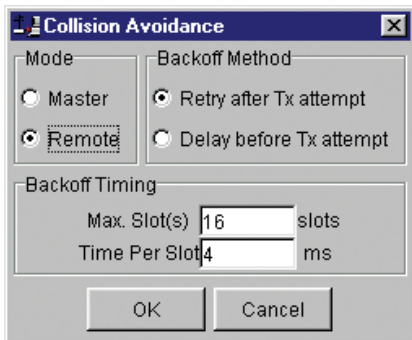


- Mode – “Master” or “Remote”. When the master unit receives a valid transmission from a remote unit it sets the channel busy indication bit. This busy bit is interpreted by the other remotes to not transmit. Once the transmission from the first remote ends the master unit resets the busy bit to indicate the channel is now clear to transmit on. The master unit, which is normally a base station, takes about 5ms to detect a transmission from a remote unit and set the channel busy indication bit on the radio channel. During this period collision of remote transmissions can still occur and is unavoidable. NOTE: The master can only be a full duplex unit.
- Backoff Method – “Retry after Tx Attempt” or “Delay before Tx Attempt”. The method chosen is system dependent and can only be configured if the mode is “remote”. The former is best used when data responses from remotes are largely asynchronous. The latter is best used when this is not the case.
- Backoff Timing – “Maximum Slots”, “Time per Slot”. This can only be configured if the mode is “remote”. When a remote is ready to transmit data but it finds the busy bit from the master set it holds back its transmission for a random “backoff” time after which it tries to transmit data again. This ensures that modems waiting to be allowed to transmit do not re-attempt to do so at the same time. The “Maximum Slots” (1 to 16) and the “Time per Slot” (1 to 255ms) are used to calculate the backoff time by multiplying the slot time by a random number between 1 and the maximum slot number. For example if the time per slot is 30ms and the maximum slots is 4, the random backoff times can be 30, 60, 90 or 120ms.

As the channel busy indication bit is critical for reliable operation default interpretation of this bit is defined in the remote units. If the master modem stops transmission (or has not yet started) the remote will interpret that the channel is busy and will not transmit until the master comes on line.

**Carrier Detect**

This method of collision avoidance utilises a carrier transmitted to all remotes to indicate that the radio channel is busy. When selected a dialogue box appears and several options must be configured:

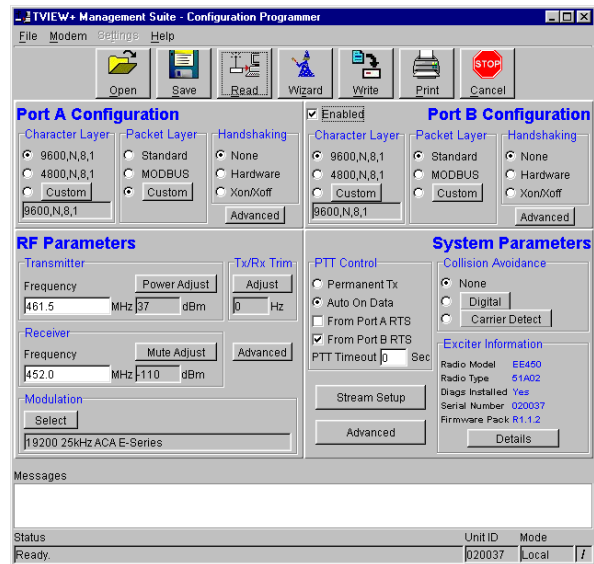


- Mode – “Master” or “Remote”. When the master unit receives a valid transmission from a remote unit it transmits a carrier signal to indicate busy. Of course the master will also initiate a transmission if it has data to send. The transmitted carrier is interpreted by the other remotes to not transmit. Once the transmission from the first remote ends the master unit stops transmission to indicate the channel is now clear to transmit on. The master unit, which is normally a base station, takes about 5ms to detect a transmission from a remote unit and transmit a carrier signal. During this period collision of remote transmissions can still occur and is unavoidable.

NOTE: The master can only be a full duplex unit and cannot be permanently transmitting. For half duplex and simplex systems all units should be set as “Remote” (no Master).

- Backoff Timing – “Maximum Slots”, “Time per Slot”. This can only be configured if the mode is “remote”. When a remote is ready to transmit data but it detects a carrier signal from the master set it holds back its transmission for a random “backoff” time after which it tries to transmit data again. This ensures that modems waiting to be allowed to transmit do not re-attempt to do so at the same time. The “Maximum Slots” (1 to 16) and the “Time per Slot” (1 to 255ms) are used to calculate the backoff time by multiplying the slot time by a random number between 1 and the maximum slot number. For example if the time per slot is 30ms and the maximum slots is 4, the random backoff times can be 30, 60, 90 or 120ms.

**Unit Information**



The information displayed is intended to assist the user to identify the radio modem as well as support should their services be needed.

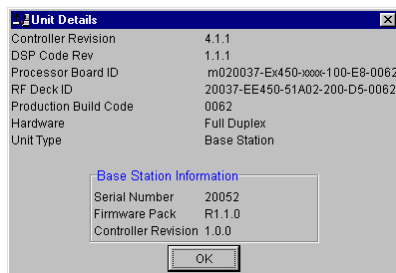
Radio Model refers to the type of unit. The ER450 is a remote unit and the EE450 is an exciter inside a base station unit.

Radio Type refers to the frequency band supported by the radio as well as the channel bandwidth. For example 51A02 is a type 51 band with a 25kHz channel.

Diags Installed is set to yes or no depending on whether the diagnostics key has been set in the unit.

Serial Number is unique to each unit and is set within the unit at time of production as well as included on the label fixed to the unit.

Firmware Pack refers to the firmware package version installed in the radio. There are several components associated with microcontroller and DSP firmware installed and a single version number is used to identify them.



### Unit Information - Details

More detailed information is also available to assist in identifying components installed in the unit (remote, base station or hot standby).

