

WTE-MT-RX-3-Mini

AIS SART, 406 BEACON + 121.5MHz MINI RECEIVER



User Manual

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Introduction

The WTE-MT-RX-3-Mini is a compact, multi-band receiver engineered to decode emergency signals and deliver alerts to pinpoint the source of transmissions, facilitating swift rescue operations. In its most basic setup, the receiver is programmed to serially output data from 406 MHz and AIS beacons. It also allows for continuous monitoring of all nearby AIS traffic or specific configured signals, such as those on 121.5 MHz.

This miniature version is typically chosen for its advantages in weight and size compared to the MT-RX-3+. The inclusion of a display is optional but can be beneficial for simplifying the unit's configuration. The receiver is provided as a bare printed circuit board (PCB) and does not come with an enclosure.

Key Features

The following features make this device a powerful and versatile tool for monitoring and locating radio beacons and marine vessels:

- Serial output of all first generation 406 beacon transmissions.
- Serial output of all AIS transmissions on both AIS channels.
- Configurable through USB connection, directly on SD card or through optional display board.
- Stand-alone operation, without the need for connected equipment to analyse results.
- Inbuilt simple spectrum analyser, allowing confirming operation of many VHF/UHF radio transmitters from 121 MHz to 449 MHz.
- Signal strength tools for homing signal direction finding (using a directional antenna).
- Peak signal hold allowing 406 beacons without 121.5MHz to capture brief transmissions.
- Dual AIS receivers for summary of vessel operation in the area.
- Ultra lightweight and small, making it ideal for weight critical applications such as when fitted to small search and rescue drones.

Safety Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it.

The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



This is the safety alert symbol. It is used to alert you to a potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

!WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

!CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury

NOTICE

NOTICE is used to address practices not related to physical injury.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

- This product is not chemical resistant. Detergent, alcohol, aerosol sprays, and/or petroleum products may damage the front panel.
- The radio can be damaged if there is any potential difference between the chassis-ground, Serial signal ground, power (-) input, or antenna coaxial shield. Before connecting any wiring, ensure that all components are earthed to a common ground point.
- The antenna port can be damaged if signals greater than 0 dBm are injected/received. Do not directly connect any other transmitter to the RF connector.
- Extreme Heat or High temperatures can damage WTE-MT-RX-3-Mini components. DO NOT expose or operate the unit in extreme heat (above 70 degrees Celsius) or leave in direct sunlight or any other UV source.
- Although this product is designed to be rugged, it will not survive excessive shock or vibration abuse. Suitable mounts should be use in the system that the unit is incorporated with.
- The WTE-MT-RX-3-Mini IP rating is IP-00. The WTE-MT-RX-3-Mini is not waterproof and not suitable for use without an enclosure. DO NOT directly expose to rain or use in a condensation forming environment.

FCC NOTICE

This device complies with Part 15.247 of the FCC Rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference and
2. This device must accept any interference received, including interference that may cause undesired operation.

This device must be operated as supplied by the equipment supplier. Any changes or modifications made to the device without the written consent of the equipment supplier may void the user's authority to operate the device.

NOTICE



This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment.

The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and help ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, contact the dealer from whom you originally purchased the product.

Operation

When power is applied the red LED will light for approximately 5 seconds, then the green LED will flash once per second.

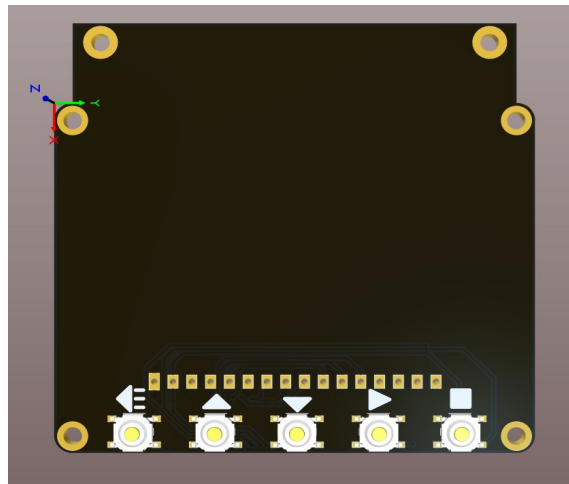
Once started, operation is determined by configuration, displaying received messages or sending received messages from various sources and sending to the RS232 serial port.

When sending decoded messages out the serial port, the red LED will operate for approximately 200ms for an AIS message, and approximately 1s for a 406 message.

If the display is fitted, decoded messages are displayed as described below. Configuration through the menu system will also be possible.

Buttons

Buttons are fitted to the optional display board. This section is not applicable if the display board is not present. When used without the display board the application note MT-RX-AN003 should be consulted (deals with serial only operation).



MENU/BACK:

When on the MAIN SCREENS used to enter the MENU. When inside the MENU, used to return back one level from within the MENU, until returning back to the MAIN SCREENS.



UP:

When on the MAIN SCREENS used to cycle between sub-screens. When in the MENU used to navigate or alter selected configuration items.



DOWN:

When on file related screens of the MAIN SCREENS shifts between entries. When in the MENU used to navigate or alter selected configuration items.



RIGHT:

When on the MAIN SCREENS used to cycle between main screen. Within the MENU used to enter sub MENU items or select items for configuration.



ENTER:

Used to select file related items from within the MAIN SCREENS. Also used to accept a value on a confirmation popup screen.

On the RSS and Spectrum Analysers screens is used to clear the peak held signal values.

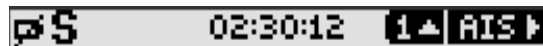
Icon Bar







The WTE-MT-RX-3-Mini top icon bar provides information about the display screen and operating status.

On this screen the battery condition, alert indication and system time can be monitored at a glance.

The far right text indicates the selected main screen. This is either “406”, “RSS” or “AIS”. Pressing the RIGHT button cycles through these screens.

Each screen can have sub screens. When these are available, there is a small UP arrow next to the sub-screen number (shown as “1” on the example below). These screens can be accessed by pressing the “UP” button.

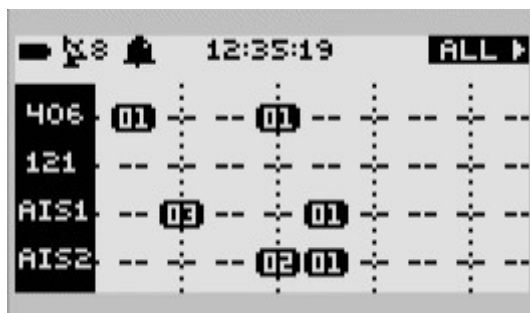


Icon	Description
	The far left battery icon indicates remaining battery capacity. When a line is drawn through the icon, the battery cells should be replaced.
	The alert shown on the screen is a distress message, and NOT a test.
	The alert shown is a TEST message.
	There currently is a signal present that has opened the squelch (better viewed on the RSS screen), that has been present for at least the configured TRIG period of time. This could be any signal that exceeds the configured squelch setting.
	A valid emergency homing signal has been detected for at least the configured TRIG period of time. This is the sweep signal that is present on 121.5MHz or 243MHz transmitted by 406 beacons and used for search and rescue final location. This icon takes priority over the “S” icon. The signal strength of the homing signal must also exceed the squelch setting.
	An alert has been raised based on the current ALERT configuration within the last 60 seconds.

Summary Screen

This screen provides the best indication of recent activity on distress channels of interest. If the user has shifted from the main screen, after several minutes of inactivity the MT-RX-3 will automatically return to this screen.

The start up and main returning screen can be altered by the user to any screen (MENU->SYSTEM->MAIN SCREEN), e.g. to primarily display AIS vessel transmissions.



Activity on each distress channel is shown by the number of messages received on each channel within a 30 second time slot. On AIS channels, large numbers of transmission can be expected when SART AIS messages have not been filtered and in proximity to shipping channels. The AIS display can be configured to display only SART AIS messages.

On the top line of the screen shown there is "406" shown with a "01" then on the same line another "01". Each dotted vertical line is used to mark the passing of one minute, allowing the activity of the last 5 minutes to be seen. On the 406 line it can be seen that there was a 406 transmission decoded approximately 20 seconds ago, and other nearly 2 minutes ago. If the number displayed "04" - then 4 messages have been decoded in that particular 30 second time slot.

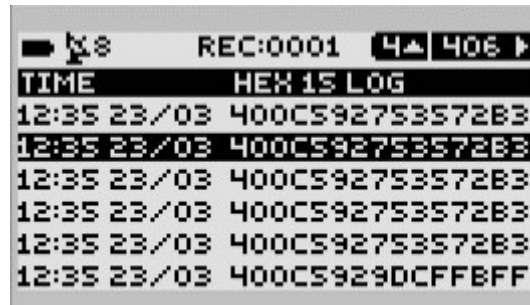
From this top level screen, pressing the right button cycles through each technology specific summary screen. While on each screen, pressing the up button cycles through sub screens for each, providing access to logged results, live data as received and additional parameters.

406 Decode Screens

The 406 main screen provides several decode sub screens that display details regarding the 406 message processed. Recent database files stored on internal SD card provide translations from country ID to country name and also provide details of beacon model and manufacturer.



The decode history sub screen provides a means to view time-stamped entries, and also allows the entries to be selected to be used with the direction finding screen (see Target Setting).



