latest statistics from the device. This message will always be in ASCII format regardless of message format settings and approximately 80 bytes.

This message can be prompted using **$sysinf**



Information Readout	
02210243	Timestamp in UTC (Month/Day/Hour)
I	Type of message (Information)
V=10.59/9.03/9.00	Battery voltages unloaded/after Iridium session/after GPS session
T=0.0	Most recent temperature measurement, not used in Apollo
SNR=37	MaxSNR (Signal-to-Noise ratio) of the last GPS attempt
nSats=7	Number of connected satellites during last GPS attempt
GPS:25/1/729	Quantity of good fixes since powerup, fails/Quantity of failed fixes/ Seconds total GPS has been powered on since power-up
Ird:30/29/764	Quantity of Iridium messages/Quantity of Iridium sessions/ Seconds total on time for Iridium
RSSI=5	Value reported back from the modem. Always a number between zero and five; five being the strongest signal.

Communicating with the Apollo

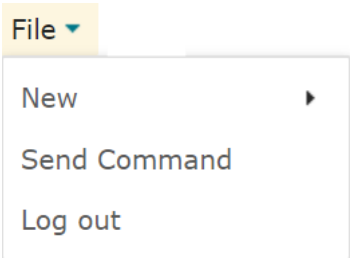
There are 3 ways to communicate with the Apollo:

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

Sending Commands Using Xeos Online

Before using Xeos Online make sure that your account has been set up and your device added to your organization. Contact activations@xeostech.com for more information.

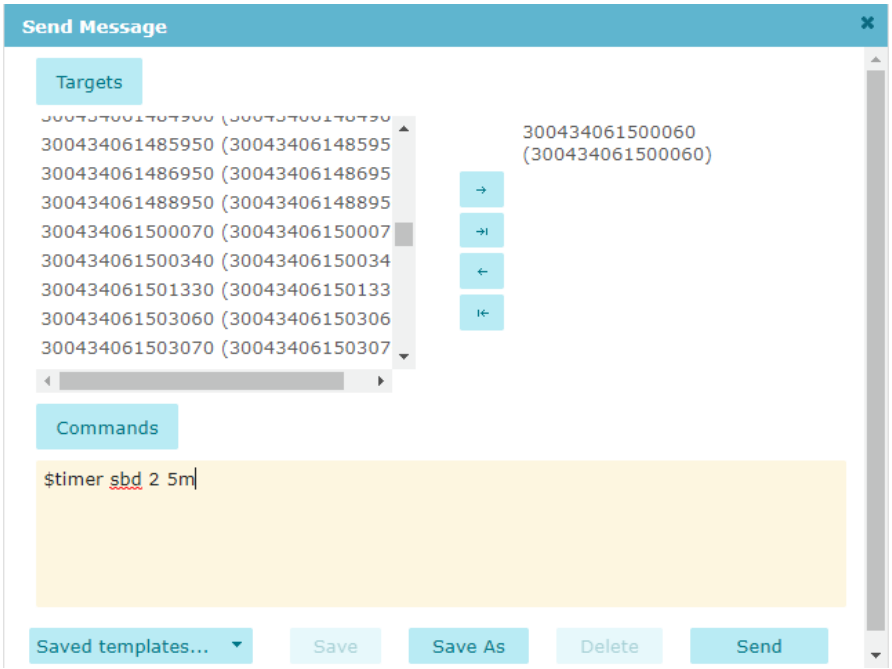
Setting up to Send



- Navigate to the Send Command window.
- From the Home Tab, choose **File > Send Command**
- Select the units you wish to target with commands and move them over to the right-hand target list using the **->** button.
- Type your command(s) into the command box and press send.

Remember to include the dollar sign (**$**) ahead of each command, and enter each command on a separate line.

Outgoing messages will appear in the Message Log for the commanded device.



Sending Commands via Email

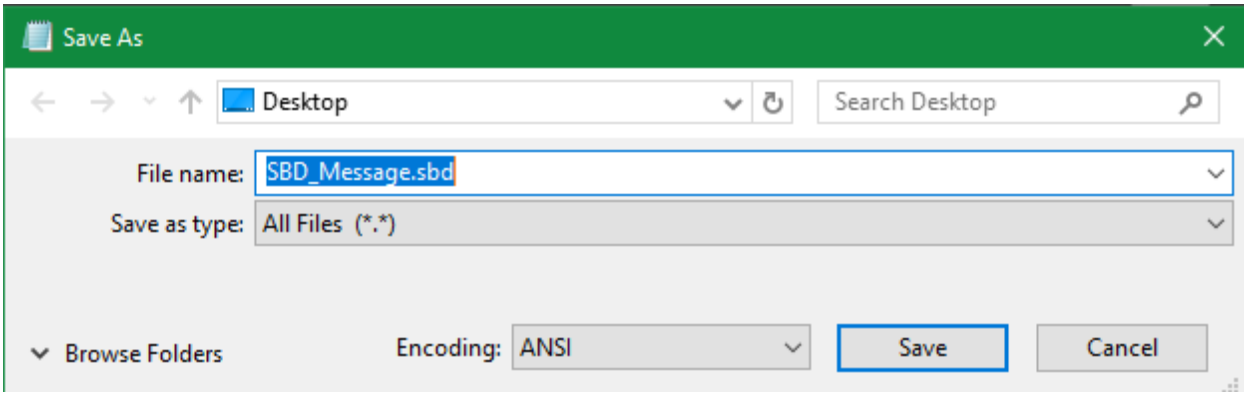
E-mail commands can also be used to communicate with the Apollo when it is above water. These commands are sent as email attachments. Commands can configure the Apollo remotely in the same way as commands sent by Xeos Online. Available Apollo commands are covered in Changing Timers and Additional Settings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

To receive commands from the Iridium network, the device in use must have a clear view of the sky. If the device is unable to communicate with the Iridium network, commands will remain queued for five days.

Command Format

Creating the file

To create an SBD command, open a new file in a text editor (ex. Notepad) and save it using the **.sbd** extension. Make sure the **Save as type** option is set to **All Files** to achieve this.



Command Structure

Commands must be structured in the following way:

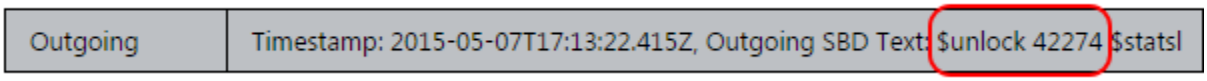
1. Each command **MUST** have a dollar sign (**$**) before each command.
2. The unit's unlock code in the following format: **$unlock XXXXX**
   where **XXXXX** is the unit's five digit unlock code.
3. A list of commands, one command per line.

The Unlock Code

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 via Bluetooth or Iridium. 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.



Sending the Command

To send your sbd command, create a new email message with the following fields:

To:	**data@sbd.iridium.com**
Subject:	**Your device's IMEI**
Body:	**Empty**
Attachments:	**Your .sbd file**

A confirmation will be immediately returned from the Iridium Gateway from the address **sbdservice@sbd.iridium.com** indicating that your message is now in the message queue. It will be delivered to the device during its next Iridium check.

