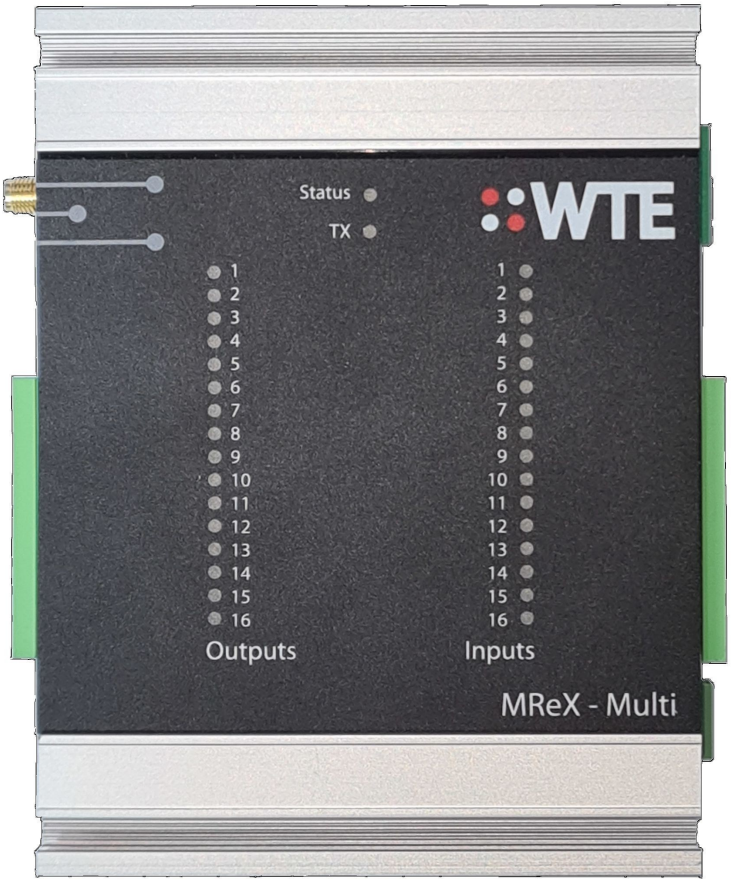
MReX Multi-IO RADIO and SERIAL I/O EXPANSION UNIT



User Manual

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Introduction

Thank you for choosing the MReX Multi-IO Radio and Serial I/O Expansion Module.

The MReX Multi-IO is a 16-input 16-output addressable digital IO module with RF and RS422/485 serial connectivity.

This product is ideally suited towards applications that require remote monitoring and control of large amounts of I/O.

The MReX Multi can be used as a simple method to expand the number of preprogrammed input messages for extending the capabilities of a paging system.

The MReX Multi-IO provides flexibility and customisability to suit the needs of many different projects.

Features

- 16 electrically isolated digital inputs.
- 4 relay outputs.
- 12 open-drain digital outputs.
- RS422 serial connection.
- Sends and receives 512, 1200 and 2400 baud POCSAG paging messages.
- Transmits DMR Tier 1 text messages (optional).
- Sends telemetry data from 512 baud to 9600 baud
- Paging store and forward repeater operation with configurable duplicate reject (optional).
- Configured inputs can be programmed to send POCSAG and DMR messages simultaneously when triggered.
- Periodic message support to ensure link integrity.
- High stability 0.5PPM oscillator ensuring minimal drift over the entire specified temperature range.
- Output power up 100mW.
- Operation from 421 to 480 MHz.
- High sensitivity receiver (-127dBm at 512 baud).
- Upgradable to enable store and forward repeater functions after purchase of a licence.

- Supported channel spacing of 25kHz, 12.5kHz and 6.25kHz.

Variants

The MReX-Multi is offered as 2 variants:

MReX-Multi-Messaging

This version is used for paging messaging, decoding and associating preprogrammed messages with inputs. This is the default product offered. May be used for simple telemetry applications where security is not required. Does not include any AES encryption support.

MReX-Multi-Telemetry

Does not support pre-programmed input messages. Supports AES 256-bit encryption, and is suitable for wireless I/O expansion. Input message commands are removed from this variant. This variant should be requested if required.

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

!WARNING

To comply with both **FCC RF Exposure** requirements in section 1.1310 of the FCC Rules and EN50383, antennas used with this device must be installed to provide a separation distance of at least 8 cm from all persons to satisfy RF exposure compliance.

DO NOT:

- Operate the transmitter when someone is within 8cm of the antenna. EN50383 regulatory limits have deemed that 8cm is a safe clearance distance from this product while operating at full power.
- Operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- Use within 15cm of sensitive electronic devices and medical equipment while operating at full power.
- Operate the equipment near electrical blasting caps or in an explosive atmosphere. All equipment must be properly grounded for safe operations.

!WARNING

THIS EQUIPMENT IS NOT INTENDED FOR MAINS VOLTAGES

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

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.
- 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 will be damaged if signals greater than 13 dBm are injected/received.
- Do not connect any other transmitter to the RF connector or share the antenna with any other device.
- 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 IP rating is IP-51. This product 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.

NOTICE

CARE REQUIRED WHEN TRANSPORTING

Safety and care must be taken when transporting, handling, installing and/or replacing radio equipment.

- Packaging should be adequate to ensure connectors are not damaged
- Store and handle the radio equipment in dry, clean safe environment
- Handle the equipment with care
- Care when stacking MReX boxes must be taken to not damage part of the radio, such as connectors.

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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.

End user products that have this device embedded must be installed by experienced radio and antenna personnel, or supplied with non-standard antenna connectors, and antennas available from vendors specified by the equipment supplier. Please contact the equipment supplier for end user antenna and connector recommendations.

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 the MReX-Multi-IO is operating normally, the status green LED flashes briefly once every second. When decoding messages, the green LED is held on for approximately one second. When transmitting the red LED will illuminate for the duration of the transmission.

Under normal operation, on start-up there is a sign-on message sent out the serial port. The sign on message indicates the firmware revision, serial number other software related information.

After start-up the MReX enters its receive and decode mode of operation, waits for commands to be entered serially for processing or inputs to be triggered. These may be either protocol messages to be transmitted or commands related to the configuration of the device.

When messages are received and decoded, they are immediately sent out the serial port in the format of the configured protocol in use.

Messages are transmitted as per the input configuration when inputs change state. Please refer to **Input Output Hardware Connection** or **Input Handling** sections on this manual for further information.

Outputs are driven high or low, or for a particular period of time depending on configuration. The output is controlled via the **WTE Output Control Protocol** message that is received and decoded. Front panel LEDs reflect the state of all inputs and outputs.

Ensure an antenna is attached before transmitting.

RF Security

The MReX optionally allows for AES 256-bit encryption to be used for transmitted data. Same content messages will change with each transmission due to an embedded unique timestamp. Secure RF communication on the MReX is fully compatible with that of the TReX family of products.

A default key is loaded into the MReX, common to all units. This is for evaluation purposes only, and should be changed before the system is considered to be secure. For evaluation, steps 1 and 2 below can be omitted.

In order to create a secure radio link:

1. Generate a random 256 bit key. Use a key generator or use an online web service such as https://www.allkeysgenerator.com/Random/Security-Encryption-Key-Generator.aspx. The key must be hexadecimal in format and will be 64 characters long. This key must be used on all devices in the same system, and must be changed if the key has become publicly known.
2. Use the command ***RF_KEY** to enter the key and configure other secure RF settings, either using a terminal or adding the command to a configuration file.
   *Note: Reading back the key with ***RF_KEY?** will only display the first 4 characters of the key. All other configuration items can be set through the menu if required.*

AES Encryption is only applied when using the transport options **POCSAG_A** or **WTE_EN**. **WTE_EN** must be used when 8 bit characters are being transmitted, such as when the point to point serial link is used. **WTE_EN** encrypted messages have the ability to be 20% shorter than the **POCSAG_A** transport method. **POCSAG_A** can be used in most cases when a standard format is required, or encryption for nationwide paging is desired. Both transport methods include forward error correction for high receiver sensitivity.

"Duplicate Reject" prevents repeat playback attacks where a malicious or nuisance user could record transmissions, and retransmit in an attempt to defeat security. Duplicate reject examines the encrypted time stamp in a transmission and only allows more recent time-stamped messages to be processed. Using this method all historic repeated messages from a transmitter can be rejected.

A duplicate reject timeout can be configured using ***RF_KEY**, which allows for duplicate reject histories to be cleared after a certain amount of time since receiving a valid message from a specific device. This is useful in the event that a device within the network loses power and resets its timestamp. This has a default value of 1 hour or 3600 seconds but can be set as high as ~8 hours (30000 seconds) or disabled entirely (by setting value to 0). For maximum system reliability it is recommended to use this setting in conjunction with a periodic transmission (see ***TX_PERIODIC**), with the duplicate reject timeout value set higher than the transmission period.

Configuration

Parameters can be changed using any common serial terminal program. A 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.

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)

There are some commands that support multiple entries (such as the same command but for different ranges). In this case the question mark can be followed by the parameter to be interrogated. E.g.

**RX_RANGE?<CR>*

Returns (lists all ranges)

**RX_RANGE=1:8,2000000*

**RX_RANGE=2:0,0*

**RX_RANGE=3:0,0*

**RX_RANGE=4:0,0*

To find the first range only, usage would be:

**RX_RANGE?1<CR>*

Returns

**RX_RANGE=1:8,2000000*

Note: It is a good practice to restart the unit after changing configuration. This can be achieved by removing power to the unit or sending the **REBOOT<CR>* command.

Transmit Commands

*TX_FREQ

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

**TX_FREQ=458600000<CR>*

*TX_BAUD

***TX_BAUD** Specifies the baud rate and channel width of the transmitter when using a protocol that does not permit a baud rate and channel width to be specified.

This includes whether the modulation is 2 or 4 levels GFSK plus the channel width:

512_25 indicates 512 baud with 25kHz channel spacing (2 level GFSK).

1200_12 indicates 1200 baud with 12.5kHz channel spacing (2 level GFSK).

4800-4L_6 indicates 4800 baud with a 6.25kHz channel spacing (4 level GFSK).

Accepts: 512_25, 512_12, 512_6, 1200_25, 1200_12, 2400_12,
4800_12, 4800-4L_6, 9600-4L_12

Typical usage:

*TX_BAUD=512_25<CR>

*TX_PROTO

***TX_PROTO** specifies the protocol to apply for serial input. Accepts WTE and RAW e.g.

**TX_PROTO=WTE<CR>*

Note: See protocol section for more details on protocols and configuration. The following commands TX_MODE, TX_LEVEL and TX_CAP are only used when NON WTE protocols are selected.

*TX_MODE

***TX_MODE** specifies the default transport method of the transmitter (how the information is transmitted over the air).

- POSCAG_A must be used in order to transmit alphanumeric messages.
- POSCAG_N must be used in order to transmit numeric messages.
- WTE_EN must be used in order to transmit 8 bit characters (POSCAG_A transmits 7 bit characters only).

Accepts POSCAG_A, POCSAG_N and WTE_EN. E.g.

**TX_MODE=POSCAG_A<CR>*

*TX_LEVEL

***TX_LEVEL** specifies the default level of messages transmitted. This is sometimes referred to as "Beep Level". This is a value 0-9, however, when POCSAG is the transport method, only 0-3 will be used. E.g.

**TX_LEVEL=3<CR>*

*TX_CAP

***TX_CAP** specifies the default code used to identify transmissions (same as the RIC code). The TX_CAP code would only be used by protocols that do not require the CAP code to be specified. This code can be any number between 8 and 2000000. E.g.

**TX_CAP=1234567<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 (0-255. 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_PREAMBLE

***TX_PREAMBLE** set the preamble length in multiples of 32 bits.

Short preambles allows the messages to be transmitted quickly.

Long preambles are typically used in conjunction with a matching receiver to save battery power when the receivers is in deep sleep mode.

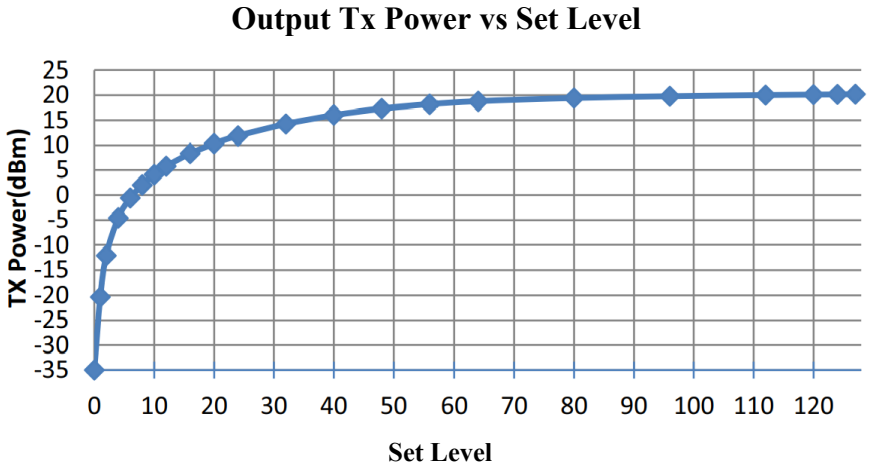
The POCSAG standard uses a setting of 18 (576 bits). This very long preamble means that paging receivers need only to wake once per second (at 512 baud) in order to check for an incoming message. If the receiver is always powered and receiving, then much shorter preambles can be used, and in some cases halve the channel activity.

Typical usage:

*TX_PREAMBLE=18<*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.



