

UM-8326

User Manual for the Type 8326 Marker 6 Transponder

Issue A Rev 2

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Note



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Amendment History

The amendment history records all amendments and additions made to this manual.

Issue	Revision	Date	Comments	Section	Page
A	1	11/06/2018	First Issue	All	All
A	2	04/05/2021	Alkaline battery life changed from 12 to 9.5 months Type 8326-7511 (7000 m) version added	11.2.1 3.2 3.5 10.2 11	29 4 5 27, 28 29, 30, 31

Section 1 – Introduction

1.1 Scope of this Manual

This User Manual describes the safe installation, operation and maintenance of the Type 8326 Marker 6 Transponder. The information and procedures within this manual are based on Sonardyne's experience and knowledge.

1.1 Purpose of this Manual

This user manual contains information for anyone involved with installing, operating and maintaining the Marker 6.

To ensure the safety of the installer and operator is maintained it is important that all warnings and cautions in *Section 2 – Safety* of this manual and in any related manuals are read and fully understood.

1.2 Related Publications

To ensure the equipment is operated safely, a *Sonardyne Safety Manual* is supplied with this user manual. It is important that the *Sonardyne Safety Manual* is read and fully understood before proceeding with any activity on the equipment.

Table 1-1 Related Publications

Publication	Title
<i>Sonardyne Safety Manual</i>	<i>Operational and Safety Precautions</i>

1.3 Conventions

Table 1-2 Conventions used in this Manual

Format	Convention
Boldface Type	User Input, Menu Options, Keys, e.g. Click OK
Arrow (>)	Selection of an additional menu item e.g. File>Save
<i>Italic Type</i>	References to Figures, Tables, Sections and internal/external source

Section 2 – Safety

2.1 Introduction

Before any activity is carried out on the equipment, it is recommended that the included *Sonardyne Safety Manual* and all warnings and cautions in this manual are read and fully understood.

It is recommended that the operator complies with the Health and Safety Regulations applicable to the vessel and the region before operating this equipment.

Operators and service personnel must be familiar with the normal operating and safety procedures for the subsea equipment being operated.

Documentation must be consulted whenever a  or  warning symbol is found on the equipment, in order to determine the nature of the potential hazard and any actions which must be taken.

If any additional equipment is used, any warnings and cautions in the equipment user manual must be read and fully understood and the equipment must only be used as specified by the manufacturer.

The safety of any system incorporating this equipment is the responsibility of the assembler of the system.

2.2 Safety Procedures

2.2.1 Warnings

 **Personal protection.** Appropriate protective equipment such as protective footwear, hard hat and gloves must be worn when handling or carrying out any procedures involving Sonardyne and other equipment.

 **Heavy equipment.** Many Sonardyne products and equipment types, such as transponders, transceivers, cable drums etc. require Manual Handling Equipment (MHE) for lifting due to their heavy weight. If MHE is not available, it is the responsibility of the operator to perform a manual handling risk assessment prior to carrying out manual lifting/handling. Refer to the individual equipment documentation for weight specifications.

 **If the battery pack has failed or water has penetrated the internal housing, the battery pack may vent gasses causing the build-up of internal pressure.**

 **High Internal pressure risk.** Due to the high internal pressure risk, dismantling the sub-sea equipment must only be carried out by suitably qualified personnel.

 **Risk of toxic gases and liquids.** Make sure the work environment is well ventilated. Toxic gases and liquids may be released when operating the pressure relief vent valve.

 **When transporting and storing the MARKER 6, the battery must be disconnected.**

 **Risk of burns.** Do not carry out maintenance on the transponder if the housing is hot. Lower the transponder into cold water and wait for the housing to cool. Wear Personal Protective Equipment such as gloves.

2.2.2 Cautions



Risk of equipment damage. All instruments must be maintained according to their individual operating manuals. Failure to follow recommended procedures could result in instrument failure, and loss of system integrity.



Multiple beacon address conflict. Do not operate multiple beacons on the same address in the water at the same time. The address must be unique to any one beacon operating in the same acoustic area.



Protective coating failure. Do not use any abrasive brushes or sharp tools to remove marine growth when cleaning the instrument.

Section 3 – Technical Description

3.1 Introduction

The Type 8326 Marker 6 transponder is a low-cost acoustic positioning solution where compact design and deep water are important operational factors. The Marker 6 enables critical targets such as underwater structures or instrumentation packages to be marked unambiguously and later relocated using a Sonardyne USBL system. The transponder is mounted inside a tough polypropylene housing and held in place using a horseshoe retainer.

The Marker 6 incorporates Near Field Communications (NFC) allowing fast programming of its acoustic address to 1 of >200 unique acoustic identities.

The NFC link provides the ability to enter Marker 6 into a storage mode when not in use, thereby significantly increasing the overall battery endurance.

The Wideband acoustic technology uses a correlation reception technique with phase encoded signals over a wide range of carrier frequencies. Signal coding allows for hundreds of channels enabling multiple users to work in the same area without interference.

3.2 Depth Rating

The Marker 6 is available in two versions:

- Type 8326-4311, depth rating 4,000 m
- Type 8326-7511, depth rating 7,000 m

Figure 3-1 Type 8326 Marker 6



3.3 Housing Labelling

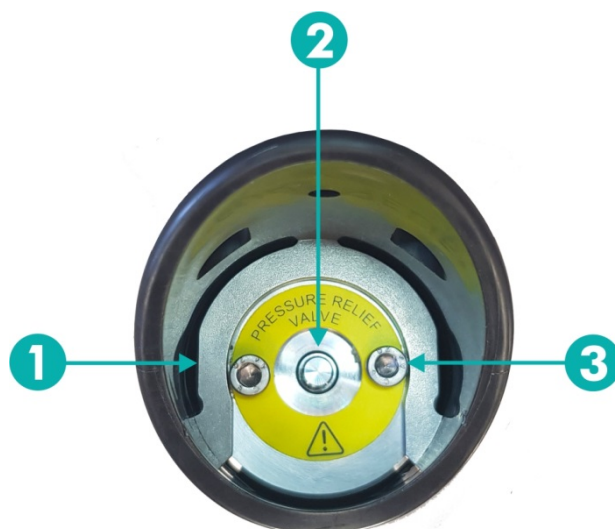
Waterproof labels on the housing uniquely identify the transponder as follows:

- Description Marker 6 Transponder
- Type No. 8326
- Serial No. 123456-XXX

3.4 Endcap

The endcap can be removed by a suitably qualified person to replace the battery pack. The endcap is described in *Figure 3-2*.