Commands can be sent from any email address, but responses will be returned **only** to email addresses on the unit's forwarding list.

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 Apollo.

Messages to the Apollo

Settings

```
T/A:Td=0;Ts=100 GPS:MxOn=100;MxPr=30;Tmn=-30;Vmn=0.000;gBlk0=0,0;gBlk1=0,0;gRtyQ=2;
gRtyD=20;gFRst=50;gNM=n;gSB=Y;wcIC=85;gBL=40;gFQ=24 Sys:PB=5284;Dsc=;BtP=n;BtT=5;
BtN=HouseApollo;LL=0;UC=99999;rHr=0;rMn=2 Ird:iBlk0=0,0;iBlk1=0,0;iRtyQ=2;Smx=8;MxLn=330;
iWR=Y;um=3 Tilt:Tt=10;Secs=4;USec=4 mSF:mNum=0;mMsg=20;mByt=4000;mHrs=24
Flsh:strS=15;strN=2;strFlshUW=n
```

The **$settings** command will return a truncated list of important Apollo settings aside from timers:

Name	Default	Description
GPS Settings (GPS)		
MxOn	100	Maximum GPS session length in seconds
MxPr	30	Maximum GPS session length in poor conditions
Tmn	-30	Temperature minimum
Vmn	0.000	Voltage minimum
gBlk0	0,0	GPS Blackout, Unused
gBlk1	0,0	GPS Blackout, Unused
gRtQ	2	GPS retry quantity
gRtyD	20	GPS retry delay in seconds
gFRst	50	Number of GPS failures for GPS reset
gNM	N	GPS NMEA Mode On/Off
wcIC	85	WC Inner Percent for WC Warning message (Val = % WC Radius)
gBL	40	Maximum saved GPS fixes
gFQ	24	Maximum GPS fixes per message
System Settings (Sys)		
PB	Build	Firmware Build
BtP	Y	Bluetooth on or off
BtT	5	Bluetooth Timeout in minutes
BtN	Name	Bluetooth Name
LL	0	Diagnostic Log detail level
UC	Code	Unlock Code
rHr	0	Hour on which timings are based (24h UTC)
rMn	2	SBD hour offset in minutes
Iridium Settings (Ird)		
iBlk0	0,0	Iridium Blackout, Unused
iBlk1	0,0	Iridium Blackout, Unused
iRtyQ	2	SBD Retry Quantity
Smx	8	Maximum SBD attempts per session
MxLn	330	Maximum message length (bytes)
iWR	Y	Wait for registration
um	3	Unsolicited Messages, Unused

Tilt Settings (Tilt)		
Tt	10	Tilt Threshold
Secs	4	Tilt Seconds
USec	4	Untilt Seconds

Relay Settings (mSF), Relay Only		
mNum	0	Last message number
mMsg	20	Max backlog msgs
mByt	4000	Max backlog bytes
mHrs	24	Max backlog age

Strobe Settings (Flsh)		
strS	15	Strobe interval
strN	2	Strobe number
strFlsUW	n	States if strobe will flash if Apollo is underwater

Lifetime Stats

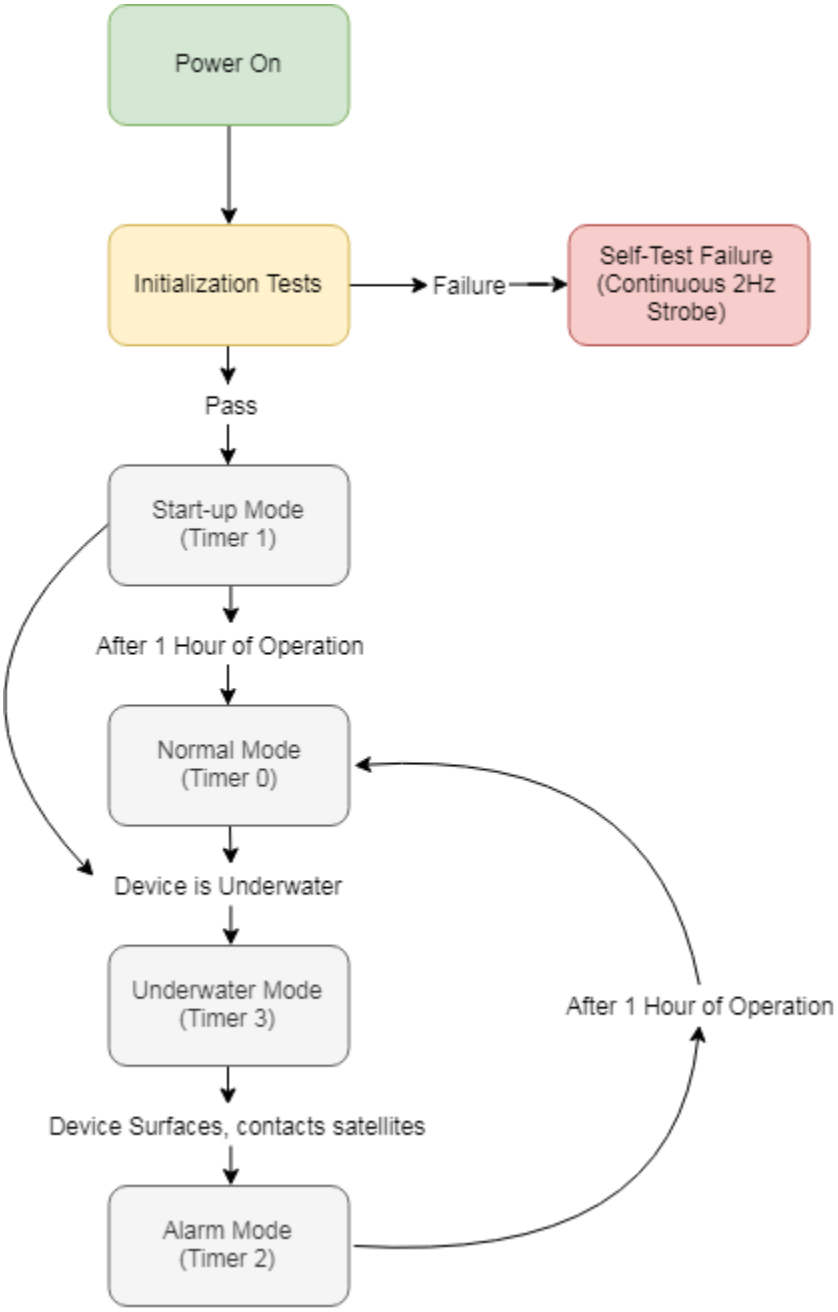
The **$statsl** command will return various performance statistics recorded since the last firmware install as well as current statistics. A similar command **$stats** omits **Power Cycle Count** and **Watchdog Reset Count**, and counts from the last reset.

```
Message SubType: 0, Timestamp: 2019-04-15T15:35:41.000Z, BatteryV: 9.84, Voltage Unloaded: 10.92, Uptime: 3492043,
Power Cycle Count: 78, Watchdog Reset Count: 0, Lowest Battery Voltage: 0, Highest Battery Voltage: 26.01,
Iridium Message Count: 4166, Iridium Session Count: 7254, Iridium On Time: 5471, Iridium Send Failures Non18: 18257, Iridium Send Failures Type 18: 256,
Bytes TX: 153239, Iridium Messages Received: 50, Bytes RX: 1807,
GPS Sessions: 4639, GPS On Time: 2235, GPS Fix Count: 4111, GPS TTFF Average: 10, High Temperature: 0, Low Temperature: 0
```

Lifetime Statistics Readout	
BatteryV	Last measured battery voltage (Loaded, Unloaded)
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
Iridium 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 type18	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, Low Temperature	Not used with the Apollo

The Apollo's Timers

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



Apollo Timer Types

The Apollo's behavior is based on multiple timed events. Understanding how these events interact is necessary to properly use 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, Apollo will transmit any messages queued to be sent to the user. Once this is finished it will receive any queued messages from the Iridium Gateway and implement them, provided the proper Unlock Code is received.

