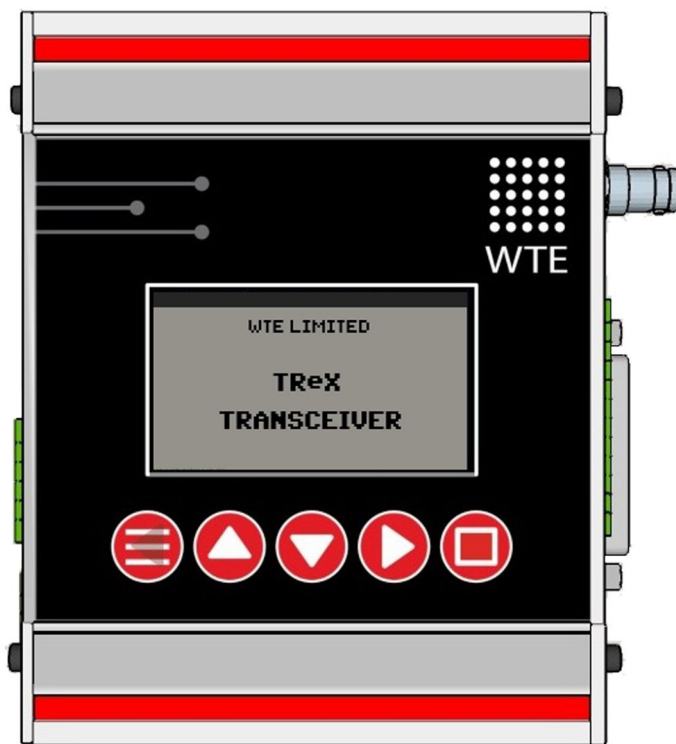


WTE TReX

IoT, TELEMETRY, DMR & MESSAGING I/O TRANSCEIVER



User Manual

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Introduction

Thank you for choosing the TReX.

The TReX is an Ethernet, Serial (RS232 plus RS485/RS422) and USB capable transceiver for data, paging (one and two-way) and general telemetry use. The TReX can be configured through; a simple integrated display and keypad, serial commands, TCP, USB or via a web browser. The TReX is suitable for commercial, industrial and remotely managed control/monitoring applications.

Use the TReX when high reliability, long range and high speed control or messaging is required.

The TReX can be used to:

- Transmit and receive POCSAG paging messages.
- Send DMR text messages.
- Operate as an IoT gateway allowing control and monitoring from devices supporting the MQTT protocol.
- Connect to third party SCADA control and monitoring systems using Modbus protocols.
- Log messages to internal memory to meet auditing requirements.
- Mirror analog and digital inputs to a remote unit.
- Inspect potential site interference using the integrated spectrum analyser.
- Report system and installation errors, such as loss of communications, and battery states.
- Detect antenna faults during normal operation.
- Transmit and receive serial and telemetry data at high data rates and over a very long range.
- Act as a repeater for forwarding telemetry and paging messages in poor coverage areas.

TReX Features

- Up to 4W power output.
- DIN rail mountable aluminium enclosure that also allows simple mounting from top, bottom or sides.
- Data transmit rates from 512 baud to 32K baud. Supported channel spacing of 25kHz, 12.5kHz and 6.25kHz.
- Support for an unlimited number of IoT devices to publish to a MQTT broker service.
- Support for **two-way** paging. Provides receipt of delivery and optionally receipt for accepted jobs.
- Supports 512, 1200, 2400, 4800 and 9600 baud POCSAG paging messages.
- Transmits DMR Tier 1 text messages (optional).
- Receives 1600 baud 2 level FLEX™ paging messages.
- Modbus RTU and TCP support for easy SCADA system integration.

- Paging store and forward repeater operation with configurable duplicate reject.
- 8 digital inputs and outputs.
- Two 0-10V/4-20mA analog outputs
- Two 0-10V analog inputs.
- Integrated spectrum analyser (optional).
- Simple to configure back to back mirroring and monitoring of analog and digital IO.
- Extended SCADA system expansion supporting up to 11 wirelessly connected units per system (optional).
- Optional logging to SD card of all received and transmitted messages.
- Graphics display shows all radio activity including I/O state.
- Multi language support (English and Spanish) and additional languages available on request.
- Fully configurable via front panel without the need for an external PC connection.
- Configurable via serial port, direct USB connection or Ethernet.
- RS232, RS422 and RS485 (both 4 and 2 wire) support.
- USB connection allows downloading of message logs or direct access to configuration files.
- Configured inputs can be programmed to output messages when triggered.
- Configured digital and analog outputs can be controlled via received messages.
- Any output can be assigned to indicate:
 - Channel busy. The channel busy output level is configurable.
 - Filtered match of message payload.
 - Reception of any message.
 - Comms link fail.
 - Antenna fault.
 - Low output power.
 - High temperature.
 - Low RF output.
 - Low supply voltage.
 - Change in any input state.
- Periodic message support to ensure radio link integrity.
- Low battery messaging.
- Support for additional protocols upon request and negotiation.
- Firmware upgradable.
- High stability oscillator ensuring a maximum of 80Hz drift (at 160MHz) over the entire specified temperature range.
- Antenna mismatch detection capability.
- High sensitivity receiver.
- Internal real time clock.
- Long-life design uses no moving or electromechanical parts. No limited life

components such as electrolytic capacitors.

TReX Versions

TReX-460:

IoT, Telemetry, Data & Messaging I/O Transceiver

TReX-460-R:

Ethernet Paging I/O Receiver (no transmit capability)

The TReX can be supplied to operate within these bands:

- TReX-160 (142MHz to 175MHz)
- TReX-460 (421MHz to 480MHz).

TReX I/O Connection Variants

The TReX can be supplied as different models with different input and output connections.

- **TReX-460** is the standard TReX using a DB25 connector.
 - 8 digital inputs
 - 2 analog inputs
 - 8 digital outputs
 - 2 analog outputs
- **TReX-460 i8o1** (all screw terminals)
 - 8 digital inputs
 - 2 analog inputs
 - 7 digital outputs
 - 2 analog outputs
 - 1 output relay
- **TReX-460 i8o8** (all screw terminals)
 - 8 digital inputs
 - 2 analog inputs
 - 8 outputs relays
 - 2 analog outputs

For more information on these TReX I/O variations please refer to the **Installation** section on this manual.

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 to 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.

⚠CAUTION

HAZARD OF THERMAL BURNS

High operating temperature possible when transmitting continuously for extended periods.

- Avoid direct contact with device while in operation.
- Install device in a restricted access location to avoid unintentional contact.

Failure to follow these instructions can result in minor injury.

⚠CAUTION

HAZARD OF RADIO FREQUENCY (RF) BURNS

Ensure that a matching load or antenna is attached to the RF port prior to applying power to the device.

The TReX operates at a moderately high power level. RF energy has the potential to cause burns.

Failure to follow these instructions can result in moderate 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

HAZARD OF DEATH OR SERIOUS INJURY

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 55 cm from all persons to satisfy RF exposure compliance.

DO NOT:

- Operate the transmitter when someone is within 55cm of the antenna. EN50383 regulatory limits have deemed that 55cm 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 1m 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.

All equipment should be installed only by a qualified technician or engineer.

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

⚠WARNING

THIS EQUIPMENT IS NOT INTENDED FOR MAINS VOLTAGES

- The TReX was **NOT** designed to operate and/or be connected directly to live main voltages. The TReX 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 TReX 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 TReX is intended to be mounted permanently either in a land based location or in a vehicle. When fitting in a vehicle, vibration damping mounts may be required.
- The TReX 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
- Avoid intrusion of any object/material into the radio case
- Care when stacking TReX boxes must be taken to not damage part of the radio, such as connectors.

NOTICE introduction of foreign object into the TReX radio enclosure will void warranty.

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 43cm 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 waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information regarding recycling, contact the dealer where the product was originally purchased.

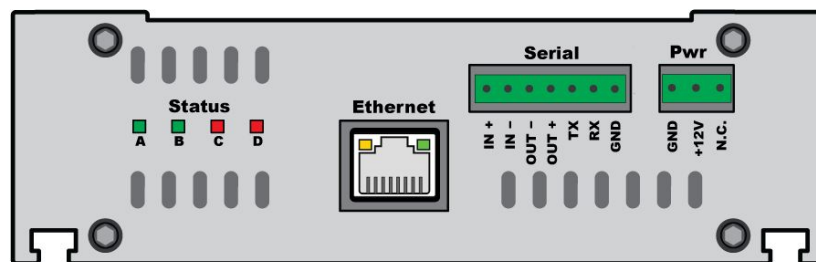
Operation

Once a 13.8V source has been connected to the power connector the TReX start-up status is displayed on the LCD.

When the TReX is operating normally, the two green status LEDs flash briefly once every second.

When decoding messages, the “A” green LED is held on for approximately one second.

The “C” red LED is held on for the duration of a transmission, while processing TCP data, Modbus protocol commands and decoding received messages. Both the “C” and ‘D’ red LEDs light while starting. The ‘D’ red LED remains lit if no IP configuration has been enabled.



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

After finishing the start-up procedure and loading of configuration settings the TReX enters its receive and decode mode of operation. The TReX now waits for commands to be entered serially for processing or inputs to be triggered. These may be either protocol messages to be processed or commands related to the configuration of the device. Serial messages may arrive on any serial port, or may also arrive through a TCP connection.

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.

The TReX outputs are driven high or low, or for a particular period of time depending on configuration. The outputs are controlled via the **WTE Output Control Protocol** message received and decoded. Each output can be configured to operate under various error states (Refer to **Outputs**).

Buttons



MENU/BACK:

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



UP:

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



DOWN:

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



RIGHT:

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



ENTER:

Used to select file related items from within the MAIN SCREENS.

Main Screens

The TReX top icon bar provides information about the display screen and operating status. The far right text indicates the selected main screen. This is either “IO” (inputs and outputs), “TX” (transmit) or “RX” (receive).



The time in the middle is the current RTC time (MENU->SYSTEM->TIME).

The “S” letter indicates that the master or slave SCADA telemetry modes are in operation.

The “M” letter, when present indicates that a Modbus telemetry request packet has been processed within the last 2 seconds.



The “Incoming” down arrow indicates that the TReX is in receiving (absent when RX is DISABLED). The “Outgoing” up arrow indicates that the TReX is transmitting.



The Icon “T” below indicates the TReX has been configured for telemetry stand-alone “Back-to-Back Mirror Mode”.



The back to back arrows indicate the unit is operating in “Serial Link” Telemetry mode.



The RJ45 connector icon is used to indicated when the TReX is TCP connected.



The chain link icon indicates when there is an active link to another device. Each time a message is received this icon is shown. This icon is also present immediately after start to ensure a link fail alert is not immediately raised after startup.



Same as chain link icon used by firmware versions prior to 2.38.



The “X” indicates a loss of an active link. This occurs when there has been no messages received for a configured period of time. The “link-fail” output if enabled will operate when this icon is shown.



The bell icon is shown when there is an alert that has been raised. This may operate an output if configured.



The far left battery icons indicate system voltage as a proportion of the configured high and low battery levels (MENU->INPUTS->BATT HIGH/LOW V).



The crossed out speaker indicates that the sounder has been disabled. Alerts and keypresses will not produce any sound.

IO Screens

Screens that relate to inputs and outputs.

IO (1):

All input and output states. Each IO highlighted state changes if the IO level is HIGH or LOW. There is a small line above each input or output if HIGH, and a line below if LOW. All ADCs (analog inputs) and DACs (analog outputs) show a bar graph as a proportion of full scale and display a raw count from 0-1023. When scaling has been applied to an analog output, the DAC value shown is the unscaled value.

In the middle, shown in larger text is “01”. The number “01” in this case is the telemetry UNIT ID. When TELEMETRY->MODE is configured to SCADA_MASTER a small down arrow may be visible if the TELEMETRY->REMOTES have been configured to be more than 0. Pressing the down arrow (when configured as a SCADA_MASTER) allows the UNIT ID to be cycled to view the IO of each remote slave in the system – allowing a possible system of up to 88 digital IO, 22 ADCs and 22 DACs to be viewed.

Next to the UNIT ID is the smaller number “123”. Each TReX resets this number to the LINK FAIL TIME each time a message is decoded. This “link count” reduces, and if reaches 0, the link fail output can be operated.

SCADA_MASTER TReX units allow the “link count” to be viewed for all remote TReX SCADA_SLAVE units.



TX Screens

Screens that relate to messages transmitted.

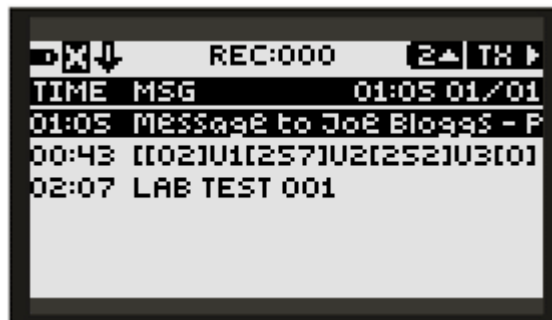
TX (1):

Last message transmitted. Includes the time the message was transmitted, message RIC (radio identifying code/CAP Code) and level (0-3). To the right the modulation type and rate is displayed also with the transmit frequency.

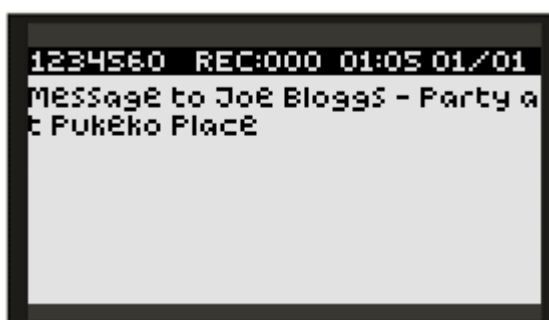


TX (2):

List of all time-stamped messages retrieved from internal storage. Most recent message displayed at top. Next sub-screen can only be selected when top entry is displayed. Note that messages are only available here when TX logging has been enabled (MENU->TX->MSG LOG).



When an entry is selected pressing the UP/DOWN buttons, pressing the ENTER button displays the entire message.



TX (3):

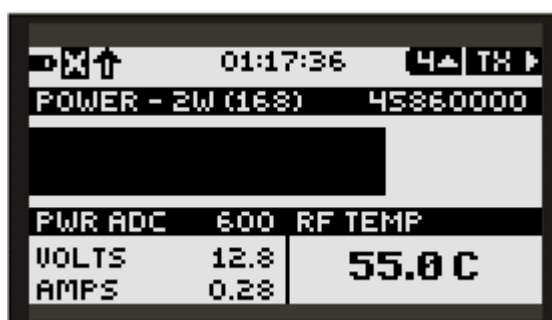
Displays the last transmitted message in large font. If the message exceeds the screen size, the DOWN button allows scrolling.



TX (4):

A TX power bar graph is displayed as a proportion of full power during a message transmission. Above the power bar is the text "POWER – 2W (168)". "2W" relates to the power setting in use. In brackets is the power amplifier DAC setting which is for factory use only.

The POWER ADC count is used to indicate forward power. RF TEMP relates to the RF amplifier temperature (not ambient) in degrees Celsius. VOLTS is the supply voltage and AMPS is the total supply current.



RX Screens

Screens that relate to messages received. Note, when messages are received, additional icons may be displayed in the top bar.

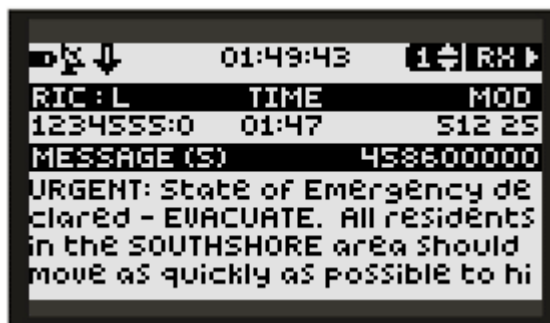


The second left icon changes from the “X” icon to the satellite icon when a message has been received. This indicates that the receiver is operational.

When the “BELL” icon is displayed with a following number, this means that there is an ALERT active. See **Alert Handling** for configuration and operation.

RX (1):

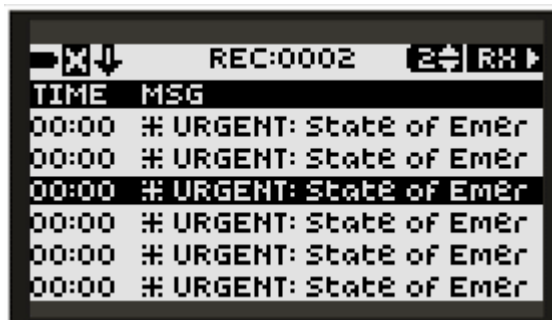
Basic summary of last received message. If the message is too large to fit on the screen the DOWN arrow will be visible in the title bar. Pressing the DOWN button will now scroll through the rest of the message.



RX (2):

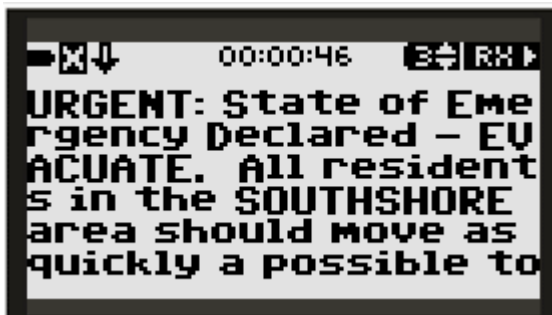
List of all time-stamped received messages retrieved from internal storage. Most recent message displayed at top. Next sub-screen can only be selected when top entry is displayed. Note that messages are only available here when RX logging has been enabled (MENU->RX->MSG LOG).

Messages starting with “*” are messages that met the ALERT filter requirements, and were eligible to operate the ALERT output when logged.



RX (3):

Displays the last received message in large font. If the message exceeds the screen size, the DOWN button allows scrolling.



RX (4):

Displays the signal strength of the configured channel in real time. Displays signal strength from -128dBm to 0dBm.

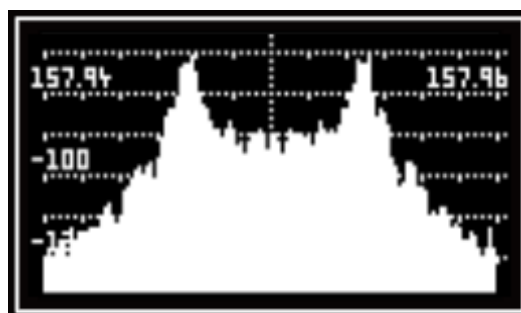
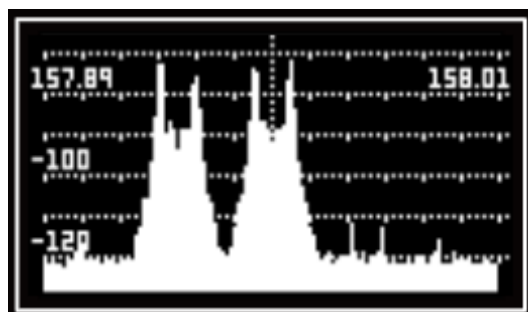
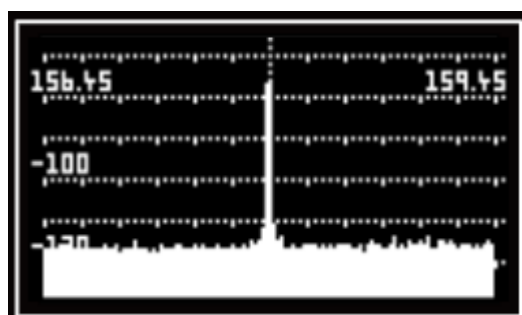
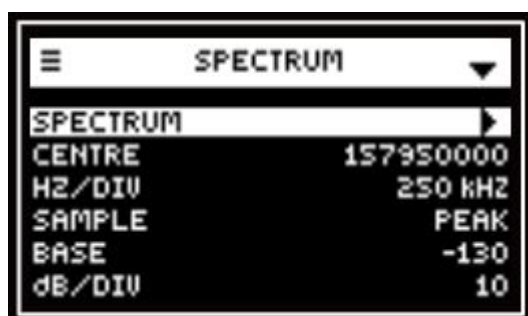


Site Configuration Tools

The TReX includes tools to ensure suitability for use at the current location and quality of the installation.

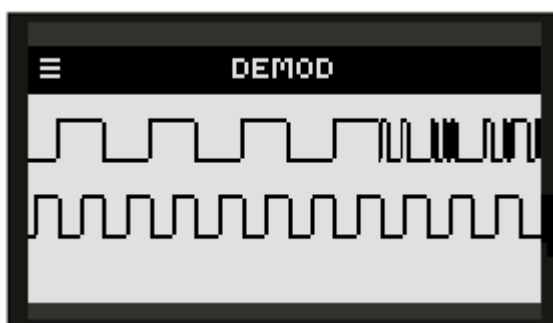
Spectrum Analyser

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



Demodulated Signal Viewer

The demodulated signal viewer allows inspection of raw demodulated data and the recovered clock from that data. This is useful for viewing channel activity. This facility is available for 2 level modulation modes of operation. 4 level modulation modes will display as straight lines.



Two-Way Paging

The TReX supports two-way paging. The TReX can return responses via serial or TCP connections. Transmitter capable TReX units can additionally respond at high power across the air.

Not only can acknowledgements be returned from the TReX, but confirmation of job acceptance receipts can be returned. This means that messages can be sent to single or multiple TReX units and clear details can be returned to notify if a message has been read or an action is being performed.

Applications for this feature include:

- sending messages to a fleet of vehicles (e.g. ambulance or taxi) for one of many to respond
- use in a muster station type scenario, where in the case of emergency, a warden can notify when an area is safe or all personnel are present.

Example:

An emergency dispatch system may send a paging message to a group of ambulances for attendance at an emergency. The message will be displayed on a TReX unit within the ambulance with prompt to attend if possible. Accepting the job can be performed with a simple keypress that will send receipt to the dispatch system that the vehicle is on-route.

See **WTE Ack and Confirm Protocol** for usage details.



With a single keypress, key messages can be responded to. Details of the responder are returned and logged.

DMR Messaging

The TReX supports the transmission of short Digital Mobile Radio text messages, allowing direct messaging to DMR radios. This is an optional feature.

The TReX 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 70 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 TReX concurrently supports POCSAG and DMR messaging, allowing an input to send messages to both legacy paging systems and newer DMR radios. Additionally a POCSAG and separate DMR database is provided allowing a message to be transmitted to many POCSAG and DMR devices from the same serial protocol message. DMR transmissions may be on different frequency than POCSAG transmissions.

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

All protocols implemented support direct DMR messaging. In order for a protocol to transmit directly to a DMR radio the DMR_DB database should be configured with group IDs, together with colour code, radio type and DMR radio frequency.

Configuration Methods

There are several methods to configure the TReX unit, such as:

- Directly from the front panel
- Via a web browser
- Via Serial terminal over the RS232, RS422 and or RS485.
- Via a TCP terminal (either client or server).
- USB connection and editing of the WTE_CONF.INI configuration file.

Configuration Backup and Restoration

Once the TReX has been configured using any of these methods, the configuration may be copied, backed up and restored if required. Using the method below, any number of TReX units can be quickly configured to behave identically.

To Backup Configuration:

1. Connect a USB lead from a computer to the TReX.
2. Wait for the TReX to appear as a mass storage device.
3. Copy the file WTE_CONF.INI to any location for backup.

To Restore Configuration:

1. Connect a USB lead from a computer to the TReX.
2. Wait for the TReX to appear as a mass storage device.
3. Copy the backed up file WTE_CONF.INI to the TReX, replacing the existing file.
4. Restart the TReX.

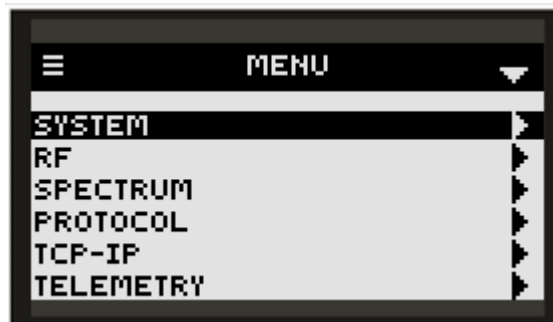
Front Panel Menu Configuration

All typical configuration items are accessible and configurable via the on-board menu system. This includes the ability to configure input messages. Through the use of the menu system the TReX is able to be set up and configured without any PC connection.

While inside the MENU transmit features are disabled to ensure that safe operating clearances are maintained. The TReX will continue to operate normally and transmit if required immediately on leaving the menu.

To enter the menu, press the MENU button. The top line icon bar shows when the DOWN button can be used when the DOWN arrow is visible. When scrolling down and the DOWN arrow disappears, then the end of the menu section has been reached. The UP arrow will be visible when navigation in the up direction is permissible. The RIGHT arrow indicates that the RIGHT button can be pressed to enter a MENU category when highlighted.

Pressing the MENU button again moves back one level, until the top is reached, and then the TReX leaves the MENU mode. If any change has been made, changes will only be written to internal storage when leaving the MENU mode.



To edit any field, first move to the item, press RIGHT to select the field. Once highlighted, the UP/DOWN arrows change the field. On completion, pressing RIGHT again will deselect the field.

Some fields are text that can be edited. There is a built-in text editor. Fields that are edited by the text editor are presented with the title “EDIT TEXT”.



Each character can be selected by pressing the RIGHT button. The selected character is inverted. Pressing the UP/DOWN buttons allows the character to be changed to any printable character. Characters can now be selected via the text input screen.



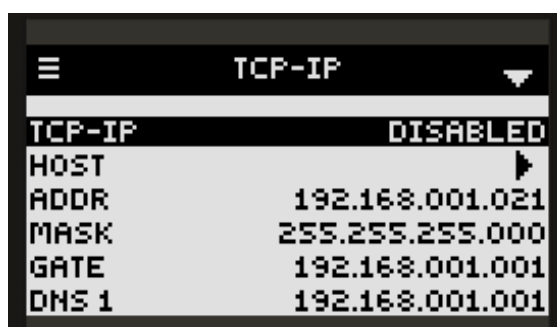
Once a character has been selected, pressing the ENTER button accepts the change.

The BACK arrow indicates the end of the text. This arrow is not part of the actual text but present as a marker. To make the text longer, highlight the BACK arrow and change the character using the UP/DOWN buttons. To make the text shorter or to delete a character, highlight the BACK arrow and press the ENTER button. Press the BACK button to exit the editor.

Web Browser Configuration

For web browser configuration to be possible (using browsers that support SVG such as “Chrome”, “Firefox” etc.), the Ethernet/IP must be ENABLED via the menu (ENABLED by default). This is located in SYSTEM->IP. In this menu section network parameters can be configured such as the IP, Mask and gateway.

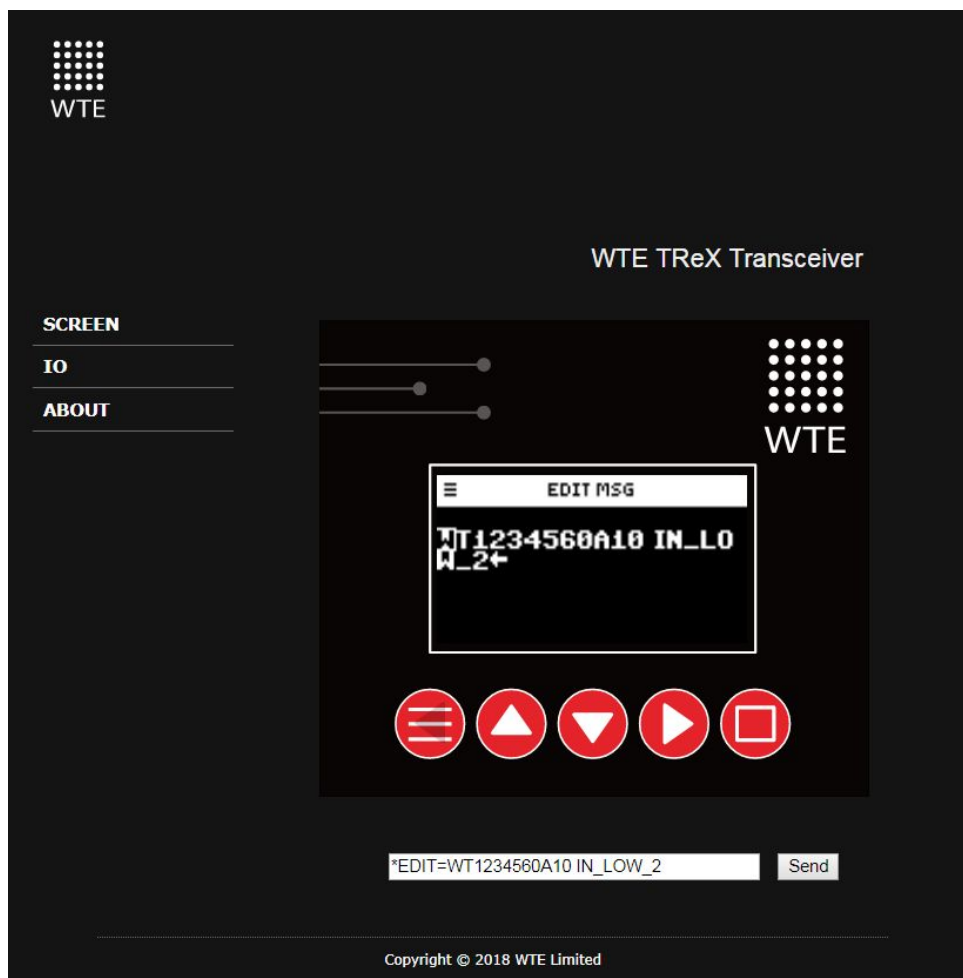
Only a single connection to the TReX should be allowed. Multiple connections will result in impaired responsiveness.