Figure 3-2 Marker 6 Endcap Description



1 Horseshoe Retainer Clip	2 Pressure Relief Vent Valve
3 Horseshoe Retainer Locking Cap Head Screws M4 x 2	

3.5 Battery

The Marker 6 can be supplied with an alkaline or lithium battery pack; see *Section 11.2.1 “Battery”* for the battery specifications.

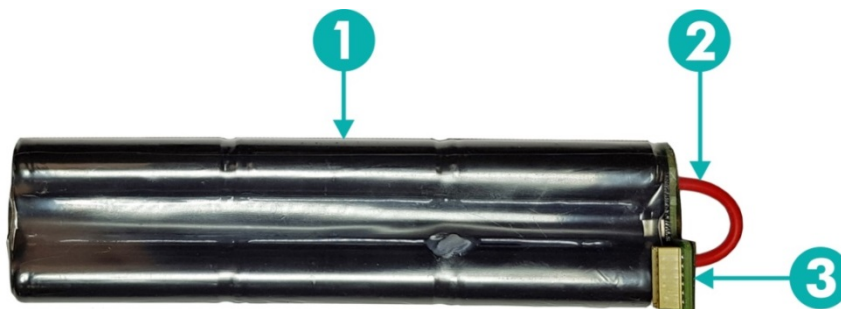
The battery options are shown below.

Battery	Type Number
Alkaline	8326-4311-A
Lithium	8326-4311-L
Lithium	8326-7511-L

The battery’s status can be displayed and connected/disconnected using an NFC supported device; see *Sections 7.6 “Battery Status”* and *7.7 “Connecting and Disconnecting the Battery”*.

Replacement battery packs must be obtained from Sonardyne. To replace the battery pack, see *Section 7.5 “Replacing the Battery”*.

Figure 3-3 Marker 6 Battery Pack



❶ Battery Cells	❷ Removal Pull-Loop
❸ Connector	

3.6 Pressure Relief Vent Valve

A pressure relief vent valve is fitted to automatically release any build-up of pressure inside the Marker 6. This could be caused by water ingress during deployment and/or the degassing of the battery.

In normal conditions the pressure relief vent valve should always be flush with the endcap face.

The valve is spring loaded and operated by gripping the top recess with a thumb and forefinger or a suitable tool and pulling gently upwards.

The valve is shown below in the closed ❶ and open ❷ positions.

Figure 3-4 Pressure Relief Vent Valve



If there is any reason to suspect there may be pressure inside the transponder, the pressure relief vent valve must be operated; see *Section 7.8 “Operating the Pressure Relief Vent Valve”*.

Section 4 – Installation and Deployment

4.1 Introduction

Before installing and deploying the equipment, ensure *Section 2 – Safety* is read and fully understood.

4.2 Pre-use Installation Checks

On receipt, the transponder will be in a fully working condition, with the internal battery pack fitted and electrically disconnected.

Before installation and deployment, checks should be carried out to make sure the Marker 6 is serviceable and ready for use. These checks include:

- Inspect the Marker 6 for any signs of mishandling, external damage or leakages.
- Check the pressure relief vent valve; see *Section 7.8 “Operating the Pressure Relief Vent Valve”*.
- Check the battery status; see *Section 7.6.1 “Checking the Battery Status”*.

4.3 Configuration

The Marker 6 is configured using NFC with a suitable NFC enabled handset (including an NFC enabled Android™ handset) or a dedicated HF Radio Frequency Identification (RFID) reader.

The NFC antenna for the Marker 6 is embedded into the top face of the acoustic transducer and so to communicate with the transponder, the NFC reader must be placed as close as possible in-line with the antenna.

The following transponder information can be read using NFC:

- Unique ID
- Firmware version
- Serial number
- Acoustic address
- Nav power
- TAT
- Battery voltage
- Battery capacity remaining estimate percentage

The following transponder settings can be changed using NFC:

- The Marker 6 can be enabled/disabled (the battery is electronically disconnected)
- Acoustic discovery of the transponder can be enabled/disabled
- The address can be changed
- A Terminal session can be initiated to send manual commands to the Marker 6

4.3.1 Dedicated NFC Reader

For interfacing with Marker 6 using dedicated NFC reader contact Sonardyne Support.

4.3.2 NFC Enabled Android Device

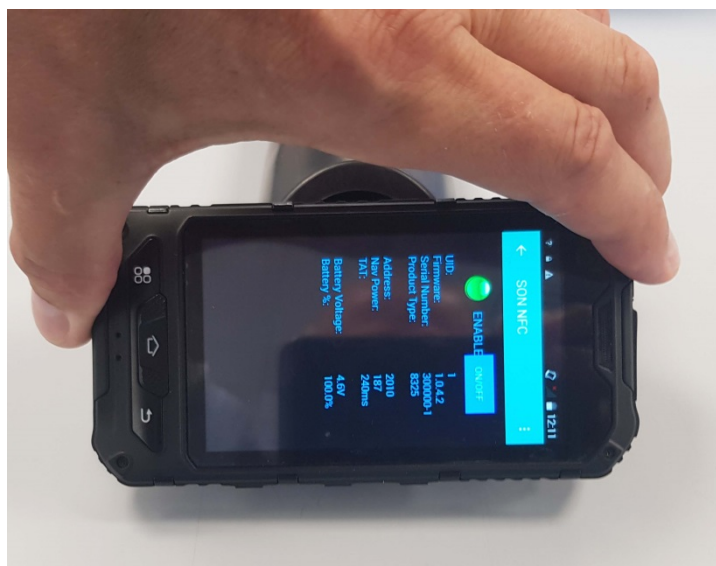
4.3.2.1 Sonardyne NFC App

1. To configure the Marker 6 using an NFC enabled Android device the Sonardyne NFC app must be downloaded and installed from the Google Play™ store (search for “SON NFC”) or requested directly from Sonardyne.
2. Start the Sonardyne NFC app on the Android device.

