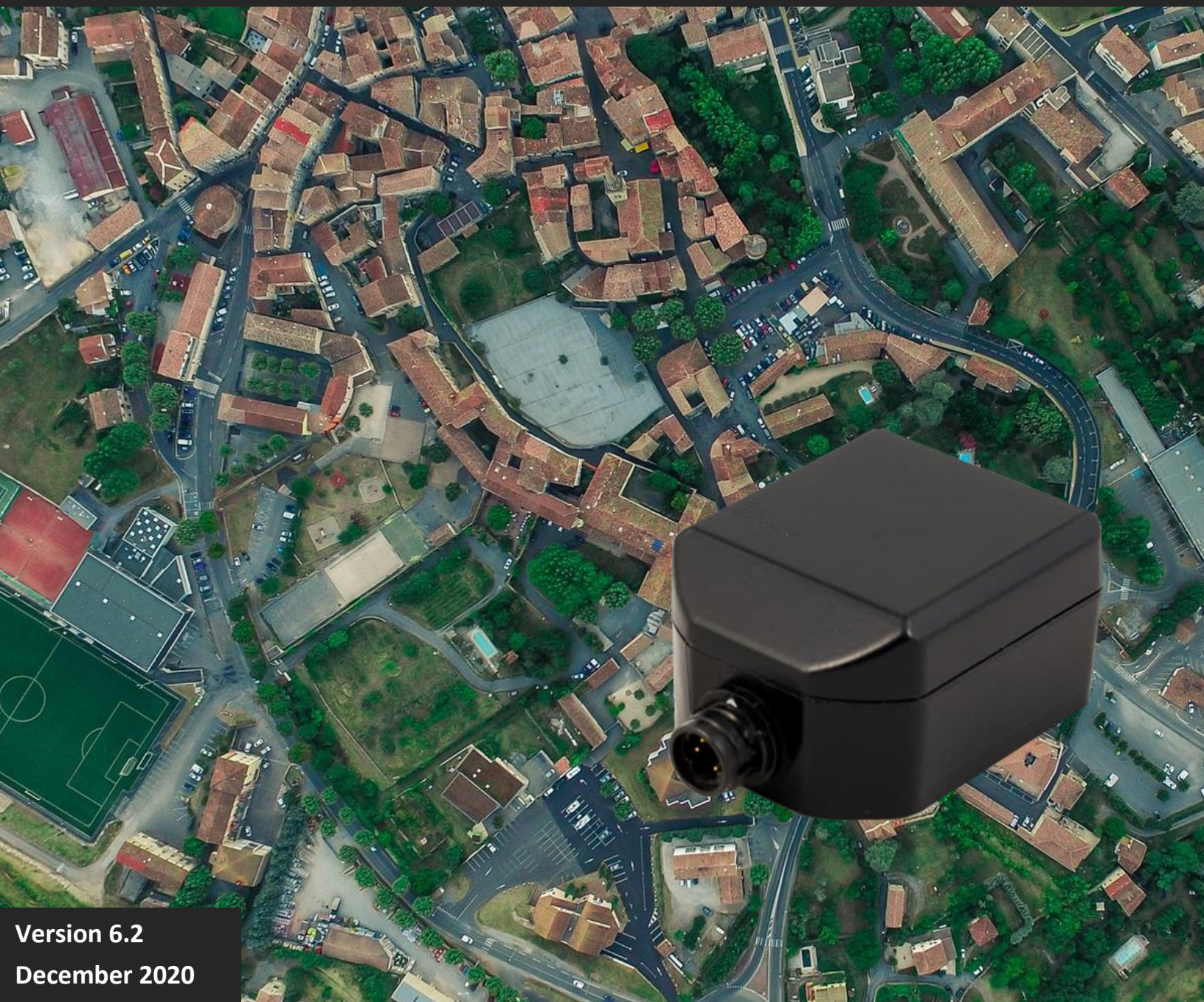
Xeos Technologies Inc.

Onyx User Manual

Miniature Iridium Asset Tracker with Relay Function



Version 6.2

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Shipped From

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Specifics

This manual version is written with respect to Onyx Firmware builds 6790 to 6808. To acquire the latest firmware for your device, contact support@xeostech.com

Version History

Version No.	Date	Description
1.0	Jun 2013	Base document
2.0	Aug 2014	Updated format, included relay instructions
3.0	Nov 2014	Updated commands
3.1	Jan 2015	Updated with Onyx-R and I Information
3.2	Feb 2015	Added info regarding In-Motion mode
3.3	Mar 2015	Added Advanced Config Options in appendices
3.4	Mar 2015	Corrected error in Appendix B
3.5	Apr 2015	Added OEM Info
3.6	Nov 2015	Added LV OEM Info to Appendix D
3.8	Feb 2016	Added Onyx-M Info
4.0	Sept 2017	Document overhaul
5.0	Apr 2018	Added Onyx-WB info, drawings, additional commands
5.1	Apr 2018	Added Understanding Position Information Section
5.2	May 2018	Rewrote Appendix F, Added I and P-type messages
6.0	July 2019	Overhaul; Geofencing, Onyx-M now Onyx-M2, Relay section moved, accessories
6.1	Jan 2020	LiveTrack, Xeos Bluetooth Dongle accessory, Onyx-LV OEM Pinout, Troubleshooting
6.2	Dec 2020	Watch Circle, edits to serial relay section

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

General Description

The Onyx is a miniaturized asset tracking beacon which continuously monitors for asset location and reports location and sensor information via the Iridium satellite network. Onyx makes use of the bi-directional, global, real time Iridium Satellite Short Burst Data (SBD) network in combination with GPS position location. Onyx's extremely small size and form factor make it easy to install quickly for overt installations or hide in a wide variety of locations for covert tracking or custom concealments.

Inside the Onyx is a 9603 Iridium satellite Short Burst Data core radio transceiver, a specialized low-power Xeos digital controller with GPS, Iridium & GPS antennas, and complex accelerometer for motion detection.

While the Onyx is intended for both covert and overt mobile deployments. Xeos Technologies Inc. (Xeos) manufactures other products for fixed location monitoring, remote tracking and surveillance.

The Onyx also features a built-in relay function for the remote control and retrieval of serial devices, such as sensors or cameras.

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

Theory of Operation

The Onyx is intended for continuous and/or periodic monitoring of high value assets globally. The Onyx can facilitate instant and accurate location of assets for recovery or monitoring purposes.

The internal GPS determines location which is stored on board the Onyx. An Iridium modem provides two-way communications for retrieval of data, live tracking and sending commands to the remote tracker. The deployment is facilitated by the miniature device which has both GPS and Iridium antennas on board.

Operators can communicate with the Onyx via Iridium using XeosOnline or via email commands when appropriately configured. Status information can be obtained, including the health of the GPS system and battery voltage. Timings are settable remotely and can be modified as the nature of the tracking or monitoring operation changes.

The internal relay function allows the Onyx to be piggy-backed to an external serial device and used as a communications interface for that device to, for instance, send commands to a remote camera or receive data from a temperature sensor.

While any email application can be used to send and receive messages between the user and the Onyx, XeosOnline is the easiest way to manage and monitor multiple Onyx devices. XeosOnline presents the information in a readable format and displays it on street level maps.

Onyx Variants

Onyx

The standard Onyx has no internal power source. It requires an external power supply of **7 - 32 Volts**. The Standard Onyx is also available without an enclosure as the **Onyx OEM**.

Onyx-I

The Onyx-I has an internal power source, consisting of four 3 Volt CR123A Lithium non-rechargeable batteries in series. This model has a larger profile than the standard Onyx but functions identically, save for the lack of an external connector. An additional magnet plate can be added to the bottom of the enclosure for quick deployment.

Onyx-R

The Onyx-R also has an internal power source, consisting of a rechargeable 3.6 Volt Lithium-Ion battery pack. This model also has a larger profile than the standard Onyx as well as charging indicator LED's. A front connector is used for diagnostics and charging. Like with the Onyx-I, an additional magnet plate can be added to the bottom of the enclosure for quick deployment.

Onyx-M2

The Onyx-M2 is the marine variant of the Onyx and is submersible to 10m. The Remote-Head and Battery pack are both waterproof, but cables should remain attached while underwater to prevent pin corrosion.

The Onyx-M2 can be treated identically to an Onyx when considering installation. The magnet cups on the bottom of the Remote-head and Battery pack are designed for 5/8" diameter magnets, which are not included.

The Onyx-M2 replaces the Onyx-M, swapping the previous Teledyne connector with a new Chogori connector on both the battery pack and head.

Onyx-WB

The Onyx-WB (Work Boat) is the marine variant of the Onyx designed for static mounting. The enclosure of the Onyx-WB is rated IP-67 enclosure to prevent water ingress.

Wings on the sides of the WB's enclosure allow for mounting to frames of objects, while the twist-on cable prevents unintentional unlatching of the power supply from the device.

Onyx-LV OEM

The Onyx-LV OEM includes an Onyx low voltage board identical to the Onyx-R. However, customers must supply their own input power of between 3.3 and 5.5 Volts and does not come with an enclosure. Serial communication is possible with the supplied programming cable. See Appendix D: Cable Drawings

Onyx Flat OEM (Standard Voltage and Low Voltage)

The Onyx Flat has a lower profile for smaller locations, but does not come with an enclosure. They are available as standard (**7 – 24 Volts**) and low voltage (**2.4 – 5 Volts**) variants. Like the stand Onyx, they must be powered externally.

Preliminary Setup

Setting up your Iridium Account

Onyx makes use of the Iridium satellite system's Short Burst Data (SBD) service for the 9603 transceiver. This service is a global, two-way, real-time, email-based data delivery service that has a maximum outbound (from Onyx) message size of 340 bytes and a maximum inbound (to Onyx) message size of 270 bytes.

Onyx end users must set up an approved data delivery account with their preferred service provider. Xeos is an Iridium VAR and can provide Iridium service if desired.

Setting up service requires the International Mobile Equipment Identity (IMEI) number. Each 9603 has a unique IMEI number that must be registered with a preferred service provider. Xeos will make these numbers available when the product is delivered.

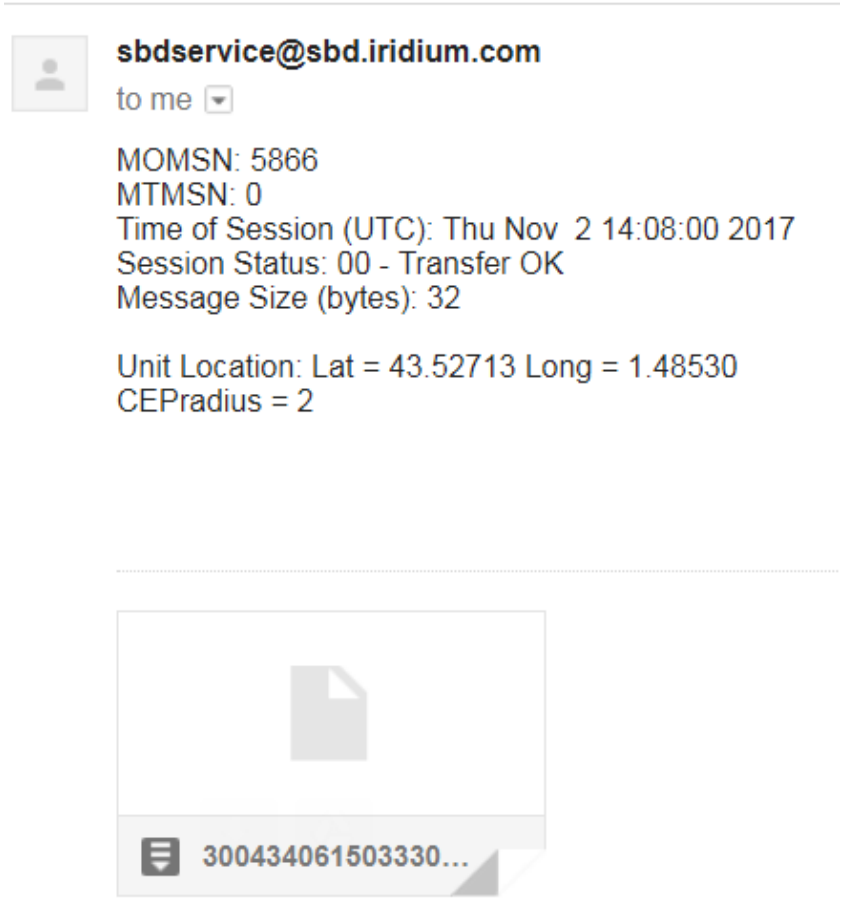
Each IMEI number is capable of being associated with up to five destinations, made up of either email addresses, IP addresses, or other Iridium IMEIs. This may vary between service providers. When activating the device's IMEI, please provide the service provider with the temporary Xeos testing account email address; you may contact Xeos for this email. Setting up this email address allows for better technical support during the initial learning period for the product.

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.



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 center 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

Onyx Operation

Powering the Onyx

Since there are different models of Onyx, there are different methods of turning on the device.

For models with no internal power source, or those with a removable power supply, providing that supply immediately turns the unit on.

Standard Onyx, Onyx-M2, Onyx-WB

While the power source can be set within operating range, it is recommended that users not use a power source very close to either extreme. Once the power supply dips below 7V, communication may not be possible with the Onyx.

If the power supply is subject to power surges, it may not be advisable to use a power supply with an average voltage of 24 VDC to avoid damaging the internal circuitry of the Onyx. Refer to the voltage ranges for the corresponding appropriate input.

Onyx-I

The Onyx-I uses a non-rechargeable battery source, and therefore does not have a charging LED. Equipped with four 3-Volt CR123A Lithium batteries in series, nominal voltage is identical to the standard Onyx at 12 VDC. The **Status LED** functions identically to the other Onyx models and is in the same location, on the side of the unit.

Onyx-R

The Onyx-R features a hard-wired internal Lithium battery pack at a nominal voltage of 3.6V. Turning the Onyx-R on involves the use of the magnetic switch.

Using the front connector of the Onyx-R, the device can be recharged and redeployed.

LED Indicators

Device Status LEDs

The Onyx-I, R, M2 and WB all have a small window on the side of the device to show its on/off status using an LED. It is to be used as an indicator for when the magnetic switch is used to turn the device on/off. This same LED also pulses red in the event of a self-test failure at start-up.

Unit Status Indicators	
Action: Turn On	Swipe Magnet back and forth across topside until LED is solid green
Action: Turn Off	Swipe magnet back and forth across topside until LED is solid red
Check Status	Swipe magnet once across topside (red is off, green is on)

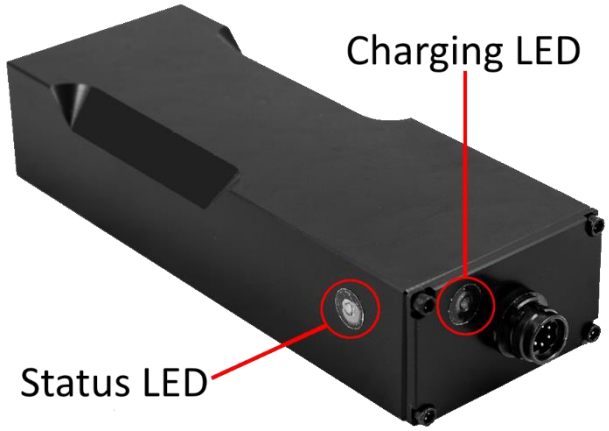
Other Indicators	
Flashing 4 Hz **on power-up**	Device powering up, performing self-test
Flashing 0.5 Hz **after power-up**	Self-test failure; note that a self-test failure occurs if the only source of power is via USB. The Iridium modem is off and fails self-test in this setup

Recharging the Onyx-R

The Onyx-R comes with a charging cable with power and ground leads. The power supplied should be **12 VDC.** A front-mounted window displays the charging status of the device.

Current draw during charging will decrease until the device reaches max voltage, at which time the charging LED will shut off.

Charging LED LED State	Charging Status
Off	Not charging
Red	Battery fault
Green	Normal charging



Serial Interface

Pre-programming of the Onyx is not required since it is pre-configured for most tracking scenarios and configurable settings can be changed over the Iridium link. Confirmation of settings can be done via an Onyx diagnostic cable through a terminal emulator using these settings:

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

USB connection is not sufficient to power the Iridium system on the Onyx and will therefore always fail the start-up self-test check during USB sessions. Sending any character to the Onyx bypasses this check to move onto configuration.

Connections to the communication lines are not required for normal operation (aside from the Onyx Relay); with that exception these lines are only used for configuring the device locally.

If +5V is applied to the 5V-USB pin, the USB interface circuit will be activated and pins 3 and 5 will act as the D+ and D- USB signals. The device will then be recognized by a PC.

If no voltage is applied to the 5V-USB pin, the UART interface circuit will be activated. The communication pins will act as 3V signals and will typically require the use of a TTL to USB converter (such as the Xeos blue box) to interface with a computer. Diagnostic cables distributed by Xeos are configured to use the 5V-USB pin.

Things to Remember

- The configuration of the Onyx is saved internally. Any changes made will be saved, even if the power is removed and reapplied later.
- As soon as power is applied to the Onyx, it will attempt to get a GPS fix and transmit a report. Once it successfully makes that report, it will go to “Sleep” for 1 hour according to the default settings. If users need to apply power prior to deployment position and with a view of the sky during a covert installation, one of two things must be done:
    1. Trigger the motion sensor once power is applied by continuously shaking the device for 1 minute. The interval will change to taking location fixes every 20 seconds and reporting every 1 minute. It will stay in this mode for five minutes which will allow time to finalize the install and test it.
    2. Before installing the device, send a message via XeosOnline to change the normal operating parameters to a shorter time frame, for instance, GPS fix and SBD report every 1 minute. Proper installation can then be quickly confirmed. Don’t forget to set the parameters for your preferred normal mode once deployed.
- Some types of installation will not trigger the motion sensor since it senses vibration. Installation in a padded cushion, on a person or in a non-structural location on a vehicle may not register motion and may require changes to the reporting parameters according to operational needs.

