IK TRAX

EMRx Subsea Operating Manual

Electromagnetic Receiver

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

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1. GENERAL DESCRIPTION

The IK Trax 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 provides three colour coded (red, blue and white) 20x LED bar graphs which can be individually configured in the field via Bluetooth or RS485 using the EMRx Windows or Android application to display received signal at any fixed frequency between 10Hz and 30Hz. The LED frequencies can be pre-configured during manufacture 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 bar graphs. 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.
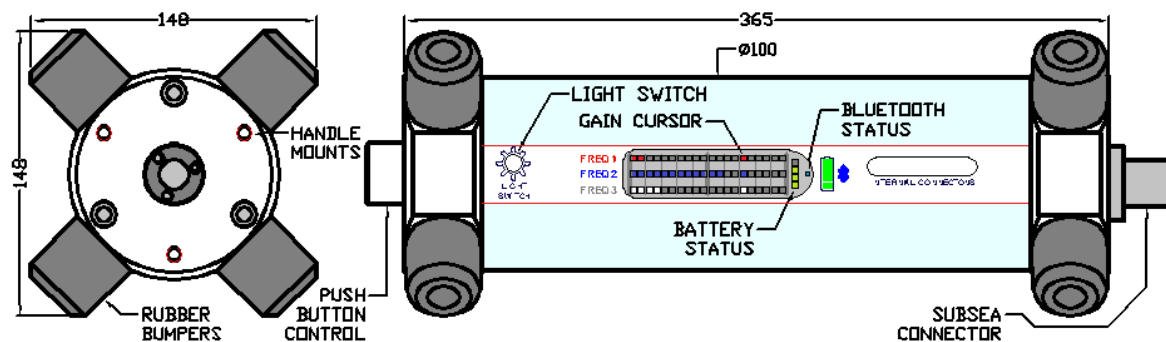
- The image above shows a gain setting of 15x LEDs out of 20 (75%).

- 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 may be interfaced to the EMRx Windows or Android application via RS485 (Windows only) or Bluetooth which allows advanced receiver functionality including the ability to simultaneously receive any number of different frequencies between 10Hz and 30Hz, an audio output, and configuration of all receiver parameters such as the colour coded LED frequencies. The EMRx unit 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 operational downtime by facilitating confirmation of pig launch, pig passage and pig receipt as well as speedy location of a stuck pig.

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 IK Trax to discuss the most effective configuration.

2. SPECIFICATIONS

Typical lifetime used continuously without Bluetooth ....72 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

Subsea connector .... BURTON 5506-1508 FCR

Subsea connector pin out ....See section 3.12 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 IK Trax 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 IK Trax 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 bar graph 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 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 bar graph 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 3.12 INTERNAL CONNECTIONS).

4. If the EMRx Subsea unit is to be interfaced with an ROV via RS485 refer to section 3.12 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, the ground, or on the seabed 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 bar graph. 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.

12. Look out for potential problems due to excessively large signals.

13. 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 bar graphs 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 bar graphs as shown in the example image below. To determine the frequency configuration simply count the number of LEDs illuminated on each half of each bar graph. In the example below the 3x frequencies are configured as (1 | 7) 17Hz, (2 | 2) 22Hz and (3 | 0) 30Hz respectively.
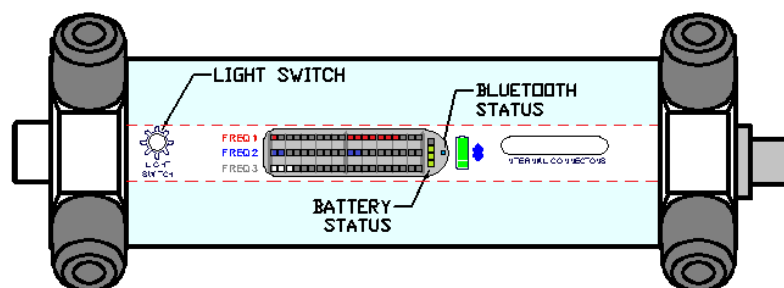
3. If required keep the control button depressed until a Bluetooth connection has been established as per sections 4 EMRx WINDOWS APPLICATION and 5 EMRx ANDROID.

4. Release the control button.

5. Confirm that all personnel who are to be involved in the deployment are aware of what frequency is represented by each LED bar graph colour. Confirm the frequencies are configured as required for the deployment. The EMRx Subsea unit is dispatched configured as per the configuration information on p2 of this manual however the user may alter this configuration at any point.

6. 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 3.11 BATTERY REPLACEMENT.

Confirm that a suitable gain setting has been selected and complete a function test as per 3.8 FUNCTION TEST.

3.3. MEASUREMENT DISPLAY

The EMRx can be configured such that all 3 rows of LEDs will display the signal strength of the EM frequencies configured for each row, adjusted in magnitude by the gain setting.
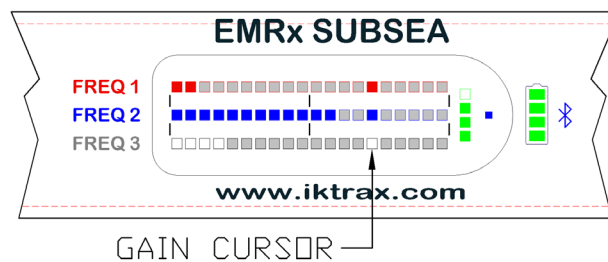
3.4. GAIN ADJUSTMENT

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

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

4. Each gain step applies a factor of approximately 1.6 to the number of signal LEDs currently illuminated. E.g. if there are currently 10 LEDs illuminated and gain is increased one step then 10x1.6=16 LEDs will become illuminated. Alternatively if there are currently 10 LEDs illuminated and gain is decreased one step then 10/1.6=6 LEDs will become illuminated.

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

6. Section 3.7 LIGHT SWITCH describes how the gain can be controlled using an ROV light.

7. Sections 4 EMRx WINDOWS APPLICATION & 5 EMRx ANDROID describe how the gain can be controlled using the EMRx applications.

3.5. TURNING OFF

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

2. Release the control button.

3. Confirm that no LEDs are illuminated.

4. Always turn the unit off using this method to preserve the latest changes made to any settings.

3.6. MANUAL FREQUENCY THRESHOLD ADJUSTMENT

The 3 row of LEDs on EMRx receiver display a specific frequency measurement.

To change the frequency threshold configuration manually without access to or using the mobile device application.

1. Turn the receiver off, if currently turned on.

2. Turn the receiver on (Section 3.2 steps 1-4) releasing the control button as soon as the display becomes active. When the battery level LED indicator alights press and hold the control button for 5 seconds. Whilst the control button is held the LEDs will display the current configuration. If the control button is released before 5 seconds the unit enters normal mode of operation.

3. Whilst the control button is held, and after 5 seconds, the battery status LEDs will turn off and the LEDs will flash with the current configuration.

4. Release the control button. The LEDs will continue to flash for approximately 3 seconds with the current configuration.

5. The top row of LEDs will then display the current frequency set for that row with the left 10 LEDs flashing with a value representing the decade value. E.g. if the current configuration has a value of 27 then the decade value will be '2' and two LEDs will flash. The 7 LEDs on the right side representing units will remain static.

6. Briefly press the control button to change the decade value to the required setting. If zero is selected all 10 LEDs flash.

7. Once the required decade value has been set wait 5 seconds where upon the LEDs on the righthand side, representing the units, will flash. These are configured as per the previous step.

8. Once the units are configured the next LED row will flash and is configured as per steps 7 – 9 above.

9. Only frequency settings configured between 10 – 30 Hz will be saved.

10. The unit will then check the values entered and save if valid.

3.7. LIGHT SWITCH CONTROL

1. 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. The EMRx Subsea unit is dispatched configured as per the configuration information on p2 of this manual however the user may alter this configuration at any point. If not required ensure that the light switch function is disabled to avoid nuisance gain adjustments due to changes in ambient light as per section 4.10.2 HARDWARE CONFIGURE GROUP.
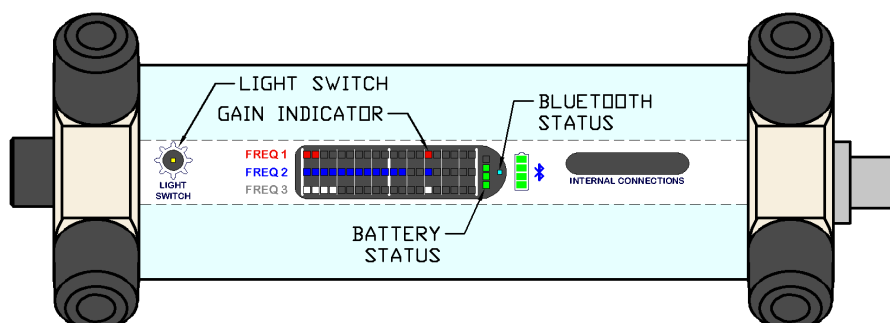
1. Ensure that the light switch function has been enabled. See section 4.10.2 HARDWARE CONFIGURE GROUP.

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.

3.8. 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 3.4 GAIN ADJUSTMENT to achieve approximately 2x LEDs (10%) illuminated on all bar graphs (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, or on the seabed it should be possible to set gain to maximum and have no signal registered on any LED bar graph. 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 3.9 APPROXIMATE TRANSMITTER LOCATION and 3.10 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.

3.9. 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 bar graph. 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.
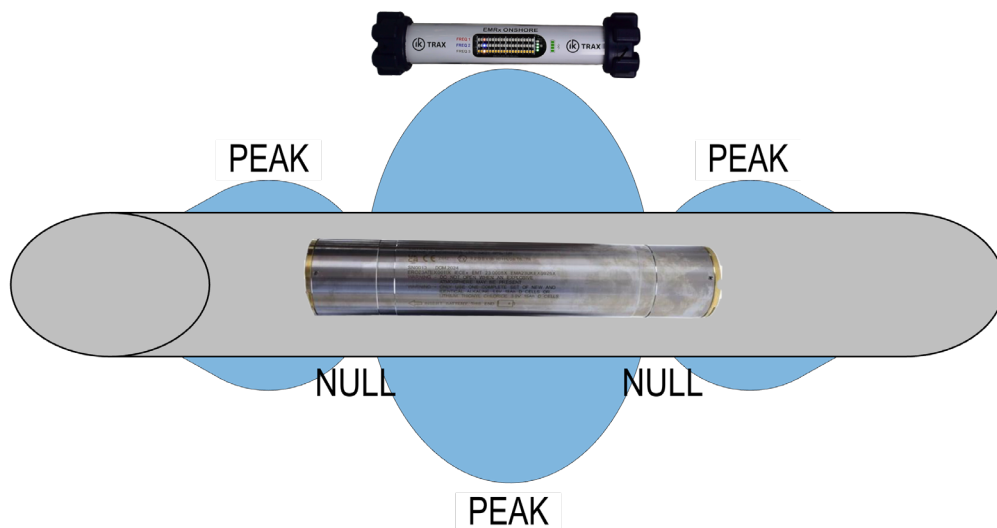

5. If the received signal is extremely weak then the receiver gain will need to be high, and the receiver must be held as still as possible and as close as possible to the pipeline surface. Ideally it should be balanced on top of the pipeline surface or placed on the ground as close as possible to the 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 3.10 ACCURATE TRANSMITTER POSITION if a more accurate location is required.