RSS Screen

The RSS (Received Signal Strength) screen provides continuous measurement of signal strength from up to two configured frequencies. When used in conjunction with a directional aerial, this screen can assist in close-range location of many varieties of man-overboard transmitters, 406 PLBs and voice transmitters.



The RSS screen can be configured to display and provide an alert for any frequency from 120MHz to 449MHz, but particularly useful for the distress homing signals transmitted on 121.5MHz, 406MHz and 243MHz.

Alerts can be raised when the signal level has increased above a configured squelch level for the set trigger period. Optionally, and more usefully, an alert can be raised only when the 121.5MHz downwards sweep on the channel that will greatly decrease the probability of false alerts.



As shown above, when a signal level increases above -80 dBm for 3 seconds the RSS receiver begins to look for a valid sweep signal. The 'S' icon will now be displayed indicating that the RSS squelch is open.

If the downwards sweep is present for 3 seconds an alert will be raised (if RSS alerts are enabled) and the 'S' icon will change to the 'H' icon (to indicate that a homing signal has been detected). Any squelch level, squelch trigger period and sweep trigger period can be configured. Sweep detection can be disabled if required.



Peak signal values are held for the last minute. The SIGNAL bar shows first the last received signal strength measurement, followed by the peak signal measurement.



The first RSS screen switches between the 2 configured RSS frequencies (A+B shown top left), allowing homing sweep signals to be identified. Pressing the up button will allow a clearer non-switched view of frequency A and B in isolation.

In the following screen RSS frequency B has been set to 406.028MHz, allowing 406 beacon signals to be captured and held even though they are only transmitted once every 50 seconds.



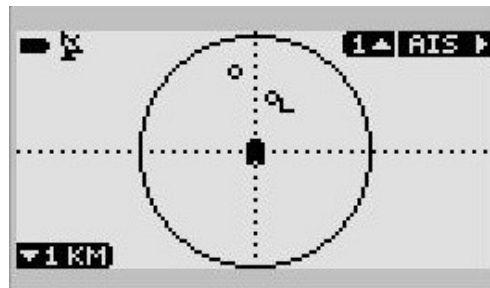
AIS Screens

The top level AIS screen defaults to the graphical vessel summary, providing details of vessels within the area and direction of travel. AIS target and collision avoidance status can be viewed on this screen.

NOTICE

Distance to target determination is only possible when GPS NMEA data is provided on the secondary UART2 serial port.

The vessels shown on the top level AIS screen are as follows:



Stationary vessel



Moving vessel, indicating direction.



Vessel expected to collide based on collision alert configuration (flashing).



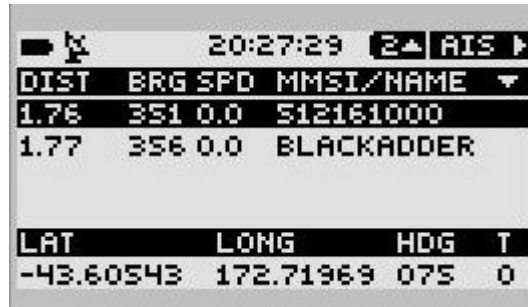
Vessel set as a target (for direction finding using the DF screen).



Vessel that has not transmitted data in the last minute.



The AIS vessel list screen provides an ordered list of the closest vessels, updated as new transmissions are decoded. The last transmission from each vessel can be selected to provide additional information such as current location. Any vessel on this screen can be selected as a target by pressing the square button, allowing the Direction Finding (DF) screen to be used.

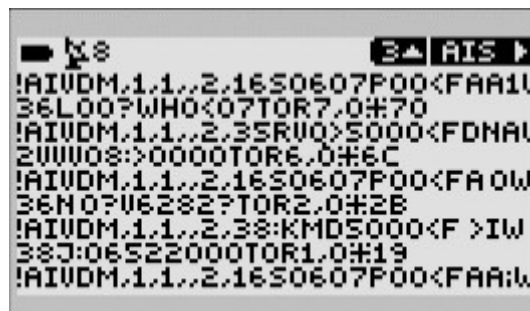


The SART (Search and Rescue Transponder) screen provides information relating to AIS distress type transmitters operating on both 161.975MHz and 162.025MHz. These transponders are commonly used as man-overboard transmitters.

Information decoded on this screen is logged directly to SD card, and can be used to set as a target for direction finding to.



The AIS raw data screen displays decoded AIS packets from both channels in real time. The MT-RX-3 can be configured to output this data out the serial ports, that can then be used by PC based AIS mapping tools. All AIS single and double sentence messages are decoded. Variable length AIS messages are decoded up to a length of 2 sentences (AIS transmissions greater than 2 sentences are rare).



The decode history sub screen provides a means to view time-stamped entries, and also allows the entries to be selected to used with the direction finding screen (see Target Setting). Only AIS-SART messages are listed in the history.



The screenshot shows a terminal-style interface with a header bar and a list of entries. The header bar contains 'N8', 'REC:0000', and '4 AIS'. Below the header, there are two columns: 'TIME' and 'SART ID LOG'. The list contains seven entries, all with the same timestamp and ID.

TIME	SART ID LOG
12:35 23/03	548206000
12:35 23/03	548206000
12:35 23/03	548206000
12:35 23/03	548206000
12:35 23/03	548206000
12:35 23/03	548206000
12:35 23/03	548206000

GPS Screen

The GPS screen provides details of the GPS data that is provided to the MT-RX-3 for direction finding. If the GPS anchor feature is currently in use, the distance from the anchor set location is shown – see “GPS Anchor”.

NOTICE

GPS details only possible when GPS NMEA data is provided on the secondary UART2 serial port.

LAT		S	SPEED
43°40.238'			5.0
LONG		E	HEADING
172°51.000'			0.0
GPS ANCHOR		GPS TIME	
185 M		13:33:05	

The GPS raw data sub screen provides real time updates of provided GPGGA and GPRMC NMEA sentences that are used to determine the current location, quality of fix and time.

```

GPGGA,12.3519,4807.038,N,01131
.000,E,1.08,0.9,54S,4,M,46.9,M,
#47
GPRMC,12.3519,A,4307.038,S,172
31.000,E,0.00,0.084,4.230394,00
3.1,W#7C
GPGGA,12.3519,4807.038,N,01131
.000,E,1.08,0.9,54S,4,M,46.9,M,
#47

```

DF Screen

The GPS DF (GPS direction finding to target) provides an indication of the current target that has been selected, bearing and distance to that target. The operation and use of the DF screen is better described in the “Target Setting” section.

The DF screen allows direction finding to 406 and AIS transmissions, and also to manually entered waypoints.

NOTICE

This screen relies on the connection of a GPS signal (or for a position to be manually entered), and for the alerting device to be transmitting its position.



Alert Operation

The WTE-MT-RX-3-Mini can be configured to raise an alert through an internal piezo sounder (if fitted) under a variety of conditions. The duration of sounder operation can be configured via the alert menu system.

NOTICE

The MT-RX-3 Mini has an optional sounder fitted. The sound output is low. Alerting capability is influenced by the equipment that the MT-RX-3 Mini is interfaced with. The MT-RX-3+ is best suited for alerting applications.



406 alerts can be raised for transmissions that are:

- General Distress.
- General Distress plus any test transmission.

AIS alerts can be raised for transmissions that are:

- Type 1 messages, status 14 (SART active).
- Type 1 messages, status 14 plus status 15 (SART test).

RSS (Received Signal Strength) alerts can be raised for transmissions that are:

- Within a configured frequency of 120MHz and 449MHz.
- Above a configured signal strength threshold.
- Above a signal strength for a configured period of time or determined to contain a valid downwards sweep signal for a period of time.

GPS Anchor alerts can be raised when moving outside the safe anchor radius for a set location.

Upon reception of a configured alert message type, the piezo operates independently for a configured period of time.

Sequence of events when an alert is processed:

1. Sounder Operates (for configured period of time).
2. The display shifts to either the 406, 121 or AIS decode screen as appropriate.
3. An alert pop-up to indicate a new alert is displayed (if this is a new alert).

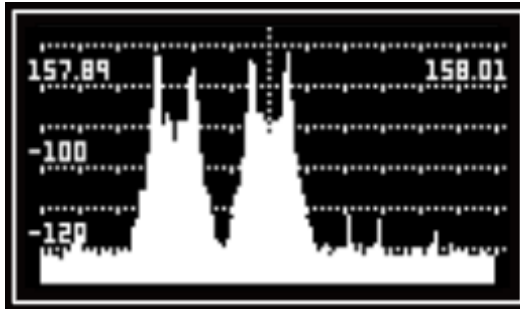
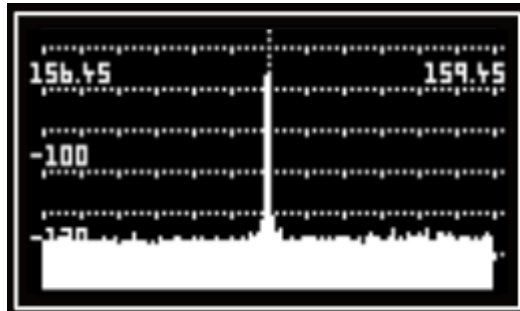
If there is an ID and location available for the alert (not applicable for 121.5 alerts):

4. The configurable duplicate reject timer is started (preventing the same ID raising another alert until a period of inactivity has elapsed).

When any key is pressed the sounder will cease to operate.