Examples :

Setting MReX to transmit at 10mW (10dBm ±2dBm):

**TX_PWR=20<CR>*

Setting MReX to transmit at 50mW (17dBm ±2dBm):

**TX_PWR=55<CR>*

Setting MReX to transmit at 100mW (20dBm ±2dBm):

**TX_PWR=80<CR>*

*RF_KEY

Sets RF link encryption key details, including the 32 or 64 character AES keys and encryption options. This command must be used in order to set the used key. Once the key is set, resetting to factory defaults will NOT clear the key.

**RF_KEY=A,B,C,DDDD,E*

where:

A is 1 when encryption is enabled for RF links.

B is 0 for AES 128-bit encryption, or 1 for AES 256-bit encryption.

C is 1 when rejection is enabled for repeated or older messages.

DDDD is the shared 128 or 256 bit key. This is a random hex sequence that must be 32 or 64 hexadecimal characters in length. All WTE devices in a system must share this key.

E is the duplicate reject record timeout in seconds (0-30000). This allows for connections between devices to be reset in the event that a device restarts and loses it's current message sequence. It is recommended to set this higher than any configured periodic message periods. Setting to 0 disables duplicate reject entry timeouts.

Typical usage:
**RF_KEY=1,1,1,452948404D635166546A576E5A7234753777217A25432A462D4A614E64526755,3600<CR>*

**RF_KEY?*

Typical response:

RF_KEY=1,1,1,-4529**,3600<CR>*

Note: only the first 4 characters of the key are displayed.

*RF_ID

Configures the unit ID number used by the RF AES to identify the device. This should be unique within the network of devices to avoid conflicts with the duplicate reject system.

**RF_ID=A*

Where:

A is the individual ID to use (0-255).

Typical usage:

**RF_ID=1<CR>*

Receive Commands

*RX_FREQ

***RX_FREQ** specifies the receive frequency in Hz (range limited to the variant of product) e.g.

**RX_FREQ=460000000<CR>*

*RX_BAUD

***RX_BAUD** specifies the baud rate and channel width of the receiver.

This includes whether the modulation is 2 or 4 levels GFSK plus the channel width:

512_25 indicates 512 baud with 25kHz channel spacing (2 level GFSK).

1200_12 indicates 1200 baud with 12.5kHz channel spacing (2 level GFSK).

4800-4L_6 indicates 4800 baud with a 6.25kHz channel spacing (4 level GFSK).

Accepts: 512_25, 512_12, 512_6, 1200_25, 1200_12, 1800_12, 2400_12,
4800_12, 4800-4L_6, 9600-4L_12

Where:

Typical usage:

**RX_BAUD=512_25<CR>*

*RX_PROTO

***RX_PROTO** specifies the protocol to apply for serial output, accepts WTE, RAW. See protocol section for more detail on protocols and configuration. E.g.

**RX_PROTO=WTE<CR>*

*RX_MODE

***RX_MODE** specifies the transport method of the receiver (how the information is received over the air).

- POSCAG_A must be used in order to receive alphanumeric messages.
- POSCAG_N must be used in order to receive numeric messages.
- WTE_EN must be used in order to receive 8 bit characters (POSCAG_A transmits 7 bit characters only).

Accepts POSCAG_A, POCSAG_N, WTE_EN and FLEX. E.g.

**RX_MODE=POSCAG_A<CR>*

*RX_RANGE

***RX_RANGE** specifies up to 4 CAP RX ranges for decoding. Messages received with CAP codes not allowed on the RX_RANGE will be discarded by the receiver.

*RX_RANGE=N:LLLLLLL,HHHHHHH (where N is the range between 1 and 4, LLLLLLL is the lowest cap code to match, HHHHHHH is the highest). E.g.

**RX_RANGE=1:8,200<CR>*

*CH_BUSY

***CH_BUSY** Enables the BUSY alert and channel busy level for the configured channel.

*CH_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>*

*RX_ENABLE

***RX_ENABLE** Enables or disables the receiver.

Although the MReX supports several receiver modes, the MReX-Multi only supports Disabled (0) and Enabled (1). Enabling the receiver increases operating current by 18mA.

Typical Usage:

RX_ENABLE=1<CR>

Base Commands

*REBOOT

***REBOOT** forces the unit to immediately restart.

Usage:

**REBOOT<CR>*

*CONFIG

***CONFIG** displays current configuration.

**CONFIG<CR>*

*SAVE

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

Usage:

**SAVE <CR>*

*LIST

***LIST** displays all available commands. This command also lists many specific field names that need to be used with listed commands.

Usage:

**LIST<CR>*

*DEFAULTS

***DEFAULTS** forces to reset temporary to factory default settings. The user must issue the **SAVE<CR>* command in order to write these default settings to internal memory.

Usage:

**DEFAULTS<CR>*

*SERIAL_LINK

***SERIAL_LINK** sets default RS232 point to point configuration. See **Serial Point To Point Operation**

Usage:

**SERIAL_LINK<CR>*

*VER

***VER** sends the MReX sign on message back to the user. This is useful to determine the model and serial number of the unit.

Usage:

**VER<CR>*

*IO

Returns all input and output states.

Typical usage:

**IO<CR>*

Typical output:

IO=I:0000000000000000, O:1111000000000000

In this typical output, there are 16 inputs shown. 16 output states follow.

*BYPASS

Allows messages to be entered via serial to simulate as if decoded across the air. This can be useful for testing.

Commands take the format:

***BYPASS**=[1234567:1]Message_Payload

Where:

[is the character '['

1234567 is the simulated RIC

: is the character ':'

1 is the beep level of the messages

] is the character ']'

Message_Payload is any message to inject as if received across the air.

This message will now be processed according to the configured RX_PROTO configuration.

Typical Usage 1:

**BYPASS=[1234567:1]Test Message<CR>*

"Test Message" will be added to the received message serial output, as if received across the air.

Typical Usage 2:

**BYPASS=[1234567:1][[01]U0[*REBOOT]]<CR>*

The unit will reboot the unit, please refer to WTE Output Control Protocol section on this manual for more information.

*RSSI

***RSSI** returns the receiver signal strength in -dBm. (returns between 0 and -130).

Usage:

**RSSI<CR>*

*LAB

Set the unit in transmit mode, it can be configured to transmit carrier only or modulated. This feature together with the *RSSI command are useful when antenna alignment is necessary.

*LAB syntax:

**LAB=x,y<CR>*

Where:

x is used to:

1 – Enable Carrier only,

2 – Enable Carrier with random modulation,

0 – Disable Carrier

y is the time in seconds which the MReX will be transmitting for.

Example carrier only for 60 seconds:

**LAB=1<CR>*

Example carrier only for 20 seconds:

**LAB=1,20<CR>*

Store Forward Commands

For the MReX this is an optional feature that by default is not supplied.

Store forward operation is when the unit is used to listen to transmissions in the area, decode the messages and retransmit again to provide greater coverage than would normally be possible.

> **Note:** In order to forward messages the decoded message CAP codes must fall within the configured CAP ranges.

*STORE_FWD

Configures the store forward operation, this command uses 2 parameters as follows:

**STORE_FWD=XX,YY<CR>*

Where:

XX is the **Store Forward Operation**

YY is the **Duplicate Reject Operation**

Store Forward Operation:

Setting to 0 disables the feature. The non zero value set is the delay in 100ms steps after each transmission. This delay allows time for any downstream forwarding equipment to clear the message. Max store forward delay is 24 seconds. All messages are immediately queued for transmission, and up to 5 messages may be retransmitted after the store forward delay.

Duplicate Reject Operation:

Setting to 0 disables the feature, otherwise this is the number of seconds to reject identical messages for up to 240 seconds. Duplicate rejection operates only on messages decoded for forwarding. This means that receiving of duplicate messages is not prevented (nor the transmission of same messages resulting from a protocol command), but when used as part of a simple store forward system re-queueing of messages can be controlled. Duplicate reject only tests the previous 5 messages in the historic transmit queue.

For example, to configure to use a 2 second clearing delay after each transmission and 10 second message duplicate reject:

**STORE_FWD=20,10<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 Output Hardware Connection** section on this manual for examples of how to connect the inputs and output.

*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 (1-16 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_CONFIG_H

***IN_CONFIG_H** specifies all input High configuration parameters. Inputs are triggered by moving the input to a high state or released from GND for a time exceeding the specified debounce period. The input message is configured using the ***IN_MSG_H** command. Usage is as follows:

*IN_CONFIG_H=I:N,D,R

Where:

I = The input to configure (1-16 valid)

: = the colon character ':'

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

, = the comma character ','

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

, = the comma character ','

R = time in seconds between retransmissions.

Example:

**IN_CONFIG_H=1:1,10,15<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>*

*IN_MSG_H

***IN_MSG_H** specifies the high level message that will be transmitted if configured. E.g.

**IN_MSG_H=1:WT1234560A10 IN_1_HIGH<CR>*

Output Commands

Outputs are controlled using the **WTE Output Control Protocol**.

*OUT_CONFIG

***OUT_CONFIG** specifies all output configuration items, usage as follows:

*OUT_CONFIG=O:E,T,A,B <*CR*>

Where:

O = The output to configure (1 or 2 valid)

: = the character ':'

E = 0. Unused for the MReX Multi.

T = time for output to close for in 100ms steps. E.g. 100 is 10 seconds. Max value is 32000. Setting to 0 disables the timer and output is latched indefinitely.

A = On time in 100ms steps. (when 0, is not used). Allows cycling of outputs when an output has been enabled.

B = Off time in 100ms steps. (when 0, is not used).

Example:

**OUT_CONFIG=1:0,100,0,0<CR>*

*UNIT_ID

***UNIT_ID** specifies the output unit ID. Note that this ID is not the same as the **AES_ID** if encryption options are used. The first Unit ID is used to address the I/O 1-8, second ID I/O 9-16.

*UNIT_ID=XX,YY<CR>

where:

XX and YY are any characters (up to 12 either numeric or alphanumeric) that are used to uniquely address each MReX when used in conjunction with the **WTE Output Control Protocol**. By default these values are "01" and "02", allowing numeric paging to be used to transmit messages.

Example:

**UNIT_ID=01,02<CR>*

Protocols

Serial input into and out of the MReX can be formatted differently by selecting an appropriate protocol. Any additional serial protocols are provided at the discretion of WTE Limited, or through negotiation. By default only WTE protocol is provided.

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

W= POCSAG WTE (WTE 8 bit format allowing all 8 bit characters to be transmitted)

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):

25 kHz Channel Space Settings

0 = 512 Baud 2 Level FSK

1 = 1200 Baud 2 Level FSK

12.5 kHz Channel Space Settings

A = 512 Baud 2 Level FSK

B = 1200 Baud 2 Level FSK

C = 2400 Baud 2 Level GFSK

D = 4800 Baud 2 Level GFSK

X = 9600 Baud 4 Level GFSK

Y = 1800 Baud 2 Level GFSK

6.25 kHz Channel Space Settings

a = 512 Baud 2 Level FSK

d = 4800 Baud 4 Level GFSK

<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"

WT1234567A10<SPACE>TEST<CR>

After processing/transmitting responds with:

WT[NNN]<CR>

where:

NNN is the number of characters from W until, but not including <CR>, the test message above results in the following response

WT[017]<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.

WT1234560A10*WT1222222A10*<*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.

WT1234560A10***WT0001001D60***<*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.

WT1234560A10*WT1222222A10***WT0201234A11***WT0005647A11*<*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.

Serial Output Support

Alternatively, the WT Output Protocol can be used to send messages over the device's RS422 connection. This is useful for systems that implement wired connections between units.

Message format:

WTS<SPACE>MMMMMM<CR>

Where:

WTS are the 3 characters WTS.

MMMM is the payload, up to 240 characters.

Example:

To send the message "TEST" over the device's RS422 connection.

WTS<SPACE>TEST<CR>

The message "TEST" will be sent over the device's RS422 connection. No other reply will be sent.

Input Handling

Note: Please refer to **Input Output Hardware Connection** section on this manual for examples of how to connect the inputs and outputs.

The MReX Multi-IO supports 16 programmable inputs. Each input can be programmed with a short message up to 30 characters in length. Input messages must always be formatted as **WT Protocol**.

On start-up each input is read. Only inputs that change from the start-up input state are processed.

Commands relating to input handling:

***IN_CONFIG_H** specifies all input transition to high level configuration parameters.

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

***IN_MSG_H** specifies the high level message that will be transmitted if configured.

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

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

Full example:

In this example inputs 1 and 2 are configured to transmit only when moving from high to low (no high level transmissions). Transmit 5 times, 10 seconds between each transmission. Debounce period is to be configured to 2 seconds (input must have transitioned from a stable low level to constant high level for two whole seconds).

The protocol being used is WT protocol, and the message for each input message is “IN 1 LOW” and “IN 2 LOW”. Message is to be transmitted as POCSAG alphanumeric to cap code 1234560, beep level 1 and 512 baud.

Both Input 1 and 2 configured to disable all high level processing.

**IN_CONFIG_H=1:0,0,0<CR>*

**IN_CONFIG_H=2:0,0,0<CR>*

Both input 1 and 2 are configured as per the full example details above.

**IN_CONFIG_L=1:5,20,10<CR>*

**IN_CONFIG_L=2:5,20,10<CR>*

Configured messages to be transmitted once triggered.

**IN_MSG_L=1:WT1234560A10 IN 1 LOW<CR>*

**IN_MSG_L=2:WT1234560A10 IN 2 LOW<CR>*

High level messages can be set to anything since they are configured not to be used

**IN_MSG_H=1:<CR>*

**IN_MSG_H=2:<CR>*

For more details on command usage please refer to the Configuration section if required.

