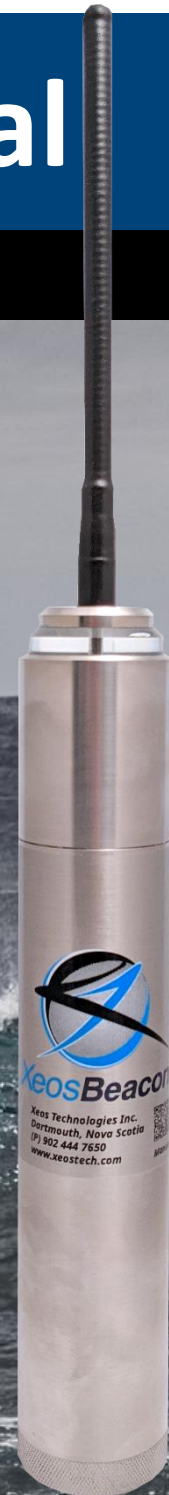




Xeos
Technologies Inc.

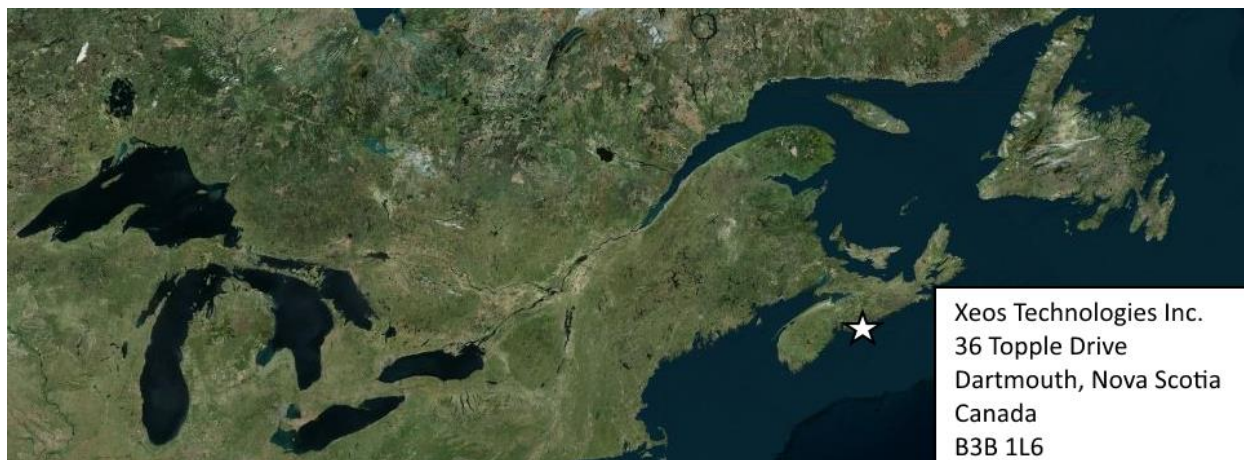
Petrel-X User Manual

Submersible AIS-Compatible Beacon



Version 1.1
April 2024

Shipped From



Contact Us

Email support@xeostech.com
Phone +1 (902) 444-7650
Fax +1 (902) 444-7651
Website xeostech.com

Specifics

The Petrel-X is the successor to the Petrel. For the manual of the original Petrel, please see [here](#).

Version History

Version No.	Date	Description
1.0	Apr 2024	Initial release
1.1	Apr 2024	Converted consumption to Watts

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

Preliminary Setup.....	4
Outside Diagram.....	4
Physical Connection (Remote Head).....	4
Petrel-X Operation	5
Installation.....	5
Operational Tips	5
State Diagram.....	5
Petrel-X Operating Modes	6
Powering the Device	6
Using the Magnet Switch	6
Self-Test Failure Codes	7
Water Sensing.....	11
Tilt Sensing	11
Bluetooth	11
Commands	12
Settings and Defaults	13
Maintenance	14
Battery Pack	14
O-Rings	15
Electrical Specifications.....	16
Maintenance Specifications.....	16
Mechanical Documentation.....	16
Connector Pinout	17
Petrel-X Remote Head.....	17
Battery Pack	17
Warranty, Support and Limited Liability.....	18