GPS

The Apollo will search for 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 internal 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. If the light level is below the threshold in the device, the Strobe will be active.

This timer is not active in underwater mode.

TLT

At default settings the Apollo's tilt sensor is disabled. When enabled, the tilt sensor will take continuous readings to determine the orientation of the Apollo, and will only take readings after one GPS fix has been acquired during that power-on session.

After a set time of inversion beyond the threshold (TltSecs) the Apollo will not strobe until the device detects it has reverted back to an upright position according to TltUSecs.

Apollo Timer Modes

Start-up Mode (Timer 1)

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 (**$resetnow**). This mode will last for a maximum of one hour, but can be interrupted by another mode (ex. underwater or alarm).

While the maximum time of Timer 1 cannot be changed, GPS and SBD intervals can be set by the user as with all other timers.

Underwater Mode (Timer 3)

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 midnight 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 be queued and attempted. If the Apollo successfully connects to the Iridium network, the Apollo will exit underwater mode and enter Alarm Mode.

The Apollo will always exit underwater mode if it successfully connects to the Iridium network.. Since the Apollo will only enter underwater mode after 3 consecutive failed Iridium transmissions, it can take several hours depending on the Apollo's Iridium transmission rate.

Alarm Mode (Timer 2)

Alarm mode will always begin after the Apollo has exited underwater mode or if the device exits its watch circle. When it enters Alarm mode due to surfacing, 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 this Alarm Mode has finished, the Apollo will enter normal mode.

Normal Mode (Timer 0)

Timer zero 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 hour. If no other modes are engaged, the Apollo will continue in normal mode until its batteries are depleted or the unit powered off.

Low Battery Mode (Timer 4)

The Apollo will enter Low Battery mode if the device's voltage drops below 8 Volts. This is triggered by 2 consecutive Iridium sessions with a minimum battery voltage less than the threshold.

Since various voltages can power the Apollo, this mode is disabled by default.

Default Settings

Timer	<T0>	T1	T2	T3	T4	T5	T6	T7	Min-Max
SBD	1h	15m	10m	1d	1h	1h	1h	1h	1m-1d
GPS	1h	15m	10m	1d	2h	1h	1h	1h	20s-1d
WTR	1m	15s	1m	1m	1m	1m	1m	1m	5s-1d
LIT	1m	15s	1m	5m	1m	1m	1m	1m	5s-1d
TLT	1m	15s	1m	5m	1m	1m	1m	1m	1s-1h

Legend	
SBD	SBD (Iridium) transmission interval
GPS	GPS acquisition interval
WTR	Water sensor check interval
LIT	Light sensor check interval
TLT	Tilt sensor check interval if “Tilt” is enabled in the “Switch” menu
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 immediately after power-up or reset (one hour duration)
Timer 2	Alarm	Used when the device has surfaced or exited its Watch Circle (1hr)
Timer 3	Underwater	Used when the device determines it is underwater
Timer 4	Low Battery	Used when the device consistently detects low voltage (disabled by default)

- The default timer settings of the Apollo are suitable for most use cases.
- Timers 5 – 7 are not used in the Apollo.

Timer

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 GPS and SBD timers. The first five timers are used by the Apollo.

Changing the Timers

The length of the Apollo's various modes cannot be altered. Alarm 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 independently 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:

$timer SYSTEM TIMER-MODE INTERVAL

Example	Command	Timer Type	Mode	Interval
1	$timer	GPS	0	1h
2	$timer	GPS	2	5m
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 Strobe

Strobe Number and Interval

There are two parameters available for configuring the Apollo's flasher, the period and the pulse count. At default settings, the Apollo's LED will flash twice every ten seconds, each LED pulse lasts for 50 milliseconds

The period setting determines the number of seconds between flashes, while the pulse count determines the number of pulses with each flash. Both parameters are set using the following command:

$strobe [number of pulses] [period in seconds]

The number of pulses can be up to 4, while the period is limited to a maximum 60 seconds. This command is written as:

$strobe X Y

Example	Command	Pulse Number	Strobe Interval
1	$strobe	1	20
2	$strobe	2	50

Sending the commands in Example 1 would set the flasher to pulse once for 50ms every 20 seconds. While Example 2 would set the flasher to pulse 2 times every 50 seconds.

Strobe Disable

Semi-permanent Disabling

Some users may prefer to disable the Apollo's strobe regardless of environment. To disable the regular operation of the strobe, issue the following command:

$switch B 0

To re-enable the strobe, issue:

$switch B 1

With this feature, the strobe will not pulse according to its settings according to the **$strobe** command. The strobe will only illuminate if the magnetic reed switch is acted upon, as the LED is the visual aid used to indicate the Apollo's power status.

Using the $switch method to disable the strobe is saved in memory. This means the strobe will remain in a disabled state through resets unless commanded otherwise.

Timed Disabling

If there is a need to disable the strobe temporarily, **$StrDisbl** can be used to disable the feature in the following ways:

$StrDisbl 1	Disables the Strobe for **1 hour**
$StrDisbl 0	Enables the Strobe immediately (Default strobe setting is **ENABLED**)
$StrDisbl 1 6h	Disables the Strobe for **6 hours**

The Maximum time the strobe can be disabled is **24 hours ($StrDisbl 1 24h**).

Other Strobe Features

By default, the Apollo's strobe discontinues flashing once the device is submerged. This can be changed to flash continuously regardless of submergence by issuing the command:

$StrFlshUw 1

The opposite setting is restored by sending:

$StrFlshUw 0

Disabling the Magnetic Switch

To avoid inadvertent triggers of the magnetic switch, **$MagDisbl** can be used to disable the feature in the following ways:

$MagDisbl 1	Disables the Magnetic Switch for **1 Hour**
$MagDisbl 0	Enables the Magnetic Switch (Default switch setting is **ENABLED**)
$MagDisbl 1 6h	Disables the Magnetic Switch for **6 hours**

The **maximum** time the magnetic switch can be disabled is **24 hours ($MagDisbl 1 24h**).

Watch Circle

The watch circle functionality allows the Apollo to increase message rates 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. 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 intervals.

Enabling the Watch Circle

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

$engmode 2009
$enable c 1
$WCenable 1

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

Note: **engmode** will be disabled upon reset of the device. Changes done using the **enable** command will survive resets, and therefore will only need to be used once to enable watch circle functionality, unless a **$factorydefaults** command is issued.

