MT-RX-P
FLEX AND POCSAG
DUAL PAGING RECEIVER

User Manual

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Introduction

Thank you for choosing the WTE MT-RX-P Paging Receiver.

The WTE MT-RX series receivers are true multi-band receivers. The MT-RX-P Paging receiver incorporates 2 separate paging receivers that can be configured to decode FLEX, POCSAG or both simultaneously on up to 2 frequencies.

The MT-RX-P logs all messages if required to internal SD card, that can be browsed on the unit or retrieved by direct USB connection to a PC computer.

The MT-RX-P is supplied by default to support the decoding of VHF frequencies from 140-170MHz. UHF support is from 440-470MHz, but by default reduced sensitivity (less 8dBm) unless requested at time of purchase.

MT-RX-P features include:

• Dual -121dBm receivers (at 512 baud).
• Optional logging of messages to SD card.
• Support for FLEX 1600 and 3200 2 level paging.
• Support for POCSAG 512, 1200 and 2400 paging.
• Fully configurable via front panel without the need for an external PC connection.
• Can be configured to provide audible and spoken alerts when new messages are received.
• RS232, RS422 and RS485 support.
• Serial output of messages in several formats including Salcom protocol and TNPPB protocol.
• Raw FM demodulated signal (plus inverted) available on RS232 TX pin allowing for decoding of FM signals up to 10 K baud (not only paging data).
• Message filtering options allow messages with key words specified to be required or messages discarded as required.
Wireless Technologies

- Alerts can be raised on arrival of messages matched on either RIC or key words.
- Support for multiple languages on request with use of international characters, such as Danish.
- Support for additional protocols upon request and negotiation.
- Internal real time clock.
- DIN rail mountable aluminium enclosure that also allows simple mounting from top, bottom or sides.
- Integrated spectrum analyser (optional).
- 2 open collector outputs.
- 1 relay output.

The on-board relay can be configured to close on reception of messages.

Logged information can be viewed on the MT-RX-P itself or connection to a PC via the USB port.
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.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTICE is used to address practices not related to physical injury.</td>
</tr>
</tbody>
</table>

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 !WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and over travel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link.

Failure to follow these instructions can result in death or serious injury

!WARNING

THIS EQUIPMENT IS NOT INTENDED FOR MAINS VOLTAGES

- WTE MT-RX was NOT designed to operate and/or be connected directly to live main voltages. The MT-RX must be connected to a certified, suitably rated low voltage DC supply.

Failure to follow these instructions can result in death or serious injury
HAZARD OF EQUIPMENT DAMAGE

- This product is not chemical resistant, detergent, alcohol, aerosol sprays, and/or petroleum products may damage the front panel. Clean using a soft cloth moistened in water.
- 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 13 dBm are injected/received. Do not directly connect any other transmitter to the RF connector.
- Extreme Heat or High temperatures can damage MT-RX 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. The MT-RX is intended to be mounted permanently either in a land based location or in a vehicle. When fitting in a vehicle, vibration damping mounts may be required.
- The MT-RX IP rating is IP-51. MT-RX is not waterproof or dustproof. DO NOT directly expose to rain or use in a condensation forming environment.
- When antennas are co-located on a community (shared) site the correct site engineering must be performed to ensure that RF exposure limits are met.
**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

Once a power source has been connected to the power connector the MT-RX start-up status is displayed on the LCD.

When the MT-RX is operating normally, the two green status LEDs flash briefly once every second. When decoding messages, the “A” green LED is held on for approximately one second.

For all electrical wire connections please look the “Installation” Section in this manual.

On start-up under normal operation there is a message sent out the serial ports. The message indicates the firmware revision, serial number other software related information.

In this revision of firmware, Ethernet functions are not supported.
Buttons

**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.
Icon Bar

The MT-RX-3 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 “A” or “B” which is either the first or second configured receiver. Pressing the RIGHT button cycles through these receivers.

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.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄</td>
<td>The far left battery icon indicates system voltage. When connected to an external supply, this icon displays always as a full battery.</td>
</tr>
<tr>
<td>☐</td>
<td>Indicates that no messages have been decoded within 5 minutes.</td>
</tr>
<tr>
<td>🔔</td>
<td>An alert has been raised based on the current ALERT configuration within the last 60 seconds.</td>
</tr>
</tbody>
</table>
Main Operating Screens

There are 2 receivers and decoders operating concurrently. When a new message is received, the receiver is automatically selected for that message.

The bell icon and number displays how many messages have been received that need to be read (if message alert has been enabled).