The additional information provided is:

- Controller Rev refers to the microcontroller firmware component version for the radio.
- DSP Code Rev refers to the DSP firmware component version for the radio.
- Processor Board ID refers to the processor board identification number and hardware revision information for the radio.
- RF Deck ID refers to the RF deck board identification number and hardware revision information inside the radio.
- Production Build Code refers to the automated production test and calibration sequence used during manufacture of the radio.
- Hardware indicates whether the radio is half or full duplex.
- Unit Type indicates whether the unit is recognised as a remote or base station.

In the case of a base station unit the following additional information is provided:

- Base Firmware Pack refers to the firmware package version installed in the base station (front panel) controller which is separate to the radio installed. There are several components associated with this firmware package and a single version number is used to identify them.
- Base Controller Rev refers to the microcontroller firmware component version for the base station.

### Messages

The message window provides a log of error messages occurring during use of the programmer utility. Several error messages may occur as a result of a selection.

### Status Bar

The status bar is located at the bottom of the main window and provides information regarding communication actions occurring with the radio data modem.

Additional fields located on the status bar include:

- Unit ID refers to the identification label used by the diagnostics utility. This is currently the same as the unit's serial number.
- Mode refers to the type of session established. It can be a File, Local indicating a local port connection to the unit or Remote indicating communications is via a radio channel.
- Rotating bar progress indicator showing data is being transferred to or received from a unit.

# Part J – TVIEW+ Management Suite - Remote Diagnostics & Network Controller

## Introduction

This section covers the operation of the *Remote Diagnostic and Network Management Controller* Software Version 3.7.X or greater.

## Overview

The Diagnostic Controller is a Windows® based program, that can be run on a standard desktop or laptop PC.

The software runs in the 32 bit Windows environment and offers many options and configurations which are easily accessible via pop-up windows. These include group or timed polling, remote switching of duplicated base stations, viewing of databases, logging and trending of real time parameters, etc.

The Diagnostic Controller can be installed to run as a stand-alone package, or as part of the TView+ Management Suite.

It is for use in conjunction with the D & E Series of data radio modems and can be used for simple point-to-point links, or for more complex point-to-multipoint and multilayer link systems.

The diagnostic facilities allow retrieval of packet statistics from each radio modem. These statistics are used to calculate Packet and Bit Error Rates, a units' condition/health, network efficiency and bandwidth utilisation.

The use of the diagnostics facilities provided by the controller gives the radio modem system designer and operator a powerful tool for both the maintenance and continuing reliability of their system.

The general operating parameters that can be obtained from remote modem units are:-

- Last RSSI level.
- Last transmitted power level.
- Receive frequency offset.
- Power supply voltage level.
- Current internal temperature.

These are displayed on the controllers screen in a "quick read" format of bar graphs, as well as detailed response listings.

For the E Series radio modems to operate with the diagnostic controller, they must be factory preset to include the diagnostics response facilities or installed at a later stage (in the field) via the programmer. Contact your supply for details.

The diagnostics data stream operates "alongside" the main user data stream. No interference between the two streams occurs, so as far as the primary user of the data system is concerned, the diagnostics data does not exist.

## Features

- 32 Bit Windows Based User Software.
- Full graphical presentation.
- Full SCADA style features such as database, trending, networking, etc.
- Able to interrogate and display important operating parameters of each radio modem.
- Provides performance data of any unit - good frames received, bad frames received, packet error rate, transmitted packet sizes, channel usage, etc.
- Provides statistical Packet Error Rate (PER) performance calculations for any unit.
- Provides powerful network tools such as channel occupancy statistics, average received transmission duration, etc.
- Can be set to background poll radio system for continuous system monitoring and logging.
- Provides full time/date stamped Status and Alarm logging/reporting. A relational database is created and managed using Microsoft Jet database engine Ver3.5. The database file, which is an ".mdb" file, can be accessed with external programs such as Microsoft Access.

## System Description

### General

The diagnostics process is based on a series of polls being transmitted to the remote modem units with each modem having its own unique assigned address which is factory preset.

When a diagnostic poll is received by a modem it checks to see if it is addressed to itself, and if so, it responds with its diagnostic data back to the controller. If it is not addressed to the modem, the modem simply "passes the message on", and does not respond to the controller.

In a multilayer system, several "pass on's" may occur before the destination modem is reached.

The modem's diagnostic response message is addressed to the controller, and as each modem in the "chain" decodes this message it will "pass it back", eventually the message reaches the controller for processing.

The controller software provides a database to hold the modem units associated data (i.e. Serial number, assigned name, location, alarm limits, SID code address, base station pairing information, status poll response data, alarms, etc).

The units' address is the serial number of the unit which is factory preset. The name is any mnemonic that the user wishes to attach to the modem. This name is then used to address the unit for access to diagnostic facilities.

The responses from the modem have boundary limits placed on them. If a response is outside these limits then an alarm is raised. For instance, the DC supply volts can have a lower limit of 12V, and an upper limit of 16V. Should a response to a poll received show that the DC volts is at 11V, then an alarm is reported.

A unit can be excluded from a poll sequence by removing it from the poll group.

Intensive polling of a single unit is possible using the Individual polling facility.

A poll "run" can be set up. A time can be designated for the controller to poll each of the modems in the system. This may be useful for systems that have a low traffic period where diagnostics can be "slotted in", thereby spreading the data throughput of the system more efficiently.

The screen is divided into three main scrolling sections - Status Polls, Alarms and Base Station Activities. The status poll section displays current poll activity while the alarm section displays any polls alarms which have been reported. The Base Station activity section displays any changeovers that have occurred to Hot Standby Base Units - if no Hot Standby Base Stations are employed within the system, this section will remain blank.

If base stations are employed in the system, then the two exciter units contained in one base unit can be paired together. The exciters operate in a mutually exclusive environment i.e. only one is active at a time. When the exciters are to be polled, only the active one will be sent a poll.

The base exciters can be toggled, so as the other exciter unit in the base can be polled if required.

A relational database is created and managed using Microsoft Jet database engine Ver3.5. The database file, which is an ".mdb" file, can be accessed with external programs such as Microsoft Access. All polls and alarms are time and date stamped and saved to the database. All database entries can be sorted and printed.

