

NOVATECH Beacons & Flashers



Mini-Beacon **MMI-7500**

-RH

-MAXI-7

-MAXI-3

-OEM

**Iridium/GPS Satellite Beacon
Operation & Maintenance Manual**

TD 13-053
Version 1.3
July 2014

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Table of Contents

1	SAFETY INFORMATION	1
1.1	PRESSURE CASE	1
2	INTRODUCTION	2
3	QUICK START	3
4	INSTALLATION.....	4
4.1	ALTERNATIVE POWER OPTIONS	4
4.2	ANTENNA.....	5
4.3	PRESSURE CASE	5
5	OPERATING INSTRUCTIONS	6
5.1	ON/OFF	6
5.2	BATTERIES	6
5.3	TEST OPERATION	7
6	OPERATION	8
6.1	CONFIGURATION	11
6.2	IRIDIUM SATELLITE COMMUNICATION	12
6.3	BLUETOOTH® COMMUNICATION.....	13
6.4	CONFIGURATOR SOFTWARE TOOL	16
6.5	TRANSMISSION DATA FORMAT	18
7	MAINTENANCE.....	20
7.1	REGULAR MAINTENANCE	20
7.2	BATTERY CHANGE	20
7.3	“O” RING FACTS	23
7.4	“O” RING MAINTENANCE	24

7.5 CORROSION PREVENTION 25

8 LICENSING REQUIREMENTS26

9 WARRANTY27

SPECIFICATIONS28

MMI-7500-OEM SPECIFICATIONS30

SALES AND SERVICING31

List of Figures

Figure 1: Magnet Placement on Head Assembly 6

Figure 2: Bottom end caps removed for battery change..... 21

1 Safety Information

1.1 Pressure Case

As with any sealed pressure case, the contents could be under pressure due to a battery or seal failure. This could expel the batteries when either end cap of the case is removed. To be safe, always point the end being opened away from you during opening. The end caps are designed to vent internal pressure as they are being removed. If venting is heard during end cap removal, stop removal until venting has stopped. If a battery is trapped in the case take extreme care, there could be a pressure buildup behind it and the battery could be expelled at any time.

2 Introduction

The MMI-7500 is a self-contained submersible Iridium/GPS Satellite Beacon designed to assist in the location and recovery of underwater oceanographic equipment. It may be submerged for long periods in ocean down to 7500 meters (24,600 feet).

The MMI-7500 does not transmit when submerged. The MMI-7500 monitors water conductivity to determine submergence state. The MMI-7500 may be disabled by attaching a magnet to the indicated location on the head assembly for extended power savings.

At the surface the MMI-7500 transmits its GPS position at a pre-configured interval.

There are various power options available for the MMI-7500 to accommodate various mission life and size requirements. This manual covers all technical details of the MetOcean Data Systems Ltd. MMI-7500 product line.

- MMI-7500 – Iridium Mini-Beacon (9x CR123A tube)
- MMI-7500-MAXI-7 – Iridium Mini-Beacon (7x “D” tube)
- MMI-7500-MAX-3 – Iridium Mini-Beacon (3x “D” tube)
- MMI-7500-RH – Iridium Mini-Beacon Remote Head
- MMI-7500-OEM – Iridium Mini-Beacon Electronics only

3 Quick Start

1. Remove the magnet prior to attaching the head assembly to the battery tube unless a delayed activation is needed. For the –RH version (Remote Head), confirm power is applied to the head assembly.
2. Insert batteries into the battery tube and attach the head assembly to the battery tube.
3. Check that the head assembly at the end of the Pressure Case is secure, clockwise finger tight.

Note: Successful operation of the mini-beacon relies on maintaining a water tight seal. When closing the unit, position the beacon so that the O-ring is held in place by gravity. This can prevent the O-ring from being dislodged and improperly sealing the beacon. Please refer to section 8.3-8.4 for information regarding proper O-ring maintenance.

4. Optionally, establish a Bluetooth serial connection to the beacon if modifications to the configuration are required.
5. Confirm the MMI-7500 is transmitting Iridium messages by using an Iridium message detector like the JouBeh Technologies iON Iridium Detector.
6. MMI-7500 is ready to be deployed.

4 Installation

Various installation factors can affect the performance of the MMI-7500. Install the unit in a location that will ensure that at the surface of the head assembly will be vertical and well out of the water. Keep the antenna clear of metal obstructions – nearby metal can absorb some of the RF energy.

