EMRx SUBSEA MULTIFREQUENCY ELECTROMAGNETIC RECEIVER MANUAL

The EMRx Subsea is a multifrequency Electromagnetic (EM) receiver used for locating and tracking pigs fitted with any EM pig transmitters in depths up to 3000m.

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CONFIGURATION INFORMATION	
Serial Number	
Product Code	
Frequency 1 (red)	
Frequency 2 (blue)	
Frequency 3 (white)	
Light Switch	
Subsea connector pin 1	
Subsea connector pin 2	
Subsea connector pin 3	
Subsea connector pin 4	
Subsea connector pin 5	
Subsea connector pin 6	
Subsea connector pin 7	
Subsea connector pin 8	

ONLINE ELECTRONICS LTD

			EMRx SUBSEA MANUAL		
Rev	**Date**	**By**	**Summary of change**		
A00	04/06/19	BG	CR00745 Initial release for 22Hz receiver.		
B00	27/06/19	EI	CR00745 Initial release for multi frequency receiver with software for SQ-18-02-014.		
B01	21/08/19	EI	CR00745 Updates for SQ-18-02-014 FAT. Updates for latest EMRx20_3100_A06 software. Feedback from CA, AT. Fit connector blank if connector not used. Shows 3x frequencies during switch on. Bluetooth now activated after switch on while control button held. Rebrand from "EMRx20" to "EMRx Subsea". Increased software minimum frequency from 10Hz to 15Hz.		
C00	30/08/19	EI	CR00745 Ensure host PC is not in "Flight Mode" and Bluetooth is enabled. Re-wording of approximate transmitter location procedure. Moved tips section to start of operation section. Software header now includes "EMRx Subsea". Intensity chart frequency range now back to 10Hz to 30Hz. Turned instructions for changing settings via EMRx software into a step by step procedure.		
C01	31/10/19	EI	CR00745 Updates after design review. Added bumpers. Added handles section. Set frequency to 0 to disable LED bargraph. RS485 data rate 896 bytes per second. For optimum EMI immunity twist RS485A/B and VEXT+/-. VEXT can be connected while batteries are installed. Removed Duracell recommendation. Fishtail weight added. Changed operating pressure to operating depth. <2Nm torque specified for all endcap screws. Added test cable information. Software title bar includes date and time for snapshots. Removed LED brightness, FS, N and RPS settings from software. Added Light Switch control information. Added excessively large input warning section. Removed dynamic range and bandwidth specifications. Audio output added.		
C02	06/04/20	TL	CR00885: Email address updated.		
COMMENTS:					

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1. GENERAL DESCRIPTION

The Online Electronics EMRx Subsea is a robust, state of art, multifrequency, electromagnetic (EM) receiver used for locating lost or stalled pigs and tracking pigs fitted with any EM pig transmitters. It can also be used to confirm a pig has left or arrived at a particular location and for general monitoring of pig movements. The enhanced sensitivity permits the location of transmitters even within very heavy walled receivers/launchers, pipeline bundles or Pipe-in-Pipe and is suitable for use in depths up to 3000m.

The EMRx Subsea unit provides three colour coded (red, blue and white) 20x LED bargraphs which can be individually configured in the field via OELs EMRx software (see section 4 EMRx SOFTWARE) to display received signal at any fixed frequency between 10Hz and 30Hz. The LED frequencies can be pre-configured at OEL if required (default frequencies are red 17Hz, blue 22Hz, white 27Hz).

A single control button allows gain adjustment as well as turning the unit on and off. Gain setting is indicated by a vertical strip across the three 20x LED bargraphs. The unit may be powered from internal batteries or from an external 24VDC supply. Handles suitable for use by divers or fishtail type handles suitable for ROV manipulators can be provided.
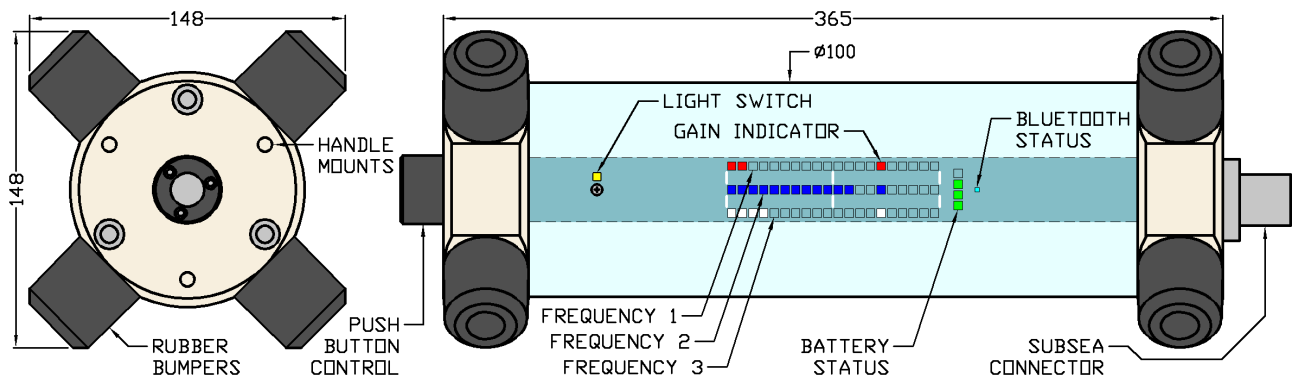
- The image above shows a gain setting of 15x LEDs out of 20 (75%).

- The image above shows a frequency 1 (red) signal level of 2x LEDs out of 20 (10%).

- The image above shows a frequency 2 (blue) signal level of 12x LEDs out of 20 (60%).

- The image above shows a frequency 3 (white) signal level of 4x LEDs out of 20 (20%).

- The image above shows a battery level of 3x LEDs out of 4 (75%).

The EMRx Subsea may be interfaced to OELs EMRx software via a standard RS485 or Bluetooth interface which allows advanced receiver functionality including an audio output and the ability to simultaneously receive any number of different frequencies between 10Hz and 30Hz and configure all receiver parameters such as the colour coded LED frequencies. The EMRx Subsea uses modern Digital Signal Processing (DSP) to provide enhanced functionality, signal-to-noise ratio and frequency selectivity.

This combination of features and functionality has the potential to greatly reduce vessel and operational downtime by facilitating the speedy process of locating a stuck pig or confirming if a pig has left the launcher or been successfully received.

Detection through pipeline walls in excess of 40mm thick is possible dependent on several factors including the type of transmitter used, distance between receiver and transmitter, pig design, pig speed, pipeline diameter, pipeline material and background EM noise levels. Please contact OEL to discuss the most effective configuration.

2. SPECIFICATIONS

Lifetime used continuously ....24 hours

Battery type...6 x 1.5V, Alkaline, AA cells

External supply .... 15VDC to 28VDC

RS485 interface..................... 115200 baud, 8 data bits, no parity, 1 stop bit, no flow control

Bluetooth interface........... SPP, 115200 baud, 8 data bits, no parity, 1 stop bit, no flow control

Subsea connector.. BURTON 5506-1508 FCR

Subsea connector pin out ....See section 3.10 INTERNAL CONNECTIONS

Frequency range ....10Hz to 30Hz

Operating temperature range ....+0°C to +40°C (32°F to 104°F)

Maximum Operating Depth 3000m (9843ft)

Housing material...Acrylic

Endcap material .... Acetal

EMRx Subsea weight in air (no handles) 4.5kg (9.9lbs)

EMRx Subsea weight in water (no handles)...1.5kg (3.3lbs)

Diver handle material .... Acetal

ROV fishtail handle material ....Stainless Steel

ROV fishtail handle weight 1.5kg (3.3lbs)

3. OPERATION

⚠ WARNING: Any operation involving pressure is potentially hazardous. No person should use this equipment unless fully aware of the potential hazards of working with pressurised vessels. The purchaser of this equipment is responsible for the training and competence of operators and the manner in which it is used. This manual should be read through and understood before installation and commissioning so that the operator is familiar with the equipment. Contact Online Electronics Ltd immediately should any difficulty arise in the use of this equipment.

⚠ WARNING: Always use caution when opening equipment which has been in a pressurised environment. It is possible for pressure to leak into the equipment and remain there even after external pressure has been removed. ALWAYS point the end to be opened towards a safe area and away from yourself or others. Contact Online Electronic immediately if there is a suspicion that the equipment has become pressurised.

⚠ WARNING: Replace all batteries at the same time. NEVER install used batteries. NEVER install a mix of new and used batteries. USE ONLY new batteries from the same package or manufacturing batch. DO NOT mix different brands or types of batteries. ALWAYS observe correct battery polarity. New batteries should be installed before each deployment.

⚠ CAUTION: Opening of the equipment should take place in a clean laboratory environment.

⚠ CAUTION: To prevent the formation of condensation within the equipment, allow the equipment temperature to stabilise within the laboratory environment for a minimum of 6 hours prior to opening.

⚠ CAUTION: It is possible for liquids to become trapped in threads and/or gaps around openings. ALWAYS point the end to be opened downwards to allow any trapped liquid to drain out of and not into the equipment.

⚠ CAUTION: If the equipment is to be placed in storage, always ensure that it is turned OFF and the batteries are removed and stored separately.

3.1. DEPLOYMENT CONSIDERATIONS AND TRACKING TIPS

1. Confirm that the 3x LED bargraph frequencies are configured to the required frequencies as per 3.2 TURNING ON and that a note has been taken of these frequencies. The EMRx Subsea unit is dispatched from Online Electronics configured as per the configuration information on p2 of this manual however the user may alter this configuration at any point.