3.10. ACCURATE TRANSMITTER POSITION

Establish the approximate transmitter location as per section 3.9 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.
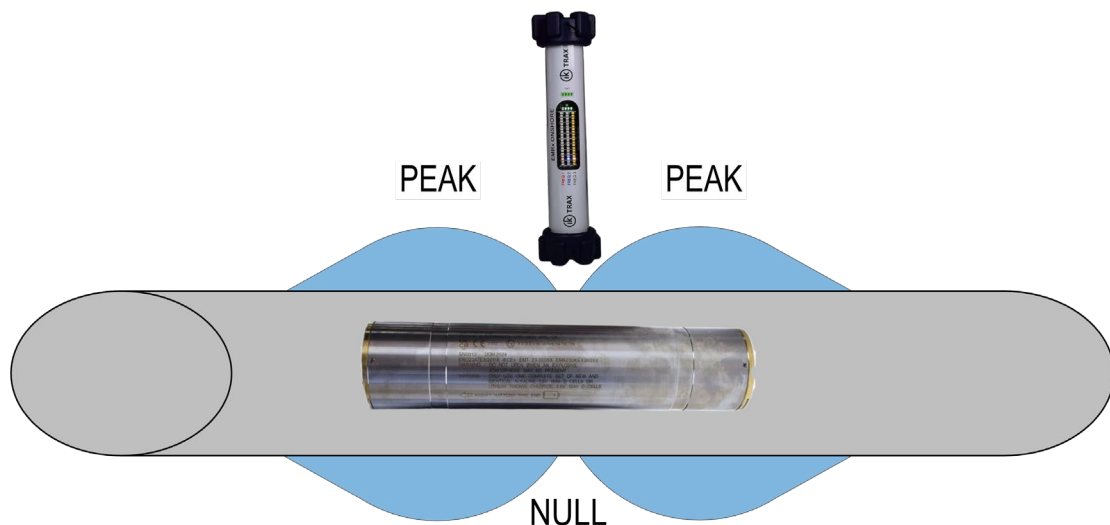
2. Typically, the receiver should be held stationary approximately 1m from the pipeline surface however this distance may need to be reduced or increased depending on how weak or strong the received signal is respectively.

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.

3.11. 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.
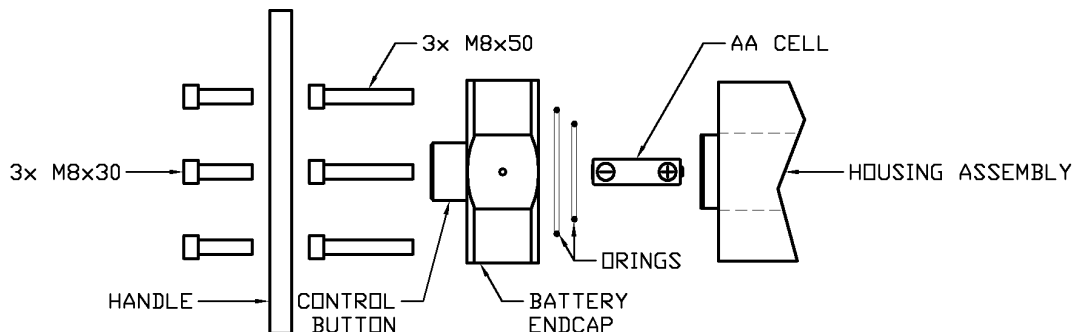

1. Observe the warnings at the start of 3 OPERATION.

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 IK Trax 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 3.14 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 3.8 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.5 TURNING OFF.

3.12. INTERNAL CONNECTIONS

All connections between the EMRx Subsea PCB and the subsea connector are made using re-makeable trap connectors (see 3.12.3 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. It is also possible to view the connections through the transparent housing.

To gain access to these connections remove the battery endcap, batteries and housing as per 3.14 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 3.14 O-RING REPLACEMENT.
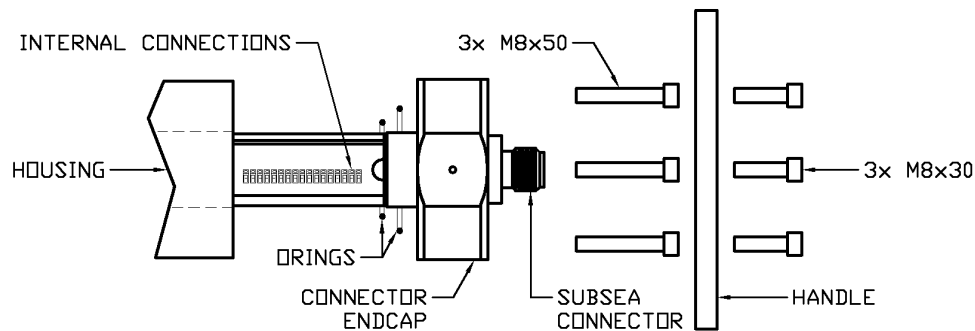
A description of all available connections is given in the table below. Each connection is clearly marked with the pin name on the EMRx Subsea PCB.

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+	RS485+ non-inverting data	See 3.12.1 RS485 CONNECTIONS.
RS485B-	RS485- inverting data	See 3.12.1 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 3.12.2 VEXT CONNECTIONS.
VEXT-	External Supply Negative	See 3.12.2 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.

3.12.1. RS485 CONNECTIONS

Connection to RS485+, RS485- and DGND# will be required. The connection to DGND# is required to provide a reference for the RS485 signals. Note that the use of A & B to indicate the polarity of the data lines is ambiguous among device manufacturers. Always use non-inverting (+ / high for logic 1) and inverting (- / low for logic 1) terminology. If RS485 communications cannot be established and you are certain you have selected the correct COM port then it is likely that swapping the RS485+ & RS485- connections is the solution.

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 RS485+ and RS485- 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 3.12.3 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.

Test cable colour	EMRx Subsea connection
Black	DGND#
Yellow	RS485-
Red	No connection
Brown	No connection
Orange	RS485+
Green	No connection

The test cable is provided terminated with sockets which can be pushed directly onto the pins of a Burton 5506-1508 FCR. The connections shown are required.

When a USB to RS485 serial cable is first plugged into a host PC the drivers should be automatically installed and the cable should appear as a new USB Serial Port under Device Manager> Ports where it will be assigned the next available and unique COM number (COM28 in this example).

From this moment onwards this particular host PC will identify this particular cable as COM28 unless the number is changed manually or the cable drivers are uninstalled. Be aware that if the same cable is plugged into a different PC then the different PC will assign the cable its own unique COM number which is very unlikely to match the COM28 number used by the original PC.

The easiest way to determine the allocated COM number for a particular cable and a particular host PC is to open Device Manager and plug/unplug the cable while watching to see which COM port appears/disappears from the Device Manager> Ports list.
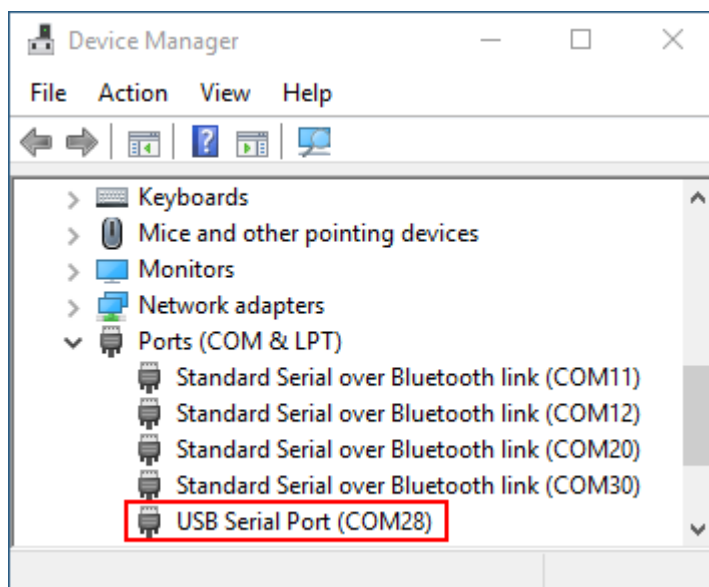
3.12.2. VEXT CONNECTIONS

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 3.5 TURNING OFF until the external supply is turned off or disconnected. The LED bar graphs may be disabled by setting all frequencies to 0 (zero) as described in sections 4 EMRx WINDOWS APPLICATION and 5 EMRx ANDROID.

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 3.12.3 TRAP CONNECTORS.

3.12.3. 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 fingernail. 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).
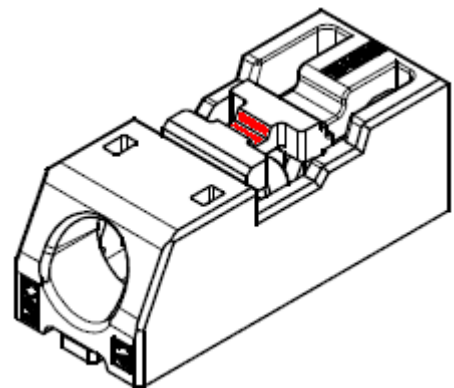
To insert a wire into a trap connector:

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 fingernail.

3. Push the wire into the trap connector.

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

3.12.4. 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

3.13. 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 IK Trax to discuss the most effective configuration.
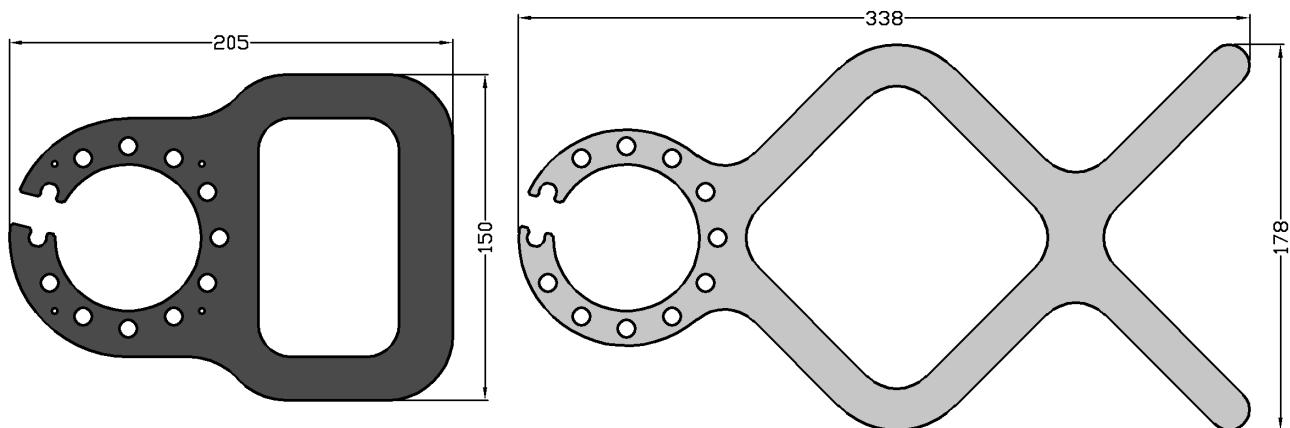
3.14. O-RING REPLACEMENT

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). IK Trax can supply redress kits containing a complete set of replacement batteries, O-rings and O-ring grease, contact IK Trax for more information.
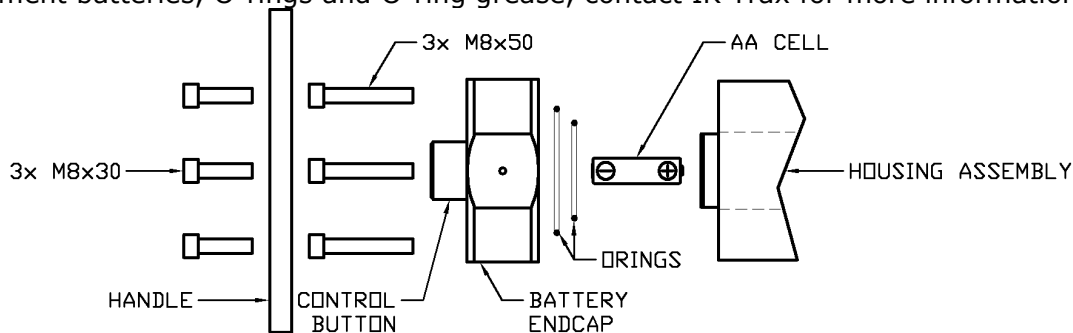