4.1 Alternative Power Options

The MMI-7500 uses a 9 x CR123A Lithium battery tube; however, other power options are available for the head assembly. Refer to the MetOcean Mission Life Estimator for details on the mission life of the various power options.

<http://lifetimeestimator.metocean.com>

The MMI-7500-OEM head assembly is a modular component that may be used in different power configurations as outlined below.

MMI Power Configurations

Configuration	Power Source	Dimensions	Mass
MMI-7500	9x CR123A cells	Ø 2.2" x 15.5"	810g
MMI-7500-MAXI-7	7x D Alkaline cells (Lithium available)	Ø 2.2" x 20.75"	3550g (Alk) 3200g (Li)
MMI-7500-MAXI-3	3x D Lithium cells	Ø 2.2" x 11.25"	1500g
MMI-7500-RH	6x C Alkaline cells (Lithium available)	Ø 3.5" x 4.0" + Ø 1.75" x 21.5"	2700g
MMI-7500-OEM	Custom Power	Ø 2.2" x 2.21"	220g

4.2 Antenna

The MMI-7500 is supplied with a dual band combined GPS and Iridium patch antenna. It is integrated inside the head assembly, pre-tuned at the factory, and is not user serviceable.

4.3 Pressure Case

When mounting the pressure case take care to prevent any side loading on the head assembly. Over time, side loading on this part could cause a leak.

To minimize corrosion, NEVER mount the pressure case directly to metal. Isolate the pressure case by wrapping it with vinyl tape or a similar material at the contact points.

5 Operating Instructions

5.1 On/Off

The device may be forced to the low-power Sleep mode by actuating the magnetic reed switch, located on the head assembly (identified by an etched cross-hatched circle) with an externally placed magnet. The device is ON by default when power is applied and the magnet is used to force the assembled beacon to Sleep for extended power savings.



Figure 1: Magnet Placement on Head Assembly

5.2 Batteries

The MMI-7500 uses 9 x CR123A Lithium cells for approximately 1 year of daily transmissions. Install batteries with the positive terminal towards the head assembly. The circuit is reverse polarity protected. Rechargeable batteries are not recommended. Always remove batteries when the MMI-7500 is not in use. Please refer to section 8.2 for battery change details.

PLEASE NOTE:

Following disconnecting the head assembly from the batteries, wait for a period of two minutes before reconnecting. This period of time is required to let the circuit fully discharge and ensures that the device will function optimally

5.3 Test Operation

The following quick test verifies that the MMI-7500 in standard configuration is functioning properly:

1. Turn device ON by attaching power source (battery tube) and ensuring the magnet is removed. For the –RH version (Remote Head), confirm power is applied to the head assembly.
2. Turn on the iON Iridium Detector or other receiver tuned to the correct frequency and check that there is a regular signal.
3. If possible, verify the transmitted data has been received and processed by the configured data delivery option. This step validates the Iridium modem provisioning setup and messages are being delivered properly.
4. MMI-7500 is ready to be deployed.

6 Operation

The NOVATECH MMI-7500 Iridium beacon is primarily intended for locating and recovering free drifting or moored, surface or submerged assets at sea. After being turned on, the NOVATECH MMI-7500 Iridium beacon can be submerged (to a maximum depth of 7500 meters) where it is deactivated by the conductivity switch. The MMI-7500 can be deployed underwater for up to 24 months.