Using the Magnetic Switch

Onyx models that have a viewing window for the Status LED are intended to be turned off via the magnetic switch inside. Swiping along the top front corner of the device triggers this switch. Repeated swipes of the magnet against this switch turns the device from one state to the other. The Unit Status LED table illustrates what is seen when attempting to turn the device on or off.

Deployment of the Onyx

The Onyx contains GPS and Iridium antennas. The only external requirement for most models is a power source. Deploying the Onyx requires the following:

- An Onyx with Iridium service activated (using IMEI provided by Xeos)
- An external power source from 7 – 32 VDC (Standard Onyx/Onyx-M2/Onyx-WB)
- (Optional) An external serial device to be managed via the Onyx

Antennas

To deploy the Onyx, ensure that the top of the device, which is where the antennas are located, has a clear view of the sky. The top of the device appears differently between models:

- Onyx Standard – Curved side up
- Onyx-I, Onyx-R – Beveled side up
- Onyx-M2 – Flat side (no magnet cups) up
- Onyx-WB – Wings down

For a covert deployment, the antenna surface must not be obstructed by metal or wood. Thick amounts of other materials may also cause interference. Testing of covert installation locations is strongly recommended.

Messages from the Onyx

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

Settings Summary Message

On startup, the Onyx will send a summary of timers and a short list of GPS and Iridium settings to confirm to the user the immediate configuration of inactive (Timer Zero) and In-Motion (Timer Two) timers.

```
Flags: Unsolicited, IRD Normal Timing: 3600sec, IRD Alarm Timing: 60sec, GPS Normal Timing: 3600sec,
GPS Alarm Timing: 20sec, GPS Retry Qty: 2, GPS Retry Delay: 20min, GPS Max On Normal: 100sec, GPS Max On Poor: 30sec,
GPS Max Backlog: 40, GPS Max Fix Per Message: 24, Ird Retry Qty: 2, Ird Retry Delay: 2min, Accelerometer Threshold: 100
```

These settings can be seen below in the Settings section.

Version (Type V)

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

```
Powerup: true, Firmware Version: OnyxTracker v1.27-6790. dev:6 , Hardware Revision: 3.2-0, Serial: 1000,
GPS Version: 5xp__5.7.7-P1.GCC_N96HG+5xpt_5.7.7-P1.KCC, Iridium Version: TA14001, Reset Reason(s): Count=14, Current=(S), Prev=(cleared)
```

Version Readout	
Powerup: true	XeosOnline detects that this is the device's power-up message
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 Onyx

Position

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: 2019-03-25T18:36:11.001Z, BatteryV: 11.91, Latitude: 44.714272, Longitude: -63.604870, Voltage Unloaded: 12.06
```

Message Log Readout	
Timestamp	Date and time in UTC of the latest position reading
BatteryV: 11.91	Loaded voltage of the power supply; minimum battery voltage observed during the previous Iridium transmission
44.714272	Latitude of fix, decimal degrees
-63.604870	Longitude of fix, decimal degrees
Voltage Unloaded: 12.06	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
Mar 25 2019 06:36:08.001 PM	44.714400	-63.604902	false	0.0	0.000	0.000	0.0	44

Location Log Readout	
Timestamp	Date and time in UTC of this specific position reading
44.714400	Latitude of fix, decimal degrees
-63.604902	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)

ASCII Position (Type P)

In this format, only the most recent fix is sent at each interval, therefore it is most efficient to have GPS and Iridium intervals equal.

P-type messages are approximately 39 bytes:

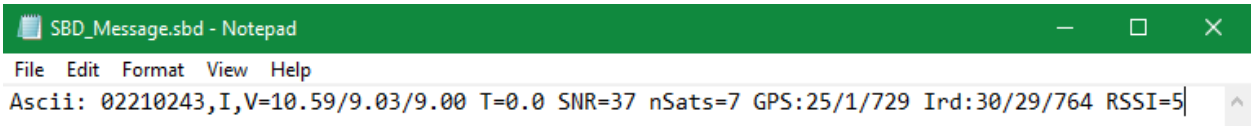
The message type used can be changed using the **$msgenable** command.

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
348	Unloaded voltage of device at the time of GPS Fix

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 Onyx
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.

Motion Message

BatteryV: 11.67, Motion: true, Voltage Unloaded: 12.06

At defaults, the Onyx will send a motion message when the device enters Motion Mode. A simple message, it can be used to bookend motion periods of interest.

This message can be disabled by removing message type 11 from the list of used types via the **$msgenable** command.

Communicating with the Onyx

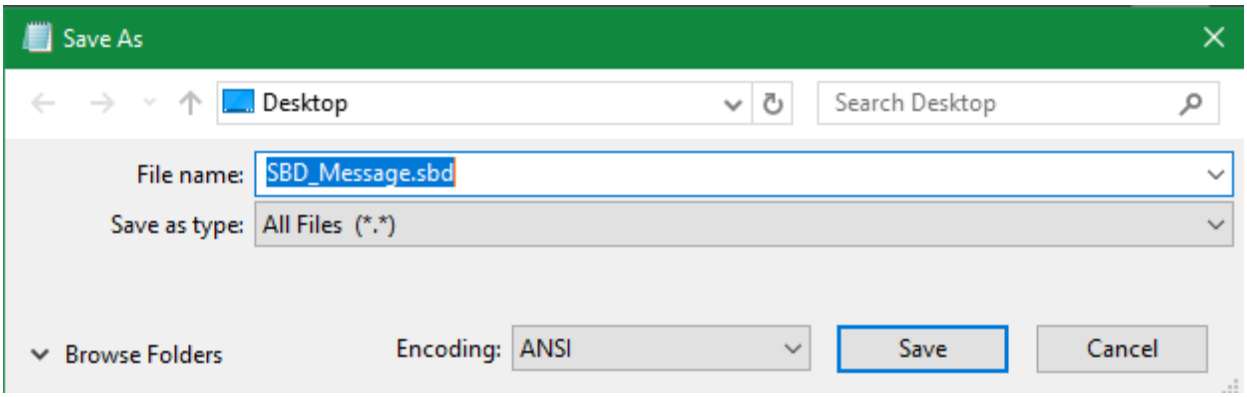
Sending Commands via Email

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

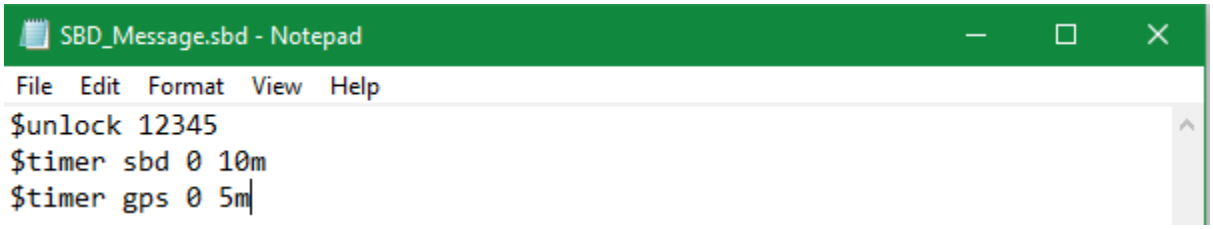
To create an SBD command, open a new file in a text editor (ex. Notepad) and save it using the **.sbd** extension. Make sure the **Save as type** option is set to **All Files** to achieve this.



Command Structure

Commands must be structured in the following way:

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



The Unlock Code

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 the unit can be queried for its unlock code 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 and click on the **Message Log** Tab. The unlock code can be seen in the most recent outgoing messages.

Timestamp: 2019-03-10T23:03:00.147Z, Outgoing SBD Text: $unlock 23570 $timer

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:

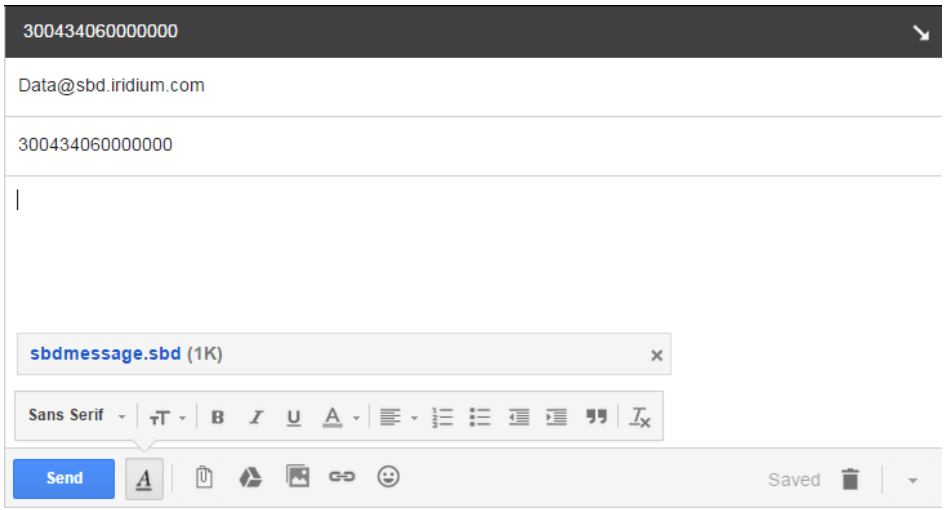
$unlock XXXXX YYYYY

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

Sending the Command

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

To	data@sbd.iridium.com
Subject	The target device's IMEI
Body	Empty
Attachments	The .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.

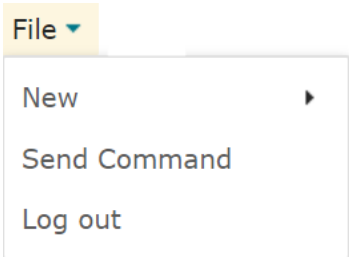
Commands can be sent from any email address, but responses will be returned **only** to email addresses on the unit's forwarding list.

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.

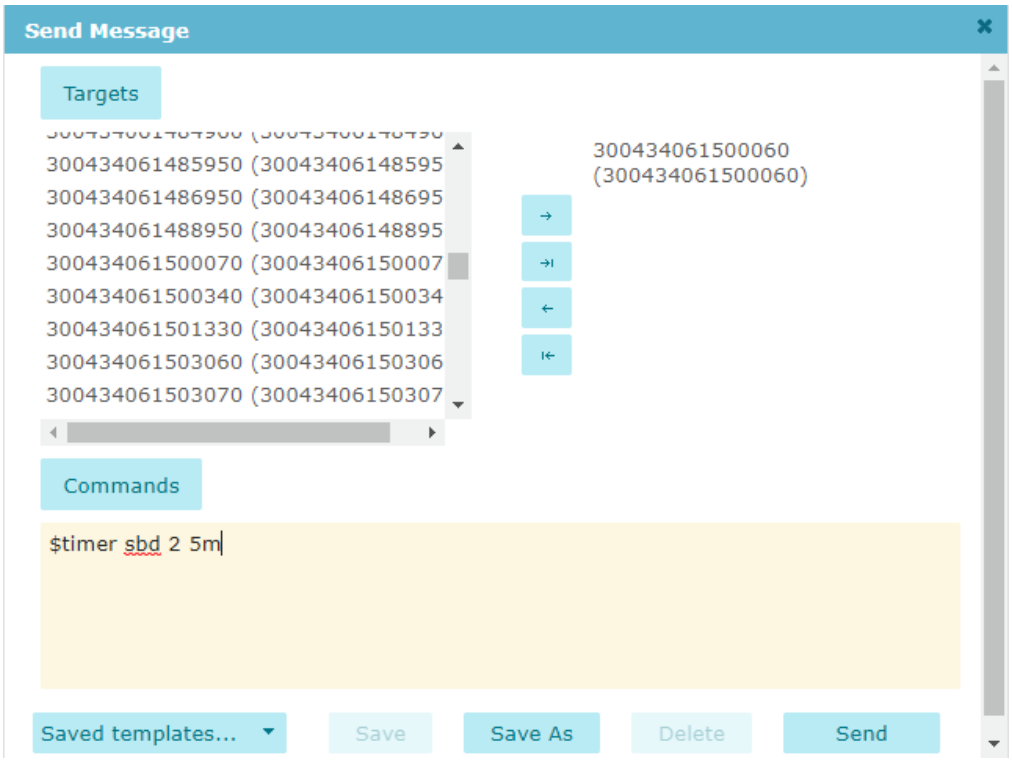


From the Home Tab, choose **File > Send Command**

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.



IMPORTANT NOTE:
Changes to configuration only takes place once the Onyx receives the relevant command. If the Onyx is set to check messages hourly, it will not change its operational behaviour until it has checked for messages at its scheduled time.

Messages to the Onyx

Settings

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

```
Ascii: T/A:Td=0;Ts=100 GPS:MxOn=100;MxPr=30;Tmn=-30;Vmn=6.000;
gBlk0=0,0;gBlk1=0,0;gRtyQ=2;gRtyD=20;gFRst=50;gBL=40;gFQ=24 Sys:PB=5567;
Dsc=;LL=0;UC=19663;aes=n;rHr=0;rMn=2;do=DL
Ird:iBlk0=0,0;iBlk1=0,0;iRtyQ=2;Smx=8;MxLn=330;iWR=Y;um=3 Tilt:Tt=5;Secs=120;USec=120
```

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	6.000	Voltage minimum
gBlk0	0,0	Unused
gBlk1	0,0	Unused
gRtQ	2	GPS retry quantity
gRtyD	20	GPS retry delay in minutes
gFRst	12	Number of GPS failures before GPS chip power cycle
wcIC	85	Watch Circle Inner Percent
gBL	40	Maximum saved GPS fixes
gFQ	24	Maximum GPS fixes per message
System Settings (Sys)		
PB	Build	Firmware Build
Dsc	N/A	Unused
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
do	DL	Digital Output (Pin 2) Disabled, Low
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 (all allowed)
Acceleration Settings		
aThrS	100	Static Threshold

Lifetime Stats

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