1. Observe the warnings at the start of 3 OPERATION.

2. Remove the battery endcap and batteries as per 3.11 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.
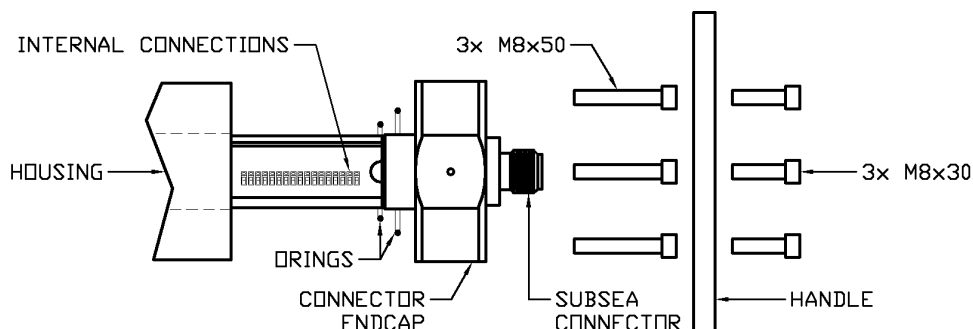
4. Stand the receiver upright on the connector endcap with the open end of the housing facing upwards. Suitably support the endcap to prevent the receiver from falling over. Carefully lift the housing straight up and away from the connector endcap. Place the housing somewhere clean and safe where it 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 3.11 BATTERY REPLACEMENT.

10. Turn the unit on and complete a quick function test as per 3.2 TURNING ON and 3.8 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.5 TURNING OFF.

4. EMRx WINDOWS APPLICATION
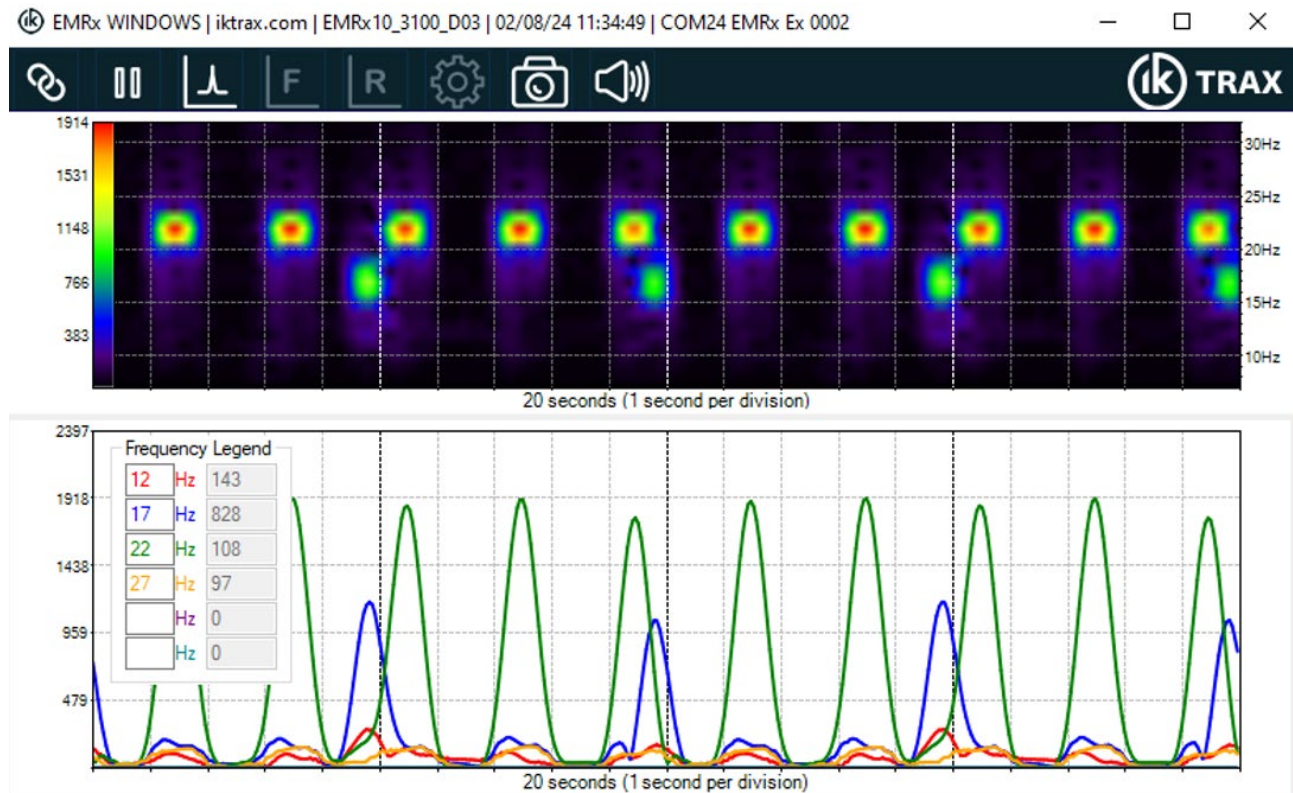
4.1. WINDOWS USAGE CONSIDERATIONS

The EMRx application may place a significant performance burden on the host device. To ensure best performance and data integrity the following measures should be observed where possible:

1. Enable "Flight Mode" and/or disable Wi-Fi (Bluetooth must be enabled).

2. Close all other applications and ensure that nothing else is running in the background.

3. Keep any other activities such as phone calls or messages to a minimum.

It is highly recommended to test the EMRx application performance on the intended host device prior to deployment to confirm the host device is capable of running the application. For critical tracking jobs it is recommended to use a dedicated host device.

4.2. WINDOWS INSTALLATION

The installation folder for the EMRx Windows application has typical name EMRx10_3100_A03 which represents the full application name and version. The installation folder will typically contain the additional folder and files shown below.

Name	Type
Application Files	File folder
EMRx10_3100_A03.application	Application Manifest
setup.exe	Application

The typical size of the installation folder is 2MB.

Simply unzip the folder if applicable, save the folder into any location on the target device, run the setup.exe file found within the folder and then follow the instructions when prompted.

Most Windows computers will already have all other necessary software and drivers installed. If not, then download and install the latest available versions of the following software and drivers:

1. Latest compatible .NET Framework Runtime from https://dotnet.microsoft.com/download.
2. Latest compatible DirectX Runtime from https://www.microsoft.com/en-gb/download.

4.3. WINDOWS ESTABLISHING RS485 CONNECTION

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

Connections to the RS485+, RS485- and DGND# connections will be required. Refer to section 3.12 INTERNAL CONNECTIONS.

It is only possible to establish an RS485 connection with the EMRx Windows application. It is not possible to establish an RS485 connection using the EMRx Android application.

1. Turn on the EMRx unit as per 3.2 TURNING ON.
2. Open the EMRx windows application on the host PC.
3. Make all cable connections between the EMRx Subsea unit and the host PC.
4. Within the EMRx application Connection Configure group select RS485.
5. Within the EMRx application Connection Configure group select the correct COM port from the Select Device drop down list. It is essential that the correct COM port is selected – see 3.12.1 RS485 CONNECTIONS for more information.
6. Within the EMRx application Connection Configure group press the Connect button.
7. The application will start displaying data in the Signal chart as per 4.7 WINDOWS SIGNAL STRENGTH CHART.

4.4. WINDOWS ESTABLISHING BLUETOOTH CONNECTION

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 device and a particular EMRx unit can be established for the first time the host device must be "paired" with the EMRx unit as per 4.4.1 WINDOWS BLUETOOTH PAIRING.

Pairing between a particular EMRx unit and a particular host device is only required once – once paired the EMRx unit and the host device will remember each other and next time a connection can be established immediately as per 4.4.2 WINDOWS BLUETOOTH CONNECTION.

4.4.1. WINDOWS BLUETOOTH PAIRING

Note that the name and location of settings may vary by device and operating system. The instructions below are for a typical Windows 10 device.

1. Ensure the EMRx is turned off.

2. Ensure that the host device is not in "Flight Mode" and that Bluetooth is enabled. Both of these settings can be found in Start> Settings> Devices.

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

4. Turn on the EMRx unit as per 3.2 TURNING ON and keep the control button depressed. 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 unit should appear in the list of visible devices on the host device with name "EMRx Subsea ###" where "###" is the serial number of the EMRx unit.

6. Click on the EMRx Subsea ### entry on the host device list to pair the host device and the EMRx unit and follow any on-screen steps.

7. Once pairing has been completed the EMRx control button can be released.

4.4.2. WINDOWS BLUETOOTH CONNECTION

Once paired as per 4.4.1 WINDOWS BLUETOOTH PAIRING a connection between the EMRx unit and the EMRx application can be established by following the procedure below.

Note that the name and location of settings may vary by device and operating system. The instructions below are for a typical Windows 10 device.

1. Ensure the EMRx is turned off.

2. Ensure that the host device is not in "Flight Mode" and that Bluetooth is enabled. Both of these settings can be found in Start> Settings> Devices.

3. Open the EMRx application on the host device.

4. Turn on the EMRx unit as per 3.2 TURNING ON and keep the control button depressed. Confirm that the Bluetooth status LED is flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

5. Within the EMRx application Connection Configure group select the correct device from the Select Device drop down list. The EMRx unit will appear in the list of available devices with name "EMRx Subsea ###" where "###" is the serial number of the EMRx unit. Note that all previously paired EMRx units will also appear in this list even if they are not powered or within range.

6. Within the EMRx application Connection Configure group press the Connect button.

7. Confirm that the EMRx unit Bluetooth status LED starts flashing twice per second indicating that a connection has been established.

8. The application will start displaying data in the Signal chart as per 4.7 WINDOWS SIGNAL STRENGTH CHART.

9. Release the EMRx control button within 5 seconds of establishing the connection to prevent the EMRx turning off as per 3.5 TURNING OFF.

4.5. WINDOWS RIBBON CONTROLS

The ribbon contains the following controls:

Shows the Connection Configure group.

Pause or play all charts.

Shows the signal strength chart.

Shows the spectrum chart.
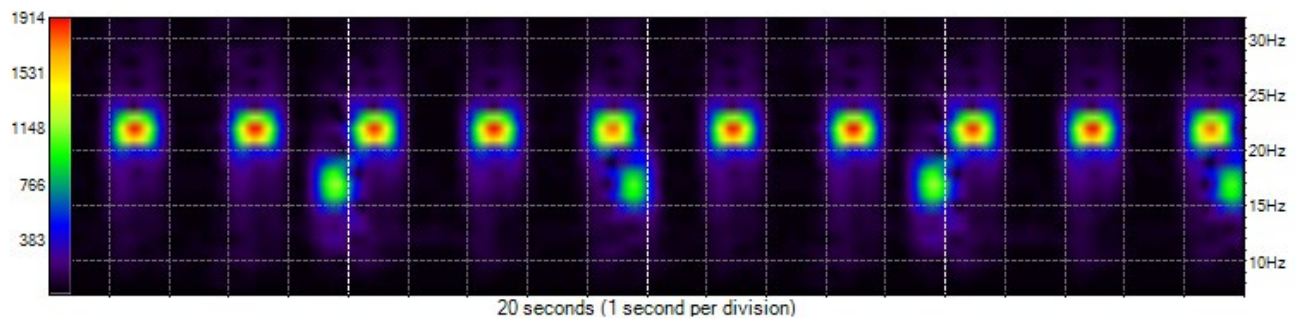
Shows the raw signal chart.

