User Equipment Manual

for

Phalcon NT

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Approval:

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Table of Contents

Introduction.

This manual provides a brief description of the Transponder and its functions. It also details the initial setup and installation procedures.

Equipment Description.

The Phalcon NT Transponder is a marine radar beacon system (RACON) capable of responding to S-band and X-band pulsed radars in compliance with the ITU recommendations ITU-R M.824-4 'Technical Parameters of Radar Beacons'. The RACON is a receiver/transmitter transponder device used as a navigation aid, identifying landmarks or buoys on a shipborne marine radar display. The RACON responds to a received radar pulse by transmitting an identifiable mark back to the radar set. The displayed response has a length on a radar monitor corresponding to a few nautical miles and is encoded as a Morse character beginning with a dash for identification.

Equipment Identification

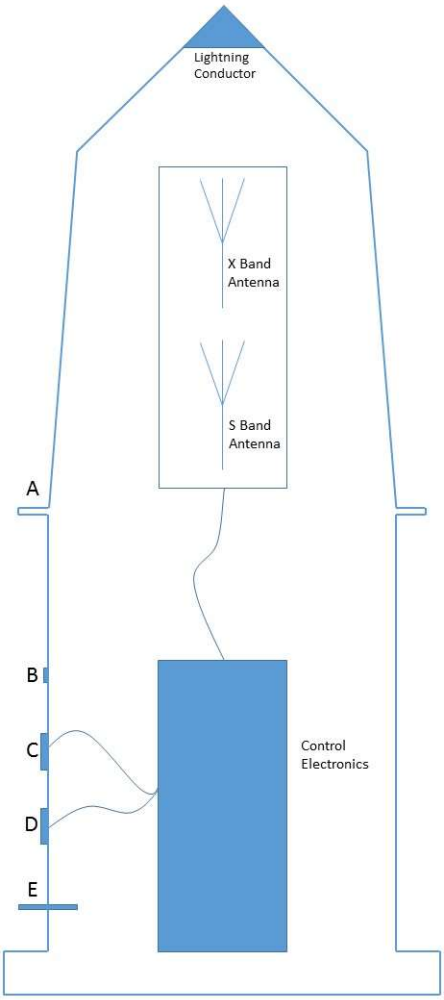
The RACON is labelled with the manufacturer's part number as well as the purchaser's name and logo.

Manufacturer Part:	Phalcon NT
Manufacturer:	PHAROS MARINE AUTOMATIC POWER LTD

*******WARNING – NON IONISING RADIATION HAZARD*********

To satisfy FCC exposure requirements, a separation distance of at least 20 cm should be maintained between the antenna of this device and persons during device operation

Block Diagram and Construction



A. Flange Joint.
B. Breather.
C. Comms Connection.
D. Power connection.
E. Lightning Ground connection.

The Transponder comprises one major assembly that contains the S-band and X-band receivers, transmitters and antennas, together with the signal processing and power conditioning sub-systems.

The Transponder can be considered as being two sub-assemblies: the Base Housing and the Radome. These sub-assemblies are joined at the main flange where a gasket is used to prevent water ingress during severe climatic conditions or accidental submersion to a depth of 2m.

The Base Housing is below the main flange and made from RIM plastic painted with two pack polyurethane primer and top coat. Inside the Base Housing is the Main Electronics Assembly which is a hermetically sealed unit designed to additionally protect the electronics from the environment. The Base Housing also contains two sealed connectors;

one for power and the other for communication. Additionally, a water impervious breather is used to allow pressure equalisation for air transport and the daily change in atmospheric pressure. This negates the need to pressurise the assembly.

Above the main flange is the radome which contains and protects the antennas. This is made from Lustran® which is transparent to RF signals.

Specification

Frequency of Operation	
S band	2.9 to 3.1GHz
X band	9.2 to 9.5GHz
Output power to antenna	30dBm min
Lightning protection – Surge protection (1ms)	3000V

X band	
Gain	6dBi
Polarisation	Horizontal
Vertical divergence	22 degrees min
Effective Isotropic Radiated Power (EIRP)	36dBm

S band	
Gain	1dBi horizontal, 0dBi vertical
Polarisation	Horizontal and vertical
Vertical divergence	22 degrees min
Effective Isotropic Radiated Power (EIRP)	30 to 31dBm

Amplitude Detection	
Terminal sensitivity (Firmware programmable)	-50dBm min
Side lobe rejection	Automatic detection via amplitude mapping

Frequency performance	
Frequency accuracy (50ns to 200ns pulse widths)	±3.5MHz
Frequency accuracy(>200ns pulse widths)	±1.5MHz
Modulation – Plain Pulse	
Morse pulse	As per IALA legislation
Output Duration for Morse Letter (750 m to 8 km)	5us to 53 us
Modulation – Response to Linear Chirp Pulse	
Morse Pulse	Derived from IALA legislation
Output Duration for Morse Letter (750 m to 8 km)	Chirp Duration + 5us to 53 us
Response Timing	
Range to start position	As per IALA legislation
Angular width of displayed response	Minimum angle emitter rotates in 8 PRI or selectable multiples of this
Firmware control functions (via terminal and RS232/USB interface)	
Morse selections	
Firmware updates	
Firmware version number	
Transmitted pulse length vs received pulse length	
Wake up timing	
Turn on / off timings (for a pulse stream)	