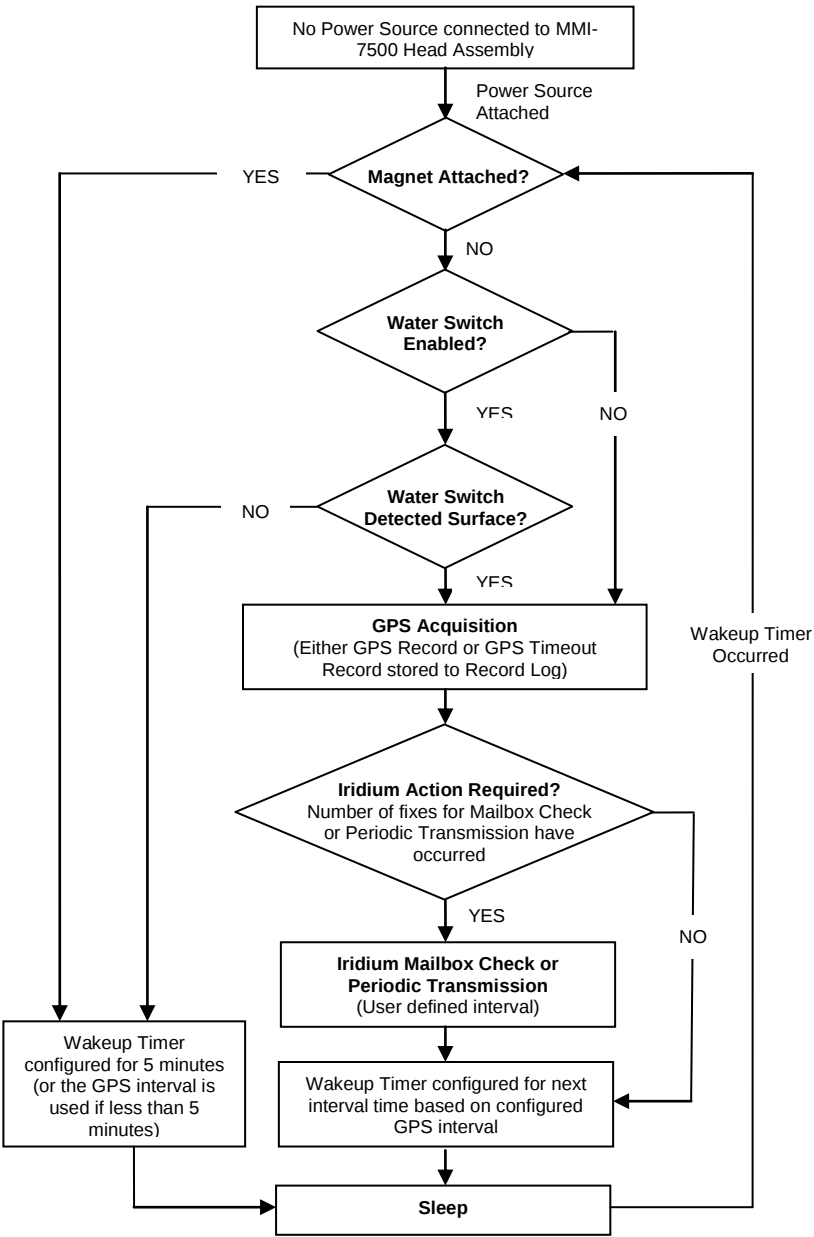
The MMI-7500 is equipped with a conductivity sensor to monitor submergence state. With this sensor enabled, the device will not transmit during submergence. Upon surfacing/activation, the beacon will attempt to transmit an initial Position Report and then continue at its pre-configured interval.

The operator can communicate with the beacon on the surface by sending commands over the Iridium network. The commands allow the operator to change the reporting interval of the beacon.

Due to the specifics of Iridium communication scheme, the beacon is able to receive incoming commands only when it sends reports out or is scheduled to perform a Mailbox check.

The surfaced NOVATECH MMI-7500 Iridium beacon will continue to send its GPS position messages until it is manually turned off, the battery pack is depleted, or it returns back to the submerged position.

The following flow chart outlines the activation sequence and timing of the MMI-7500 operation.



Operating Notes

The Bluetooth connection is available for at least 10 minutes upon initial power-up of the device. Each Bluetooth command sent to the device resets the Bluetooth timeout period extending the connection time. The Bluetooth connection is shut down after the connection time expires to conserve power.

To re-activate the Bluetooth connection, the power source must be removed and re-attached. It is important to leave the power source disconnected for at least 2 minutes before reconnecting to ensure a fresh power-up sequence otherwise the Bluetooth connection may not be enabled.

The default configuration GPS interval is 5 minutes with a transmission occurring at every interval. This is a rapid reporting behavior that is useful during testing and initial deployment. Re-configuration using the local Bluetooth connection or the Asset Website Over-The-Air interface is recommended to extend mission life.

6.1 Configuration

The MMI-7500 configuration consists of 4 operating parameters.

GPS Position Interval – This interval sets the timing for GPS position acquisitions. Positions are stored into the internal memory log. Minimum setting is 2 minutes with a maximum setting of 2 days.

Number of Intervals per Transmission – This setting sets the number of GPS Position Intervals to occur before transmitting the data. The default setting is 1, which transmits the data upon each GPS Position acquisition. However, multiple GPS positions can be accumulated and transmitted together to reduce power usage.