Shows the settings page.

Captures a screenshot.

Enables or disables audio output. When enabled audio tone(s) with amplitude and frequency proportional to received signal are generated for each frequency enabled on the signal strength chart.

4.6. WINDOWS INTENSITY CHART

20 seconds (1 second per division)

The intensity chart is always shown in the upper half of the main window.

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. To determine the accurate signal strength of each frequency it is best to use the 4.7 WINDOWS SIGNAL STRENGTH CHART.

The horizontal axis of the intensity chart is time (1 second per division) and the right-hand side vertical axis is frequency (Hz). Intensity (signal strength) at each point on the chart is represented by a colour ranging from black (low signal strength) through blue, green and yellow 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 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.

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 example shown can see that red represents a signal of approximately 1900, yellow represents a signal strength of approximately 1500, green represents a signal of approximately 1100, and so on.

The vertical scale can be adjusted by clicking and dragging the mouse up or down anywhere on the chart. If the chart has been clicked previously then you can also use the keyboard up and down arrows. Double clicking on the chart will autozoom to the visible data.

The horizontal scale can be adjusted between 5 seconds and 60 seconds by clicking and dragging the mouse left or right anywhere on the chart.

The main window can be resized like a normal windows application. The individual chart heights can be adjusted by dragging the grey bar immediately below the intensity chart up or down.

4.7. WINDOWS SIGNAL STRENGTH CHART
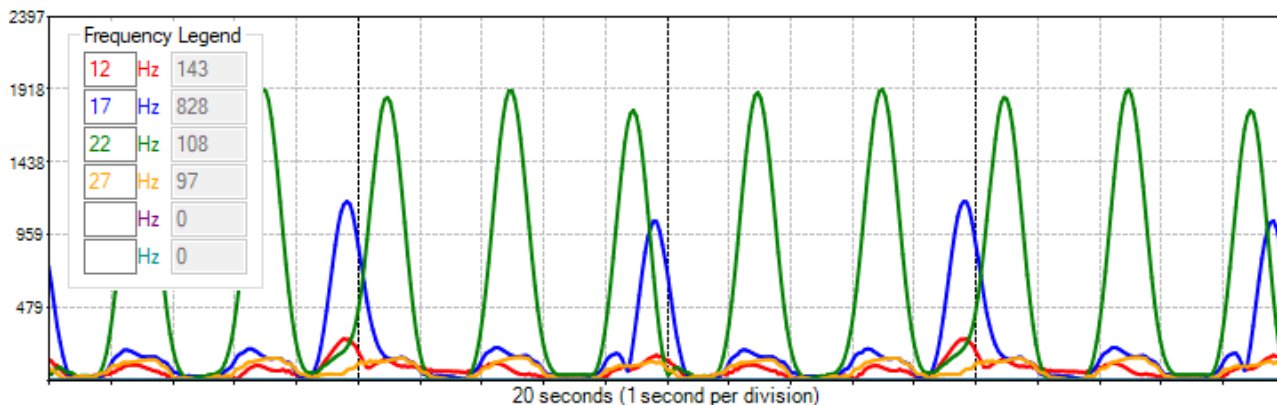
The signal strength chart can be displayed in the lower half of the main window by pressing the relevant icon on the ribbon.

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 six colour coded transmitters. Normally the intensity chart will be used to confirm the frequencies present and then the signal strength chart will be used to determine the accurate signal strength of each frequency.

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. In the example shown above can see 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 right-hand side can see that the signal strength of each 22Hz pulse is approximately 1900 and the signal strength of each 17Hz pulse is approximately 1100.

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.

The vertical scale can be adjusted by clicking and dragging the mouse up or down anywhere on the chart. If the chart has been clicked previously then you can also use the keyboard up and down arrows. Double clicking on the chart will autozoom to the visible data.

The horizontal scale can be adjusted between 5 seconds and 60 seconds by clicking and dragging the mouse left or right anywhere on the chart.

The main window can be resized like a normal windows application. The individual chart heights can be adjusted by dragging the grey bar immediately below the intensity chart up or down.
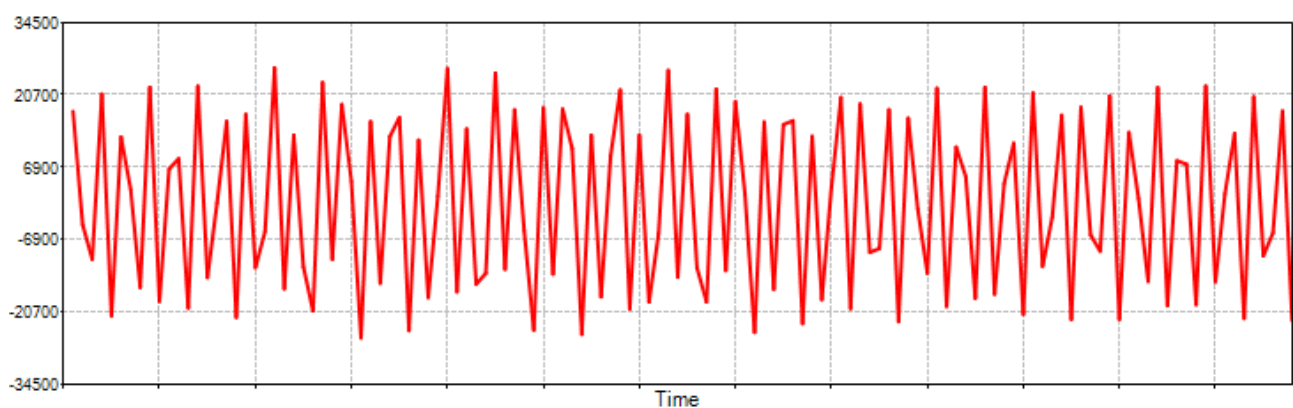
4.8. WINDOWS SPECTRUM CHART
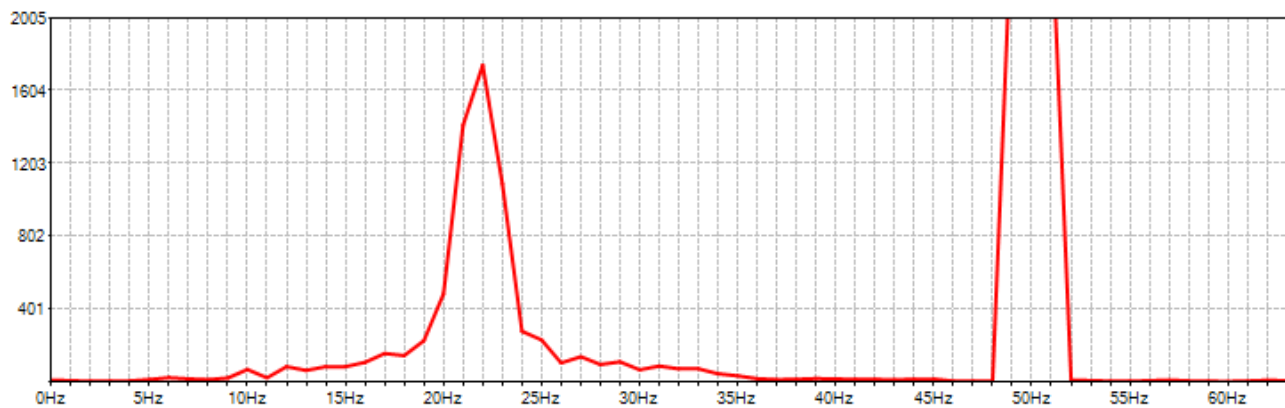
The spectrum chart can be displayed in the lower half of the main window by pressing the relevant icon on the ribbon.

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 a huge noise component at 50Hz. 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 and/or cause "clipping" of the input signal as per 4.11 WINDOWS EXCESSIVELY LARGE INPUT WARNING.

4.9. WINDOWS RAW CHART

The raw signal chart can be displayed in the lower half of the main window by pressing the relevant icon on the ribbon.

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 particularly for identifying "clipping" of the input signal.

4.10. WINDOWS SETTINGS

The settings page can be displayed in the lower half of the main window by pressing the relevant icon on the ribbon.

4.10.1.   CONNECTION CONFIGURE GROUP

The Connection Configure group is used to establish connection to an EMRx unit.

Select Device	Drop down list to allow selection of the required EMRx unit. EMRx units will appear in the list of available devices with name "EMRx Onshore ###" where "###" is the serial number of the EMRx unit. Note that all previously paired EMRx units will also appear in this list even if they are not powered or within range.
Connect / Disconnect	Connect or Disconnect to the device selected within the Select Device drop down list.
Bluetooth	Check to display only EMRx Bluetooth devices within the Select Device drop down list. Clicking on this item will refresh the list.
RS485	Check to display all available COM ports within the Select Device drop down list. Clicking on this item will refresh the list.
Demonstration	Check to simulate 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 application without the need of an actual EMRx unit or EM transmitter.

4.10.2.   HARDWARE CONFIGURE GROUP

The Hardware Configure group is used to view and modify settings on the EMRx unit. To refresh settings press the settings control within the ribbon.

The Write button is only required when updating the LED frequency settings, all other settings are sent to the connected EMRx unit as soon as they are modified. The EMRx unit will memorise settings even after it has been turned off.

When configuring the 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 using the application or as per 3.2 TURNING ON to determine the current LED frequency settings.

Although the EMRx is only designed to work with frequencies between 10Hz and 30Hz the LED frequencies can be set to any frequency between 1Hz and 63Hz. To disable an LED bar graph set the corresponding LED frequency to 0Hz (zero).

Supply Voltage	Supply voltage (V) and percentage (%) of connected EMRx unit. A reading of 9.0V or more indicates new batteries are installed. A reading of 6.0V or below indicates critically low batteries are installed which should be replaced immediately.
Gain	Drop down list for gain setting of connected EMRx unit. See 3.4 GAIN ADJUSTMENT.
LED Frequency 1 (red) LED Frequency 2 (blue) LED Frequency 3 (white)	Frequency settings for 3x available colour coded LED bar graphs of connected EMRx unit. Simply type in any frequency between 10Hz and 30Hz and then press the Write button.
LED brightness	Drop down list for LED brightness setting of connected EMRx unit. Available settings are from 1 (lowest LED brightness) to 6 (highest LED brightness). Increasing LED brightness will reduce battery lifetime, so it is recommended that this setting is left at the default setting of 1 (minimum) whenever possible.
Filter ☑	This setting should be left ticked by default.
Low Noise ☑	This setting should be left ticked by default.
Light Switch ☐	If this setting is ticked, then the EMRx light switch control is enabled (if fitted).
Calibration 200	This setting is for information only.

4.10.3.   SOFTWARE CONFIGURE GROUP

The Software Configure group is used to view and modify settings within the EMRx application.

N 128	This setting should be left at default 128.
Intensity Chart ☑	This setting enables or disables the Intensity Chart. Disabling the Intensity Chart may allow the application to run on lower performance devices.
Signal Chart ☑	This setting enables or disabled the Signal Chart. Disabling the Signal Chart may allow the application to run on lower performance devices.
Filter ☑	This setting should be left ticked by default.

Debug ☐ This setting should be left unticked by default.

Fresponse ☑ This setting should be left ticked by default.