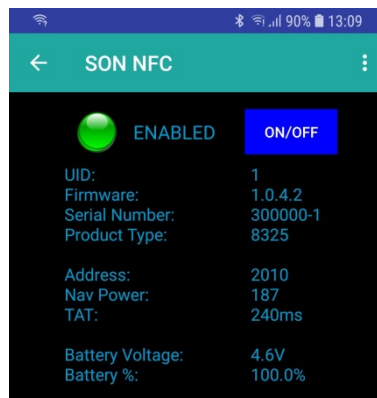


4.3.2.2 Discovering the Marker 6

1. Place the Android device adjacent to the Marker 6's transducer as shown below.



2. When discovered, the NFC app displays transponder information and the option to set the mode of the Marker 6 (Enabled/Disabled) and set the address.



4.3.2.3 Setting the Marker 6's Address

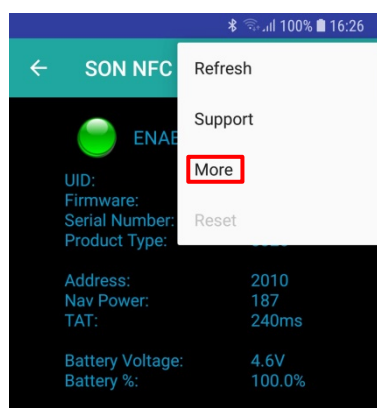
Note



The transponder must be enabled to set its address.

Set the Wideband 2 address as follows:

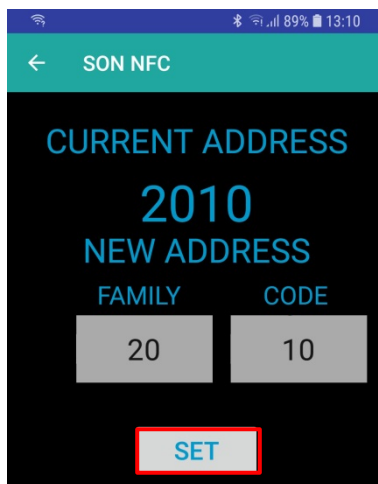
1. Tap the three vertical dots  and then tap **More**.



2. Tap **Address Selector**.



3. Scroll to set the new address and then tap **Set**.



Check that the **Update Success** message is displayed indicating the new address has been applied.

4.3.2.4 Disabling and Enabling the Marker 6

When the Marker 6 is enabled, a green led with **ENABLED** is displayed.

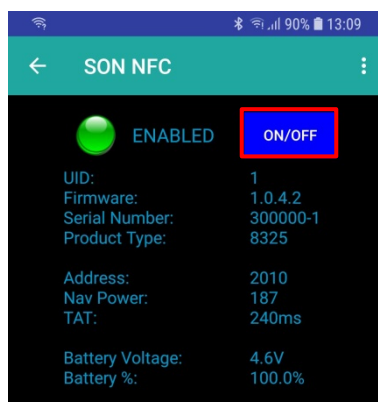


When the Marker 6 is disabled (storage mode), the battery is electronically disconnected and a red led with **DISABLED** is displayed.

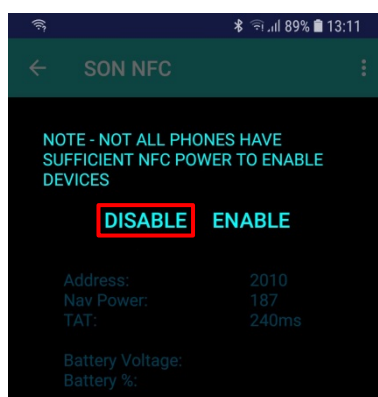


Disabling the Marker 6

1. To disable the Marker 6, tap **ON/OFF**.



2. Tap **DISABLE**.



3. The Marker 6 enters storage mode and can be woken by placing an NFC Android device adjacent to the transponder.

Enabling the Marker 6

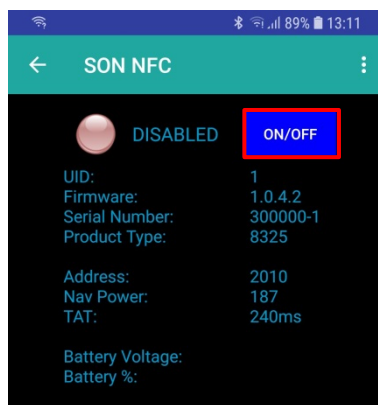
1. To enable a disabled Marker 6, place an NFC Android device adjacent to the transponder.

Note

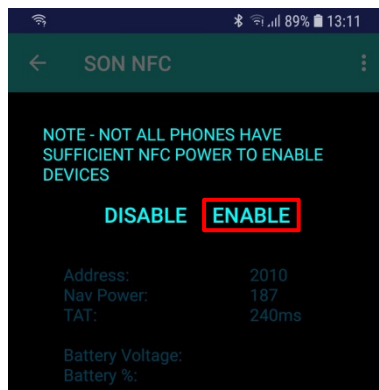


Ensure the NFC app is running on the Android device.

2. Tap **ON/OFF**.



3. Tap **ENABLE**.



4.3.3 Enabling/Disabling Acoustic Discovery

Acoustic discovery is a capability of 6G transceivers that enables the addresses of instruments to be discovered without any prior knowledge. The Marker 6 can enable acoustic discovery, allowing this feature to be used to re-locate a transponder with an unknown address or disable it to ensure the transponder can only be tracked by systems which have prior knowledge of the address.