2. Confirm that all personnel who are to be involved in the deployment are aware of what frequency is represented by each LED bargraph colour.

3. Decide how the unit is going to be powered. It may be powered from internal batteries or from an external 15VDC to 28VDC supply connected across the +VEXT and -VEXT pins (see section 3.10 INTERNAL CONNECTIONS).

4. If the EMRx Subsea unit is to be interfaced with an ROV via RS485 refer to section 4.2.1 CONNECTING VIA RS485 and section 3.10 INTERNAL CONNECTIONS.

5. If the unit is fitted with a subsea connector which will not be used then it must be fitted with a suitable blanking connector to prevent conduction between pins and malfunction when submerged.

6. Keep sources of electrical noise such as laptops, computers, radios, mobile telephones, electrical motors, electrical valves etc as far away from the receiver as possible to minimise unwanted noise.

7. Keep any magnetic items in the vicinity of the receiver such as steel toecaps, steel tools, magnets, vehicles etc as still as possible relative to the receiver to minimise unwanted noise. If possible remove them from the vicinity of the receiver.

8. Do not vibrate, knock or move the receiver excessively while attempting to receive signals. This causes false signals due to the receiver moving in the earth's magnetic field. Keep any movements slow and smooth. The receiver should be placed stationary on the pipe surface or on the ground when attempting to receive very weak signals.

9. In an ideal, electrically quiet environment and with the receiver stationary on the ground it should be possible to set gain to maximum and have no signal registered on any LED bargraph. Unfortunately, most industrial environments are electrically noisy.

10. If received noise is not illuminating any LEDs, then the gain may be too low. Increase gain to keep received noise around 2x LEDs (10%).

11. If the received signal is regularly exceeding 18x LEDs (90%) then the gain is too high. Adjust gain to keep the received signal between 50% and 90% deflection. See 4.5 EXCESSIVELY LARGE INPUT WARNING.

12. Sometimes it can be difficult to tell whether the signal being received is a legitimate transmitter signal or due to nearby noise source. If this is happening then gradually move the receiver away from where you believe the transmitter is, if the received signal drops sharply then it is likely a legitimate transmitter signal. If the received signal does not drop sharply then it is likely a noise source not originating from the transmitter. Note that the relationship between distance from a transmitter and the signal received is approximately cubic so if you double the distance between the receiver and transmitter then the received signal should reduce by approximately 8 times. This means that a small change in distance causes a large change in signal.

3.2. TURNING ON

1. To turn the receiver on, fully depress and hold the control button until all LED bargraphs illuminate from left hand side to right hand side (approximately 5 seconds).

2. Keep the control button depressed while the unit displays the frequency configuration of each of the 3x LED bargraphs as shown in the example image below. To determine the frequency configuration simply count the number of LEDs illuminated on each half of each bargraph. In the example below the 3x frequencies are configured as (1 | 7) 17Hz, (2 | 2) 22Hz and (3 | 0) 30Hz respectively.
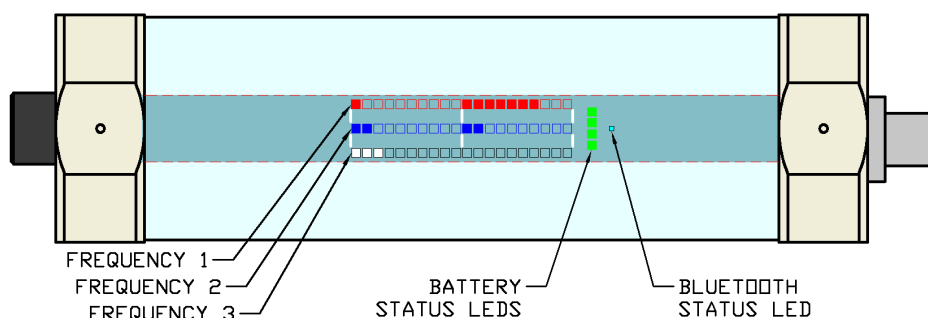
3. Release the control button.

4. Confirm that all personnel who are to be involved in the deployment are aware of what frequency is represented by each LED bargraph colour. Confirm the frequencies are configured as required for the deployment. The EMRx Subsea unit is dispatched from Online Electronics configured as per the configuration information on p2 of this manual however the user may alter this configuration at any point as per 4.4.4 CONFIGURE HARDWARE, FIRMWARE & SOFTWARE.

5. Confirm that at least 3 out of 4 of the green battery status LEDs are illuminated indicating that at least 75% battery lifetime is available. If less than 3 out of 4 of the green battery status LEDs are illuminated, then consider changing the batteries as per 3.9 BATTERY REPLACEMENT.

6. Confirm that a suitable gain setting has been selected and complete a function test as per 3.6 FUNCTION TEST.

3.3. GAIN ADJUSTMENT

1. To adjust gain upwards use short (approximately 0.5 seconds long) presses of the control button to increment gain setting along the LED bargraphs from left to right.

2. To adjust gain downwards use long (approximately 1.0 seconds long) presses of the control button to decrement gain setting along the LED bargraphs from right to left.

3. There are 20x possible settings displayed by a vertical line across all three 20x LED bargraphs. Minimum gain setting is on the extreme left of the LED bargraphs. Maximum gain setting is on the extreme right of the LED bargraphs.

4. If the gain setting is already at maximum (on the extreme right of the LED bargraphs) then the next short button press will wrap around to the minimum gain setting (on the extreme left of the LED bargraphs) and vice versa.

5. See also section 3.5 LIGHT SWITCH which describes how the gain can be controlled using an ROV light.

3.4. TURNING OFF

1. To turn the receiver off, fully depress and hold the control button until all LED bargraphs illuminate from right hand side to left hand side (approximately 5 seconds).

2. Release the control button.

3. Confirm that no LEDs are illuminated.

3.5. LIGHT SWITCH CONTROL

The image below shows the approximate position of the EMRx Subsea light switch sensor. This sensor allows the gain setting to be controlled by illuminating the light switch. If not required ensure that the light switch function is disabled to avoid nuisance gain adjustments due to changes in ambient light. See 4.4.4 CONFIGURE HARDWARE, FIRMWARE & SOFTWARE.
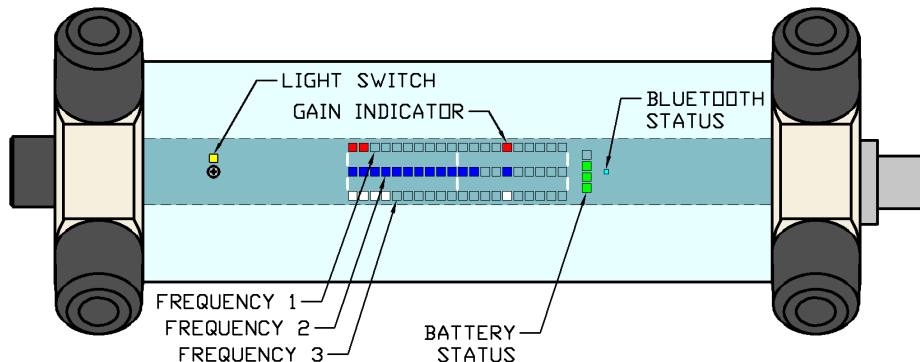
1. Ensure that the light switch function has been enabled. See 4.4.4 CONFIGURE HARDWARE, FIRMWARE & SOFTWARE.

2. To adjust gain upwards illuminate the light switch for between 0.75 and 1.25 seconds.

3. To adjust gain downwards illuminate the light switch for between 1.75 and 2.25 seconds.

4. In bright ambient light it may be necessary to take the EMRx unit into the shade so that whatever light is being used to illuminate the light switch is relatively bright enough compared to ambient light. This is not required subsea where ambient light level is typically very low relative to any light generated by an ROV or diver.

3.6. FUNCTION TEST

At least 24 hours prior to deployment any personnel who are going to be involved in the operation of the receiver should review this entire manual and be given time to practice operating the transmitter and receiver system. By familiarising themselves with the system prior to deployment the chances of a potentially costly operator error are greatly reduced.

1. Turn on the receiver as per 3.2 TURNING ON.

2. Place the receiver stationary on the ground.

3. With no transmitter activated adjust gain as per 3.3 GAIN ADJUSTMENT to achieve approximately 2x LEDs (10%) illuminated on all bargraphs (assuming that the receiver is in a typical, electrically quiet, environment). If gain at this point is less than half, then it indicates that there is a source of electromagnetic noise nearby and the receiver should be moved away from the noise source if possible. If it is not possible to remove the noise source, then it must be accepted that the noise source is going to reduce the detectability of any transmitter at that frequency in the vicinity.

4. In an ideal, electrically quiet environment and with the receiver stationary on the ground it should be possible to set gain to maximum and have no signal registered on any LED bargraph. Unfortunately, most industrial environments are electrically noisy.

5. Gently bump the receiver with your hand. This should cause peaks in the received signal and gives a basic confirmation that the equipment is functional. These peaks are due to the receiver moving in the earth's magnetic field and demonstrate why it is important not to shake or vibrate the receiver when you are trying to use it to detect relatively weak signals. Always keep the receiver as still as possible, any movements should be slow and smooth.

6. Pick up the receiver and gently shake it. This should cause peaks in the received signal due to the receiver moving in the earth's magnetic field.