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 Apollo will average its GPS location fixes for 48 hours. The device will create a Watch Circle using the 48-hour average as its centre and a user definable radius (default radius is 100m)

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 surfacing all use Timer 2.
- The Watch Circle's radius alone can be adjusted by setting the latitude and longitude parameters to 0, followed by the new radius.

The Apollo's Sensors

Water Sensing

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.

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 a water measurement 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 alarm mode for 1 hour. After the hour has elapsed, the Apollo will return to normal mode.

2017-01-24T21:21:41.000Z, Ascii: Surfaced

The Apollo's water sense mechanism is programmatically set to operate optimally in salt water environments. To operate the device in fresh water, the water sense threshold value must be **increased** to trigger a water sense surfacing event.

To change the water sense threshold, use the following commands in order:

$engmode 2009
$wsthresh X

Where **X** is the new value of the threshold.

The water sense reading has to be **lower** than the threshold number when submerged, and **higher** than the threshold number when surfaced for surfacing to take place. Fresh water environments can vary in the reading given, therefore testing should be done ahead of fresh water deployments to ensure proper operation.

The water sense reading can be interrogated via a Bluetooth connection via the **$wsr** command.

Light Sensing

The Apollo's light sensor measures illuminance every 15 seconds. If the light level is below the set threshold, the strobe will begin flashing according to its Strobe settings.

The light sensor can be disabled so the Apollo treats the environment as permanently dark, or permanently light using the following command:

$switch L 0

Care must be taken when disabling the light sensor; upon disabling, the LED will take on the characteristics based on the last light sensor reading. It is suggested to reset the device after disabling the light sensor if permanent strobing is desired.

Tilt Sensing

The Apollo's tilt sensor takes an accelerometer reading every 15 seconds when enabled. If the Apollo is tilted beyond its threshold, the Apollo not will strobe until returning to an upright position. The Apollo does not stop transmitting while inverted.

The timer for the tilt sensor is not activated until the Apollo acquires at least one GPS fix.

To activate the Apollo's tilt capability, use the command:

$switch T 1

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 for use:

Message Number	Message Type
0	GPS Plain Text Short
1	GPS Plain Text Long
10	GPS Bin Compressed

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

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

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

$msgenable (timer) (message types separated by commas)

To enable GPS plain text short (Type 0), GPS Binary Compressed (Type 10), and Water Sense data (Type 8) on Timer 0 (normal mode) you would send the following command:

$msgenable 0 0,10,8

The Apollo will respond to the command by displaying the numerical values for the used message formats.

```
Ascii: Msgs0:0,1,8 Msgs1:10 Msgs2:10 Msgs3:10 Msgs4:10
```

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

Bluetooth

The Apollo 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 Apollo'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 Apollo will **always** advertise its name for connection (except when in underwater mode) until the Bluetooth power-off (**$btpwr 0**) command is received.

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

Since the Bluetooth in the Apollo shares the same antenna as GPS and Iridium, connection can be interrupted by these systems if they are in session.

Other Commands

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

Command	Parameters	Description
ver	---	Show hardware and firmware versions, outputs “V” message
Status	---	Show operating status, outputs “S” message
sysInf	---	GPS/Ird summary, outputs “I” message
FactoryDefaults	---	Reset all to defaults and reset.
btPwr	1/0	Bluetooth power On/Off
btName	NAME	Set Bluetooth name for the device. Power cycle Bluetooth after sending this command to initiate new name.
btpcycle	---	Power cycle Bluetooth
rv	---	Read battery voltage
settings	---	Show all settings.
stats	---	Show statistics (since last powerup/reset)
statsL	---	Show Lifetime Statistics
switch	X 1/0	Switch component X on/off. No parameter lists components
enable	Y 1/0	Enable component Y on/off. Requires entry to Eng. Mode
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
StrFlshUW	1/0	Enable strobe flashing while underwater (1 = Flash)
ResetNow	---	Restarts the system. The effect is the same as restarting via the magnet

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.

Standard Enclosure: Can hold **7 Energizer Industrial LR20** D-Cell alkaline (10.5V nominal) batteries.

Short Enclosure: Holds **3 Saft LSH20** Size D 3.6V (10.8V nominal) lithium batteries

For lithium models, only the Saft LSH20 has the ability to source enough current to supply peaks in Iridium transmissions, therefore the Saft LSH20 is required for use with lithium Apollos.

Opening the Housing

The mechanism for installing the batteries is the same regardless of which enclosure is provided. A plastic insert is vacuum-sealed to the full length of the inside of the battery chamber to prevent shorts.

The connection between the Apollo's head and battery tube is torqued at the factory. Users should not attempt to unscrew the head when changing batteries, as the amount of force required could damage the electronics.

O-Rings

Locations

The Standard Apollo has O-rings at two distinct locations:

O-ring A is located at the connection between the electronics head and the battery tube. It is not recommended that users separate the electronics head from the battery tube unless as part of long-term maintenance and is torqued at the factory to deter opening.

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.

Both O-ring areas utilize the same type of O-ring: **2-031/N70**

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.

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 seal lubricant (Molykote 111 from Dow Corning) to the new O-ring.
- Slide the new O-ring down over the threads of the endcap and into the O-ring groove.

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; this could cause fatal damage to the unit.

Replacing the Batteries

All Apollo batteries are configured in a single column. Make sure to only use new batteries.

To replace the batteries:

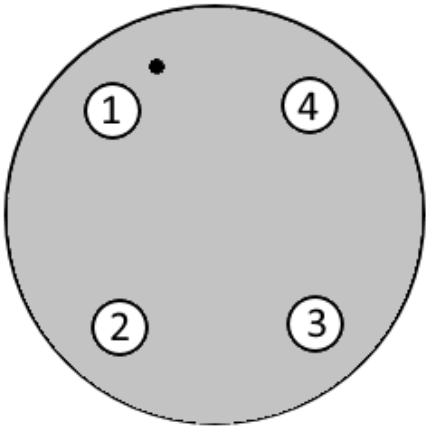
- Tip the old batteries out of the enclosure once the end-cap has been unscrewed. Make sure to dispose of them appropriately
- Slide the first battery into the column, ensuring that the positive (+) terminal faces the head of the Apollo
- Add the remaining batteries in the same orientation
- Restore the endcap to its place on the device, taking care to inspect the O-ring first

DO NOT MIX BATTERY TYPES.

Appendix A: Apollo Remote Head

The Apollo has a remote head option to allow for better load balancing by separating the locations of the electronics package from the battery pack. The Apollo Remote Head features all of the capabilities of the standard Apollo and is supplied power via a waterproof cable to a 4-Pin SubConn connector.

Connector Pinout



Connector: MCBH-4-FS-TI, External View

Pin Number	Name
1	Ground
2	No Connection
3	+V Battery (7VDC – 30VDC)
4	No Connection

Appendix B: Apollo Relay

Some custom versions of the Apollo allow for serial relay functionality. Apollo units with the proper firmware can send data to and from a connected serial device over the Iridium Satellite Network.

