Xeos Technologies Inc.

OSKER User Manual

IRIDIUM/GPS SURFACE TRACKING SYSTEM

Version 3.1

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Shipped From

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Specifics

This manual version is written with respect to OSKER firmware build 6252. If you wish to acquire the latest firmware for your device, contact support@xeostech.com

Version History

Version No.	Date	Description
1.0	Nov 2015	Initial document
2.0	Jun 2017	Updated magnet switch details
2.1	Apr 2018	Re-formatting, standardized commands
2.2	Apr 2018	Rewrote Understanding Position Information Section
3.0	Mar 2019	Overhaul, expanded message formats
3.1	Apr 2020	Bluetooth internal details, changes to defaults

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

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General Description

Reliable, continuous information from the ocean's surface can be difficult to gather. The OSKER (Oil Spill Kit Emergency Response) provides global communications via the Iridium satellite system in a small, rugged package with sophisticated on-board programming.

The OSKER makes use of the bi-directional, global, real time Iridium Satellite Short Burst Data **(SBD)** network in combination with GPS position location. Inside the OSKER is a 9603 Iridium Satellite Short Burst Data core radio transceiver, a specialized low power Xeos digital controller with GPS, and hard-wired battery package.

When deployed in a group, the OSKERs provide accurate real time tracking over an area of the surface, mapping currents, oil spills, or other phenomenon. Users can set the Watch Circle with a radius of up to 15km to get automatic notification if any of the units travel outside of a designated area.

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

Preliminary Setup

Front Diagram

The front of the OSKER has pertinent information beneficial not only to the user, but any individual that may find the device after deployment.

FIGURE 1: TOP-DOWN DIAGRAM OF DATA DISPLAYED ON AN OSKER

1	View the Green LED on power-up or later to confirm that the device is on
2	Xeos Technologies will insert contact information of the customer's choosing here. Customers can also request Xeos Support be the contact information inserted.
3	The IMEI of the device as well as the production Serial Number (in smaller text) is here
4	The OSKER is capable of command and updates via the Xeos Bluetooth App
5	Scan the QR Code to receive the link to the Xeos Manuals page

Setting up an Iridium Account

OSKER 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.

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

OSKER 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 OSKER, however, the messages from the OSKER in this format are not human-readable. **XeosOnline** is a web-based monitoring system which allows users to view and manage information from the OSKER 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 device, as opposed to emails forwarded by XeosOnline. 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.

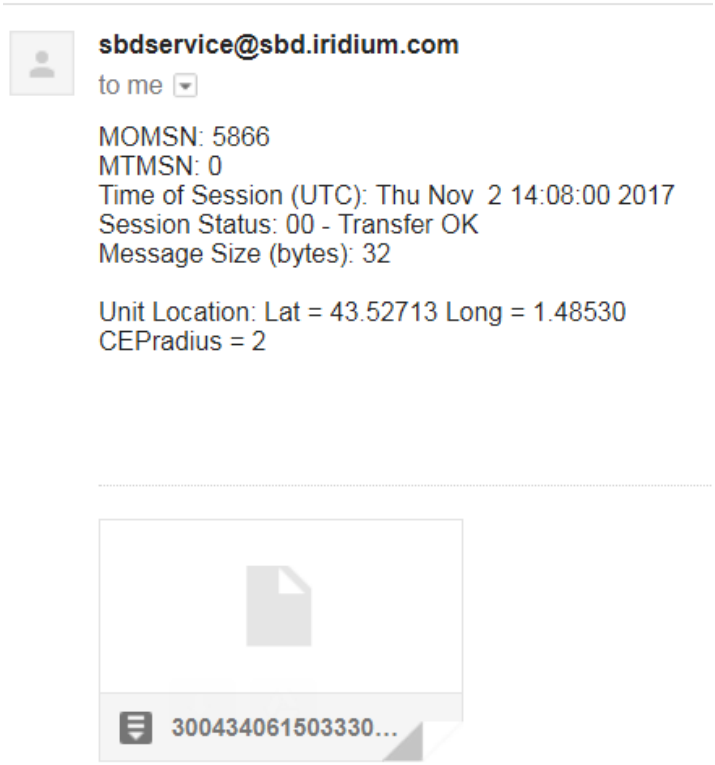


FIGURE 2: AN EXAMPLE OF A RAW IRIDIUM MESSAGE FROM A DEVICE VIA EMAIL

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 XeosOnline 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

OSKER Operation

As a free-floating drifter, the OSKER is designed to regularly transmit its position despite its orientation, while being easily deployed from the air or from a marine vessel on demand. If no changes are made to operation, the OSKER will transmit one position every ten minutes until its batteries are expended. While deployment life varies depending on the time it takes to transmit information (quality of reception) the OSKER typically sends a minimum of 1500 messages to a full deployment (battery depletion).