BITE Monitoring / communication (via terminal and RS232 interface)	
Input voltages	
Firmware version	
Serial number	
Unit ID	
Alarms	
Alarm/Siren Control	
Closed fully floating contacts on fault	Internal Fault detected

Environmental

Environmental Operating ranges	
GMU and ATEX Category 3	-40^{o}C to +70^{o}C
ATEX Category 2	-20^{o}C to +40^{o}C
Altitude	<2000m
IP Rating	Designed to meet IP67

Interfaces

External interface	
+10V to +36V DC (operating – 10% Tx duty cycle)	< 10 W
+10V to +36V DC (standby)	<0.1W
Current	3A max
Power	Connector types – MIL-C-38999 . See appendix B
Control Interface Monitor and Control (M&C) and in field programming	RS 232 Connector types – MIL-C-38999 . See appendix B

Mechanical

Height	810mm nom
Diameter (including lift ring)	384mm nom
Weight (Transponder with standard base ring)	10.5kg
Housing	Plastic Moulding
Submersion Capability (Survival - Non operating)	2m min.
Lifting	2 painted metal handles attached to mid section

Parts List

The following list identifies those parts that the end user will have interaction with, i.e. the external parts of the RACON. Additionally the main assemblies inside the RACON are detailed, although it is not expected that the unit will be disassembled at any time unless returned to the manufacturer, and disassembly should only be undertaken by trained and approved technicians.

External Parts

SA00-701191	ANTENNA ASSEMBLY	Qty 1
0000-793222	BASE HOUSING FOR LW26-701189	Qty 1

Main Internal Parts

SA00-701190	MAIN ELECTRONICS ASSEMBLY	Qty 1
5C-0.75MM-LKSM-HF	CABLE KIT	Qty 1
CONN-19WAY-STRT-0001	19 WAY CIRCULAR CONNECTOR	Qty 1

Software and Transponder Setup

The Transponder does not require the user to load any software. In normal operation the Transponder runs autonomously with the necessary firmware already embedded in the unit.

In addition, the following software and PC hardware is required by the installer to be able to communicate and change the settings that are under user control:

Configuration GUI (Software as supplied)

USB to Serial communications cable

Installation

The Transponder is supplied in custom packaging for safety during transportation. Should the unit need to be relocated at any time it is recommended that it is carried in suitable packaging to avoid the potential for damage.

After the unit has been unpacked it should be inspected for any signs of damage that may have occurred during shipping. Also included in the package is a USB to serial communication cable required to change the default settings of the Transponder if required.

The Transponder is secured to a platform using three or more bolts (suitable for M10 bolts torqued to a max of 15 Nm), arranged in the pattern given in Appendix A.

As the manufacturer of the equipment, Linwave do not know the specifics of each installation site and so the supply of the fixing's and any other parts required are left to the customer's discretion; however a clear line of sight to intended radars is necessary for correct operation.

Note: A low impedance (<20mΩ) connection capable of carrying 20A to earth is necessary for the Lightning Ground Connector (See page 5. Connection E) to meet the surge protection specification.

See Appendix A for mechanical details.

Electrical Connection

The Transponder is intended to operate from a single DC power supply of between +10V and +36V via an Amphenol connector. The source impedance of the DC supply applied to the Transponder must be less than 1 Ohm. Information on the fitted connector type and connections to the Transponder can be found in Appendix B and the Block Diagram above. The alternate mating half of the connector is required for the external power cable (not supplied).

Correct choice of wire gauge for the cabling is left to the customer but must be sufficient to supply the required 10V to 36V DC, with a nominal peak current of up to 2A, at the terminals to the device and be appropriate for the external operating environment. For reference the internal wiring to the main power connector is made up of three parallel 26AWG wires, each consisting of 7 strands 34AWG tinned copper wire, with a voltage rating of 300V and PVC Insulation. It may be necessary to consider a larger gauge than this for long cable runs to the transponder device where the voltage drop across the supply cable may drop the applied voltage below the 10V minimum requirement for correct operation.

A fuse rated in excess of 2A but less than 3A fitted in series with the positive voltage connection wires is recommended for additional fault protection purposes and should be used in all battery based applications.

In order to meet conducted emissions requirements of BS EN 60945, through the power cables, the floor of the transponder must be situated more than 25mm away from a ground plane if other electronic equipment is connected to the common supply.

Connection process

The two circular cable connectors are designed to be fitted by hand. This is done by grasping the connector firmly, aligning the outer connector to match the alignment pins on the mating half in the housing and then pressing towards the body of the transponder whilst twisting the outer body of the connector clockwise until the connector mates with the mating half fitted to the transponder housing. The connector incorporates a sprung locking mechanism to maintain connection once correctly mated.