7. If available a test transmitter of suitable frequency should always be used to confirm full functionality. If a test transmitter is available then practice detecting the test transmitter as described in 3.7 APPROXIMATE TRANSMITTER LOCATION and 3.8 ACCURATE TRANSMITTER POSITION. If testing a transmitter in air remember that the signal received will be much larger than the signal which would be received from the same transmitter inside a pig inside a pipeline.

3.7. APPROXIMATE TRANSMITTER LOCATION

The typical procedure for determining the approximate position of an electromagnetic transmitter is given below.

1. Turn on the receiver as per 3.2 TURNING ON.

2. Place the receiver stationary on the ground at least 10m from the expected location of the transmitter. At this range it is expected that the signal received from the transmitter will be negligible and any signal you do detect is background noise.

3. Increase the gain to the maximum setting possible without allowing the background noise level to illuminate more than 2x LEDs (10%) on the bargraph. The optimum background noise level for identifying an EM signal is typically 2x LEDs (10%) or less. It will be extremely difficult to detect a signal if the background noise level is more than 50%. If the background noise is more than 50% then the receiver gain must be reduced or the source for the excessive background noise must be identified and removed. Note that more gain is not always best, if there is significant background noise and the gain is too high then the transmitter signal may be hidden by the background noise.

4. Now gradually move the receiver towards the expected location of the transmitter keeping the receiver orientated parallel to the expected transmitter orientation as shown to maximise received signal and range. If the transmitter is at the expected location, then the received signal should rise significantly.
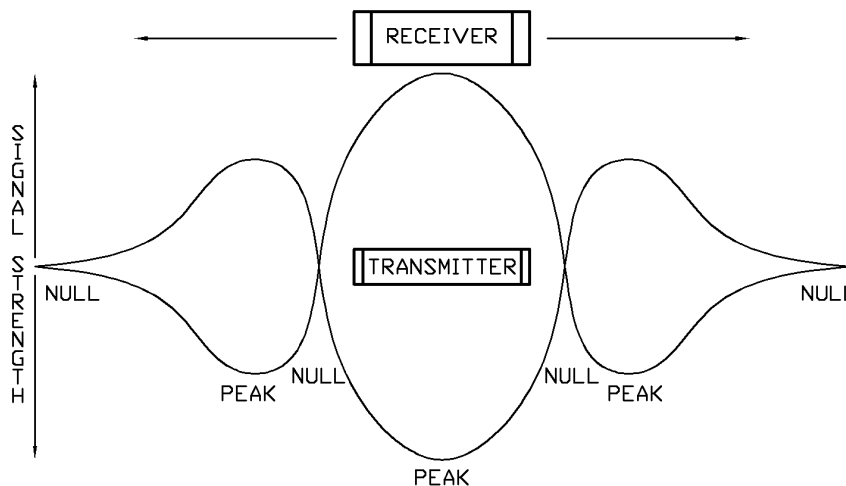

5. If the received signal is extremely weak then the receiver gain will need to be high and the receiver must be held as still as possible and as close as possible to the pipeline surface. Ideally it should be balanced on top of the pipeline surface or placed on the ground as close as possible to the pipeline.

6. If the transmitter is in pulsing mode confirm that the expected pulse rate is being received.

7. Keeping the receiver parallel to the pipeline step slowly and methodically along the pipeline (keeping a constant distance between the receiver and the pipeline surface) while watching the received signal to determine which direction results in an increasing signal. Keep moving in this direction until a peak in signal is received which will occur at the approximate position of the transmitter. Gain should be reduced whenever the received signal exceeds approximately 18x LEDs (90%).

8. If the signal is strong and clear, then it should be possible to find this peak by following the pipeline keeping the receiver as still as possible. If the signal is weak and difficult to detect without high gain, then it is usually best to periodically place the receiver stationary on top of the pipeline at 1m intervals to prevent false signals caused by movement of the receiver. A 1m interval is typical but may be increased or decreased depending on whether a strong or weak signal is expected.

9. Once a peak has been found confirm that if the receiver is moved away from the transmitter in any direction (along the pipeline or away from the pipeline) that the received signal drops.

10. Once the approximate transmitter location has been established refer to 3.8 ACCURATE TRANSMITTER POSITION if a more accurate location is required.

3.8. ACCURATE TRANSMITTER POSITION

Establish the approximate transmitter location as per section 3.7 APPROXIMATE TRANSMITTER LOCATION before attempting to establish a more accurate location. The perpendicular receiver orientation used to establish the accurate transmitter location is not suitable for searching for the approximate transmitter location due to the relative insensitivity of this orientation.

1. Once the approximate location of the transmitter has been determined turn the receiver 90° so that it is perpendicular to the transmitter as shown.
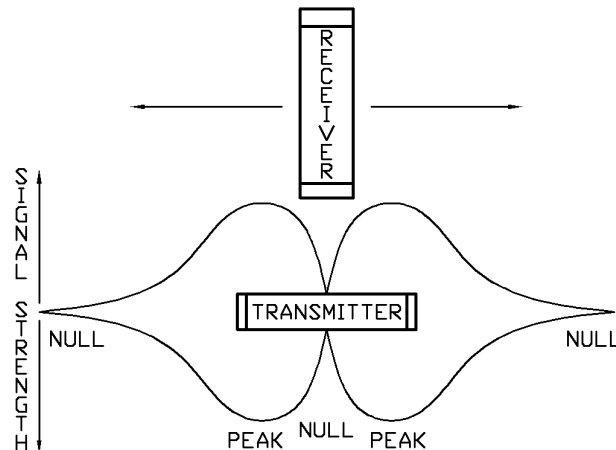
2. Typically the receiver should be held stationary approximately 1m from the pipeline surface however this distance may need to be reduced or increased depending on how weak or strong the received signal is respectively.

3. If received signal is above 90% at the peaks then reduce gain and/or move away from the pipeline to reduce received signal.

4. Maintain the separation and orientation and slowly and methodically step the receiver along the pipeline in either direction from the approximate transmitter location. The received signal should drop significantly as you pass the inherent 'null spot' of the transmitter which occurs when the perpendicular receiver is pointing at the centre of the transmitter. Moving just a few centimetres ahead or behind this point will cause a relatively large and sudden increase in signal.

5. This configuration can be used for centimetre accurate transmitter location. If the null spot cannot be found then try increasing the distance between the transmitter and receiver and/or reducing gain. Remember that the signal received from a transmitter in a pig inside a pipeline is going to be significantly less than the signal received from a transmitter in air.

6. In a situation where a particularly weak signal is being received it may not be possible to detect the accurate location of the transmitter using this method however if this is the case then the results of the approximate transmitter location will usually be a relatively narrow, well defined peak giving a relatively accurate location for the transmitter.

3.9. BATTERY REPLACEMENT

The battery indicator consists of 4, green, LEDs. If total battery voltage is greater than 9.0V (1.5V per cell) all LEDs will be illuminated indicating the batteries are near full. If total battery voltage is less than 6.0V (1.0V per cell) then no LEDs will be illuminated indicating that the batteries are near empty and must be replaced as soon as possible.
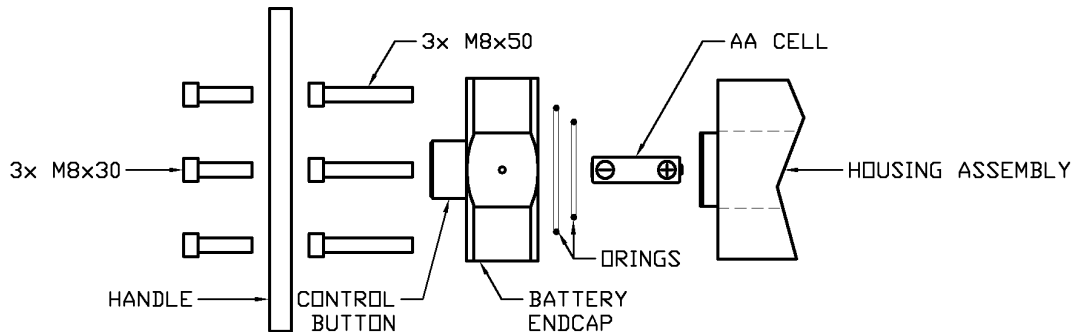

1. Observe the warnings at the start of 3 OPERATION.

2. The batteries are replaced by removing the battery endcap on the side of the receiver which has the control button mounted on it.

3. If a handle is fitted to the battery endcap use a 6mm hexagon key to remove the 3x M8x30 hexagon socket cap screws holding the handle in place.

4. Using a 6mm hexagon key remove the 3x M8x50 hexagon socket cap screws holding the endcap in place.

5. Remove the endcap. Ensure that the O-rings remain within the endcap O-ring grooves. Ensure that the endcap and O-rings are placed somewhere clean and tidy to prevent the O-rings being damaged or contaminated.

6. Remove all 6x AA cells. Visually inspect the cells, contact Online Electronics Ltd immediately if there are any signs of damage or electrolyte leakage. Dispose of them in a responsible way.

7. Observing correct battery orientation, insert 6x new 1.5V, AA sized, Alkaline cells into the battery compartment positive end (nipple, +) first.

8. Once all cells are installed ensure that it is the negative end (flat, -) of the cells which you see when looking into the open end of the receiver.

9. Examine the O-ring seals for any signs of contamination or damage, clean and/or replace and/or re-grease if necessary. Refer to 3.12 O-RING REPLACEMENT for guidance.