Using the Magnets

A magnetic tab embedded into the side of the OSKER's enclosure keeps the device's power source disengaged from the electronics. Remove the breakaway tab to turn on the OSKER.

- A solid **FLASHING GREEN LED** indicates that the OSKER is powering on

To turn the OSKER off, return the magnet that was attached to the OSKER to its place along the side of the enclosure.

FIGURE 3: REMOVE THE MAGNETIC TAB TO TURN ON THE OSKER

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

Note: Cycling power for any reason, for example by using the switch to turn OFF/ON, will initiate Start-up Mode.

Messages From the OSKER

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

Version

The **Version** message is sent upon start-up of the OSKER, from both hard and soft resets. It can also be called upon using the **$ver** command.

Powerup: true, Firmware Version: Rover_NT v1.27-6252. dev:4 , Hardware Revision: 3.2-0, Serial: 1010, GPS Version: GSD4e_4.1.2-P1 R+ 11/15/2011 319-Nov 15 , Iridium Version: TA16005, Reset Reason(s): Count=5, Current=(P), Prev=(cleared)

Version Readout	
Rover_NT v1.27-6252 dev:4	Product; Major, minor, build of firmware
Hw: 3.2-0	Hardware revision, set during assembly
SN=1010	The unit's serial number
GPS	Firmware version of GPS chip
IRD	Firmware version of Iridium modem
Reset: Count=23	The number of resets since firmware was uploaded
Current=(P)	Cause of last power off
Previous=(cleared)	Cause of previous power off, not used in OSKER

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

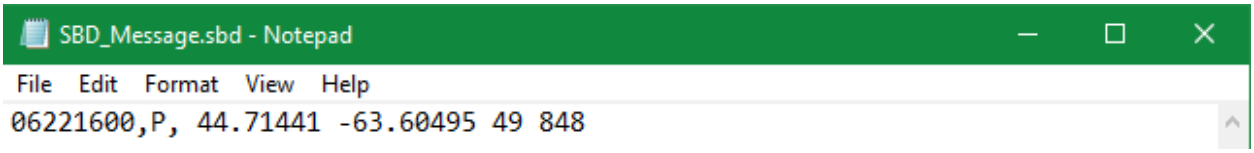
Location Log Readout	
Timestamp	Date and time in UTC of this specific position reading
44.714406	Latitude of fix, decimal degrees
-63.604947	Longitude of fix, decimal degrees
Alarm: False	Indicates if the device has determined if it is in an alarm state
Bearing	Direction of movement determined by device
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:

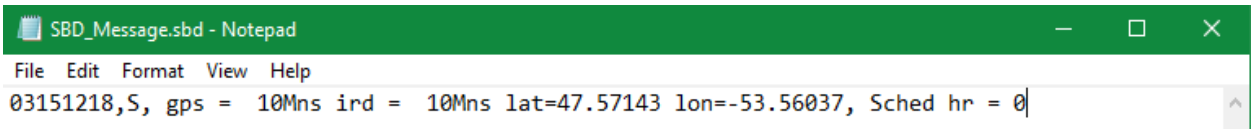


The message type used can be changed using the **$msgenable** command.

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

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 (Start-up mode to Normal mode). This message is always sent in ASCII format.

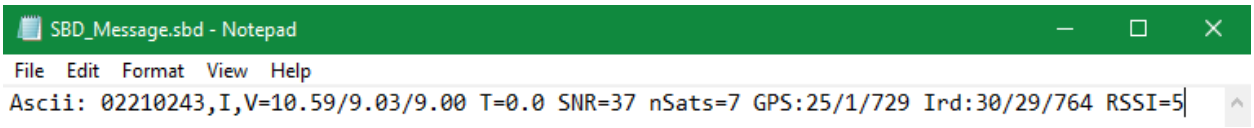


Status Readout	
03151218	Timestamp in UTC (Month/Day/Hour)
S	Type of message (Status Change)
Status / Value Change	Indicates that a setting has been changed
gps = 10Mns	Currently used GPS repetition rate
ird = 10Mns	Currently used Iridium repetition rate
lat=47.57143	Latitude of latest fix
lon=-53.56037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