Operation

Once the DC power cable has been connected to the unit via a suitable PSU, the power can be turned on. The Transponder will enter a start-up routine and then commence normal operation using its programmed settings. Should it be necessary to make changes to the settings, or to monitor the operation of the unit, the USB to serial comms cable supplied should be connected between the Comms Connector on the Transponder and a serial or USB socket on a PC or laptop. Using the Configuration GUI, the default values can be adjusted to suit the intended application (Refer to Appendix C for command details).

After removing the comms cable, the dust cap should be fitted to the Transponder comms connector.

Battery Operation

If operating off a standalone battery i.e. one not continually being replenished by means of a secondary charging system, then consideration should be given to the required operation times, in order to select a battery with sufficient capacity to provide charge for the required period of operational time. Configuration of the operating modes and the amount of radar traffic around the transponder can significantly affect this capacity requirement but a worst case figure of 4Ah/day from a 12V battery may be considered to aid in the selection process.

Disconnection in the event of a fault

In the event of a fault, power should be removed from the device by disconnecting the power lead from the input connector. This is done by grasping the connector firmly, pressing towards the body of the transponder to release the sprung locking mechanism, and then twisting the outer body of the connector anti-clockwise until the connector disconnects from the mating half fitted to the transponder housing.

Fault Diagnosis and Repair

The unit contains no user-serviceable parts. In the event of failure, the unit should be returned to the supplier.

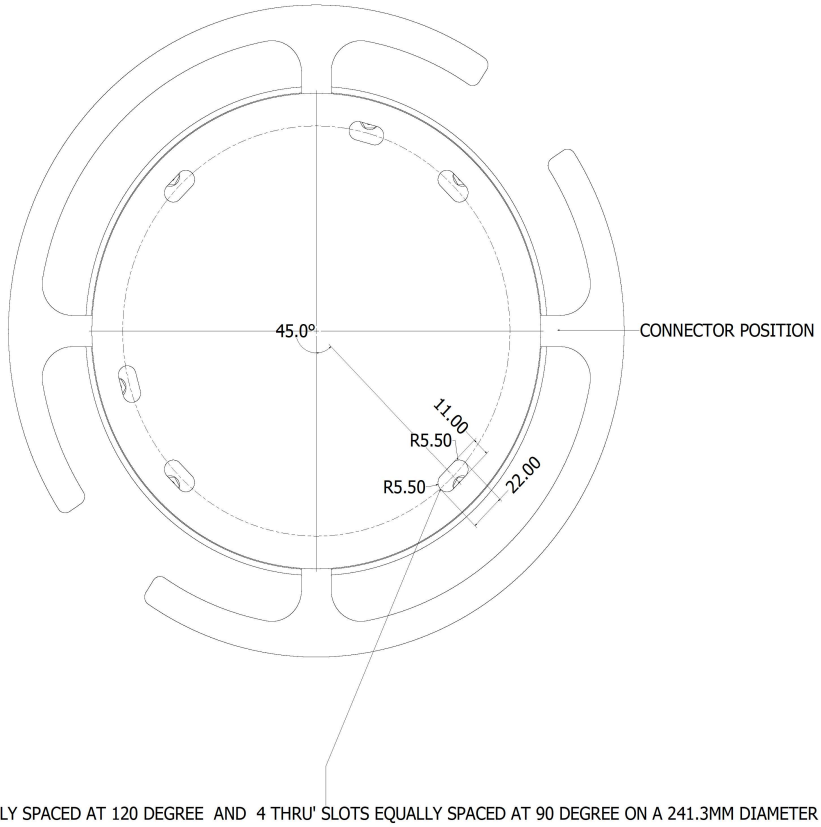
Safety

Only trained and approved technicians should attempt to disassemble the transponder or attempt to repair or replace any items within the transponder. RF power levels and surface temperatures within the transponder may exceed safe limits if the unit is still operating and/or has been recently operating at temperatures in excess of 60°C.