Output Handling

Note: Please refer to **Input Output Hardware Connection** section on this manual for examples of how to connect the inputs and outputs.

The MReX Multi-IO supports 16 outputs, the first 4 of which are relay outputs.

Outputs are configured using the commands:

*OUT_CONFIG

*UNIT_ID

The output is controlled through messages received that conform to the **WTE output control protocol**.

WTE Output Control Protocol

Introduction

This section describes how to control the outputs of WTE Products via transmission or RS422 serial message payloads.

The WTE protocol needs to be able to switch many outputs on, and many off in a single message. Receivers need to be able to be uniquely addressed, and in a manner that is maintainable.

Once an output has been activated, it will remain in its activated state for its configured period. This may be many seconds, or permanently latched.

The control message can be placed in any position in the message payload, and there can be multiple control messages in the same payload.

The 16 outputs of the MReX Multi-IO are split into two groups of 8 outputs, with each group addressed by 1 of the configured UNIT_ID values. Functionally, this requires that each Multi-IO unit is treated as 2 separate units, each with 8 inputs and 8 outputs. The relay outputs of the Multi-IO device are addressed as the first 4 outputs of the first device.

Format

The payload of a message must fit the following format in order to operate the unit outputs.

[[ID]EEEE-DDDD]

Where:

[is the character '['

] is the character ']'

ID is the either of the two configured UNIT_ID values. (e.g "01" or "02"). Note that the first unit ID is used to address I/O 1-8 and the second to address I/O 9-16.

E is the output to enable (1-8 for each UNIT_ID value). Note that to access I/O 9-16 the values **1-8** are still used the secondary UNIT_ID.

- is the hyphen character '-' All digits following the '-' are outputs that are disabled

D is the output to disable

Examples:
Consider an MReX configured with UNIT_ID values of "01" and "02":

**UNIT_ID=01,02<CR>*

**OUT_CONFIG=1:1,0<CR>*

**OUT_CONFIG=9:1,0<CR>*

Scenario 1: To turn output 1 ON;

Message payload:

[[01]1]

Scenario 2: To turn OFF output 1;

Message payload:

[[01]-1]

Scenario 3: To turn output 9 ON:

Message payload:

[[02]1]

Scenario 4: To turn OFF output 9:

Message payload:

[[02]-1]

Note that to address outputs 9-16, they must be treated as outputs 1-8 on a device with UNIT_ID of "02".

Consider that we have 3 MReX-Multi Units and each one is configured with different UNIT_ID values (note that 2 units IDs must be configured for each unit);

First Unit:

"Unit_A1" and "Unit_A2" (**UNIT_ID=Unit_A1,Unit_A2<CR>*)

Second Unit:

“Unit_B1” and “Unit_B2” (**UNIT_ID=Unit_B1,Unit_B2<CR>*)

Third Unit:

“Unit_C1” and “Unit C2” (**UNIT_ID=Unit_C1,Unit_C2<CR>*)

Scenario 5: To turn output 1 for the FIRST unit:

Message payload:

[[Unit_A1]1]

Scenario 6: We want:

to turn output 10 ON in the FIRST unit,

to turn output 1 ON on the SECOND unit,

to turn OFF output 4 on the THIRD unit,

to turn OFF output 11 on the THIRD unit;

Message payload:

[[Unit_A2]2] [[Unit_B1]1] [[Unit_C1]-4][[Unit_C2]-3]

Notes:

- The unit will only process the Output Control Protocol for the unit configured in the UNIT_ID and will ignore the other Output Control Protocol contained in the message
- Additional security to prevent false activation can be achieved through CAP restriction via the RX_RANGE and/or a more complex UNIT_ID.
- These payloads can be used either over the units' radio link or through a common RS422 connection to a PC or central TReX/MReX unit.

Remote Command Output Format

The WTE output control protocol allows the direct control of remote units. This allows specific MReX units to accept commands or protocols for processing "over the air". Care must be taken issuing commands that leave the MReX unable to process further remote commands (such as changing frequency, RIC range, modulation settings).

[[ID]U0[AA]]

Where:

[is the character '['

] is the character ']'

ID is either UNIT_ID values of the desired MReX to be controlled.

U0 are the characters "U0" (U followed by zero) and is used to indicate that directed content for processing follows.

Examples:

Example applications for this may be:

- Restarting of a remote unit
- Changing configuration of a remote unit over the air
- Retransmitting a message at a different rate.

Example 1 - To restart a remote unit:

Remote unit configured to have UNIT_ID values of "UNIT-1A" and "UNIT-1B".

Message payload:

[[UNIT-1A]U0[*REBOOT]]

or

[[UNIT-1B]U0[*REBOOT]]

Example 2 - To change a RIC range on a remote unit:

Commands can be directed to either unit ID for a particular MReX-Multi.

Remote unit configured to have UNIT_ID values of “UNIT-1A” and “UNIT-1B”.

Message payload:

[[UNIT-1A]U0[*RX_RANGE=1:1234560,1234567]]

or

[[UNIT-1B]U0[*RX_RANGE=1:1234560,1234567]]

Example 3 - To transmit a message only from a specific remote unit:

In this case, the remote unit is configured to accept WT protocol.

Remote unit configured to have UNIT_ID values of “UNIT-10” and “UNIT-11”.

Message payload:

[[UNIT-10]U0[WT1234560A10 Test Message]]

or

[[UNIT-11]U0[WT1234560A10 Test Message]]

The message transmitted by the remote unit will be “Test Message” at 512 baud, but the message may have been received at a different configured baud rate.

Applications of this may include:

A full network operating in a telemetry mode may be transmitting data at 9600 baud. This method allows a message to be sent through the network at high speed, yet still able to be retransmitted from a specific unit at a standard low rate for a common POCSAG belt pager.

Installation

The MReX Multi-IO 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. 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 RF connector is 13 dBm. Levels above this will destroy the receiver RF input and invalidate the unit warranty.

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.

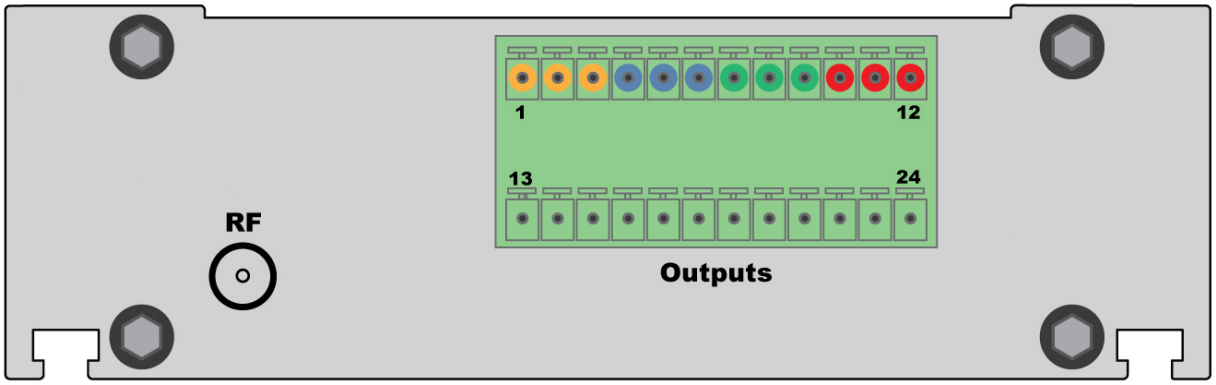
If cables are to be supplied, they must be ordered at time of purchase.

Connecting to the MReX Multi-IO

The minimum required connections for a usable system:

1. Connection to an antenna.
2. 13.8V, 3A power supply.
3. RS422/485 connection OR an active RF link for configuration and commands.

Left Panel

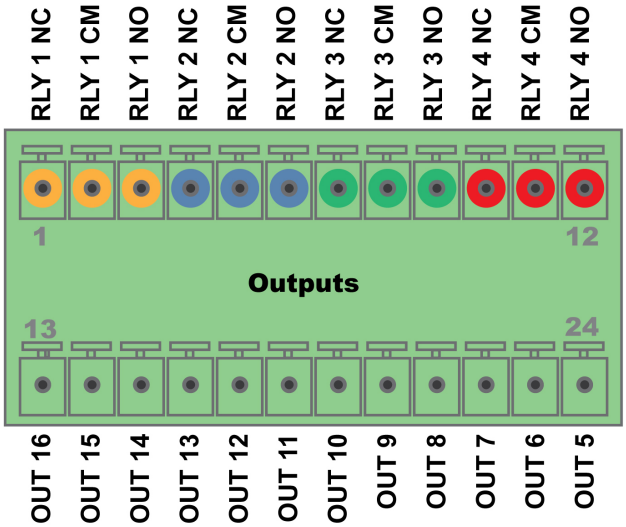


SMA connector is female type. The module must be connect to a 50 ohm antenna designed for use at the intended frequency of operation.

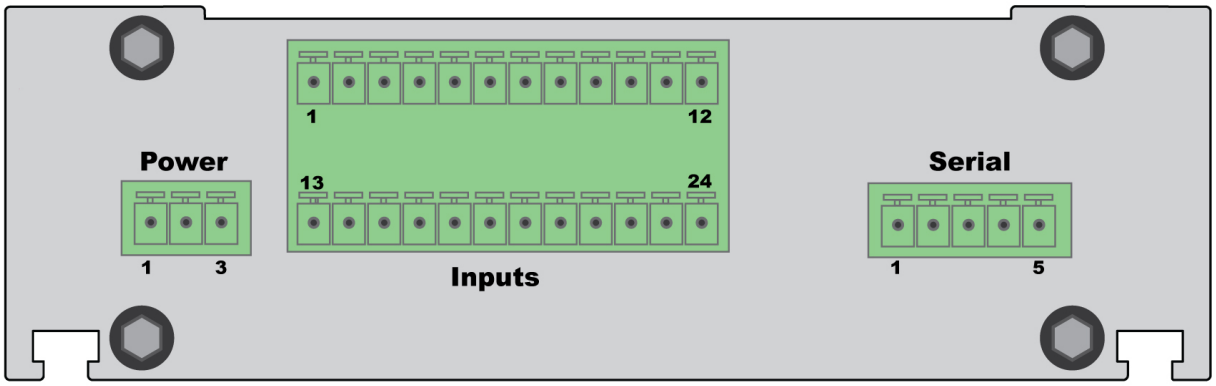
Output Connector

Pin Number	Description
1	Relay 4 NC
2	Relay 4 CM
3	Relay 4 NO
4	Relay 3 NC
5	Relay 3 CM
6	Relay 3 NO
7	Relay 2 NC

8	Relay 2 CM
9	Relay 2 NO
10	Relay 1 NC
11	Relay 1 CM
12	Relay 1 NO
13	Output 16
14	Output 15
15	Output 14
16	Output 13
17	Output 12
18	Output 11
19	Output 10
20	Output 9
21	Output 8
22	Output 7
23	Output 6
24	Output 5



Right Panel



Power Connector

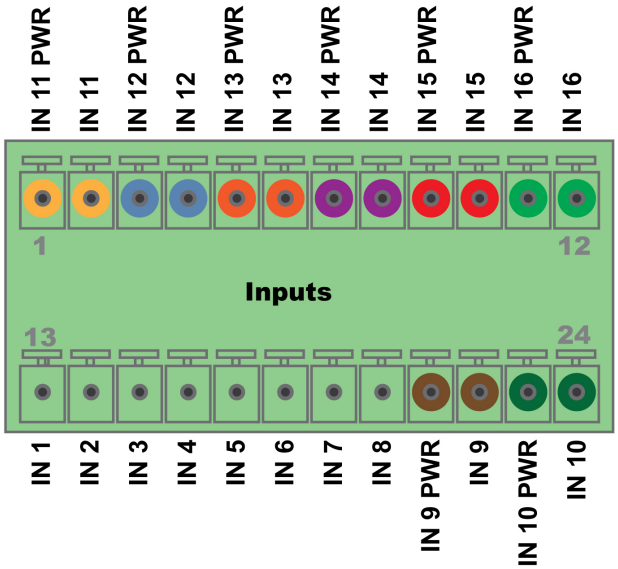
Pin Number	Description
1	Ground
2	Primary Supply Voltage (+12V)
3	Isolated I/O Supply Voltage (V_ISO)

Note that for digital inputs 1 – 8 to properly operate, pin 3 must be connected to a supply voltage.