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 OSKER
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 OSKER

There are 3 ways to communicate with the OSKER:

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

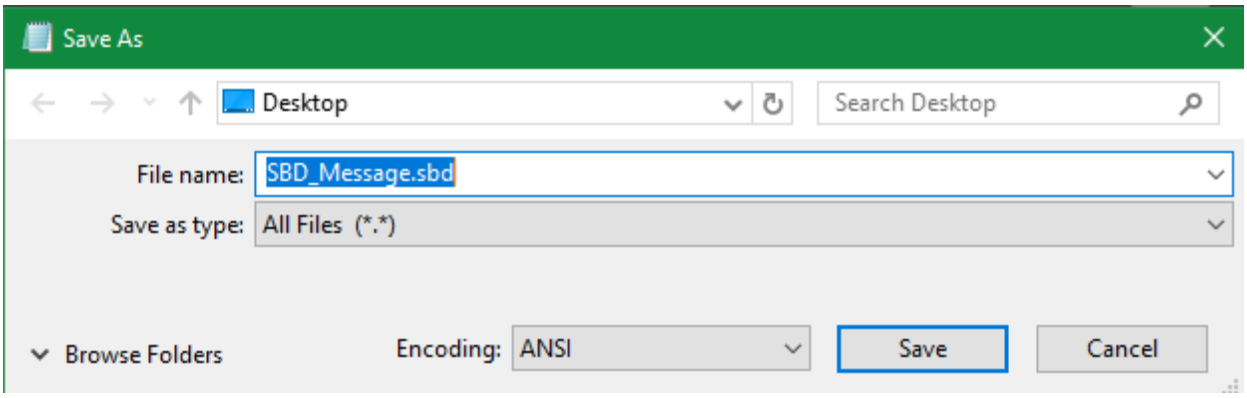
Sending Commands via Email

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

The Unlock Code

SBD commands without an unlock code will be ignored by devices that require it. The unlock code is generated by the device itself and can be retrieved from XeosOnline, or can be queried by sending **$unlock** to the device as a command. The device will respond by sharing the 5-digit code with its provisioned destinations.

Navigate to your unit on XeosOnline and click on the **Message Log** Tab. You will see the unlock code in the most recent outgoing messages.

```
Timestamp: 2019-03-06T15:20:32.000Z, Outgoing SBD Text: $unlock 76818 $timer sbd 0 5m $timer gps 0 5m
```

Once XeosOnline has a device's unlock code, all outgoing commands will have the code added at the beginning of the message.

The unlock code will only be changed if the firmware is updated, or if commanded via:

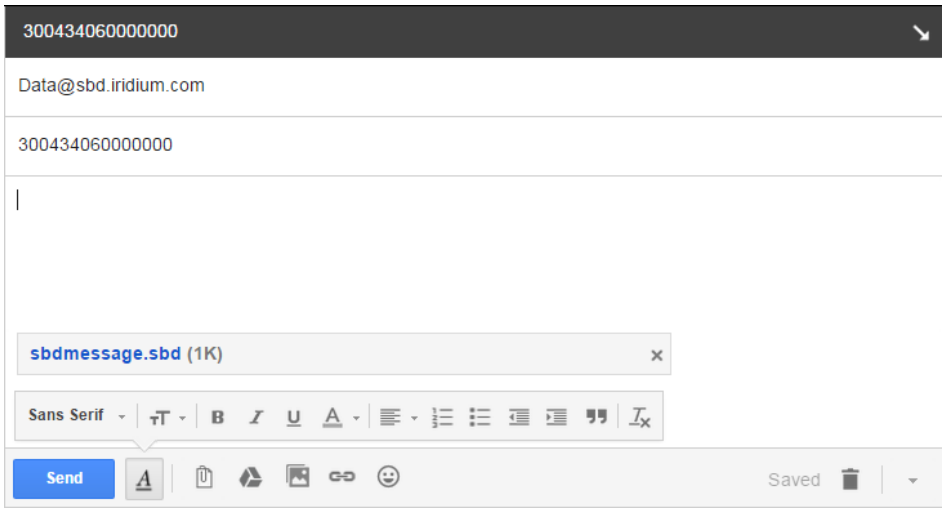
$unlock XXXXX YYYYY

Where XXXXX is the current code, and YYYYY is the new code to be used in the future.