Preliminary Setup

Outside Diagram

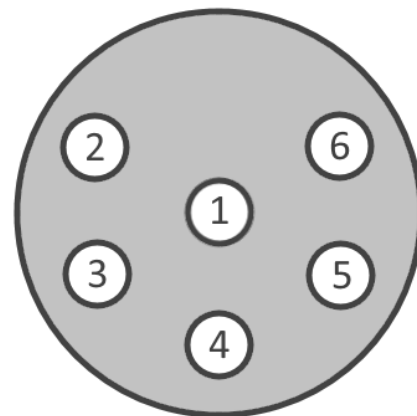
The Petrel-X has several items of note to help identify a specific device. Shown below are those identifiers along with key sections.



1	The AIS antenna is screwed into the top of the Petrel-X and must be installed before operation
2	The on/off LED of the Petrel-X is located here. The titanium sections above and below the glass must be shorted to trigger the water sense
3	The magnet switch for turning the Petrel-X on and off is located directly below the glass
4	The meeting point of the electronics head and battery chamber is torqued and should not be opened. A sealing O-ring is installed here.
5	The factory serial number of the Petrel-X is on the label.
6	A QR code is available to scan to download the manual on the label
7	The bottom endcap is hand-tight for battery replacement. A sealing O-ring is installed here.

Physical Connection (Remote Head)

Pin Number	Name
1	N/C
2	N/C
3	N/C
4	+V Battery
5	N/C
6	Ground



Connector: MCBH-6F-TI, External View

Petrel-X Operation

Installation

When installing the Petrel-X there are several factors that can influence performance.

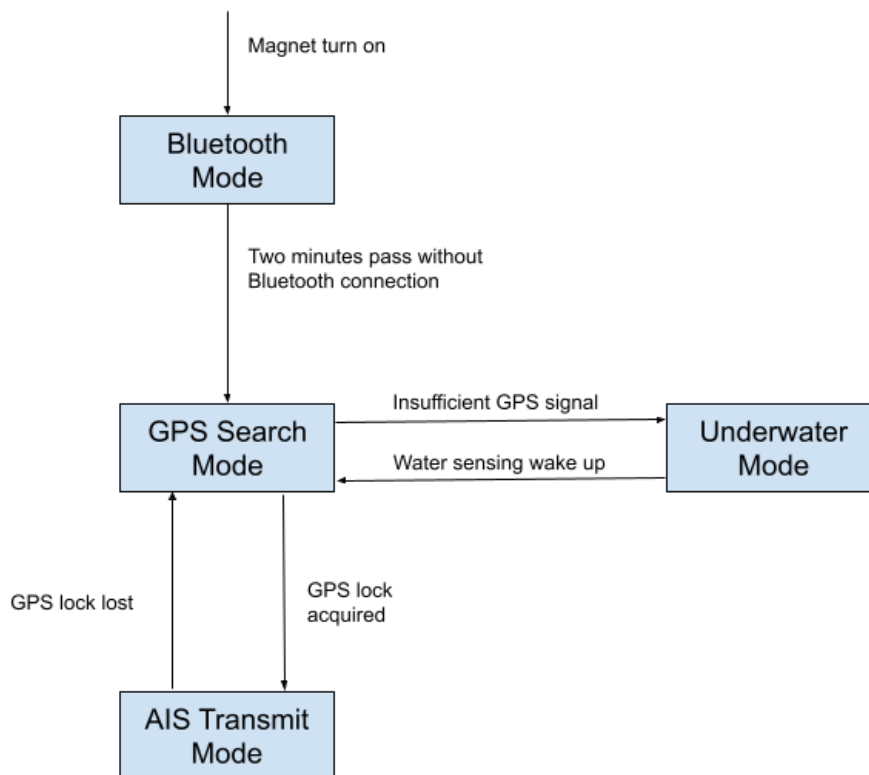
- The Petrel-X’s head must be pointing directly upward as much as possible.
- GPS and AIS performance may suffer if large angles of the sky and horizon are blocked, such as if the Petrel-X is next to a wall.
- Do not use conductive material at the top of the Petrel-X around the glass lens; this will cause the water sensor to fail.