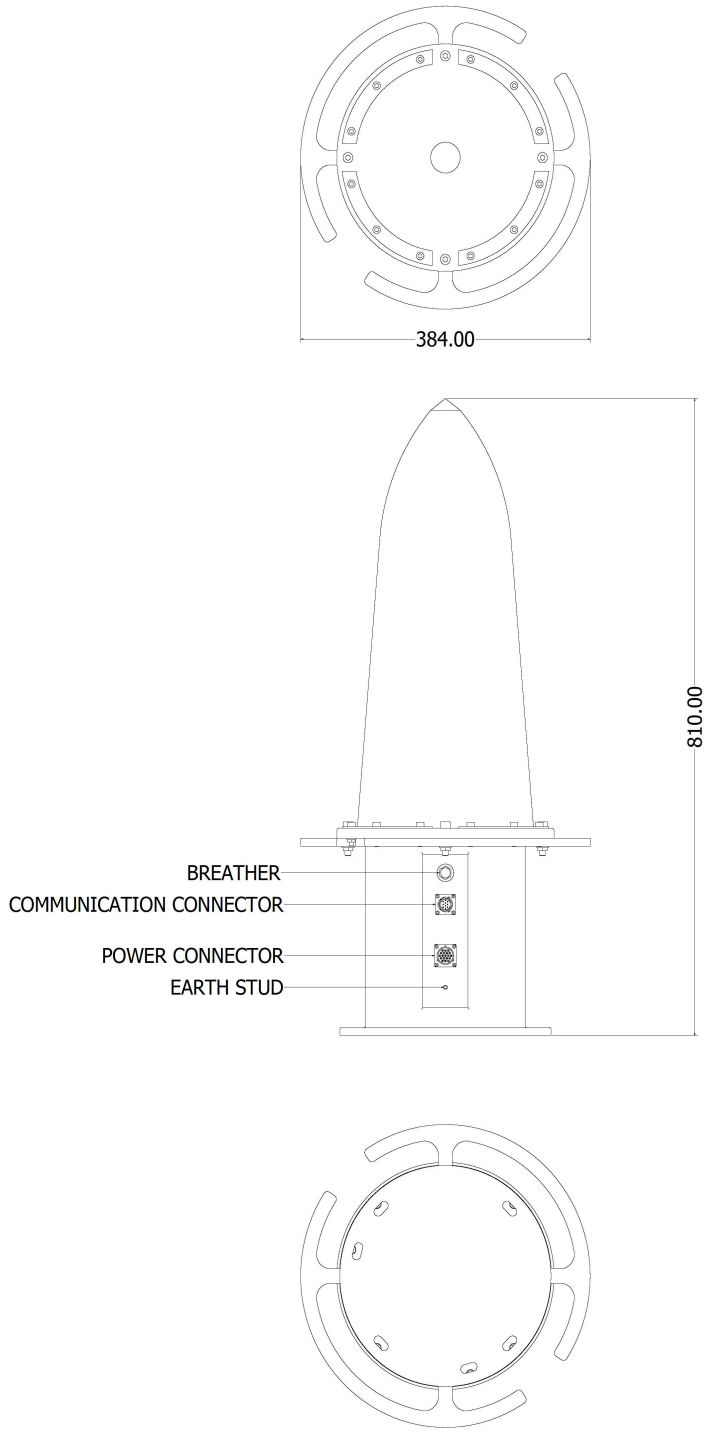
Disassembly should not be undertaken by the end user.

Appendix A. Mechanical Details

Mounting hole locations (distribute fixings evenly about the circumference)

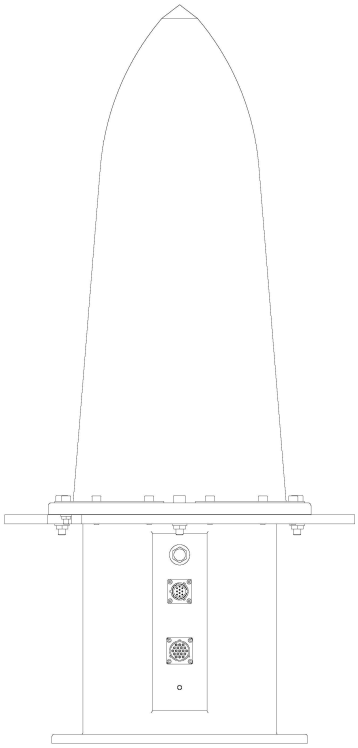


External Dimensions



Appendix B. Electrical Connection Points

Connector Positioning



Breather.

Comms Connection.

Power connection.

Lightning Ground connection.

Connector Pin outs

The Comms Connector on the Transponder is defined and configured as shown below. A mating connector is supplied with the system at one end of the comms cable.

Transponder's Comms Connector: Amphenol 62GB-12E12-10SN

12-10
10-#20

Function	Signal	10-Way Metal Circular Bulkhead Connector COMMS BLANKING
BLANKING	Inhibit + (Inhibit Low if Inhibit + >Inhibit -)	A
BLANKING	Inhibit - (Inhibit Low if Inhibit + >Inhibit -)	B
COMMS	U3_RX232	C
COMMS	U3_TX232	D
COMMS	SER_BOOT_N	E
COMMS	MAN_RST_N	F
POWER	+V	G
POWER	0V	H

The Power Connector on the Transponder is defined and configured as shown below. A suitable mating connector with appropriate sealing should be used in the construction of the power cable.

Transponder's Power Connector: Amphenol 62GB-12E14-19PN

19 Way cable connector cores with optional 4 CORE CABLE

Function	Signal	19-Way Metal Circular Bulkhead Connector POWER BITE	19 Way cable connector cores With optional 4 core cable
BITE	On - Normally Close Relay Contact (Open if Fault A High)	A	
BITE	Middle - Relay Contact	M	3
BITE	Off - Normally Open Relay Contact (Closed if Fault A High)	L	4
BITE	Fault Ref	B	
BITE	Neg Fail - Opto Pulled to Fault Ref when Fault A High	C	
POWER	+V	J	1
POWER	+V	H	
POWER	+V	G	
POWER	0V	K	2
POWER	0V	T	
POWER	0V	S	
BITE	Relay Enable A (Link to Relay Enable B to enable relay)	D	
BITE	Relay Enable B (Link to Relay Enable A to enable relay)	E	