10. Replace the endcap noting that there is a 3mm locating dowel to ensure correct orientation.

11. Replace the 3x M8x50 hexagon socket cap screws which hold the endcap in place. To prevent potential cross threading engage all 3x screws several turns using fingers only and only once all 3x screws are engaged properly tighten using a 6mm hexagon key. Note that very little torque is required (<2Nm). Damage may occur if over tightened.

12. If required, replace the handle using a 6mm hexagon key and 3x M8x30 hexagon socket cap screws.

13. Turn the unit on and complete a quick function test as per 3.2 TURNING ON and 3.6 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.4 TURNING OFF.

3.10. INTERNAL CONNECTIONS

All connections between the EMRx Subsea PCB and the subsea connector are made using re-makeable trap connectors (see 3.10.3 TRAP CONNECTORS) meaning that the subsea connector pin out can be modified in the field to suit any ROV pin out. Refer to the configuration information on p2 of this manual for the pinout of the EMRx subsea connector when it was dispatched from Online Electronics Ltd.

To gain access to these connections remove the battery endcap, batteries and housing as per 3.12 O-RING REPLACEMENT. The connections are located on the PCB near the connector endcap as shown below. To reassemble the unit follow the relevant steps in section 3.12 O-RING REPLACEMENT.
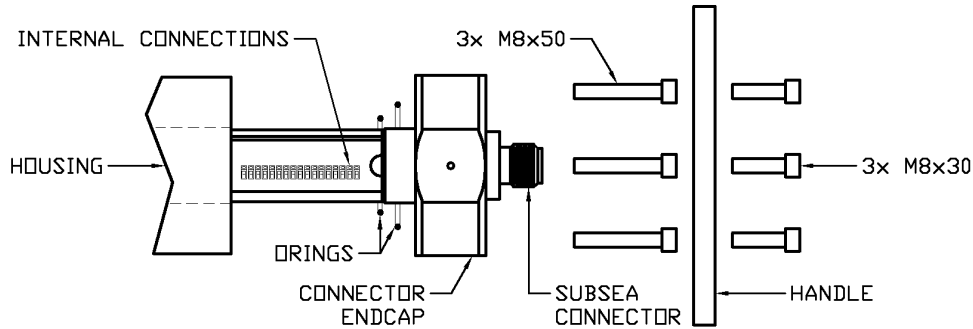
A description of all available connections is given in the table below. Each connection is clearly marked with the pin name on the EMRx Subsea PCB.

Pin Name	Description	Comment
RX-	Ethernet Receive Minus Input	No internal connection.
RX+	Ethernet Receive Plus Input	No internal connection.
TX-	Ethernet Transmit Minus Output	No internal connection.
TX+	Ethernet Transmit Plus Output	No internal connection.
DGND1	Data Ground	Note that all DGND# pins are connected to each other.
RS485A	RS485A non-inverting	See 3.10.1 RS485 CONNECTIONS.
RS485B	RS485B inverting	See 3.10.1 RS485 CONNECTIONS.
NO-	Normally Open Minus Output	Do not use.
NO+	Normally Open Plus Output	Do not use.
DGND2	Data Ground	Note that all DGND# pins are connected to each other.
EX4	Expansion pin	No internal connection.
EX1	Expansion pin	No internal connection.
EX2	Expansion pin	No internal connection.
EX3	Expansion pin	No internal connection.
VEXT+	External Supply Positive	See 3.10.2 VEXT CONNECTIONS.
VEXT-	External Supply Negative	See 3.10.2 VEXT CONNECTIONS.
CON	Connector shell	This pin is connected to the metal shell of the subsea connector and can be used for ground fault/pin fault detection.

3.10.1. RS485 CONNECTIONS

Connection to RS485A, RS485B and DGND# will be required. The connection to DGND# is required to provide a reference for the RS485 signals.

Data format is 115200 baud, 8 data bits, no parity, 1 stop bit, no flow control with a data rate of approximately 896 bytes per second.

When using the RS485 interface the EMRx Subsea may be powered from internal batteries or an external supply.

For optimum EMI immunity the RS485A and RS485B wires must be twisted together along their entire length. This includes the internal EMRx Subsea wires between the subsea connector and the trap connectors described in section 3.10.3 TRAP CONNECTORS.

A USB to RS485 serial test cable (FTDI USB-RS485-WE) is provided to allow a test connection between the EMRx Subsea unit and a host PC. See www.ftdichip.com/Products/Cables/USBRS485.htm for datasheets and drivers.

The test cable is provided terminated with sockets which can be pushed onto the pins of a Burton 5506-1508 FCR as per 3.10.4 BURTON 5506-1508 FCR PINOUT. The connections below are required.

Test cable colour	EMRx Subsea Connection
Orange	RS485A
Yellow	RS485B
Black	DGND#

3.10.2. VEXT CONNECTIONS

Connect the positive side of the external 15VDC to 28VDC supply at VEXT+ and the negative side to VEXT-.

An internal bridge rectifier circuit protects VEXT+ and VEXT- from polarity reversal and results in an internal bridge rectifier diode being connected from DGND# (anode) to the negative side of the external supply (cathode).

An external supply can be connected while batteries are installed in which case the external supply will power the EMRx Subsea unit. If the external supply is turned off or fails then the unit will automatically switch to internal batteries without turning off.

While powered from an external supply the EMRx Subsea is forced on automatically. It will not turn off as per section 3.4 TURNING OFF until the external supply is turned off or disconnected. The LED bargraphs may be disabled by setting all frequencies to 0 (zero) as per 4.4.4 CONFIGURE HARDWARE, FIRMWARE & SOFTWARE.

For optimum EMI immunity the VEXT+ and VEXT- wires must be twisted together along their entire length. This includes the internal EMRx Subsea wires between the subsea connector and the trap connectors described in section 3.10.3 TRAP CONNECTORS.

3.10.3. TRAP CONNECTORS

All connections between the EMRx Subsea PCB and the subsea connector are made using re-makeable Molex Mini Lite-Trap connectors (Molex part number 104238-0110) meaning that the subsea connector pin out can be modified in the field to suit any ROV pin out.

To remove a wire from a trap connector:

1. Depress the trap connector lever (shown highlighted red) with a finger nail. Using a screwdriver to depress the trap connector lever is likely to damage the trap connector. If a screwdriver is used then to minimise the likelihood of damage use only a 2mm wide flat head and be gentle.

2. Push the wire slightly further into the trap connector, rotate 90° if possible and then gently withdraw the wire from the trap connector.

3. Release the trap connector lever (shown highlighted red).
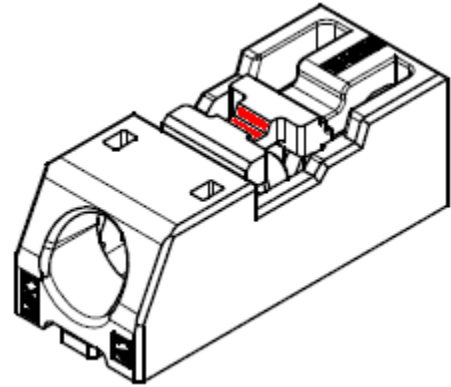
To insert a wire into a trap connector:

1. Examine the wire end and if bent or otherwise damaged carefully cut off the damaged end and strip back 5mm ±0.5mm. If the wire is stranded then the exposed end must also be lightly tinned using a soldering iron to keep the strands together. The total conductor diameter must be kept below 0.65mm.

2. Depress the trap connector lever (shown highlighted red) with a finger nail.

3. Push the wire into the trap connector.

4. Release the trap connector lever (shown highlighted red).

3.10.4. BURTON 5506-1508 FCR PINOUT

The standard subsea connector is a Burton 5506-1508 the wire colours shown below are used.

Mating Face View	Pin	Wire Colour
	1	Black
	2	Red
	3	Orange
	4	Yellow
	5	Green
	6	Blue
	7	Pink
	8	Grey

3.11. HANDLES

Two standard handle types are available for the EMRx Subsea:

1. Acetal diver/human handles

2. Stainless steel ROV fishtail handles

The handles are attached to the EMRx Subsea endcaps using 3x M8x30 hexagon socket cap screws and can be angled at any 30° increment. Custom handles may be manufactured for project specific requirements. Please contact OEL to discuss the most effective configuration.
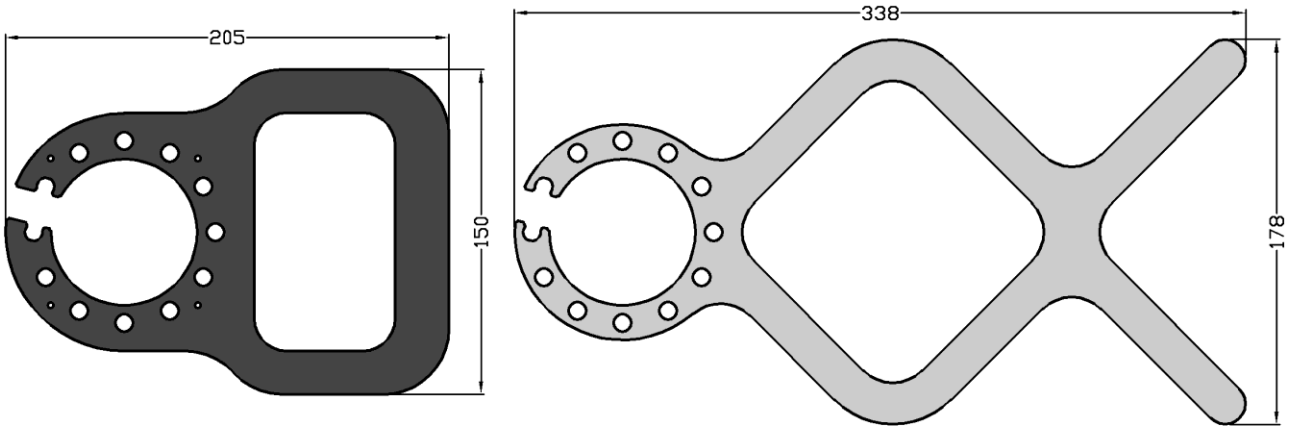
3.12. O-RING REPLACEMENT