Sending a 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 the device's next Iridium check.

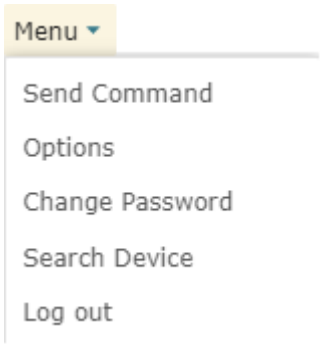
Commands can be sent from any email address, but responses will be returned **only** to email addresses on the unit's forwarding list.

Sending Commands Using XeosOnline

Before using XeosOnline 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

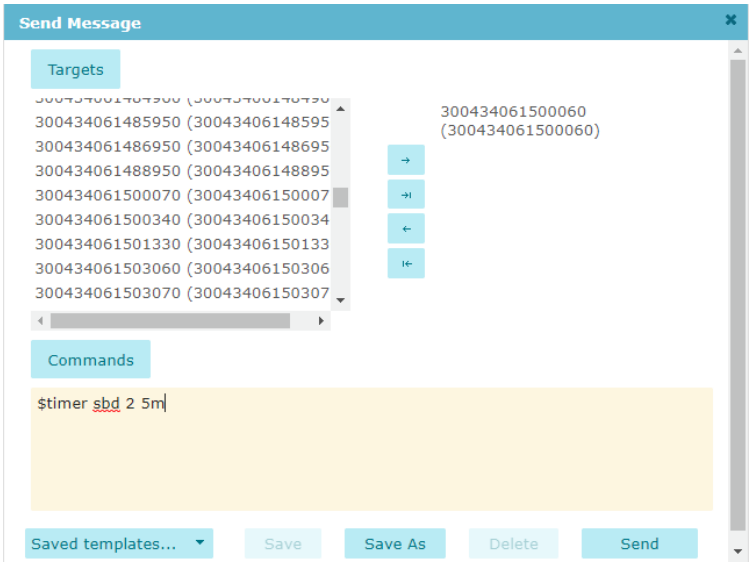
Navigate to the Send Command window.
From the Home Tab, choose
File > Send Command



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.



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 OSKER.

Messages to the OSKER

Settings

The **$settings** command will return a truncated list of important OSKER settings aside from timers with their current values. Changing any of these values WILL impact performance. Greyed out sections are unused by the OSKER.

```
Ascii: T/A:Td=0;Ts=15 GPS:MxOn=180;MxPr=90;Tmn=-30;Vmn=9.000;gBlk0=0,0;gBlk1=0,0;gRtyQ=2;gRtyD=20;gFRst=50;wcIC=85;gBL=24;gFQ=12
Sys:PB=5123;Dsc=;BtP=Y;BtT=5;BtN=Osker_5123;LL=0;UC=23570;aes=n;rHr=0;rMn=2 Ird:iBlk0=0,0;iBlk1=0,0;iRtyQ=2;Smx=8;MxLn=330;iWR=Y;um=3
Tilt:Tt=0;Secs=10;USec=10
```

Name	Default	Description
GPS Settings (GPS)		
MxOn	180	Maximum GPS session length in seconds
MxPr	90	Maximum GPS session length in poor conditions
Tmn	-30	Temperature minimum
Vmn	9.000	Voltage minimum
gBlk0	0,0	GPS Blackout, unused
gBlk1	0,0	GPS Blackout, unused
gRtQ	3	GPS retry quantity
gRtyD	8	GPS retry delay in seconds
gFRst	2	Number of GPS failures for GPS reset
wcIC	85	WC Inner Percent for WC Warning message (Val = % of WC Radius)
gBL	24	Maximum saved GPS fixes
gFQ	12	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
aes	N	AES Encryption enabled yes/no
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 Iridium session
MxLn	330	Maximum message length (bytes)
iWR	Y	Wait for registration with Iridium network to send data
um	3	Unsolicited messages

Tilt Settings (Tilt)		
Tt	0	Tilt Threshold
Secs	10	Tilt Seconds
USec	10	Untilt Seconds

