

MReX-MB1

MINI POCSAG & DMR MESSAGING TRANSMITTER



User Manual

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Introduction

Thank you for choosing the MReX-MB1.

The MReX-MB1 is a table mountable, single button POCSAG and DMR messaging transceiver.

MReX-MB1 Features

- Sends 512, 1200 POCSAG paging messages.
- Transmits DMR Tier 1 text messages.
- Firmware upgradable.
- High stability oscillator ensuring minimal drift over the entire specified temperature range.
- Output power 25mW, but optionally up to 100mW.
- “Polite” operation, checking the channel is clear before transmission.
- Operates from 1 CR2450 batteries.
- Transmit LED.
- Can be configured to operate over the frequency range of 421 to 480MHz.
- Can transmit a periodic message.

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.

!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

NOTICE

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.
- Extreme Heat or High temperatures can damage MReX 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 MReX-MB1 IP rating is IP-62. This product should not be submerged or subjected to spraying water.

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.

Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment as a result of its actions in General Docket 79-144 on March 13, 1996.

This equipment complies with the FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 11cm between the radiator and any part of your body

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 first installing a coin cell battery, the LED will slowly flash for 5 seconds. While the LED is slowly flashing on and off the MReX-MB1 will accept configuration commands if connected.

The MReX-MB1 will illuminate the red LED when the button is pressed and remain lit until the programmed transmission has been sent. If the button is pressed, and held until after the red LED turns off, the MReX-MB1 will begin to flash on and off for 5 seconds, allowing the unit to accept configuration commands.

Prior to the normal long LED illumination after the button press the MReX-MB1 may:

- Flash once briefly. This indicates that the battery has less than 30% battery capacity remaining.
- Flash rapidly for up to 4 seconds. This indicates that the channel is currently busy.

Under normal operation, on start-up there is a sign-on message sent out the 3.3V TTL programming serial port two seconds after a battery is inserted. The sign on message indicates the firmware revision, serial number other software related information.

Commands may be issued and firmware updated from this 3.3V TTL serial port. Messages and frequency can be preconfigured on order, or a serial may be purchased for qualified end user configuration.

Replace battery if LED does not light after pressing button or if messages are not received.

DMR Messaging

The MReX-MB1 supports the transmission of short Digital Mobile Radio text messages, allowing direct messaging to many brands of DMR radios.

The MReX has a partial implementation of the ETSI TS 102 361-1 DMR standard allowing for DMR “Tier 1” messaging and therefore cannot be used in systems that have repeaters.

This is not a full implementation, and as a result has the following restrictions:

- Messages are limited to a maximum length of 50 characters.

DMR messages can be sent when an input is triggered or through use of the WT protocol in a similar manner as sending POCSAG paging messages. Refer to WT Protocol for usage information.

The MReX concurrently supports POCSAG and DMR paging, allowing an input to send messages to both legacy paging systems and newer DMR radios.

Different DMR manufacturers have interoperability limitations. The MReX is similar in this regard. Please refer to the Specification section for a list of tested DMR radios. The MReX WT protocol allows for switching between supported radio types to allow support for Hytera, Kirisun and other brands.

Configuration

Parameters can be changed using any common serial terminal program. A free serial terminal program that also allows saving and loading of configuration files can be downloaded from wte.co.nz/tools.html

Start-up operation is always at 9600:8-N-1.

The MReX-MB1 integrates the MReX-460 module, therefore has available the MReX-460 command set. However, only a subset of those commands are relevant to the MReX-MB1. Relevant commands are listed below.

All configuration commands always start with the asterisk '*' character.

All messages that do not start with the * character are processed by the protocol decoder.

All messages are terminated by a Carriage Return character, shown in this manual as <CR>

All commands that accept a value, can have that value read back by using the '?' suffix. E.g.

**TX_FREQ?*

Returns

**TX_FREQ=460000000 (for example)*

Note: It is a good practice to restart the unit after changing configuration. This can be achieved by removing the coin cell.

Transmit Commands

***TX_FREQ**

*TX_FREQ specifies the transmit frequency in Hz e.g.