The only serviceable O-rings within the EMRx receiver are the 2x O-rings under each endcap (O-ring sizes 50-136 and 50-146). Online Electronics Ltd can supply redress kits containing a complete set of replacement batteries, O-rings and O-ring grease, contact Online Electronics Ltd for more information.
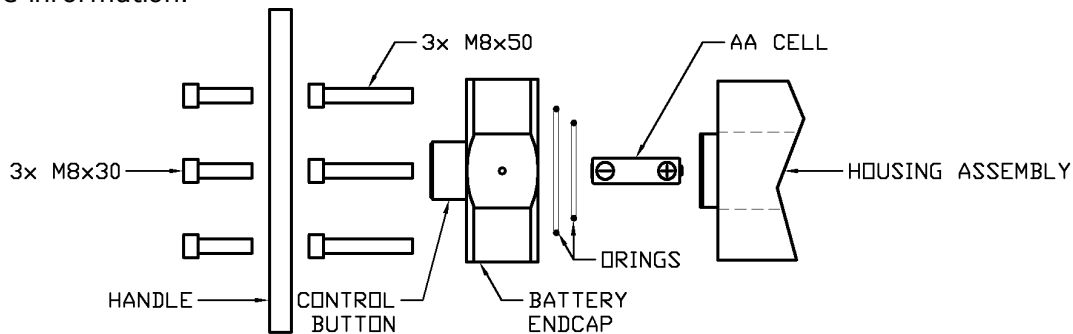
1. Observe the warnings at the start of 3 OPERATION.

2. Remove the battery endcap and batteries as per 3.9 BATTERY REPLACEMENT.

3. Using a 6mm hexagon key remove the 3x M8x50 hexagon socket cap screws holding the connector endcap in place. Note that the connector endcap has the internal receiver assembly attached to it and once the 3x M8x50 hexagon socket cap screws mentioned have been removed the housing is no longer attached to anything.
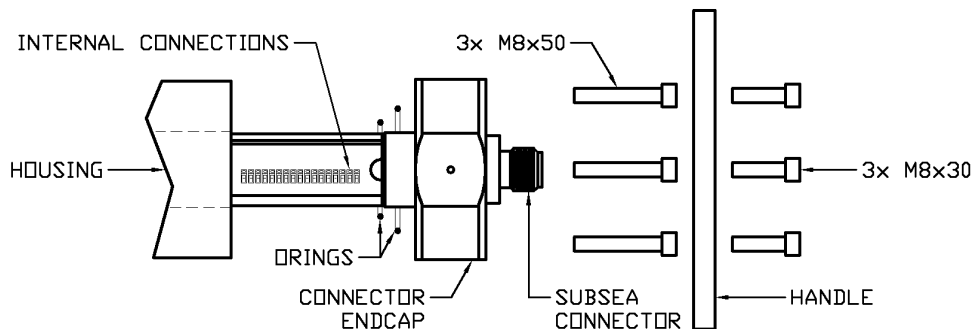
4. Stand the receiver on the connector endcap with the open end of the housing facing upwards and then carefully lift the housing straight up and away from the connector endcap. Place the housing somewhere clean and safe where it will not be scratched or damaged.

5. Remove all O-rings from the endcaps and clean all sealing surfaces on all parts. Examine all sealing surfaces on the endcaps and housing for signs of corrosion, scoring, and other damage. If there is excessive damage the parts may need to be replaced.

6. Lightly grease all sealing surfaces using a suitable grease (e.g. DOW CORNING MOLYKOTE 111 COMPOUND).

7. Lightly grease each O-ring with a suitable grease (e.g. DOW CORNING MOLYKOTE 111 COMPOUND) before fitting.

8. Stand the connector endcap on end and then carefully slide the housing into position ensuring no wires are trapped at the connector end. Replace the 3x M8x50 hexagon socket cap screws. To prevent potential cross threading engage all 3x screws several turns using fingers only and only once all 3x screws are engaged properly tighten using a 6mm hexagon key. Note that very little torque is required (<2Nm). Damage may occur if over tightened.

9. Refit the batteries, battery endcap and handles as per 3.9 BATTERY REPLACEMENT.

10. Turn the unit on and complete a quick function test as per 3.2 TURNING ON and 3.6 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.4 TURNING OFF.

4. EMRx SOFTWARE
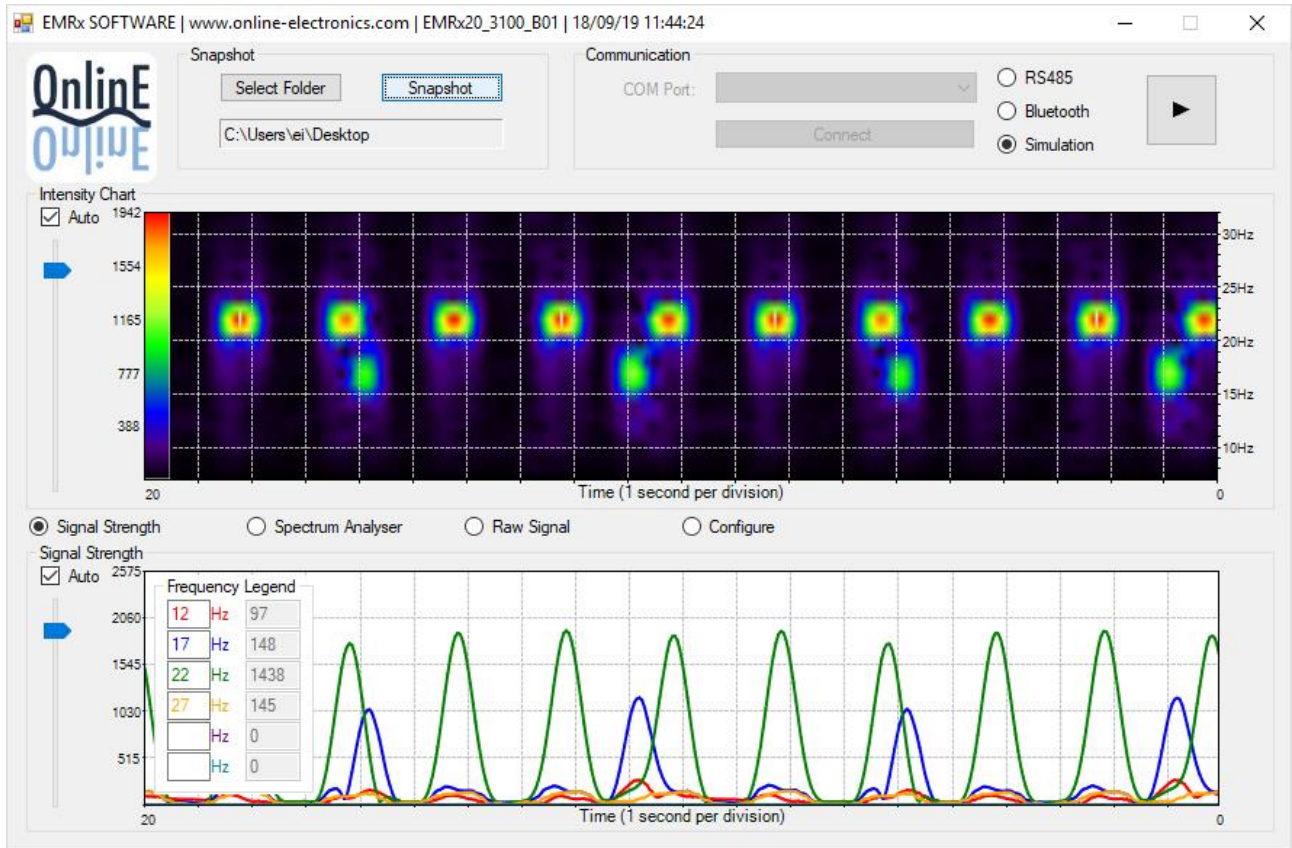
4.1. SNAPSHOT GROUP

The Snapshot group controls allow timestamped screenshots of the current display to be captured at any point. Simply select a destination folder using the Select folder button and then press Snapshot to capture a screenshot. Screenshots are saved as a *.png image with filename <SNAPSHOT YYMMDD hhmmss.png> where YYMMDD hhmmss is date and time. The title bar of the EMRx Software also includes date and time which will provide a timestamp on the screenshot.
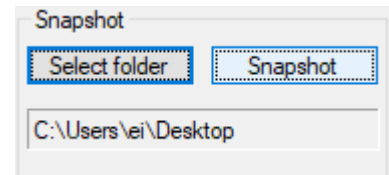
4.2. COMMUNICATION GROUP

The Communication group controls are used to establish communication with the EMRx receiver or to simulate signals from an EMRx receiver for demonstration and/or training purposes.
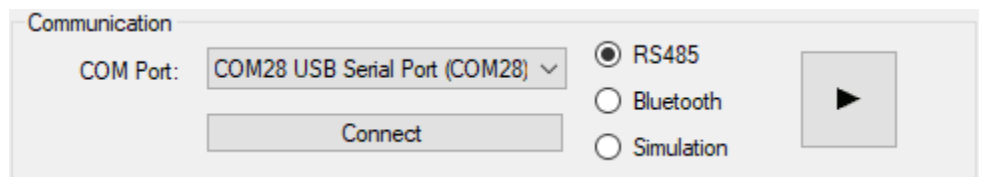
The COM Ports drop down menu allows selection of the correct COM port.