Operational Tips

- Connecting power, or power cycling the device will cause the device to restart from the beginning of its operational cycle.
- The beacon requires a good view of the sky for any test. It is necessary that any tests be done outside of a building, far from potential obstructions.

State Diagram

Below is a diagram of the various transitions in the Petrel-X.



Petrel-X Operating Modes

Powering the Device

The Petrel-X will turn ON as soon as power is given to the device. Due to this, starting or resetting the device can be achieved by adding batteries and closing the bottom endcap. Once the Petrel-X is powered, it will flash a green LED for several seconds while initializing. Once initialization is complete, it will stop flashing. During startup, the Petrel-X will perform a self-test. If the self-test fails, the unit will flash a self-test error code. See the [Self-Test Failure Codes](#) section for more information.

In situations where the device is closed and the desired state is **OFF** (for example, during transit) the magnetic switch can be used. However, be aware that there is still a small amount of power consumption even when the Petrel-X has been turned off with the magnetic switch. For this reason, always remove the batteries if the Petrel-X is being stored long-term.

Using the Magnet Switch

The Petrel-X can be turned **ON** and **OFF** using an external magnet near an internal magnetic switch, located just below the glass. The Petrel-X will flash an LED to indicate its ON/OFF state after 1-2 magnet swipes near the switch. A **green** LED flash means the unit is ON, a **red** LED flash means the unit is OFF.

To change the Petrel-X to the opposite ON/OFF state, swipe the magnet repeatedly until the LED color changes to that of the desired state.

For example, if the unit is currently ON and needs to be turned OFF, swipe the magnet repeatedly until the LED changes from green (ON) to red (OFF). Once the red LED is seen, the device will transition to the off state.

Unit Status Indicators	
Action: Turn On	Swipe magnet across switch until LED is solid green
Action: Turn Off	Swipe magnet across switch until LED is solid red

The Petrel-X can be turned on or off using the magnet turn-off method any time, regardless of its current state.

Self-Test Failure Codes

The Petrel-X performs a self-test every time it is turned ON, either by applying power or turning it ON with the magnet switch.

If any of the self-test criteria fail, the Petrel-X will flash its **RED** LED in an error code pattern to indicate which criteria failed. If multiple criteria fail, only the highest priority failure code will be displayed. These patterns are in Morse code (short and long flashes), writing the first letter of the criteria that failed

The table below shows the failure code patterns, with the highest priority criteria at the top.

Voltage	•••—
GNSS	— — •
Flash Memory	••—•
EEPROM	•
Bluetooth	—•••
Accelerometer	•—

Bluetooth Mode

Bluetooth Mode is the initial state of the Petrel-X after a reset or power-up. In this mode, Bluetooth is active and can be connected to with the [Xeos Beacon Bluetooth App](#).

If no Bluetooth connection is made in **2 minutes**, the unit will proceed to GPS Search Mode. However, if a Bluetooth connection is established, the unit will stay in Bluetooth mode at least one minute after the most recent Bluetooth session has ended.

If the Petrel-X unit has exited Bluetooth mode before a Bluetooth connection could be made, the magnet can be used to reset the unit, to re-enter Bluetooth mode.

While in Bluetooth mode, both the AIS and GPS functionality of the unit are inactive. The unit will not attempt to acquire a GPS lock and will not transmit or receive AIS messages.

GPS Search Mode

In GPS Search Mode, the Petrel-X unit will attempt to acquire a GPS lock. While in this mode, the unit's Bluetooth and AIS functionality are inactive.

If the attempt to acquire a GPS lock is successful, the unit will proceed to AIS Transmit Mode. If the unit cannot acquire a GPS lock within the GPS timeout period, the unit will move to Underwater Mode. The GPS timeout period can be configured with the **\$gpstimeout** command.