Screenshot Folder This specifies the target folder for screenshots as per 4.12 SCREENSHOT. The default location is the host device Desktop. Press the Select button to specify an alternative location.
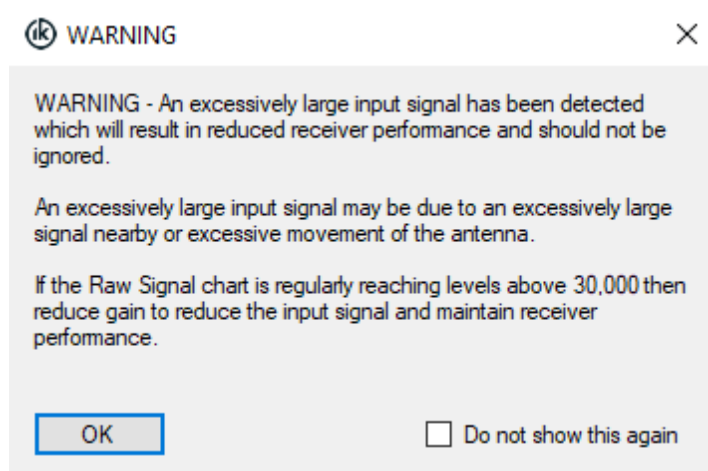
4.10.4. FIRMWARE CONFIGURE GROUP

DO NOT ATTEMPT TO UPDATE FIRMWARE WITHOUT THE EXPRESS PERMISSION OF IK TRAX.

The Firmware Configure group allows update of the firmware within an EMRx unit. To update the firmware, follow the steps below.

1. Ensure that the host device is not in "Flight Mode" and that Bluetooth is enabled. Both of these settings can be found in Start> Settings> Devices.

2. If not already done so pair the EMRx unit with the host PC as per 4.4.1 WINDOWS BLUETOOTH PAIRING.

3. Open the EMRx application on the host device.

4. Turn the EMRx unit on.

5. Press and hold the EMRx control to turn the unit off but keep the control button depressed until told to release.

6. Confirm that the EMRx unit Bluetooth status LED starts flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

7. Within the EMRx application Connection Configure group select the correct device from the Select Device drop down list. The EMRx unit will appear in the list of available devices with name "EMRx Subsea ###" where "###" is the serial number of the EMRx unit. Note that all previously paired EMRx units will also appear in this list even if they are not powered or within range.

8. Within the EMRx application Connection Configure group press the Connect button.

9. Confirm that the EMRx unit Bluetooth status LED starts flashing twice per second indicating that a connection has been established and then release the EMRx control.

10. If a successful connection is established the EMRx application 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.

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

12. 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.

13. Turn the unit on and complete a quick function test as per 3.2 TURNING ON and 3.8 FUNCTION TEST. If the unit is not going to be used immediately then turn off as per 3.5 TURNING OFF.

## 4.11. WINDOWS 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 and the EMRx unit will flash all LEDs to warn of "clipping" of the Raw Signal.

WARNING ✕

WARNING - An excessively large input signal has been detected which will result in reduced receiver performance and should not be ignored.

An excessively large input signal may be due to an excessively large signal nearby or excessive movement of the antenna.

If the Raw Signal chart is regularly reaching levels above 30,000 then reduce gain to reduce the input signal and maintain receiver performance.

OK   ☐ Do not show this again

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 RECEIVER MUST NEVER BE USED IF THIS IS HAPPENING.
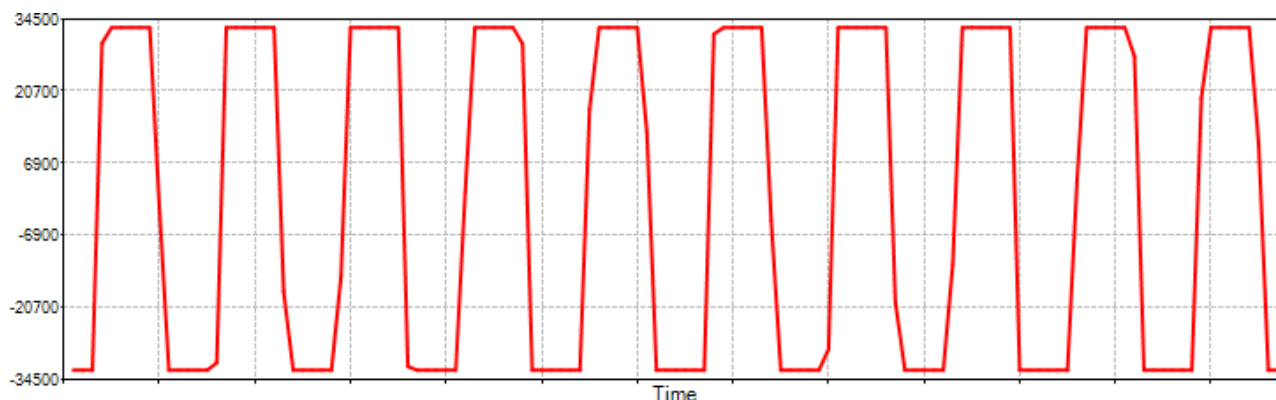
Gain must be reduced or the receiver must be moved away from the source of the excessively large signal to reduce the signal to something which looks like the signal below - notice that the peaks of the sine wave are no longer "clipped" because they do not get anywhere near a reading of 33,000.
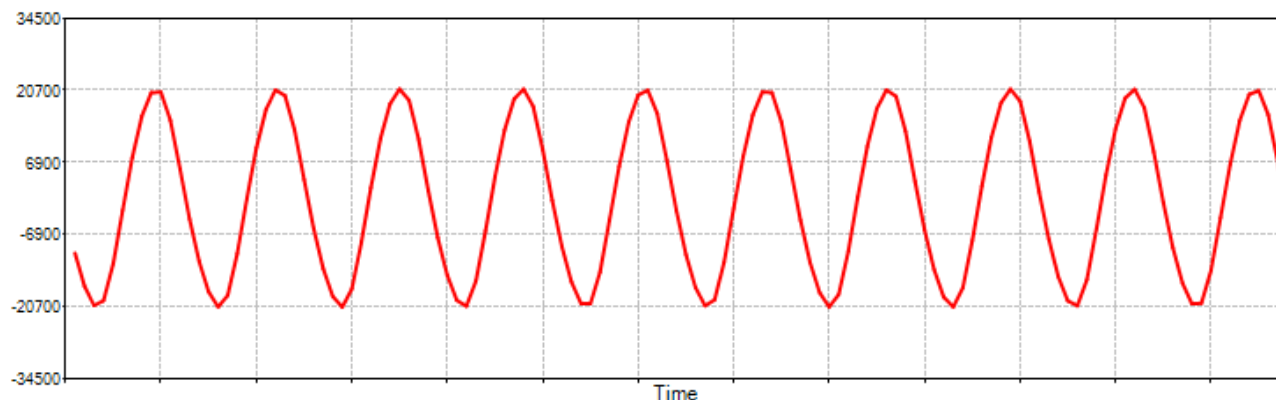
4.12. WINDOWS SCREENSHOT

At any point while using the application it is possible to capture a timestamped screenshot by pressing the screenshot icon on the ribbon.

Screenshots are saved in the specified screenshot folder. Screenshots are saved as a *.png image with filename <COM## EMRx Subsea ### YYMMDD hhmmss.png> where COM## is the COM port of the selected device, EMRx Subsea ### is the serial number of the selected device and YYMMDD hhmmss is the screenshot date and time.

The title bar of the EMRx application includes COM port number, device serial number, date and time which will all appear on the screenshot itself.

For the screenshot feature to work reliably the application should be on the primary display of the host PC and the display scale should be set to 100%. On a typical Windows 10 device this setting can be found under Start> Settings> System> Display> Scale and layout.

5. EMRx ANDROID APPLICATION
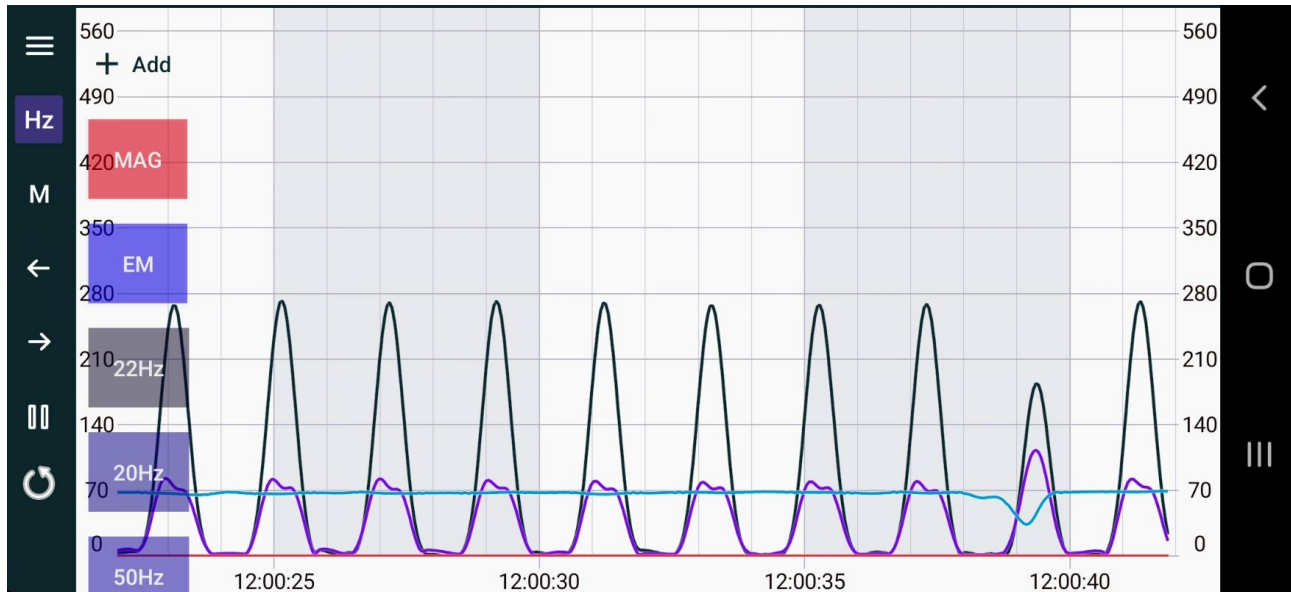
5.1. ANDROID USAGE CONSIDERATIONS

The EMRx application may place a significant performance burden on the host device. To ensure best performance and data integrity the following measures should be observed where possible:

14. Enable "Flight Mode" and/or disable Wi-Fi (Bluetooth must be enabled).

15. Close all other applications and ensure nothing is running in the background.

16. Keep any other activities such as phone calls or messages to a minimum.

It is highly recommended to test the EMRx application performance on the intended host device prior to deployment to confirm the host device is capable of running the application. For critical tracking jobs it is recommended to use a dedicated host device.

The Android operating system requires Location permissions in order to scan for and connect to Bluetooth devices. Ensure that the application has been allowed Location permissions (normally found under Settings> Apps> EMRx> Permissions> Location). In addition, some devices will also need Location services to be enabled (normally found under Settings> Location). Once an EMRx has been connected Location services may be disabled if desired. The EMRx application does not use, record or report Location information.

5.2. ANDROID INSTALLATION

The EMRX android application can be downloaded from the Google app store.

1.   Open the google app store and search for the EMRX app.

2.   From the search results locate the EMRX app. It can be identified by its logo.

3.   Ensure that the app you are downloading matches the one described in this section to avoid downloading a similar-looking app.