As of Build 4170, Apollo Relays can output NMEA sentences serially. This feature can be enabled using the command:

$gNMEA 1

Available NMEA sentences are listed in Appendix C.

Basic Functionality

The Apollo has a single serial line which must be switched between relay and diagnostics mode. By default, the Apollo-Relay will be in Relay Mode and will not accept most commands. Diagnostics can be enabled by issuing the command **$diag 1**, and disabled with **$diag 0** over the serial line (this also applies when communicating via Bluetooth).

The Apollo will always accept commands over Iridium.

Serial Relay

After the device is configured to your specifications, you can now use it to relay data to and from a connected serial device over the Iridium Satellite Network. To send data to or from the connected serial device, connect a device to the serial port on the Apollo-Relay. The Apollo-Relay will uses these connection settings:

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

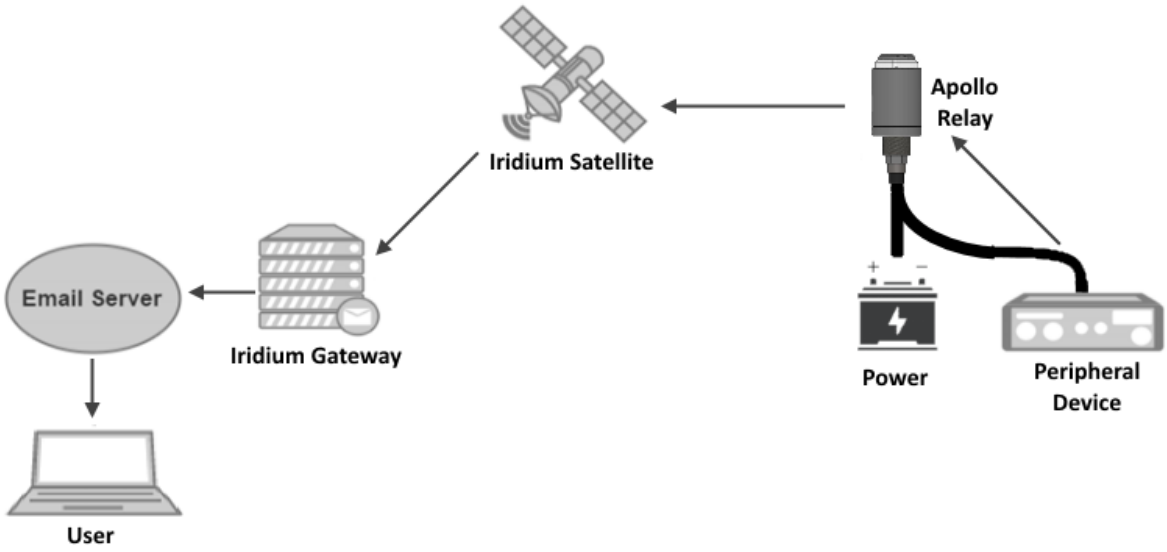
In the event the peripheral device has a different baud rate, the Apollo-Relay can be changed to match for communication purposes using:

$baudrate XXXXX Y

XXXXX	Baud Rate
Y	Stop Bits (0 or 1)

The Apollo-Relay will immediately use the commanded baud rate.

Mobile Originated SBD (From Device)



To send a payload of data from your connected serial device via the Apollo Relay to the user, the device will send the payload in the following format:

$sendSBD
payload line 1
payload line 2
payload line 3
$finished

All lines are terminated with either a carriage return, line feed, or both.

For example, using a carriage return as the line terminator for the same content as the previous example (represented with "\R"):

$sendSBD\R payload line 1\R payload line 2\R payload line 3\R $finished\R

$sendSBD\R The payload of the message can be single-lined as well\R $finished\R

The **$sendSBD** and **$finished** commands **must** be immediately preceded and followed by a line terminator character. The payload can be data of any type and is not limited to ASCII characters.

Any data that exceeds the 330 byte SBD message limit will be split into several chunks and sent according to the Iridium device's SBD interval. Each Iridium transmission can send up to 8 SBD messages of 330 bytes each.

At default settings, the maximum sized message that can be queued for transmission is 4 kilobytes; this limit can be increased to 24 kilobytes, but this can cause loss of data and other

issues if transmission conditions are not ideal. Contact Xeos Technologies if your requirements exceed default settings.

Mobile-originated messages will be transmitted over the Iridium satellite network from the Iridium device and arrive as an e-mail attachment. The first line in the e-mail attachment will have the following format:

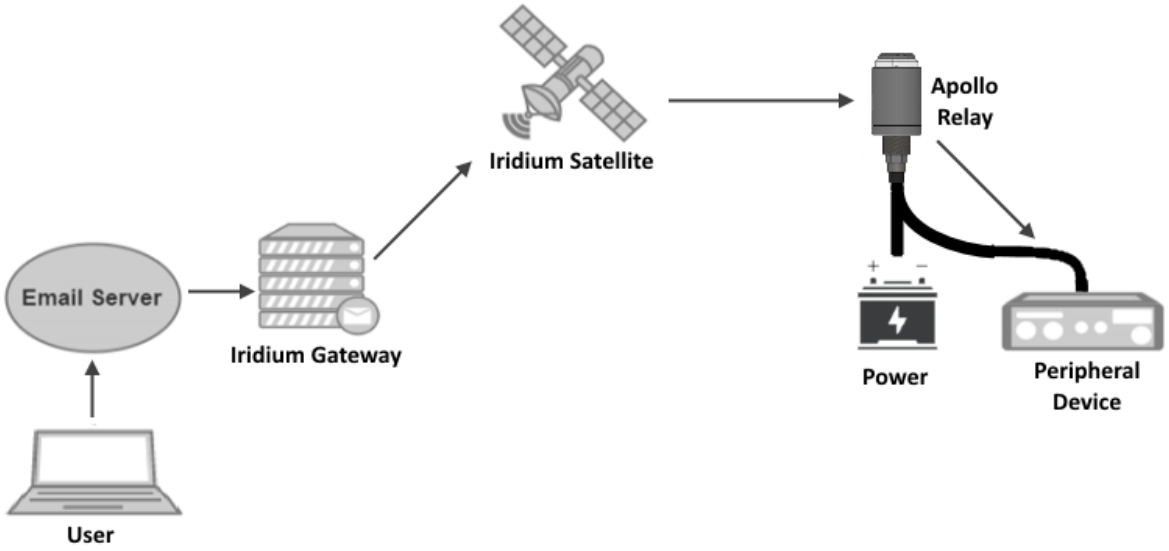
devData X,S,Y,Z PAYLOAD

devData a,1,1,1 The payload of the message can be single-lined as well

X	The alphabetic representation of the port the device is connected to
S	The sequence number of the incremented with each new $sendSBD command
Y	The message part number
Z	The total number of parts to the complete message

Following the "devData" line will be all or part of the payload, depending on the size of the payload.

Mobile Terminated SBD (To Device)



To send a payload of data to your connected serial device via the Apollo, create a file with the extension ".sbd" with its contents adhering to the following format:

$unlock 12345
$outPort X (where 'X' is the alphabetic port number of the connected device)
payload line 1
payload line 2
payload line 3

Again, all lines are terminated with either a carriage return, line feed, or both. The unlock line will be a 5 digit numerical code, unique to each device. Its purpose is to prevent accidental or malicious commands from being processed by either the Apollo, or your connected device.