Spectrum Analyser

The spectrum analyser is a very simple to use tool that provides a span of either 24kHz, 120kHz or 3MHz around a configured centre test frequency. The receive bandwidth of 1kHz is suitable for inspection of potentially interfering adjacent channel signals. The analyser can display signals as low as -120dBm. Use for site inspection or to view a large range of frequencies, hugely simplifying search and rescue efforts looking for a channel that someone is talking on, or can be used to direction find to with a directional antenna.



Beacon Monitoring

The WTE-MT-RX-3 is well suited as a portable monitoring receiver for search and rescue applications. By simply turning the unit on, beacon transmissions will be displayed as they are received. Optionally the internal piezo will sound. The WTE-BT-01 also behaves this way.

406 Beacons transmit at 406MHz burst with a much higher power than the 121.5MHz homing signal often transmitted by many devices. This high power burst is only transmitted once every 50 seconds, and is normally very difficult to capture to allow use for an indication of proximity to a beacon.

The WTE-MT-RX-3 includes a 1 minute peak capture and hold to allow 406 beacon transmission signal strength to be tracked, albeit only updated every 50 seconds (since this is the behaviour of 406 beacons). After 1 minute of inactivity, the peak signal is automatically cleared. Manual clearing of the peak signal is possible at any time by pressing the square ENTER button.

Setting the RSS frequency to a known 406 beacon frequency will allow signal strength measurements close to that frequency to be monitored. An exact frequency can be used or setting to 406.030 to allow coverage of 406 beacon frequencies from 406.025 to 406.035 MHz.



Configuration

If the display board has been supplied and is in use, the menu system can be used to configure the unit. This is the simplest configuration method.

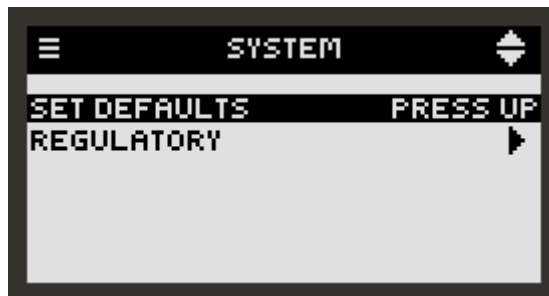
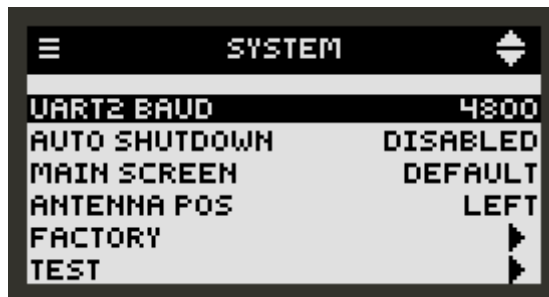
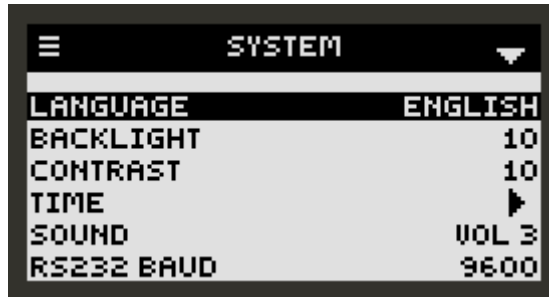
At any time the “MENU” button can be pressed that will enter the configuration menu. Entering the menu aborts any testing or receive functions.



At any time the active buttons that may be pressed are shown on the screen, such as the “MENU”, “UP”, “DOWN” and “RIGHT” buttons. Using the above screen as an example, pressing the “RIGHT” button will enter the “SYSTEM” sub menu. When reaching any configuration item, pressing the “RIGHT” button again will highlight the item to change if there is not a sub menu available.

Once inside the menu, pressing the “MENU” button again will go back up one level until the menu mode is exited. All configuration changes are stored only when leaving the menu.

SYSTEM Menu



LANGUAGE

The currently used language. Currently only English and Spanish are included. Please advise if you require translations for another language.

BACKLIGHT

This is the time in seconds that the backlight stays on for after each key press. The backlight may be set between values of 0 and 30. A value of 0 results in the backlight being disabled, a value of 30 results in the backlight being permanently on.

CONTRAST

The screen contrast setting. Although the display is temperature compensated across the MT-RX-3

operating range, at times improved viewing is possible through this contrast adjustment. Default value is 26.

TIME

Setting of the internal real time clock. System time will be reset if power source is removed for more than 30 seconds.

SOUND

Setting to OFF prevents the sounder from operating and disables all system sounds except when an alert is raised.

RS232 BAUD

Allows for the primary serial port (RS232) baud rate to be changed up to 115200 bps. Any change only takes effect after cycling power. Default is 9600.

UART2 BAUD

Allows for the secondary serial port (3V TTL) baud rate to be changed up to 115200 bps. Any change only takes effect after cycling power. Default is 4800. Typically this serial port would be connected directly to a GPS module.

AUTO SHUTDOWN

This is the period of inactivity that will result in the unit automatically powering down. Disabled by default. Behaviour of the WTE-MT-RX-3 Mini is to restart instead of shutdown.

MAIN SCREEN

This allows any page on any main screen to be set as the default main screen. This results in this screen being the screen that is first seen when powering up the unit, or after a period of inactivity the WTE-MT-RX-3-Mini will automatically revert to this screen.

Setting to DEFAULT will unset the last custom set screen and will return to the factory default main screen. Setting to USER SET will set the screen to be the screen that was last used before entering the menu.

ANTENNA POS

Selects the SMA connector to which an antenna or attenuator has been attached. For further details, see section “RF Connections”. Default LEFT. On the WTE-MT-RX-3 Mini, this setting is not used.

FACTORY

WTE factory use only.

TEST

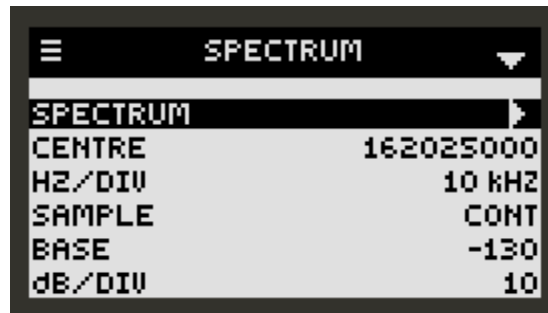
WTE factory use only.

SET DEFAULTS

Allows all configuration items to be reverted to the default factory new state. When the confirm pop-up is selected, pressing the RIGHT button will allow the tick to be selected. Pressing the square ENTER button will now allow defaults to be set. Default settings will only be applied when leaving the menu.



SPECTRUM Menu



SPECTRUM

Displays the radio spectrum using the settings in this menu. Signals between -120dBm and 0dBm can be displayed. **Power levels above 13dBm (will destroy the receiver input and invalidate the WTE-MT-RX-3-Mini warranty).**

CENTRE

Displays the centre frequency to be displayed on the screen.

HZ/DIV

2kHz, 10kHz or 250kHz. The screen is 6 divisions wide in 120 steps. When on the 10kHz setting the RBW (receiver bandwidth) is set to 1kHz. The span on this setting is 120kHz, allowing for adjacent channel power to be observed. When on the 250kHz setting the RBW is set to 25kHz. The span on this setting is 3 MHz.

SAMPLE

When set to CONT the spectrum analyser screen will be updated with new values approximately once a second. When set to PEAK only higher values will be written to the screen. At any time, the ENTER button can be pressed on the SCREEN to clear the screen and load new PEAK values.

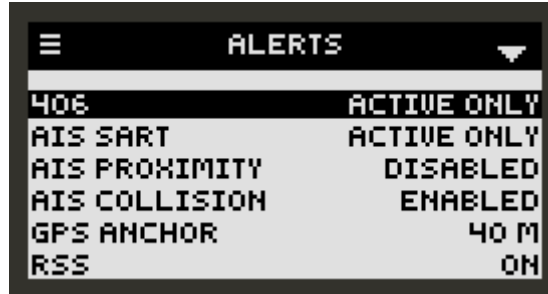
BASE

Defines the base signal level on the screen. When set to -100, only signals with a strength greater than -100 dBm will be displayed. Range is -130 dBm to -60 dBm.

dB/DIV

Scales the signal level displayed. Either 10 dB/DIV or 20 dB/DIV can be set. When 20 is set a range of 120 dB is able to be viewed.

ALERTS Menu



406

Items ACTIVE ONLY, ACTIVE+TEST and ACTIVE+DB can be selected.

ACTIVE ONLY:

Only distress transmissions will activate an alert. All test transmissions are logged and displayed, but will not raise an alert.

ACTIVE+TEST:

Both distress AND test transmission will result in an alert being raised.

ACTIVE+DB:

All distress transmissions AND any test transmission that matches an ID in the 406 selective database will result in an alert being raised.

AIS-SART

Items ACTIVE ONLY and ACTIVE+TEST can be selected.

ACTIVE ONLY:

Only AIS type 1 messages with status 14 transmissions will activate an alert. All test transmissions are logged and displayed, but will not raise an alert.

ACTIVE+TEST:

Both AIS type 1 messages status 14 transmissions AND status 15 test transmissions will result in an alert being raised.

AIS PROXIMITY

Allow generation of warnings and alerts for the distances configured in the AIS menu.

Items ENABLED+WARN, WARN ONLY, DISABLED and ENABLED can be selected.