Number of Intervals per Mailbox Check – This setting sets the number of GPS Position Intervals to occur before polling the Iridium network for incoming messages. A mailbox check is similar to a transmission however no data is sent from the beacon. This allows the beacon to be responsive to incoming configuration commands without having to always transmit data. The default setting is 1.

Water Switch Enable – This setting controls the use of the conductivity water sense feature.

When ENABLED and submerged, the beacon will sample the conductivity water sensor every 5 minutes (or at the fix interval if configured to less than 5 minutes). It will remain in low-power Sleep mode and not acquire or transmit while submerged.

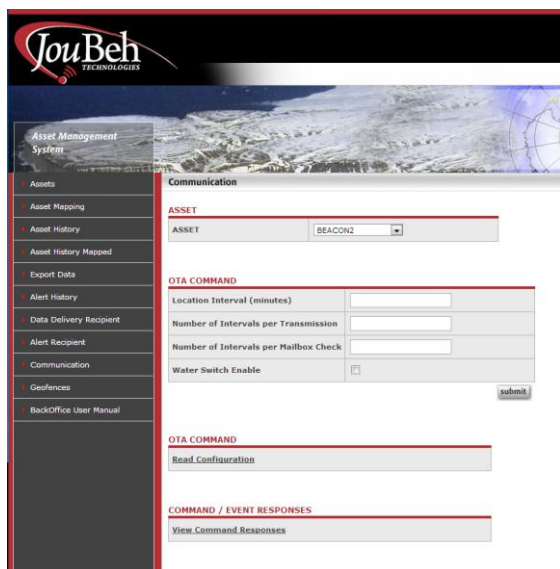
When ENABLED and on the surface or DISABLED, the beacon will acquire and transmit as per its user defined intervals.

6.2 Iridium Satellite Communication

The NOVATECH Iridium mini-Beacon uses Iridium Short Burst Data (SBD) mode for transmitting data.

During transmission, the modem remains powered until a successful transmission occurs, or 180 seconds have elapsed. Should the transmission time-out the data set will remain buffered and sent during the following transmission cycle.

The configuration of the mini-Beacon may be changed using Over-The-Air commands. These commands may be issued by the JouBeh Asset Website or customized solutions may be developed (contact MetOcean for further details).



The screenshot displays the JouBeh Asset Management System web interface. The header features the JouBeh Technologies logo and a satellite map background. A left sidebar contains a navigation menu with options: Assets, Asset Mapping, Asset History, Asset History Mapped, Export Data, Alert History, Data Delivery Recipient, Alert Recipient, Communication, Geofences, and BackOffice User Manual. The main content area is titled 'Communication' and includes three sections: 'ASSET' with a dropdown menu set to 'BEACON2'; 'OTA COMMAND' with input fields for 'Location Interval (minutes)', 'Number of Intervals per Transmission', and 'Number of Intervals per Mailbox Check', along with a 'Water Switch Enable' checkbox and a 'submit' button; and 'OTA COMMAND' with a 'Read Configuration' button. At the bottom, a 'COMMAND / EVENT RESPONSES' section contains a 'View Command Responses' button.

Figure 2: JouBeh Asset Website Over-The-Air Commands

6.3 Bluetooth® Communication

The configuration of the device is controlled through the Configurator Software Tool or the JouBeh Asset Website. The device uses a Bluetooth® serial connection to interface with the software tool. Prior to using the Configurator Software, a Bluetooth® connection must be established with the device.

The Bluetooth® interface on the device is activated upon power-up for a period of 10 minutes. If there is no connection established during this time, the Bluetooth® interface is disabled until the next power cycle event.

1. Attach batteries to power-up the device.
2. Add the Device to the PC's Bluetooth® Devices.

The mini-Beacon appears as **MMI-7500 Bluetooth®** Device. Select **MMI-7500** device and click Next...