The Connect/Disconnect button connects/disconnects from the selected COM port.

The Play/Pause button can be used to temporarily pause the software to allow examination of received data.

The RS485, Bluetooth and Simulation selections are described in the following sections.

4.2.1. CONNECTING VIA RS485

Connections to the RS485A, RS485B and DGND# connections will be required. Refer to section 3.10 INTERNAL CONNECTIONS.

Connecting via RS485 allows the EMRx Subsea unit to be interfaced with an ROV so that the unit can be taken subsea while the operator uses the EMRx software topside.

1. Open the EMRx software on the host PC.

2. Turn on the EMRx Subsea unit.

3. Make all cable connections between the EMRx Subsea unit and the host PC.

4. Within the EMRx software Communication group select RS485.

5. Within the EMRx software Communication group select the correct COM port from the COM Ports drop down menu.

6. Within the EMRx software Communication group press the Connect button.

7. The software will immediately connect and start displaying data in the intensity chart.

4.2.2. CONNECTING VIA BLUETOOTH

The EMRx Subsea Bluetooth interface provides a convenient way to configure the EMRx Subsea without having to open or make physical connections to the unit. When connected via Bluetooth the receiver performance of the EMRx Subsea is slightly compromised due to electromagnetic interference from the Bluetooth communications so it is not recommended to attempt to receive very weak signals while Bluetooth is active.

While the EMRx Subsea control button is held and the unit is showing the frequency configuration as per 3.2 TURNING ON the Bluetooth interface will be active and looking for a new connection (indicated by the Bluetooth status LED flashing once every second).

When the control button is released the Bluetooth interface will deactivate and it will no longer be possible to establish a connection.

If a connection is established before the control button is released (indicated by the Bluetooth status LED flashing twice every second) then the Bluetooth interface will remain active after the control button is released until the connection is closed.

Before a connection between a particular host PC and a particular EMRx Subsea unit can be established for the first time the host PC must be "paired" with the EMRx Subsea unit. "Pairing" between a particular EMRx Subsea unit and a particular host PC is only required once – once paired the EMRx Subsea and the host PC will remember each other and a connection between the EMRx Subsea unit and EMRx software can be established immediately.

In windows 10 "pairing" is established by:

1. Ensure the EMRx Subsea is turned off.

2. Ensure that the host PC is not in "Flight Mode" and that Bluetooth is enabled.

3. Begin scanning for new Bluetooth devices on the host PC by selecting Start> Settings> Devices> +Add Bluetooth or other device > Bluetooth.

4. Turn on the EMRx Subsea but keep the control button depressed. Wait for the frequency configuration to be displayed and then confirm that the Bluetooth status LED is flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

5. After a moment the EMRx Subsea should appear in the list of visible devices on the host PC with name "EMRx Subsea ###" where "###" is the serial number of the EMRx Subsea unit.

6. Click on the EMRx Subsea ### entry on the host PC list to pair the host PC and the EMRx Subsea unit.

7. Once the host PC has reported that pairing was successful release the EMRx Subsea control button.

Once paired a connection between the EMRx Subsea unit and the EMRx software can be established by:

1. Ensure the EMRx Subsea unit is turned off.

2. Ensure that the host PC is not in "Flight Mode" and that Bluetooth is enabled.

3. Open the EMRx software on the host PC.

4. Within the EMRx software Communication group select Bluetooth.

5. Within the EMRx software Communication group select the correct COM port from the COM Ports drop down menu. The EMRx Subsea will appear in the list of available ports with name "EMRx Subsea ###" where "###" is the serial number of the EMRx Subsea unit. Not that all previously paired EMRx units will also appear in this list even if they are not powered or within range.

6. Turn on the EMRx Subsea but keep the control button depressed. Wait for the frequency configuration to be displayed and then confirm that the Bluetooth status LED is flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

7. Press the Connect button within the EMRx software Communication group.

8. Wait for the EMRx Subsea Bluetooth status LED to start flashing twice per second indicating that a connection has been established and then release the EMRx Subsea control button.

9. The software will start displaying data in the intensity chart.

4.2.3. SIMULATION

If Simulation is selected then the software simulates the signals from a 22Hz, 2 second pulse rate transmitter and a 17Hz, 5 seconds pulse rate transmitter being received simultaneously. This allows demonstration and training with the various controls and charts within the software without the need of an actual EMRx Subsea receiver or transmitter.
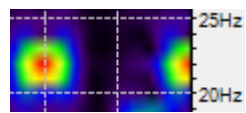
4.3. INTENSITY CHART
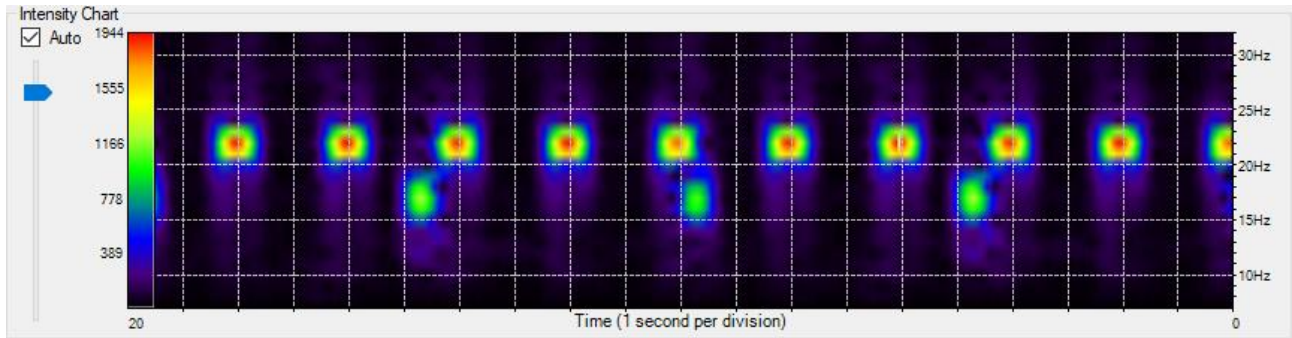
The intensity chart provides an intuitive representation of the signal strength at all frequencies between 10Hz and 30Hz against time. It is excellent for reliably determining the frequency and pulse rate of one or more transmitters simultaneously.

The horizontal axis of the intensity chart is time (1 second per division) and the vertical axis is frequency (Hz). Intensity (signal strength) at each point on the chart is represented by a colour ranging from blue (low signal strength) to red (high signal strength). The chart constantly scrolls from right to left as new data is received.

The example shown above shows the typical display while both a 22Hz electromagnetic transmitter pulsing once every 2 seconds and a 17Hz electromagnetic transmitter pulsing once every 5 seconds are received simultaneously. It is obvious that one transmitter is at 22Hz because the most intense point of each pulse is aligned with the 22Hz tick mark on the vertical axis on the right hand side of the chart. It is obvious that the received signal of this transmitter is pulsing every 2 seconds because each pulse is separated by 2 horizontal divisions which are fixed at 1 second apart.


An intensity key (vertical bar on left hand axis of the chart with colour gradient going from black at the bottom to red at the top) indicates what signal level each colour represents. In the key shown can see that bright red represents a signal of approximately 1900, yellow represents a signal of approximately 1500, green represents a signal of approximately 1000, and so on. The scale can be adjusted as required by using the slide control to the left of the intensity chart key. To move the slider drag it with the mouse or for more fine control select it with the mouse and then use the keyboard arrow keys to adjust up and down. If the Auto checkbox is ticked then this slider will be adjusted automatically by the software.
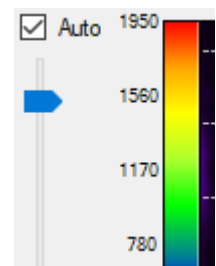
The number below the horizontal axis at the bottom left hand side of the chart indicates the length of the horizontal axis in seconds. It can be modified by double clicking on the number and then typing a new value between 1 second and 60 seconds.
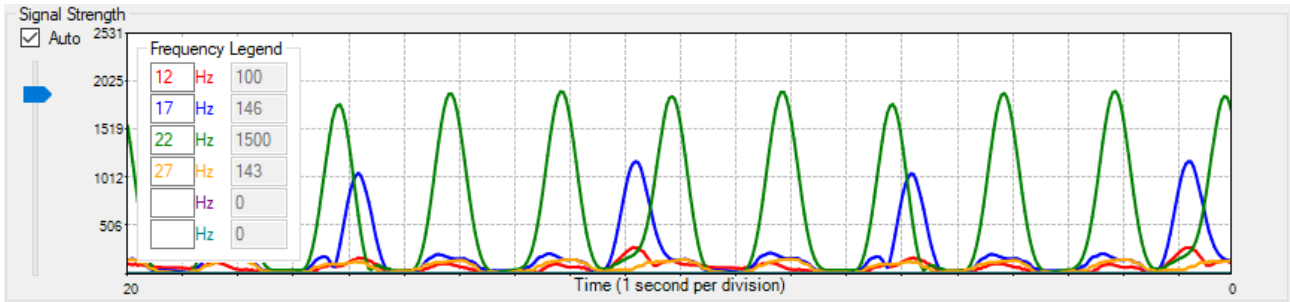

4.4. SECONDARY FUNCTIONS
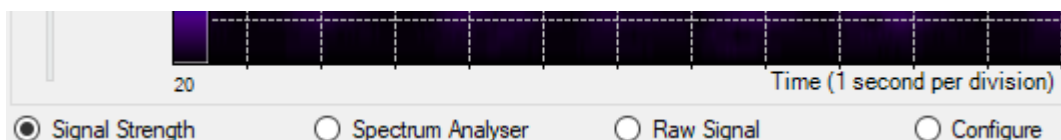
The intensity chart is always displayed. The secondary function of the EMRx software can be selected from the area immediately below the intensity chart as shown. The Signal Strength chart is the default secondary function but can be replaced by any of the secondary functions shown.