19 Way cable connector cores with optional 5 CORE CABLE

Function	Signal	19-Way Metal Circular Bulkhead Connector POWER BITE	19 Way cable connector cores With optional 4 core cable
BITE	On - Normally Close Relay Contact (Open if Fault A High)	A	3
BITE	Middle - Relay Contact	M	4
BITE	Off - Normally Open Relay Contact (Closed if Fault A High)	L	5
BITE	Fault Ref	B	
BITE	Neg Fail - Opto Pulled to Fault Ref when Fault A High	C	
POWER	+V	J	1
POWER	+V	H	
POWER	+V	G	
POWER	0V	K	2
POWER	0V	T	
POWER	0V	S	
BITE	Relay Enable A (Link to Relay Enable B to enable relay)	D	
BITE	Relay Enable B (Link to Relay Enable A to enable relay)	E	

Appendix C. Transponder Configuration GUI

Overview

The Configuration GUI provided with the system allows a simple method by which the transponder can be configured for the user's requirement.

The key configurable parameters are:

- Response Character (The letter to appear on the radar)
- Response Length (The nominal size on the response shown on the radar screen)
- System Sensitivity (How far away the radar can be detected from)
- Response Duty Cycle (Configured using the Sleep times and Wakeup conditions to optimize power consumption)

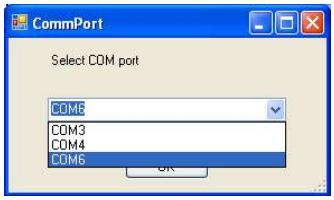
In addition to these, the estimated mean power consumptions are also shown allowing the user to assess how well matched the unit's configuration is to a particular power supply.

Configuration GUI Setup

The Configuration GUI runs on a standard Windows™ based PC and requires the supplied USB to Serial communications cable to be connected between one of the PCs USB/serial ports and the transponder.

The following sequence should be used once the GUI has been installed:

- The transponder should be switched off, i.e., its main power cable should be disconnected from the unit.
- Connect one end of the USB to Serial communications cable to the PC.
- Connect the other end of the USB to Serial communications cable to the transponder.
- Run the Configuration GUI installed on the PC.
- From the drop down list select the COM port that the Communications Cable has been allocated to and then click *OK (The light at the bottom should still be red at this point).*



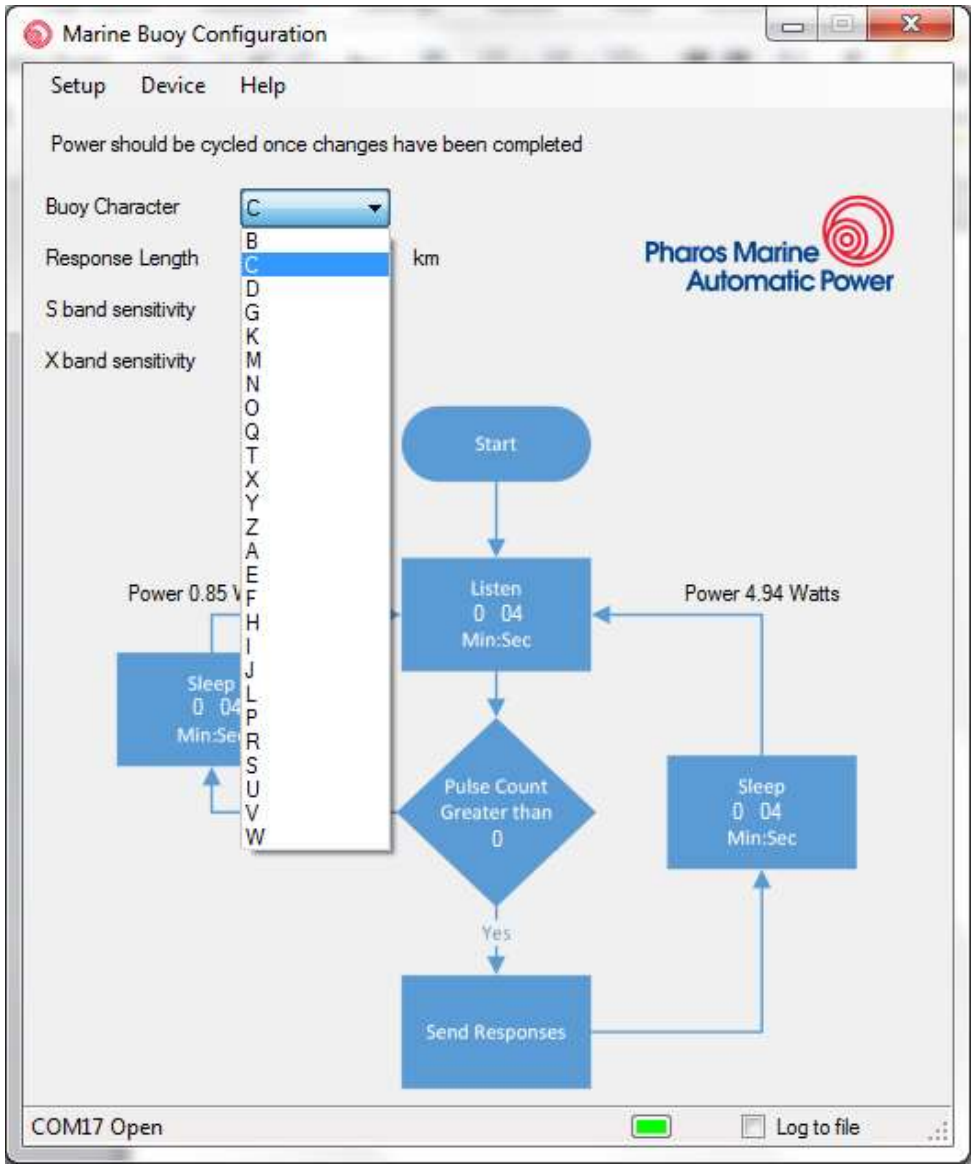
- Power up the transponder by plugging in its supply cable. The present configuration of the transponder will be read by PC (see reading configuration window below) and the Configuration GUI will be populated with these settings. The transponder is now held in a listening state ready for changes to be made to its configuration. (The light at the bottom should now have gone green).