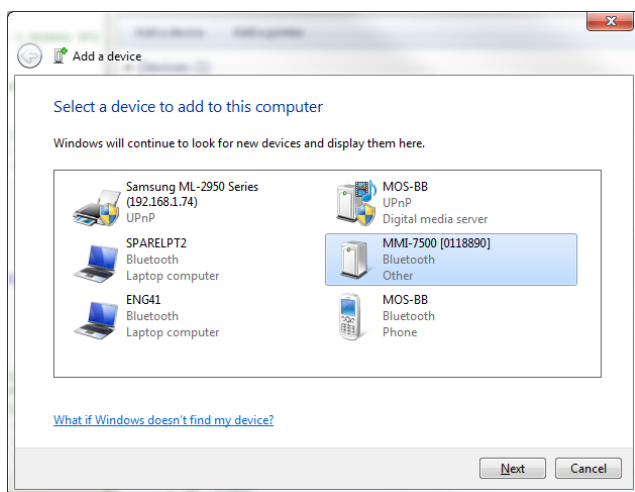


Figure 3: Adding a Bluetooth Device

Select **Enter the device's pairing code** to setup the Bluetooth® link and click Next...

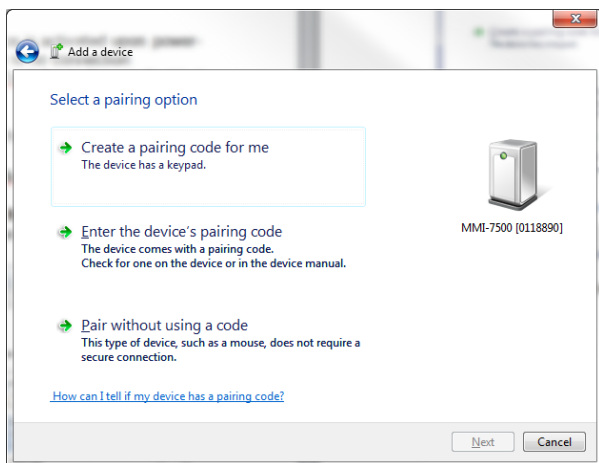


Figure 4: Select Pairing Code Option

Enter the pairing code **0000** and click Next...

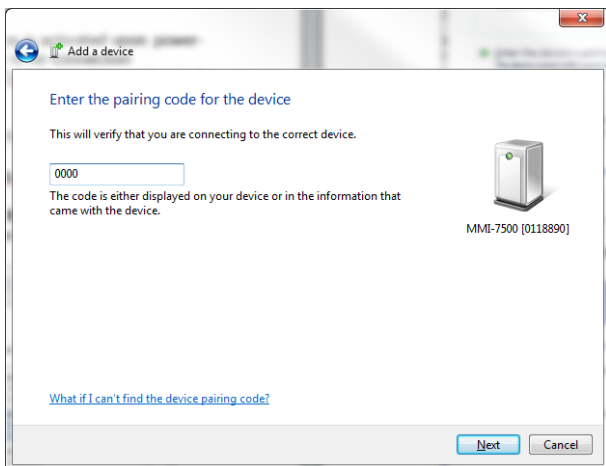


Figure 5: Enter Pairing Code

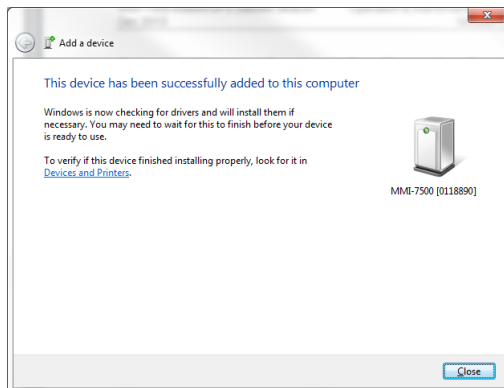


Figure 6: Bluetooth Connection Established

Once the system installs the communication drivers and assigns a COM port, the connection to the device is established and the Software Tool may be used.

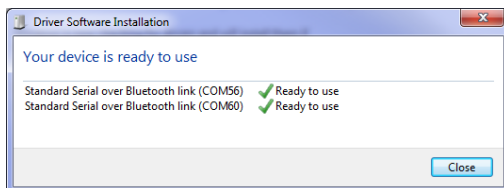


Figure 7: Pairing Complete with COM port assigned

Note:

The Bluetooth Interface is only activated on the device for 10 minutes. If no connection is established within that time, the device must be power cycled (remove and re-attach battery pack) to attempt a new connection. Remember to allow several minutes between removing power and re-applying power to allow the circuit to fully discharge.

6.4 Configurator Software Tool

The Configurator Software Tool may be used with an established Bluetooth connection to the Iridium Mini-Beacon. The software tool displays device status, read/write device configuration, as well as downloading of the internal record log.

Once the software is connected, the main dialog screen displays the device status information as shown below.