**TX_FREQ=458600000<CR>*

***TX_PERIODIC**

*TX_PERIODIC allows a periodic message to be transmitted. This could be used as a “heartbeat” to confirm that the system is continuing to operate as expected.

**TX_PERIODIC=TT,MMMM<CR>*

where:

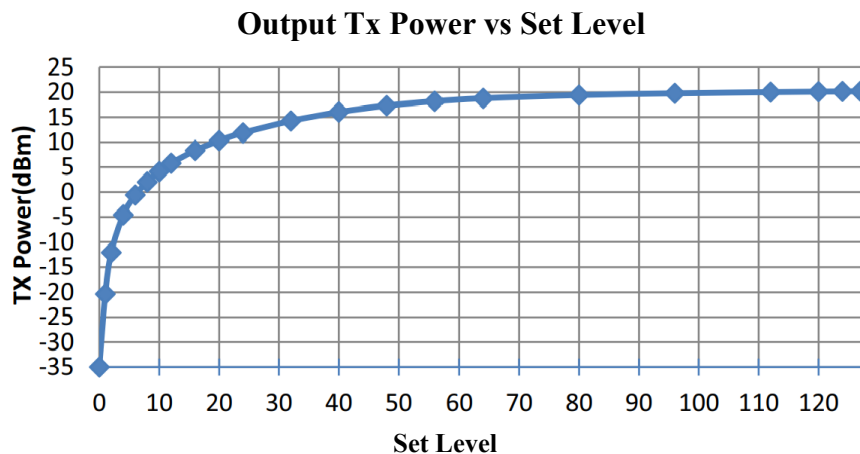
TT is the time in seconds between transmissions (60-65536. 0 disables the feature).

MMMM is the periodic message to transmit (up to 50 characters). E.g.

**TX_PERIODIC=10,WT1234560A10 Test_Message<CR>*

*TX_PWR

*TX_PWR set the Transmitter Power Output levels. Levels value ranges from 0 to 127, please use the following graph to determine the transmitter level value to use. Note that settings above 80 will have very little effect on output power. The MReX-MB1 by default is limited to a value of 33, which is around 25mW. This power level can be increased as an option. Being able to set the periodic message at a lower level means that if the MReX-MB1 is used as a pendant, a frequent low power transmission could be used to determine if someone is in proximity to a location of interest.



*TX_PWR=AA,BB<CR>

where:

AA is the power level of a transmission when the button is pressed.

BB is the power level of a transmission for each periodic transmission.

Examples :

Setting MReX to transmit at 10mW (10dBm $\pm$ 2dBm), and periodic messages at 10mW:

*TX_PWR=20,20<CR>

Setting MReX to transmit at 50mW (17dBm $\pm$ 2dBm), and periodic messages at 10mW:

*TX_PWR=55,20<CR>

Setting MReX to transmit at 100mW (20dBm $\pm$ 2dBm), and periodic messages at 10mW:

*TX_PWR=80,20<CR>

***CH_BUSY**

***CH_BUSY** Enables the channel busy level for the configured channel.

***CX_BUSY=BB**

Where:

BB is the signal level from 0 to -130 (in dBm).

In this example the channel will be considered “busy” if signal strength is above -80dBm.

Typical usage:

***CH_BUSY=-80<CR>**

Base Commands

***CONFIG**

***CONFIG** displays current configuration.

**CONFIG<CR>*

***SAVE**

***SAVE** saves all configuration settings (all config changes are restored on start-up).

Usage:

**SAVE <CR>*

***DEFAULTS**

***DEFAULTS** forces to reset temporary to factory default settings.

Usage:

**DEFAULTS<CR>*

Input Commands

The input commands allow messages to be configured for transmission when changing state. Debouncing (how long an input is settled before acting on the new level) can be configured with the number of times to transmit the input message.

Note: Even if an input is configured to transmit a certain number of messages, should the input level change before all messages are transmitted, then the remaining transmissions will be cancelled.