To enable or disable acoustic discovery use the following NFC manual commands.

Feature	Manual Command
Enable	US:DISC1
Disable	US:DISC0
Query	US

4.4 Pre-Deployment Checks

Carry out the following procedures to check and configure the Marker 6, ready for deployment.

1. Read Marker 6 information and check battery level is sufficient for the deployment; see *Section 7.6*.
2. Check the Marker 6 is enabled; see *Section 4.3.2.4*.
3. Apply the correct acoustic address; see *Section 4.3.2.3*.
4. Run a self-test; see *Section 8.3.2*.

Section 5 – Operation

5.1 Introduction

Before operating the equipment, ensure *Section 2 – Safety* is read and fully understood.

5.2 Operational Modes

Marker 6 transponders are tracked by a Sonardyne 6G surface control system such as Ranger 2 or Mini-Ranger 2.

For operating instructions refer to the system's user manual.

5.3 After Use

After retrieval from the water, see *Section 6 – Retrieval, Transportation and Storage*.

Section 6 – Retrieval, Transportation and Storage

6.1 Introduction

Before retrieving the transponder, make sure *Section 2 – Safety* is read and fully understood.

CAUTION



If the transponder is not functioning after retrieval, be aware that it may be pressurised.

6.2 Retrieval

When retrieving from the water, the transponder must be cleaned and inspected before being stored.

1. Clean the Marker 6; see *Section 7.3 “Cleaning”*.
2. Inspect the Marker 6; see *Section 7.4 “Inspection”*.

6.3 Transportation and Storage

The Marker 6 can be transported and placed in storage as described below. See *Table 6-1* for the recommended storage conditions.

WARNING



When transporting and storing, the Marker 6 must be disabled (battery electronically disconnected).

1. Disable the Marker 6; see *Section 4.3.2.4 “Disabling and Enabling the Marker 6”*.
2. Store the Marker 6 in its transit case.
3. Equipment must be kept in a dry, non-condensing atmosphere (20% to 80% humidity), free from corrosive agents and isolated from sources of vibration.
4. When storing for long periods of time it is recommended to visually inspect the equipment at least annually.
5. When equipment is taken from low temperature storage for immediate use its temperature should be raised to normal operating temperature before use.

Table 6-1 Storage Conditions

Item	Specification
Storage Temperature	-20 to 55°C (see <i>Notes below</i>)
Relative Humidity	20 to 80% (non-condensing)

Notes



To prolong the life of the battery, it is recommended not to exceed the storage temperature range of 10 to 25°C.

Section 7 – Maintenance

7.1 Introduction

Before any maintenance activity is carried out on the equipment, ensure *Section 2 – Safety* is read and fully understood.

7.2 Retrieving from the Water

See *Section 6 – Retrieval, Transportation and Storage*.

7.3 Cleaning

Thoroughly wash the transponder in warm clean fresh water, paying particular attention to the pressure relief vent valve.

7.4 Inspection

Regularly inspect the transponder for the following:

1. Inspect the pressure relief vent valve; see *Section 7.8 “Operating the Pressure Relief Vent Valve”*.
2. Inspect the transducer and housing for any signs of mishandling, external damage or leakages.

7.5 Replacing the Battery

The battery packs can be replaced in the field by a suitably qualified person without any specialist equipment. It is important to ensure that a clean and dry environment is available when dismantling the transponder.

WARNINGS



Due to the high internal pressure risk, dismantling the sub-sea equipment must only be carried out by suitably qualified personnel.



If the battery pack has failed or water has penetrated the internal housing, the battery pack may vent gasses causing the build-up of internal pressure.



Risk of toxic gases and liquids. Make sure the work environment is well ventilated. Toxic gases and liquids may be released when operating the pressure relief vent valve.

To replace the battery the transponder must be disabled and then removed from the outer housing and the endcap removed as described in the following sections.

7.5.1 Disable the Transponder

Disable the Marker 6; see *Section 4.3.2.4 “Disabling and Enabling the Marker 6”*.

Note

 If the Marker 6 is not disabled, the Sonardyne App may indicate the Marker 6 is still enabled after the battery is removed.

7.5.2 Removing the Transponder from the Housing

1. Before removing the transponder from the housing, operate the pressure relief vent valve **1** to equalise the internal/external pressure; see *Section 7.8 “Operating the Pressure Relief Vent Valve”*.



2. Using a 4 mm Allen key, carefully unscrew and remove the two M4 cap head screws on the bottom endcap.



3. Using a suitable tool, disengage the horseshoe retainer locking tab from the outer housing slot and push it all the way backwards.



4. Carefully rotate the horseshoe retainer clockwise or anti-clockwise and remove it through one of the outer housing slots.



5. Hold the housing upright on a soft surface with the Marker 6 facing upwards and use a thumb(s) to carefully push the transponder down through the outer housing.



7.5.3 Removing the Endcap

1. Grip the transponder and use a twisting motion to start to separate the endcap from the housing.
2. Once a gap appears a Sonardyne opening tool (part no. 641-3332) can be used to lever the endcap off.



7.5.4 Removing and Replacing the Battery

1. Remove the circular rubber gasket and then withdraw the battery pack from the housing using the pull cord.



2. Insert the new battery pack into the housing and ensure the battery connector mates to the PCB.



7.5.5 Replacing the Endcap

1. Insert the circular rubber gasket against the PCB.
2. Push the endcap fully onto the housing ensuring there is no gap between endcap and housing.

Note

Use petroleum jelly to lightly lubricate the endcap O-rings if required.