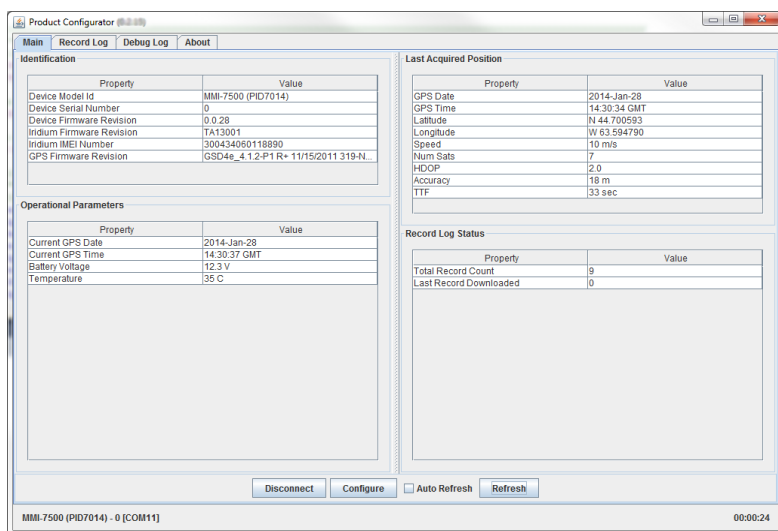


Figure 8: Configurator Software Tool

Device Configuration may be accessed and modified by clicking the “Configure” button. A summary area is displayed to provide feedback on the configuration parameters.

The screenshot shows a 'Configuration Dialog' window with a title bar containing a close button. The window is divided into two main sections: 'Settings' and 'Summary'.

The 'Settings' section contains the following controls:
- 'GPS Sampling Interval': A text box with the value '1' and a dropdown menu set to 'days'.
- 'Transmit After Every': A checked checkbox, a text box with '1', and a 'GPS Samples' label.
- 'Additional Mailbox Check Every': An unchecked checkbox, a text box with '1', and a 'GPS Samples' label.
- 'Water Switch Enable': A checked checkbox.

The 'Summary' section contains a text area with the following text:
->> GPS Sampling:
Device will sample the GPS every 1 days.
->> Iridium transmissions:
Device will automatically transmit data every 1 days.
->> Mailbox Checks:
Device will only check for incoming messages from the network during transmissions, every 1 days.
->> Water Switch:
Water Switch is enabled. The device will sleep while submerged, sampling the water switch periodically in a low power mode.

At the bottom of the dialog are two buttons: 'Apply' and 'Close'.

Figure 9: Configuration Dialog

6.5 Transmission Data Format

The following tables define the data formats of transmitted position reports from the MMI-7500.

Position Reporting – multiple reports (up to 195 bytes)

CMD_TYPE = 0x01 CMD_SUB_TYPE = 0xFD

Multiple Position Report Packet Format

Data Name	Value	Start Byte	Start Bit	Bit Length
CMD_TYPE	0x01	1	8	8
CMD_SUB_TYPE	0xFD	2	8	8
SEQ_NUM	0x00	3	8	8
T_POSITION_REPORT		4	8	128
... (up to 12 T_POSITION_REPORTs per packet)	...	...	...	...
T_POSITION_REPORT		179	8	128

The T_POSITION_REPORT data format is 16 bytes in length defined as the following:

T_POSITION_REPORT Data Format

Data Name	Min	Max	Start Byte	Start Bit	Bit Length	Unit	Decoding Equation
GPS Time	0	2 ³²	1	8	32	sec	$y = x$
Record Type	0	1	5	8	1		$y = x$ 1 = GPS Record 0 = Event Record (see ICD for more details)
The following fields only apply to the GPS Record Type.							
Reserved	0	1	5	7	1		$y = x$
Number Sats Visible	3	10	5	6	3	sats	$y = x + 3$
HDOP	0	3.5	5	3	3		$y = 0.5x$
GPS Latitude	-90	90	6	8	32	deg	$y = 0.000001x - 90$
GPS Longitude	-180	180	10	8	32	deg	$y = 0.000001x - 180$
Speed	0	255	14	8	8	m/s	$y = x$
GPS Fix Accuracy	0	255	15	8	8	m	$y = x$
Time to Fix	0	255	16	8	8	sec	$y = x$

Other data commands are available for advanced communication with the NOVATECH Iridium mini-Beacon. Please consult MetOcean for the "TD-14-014 MMI-7500 Interface Control Document" for further information. **Note:** Event records are similar length as GPS records with event specific data. Refer to the Interface Control Document for further information on Event records.