Please refer to **Input Hardware Connection** section on this manual for examples of how to connect the input pins on the MReX board.

*IN_CONFIG_L

*IN_CONFIG_L specifies all input Low configuration parameters. Inputs are triggered by connecting the input to ground for a time exceeding the specified debounce period. The input message is configured using the *IN_MSG_L command. Usage is as follows:

*IN_CONFIG_L=I:N,D,R

Where:

I = The input to configure (1 valid)

: = the colon character ':'

N = number of transmissions (0 = no transmissions, 9 is max tx count)

, = the comma character ','

D = debounce in 100 ms steps (from 0-255)

, = the comma character ','

R = time in seconds between retransmissions.

Example. Configure input 1 to send two message after input is debounced by 300 milliseconds and repeat/retransmit this message 4 times.

```
*IN_CONFIG_L=1:2,3,4<CR>
```

*IN_MSG_L

*IN_MSG_L specifies the low level message that will be transmitted if configured. E.g.

```
*IN_MSG_L=1:WT1234560A10 IN_1_LOW<CR>
```

WT Protocol

The **WT Protocol** is the default protocol used by WTE products. It allows for a variety of over the air transport methods (such as POCSAG paging) to be used and a variety of baud rates.

Transmitting Messages

Message format:

WTNNNNNNNABC<SPACE>MMMMM<CR>

Where:

WT are the 2 characters WT

NNNNNNN are 7 ASCII digits from 0000000-9999999

A is the Transport method:

A = POCSAG Alpha

N = POCSAG Numeric

D = DMR Text Message (directed to a group)

d = DMR Text Message (directed to an individual)

B is the Level 1-9. Note that POCSAG only supports levels 1-4 which is the same as the “Beep Level”. When the Transport method is ‘D’ this is the DMR “colour code”

C is the data rate (specified in channel width ranges):

12.5 kHz Channel Space Settings

A = 512 Baud 2 Level FSK

B = 1200 Baud 2 Level FSK

<SPACE> is a single space character.

MMM... is the payload, up to 240 characters.

<CR> is the carriage return character

Example:

To send a 512 baud alpha message to 1234567 level 1 with payload of “TEST”

WT1234567A1A<SPACE>TEST<CR>

After processing/transmitting responds with:

SENT<CR>

Support for Multiple Messages

The WT protocol allows for the same message to be sent to a variety of different radio types. This allows for an efficient way to send to several different RIC codes or technology types. Many message transmissions can be supported, until the max message length for the message is exceeded.

Example:

To send the message “TEST” to RIC codes 1234560 and 1222222 as a 512 baud POCSAG message.

WT1234560A1AWT1222222A10<SPACE>TEST<CR>

2 messages will be transmitted, batched in a single transmission.

Note: The format is the standard WT Protocol format, but repeated without a space in-between headers.

Example:

To send the message “TEST” to RIC code 1234560 as a 512 baud POCSAG message and also a DMR message to group 1001, colour code 6 for a Hytera radio.

WT1234560A1AWT0001001D60<SPACE>TEST<CR>

2 messages will be transmitted, as 2 transmissions. First message is in a POCSAG format, second transmission is in a DMR format.

Example:

To send the message “TEST” to RIC codes 1234560 and 1222222 as a 512 baud POCSAG message and also RIC codes 0201234 and 0005647 as a 1200 baud POCSAG message.

WT1234560A1AWT1222222A1AWT0201234A1BWT0005647A1B<SPACE>TEST<CR>

4 messages will be transmitted, batched in 2 transmissions, one for 512 baud messages and another transmission for the 1200 baud messages.

DMR Message Format

The WT Protocol can be used for sending DMR tier 1 messages. The protocol allows for an ID (group or individual), colour code, radio type and message to be specified.

Different DMR Radio manufacturers frequently have differing DMR implementations that often allows only same brand to same brand communication.

The WT protocol uses the commonly used “baud” field to set the DMR radio type. Sending a DMR message to an incorrect radio type may result in the radio not receiving messages, or the message being corrupted. Ensure that the group ID used is common to all same brand radios.