The time displayed initially is the time operating, but is updated within a few seconds to the current minutes and seconds (from the FLEX paging network – if using that frequency of 157.950MHz in N.Z.). Within 60 minutes the current hour will also be set, then maintained.

To the right of the time is the Message screen number. The up arrow indicates that the up button can be pressed to move to the next message screen for this receiver.

Operation is identical for the next operating receiver.

Message Screen 1:
Top level small display. If the message can not fit on the screen, the down arrow is displayed allowing the message to be scrolled.
Message Screen 2:

This screen displays as much of the last 3 messages that can fit on the screen. This screen is updated in real time as the messages arrive.

![Message Screen Image]
Message Screen 3:

This screen displays all messages logged to the SD card. The most recent message is always displayed first. This screen is not operable if MSG LOG is set to DISABLED in the menu.

To display messages in full:

1. Select the message by pressing the down button.
2. Press the square button. The full message will be displayed.
3. Press ANY key to return to the message list.
4. Press the down button to move to next message.
5. Repeat 2-4
6. Press the up button to move to next message screen.
Message Screen 4:

This screen displays the last message on this receiver in a large font. If the content of the message does not fit on the screen, the down arrow will be displayed, and the pressing the down button will allow the message to be scrolled through.

![Message Screen Example]

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
Site Configuration Tools

The MT-RX can optionally include tools to ensure suitability for use at the current location and quality of the installation.

**Spectrum Analyser**

The optional spectrum analyser is a very simple to use tool that provides a span of either 3MHz, 120kHz or 24kHz around a configured test frequency. The receive bandwidth down to 500Hz is suitable for inspection of potentially interfering adjacent channel signals. The analyser can display signals as low as -125dBm making and is suitable for site inspection. This is an optional feature that requires a feature key to be purchased.
MT-RX-P Configuration

At any time the “MENU” button can be pressed that will enter the configuration menu. The receivers continue to operate normally and can receive and log messages while in the menu system.

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 “ALERTS” sub menu. When reaching any configuration item, pressing the “RIGHT” button again will highlight the item to change.

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 written to file only when leaving menu mode.
System Sub Menu

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LANGUAGE</td>
<td>ENGLISH</td>
</tr>
<tr>
<td>BACKLIGHT</td>
<td>0</td>
</tr>
<tr>
<td>SOUND</td>
<td>OFF</td>
</tr>
<tr>
<td>RS232 BAUD</td>
<td>57600</td>
</tr>
<tr>
<td>MAIN SCREEN</td>
<td>DEFAULT</td>
</tr>
<tr>
<td>POWER</td>
<td>EXTERNAL</td>
</tr>
</tbody>
</table>

LANGUAGE

Items ENGLISH plus others can be selected. To incorporate specific language support please contact WTE Limited directly.

BACKLIGHT

The backlight setting is how long in seconds the backlight is lit after each key press and also when a message is received. Setting to 0 disables the backlight completely.

SOUND

Allows control of system sounds and playing of wave files.

Items ON and OFF can be selected.

RS232 BAUD

Allows configuration of the RS232 port baud rate. All settings are N:8:1. Available rates are:

2400, 4800, 9600, 38400, 57600 and 115200

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 MT-RX 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.

POWER

Configures the power source that will be used for determining battery state.

EXTERNAL should be used by default if a fixed supply is connected (or USB cable), and will result in a “Full” battery on top level display.
USB MODE

Configures the USB mode of operation. Leaving the MT-RX connected to a PC can affect the receive performance of the unit. Selecting DISABLED will disable all USB functions and the MT-RX will no longer display as a mass storage drive when connected to a PC. Selecting MASS STORAGE allows the internal storage of the MT-RX to be viewed and changed.

Setting to DISABLED is recommended if permanently powering the MT-RX from the USB port.

FACTORY

Sub menu responsible for calibration screens and setting of feature unlock keys.

TEST

Test sub menu for generation of test messages and testing of relay.
Factory Sub Menu

<table>
<thead>
<tr>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST RX A</td>
</tr>
<tr>
<td>TEST RX B</td>
</tr>
<tr>
<td>DIAGNOSTICS</td>
</tr>
<tr>
<td>SERIAL</td>
</tr>
<tr>
<td>KEY</td>
</tr>
</tbody>
</table>

TEST-RX A and TEST-RX-B

Allows entry to the integrated oscilloscope that allows real time viewing of demodulated data for receivers A and B. Useful for factory sensitivity testing only. Note that this demodulated data (from RX A only) is directly available via the RS232 TX pin when the SERIAL_OUT option is configured to allow this.

SERIAL

Serial number of the MT-RX. Can only be set in the factory once.