When the data to be sent is compiled, normal methods of sending commands to Iridium devices can be implemented, either through email or a web service such as XeosOnline.

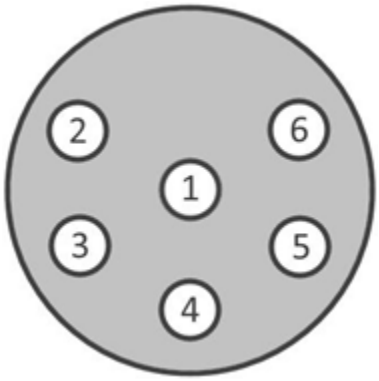
All lines after the **"$outPort"** line will be delivered to the connected serial device the next time the Apollo-Relay is scheduled to contact the Iridium network. The total message, cannot exceed 270 bytes. Upon reception of the **$outPort** command, the Apollo would output the following data to the connected serial device, according to the above example:

payload line 1
payload line 2
payload line 3

Settings

By default, the Apollo's serial settings are identical to what is detailed at Connecting to the Apollo. It is recommended that relay functionality be tested over a USB connection before deployment.

Apollo Relay Pinout Options – 6-Pin Connector

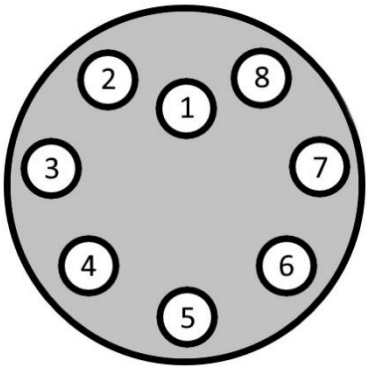


Connector: MCBH-6F-TI, External View

Option 1 – Dual Supply, no 1PPS	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**+V Battery**
5	+V External
6	Ground

Option 2 – Single Supply with 1PPS	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**GPS-1PPS**
5	+V External
6	Ground

Apollo Relay Pinout Options – 8-Pin Connector



Connector: MCBH-8F-TI, External View

Option 1 – Dual Supply	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**+V Battery**
5	+V External
6	GPS-1PPS
7	Ground
8	Shield

Option 2 – Single Supply	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**No Connection**
5	+V External
6	GPS-1PPS
7	Ground
8	Shield

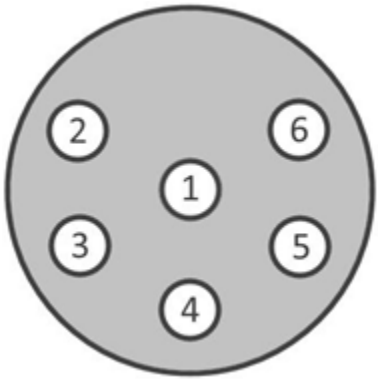
Appendix C: Hades

The Hades variant of the Apollo provides continuous GPS updates to any connected devices. GPS updates include both NMEA sentences and a connection to the GPS circuit's PPS pin. GPS will run continuously while the Apollo is not underwater, outputting a GGA sentence once per second.

Enabled NMEA Strings include:

GGA	Fix information
GLL	Lat/Lon data
GSA	Satellite Data
GSV	Detailed Satellite Data
RMC	Recommended Minimum Specific GNSS Data
VTG	Course & Speed Over Ground

Hades Pinout Options – 6-Pin Connector

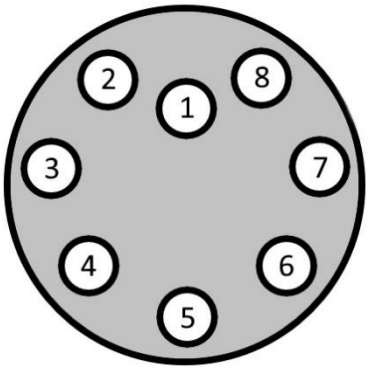


Connector: MCBH-6F-TI, External View

Option 1 – Dual Supply, no 1PPS	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**+V Battery**
5	+V External
6	Ground

Option 2 – Single Supply with 1PPS	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**GPS-1PPS**
5	+V External
6	Ground

Hades Pinout Options – 8-Pin Connector



Connector: MCBH-8F-TI, External View

Option 1 – Dual Supply	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**+V Battery**
5	+V External
6	GPS-1PPS
7	Ground
8	Shield

Option 2 – Single Supply	
Pin Number	Name
1	GPS-TXD RS-232
2	TXD RS-232
3	RXD RS-232
4	**No Connection**
5	+V External
6	GPS-1PPS
7	Ground
8	Shield

Appendix D: Technical Specifications

Electrical

	Apollo	Apollo-3	Apollo Mono	Apollo Relay
Supply Range (VDC)	7 - 30	7 - 30	2.7 - 5	7 - 30
Batteries	Energizer Industrial LR20 D-Cell (7)	Saft LSH20 D-Cell (3)	Saft LSH20 D-Cell (1)	External Power, back-up tube user discretion
Battery Capacity (Amp hours)	18.5	13	13	User discretion
Voltage Input (VDC)	10.5 Nominal	10.8 Nominal	3.6 Nominal	User discretion
Idle Current (µA), Relay (mA) (Bluetooth on/off)	110 @ 10.5V 50 @ 10.5V	110 @ 10.8V 50 @ 10.8V	250 @ 3.6V 60 @ 3.6V	4.0mA, Diag. & NMEA 2.8mA, Diag. @ 12V (Bluetooth no change)
Underwater Current (µA)	30	30	35	30 @ 12V
GPS Current (30s average, mA)	25	25	40	25
Iridium Current (30s average, mA)	60	60	120	60
Iridium Peak Current, Amps	1.5	1.5	1.5	1.5
Bluetooth Connected Current (mA)	3.2	3.2	6.1	5.8 with Diag. @ 12V
Device OFF Current (µA) Bluetooth on/off	95 @ 10.5V 20 @ 10.5V	95 @ 10.8V 20 @ 10.8V	210 @ 3.6V 10 @ 3.6V	2.3mA Diag. & NMEA 1.3mA Diag. @ 12V (Bluetooth no change)

Only the Saft LSH20 has the ability to source enough current to supply peaks in Iridium transmissions in lithium models, and is therefore required in these applications.