```
Message SubType: 0, Timestamp: 2019-07-22T20:45:52.000Z, BatteryV: 11.61, Voltage Unloaded: 12.06, Uptime: 11186,
Power Cycle Count: 11, Watchdog Reset Count: 0, Lowest Battery Voltage: 0, Highest Battery Voltage: 30,
Iridium Message Count: 7, Iridium Session Count: 4, Iridium On Time: 3, Iridium Send Failures Non18: 3,
Iridium Send Failures Type 18: 2, Bytes TX: 303, Iridium Messages Received: 1, Bytes RX: 35, GPS Sessions: 16,
GPS On Time: 9, GPS Fix Count: 5, GPS TTFF Average: 15, High Temperature: 0, Low Temperature: 0
```

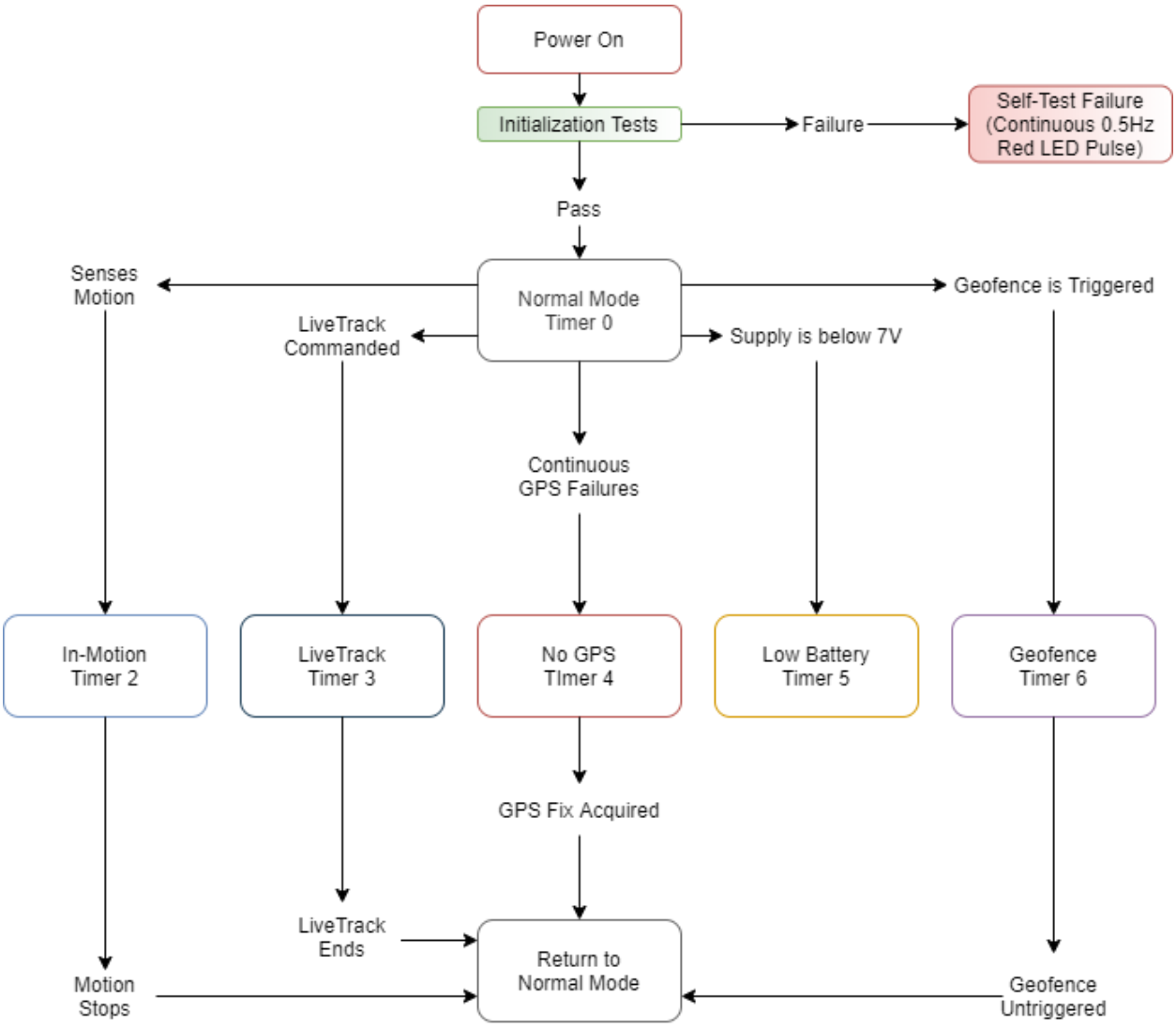
Lifetime Statistics Readout	
BatteryV	Last measured battery voltage (Loaded, Unloaded)
Uptime	Total unit uptime in minutes
Power Cycle Count	Number of power cycles
Watchdog Reset Count	Number of errors
Lowest Battery Voltage	Lowest measured battery voltage
Highest Battery Voltage	Highest measured battery 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 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**.

Onyx Mode Diagram

The Onyx has a combination of preset behaviors and configurable parameters. Below is an outline of its normal behavior. The Low battery condition shown is used in the regular Onyx type (12V).



Onyx Timer Intervals

The following are the default parameters for each mode.

Timer	<T0>	T1	T2	T3	T4	T5	T6	T7	Min-Max
SBD	1h	3m	1m	1m	1h	2h	3m	10m	25s-1d
GPS	1h	3m	20s	20s	2h	2h	1m	5m	20s-1d
ACS	2s	2s	2s	2s	2s	2s	2s	2s	1s-1m

Legend	
SBD	SBD (Iridium) transmission interval
GPS	GPS acquisition interval
ACS	Acceleration Sample Rate
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 2	In-Motion	Triggered when the device has detected sufficient motion
Timer 4	No GPS Fix	Used when the GPS module fails to acquire a fix
Timer 5	Low Battery	Used when Onyx's battery drops below 7 Volts
Timer 6	Geofence	Triggers when the user's defined Geofence settings are triggered

Note: Timer 1 is not used in the Onyx. Timer Parameter named ACP is not used.

Setting timers

$timer SYSTEM TIMER-MODE INTERVAL

Examples:

To set the **In-Motion Mode SBD** and **GPS** timer to a **10-minute interval**, issue the following two commands:

$timer SBD 2 10m
$timer GPS 2 10m

To set the **normal mode SBD** timer to a **1-day** interval, and the **normal mode GPS** timer to a **1-hour** interval, issue the following two commands:

$timer SBD 0 1d
$timer GPS 0 1h

The configuration above will result in the unit acquiring a GPS position every hour, which will cause all 24 GPS positions to be sent in a single SBD transmission once daily.

Motion

The Onyx uses an on-board accelerometer to detect changes in motion and orientation and is measured constantly by default. Once sufficient changes to these readings are detected, the Onyx enters in-motion mode (Timer 2) to more rapidly collect and send GPS coordinates until the motion period has stopped.

Motion Enable/Disable

Motion detection can be disabled or enabled using the $switch command:

$switch m 0

To re-enable motion detection if it has been disabled, issue the command:

$switch m 1

Once the Onyx receives this command, the "Motion" component (M) will be moved to the respective Yes (Y) or No (N) section of the Switch Response:

Ascii: Switch: Y = GF, N = M

Note: The Onyx Relay variant of firmware has motion disabled by default.

In-Motion Threshold

The magnitude of motion required to enter In-Motion mode can also be adjusted with the **$athrs** command. The default threshold is 100. **Increasing** this value will make the Onyx **less likely** to enter In-Motion mode.

$athrs 200

Note: It is recommended that $athrs **NOT** be set to a value less than 100, as the Onyx is very sensitive to movement by default.

Message Enable

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

The Onyx has the following message types available for use:

Message Number	Message Type
0	GPS Plain Text Short
1	GPS Plain Text Long
5	Argos PDR
10	GPS Bin Compressed
11	Motion Binary

The **$msgenable** setting 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 (Type 0), GPS Binary Compressed (Type 10), and GPS Text Long (Type 1) on Timer 0 (Normal mode) you would send the following command:

$msgenable 0 0,10,1

The Onyx 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 Onyx will use additional Iridium data.

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. Once a GPS position is logged that shows the device is outside the circle, the device immediately transitions to Alarm Mode **(Timer 7)** and transmits according to Alarm Mode timer intervals.

Enabling the Watch Circle

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

$WCenable 1

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

Ascii: Switch: Y = MGFC, N =

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 Onyx will place its centre on the average locations so far acquired (up to positions 48 hours old) and the default radius of 100m.

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

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

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

Notes

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

Geofencing

The Onyx tracker has the ability, after user input, to alarm and change its reporting interval according to its position relative to a set geofence boundary.

Through user input, the Onyx can contain:

- Three separate geofences, in a polygon consisting of a maximum of 8 points
- Instructions for each geofence for what qualifies as an alarm:
  - In – Alarm when the Onyx is inside a geofence
  - Out – Alarm when the Onyx is outside a geofence
  - Cross – Alarm when the Onyx crosses a geofence boundary in either direction
- The timer interval used when a geofence is in an alarm state; all geofences use the same timer (Timer 6). By default, the Onyx will remain in Timer 6 for a minimum of 20 minutes, **plus** any additional time that the Onyx is in a position that keeps any fence triggered.

Set Geofence

The **$gfs** command allows setting and editing geofence details. **Note the comma placements:**

$gfs Index, Direction, lat long, lat long, etc.

$gfs 1, c, 47.57690 -53.56883, 47.57147 -53.54495, etc.

$gfs	Base Command
Index	Number of the geofence (1 – 3)
Direction	Dictates where the Onyx must be located to alarm according to this geofence (i, o, c)
Lat Long	The points used to draw the geofence (3 - 8 pairs)

Show Geofence

The **$gfp** command shows the set parameters of the index specified. This command returns the reply via Iridium if sent to the Onyx over Iridium. If no index is specified, all active geofences' parameters are returned.

$gfp Index

$gfp 1

Test Geofence

After the geofences are set, false coordinates can be sent to the device to test the Onyx's reaction and ability to alarm. The **$gft** command is used for this purpose.

$gft lat long

$gft 47 -53

Clear Geofence

In the event a geofence needs to be deleted, the **$gfc** command can be used to specify an index to clear.

$gfc Index

$gfc 1

Geofence Messages

When the Onyx triggers a set geofence, the Onyx will send an event message, outlining which fence has been triggered and in which direction caused the triggering.

The Onyx will then begin to report at the rates laid out in Timer 6.

```
BatteryV: 10.83, Geofence: Fence 1 IN, Fence 2 IN, Voltage Unloaded: 11.19
```

LiveTrack

The LiveTrack mode can be used for finer resolution position gathering in cases where the motion and Geofence modes are not appropriate. It should be noted that the LiveTrack session begins once the Onyx receives the command to initiate.

To initiate LiveTrack Mode, issue the command:

$LiveTrack 1

LiveTrack is set to operate for a set period of 20 minutes, and can be stopped via:

$LiveTrack 0

Digital Output Pin

The Digital I/O pin of the Onyx can be toggled via command to have a high or low logic output of 3V at a maximum of 5mA. The command is as follows:

$dOut X Y

As seen below, only one of the possible four number combinations leads to a high output.

Parameter	Purpose
$dOut	Base Command
X	Capability to turn the pin on/off; Enabled (1) or disabled (0)
Y	High (1) or Low (0)

Command	Pin Enable/Disable	Output High/Low	Result
$dOut	0	0	Output Low
$dOut	0	1	Output Low
$dOut	1	0	Output Low
$dOut	1	1	Output High

Encryption

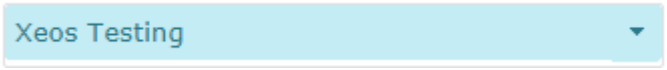
The Onyx has some security features enabled by default, such as an unlock codes for receiving commands. Users can also enable end-to-end 256 bit AES encryption between their device and XeosOnline for an additional layer of security. Messages are zero-padded to fill out the 32 byte blocks.

Note: It is advantageous, though not required, to input the encryption key for the Onyx into XeosOnline **first**, as the key cannot be retrieved from the Onyx once it is installed (though it can be overwritten if unknown/forgotten **over the diagnostic port only**). If the device is in the field with an unknown or mismatched encryption key, commands sent to the device will not be properly encrypted when sent over Iridium, and thus improperly decrypted by the Onyx, ending with the command not being valid.

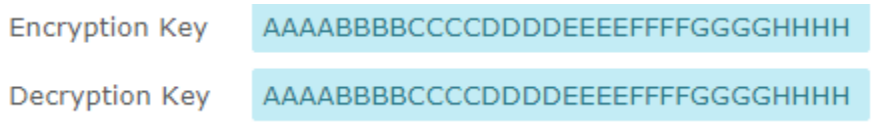
Setting Up Encryption on XeosOnline

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

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



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

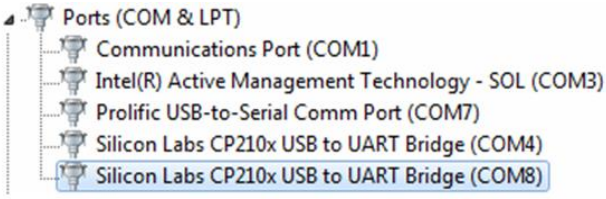


Now that the key is saved, it can be referenced when adding it to the Onyx itself.

Generating your Key

Getting the COM Port

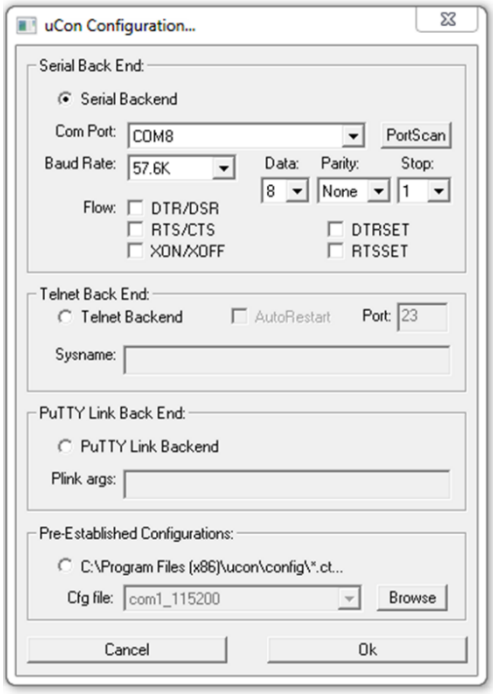
1. Connect the Onyx to your PC via the Onyx to USB cable.
2. Take note of the COM port number in Control Panel → Device Manager

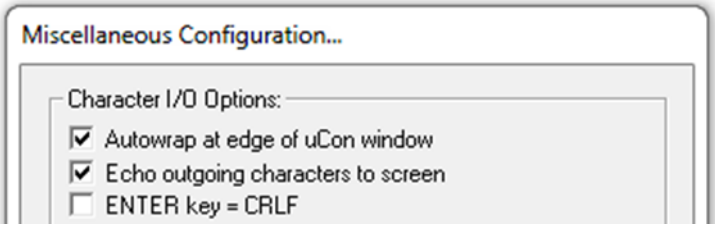


In this case: COM8

Connect Using Terminal Emulator (uCon)

1. Download the uCon Serial Console software
2. Install uCon and open the program
3. Connect to the Onyx using the following settings (right), use the COM port from the previous section.
4. Press Ok. Turn on echo by going to Config → Miscellaneous (see below)





5. Enter your encryption passphrase by entering
   $aky PASSPHRASE
   The pass phrase must be exactly 32 characters long.
   Note: This step cannot be done through Iridium.

Enabling Encryption Use

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

Flash Memory

The Onyx comes equipped with internal flash memory, used to store logged events and GPS positions over the lifetime of the product. This information can be retrieved for data collection or troubleshooting purposes.

Dumping the Flash Memory

- Connect a PC to the Onyx using the appropriate diagnostic cable (Hirose or Chogori). External power is not required; diagnostics are powered via USB.
- Open the terminal emulator and use the typical port settings:

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

- Send a **$ver** command to output the device's serial number and firmware version
- Send the flash dump command: **$fdumpall**
- The entire memory log of the device will begin outputting into the terminal. When the output slows, the dump is complete.
- Save the output in the appropriate manner for the terminal emulator

The flash logs of the Onyx are comma delimited and organized by type of data.

Deleting the Flash Memory

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

To delete the GPS records, send the command: **$flasheraseuserdata**

Erasing of the GPS records using this command can be done over Iridium if necessary.

To delete **ALL** data (via USB ONLY):

- Enter Engineering Mode: **$engmode 2009**
- Delete all flash memory: **$flasherasechip**

Either of the above deleting processes can take up to 30 seconds, after which the device will reset. Current settings in the Onyx (timers) will not be changed by this process.

Data Relay

Relay functionality requires separate firmware for the Onyx tracker. This functionality must be requested prior to purchasing the unit or the firmware can be installed with a firmware update. The Onyx Relay can receive and transmit serially to a remote device in the field. To do so, the Onyx requires a cable capable of supplying both power and serial.

Basic Functionality

The Onyx Relay has a single serial line with which to communicate with the device for relay of external data to and from Iridium, or to monitor diagnostics.

On start-up, diagnostics will be disabled on the Onyx Relay, but can be enabled by issuing the command **$diag 1**, and disabled with **$diag 0**. The Onyx Relay will accept commands and send appropriate responses in either "diag" state, but not stream more detailed diagnostic data when diagnostics are off. The Onyx Relay will always accept commands over Iridium.

Serial Relay

To send data to or from a connected serial device, connect to the serial port on the Onyx Relay. By default, the Onyx Relay will use these connection settings:

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

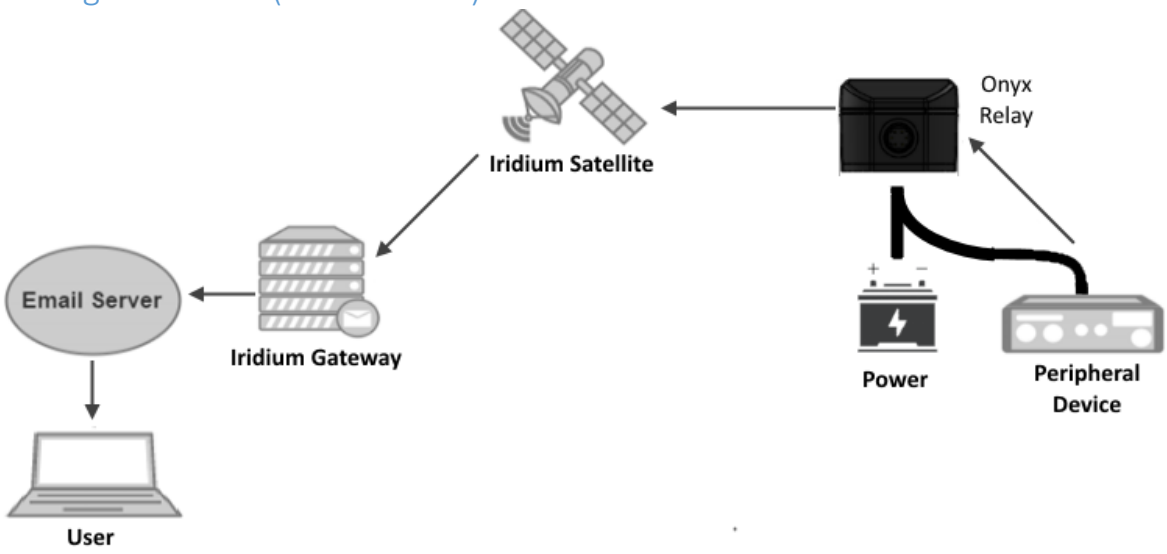
In the event the peripheral device has a different baud rate, the Onyx Relay can be changed to match for communication purposes using:

$baudrate XXXXX Y

XXXXX	Baud Rate
Y	Stop Bits (0 or 1)

The Onyx Relay will immediately use the commanded baud rate, **but this setting does not survive resets.**

Mobile Originated SBD (From Device)



To send a payload of data from your connected serial device via the Onyx 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:

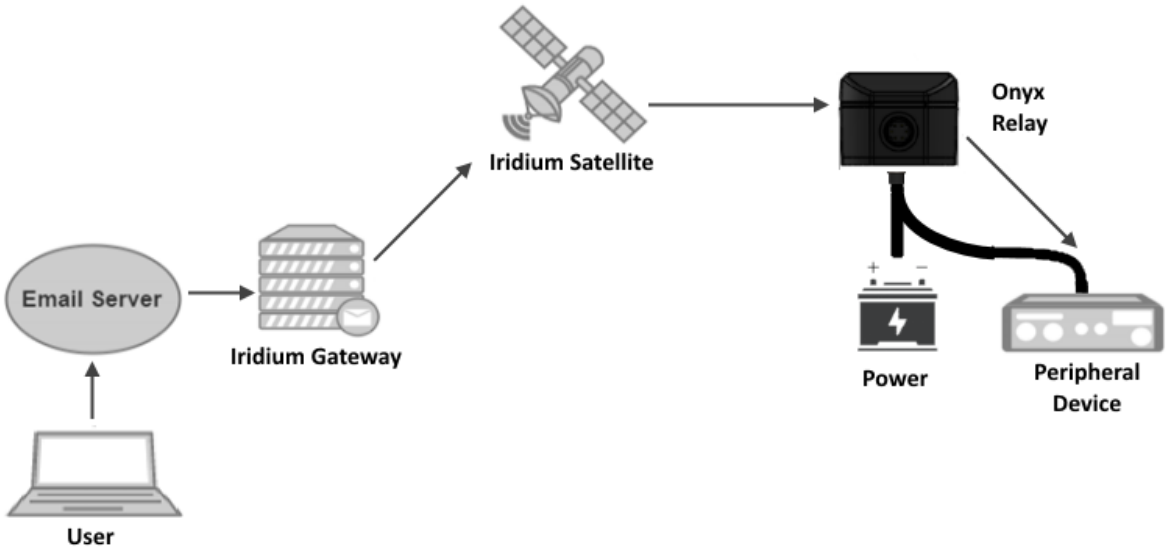
devData,X,S,Y,Z PAYLOAD

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

payload line 1
payload line 2
payload line 3

Other Commands

Below is a list of other commands that can be sent via Iridium or serially to acquire additional information, or configure the Onyx. 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.
batt	---	Show battery status
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
ReportHour	Hour (0 – 23)	Set/Show Daily Reporting Hour offset from UTC
RepMinute	Minute (0 – 55)	Minutes offset past the hour for GPS/Iridium
ResetNow	---	Restarts the system. The effect is the same as restarting via the magnet

Testing the Onyx

Before testing

The following should be confirmed ahead of testing:

- The Onyx should be confirmed **activated** on the Iridium network to ensure that any messages transmitted are able to be received, and directed to send messages to the intended destinations.
- Each battery used during the test should be examined with a voltmeter to ensure none of the cells are defective or discharged. **New batteries should be used during deployments.**

Testing

Power-up and Batteries

- Power the device with its respective source. For the Onyx-I, the battery pack is polarized; negative ends of the battery meet the springs on the pack.
    - The Onyx enters operation immediately on power-up.
    - The Onyx-R has an integrated battery pack; if the device is off (Red LED on magnet input) a magnet swipe is required to turn the device on.
    - If the red LED continuously flashes after start-up, a self-test failure has occurred. Recheck the batteries and their orientation first, and if this persists, contact Xeos.
- Once all LED action has ceased, use a magnet to find the magnetic on/off switch on the device (the green LED will illuminate on detection). Use this opportunity to turn the device off by swiping the magnet repeatedly at this location (OFF is indicated by a solid RED LED) to confirm proper operation of the magnetic switch. Use the same method to turn the device on (ON is indicated by a solid GREEN LED).

Transmission

- Place the device upright in a location outside that has as much of the sky visible as possible; buildings and other tall objects can impede a beacon's ability to transmit.
    - If a covert deployment is upcoming, a second test to check the performance in a similar environment to deployment is suggested.
- The following messages are to be expected from the Onyx after turning on within five minutes:
    - A general settings message laying out normal and in-motion timers
    - A power-up message displaying the firmware version and serial number:

```
Ascii: 01171326,V,Onyx_LV v1.27-6152. dev:4
Hw:2.3-0 SN=927 GPS:5xp__5.7.7-P1.GCC_N96LG+5xpt_5.7.7-P1.KC IRD:TA16005
Reset: Count=2, Current=(P), Prev=(cleared)
```

    - A GPS Position, the SNR strength of which should consistently be greater than or equal to 40. The Position will appear in both the message and location logs, and the SNR will appear in the location log only.

BatteryV: 11.88, Latitude: 44.714394, Longitude: -63.604902, Voltage Unloaded: 12.96

Latitude	Longitude	SNR
44.714195	-63.604902	41

The device will then send one GPS message every 60 minutes unless another event occurs. The SNR value for each GPS position should be a value no less than 38.

After this point, transmission intervals are tied to the rates laid out by Timer Zero.

Response to commands

During testing, commands can be sent to the device to change configuration or request statistics. These commands are read in during Iridium sessions and prompt responses from the Onyx, confirming that said commands were acted upon.

- Send the **$timer** command, which will prompt the Onyx to report its current timer intervals.

Response to $timer

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

In-Motion messaging

Subject the device to sufficient motion, and the Onyx will enter its in-motion mode. On the next GPS session, the Onyx will begin utilizing its bottom antenna for GPS and Iridium sessions. This can be simulated (moved back and forth) or real (driving in a vehicle).

The Onyx will send a motion message:

BatteryV: 10.02, Motion: true, Voltage Unloaded: 12.12

The Onyx will operate in this mode until it no longer registers sufficient motion to warrant this mode. It will then transmit that it no longer reads motion:

BatteryV: 10.17, Motion: false, Voltage Unloaded: 12.06

Deployment of the Onyx

Below are installation tips for the Onyx:

- The top of the Onyx must have as good a view of the full sky as possible.
  - Alongside a wall or tall obstruction will cause coverage to suffer.
  - For concealed deployment, the antenna surface must not be obstructed by metal or wood. Thick amounts of other materials may also cause interference.
- Onyx should not be deployed near (less than 1 metre) other transmitters.
- Testing covert deployments with concealment materials is strongly suggested.

Troubleshooting

Note that the LED is not visible in the Standard Onyx.

Red LED/blinking
Indicative of a self-test failure. As of build 6058**,** using the **$status** command will show what failure code is present, but this does not survive resets.
i - Iridium - Modem cannot communicate with CPU of Onyx; if the self-test runs when the device is connected to a PC, this criteria will fail, as 5V-USB cannot power the Iridium modem.
f - Flash - Flash error is showing as a full chip; erasing the chip may resolve this issue.

No Iridium messages (assuming no self-test failure)

- Determine the nature of the issue (antenna-related, system related or location-related)
  - Ensure the device's Iridium IMEI is active on the Iridium network with your service provider.
  - Ensure the device is provisioned to send messages where intended.
  - Change the location of the device; place the device in an area with as much total view of the sky as possible.
- Dumping the flash memory will display all Iridium sessions that occurred, regardless of success.

Messages are not readable (in binary)
Messages are in compressed binary format by default; use the **$msgenable** command to change the format to ASCII.

No GPS/poor GPS

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

Device is transmitting too frequently/not enough

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

Device is going into alarm when it should not

- Motion detect is enabled when it should not be enabled.
    - Use **$switch m 0** to turn off motion functionality
- Device is moving too much, triggering motion events
    - Securing the device further can prevent unwanted movement.
    - Changing the **$athrs** threshold value can make motion events less likely.
- Geofences are set incorrectly (alarming at wrong times and locations)
    - Check the fence boundaries using **$gfp X**
    - Adjust fence characteristics as required

Appendix A: Firmware Update Procedure

If you have been notified that the firmware in your Onyx needs to be updated, please use the instructions below. Please note, the Onyx must be removed from the field.

Process

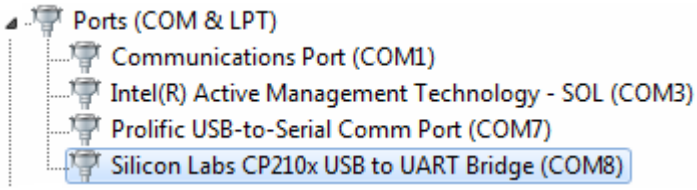
- Remove unit from field
- Update Onyx firmware
- Test Onyx's ability to transmit
- Once transmission is confirmed, safe to redeploy
- Notify Xeos of successful update

Requirements

- Use of a computer running some version of Windows OS
- Onyx to USB cable (A-05-008)
- Device driver for the USB port
- Onyx firmware package

Loading Firmware into the Onyx