After the unit has been enabled to be use over the web, a web browser address matching the configured IP should be used. e.g.

<http://192.168.1.21>

This IP address is shown as a pop-up each time the TReX starts up.



Using the web browser the TReX can be remotely configured. When moving to a text field, the text box at the bottom of the browser is automatically loaded. Changes can now be made and committed by pressing the SEND button. This text box can also be used to transmit messages for a configured protocol.

Serial Command Configuration

Parameters can be changed using any common serial terminal (available on request if required) program using the RS232 or RS422/485 ports.

Start-up baud rate is determined by the baud rate as configured through the MENU.

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.

Typical usage:

**RX_FREQ?*

Typical response:

**RX_FREQ=160000000*

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*

**RX_RANGE=5:0,0*

**RX_RANGE=6:0,0*

**RX_RANGE=7:0,0*

**RX_RANGE=8:0,0*

To find the first range only:

Usage:

**RX_RANGE?1<CR>*

Response:

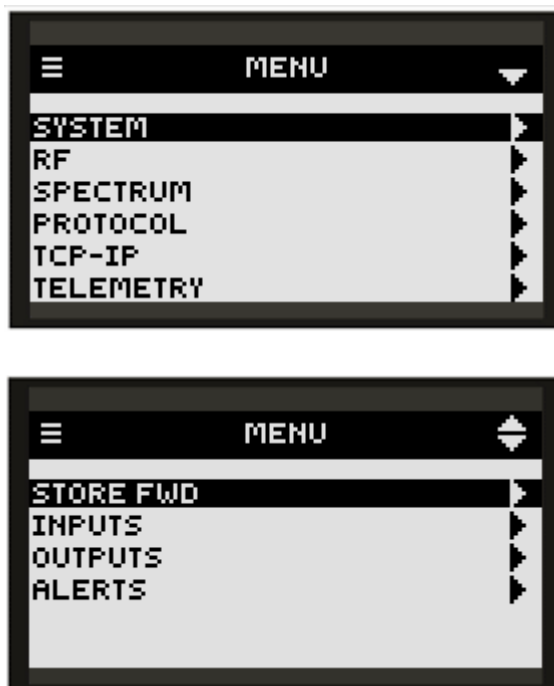
**RX_RANGE=1:8,2000000*

In order for any configuration changes made via serial to be saved the command **SAVE<CR>* must be sent to the TReX before removing power or restarting.

Note: Although most configuration changes are applied immediately, 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.

MENU Configuration



SYSTEM

Configures language, backlight, screen contrast, time, unit ID, sound, baud rates, factory test, main operating screens and menu lockout.

RF

Transmitter and receiver configuration items. Includes frequency, baud rates and logging settings.

SPECTRUM

Configures and allows access to the spectrum analyser.

PROTOCOL

Control of the handling and formatting for incoming and outgoing messages.

TCP-IP

Control of all aspects of internet connectivity. Allows remote configuration and operation through the use of the “Chrome” or “Firefox” web browser, TCP client or TCP server.

TELEMTRY

Determines if operation is on a controlled protocol basis, or autonomously operating input states to a remote TReX device.

STORE FWD

Configuration of the paging store and forward repeater operation including duplicate reject.

INPUTS

Configuration of all inputs.

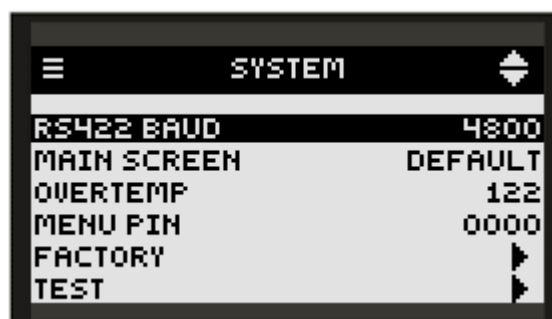
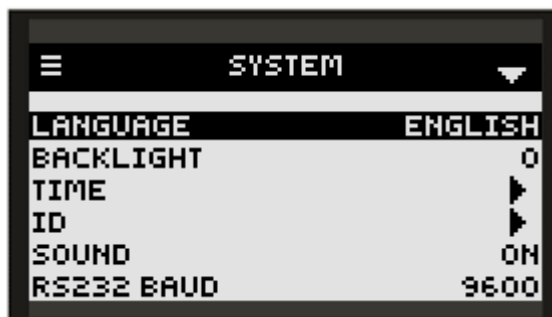
OUTPUTS

Configuration of all outputs.

ALERTS

Configuration of all alerts.

SYSTEM Menu



LANGUAGE

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

BACKLIGHT

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

TIME

Sets the internal clock.

ID

This is the unit ID that is used by the WTE output control protocol. This can be any number of alpha numeric description. e.g. “01” or “Unit-A”

SOUND

Allows control of system sounds that may be heard on an ALERT and also key beeps.
Items ON and OFF can be selected.

RS232 BAUD

Allows configuration of the RS232 port baud rate. All settings are N:8:1. Available rates are: 2400, 4800, 9600, 19200, 38400, 57600 and 115200.

Note: that for the most efficient transmission, the serial baud rate should be higher than the transmit over the air baud rate.

RS232 PARITY

Allows configuration of the RS232 port parity setting. May be set to N:8:1 or E:8:1

RS422 BAUD

Allows configuration of the RS422 port baud rate. All settings are N:8:1. Available rates are: 2400, 4800, 9600, 38400, 57600 and 115200

Note: that for the most efficient transmission, the serial baud rate should be higher than the transmit over the air baud rate.

MAIN SCREEN

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

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

MENU PIN

When the MENU PIN is set to a non-zero value, the MENU will be prevented from opening until the PIN is entered. Prevents accidental or unauthorised misconfiguration. If the PIN is ever forgotten, the PIN is visible using the command *CONFIG or viewing the WTE_CONF.INI file through a USB connection. Once the MENU is unlocked, it will remain unlocked until the unit is restarted.

FACTORY

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

TEST

Test sub menu for generation of test messages and testing of outputs.

REGULATORY

Regulatory items such as FCC-ID*.

*Note: Publication number 784748-D02, FCC-Part 90 allows for devices with integrated display to not require a printed label on the device holding this information.

CONTRAST

The screen contrast setting. Although the display is temperature compensated across the TReX operating range, at times improved viewing is possible through this contrast adjustment. Default value is 32.

TEST Sub Menu



	TEST	
1		0 mS
2		0 mS
3		0 mS
4		0 mS
5		0 mS
6		0 mS

1-8

Digital output to test. Pressing up pulls the output to ground for 60 seconds. Pressing down releases the output.

FACTORY Sub Menu

This menu is typically for factory use only or to return the unit to a factory new state.



DIAGNOSTICS

Diagnostic information for factory use only.

TERMINAL

Basic serial analysis tool for factory use only.

SERIAL NUM

Read only unit serial number.

KEY

The key used to unlock unit features. If features are purchased after sale, a new key may be required to be entered here. They key is unique to the unit serial number.

SET DEFAULTS

Used to set the TReX back to factory defaults. Calibration data is not cleared. This may be used at any time to restore the unit to a known starting point.

MIN PWR

Specifies the minimum power level as read from the forward power ADC during a

transmission. If this minimum level is not reached, there will be a transmit warning and the RF OUTPUT (Shared with the MISMATCH output) will operate if configured. This parameter should NOT be changed without instruction from WTE.

MAX PWR

Specifies the maximum power level as read from the forward ADC during a transmission. When this level is exceeded the RF OUTPUT will operate if configured. This parameter should NOT be changed without instruction from WTE.

MAX I (mA)

Specifies the max current that can be drawn during transmission. When there is an antenna mismatch the current will often be higher than under normal use. During transmission power ramp up the system current is examined limited to this value. If the limit defined here is reached, the RF OUTPUT will operate to indicate a fault condition. This parameter should NOT be changed without instruction from WTE.

TIME Sub Menu



HOUR, MIN, DAY, MONTH and YEAR

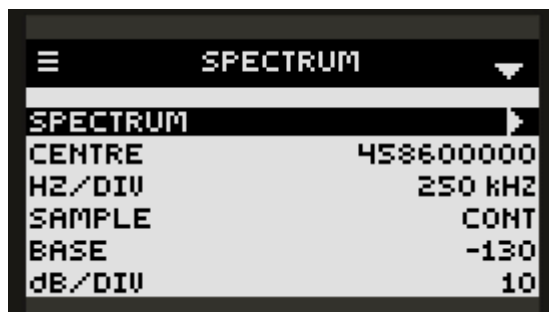
Configuration of the real time clock.

SOURCE

Determines how time is maintained in the TReX.

- RTC uses the internal real time clock to keep time.
- FLEX takes the time from the FLEX transmission time details (if present).
- SEQ TEST takes the time from national paging network (used in N.Z. only).
- NONE only uses the internal processor clock. This will only be the time since last reset.

SPECTRUM Menu



SPECTRUM

Displays the radio spectrum using the settings in this menu. Signals between -128dBm and 0dBm can be displayed. **Power levels above 17dBm (50mW) will destroy the receiver input.**

CENTRE

Displays the centre frequency to be displayed on the screen.

HZ/DIV

Either 250kHz, 10kHz or 2kHz. The screen is 6 divisions wide in 120 steps.

The RBW (receiver bandwidth) and frequency span is automatically set when the Hz/Div changes.

HZ/DIV	RBW	Frequency Span
250kHz	25kHz	3MHz
10kHz	1kHz	120kHz
2kHz	500Hz	24kHz

SAMPLE

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

BASE

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

dB/DIV

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

RF Menu



⚠WARNING

CHANGING RF PARAMETERS WITHOUT AUTHORISATION MAY RESULT IN PROSECUTION AND AFFECT OTHER USERS.

- The TReX can be configured to operate on many frequencies and at many power levels. Only use the TReX at power levels and frequencies legally permitted to do so at. If unaware of the restrictions of use for radio transmitters in the country of use, seek professional guidance.

Failure to follow these instructions can result in local body prosecution. Misuse may affect other radio users that may in return affect their safety when critical systems have been employed.

RF

When SIMPLEX, the TReX receiver frequency, modulation and mode are used from this menu (common to TX). This allows common parameters to be easily changed in a single place. When DUPLEX the TReX receiver frequency, modulation and modes are used from within the RX menu. DUPLEX may be desired when forwarding onto another device in a different format (such as receiving in FLEX on one frequency and transmitting in POCSAG on another). RX_DISABLED disables all receiver functions. TX_DISABLED disables all transmitter functions. When RX_DISABLED is selected an operating current reduction of 50mA is typical.

FREQUENCY

Specifies the transmit and receive frequency in Hz (range limited to the variant of product). When RX is configured to DUPLEX, this setting may be independently configured for the receiver.

MODULATION

Specifies modulation parameters. 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). 4800-4L_6 indicates 4800 baud with a 6.25kHz channel spacing (4 level GFSK). Modulation rates from 512 baud to 32K baud can be set.

When RF is configured to DUPLEX, this setting may be independently configured for the receiver.

MODE

Specifies the transport mode of the transmitter and receiver (how the information is received over the air).

- **POCSAG_A** must be used in order to receive alphanumeric messages.
- **POCSAG_N** must be used in order to receive numeric messages.
- **POCSAG_T** should be used in order to receive tone only messages.
- **WTE_EN** must be used in order to receive 8 bit characters (POCSAG_A transmits 7 bit characters only).

When RF is configured to DUPLEX, this setting may be independently configured for the receiver.

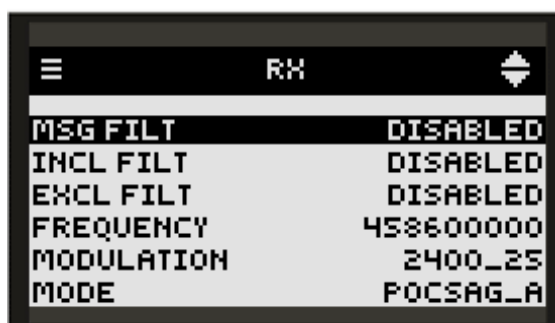
TX

Transmitter configuration items. Includes output power level, power limits and other TX only parameters.

RX

Receiver configuration items. Includes RIC ranges, alerting options plus RF parameters such as frequency when RF has been configured to be DUPLEX.

RX Menu



RIC RANGES

Specifies up to 8 RIC RX ranges for decoding. Messages received with RIC codes not allowed with the RX_RANGE will be discarded by the receiver.

Note: When configuring the RIC RANGE, the LOW RIC must not be higher than the HIGH RIC and the HIGH RIC must not be lower than the LOW. Any attempt to configure illegally will reset the RIC RANGE to ensure these rules are not broken. Any RIC RANGE with a LOW RIC set to 0000000 will NOT be used.

BUSY LEVEL

Specifies the busy level for the configured channel.

The configured value is the signal level from 0 to -130 (in dBm). If the signal strength on the receiving channel is above this configured value, the channel will be considered to be busy. Transmissions will not be possible if the channel is considered to be busy. After the configured BUSY TIME period, the transmitter will transmit anyway.

Note: If the TReX continually reports BUSY serially or via screen message, adjust the busy level appropriately or investigate the source of the channel interference.

BUSY TIME

Specifies the max period in seconds that a channel may be considered to be BUSY before transmitting anyway.

LINK FAIL TIME

This is the number of seconds (up to 240) that is allowed to pass in-between received messages without setting the LINK FAIL output (if LINK FAIL output is configured).

ALERT

Visual notification and repeating beep (at a configurable interval) when a message is received that meets the conditions for raising an alert. See **ALERT FILTER**.

If the ALERT output is enabled the configured output will also operate.

Can be configured from 0-250 seconds. When set to 0 the alert is disabled.

DEMODO

Access to the raw signal demodulation screen allowing raw data and recovered clock signals to be viewed in real time. Only used for 2 level demodulations.

MSG LOG

When ENABLED all received messages are written to RX-LOG.TXT on the SD card. Should be set to DISABLED in critical applications when the SD card cannot be allowed to completely filled (such as when unsupervised). Logging is disabled while connected to the USB port.

DISABLED:

Messages are not logged.

ENABLED:

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

CLEAR:

Setting to CLEAR will result in RX-LOG.TXT being deleted when exiting the menu.

FILTERS

The TReX supports the use of message filters. These filters inspect the content of incoming messages and then make decisions on whether to ignore or pay attention to these messages based on filter setting.

There are 3 types of supported filters:

- Include filters (messages must include one or more of the matching entries).
- Exclude filters (messages must NOT include any of the matching entries).
- Message filters (ALERT may be triggered for message with any of the matching entries - see **Alert Handling**)

Message filters take priority over Exclude filters. This means that if “PUKEKO” has been specified in MSG.TXT and “FIRE” is specified in EXCL.TXT then a message with “FIRE AT PUKEKO PLACE”, although it would normally be excluded, could still operate an output and display the message.

Each of the filter matching entries are NOT case sensitive and can be part of a longer word or phrase.

Entries are allowed to be more than one word e.g.

THIS IS A TEST

This will match on “ThiS is a TEST” but not the single words in the entry, unless they have been added as separate match entries.

Up to 15 key words can be stored, each up to 20 characters in length. There must be no ASCII control characters within the key words used and each matching phrase must be on a new line.

MESSAGE FILTER

This filter option allows the use of a text file called “MSG.TXT” to be stored and modified on the SD card (accessible via the USB port). If the feature is enabled this file (if present) will be searched for key words. If any of these key words are found then the configured alert output is operated. If logging is ENABLED, all messages resulting in an output being operated will add a leading ‘*’ to the message.

In all the following examples:

ALERTS->ALERT OUT set to 2.

ALERTS->MSG set to ENABLED.

OUTPUTS->2->MODE set to DISABLED (to ensure no other IO function shares output 2)

Example:

MENU->RF->RX->MSG FILT set to ENABLED:

A text file named MSG.TXT is added to the SD card root directory that has the following contents:

TSUNAMI

MAJOR EMERGENCY

All messages WITH these key words will result in OUTPUT 2 being operated and an alert being raised. These messages will be displayed and logged normally as per the system configuration.

All other messages will still be decoded and displayed based on RIC range settings.

MENU->RF->RX->MSG FILT set to DISABLED:

Messages are not filtered. All received messages will operate OUTPUT 2 and raise an alert.

If the ALERT is now disabled:

ALERTS->MSG set to DISABLED.

There will be no visual or audible alert (see **Alert Handling**)

NOTE: Restarting is required in order to load the MSG.TXT settings. This applies both when enabled via the serial port or from the menu.

INCL FILTER

This filter option allows the use of a text file called “INCL.TXT” to be stored and modified on the SD card (accessible via the USB port). If the feature is ENABLED, this file (if present) will be searched for key words. Any of these key words MUST be present in order for the message to be processed.

NOTE: messages received for filtering must still fall within configured RIC ranges.

Example:

A text file named INCL.TXT is added to the SD card root directory that has the following contents:

FIRE

EMERGENCY

All messages WITHOUT these key words WILL BE DISCARDED. Even though non matching messages are discarded, the receiver OK indicators and timers will continue to operate normally.

INCL FILT set to DISABLED:

Messages are not filtered

INCL FILT set to ENABLED:

Messages are filtered

EXCL FILTER

This filter option allows the use of a text file called “EXCL.TXT” to be stored and modified on the SD card (accessible via the USB port). If the feature is ENABLED, this file (if present) will be searched for key words. Any of these key words MUST NOT be present in order for the message to be processed.

Example:

A text file named EXCL.TXT is added to the SD card root directory that has the following contents:

THIS IS A TEST

DISCARD

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

EXCL FILT set to DISABLED:

Messages are not filtered

EXCL FILT set to ENABLED:

Messages are filtered

FREQUENCY

Specifies the receive frequency in Hz (range limited to the variant of product).

Applicable only when RX is DUPLEX.

MODULATION

Specifies modulation parameters. 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). 9600-4L_6 indicates 9600 baud with a 6.25kHz channel spacing (4 level GFSK). Modulation rates from 512 baud to 48K baud can be set.

Applicable only when RX is DUPLEX.

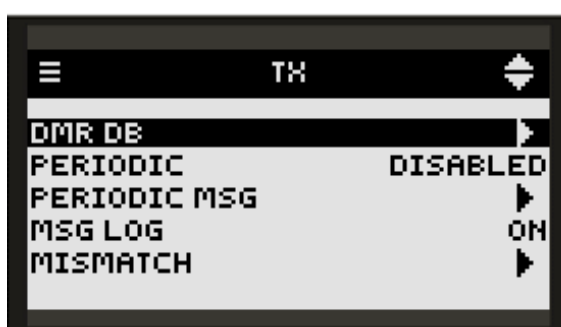
MODE

Specifies the transport mode of the receiver (how the information is received over the air).

Applicable only when RX is DUPLEX.

- **POCSAG_A** must be used in order to receive alphanumeric messages.
- **POCSAG_N** must be used in order to receive numeric messages.
- **POCSAG_T** should be used in order to receive tone only messages (“TONE” displayed on screen for message payload, but not actually transmitted or received).
- **WTE_EN** must be used in order to receive 8 bit characters (POCSAG_A transmits 7 bit characters only).
- **FLEX** must be used in order to receive and decode 2 level 1600 baud FLEX messages.

TX Menu



POWER

Specifies the transmit power. Allows a maximum of 4W power to be set.

DEF LEVEL

Some protocols require a default message priority (or LEVEL) to be set when sending POCSAG messages. This level between 0 and 3 may be set here. WT protocol does not use this configuration item.

PREAMBLE

Set the transmitter preamble length (specified in 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 preamble of 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 make significant reductions to channel activity.

LEAD IN

Sets the time in ms that the carrier is present BEFORE the START of a data stream. By default this is set to 0. Some receivers require a settling time before decoding. The lead-in time allows this to be managed, with a lead-in time up to 500ms.

LEAD OUT

Sets the time in ms that the carrier is present AFTER the END of a data stream. By default this is set to 0. A lead-out time up to 500ms can be configured.

RIC DB

Some protocols do not need a RIC to be specified for each transmission. When the RIC DB is used, the RIC DB provides the destination RIC information. One or many RIC codes can be specified so that a message can be sent to many RIC codes at the same time.

DMR DB

When the DMR DB is used, the DMR DB provides the destination DMR group ID information for serial protocols. One or many DMR group IDs can be specified so that a message can be sent to many DMR radios at the same time. Inside this menu the DMR colour code and radio type can also be specified. The FREQUENCY specified allows all the DMR entries to be transmitted on a different frequency than POCSAG messages originating from other sources.

PERIODIC

If DISABLED the configured PERIODIC MSG is not transmitted. When not DISABLED, the value is the time in seconds between transmitting the PERIODIC MSG.

PERIODIC MSG

This message is transmitted periodically depending on PERIODIC setting. The message should match the used protocol. e.g “WT1234567A10 Periodic Message” should be configured if the WT protocol is selected.

MSG LOG

When ENABLED all transmitted messages are logged to “TX-LOG.TXT”. It should be noted that logging all messages to the SD card does slightly impair the performance of the transmitter. In some cases transmitting of batched messages may not be possible at high data rates. All messages will still be transmitted correctly, but in some cases less efficiently (through occasional resending of a preamble between messages). This means for some applications, especially when the TReX is not actively being managed (perhaps through being installed at a remote site), MSG LOG should be set to DISABLED. When the SD card is full, the message “SD CARD FULL” will be displayed until acknowledged. Operation will continue normally after the SD card is full. Logging is disabled while connected to the USB port.

DISABLED:

Messages are not logged.

ENABLED:

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

CLEAR:

Setting to CLEAR will result in TX-LOG.TXT being deleted when exiting the menu.

MISMATCH Sub-Menu



The MISMATCH feature allows for antenna mismatch conditions to be reported. Should the antenna become disconnected or damaged the antenna matching (in essence, how well power is transferred from the TReX to the antenna) may change. This feature is intended for use at the TReX 4W power setting from a fixed voltage power supply.

This mismatch may be observed by:

- An increase or decrease in drive to the RF amplifier in order to achieve the required output power.
- An increase or decrease in current flowing into the TReX.

This condition can be reported by raising an alert (see Alert Handling).

Every installation and antenna is different, therefore the MISMATCH feature must be calibrated for each unit after it has been installed. Even changing the length of coax to the antenna will affect the matching behaviour.

Calibration Process:

1. Complete TReX installation with antenna connected.
2. Complete configuration of the TReX including power level.
3. Select the MISMATCH output. If DISABLED, the MISMATCH feature will not operate.
4. Select RF->TX->MISMATCH->CAL and change to ENABLED. This will automatically calibrate the MISMATCH feature after the next transmission.
5. Exit the MENU.
6. Transmit any message, typically a short 512 or 1200 baud transmission. A pop-up message indicating that the MISMATCH feature has been calibrated will be displayed, and "CAL DONE" will be sent out the serial port.
7. Test the system by either changing or removing the antenna, then transmitting a message. Perform this test with care, and infrequently since this will place stress on the transmitter. The selected output will operate and pop-up will be seen.

All parameters and calibration may also be controlled via MISMATCH serial commands.

CAL

Setting to ENABLED results in calibration of the MISMATCH feature after the next transmission.

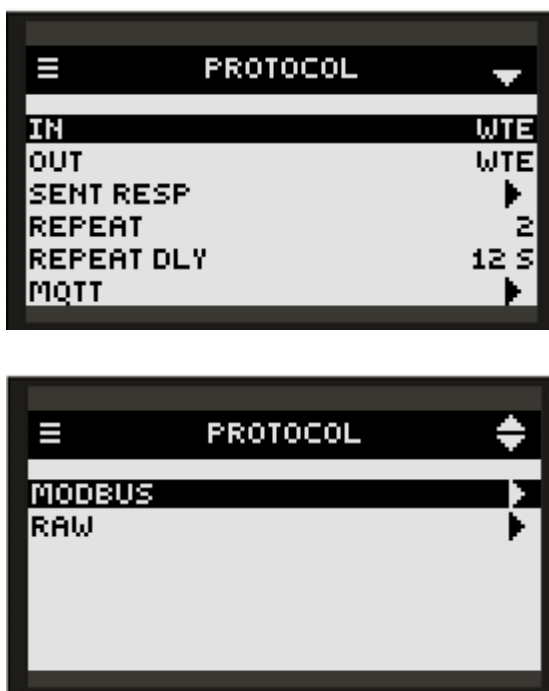
DELTA DAC

This should not need to be changed. This is the permitted variation in drive to the power amplifier. Decreasing this value will result in higher rate of false MISMATCH alerts but greater sensitivity to small changes. Typically a value of 5 will be appropriate.

DELTA mA

This should not need to be changed. This is the permitted variation in transmit current. Decreasing this value will result in higher rate of false MISMATCH alerts but greater sensitivity to small changes. Typically a value of 50 will be appropriate.

Protocol Menu



IN

Specifies the protocol to apply for serial input. Accepts WTE, CUSTOM, RAW, AUX and in some cases others as required or specified.

OUT

Specifies the protocol to apply for serial output. Accepts WTE, CUSTOM, RAW, AUX and in some cases others as required or specified.

SENT RESP

This the response out the serial port at the completion of each transmitted message. By default this is “Page Sent”.

Note: The default overriding response for WT protocol is “WT[xxx]”. To change the sent response to “Page Sent” a leading “” character must be used. e.g. “*Page Sent”.*

REPEAT

When any serially controlled protocol is used and a message is transmitted, the REPEAT can be configured to result in additional transmissions. If the RIC_DB or DMR_DB is configured, the REPEAT will result in a retransmission to all entries in the populated databases. The REPEAT will not affect input, periodic or store and forward related transmissions. Setting to 0 will result in no repeating.

REPEAT DLY

Specifies the delay in seconds before any REPEAT transmission takes place. Max 60 seconds, min 1 second.

MQTT

Specifies parameters used for the “MQTT” protocol. This is a common “IoT” service protocol.

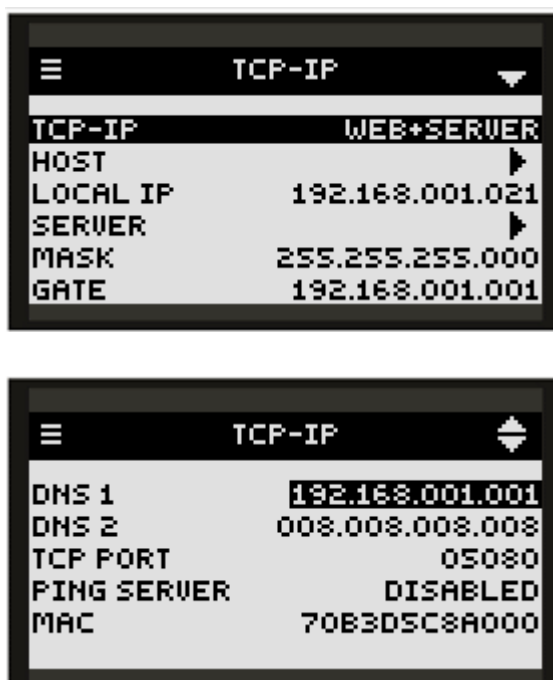
MODBUS

Specifies parameters used for the “MODBUS” protocol.

RAW

Specifies parameters used for the “RAW” protocol.

TCP-IP Menu



TCP-IP

Selects the TCP protocol for use on the TReX.

WEB:

This setting allows the TReX to be monitored and configured from a Chrome web browser either on a PC or mobile device.

SERVER:

This setting allows the TReX to be operated as a TCP server on the specified TCP port. SERVER would typically be used if a short term connection was required, such as to change a configuration item or send a message for transmitting. Only a single connection is allowed, however multiple users can conceivably connect in this mode for short durations in order to offload content to be transmitted. A long term or held connection will allow decoded messages to be viewed in real-time (preventing further connections).

CLIENT:

This setting allows the TReX to be operated as a TCP client on the specified TCP port and REMOTE IP. SERVER would typically be used if a remote device required a long duration or permanent connection. This would be desirable if monitoring decoded messages.

WEB+SERVER:

Concurrent WEB and SERVER functionality.

WEB+CLIENT:

Concurrent WEB and CLIENT functionality.

DISABLED:

Setting to DISABLED ensures the maximum possible power savings even when an Ethernet cable has been connected. When IP is DISABLED, current consumption will reduce by approximately 150mA and disable the TCP stack.

HOST

This is the name that can be associated to the TReX. This name can be used directly instead of the IP address to address the TReX. By default is “WTE-TReX”

LOCAL IP

IP Address for access to the TReX.

SERVER

IP Address for the TCP CLIENT to connect to. When performing a PING this is the resolved address that is used.

MASK

IP Mask

GATE

IP Gateway

DNS1

Primary Domain Name Server

DNS2

Secondary Domain Name Server.