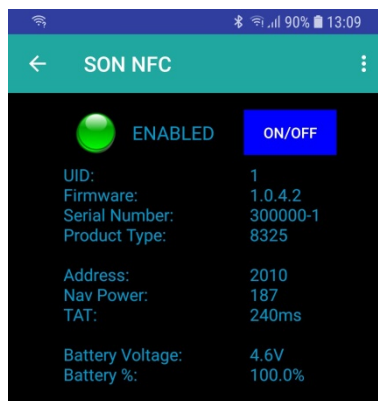
7.5.6 Replacing the Transponder into the Housing

1. Push the transponder fully into the outer housing until it reaches the retaining flange.
2. Insert the horseshoe retainer into one of the rear slots and carefully rotate it until the locking tab aligns with the outer housing slot.
3. Push the horseshoe retainer forwards into the slot.
4. Using a 4 mm Allen key, carefully screw the two M4 cap head screws onto the bottom endcap.
5. Check the battery status if required; see *Section 7.6 Battery Status*.

7.6 Battery Status

7.6.1 Checking the Battery Status

See *Section 4.3 “Configuration”* to connect to the Marker 6 and display the battery voltage and capacity.



7.7 Connecting and Disconnecting the Battery

7.7.1 Physically

To physically disconnect and connect the battery, see *Section 7.5 “Replacing the Battery”*.

7.7.2 Electronically

To electronically disconnect the battery, disable the Marker 6; see *Section 4.3.2.4 “Disabling and Enabling the Marker 6”*.

7.8 Operating the Pressure Relief Vent Valve

A pressure relief vent valve is fitted to automatically release any build-up of pressure inside the transponder during deployment. This could be caused by water ingress during deployment and/or the degassing of a battery.

The pressure relief vent valve should be flush with the endcap face. If there is any reason to suspect there may be pressure inside the transponder, the pressure relief vent valve must be operated as described below.

WARNINGS



Make sure the work environment is well ventilated. Toxic gases and liquids may be released when operating the pressure relief vent valve.

1. Using a thumb and forefinger or a suitable tool, carefully withdraw the pressure relief vent valve **1** as far as it will extract and wait for any internal pressure to be released.

Note



If using a tool to extract the valve be careful not to damage the valve's surface.



2. After any pressure has been released, push the valve fully back into its recess.

Section 8 – Functional Testing

8.1 Introduction

Before performing any functional testing on the equipment, ensure *Section 2 – Safety* is read and fully understood.

Make sure the Marker 6 has been cleaned; see *Section 7.3 “Cleaning”*.

To make sure the Marker 6 functions correctly, testing can be carried out including:

- Hardware self-check

8.2 Equipment

The following equipment can be used to carry out functional testing of the Marker 6:

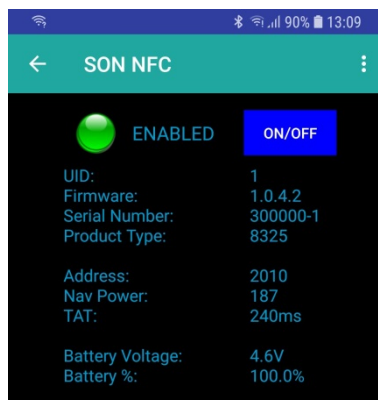
- RFID/NFC Device; see *Section 4.3 “Configuration”*
- Sonardyne NFC app; see *Section 4.3.2.1 “Sonardyne NFC App”*

8.3 Test Procedures

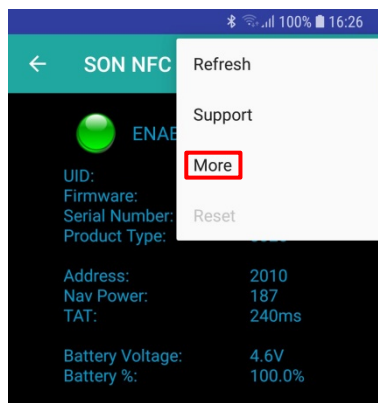
8.3.1 Manual Commands

The Sonardyne App can be used to send manual commands to the Marker 6.

1. See *Section 4.3 “Configuration”* to connect to the Marker 6.



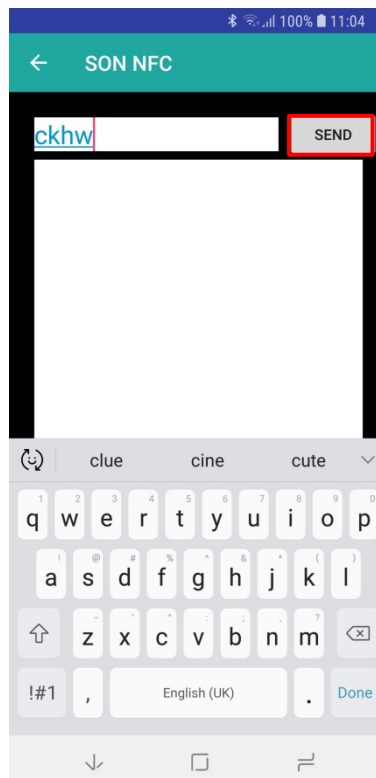
2. Tap the three vertical dots  and then tap **More**.



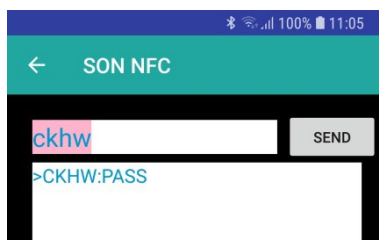
3. Tap **Terminal**.



4. Type the Terminal command, for example, to perform a hardware check, type **ckhw** and then tap **SEND**.



5. The **ckhw** command result is displayed below.



8.3.2 Self-Test

A self-test can be performed on the transponder including an acoustic loopback check.