ENABLED:

When selected, when any AIS transmission that is determined to be less than the configured PROX ALERT DIST will result in the sounder operating.

ENABLED+WARN:

In addition to the same functionality as the ENABLED setting, this setting also provides a short duration audible warning and screen pop-up when any AIS transmission that is less than the configured PROX WARN DIST distance.

WARN ONLY:

When selected, upon reception of any AIS transmission that is less than the configured PROX WARN DIST will result in a short duration audible warning and screen pop-up.

DISABLED:

No AIS proximity alerts or warnings will be generated.

AIS COLLISION

Allows the generation of collision alerts based on the settings configured in MENU->AIS->COLLISION.

Items ENABLED and DISABLED can be selected. See “AIS Collision Avoidance”

GPS ANCHOR

Sets the allowed travel distance before raising an alert. Distances from 5 – 500 meters can be set. The GPS Anchor feature is set from the GPS main screen, not in the menu – see “GPS Anchor”

RSS

The RSS (Received Signal Strength) alert when enabled will operate the sounder as configured. Disabling will result in no alert being raised.

SOUNDER TIME

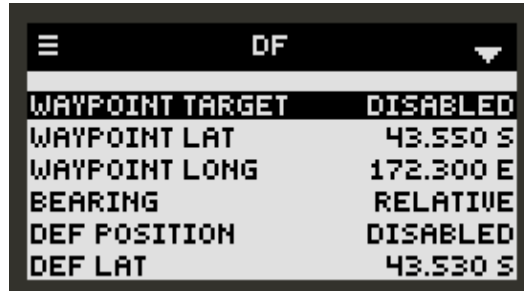
The time in seconds that the on-board sounder will operate for when an alert is raised. Pressing any button after an alert is raised will result in sounder operation ceasing.

DUP REJECT TIME

The duplicate reject feature determines the period of time that must pass before an alert of the same ID or type will raise an alert again. Typically alert transmissions are sent every minute. Raising a new alert that needs cancelling again every minute when tracking an alert is not typically desirable. When the feature is set to a non-zero value a duplicate reject timer is restarted each time the same ID is received. If the transmission source was to cease for this period of time, then restart, a new alert would be raised. When set to 0, the feature is disabled and a new alert is raised for each transmission. The duplicate reject applies to AIS, 406, RSS and PROXIMITY alerts. Once an RSS alert has been raised, the signal level must decrease below the trigger threshold for

the duplicate reject time before a new RSS alert can be raised.

DF Menu



DF	
WAYPOINT TARGET	DISABLED
WAYPOINT LAT	43.550 S
WAYPOINT LONG	172.300 E
BEARING	RELATIVE
DEF POSITION	DISABLED
DEF LAT	43.530 S

WAYPOINT TARGET

When enabled the DF screen uses the WAYPOINT LAT and WAYPOINT LONG settings to navigate to. It is not possible to permanently enable this setting and is reset after being activated. Reset of this option is to ensure that normal preference on startup is to set a target to a new 406 or AIS alert, not a previously set waypoint that may not longer be current.

WAYPOINT LAT

Waypoint latitude to use when the WAYPOINT TARGET is enabled. This setting is stored with other configuration data, but not actively used unless the WAYPOINT TARGET has been enabled.

WAYPOINT LONG

Waypoint longitude to use when the WAYPOINT TARGET is enabled. This setting is stored with other configuration data, but not actively used unless the WAYPOINT TARGET has been enabled.

BEARING

The RELATIVE bearing is expressed as 0-360 degrees relative to the current direction of travel.

The TRUE bearing is relative to true north.

DEF POSITION

When ENABLED the MT-RX-3 will use the configured default latitude, longitude and heading until an externally provided GPS position has been provided. This means that if the MT-RX-3 is used in a fixed position, such as in a building or oil rig, the heading and distance to an alert can be determined without the need to connect an external GPS source.

DEF LAT

Default Latitude for use when the default position is enabled.

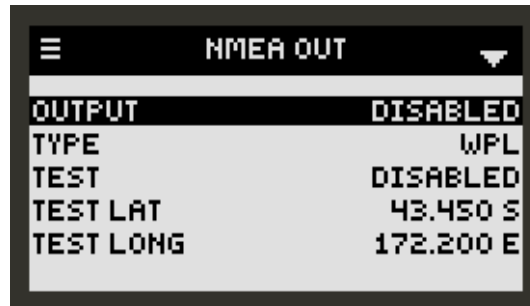
DEF LONG

Default Longitude for use when the default position is enabled.

DEF HEADING

Default heading for use when the default position is enabled.

NMEA OUT Menu



OUTPUT

When ENABLED the configured NMEA output sentence will be sent out the serial port once every second only after a 406 message with a valid position has been decoded. The NMEA output will be at the rate configured in the SYSTEM sub menu. Typically the NMEA output should be configured to be 4800 baud which is the default rate for NMEA 0813 compatible equipment.

TYPE

Items WPL, RMB, BWC and GLL can be selected. This is the NMEA sentence type that will be used when there is valid information to display. The type WPL or BWC should be used when possible, since these sentence types when used with the MT-RX-3 allow not only the position of the alert to be displayed, but also the nature of the alert in the form of a way-point, such as 406-SOS.

Activating Alert	WPL and BWC Waypoint Tag Used
406 Beacon Distress Transmission	406-SOS
406 Beacon Test Transmission	406-TEST
406 Beacon Transmission in Database	MOB-1, MOB-2, MOB-3... indicating entry in database.
NMEA Test Output	TEST

NMEA Sentence Type	Typical NMEA Output
WPL	\$GPWPL,3751.65,S,14507.36,E, 406-SOS *77
RMB	\$GPRMB,A,,,001,MOB,3751.65,S,14507.36,E,,,,V*88
BWC	\$GPBWC,,3751.65,S,14507.36,E,,,,,,,, 406-SOS *99
GLL	\$GPGLL,3751.65,S,14507.36,E,*93

TEST

When ENABLED the NMEA output test feature is enabled, using the TEST LAT and TEST LONG settings. This allows testing of a navigation system without the need to activate an actual 406 beacon. For this feature to operate the OUTPUT must be ENABLED. The configured TYPE will be used for the duration of the NMEA output test. This setting is not persistent; cycling power to the MT-RX-3 will always result in the feature being disabled. If the feature is enabled and an actual 406 message is decoded, the test setting will be automatically disabled.

TEST LAT

Latitude for use when the NMEA output TEST is ENABLED.

TEST LONG

Longitude for use when the NMEA output TEST is ENABLED.

AIS Menu



COLLISION

Allows all collision avoidance parameters to be set – see “Collision Avoidance”. Although provided with the MT-RX-3 Mini, this feature is best suited for the WTE-MT-RX-3+ so that relay alarm outputs and sounders can be used.

PROX ALERT

Defines a vessel closest point of approach (CPA) from the current position before raising an alert (note that proximity alerts must also be enabled in the ALERTS menu).

PROX WARN

Defines a vessel closest point of approach (CPA) from the current position before raising a warning (note that proximity alerts must also be enabled in the ALERTS menu).

OUT PORT

Controls which serial interface decoded AIS messages are sent out. By default this is set to NONE. Options are RS232, UART2 or ALL. Baud rates are configured by the SYSTEM->RS232 BAUD or SYSTEM->UART2 BAUD setting.

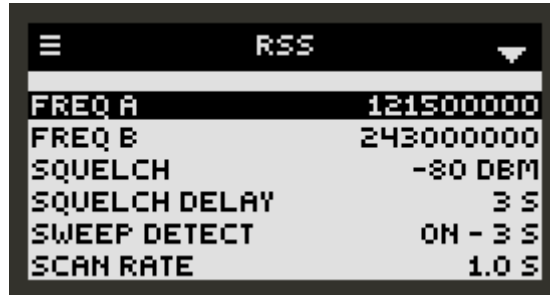
This output can be used by navigation equipment that can accept standard “!AIVDM” NMEA style messages. The system baud rate typically should be configured to be 38400 baud if this feature is used.

DISPLAY

Setting to SART ONLY will result in ONLY AIS type 1 status 14 and 15 messages being displayed on the summary screen. Setting to ALL displays all AIS messages on the summary screen. This setting does not affect the ability to raise an alert or use any AIS feature.

RSS Menu

The RSS menu allows configuration of scanning frequencies. If a signal of a configured level is detected, and then optionally the presence of a sweep tone, an alert can be raised.



FREQ A

This is the frequency used by the Received Signal Strength alert and RSS screen. The FREQUENCY parameter can be set between 120MHz and 449MHz. By default 121.5MHz is configured.

If set to 120000000, RSS scanning will be disabled completely. This will result in a slightly improved AIS1 decode performance since RSS scanning shares the AIS1 receiver for approximately 2% of its normal operating time.

FREQ B

This is the secondary frequency used by the Received Signal Strength alert and RSS screen. The FREQUENCY parameter can be set between 120MHz and 449MHz. By default 243MHz is configured. This frequency may be configured to the same as FREQ A if dual frequency scanning is not required.

SQUELCH

This is the signal level that the received signal must exceed (for the SQUELCH DELAY period) in order to raise an alert.

SQUELCH DELAY

This is the time in seconds that the measured signal must have exceeded the configured SQUELCH level before an alert is raised. Each time the signal drops below the SQUELCH level the SQUELCH TRIG (as shown on the RSS screen) is reset and the full delay period must elapse again before an alert can be triggered.