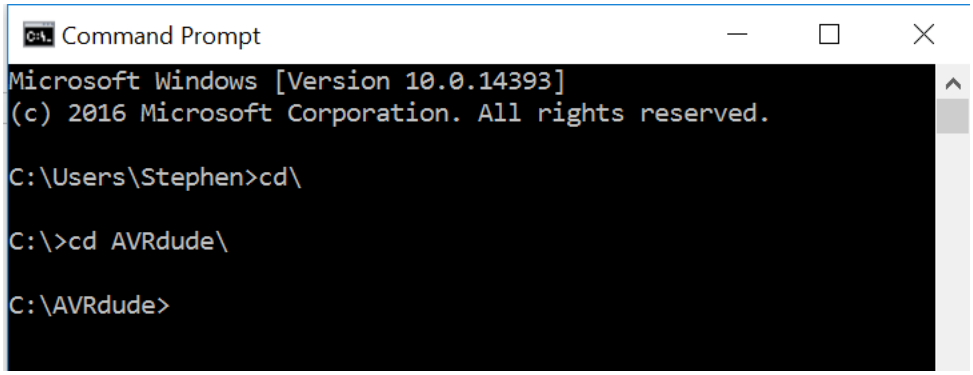
1. Connect the Onyx to your PC via the Onyx to USB cable.
2. Take not of the COM port number in Control Panel → Device Manager



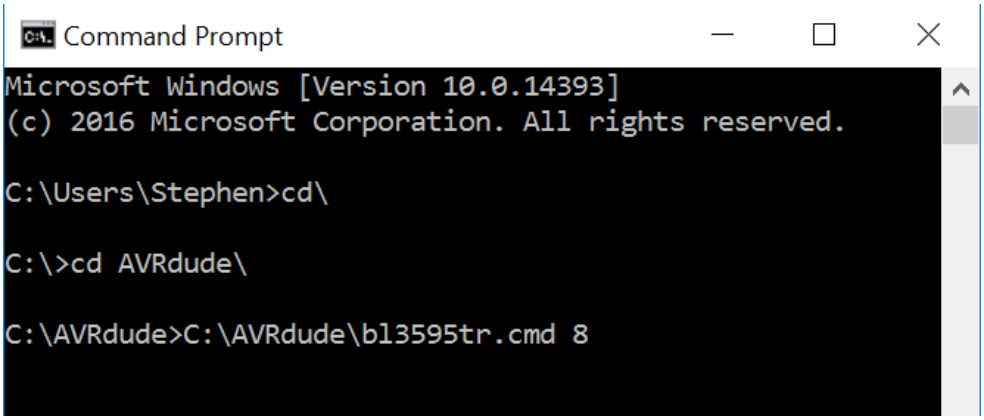
In this case: COM8

3. If the Silicon Labs CP210x does not appear in the device manager under Ports, see Installing the Serial to USB Driver below.
4. Create a new folder called **AVRDude**.
5. Extract the contents of the zipped folder containing the firmware update to the new **AVRDude** folder. You should have 4 items now in your new AVRdude folder:
    a. AVRdude.exe
    b. AVRdude.conf
    c. Firmware .cmd file
    d. Firmware .hex file
6. Place the created AVRDude folder in the C Drive.
7. Open Command Prompt.
8. Type in cd\, and hit Enter to bring you to the line C:\>

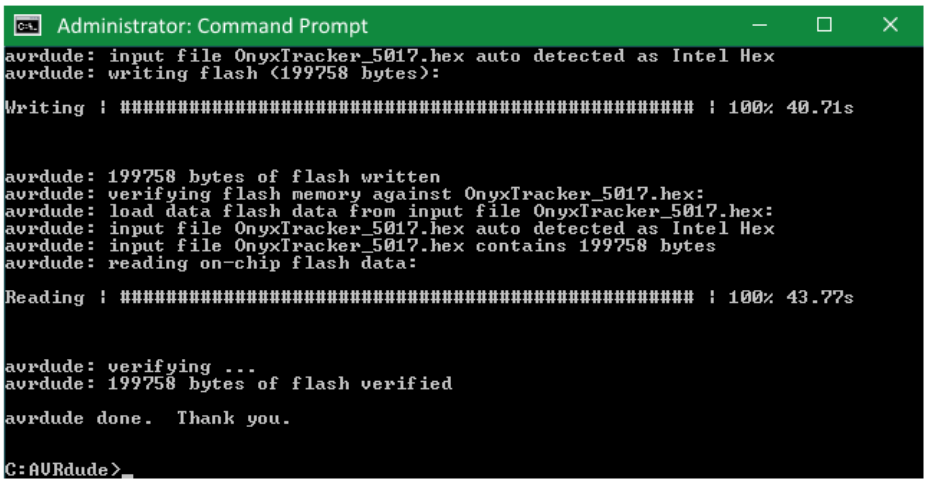
9. Next, type in cd AVRdude\ to direct command prompt to the AVRdude folder in the C drive that you have just created. You'll now see the next line read C:\AVRdude>



10. Drag and drop the .cmd file from your AVRdude folder into command prompt. Then type in the COM port number previously noted (in our case, 8), and hit Enter.



11. The firmware will begin updating right away. Firmware update should take approximately 90 seconds. If the window closes immediately upon executing the file, the firmware update has failed.



12. The Onyx update progress will be shown in the command prompt window. When it has completed successfully it will say: "avr dude done. Thank You."

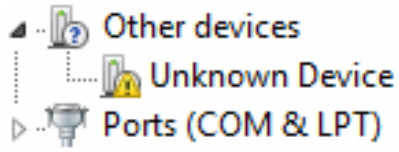
The firmware update process is complete. Command prompt can be closed.

Testing the Onyx

1. Once the Onyx firmware has been updated, please test its ability to transmit.
2. Make sure the Onyx has an active Iridium account. Xeos can setup an account for you if you do not currently have one. Ensure you have access to one of the email addresses to which messages are sent.
3. Place the Onyx outside in a location where it has a clear view of the sky and connect it to an external power source.
4. Check the email account to see if a transmission has been received. If no message is received within 20 minutes, please check operating manual to ensure it is setup as required.
5. If no message is received, please contact Xeos for assistance in troubleshooting.
6. DO NOT redeploy the Onyx until you have confirmed Iridium transmission.

Installing the Serial to USB Driver

1. Navigate to: **Control Panel** → **Device Manager**
2. The Serial to USB device should be present as an unknown device:

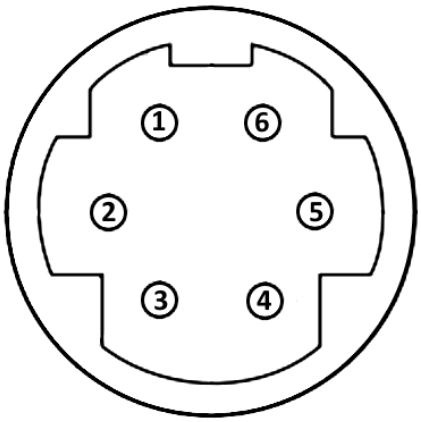


3. Right click the **Unknown Device**, select **Update Driver Software**.
4. In the new window, click **Browse my computer for driver software**.
5. Click on the **Browse** button and navigate to folder containing the Silicon Labs device driver.
6. Click **Next** and the driver should install.

Appendix B: Pinout Diagrams

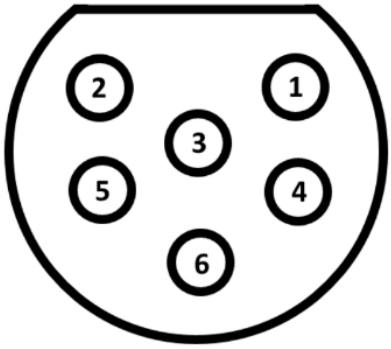
Onyx, Onyx-R (Hirose HR-30 Series)

Pin	Purpose
1	Ground (-) Battery input
2	Digital I/O
3	Data input to Onyx (Rx / D-)
4	Data output from Onyx (Tx / D+)
5	5V USB power input
6	Positive (+) Battery Input, 12V (12V Onyx-R Charging)



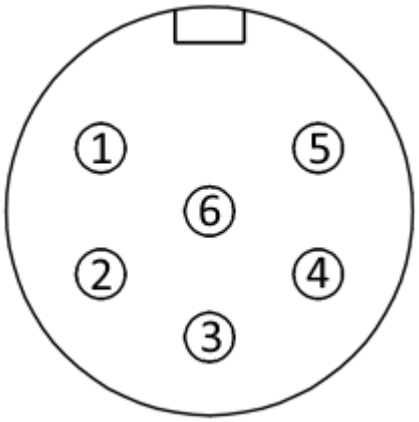
Onyx-M, Onyx M-R (Teledyne Impulse IE55-1206-BCR)

Pin	Purpose
1	No Connection
2	Positive (+) Battery input, 12V (3.6V Low Voltage Variant)
3	5V USB power input
4	Data output from Onyx (Tx / D+)
5	Data input to Onyx (Rx / D-)
6	Ground (-) Battery input



Onyx-WB, Onyx-M2 (Chogori)

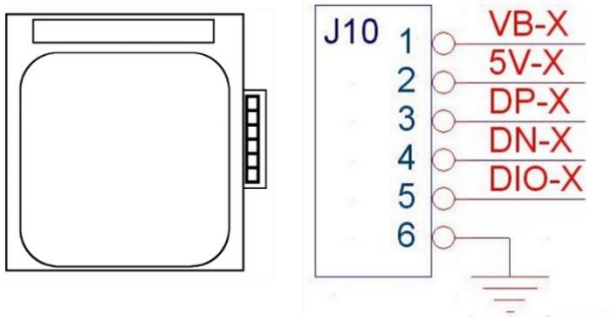
Pin	Purpose
1	Ground (-) Battery input
2	Data input to Onyx (Rx / D-)
3	Data output from Onyx (Tx / D+)
4	5V USB power input
5	Positive (+) Battery Input, 12V
6	Digital I/O



Onyx-OEM, Onyx Flat Variants

Top view (Antenna up) is displayed.

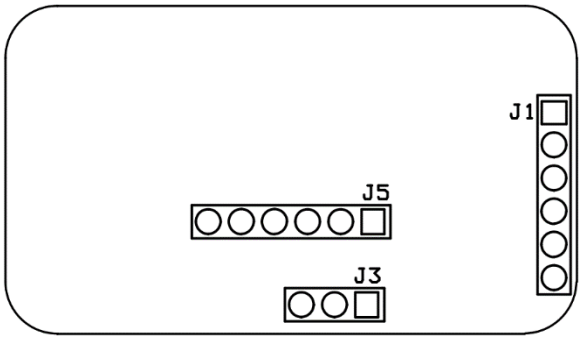
J10, Onyx-OEM Port	
Pin	Purpose
1	Positive Battery Input
2	5V-USB
3	Data output from Onyx (Tx / D+)
4	Data input to Onyx (Rx / D-)
5	Digital I/O
6	Ground (-) Battery input



Onyx-OEM LV

Pin 1 is indicated by square pads on board.

J5 is used to connect the Low Voltage board to the Onyx Stack.

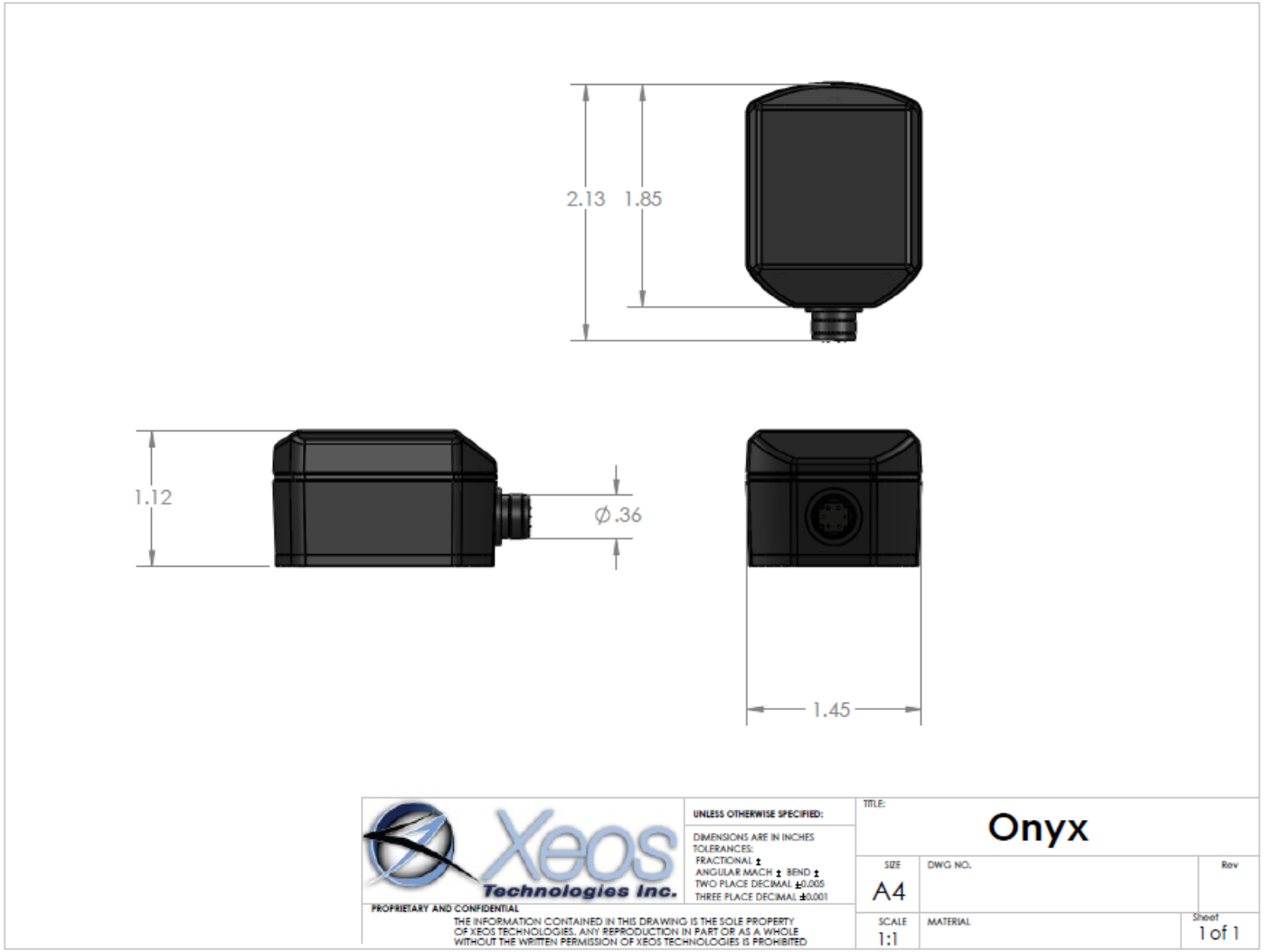


J1, Onyx-OEM LV Communications Port	
Pin	Purpose
1	No Connection
2	5V USB power input
3	Data output from Onyx (Tx / D+)
4	Ground (-) Common
5	Data input to Onyx (Rx / D-)
6	Digital I/O

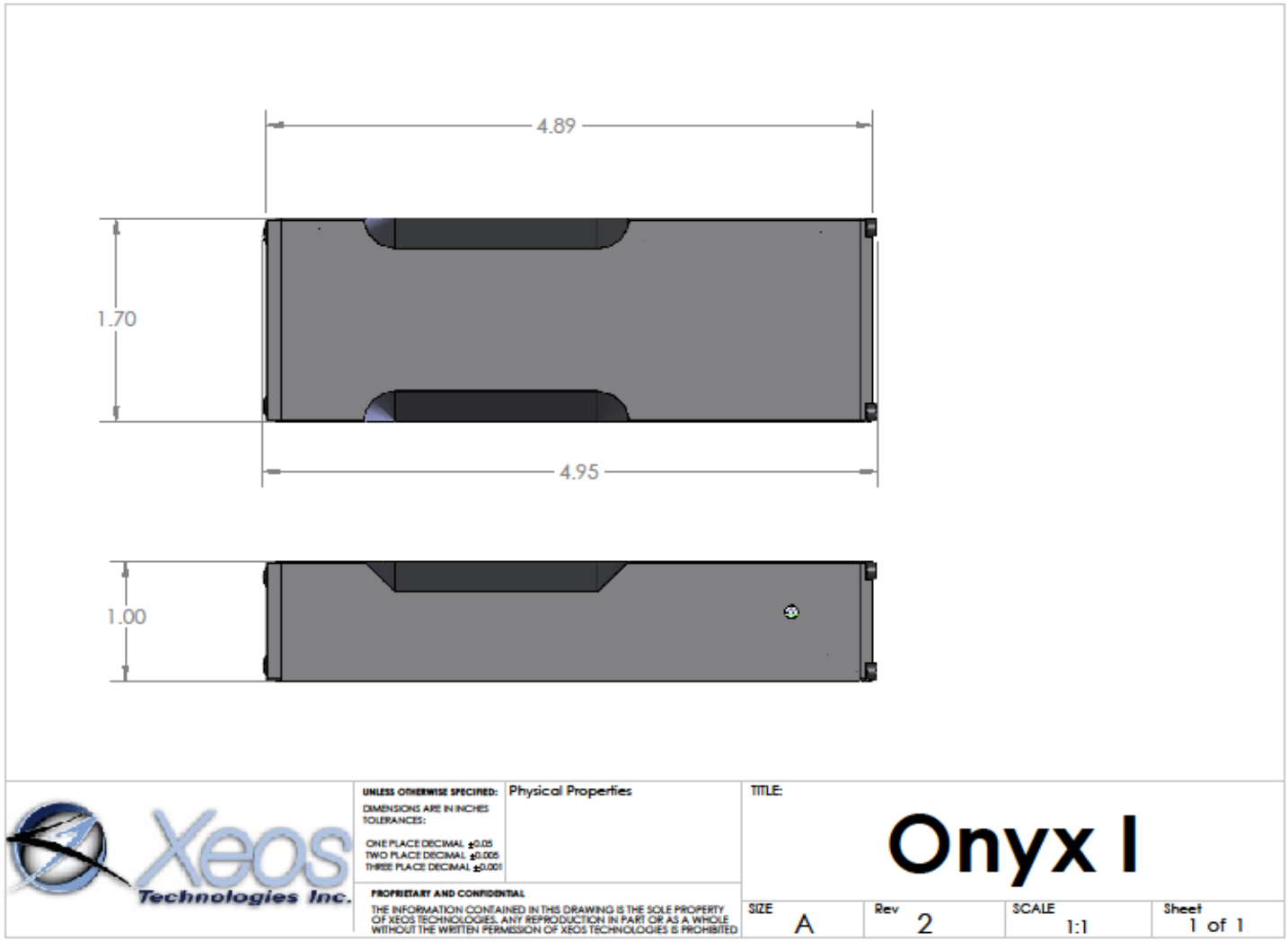
J3, Onyx-OEM LV Power Port	
Pin	Purpose
1	V+ (5 Volts Max)
2	No Connection
3	Ground (-) Battery input

Appendix C: Mechanical Drawings

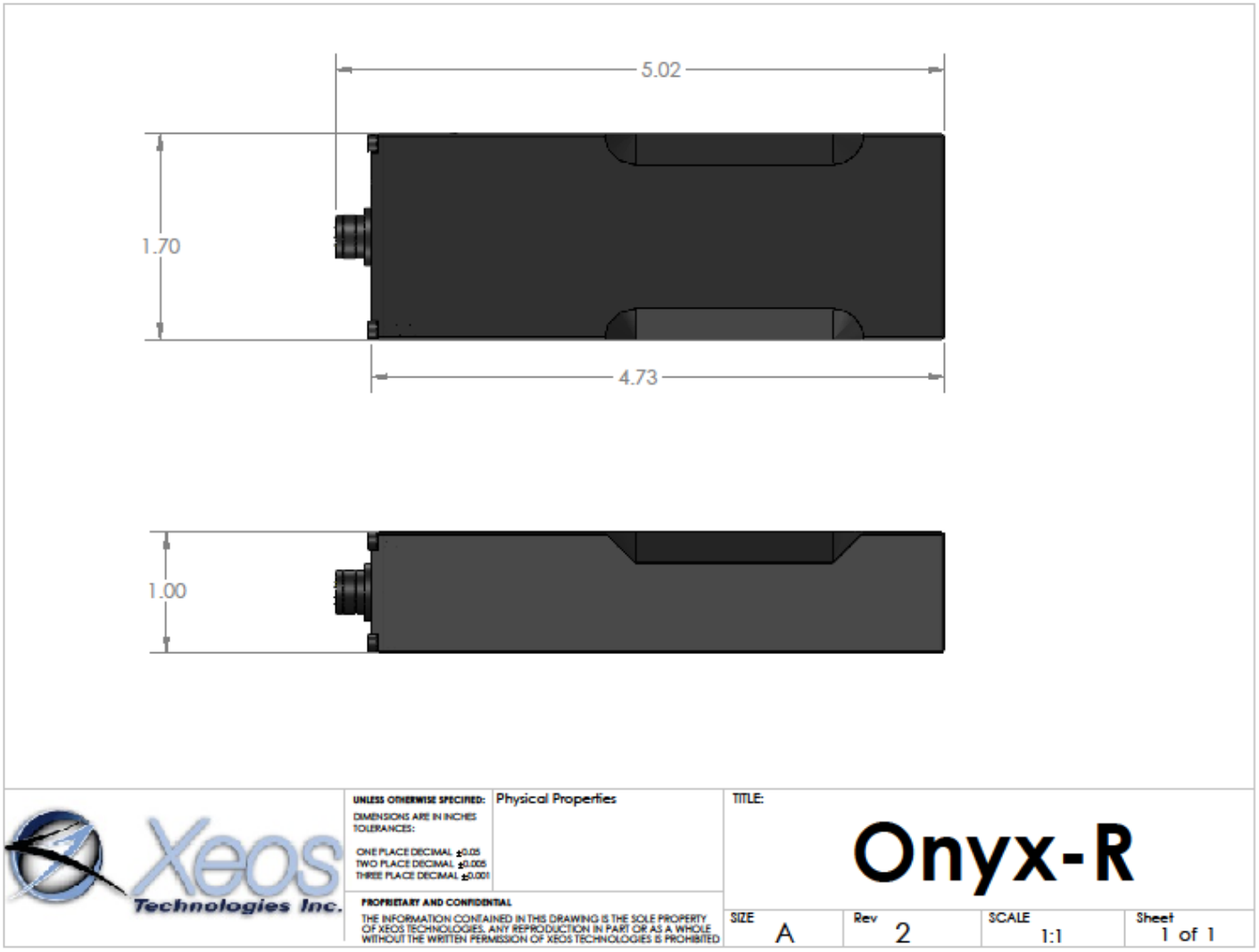
Onyx



Onyx-I


4.89
1.70
4.95
1.00
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.005
THREE PLACE DECIMAL ±0.001
Physical Properties
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF XEOS TECHNOLOGIES. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF XEOS TECHNOLOGIES IS PROHIBITED