KEY

Pre-loaded key for operation of the MT-RX. Changing this should only be under instruction from the factory. Loading new firmware or features may require the purchase of a new key. Incorrect key will result in the message pop-up “Invalid License”. When the license is invalid many features will be disabled, such as RS232 serial output.

savings are required. When enabled, this setting is the time in minutes that the unit will completely powered down after there has been no keypress activity.
Paging Sub Menu

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EXIT</td>
<td>PAGING</td>
<td></td>
</tr>
<tr>
<td>FREQ</td>
<td>RX A</td>
<td>1600000000</td>
</tr>
<tr>
<td></td>
<td>RX B</td>
<td>4586000000</td>
</tr>
<tr>
<td>RX A MODE</td>
<td></td>
<td>POCSAG 512A</td>
</tr>
<tr>
<td>RX B MODE</td>
<td></td>
<td>POCSAG 512A</td>
</tr>
<tr>
<td>RIC A LO</td>
<td></td>
<td>00000008</td>
</tr>
<tr>
<td>RIC A HI</td>
<td></td>
<td>2000000</td>
</tr>
</tbody>
</table>

FREQ RX A
Configures the operating frequency of receiver A.

FREQ RX B
Configures the operating frequency of receiver B.

RX A MODE
Decode mode for receiver A. Note that only receiver A can be configured to decode FLEX.

Items available:
FLEX 1600 2L – Decoding of all 1600 bps FSK 2 level messages (increased sensitivity for 1600 messages).
FLEX 3200 2L - Decoding of all 1600 and 3200 FSK 2 level FLEX messages.
POCSAG 512A – Decoding of 512 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.
POCSAG 512N – Decoding of 512 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.
POCSAG 1200A – Decoding of 1200 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.
POCSAG 1200N – Decoding of 1200 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.
POCSAG 2400A – Decoding of 2400 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.
POCSAG 2400N – Decoding of 2400 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.
RX B MODE

Decode mode for receiver A. Note that only receiver A can be configured to decode FLEX.

Items available:

POCSAG 512A – Decoding of 512 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.

POCSAG 512N – Decoding of 512 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.

POCSAG 1200A – Decoding of 1200 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.

POCSAG 1200N – Decoding of 1200 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.

POCSAG 2400A – Decoding of 2400 baud POCAG messages – alpha messages will be decoded, numeric messages will be displayed corrupted.

POCSAG 2400N – Decoding of 2400 baud POCAG messages – numeric messages will be decoded, alpha messages will be displayed corrupted.

RIC X LO and RIC X HIGH

There are 3 ranges that can be configured to limit the messages that are decoded. If only one pager code is needed e.g. 234444, set RIC A LO to 234444 and RIC A HI to 234444. RIC B and RIC C LO and HI should then be set to 0000000.

Note that all ranges starting with 0000000 are ignored. If all RICs are to be decoded up to 1000000 (for example) then configure the LO to begin at 0000008 (this is the first POCSAG legitimate code number). Configuration would be LO to 0000008 and HI to 1000000.

SERIAL OUT

RAW:

A decoded message of “TEST” with pager code of 1234567 will result in serial output of:

[1234567]<SPACE>TEST<CR>

WTE:

Using the WTE format ensures greater compatibility with other WTE products.

A decoded message of “TEST” at a baud rate of 512, level of 1 and with pager code of 1234567 will result in serial output of:

WT1234567A10<SPACE>TEST<CR>

TNPPB:

A decoded message of “TEST” with pager code of 1234567 will result in serial output of:
<SOH>e04ee777AA<STX>FA20'1234567TEST<ETX>CC

where:
AA is an arbitrary incrementing sequence number with each message.
CC is a 2 byte checksum conforming to the TNPP specification.

**FM DEMOD:**
The raw demodulated signal for RX A is sent out the serial port (normal RS232 functions are disabled). The FLEX_3200_2 RX MODE setting will provide the most versatile and flexible demodulation option and allow data up to 10K baud to be decoded.

**FM DEMOD INV:**
Same as FM DEMOD but data is inverted.

**MSG ALERT**

**DISABLED:**
No alert (visual or audible) when a new message is received.

**BEEP:**
Visual notification and also repeating beep until acknowledged when a message is received.

This setting plays the ALERT.WAV wave file on the SD Card. Replace this wave file with your own (formatted 8 bit PCM Mono) if desired.

**VOICE:**
Visual notification and also repeating spoken prompt until acknowledged when a message is received.

**NOTE:** When the ALERT.TXT filter option has been ENABLED, alerts are raised by matching key words in arriving messages that are within the specified RIC range. When this option is ENABLED, only the messages matching these key words will raise an alert (beep or spoken). All other incoming messages within the RIC range configured will no longer raise any alert.