TCP PORT

The port to use for TCP client TCP server connections. Default is 5080.

PING SERVER

Selecting this item results in a PING being sent to the SERVER address. Reply expected will be the responding IP address and status (OK/TIMEOUT/NOT RESOLVED).

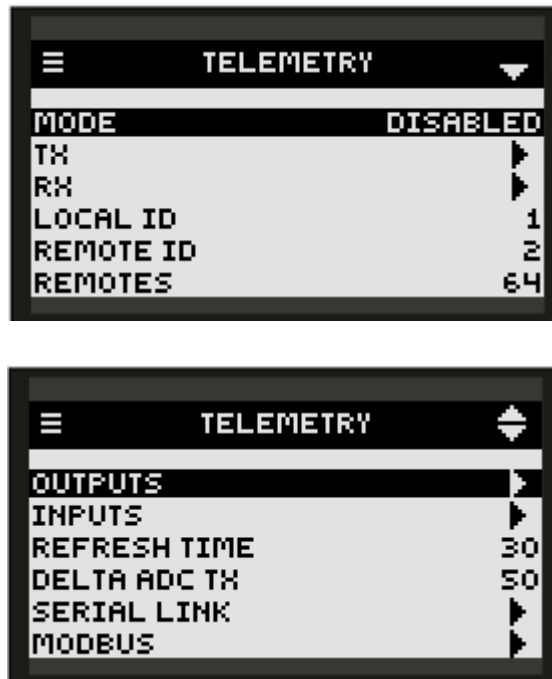
This item is useful for testing connectivity. If the TReX cannot successfully PING the SERVER, it is likely that a firewall network filtering rule is preventing the connection.

***Note:** When changing IP configuration, new settings are not applied until leaving the MENU or the unit is restarted.*

MAC

Non-editable MAC address.

Telemetry Menu



MODE

DISABLED:

there are no autonomous transmissions.

SERIAL LINK:

Serial arriving on an enabled serial port is sent to a remote TReX unit.

IO MIRROR:

All local unit enabled inputs are mirrored to outputs of a remote device based on the IO MIRROR configuration. IO_MIRROR can only support 2 TReX units. SCADA monitoring and controlling is not possible in this MODE.

SCADA_MASTER (Optional feature only):

The TReX unit can be connected via Modbus (TCP or RTU serial). This unit can then optionally report the status (and control) SCADA_SLAVE TReX units.

SCADA_SLAVE (Optional feature only):

The TReX can be installed in a remote location and wirelessly controlled by a SCADA_MASTER. See **SCADA Configuration**.

LOCAL ID

It is possible to have many TReX units operating on the same frequency. This is the ID that the REMOTE TReX needs to use in its REMOTE ID field in order to communicate.

REMOTE ID

This is the ID of the remote device that all inputs will be sent to. When the MODE is configured to be SCADA_MASTER this is the ID of the first SCADA_SLAVE TReX. All SCADA_SLAVES must be consecutively numbered following this ID.

When the MODE SCADA_SLAVE is used, the REMOTE_ID is configured to be the same as the LOCAL_ID (this is required by the SCADA_MASTER to identify the source of the transmission).

REMOTES

This parameter is only used when the MODE is SCADA_MASTER. This is the number of wireless SCADA_SLAVE units that the SCADA_MASTER will communicate with.

INPUTS

This is a shortcut to the INPUT configuration menu.

OUTPUTS

This is a shortcut to the OUTPUT configuration menu. If the OUTPUT is DISABLED, then messages from a remote unit can NOT change the units outputs. This may be desired if the OUTPUT is already configured for another purpose such as LINK FAIL OUTPUT. Outputs to be used should be set to LATCHED.

REFRESH TIME

How long in seconds before sending all input information again. If any INPUT changes then there is an immediate transmission. The REFRESH TIME ensures that if a message is lost, the remote device will eventually resynchronise its OUTPUTS with the local device INPUTS.

DELTA ADC TX

Analog data is transmitted after each REFRESH TIME count elapses. This field allows an immediate transmission if it has changed by a certain amount since its last transmission. This is the raw ADC count that is a value up to 1023. Min value is 10 to ensure that very small changes do not result in continuous transmissions in an electrically noisy environment.

SERIAL LINK

Configuration of all SERIAL LINK Settings

MODBUS

Configuration of all MODBUS Settings

SERIAL LINK Menu



These settings allow the point to point serial transmission to be optimised. By default for a point to point serial link these items should not need changing.

TX TIMEOUT

This is the period of serial port inactivity in 10mS steps that the TReX will wait before transmitting. In this case, placing a small delay between characters will result in poor transmission efficiency.

TX CHAR

This configures a special character that can be used to mark the end of a serial message. This could be configured to be a carriage return for example (value to use is 13 for a carriage return). When any carriage return character is seen, then an immediate transmission would be forced. The TX TIMEOUT item takes priority. The value of this configuration item is the decimal value of the ASCII character. Please refer to a standard ASCII chart for decimal values for ASCII characters (1-127).

STORE FWD Menu



OPERATION

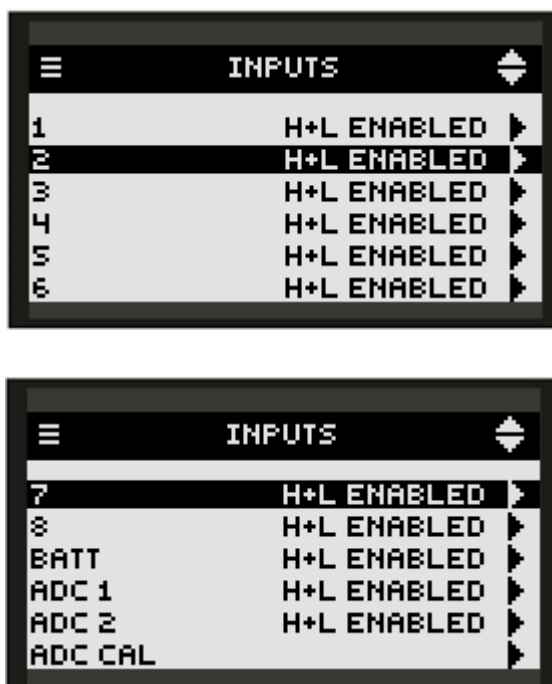
When store forward operation ENABLED the unit is used to listen to transmissions in the area, decode the messages and retransmit again to provide greater coverage than would normally be possible.

When DISABLED there is no store and forward function. 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. All messages received are immediately queued for transmission, and up to 5 messages may be retransmitted after the store forward delay.

DUPL REJECT

Setting to 0 disables the feature, otherwise this is the number of seconds to reject identical messages for up to 60 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 10 messages in the historic transmit queue.

Inputs Menu



1-8

Configuration of messages that are transmitted when an input changes. Receiver only TReX units instead of transmitting can directly send WT protocol messages via serial ports or a TCP connection.

BATT

Treated as the 9th input. Messages transmitted when system voltage is high or low (high and low levels configurable).

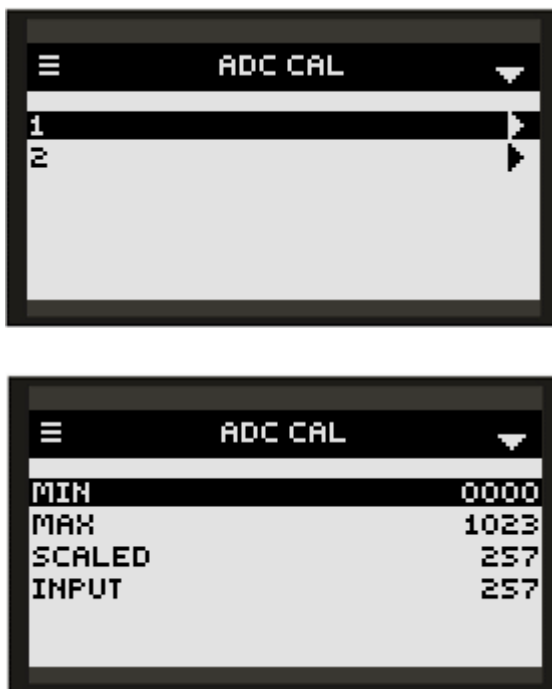
ADC 1-2

Treated as Inputs 10 and 11. Messages transmitted when ADC levels are above or below set thresholds. Thresholds are raw ADC counts.

ADC CAL

This manages calibration of analog inputs.

ADC CAL Sub-Menu



When the analog inputs are being read, scaling can be applied that allows the user to specify an INPUT from 0-1023 over a useful range from MIN to MAX. For example, if MIN is 200 and MAX is 400, then any analog INPUT below 200 will be SCALED to 0. Any INPUT above 400 will be SCALED to 1023. An INPUT of 300 will return a SCALED value of 512. These specified ADC values are raw ADC counts (value between 0 and 1023).

This is useful if a small voltage range is of interest, such as 1-5V instead of 0-10V. See following calibration procedure for full example.

1-2

Access to calibration items for ADC 1 and ADC 2.

MIN

This is the minimum used INPUT ADC value. If no scaling is to be applied set to 0.

MAX

This is the maximum used INPUT ADC value. If no scaling is to be applied set to 1023.

SCALED

This is a read only field that displays a value from 0-1023.

INPUT

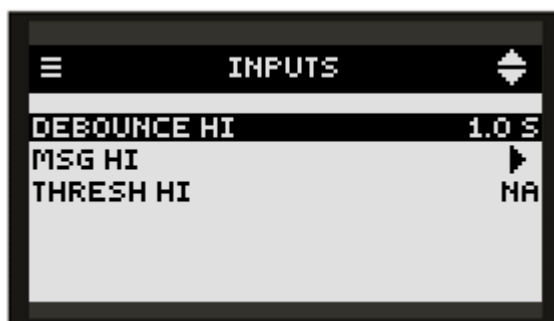
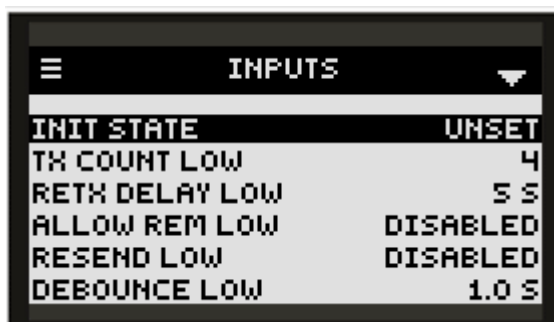
This is a read only field that displays the raw analog input value from 0-1023. The INPUT is

not scaled.

Calibration procedure for voltage inputs:

1. Connect a voltage source (with an input resistance not more than 2 k ohm).
2. Set the voltage source to the minimum voltage that will be used.
3. Set ADC CAL->MIN to the value shown in the INPUT field.
4. Set the voltage source to the maximum voltage that will be used (up to 16V).
5. Set ADC CAL->MAX to the value shown in the INPUT field.
6. Check that when the minimum voltage is connected, the SCALED field displays close to 0.
7. Check that when the maximum voltage is connected, the SCALED field displays close to 1023.
8. Check that when a mid voltage between the maximum and minimum is connected, the SCALED field displays a mid value between 0 and 1023.
9. Exit MENU and settings will be saved.

Input Config Sub-Menu



These input configuration screens repeat for each of the 8 inputs plus the BATT and ADC inputs.

INIT STATE

Input messages are transmitted when the input changes from one state to another. On start-up the first transmitted message depends on this configuration. UNSET will ensure that there is never a transmission on start, whereas the HIGH or LOW states assume a certain start condition, so that an immediate transmission on start-up is possible.

UNSET

The input state is read on start-up. There will not be a transmission until the input changes (if configured to transmit on that HIGH or LOW level).

HIGH

The input is considered to be HIGH on start. If on start the input is read and found to be LOW, then there will be an immediate transmission (if configured to transmit).

LOW

The input is considered to be LOW on start. If on start the input is read and found to be HIGH, then there will be an immediate transmission (if configured to transmit).

TX COUNT LOW

If set to 0, then there will be NO transmissions when moving to the LOW state. If non-zero then this is the number of times the LOW message will be transmitted.

If there is a change of state again, then any remaining transmissions are cancelled.

When set to a non-zero TX COUNT, the input level is considered to be ENABLED, and displayed as ENABLED on the upper menu level.

ALLOW REM LOW

If ENABLED then should multiple retransmissions be configured, if the input state changes to HIGH (that would normally cancel the remaining transmissions), the remaining LOW transmissions are allowed to complete in full.

RESEND LOW

If not set to DISABLED, the interval specified is the time in seconds between repeating retransmissions. This will resend the configured LOW input level message indefinitely at this interval (Only if the input level is LOW).

RETX DELAY LOW

How long in seconds before sending the next message if set to more than 1.

DEBOUNCE LOW

How long in seconds that the input must be settled at a LOW level before transmitting

THRESH LOW

When configuring inputs 1-8, this field has no function.

On the BATT input this is the voltage that the TReX BATT input is considered to be low. A voltage below this may result in a BATT transmission if configured.

On the ADC 1 and ADC 2 inputs this is the ADC count that the TReX ADC input is considered to be low. An ADC count below this may result in an ADC input transmission if configured.

MSG LOW

The message that is transmitted when the input moves to the LOW level. Input messages must always use WT Protocol.

TX COUNT HI

If set to 0, then there will be NO transmissions when moving to the HIGH state. If non-zero then this is the number of times the HIGH message will be transmitted.

If there is a change of state again, then any remaining transmissions are cancelled.

When set to a non-zero TX COUNT, the input level is considered to be ENABLED, and displayed as ENABLED on the upper menu level.

ALLOW REM HI

If ENABLED then should multiple retransmissions be configured, if the input state changes to LOW (that would normally cancel the remaining transmissions), the remaining HIGH transmissions are allowed to complete in full.

RESEND HI

If not set to DISABLED, the interval specified is the time in seconds between repeating retransmissions. This will resend the configured HIGH input level message indefinitely at this interval (Only if the input level is HIGH).

RETX DELAY HI

How long in seconds before sending the next message if set to more than 1.

DEBOUNCE HI

How long in seconds that the input must be settled at a HIGH level before transmitting

THRESH HI

When configuring inputs 1-8, this field has no function.

On the BATT input this is the voltage that the TReX BATT input is considered to be high. A voltage above this may result in a BATT transmission if configured.

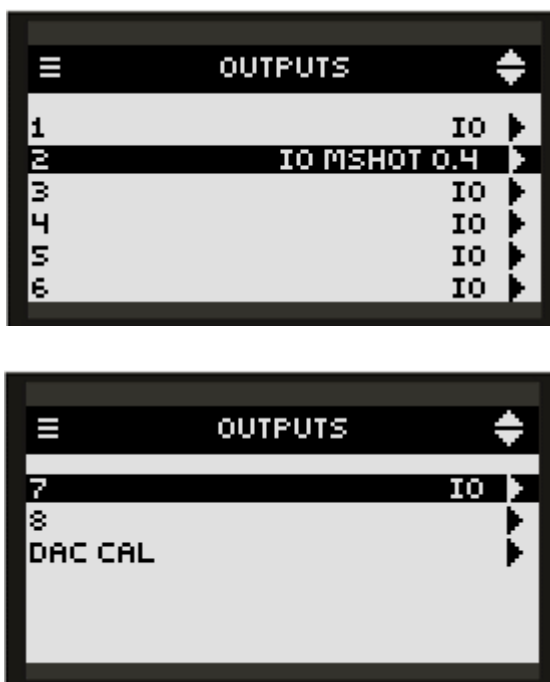
On the ADC 1 and ADC 2 inputs this is the ADC count that the TReX ADC input is considered to be HIGH. An ADC count above this may result in an ADC input transmission if configured.

Note: The BATT input threshold settings are also used to set the battery icon on the main screens.

MSG HI

The message that is transmitted when the input moves to the HIGH level. Input messages must always use WT Protocol.

Outputs Menu



1-8

The output to configure. If the output has been configured for general output control through telemetry or messaging the output must be configured to IO or MSHOT. In order to set to IO or MSHOT the output MODE must be set to **IO** in the Output Config Sub-Menu.

Note: Care must be taken when assigning an output to more than one function (setting ALERTS->ALERT OUT to a used IO output) as the behaviour of the output can be difficult to predict or determine the trigger for the output change. In general, assignment of an output to more than one function is not recommended.

DAC CAL

Configures calibration of analog output 1 and 2. See DAC CAL Sub-Menu.

Output Config Sub-Menu



MODE

When set to IO the output can be controlled through TELEMETRY settings or through output control messages that may be received. Setting to IO will show the output to be configured to either IO or IO MSHOT depending on the MSHOT setting.

On start outputs are ALWAYS LOW. After the expiration of any MONOSHOT period for an output, the OUTPUT will return to the LOW state.

When RIC RANGE X, then the output is configured to close, either LATCHED or MSHOT when a message is received with a RIC within that RANGE. RIC RANGE N controls OUTPUT N.

MONOSHOT

If LATCHED or RIC RANGE the output will remain in the set state until another message is received to change the state. If set to a time, then after receiving a message to operate HIGH the output will return to a LOW state after this period of time has passed.

ALERT

If ENABLED, the output is able to generate an ALERT when operated. See **Alert Handling**.

DAC CAL Sub-Menu



Analog outputs can be configured to operate as constant voltage or constant current. This makes the outputs suitable for outputs such as 0-10V or 4-20mA.

The analog output is current limited internally at approx 35mA. DAC Output impedance is 5 ohms.

MODE set to VOLTAGE:

Ensure that the wiring SERIES impedance is as low as possible. There will be a voltage drop across any series resistance that will affect the output voltage. How much the output will vary will depend on the load of the connected equipment. This load resistance preferably should not be less than 2k ohms.

MODE set to CURRENT:

Ensure that the full loop impedance is less than 500 ohms and at least 100 ohms. Add a small series resistor if required since the internal series resistance is only 5 ohms.

When the analog outputs are being controlled, scaling can be applied that allows the user to specify an OUTPUT from 0-1023 over a useful range from MIN to MAX. For example, if MIN is 200 and MAX is 400, then setting the analog output to a SET value of 1023 will in fact set the OUTPUT to the MAX value of 400. SET configured to 0 will set the OUTPUT to the MIN value of 200. A SET value of 512 will set the OUTPUT to a value of 300. See following calibration procedure for full example.

MIN

This is the minimum used unscaled DAC count of interest. If no scaling is to be applied set to 0.

MAX

This is the maximum used unscaled DAC count of interest. If no scaling is to be applied set to 1023.

SET

This sets the output as a value between 0-1023 that is scaled and applied between the MIN and

MAX OUTPUT values. Regardless of the MIN and MAX settings, the full control range of 0-1023 can be used. This is a test parameter only, useful for calibration. This is the value that the user would send to the TReX in order to control the outputs.

OUTPUT

This is a read only field showing the current flowing and unscaled raw output. This value will sit between MIN and MAX.

MODE

Sets either constant VOLTAGE or CURRENT mode. When in VOLTAGE mode the output is fixed depending on the output set value. This mode is used for outputs such as 1-10V, 1-5V or any other voltage as configured. When in CURRENT mode the set value is the desired current that is to be maintained. This is used for outputs such as 4-20mA, 0-20mA or any other current up to 30mA as configured.

CAL mA

This how much to adjust the output current sense to read correctly. This field has no function when the MODE is set to VOLTAGE. This must be set by connecting an ammeter through a small series resistor such as 100 ohms. This setting would then be adjusted until the reading is the same as the reading from the ammeter.

Calibration Procedure for Voltage Output

1. Connect load (a resistance not less than 2 k ohm).
2. Set DAC output to 0 using the DAC->OUT parameter.
3. Alter DAC->MIN until the low limit output can be obtained.
4. Set DAC output to 1023 (maximum) using DAC->OUT
5. Alter DAC->MAX until the high limit output has been set. The output voltage does not vary with power supply, but the maximum output IS based on the TReX input supply voltage. Typically with a supply voltage of 12V the DAC max output is 10.0V.
6. Exit MENU and settings will be saved.

Calibration Procedure for 4-20mA Current Output

1. Connect load with ammeter in series through a 100R resistor.
2. Set DAC->MIN to 117 and DAC->MAX to 583
3. Set DAC output to 0
4. Adjust DAC->MIN until output current is approximately 4mA.
5. Set DAC output to 1023
6. Adjust DAC->MAX until output current is approximately 20mA.
7. Exit MENU and settings will be saved.

Alerts Menu



See **Alert Handling** for more information.

MSG

When ENABLED, an alert will be raised when any message is received. If the MSG FILT menu option is ENABLED, locally stored MSG.TXT file is searched and the alert is operated ONLY if a keyword in the MSG.TXT file is found in an incoming message. See **MESSAGE FILTER**.

BUSY

When ENABLED, an alert will be raised when receive channel is BUSY (when the signal strength on the channel exceeds the RX BUSY LEVEL).

LINK FAIL

When ENABLED, an alert will be raised when the RX LINK FAIL time is exceeded between received messages.

Typically the LINK FAIL output would be used in conjunction with a known periodic message from another transmitter.

TEMP

When ENABLED, an alert will be raised when the TReX has reached the max temperature. The max temperature is set in MENU->SYSTEM->OVERTEMP. This is the TReX board

operating temperature and NOT the ambient temperature.

MAINS FAIL

When ENABLED, an alert will be raised when a MAINS FAIL event has been detected.

Alert is raised when “MAINS FAIL” is seen in the payload of an input message. Alert is cleared when “MAINS RESTORED” is seen in another input message. A typical application for this is to connect a plug pack to provide a voltage source to an input. The input HIGH and LOW messages would be configured with “WT0000000A10 MAINS_FAIL” and “WT0000000A10 MAINS_RESTORED”.

RF ERROR

When ENABLED, an alert will be raised when an RF ERROR has been detected.

Alert is raised when there an antenna mismatch or low power condition at the beginning of a transmission.

BATT

When ENABLED, an alert will be raised when low BATT voltage has been detected.

Alert is raised when the system voltage is below the minimum BATT input voltage threshold.

ALERT REPEAT

When DISABLED and SYSTEM->SOUND is ENABLED an alert will result in a single audible indication. This is the seconds between repeated alert beeps that will repeat until the alert has been acknowledged either by pressing the ENTER button, cycling power or auto-clearing as described in **Alert Handling**.

ALERT OUT

When set to an output from 1-8, this is the output that can be operated when ANY alert is raised.

SOUND

Enables sound for alerts and key presses.

Serial Command Configuration

Most items that can be changed via the MENU can also be changed through serial commands. There are some additional commands that make the TReX more usable when being managed via a serial connection. These are listed immediately below.

These commands must begin with the character ‘*’ and are processed with a carriage return character. Any characters before the ‘*’ may result in the command not being processed.

Main Commands

***REBOOT**

Forces the unit to immediately restart.

Usage:

**REBOOT<CR>*

***CONFIG**

Displays current configuration.

Usage:

**CONFIG<CR>*

***SAVE**

Saves all configuration settings (all configuration changes are restored on start-up).

Usage:

**SAVE <CR>*

***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**

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>*

*RSSI

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

Usage:

**RSSI<CR>*

*USERPASS

Sets the web and TCP user and password. User must be at least 3 letters and password must be at least 4 letters. These credentials are requested for each new web and TCP connection.

Typical usage:

**USERPASS=admin:TReX<CR>*

When prompted for a login when using a TCP connection (not through web browser), login with the full user and password together.

e.g. in response to “login:”

enter

“admin:TReX”

The TReX will immediately report if successfully logged in.

To completely disable all web and TCP connection user and passwords, enter

**USERPASS=none:none<CR>*

**SAVE<CR>*

By default the user and password is set to “none:none”

*IO

Returns all input and output states.

Typical usage:

**IO<CR>*

Typical output:

IO=I:01000000--- O:00000000 ADC:257,252 DAC:0,0

In this typical output, there are 11 inputs shown. First 8 are the digital inputs. The 9th input is 1 or 0 based on battery high/low thresholds set. Inputs 10 and 11 are ADCs, again displayed as 1 or 0 based on set thresholds. The ‘-’ is shown when the input level is unknown, such as when an input is between the high and low configured thresholds. Output states for all 8 outputs follow, then ADC inputs 1 and 2 and finally the current DAC settings.

***TEMP**

Returns temperature of first the digital board, then the RF temperature sensor. This is NOT the ambient temperature. Temperatures in excess of 100 degrees C are completely normal under typical transmitting operation.

Usage:

**TEMP<CR>*

Typical output:

TEMP=DIG:55.0C RF:60.1C

***PWR**

Returns current forward power ADC count and system current both at the time of reading and recorded during the last transmission.

Usage:

**PWR<CR>*

Typical output:

PWR=500,34,160,0.28,1.23

The first parameter is the forward power ADC count at the time of reading. The second value is the forward power recorded during the last message transmission. Parameter 3 is the RF output drive value used to achieve the ADC count. Parameter 4 is the system current. Parameter 5 is the system current recorded during the last message transmission.

***VER**

Sends the TReX sign on message back to the user. This is useful to determine the model and serial number of the unit.

Usage:

**VER<CR>*

***BYPASS**

This a command that is useful for test and special serial control cases. This command specifies a RIC code and beep level that allows processing as if arriving from the receiver. In order for the message (in the case below “Test Message”) to arrive as a message, a RIC range must be configured in the TReX to suit.

**BYPASS=[NNNNNNN:L]MMMMMMMMM<CR>*

where:

[is the character ‘[’

NNNNNNN are 7 digits specifying the RIC code to be used for the message

: is the character ‘:’

L is beep level for the message to be processed from 0-3.

] is the character ‘]’

MMMMMM is the payload of the message to be processed.

Typical Usage 1:

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

“Test Message” will be added to the RX message screens, logged etc, as if received across the air.

Typical Usage 2:

**BYPASS=[1234567:1][[01]12345-8]<CR>*

“[[01]12345-8]” will be added to the RX message screens, logged etc., as if received across the air. In this case, the message will also be processed as a **WTE Output Protocol** message and immediately operate the TReX outputs.

***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 enable (1) or disable (0) the carrier; Setting to 2 enables random modulation for the configured transmit modulation.

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

Typical usage:

**LAB=1,10<CR>*

Note: *LAB=1<CR> can be used, as it will enable carrier for 60 seconds

Transmit Commands

***TX_FREQ**

Specifies the transmit frequency in Hz e.g.

**TX_FREQ=160000000<CR>*

***TX_PROTO**

Specifies the protocol to apply for serial input. Accepts WTE, RAW and AUX.

Typical usage:

**TX_PROTO=WTE<CR>*

Note: See protocol section for more details on protocols and configuration.

***TX_BAUD**

Specifies the baud rate of the transmitter when using a protocol that does not permit a baud rate to be specified.

Accepts: 512_25, 512_12, 512_6, 1200_25, 1200_12, 1200_6, 1600_25, 2400_25, 2400_12, 2400_6, 3200-4L_25, 4800_25, 4800_12, 4800-4L_6, 9600_25, 9600_12, 9600-4L_25, 9600-4L_12, 16K-4L_25, 16K-4L_12, 32K-4L_25

Typical usage:

**TX_BAUD=512_25<CR>*

Note: This product has been certified for use in multiple markets. The modulation 32K-4L_25 is compliant under FCC only – it is the responsibility of the user to ensure that this modulation is used in the application territories only.

***TX_PWR**

Specifies the output power of the transmitter.

Accepts: 250MW, 500MW, 1W, 2W, 4W

Typical usage:

**TX_PWR=4W<CR>*

Note: It is the responsibility of the user to ensure that a power level is selected that is compliant with the frequency and region of use.

***TX_MODE**

Specifies the transport method of the transmitter (how the information is transmitted over the air).

- POCSAG_A must be used in order to transmit alphanumeric messages.
- POCSAG_N must be used in order to transmit numeric messages.
- POCSAG_T should be used in order to transmit tone only messages (“TONE” displayed on screen for message payload, but not actually transmitted or received).
- WTE_EN must be used in order to transmit 8 bit characters (POCSAG_A transmits 7 bit characters only).

Accepts POCSAG_A, POCSAG_N, POCSAG_T and WTE_EN.

Typical usage:

```
*TX_MODE=POCSAG_A<CR>
```

***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.

Typical usage:

```
*TX_LEVEL=3<CR>
```

***TX_CAP**

Specifies the default code used to identify transmissions (same as the RIC code). A list of up to 9 codes can be specified.

The TX_CAP code would be used when a protocol supplied code is to be overridden, and sent to a single or multiple other recipients instead.

TX_CAP syntax:

```
*TX_CAP=X:nnnnnnnn<CR>
```

Where:

X, is the input range index from 1 to 9

nnnnnnnn, This code can be any number between 8 and 2000000.

Typical usage:

```
*TX_CAP=1:1324560<CR>
```

***TX_DMR**

Specifies a list of DMR group IDs that messages will be sent to. All entries in this list require the colour code, radio type and transmit frequency to be specified in the DMR_DB command.

The TX_DMR code would be used when a protocol supplied code is to be overridden, and sent to a single or multiple other recipients instead. This DMR recipient list is only for use with group IDs. Should a single radio need to be addressed, a group should be created with only a single user.

TX_DMR syntax:

**TX_DMR=X:nnnnnnnn<CR>*

Where:

X, is the input range index from 1 to 9

nnnnnnnn, This code can be any number between 8 and 2000000.