Input Connector

Pin Number	Description
1	Input 11 Supply Voltage
2	Input 11
3	Input 12 Supply Voltage
4	Input 12
5	Input 13 Supply Voltage
6	Input 13
7	Input 14 Supply Voltage
8	Input 14
9	Input 15 Supply Voltage

10	Input 15
11	Input 16 Supply Voltage
12	Input 16
13	Input 1
14	Input 2
15	Input 3
16	Input 4
17	Input 5
18	Input 6
19	Input 7
20	Input 8
21	Input 9 Supply Voltage
22	Input 9
23	Input 10 Supply Voltage
24	Input 10

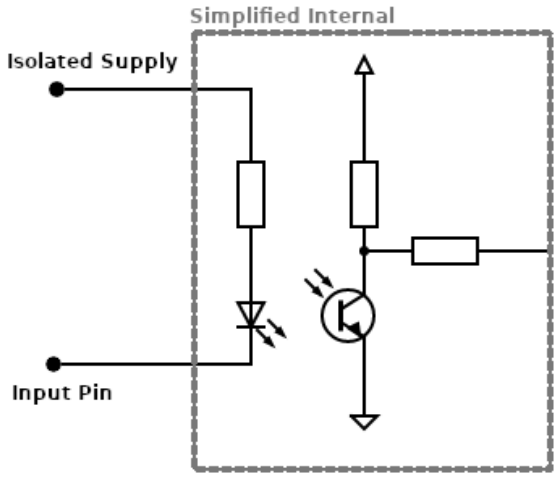


Serial Connector

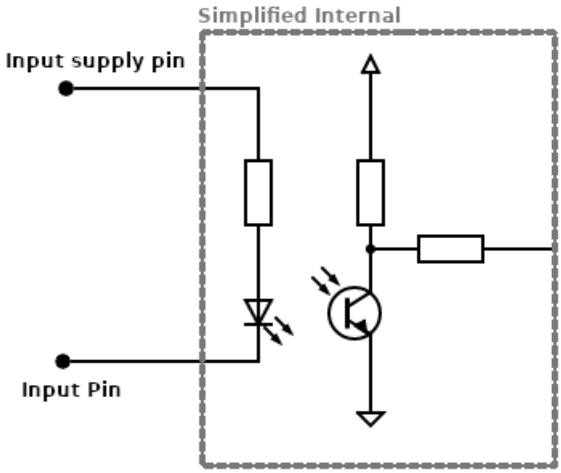
Pin Number	Description
1	Ground
2	RS422 TX + (OUT+)
3	RS422 TX - (OUT-)
4	RS422 RX - (IN-)
5	RS422 RX + (IN+)

Input Hardware Connection

Inputs are driven low from an external source, with the first 8 inputs requiring an external supply on the single isolated power supply pin and the second 8 inputs requiring an external supply on a separate pin for each input.



Simplified internal input diagram for first 8 inputs.



Simplified internal input diagram for second 8 inputs.

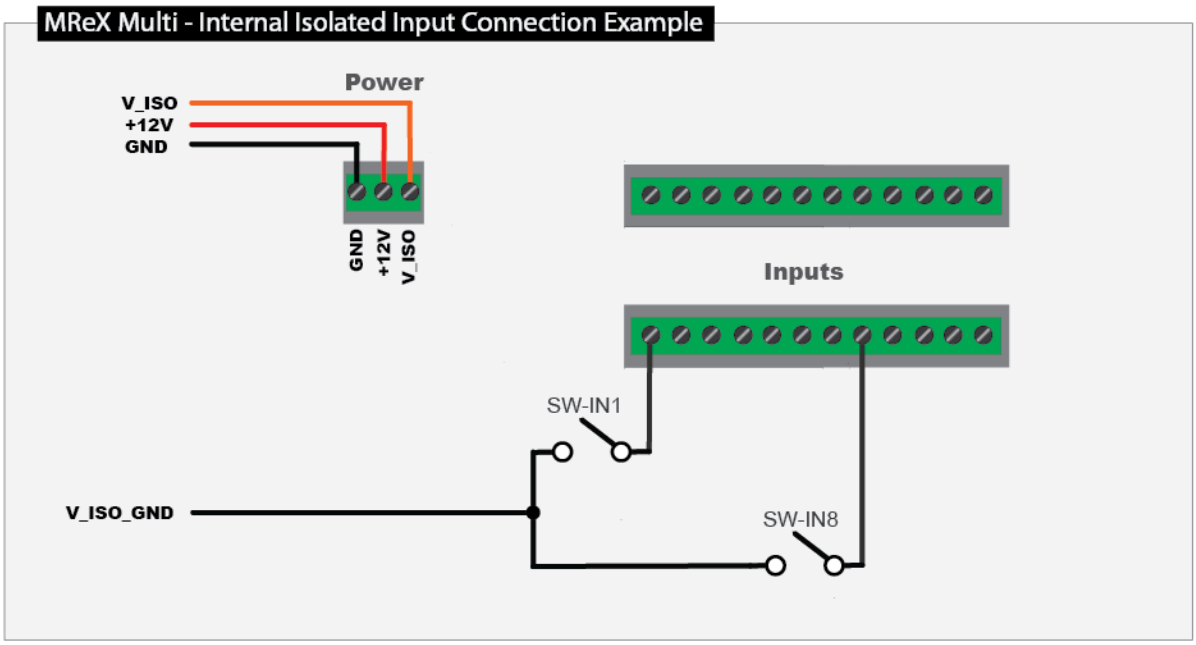
For specific electrical ratings, see **Specifications** section.

Note that when an input pin is pulled to ground, it's corresponding LED on the front of the device will be switched ON.

Input Connection Examples

Input 1 and 8

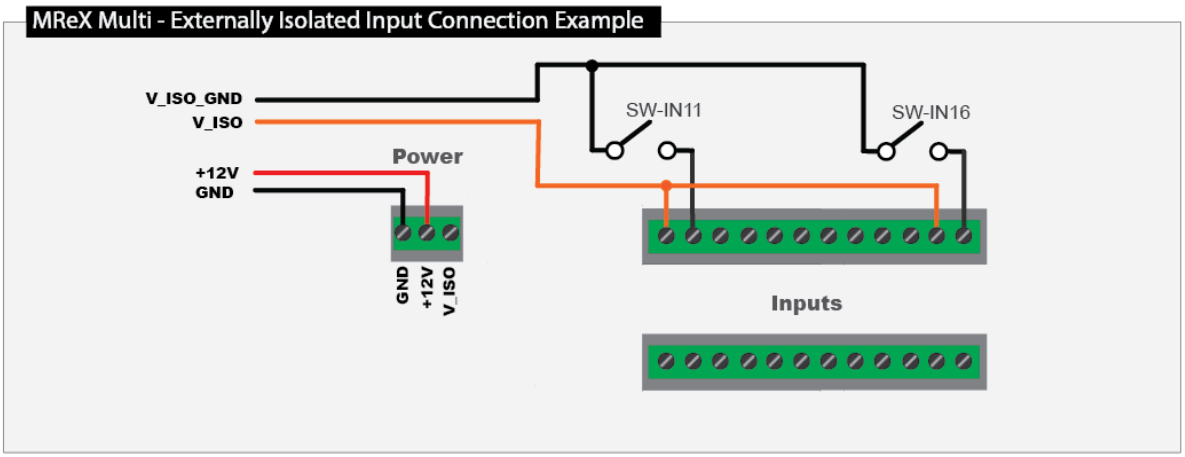
Input 1 to input 8 are internally connected to the power connector pin 3 (**V_ISO**) these 8 inputs internally share **V_ISO**. **V_ISO_GND** is the ground for the isolated supply, which may have no connection to **GND**. Optionally, electrical isolation can be ignored. In this case, **V_ISO** would be connected directly to **+12V**, and **V_ISO_GND** connected directly to **GND**.



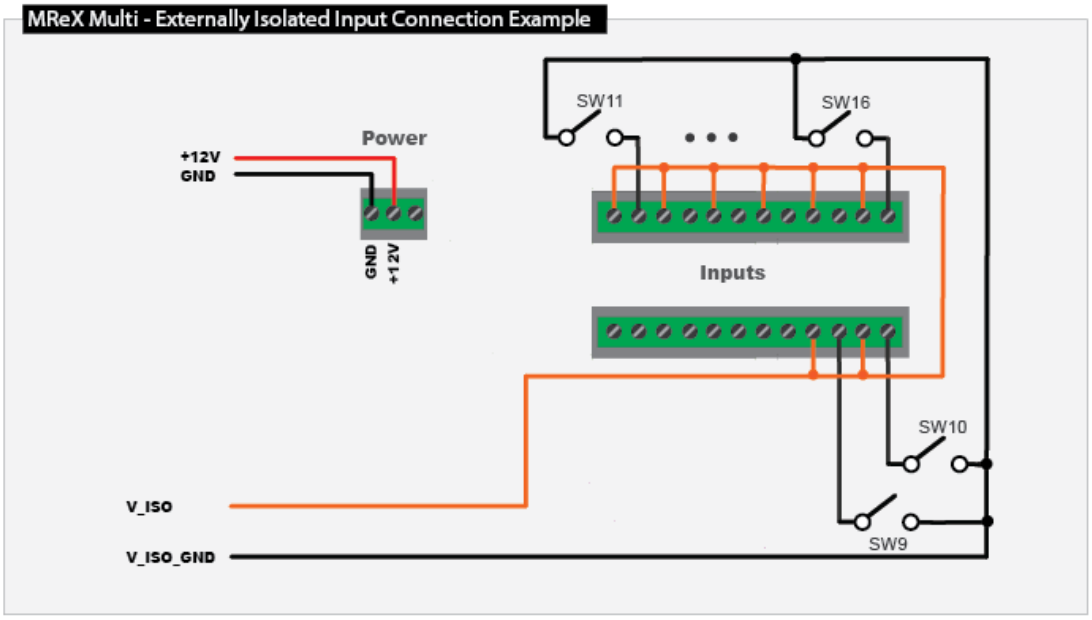
Input 9 and 16

Input 9 to Input 16 must be externally powered, the following example shows input 11 and input 16 been connected to an isolated power supply.