TITLE:
Onyx I
SIZE
A
Rev
2
SCALE
1:1
Sheet
1 of 1

Onyx-R


5.02
1.70
4.73
1.00
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.005
THREE PLACE DECIMAL ±0.001
Physical Properties
TITLE:
Onyx-R
PROPRIETARY AND CONFIDENTIAL
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SIZE
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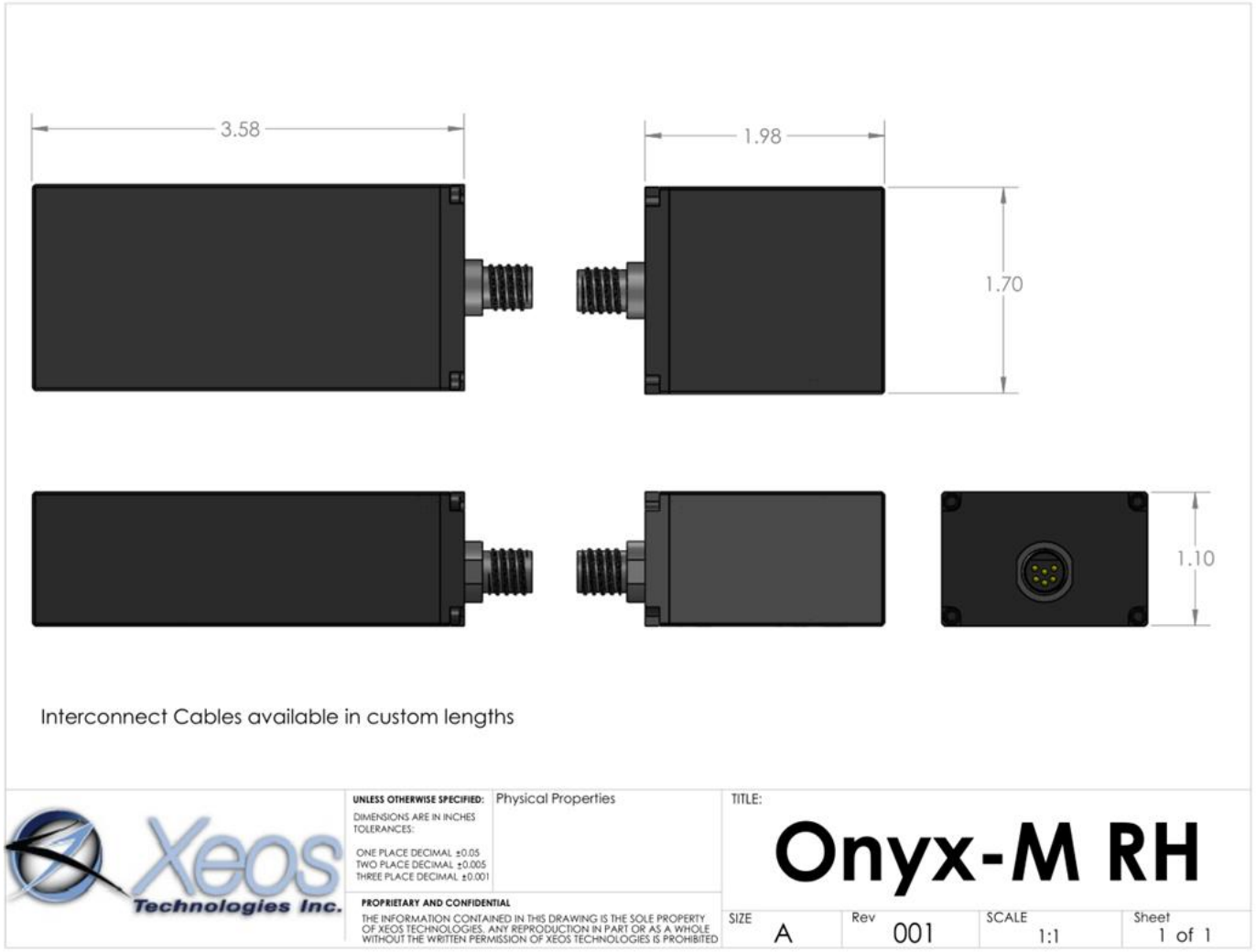
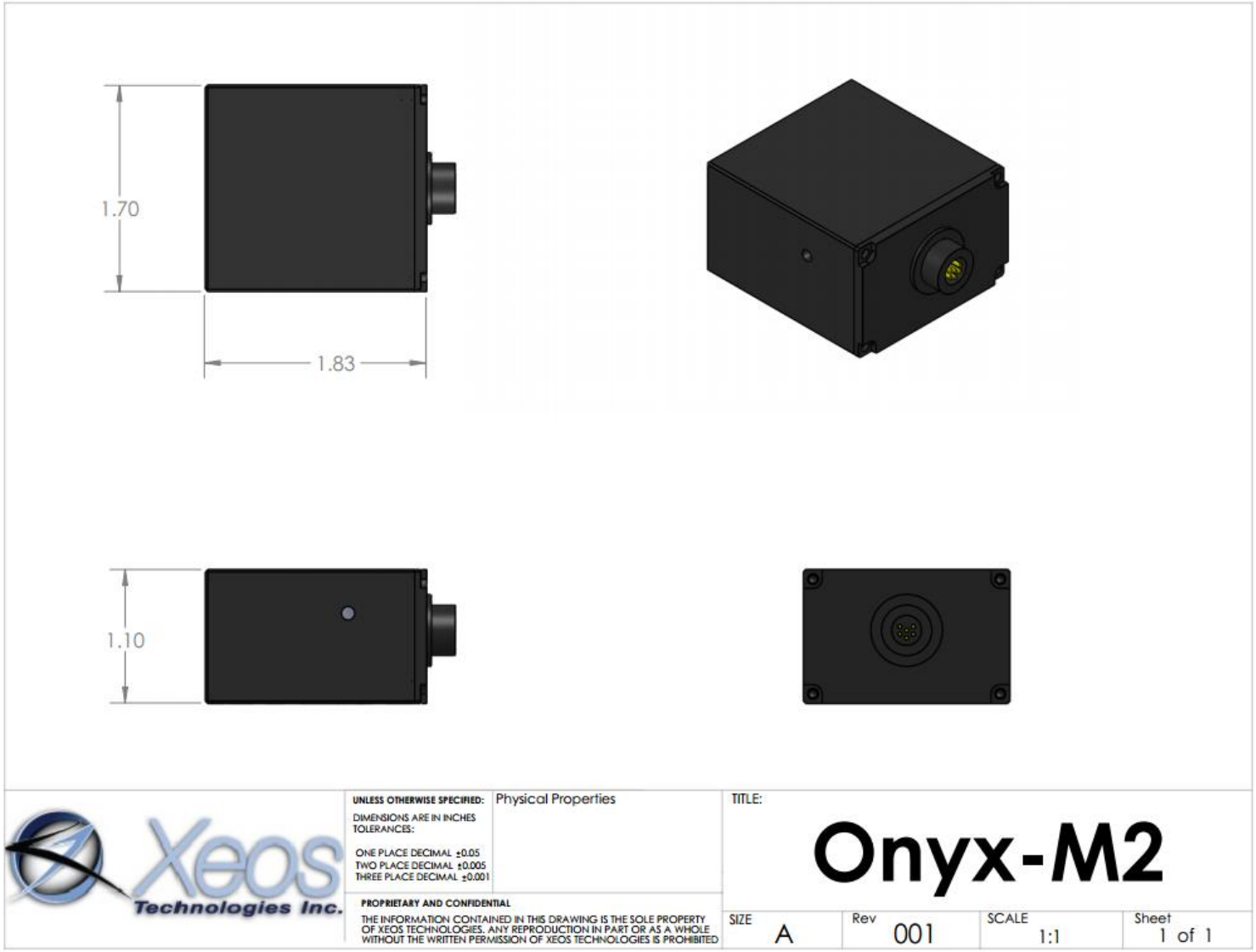
Rev
2
SCALE
1:1
Sheet
1 of 1

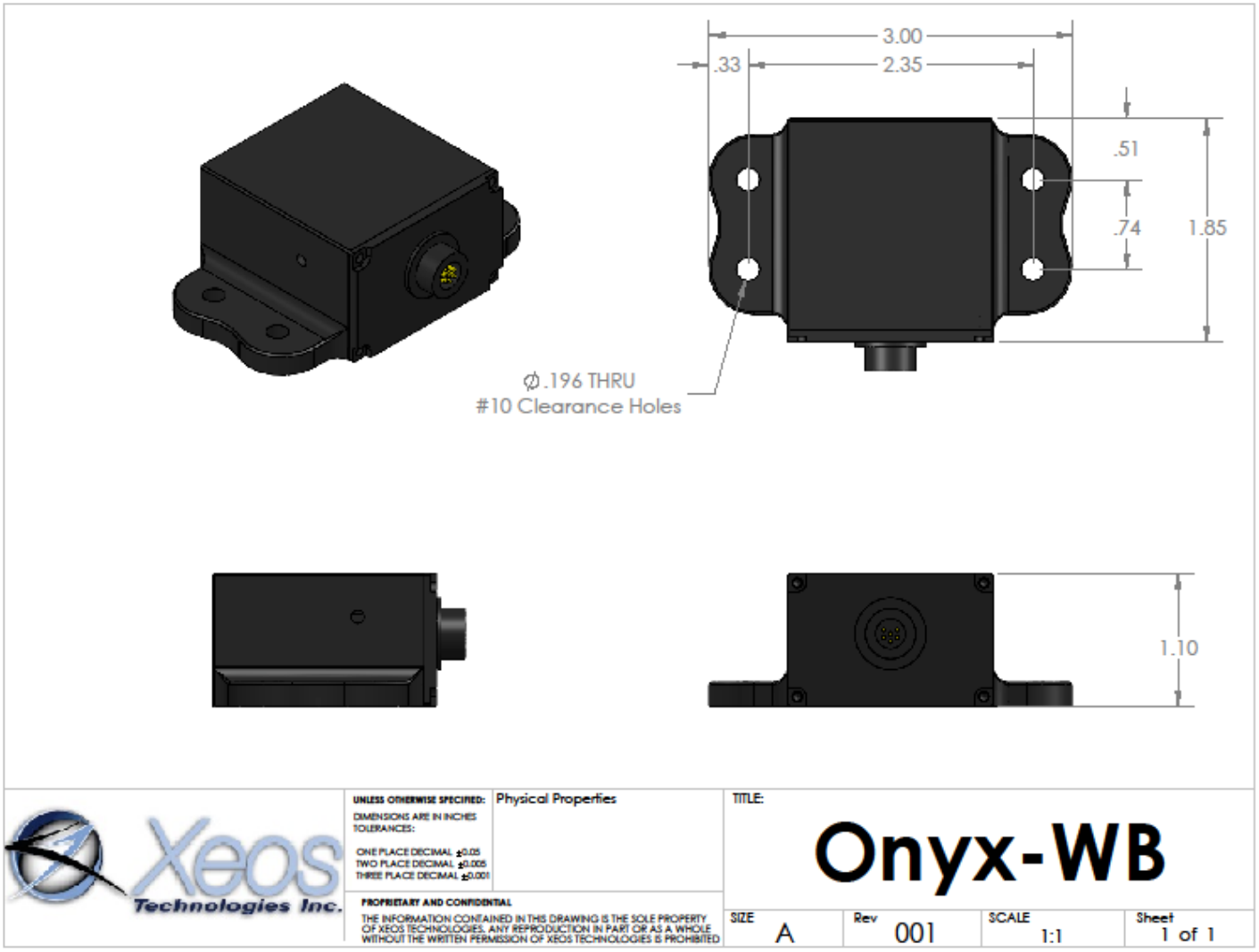
Onyx-M RH (Discontinued)



Onyx-M2


1.70
1.83
1.10
Xeos Technologies Inc.
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.005
THREE PLACE DECIMAL ±0.001
Physical Properties
PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF XEOS TECHNOLOGIES. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF XEOS TECHNOLOGIES IS PROHIBITED
TITLE:
Onyx-M2
SIZE
A
Rev
001
SCALE
1:1
Sheet
1 of 1

Onyx-WB


3.00
.33
2.35
.51
.74
1.85
⌀.196 THRU
#10 Clearance Holes
1.10
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.005
THREE PLACE DECIMAL ±0.001
Physical Properties
PROPRIETARY AND CONFIDENTIAL
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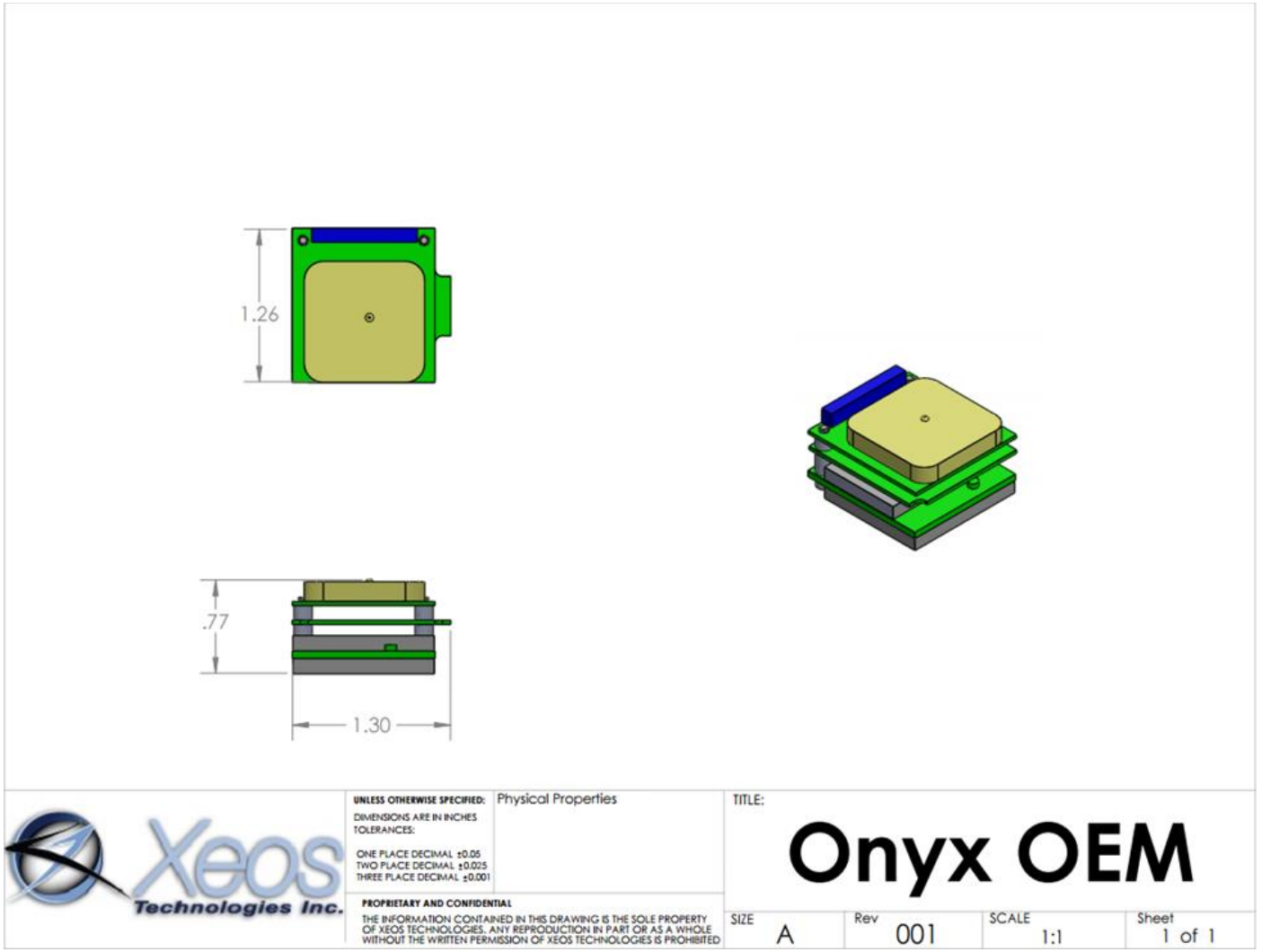
TITLE:
Onyx-WB
SIZE
A
Rev
001
SCALE
1:1
Sheet
1 of 1

Onyx OEM


1.26
.77
1.30
Xeos
Technologies Inc.
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.025
THREE PLACE DECIMAL ±0.001
Physical Properties
PROPRIETARY AND CONFIDENTIAL
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TITLE:
Onyx OEM
SIZE
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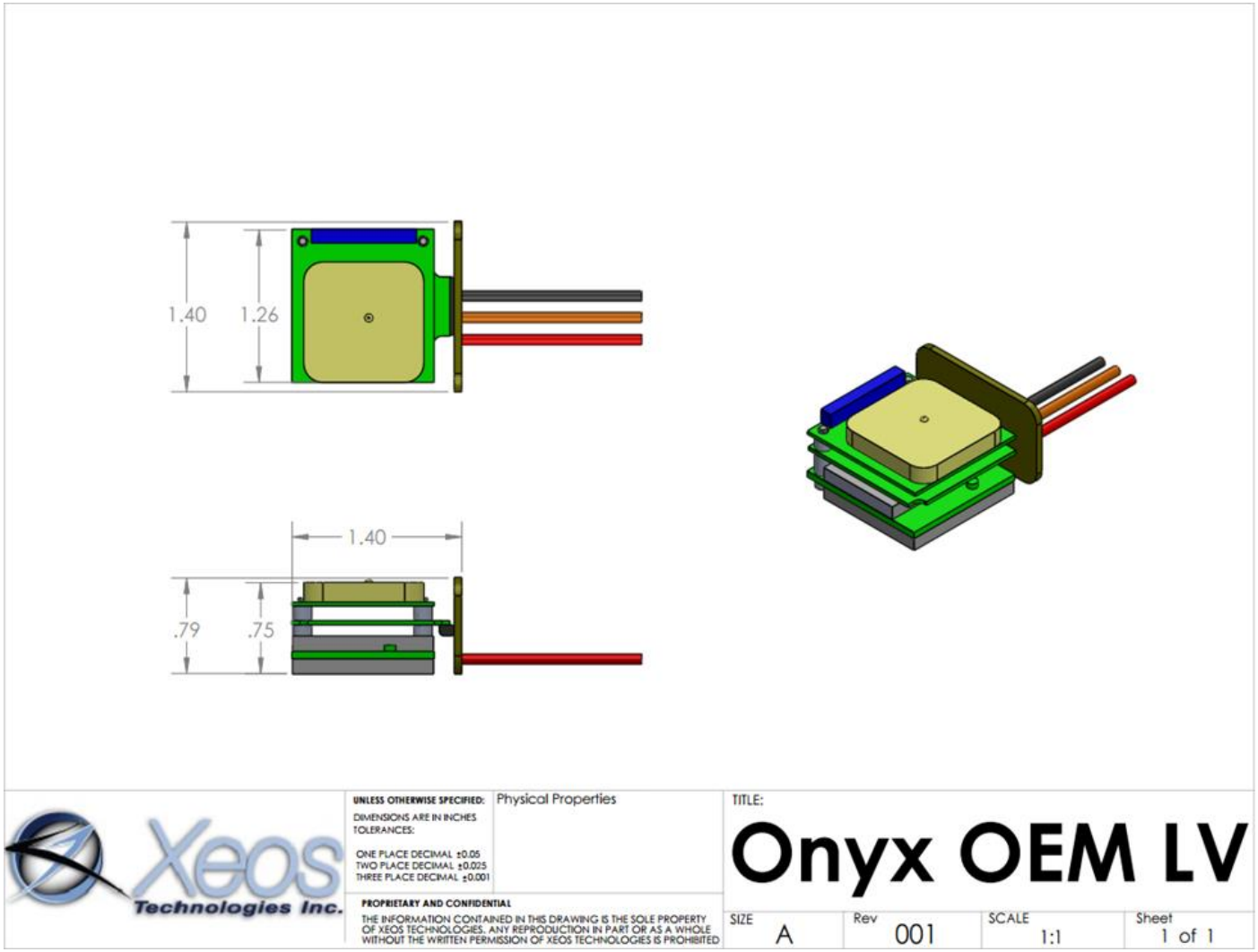
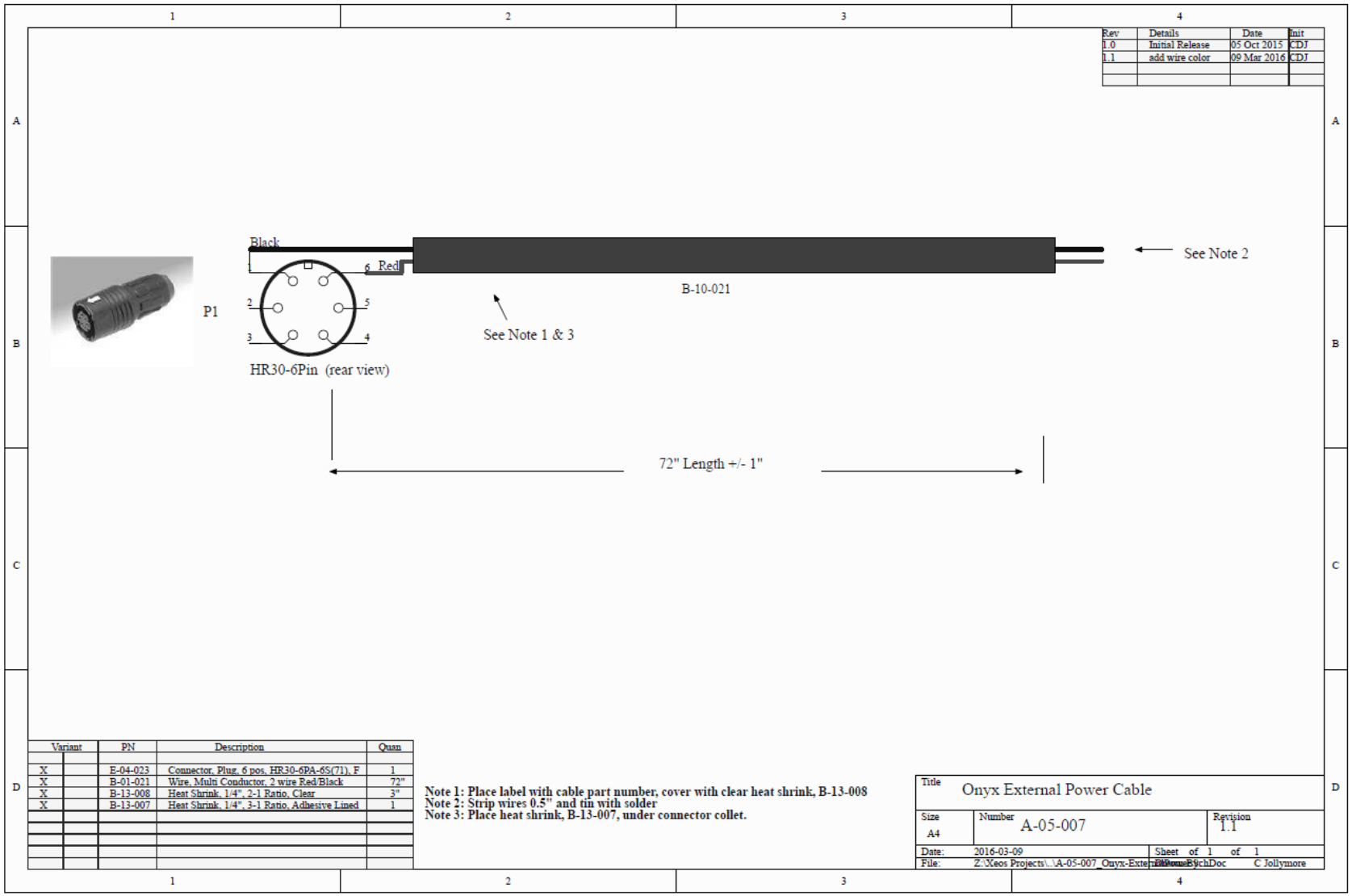
Rev
001
SCALE
1:1
Sheet
1 of 1

Onyx Low Voltage OEM



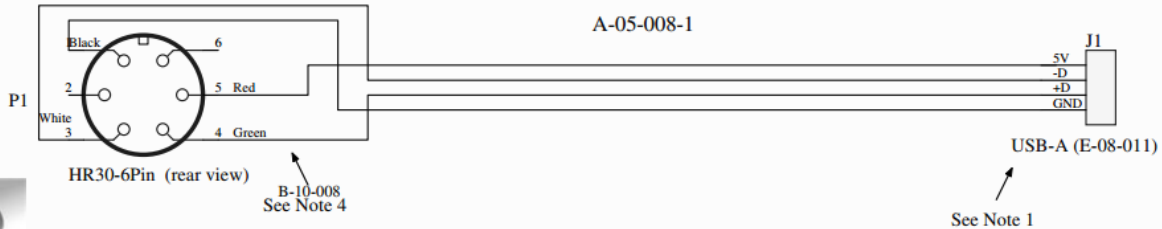
Appendix D: Cable Drawings

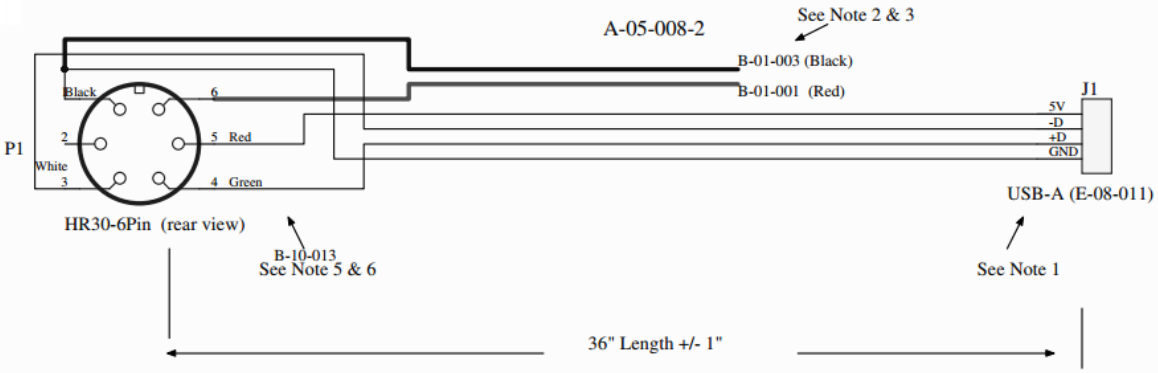
A-05-007: Onyx Hirose Power Cable/Onyx-R Hirose Charging Cable



A-05-008: Onyx Hirose/Onyx-R Hirose Diagnostic Cable

Rev	Details	Date	Init
1.0	Initial Release	17June2015	CDJ
1.1	Rev due to FAI	26 June2015	CDJ
1.2	add wire clrs, corr PN	07 Dec 2015	CDJ
1.3	Removed note 6, -1	19 Feb 2019	SM



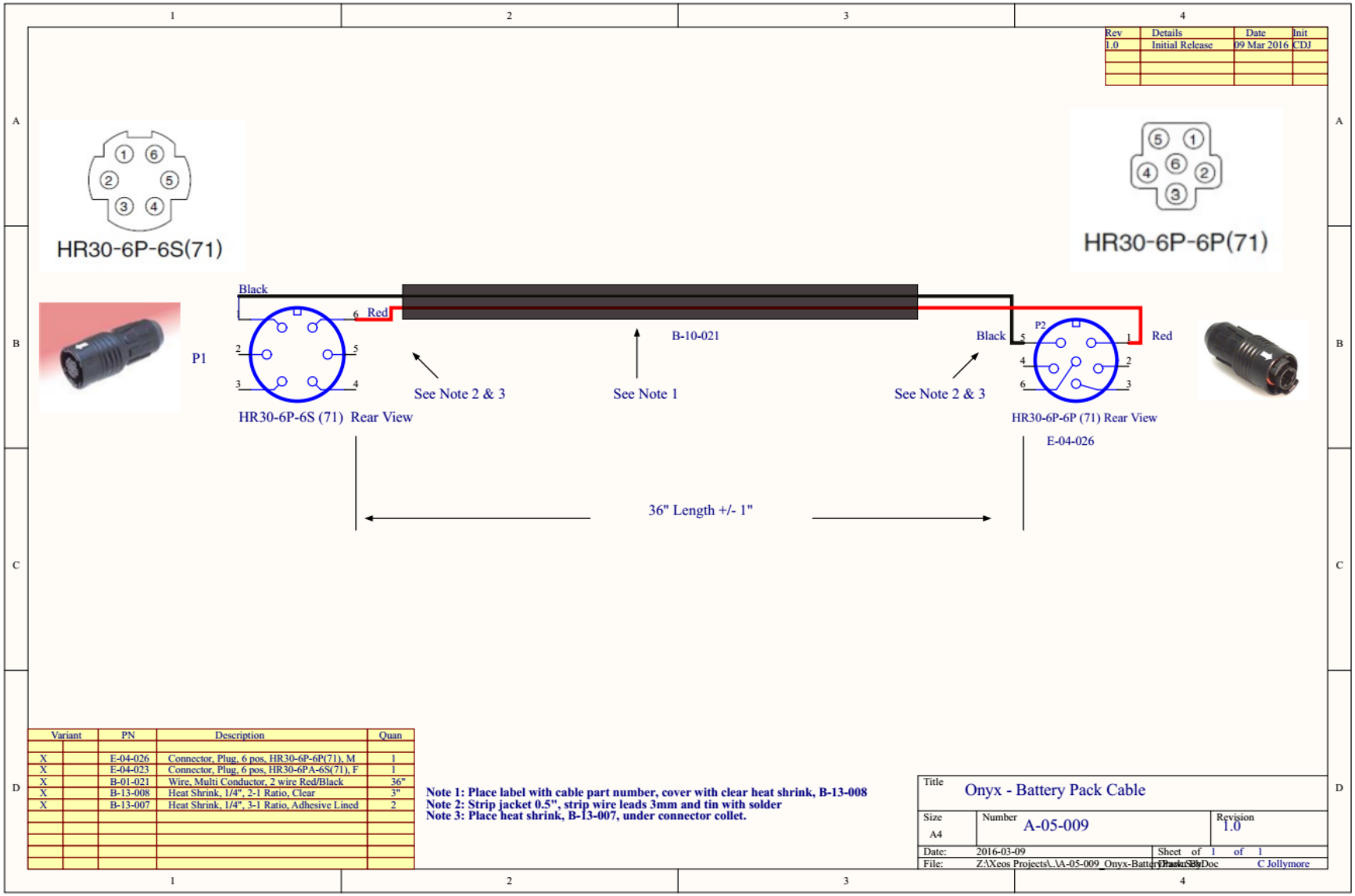


Variant -1	Variant -2	PN	Description	Quan
X	X	E-04-023	Connector, Plug, 6 pos, HR30-6PA-6S(71), F	1
X	X	E-08-011	Cable, OEM, USB-A to USB-A	0.5
X	X	B-13-008	Heat Shrink, 1/4", 2-1 Ratio, Clear	3"
X		B-10-008	Label, Onyx Programming Cable	1
	X	B-10-013	Label, Onyx Diagnostic-Pwr Cable	1
	X	B-01-001	Wire, Red, 26 AWG stranded	12"
	X	B-01-003	Wire, Black, 26 AWG stranded	12"
	X	B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	1"

Note 1: Place label with cable part number, cover with clear heat shrink
Note 2: Strip wires 0.5" and tin with solder
Note 3: Place label (tab) B-01-001 (Red wire) with '+12Vdc'
Note 4: Place label with "Programming Only", cover with clear heat shrink
Note 5: Place label with "Diagnostic", cover with clear heat shrink
Note 6: Remove plastic collar from E-04-023, use B-13-007 under connector backshell

Title	Onyx - Hirose Programming/Diag		
Size: A4	Number: A-05-008		Revision: 1.3
Date:	19-Feb-19	Sheet of 1	of 1
File:	A-05-008_Onyx-Diagnostic.SchDoc	Drawn By:	S Miller

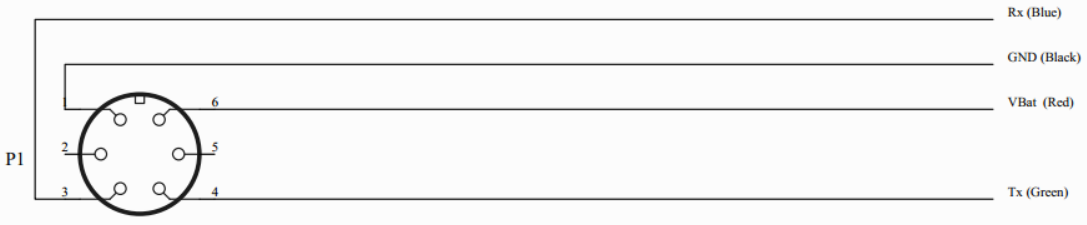
A-05-009 - Onyx Hirose to Onyx Hirose Battery Pack interconnect



A-05-036 - Onyx Hirose Relay Cable (Power/GND/Tx/Rx) all flying leads

Rev	Details	Date	Init
1.0	Initial Release	20Aug2015	CDJ

A-05-036

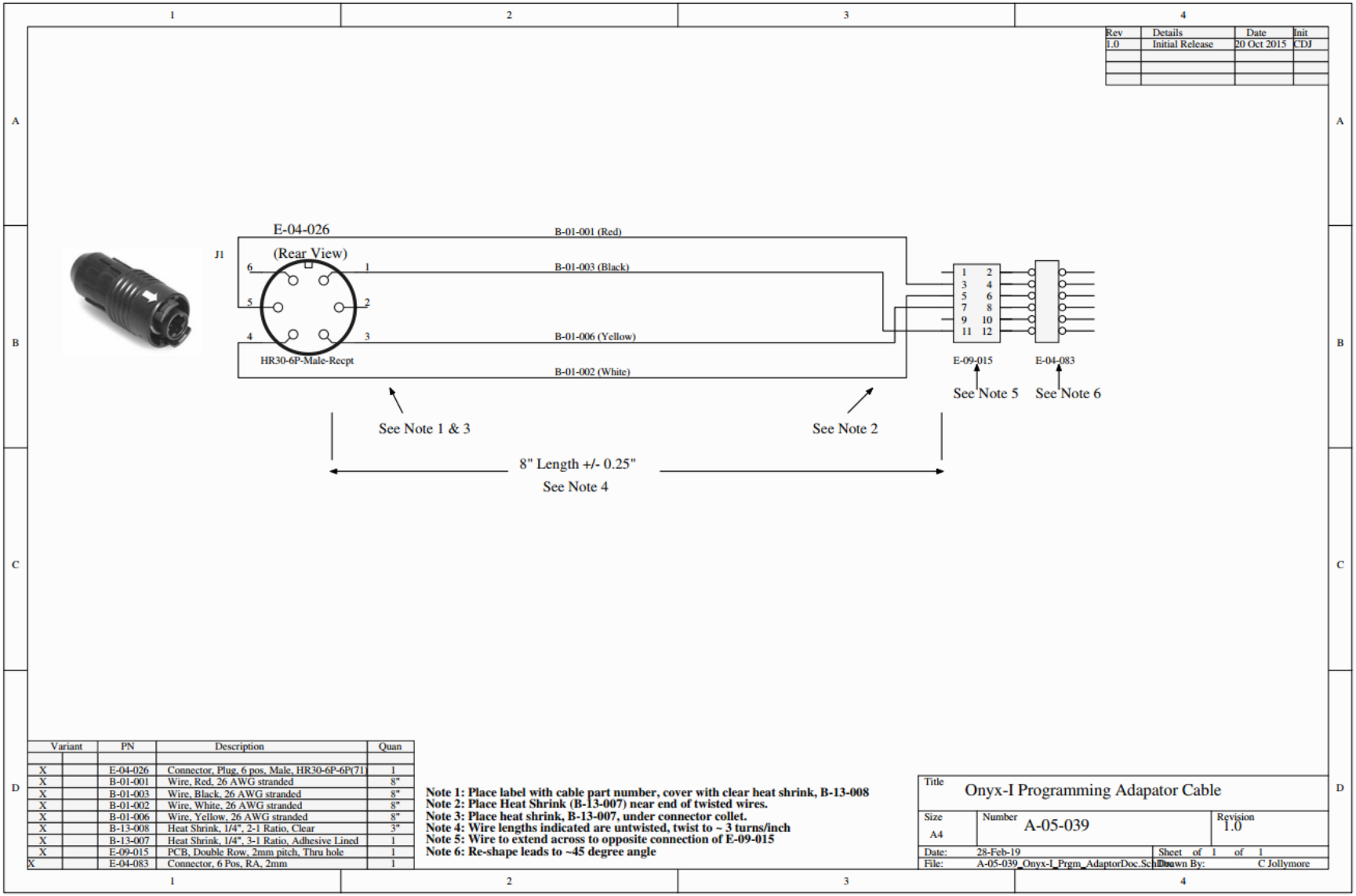


Variant		PN	Description	Quan
		E-04-023	Connector, Plug, 6 pos, HR30-6PA-6S(71), F	1
		B-01-035	Wire, Grey, 6 Conductor 26 AWG, Stranded	72"
		B-13-008	Heat Shrink, 1/4", 2-1 Ratio, Clear	3"
		B-13-003	Heat Shrink, 1/4", Adhesive lined, 3:1 Ratio	1"

Note 1: Place label with cable part number, cover with clear heat shrink (B-13-008)
Note 2: Strip wires 0.5" and tin with solder
Note 3: Cut extra wires flush to jacket and place heat shrink over (B-13-003) this end

Title	Onyx Relay Cable		
Size A4	Number A-05-036		Revision 1.0
Date:	2015-08-20	Sheet of 1 of 1	
File:	Z:\Xeos Projects\..\A-05-036_Onyx-Relay.SchDoc	Drawn By:	C Jollymore

A-05-039 - Onyx-I Programming Adaptor Cable



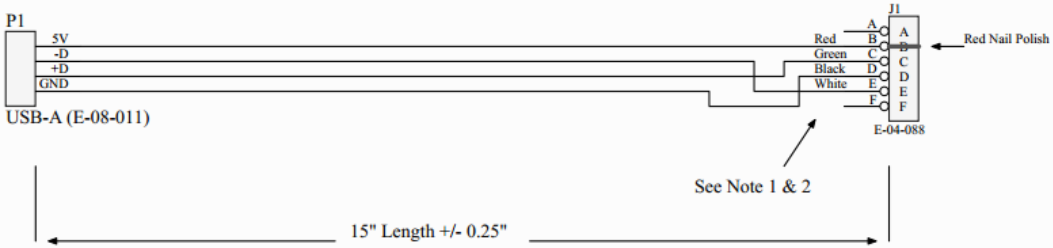
Variant		PN	Description	Quan
X		E-04-026	Connector, Plug, 6 pos, Male, HR30-6P-6P(71	1
X		B-01-001	Wire, Red, 26 AWG stranded	8"
X		B-01-003	Wire, Black, 26 AWG stranded	8"
X		B-01-002	Wire, White, 26 AWG stranded	8"
X		B-01-006	Wire, Yellow, 26 AWG stranded	8"
X		B-13-008	Heat Shrink, 1/4", 2-1 Ratio, Clear	3"
X		B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	1
X		E-09-015	PCB, Double Row, 2mm pitch, Thru hole	1
X		E-04-083	Connector, 6 Pos, RA, 2mm	1

Note 1: Place label with cable part number, cover with clear heat shrink, B-13-008
Note 2: Place Heat Shrink (B-13-007) near end of twisted wires.