Typical usage:

**TX_DMR=1:1324560<CR>*

***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. WT protocol must be used for the periodic message.

**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).

Typical usage:

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

***TX_PREAMBLE**

Sets 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 – configured in steps of 32). This very long preamble means that paging receivers need only to wake briefly 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. When the TReX is used as transmitter and receiver at both ends of the link, a setting of 2 (64 bits) will work equally well.

Typical usage:

**TX_PREAMBLE=18<CR>*

***TX_LEAD**

Sets the transmit lead-in and lead-out time in multiples of 10ms.

Some receivers require time to settle when a transmitter is keyed up. The command allows the lead-in and lead-out times to be set.

**TX_LEAD=II,OO<CR>*

where:

II is the lead-in time. This is the duration after the carrier is applied BEFORE data is transmitted. Default is 0, max is 50 (500ms).

OO is the lead-out time. This is the duration AFTER data is transmitted that the carrier is applied before keying down the transmitter. Default is 0, max is 50 (500ms).

Typical usage:

**TX_LEAD=5,5<CR>*

***TX_REPEAT**

Sets the number of repeated transmissions from all serial protocols. A delay can be configured between each transmission. Configuration of this item DOES NOT affect messaging from inputs, the periodic timer or any store and forward function. If the RIC_DB or DMR_DB has been configured, the repeated transmission will result in ALL entries in the databases being used for retransmitted messages.

**TX_REPEAT=A,BB<CR>*

where:

A is the number of repeated transmissions. Max 5. Default 0.

BB is the delay in seconds between repeated transmissions. Max 60, min 1.

Typical usage:

**TX_REPEAT=3,10<CR>*

Receive Commands

*RX_ENABLE

Allows the receiver to be disabled to save power if required. Set to 0 to set to SIMPLEX. Use 1 for DUPLEX operation (may be set to different frequency than the transmitter), 2 for RX DISABLED operation. Set to 3 for TX DISABLED operation.

Typical usage:

`*RX_ENABLE=0<CR>`

*RX_FREQ

Specifies the receive frequency in Hz (range limited to the variant of product).

Typical usage:

`*RX_FREQ=160000000<CR>`

*RX_BAUD

Specifies the baud rate of the receiver.

Accepts: 512_25, 512_12, 512_6, 1200_25, 1200_12, 1200_6, 1600_25, 2400_25, 2400_12, 2400_6, 3200-4L_25, 4800_25, 4800_12, 4800-4L_6, 9600_25, 9600_12, 9600-4L_25, 9600-4L_12, 16K-4L_25, 16K-4L_12, 32K-4L_25

Typical usage:

`*RX_BAUD=512_25<CR>`

*RX_PROTO

Specifies the protocol to apply for serial output, accepts WTE, RAW and AUX. See protocol section for more detail on protocols and configuration.

Typical usage:

`*RX_PROTO=WTE<CR>`

*RX_MODE

Specifies the transport method of the receiver (how the information is received over the air).

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

Accepts POCSAG_A, POCSAG_N, WTE_EN and FLEX.

Typical usage:

***RX_MODE=POCSAG_A<CR>**

***RX_RANGE**

Specifies up to 8 CAP RX ranges for decoding. Messages received with CAP codes not within the RX_RANGE will be discarded by the receiver.

CAP codes should not fall within multiple ranges. If an output has been configured to operate on a range match, a second output configured for another range with the same CAP code will not operate.

***RX_RANGE=N:LLLLLLL,HHHHHHH** (where N is the range between 1 and 8, LLLLLLL is the lowest cap code to match, HHHHHHH is the highest).

Typical usage:

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

***RX_BUSY**

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

***RX_BUSY=A,BB,CC**

Where:

A Enables the BUSY alert (0-1)

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

CC is the max duration in seconds that the channel may be “busy” before transmitting regardless of channel activity. Max is 100 seconds.

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

Typical usage:

***RX_BUSY=1,-80,5<CR>**

Note: If the TReX continually reports BUSY, issue the command ***RSSI<CR>** to view the current noise floor and adjust the busy level appropriately.

***RX_LINK**

Enables the LINK FAIL alert and timeout period.

***RX_LINK=A,BB**

Where:

A Enables the LINK FAIL alert (0-1)

BB is the period in seconds in which a message should be received within.

Typical usage:

**RX_LINK=1,120<CR>*

Store Forward Commands

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. Periodic retransmissions of all messages for latched input states are possible at independent intervals.

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. Should this behaviour not be required, modify the “Allow remaining input transmissions” option.

Please refer to **Input Output Hardware Connection** section on this manual for examples of how to connect the input and output pins on the TReX.

Also refer to **Input Handling** for more information and applications such as controlling outputs from input messages.

*IN_INIT

Specifies the expected initial logic level for each input on start. Input messages are transmitted when the input changes from one state to another. On start-up the first transmitted message depends on this configuration. Setting an input to a value of 2 will ensure that there is never a transmission on start, whereas setting to 0 (low) will result in an immediate transmission on start if the input is 1 (high). Setting to 1 will result in an immediate transmission on start of the input is 0 (low).

*IN_INIT=I:S

Where:

I = The input to configure (1-11 valid). Input 9 is the VIN input, 10 is ADC 1 and 11 is ADC 2.

: = the colon character ‘:’

S = The expected start level required for no start transmission (0,1 or 2)

Typical usage:

*IN_INIT=1:2<CR>

*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,A,L

Where:

I = The input to configure (1-11 valid). Input 9 is the VIN input, 10 is ADC 1 and 11 is

ADC 2.

: = 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)

R = time in seconds between retransmissions.

A = Allow remaining input transmission on state change (1 = Allow). If 0 then all remaining transmissions will be cancelled on any debounced state change.

L = Latched resend interval. This is a period from 0 – 255 (0 is disabled). Should the input be latched (for an L input is when the input is low, for a H input, is when the input is high). At this repeating interval, if non-zero, there will be another single transmission.

Example. Configure input 1 to send 2 messages after input is debounced by 300 milliseconds and repeated with 5 seconds between transmissions. Any remaining messages to transmit are cancelled if the state changes again to high before all transmissions are complete. The messages are not retransmitted periodically.

Typical usage:

```
*IN_CONFIG_L=1:2,3,5,0,0<CR>
```

*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,A,L**

Where:

I = The input to configure (1-11 valid). Input 9 is the VIN input, 10 is ADC 1 and 11 is ADC 2.

: = 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)

R = time in seconds between retransmissions.

A = Allow remaining input transmission on state change (1 = Allow). If 0 then all remaining transmissions will be cancelled on any debounced state change.

L = Latched resend interval. This is a period from 0 – 255 (0 is disabled). Should the input be latched (for an L input is when the input is low, for a H input, is when the input is high). At this repeating interval, if non-zero, there will be another single transmission.

Example. Configure input 1 to send 2 messages after input is debounced by 300 milliseconds

and repeated with 5 seconds between transmissions. Any remaining messages to transmit are cancelled if the state changes again to low before all transmissions are complete. The messages are not retransmitted periodically.

Typical usage:

**IN_CONFIG_H=1:2,3,5,0,0<CR>*

***IN_MSG_L**

Specifies the low level message that will be transmitted if configured. Input messages must always use WT Protocol.

Typical usage: .

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

***IN_MSG_H**

Specifies the high level message that will be transmitted if configured. Input messages must always use WT Protocol.

Typical usage:

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

***IN_ANALOG**

Specifies the high and low ADC count thresholds for an analog input to be considered a digital HIGH or digital LOW. When these thresholds are exceeded, then programmed messages for HIGH and LOW levels can be transmitted. All ADC counts are the SCALED ADC counts.

**IN_ANALOG=1H,1L,2H,2L,3H,3L*

Where:

1H = Input voltage high (x10)

1L = Input voltage low (x10)

2H = ADC1 voltage high ADC count

2L = ADC1 voltage low ADC count

3H = ADC2 voltage high ADC count

3L = ADC2 voltage low ADC count

Typical usage:

**IN_ANALOG=138,114,200,100,500,400<CR>*

Output Commands

The output commands allow the GPIO pins to be configured as outputs or inputs. Following configuration of the pins as outputs, they are controlled using the **WTE Output Control Protocol**.

Note: Please refer to **Input Output Hardware Connection** section on this manual for examples of how to connect the input and output pins on the TReX board.

*OUT_CONFIG

Specifies all output configuration items, usage as follows:

*OUT_CONFIG=O:E,T <CR>

Where:

O = The output to configure (1-8 valid)

: = the character ':'

E = IO enabled mode (0 is DISABLED, 1 is ENABLED, 2 assigns output to close on a RIC RANGE match). When DISABLED, the output can still be used by the alert output.

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.

Typical usage:

*OUT_CONFIG_L=1:1,10<CR>

*UNIT_ID

Specifies the output unit ID. The unit ID is also used to identify DMR transmissions. If set to 0, DMR transmissions use the unit serial number as the DMR ID, if the unit ID is set, the DMR ID will assume this value.

*UNIT_ID=XX<CR>

where:

XX are any characters (up to 12 either numeric or alphanumeric) that are used to uniquely address each TReX when used in conjunction with the **WTE Output Control Protocol**. By default this ID is "01", allowing numeric paging to be used to transmit messages.

Typical usage:

*UNIT_ID=Unit-A<CR>

Mismatch Commands

Commands relating to the configuration of the MISMATCH feature. This feature is best operated from within the MENU (see MISMATCH Sub-Menu for further details).

When an antenna is missing, damaged or mismatched, the following may be observed; The current may increase/decrease and the RF power detected may increase/decrease through reflection. Should any of these be detected, the mismatch output can be configured to operate.

***MISMATCH_CAL**

After sending this command the transmitter will calibrate on the next transmission.

When calibration is complete the transmitter will return “CAL DONE” and calibration threshold figures to the terminal receive window.

Typical usage:

**MISMATCH_CAL=1<CR>*

Through the MENU this command may be invoked with the MISMATCH CAL item, setting to ENABLED.

***MISMATCH_DATA**

Sets parameters that control the antenna mismatch detection feature. These parameters are not intended to be manually set. Use MISMATCH_CAL=1 to auto-set the following parameters.

**MISMATCH_DATA=YY,ZZ,BB,CC,DD,EE*

where:

YY = allowed DAC variation (DAC count).

ZZ = allowed current variation (mA).

The following parameters should not be manually changed unless with factory assistance.

BB = the min forward power permitted (ADC count).

CC = the max forward power permitted (ADC count).

DD = the min permitted TX current (mA).

EE = the max permitted TX current (mA).

Typical usage:

**MISMATCH_DATA=7,70<CR>(sets DAC variation to 7, current variation to 70mA)*

DMR Commands

Commands relating to DMR Transmissions.

***DMR_CAL**

Factory Use only.

***DMR_DB**

Sets parameters that are associated with transmissions from the DMR database (see TX_DMR). The DMR database is only for use with group IDs. Should a single radio need to be addressed, a group should be created with only a single user.

***DMR_DB=A,B,C,D**

where:

- A = DMR Radio Type (0-2)
- B = DMR transmission Colour Code (1-16)
- C = DMR Slot (not used for Tier 1)
- D = DMR transmit frequency.

Typical usage:

***DMR_DB=0,6,0,458600000<CR>**

System Commands

***Trex_LANG**

Specifies the language used by the unit

***Trex_LANG=X**

where:

0 = English

Typical usage:

***Trex_LANG=0<CR>**

***Trex_BACKLIGHT**

Specifies the time in seconds which the display LED backlight will be lit for after a key is pressed. Setting to 0 disables. Setting to 30 enables permanently. This command is also used to set the LCD contrast. The default LCD contrast value is 32.

Typical usage:

***Trex_BACKLIGHT=10,32<CR>**

***Trex_SOUND**

Controls sounds made when a key is pressed or when a message is received that results in an ALERT being raised.

Typical usage:

***Trex_SOUND=1<CR>**

***Trex_RS232**

Sets the serial baud rate of the RS232 port. The second parameter should be set to 1 if EVEN parity is required.

Typical usage:

***Trex_RS232=9600,0<CR>**

***TREX_RS422**

Sets the serial baud rate of the RS422 port.

Typical usage:

**TREX_RS422=4800<CR>*

***TREX_ALERT**

Configures alerting configuration and some alerting options.

**TREX_ALERT=A,BB,C,D,E,F,G*

Where:

A Enables the MSG alert (0-1)

BB Sets the time before an ALERT beep is repeated (0-32000). Setting to 0 results no repeat.

C Sets the alert output to use (0-8). Setting to 0 disables the output function.

D Enables the BATT alert (0-1)

E Enables the MAINS FAIL alert (0-1)

F Enables the over-temperature alert (0-1)

G Enables the RF Fault (antenna mismatch) alert (0-1)

See **OUT_CONFIG** and **Alert Handling**.

Typical usage:

**TREX_ALERT=0,60,0,0,0,0,0<CR>*

***TREX_OVERTEMP**

Configures the over-temperature set-point. This is the TReX board operating temperature and NOT the ambient temperature.

See **Alert Handling**.

**TREX_OVERTEMP=T*

Where:

T is the RF temperature sensor set point.

Typical usage:

**TREX_OVERTEMP =95<CR>*

***TREX_FILTERS**

Sets the message filters that are in use when a message is received.

***TREX_FILTERS =I,E,A<CR>**

where:

I is set to 1 if the INCL.TXT filter is to be used.

E is set to 1 if the EXCL.TXT filter is to be used.

A is set to 1 if the MSG.TXT filter is to be used.

See **FILTERS** for details of use.

Typical usage:

***TREX_FILTERS =0,0,0<CR>**

***TREX_TELEMETRY**

Sets all parameters necessary to enable either the point to point serial link or back to back mirror mode of operation.

***TREX_TELEMETRY=M,R,A,B,C**

where:

M is telemetry mode of operation

0 = DISABLED,

1 = SERIAL_LINK,

2 = IO_MIRROR,

3 = SCADA_SLAVE,

4 = SCADA_MASTER

R is the number of remote TReX units when the telemetry mode is SCADA_MASTER (valid 0-10)

A is the local unit ID (from 1-255).

B is the remote unit ID (from 1-255).

C is how long in seconds before sending all input information again.

Typical usage:

***TREX_TELEMETRY=0,0,1,2,10<CR>**

***TREX_SCREEN**

Sets the default main screen and the page for that main screen. On start-up the first screen viewed is this screen. After a period of keypress inactivity, this is the return screen. This is shown here only for completeness. Typically this would only be set through the MENU system, and has no relevance when the TReX is being serially controlled.

***TREX_SCREEN=X,Y**

where:

X = main screen

Y = page for that main screen.

Typical usage:

***TREX_SCREEN=0,0<CR>**

***TREX_PIN**

Sets the Personal Identification Number, which can be used to unlock the unit. The PIN prevents accidental mis-configuration or changes by unauthorised users.

***TREX_PIN=nnnn**

where:

nnnn = 4 digit PIN number.

Typical usage:

***TREX_PIN=0000<CR>**

***TREX_AN_CAL**

Sets parameters used to calibrate the analog outputs and inputs. See DAC and ADC CAL Sub-Menus for more information.

***TREX_DAC_CAL=AA,BB,CC,DD**

where:

AA = DAC1 minimum count. Default 0.

BB = DAC1 maximum count. Default 1023.

CC = DAC2 minimum count. Default 0.

DD = DAC2 maximum count. Default 1023.

EE = ADC1 minimum count. Default 0.

FF = ADC1 maximum count. Default 1023.

GG = ADC2 minimum count. Default 0.

HH = ADC2 maximum count. Default 1023.

Typical usage:

***TREX_AN_CAL=0,1023,0,1023,0,1023,0,1023,**

***LIMITS**

Sets parameters used to set max and minimum limits used to protect the TReX from installation faults. This command is for factory use only. Linked to the MIN PWR, MAX PWR and MAX I items found in MENU->SYSTEM->FACTORY.

***LIMITS=AA,BB,CC**

where:

AA = minimum output power sense setting. If, during a transmission this output power is not achieved, a low output fault condition will be raised. Default value 10.

BB = maximum output power sense setting. During a transmission, the output power is not permitted to exceed this level. If it is reached, a fault condition will be raised. Default value 1000.

CC = Current limit in mA. This is the maximum current permitted during transmission. This limit ensures that the TReX and connected power supply is protected during an installation fault condition. Default value 1500.

TCP-IP Commands

***IP_ENABLE**

Enable/disable the Ethernet subsystem of the radio.

Use:

- 1 to enable WEB only.
- 2 to enable WEB plus TCP SERVER
- 3 to enable WEB plus TCP CLIENT
- 4 to enable TCP SERVER only.
- 5 to enable TCP CLIENT only.

Typical usage:

**IP_ENABLE=1<CR>*

***IP_HOST**

Configures the name used by the DNS server to allocate name to IP translation on the network.

Typical usage:

**IP_HOST=WTE-TReX<CR>*

***IP_ADD**

Specifies the default TReX IP address and the server address.

**IP_ADD=LLL,SSS<CR>*

where:

LLL = the local IP (the default IP is 192.168.1.21)

SSS = the server IP or address.

Typical usage without setting a server:

**IP_ADD=192.168.1.21<CR>*

Typical usage including a server name or IP:

**IP_ADD=192.168.1.21,m24.cloudmqtt.com<CR>*

***IP_PORT**

Specifies TCP Port used by the TCP server and client. Port for web configuration is fixed at 80.

Typical usage:

**IP_PORT=5080<CR>*

***IP_MASK**

Specifies default network mask number.

Typical usage:

**IP_MASK=255.255.255.0<CR>*

***IP_GATE**

Specifies the address used for the gateway.

Typical usage:

**IP_GATE=192.168.1.1<CR>*

***IP_DNS**

Specifies the IP number used to connect to the DNS server, up to 2 DNS servers can be set.

**IP_DNS=aaa.bbb.ccc.ddd,eee.fff.ggg.hhh*

where:

aaa.bbb.ccc.ddd = first DNS server IP,

eee.fff.ggg.hhh = second DNS server IP

Typical usage:

**IP_DNS=192.168.1.1,0.0.0.0<CR>*

Note: The IPs are separated by the use a “,” (COMMA)

***IP_MAC**

Returns the MAC (Media Access Code) number of the unit, this is a readable field only.

Typical usage:

**IP_MAC?<CR>*

Typical output:

**IP_MAC=60AD45676000<CR>*

***PING**

Sends a PING to the SERVER address. Reply expected will be the responding IP address and status (OK/TIMEOUT/NOT RESOLVED).

This item is useful for testing connectivity. If the TReX cannot successfully PING the SERVER, it is likely that a firewall network filtering rule is preventing the connection.

Usage:

**PING<CR>*

Protocols

Serial input into and out of the TReX can be formatted differently by selecting an appropriate protocol handler.

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 and DMR paging) to be used and a variety of baud rates. The WT Protocol also supports the use of macros to embed variable information in messages such as system voltage, time etc. – see **Variable Content Macros**.

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

T = POCSAG Tone Only

D = DMR Text Message (directed to a group)

d = DMR Text Message (directed to an individual)

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

2 = 1600 Baud 2 Level FSK

3 = 2400 Baud 2 Level FSK

4 = 3200 Baud 4 Level GFSK

- 5 = 4800 Baud 2 Level GFSK
- 6 = 9600 Baud 2 Level GFSK
- 7 = 9600 Baud 4 Level GFSK
- 8 = 16000 Baud 4 Level GFSK
- 9 = 32000 Baud 4 Level GFSK

12.5 kHz Channel Space Settings

- A = 512 Baud 2 Level FSK
- B = 1200 2 Level FSK
- C = 2400 2 Level FSK
- D = 4800 2 Level GFSK
- E = 9600 2 Level GFSK
- F = 9600 4 Level GFSK
- G = 16000 4 Level GFSK

6.25 kHz Channel Space Settings

- a = 512 Baud 2 Level FSK
- b = 1200 2 Level GFSK
- c = 2400 2 Level GFSK
- d = 4800 4 Level GFSK

NOTE: Although the protocol supports the following modulation types and channel spacings, the supplied WTE product may only support a subset of these modulation rates (determined by regional restrictions).

<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>

Responses

After processing/transmitting responds with:

WT[TTT,NNN]<CR>

where:

TTT is the “ticket ID” that was assigned to the transmission. Rotates from 999 to 0.

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

WT[123,017]<CR>

If a user specified response is required this response can be changed. To change the sent response to “Page Sent” a leading “*” character must be used in the PROTOCOL->SENT RESP config item. e.g. “*Page Sent”.

If the entire WT Protocol message needs to be sent out the serial port after each transmission: Change the sent response to “**” using the menu item PROTOCOL->SENT RESP or the command **SEND_RESP=**<CR>**. This means that triggering an input with the programmed content of “WT1234560A10 test message” will result in “WT1234560A10 test message\r\n” being sent out the configured serial/TCP ports. If the message is not to be transmitted, change WT1234560A10 to WT1234560S10.

Received Messages

All messages received come out via the serial port as configured in by the *RX_PROTO setting:

If *RX_PROTO=WTE then the output will look like:

WT1234567A10<SPACE>TEST<CR>

The exact same format allows units to be connected together, or protocols to be converted from one type to another.

Serial Only Output of Messages

There is sometimes a need to only send WT protocol messages out a serial port and not transmitted on a particular event. For example, if an input changes state, it might be desirable to send a message out the serial port to control another piece of equipment, or it might be useful to use the periodic message to send a health check message out the serial port once every 5 seconds. Receiver only TReX units use this method to output messages.

From v3.45 firmware a new type of message has been assigned for this purpose. This is ‘WTS’

Example:

To send the message “INPUT 1 LOW” out the serial port when input 1 moves low program the input 1 low message with:

WTSINPUT 1 LOW<CR>

To send “WT1234560A10 test” out the serial port:

WTSWT1234560A10 INPUT 1 LOW<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.

WT1234560A10WT1222222A10<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.

WT1234560A10WT0001001D60<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.

WT1234560A10WT1222222A10WT0201234A11WT0005647A11<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>

TReX DMR ID

Messages transmitted will have the TReX serial number as the source. If the TReX unit ID is configured to a numeric value greater than 1, then this becomes the transmitted source ID.

Variable Content Macros

WT Protocol can use several macro tags to display variable content. This may be useful as part of a periodic message for example to report battery voltage or IO conditions. Any number of macros can be used in any location of the message until the max message length has been reached.

Macro Tag	Description	Example Output
**01	Auto Incremented Ticket ID (3 digits rotating)	123
**02	Time/Date	23:34 01/02
**03	Digital IO	I:11110000--- O:1111000000
**04	Analog IO	ADC:1023,1003 DAC:1023,1003
**05	System Voltage	12.1
**06	Temperature (Digital, RF degrees Celsius)	23.4, 44.5
**09	MQTT Topic	TREX/01/ where 01 is the Unit ID

Example:

To transmit the system voltage when input 1 goes low, program the input 1 low message with:

*WT1234567A10<SPACE>INPUT 1 **05V<CR>*

The message that will be transmitted and then received will look approximately like:

INPUT 1 12.1V

Modbus

The TReX supports both RTU and TCP modbus protocol options. These are well established and defined protocols used primarily in SCADA control and monitoring applications.

These Modbus protocols can be used over any of the RS232, RS422, RS485 and Ethernet interfaces.

Baud-rates, IP configuration and Modbus specific configuration items are through: MENU->PROTOCOL->MODBUS. This is an optional feature.

Note that the Modbus TCP protocol by default uses port 502. This is not a firm requirement, and this can be changed to another port. The TReX defaults to port 5080.

Modbus RTU

The Modbus RTU protocol, as well as the TCP extension, are well documented in the specifications which are available at <http://www.modbus.org>, a website established by the Modbus Organization for supporting and organizing the Modbus protocol. Only the use of the protocol is documented here.

The first byte of the Modbus RTU protocol is a single byte Modbus Slave ID. The TReX uses the Slave ID as the Unit ID when the Modbus TCP protocol is used. These ID codes allow multiple units to be addressed, or in the case of Modbus TCP, multiple units to be used on the same IP address.

Modbus TCP

The Modbus/TCP extension includes 6 additional bytes to the original Modbus RTU protocol, which allows for transport over the TCP/IP layers.

Only a single TCP connection is permitted at any one time.

The TReX sends these 6 bytes PLUS the entire RTU protocol payload (except the last two CRC bytes). The first byte of the RTU protocol is the unit ID (usually described as part of the Modbus MBAP header)

Function Codes

Listed are the supported Modbus function codes. All function codes not specified will return a Modbus standard error response.

The TReX supports 1 MASTER plus up to 10 SLAVES wirelessly connected.

Note: in the following mapping, provision has been allowed for multiple SLAVE units. The first single register (and in the case of discrete I/O, 8 registers) are for the MASTER unit, and following registers are for the installed SLAVE units in the system.

Function Code	Description	Valid Address Range	Registers
01 – Read Coils	Code to read the 8 TReX digital outputs (MASTER TReX plus up to 10 wireless SLAVE TReX units)	0x0000 - 0x0057	1 to 88
02- Read Digital Inputs	Code to read the up to 88 TReX digital inputs (MASTER TReX plus up to 10 wireless SLAVE TReX units)	0x0000 - 0x0057	10001 to 10088
03- Read Holding Registers	Read DAC1 registers Read DAC2 registers	0x0000 – 0x000A 0x0100 - 0x010A	40001 to 40011 40257 to 40267
04 – Read Input Registers	Code to read the ADC1 Code to read the ADC 2 Code to read Temperature Reserved Code to read BattV Read Link Status Count	0x0000 – 0x000A 0x0100 – 0x010A 0x0200 – 0x020A 0x0300 – 0x030A 0x0400 – 0x040A 0x0500 – 0x050A	30001 to 30011 30257 to 30267 30513 to 30523 30769 to 30779 31025 to 31035 31281 to 31291
05 – Write Single Coil	Code to write to the 8 TReX outputs(MASTER TReX plus up to 10 wireless SLAVE TReX units)	0x0000 - 0x0057	1 to 88
06 – Write Single Register	Code to write DAC1 Code to write DAC2 Special Command Code	0x0000 – 0x000A 0x0100 – 0x010A 0x0200 – 0x020A	40001 to 40011 40257 to 40267 40513 to 40523
15 – Write Multiple Coils	Code to write to up to 8 outputs at once (MASTER TReX plus up to 10 wireless SLAVE TReX units)	0x0000 - 0x0057	1 to 88
16- Write Multiple Registers	Message TX Buffer (see below)	0x0300 – 0x03FA	40769 to 40892

Modbus Mapping Table

Base Address	Num Registers	Description	R/W	Bits
1	88	Digital Out (discrete)	R/W	1
10001	88	Digital In (discrete)	R	1
30001	11	ADC 1 (raw count 0-1023)	R	16
30257	11	ADC 2(raw count 0-1023)	R	16
30513	11	Temperature 1(signed short x 10)	R	16

30769	11	Status(signed short x 10)	R	16
31025	11	Battery(signed short x 10)	R	16
40001	11	DAC 1 (value from 0-1023)	R/W	16
40257	11	DAC 2 (value from 0-1023)	R/W	16
40513	11	Special Function Commands 1 – Reboot Unit 2 – Request Slave I/O to be returned to Master.	W	2
40769	125	Message Tx Buffer (variable len up to 250 bytes)	W	16

RAW Protocol

The Raw protocol uses all default settings to determine the data rate, transport method, cap code etc. This protocol is the protocol used when using a point to point serial link.

Default transmission settings are configured with the commands:

***TX_BAUD**

***TX_CAP**

***TX_LEVEL**

In addition, the following commands are used with RAW protocol:

***RAW_TIMEOUT**

Specifies the time of inactivity in 25ms steps before sending all stored data (max 255), example for a timeout of 100mS:

Typical usage:

***RAW_TIMEOUT=4<CR>**

***RAW_END**

Specifies a character that results in immediate transmission, or displayed after reception (0 if unused). Decimal value of ASCII character.

Typical usage:.

***RAW_END=13<CR>**

This means transmit immediately after the carriage return character is seen. Also after decoding each message, the carriage return character is also displayed.

***RAW_CONFIG**

Specifies all RAW protocol parameters.

Parameter 1 specifies the time of inactivity in 25ms steps before sending all stored data (max 255).

Parameter 2 specifies a character that results in immediate transmission (0 if unused). Decimal value of ASCII character,

Typical usage:

***RAW_CONFIG=4,13<CR>**

MQTT

MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol.

When this protocol is selected a MQTT password, user, port, server and client ID can be configured for use.

The TCP-IP mode should either be TCP CLIENT or WEB+CLIENT in order to operate as a MQTT TCP client.

The TReX uses a system that allow an indefinite number of IoT devices to be connected and monitored using any MQTT phone application or software. The TReX also allows outputs to be controlled and paging messages to be transmitted and sent as MQTT messages.

TReX units can be used as intermediate repeaters for connected sensors allowing for extremely long range monitoring and control for IoT devices. Range is limited by the power that the TReX is allowed to transmit at for the channel of use and how TReX repeaters have been deployed.

While operating an MQTT IoT network, the network continues to operate normally for paging messages, allowing notifications to be delivered to any paging receiver or TReX operating within the MQTT IoT network.

Contact info@wte.co.nz to request the MQTT system application note AN001 describing MQTT topics and system implementation.