Lifetime Stats

The **$statsl** command will return various performance statistics recorded since the last firmware install, over all resets.

```
Message SubType: 0, Timestamp: 2019-03-26T15:05:31.000Z, BatteryV: .09, Voltage Unloaded: 7.86,
Uptime: 320163, Power Cycle Count: 37, Watchdog Reset Count: 0, Lowest Battery Voltage: 0, Highest Battery Voltage: 30,
Iridium Message Count: 646, Iridium Session Count: 628, Iridium On Time: 318, Iridium Send Failures Non18: 612,
Iridium Send Failures Type 18: 81, Bytes TX: 37118, Iridium Messages Received: 19, Bytes RX: 697,
GPS Sessions: 647, GPS On Time: 280, GPS Fix Count: 528, GPS TTFF Average: 7, High Temperature: 0, Low Temperature: 0
```

Lifetime Statistics Readout	
Timestamp	Date and time of message
BatteryV	Last measured loaded battery voltage
Voltage Unloaded	Last measured unloaded 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
Iridium Session Count	Total successful Iridium connections
Iridium On Time	Total time Iridium has been on in seconds
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 time GPS has been on in seconds
GPS Fix Count	Successful GPS fix count
GPS TTFF Average	Average time to fix (Seconds)
High Temperature	Not used with the Onyx
Low Temperature	Not used by the Onyx

Stats

The **$stats** command will return performance statistics recorded since the last power up. The statistics are those found in **$statsl**, but exclude **Power Cycle Count** and **Watchdog Reset Count**.

The OSKER's Timers

Timer Types

SBD

The OSKER will communicate with the Iridium Gateway based on this interval. If the OSKER successfully registers with the Iridium Satellite Constellation, it will send any messages queued for transmission. Once this is finished and the queued outgoing messages have been implemented, the OSKER will receive any queued commands from the Iridium Gateway.

GPS

The OSKER will 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 OSKER's real-time 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.

OSKER Timer Modes

Start-up Mode

Start-up mode (Timer 1) will begin when the OSKER is turned on via magnet removal, or if the OSKER is reset by an SBD command. This mode will last for one hour, after which the OSKER will enter **Normal mode.**

Normal Mode

Once Start-up mode has finished, the OSKER will enter **Normal mode (Timer 0)**. This is the default timer mode of the OSKER and will be used if no other modes apply. At default settings, the OSKER will transmit 1 GPS fix every 10 minutes. If no other modes are engaged, the OSKER will continue in normal mode until its batteries are depleted or the unit powered off.

Alarm Mode

If a watch circle has been set, the OSKER will enter **Alarm Mode (Timer 2)** when it exits the set radius or when the device detects it has been inverted on its GPS interval (if enabled).

While in watch circle alarm mode, the OSKER will send information pertaining to the Watch Circle with each message, such as distance from centre and the duration in minutes that the device has been in that mode.
If the device enters Alarm Mode due to inversion, the device will send an Orientation Change Message (see Stats message) at each point that it has changed its antenna used for transmission.

No-GPS-Fix Mode

If the OSKER is unable to get a GPS fix after repeated attempts, it will transmit a GPS Failure message and move to this timer mode **(Timer 4)**.

Default Settings

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

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

Timers		
Timer 0	Normal	Used if none of the following modes are triggered
Timer 1	Start-up	Used for the first hour after the unit is powered on or reset
Timer 2	Alarm	Used once the unit's watch circle is triggered
Timer 4	No GPS Fix	Used when the GPS module consistently fails to acquire a fix

While the timers are able to be manipulated to the user's liking, by default the OSKER is programmed to transmit in a consistent manner no matter the case.