If under normal operation the “S” icon is seen frequently (due to interfering signals in proximity), the SQUELCH level should be increased until the “S” icon is no longer seen under normal

operation.

SWEEP DETECT

This item can be set to DISABLED or a value between 1 and 20. When DISABLED, an alert can be raised without the need to detect a valid sweep. When set to between 1 and 20, the sweep signal must be present for this period of time before an alert can be raised.

SCAN RATE

This option is used in conjunction with the SERIAL OUT option. This item can be set to DISABLED when set to 0 or to a value between 0.1 and 3.0 seconds. When setting to DISABLED there is no signal strength scanning of the set frequency. The user may wish to alter this setting in particular when sending the RSS value to the serial port in an application that requires a relatively high rate of signal strength reporting. The SCAN RATE option increases internal noise, and results in a degradation to AIS receiver sensitivity. This option would not normally be used unless the MT-RX-3 is under external software control, and used for a short duration of time. A setting of 1.0 would result in no noticeable degradation in performance.

SERIAL OUT

This item can be set to DISABLED or ENABLED. Setting to ENABLED will result in a signal strength sentence to be sent to the serial port at the SCAN RATE configured above. There will be no periodic serial output if the SCAN RATE is DISABLED. If SCAN RATE is DISABLED and SERIAL OUT is ENABLED, there will be serial output only when the signal strength is above the configured SQUELCH level.

The serial output format for the RSS frequency is:

SS,C,NNN<CR>

where NNN is the signal strength in dBm.

where C is 0 for FREQ A and 1 for FREQ B.

When an RSS is above the SQUELCH level the following serial output is generated, regardless of the alert setting.

SS,A,NNN<CR> (when FREQ A signal level high)

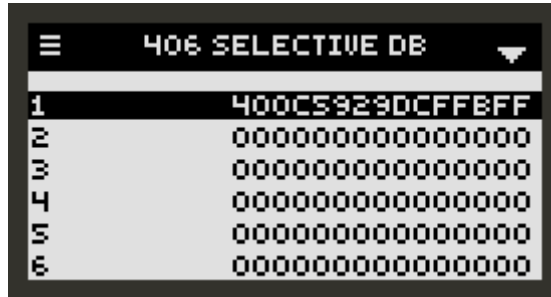
SS,B,NNN<CR> (when FREQ B signal level high)

NOTE:

An RSS alert can only be raised when RSS alerts have been enabled in the ALERTS menu.

RSS output is more intuitive when both FREQ A and FREQ B are set to the same frequency.

406 SELECTIVE DB Menu



Allows setting of the 406 beacon database. This is a patented feature that allows a database of known beacons to be loaded for locally managed search and rescue. Once loaded in the database, a user in distress can raise a local alarm when the “TEST” button for locally managed rescue without involving nationwide agencies as when a beacon is fully activated. The entries correspond a 406 beacons Hex 15 ID.

Entries in this menu will take no effect unless the 406 alerts option ACTIVE+DB has been selected.

Decoded 406 Message Serial Output

MT Serial Out Packet Format

Data provided from the MT-RX via serial ports/TCP is in the following format:

MT1UUUNNTFFHHHHHHHHHHHHSS112233N4445566WYYYY

Where:

MT1 is fixed and actually “MT1”

UUU- is a 3 character MT-RX configurable ID – by default this is “001”

NNN -is a 3 decimal digit cycling packet sequence number from 000 to 511. This sequence number increments after each new test or distress message is received. After 511 the sequence cycles to 000 and begins again.

T – is a single character message type 'T' or 'A' (test or distress alert)

F – is a single character format flag 'S' or 'L' (short or long) – this relates to the 406 beacon transmission specification.

HHHHHHHHHHHHHHHH – is a 15 character hex code used to define beacon owner and beacon capabilities as per the 406 beacon specification.

SS – is a 2 character signal strength indication – “00” if not used.

11 – is a 2 decimal character latitude degrees

22 – is a 2 decimal character latitude minutes

33 – is a 2 decimal character latitude seconds

N – is 'N' or 'S'

444 – is a 3 decimal character longitude degrees

22 – is a 2 decimal character longitude minutes

55 – is a 2 decimal character longitude seconds

W- is 'W' or 'E'

YYYY – is a 4 character checksum (calculated from M – the first character)

If all location characters are '-' then there is no location information available.

Legitimate example packet:

MT1001000AL400C592753572B323433212S1723756E4706

}

AIS Serial Messages

All AIS serial messages are provided in a standard raw format such as:

!AIVDM,1,1,,B,13PRrB0000OvbS@NhA9=oPbr0<0u,0*58

This output format is suitable for the connection to many PC based AIS mapping applications. This is a standard output format for most AIS receivers – please consult internet resources for further information regarding these messages.

If there is a need to be provided with fully decoded AIS sentences via the serial port, such as MMSI, vessel name etc, please contact info@wte.co.nz

All messages of all types are decoded up a length of 2 AIS sentences – for further information regarding the decoding of AIS messages consult the AIS specifications that are available on the internet.

Target Setting

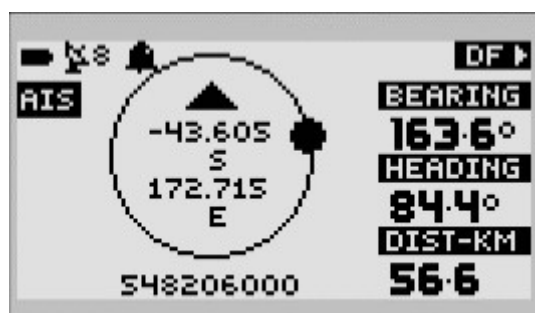
The MT-RX-3, when a GPS position is presented via internal or externally supplied NMEA sentence, can provide a bearing and distance to a specified target. When the MT-RX-3 is first powered on, the target is unset. Viewing the “DF” screen (direction find to target) the status “NO TARGET” will be shown.



If the current location is unknown through the absence of a NMEA RMC sentence, then determination of distance and bearing to target is not possible (unless a DF default position has been configured through the menu). When a distress message (406 or AIS) that matches the alert configuration settings for the MT-RX-3 (that would result in an alert being raised) is received the target and the target is currently unset, the target will automatically be set to the ID of that alert (even if the alert does not provide a position). When an alert is activated the “ALERT” pop-up is shown, and the active screen moves to either the top level 406 or AIS screen as appropriate.

Manually moving to the “DF” screen will show the bearing and distance to the target only if the current location is known AND the 406 or AIS transmission has provided a valid position.

Optionally a waypoint can be manually entered through the menu system (MENU->DF). Any waypoint can be entered that will then be shown as a DF target of “WAYPOINT”.



When a new alert message is decoded, the target will **NOT** be updated if the target has a different ID (but an alert will still be raised). If a new message has the same ID the location of the target will be updated.

To set a new target the square “ENTER” button must be pressed while on the top level 406 or AIS screen. Using this method it is possible to browse through the file history of decoded 406 or AIS messages and set any of those messages as a new target.

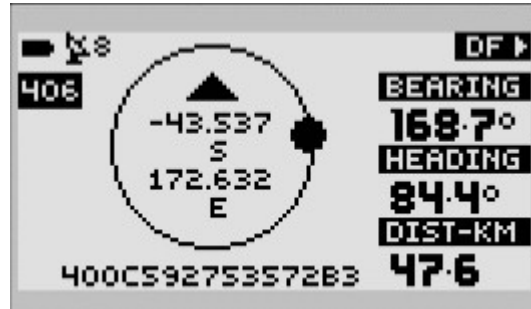
To Set a Target To Last 406 or AIS transmission:

1. Move to either the 406 or AIS screens.
2. To set this entry as the target now press the “ENTER” button.
3. The pop-up “TARGET SET” will be displayed.
4. The DF screen will now show bearing and distance to this new target.

To Set a Target From File:

1. Move to either the 406 or AIS screens.
2. Press the “UP” button until the log screen is shown.
3. Press the “DOWN” button to select the ID of the transmission to VIEW (target has not been set yet).
4. Press the square “ENTER” button.
5. The screen will automatically move to the top level display screen and show details for that file entry (showing the record number at the top instead of the current time).
6. To set this entry as the target press the “ENTER” button.
7. The pop-up “TARGET SET” will be displayed.
8. The DF screen will now show bearing and distance to this new target.





406 Selective Decode

The WTE patented selective decode feature allows a database to be built of beacon hex ID codes within the decoder.

This means that the decoder will only activate the alert output when a 406 transmission has been received by beacons with the matching unique ID.

Using this technology, new systems can be developed using powerful 406 beacons to instantly provide a distress alert, either using the test button or fully activating the beacon. In many cases immediate assistance can be provided without the need to notify search and rescue.

These systems are secure, and will not result in a false activation from beacons being tested or that have been activated in the wider surrounding area.

406 Selective Decode Applications

Man-Overboard Alarm

The MT-RX-3 is perfectly suited as the foundation of a marine 406 man overboard system, providing an instant alert, with very high range capability.

A vessel for example may have 20 crew, all with PLB devices fitted to life jackets. Each of the PLB hex codes can be programmed into the MT-RX-3 decoder. This means that the decoder on a vessel can be alerted by the press of the test button from any of the crew members, or by full activation of the beacon. The MT-RX-3 will not produce any false alarms from other beacons in the wider surrounding area.