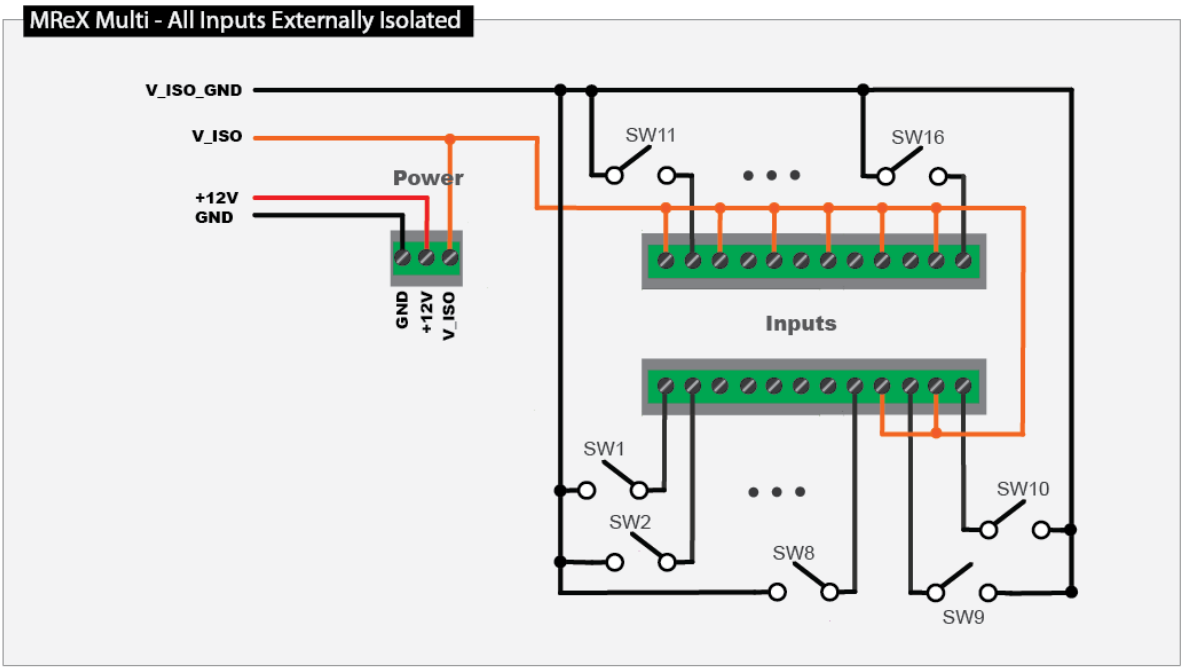
Example using Input 11 and Input 16



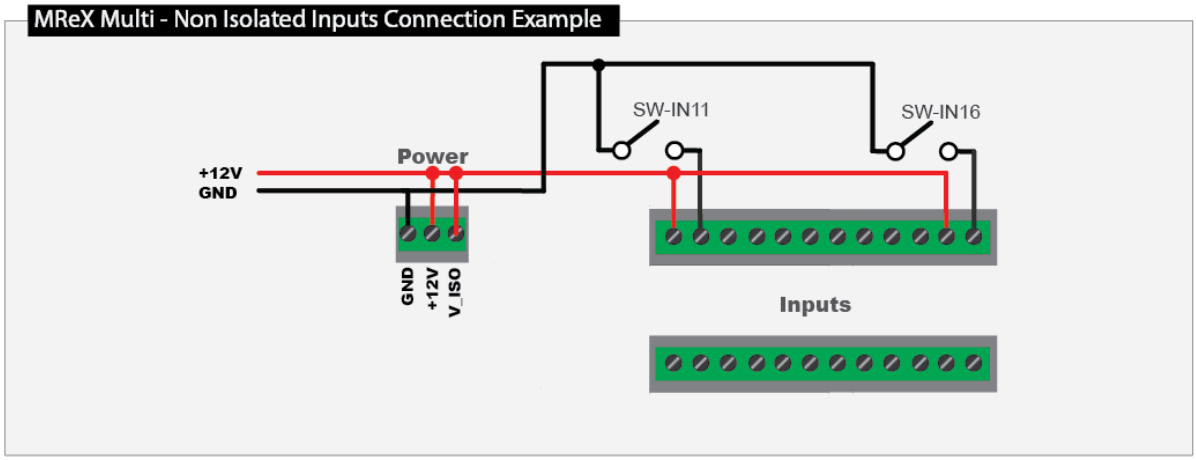
Example using Input 9 to Input 16



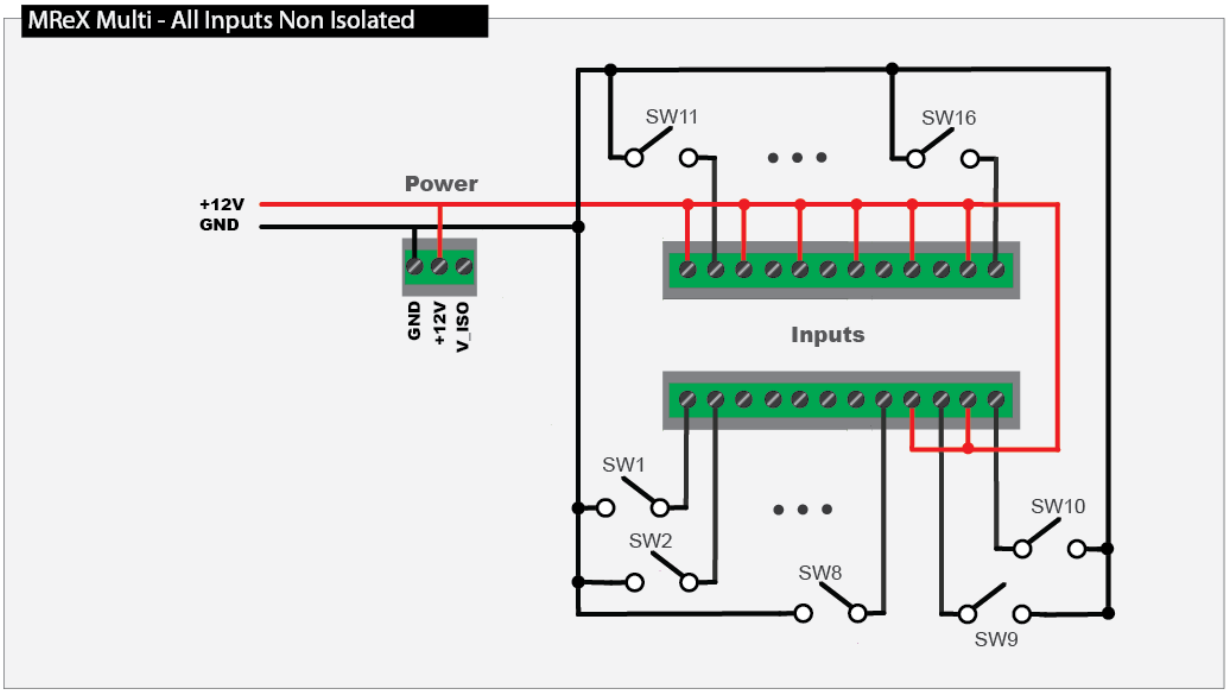
All inputs connects



NON Isolated

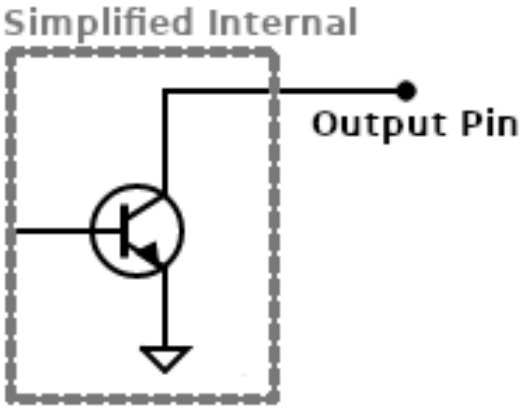


All non isolated



Output Hardware Connection

The MReX Multi-IO has 4 relay outputs and 12 open-drain outputs. When using inductive loads, such as relay coils, flyback diodes must be fitted to prevent damage to the MReX Multi-IO.



Simplified internal diagram for open-drain outputs

For specific electrical ratings, see **Specifications** section.

Note that when an open-drain output is being pulled to ground, it's corresponding LED on the front of the device will be switched OFF. When a relay output is closed, it's corresponding LED will be switched ON.

Serial Connection

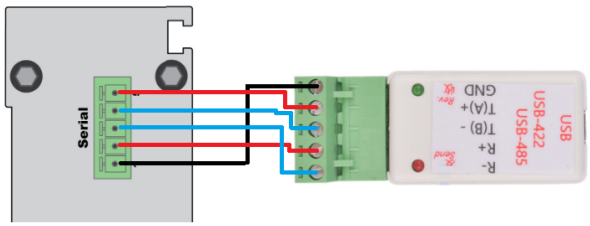
RS422 / RS485

The MReX Multi-IO supports RS422/RS485 connections in either a point-to-point configuration or a multi-point configuration with up to 10 listeners.

Point To Point Connection

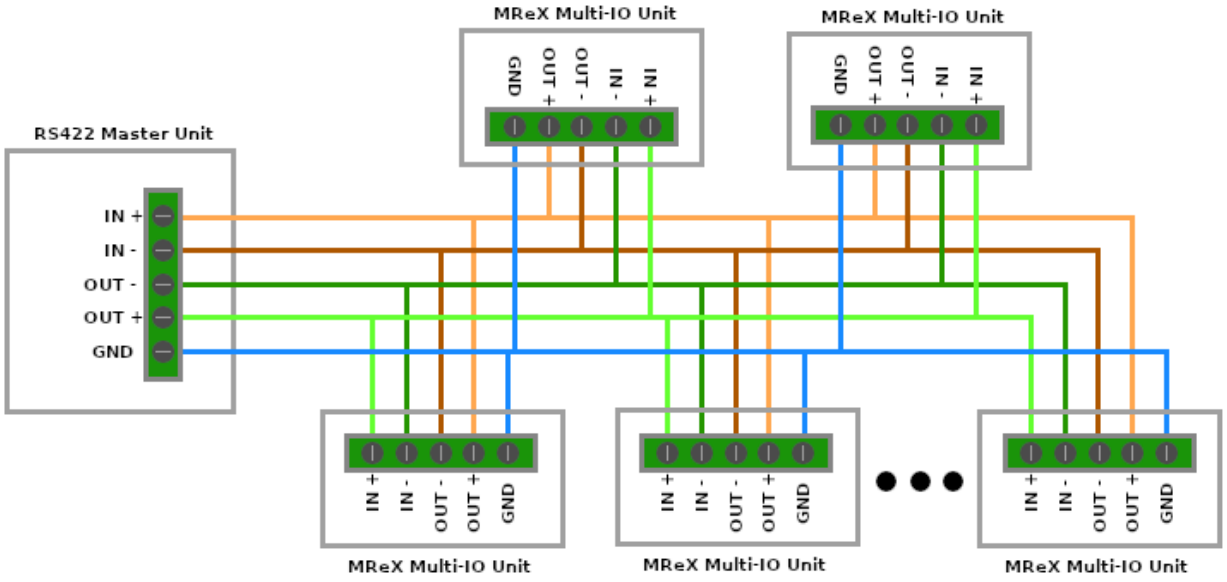
This configuration would commonly be used with a single MReX Multi-IO unit connected to either a PC to directly send commands via a serial terminal or to a TReX unit for expanded IO capabilities.

When connected directly to a PC, a common RS422/RS485 adaptor should be used, or alternatively, shown in the RS232 section, a simple adaptor can be constructed.



Multi-Point Connection

This configuration would commonly be used with multiple MReX Multi-IO units connected as listeners to a master unit. This master unit could be a PC, a TReX device or another MReX Multi-IO unit. This would allow the master unit to control the IO for each individual MReX Multi-IO unit over a single RS422/RS485 connection.

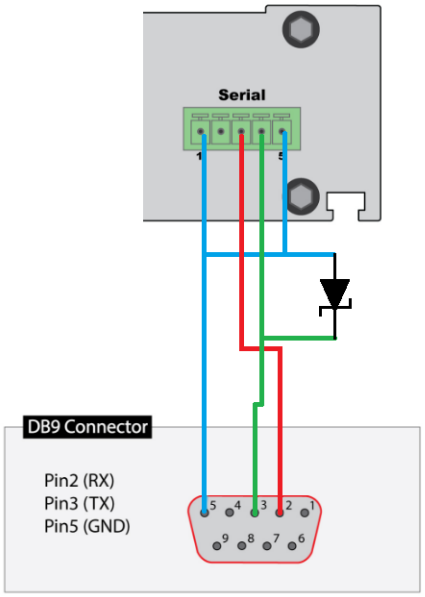


Bus Terminating Resistor

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.

RS232

The MReX Multi-IO does not include a dedicated RS232 port, however, simple support can be provided for a standard RS232 connection as follows:



Note: between pins 4 and 5 of the MReX Multi, a zener diode is fitted. This zener diode should have a breakdown voltage between 5 and 10 volts.

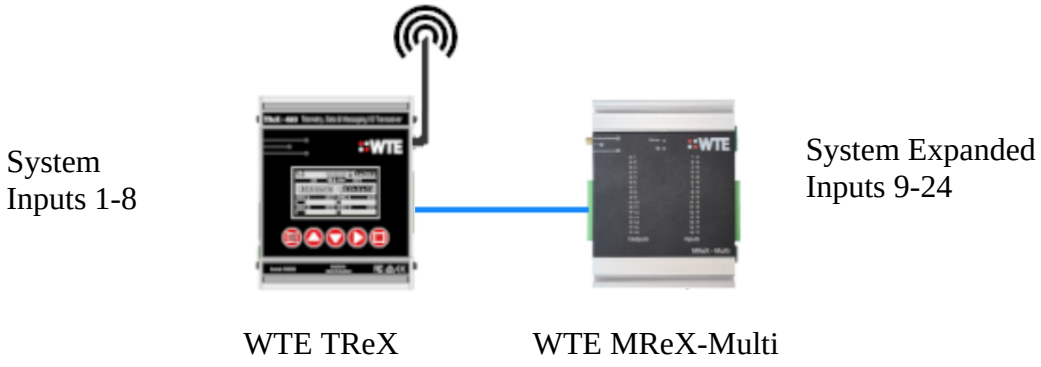
Multi-Unit Configurations

The MReX Multi-IO allows for a large degree of flexibility when setting up a network consisting of multiple units as it supports both wireless and wired connections between units. These connection options can be mixed within a network of units to customise that network to the specific needs of the user.

The following examples represent a small number of potential configurations.

Example 1

In this simple configuration, to the MReX-Multi is connected to a TReX to extend the available inputs and outputs. The desired outcome is have additional inputs for the TReX, all behaving as if they are part of the TReX itself. The MReX-Multi is not being used for any radio function, using the RS422 port to connect to the TReX. Any inputs triggered on the MReX-Multi should result in pre-programmed messages being transmitted by the TReX.



Messages are programmed on the TReX to transmit directly using the WT1234560A1B at the start of the message. The MReX-Multi is sending the message across the serial port only.

TReX:

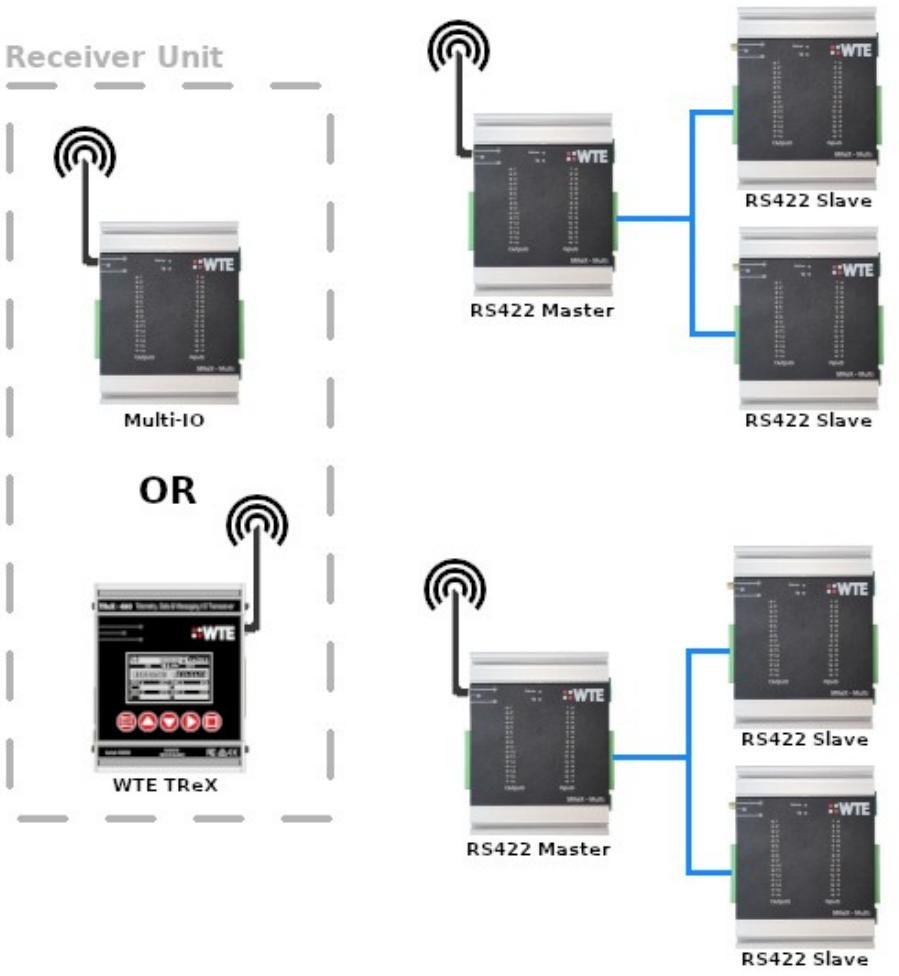
*IN_MSG_L=1:WT1234560A1B IN_LOW_1
...
*IN_MSG_L=8:WT1234560A1B IN_LOW_8

MReX-Multi:

*IN_MSG_L=1:WTS WT1234560A1B IN_LOW_9
...
*IN_MSG_L=16:WTS WT1234560A1B IN_LOW_24

Example 2

In this configuration, 2 sets of 3 Multi-IO units need to report their IO back to a central TReX or MReX Multi-IO operating as a receiver. Both sets of units have their own RS422 bus with one unit acting as an RS422 master and two acting as slaves.