The Timer Command

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,10m,10m,10m,1d,10m,10m,10m,10m Tmr:GPS,10m,10m,5m,1d,10m,10m,10m,10m
```

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

Timer 0 (Normal mode)
Timer 1 (Start-up mode)
Timer 2 (Alarm mode)
Timer 4 (No-GPS-Fix mode)

The last 3 timers are unused by the OSKER and can be ignored.

Changing the Timers

The length of the OSKER's various modes cannot be altered. **Start-up mode** is 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 OSKER 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 OSKER, timer commands are always the same format:

$timer SYSTEM TIMER-MODE INTERVAL

Typed out as:

$timer SBD 0 2h

	Command	Timer	Mode	Interval
Example 1	$timer	GPS	0	1h
Example 2	$timer	SBD	0	6h

Example 1 would change the GPS interval of Normal mode to every hour, while **Example 2** would change the SBD message interval to 6 hours. After sending the commands from both **Example 1** and **Example 2**, 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.

Watch Circle

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

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

Enabling the Watch Circle

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

$WCenable 1

The OSKER will return this line, indicating Watch Circle (C) is enabled (Y)

Ascii: Switch: Y = GC, N = MO

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

Setting the Watch Circle

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

$setcircle Latitude Longitude Radius

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

Example:

$setcircle 47.56989 -53.55682 100

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

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

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 (distance based on the WCInner value). 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, WCInner and inverted mode (if applicable) use the same timer.
- You can adjust the Watch Circle's radius alone by setting the latitude and longitude parameters to 0, followed by the new radius.

Enable Inversion Events

As of 5123, the OSKER no longer transmits automatic Orientation Change messages. Orientation change messages occur when the device uses a different antenna for GPS acquisition from the previous acquisition. The message sent is in the form of a Stats message.

To enable this message, use the command:

$evtconfig 2 2 Y

Message Enable

The OSKER has several message types that can be enabled for GPS and event messages. At factory defaults, the OSKER 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 OSKER 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 message format used for positions is GPS Binary Compressed.

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

$msgenable (mode, always zero) (message types separated by commas)

To enable GPS plain text short (Message Type 0) and GPS Binary Compressed (Message Type 10), the following command would be sent:

$msgenable 0 0,10

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

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

Bluetooth

The OSKER 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 OSKER'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 OSKER will **always** advertise its name for connection until the Bluetooth power-off (**$btpwr 0**) command is received.