A PLB has a much higher power output than most other man overboard systems, so can have a higher range from the vessel. PLBs are also becoming increasingly more affordable, and are now a similar price to traditional Man-Overboard transmitters. The decoder when used for this application can still provide position information to crew members on the vessel, that can then be processed by a connected mapping tool. All activations would be logged normally.

Diver Resurfacing Alert

The MT-RX-3 is well suited to provide a diver resurfacing alert. A resurfacing diver, if carrying a PLB, can in distress press the test button on a beacon and signal for assistance from the dive boat with or without notifying the emergency services.

There is no chance of false alerts from beacons being tested or activated in the wider surrounding area, messages are all logged and notification is instant. If a beacon is fully activated, the position

can be provided by the decoder allowing early diver location in an emergency situation.

Any standard 406 beacon of any kind can be used.

Note: Alert position is not provided by the test button press of all 406 beacons. Typically 406 transmitters that support sending of location information in the test transmission require a different mode of activation, such as holding the test button for 5 seconds.

Firmware Upgrade

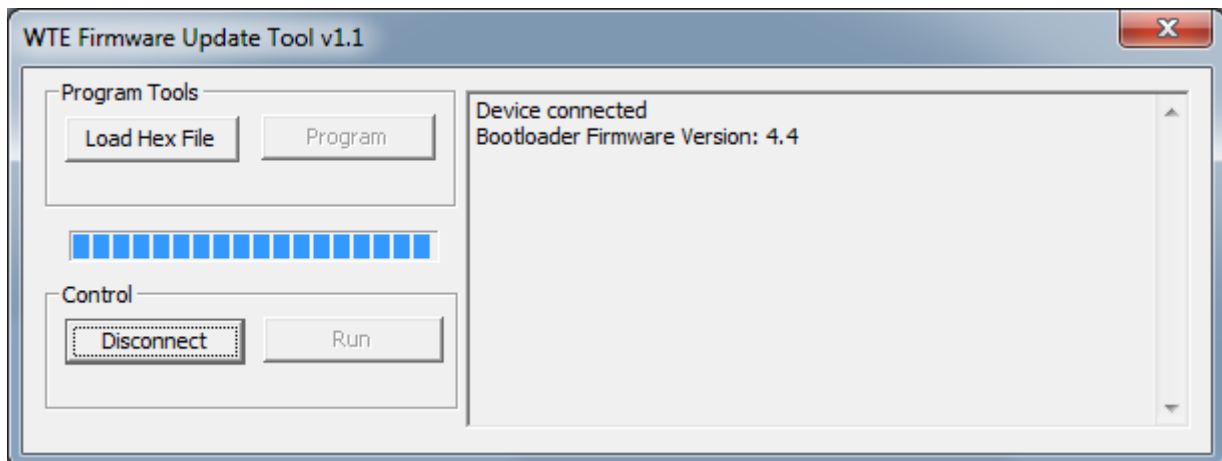
In order to update the WTE-MT-RX-3-Mini firmware you will need:

1. The WTE Firmware Update Tool (available from <https://www.wte.co.nz/tools.html>).
2. One USB C cable.
3. An appropriate digitally signed hex file supplied by WTE Limited.

Note: Attempting to load a hex file not intended for use with the WTE-MT-RX-3-Mini or is not digitally signed by WTE Ltd. will render the WTE-MT-RX-3-Mini inoperable. Uploading firmware should only be performed if instructed to do so by WTE Limited or an authorised agent.

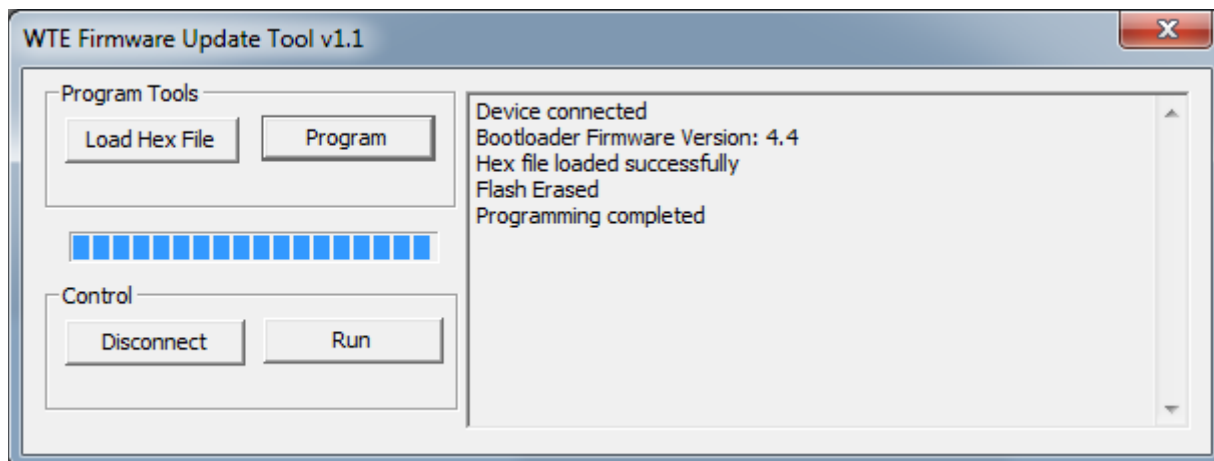
Firmware Upgrade Utility

This bootloader software has been customised by WTE to simplify the firmware replacement process for the WTE-MT-RX-3-Mini. This application automatically handles the process of updating the unit firmware.



Upgrade Process

1. Run the application WTE-UBL.exe – this is the WTE Firmware Update Tool as shown above.
2. **BEFORE** applying power to the WTE-MT-RX-3-Mini, press the “UP” button, and **HOLD** the button down. If the display board is not fitted, press the button next to the display connector.
3. Apply power to the WTE-MT-RX-3-Mini.
4. The WTE-MT-RX-3-Mini backlight will flash on and off (approximately once every second) and display “MT-RX BOOTLOADER” – **keep the “UP” button pressed**. You now have 10 seconds to press the PC application “Connect” button on the WTE Firmware Update Tool before the WTE-MT-RX-3-Mini exits the bootloader mode of operation.
5. Press the WTE Firmware Update Tool “Connect” button. If connected, the PC application will display the message saying “Device Connected”. The WTE-MT-RX-3-Mini backlight will now stay constantly on.
6. You can now **RELEASE** the WTE-MT-RX-3-Mini “UP” button.
7. On the PC application press the “Load Hex File” button.
8. Select the supplied WTE-MT-RX-3-Mini hex file. NOTE: the firmware used must MATCH the WTE-MT-RX-3-Mini receiver variant. A WTE-MT-RX-3-Mini can only be used with WTE-MT-RX-3-Mini encrypted firmware. Failure to comply may leave the device inoperable.
9. Press the WTE Firmware Update Tool “Program” button.
10. Wait for the WTE Firmware Update Tool to indicate that programming has been completed.
11. If successful, the WTE-MT-RX-3-Mini will automatically restart. If the USB cable is still connected, the “USB CONNECTED” screen may be displayed.
12. Remove the USB cable, and the WTE-MT-RX-3-Mini will restart again in its normal mode of operation.
13. If the WTE-MT-RX-3-Mini does not correctly start, then repeat this procedure.



14. If successful the WTE-MT-RX-3-Mini will start normally when power is cycled. If the WTE-MT-RX-3-Mini does not correctly start, then repeat the procedure.

Customisation

The WTE-MT-RX-3-Mini has been developed by WTE Limited, and therefore if a specific requirement exists, customisation of WTE products may be possible (at additional cost).

Examples of possible customisation:

- Decryption of data parameters (e.g. for military use).
- Support of additional protocols.
- Support for different Languages.