7 Maintenance

There are no user serviceable parts in the Pressure Case.
Return the unit to the factory for repairs.

7.1 Regular Maintenance

- Rinse thoroughly with fresh water after every use
- Always remove batteries when not in use
- Always use fresh batteries
- Protect “O” ring surface from damage
- Replace worn or damaged “O” rings
- Keep batteries and electronics dry

7.2 Battery Change

The MMI-7500 series have a variety of battery options, as listed below.

- MMI-7500 Mini-beacon: 9 x CR123A Lithium cells
- MMI-7500-RH Beacon: 6 x ‘C’ Cell Alkaline Cells
- MMI-7500-MAXI-7 Beacon: 7 x ‘D’ Cell Alkaline/Lithium Cells
- MMI-7500-MAXI-3 Beacon: 3 x ‘D’ Cell Lithium Cells

It is recommended in all cases that these batteries be accessed and changed through the bottom end of the beacon. Install fresh batteries with the positive terminal towards the head assembly.

See figure 4. Please ensure that the insulating plastic tube remains within the pressure case during battery change.

PLEASE NOTE:

Cycling power to the head assembly will result in the device defaulting to the ON state, unless the Magnet is attached.

PLEASE NOTE:

Following disconnection of the head assembly from the batteries, wait for a period of two minutes before reconnecting. This period of time is required to let the circuit fully discharge and ensures that the device will function optimally.



Figure 10: Bottom end caps removed for battery change

PLEASE NOTE:

The batteries are vulnerable to damage if the battery tube experiences a large vertical shock. The batteries may deform under these conditions and provide intermittent power to the head assembly. Replace any damaged batteries to ensure the device will function optimally.

The MMI-MAXI-7 battery pack is particularly sensitive to impact and vibration. If impact and vibration are predicted during the deployment of a MMI-MAXI-7 beacon it is suggested that contact wave springs be installed between D cells in the battery tube. For your convenience, six (6) wave springs (MetOcean part # 101756) are included with the MMI-MAXI-7.

Lithium batteries are not safe to use after suffering an impact. Any configuration using lithium batteries must have its batteries replaced following an impact. Damaged lithium batteries must be disposed of according to local regulations.

7.3 “O” Ring Facts

The main problem with “O” rings is that over time they can take a “set” shape. They lose their original round shape and they become slightly flattened resulting in less compressibility. Reduced compressibility can lead to a water leak near the surface. The best way to prevent a problem is to service the “O” rings before every deployment.

Some of the main factors that can cause a “set” are:

- High storage temperature (exceeding 40°C) over time will cause the rubber to harden.
- Exposure to sunlight and ozone will cause the “O” ring to deteriorate and stiffen.
- Temperature does not have to be that cold for an “O” ring to lose a great deal of its flexibility. At 4°C, an “O” ring has stiffened significantly.
- “O” rings must be lightly lubricated with silicone-based grease. We recommend “Parker Super O Lube”.
- A typical seal failure results in a very small amount of water, not a flooded case. Most seal failures occur near the surface.
- The “O” ring becomes less flexible as the rubber ages.
- If you are operating or storing at low temperature, it makes it even more important to service the “O” ring regularly.

7.4 “O” Ring Maintenance

MetOcean strongly recommends that “O” rings be serviced on a regular basis to ensure a reliable seal. **Remove and lubricate at least once a year, preferably more often, and replace every two years or sooner.** With regular maintenance, “O” rings will be very reliable and trouble free. It has been, however, our observation that most “O” rings are neglected for years and expected to perform at the extremes of their design limits.

There are multiple “O” rings that require service on this device. The following table outlines the “O” rings used on the various models of the device.

Lubricate “O” rings slightly with silicone grease; the recommended grease is Parker Super O Lube.