If an MReX Multi-IO unit is used as an RF receiver, then the total I/O capacity of the network is 112 inputs and 112 outputs, the latter including 28 relay outputs. This I/O is distributed across 3 separate locations.

To configure this network, the following commands are required:

RS422 Slave Units:

**IN_MSG_H=N:WTS<SPACE>WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

**IN_MSG_L=N:WTS<SPACE>WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

where:

N is input number to be configured (1 – 16).

WTS are the characters WTS.

WTNNNNNNNXYZ is a standard WT protocol transmission header (see section **WT Protocol** for further details).

MMMMMM is the desired message payload to be sent for that specific input and input state.

Essentially, these commands configure the RS422 slave units to send a serial command to the RS422 master unit telling the master unit to transmit a specific message. This message could include the ID of the RS422 slave unit as well as the input number and state.

RS422 Master Units:

**IN_MSG_H=N:WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

**IN_MSG_L=N:WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

where:

N is input number to be configured (1 – 16).

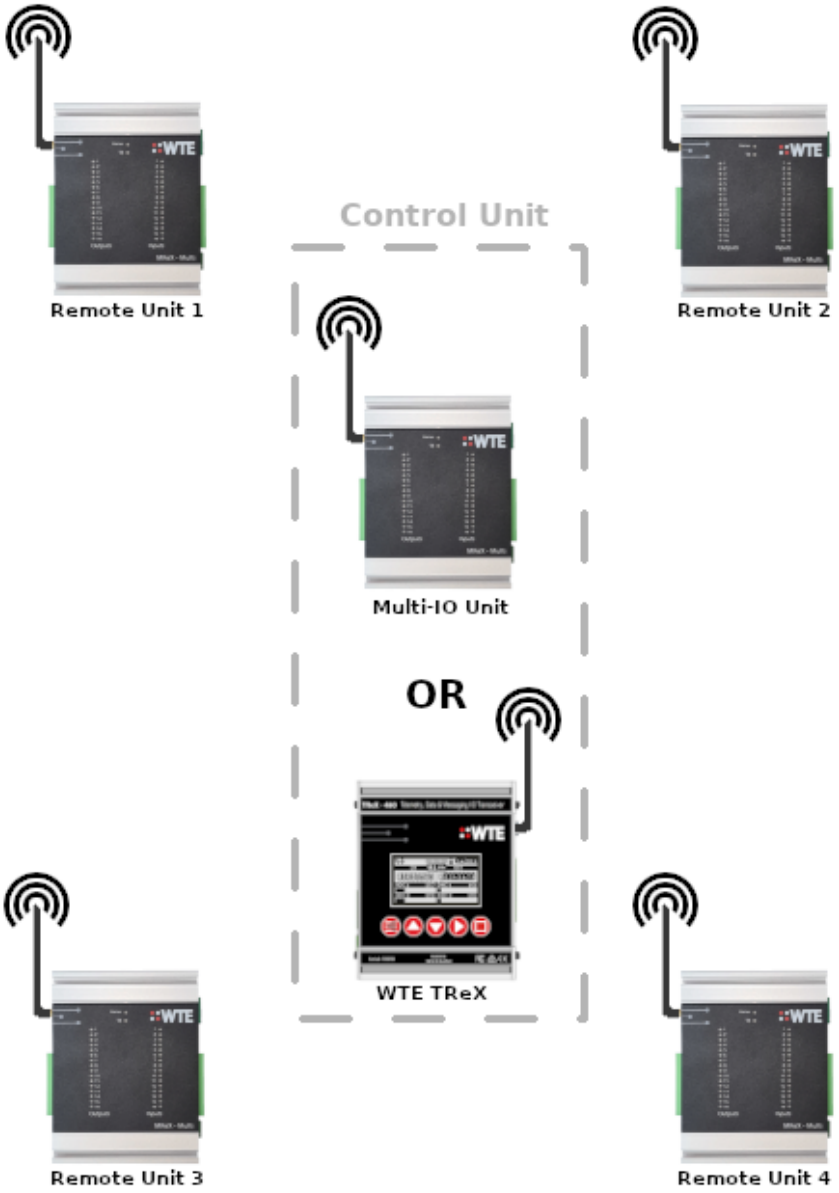
WTNNNNNNNXYZ is a standard WT protocol transmission header (see section **WT Protocol** for further details).

MMMMMM is the desired message payload to be sent for that specific input and input state.

These commands are similar to that of the RS422 slave unit commands with the exclusion of the WTS prefix as the RS422 master unit can transmit directly to the RF receiver unit.

Example 3

In this example, 4 separate Multi-IO units need to report their I/O back to a central control unit via RF link from 4 different locations and the central control unit needs to be able to set the outputs of the remote units individually.



If an MReX Multi-IO unit is used as a central receiver, the total I/O capacity of this network is 80 inputs and 80 outputs, 20 of which are relay outputs.

To configure the units in this network, use the following commands:

Remote Units:

**IN_MSG_H=N:WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

**IN_MSG_L=N:WTNNNNNNNXYZ<SPACE>MMMMMM<CR>*

where:

N is input number to be configured (1 – 16).

WTNNNNNNNXYZ is a standard WT protocol transmission header (see section **WT Protocol** for further details).

MMMMMM is the desired message payload to be sent for that specific input and input state.

Central Control Unit:

To change the outputs on the remote units, use the following commands:

WTNNNNNNNXYZ<SPACE>[[UNIT_ID]XXXX-YYYY]<CR>

where:

WTNNNNNNNXYZ is a standard WT protocol transmission header (see section **WT Protocol** for further details).

UNIT_ID is the unit ID of the desired device that controls the desired output. For details, see the **WT Output Control Protocol** section.

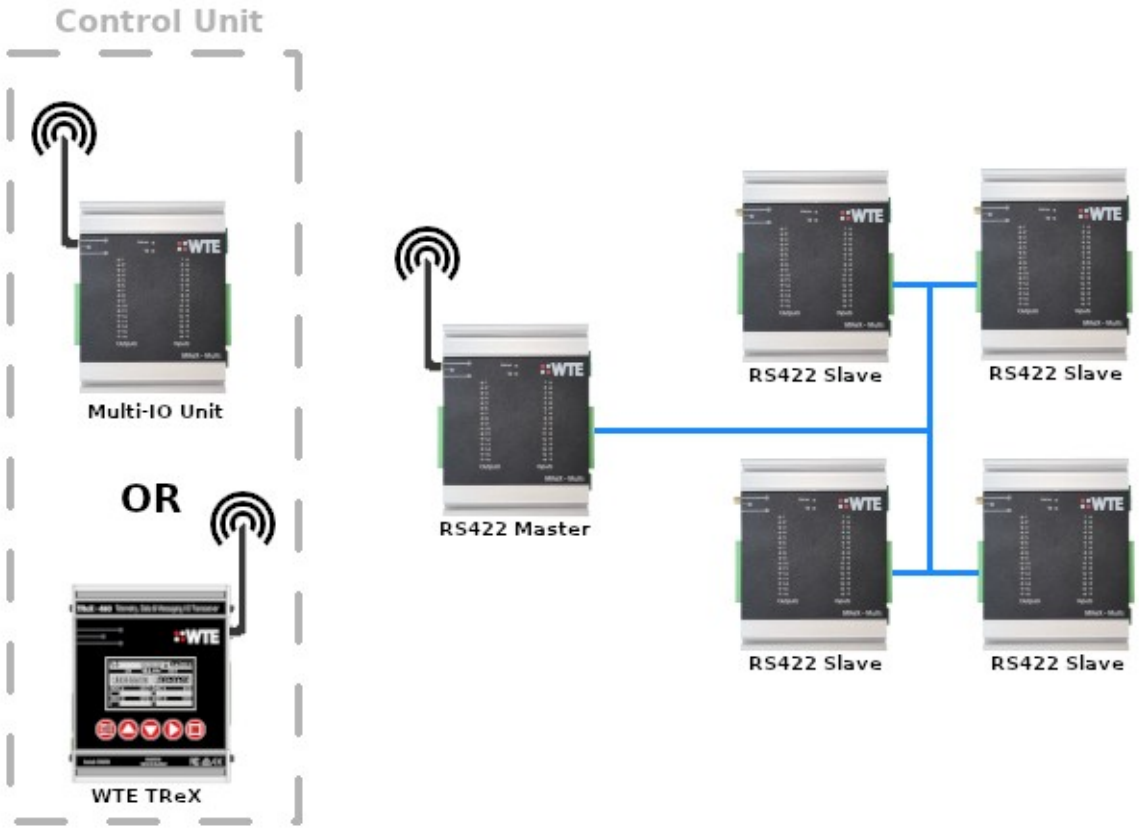
XXXX is the desired individual outputs to be switched on.

YYYY is the desired individual outputs to be switched off.

The total number of units that can be controlled by the central control unit in this network configuration is only limited by the possible number of configurable individual unit IDs.

Example 4

In this example, a central control unit (either a Multi-IO unit or a TReX-460) needs to control the outputs of 5 units remotely via RF link. The remote units consist of one RS422 master unit that maintains an RF link with the control unit and 4 RS422 slave units which report their I/O to the RS422 master unit.



If a Multi-IO unit is used as the control unit, the total I/O available to this network configuration is 96 inputs and 96 outputs, 24 of which are relay outputs.

To set the outputs of the remote units, use the following commands with the control unit:

To set both Master Unit and Slave Unit outputs:

WTNNNNNNNXYZ<SPACE>[[UNIT_ID]XXXX-YYYY]<CR>

where:

WTNNNNNNNXYZ is a standard WT protocol transmission header (see section **WT Protocol** for further details).

UNIT_ID is either of the configured unit IDs of the intended device that controls the intended output. For details, see the **WT Output Control Protocol** section.

XXXX is the desired individual outputs to be switched on.

YYYY is the desired individual outputs to be switched off.

Essentially, this command consists of a WT Output Control message that is sent to the master unit, which automatically forwards the message over it's RS422 connection. If the message is intended for the master unit, then it is handled immediately. If the message is intended for one of the slave units, it is handled once it has been forwarded over RS422.

MReX Firmware Upgrade

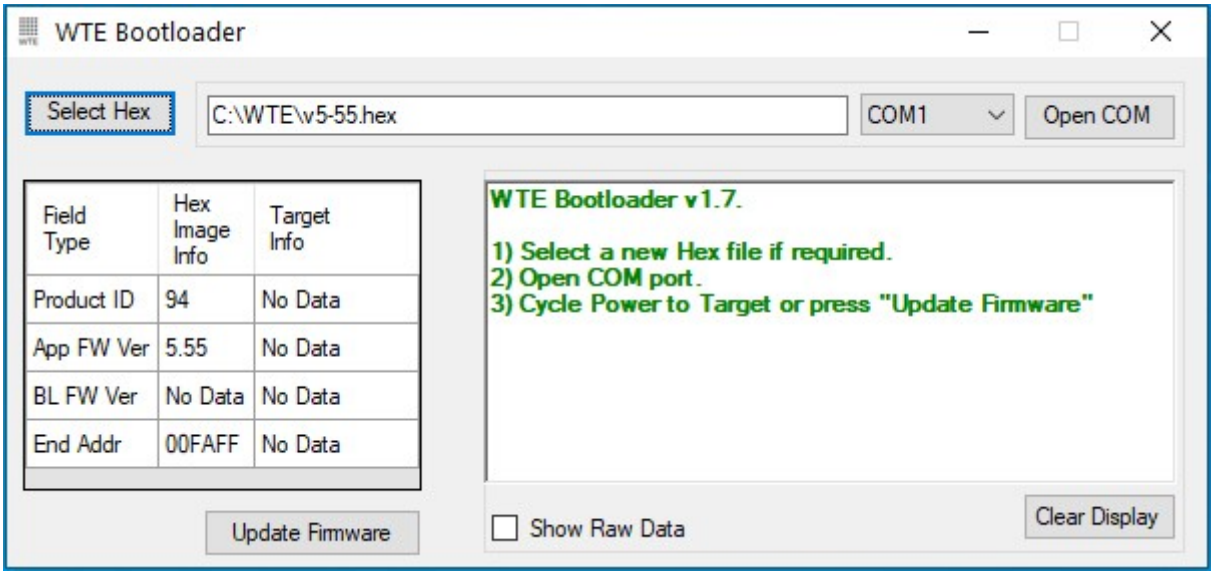
In order to update the MReX firmware you will need:

1. The WTE Bootloader Tool (available from http://www.wte.co.nz or provided if required from info@wte.co.nz).
2. RS422 Serial cable, or RS232 adaptor cable.
3. An appropriate encrypted hex file supplied by WTE Limited.