AIS Transmit Mode

In AIS Transmit Mode, the Petrel-X will maintain its GPS lock and activate its AIS functionality to transmit and receive AIS messages. While in this mode, the unit's Bluetooth functionality is inactive.

The Petrel-X will continuously receive AIS messages and interpret them in order to build an internal AIS slot map. This slot map is used to avoid slot collisions with other AIS devices when the Petrel-X chooses to transmit.

The Petrel-X will wait at least 1 minute before transmitting to ensure it has fully mapped which AIS slots are in use. Once this process is complete, it will use its slot map and slot selection algorithm to find two consecutive free slots. Two slots are required because the Petrel-X transmits AIS message type 21, which fills two AIS slots.

A Petrel-X's AIS transmissions contain an **MMSI** and an **AIS name**.

- The AIS name is made of up to 20 characters, which can be a combination of uppercase letters (A-Z), numbers (0-9). Some special characters are also supported, such as dashes and commas. The AIS name can be set by the user.
- The MMSI is set during the assembly phase and cannot be changed by the user.

A Petrel-X's first transmission after entering AIS Transmit Mode will always be on AIS channel B. It will then proceed to alternate between channels A and B for successive transmissions.

If the Petrel-X loses its GPS lock while in AIS Transmit Mode, it will return to GPS Search Mode and attempt to regain the GPS lock. Repeatedly losing and regaining GPS lock may cause the unit's transmission period to deviate from the usual 3 minutes, and cause it to perform consecutive channel B transmissions.

Underwater Mode

While in Underwater Mode, the Petrel-X will turn off all non-essential functionality and put itself into a sleep state to minimize power consumption. At regular intervals (every 30 seconds by default), the Petrel-X unit will perform a water sense check to determine if it is above water or submerged. If the check indicates that the unit is above water, it will exit Underwater Mode and return to GPS Search Mode.

Due to environmental concerns such as biofouling, it is possible for the water sense check to result in false positives. To combat this problem, the Petrel-X has a backup counter that automatically returns the unit to GPS Search Mode when it expires. In the event the unit surfaces, but cannot sense the lack of water due to biofouling, the unit will still progress to GPS Search Mode when the backup timer expires. The duration of this timer is user-adjustable by changing the **GPS Backup Period** setting, which is set to every 12 hours by default.

If the backup counter expires while the unit is still underwater, it will transition to GPS Search Mode while underwater. In this situation, the unit will not be able to receive messages from any GPS satellites at sufficient signal integrity. It will therefore return to Underwater Mode once the GPS session times out.

Water Sensing

The Petrel-X's water sensor is used to detect whether it is above water or submerged. The sensor measures the resistance between the antenna and the electronics head. When the Petrel-X is above water, the water sensor is not used. The water sensor will only begin measuring once the unit enters underwater mode in an effort to detect surfacing events.

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

Tilt Sensing

In some applications, a Petrel-X may be installed on a device whose orientation changes when it is surfacing compared to when it is staying submerged. A Petrel-X can be configured to use internal orientation sensing as a replacement for its conventional water sensing.

When tilt-sensing is enabled (using the **\$usetilt 1** command), the Petrel-X will perform tilt checks **instead** of normal water-sense checks. When using tilt-sensing instead of water-sensing, being upright (antenna pointed towards the sky) is considered **Surfaced** and will cause the unit to go to GPS Search Mode. The Petrel-X will stay in underwater mode if it is kept inverted (antenna pointed towards the earth). Tilt checks are performed with the same schedule and timing as water checks.

The cutoff between upright and inverted is approximately 120 degrees from the upright position. So a Petrel-X will consider itself upright rather than inverted if it is laid down sideways, since that is only 90 degrees off from being upright.

When using tilt sensing, the conventional water sense is not used. The Petrel-X can only use one or the other.

Bluetooth

The Petrel-X has integrated Bluetooth hardware to facilitate local communication with the user for configuration and firmware upgrades via the [Xeos Beacon Bluetooth App](#).

The Petrel-X's Bluetooth will advertise while in Bluetooth mode, after boot. When a Bluetooth connection is established, the unit will flash its green LED several times.