For some multilayer systems, Stream Identifier (SID) Codes may have to be added to the diagnostic data packets. Each modem can be assigned a SID address (the default is 00) and the SID code feature enabled.

Refer to Appendix A "Technical Notes" for further details of SID code addressing.

The diagnostic core of each radio (Firmware Version 2.4.0 and above) stores packet statistics for later retrieval. The Diagnostic controller software uses these statistics to calculate packet and bit error rates, network efficiency, bandwidth utilisation, and radio link integrity. These network analysis features are an invaluable tool for larger networks.

In the transmit direction, each radio modem can report the number of:-

- data bytes transmitted (TxByteCnt).
- frames transmitted (TxFrameCnt).

With these counters one can then calculate average frame size, average frame rate and channel utilisation.

In the receive direction, each radio modem can report the:-

- Data bytes received (GoodByteCnt).
- Good frames received (GoodFrameCnt).
- Bad frames received (BadFramCnt).
- Total time the radio has received signal (RSSIgoodTicker).
- Lost synchronization count (LostSynchCnt).
- Lost RSSI count (LostRSSICnt).

These counters can be used to calculate average frame size, average frame rate, channel occupancy, channel utilisation and link integrity.

Radio modems with Firmware Revisions 2.4.x and above have the advanced statistical counters as noted above. Firmware revisions below this (i.e. 2.3.x) only have Good Frame count, Bad Frame count, Lost RSSI count and Lost Synch Count available. The diagnostic controller will detect which firmware the radio has, and only report the available counters.

All these features combine to provide a powerful tool for the system operator.

## Modem Connection

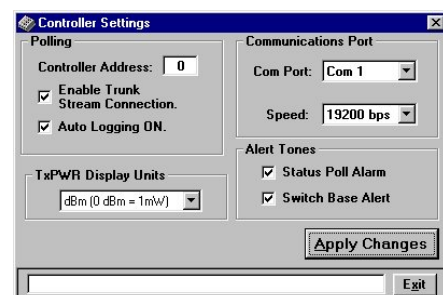
The diagnostics controller normally connects via a COM port on the controller PC and the "System Port" on the radio modem (Port "A & B" can be used if required).

NOTE: The controller can connect to any port of any data radio modem within the system as long as the data radio port is configured accordingly. When "Settings" is selected, the controller will interrogate the computers coms ports and display the available ports. Possible valid com ports are 1-16 or "None". Choose the desired port. None allows you to free the com port for use with other programs without exiting the diagnostic.

The modem port must have its SID codes enabled, and have the SID code set to the system diags SID (normally this is set to "00").

The data format used is the SLIP protocol, running at 9600 baud, No parity, 8 data bits and 1 stop bit. Appendix B "SLIP Protocol" contains a detailed definition of the SLIP Protocol.

COM1 of the controller PC is to be directly connected to the 9 way D-Min of the modem using a 3 wire interface (see drawing below). Should the PC have a 25 way connector, then the standard RS232, 25 way to 9 way conversion should be used.



## Operating Instructions

### General

When the Diagnostic controller starts, a presentation screen is displayed which will then lead you into the main diagnostics screen. This is where all the major functions of the controller are accessed.

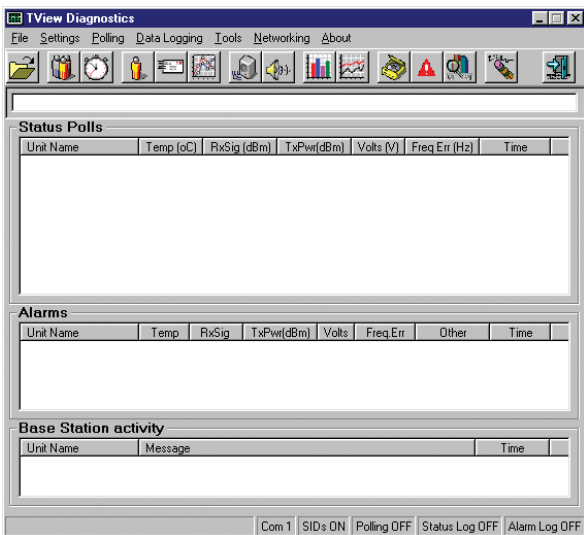
The main screen presents the operator with the typical Windows pull down type menu bars - "File", "Settings", etc. Icons of the most commonly used selections are also provided across the top of the screen.

This screen is divided into 3 main sections:-

1. **Status Polls** screen which displays all poll results obtained.
2. **Alarms** screen which displays any alarms that occur.
3. **Base Station Activity** screen which displays any changeovers that occur with Hot Standby Base Stations within the system.

The line above Status Polls is a "Processing Status Bar". It will display messages about errors, warnings and poll processing.

The bottom row of the screen also displays a summary of the configured parameters such as which com port is being used, whether SID codes are on or off, whether polling is enabled or disabled, current database path and file name, etc.

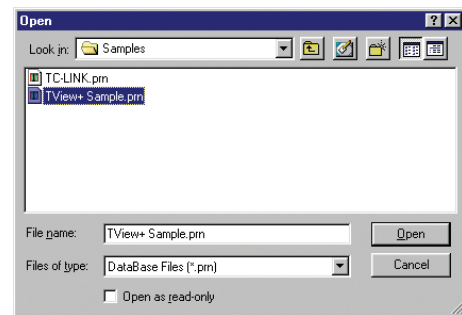


### Menu Selection

#### File Menu

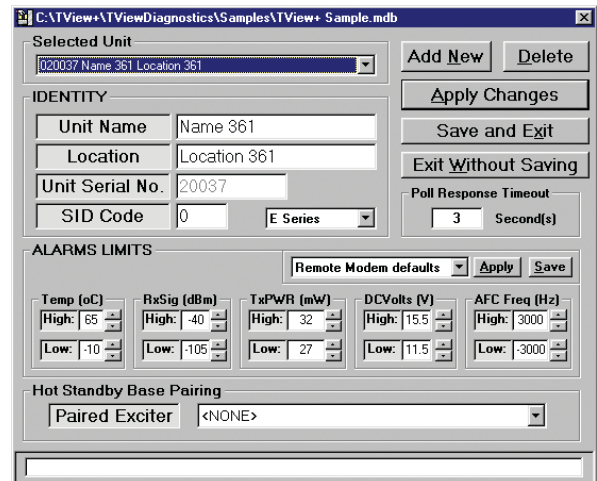
To utilise the Remote Diagnostics facilities, a database must be created which includes the individual serial numbers, alarm parameters and various other parameters of each unit.