Connections

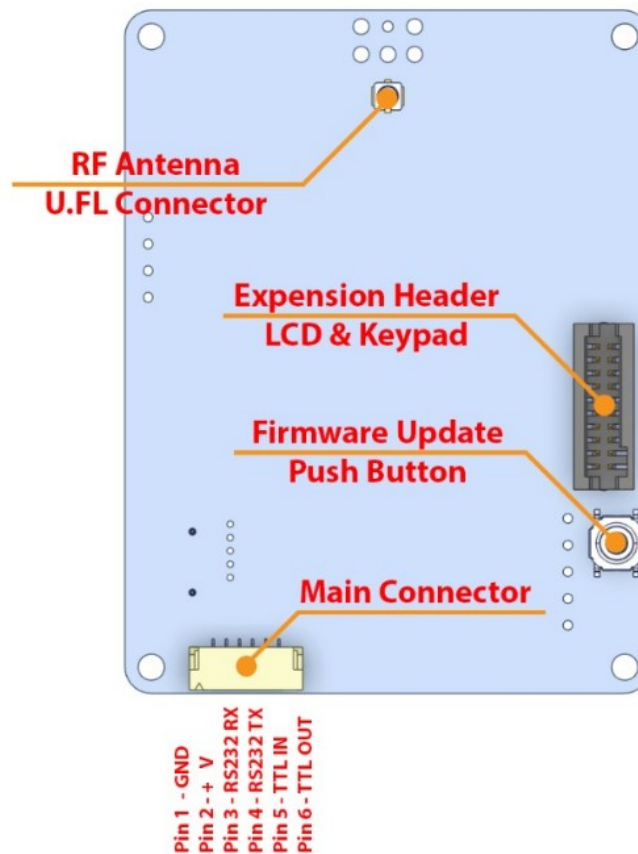
NOTICE

HAZARD OF EQUIPMENT DAMAGE

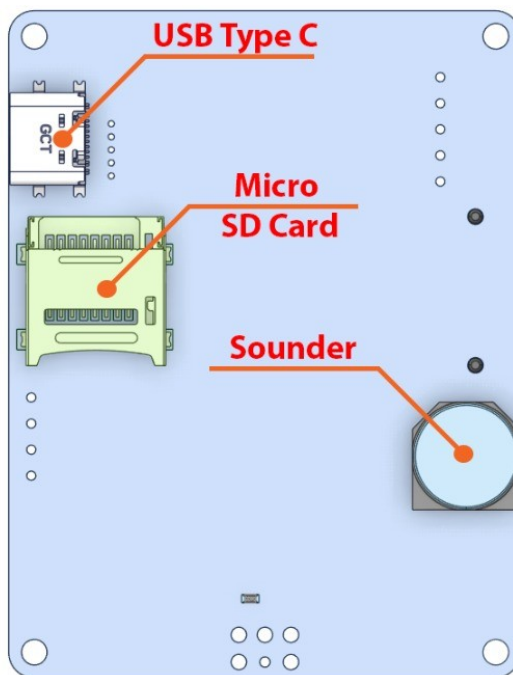
- The antenna port can be damaged if signals greater than 13 dBm are injected/received. Do not directly connect any other transmitter to the RF connector. A transmitter may be indirectly connected through an attenuator that provides at least 50dB attenuation.

Failure to fit a 50dB attenuator will destroy the unit, and invalidate the product warranty.

Main Board Connection Top Layer



Main Board Connection Bottom Layer

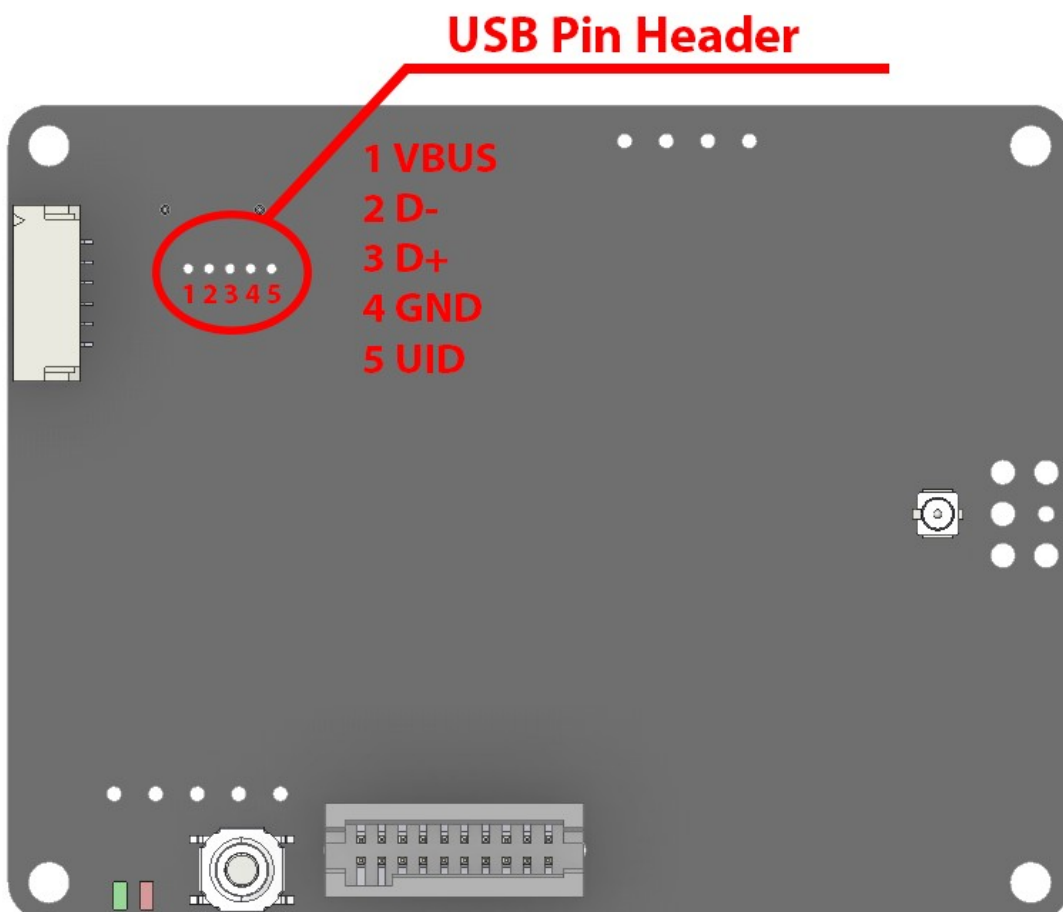


USB Connection

Connecting a USB C cable to a computer or smart device will result in the unit restarting in a USB mass storage mode of operation. After connection, there may be up to a 20 second delay before files may be seen or accessed by another device.

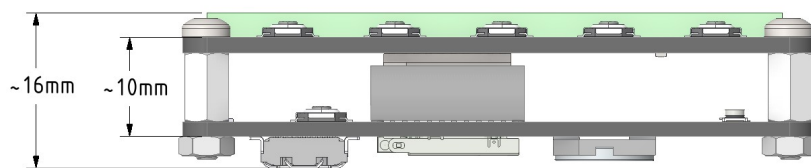
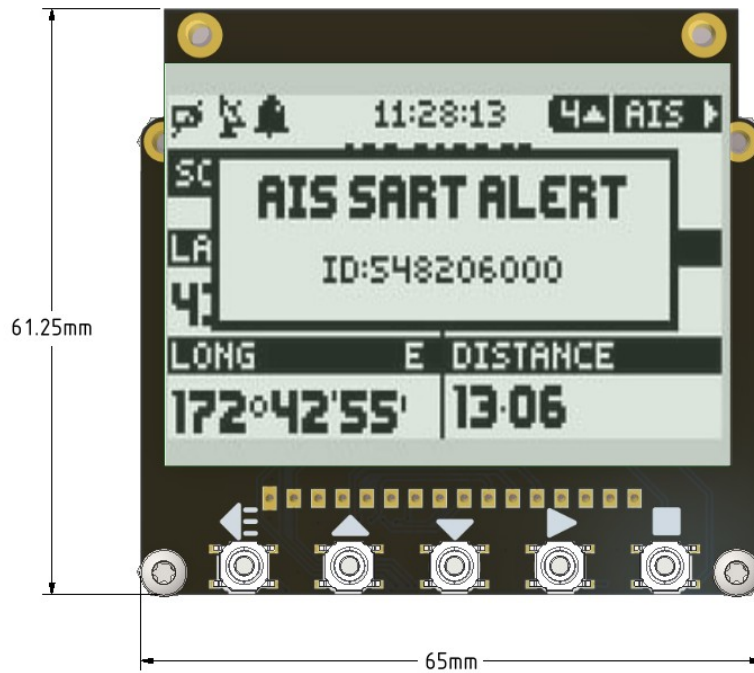
USB Pin Header

The USB on the main board is exposed via the USB Type C connector or via a pin header shown below.