Note 3: Place heat shrink, B-13-007, under connector collet.
Note 4: Wire lengths indicated are untwisted, twist to ~ 3 turns/inch
Note 5: Wire to extend across to opposite connection of E-09-015
Note 6: Re-shape leads to ~45 degree angle

Title	Onyx-I Programming Adaptor Cable		
Size: A4	Number: A-05-039		Revision: 1.0
Date: 28-Feb-19		Sheet of 1 of 1	
File: A-05-039_Onyx-I_Prgm_AdaptorDoc.SchDoc		Drawn By: C Jollymore	

A-05-041 - OnyxLV OEM Diagnostic Cable

Rev	Details	Date	Init
1.0	Initial Release	19 Nov 2015	CDJ



Variant		PN	Description	Quan
X		E-08-011	Cable, OEM, USB-A to USB-A	0.5
X		B-13-017	Heat Shrink, 1/2",Clear, 2-1	4.5"
X		E-04-088	Connector, Conn Hrd 2mm, Female, 1Row, 6POS	1
X		B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	1"

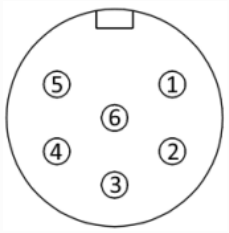
Note 1: Place label with cable part number, cover with 3" of clear heat shrink (B-13-017)
Note 2: Place 1.5" of clear heat shrink (B-13-017) over connector body and cable after marking PinB with Red nail polish.

Title	Onyx-LV Diag/Programming Adapator Cable		
Size: A4	Number: A-05-041		Revision: 1.0
Date:	2015-11-19	Sheet of 1 of 1	
File:	Z:\Xeos Projects\..\A-05-041_Onyx-LV_Diag_Prog.SchDoc	Drawn By:	C Jollymore

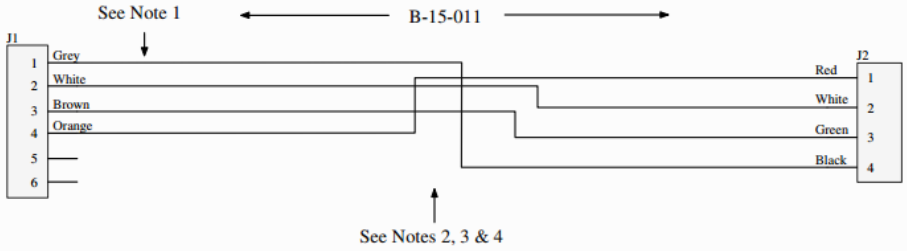
A-05-063: Onyx Chogori Diagnostic Cable

Rev	Details	Date	Init
1.0	Initial Release	04-Jan-19	SM
2.0	Convert to Altium	20-Feb-19	SM

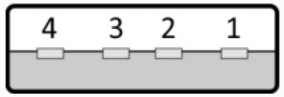
A-05-063



Front View



Cut lengths 20.5" to accomodate splice



Front View

PN	Description	Quan
E-08-011	Cable, OEM, USB-A to USB-A	20.5"
E-08-034	Cable, OEM, Bayonet 6 P molded Plug to Plug	20.5"
B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	0.75"
B-13-011	Heat Shrink, 3/8", Adhesive lined, 4ft, 3-1	1"
B-13-015	Heat Shrink, 3/32", Black, 2-1	2"
B-13-017	Heat Shrink, 1/2",Clear, 2-1	1.5"
B-15-011	WM, Abrasion Resist Jacket, 3/8"	40"

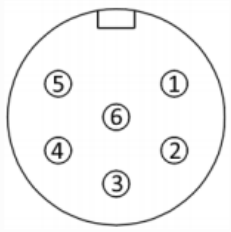
Note 1: Place label with cable part number, cover with clear heat shrink, B-13-017
Note 2: Strip wires 0.5" and tin with solder
Note 3: Cut cable to intended length, splice wires to restore connection
Cover each wire with Splicing tape
Note 4: Cover opening with Heat Shrink B-13-007, B-13-011

Title	Onyx Chogori USB		
Size A4	Number A-05-063		Revision 2.0
Date:	20-Feb-19	Sheet of 1 of 1	
File:	A-05-063_Onyx-ChigoriUSB.SchDoc	Drawn By:	S Miller

A-05-064: Onyx Chogori Power Cable (Flying Leads)

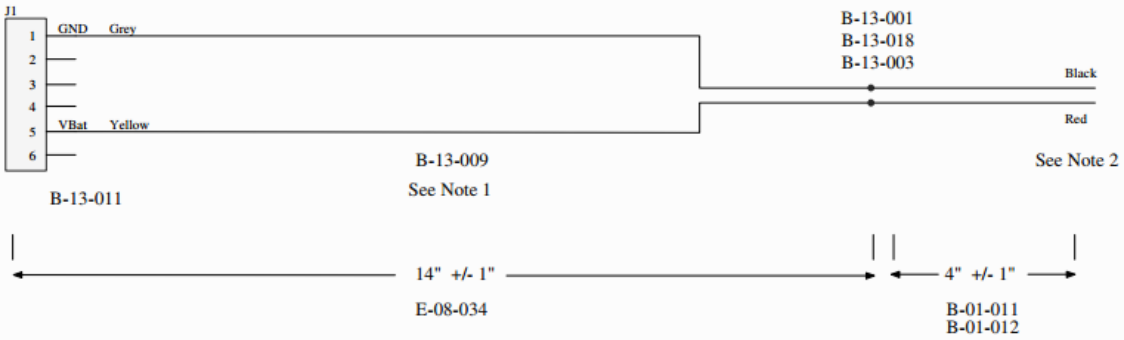
Rev	Details	Date	Init
2.0	Format Change	8 July 2019	SM

A-05-064



Front View

Chogori 6-Pin, Female
(Cable, E-08-034)



PN	Description	Quan
B-01-011	Wire, Red, 24 AWG	4"
B-01-012	Wire, Black 24 AWG	4"
E-08-034	Cable, Chogori, CUT LENGTH	0.5 ea (14")
B-13-001	HS 1/16", Black	2"
B-13-003	HS 1/4", 3-1 ratio, Adhesive lined, Black	3.25"
B-13-009	HS 1/4", Clear	2"
B-13-018	HS 1/8", Adhesive lined, Black	1.75"

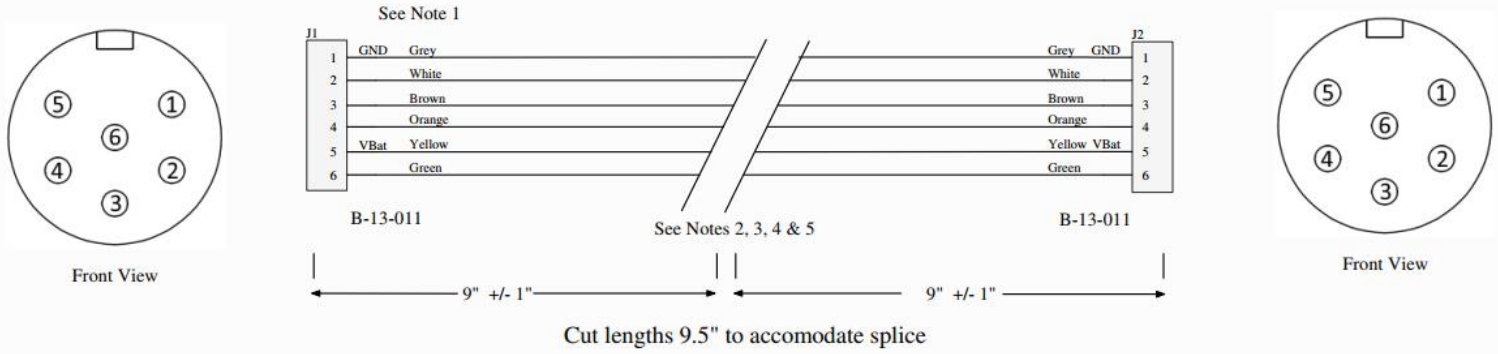
Note 1: Place label with cable part number, cover with clear heat shrink, B-13-009
Note 2: Strip wires 0.5" and tin with solder

Title	Onyx Chogori Power Cable		
Size A4	Number A-05-064		Revision 2.0
Date:	08-Jul-19	Sheet of 1 of 1	
File:	A-05-064_Onyx-ChigoriPower.SchDoc	Drawn By:	S Miller

A-05-075 – Onyx Chogori to Battery Pack Chogori

Rev	Details	Date	Init
1.0	Initial Release	04-Jan-19	SM
1.1	Adjust after Prototype	18-Jan-19	SM
1.2	Add potting/Note 5	19-Feb-19	SM

A-05-075



Cut lengths 9.5" to accomodate splice

PN	Description	Quan
E-08-034	Cable, OEM, Bayonet 6 P molded Plug to Plug	18"
B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	0.75"
B-13-011	Heat Shrink, 3/8", Adhesive lined, 4ft, 3-1	1"
B-13-015	Heat Shrink, 3/32", Black, 2-1	2"
B-13-017	Heat Shrink, 1/2",Clear, 2-1	1.5"
B-15-011	WM, Abrasion Resist Jacket, 3/8"	14"

Note 1: Place label with cable part number, cover with clear heat shrink, B-13-009
Note 2: Strip wires 0.5" and tin with solder
Note 3: Cut cable to intended length, splice wires to restore connection
Cover each wire with Heat Shrink B-13-015
Note 4: Cover opening with Heat Shrink B-13-007, B-13-011
Note 5: Encapsulate spliced section with potting

Title	Onyx Chogori Battery Cable	
Size: A4	Number: A-05-075	Revision: 1.2
Date: 19-Feb-19		Sheet of 1 of 1
File: A-05-075_Onyx-ChigoriBatt.SchDoc		Drawn By: S Miller

Appendix E: Specifications

Standard Onyx, Onyx-I, Onyx-M2, Onyx-WB

	Onyx	Onyx-I	Onyx-M2	Onyx-WB
Connector	Hirose	None	Chogori	Chogori
IP Rating	IP-65	IP-68	IP-67	IP-67
Supply Input	7 – 32V	12V (4 x CR123A Lithium), 1.8Ah	7 – 32V	7 – 32V
Idle Current @ 12V	<50µA	<50µA	<50µA	<50µA
Off Current @ 12V	<20µA	<20µA	<20µA	<20µA
GPS Current (30s average, 12V)	15mA	15mA	15mA	15mA
Iridium Current (30s average, 12V)	50mA	50mA	50mA	50mA
Dimensions (Length, Width, Height)	1.87" L 1.44" W 1.10" H	4.89" L 1.71" W 1" H	1.85" L 1.7" W 1.1" H	2.04" L 1.7" W * 1.1" H