The file menu allows the operator to create a **New** database, **Open** an existing database, **Add/Edit/Delete** a database or **View** an existing database. All such database tools utilise standard Windows type formats for file selections as shown.



#### File - Add/Edit/Delete

After creating a New database or Opening an existing database, the Add/Edit/Delete menu can be accessed.



#### Selected Unit

Selected unit is a pull down selection box, for selecting a unit to view or edit.

The bottom line is a "Processing Status Bar". It will display messages about errors, warnings and poll processing.

**Unit Name and Location**

Unit name is required and must be unique(max. 20 character).

Location allows the user to enter descriptions of sites and their locations (optional, (max. 20 character).

**Unit Serial Number**

Is the factory preset unique serial number of the unit. This is obtained from the label located on the unit or read from the unit using the Programmer. On base stations the exciter serial numbers must be read from the lid label or electronically with the programmer.

**SID Code (Diagnostic Stream Identifier)**

Is the SID code address number being used by the unit for the diagnostics stream. This is normally set to 0. Check the radio units programmed configuration for confirmation and or system configuration.

**Unit Series**

Default to "E Series", option on pull down box to select "D Series"

**Poll Response Timeout**

Is the time in seconds the Diagnostic controller will wait for a response from the remote unit. When a time out occurs, the controller will retry. If three poll attempts fail then the poll request is terminated, and a No Acknowledge (No Ack) message will appear in the alarms window. One second is usually more than enough "wait" time. In a multilayer system, longer response times may be necessary.

**Alarm Limits**

Allows the user to set thresholds for each unit which, when exceeded, will report an alarm. Default settings are provided for remote devices and base stations. These are selected by clicking on the appropriate buttons presented.

If the controller receives a status poll parameter result which is outside any of the threshold settings, it will immediately retry, in case it was an erroneous measurement. If the next received poll result is still outside the threshold, the retries will continue until it has received a status poll within the threshold settings, or three status polls. If three polls outside the required threshold are received, the average of these polls is displayed in the status poll window and the offending parameter(s) appear as alarms in the Alarms window.

**Defaults drop down box**

Choose either "Remote Modem Defaults" or "Base Modem Defaults" from the drop down list. Click "Apply" to set the alarm limits to the selected defaults. Click "Save" to save custom default values.

**Hot Standby Base Pairing**

Is used when a Hot Standby Base is employed within the system. The two exciters contained in each base unit need to be "paired" together. Since only one of the exciter-modems can be active (on-line) at any time, only one can answer a poll. Thus the two should be paired together so they are treated as mutually exclusive.

This selection allows the user to pair the two radio modems, by selecting the other exciter with which the currently selected exciter is to be paired with. The two units must of course exist in the database as independent serial numbers before they can be paired.

**Add New Button**

Click this button to add a new radio modem to the database. The Selected Unit, Name, Location, Unit Serial numbers and Hot Standby Base Pairing fields will be cleared, ready for the entry of a new unit. After filling in the details click the "Apply" button to complete entry.

**Apply Button**

Applies changes to selected units or complete the "add new" radios to the data base. Additions and changes made on the screen do not result in changes to the database unless this button is activated. This must be done before selecting a new serial number/unit. Note that the newly changed database will not be saved to disk until the Save and Exit button is activated.

**Delete Button**

Allows deletion of units from the database. NOTE: Deleting a unit from the database will delete all it's associated status poll and alarm history.

Click and a selection list of serial numbers will appear. Select one at a time and then press the "Delete" button on the selection box.

**Save and Exit Button**

Press this button to save the newly changed database and then exit. Additions and changes to the database will be saved to disk as long as the "Apply" button was pushed.

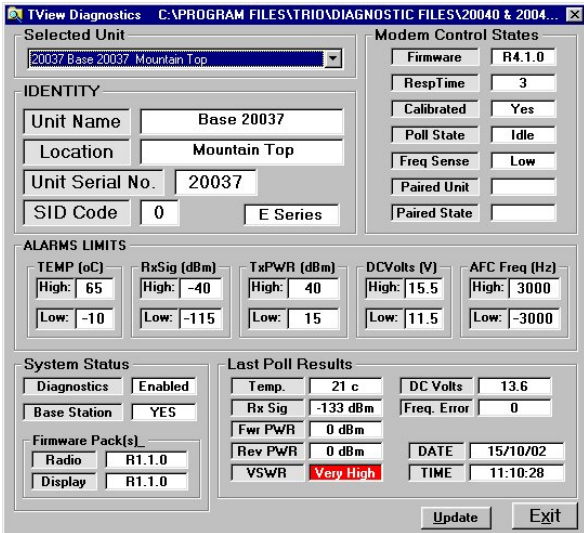
**Exit without Saving Button**

Press this button to exit without saving the newly changed database.

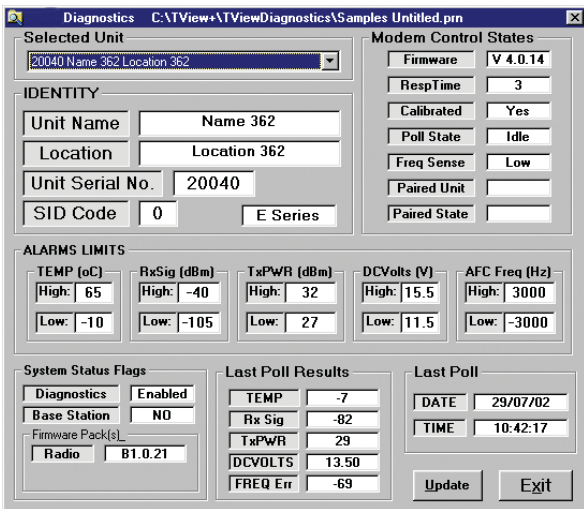
**File - View (view only)**

The View Screen shows the unit alarm limits, current control states, calibration constants, last poll results for firmware and system information.