Basic Format:

```
WT1234567D6x TEST\r
```

Where all fields are previously defined, but ‘x’ is now a DMR “Type”.

Type ‘0’ – This is a short message type, often used by Hytera.

Type ‘1’ – This is a short message type, often used by Kirisun.

Type ‘2’ – This is a compressed UDP type, often used by Hytera and Motorola.

Motorola Radio Usage:

No messages are transmitted using any Motorola format. Motorola radios must be configured as follows:

- Compressed UDP Data Header: **DMR Standard**
- Text Message Type: **DMR Standard**

Example:

To send a DMR message to group ID 1001, colour code 6 with payload of “TEST MESSAGE” and to a type ‘0’ radio (Hytera)

```
WT0001001D60<SPACE>TEST MESSAGE<CR>
```

Example:

To send a DMR message to individual ID 104, colour code 6 with payload of “TEST MESSAGE” and to a type ‘0’ radio (Hytera)

```
WT00001041d60<SPACE>TEST MESSAGE<CR>
```

Input Handling

The MReX-MB1 supports a single programmable input short message up to 50 characters in length. Input messages must always be formatted as **WT Protocol**.

Commands relating to input handling:

***IN_CONFIG_L** specifies all input transition to low level configuration parameters.

***IN_MSG_L** specifies the low level message that will be transmitted if configured.

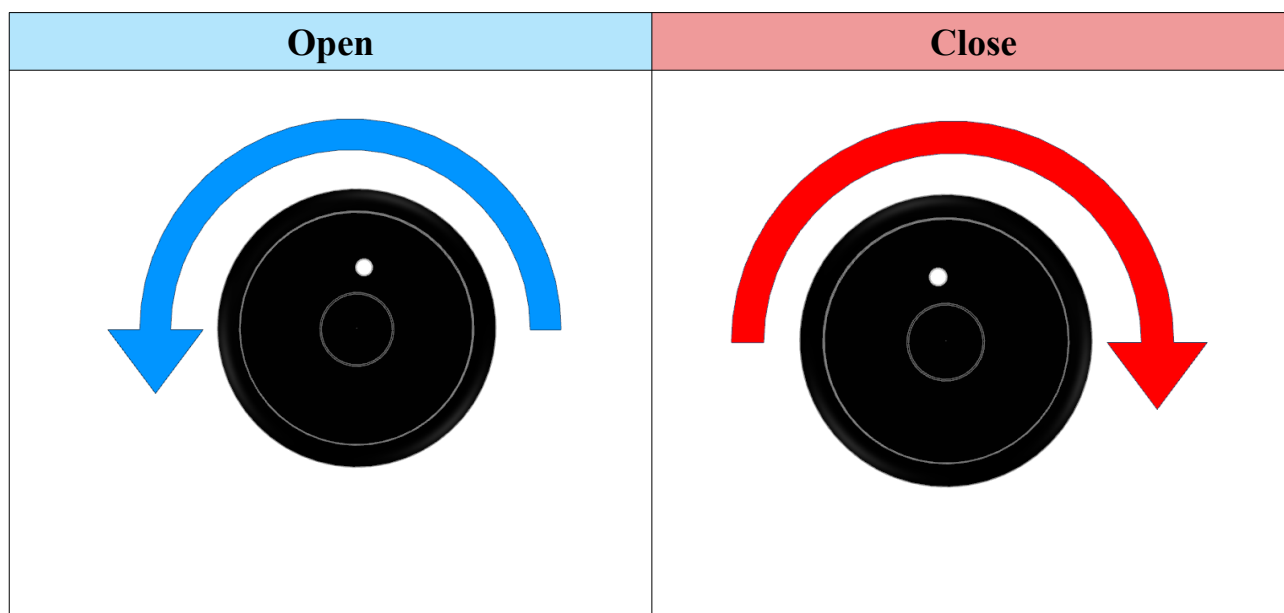
The ***IN_CONFIG_L** command allows the input to specify:

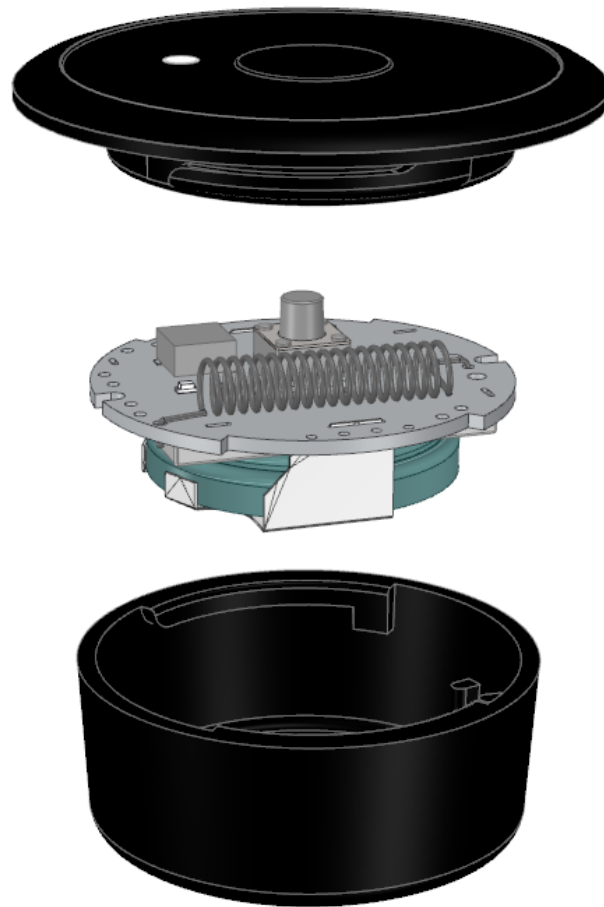
- How many messages are transmitted once triggered.
- The debounce period (how long the input must be in a new state continuously in order to transmit) before the input is triggered.
- How long to wait until the message is retransmitted.

The ***IN_MSG_L** commands allow the input to specify the message which will be transmitted when the input is triggered.

Hardware and Configuration

In order to replace/install batteries and/or change the transmitter configuration remove the lid to access the battery compartment and programming header.

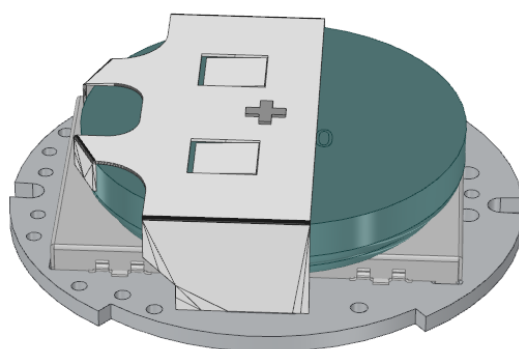
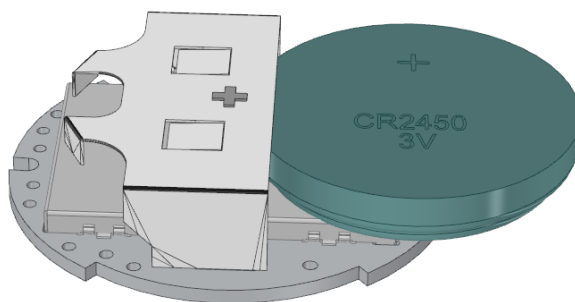




Battery Installation

Fit coin cell battery as shown below.

Note: ESD precautions must be observed at all times when handling.



Loading Configuration



Figure 1: MReX-PROG connected to MReX-MB1

1. Unscrew the lid
2. Attach the MReX-PROG USB programming adaptor as shown above.
3. Operate a terminal program using COM port settings 9600:N:8:1. A free serial terminal is available from <https://www.wte.co.nz/tools.html>. This terminal program (wte_serialterminal) also allows loading and saving of WTE product configuration files.
4. Press and hold the button, and keep the button depressed.
5. The MReX-MB1 will illuminate the LED as a message is transmitted.
6. There should be a message such as “SENT” seen on the terminal program. If this message is not seen, then there is a problem with either the serial connection or terminal program port settings.
7. The MReX-MB1 red LED will slowly flash on and off to indicate that commands can be accepted.
8. Release the depressed button.
9. Issue any command as listed below (such as *CONFIG<CR>). For changes to the configuration to become permanent, the command *SAVE<CR> must be issued.