**MSG LOG**

**DISABLED:**
Messages are not logged.

**ENABLED:**
All messages displayed are written to internal SD card and can be viewed on the message history screen.

**CLEAR:**
Setting to CLEAR will result in all SD logs being deleted when exiting the menu.

**INCL.TXT FILT**

This filter option allows the use of a text file called “incl.txt” to be stored and modified on the SD card (accessible via the USB port). If the feature is ENABLED, this file (if present) will be searched for key words. Any of these key words MUST be present in order for the message to be processed. Up to 20 key words can be stored, each up to 20 characters in length. There must be no control characters within the key words used.

NOTE: Filtered messages must still fall within configured RIC ranges.

e.g. if the incl.txt file has the contents (each matching phrase on a new line):

```
FIRE
EMERGENCY
```

Then all messages without these key words WILL BE DISCARDED. Even though non matching messages are discarded, they receiver OK indicators and timers will continue to operate normally.

**DISABLED:**

Messages are not filtered

**ENABLED:**

Messages are filtered

**EXCL.TXT FILT**

This filter option allows the use of a text file called “excl.txt” to be stored and modified on the SD card (accessible via the USB port). If the feature is ENABLED, this file (if present) will be searched for key words. Any of these key words MUST NOT be present in order for the message to be processed. Up to 20 key words can be stored, each up to 20 characters in length. There must be no control characters within the key words used.

e.g. if the excl.txt file has the contents (each matching phrase on a new line):

```
THIS IS A TEST
DISCARD
```

Then all messages WITH these key words WILL BE DISCARDED. Even though non matching messages are discarded, they receiver OK indicators and timers will continue to operate normally.

**DISABLED:**
Messages are not filtered

ENABLED:
Messages are filtered

NOTE: Filtered messages must still fall within configured RIC ranges.

**ALERT.TXT FILT**

This filter option allows the use of a text file called “alert.txt” to be stored and modified on the SD card (accessible via the USB port). If the feature is ENABLED, this file (if present) will be searched for key words. If any of these key words are found then an alert is raised based on the alert configuration (beep or voice). Up to 20 key words can be stored, each up to 20 characters in length. There must be no control characters within the key words used.

E.g. if the alert.txt file has the contents (each matching phrase on a new line):

```
TSUNAMI
MAJOR EMERGENCY
```

Then all messages WITH these key words will result in an alert being raised. These messages will be displayed and logged normally as per the system configuration.

DISABLED:
Messages are not filtered to raise an alert. When DISABLED messages can still raise alerts based on the alert settings within the menu.

ENABLED:
Messages are filtered to raise an alert. When ENABLED only the messages found in the alert.txt file will raise an alert. No other messages, even if displayed will raise an alert.

NOTE: Filtered messages must still fall within configured RIC ranges.

**RELAY TIME**

How long in seconds the relay is closed when a message is displayed. Setting to 0 will result in the relay not closing.

**ALERT REPEAT TIME**

The repeat time only works if MSG ALERT is set to BEEP or VOICE.

This is the time in seconds before the MT-RX repeats a BEEP or voice message that there are new messages.
This configuration option allows the method used to maintain system time to be configured.

SEQ TEST:
In New Zealand, on 157.950MHz there is a periodic FLEX transmission every one minute. This message contains the content “THIS IS A TEST PERIODIC PAGE. XX HH-MM”. Where HH-MM is hours and MM is minutes. This option parses this message and maintains system time with this, and continues to keep time should the periodic message be lost.

FLEX:
FLEX messages contain minute and second information embedded in every message. When this option is selected the time is maintained this information. Once every hour the current hour is transmitted, so using this setting there may be a delay of up to one hour before current time is set.

NONE:
The system time is purely displayed as the time running since turn on.

WAV SUPPORT
This configuration item, when ENABLED looks for a 8.3 format wavefile name in a received message payload. If that exact wavefile has been loaded onto the internal SD card, that wave file will be played. Wave files must be formatted as 8 bit MONO, PCM 11025Hz.
In order for the wave file to be processed, it must be at the start of the message.

e.g.
HELP.WAV HELP REQUIRED AT RECEPTION.
Will play the wave file HELP.WAV if loaded onto the SD card.
Installation

The MT-RX-P should be situated away from direct sunlight, extreme vibration and heat sources, and high power transmission sources.

An external aerial correctly designed to operate at your intended frequency of operation will result in best performance. Dual VHF/UHF aerials may operate acceptably for your requirements. Do not situate the aerial immediately next to the aerial of a high power transmission source – position greater than 2 M from any other aerial. Mount the external aerial with as much elevation as possible for best results (see “Aerial Elevation” below).