4.   On the app's page, tap the 'Install' button to begin the installation. Once installed, the app can be accessed by tapping the 'Open' button on the app page, or by locating and launching it on your device.

5.   The app page also contains the app description and screenshots.

6.   Please leave a review. Monitoring user experiences helps improve the application.

Note: Signed APKs are available on request, in case unable to download or install the app.
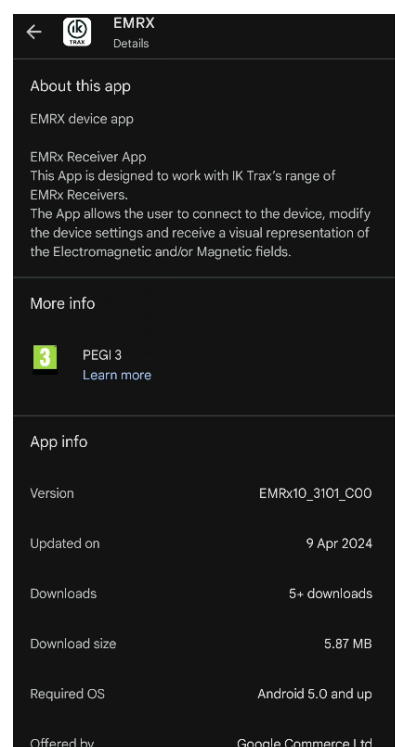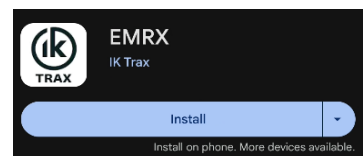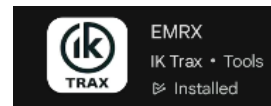
5.3. ANDROID ESTABLISHING BLUETOOTH CONNECTION

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.

A connection between the EMRx unit and the EMRx application can be established by following the procedure below.
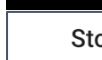
Note that the name and location of settings may vary by Android device. For more information contact your device manufacturer.

1. Ensure the EMRx is turned off.

2. Turn on the EMRx unit as per 3.2 TURNING ON and keep the control button depressed. Confirm that the Bluetooth status LED is flashing once every second indicating the Bluetooth interface is active and advertising for a connection.

3. Ensure Bluetooth is enabled on the host device. This setting can be found in the Quick Settings panel which is revealed by swiping down from the top of the device screen.

4. Open the EMRx application on the host device.

5. Within the EMRx application select Start Tracking.

6. Within the EMRx application select the desired EMRx unit from the available list. The EMRx unit will appear in the list of available devices with name "EMRx Subsea ###" where "###" is the serial number of the EMRx unit.

7. Confirm that the EMRx unit Bluetooth status LED starts flashing twice per second indicating that a connection has been established.

8. The application will start displaying data in the Signal chart as per 5.5 ANDROID SIGNAL STRENGTH CHART.

9. Release the EMRx control button within 5 seconds of establishing the connection to prevent the EMRx turning off as per 3.5 TURNING OFF.

5.4. ANDROID MAIN MENU
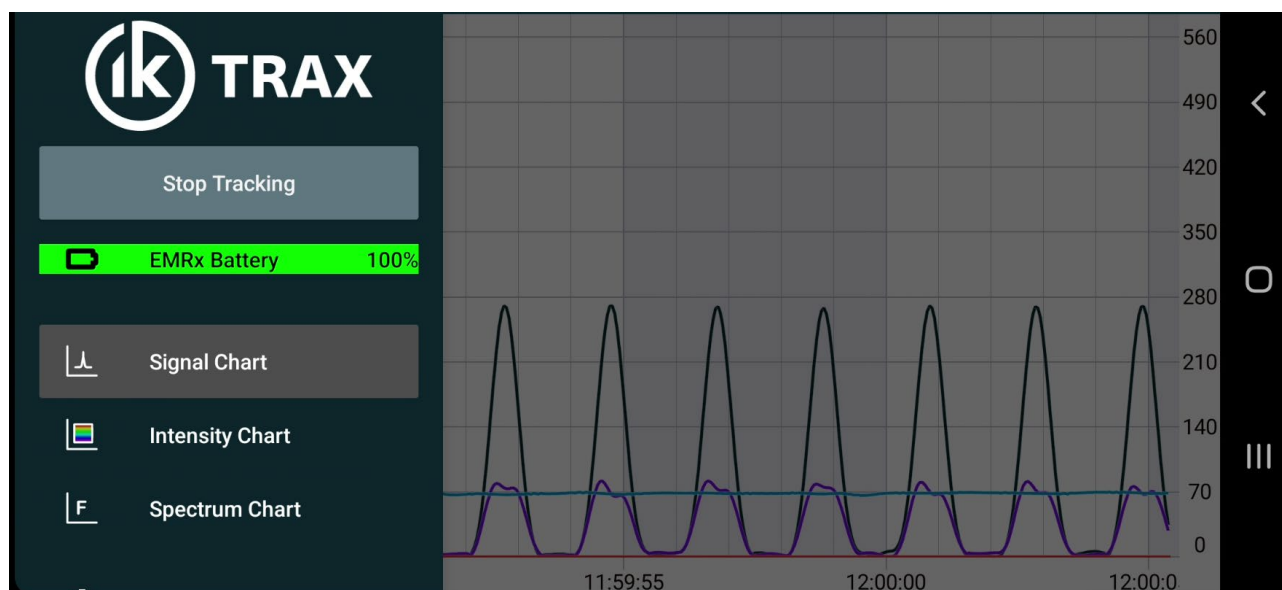
The main menu has the following controls while connected to an EMRx unit. Only the signal chart control and a close file option are available if looking at a logged file.

Stop Tracking — Disconnects from the EMRx hardware and saves log file.

EMRx Battery — Shows battery status of the connected EMRx hardware in %.

Signal Chart — Selects the signal chart.

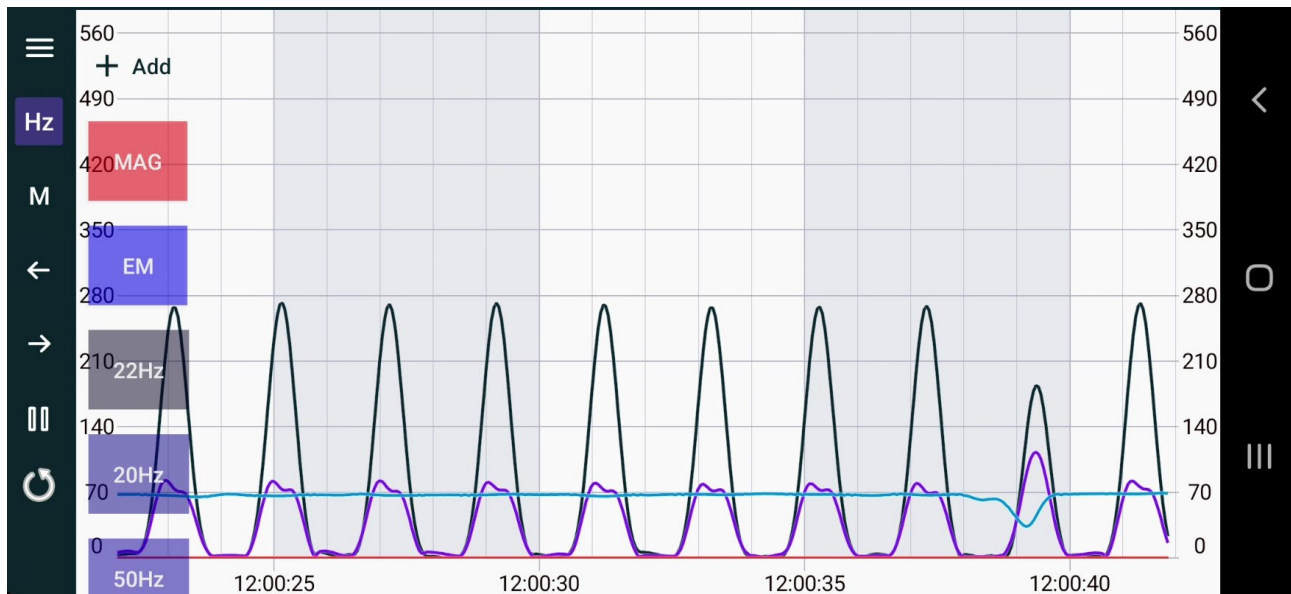**Intensity Chart** — Selects the intensity chart.

Spectrum Chart — Selects the spectrum chart.

Settings — Selects the settings menu.

Audio — When Audio is enabled audio tone(s) with amplitude and frequency proportional to received signal are generated for each frequency enabled on the signal chart.

5.5. ANDROID SIGNAL STRENGTH CHART

The signal strength chart provides a traditional chart of received signal against time (hh:mm:ss). It is excellent for determining the relative signal strength of up to six colour coded transmitters. Normally the intensity chart (see 5.5 ANDROID SIGNAL STRENGTH CHART) will be used to confirm the frequencies present and then the signal strength chart will be used to determine the accurate signal strength of each frequency.

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. In the example shown above can see 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 right-hand side can see that the signal strength of each 22Hz pulse is approximately 150 and the signal strength of each 17Hz pulse is approximately 300.

Touchscreen pinch, drag and fling gestures can be used to zoom and pan as required. Panning is only possible while the chart is paused.

This button opens the main menu.

This button hides or shows the colour coded frequency boxes. Up to six colour coded frequencies can be added by tapping the +Add button. Frequencies can be altered by tapping the relevant colour coded frequency box.

Place marker button allows placement of a marker.

Previous marker button jumps to previous marker.

Next marker button jumps to next marker.

Alternates between a play and pause button which plays or pauses the chart.

This button resets the screen to latest peak recorded.

This button allows addition of up to 6x colour coded frequencies to the chart. This button can be toggled on or off by tapping the Hz button.

Frequencies can be modified by tapping the relevant colour coded frequency box. These boxes can be toggled on or off by tapping the Hz button.
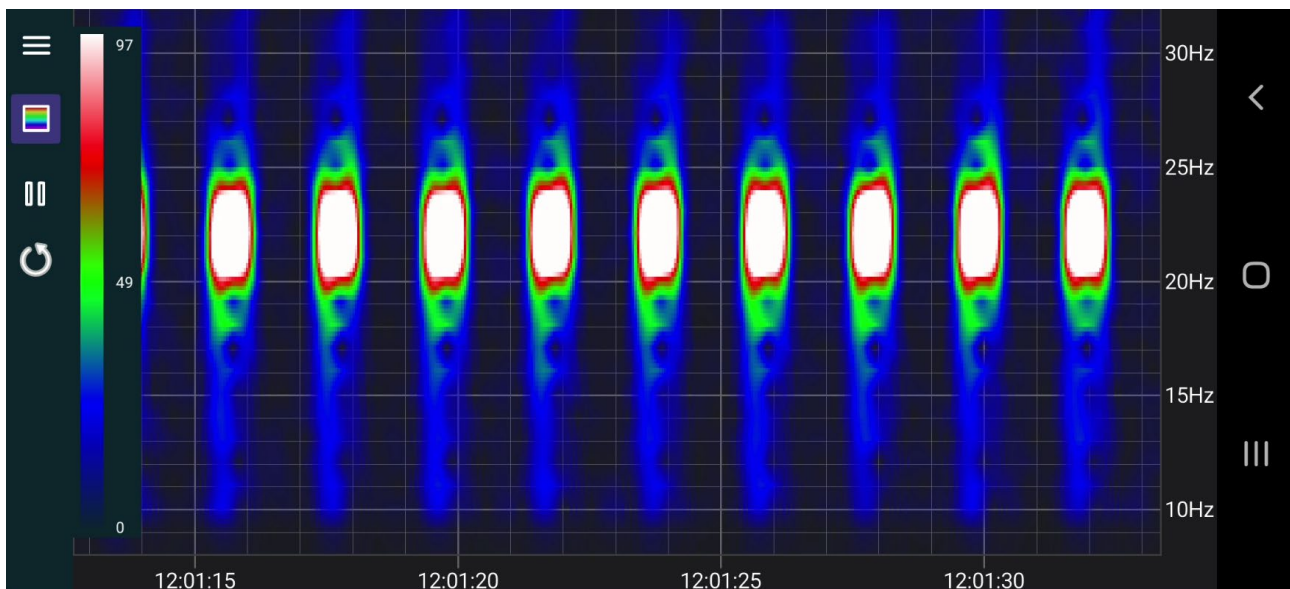

This button will toggle on or off the Magnetic detection line. (N/A to EMRx Subsea).