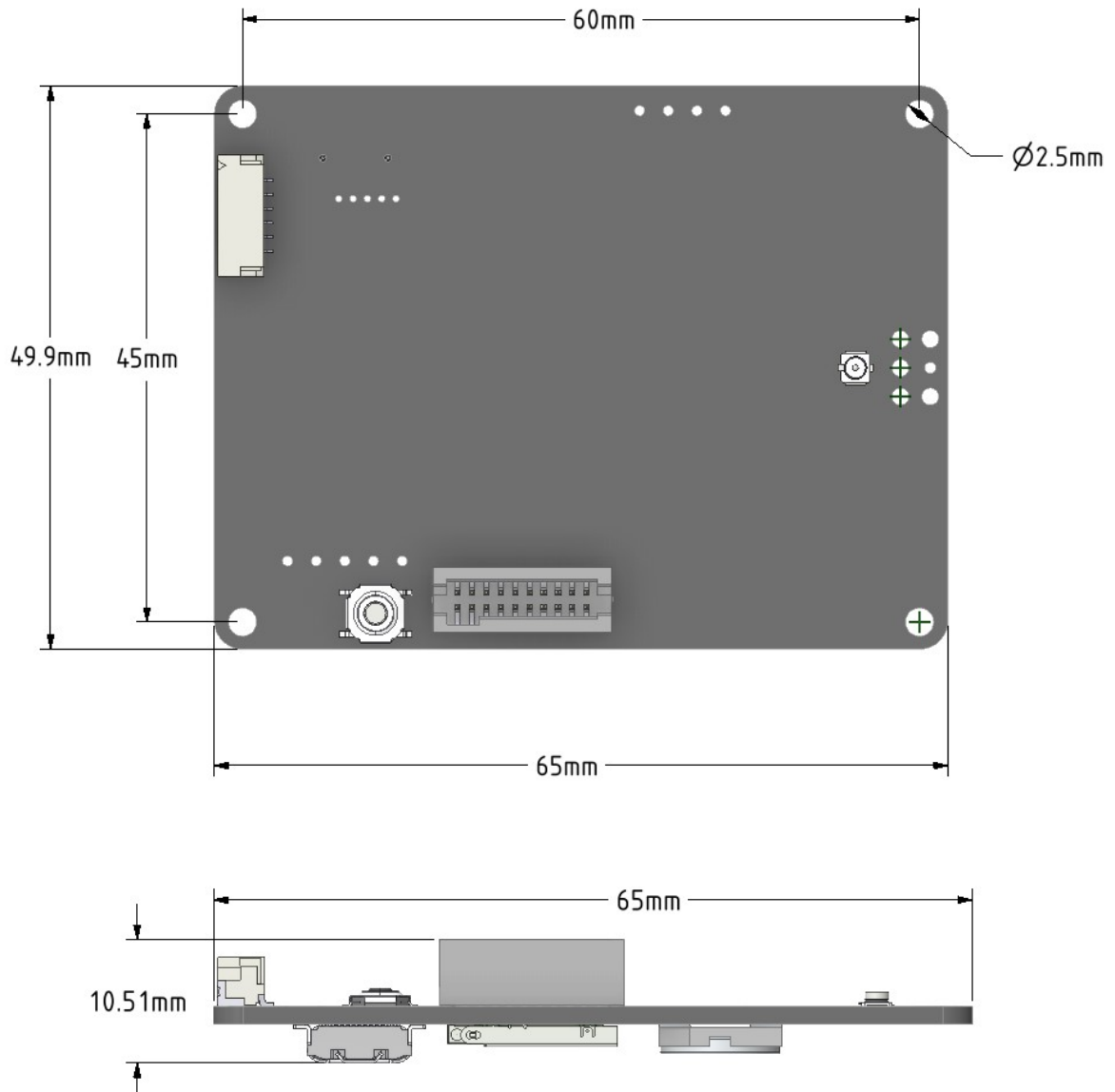


Physical Dimensions

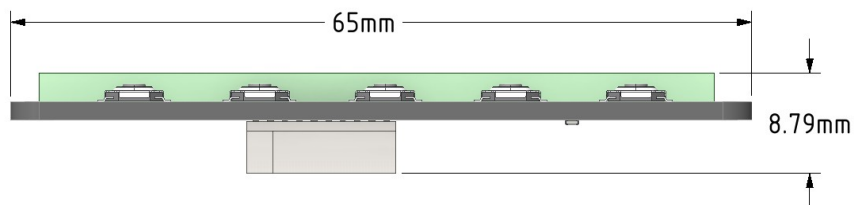
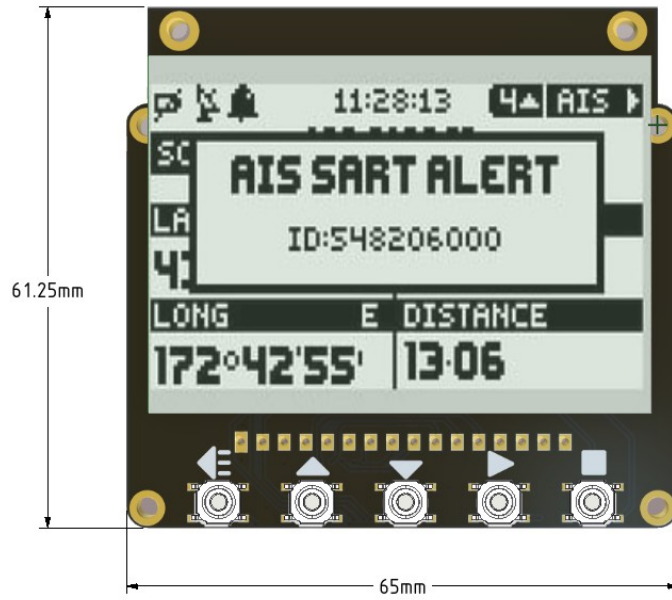
Overall Dimensions



Main Board Only



Keypad Board Only



Disclaimer

THE RESPONSIBILITY LIES COMPLETELY ON THE USER TO ENSURE THAT THIS DEVICE IS TESTED, THROUGH METHODS THAT ARE APPROPRIATE, TO CONFIRM THAT ALL SYSTEM COMPONENTS ARE WORKING CORRECTLY.

THIS DEVICE IS NOT INTENDED TO BE USED AS A PRIMARY LIFE SAVING OR ASSET PROTECTION TOOL, BUT MAY BE USED TO STRONGLY COMPLEMENT OTHER EMERGENCY DETECTION TOOLS ONLY WHEN CORRECTLY CONFIGURED AND TESTED.

THE PRIMARY LIFESAVING MECHANISM FOR 406 BEACONS SHOULD ALWAYS BE CONSIDERED TO BE THE 406 SATELLITE NETWORK, FOR WHICH THE 406 BEACON HAS BEEN DEVELOPED.

This document has been prepared in good faith and produced to assist in the use of this product, however WTE Limited reserves the right to modify, add or remove features without notice.

When product is supplied, it is the user who is responsible for payment of any customs fees/taxes that are imposed on importation.

No User-Serviceable Components. There are no user-serviceable components within the radio

RoHS and WEEE Compliance

WTE-MT-RX-3-Mini is fully compliant with the European Commission's RoHS (Restriction of Certain Hazardous

Substances in Electrical and Electronic Equipment) and WEEE (Waste Electrical and Electronic Equipment) environmental directives.

Restriction of hazardous substances (RoHS)

The RoHS Directive prohibits the sale in the European Union of electronic equipment containing these hazardous substances: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs).

End-of-life recycling programme (WEEE)

The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly.

Maintenance

No User-Serviceable Components. Servicing is only to be performed by WTE Limited, or agent appointed by WTE Limited. Servicing outside of the warranty period is at the discretion of WTE Limited.

Product End Of Life



It is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and help ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling contact your local dealer or city council



Please recycle this device responsibly.

Product Warranty

WTE Limited products are warranted for a period of 12 months after purchase date against faulty workmanship or materials. Return the product, all freight paid by the customer and the product will be repaired or replaced.

The product warranty will be invalidated through evidence of:

- Unauthorised work carried out.
- Tampering, including evidence of removal of internal electronics from the case.
- Installation in wet or corrosive environments.
- Exposure to impact or excessive vibration.
- Use or installation outside of the specified operating parameters.
- Not following ESD precautions or design best practices.

Abbreviations and Glossary

USB (Universal Serial Bus) - A common interface that enables communication between devices and a host controller such as a personal computer (PC).

kHz Kilohertz

LED Light Emitting Diode

mA Milliamps

MHz Megahertz

ms milliseconds

PC Personal Computer

IMO International Maritime Organisation

ppm Parts Per Million

RF Radio Frequency

RoHS Restriction of Hazardous Substances

RSSI Received Signal Strength Indication

RX Receiver

TCXO Temperature Compensated Crystal Oscillator

VDC Volts DC

WEEE Waste Electrical and Electronic Equipment

SOLAS Safety of Life At Sea

Specification

Fixed Supply Voltage:

- 7-24V Internally fused (not self resetting)

Operating Current:

- 24V: 39mA (49mA with display board).
- 12V: 55mA (79mA with display board).
- 7V: 87mA (125mA with display board).

Serial Connections:

- RS232 Serial 9600 (2400 to 115200 baud).
- TTL Serial (3.3V) (2400 to 115200 baud).

Antenna Connector

- U.FL
- SMA female (if requested)

Internal Storage Capacity:

- 4GB

406 Frequency Range:

- All used 406 Beacon frequencies 406.020MHz – 406.045MHz (concurrently)

Rx Frequency Accuracy:

- 0.5ppm. 235Hz max error at 480MHz over entire temperature range.

Sensitivity:

- 121.5MHz Receiver Sensitivity -110 dBm.
- 406 MHz Receiver Sensitivity -119 dBm
- AIS (A) MHz Receiver Sensitivity -113 dBm
- AIS (B) MHz Receiver Sensitivity -113 dBm

Max Useful Input Power:

- -10 dBm. Connecting a 406 beacon directly (with attenuator) to the aerial input will result in certain damage. Use a 50dB attenuator for accurate power measurements.

Receiver Absolute Maximum Input Power:

- +13dBm. Do NOT connect directly to a 406 beacon with a 50dB attenuator.

Frequency Accuracy:

- +/-100Hz from over the temperature range. This accuracy applies to 406, 121.5 and AIS.

RSSI Range:

- -120dBm to 0dBm (not calibrated)

RSSI Resolution:

- 1 dBm

406 Error Correction:

- Correction of up to 5 bit errors per 406 packet.

AIS Decode Support

- Both 161.975MHz and 162.025MHz. Alert only on type 1 SART status 14 or 15 as configured.

406 Location Protocol Support (First Generation 406 Beacons)

- All COSPAS SARSAT C/S T001 Issue 3 Rev 12 Location protocols.
 - User Location Protocol
 - Standard Location Protocol
 - Standard Test Location Protocol
 - National Location Protocol
 - National Test Location Protocol
 - RSL Location Protocol

121.5 Homing Signal

- Sweep detection within 100ms

Test Support

- SOLAS and IMO circulars 1039 and 1040

Spectrum Analyser :

- Frequency range: 142-175, 350 - 449 MHz
- RBW: 1kHz/25kHz
- Span: 120kHz/3MHz
- Continual or peak display.
- Min signal -120dBm, max signal -10dBm.
- Input Power accuracy: 421-449MHz +/-8 dB, 120-175MHz +/-2dB.

Firmware:

- Field upgradable.

Physical Dimensions (L x W x H):

- MODULE without SMA connector is 65mm X 62mm X 16mm.

Temperature Limits

- -30 to + 70 degrees Celsius.