Maximum tolerated input power into the decoder BNC connector is 17dBm. Levels above this will destroy the receiver RF input.

Cables Supplied

By default NO cables are supplied on purchase. Because there are so many possible frequencies and variations in installation an aerial is NOT supplied by default. If an aerial is supplied, it will be a generic variety that will not perform as well as an aerial produced for the intended frequency of operation, or a high gain externally mounted type.

If cables are to be supplied, this must be ordered at time of purchase.
Connecting to the MT-RX-P

The minimum required connections for a usable system:

1. Connection to an aerial.
2. Connection to a 12V supply.
**Connector Pin descriptions**

**RHS (Right Panel)**

![Diagram of RHS panel](image)

**RF**  
BNC connector (50 ohms)

**USB**  
Mini type B connector

**Output Connector**

<table>
<thead>
<tr>
<th>Outputs Pin Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital Output 2</td>
</tr>
<tr>
<td>2</td>
<td>Digital Output 1</td>
</tr>
<tr>
<td>3</td>
<td>Speaker</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>Relay Normally Connected (NC)</td>
</tr>
<tr>
<td>6</td>
<td>Relay Normally Open (NO)</td>
</tr>
<tr>
<td>7</td>
<td>Relay Common (CM)</td>
</tr>
</tbody>
</table>
Serial Connector:

<table>
<thead>
<tr>
<th>Serial Connector Pin Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS422 RX+ (IN+)</td>
</tr>
<tr>
<td>2</td>
<td>RS422 RX- (IN-)</td>
</tr>
<tr>
<td>3</td>
<td>RS422 TX- (OUT-)</td>
</tr>
<tr>
<td>4</td>
<td>RS422 TX+ (OUT+)</td>
</tr>
<tr>
<td>5</td>
<td>RS232 TX</td>
</tr>
<tr>
<td>6</td>
<td>RS232 RX</td>
</tr>
<tr>
<td>7</td>
<td>Ground (GND)</td>
</tr>
</tbody>
</table>

Power Connector:

<table>
<thead>
<tr>
<th>Power Connector Pin Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground (GND)</td>
</tr>
<tr>
<td>2</td>
<td>+12V</td>
</tr>
<tr>
<td>3</td>
<td>Not Connected (N.C.)</td>
</tr>
</tbody>
</table>

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Ethernet Connector:

<table>
<thead>
<tr>
<th>Connector Pin Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TX+</td>
</tr>
<tr>
<td>2</td>
<td>TX-</td>
</tr>
<tr>
<td>3</td>
<td>RX+</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
</tr>
<tr>
<td>6</td>
<td>RX-</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
</tr>
</tbody>
</table>

**Note:** pins: 4 and 5 are connected to ground via a 75R resistor

7 and 8 are connected to ground via a 75R resistor

**Note:** Do not connect a Power over Ethernet (PoE) connection to the MT-RX Ethernet port as this will result in damage.
Output Hardware Connection

Examples of how to connect external devices to the MT-RX output pins.

The MT-RX contains 3 outputs, where 2 are open collector and one is a clean contact to an internal relay.

Care must be taken to ensure the sinking output current does not exceed 30mA. When using inductive loads, such as relay coils, flyback diodes must be fitted to prevent damage to the MT-RX.

Open Collector Outputs
Internal Relay

MT-RX provides a relay clean contact in the output connector, these contacts are not designed for high voltages and currents. The maximum voltage in these contacts should not pass 50V and 100mA.

External Speaker

A small 8 Ohms 50mW speaker can be connected directly into the output connector, this line can be used to connect to an audio amplifier if higher volume is required.
Serial Connections

RS-232

RS-232

RS-422

RS-422 (EIA RS-422-A Standard) uses a differential electrical signal, as opposed to unbalanced signals referenced to ground with the RS-232. Differential transmission uses two lines each for transmit and receive signals which results in greater noise immunity and longer distances as
compared to the RS-232. These advantages make RS-422 a better fit for industrial applications.

RS-422 Point To Point

RS-422 Terminating Resistor

RS422/RS485 may require the fitting of a terminating resistor. The purpose of termination is to match the impedance of a transmission line to the hardware impedance of the interface it is connected to. There is more than one way to add termination to an RS485/422 serial connection. The most commonly used is DC Termination, accomplished by attaching a resistor between the signal lines on the extreme ends of the transmission line.

The rule of thumb for termination is:

- If the propagation delay of the data line is much less than one bit (pulse) width, termination is not needed.

This assumes reflections will damp out in several trips back and forth on the data line.