10. Load configuration file if required. Select the configuration file that has been saved previously using the top right “Load Config” button.

The screenshot shows the WTE Serial Terminal 1.0.1.4 interface. At the top, it says "COM2 already in use". Below this are buttons for "Connect", "Clr Screen", and "Settings". On the right side, there are buttons for "Save Config" and "Load Config". The main area on the left contains several input fields with "Send" buttons next to them:

- *CONFIG\r
- *LIST\r
- *SAVE\r
- *DEFAULTS\r
- *TX_FREQ=458600000\r
- WT1234560A10 test\r
- *VER\r

Below these are a "Clr List" button, a "1000" value with a dropdown arrow, and a "Send" button. Further down is a "Raw Data" section with a "240" value and a "Send" button. At the bottom, there is a "Load Macros" button, a "Save Macros" button, and a text field containing "*IN_MSG_L=1:WT0691896A1A Disabled Alarm Activated" with a checked checkbox and "+CR" label, followed by "Send" and "About" buttons. A large empty rectangular area is on the right side of the interface.

11. After 60 seconds of serial port activity, the MReX-MB1 will exit its configuration mode and return to normal low power operation.

Firmware Upgrading

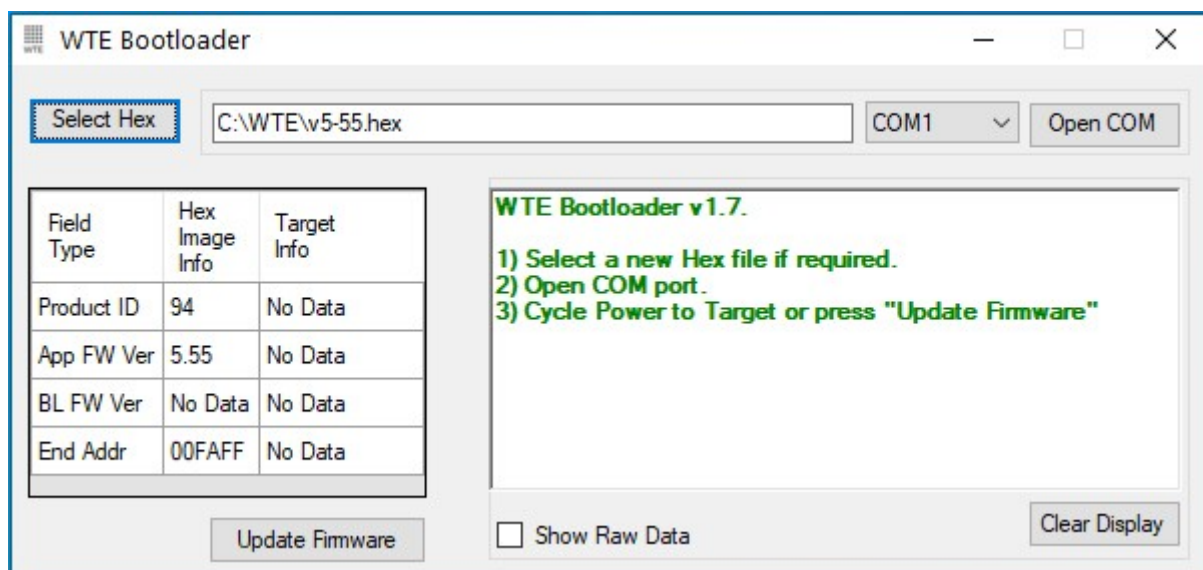
In order to update the MReX firmware you will need:

1. The WTE Bootloader Tool (available from <http://www.wte.co.nz> or provided if required from info@wte.co.nz).
2. MReX-PROG USB programming adaptor.
3. An appropriate encrypted hex file supplied by WTE Limited.