- If for any reason the USB to serial connector is disconnected from either the PC or the transponder before completing the configuration of the transponder, then the GUI will need to be closed and reloaded (selecting the appropriate COM port as before) and the main power to the transponder cycled off and on.

Configuring the Transponder

Buoy Character

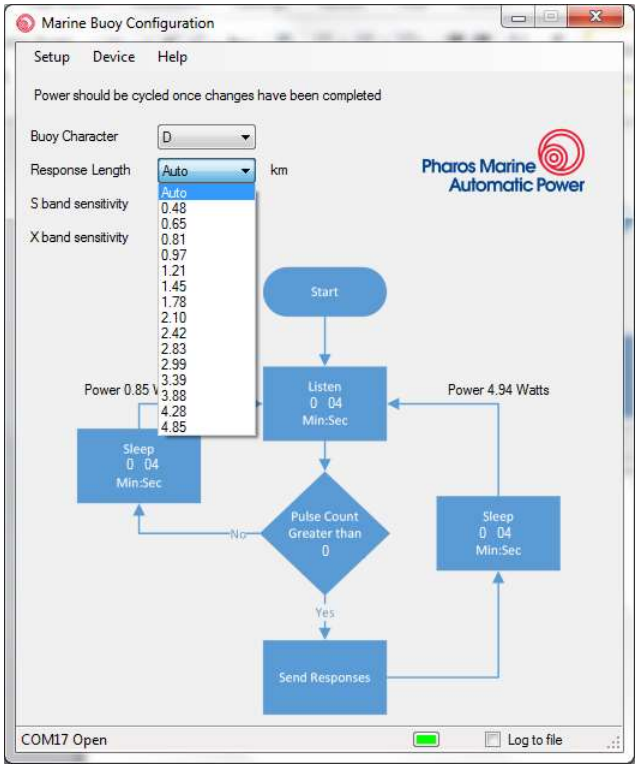
The Morse character used for the transponder's response can be chosen from the drop down list. The list contains those characters recommended by IALA, all starting with a 'dash'. Codes M,C,G,O,K,D,B are available.



Response Length

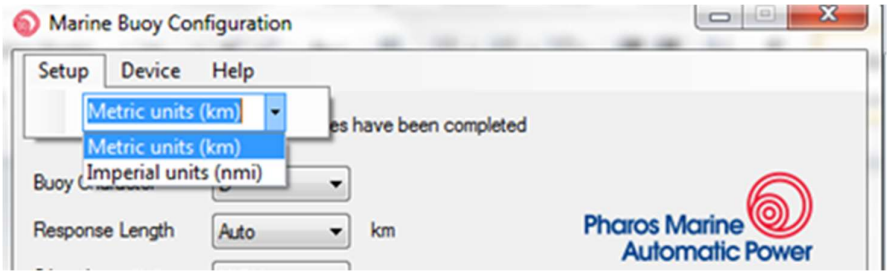
The length of the response, as seen by the radar that the transponder is responding to, can be selected from the drop down list. The units of measure for this can be changed between km and nautical miles (nmi) using an option under *Setup*. *(Note that after changing the units of measure, the response length will be set to Auto.)*

If the *Auto* option is selected, then the Response Length is based on the length of the pulse received from the interrogating radar. In this case, where a radar is using short pulses for close-in navigation, a short response will be generated. If the radar is using a long-range pulse, then a longer response will be generated. This feature allows the transponder's response to be optimally fitted to the radar's display.