Bluetooth mode normally lasts for 2 minutes after the unit is turned on. If a Bluetooth connection is established, the unit will not exit Bluetooth mode until at least 1 minute has passed since the last Bluetooth session ended.

Commands

Below are commands for the Petrel-X.

- Each command starts with a dollar sign (\$). The Bluetooth app prepends this automatically.
- If a parameter is possible (marked with an X below), that parameter can be an integer to change the setting, or can be left blank to query the current settings. Please refer to the [Settings and Defaults](#) section below for limits and defaults.

Command	Description
aisname [name]	Set the ais name that the unit will use in its AIS messages. Maximum 20 characters, using uppercase letters (A-Z) or numbers (0-9). If no name is given, the unit will just print its current name.
settings	Show all settings and thresholds.
gpstimeout X	Duration GPS runs before shutting off, in minutes.
wsthresh X	Change or query the water/underwater threshold.
wsperiod X	The rate of water-sense (or tilt-sense) checks while in the underwater mode. Sent as an integer representing the number of seconds in between water checks.
wsbackper X	The period of backup GPS checks while in underwater mode, in hours.
usetilt X	Send parameter 1 to use tilt-sensing instead of water-sensing to detect surfacing (upright = surfacing; inverted = submerged). Send parameter 0 to use water-sensing instead of tilt-sensing (default).
readsensor	Perform a reading with each sensor (voltage, water-sense and tilt-sense). Note: Results will not be printed until the viewsensor command is sent.
viewsensor	Display the latest sensor readings.
sysinfo	The unit will display system information.
resetnow	The unit will reset itself. No settings will be changed.
skipbt	The unit will disconnect from any Bluetooth connection, exit Bluetooth mode and proceed directly to GPS Search mode.
factorydefaults	Sets all the user-adjustable settings (except the AIS name) back to their default values. The AIS name has to be manually changed with the \$aisname command.
ver	Show the unit's current firmware and hardware version, as well as some other information about the unit.

Settings and Defaults

Setting	Default	Min	Max	Description
GPS Timeout	10 min	1 min	60 min	Length the Petrel-X will be in GPS Search Mode before timing out and transitioning to Underwater Mode.
Water Sense Threshold	2	0	65535	The numerical boundary between submerged and surfaced.
Water Sense Period	30s	5s	600s	The rate at which the water sense measurement is taken.
GPS Backup Period	12 hours	1 hour	48 hours	Time between backup GPS checks.
Use Tilt	0	0	1	When ON (1) the Petrel-X will use its tilt sensing to determine if it is underwater or not, instead of the conventional water sense circuit.
AIS Name	Up to 20 characters, which can be uppercase letters or numbers. Some special characters are also supported.			The name of the Petrel when it transmits over AIS.

Maintenance

Battery Pack

The power source for the Petrel-X is its battery pack. There are two battery pack sizes for the Petrel-X:

Long Pack	7 Energizer LR20 D-Cell Alkaline	10.5V
Short Pack	3 Saft LSH20 D-Cell Lithium	10.8V

For Lithium models, only the Saft LSH20 has the ability to source enough current to supply peaks in AIS transmissions.

Replacing Batteries

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

To replace the batteries:

- Slowly unscrew the bottom endcap of the Petrel-X. Any batteries already installed are under spring pressure.
- Tip the old batteries out of the enclosure. Make sure to dispose of them appropriately.
- Slide the first battery into the column, ensuring that the positive (+) terminal faces the head of the Petrel-X (or SubConn connector if a Remote Head).
- Add the remaining batteries in the same orientation.
- Restore the endcap to its place on the device, taking care to inspect the O-ring first.

Batteries should be removed if the device is entering storage.

DO NOT MIX BATTERY TYPES

O-Rings

The Petrel-X has permanent O-rings installed in the head that are not meant to be replaced. The head of the Petrel-X proper is torqued at the factory to prevent accidental opening.

The O-ring of the battery pack endcap is user-replaceable and should be visually inspected to make sure it is properly seated in its groove. It should also be inspected for visible damage or debris.