## 4.4.1. SIGNAL STRENGTH CHART

The signal strength chart provides a traditional chart of received signal against time. It is excellent for determining the relative signal strength of up to four transmitters. Normally the intensity chart will be used to confirm the frequencies present and the signal strength chart will be used to determine the accurate signal strength of each frequency.

The horizontal axis of the signal chart is time (1 second per division) and the vertical axis is relative signal strength. Any six frequencies can be plotted by typing the required frequency into the colour coded Frequency Legend. The numbers in grey to the right of each frequency show the instantaneous signal strengths at each frequency. Blank frequencies will not be plotted. An audio tone is generated for all frequencies entered within the Frequency Legend with amplitude and frequency proportional to received signal.
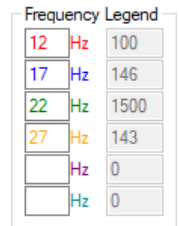

The example shown above shows the typical display while both a 22Hz electromagnetic transmitter pulsing once every 2 seconds and a 17Hz electromagnetic transmitter pulsing once every 5 seconds are received simultaneously. Using the signal strength chart it is not necessarily obvious what frequencies the transmitters are transmitting at – the intensity chart should be used to determine this. It is obvious that the received signals are pulsing every 2 seconds and every 5 seconds because the pulses are separated by 2 and 5 horizontal divisions (which are fixed at 1 second apart) respectively. From the vertical axis on the left hand side it is obvious that the signal strength of each 22Hz pulse is approximately 1950 and the signal strength of each 17Hz pulse is approximately 1100.
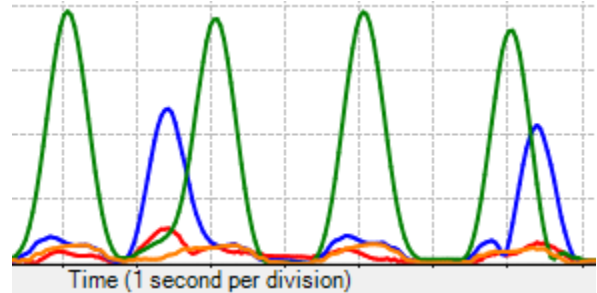

The vertical axis scale can be adjusted as required by using the slide control to the left of the chart. To move the slider drag it with the mouse or for more fine control select it with the mouse and then use the keyboard arrow keys to adjust up and down. If the Auto checkbox is ticked then this slider will be adjusted automatically by the software.

The number below the horizontal axis at the bottom left hand side of the chart indicates the length of the horizontal axis in seconds. It can be modified by double clicking on the number and then typing a new value between 1 second and 60 seconds.
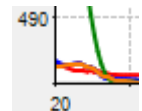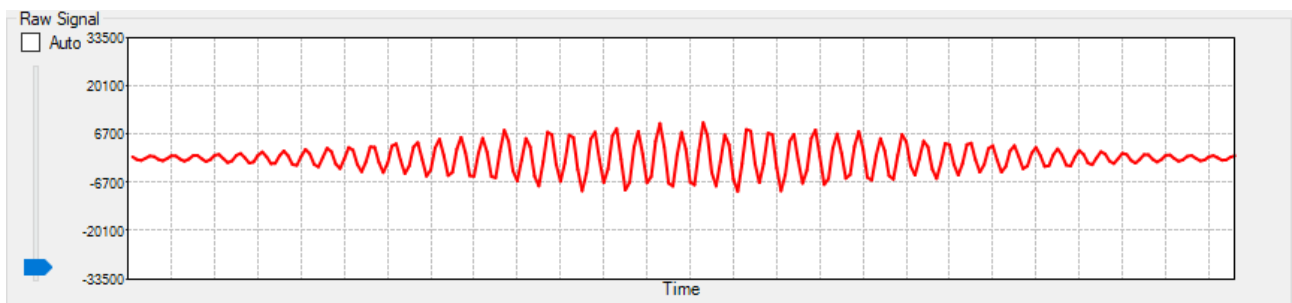
4.4.2. SPECTRUM ANALYSER
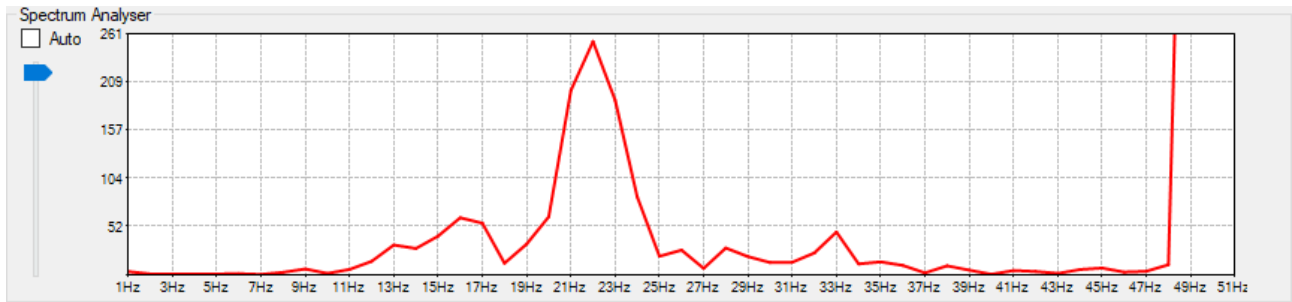
The spectrum analyser chart provides a live chart of signal against frequency. It is not usually required for normal EM transmitter reception but can be useful for debug purposes – particularly identifying significant noise sources outside the normal 10Hz to 30Hz range of interest.

The horizontal axis of the spectrum analyser is frequency (Hz) and the vertical axis is relative signal strength. The example shown above shows a strong signal component at 22Hz and the edge of a huge 50Hz noise component. 50Hz and 60Hz are common noise frequencies due to their use for mains powered equipment and if large enough can compromise reception of signals in the normal 10Hz to 30Hz range.

4.4.3. RAW SIGNAL

The raw signal chart provides a live chart of the raw signal being received by the EMRx prior to the digital signal processing. It is not usually required for normal EM transmitter reception but can be useful for debug purposes and for confirming "clipping" (see 4.5 EXCESSIVELY LARGE INPUT WARNING).

4.4.4. CONFIGURE HARDWARE, FIRMWARE & SOFTWARE
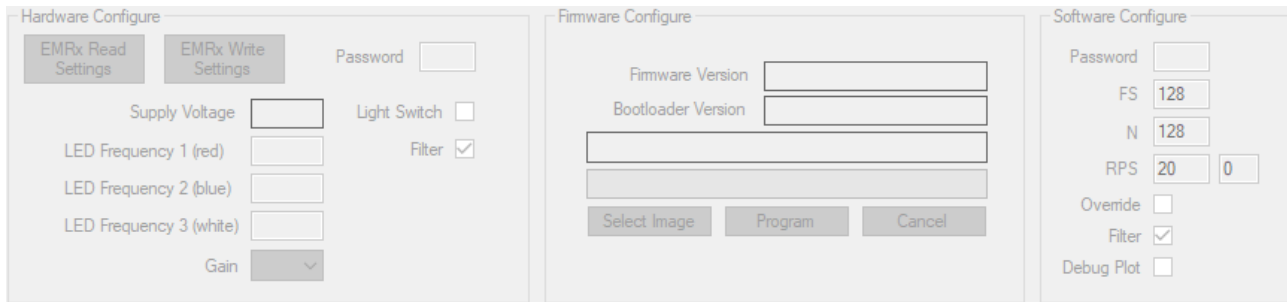
The configure screen allows configuration of the connected EMRx unit, update of the connected EMRx unit firmware and configuration of the EMRx software.

Hardware Configure

The Hardware Configure group allows configuration of the connected EMRx unit.

To read and/or change settings:

1. Press EMRx Read Settings to read current settings and enable the write controls.
2. Update the desired value(s) or select from the corresponding drop-down list to configure the settings required.
3. Press the EMRx Write Settings button to send the new settings to the EMRx unit. The settings will be memorised by the EMRx unit even after it has been turned off.
4. To change any setting again restart at step 1.