Measurement Units

The GUI can be configured to display distances in either metric or imperial units by selecting the required option from the menu item at the top of the screen

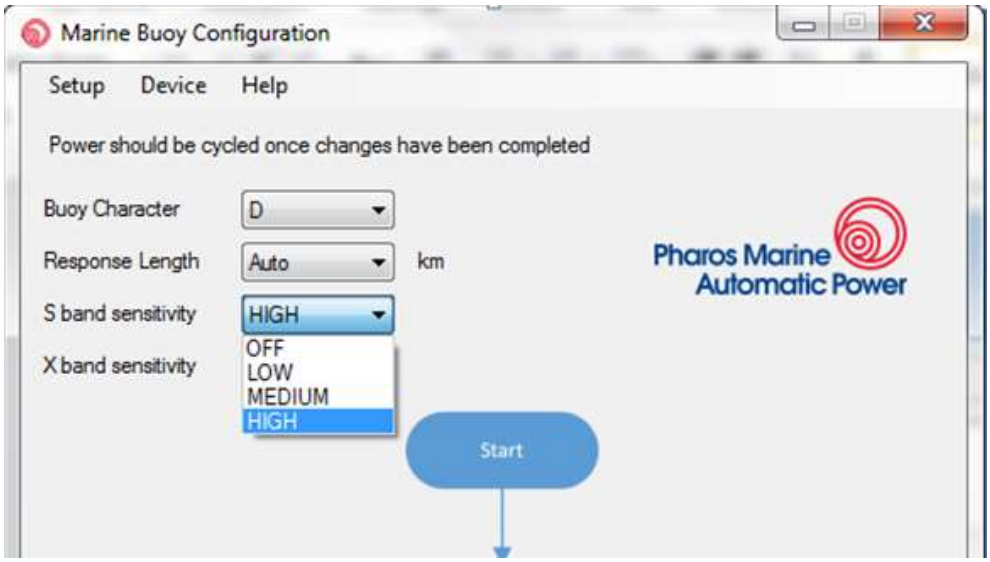


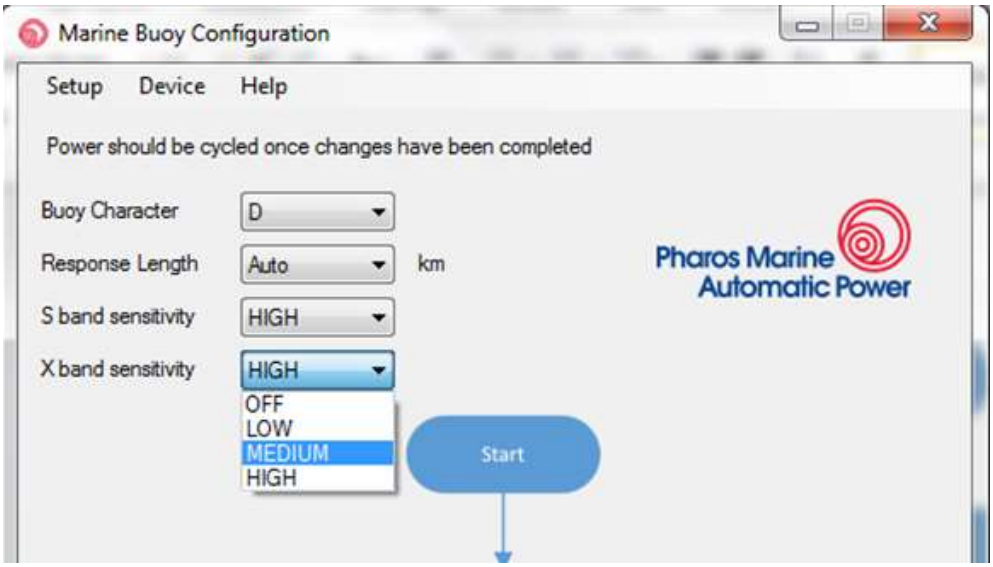
Sensitivity

The sensitivity of the transponder to S-Band and X-Band signals can be set independently. The *HIGH*, *MEDIUM* and *LOW* settings are related as described in the following example:

> A radar that just triggers the transponder at some range (say 40km) when the *HIGH* option is selected would need to be at half that range (20km) to trigger a response if the *MEDIUM* setting was selected. Similarly, if *LOW* had been selected, then the radar would need to be at half the range again, i.e., 10km.

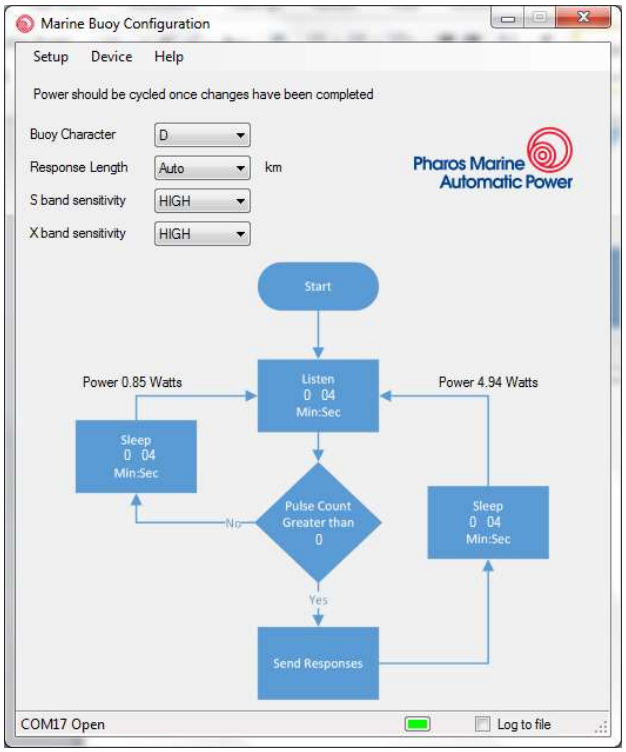
When the *OFF* option is selected, any pulses received in that band are ignored.