1. Tap **SELF TEST**.



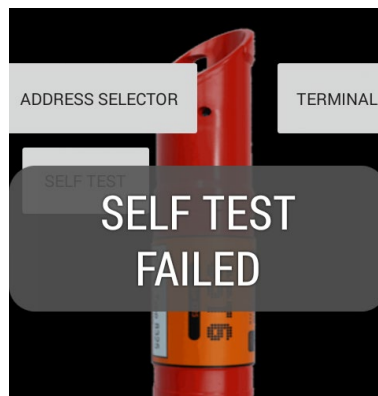
2. If the self-test is successful, the app reports **SELF TEST PASSED!**



3. If the self-test is unsuccessful, it may be due to an NFC or hardware error.
 - a. If the app reports **NFC READ FAIL**: retry the self-test and try re-positioning the handset (NFC antennas can be in different positions within the device).



- b. If the app reports **SELF TEST FAILED**: enter the manual command **ckhw** to list details of any hardware errors; see *Section 8.3.1 “Manual Commands”*.



- c. If the self-test failures cannot be resolved, contact Sonardyne Support.

Section 9 – Fault Diagnosis

9.1 Introduction

The following section assists in diagnosis when the transponder fails to operate correctly. Each section identifies a fault, the possible cause and the recommended action to rectify the fault.

9.2 Fault Types

Fault	Possible Cause	Action
Transponder does not reply to interrogation or commands	Incorrect transponder address set in the surface transceiver	Check address and repeat with the correct address
	Operating at long range	Increase power to the surface transceiver
	Ray-bending effects stopping the transponder from receiving	Use software application RAY_TRACE available from Sonardyne Int Ltd
	Surface thermocline refracting reply signals	Lower transducer below thermocline
	Noise level at surface transducer too high	Lower the dunking transducer/transceiver and reduce the surface transceiver gain settings
	Noise level at surface transducer too high	Do a noise check using the applicable transceiver noise check command
	Transponder has low battery power	Check log for battery output before deployment
		Check battery levels since deployment
NFC device unable to contact transponder	Other acoustic systems maybe operating in the same frequency band	
	NFC device is not close enough to transponder or held at an incorrect angle	Reposition the NFC device next to the transponder
	NFC device is not working correctly or has locked	Check/restart the NFC device
	NFC app has locked	Restart the NFC app
	NFC interface has locked	Power cycle the Marker 6 by removing battery and waiting 60 seconds before replacing

Section 10 – Spares

10.1 Introduction

When ordering spare parts, please provide:

- a) The part number
- b) The drawing number (if known)
- c) The description

Enquiries about, or orders for spare parts should be directed to your local Sonardyne office or agent. Local agents contact details can be found on the back cover of this manual and at www.sonardyne.com

10.2 Spares

The following diagram shows a list of available spares for the Type 8326-4311. See *Table 10-1* for Type 8326-7511 spares.