Note: Attempting to load a hex file not intended for use with the MReX will render the MReX inoperable. Uploading firmware should only be performed if instructed to do so by WTE Limited or an authorised agent.

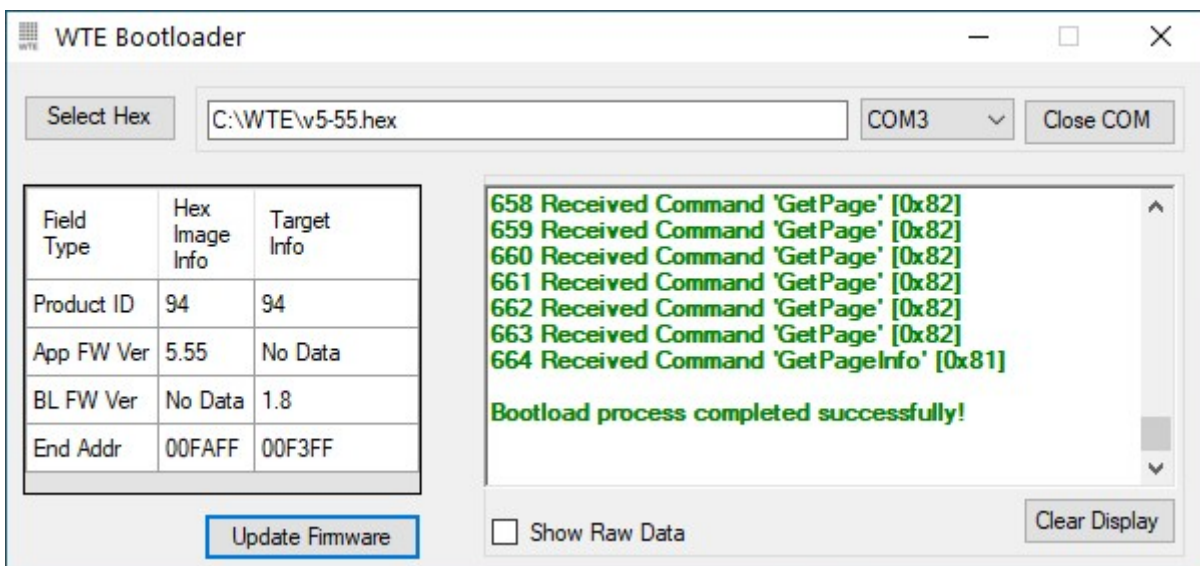
Firmware Upgrade Utility

Bootloader software has been customised by WTE to simplify the firmware replacement process for the MReX. The application automatically handles erasing and verifying of uploaded firmware.



Firmware Upgrade Process

1. Run the application WTEBoot.exe – this is the WTE Firmware Update Tool as shown above.
2. Ensure the coin cell battery has been removed.
3. MReX must be connected to a MReX-PROG USB programming adaptor, please refer to the “**Loading Configuration**” section of this manual for more information.
4. Press the “**Select Hex**” button on the WTE Firmware Update Tool and select the appropriated MReX firmware file.
5. Confirm that the App FW Ver displayed is the version described in the file name.
6. Select the correct COM port on the WTE Firmware Update Tool
7. Press “**Open COM**” button on the WTE Firmware Update Tool
8. Insert the coin cell battery.
9. Wait for the WTE Firmware Update Tool to indicate that programming has been completed.



The MReX now is ready and the WTE Firmware Update Tool can be closed.

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 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.

Please note that the maximum permitted transmit power level may vary from country to country. It is the users responsibility to ensure local regulations are adhered to.

In no event shall WTE Limited be liable for any incidental, special, indirect or consequential damages, harm to any person, lost profits or lost data, harm to your equipment, cost of procurement of substitute goods, technology or services, any claims by third parties (including but not limited to any defence thereof), any claims for indemnity or contribution, or other similar costs. The maximum financial liability is limited to the price paid for the supplied product.

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

RoHS and WEEE Compliance

MReX 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.