SCADA Support

SCADA (Supervisory Control And Data Acquisition) is a term used widely in many industries relating to monitoring and control systems. This section deals with the integration of the TReX into a SCADA system. This is an optional feature, that requires a feature key to be purchased.

Terminology

SCADA application:

This is a software package that is used to control and monitor devices. This could be free open source packages such as “Rapid SCADA” or “openSCADA”. Alternatively, this could be industry standard applications such as “WonderWare” or “LabView”.

SCADA system:

This is a system comprising of one or many TReX units monitoring equipment that the TReX units are connected to. This includes also the SCADA application.

MASTER:

This is the unit that is connected through Ethernet or another interface to a SCADA monitoring application.

This master unit can now control and hold the details of up to 10 TReX slaves. Input and output status of all units can be immediately requested or modified directly by the SCADA application.

To set the TReX as a master set MENU->TELEMETRY->MODE to SCADA_MASTER.

SLAVE:

These TReX units are directly controlled by the TReX master. The slave’s primary function is to report input changes and/or operate its outputs upon a master request.

There may be up to 10 slave units, all located in different locations around a site, all monitoring and controlling different aspects of the SCADA system.

To set the TReX as a slave set MENU->TELEMETRY->MODE to SCADA_SLAVE.

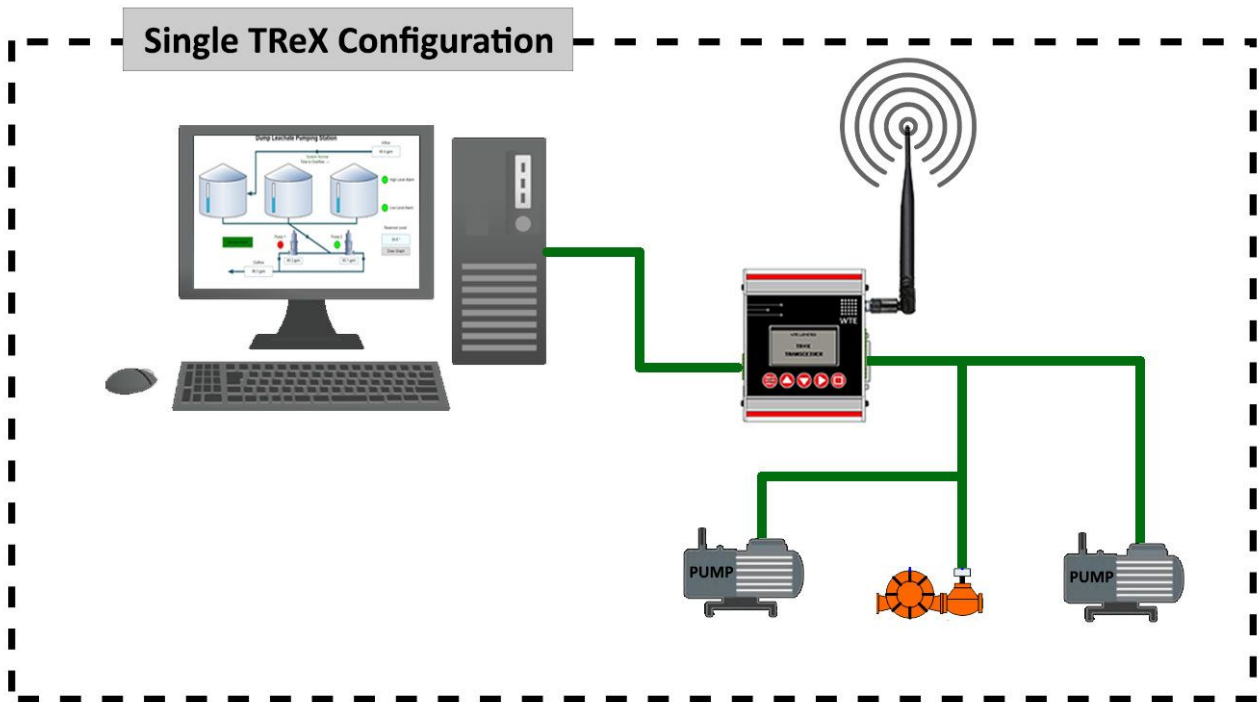
As a simple working example shown below, web content is being served to a PC and mobile devices using the open source application “RapidSCADA”.

SCADA applications have the advantages to provide a means to notify through; email, paging messages, SMS or to generate alarms of critical system events.

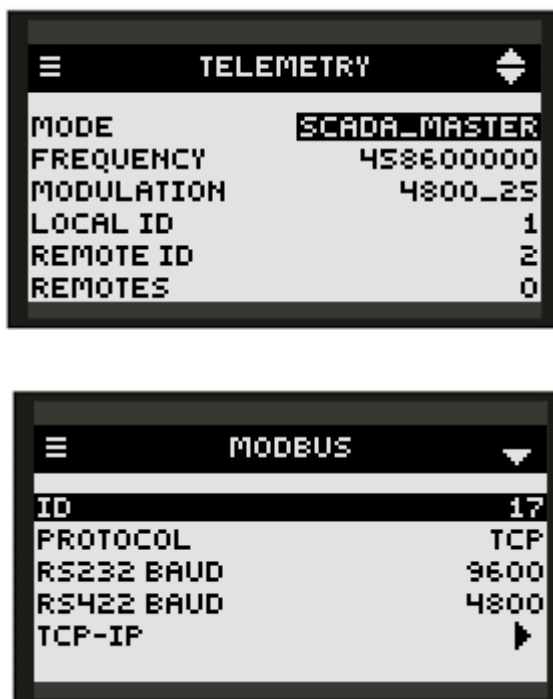
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SCADA System Single TReX Configuration

This is a system that requires no expansion through use of SLAVE units.



Unit Configuration



Since this system configuration is only for a single TReX unit, the LOCAL ID and REMOTE ID fields are not used and can be set to anything. The MODBUS ID can be any value from 0-127 (except 42 or 87).

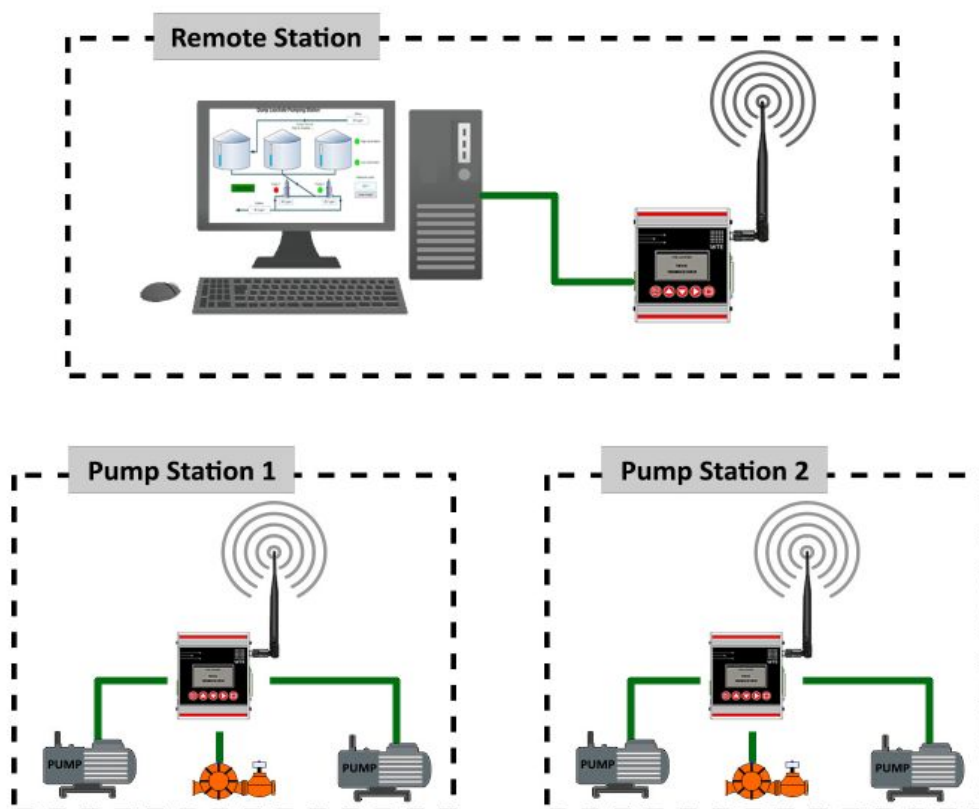
MENU->PROTOCOL->MODBUS is used to configure the key SCADA parameters, such as unit ID and the protocol. Typically, if an Ethernet connection is used, the TCP protocol will be used.

See **MODBUS Protocol** for more Modbus information.

SCADA System Multiple TReX Configuration

Up to 10 wireless SLAVES can be controlled by a MASTER.

A SCADA application will be able to monitor and control all TReX IO on the MASTER and SLAVE TReX units.



Simple Example

A remote station controlling two separate pump stations, where the "Remote Station" has a TReX units connected to a SCADA system and the "Pump Stations" may have several pumps and other I/O devices connected. Here the "Remote Station" is configured as MASTER and the "Pump Station" are configured as SLAVE units.

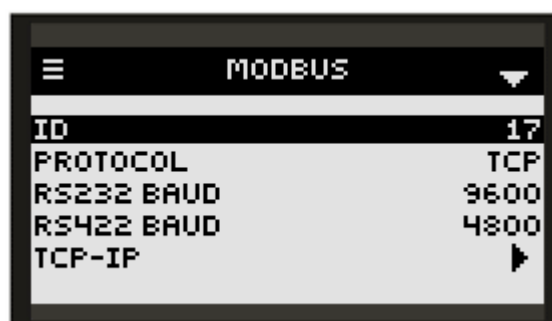
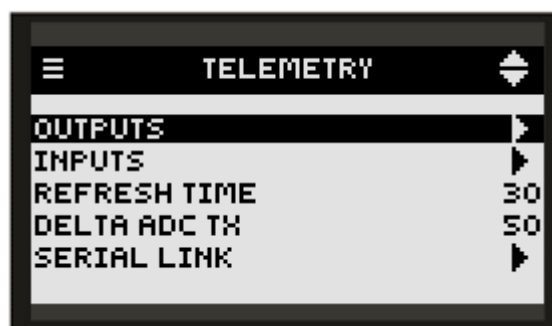
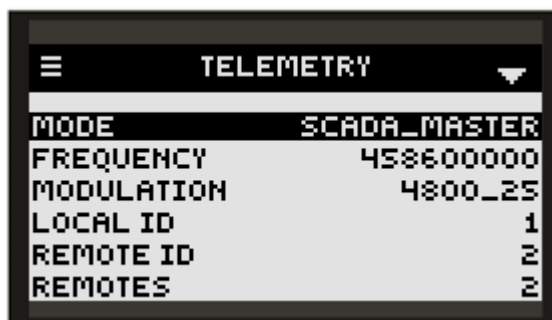
Example Configuration:

- "Remote Station" has a LOCAL ID configured to be 01.
- "Pump Station 1" SCADA_SLAVE has a LOCAL ID of 02,
- "Pump Station 2" SCADA_SLAVE has a LOCAL ID of 03,
- All Units have been configured to refresh I/O each 30 seconds (REFRESH TIME).

Note: Refreshing of SCADA status is immediate on any digital input change or any analogue input that changes by more than ADC counts configured in DELTA ADC TX.

Units Configuration

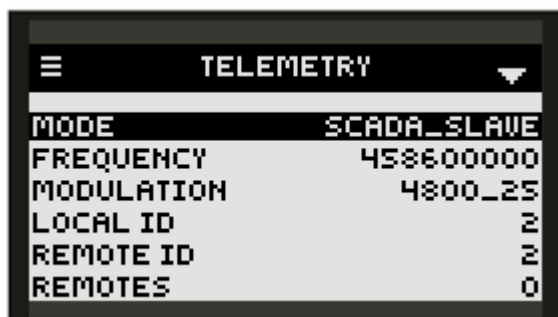
“Remote Station” Configuration



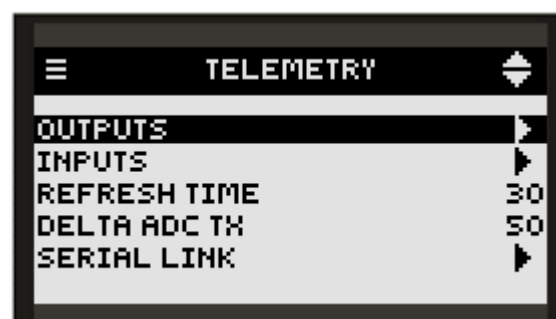
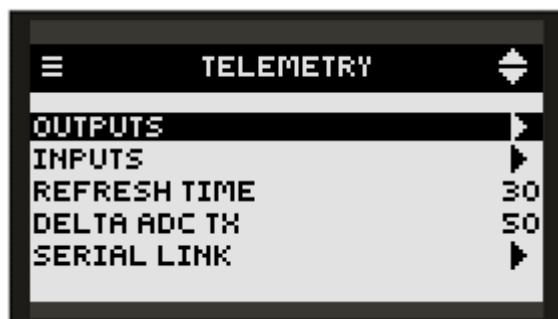
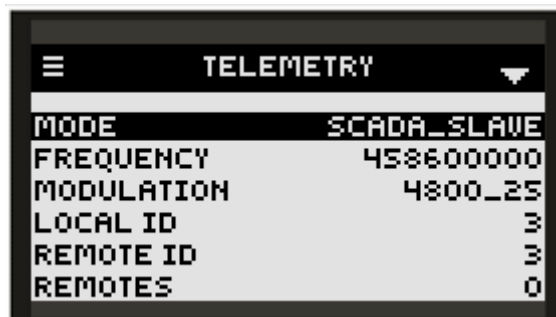
The LOCAL ID must be configured to a system unique value (default “01”). REMOTE ID must be configured to the ID of the **first** SLAVE LOCAL ID.

MODBUS ID can be any value from 0-127 (except 42 or 87).

“Pump Station 1” Configuration



“Pump Station 2” Configuration



The MASTER unit has configured REMOTES to a value of 2 (meaning there are 2 SLAVE units). Note that each SLAVE must start at the REMOTE ID configured on the MASTER, and each SLAVE in the system must be consecutively numbered.

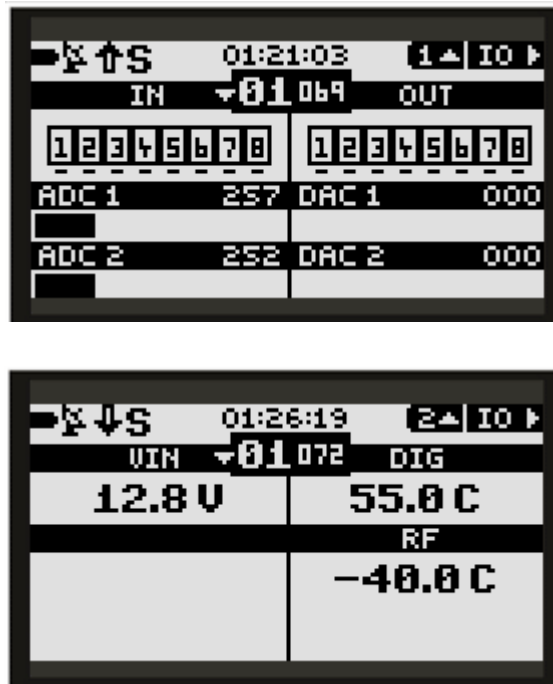
The SLAVE configuration is unique in that both the LOCAL ID and REMOTE ID need to be the same. In this configuration, the MASTER unit requires these settings in order to identify the SLAVE unit messages.

The SCADA application will report inputs 1-8 to be from “Remote Station”, inputs 9-16 from “Pump Station 1” and inputs 17-24 from “Pump Station 2”.

See **Modbus Protocol** for more information.

Viewing Multiple TReX Unit IO on the MASTER Unit.

The MASTER on the IO screens can view all system inputs and outputs without the need for a SCADA application. This is useful for debugging and installation.

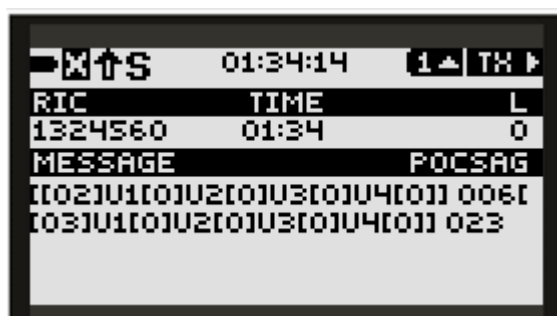


Shown in this case is the number “01”, followed by “069”, where “01” in this case is the UNIT ID in the system. The “069” is a “link fail” counter used to determine loss of communication for a unit. This number is reset whenever a new message is decoded from a SLAVE unit.

Pressing the DOWN button will cycle through all the remote UNIT IDs in the system, displaying all system IO, link states, temperatures and battery voltages.

SCADA Communication Between MASTER and SLAVE

All communication between the MASTER and SLAVE units can be viewed on the RX and TX screens.



These messages are of little application to the user, and documented here purely for clarity of function and debugging if required.

These messages are a variation of the **WTE Output Control Protocol**. There are however special codes used reserved for internal use only.

Messages from MASTER to SLAVE:

Code	Description
U1	DAC 1 Control Value
U2	DAC 2 Control Value
U3	Digital Output Bitmap
U4	Special Slave Commands

Messages from SLAVE to MASTER:

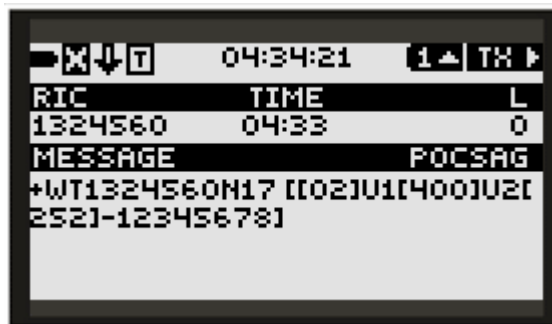
Code	Description
U1	DAC 1 Control Value
U2	DAC 2 Control Value
U3	Digital Output Bitmap
U4	Digital Input Bitmap
U5	ADC 1 Value
U6	ADC 2 Value
U7	Temperature * 10
U8	Battery V * 10

IO Mirror Operation

The IO MIRROR is the simplest self managed telemetry mode that mirrors the inputs of one TReX unit to the outputs of another TReX unit.

SCADA monitoring and control is not possible in this mode of operation (see **SCADA Configuration and Operation**). This mode is intended for a simple system that allows remote outputs to be controlled and inputs monitored without any supervising equipment.

When TELEMETRY->MODE is set to IO MIRROR the small “T” icon is displayed in the title bar.



The IO MIRROR mode can map a single TReX unit to another TReX unit or to many selectively configured TReX units.

When enabled, the REMOTE ID device outputs are mirrored to the state of LOCAL ID device inputs. In order for a REMOTE ID device to have its outputs changed through the MIRROR MODE, the output must be configured to be TELEMETRY. It is possible to restrict outputs(s) that are updated by DISABLING outputs on the REMOTE ID device.

REMOTE ID devices are automatically controlled using the **WTE output control protocol**. When there is any input change, or an analog input changes by more than a configured threshold amount, there is an immediate transmission that updates a REMOTE ID device outputs.

A periodic refresh time can also be configured to ensure that outputs and inputs remain synchronised. On a REMOTE ID device inputs may optionally be tied to outputs to allow the actual remote output state to be displayed on the originating ID unit.

Mirrored INPUTS use the same TX DEBOUNCE and TX COUNT configuration items as normal message inputs. To prevent inputs from being mirrored, set the TX COUNT to 0. In some cases multiple transmissions may be desired. The default configuration is to transmit an input after being debounced for 200mS.

When IO MIRROR is enabled, configurable messages cannot be transmitted from inputs. If mirroring of some inputs and messages transmitted on other inputs is a requirement, this can be

achieved by configuring some input message using the **WTE output control protocol**.

After selecting a frequency to transmit on, the default settings will in many cases be enough for the system to be ready to test before deployment.

NOTE: Make sure the REMOTE ID of one device matches the LOCAL ID of the other.

Serial Link Operation

The TReX is well suited for use as a wireless point to point serial link.

When TELEMETRY->MODE is set to SERIAL LINK the small back to back arrow icon is displayed in the title bar.



Raw serial data in any format presented to the TReX is transmitted across the air and is output from a remote TReX serial port. The behaviour of this feature is the same as if a serial wire cable would be fitted between the units.

A typical application for this feature would be the writing information to remote LED signs. The TReX can write to many remote units simultaneously.

In order to transmit serial characters, the TReX needs to be configured to know which ASCII character should be used to invoke an immediate transmission (or if any), the maximum number of serial characters to transmit at any time and how long after a period of inactivity any buffered data should be transmitted.

The rate that data is transmitted across the air varies based on application. Typically, slower over the air transmitted rates such as 1200 or 2400 will result in higher sensitivity of the receiver, making the possible distance between each TReX greater. By default the transmission baud rate is 4800_6L allowing for use on 6.25kHz channels.

The TReX will typically allow up to 234 characters to be transmitted at a time, with buffering capability to allow several messages of this length to be queued for rapid transmission (up to approximately 1000 characters per burst).

If the buffering capacity of the TReX is exceeded then the TReX will respond with "FULL<CR>".

Prior to each transmission the channel checks if TReX is clear to transmit, meaning that in some cases transmissions could be slower depending on channel usage.

The TReX uses the default CAP code to identify each transmission, meaning that the TReX can either transmit to one or many other TReX units addressed individually or multicast to many at once.

It is possible to use RAW protocol without the SERIAL LINK option being enabled. Enabling SERIAL LINK prevents additional message filtering and file operations that may normally reduce throughput.

Once SERIAL LINK has been enabled through the menu, other than selecting the operating frequency, no further configuration will be required in most cases.

NOTE:

While operating using the RAW protocol, the TReX will **NOT** respond to any configuration commands. Configuration remains possible through the keypad, SD card ini file or web browser.

In order to quickly configure the point to point serial feature:

From the menu:

1. MENU->FACTORY->SYSTEM DEFAULTS
2. MENU->TELEMETRY->MODE – Set to SERIAL LINK
3. Exit from menu to save configuration.

The unit is now operating in a point to point serial link mode.

Configure RF aspects:

1. MENU->RF->FREQUENCY (to set transmit frequency)
2. MENU->RF->MODULATION (to set modulation transmit rate and channel usage).
3. MENU->SYSTEM->RS232 BAUD (to set serial baud rate – that should be a higher rate than the over the air transmit rate).
4. Exit from menu to save configuration.

Alert Handling

Use of Alerts is the TReX mechanism for providing notification of key events.

When an ALERT is triggered, there are three possible notifications:

- Visual: flashing bell icon in the top bar.
- Audible: Beep when SYSTEM->SOUND is set to ENABLED. Repeating beep at configurable interval when MENU->ALERTS->ALERT REPEAT is not set to DISABLED. When ALERT REPEAT is set to DISABLED, there will only be a single audible alert.
- ALERT output operation: MENU->ALERTS->ALERT OUT can specify an output that is operated when ANY alert is triggered. This allows for common monitoring of many outputs, also allowing the source of those alerts to be identified.

If the ALERT output has been specified and is not MONOSHOT, then this output may remain in a latched state. Many alert conditions are auto-clearing as described below. Once all ALERTS sources have been cleared (either automatically or manually) then the ALERT output will not longer operate and the audible beep will cease (if configured).

Output Alert	Description	Auto-Clearing	Alert Clearing Condition
RF	RF low power or antenna mismatch on transmit.	Yes	Next transmission that does not have low power or antenna mismatch detected.
TEMP	Over temperature specified in SYSTEM->OVERTEMP	Yes	No longer over temperature.
MAINS FAIL	Input message with MAINS FAIL is processed.	Yes	Input message with MAINS RESTORED is processed.
LINK	Link fail timer expires through the absence of received messages.	Yes	New message is received, resetting the link-fail timer.
BUSY	Channel is busy, checked every 100ms.	Yes	Channel is no longer busy.
MSG	Received a new message.	No	Pressing the ENTER button to acknowledge.
BATT	Battery voltage is BELOW the BATT input low voltage threshold, checked once a second.	Yes	Battery voltage is ABOVE the BATT input low voltage threshold, checked once a second.

Whenever an alert is raised the alert bell icon is displayed, except when in the menu. If an alert has been raised in the menu, the alert will be visible upon leaving the menu.

The Alert Summary IO screen shows at a glance the status of each alerting function. It also shows which ALERTS are ENABLED. The total number of alert activations for each ALERT source can be seen here. Alert counts are cleared on start-up.



07:35:38		IO	
BUSY	LINK	MAINS	
1 000 -	2 001	3 000 -	
RF	TEMP	MSG	
4 000 ✓	5 000 ✓	6 000 -	
BATT			
7 000 ✓			

In the following example there are 3 alert types of interest; BATT, TEMP and LINK FAIL that all need to notify a problem through a single output (in this case output 8). An audible alert is required repeating every 30 seconds.

1. Set ALERTS->BATT to ENABLED
2. Set ALERTS->TEMP to ENABLED
3. Set ALERTS->LINK FAIL to ENABLED
4. Set ALERTS->ALERT OUT to 8.
5. Set ALERTS->SOUND to ENABLED.
6. Set ALERTS->ALERT REPEAT to 30.

The alert configuration will be as follows (assuming initial state was the factory default state):



ALERTS	
MSG	DISABLED
BUSY	DISABLED
LINK FAIL	ENABLED
MAINS FAIL	DISABLED
TEMP	ENABLED
RF ERROR	DISABLED



The alert summary screen shows:



Of interest is the tick under BATT and TEMP indicating that the ALERTS for these functions are enabled. The bell icon in the top bar shows there is an active alert (visible on all screens outside of the menu). Under LINK the bell shows that the LINK FAIL is currently active. The “001” indicates that a single alert has been raised since start-up. The TEMP tick means that the TReX is NOT over-temperature, and the BATT ticks means the voltage supplying the TReX is above the minimum programmed BATT input threshold.

Since there is at least one ALERT active, the main IO screen shows that output 8 has been operated.



Clearing Alerts

All alerts except the MSG alert are auto-clearing.

To clear a MSG alert:

Pressing the square “ENTER” key will clear MSG alerts (if not in the MENU). This will:

- Deactivate the ALERT output (if no other alerts are active).
- Disable the audible beep (if sound is enabled and no other alerts are active).
- Clear the bell from the top icon bar (if no other alerts are active).

Input Handling

Note: Please refer to **Input Output Hardware Connection** section on this manual for examples of how to connect the input and output pins on the TReX board.

The TReX supports 8 programmable inputs. Each input can be programmed with a short message up to 50 characters in length. Input messages must always be formatted as **WT Protocol** or the **WTE output control protocol**.

On start-up each input is read. By default only inputs that change from the start-up input state are processed. The expected initial state of each input can be configured, so that on start the input is not in its expected state there can be an immediate transmission. Outputs can be controlled through any input message if required (see **Controlling Outputs from Inputs**).

Commands relating to input handling (if preferred, all input options can be configured through the menu system):

- *IN_INIT specifies the expected level on start.
- *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.
- If pending transmissions should be allowed to complete after state change.
- An independent resend timer for every input message allowing input messages to be indefinitely retransmitted if required.

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 both inputs 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=1:0,0,0,0,0<CR>
```

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

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

```
*IN_CONFIG_L=1:5,20,10,0,0<CR>
```

```
*IN_CONFIG_L=2:5,20,10,0,0<CR>
```

Both input 1 and 2 are configured as per the full example details above and in addition both inputs resend the programmed message once every 30 seconds (only while the input is low)

```
*IN_CONFIG_L=1:5,20,10,0,30<CR>
```

```
*IN_CONFIG_L=2:5,20,10,0,30<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.

Controlling Outputs from Inputs

Any input (including battery and analog inputs) can be used to control any output(s) if required. The **WTE output control protocol** can be used as the payload of any message.

Desired control solution 1:

To close output 2 when the battery voltage is low. The assumption in this case is that the unit ID is the default ID of 01.

The default low battery voltage message which is associated with input 9 is as follows.

```
*IN_MSG_L=9:WT1234560A13 BATT LOW<CR>
```

Change the message to:

```
*IN_MSG_L=9:[[01]2]<CR>
```

Output 2 will now close and will be latched or a mono-shot operation as configured.

Desired control solution 2:

To close output 2 when the battery voltage is low and also transmit a message. The assumption in this case is that the unit ID is the default ID of 01.

The default low battery voltage message which is associated with input 9 is as follows.

`*IN_MSG_L=9:WT1234560A13 BATT LOW<CR>`

Change the message to:

`*IN_MSG_L=9:[[01]2]WT1234560A13 BATT LOW<CR>`

Output 2 will now close and will be latched or a mono-shot operation as configured. In addition the following BATT LOW will be transmitted.

Output Handling

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

The TReX supports up to 8 outputs. One of these outputs can be shared with the ALERTS->ALERT OUT output.

Outputs are configured using the commands:

*OUT_CONFIG

*OUT_ID

The outputs are 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 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.

The output control protocol can also be used to direct commands or protocol messages to specific remote units.

It may be likely that the payload is transmitted as part of a paging payload, such as POCSAG or FLEX, but ultimately the transport method is irrelevant as long as it is capable of transmitting the characters used by the protocol.