Flow Chart

The flow chart shown on the Configuration GUI illustrates the way the transponder works through its various states, as well as allowing the various parameters that control its power consumption to be edited.



Three of the boxes contain durations in minutes and seconds that can be edited, whilst a fourth box allows a *Pulse Count* threshold to be set. Their specific functions are described as follows:

- The transponder listens for radar pulses for up to the time entered in the *Listen* box.
- If the total number of pulses received in this time is not greater than the parameter entered in the *Pulse Count* box, then the transponder:
    - Enters the left hand *Sleep* box where it waits in its low power consumption mode until the duration entered in that box is exceeded.
    - Restarts the process by entering the *Listen* box.
- If the total number of pulses received in this time is greater than the parameter entered in the *Pulse Count* box, then the transponder:
    - Fully powers up
    - Measures the pulses in the RF environment
    - Calculates the appropriate responses
    - Sends interlaced responses for the selected number of sweeps for each emitter detected
    - Enters the right hand *Sleep* box where it waits in its low power consumption mode until the duration entered in that box is exceeded.
    - Restarts the process by entering the *Listen* box.

Power Consumption

As can be seen from the flow chart on the Configuration GUI, the transponder runs through one of two loops. The choice of loop depends on whether the number of pulses received during the *Listen* period exceeds the figure entered in the *Pulse Count* box. When measuring the RF environment in order to calculate and send a response, more power is consumed by the transponder than if it is simply monitoring a benign RF environment. Consequently, a mean Power Consumption figure is given for each of the loops. When adjusting the *Sleep* and *Listen* times, the power consumption figures are updated to reflect the new duty cycle.

Please note: These are indicative estimates only and not measured values.

Saving the Settings

The settings are automatically *Saved* to the transponder's non-volatile memory as each parameter is changed. An unsaved parameter is displayed in italic, which will change to non-italic when the transponder has accepted the command.

Note that if a mismatch occurs between the transponder's settings and those held by the GUI, then the GUI will display an italicized setting. In this case, assuming the communication between the PC and the transponder is correctly connected, then simply selecting the desired setting for the parameter should produce a non-italicized response.

Once the transponder has been configured, it is recommended that the following procedure is performed:

- Disconnect the power supply from the transponder.
- Close the Configuration GUI.
- Re-launch the Configuration GUI.

- Change some of the Configuration GUI's settings.
- Re-connect the power supply to the transponder.
- Observe that the Configuration GUI's settings are restored to the configuration previously set and that none of the settings are shown in italics.
- Disconnect the power supply from the transponder.
- Disconnect the comms cable from the transponder.

Appendix D. Commissioning of the Racon

Care must be exercised in the location of the RACON:

- The racon must be installed in an area that has a clear view or sight of where the client ships or vessels are located. **Do not install the racon behind poles, posts, fences or guard rails.** The racon signal behaves like light and cannot go through or around objects of any kind.
- **The racon should be levelled**. For fixed mounting surfaces, install the racon within a few degrees of true vertical. For best results, locate the racon as high as practical in order to provide a clear line-of-sight path between the racon and where the client ships or vessels are or will be located. In general, the higher the racon is mounted; the better is its useful range.

Care must be exercised in the use of the radar display controls:

- **The radar must be switched to a display range scale appropriate for the distance of the RACON from the ve ssel.**
- **Radar is correctly tuned.**
- **Switch off rain and sea clutter.** The settings of the rain clutter and/or sea clutter controls on some radars may cause the RACON response to disappear partially or completely. If such effects are suspected, these controls should be switched off for the desired RACON observation period.
- **Adjust enough gain when looking for RACON response.**

Please note:

- The observer must be aware that RACONs are programmed and are active for only (typically) 15 seconds in each minute.
- Radio propagation conditions may cause a RACON response to be seen at distances significantly greater or less than the geographic range. The most important radio propagation factor is the multi path effect. This is due to reflections from the sea interfering with the direct signal between the radar and the RACON, causing cancellation of the received signal. The effect can be pronounced in calm sea conditions. It can cause the loss of RACON paints well within the geographic range of the racon to radar antenna path. Multi path effects may cause a RACON paint to intermittently disappear and reappear as a vessel gets closer to a RACON. The distance over which a RACON paint disappears could be only several metres, but it could be up to a few miles. For more information about racon range estimates, please see the latest IALA publication "*Guideline 1010 on Racon Range Performance*"