Note: The View window is different for Remote radios and Base Stations as well as for D Series.



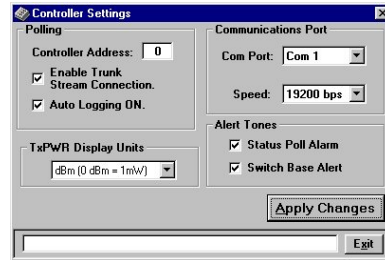
Base Station - E Series



Remote Radio - E Series

**Settings**

The settings menu allows the user to configure various setup parameters. These include:-



**Communications Port**

With the pull down box, select the required communications port. Com 1 to Com 16. Select the required com port speed (9k6 or 19k2bps). Default is 19k2bps.

**Controller Address**

Normally set to 0. Networks which have multiple controllers active, should use different controller addresses, so responses from remotes are ignored if the poll was not sent by that controller.

**Enable SID Codes**

Enabled or disabled (Default enabled). In some systems, external application of SID codes is used as a method of giving the modems in the system specific data addresses. The modems are placed into the "stream routing" mode, and the user (e.g. Diagnostic controller) supplies the SID code at the start of each data packet to be transmitted. In this way the user can "steer" the data flow through the given network path.

Should the diagnostics controller be used in such a network then it too needs to append the data addresses or SID codes to the beginning of all data messages sent.

In the controllers database record for each modem, a field is supplied where the user can select the SID code for that particular modem. By selecting the Diagnostic SID code that suits the system topology, the diagnostics data messages can be routed successfully to the correct destination.

**Auto Logging ON**

When enabled all logging functions will be activated when polling is turned on.

**Alert Tones**

When enabled will emit a tone from the PC speaker or sound card when Status poll alarms occur and/or Base Station change overs occur.

**Tx Power Display Units**

Select either "dBm" or "milli Watts" as the display units. Power will be displayed throughout the system in the selected power measurement unit.

Note: Power will always be stored in the database file as milli-watts

**Polling**

In order to obtain diagnostics information, the diagnostics controller provides a number of automatic polling facilities, which include: Group polling, Timed polling and Individual polling. The Group and Timed poll facilities will automatically cycle through a selected group of units at a predetermined interval (in seconds). The Individual poll facility permits intensive polling of a single unit at a selectable rate, independent of any Group polling that may be active at the time.

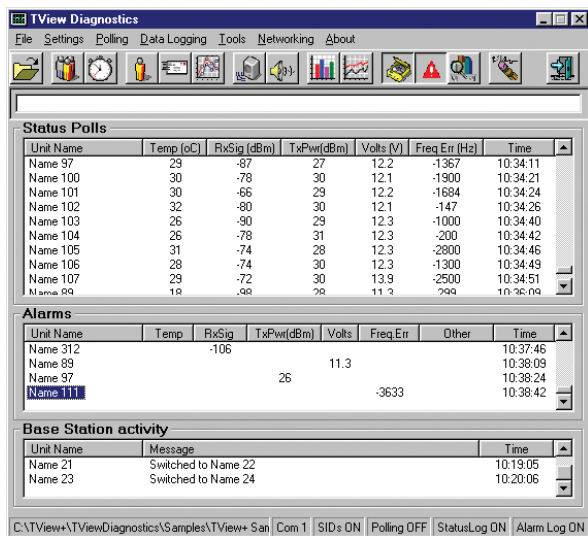
When the modem is polled for the first time, the controller will poll (ask) the radio for its calibration constants and firmware revision (these can be viewed in the "View" window under the File menu). When this initialisation procedure is complete, status polling can commence. If the radio were to perform a "cold boot" for what ever reason (eg loss of power, cold boot command received, etc), the controller will detect this and initiate the above initialisation procedure again and display "cold boot" alarm in "other".

If Hot-Standby base stations are employed in the system, then only the "on-line" unit will be polled. If a hot standby changeover occurs at the base, then the new "on-line" modem will be polled and the off-line unit removed from the poll sequence. A "Changeover" alarm will be displayed in the Base Station Activity screen.

The status poll requests that are reported and displayed on the main screen are;

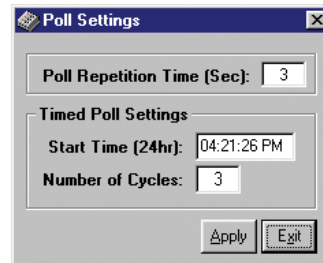
- Temperature
- Received Signal Strength
- Transmitter Power
- DC Supply Volts
- Received Frequency Error
- Time and dat stamped

The line above Status Polls is a "Processing Status Bar". It will display messages about errors, warnings and poll processing.



**Poll Setup (Settings)**

Under the Polling menu option, choose "Setup..." The Poll Settings dialog box will appear. Here you can set :



**Poll Repetition Time**

Is the time in seconds (2 to 3600 secs) between each status poll of the group poll cycle. Each unit in the poll group will be polled in turn, at this time interval.

**Timed Polling**

Allows the user to schedule a period when the group poll will commence. This is a useful feature for systems that have times of little traffic loading such as the early hours of the morning.

**Start Time**

Time at which the Timed poll cycle will commence. The time format will be as per the regional settings.

**Number of Cycles**

This is the number of times the controller will cycle through the poll group when the Timed Group poll commences. Each unit in the poll group will be polled this number of times.

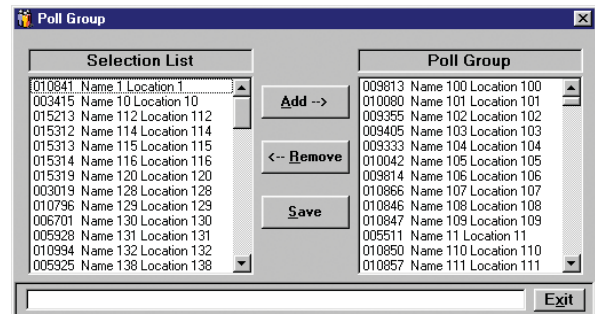
**Apply Button**

Click "Apply" to initiate any changes made in this dialog box.