Typically for slow speeds of 9600bps or below, no termination resistor is required.

If termination is required a resistor value of 120Ω or greater should be used, and no more than 2 termination resistors should be used, one at each end of the RS422 transmission line.
Do not use termination resistors with a value of less than 90Ω.

There are many online references available to calculate these resistors if required.

**RS-422 Multi-Point**

RS-422 can have one driver and up to 10 receivers

![Illustration 4: MT-RX RS-422 Multi-Point](image)

**Note:** this configuration only applies if driving less than 10 listeners/receivers.

**RF Connections**

A 50 ohm matched load must be fitted to the MT-RX antenna port.
Note: Earth the antenna tower, feeders and lightning protection devices in accordance with the appropriate local and national standards. Use grounding kits as specified or supplied by the coaxial cable manufacturer to properly ground or bond the cable outer.

<table>
<thead>
<tr>
<th>!CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning will destroy electronic equipment.</td>
</tr>
<tr>
<td>To avoid this risk, install primary lightning protection devices on any interfaces that are reticulated in the local cable network.</td>
</tr>
<tr>
<td>You should also install a coaxial surge suppressor on the radio antenna port.</td>
</tr>
</tbody>
</table>
Power Connections

Power to the MT-RX is achieved via the power connector as described in the section **Installation** in this manual.

---

**WARNING**

**EXPLOSION HAZARD**

MT-RX was **NOT** designed to operate and/or be connected to voltages above what has been specified.

**Failure to follow these instructions can result in death or serious injury**
MT-RX Firmware Upgrade

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

1. The WTE Firmware Update Tool (available from http://www.wte.co.nz or provided if required from info@wte.co.nz).
2. One USB mini B cable.
3. An appropriate encrypted hex file supplied by WTE Limited.

Note: Attempting to load a hex file not intended for use with the MT-RX will render the MT-RX 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 MT-RX. This application automatically handles erasing and verifying of uploaded firmware. This utility does not perform any decryption function (decryption is carried out by the MT-RX itself).
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 MT-RX, press the “UP” button, and **HOLD** the button down.

3. Apply power to the MT-RX.

4. The MT-RX backlight will flash on and off (approximately once every second) – **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 MT-RX 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 MT-RX backlight will now stay constantly on.

6. You can now **RELEASE** the MT-RX “UP” button.

7. On the PC application press the “Load Hex File” button.

8. Select the supplied MT-RX hex file. **NOTE:** the firmware used must MATCH the MT-RX receiver variant. A MT-RX can only be used with MT-RX encrypted firmware. Failure to comply will 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. When programming is complete press the “Run” Button, or remove power to the MT-RX and apply power again.

12. If successful the MT-RX will start normally when power is applied. If the MT-RX does not correctly start, then repeat the procedure.
Omni or Directional Antenna

It is common in radio systems to consider an omni or directional antenna. Both have their advantages and disadvantages as follows.

If in doubt, consult a local antenna specialist who will be able to advise and construct an antenna best suited to your application.

**Omni antenna**

Omni antenna have the advantage of transmitting and receiving signals equally well in all horizontal directions. This means that if the transmitter or the receiver moves, the antenna will not need to be changed/adjusted to compensate.

This is the common antenna used in cellular phones and handhelds radios.

**Directional antenna**

Directional antenna have the ability to focus energy in a particular direction. This advantage increasing the maximum distance between transmitter and receiver units. Since the signals are focused/concentrated into a direction it also increase the overall performance of the system.

This is mainly used for fixed transmitter and receiver locations.
Antenna Elevation

As with any radio receiver, raising the height of either the transmitter or receiver antenna will result in dramatic improvements to the maximum possible receive distance. Although a high power transmission will increase distance, the installed height of the receiver antenna is the key to a high performing system.

When close to the ground the major obstacle to overcome, since radio signals are mainly “line of sight”, is the curvature of the earth. The typical distance to expect can be approximately calculated as follows:

\[ D = \sqrt{\frac{2r_0h_f}{6076.1 \beta_0}} \]

Where:
- \( D \) is the distance to the horizon in NM,
- \( r_0 \) is the mean radius of the earth (3440.1 NM),
- \( h_f \) is the height of your antenna,
- \( \beta_0 \) (0.8279) accounts for terrestrial refraction.

This formula can be simplified to:

\[ d = 1.17 \times \sqrt{h_f} \]

Where:
- \( d \) = range in nautical miles,
- \( h_f \) = the height of your antenna in feet.