** Onyx WB's Width including tabs is 2.9 inches.

Onyx-R, Onyx-M (Low Voltage), Onyx-LV-OEM

	Onyx-R	Onyx-LV-OEM	Onyx-M-R (Discontinued)
Connector	Hirose	None	Teledyne
IP Rating	IP-67	N/A	IP-67
Supply Input	3.6V Internal Rechargeable Lithium – 5.3Ah	3.3 – 5.5V	3.6V Internal Rechargeable Lithium – 5.3Ah, 3.3 – 5.5V *
Idle Current @ 3.6V	<100µA	<100µA	<100µA
Off Current @ 3.6V	<20µA	<20µA	<20µA
GPS Current (30s average, 3.6V)	40mA	40mA	40mA
Iridium Current (30s average, 3.6V)	120mA	120mA	120mA
Dimensions (Length, Width, Height)	4.73" L 1.7" W 1.11" H	1.40" L 1.40" W 0.79" H	1.98" L 1.70" W 1.10" H **

* Onxy-M-Rs can be powered externally due to their remote head nature.

** Dimensions laid out are for the electronics head, not battery pack.

Onyx-OEM, Onyx-Flat Variants

	Onyx OEM Stack	Onyx Flat OEM	Onyx Flat OEM Low Voltage
Connector	None	None	None
IP Rating	N/A	N/A	N/A
Supply Input	7 – 32V	7 – 24V	2.4 – 5V
Idle Current	<50µA	<50µA	<100µA
Off Current	<20µA	<20µA	<20µA
GPS Current (30s average)	15mA	15mA	40mA
Iridium Current (30s average)	50mA	50mA	120mA
Dimensions (Length, Width, Height)	1.23" L 1.30" W 0.75" H	2.62" L 1.24" W 0.50" H	2.62” L 1.24” W 0.50” H

Shared Characteristics

GPS Hardware	Xeos Technologies 48 channel GPS (SiRFStarIV, SiRFStarV as of January 2018, hardware dependent)
Antenna	Integrated Iridium and GPS antennas
Operating Temperature	Operating Temperature: -20° C to +60° C

Appendix F: Accessories

Battery Pack

For the standard Onyx and Onyx M2/WB, external battery packs are available for use. The standard Onyx's battery pack employs a Hirose connector, and the Onyx-M2/WB pack employs a Chogori connector.

Both battery packs use 9 AA batteries in series for a nominal voltage of 13.5 Volts.

Hirose Battery Pack

Chogori Battery Pack

Magnet Plate

Onyx variants have optional mounting holes for the addition of magnets, through the use of a plastic magnet plate.

To add the magnet plate to the Onyx:

- Lay the magnet plate flat-face down on a magnetic surface
- Add the magnets to the plate
- Lay the Onyx over the plate
- Slide the assembly partially off the magnetic surface and add the first mounting screw
- Slide the assembly from the surface fully and add the remaining screws

Not all magnet cups require magnets; 2 for the regular Onyx and 4 for the Onyx-I/R are normally sufficient. Ensure that the magnetic reed switch on the device is still operational before deployment when mounting Onyx-I's and R's.

Onyx Serial Dongle

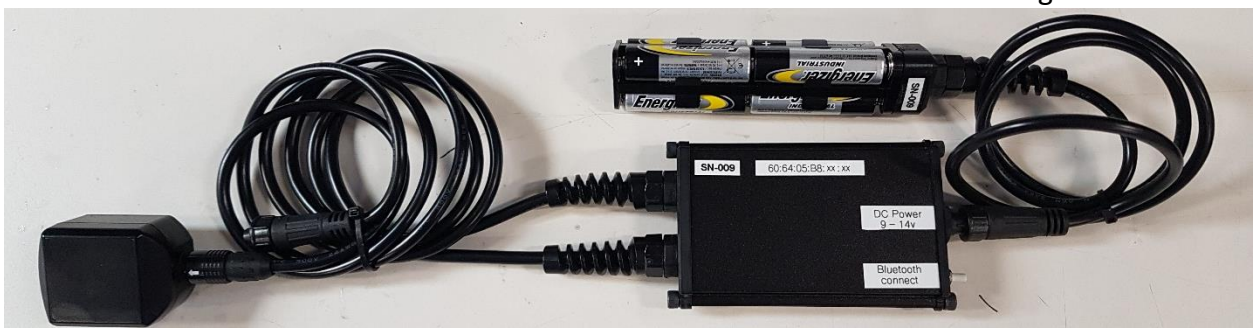
The Onyx Serial Dongle allows for Bluetooth communication between an Android device with the Xeos Beacon app, and a connected Onyx device. It is only for use with Onyx models that are powered at the standard voltage (9 - 14 Volts).

Before using the Dongle

- Ensure the Xeos Bluetooth app is installed on your mobile device. (https://manuals.xeostech.com/bluetoothapp/)
    - The file is downloaded as an .apk to install manually on an Android device
    - Allow **"Unknown Sources"** under Settings > Security to install raw .apk files.
- Or, download from the Google Play Store

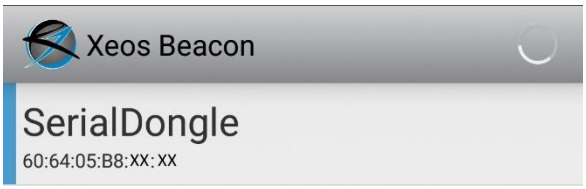
Setup

- Connect the target Onyx to the Bluetooth Dongle.
- With the batteries installed in the pack, connect the battery pack to the Bluetooth Dongle.
- Press the **BLUETOOTH CONNECT** button on the side of the Bluetooth Dongle.



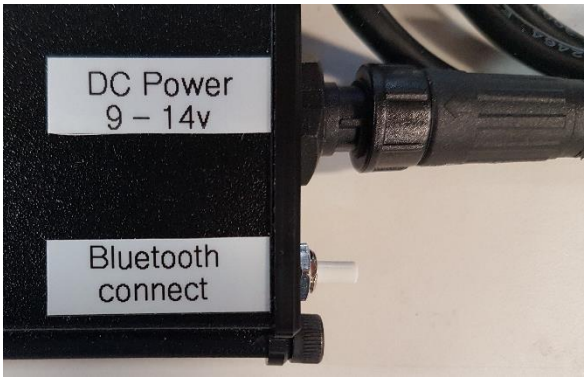
Bluetooth Connection

- Open the Xeos App. The Bluetooth Dongle will advertise its name for connection.
    - If there are multiple dongles powered, match the MAC address displayed to the label on the dongle to ensure connection to the intended device.



Disconnecting

- Returning to the main menu on the app will disconnect the mobile device from the dongle.
- Press the **BLUETOOTH CONNECT** button at any point where the Onyx has been reset or replaced with another Onyx (Firmware upgrade completion, resetting via command or physical disconnection).

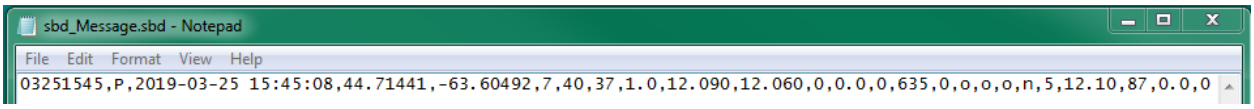


Appendix G: GPS Text Long

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 Onyx.



GPS Text Long Readout	
03251545	Date and Time, MMDDHHMM
P	Position Type message
2019-03-25 15:45:08	Date and time, adds year and second of fix
44.71441	Latitude
-63.60492	Longitude
7	Number of satellites seen
40	Maximum SNR of fix
37	Time to fix
1.0	HDOP (Horizontal Dilution of Precision)
12.090	Loaded Voltage
12.060	Unloaded Voltage
0	Temperature
0.0	Speed
0	Heading
635	GPS Horizontal Error
0	Watch Circle Set 1 (Yes) 0 (No)
o	Geofence 1 In/Out
o	Geofence 2 In/Out
o	Geofence 3 In/Out
n	Alarm State (Motion Only)
5	RSSI (Iridium signal strength)
12.10	Battery Voltage
87	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 Onyx 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.