This Button will toggle on or off all the EM frequencies.

5.6. ANDROID 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. To determine the accurate signal strength of each frequency it is best to use the 5.5 ANDROID SIGNAL STRENGTH CHART.

The horizontal axis of the intensity chart is time (hh:mm:ss) and the right-hand side vertical axis is frequency (Hz). Intensity (signal strength) at each point on the chart is represented by a colour ranging from black (low signal strength) through blue, green and red, to white (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 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.
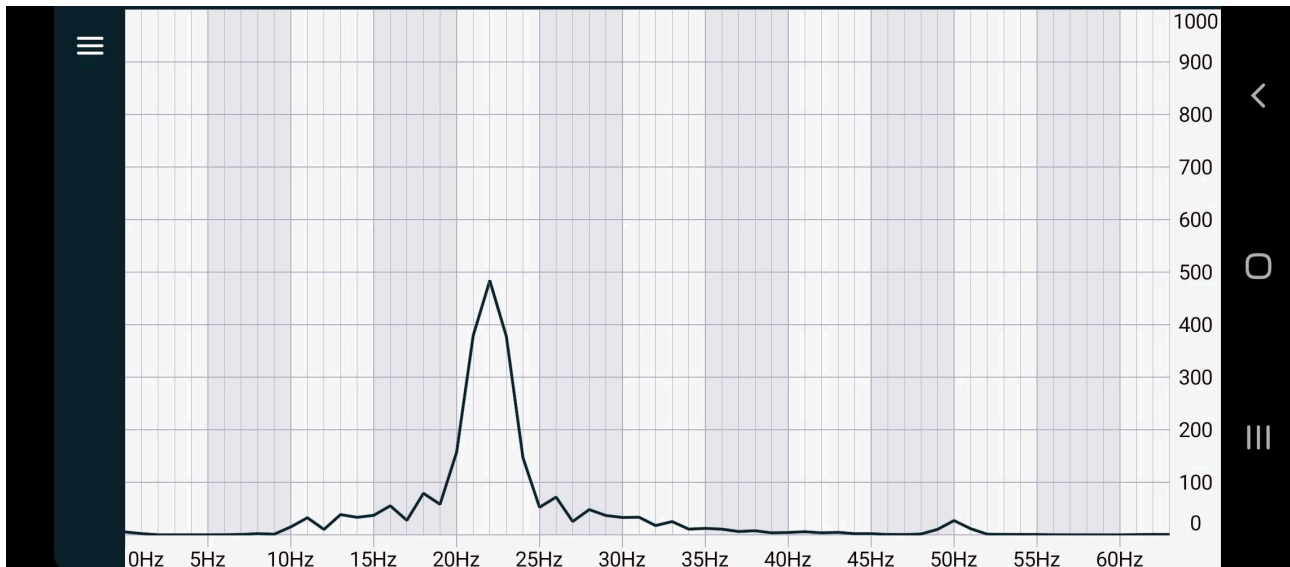
An intensity key (vertical bar on left hand axis of the chart with colour gradient going from black at the bottom to white at the top) indicates what signal level each colour represents. In the key

shown can see that white represents a signal of approximately 250, red represents a signal strength of approximately 190, green represents a signal of approximately 125, and so on. The scale can be adjusted using vertical drag and fling gestures.

This button hides or shows the intensity key.

5.7. ANDROID SPECTRUM CHART

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 a huge noise component at 50Hz. 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 and/or cause "clipping" of the input signal as per 5.11 ANDROID EXCESSIVELY LARGE INPUT WARNING.

5.8. ANDROID SETTINGS
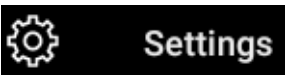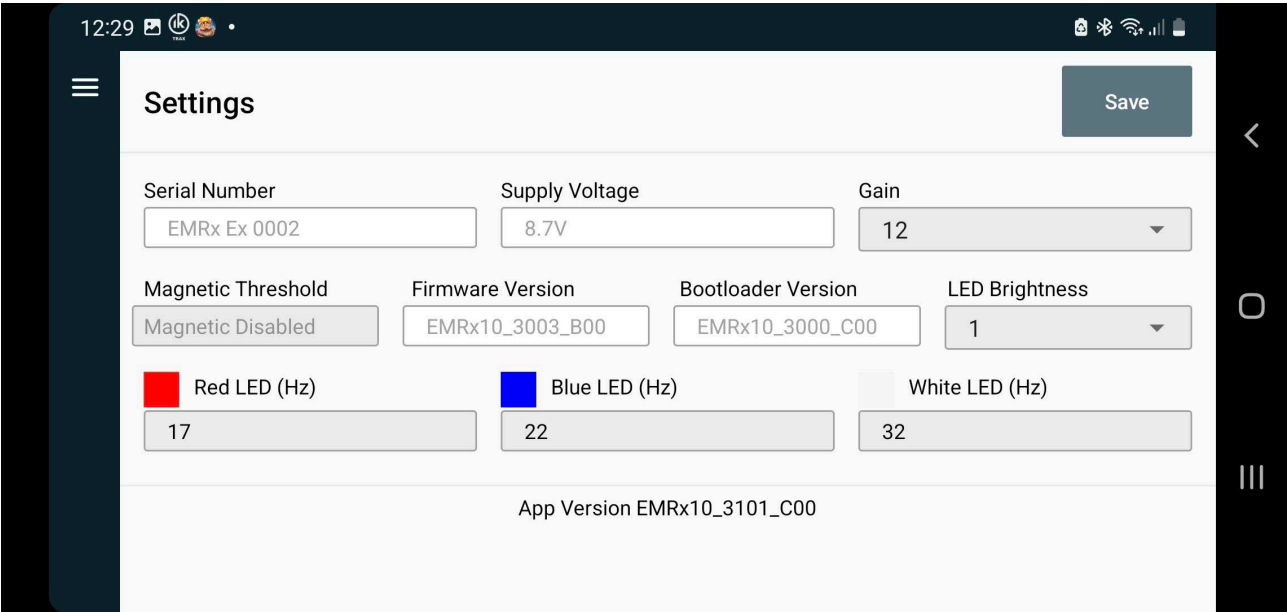
 Settings allows configuration of the connected EMRx unit. Once settings have been modified the Save button must be used to save settings to the EMRx unit. Once settings are saved to the EMRx unit they will be remembered even after it has been turned off.

 Saves settings to EMRx unit.

Serial Number — Serial number of connected EMRx unit.

Supply Voltage — Supply Voltage of connected EMRx unit. A reading of 9.0V or more indicates new batteries are installed. A reading of 6.0V or below indicates critically low batteries are installed which should be replaced immediately.

Gain — Gain setting of connected EMRx unit. See 3.4 GAIN ADJUSTMENT.

Firmware Version — Current firmware version of the connected EMRx unit. Note that the firmware can only be updated using the Windows application as per 4.10.4 FIRMWARE CONFIGURE GROUP.

Bootloader Version — Current bootloader version of the connected EMRx unit.

LED Brightness — LED brightness setting of connected EMRx unit. Available settings are from 1 (lowest LED brightness) to 6 (highest LED brightness). Increasing LED brightness will reduce battery lifetime, so it is recommended that this setting is left at the default setting of 1 (minimum) whenever possible.

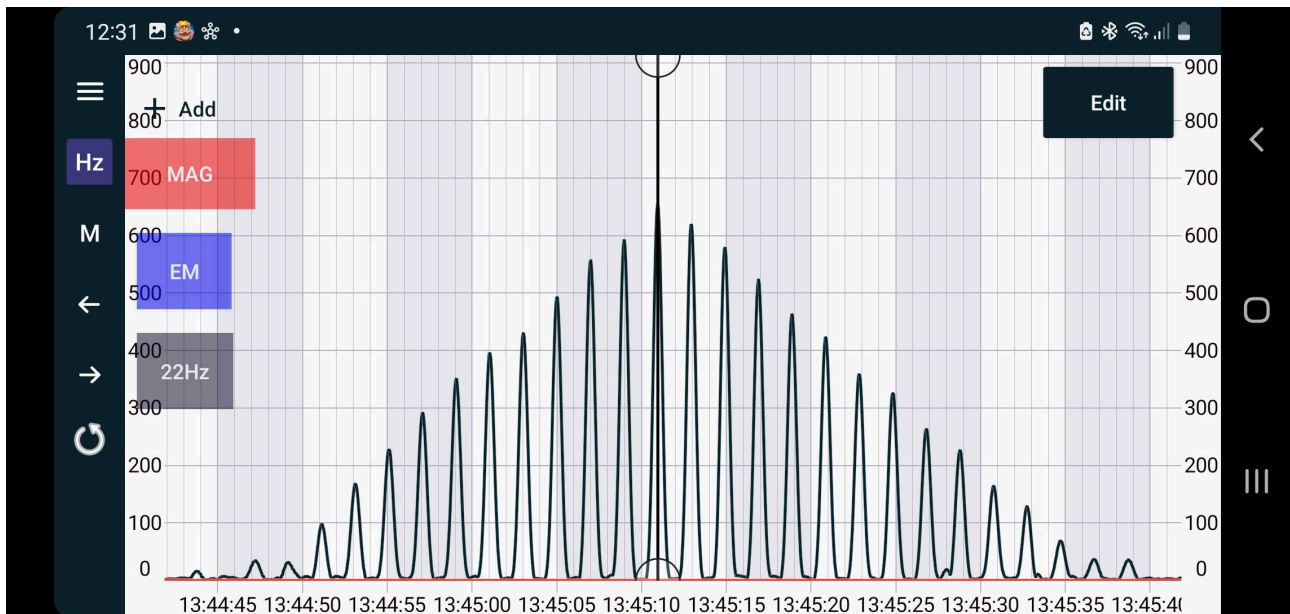 Frequency 1 setting (Hz) of Red LED bar graph.
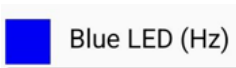
 Frequency 2 setting (Hz) of Blue LED bar graph.

| White LED (Hz) | Frequency 3 setting (Hz) of White LED bar graph. |

| App Version | Application version. This information can also be found by tapping and holding the application icon and then tapping App info. |

5.9. ANDROID MARKERS

Markers and marker controls are available in the signal chart as shown above. Markers can be placed at points of interest as per 5.9.1 PLACING A MARKER. Once one or more markers have been placed the user can navigate between markers as per 5.9.2 NAVIGATING BETWEEN MARKERS or add notes to markers as per 5.9.4 ADDING NOTES TO A MARKER.

5.9.1. PLACING A MARKER

M Tap this button once to highlight the M and then tap anywhere on the chart to place a marker. Markers appear as a bold vertical line as shown in the image above.

5.9.2. NAVIGATING BETWEEN MARKERS

← Previous marker button jumps to the previous marker, while paused.