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.

Digital Output Format

The payload of a message must fit the following format in order to operate the unit outputs. Note that this description is extended below to describe how this format is extended to also allow control of analog outputs.

[[ID]EEEE-DDDD]

Where:

[is the character '['

] is the character ']

ID is the OUT_ID that has been programmed (e.g. "01" or "Unit_A"). The ID may also be a comma separated list of units (e.g. [01,Unit_A,03])

E is the output to enable (1-8 for the TReX). Up to 2 outputs can be specified.

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

D is the output to disable

Examples:

Consider an TReX configured with OUT_ID of “Unit_A” and both pins configured as outputs:

```
*OUT_ID=Unit_A<CR>
*OUT_CONFIG=1:1,0<CR>
*OUT_CONFIG=2:1,0<CR>
```

Scenario 1: To turn output 1 ON and turn OFF output 2;

Message payload:

```
[[Unit_A]1-2]
```

Scenario 2: To turn output 2 ON and turn OFF output 1;

Message payload:

```
[[Unit_A]2-1]
```

Scenario 3: To turn output 1 and 2 ON;

Message payload:

```
[[Unit_A]12-]
```

Scenario 4: To turn output 1 and 2 OFF;

Message payload:

```
[[Unit_A]-12]
```

Consider that we have several TReX Units and each one is configured with a different OUT_ID; “Unit_A”, “Unit_B” and “Unit_C”

Scenario 5: To turn output 1 and 2 ON in the Unit_A:

Message payload:

```
[[Unit_A]12-]
```

Scenario 6: We want:

- to turn output 1 and 2 ON in the Unit_A,
- to turn output 1 ON and turn OFF output 2 on the Unit_B,
- turn OFF output1 and 2 on the Unit_C;

Message payload:

```
[[Unit_A]12-] [[Unit_B]1-2] [[Unit_C]-12]
```

Scenario 7: To turn output 1 and 2 ON in the Unit_A and on Unit_B:

Message payload:

```
[[Unit_A,Unit_B]12-]
```

Analog & Digital Output Format

The WTE output control protocol allows the direct control of analog outputs.

`[[ID]UZ[AA]CCC-OOOO]`

Where:

[is the character '['

] is the character ']

ID is the UNIT_ID that must match the TReX to be controlled..

U is the character 'U' and is used to mark that an analog or special output follows

Z is the analog output (1-2). 3 is used to write a digital output bitmap.

C is output to close (1-8). Up to 8 outputs can be specified.

- is the character '-'

O is the output to open

AA is the value to set an analog output to (0-1023). When a digital output bitmap value is used this value can be a value from 0-255. When an analog output is set to higher than 1023, the value 1023 is used.

When square brackets are after an analog output specifier ('U'), then the value specified is the DAC value to set. Note that both a digital output and analog output can have the same output number.

When analog outputs are controlled they must always be before any digital outputs.

Example 1:

Unit configured to have UNIT_ID of "UNIT-1". Digital outputs 2 and 4 are to be set, and output 1 cleared. Analog Output 2 is to have the DAC set a value of 927

Message payload:

`[[UNIT-1]U2[927]24-1]`

Example 2:

Unit configured to have UNIT_ID of 01. Analog Output 1 is to have the DAC set a value of 18, analog output 2 is to have a DAC value of 145.

Message payload:

`[[01]U1[18]U2[145]]`

Notes:

- The unit will only process the Output Control Protocol for the unit configured in the

OUT_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 OUT_ID.

Remote Command Output Format

The WTE output control protocol allows the direct control of remote units. This allows specific TReX units to accept commands or protocols for processing “over the air”.

[[ID]U0[AA]]

Where:

[is the character ‘[’

] is the character ‘]’

ID is the UNIT_ID that must match the TReX to be controlled. ID may be a comma separated list of units (e.g. [01,04,06])

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

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 of “UNIT-10”.

Message payload:

[[UNIT-10]U0[*REBOOT]]

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

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

Message payload:

[[UNIT-10]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 of “UNIT-10”.

Message payload:

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

The message transmitted by UNIT-10 will be “Test Message” at 512 baud, but the message

may have been received at a different configured baud rate.

Application of this may be:

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.

WTE Ack and Confirm Protocol

Introduction

This section describes how to use this protocol to invoke automatic acknowledging and optionally manual confirmation of messages sent/received. This protocol can also be used to message TReX units to display confirmation prompts. The use of this protocol is the heart to making two-way paging or messaging possible.

Monitoring equipment can make decisions based on acknowledge responses whether to retransmit or notify a communications link issue. Acknowledgements can be either transmitted or sent through a TCP/IP connection.

A typical application for a confirmation request would be an emergency communications room messaging several ambulances with TReX units fitted. The message would provide an on-screen prompt requesting attendance to an event. Any ambulance can then accept the message, and details of the attending vehicle would then be sent to the communications room.

The **WTE Ack and Confirm Protocol** can be embedded into the payload of any message.

Typically the protocol message would be attached to the end of a message, so that paging messages would display normally for typical users.

Note: In order for a TReX unit to acknowledge any message, the receiving TReX RIC codes used must fall within allowed normal RX receive ranges.

Protocol Usage

-[TTT-A-XXX]

where:

- is the character '-' (marks the start of the ticket ID and ACK Mode)

[is the character '['

TTT is a 3 digit ticket id

A is the ACK Mode

1 = acknowledge required

2 = acknowledge and confirmation required

3 = confirmation without acknowledgement (when sent to many stations.)

- is the character '-' marking the start of the optional confirmation title.

XXX is the optional confirm title (e.g. "Accept?"). Not specifying this field results in default of "CONFIRM". This field is only meaningful when ACK mode is 2 or 3. Max length is 14 characters.

] is the character ']'

Responses are all transmitted using the default settings for modulation type and protocol. The payload is also sent directly out the serial port and TCP sockets for when acknowledgement is required via IP.

Typical Operation

The base-station TReX sends single messages, or many batched together as required.

The transmitter can send an auto incremented ticket ID, or the ticket ID can be manually selected as part of the Acknowledge and Confirm Protocol.

Using WT Protocol allows the use of the **Variable Content Macro **01** to be used to transmit with an automatically incrementing ticket ID.

Receiving TReX units can acknowledge multiple messages if messages have been received in a batch.

e.g. The remote TReX unit receives 3 messages all to be acknowledged (ticket IDs 345, 346 and 347). The following is transmitted.

ACK[345,346,347]

Upon reception of any message requiring confirmation, the TReX shifts from any screen currently on, and does not allow leaving of the confirmation message screen until the message has either been accepted or rejected. Any messages received while waiting for confirmation will be logged and can be inspected at a later time.

Example 1:

Message payload to have delivery acknowledged is transmitted.

Message Payload:

Bob, go to Pukeko Place urgently.-[345-1]<CR>

Remote TReX responds with:

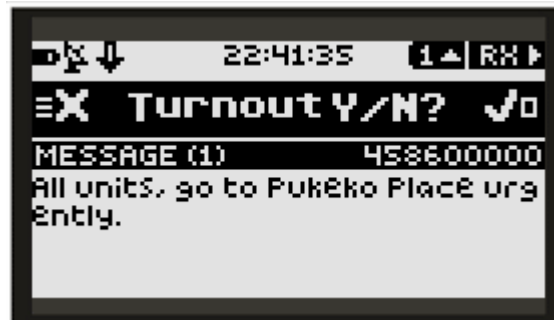
ACK[345]

Example 2:

Message payload to have delivery acknowledged and confirmed is transmitted.

All units, go to Pukeko Place urgently.-[347-2-Turnout Y/N?]<CR>

The remote TReX unit immediately displays:



Remote TReX immediately responds with:

ACK[347]

If message has been accepted (by pressing the square “ENTER/ACCEPT” button) remote TReX responds with:

ACC[347-Unit 41]

Note that the “Unit 41” in the confirmation response is the TReX programmed unit ID.

Example 3:

Message is transmitted from base station using **WT Protocol** together with the **Acknowledge and Confirm Protocol** added to the end to the message.

*WT1234567A10 HEART ATTACK, 45 YO MALE, 12 PUKEKO PL.-[**01-3-ATTEND?]<CR>*

*Note: The **WT Protocol** must be used to automatically expand the **01 macro to an automatically incremented ticket id.*

The remote TReX unit immediately displays:



In this case, the received message has not requested delivery confirmation, only confirmation of acceptance.

Should the user ACCEPT the message to attend, the remote TReX transmits to the base-station the message:

ACC[666-Unit A]

where:

666 is the ticket id.

- is the character '-'

“Unit A” is the unit ID programmed through SYSTEM->ID

SOLT Transmitter Support

SOLT transmitters, produced in Korea, are a high quality brand of call-points buttons suitable for use for hospitality, nurse call and aged care systems.

Using the TReX, it is possible to produce a wide coverage solution at low cost for large installations.

See <https://solteurope.com/>



These products are compatible with the TReX. The TReX can receive these signals, and then retransmit as either messages for belt pagers or DMR radios at high power. Alternatively the received messages can be output via serial or Ethernet ports for secondary processing.

The TReX can hold a database of hundreds of SOLT transmitters IDs, that allows the message, the paging technology or DMR radio type to be specified.

To use SOLT devices:

1. Through the MENU, set RF to DUPLEX.
2. Set RF->RX->FREQUENCY to the frequency specified on the rear of the SOLT transmitter.
3. Set RF-RX_MODE to SOLT
4. Specify transmit frequency for belt pagers or DMR radios if required.
5. Create a text file SOLT.TXT and store on the TReX internal USB storage.

Creating a SOLT Translation Table.

To allow transmitter translations, a file “SOLT.TXT” must be added to the TReX. In this file a message must be associated with each transmitter ID and button. Hundreds of buttons can be supported in this file. As the file increases to support thousands of transmitters, a small delay before transmission may be observed.

Obtain the transmitter ID by pressing a SOLT transmitter button. There will be screen pop-up displaying the transmitter ID and button type. If the file SOLT.TXT is not present or the ID is not found in that file, then the transmitter ID will also be sent out the serial port.

Default Serial Output Format:

WTXXXXXXXXsY0 SOLT ID:6748

Where:

XXXXXXXX is the SOLT transmitter ID

Y is the SOLT button ID. Most SOLT transmitters will have an ID of 0. 6 button transmitters will have a button ID from 1-6.

SOLT.TXT Content

<TX ID>:<BUTTON_NUM>,<WT Protocol message content>

6748:1,WT1234560A10 table 2 Bill

6748:2,WT1234560A10 table 2 Drinks

42679:1,WT0001001D60 Assistance required

All messages are specified in the WT protocol allowing for many pager types, DMR radios to be supported (see **WT Protocol**). Also allows content to be redirected out the serial/TCP port.

Repeater Operation Modes

The TReX is able to be used in a variety of repeater configurations depending on the application.

Store Forward

In this mode, a TReX can intercept a POCSAG paging message, either from a WTE transmitter or a third party paging transmitter. This message, after being received is then transmitted again. In this mode, the receiver must be configured to the same settings as the POCSAG message that is to be received, and the transmitted message is identical. The transmitted message may be on a different frequency if required. Duplicate reject and delay before retransmission is configurable. This is the simplest mode to configure for repeating POCSAG messages.

DMR Translate Repeat

This mode is the same as the Store Forward mode, but if the RF->MODE is set to DMR incoming POCSAG messages that are intercepted can be retransmitted as a DMR message. All DMR messages can be transmitted as a different “Group” ID if required.

Duplicate reject and delay before retransmission is configurable.

Multi-Site Repeat

This is the most useful and configuration method that should be used to control multiple sites when operated by a supervisory PC or system.

This mode allows any message to be sent to a wide coverage star system of repeating TReXs. Each message can be sent to all repeaters at high speed, and allows for many different paging types to be supported, as well as DMR messaging without the need to reconfigure any repeating TReX. Ability to temporarily change frequency for pagers and DMR radios is also possible.

Messages can be easily steered to all remote TReX units, or to a selection as required.

Duplicate reject and delay before retransmission is configurable.

Store Forward Operation

The TReX can operate as a stand-alone repeater to forward paging messages and also extend wireless serial operation.

Transmit and receive configuration should be configured to be the same when forwarding messages. *RX_PROTO should equal the *TX_PROTO and *RX_MODE should equal *TX_MODE.

Ensure that the RIC_DB and DMR_DB do not have any loaded entries. If

Typically the TReX would be configured as follows:

Delay of 2 second before forwarding, reject duplicate messages for 10 seconds.

**STORE_FWD=20,10<CR>*

Ensure all store forward units have RX_RANGES set to allow all possible CAP codes that are of interest to forward.

The duplicate reject feature is essential to use when the TReX is been used in a multi-hop store forward system. If this is set to 0, rejection of duplicated messages are not possible, and messages may bounce back and forward between repeaters.

The duplicate reject period, if used, ALWAYS must be of a longer duration than the store forward delay for reliable operation.

Multiple repeaters can be used, but increase message delivery time. Use of more than a single repeater in a system is generally less than ideal and typically more powerful transmitters should be used if multiple store forward repeaters are required.

See the Configuration section on this document for more details on command usage if required.

DMR Translate Repeat Operation

The TReX can operate as a stand-alone translator repeater to forward paging messages to support DMR radios. Without the need for any external equipment other than the TReX, legacy paging systems can support newer DMR radios by intercepting POCSAG paging messages and repeating in a translated DMR format (and optionally POCSAG concurrently).

In order to translate to DMR messages:

1. Set RF MODE to DMR

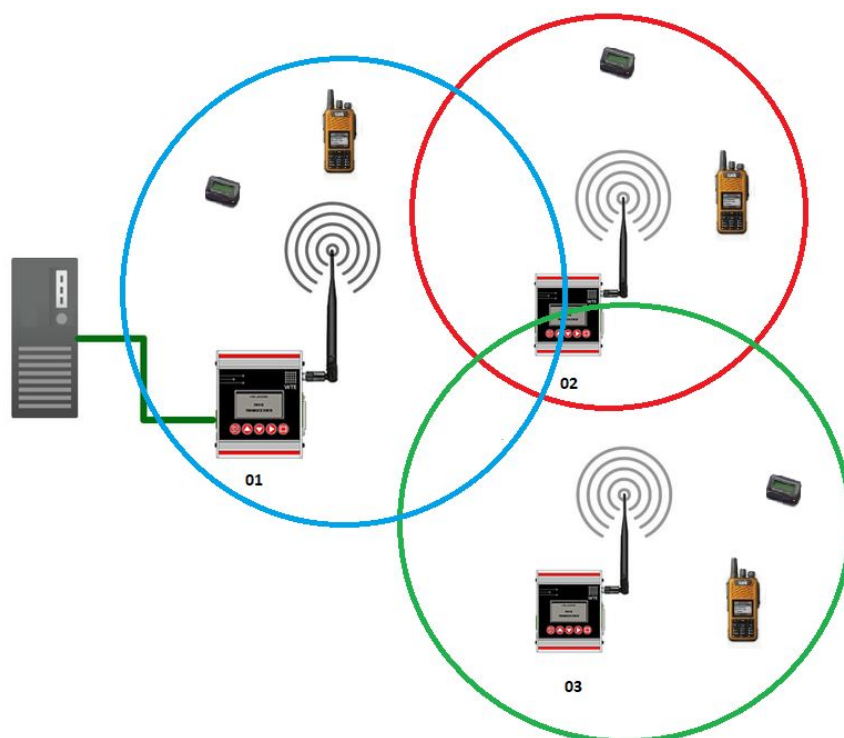
2. Configure the DMR database. Set TX->DMR DB parameters.
 1. Set CC (Colour Code).
 2. Set TYPE (DMR Radio Type – refer to **DMR Message Format**) .
 3. Set DMR transmit frequency (may be different than the TX FREQUENCY).
 4. Load DMR group IDs. (At least one group must be configured in order to translate and transmit).
 5. Ensure the TX-DB is empty (the RIC DB should not be populated unless transmission to these codes is also required).

This mode is similar to the Store Forward mode, but incoming POCSAG messages can be intercepted and retransmitted as a DMR messages. All DMR messages are transmitted as a “Group” ID using the DMR database.

If required, use the command *DMR_DB to serially configure DMR radio colour code, type and TX frequency.

Multi-Site Repeat Operation

The Multi-Site Repeat mode is the most flexible method to allow messages to be delivered to multiple radio technologies concurrently. This means messages can be sent to POCSAG pagers at different speeds and on different frequencies if required. DMR radios can be supported concurrently. Messages can be sent to all sites at high data rates for low latency, multi-site transmission. Continuous coverage across the site is shown through blue, green and red area crossover.



This mode of operation relies on the use of the WT Output Control protocol. Using this protocol, any message for transmission can be steered to some or all TReX units at the same time.

In the following examples the central controlling TReX unit is configured to be unit “01”. This TReX unit is managed either from a direct connection to a PC or through an Ethernet connection to a remote PC.

In this example units “02” and “03” are considered as repeaters. These units must have their receivers configured to a frequency and data rate that suits the installation (all units must be the same). This receiver rate may much higher than the repeater transmit rates. For the following examples, the rate between sites is fixed at 2400 baud, for a 12.5kHz channel.

Store and Forward does not need to be enabled, but if it is, the Store and forward delay and duplicate reject features both work normally. Without Store and Forward enabled there is no duplicate reject or delay after receiving and transmitting. A different delay for each repeater will result in improved performance and reliability.

Example 1:

Sending a DMR message “Hello World” to group ID 1001 on all sites

All TReX units, must receive the payload of:

[[01,02,03]U0[WT0001001D60 Hello World]]

This format is described in the user manual under output control protocol.

In order to achieve this, the controlling PC sends the following message to the central TReX transmitter:

WT1234560A1C *[[01,02,03]U0[WT0001001D60 Hello World]]*

In italics the CAP code is arbitrary, and can be any code as long as it is within the RIC range of the repeater TReX units.

In bold is **A1C** – this sets the transmission to an arbitrarily chosen 2400 baud for a 12.5kHz channel (see WT Protocol for full details)

Example 2:

Sending a 512 baud, 25kHz channel POCSAG message “ASSIST” to RIC 1234555 on all sites

All units, must receive the payload of:

[[01,02,03]U0[WT1234555A10 ASSIST]]

In order to achieve this, the controlling PC sends the following message to the central TReX transmitters:

WT1234560A1C *[[01,02,03]U0[WT1234555A10 ASSIST]]*

Example 3:

Sending a 512 baud, 25kHz channel POCSAG message “ASSIST” to RIC 1234555 on site “03” ONLY.

All units, must receive the payload of:

[[03]U0[WT1234555A10 ASSIST]]

In order to achieve this, the controlling PC sends the following message to the central TReX transmitters:

WT1234560A1C *[[03]U0[WT1234555A10 ASSIST]]*

Example 4:

Sending a 512 baud, 25kHz channel POCSAG message “RETURN TO RECEPTION” to RIC

1234777 on all sites. In this example the pagers being messaged are on different frequency (458.60MHz in this case)

All units, must receive the payload of:

[[01,02,03]U0[*TX_FREQ=458600000]U0[WT1234777A10 RETURN TO RECEPTION]]

In order to achieve this, the controlling PC sends the following message to the central TReX transmitters:

WT1234560A1C [[01,02,03]U0[*TX_FREQ=458600000]U0[WT1234777A10 RETURN TO RECEPTION]]

Note:

*The transmitter frequency must be restored to the default frequency after use. The frequency change will not be saved to the configuration and is only temporary unless the *SAVE command is issued.*

Installation

The TReX should be situated away from direct sunlight, extreme vibration and heat sources, and high power transmission sources.

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

Maximum tolerated input power into the RF connector is 17 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 antenna is NOT supplied by default. If an antenna is supplied, it will be a generic variety that will not perform as well as an antenna produced for the intended frequency of operation, or a high gain externally mounted type.

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

Connecting to the TReX

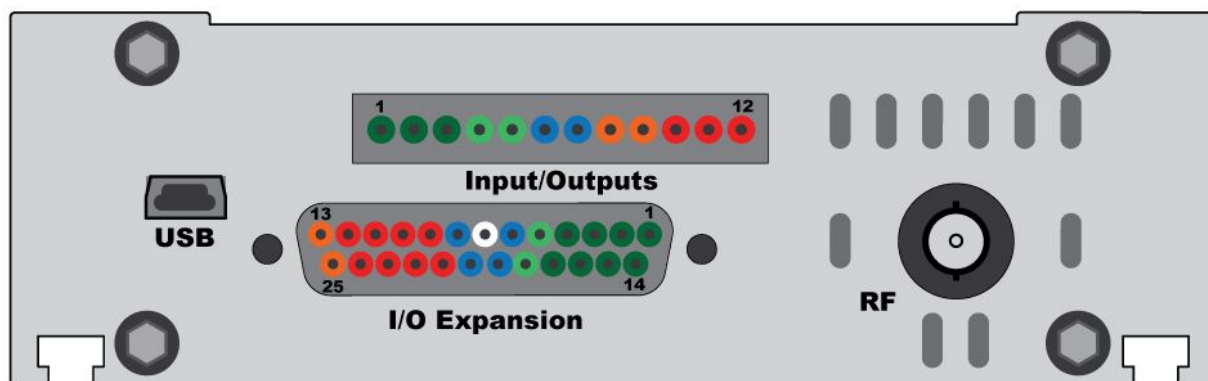
The minimum required connections for a usable system:

1. Connection to a 50 ohm antenna constructed for the frequency of interest. Mismatched antennas may result in increased current draw and reduced power output.
2. 13.8V, 3A supply connected to the power terminals

Connector Pin descriptions

RHS TReX-460

(Right Panel)



RF

BNC connector (50 ohms)

USB

Mini type B connector

Input/Output Connector:

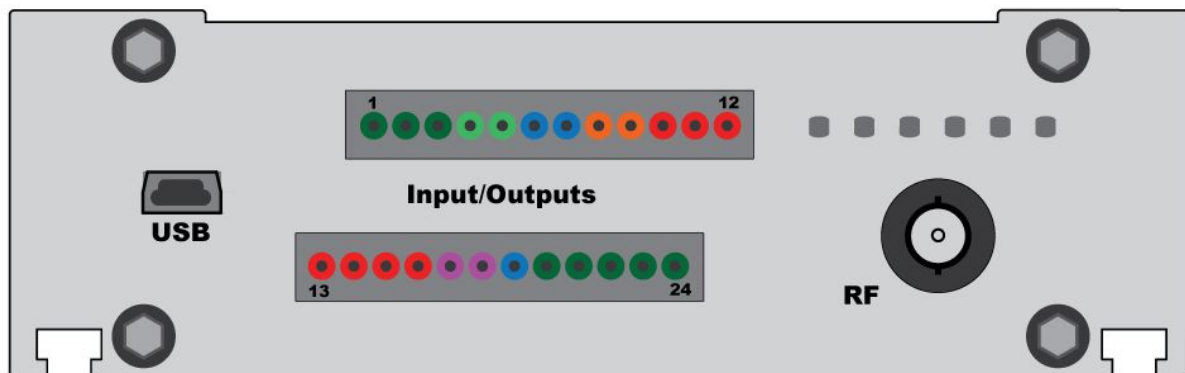
Inputs/Outputs Pin Number	Description
1	Input – Digital 1
2	Input – Digital 2
3	Input – Digital 3
4	Input – Analog 1
5	Input – Analog 2
6	GND
7	GND
8	Output – Analog 1
9	Output – Analog 2
10	Output – Digital 1
11	Output – Digital 2
12	Output – Digital 3

DB25 I/O Expansion Connector:

I/O Expansion (DB25) Pin Number	Description
1	Input – Digital 1
2	Input – Digital 3
3	Input – Digital 5
4	Input – Digital 7
5	Input – Analog 1
6	GND
7	Reserved - Do NOT Connect
8	GND
9	Output – Digital 1
10	Output – Digital 3
11	Output – Digital 5
12	Output – Digital 7
13	Output – Analog 1
14	Input – Digital 2
15	Input – Digital 4
16	Input – Digital 6
17	Input – Digital 8
18	Input – Analog 2
19	GND
20	GND
21	Output – Digital 2
22	Output – Digital 4
23	Output – Digital 6
24	Output – Digital 8
25	Output – Analog 2

RHS TREX-460-i8o1

(Right Panel)



RF

BNC connector (50 ohms)

USB

Mini type B connector

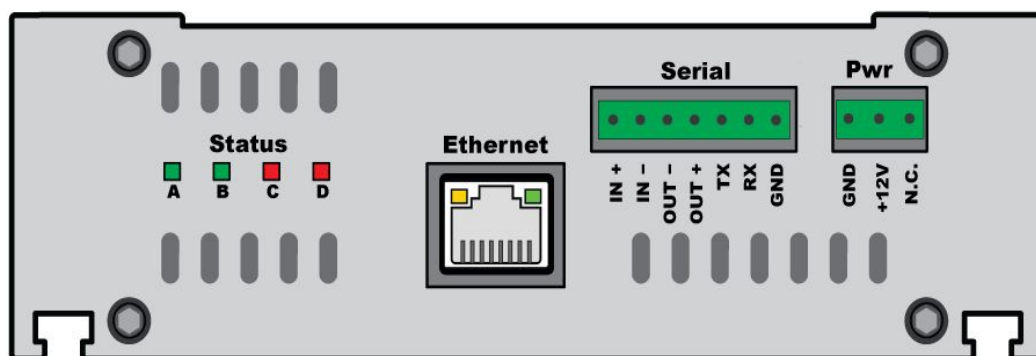
Input/Output Connector:

Inputs/Outputs Pin Number	Description
1	Input – Digital 1
2	Input – Digital 2
3	Input – Digital 3
4	Input – Analog 1
5	Input – Analog 2
6	GND
7	GND
8	Output – Analog 1
9	Output – Analog 2
10	Output – Digital 1
11	Output – Digital 2
12	Output – Digital 3

Note: The second connector with pins 13-24 are fitted upside down. This means that the screws terminals are pointing down and wiring must be secured before inserting the connector.

Inputs/Outputs Pin Number	Description
13	Output – Digital 7
14	Output – Digital 6
15	Output – Digital 5
16	Output – Digital 4
17	Relay CM
18	Relay (NO / NC)
19	GND
20	Input – Digital 8
21	Input – Digital 7
22	Input – Digital 6
23	Input – Digital 5
24	Input – Digital 4

TReX Left Side Connections



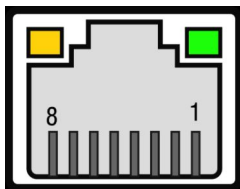
Serial Connector:

Serial Connector Pin Number	Description
1	RS422 RX+ (IN+)
2	RS422 RX- (IN-)
3	RS422 TX- (OUT-)
4	RS422 TX+ (OUT+)
5	RS232 TX
6	RS232 RX
7	Ground (GND)

Power Connector:

Power Connector Pin Number	Description
1	Ground (GND)
2	+13.8V
3	Not Connected (N.C.)

Ethernet Connector:



Connector Pin Number	Description
1	TX+
2	TX-
3	RX+
4	NC
5	NC
6	RX-
7	NC
8	NC

Note: pins: 4 and 5 are connected to ground via a 75R resistor
7 and 8 are connected to ground via a 75R resistor

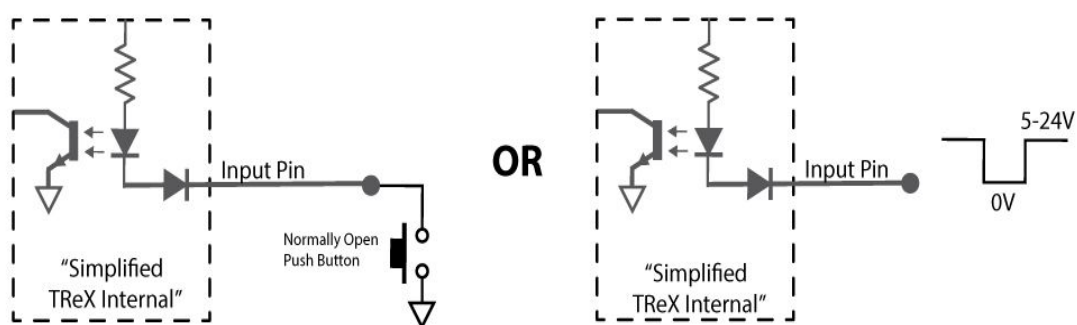
Do not connect a Power over Ethernet (PoE) connection to the TReX Ethernet port as this will result in damage.

Input Output Hardware Connection

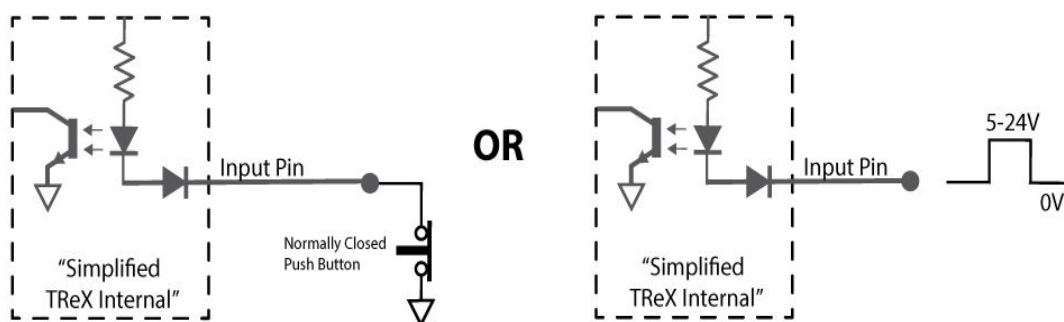
Examples of how to connect external devices to the TReX input/output pins.