Working with metric units this formula becomes:

\[ km = 2.17 \times \sqrt{0.305 \times h_m} \]

Where:
- \( km \) = range in kilometres,
- \( h_m \) = the height of your antenna in metres.
Therefore:

<table>
<thead>
<tr>
<th>Antenna Elevation (metres)</th>
<th>Clear Line of Sight Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>5</td>
<td>2.7</td>
</tr>
<tr>
<td>100</td>
<td>12</td>
</tr>
</tbody>
</table>

The Antenna Elevation is the combined elevation of both the transmitter and the receiver (transmitter at 1m and receiver at 9m will behave similarly as the transmitter at 5m and receiver at 5m.

Changes in power level will help to address a less than ideal antenna or poor line of sight conditions.

When line of sight or elevation is poor, the range can also be approximately doubled with every 6dB increase in link budget (either increase in TX power, or increase in RX sensitivity).

From testing, these ranges can be expected from a 20dBm transmitter at the indicated elevation.

(credit to [www.offshoreblue.com](http://www.offshoreblue.com) for some range calculation details)
MT-RX physical dimensions are 104mm x 130.5mm x 40mm (Length x Width x Height)
Weight: 550 grams
Mounting Hardware

The MT-RX enclosure was designed to be mounted via:

- DIN Rails
- Left or Right M4 nuts and bolts channels
- Top or Bottom M4 nuts and bolts channels

Please look the following images and descriptions to correctly mount the MT-RX radio

**DIN Rail**

Inbuilt into the MT-RX custom extrusion there is a DIN rail slot (patent pending) for easy snap fit DIN rail mounting.
Mounting Channels

The MT-RX has channel strips on the front, rear, top and bottom. In order to access the front, top and bottom channels (less common mounting option) the end plate on the power cable side will need first to be removed using a hex key. Mounting from the rear does not require the removal of the end plate.

The mounting channel allows an **M4 bolt** head or **M4 nut** to lock inside, as shown bellow.

**If an M4 nut is used inside the channels (instead of a M4 bolt head) attention must be taken to NOT use a bolt or screw longer than the channels depth. Not paying attention to this detail may result in damage to the MT-RX and invalidate the product warranty.**
The flush mount option is suitable for an installation such as onto the front panel of a case or cabinet.
Mount Bolts Dimensions

Both top and bottom are symmetric as are the left and right sides of the MT-RX radio, this allows a wide range of mounting configurations.

The channels space from centre to centre in the top and bottom of the radio is 117.40mm

Dimension are in millimetres
Note:

- All dimensions are in millimetres.
- The drilling template may not be to scale depending on your printer settings.
Note:

- All dimensions are in millimetres.
- The drilling template may not be to scale depending on the printing settings.
- Depending on installation, not all mounting points may be required.
Optional Mounting Inserts

The optional mount inserts, provided with the MT-RX, can be used to mount the MT-RX to a panel/enclosure using M4 Screws as shown below.

Remove all the insert mounts from the panel in order to use.
Optionally two mounting inserts can be used for extra strength.
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 (THAT THIS DEVICE AND PC SOFTWARE MAY BE PART OF) ARE WORKING CORRECTLY.

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

The default enclosure is NOT waterproof, however this device may be fitted inside any enclosure to achieve the degree of water protection required.

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
MT-RX 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. The MT-RX has a residual scrap value that includes 400g of Aluminium.
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.
Abbreviations and Glossary

CAP (CAPCODE) - Channel Access Protocol (CAP) code
RIC (Radio Identification Code) - an address used in the POCSAG protocol for pagers
POCSAG (Post Office Code Standardisation Advisory Group) - A standard set of code and signaling formats for radio paging.

USB (Universal Serial Bus) - A common interface that enables communication between devices and a host controller such as a personal computer (PC).
AES Advanced Encryption Standard
AGC Automatic Gain Control
ASCII American Standard Code for Information Interchange
BER Bit Error Rate
CBC Cipher Block Chaining
CCM Counter with CBC-MAC integrity
DCE Data Communications Equipment
DTE Data Radio Equipment
EMC Electro-Magnetic Compatibility
EMI Electro-Magnetic Interference
ESD Electro-Static Discharge
ETSI European Telecommunications Standards Institute
FW Firmware
HW Hardware
IF Intermediate Frequency
IP Internet Protocol
I/O Input/Output
ISP Internet Service Provider
kbit/s Kilobits per second
kHz Kilohertz
LAN Local Area Network
LED Light Emitting Diode
mA Milliamps
MAC Media Access Control
Mbit/s Megabits per second
MHz Megahertz
ms milliseconds
PC Personal Computer
PLL Phase Locked Loop
ppm Parts Per Million
PMR Public Mobile Radio
RF Radio Frequency
RoHS Restriction of Hazardous Substances
RSSI Received Signal Strength Indication
RX Receiver
SCADA Supervisory Control and Data Acquisition
SNMP Simple Network Management Protocol
SNR Signal to Noise Ratio
SWR Standing Wave Ratio
TCP/IP Transmission Control Protocol/Internet Protocol
TCXO Temperature Compensated Crystal Oscillator
TX Transmitter
UTP Unshielded Twisted Pair
VAC Volts AC
VCO Voltage Controlled Oscillator
VDC Volts DC
WEEE Waste Electrical and Electronic Equipment
MT-RX Customisation