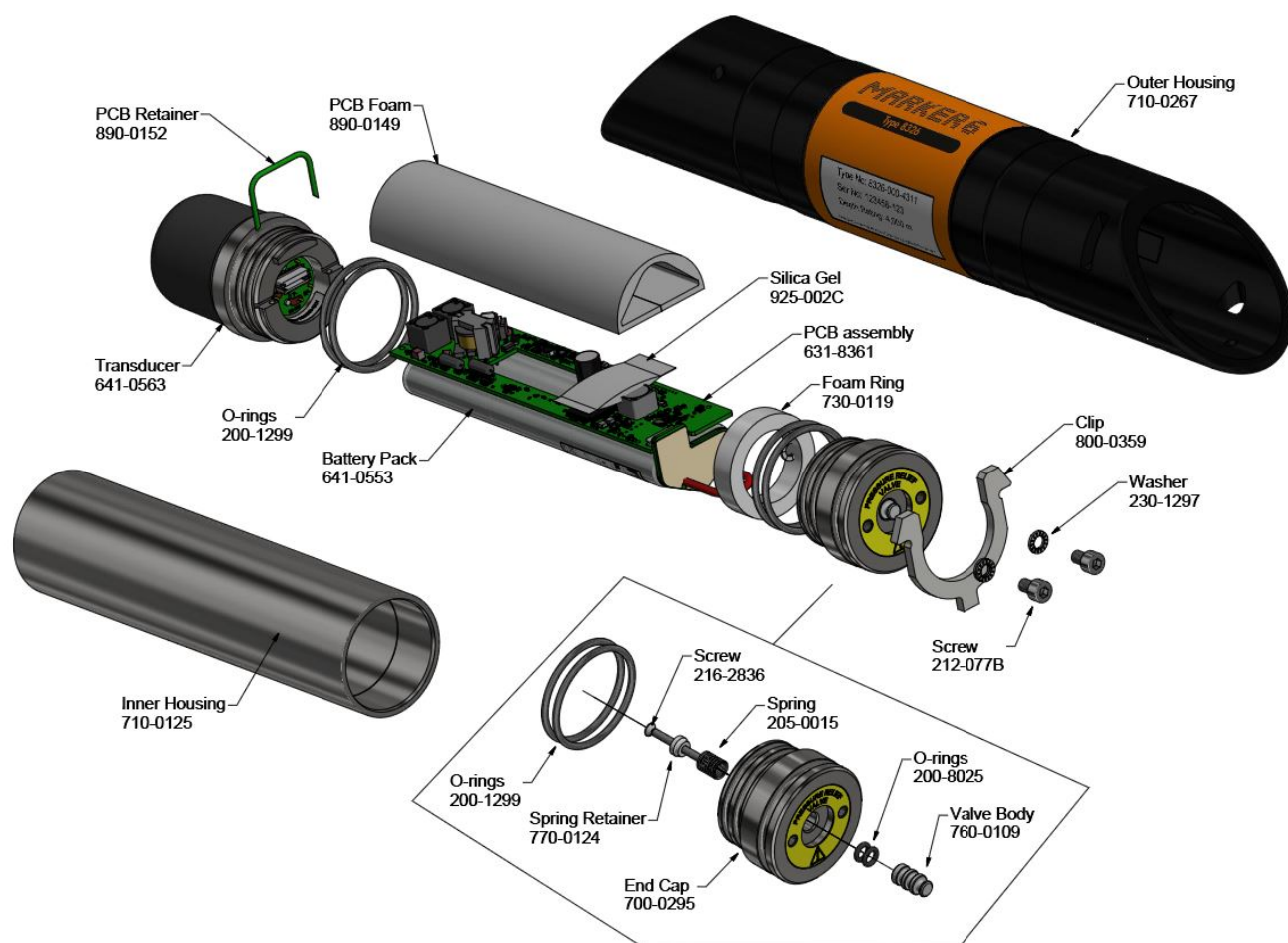


Table 10-1 Deep Marker 6 Spares

Type 8326-4311	Type 8326-7511	Description	Quantity
710-0267	710-0267	Outer Housing	1
710-0125	710-0190	Inner Housing	1
641-0553	N/A	Alkaline Battery Pack	1
641-0607	641-0607	Lithium Battery Pack	1
800-0359	800-0483	Horseshoe Retainer Clip	1
230-1297	230-1297	Endcap Washer	2
212-077B	212-077B	Endcap Screw	2
730-0119	730-0119	Foam Ring	1
631-8361	631-8361	PCB Assembly	1
925-002C	925-002C	Silica Gel	1
890-0149	890-0149	PCB Foam	1
890-0152	890-0152	PCB Retainer	1
641-0563	641-0746	Transducer	1
700-0295	700-0356	Endcap	1
200-1299	200-1299	Endcap O-rings	2
760-0109	760-0205	Pressure Release Valve Body	1
200-8025	200-8025	Pressure Release Valve O-rings	2
205-0015	205-0015	Spring	1
770-0124	770-0124	Spring Retainer	1
216-2836	216-2836	Screw	1
641-3332	641-3332	Sonardyne Opening Tool	1

Section 11 – Technical Specifications

11.1 Acoustic

Parameter	Type 8326-4311	Type 8326-7511
Operating Frequency Range	MF (19–34 kHz)	MF (19–34 kHz)
Transmit Source Level (re 1 µPa @ 1 m)	187 dB	187 dB
Individual Addresses	>200	>200
Interrogation Groups	16	16
Replies	WB2	WB2

11.2 Mechanical

Parameter	Type 8326-4311	Type 8326-7511
Depth Rating	4,000 m	7,000 m
Mechanical Construction		
Outer Housing	Polypropylene	Polypropylene
Inner Housing	Duplex stainless steel	Titanium Grade 5
Dimensions (Length x Diameter)	385 x 63.0 mm	385 x 63.0 mm
Weight in air/Water	2.0/1.3 kg	1.5/0.7 Kg

11.2.1 Battery

Parameter	Type 8326-4311-A	Type 8326-4311-L	Type 8326-7511-L
Battery Type	Alkaline	Lithium	Lithium
Battery Life (Continuously Listening)	>9.5 months	>30 months	>30 months
Storage Mode (Battery Disconnect via NFC)	5 years (battery self-discharge limited)	>10 years (battery self-discharge limited)	>10 years (battery self-discharge limited)

11.2.2 Environmental

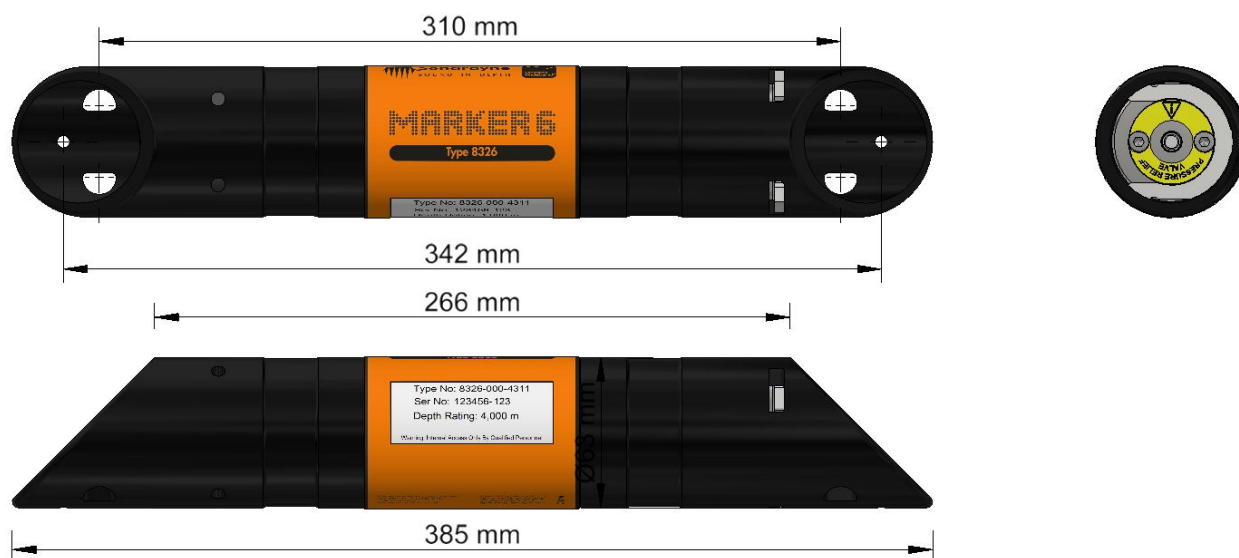
Parameter	Type 8326-4311	Type 8326-7511
Operating Temperature Range	-5 to 40°C (23 to 104°F)	-5 to 40°C (23 to 104°F)
Storage Temperature Range ¹	-20 to 55°C (-4 to 131°F)	-20 to 55°C (-4 to 131°F)

¹ To maximise battery life, the recommended storage temperature range when the instrument contains a battery pack is 10 to 25°C (50 to 77°F).