Inputs

Input Low Trig

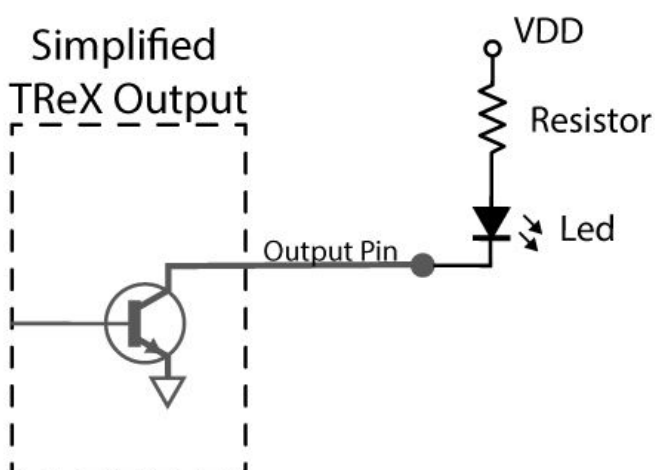
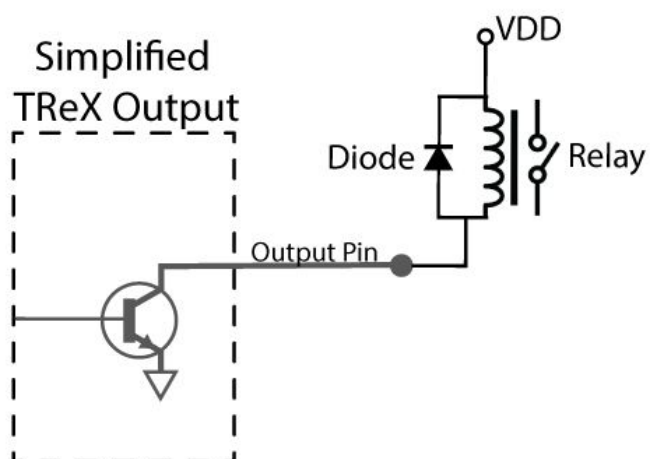


Input High Trig



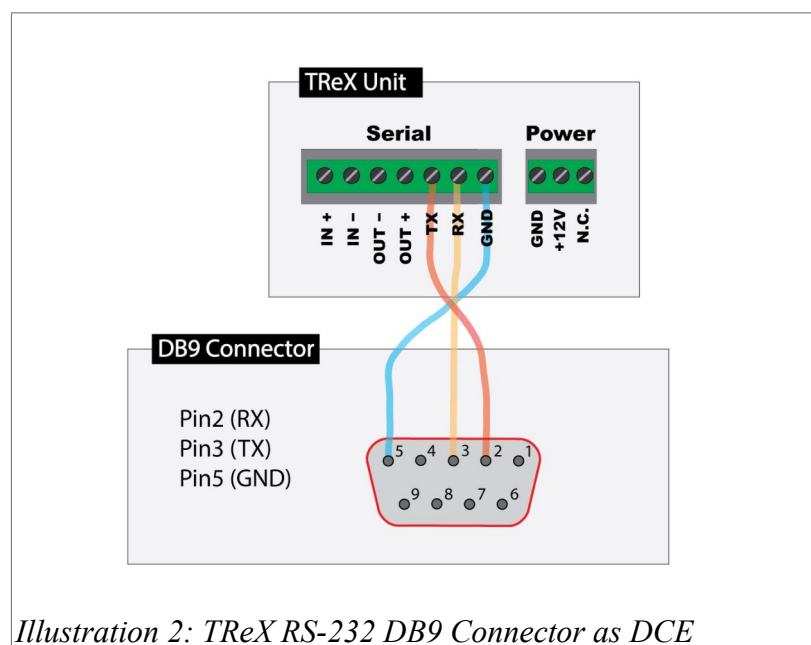
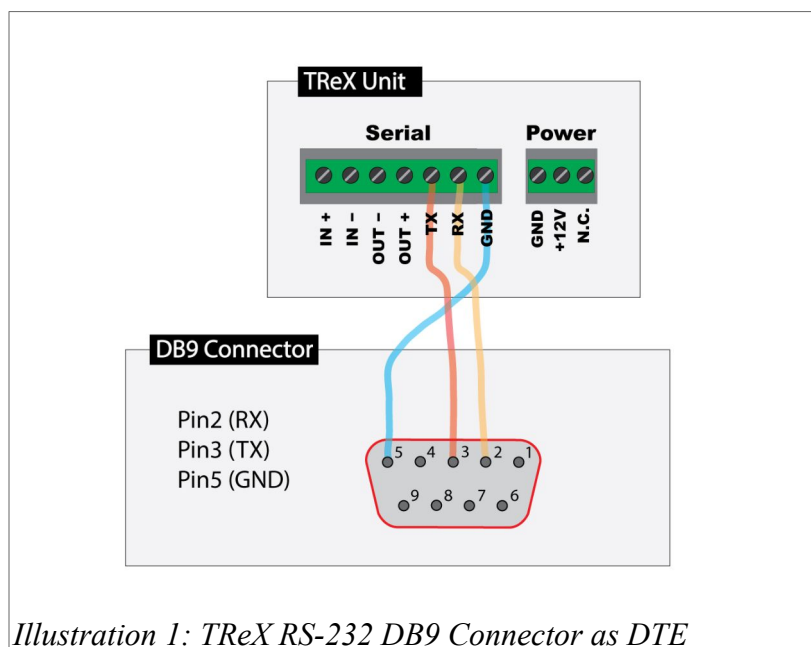
Outputs

Care must be taken to ensure the sinking output current does not exceed 100mA. When using inductive loads, such as relay coils, flyback diodes must be fitted to prevent damage to the TReX. VDD is voltage source externally provided between 5 and 24VDC depending on the control application.



Serial Connections

RS-232



RS-422/RS-485

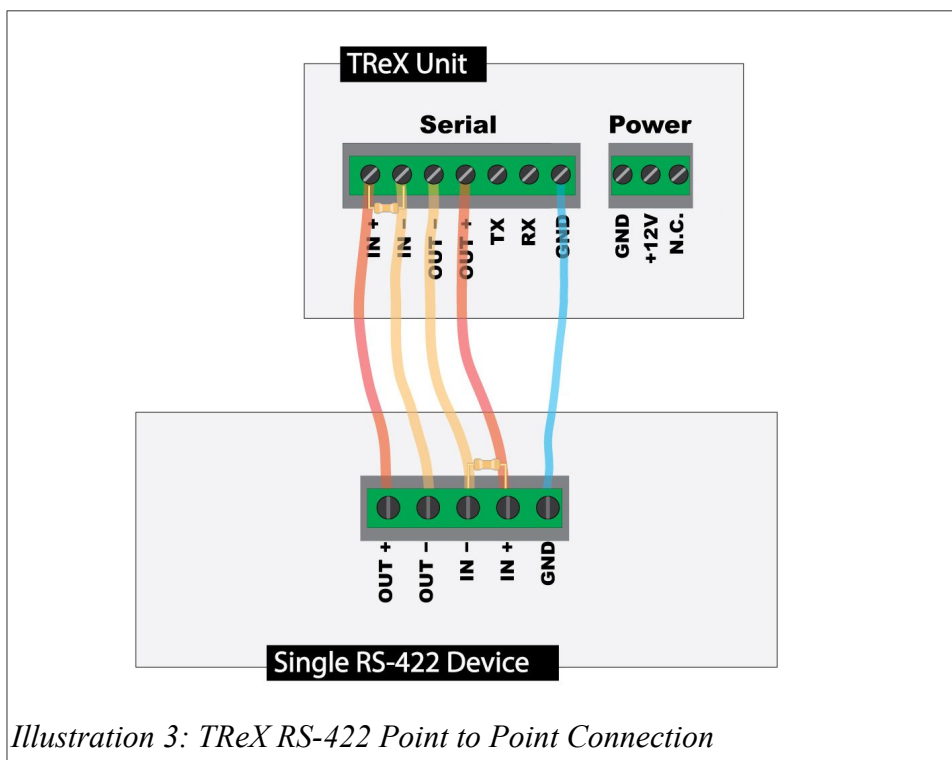
RS-422 and RS-485 use a differential electrical signal, as opposed to unbalanced signals referenced to ground as used by RS-232. Differential transmission uses two lines each for transmit and receive signals which results in greater noise immunity and longer distances between devices. These advantages make RS-422/RS-485 a better fit for industrial applications.

RS-422 is point to point interface that allows for up to 10 receivers but only a single transmitter. This would be a common serial interface for NMEA devices all sharing GPS data from a single GPS receiver for example.

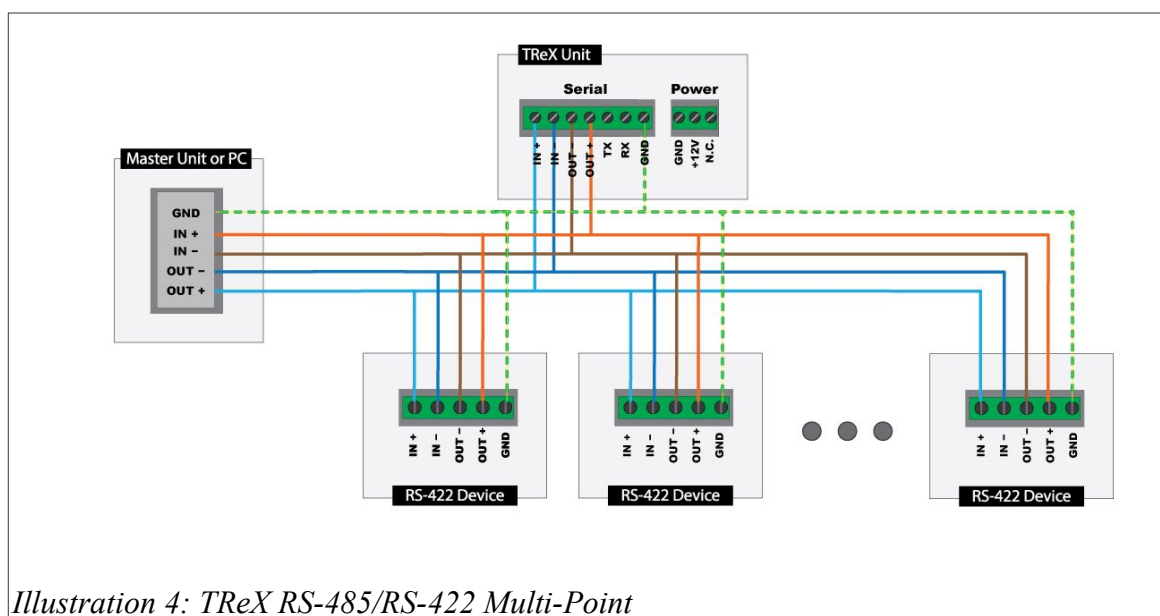
RS-485 is a multipoint interface that allows each device to be a transmitter and also a receiver. This interface also allows for more devices to be connected on a common serial bus. Because each device on the same bus can transmit, each device must be capable of setting all transmit lines to a high impedance state when not in use to ensure that all devices have the ability to transmit. RS-485 interfaces can be presented as 4 or 2 wires. When there are 2 wires required, the RS-485 device must also be able to isolate its own receiver when transmitting to prevent looping data back to itself.

The TReX satisfies the requirements for both 4 and 2 wire RS-485 communications. The TReX will also be able to operate on a RS-422 bus.

Point To Point Connection



Multi-Point Connection



Note: this configuration only applies if driving less than 10 listeners/receivers when using RS-422 devices or less than 32 devices for RS-485 devices.

2 Wire Connection

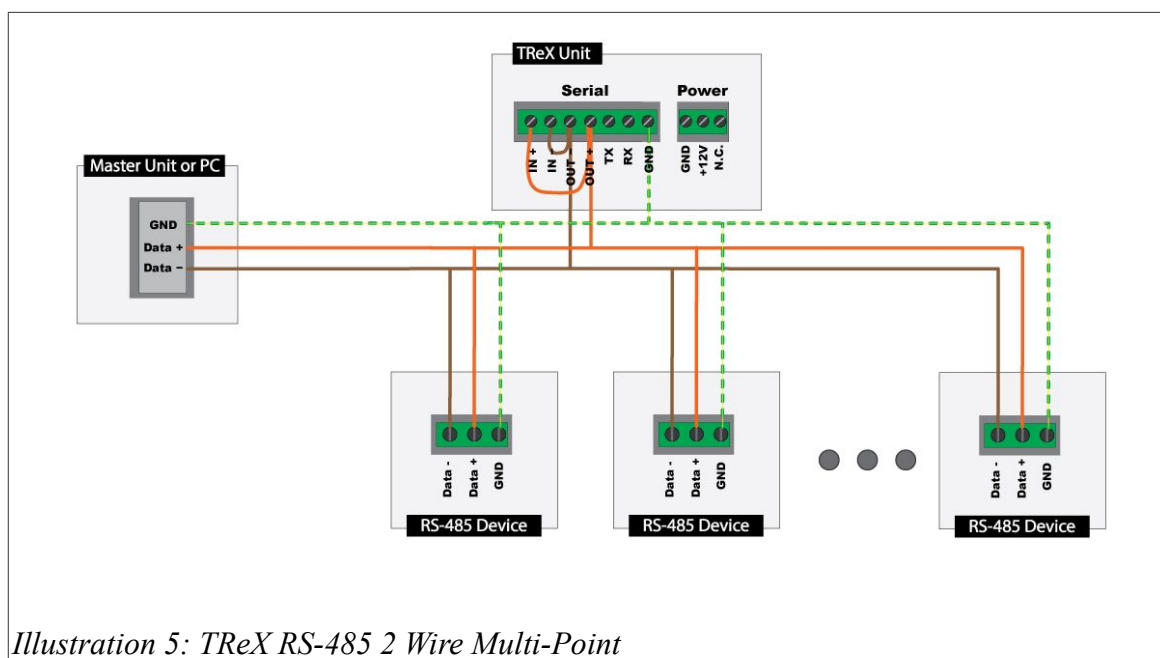


Illustration 5: TReX RS-485 2 Wire Multi-Point

Note: the TReX must have wire links fitted as shown in order to operate correctly in this configuration.

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.

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

RF Connections

A 50 ohm matched load must be fitted to the TReX antenna port.

Note: Earth the antenna tower, feeders and lightning protection devices in accordance with the appropriate local and national standards. Use grounding kits as specified or supplied by the coaxial cable manufacturer to properly ground or bond the cable outer.

⚠CAUTION

When the TReX is operating, there is RF energy radiated from the antenna.

Do not stand in front of the antenna while the radio is operating (see the 'RF Exposure Warning')

⚠CAUTION

Lightning will destroy electronic equipment.

To avoid this risk, install primary lightning protection devices on any interfaces that are reticulated in the local cable network.

Install a coaxial surge suppressor on the radio antenna port.

Power Connections

Power to the TReX is achieved via the power connector as described in the section [16.3.Connecting to the TReX](#)

⚠WARNING

EXPLOSION HAZARD

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

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

Ethernet Interface

The TReX supports a 10/100 Base-T Ethernet connection.

To simplify network setup, the TReX supports auto-negotiation and auto-sensing MDI/MDIX crossover.

General	Interface	RJ45
	Cabling	CAT-5/6 UTP, supports auto MDIX (Standard Ethernet)
	Bandwidth allocation	The Ethernet capacity maximum is determined by the available radio link capacity.
	Ethernet mode	10Base-T or 100Base-TX Full duplex or half duplex (Auto-negotiating and auto-sensing)
Diagnostics	Green LED	Off: No data present on the interface. On: Data present on the interface.
	Orange LED	Off: no Ethernet connection On: Ethernet signal received

TReX Firmware Upgrade

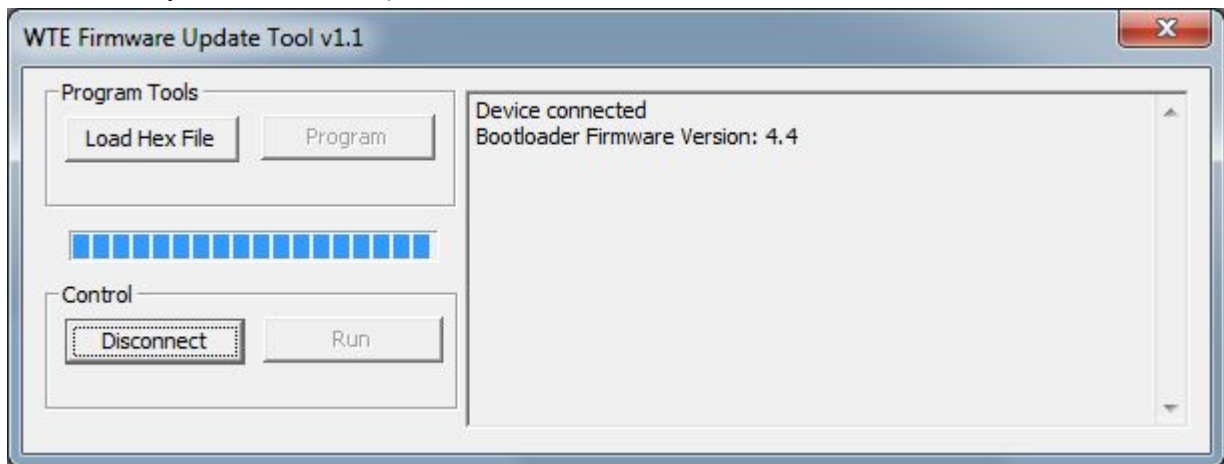
In order to update the TReX primary firmware the following is required:

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

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

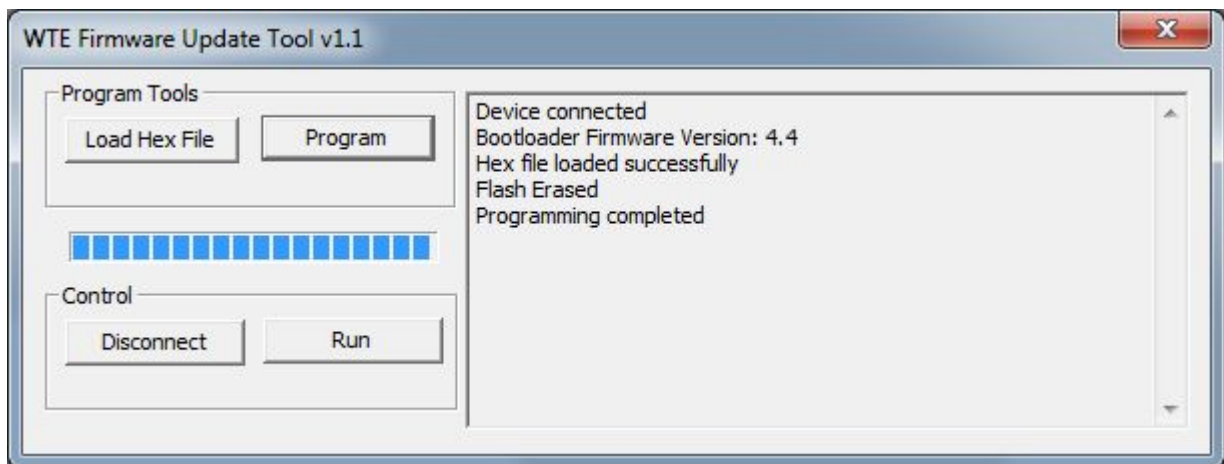
Firmware Upgrade Utility

This bootloader software has been customised by WTE to simplify the firmware replacement process for the TReX. This application automatically handles erasing and verifying of uploaded firmware. This utility does not perform any decryption function (decryption is carried out by the TReX itself).



Upgrade Process

1. Run the application WTE-UBL.exe – this is the WTE Firmware Update Tool as shown above.
2. **BEFORE** applying power to the TReX, press the “UP” button, and **HOLD** the button down.
3. Apply power to the TReX.
4. The TReX backlight will flash on and off (approximately once every second) – **keep the “UP” button pressed**. You now have 10 seconds to press the PC application “Connect” button on the WTE Firmware Update Tool before the TReX exits the bootloader mode of operation.
5. Press the WTE Firmware Update Tool “Connect” button. If connected, the PC application will display the message saying “Device Connected”. The TReX backlight will now stay constantly on.
6. You can now **RELEASE** the TReX “UP” button.
7. On the PC application press the “Load Hex File” button.
8. Select the supplied TReX hex file. NOTE: the firmware used must **MATCH** the TReX receiver variant. A TReX can only be used with TReX encrypted firmware. Failure to comply will leave the device inoperable.
9. Press the WTE Firmware Update Tool “Program” button.
10. Wait for the WTE Firmware Update Tool to indicate that programming has been completed.

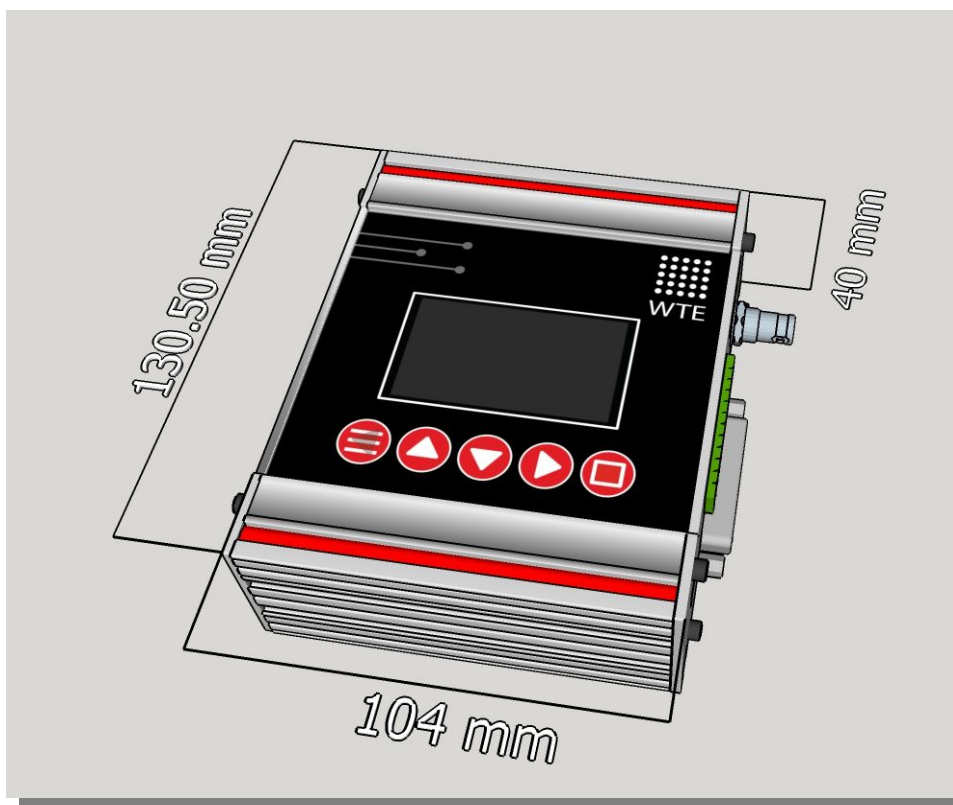


11. When programming is complete press the “Run” Button, or remove power to the TReX and apply power again.
12. If successful the TReX will start normally when power is applied. If the TReX does not correctly start, then repeat the procedure.

Physical Dimensions

TReX physical dimensions are 104mm x 130.5mm x 40mm (Length x Width x Height)

Weight: 550 grams



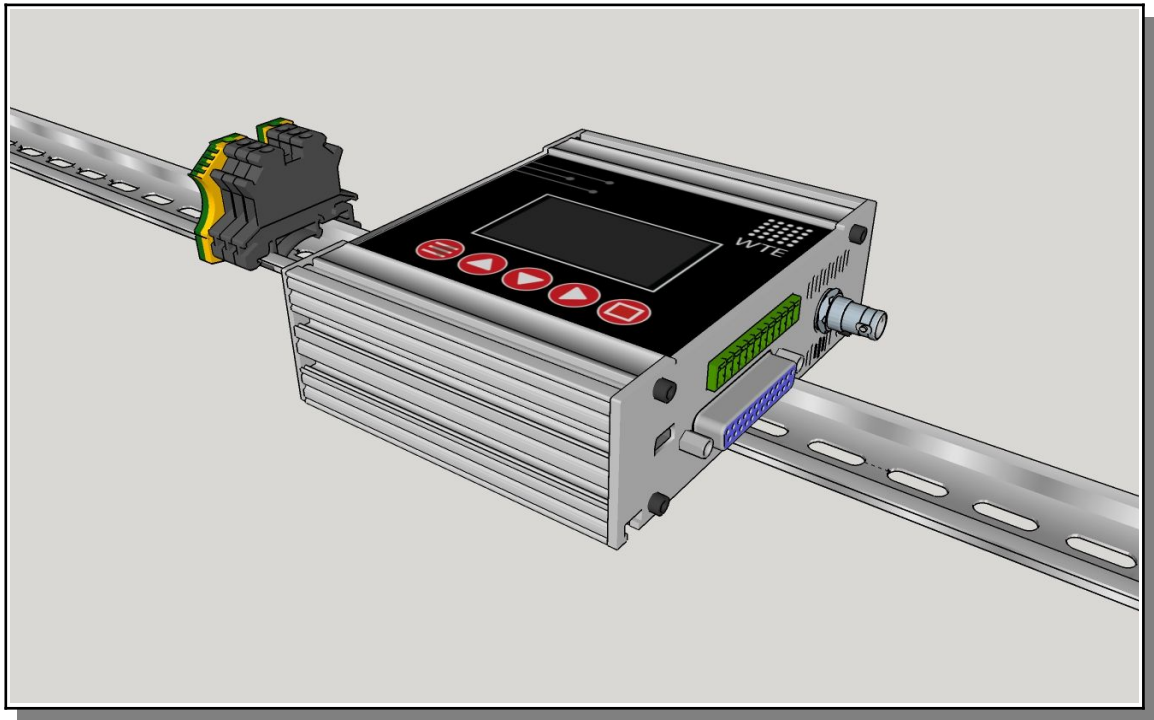
Mounting Hardware

The TReX 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 the TReX radio

DIN Rail



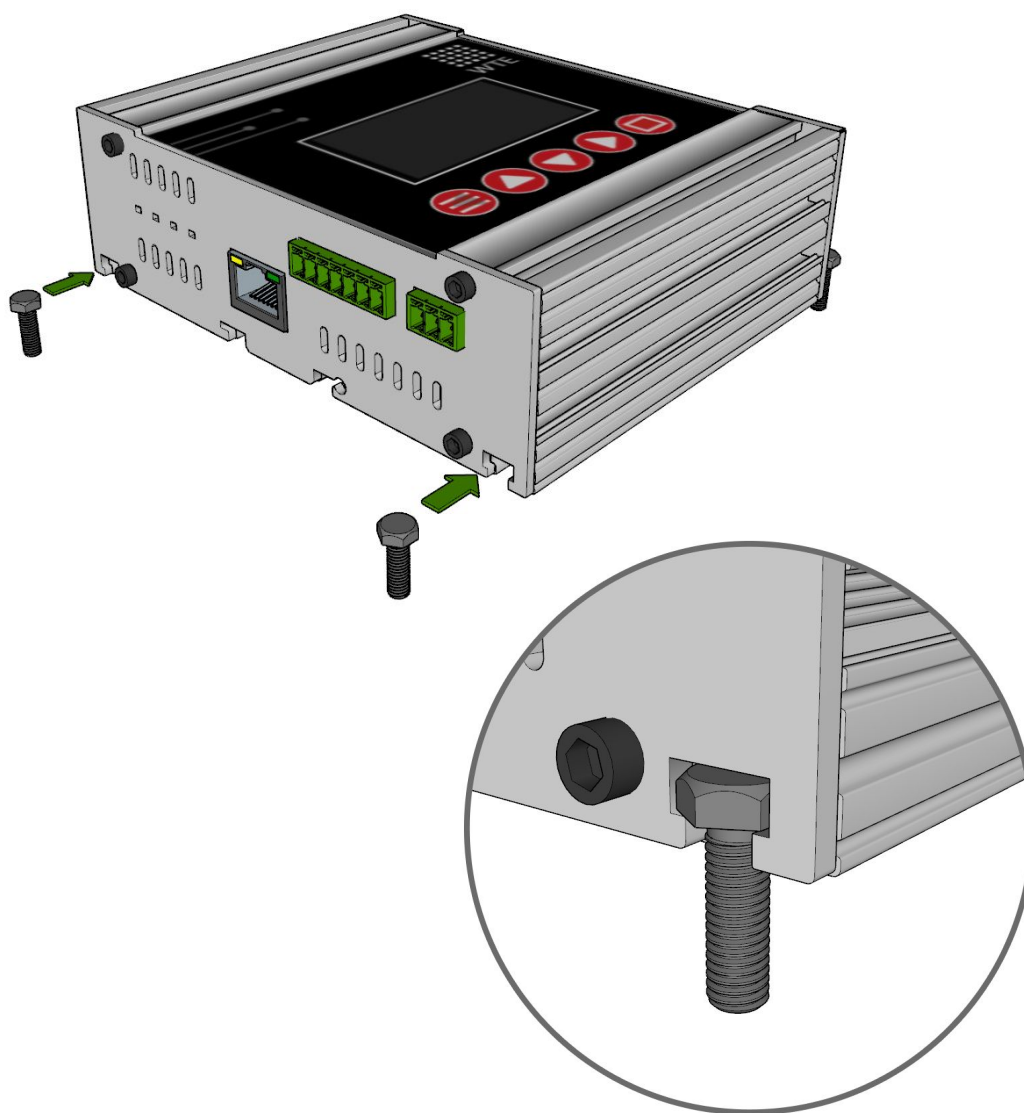
Inbuilt into the TReX custom extrusion there is a DIN rail slot (patent pending) for easy snap fit DIN rail mounting. After location on the DIN rail, 2.5mm locking pins may optionally be fitted from each end plate if desired (a 2.5mm split pin is a perfect fit).