Batteries should be removed if device is entering storage

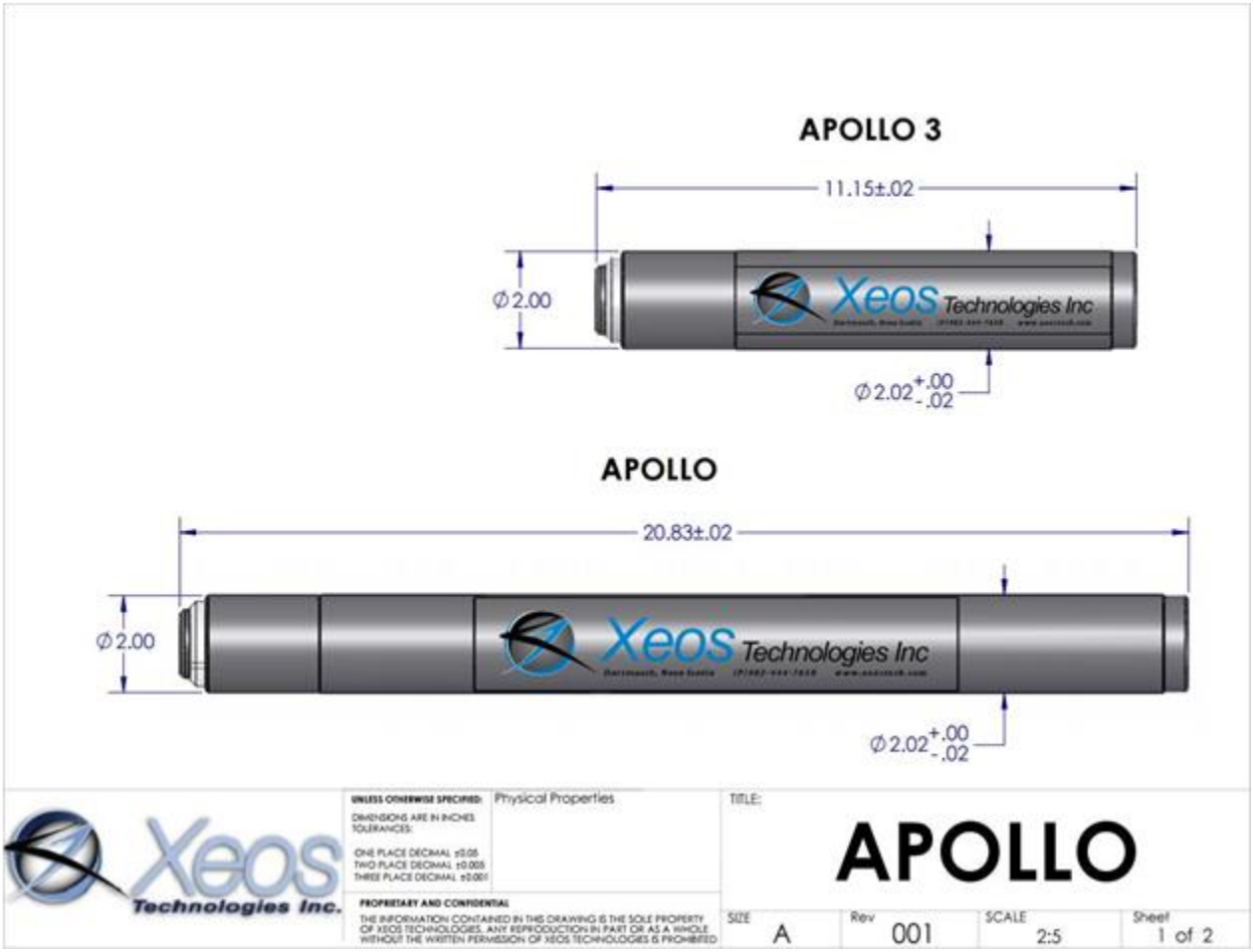
Electronics	
Digital Controller	Xeos IRDC-3
GPS Receiver	48 channel SiRFstarIV, GSD4e GPS chip
Modem	Iridium 9603
Antenna	Xeos proprietary antenna, designed to withstand high pressure environments

Sealing

Seal Lubricant	Molykote 111
O-ring Size	2-031/N1470
O-ring dimensions	1.75” x 1.875” x 0.070”

Appendix E: Engineering Diagrams

Apollo Long and Short Battery Enclosure



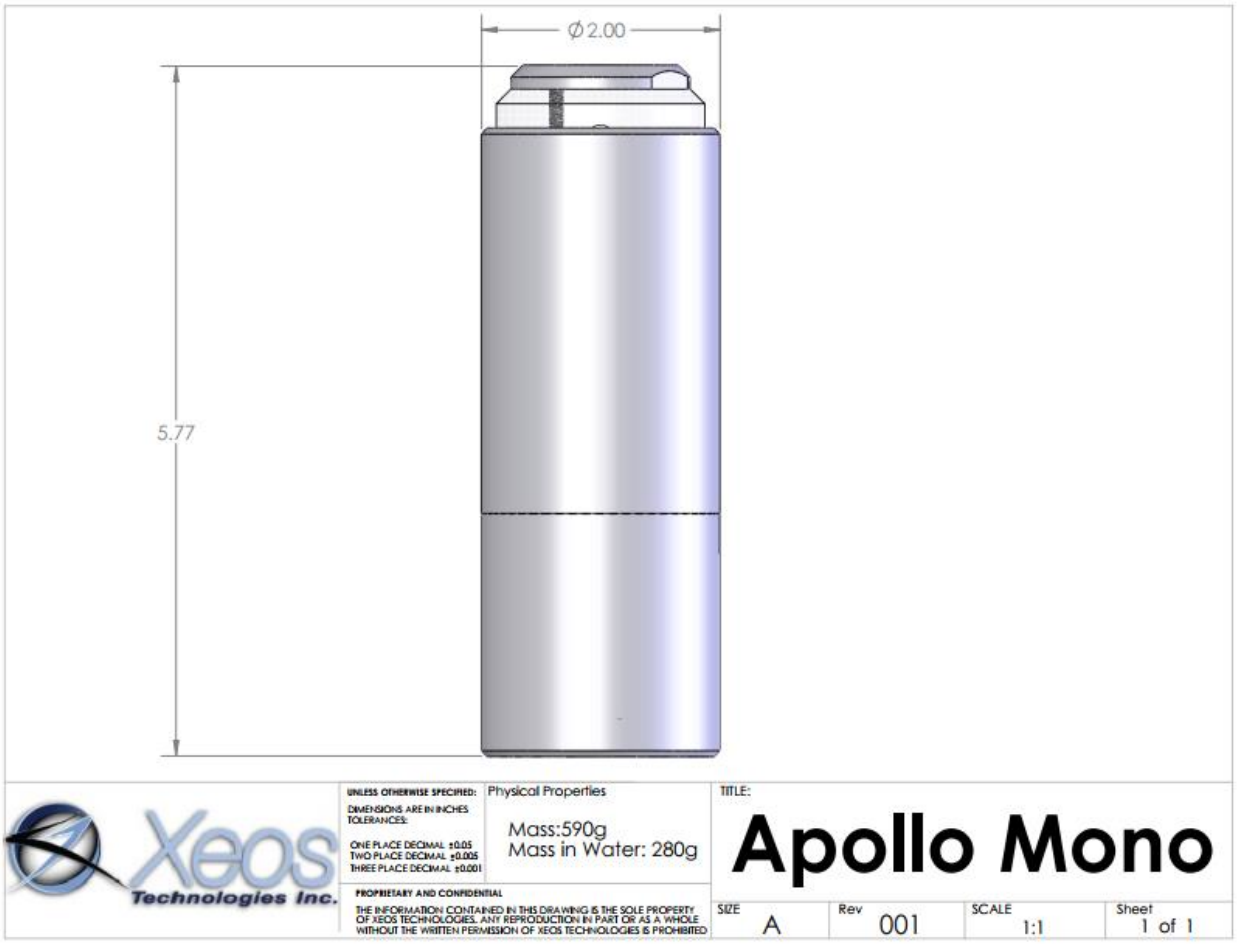
Material	All titanium with a non-permeable ceramic antenna component