The MT-RX 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:

– Changes to enclosure.
– Decryption of data parameters (e.g. for military use).
– Support of additional protocols.
– Support for different Languages.
## Specification

| **Frequency Range** | 145 - 170 MHz  
|                     | 440 - 470 MHz (with reduced sensitivity of 8dB unless requested specifically when purchased). (2 frequencies supported concurrently). Please contact us to support other frequencies between 120MHz and 930MHz. |
| **Supply Voltage**  | 12V, Internally fused at 2A. |
| **Relay Contacts**  | 1A . Maximum voltage 24V. Externally connected inductive loads (such as contactor coils) should use flyback diodes or snubber circuits. |
| **Relay Closure**   | On any paging message that raises an alert. |
| **Temperature Limits** | -30 to + 55 degrees Celsius. |
| **Optional Spectrum Analyser** | Frequency range: 142-175, 350 - 499 MHz  
|                     | RBW: 500Hz, 1kHz and 25kHz  
|                     | Span: 3MHz, 120kHz and 24kHz  
|                     | Continual or peak display.  
|                     | Min signal -120dBm, max signal -10dBm.  
|                     | Input Power accuracy: 421-480MHz +/-2 dB, 142-175MHz -8dB. |
| **Max Input Power** | 13 dBm. |
| **Receiver A Sensitivity (VHF)** | -121dBm (512 baud), -117dBm (1200 baud), -115 dBm (1600 baud), -113dBm (2400 baud). |
| **Receiver B Sensitivity (VHF)** | -121dBm (512 baud), -117dBm (1200 baud), -115 dBm (1600 baud), -113dBm (2400 baud). |
| **Aerial Connector** | BNC |
| **Operating Current** | 110mA plus:  
|                     | 18mA when relay energised.  
|                     | 40mA when backlight enabled. |
| **Firmware** | Field upgradable. |
| **SD Storage Capacity** | 1-2GB. |
| **Serial Output** | RS232 – N:8:1 1200 – 115200 baud.  
|                     | RAW, WTE, SALCOM or TNPPB as documented. |
| **FLEX Decode Support** | Decoding of all Alphanumeric and numeric messages at 1600 and 3200 baud (2 level only). Auto time setting via decoding of FLEX time messages when transmitted. |
| **POCSAG Decode Support** | All POCSAG 512, 1200 and 2400 baud messages, either alpha or numeric including batched. |
| **Compliance with Standards:** | EN 300 220-2, EN 301 489-3, EN 60950-1 satisfying the CE directives R&TTE 1999/5/EC, EMC 2004/108/EC and LVD 2006/95/EC. FCC part 15 Subpart A + B. |
Manufacturer Declaration of Conformity

Declaration of Conformity

Manufacturer:
Micro Technologies (NZ) Limited
Church Bay, RD1 Lyttelton 8971, New Zealand

Declares Compliance with the Directives:
R&TTE 1999/5/EC, EMC 2004/108/EC and LVD 2006/95/EC

Product Description:
Micro Technologies MT-RX Series Multi Band Receiver

The basis on which conformity is being declared:
The products identified above comply with the above directives, and the manufacturer has created the Technical Construction File number: CE MT-RX TF 1213
which includes reports: 131112.1, 131112.2 and 131112.3
from the EMC Competent Body: EMC Technologies (NZ) Ltd.
The products identified above also comply with the principal elements of the safety objectives of the Low Voltage directive. The manufacturer has applied the following harmonised standards:

EN 300 220-2 V2.4.1, 2012-05
Electromagnetic compatibility and Radio spectrum Matters (ERM), Short Range Devices (SRD), Radio equipment to be used in the 25 – 1000 MHz frequency range with power levels up to 500 mW;
Part 2: Harmonised EN covering essential requirements under Article 3.2 of the R&TTE Directive

EN 301 489-3 V1.4.1 –2002
Part 3: Specific conditions for Short Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz

EN 60950-1:2006
Information Technology Safety

The CE mark was first applied in: 2013

Signed: [Signature]

Authority: Shannon Reardon - Director
Date: 23/12/2013