Manufacturing marking and labels

MReX serial number can found inside the unit, also serial number and model information are sent out the serial port serial on start-up.

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. Unauthorised work carried out on products will invalidate the warranty.

The MReX-MB1 can be damaged through improper handling and system integration. ESD handling precautions must be observed. Use in any system or product without the inclusion of ESD or over voltage devices or exposure to any condition outside the operating limits of the MReX-MB1 will invalidate the warranty.

Specification

Frequency Range:

- MReX-460: 421 - 480 MHz

Tx/Rx Frequency Accuracy:

- 0.5ppm. 235Hz max error at 470MHz over entire temperature range.

Battery Supply Voltage:

- 3V Internally fused at 250mA (not self resetting). Min normal operating voltage 2.2V. Max battery voltage 3.3V. Not suitable to connection to an external supply.

Max Transmissions:

- Total: Depends on the transmission power used – up to 6000 operations. As a guide for best battery life, limit 100mW transmissions to 6 per hour. At 10mW, limit transmissions to 60 per hour.

Buttons Inputs:

- One

Message Input message length:

- Input max configured message length 50 characters

Temperature Limits:

- -10 to + 55 degrees Celsius.

Max Tx Power (+/- 1dB)

- 14dBm(25mW), optionally 20dBm (100mW)

Operating Current:

- Up to 95mA transmitting at 100mW.
- <300nA in transmit only standby when used with 3V battery (wake on input change).

Firmware:

- Field upgradable.

Physical Dimensions: (L x W x H)

- 102mm x 51mm x 28mm

Serial Output:

- Serial 9600:8-N-1 baud, 3.3V TTL.
- WTE protocol format.

POCSAG Encode Support:

- POCSAG 512 either alpha or numeric including batched.
- POCSAG 1200 either alpha or numeric including batched.

DMR Support:

- Partial ETSI TS 102 361-1 (Tier 1 direct mode).
- Text Message Types:
 - Short message, unconfirmed
 - UDP compressed header, unconfirmed.
- Max message length 50.
- Tested DMR radios:
 - Hytera – PD565, PD665
 - Kirisun DP770, TM840H
 - Motorola SL4010e

Modulations Supported:**12.5kHz Channel Width:**

512 baud (FSK 2.25kHz), 1200 (FSK 2.25kHz)

Compliance Standards:

- EN 300 224-2. (base station and mobile transceiver compliant).
- EN 301 489,
- EN 62368
- EN 50385
- FCC part 90.217
- AS/NZ 4769

Laboratory Test Results

- Base and mobile station compliant. Testing completed March 2020. This product incorporates the WTE MReX-460 Telemetry Transceiver Module, upon which compliance is based.

Declaration of Conformity



Manufacturer:

*Wireless Technologies (WTE Limited)
Christchurch, New Zealand*

WTE Limited hereby declares the MReX Telemetry, Data and Messaging Transceiver module satisfies all the technical regulations applicable to the product within the scope of Directive 2014/53/EU (Radio Equipment Directive) of the European Parliament and Councils.

The products covered by this declaration:

MReX-460, MReX-5B, MReX-SF and MReX-5IO

The basis on which conformity is being declared:

The products identified above comply with the above directive based on lab testing results from the EMC Competent Body: EMC Technologies (NZ) Ltd.

The manufacturer has applied the following harmonised standards:

- **EN 300 224-2. (base station and mobile transceiver compliant).**
Electromagnetic compatibility and Radio spectrum Matters (ERM); On-site paging service
- **EN 301 489-1 V2.1.1 (2017-02)** Electro Magnetic Compatibility (EMC) standard for radio equipment and services.
- **EN 62368-1:2018** Safety of information technology equipment
- **EN 50385:2017** RF exposure compliance for base station equipment.

The CE mark was first applied in: May 2020

Contact:

Shannon Reardon or Rodrigo Pellizzari

info@wte.co.nz

Date: 05/05/2020



Shannon Reardon
Engineer/Director



Rodrigo Pellizzari
Engineer/Director