Standard Enclosure	
Dimensions	52.91cm L x 5.08cm D (20.83” L x 2.00” D)
Mass	2562 g - in water 3637 g - out of water (alkaline Batteries)

Short Enclosure	
Dimensions	28.32cm L x 5.08cm D (11.15” L x 2.00” D)
Mass	1264g - in water 1839g - out of water (lithium Batteries)

Environmental	
Operating Temperature	-40° C to +60° C (-40° F to 140° F)
Depth Rating	Submersible to 11,000m (36,089 ft)

Mono

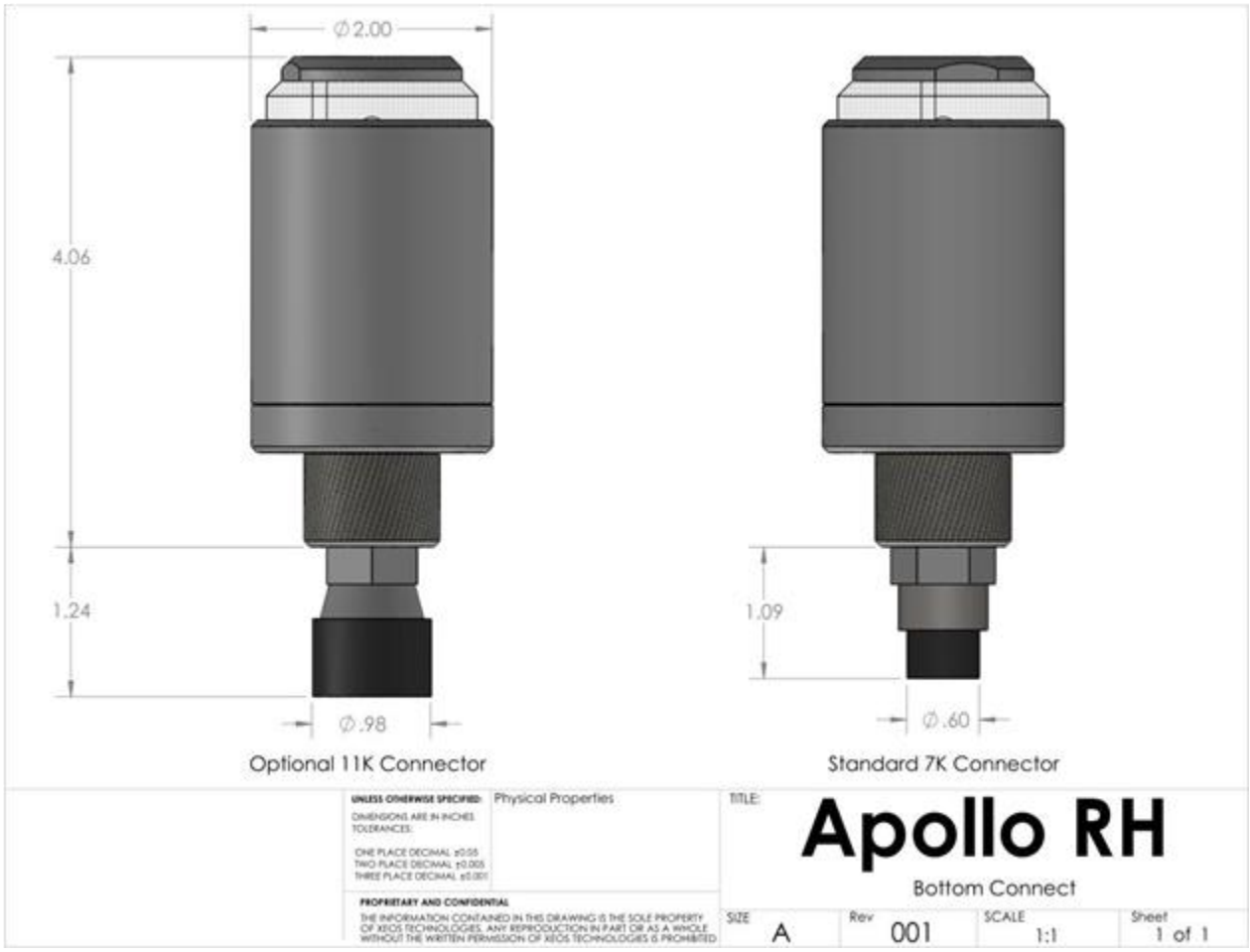


Material	All titanium with a non-permeable ceramic antenna component

Mono Enclosure	
Dimensions	14.66cm L x 5.08cm D (5.77” L x 2.00” D)
Mass	280g - in water 590g - out of water (lithium Battery)

Environmental	
Operating Temperature	-40° C to +60° C (-40° F to 140° F)
Depth Rating	Submersible to 6000m (19,685 ft)

Apollo RH



Material	All titanium with a non-permeable ceramic antenna component

Remote Head	
Dimensions	10.31cm L x 5.08cm D (4.06” L x 2.00” D) – Head 2.76cm L x 1.52cm D (1.09” L x 0.60” D) - Connector
Mass	370g - in water 557g - out of water

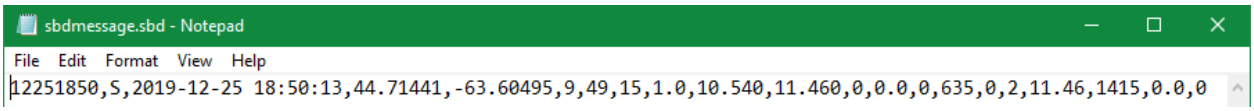
Environmental	
Operating Temperature	-40° C to +60° C (-40° F to 140° F)
Depth Rating	Submersible to 7500m (24606 ft)

Appendix F: GPS Text Long

GPS Text Long can be used for a more detailed summary of GPS information. This form is only presented in ASCII format and due to its length is a larger file, at around 110 bytes depending on the information sent.

Like GPS Text Short, only the most recent GPS position is sent, therefore this message format cannot be stacked.

Greyed out fields are not used in the Apollo



GPS Text Long Readout	
12251850	Date and Time, MMDDHHMM
P	Position Type message
2019-12-25 18:50:13	Date and time, adds year and second of fix
44.71441	Latitude
-63.60495	Longitude
9	Number of satellites seen
49	Maximum SNR of fix
15	Time to fix
1.0	HDOP (Horizontal Dilution of Precision)
10.540	Loaded Voltage
11.460	Unloaded Voltage
0	Temperature
0.0	Speed
0	Heading
635	GPS Horizontal Error
0	Watch Circle Set 1 (Yes) 0 (No)
2	RSSI (Iridium signal strength)
11.46	Battery Voltage
1415	On-seconds, seconds since power-up/last reset
0.0	Degrees Celsius
0	Movement counter

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Xeos Technologies Inc. warranties 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.

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