Mounting Channels

The TReX 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 TReX and invalidate the product warranty.

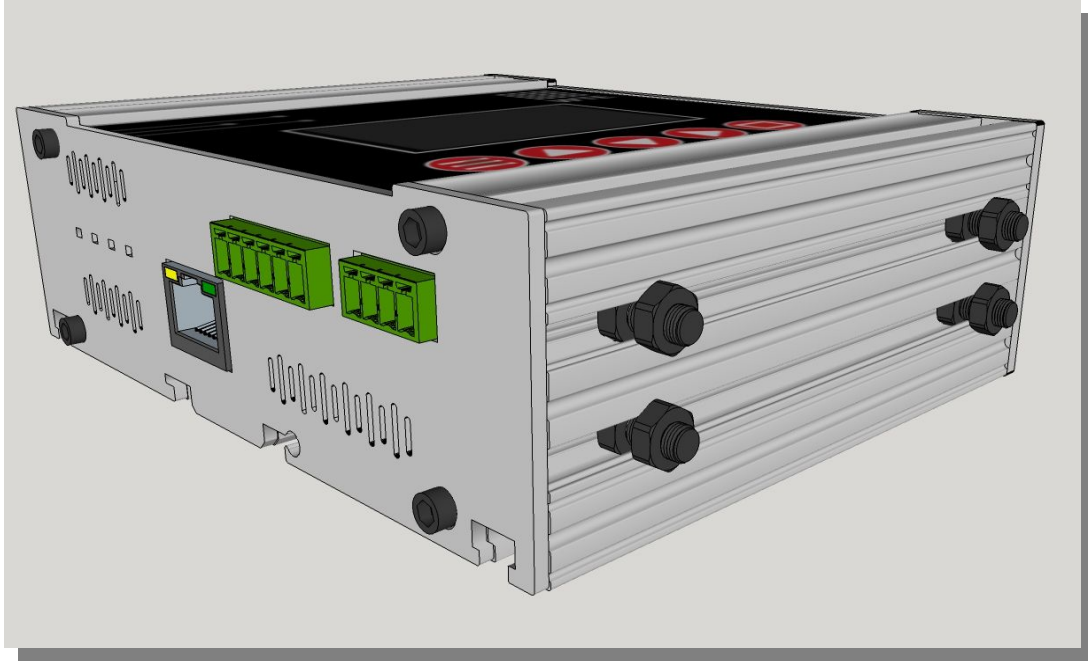


TOP Mount

The flush mount option is suitable for an installation such as onto the front panel of a case or cabinet.



SIDE Mount



Bottom Mount

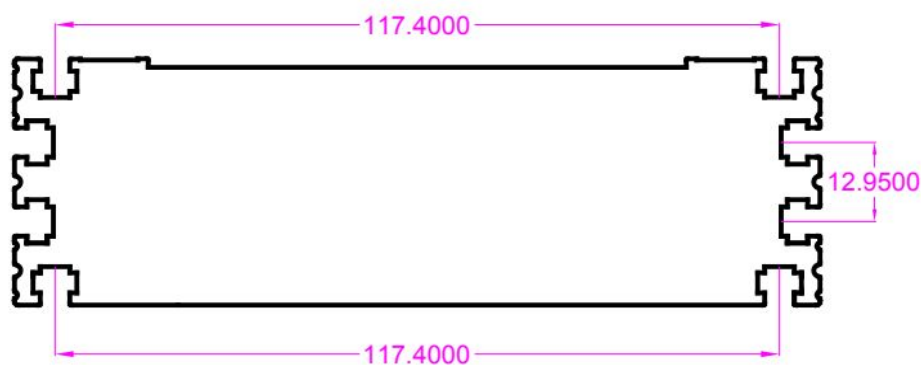


Mount Bolts Dimensions

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

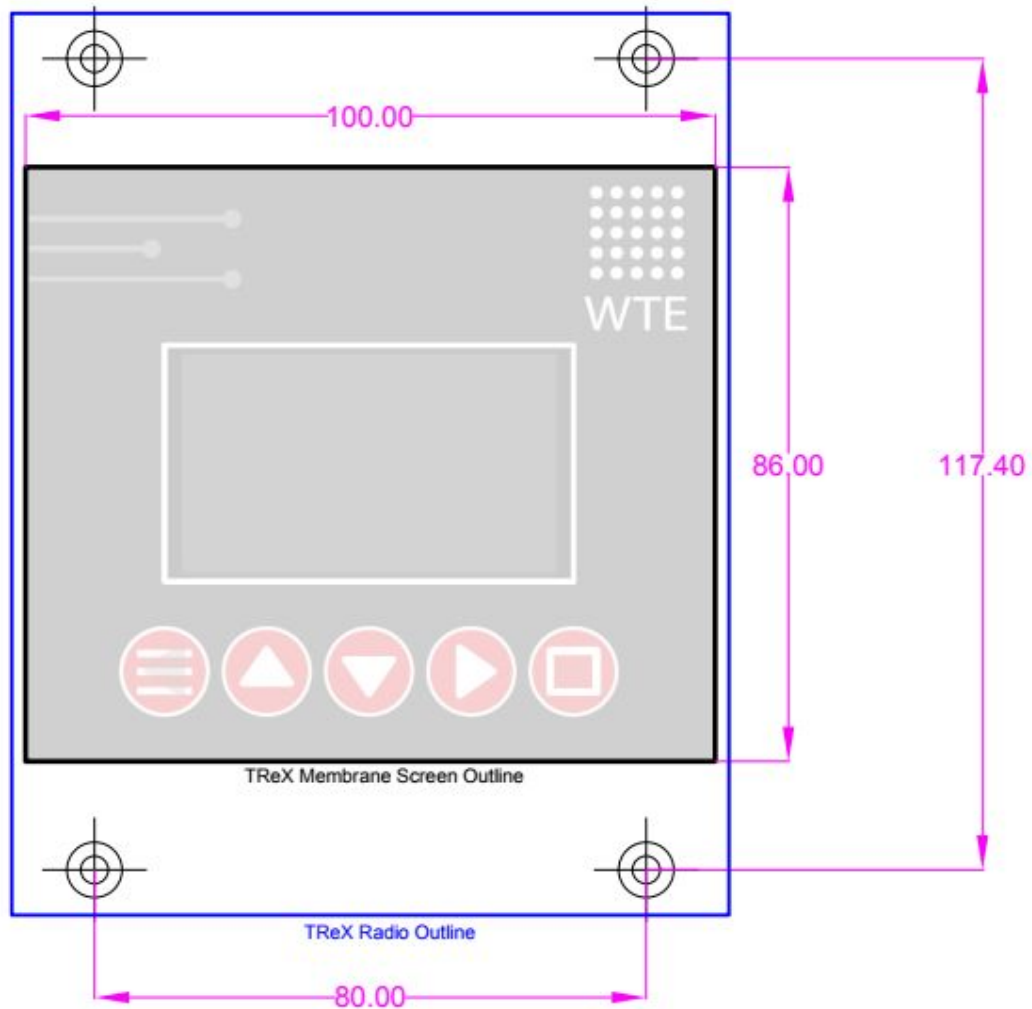
The channels space from centre to centre in the top and bottom of the radio is 117.40mm

Dimension are in millimetres



Top and Bottom Drilling Template

TOP

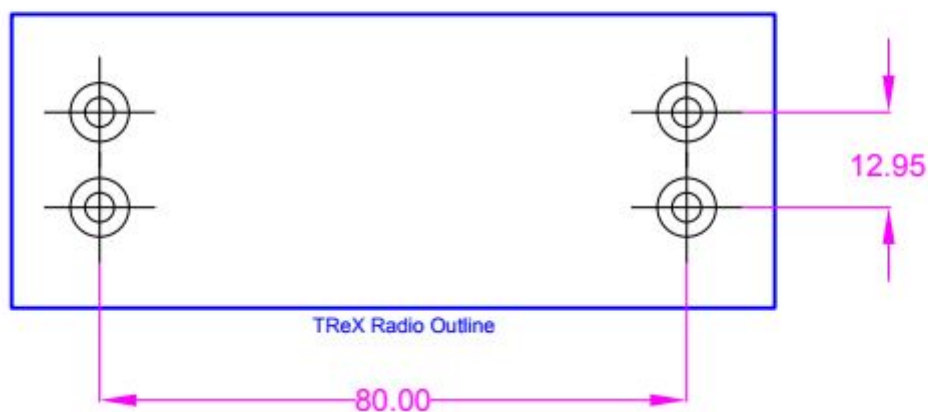


Note:

- All dimensions are in millimetres.
- The drilling template will need to be scaled depending on your printer settings.

Side Drilling Template

Side

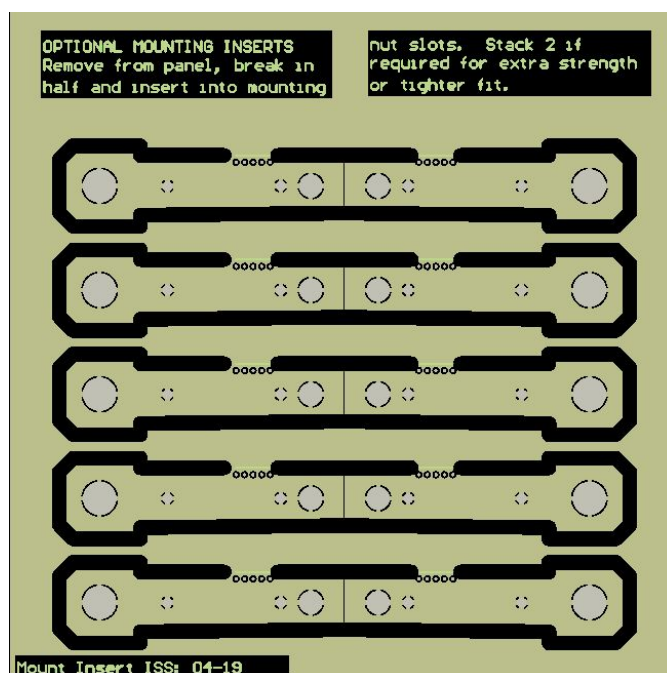


Note:

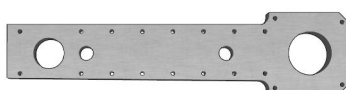
- All dimensions are in millimetres.
- The drilling template will need to be scaled depending on your printer settings.
- Depending on installation, not all mounting points may be required.

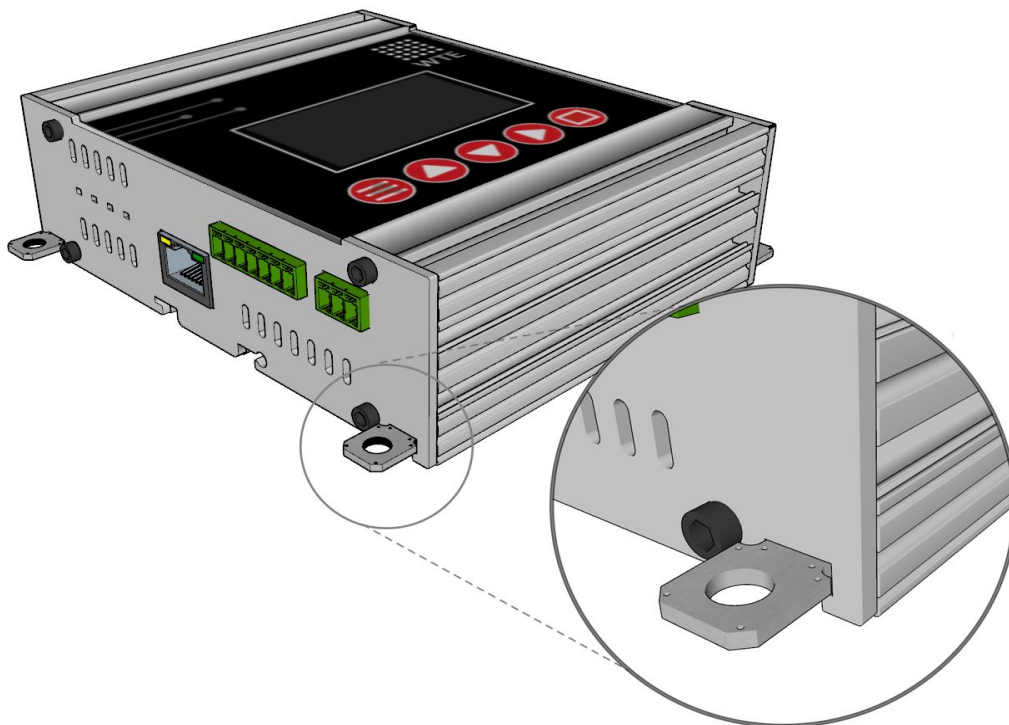
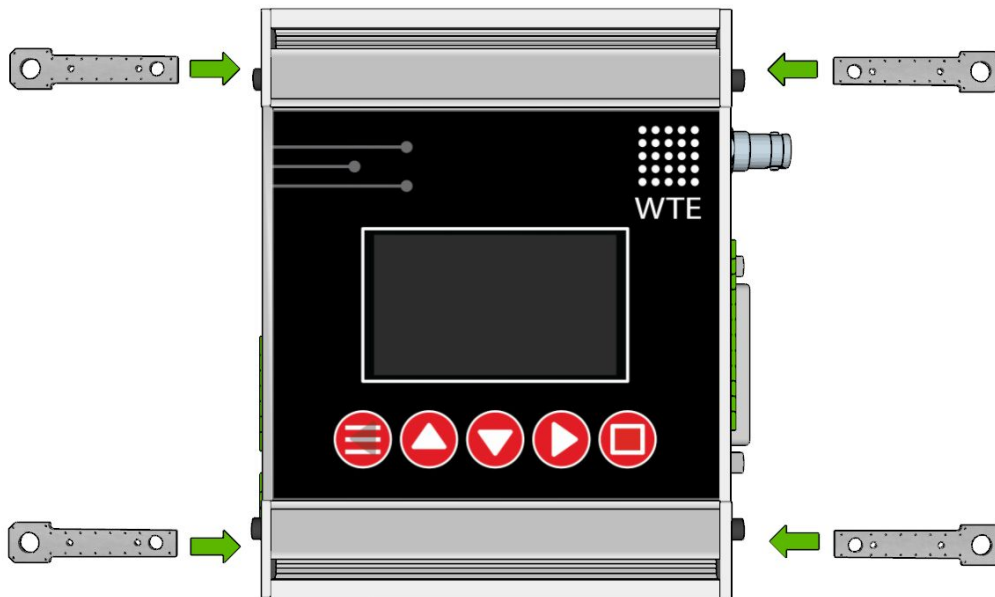
Optional Mounting Inserts

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

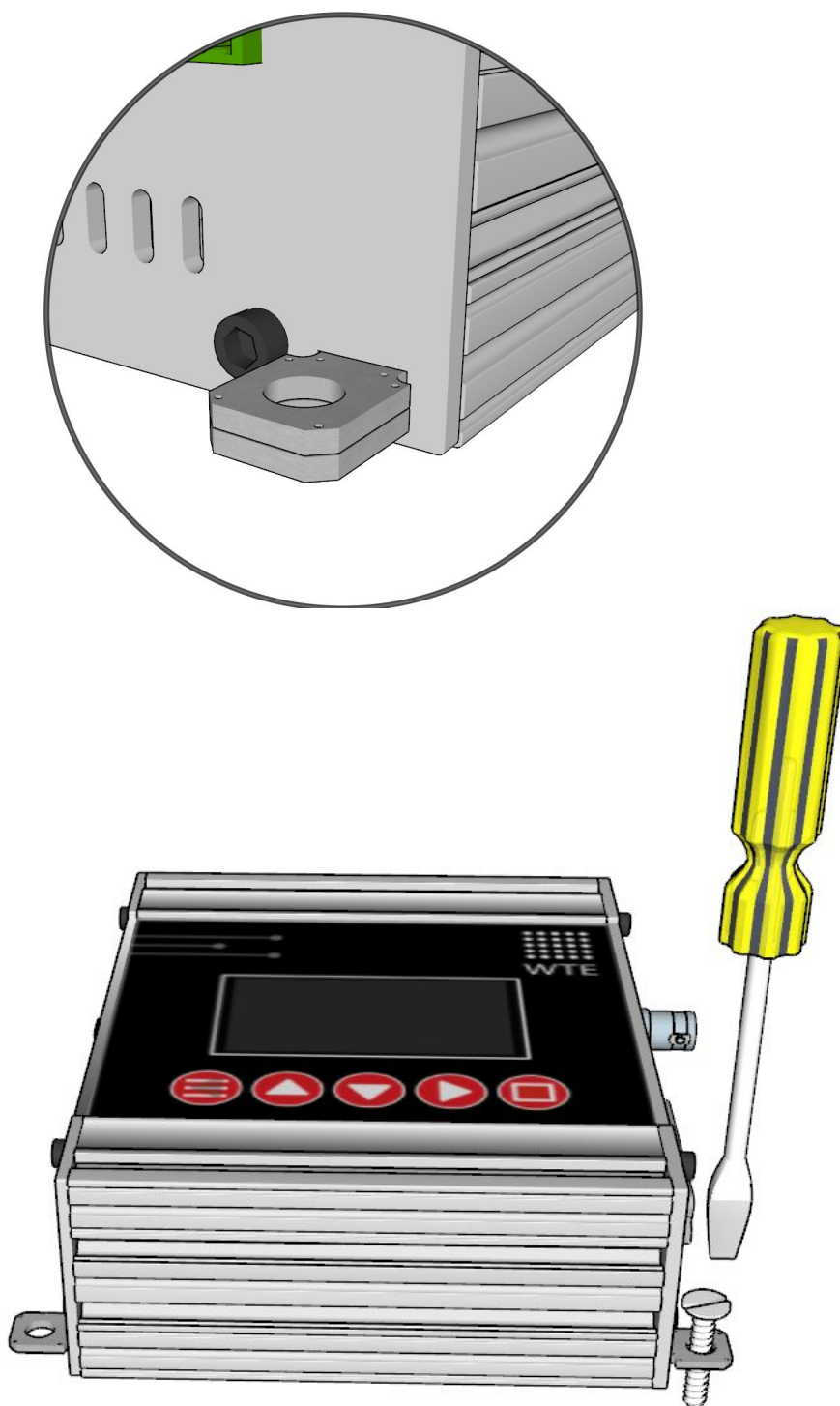


Remove all the insert mounts from the panel in order to use.





Optionally two mounting inserts can be used for extra strength.



Omni or Directional Antenna

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

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

Omni antenna

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

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

Directional antenna

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

This is mainly used for fixed transmitter and receiver locations.

Antenna Elevation

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

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

$$D = \sqrt{\frac{2r_0 h_f}{6076.1 \beta_0}}$$

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.

The TReX has an output power of **36dBm** (4W).

(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.

FLEX™ is a trademark of Motorola, Inc. This unit does not transmit any information in the FLEX format.

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.

This product has been certified for use in multiple markets. The modulation at 32K baud is compliant under FCC only – it is the responsibility of the user to ensure that this modulation is used in FCC territories only.

RoHS and WEEE Compliance

TReX 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

TReX serial number can found on the unit, also serial number and model information are displayed on start-up or accessible via:

MENU->SYSTEM->FACTORY.

FCC Regulations allow for electronic labelling.

FCC details can be found via:

MENU->SYSTEM->REGULATORY

*Note: Publication number 784748-D02, FCC-Part 90 allows for devices with integrated display to not require a printed label on the device holding this information.

Maintenance

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

Product End Of Life



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



Please recycle this device responsibly. The TReX has a residual scrap value that includes 400g of Aluminium.

Product Warranty

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

The product warranty will be invalidated through evidence of:

- Unauthorised work carried out.
- Tampering, including evidence of removal of internal electronics from the case.
- Installation in wet or corrosive environments.
- Exposure to impact or excessive vibration.
- Use or installation outside of the specified operating parameters.

Abbreviations and Glossary

CAP (CAPCODE) - Channel Access Protocol (CAP) code	ISP Internet Service Provider
RIC -(Radio Identification Code) - an address used in the POCSAG protocol for pagers	kbit/s Kilobits per second
POCSAG (Post Office Code Standardisation Advisory Group) - A standard set of code and signalling formats for radio paging.	kHz Kilohertz
USB (Universal Serial Bus) - A common interface that enables communication between devices and a host controller such as a personal computer (PC).	LAN Local Area Network
ASCII American Standard Code for Information Interchange	LED Light Emitting Diode
BER Bit Error Rate	mA Milliamps
CBC Cipher Block Chaining	MAC Media Access Control
DCE Data Communications Equipment	Mbit/s Megabits per second
DMR Digital Mobile Radio	MHz Megahertz
DTE Data Radio Equipment	ms milliseconds
EMC Electro-Magnetic Compatibility	PC Personal Computer
EMI Electro-Magnetic Interference	RF Radio Frequency
ESD Electro-Static Discharge	RoHS Restriction of Hazardous Substances
ETSI European Telecommunications Standards Institute	RSSI Received Signal Strength Indication
FW Firmware	RX Receiver
HW Hardware	SCADA Supervisory Control and Data Acquisition
IP Internet Protocol	TCP/IP Transmission Control Protocol/Internet Protocol
I/O Input/Output	TCXO Temperature Compensated Crystal Oscillator
	TMR Trunk Mobile Radio
	TX Transmitter
	UTP Unshielded Twisted Pair
	VDC Volts DC
	WEEE Waste Electrical and Electronic Equipment
	IoT Internet of Things.

Specifications

Transmit and Receive Frequency Range:

- 421MHz – 480MHz

Spectrum Analyser (Optional):

- Frequency range: 142-175, 350 - 499 MHz
- RBW: 500Hz, 1kHz and 25kHz
- Span: 3MHz, 120kHz and 24kHz
- Continual or peak display.
- Min signal -120dBm, max signal -10dBm.
- Input Power accuracy: 421-480MHz +/-2 dB, 142-175MHz -8dB.

Supply Voltage

- Nominal 13.8V. Min 10.8. Max 15.6V.
- Must be supplied with a DC power lead less than 3m in length in order to comply with ETSI EN 301-489-1.
- Supply cable should be of a cross sectional area of at least 1mm²

Operating Current at 13.8V:

- Ethernet plus TX standby and RX – 240mA
- RX only - 65mA
- TX standby plus RX – 90mA
- TX standby (RX disabled) – 65mA
- TX operating at 4W – Additional 1.0A (for correctly matched antenna). Current limit software set. Default max current 1.5A.
- Backlight on – additional 55mA.
- External fusing should be 2A.

Digital Inputs:

- To operate pull to ground or may be driven high or low. High level from 5-24V. Low Level less than 1V.

Analog Inputs:

- 2. 0-16 V. Input impedance approx. 50K. Slope and offset configurable (e.g. to support 1-5V or 1-10V).

Digital Outputs:

- 8 open drain. Max allowed supply voltage 24V. Max rated current 100mA. Digital outputs are NOT short circuit protected.

Analog Outputs:

- 2. 0-10V (for 12V supply voltage).
- Output impedance 5 ohms.
- Max current 30mA. May be configured for 4-20mA operation. Minimum loop resistance 100 ohms, maximum 500 ohms. If loop resistance is too low, a 100 ohm series resistor should be fitted.
- Configurable. to support 1-5V, 1-10V or non-standard currents up to 30mA.

- Short circuit protected. Short circuit current approximately 35mA.

Protocols Supported:

- Modbus RTU
- Modbus TCP
- WTE
- MQTT
- PET/TAP
- ESPA 4.4.4
- Multitone
- Scope
- SAL
- Ascom
- TPP
- TNPP
- TNPPB-NZFS
- AMPAC

Input Message Length:

- Input max configured message length 50 characters. Max message length via serial port 300 characters.

Temperature Limits:

- Operating -30 to + 55 degrees Celsius ambient.
- Storage/Transit -70 to +70 degrees Celsius.

Output Alerting:

- High/low supply voltage.
- High temperature.
- RF Power fault
- Antenna fault
- Comms link fail

Max Rx Input Power:

- 17dBm. Direct connection above 17dBm (50mW) will destroy the receiver.

Receiver at 450.5MHz, 512 baud 12.5kHz (compliant with EN300113):

- Sensitivity: -122dBm. Desensitised at frequency multiples of 26MHz (and within 50kHz).
- Selectivity @ +/- 1 channel: 61dB
- Blocking at 1MHz offset: Tolerates -20dBm
- Co-channel Rejection Ratio: Rejects unwanted signal at -4dB
- Error Behaviour at high signal levels: Decodes wanted signal at +13dBm.

Antenna Connector:

- BNC

Firmware

- Field upgradable.

Communication Interfaces:

- 1 x RS232
- 1 x RS422/485 (2 or 4 wire)
- 1 x Ethernet (TCP/IP)

FLEX™ Decode Support:

- Decoding of all Alphanumeric and numeric messages at 1600 baud (2 level only).

POCSAG Encode and Decode Support:

- Alphanumeric, numeric or tone only including batched.
- Deviation, 4.5 kHz, 2.25 kHz or 1.1 kHz depending on channel spacing selected.
- Rates – 512, 1200, 2400, 4800 and 9600.

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 70 characters.
- Tested and compatible DMR radios:
 - Hytera – PD565, PD665
 - Kirisun DP770, TM840H
 - Motorola SL4010e

Modulations Supported and Approved:

25kHz Channel Width:

512 baud (FSK), 1200 (FSK), 1600 (FSK), 2400 (GFSK), 3200 (4GFSK), 4800 (2GFSK), 9600 (GFSK), 9600 (4GFSK), 16K (4GFSK), 32K (4GFSK only permitted for use in USA).

12.5kHz Channel Width:

512 baud (FSK), 1200 (FSK), 2400 (GFSK), 4800 (GFSK), 9600 (GFSK), 9600 (4GFSK), 16K (4GFSK)

6.25kHz Channel Width:

512 baud (FSK), 1200 (GFSK), 2400 (GFSK), 4800 (4GFSK)

Ethernet Connection:

- Permitted simultaneous connections = 1.
- Google Chrome (64 bit Version 72.0.3626.121) or FireFox (64 bit version 65.0.2) web configuration and monitoring.
- TCP socket (both client and server) for both message protocol support and configuration.
- Cable length should be less than 3m in length in order to comply with ETSI EN 301-489-1.

Mechanical:

- Length: 104mm or 125mm including BNC connector
- Width: 131mm
- Height: 41mm

- Weight: 550grams

Mounting:

- Rack
- Wall
- DIN rail

IP rating:

- IP51.

Environmental:

- Operating temperature range: -40 to +70° C (-40 to +158° F)
- Storage temperature range: -40 to +80° C (-40 to +176° F)
- Operating humidity: Maximum 95% non-condensing
- Acoustic noise emission. No emission when sounder is disabled. Maximum sound output from sounder is less than 80dBA.

Compliance Standards:

- EN 300 113 (base-station and portable/mobile compliant).
- EN 301 489
- EN 60950 + IEC 62368-1
- EN 50385
- FCC part 90
- AS/NZ 4768

Testing Laboratory

- Base-station and mobile compliant, testing completed 8/2/2019.

Declaration of Conformity



Manufacturer:

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

WTE Limited hereby declares the TReX Telemetry, Data and Messaging Transceiver 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:

WTE – TReX 460

WTE – TReX 461

The basis on which conformity is being declared:

The products identified above comply with the above directive, and WTE Limited has created a technical construction file which includes reports: 190101.1, 190101.2, 190101.3 and 190101.4 from the EMC Competent Body: EMC Technologies (NZ) Ltd.

The manufacturer has applied the following harmonised standards:

- **ETSI EN 300 113 v2.2.1 (2016-12)**
Land Mobile Service; Radio equipment intended for the transmission of data using constant envelope modulation and having an antenna connector (for base-stations and mobile-stations).
- **EN 301 489-1 V2.1.1 (2017-02)** Electro Magnetic Compatibility (EMC) standard for radio equipment and services.
- **EN 60950-1:2006** Safety of information technology equipment
- **EN 50385:2017** RF exposure compliance for base station equipment.

The CE mark was first applied in: April 2019

Contact:

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Date: 25/04/2019



Shannon Reardon
Engineer/Director



Rodrigo Pellizzari
Engineer/Director