**Poll Group Select**

Under the Polling menu, select "Poll Group Select..."

This dialog box enables Adding/Removing of radios to/from the automatic poll group. Units in the Selection list box are available for adding to the poll group. These units will not be polled during a group poll cycle.



Units in the Poll Group list box will be polled during a group poll cycle.

Clicking the Save button will save any changes in the poll group to the database.

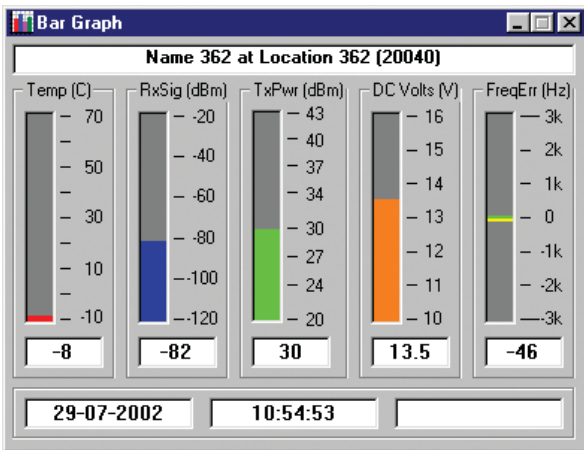


**Group Polling**

This is the standard mode of operation. The diagnostic controller will continuously cycle through the poll group, unit by unit at the poll repetition time (2 to 3600 secs).

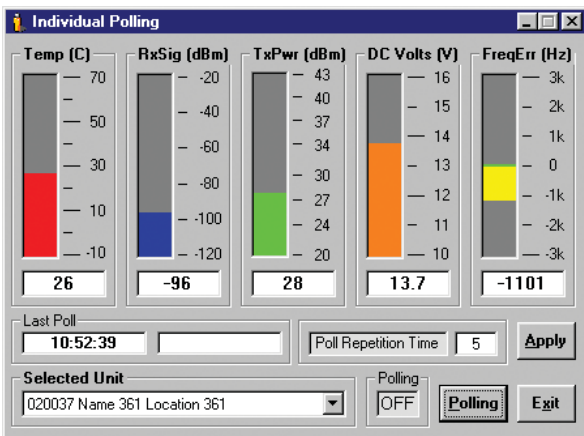
**Bar Graph**

Display Bar Graph can be selected which displays all polls on the “Bar Graph”. If a unit alarms, the measurement in question will have a red background in the Text box.



**Individual Poll**

Allows intensive polling of a single unit, independently of any group polling that may be active. The individual poll window provides a bar graph display for rapid visual recognition of the radio modems parameter levels.



The line above Status Polls is a “Processing Status Bar”. It will display messages about errors, warnings and poll processing.

**Polling Button**

The selected unit will be removed from the poll group, then polled at the selectable rate (Poll Repetition time) by clicking the Polling button.

**Poll Repetition Time (2 to 3600 Sec)**

Is the rate at which individual status polling will occur. Click on the “Apply” button to apply any change made to the poll repetition time.

**Switch Exciter**

Only visible if the selected unit is a “Hot Standby Base station” then a switch base facility is provided for remote switching of the exciter units. With polling on, click on the “Switch Exciter” button. The changeover may take a number of seconds. The active unit will be displayed in the “Active unit” field.

*NOTE:* The hot standby base station has a minimum “toggle” time of 1 minute. This is to avoid rapid switching between exciter units, should a fault be detected in both modems.

**Data Logging**

Status poll and Alarm data can be logged to a database file for viewing at a later date. A relational database is created and managed using Microsoft Jet database engine Ver3.5. The database file, which is an “.mdb” file, can be accessed with external programs such as Microsoft Access. You have the option of enabling logging of Status polls only, Alarms only or both.

**Log Status Polls**

To log Status polls either select “Log Status polls” under the Data Logging menu item or click the corresponding toolbar button.

**Log Alarms**

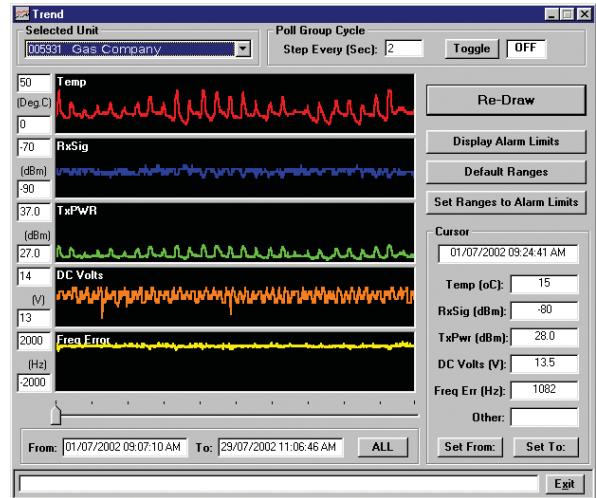
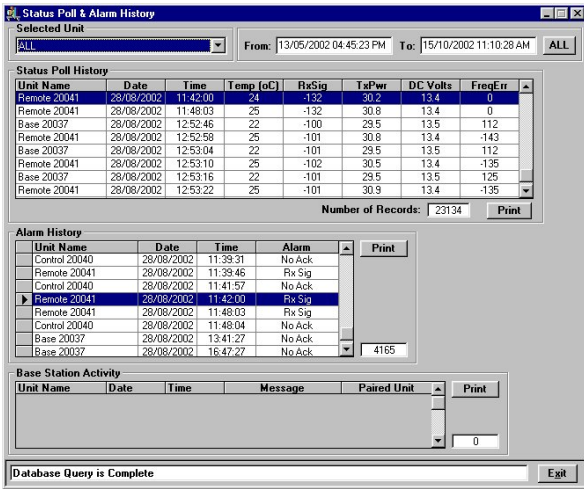
To log Alarms either select “Log Alarms” under the Data Logging menu item or click the corresponding toolbar button.