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

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



All Petrel-Xs employ O-ring size **2-031/N70** in their endcaps.

Replacing O-Rings

To replace the O-Ring:

- Remove the old O-ring, and clean all dirt away from the threads and grooves where it was seated using a lint-free cloth, cleaning alcohol, and a soft-brush.
- Apply a thin layer of seal lubricant (**MOLYKOTE 111** from Dow Corning) to the new O-ring.
- Slide the new O-ring down over the threads of the endcap and into the O-ring groove.

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

Connector Grease (Remote Head)

The connector for every Petrel-X Remote Head and battery pack manufactured at Xeos is filled with grease to protect the conductive material. If replenishing this grease, Xeos recommends **MOLYKOTE 44 Medium**.

Electrical Specifications

Power Supply	
Supply Range	7 – 28 VDC
Battery Supply (Xeos Battery Pack)	Short Pack - Qty 3 Saft LSH-20, D-Cell, 10.8V Nominal Long Pack - Qty 7 Energizer Industrial LR-20, D-Cell, 10.5V Nominal
Battery Capacity	Short Pack – 140.4 Wh Long Pack – 183.75 Wh

Power Consumption Average (Assumes default settings)	
GPS Search Mode	195mW
AIS Operation Mode	320mW
AIS Transmission (~50ms duration)	1.45W
Bluetooth Mode	40mW
Underwater Mode	480μW
Device Off	300μW

Batteries should be removed if the device is entering storage.

Electronics	
Digital Controller	Xeos Petrel-X
GNSS Receiver	uBlox MAX-8C-0
Antenna	Xeos proprietary antenna, designed to withstand high pressure environments

Maintenance Specifications

O-rings	
O-ring Size	2-031/N70
O-ring Lubricant	MOLYKOTE 111

SubConn	
Connector Lubricant	MOLYKOTE 44 Medium

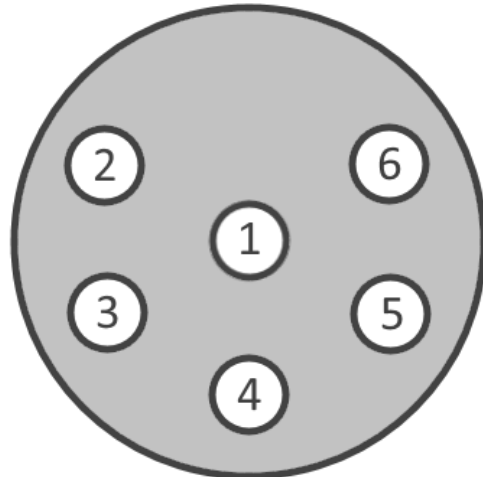
Mechanical Documentation

All Xeos Drawings are hosted in STEP and PDF format on drawings.xeostech.com

Connector Pinout

Petrel-X Remote Head

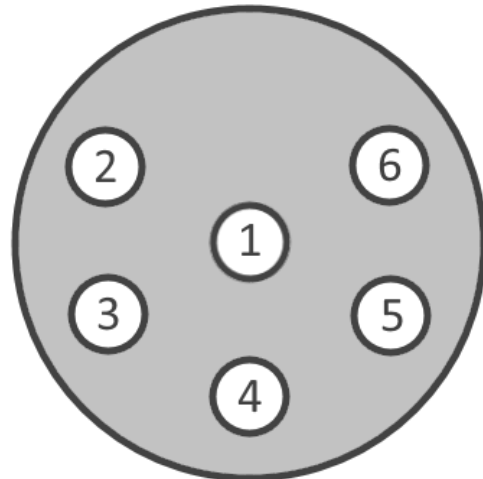
Pin Number	Name
1	N/C
2	N/C
3	N/C
4	+V Battery
5	N/C
6	Ground



Connector: MCBH-6F-TI, External View

Battery Pack

Pin Number	Name
1	N/C
2	N/C
3	N/C
4	+V Battery
5	N/C
6	Ground



Connector: MCBH-6F-TI, External View

Warranty, Support and Limited Liability

Xeos Technologies Inc. warrants the Petrel-X 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.