Since the OSKER has a magnetic on/off switch, all power is disconnected from the device when the magnet is engaged. Therefore, the Bluetooth of the OSKER will also be off.

Other Commands

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

Command	Parameters	Description
ver	---	Show hardware and firmware versions.
Status	---	Show operating status
sysInf	---	GPS/Ird summary
FactoryDefaults	---	Reset all to defaults and reset.
btPwr	1/0	Bluetooth power On/Off
btTOut	Insert Name	Bluetooth timeout (Minutes)
btName	X	Set Bluetooth name for the OSKER
btpcycle	---	Power cycle Bluetooth
batt	---	Show battery status
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
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	X (Minutes)	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
fdumpall	---	Print out Flash Memory of the OSKER (Bluetooth Only)
ResetNow	---	Restarts the system. The effect is the same as restarting via the magnet

Installation and Maintenance

Pre-deployment Storage

The OSKER is shipped in an off state with the magnet affixed to its space to preserve battery power. The unit's batteries cannot be changed by the user, so turning it off after any test is necessary to preserve battery life.

Deployment

The intended use of the OSKER is a free-floating tracker, designed to follow the surface currents of the body it is deployed in. As such it can be deployed quickly as a stand-alone unit without supplementary equipment.

Additionally, turbulent seas cause the OSKER to flip frequently. The device has two GPS/Iridium antenna assemblies for such events. Due to this the device can be deployed inverted as well as label side up.

Finally, most use-cases will require deployment from the sea or air. The OSKER is able to be deployed from oil rigs, boats and helicopters.

Recovery

Often, OSKERs are recovered from shorelines during or after their deployment life. A space on the label for the OSKER is for a contact email or phone number if the user wishes to reacquire the device directly. If the user does not specify contact information, Xeos supplies its own contact information and will contact the deploying party.

Since the OSKER is not able to be opened, Xeos can, for a fee, refurbish the device with a new enclosure and battery pack and retest the unit before returning to the customer for a new deployment.

Appendix A: Technical Specification

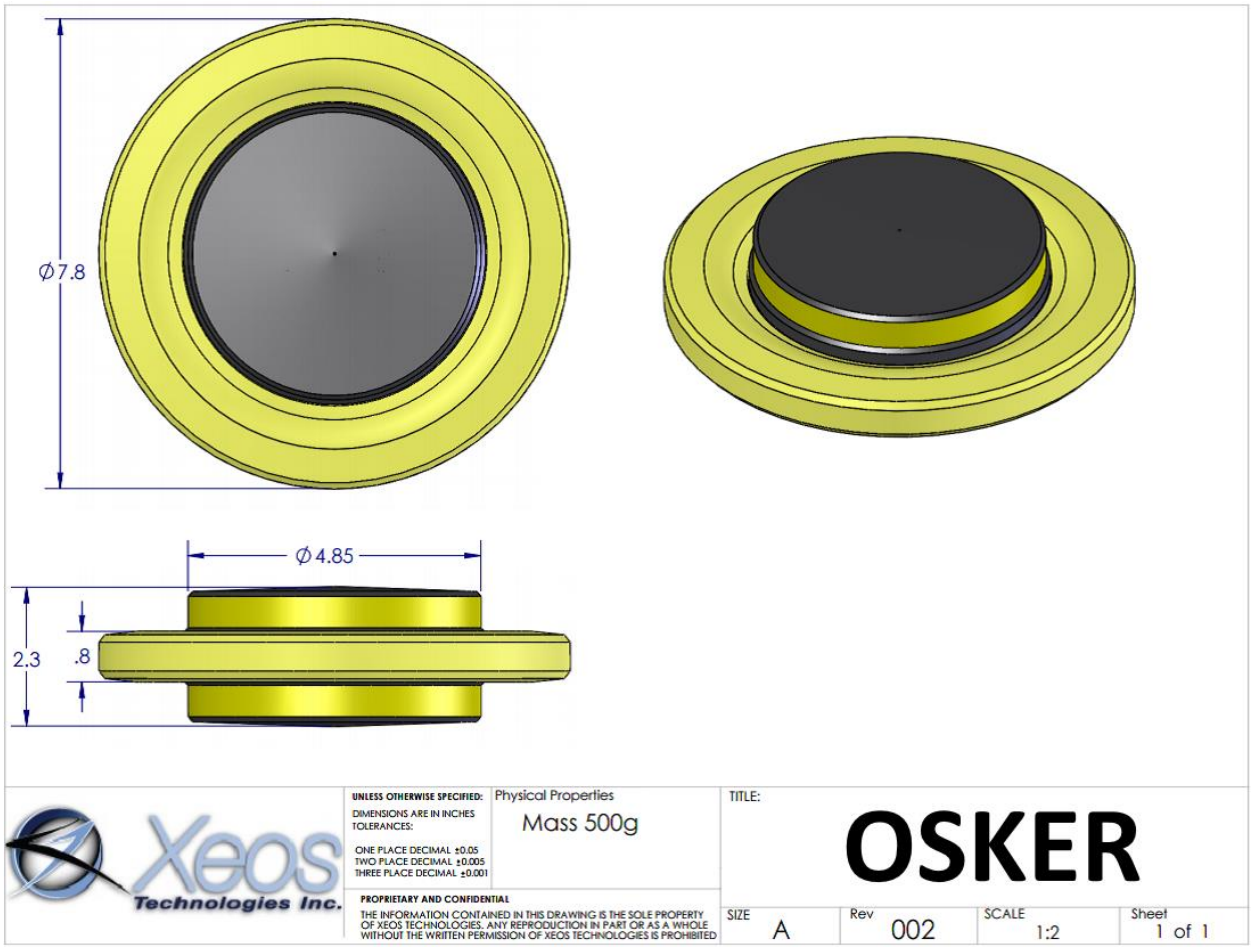
Mechanical	
Enclosure Material	Polyvinyl Chloride (PVC)
Dimensions	7.8” Diameter x 2.3” Height
Mass	500g – out of water

Electrical	
Battery Compliment	8 AA Energizer Industrial EN91 Alkaline
Idle Current (avg.) (Bluetooth On/Off)	100µA 40µA
Iridium Transmit	36mA (30s avg.)
GPS Acquisition	15 mA (30s avg.)
Bluetooth Connected	3.3mA
Voltage	12.0 Volts nominal
Capacity	2.4 Amp Hours

Electronics	
Digital Controller	Xeos IRDC-3
GPS Receiver	48 channel SiRFstarIV GSD4e GPS chip
Iridium Hardware	9603 transceiver
Antenna	Xeos proprietary antenna for high pressure environments

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

Appendix B: Engineering Diagrams

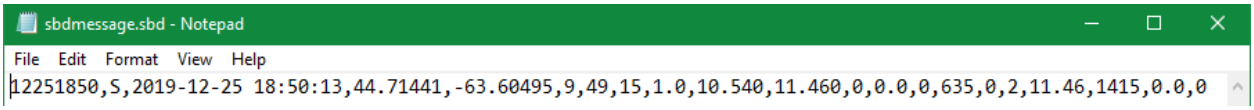


Appendix C: GPS Text Long

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 OSKER.



GPS Text Long Readout	
12251850	Date and Time, MMDDHHMM
S	Status 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 Celcius
0	Movement counter

Warranty, Support and Limited Liability

Xeos Technologies Inc. warranties the OSKER 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.