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

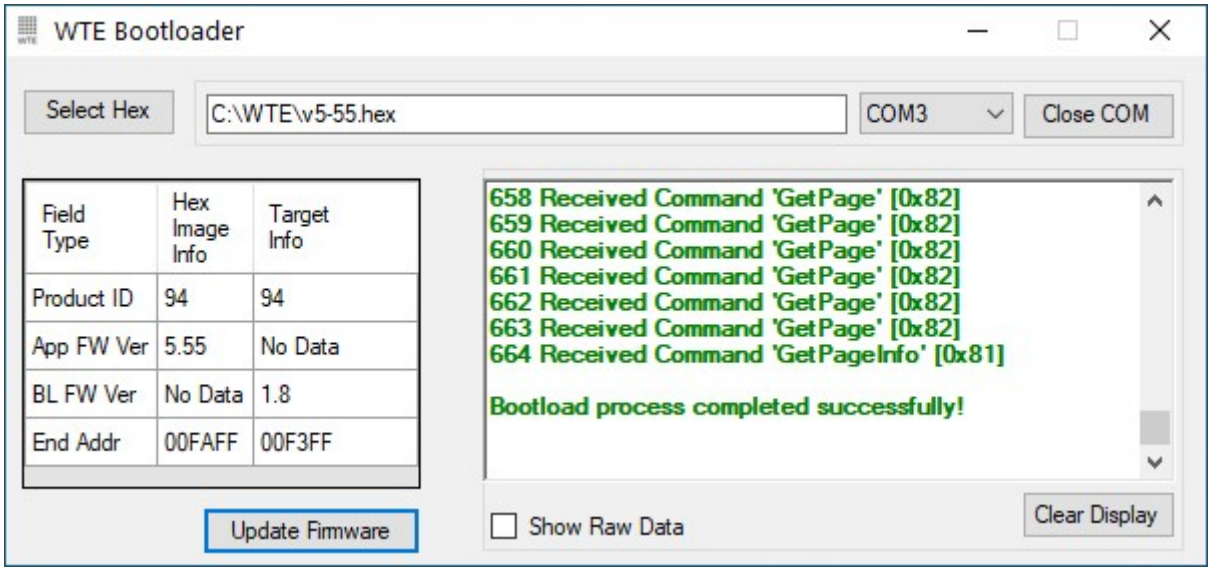
Firmware Upgrade Utility

This bootloader software has been customised by WTE to simplify the firmware replacement process for the MReX, This 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. MReX must be powered and connected to a RS422 serial cable, please refer to **Connecting to the MReX** section of this manual for more information.
3. Press the "**Select Hex"** button on the WTE Firmware Update Tool and select the appropriated MReX firmware file.
4. Confirm that the App FW Ver displayed is the version described in the file name.
5. Select the correct COM port on the WTE Firmware Update Tool
6. Press "**Open COM**" button on the WTE Firmware Update Tool
7. Press "**Update Firmware**" on the WTE Firmware Update Tool to send the new firmware to the MReX.
8. Wait for the WTE Firmware Update Tool to indicate that programming has been completed.

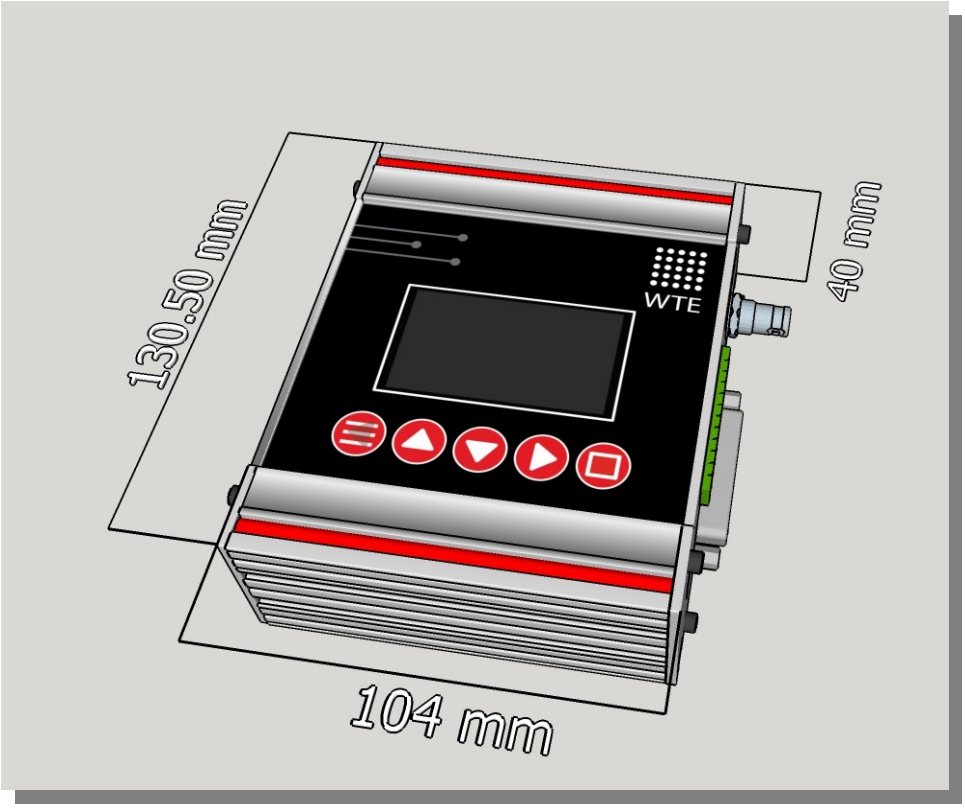


The MReX now is ready and the WTE Firmware Update Tool can be closed.

Physical Dimensions

TReX and MReX-Multi physical dimensions are 104mm x 130.5mm x 40mm (Length x Width x Height)

Weight: 550 grams



Mounting Hardware

The MReX-Multi 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
- Supplied nut slot inserts.

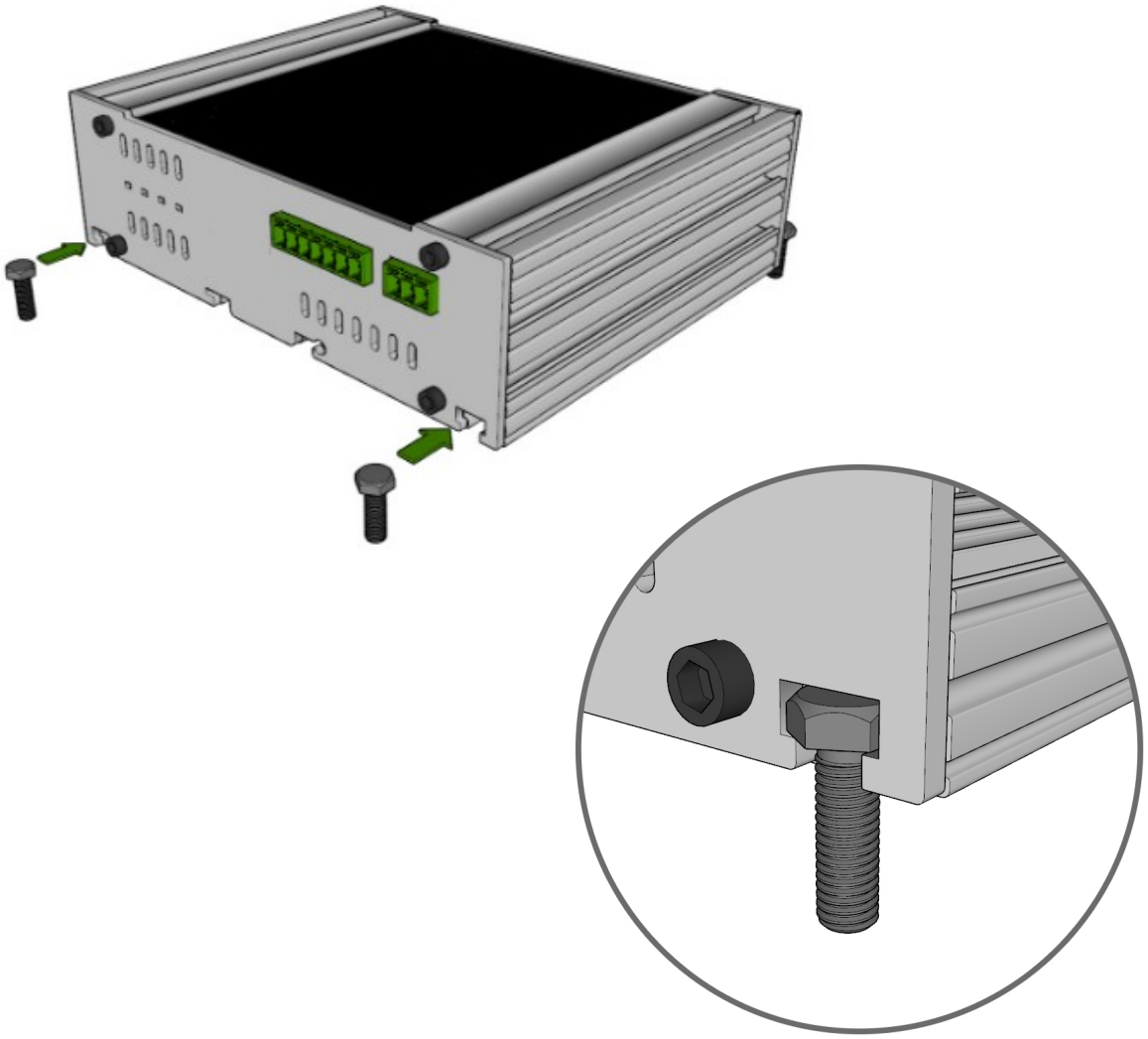
Please look the following images and descriptions to correctly mount.

Mounting Channels

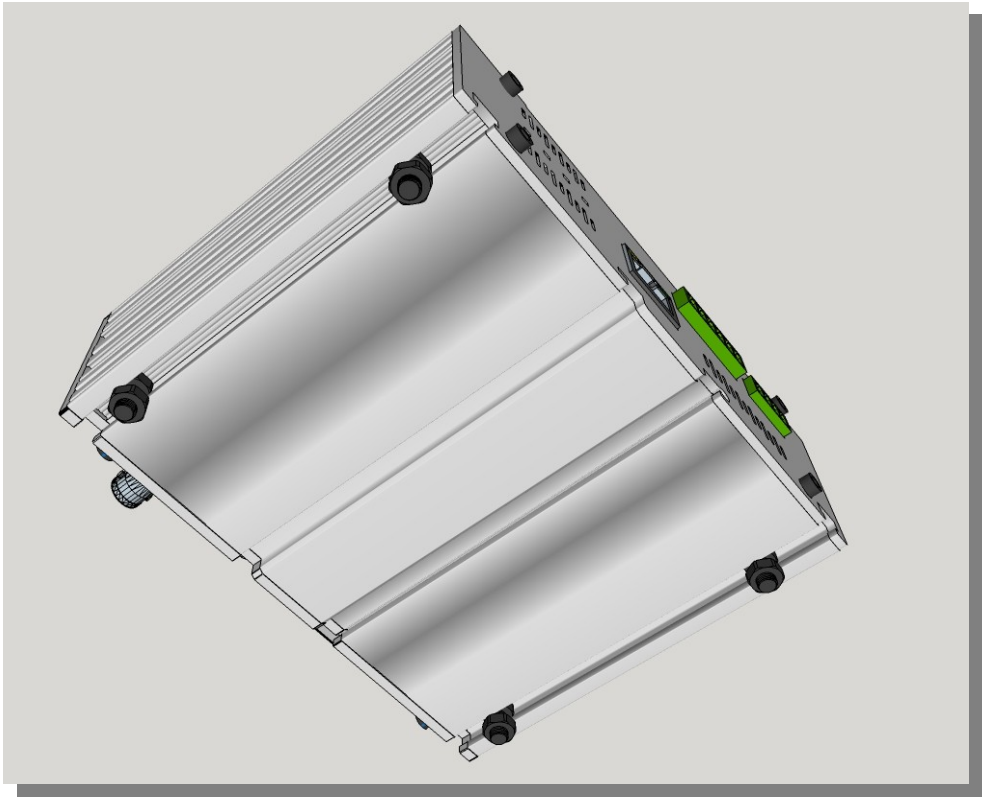
This product has channel strips on the front, rear, top and bottom. In order to access the front, top and bottom channels (less common mounting option) the end plate on the power cable side will need first to be removed using a hex key. Mounting from the rear does not require the removal of the end plate.

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 product and invalidate the product warranty.