*NOTE:* If “Auto Logging ON” is enabled in the settings dialog box, then Status Poll logging and Alarm logging will automatically be turned on when Group or Individual polling is turned on.

**View History**

Status poll history may be viewed using the Status Poll & Alarm History window. This window has three tables: Status Poll History, Alarm History and Base Station Activity. Each table has a “Number of Records” box to indicate how big the selection is.

You may select “ALL” to see every units poll results, or view an individual units poll results.



The line above Status Polls is a "Processing Status Bar". It will display messages about errors, warnings and poll processing.

**From To or ALL Fields**

These fields determine the time span you wish to view. For example, if you have collected several months of data, and only wish to view a 24 hour period, then adjust the From: and To: fields accordingly and select the unit.

When the History window first appears, the From: and To: fields will contain the last 24 hours of data.

If "ALL" is selected it will display the start and end dates of the database.

The Date/Time format will be as per the regional settings short date format.

NOTE: The smaller the time span you select, the faster the database search will be. This will also depend on the poll rate that was used during that time span.

**Sorting**

Each of these tables can be sorted in ascending order by: unit, date or poll parameter. To sort, just click on the required column header.

To show the full status of a single report in the "Alarm History" click on the box at the left by the unit name. Note this only works on valid poll results not "NoAck".

**Printing**

A printout of each table is possible by clicking on the associated Print button. The table data will be sent to the default printer and formatted as per your default printer configuration set up.

**View Trend**

The logged status poll data can be viewed in graph format, which allows viewing of status trends over selectable time spans. This provides a very effective and fast method of analysing a units' operating parameters over time.

Select "View Trend" under the Data Logging menu item or click the associated toolbar button.

Features available include:

- Scaling of graph(s).
- View individual poll results using the cursor.
- Automatically scroll through the group poll database, unit by unit at a selectable time interval.
- No Acknowledge messages are displayed by a gap in the graphed data and a "NoAck" in other on the Time Line.

The line above Status Polls is a "Processing Status Bar". It will display messages about errors, warnings and poll processing.

**Vertical Scale Setting**

- Manually set the vertical scales by simple typing in the new level(s), then either press "Enter" or click on the "Re Draw" button, or select a new unit.
- Click the "Default Ranges" button to set all the vertical scales back to the default levels.
- Click the "Set Ranges to Alarm Limits" button to set the vertical scale limits to the selected unit alarm limits.

**From: & To: Fields**

These fields determine the time span you wish to view. For example, if you have collected several months of data, and only wish to view a 24 hour period, then adjust the From: and To: fields accordingly.

When the Trending window first appears, the From: and To: fields will contain the last 24 hours of data.

If "ALL" is selected it will display the start and end dates of the database.

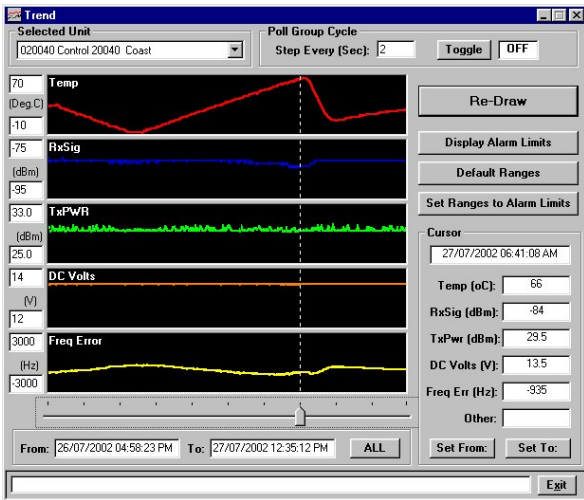
NOTE: The smaller the time span you select, the faster the database search and draw. This will also depend on the poll rate that was used during that time span.

Use the ALL button to set the From: and To: fields to the maximum and minimum dates found in the data in the database.

**Poll Group Cycle**

When toggled ON, this will step through each radio in the poll group and display the trend graph. Set the step interval in the "Step Every (Sec)" field. Default = 2 seconds

**Cursor:** Use the slider control, found at the bottom of the display to move the cursor. The cursor box displays the parameter data of the status poll at the current cursor position.



Use the "Set From" button to set the From: field to the current cursor position.

Use the "Set To" button to set the To: field to the current cursor position.

**Tools - Statistical Performance**

The diagnostic core of radios with Firmware V2.4.X and above have 6 counters which store packet statistics for later retrieval. They are:-

- Lost Synch.
- Lost RxSig.
- Good Frames.
- Bad Frames.
- Time Ticker.
- RSSI Ticker.

The Diagnostic controller software uses these statistics to calculate packet and bit error rates, network efficiency, bandwidth utilisation and radio link integrity. These network analysis features are an invaluable tool for larger networks.

**Statistical Performance Formulae**

**Timers:**

Time Ticker (10mS): (RRT) = timer that increments by one every 10mSec

Elapsed Time: = Total elapsed time in hh:mm:ss from reset calculated from RRT

RSSI Ticker (10mS): = timer that increments by one every 10mSec when RxSig present. (Virtual connection to RxSig LED)

**Transmit Channel:**

Tx Frames: = Number of Tx HDLC frames.

Tx Byte: = Number of Tx Bytes

Average Frame Size: = TxByteCnt / TxFrameCnt

Average Frame Rate (mSec): = TxFrameCnt / RTT \* 0.01

Channel Utilisation (%): = (TxByteCnt \* 8) / (RTT \* RFChannelBitRate) where RFChannelBitRate is 9600 or 4800 Bits per sec.

**Receive Channel:**

Good Frames: = Good Frames Rx'd

Bad Frames: = Bad Frames Rx'd. Rx HDLC frame error.