11.2.3 Outline Drawings

11.2.3.1 Type 8326-4311/7511

Figure 11-1 Type 8326 4311/7511 Dimensions



Appendix A – Basic Principles of Transponder Interrogation and Reply

A.1 Interrogation and Reply

The interrogation signal transmitted to a 6G Wideband 2 transponder is a phase-encoded acoustic signal around 8 milliseconds in length. The acoustic transducer converts the acoustic signal into a low level alternating voltage. All ambient noise is converted into an electrical noise voltage covering a wide frequency range. The pre-amplifier in the transponder amplifies the combined signal and noise voltages and filters to weaken frequencies outside of the band used by the transponder channels. The receiver uses Digital Signal Processing (DSP) to detect the interrogation signal, even in the presence of other noise and signals.

After a specific time-interval known as the 'turnaround time' logic circuits in the transponder and transmitter generate a powerful acoustic reply. The reply is on a different channel to the interrogation signal, but the same length.

The equipment that sent out the interrogation signal will detect the reply signal from the transponder. The delay in receiving the reply will allow the equipment to calculate the range (distance) to the transponder.

The equipment calculates the range as follows:

- *Measures the total time delay = A*
- *Subtracts the turnaround delay = B*
- *This gives the true time delay = C*
- *Multiplies by the speed of sound in water = D*
- *This equals the two way range = E.*

$$A - B = C$$

$$C \times D = E$$

Sound is reflected by the sea surface, seabed and other reflecting surfaces. This causes a received signal to appear much longer in duration than the original transmission. This extended signal has random phases and random decreasing amplitude. This sound reflection is known as reverberation. The transponder has a built in 'blocking period' this allows the reverberation to fade away before a transmission starts. The 'blocking period' prevents multiple replies from being transmitted in response to the reverberation.

The 6G Wideband 2 instruments are set to always receive the Individual Interrogation Signal (IIS), which is set by its acoustic address. The IIS can be followed by an acoustic command. If no command is present the transponder or transceiver will reply on a Common Reply Signal (CRS) depending on the address family. This interrogation mode is used for baseline measurements between transponders, where only one transponder at a time will be replying. The turnaround time is fixed to 320 milliseconds.

The transponders or transceivers can also reply to a Common Interrogation Signal (CIS); its reply can be enabled or disabled via serial or acoustic command. If enabled, it will reply to the interrogation signal using its Individual Reply Signal (IRS), which is set by the acoustic address after the programmable turnaround time. There are different CIS signals (CIS0 to CIS14) these allow independent operation of several Long Base Line (LBL) navigation systems in the same area. The CIS used and the value of the turnaround time can be set by serial port or acoustic command.

To make sure of maximum battery life, the transponder goes into a sleep mode. To wake the transponder from this mode a wake up signal is sent before interrogation. The transceiver which generates the interrogation can be instructed to transmit a wake-up signal immediately before sending the interrogation signal. When the transponder has replied to the interrogation signal it will return to sleep mode after a controllable period of inactivity. The transponder can be programmed with an inactivity time, the length of the inactivity time required depends on the task the transponder is being used. The activity time is restarted after each valid interrogation. If the transponder has not gone into its sleep mode a wake up signal is not required.

A.2 Interrogators

Wideband transponders are being used for general acoustic navigation and special projects where the efficient command structure is required to save time during position and sensor measurement cycles.

Interrogators which are compatible with the new command structure are as follows:

- *TYPE 8310 ROVNav6 is a navigation transceiver used for LBL array calibration, ROV navigation and data telemetry.*
- *TYPE 8142 HPT USBL transceiver with a multi-element array provide both range and bearing information. The transceiver is capable of receiver Sonardyne's high data rate (HDR) telemetry, 3kbps and 6kbps.*
- *TYPE 8220 AvTrak6, Versatile AUV transceiver with Omni-directional transducers and used for self navigation, tracking and acoustic telemetry.*
- *TYPE 8309 MF Dunker transceiver for deployment over the side of a surface vessel and used for command and control and data acquisition from subsea instruments.*

For testing and maintenance, the Type 8063 deck test unit can perform basic WBv1 interrogations acoustic check, but cannot command or configure the transponder. The transponder should be configured using the Sonardyne 6G Terminal Lite software and if required another 6G instrument can be used for a basic acoustic check.

Appendix B – Licence Notices and Terms

The following software is used with this product.

B.1 Open Source Software Licence Notices and Terms

B.1.1 Atmel Software Framework V3.28.0

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B.2 Other Licence Notices and Terms

B.2.1 Sonardyne NFC App

The Sonardyne NFC App is issued for use subject to licensing terms under (1) Google Play™ terms of service and (2) Sonardyne Mobile Application End-User Licence Agreement.

Definitions

Term	Definition
6G®	Sonardyne's sixth generation technology hardware platform.
Acoustic Signal	Information carried by sound pressure waves through water. The Sonardyne acoustic signal has a finite length.
Acoustic Transceiver	An instrument that emits and receives acoustic signals, and extracts information from them. Transceivers can measure the time it takes a signal to travel from its transducer to a transponder and return. Some can encode and send data in a message and extract digital data from a message (Acoustic Telemetry). Used on a surface vessel or to mark a point on the seabed, or fixed to a mobile for tracking or positioning.
Acoustic Transducer	A device that converts electrical signals into acoustic signals and vice versa.
Acoustic Transponder	An instrument that emits an acoustic signal when it detects an interrogating acoustic signal.
CIS	Common Interrogation Signal
CS	Configuration Status
FPGA	Field Programmable Gate Array
NFC	Near Field Communications
PC	Personal Computer
PCB	Printed Circuit Board
RFID	Radio Frequency Identification
ROV	Remotely Operated Vehicle
Sonardyne	Sonardyne International Limited and its affiliates.
Sonardyne Wideband®2	6G transponders and transceivers use Sonardyne Wideband 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep water.
TAT	Turn Around Time
USB	Universal Serial Bus
Ultra-Short Base Line Positioning System (USBL)	A system similar to an SBL system except the system uses three or more elements in a single transducer array. The measurements it makes are the differences in "time-phase" of the signals from each element. The co-ordinate frame is fixed to the transducer array which must be oriented in the vessel frame to be equivalent to the SBL.

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