The available settings are:

1. LED Frequency 1 (red) – the frequency to display on the top, red LED bargraph.
2. LED Frequency 2 (blue) – the frequency to display on the middle, blue LED bargraph.
3. LED Frequency 3 (white) – the frequency to display on the bottom, white LED bargraph.
4. Gain – EMRx unit gain setting as per 3.3 GAIN ADJUSTMENT.
5. Light Switch – If this checkbox is ticked then the EMRx ROV light switch control is enabled otherwise it is disabled (default). See 3.5 LIGHT SWITCH.

Although the EMRx Subsea receiver is only designed to work with frequencies between 15Hz and 30Hz frequencies can be set to any frequency between 0Hz and 63Hz including fractions. To disable an LED bargraph set the corresponding frequency to 0 (zero).

When configuring LED frequencies always ensure that a note is taken of the latest settings so that there is a record of what frequency each LED colour is assigned to otherwise the unit must be interrogated as above or as per 3.2 TURNING ON to determine the current frequency settings.

Some settings visible in the configure screens are password protected to prevent them being modified and are not described in this manual. Modifying these parameters can prevent the EMRx unit and software from functioning as expected – DO NOT MODIFY THESE PARAMETERS WITHOUT THE EXPRESS PERMISSION OF ONLINE ELECTRONICS LTD.

Firmware Configure

DO NOT ATTEMPT TO UPDATE FIRMWARE WITHOUT THE EXPRESS PERMISSION OF ONLINE ELECTRONICS LTD. The Firmware Configure group allows update of the firmware within an EMRx unit and can only be accomplished via a Bluetooth connection. To update the firmware follow the steps below:

1. If not already done so pair the EMRx unit with the host PC as per 4.2.2 CONNECTING VIA BLUETOOTH. Note that this only needs to be done the first time a connection is made between the EMRx unit and the host PC.

2. Turn the EMRx unit on.

3. Open the EMRx software on the host PC.

4. Within the EMRx software Communication group select Bluetooth.

5. Within the EMRx software Communication group select the correct COM port from the COM Ports drop down menu. Note that all previously paired EMRx units will appear in this list even if they are not powered or within range.

6. Turn off the EMRx but keep the control button depressed. Wait for the Bluetooth status LED to start flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

7. Press the Connect button within the EMRx software Communication group.

8. Wait for the EMRx Bluetooth status LED to start flashing twice per second indicating that a connection has been established and then release the EMRx control button.

9. If a successful connection is established the EMRx software will automatically show the Firmware Configure group with a Connected message and the Bootloader Version displayed. The EMRx Bluetooth status LED will be double flashing. If this is not the case then restart at step 1.

10. Press Select Image and select the required *.txt firmware file.

11. Press Program and then wait until a Completed message is received. This can take several minutes. To prevent potential corruption of the firmware do not move or operate any controls on either the host PC or EMRx unit until the completed message is received.

12. Turn the unit on and complete a quick function test as per 3.2 TURNING ON and 3.6 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.4 TURNING OFF.

Software Configure

DO NOT ALTER ANY SETTINGS WITHIN THE SOFTWARE CONFIGURE GROUP WITHOUT THE EXPRESS PERMISSION OF ONLINE ELECTRONICS LTD.

4.5. EXCESSIVELY LARGE INPUT WARNING

If the gain setting is too high or an excessively large signal or noise is present, or the receiver is being moved excessively then the warning message below may be displayed by the EMRx Software and the EMRx unit will flash all LEDs to warn of "clipping" of the Raw Signal.
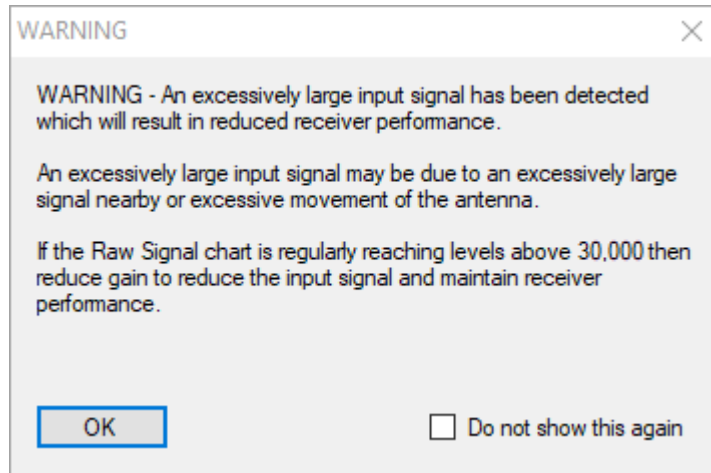
The image below shows an excessively large signal "clipping" the Raw Signal - notice the "clipped" peaks of the sine wave where they approach a reading of approximately 33,000. This excessively large signal may not be at a frequency that the user is aware of or expects. This clipping is distorting the signal which results in loss of valid frequency information and generation of spurious frequency information. THE EMRx SUBSEA RECEIVER MUST NEVER BE USED IF THIS IS HAPPENING.
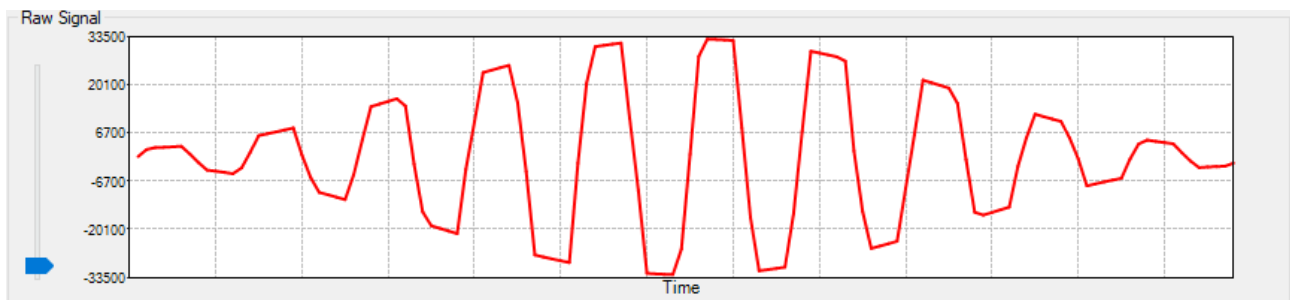
Gain must be reduced or the receiver must be moved away from the source of the excessively large signal to reduce the signal to something which looks like the signal below - notice that the peaks of the sine wave are no longer "clipped" because they do not get anywhere near a reading of 33,000.
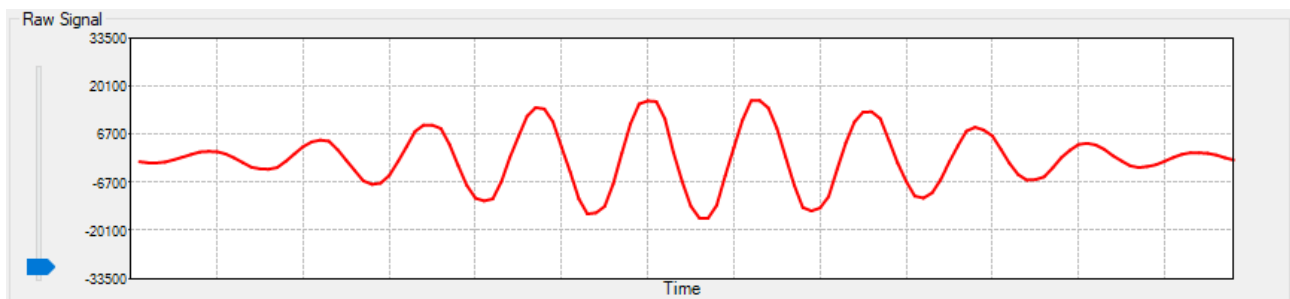
5. ROUTINE MAINTENANCE AND STORAGE

All Online Electronics Ltd equipment is designed to require minimum maintenance. The housing should be cleaned using fresh water. Do not use chemicals, solvents or oils which could be damaging to the housing, endcaps or O-rings.

Online Electronics Ltd can supply redress kits containing a complete set of replacement batteries, O-rings and O-ring grease, contact Online Electronics Ltd for more information.

If the receiver is to be placed in storage for a long period of time remove the batteries from the receiver and store separately.

6. DISPOSAL OF UNIT

Online Electronics Ltd takes its responsibilities under the WEEE Regulations extremely seriously and has taken steps to be compliant in line with our corporate and social responsibilities. In the UK, OEL has joined a registered compliance scheme WeeeCare (registration number WEE/MP3538PZ/SCH).

Electrical and electronic equipment should never be disposed of with general waste but must be separately collected for the proper treatment and recovery.

The crossed-out bin symbol, placed on the product, reminds you of the need to dispose of it correctly at the end of its life.

When buying a new product, you will have the possibility to return, free of charge, another end of life product of equivalent type that has fulfilled the same functions as the supplied equipment. These items may be deposited at:

Online Electronics Ltd
Online House
Blackburn Business Park
Woodburn Road
Blackburn
Aberdeen
AB21 0PS
UK

Alternatively, to arrange a collection of any waste electrical equipment, obligated to OEL please telephone WeeeCare on 0844 800 2004.

7. WARRANTY

Online products are guaranteed for one year from the date of purchase. Goods should be returned transportation prepaid to Online Electronics Limited.

There is no charge for parts or labour should any product require repair due to a manufacturing deficiency during the guarantee period.

In the event of a manufacturing deficiency the inward transportation costs will be repaid to the client.