Bottom Mount

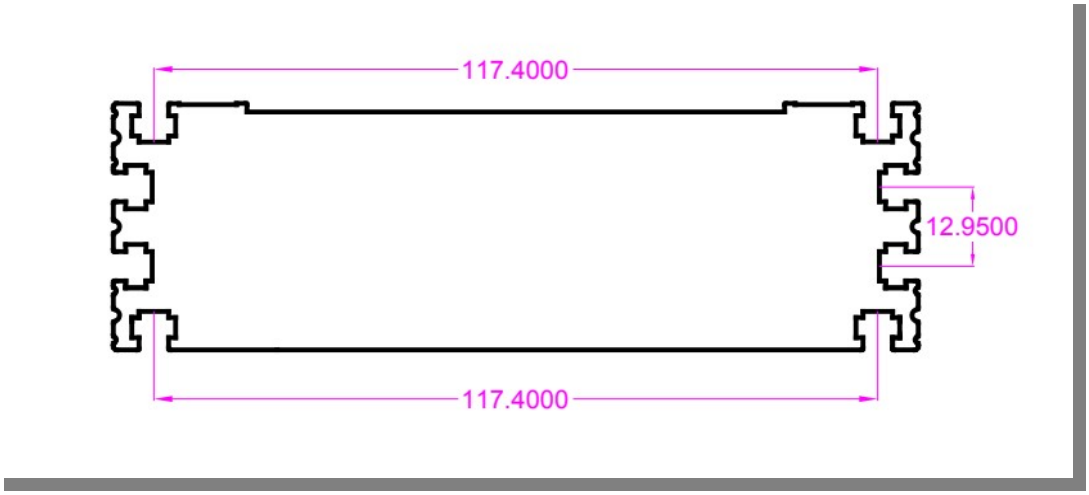


Mount Bolts Dimensions

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

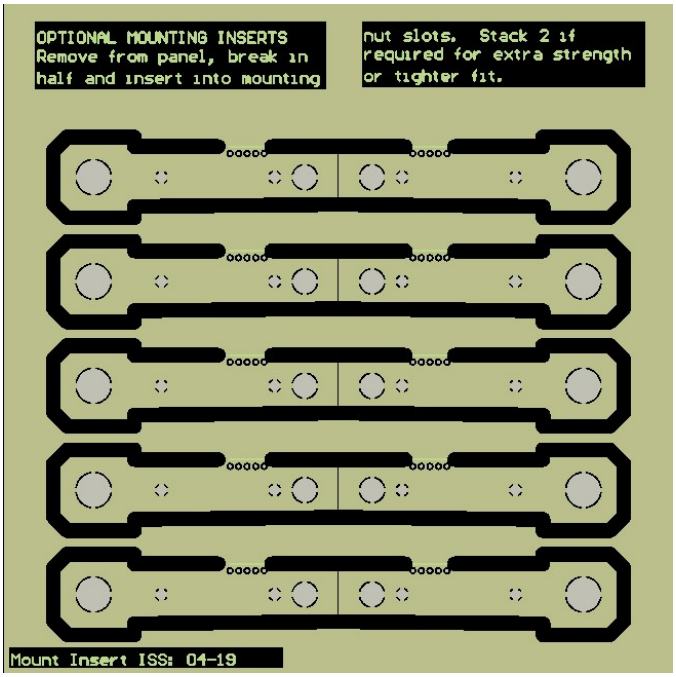
The channels space from centre to centre in the top and bottom of the radio is 117.40mm

Dimension are in millimetres

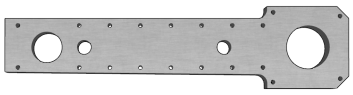


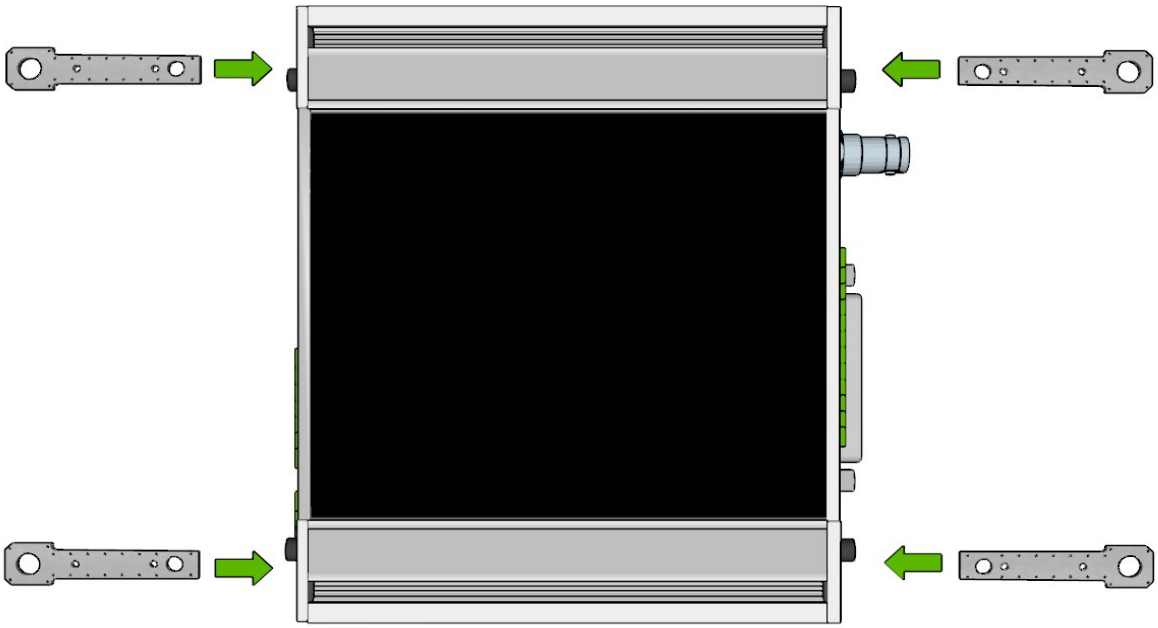
Optional Mounting Inserts

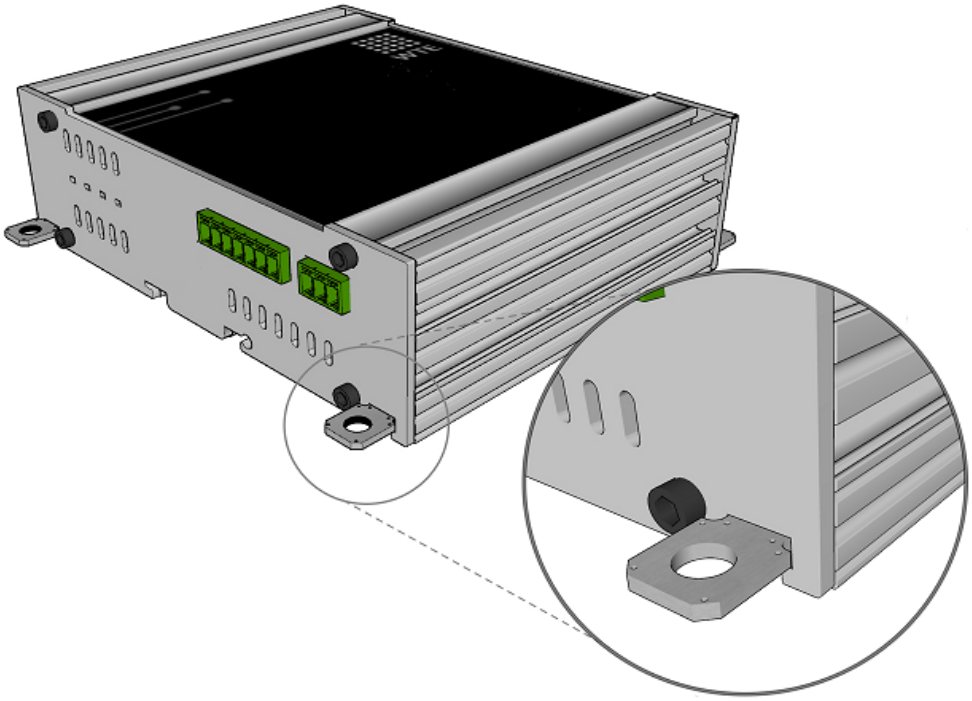
The optional mount inserts, provided with the product, can be used to mount to a panel/enclosure using M4 Screws as shown bellow.

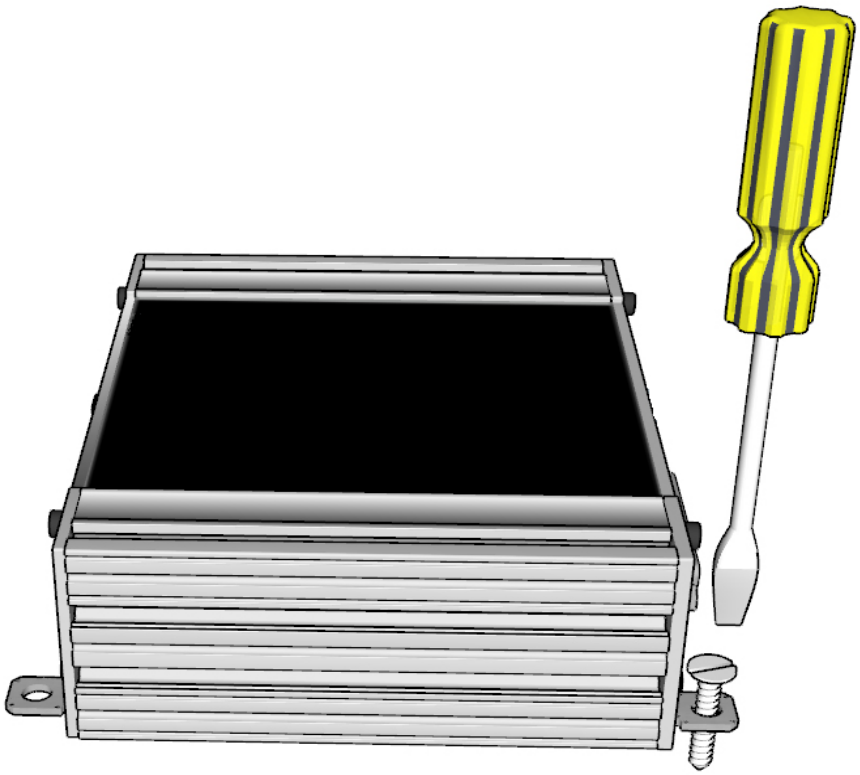


Remove all the insert mounts from the panel in order to use.

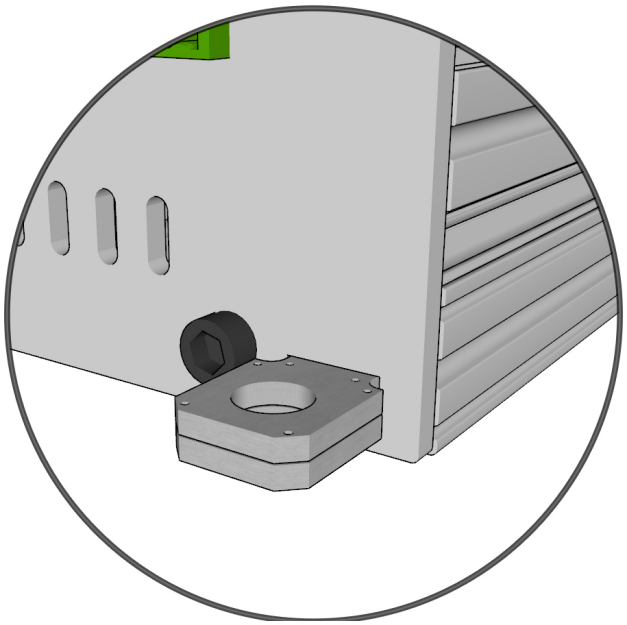








Optionally two mounting inserts can be used for extra strength.



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 aerial specialist who will be able to advise and construct an aerial 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 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,

β_0 (0.8279) accounts for terrestrial refraction.

This formula can be simplified to:

$$d=1.17*\sqrt{h_f}$$

Where:

d = range in nautical miles,

h_f = the height of your antenna in feet.

Working with metric units this formula becomes:

$$km=2.17*\sqrt{0.305*h_m}$$

Where:

km = range in kilometres,

h_m = the height of your antenna in metres.

Therefore:

Antenna Elevation (metres)	Clear Line of Sight Distance (km)
1	1.2
5	2.7
100	12

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 for some range calculation details)

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 defense 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 on the certified and internally fitted MReX module. Also serial number and model information are sent to 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.

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.

Specification

Frequency Range:
- MReX-460: 421 - 480 MHz

Tx/Rx Frequency Accuracy:
- 0.5ppm. 235Hz max error at 470MHz over entire temperature range.

Fixed Supply Voltage:
- 6-15V

Digital Inputs:
- 16, optically isolated. 8 with a common isolated supply connection, 8 individually isolated. To operate, connect either the common isolated supply pin or the specific input corresponding supply pin to a supply of 5-24V and pull the input pin to ground.

Digital Outputs:
- 12 open drain. Max allowed supply voltage 24V. Max rated current 100mA. Digital outputs are NOT short circuit protected.
- 4 relays. Maximum voltage across terminals 30V. Max rated current 500mA.

Message length:
- Input max configured message length 40 characters

Temperature Limits:
- -10 to + 55 degrees Celsius.

Max Tx Power: (+/- 1dB)
- 20dBm (100mW)

Max Rx Input Power:
- 13dBm (any level above this will destroy the receiver)

Receiver Sensitivity (+/- 1dB) @ 450MHz
- -126 dBm (512 baud),
- -124 dBm (1200 baud),

Serial Input Max message length:
- Up to 5 messages with 128 character can be queued for decoding or transmitting.

Antenna Connector:
- SMA female.

Operating Current:
- 23mA receiving, up to 102mA (depending on configured TX power) transmitting into

matched 50 ohm antenna.
- 150mA when controlling outputs and all outputs have been enabled.

Firmware:
- Field upgradable.

Physical Dimensions (L x W x H)
- 104mm x 131mm x 41mm

Mounting:
- Rack
- Wall
- DIN rail

Serial Output:
- Serial 9600:8-N-1 baud.
- WTE protocol format.

POCSAG Encode and Decode Support:
- POCSAG 512 either alpha or numeric including batched.
- POCSAG 1200 either alpha or numeric including batched.
- POCSAG 2400 either alpha or numeric including batched.
- Adjustable POCSAG preamble from 64 to 5000 bits (576 default).

Radio Link Security
- Optional AES 128-bit and AES 256-bit encryption.

Modulations Supported:
25kHz Channel Width:
512 baud (FSK 4.4kHz), 1200 (FSK 4.4kHz)

12.5kHz Channel Width:
512 baud (FSK 2.2kHz), 1200 (FSK 2.2kHz), 1800 (GFSK 3kHz), 2400 (GFSK 2.2kHz), 4800 (GFSK 2.2kHz), 9600 (4GFSK)

6.25kHz Channel Width:
512 (GFSK 1.1kHz), 4800 (4GFSK)

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 CE

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