Model	Interface	O-ring Specification	MetOcean Part #
MMI-7500	Head Assembly to Battery Tube	M1.5x21.5 – DURO 90	105670
	End Cap to Battery Tube	M1.5x21.5 – DURO 90	105670
MMI-7500-OEM	Head Assembly bottom	M1.5x21.5 – DURO 90	105670
MMI-7500-RH	Head Assembly to Remote Base	M1.5x21.5 – DURO 90	105670
	Bulkhead to Battery Case	2-218 – DURO 70	H00595
	Battery Case to Pressure Switch	2-218 – DURO 70	H00595
MMI-7500-MAXI (3 or 7 cell version)	Head Assembly to Battery Tube	M1.5x21.5 – DURO 90	105670
	Upper Cap of Battery Tube	2X 2-026 – DURO 70	106324
	Lower Cap of Battery Tube	2X 2-026 – DURO 70	106324

Table 1: O-Ring Index

7.5 Corrosion Prevention

Corrosion is a problem common to all metals used in the ocean. To help minimize corrosion the MMI-7500 is constructed using all titanium housing.

Do not mount the beacon directly against metal. Isolate the pressure case by wrapping it with vinyl tape or similar at the contact points.

8 Licensing Requirements

The Iridium/GPS Satellite beacon uses the 9603 Iridium certified SBD modem and requires no radio station license to operate it.

The 9603 Iridium modem contains transmitter module:

FCC ID: Q639603

IC: 4629A-9603

9 Warranty

MetOcean Data Systems guarantees this product to be free from defective materials and workmanship and agrees to remedy any such defects for a period of 1 year commencing from the date of purchase.

This warranty does not apply if the equipment has been subjected to misuse, neglect, accident or improper installation, or altered outside our factory, or to damage caused by defective batteries. MetOcean Data Systems neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with this product, including damage resulting from design or equipment failure.

SPECIFICATIONS

Average Transmit Power	1.6 W
Receiver Sensitivity	-117 dBm
Frequency Range	1616 MHz to 1626.5 MHz
Battery Life	1 year of daily transmissions after a subsea deployment of 1.5 years.
GPS	48-channel L1 SiRFstarIV™ receiver
Batteries	MMI-7500: 9x CR123A Lithium MMI-7500-MAXI-7: 7x D Alkaline cell MMI-7500-MAXI-7: 7x D Lithium cell MMI-7500-MAXI-3: 3x D Lithium cell MMI-7500-RH: 6x C cell (or custom)
Operating & Storage Temperature	-30°C to +70°C Operating -40°C to +85°C Storage
Ocean Depth Rating	7,500 meters (24,600 feet)
ON/OFF Control	Magnetic reed switch Water sense switch for activation
Antenna	Integrated dual band GPS/Iridium ceramic patch
Connectivity	Iridium SBD Communication Bluetooth SPP (Serial Port Profile)

Weight	MMI-7500-OEM: 220g MMI-7500: 810g MMI-7500-MAXI-7: 3550g (alkaline) MMI-7500-MAXI-7: 3200g (lithium) MMI-7500-MAXI-3: 1500g (lithium) MMI-7500-RH: 600g (RH assembly) 1900g (battery pack) 200g (cable)
Weight (in water)	MMI-7500-OEM: 110g MMI-7500: 505g MMI-7500-MAXI-7: 2450g (alkaline) MMI-7500-MAXI-7: 2100g (lithium) MMI-7500-MAXI-3: 910g (lithium) MMI-7500-RH: 360g (RH assembly) 1200g (battery pack) 50g (cable)
Dimensions	MMI-7500-OEM: 2.21" (from sealing surface) Ø 2.2" Max Diameter MMI-7500: 15.5" Overall Length Ø 1.13" Tube Diameter MMI-7500-MAXI-7: 20.75" Overall Length Ø 2.0" Tube Diameter MMI-7500-MAXI-3: 11.25" Overall Length Ø 2.0" Tube Diameter MMI-7500-RH: 21.5" Battery Tube Ø 1.75" Tube Diameter 4.0" Remote Head Length Ø 3.5" Flange Diameter

MMI-7500-OEM SPECIFICATIONS

Voltage	Positive: 7V – 28VDC through contact spring Negative: 0VDC through chassis threading
Power	<u>Sleep</u> <20uA (7V – 28VDC) <u>GPS Location Acquisition</u> 280mW (24mA @ 12V), typical time to fix: <60 seconds <u>Iridium SBD Transmission</u> - Average: 1600mW (135mA @ 12V), typical time to transmit: <15 seconds - Peak: Short 10 millisecond high current pulses during transmission (up to 1000mA @ 12V)
Thread	13/16-20 Unified National Thread, min 3/8" deep
Sealing Surface	Min Ø1.05" area, min surface finish 32µin

SALES AND SERVICING

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