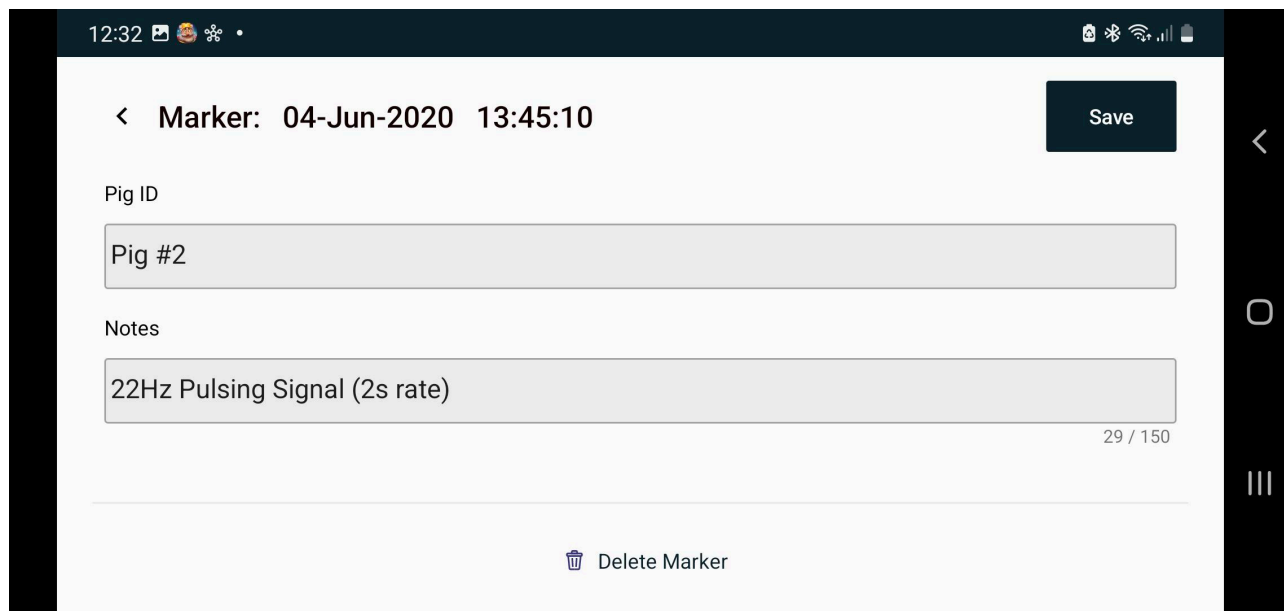**→** Next marker button jumps to the next marker, while paused.

5.9.3. MOVING A MARKER

Select the marker by tapping on it once. A circle will appear at the top and bottom of the marker vertical line indicating that it has been selected. The marker can now be dragged to a new location.

5.9.4. ADDING NOTES TO A MARKER

Select the marker by tapping on it once. A circle will appear at the top and bottom of the marker vertical line indicating that it has been selected. An Edit button will appear on the chart at the top right-hand corner.

Tapping the Edit button will open a new screen where Pig ID or Notes can be added to the marker as shown below.


5.9.5. DELETING A MARKER

Select the marker by tapping on it once. A circle will appear at the top and bottom of the marker vertical line indicating that it has been selected. An Edit button will appear on the chart at the top right-hand corner.

Tapping the Edit button will open a new screen where the marker can be deleted entirely by tapping Delete marker.

5.9.6. EXPORTING DATA LOG FILE

Use the export button to save logging information as a *.bcn text file on the host device. The app will prompt the user to select the location where the file should be saved. This file can then be located and forwarded by the user using e.g. email.

This *.bcn file can be opened in e.g. Microsoft Excel or Notepad and is simply a list data points from the log that can be used to plot the signal on the Windows App.
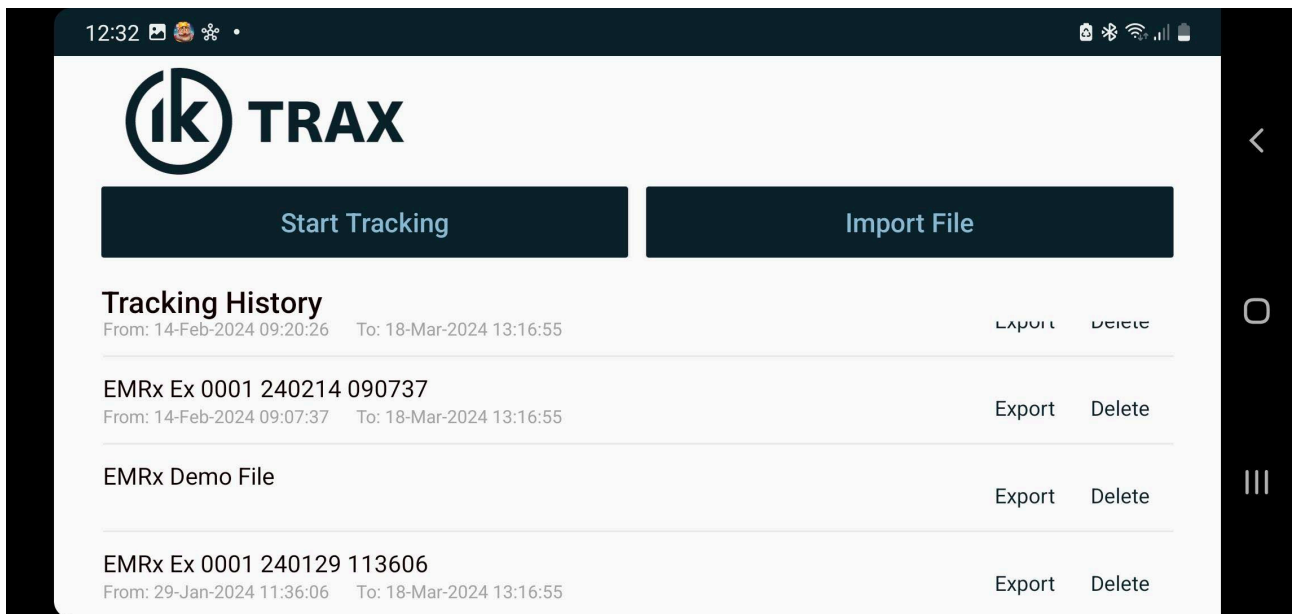
Whenever an EMRx unit is connected a new background log file is created which logs all data received by the application until Stop Tracking is pressed. These files can then be opened and examined at a later date. Typically, these files are stored on the host device at the following location:

Internal shared storage\Android\data\com.ik_trax.emrx\files

Each log file has the same format. The image displays the typical log file name which is composed of: Serial number (EMRx Ex 0001), the date (14 February 2014), time of the creation (09:07:30).
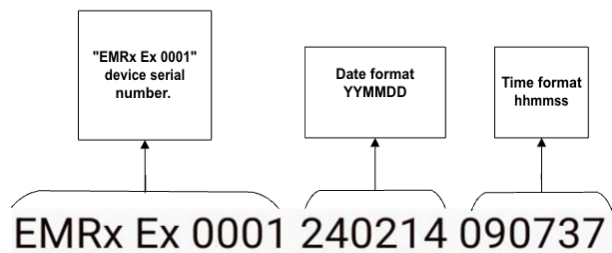
To open a log file simply tap on the filename on the screen shown above. It may take several seconds to load large files containing more than 30 minutes of data.

Once the file is loaded the user is presented with a signal chart. Up to 6x frequencies may be plotted as normal and all marker functionality is available.

Export — Exports logging information.

Delete — Deletes log file.

Import File — You can Import files from other Android devices or a logged data file from the Windows app to view on the Android device.

5.10. ANDROID 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 and the EMRx unit will flash all LEDs to warn of "clipping" of the input signal.
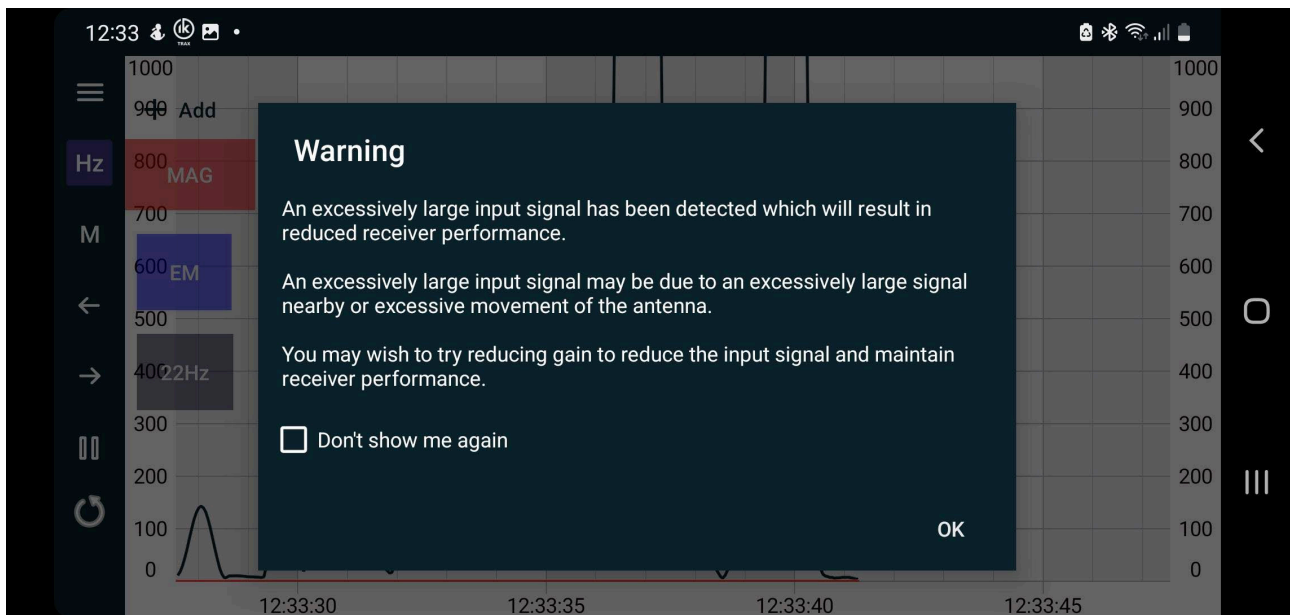
This excessively large signal may not be at a frequency that the user is aware of or expects and is distorting the input signal which results in loss of valid frequency information and generation of spurious frequency information. THE EMRx RECEIVER MUST NEVER BE USED IF THIS IS HAPPENING.

Gain must be reduced, or the receiver must be moved away from the source of the excessively large signal to reduce the signal to a level which does not cause the warning to appear.

See also 4.11 WINDOWS EXCESSIVELY LARGE INPUT WARNING.

5.11. ANDROID SCREENSHOT

At any point while using the application it is possible to capture a screenshot by using one of the standard Android screenshot methods below.

1. Press the power button for a few seconds and then tap Screenshot.
   …or…
2. Press and hold the Power and Volume down buttons at the same time for a few seconds.

6. ROUTINE MAINTENANCE AND STORAGE

All IK Trax 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.

IK Trax can supply redress kits containing a complete set of replacement batteries, O-rings and O-ring grease, contact IK Trax 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.

7. DISPOSAL OF UNIT

IK Trax 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, IK Trax 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
Doing business as IK Trax
Blackburn Business Park
Woodburn Road
Blackburn
Aberdeen
AB21 0PS
UK

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

8. WARRANTY

IK Trax products are guaranteed for one year from the date of purchase. Goods should be returned transportation prepaid to IK Trax.

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.