Good Bytes: = Good Bytes Rx'd

Average Frame Size: = GoodByteCnt / GoodFrameCnt

Average Frame Rate (mSec): = (GoodFrameCnt + BadFrameCnt) / RTT \* 0.01

Channel Occupancy (%): = RSSIgoodTicker / RTT \* 100 (Average from reset)

Channel Occ Sliding: =  $\text{RSSI}_{\text{good}} / \text{RTT} * 100$   
(Average from last update)

Channel Utilisation (%): =  $(\text{GoodByteCnt} * 8) / (\text{RTT} * \text{RFChannelBitRate})$

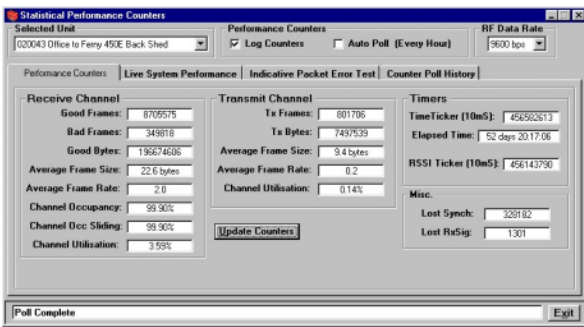
**Miscellaneous:**

Lost Synch: = Increments on lost synch, must be validated with RxSig. (Virtual connection to Synch LED)

Lost RSSI: = Increments on lost RxSig (Virtual connection to RxSig LED)

Radio modems with Firmware Revisions 2.4.x and above have the advanced statistical counters as noted above. Firmware revisions below this (i.e. 2.3.x) only have Good Frame count, Bad Frame count, Lost RSSI count and Lost Synch Count available. The diagnostic controller will detect which firmware the radio has, and only report the available counters.

**Statistical Performance Counters Window**



**Selected Unit**

When a unit is selected, the controller will confirm that the firmware revision has been received. If not, it will attempt to poll the radio automatically to retrieve the revision number.

**RF Data Rate**

Select from the pull down menu 4800, 9600 or 19200 bps, depending on your system settings

**Status Bar**

Reports any poll processing in progress or errors that may have occurred.

**Performance Counters Tab**

This is the main statistical performance tool used for assessing network performance.

- Make sure "log counters" is checked on
- Click the **Update Counters** button to retrieve the current statistical performance results.
- Click the **Auto Poll OFF/ON** button to automatically update the counters every hour for selected unit.

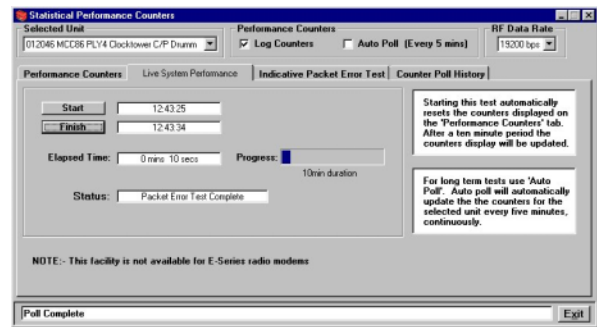
Click the **Log Counters OFF/ON** button to log the counters every time they are updated. These can be viewed on the "Counter Poll History" Tab.

**Notes:**

- The controller will attempt a series of polls when either resetting or retrieving the counters. You should monitor the status window to ensure that the poll process completes. If errors occur, they may be due to conditions like packet collisions on a busy network, diagnostic controller trying to perform too many poll functions (i.e. group polling, individual polling), etc.
- E Series data radios have 32 bit counters and will count for 1 year, 4 months & 10 days if not reset occurs.

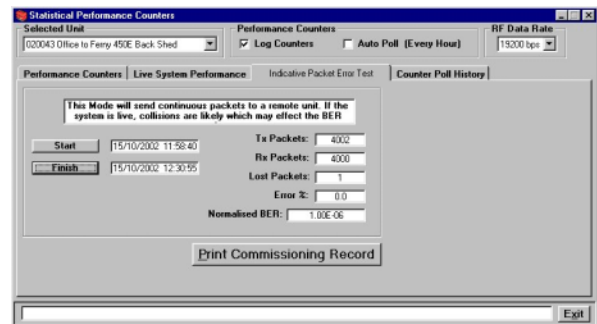
**Live System Performance Tab**

This provides an automatic test facility which will automatically reset all the radio modems counters, and then after a 10 minute period retrieve the new counter values. View the Performance counters tab to see the result.



**Indicative Packet Error Test Tab with Commissioning Record**

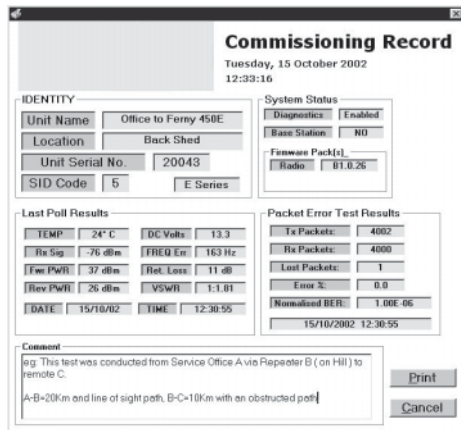
This Tab provides a simple link test facility. When this is running, continuous Poll/Response diagnostic messages will be transmitted to and from the unit and Packet Error Rate results recorded. If a response is not received within the Poll Response Timeout period, then an error (last Packet) is recorded. If the system is live, collisions are likely and may effect Error results.



**Print Commissioning Record**

From the “Indicative Packet Error test” a commissioning sheet can be printed to file (eg: using Adobe PDF write or similar), or printed directly.

After running the test for the desired time (best results with no user data), the test can be stopped with the “Finish” button. Select “Print Commissioning Record” button and a page appears with the results and also the unit identity, last poll results, system status and date/time stamp for each record.

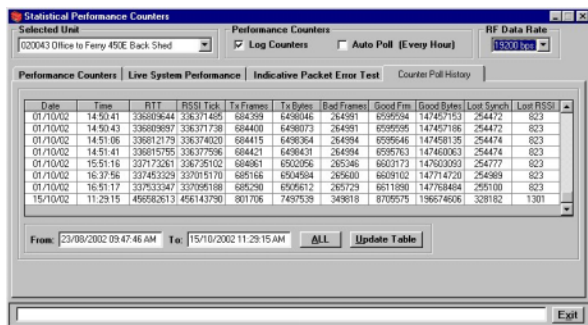


On this page there is also a facility to type in a “Comment” field. This is useful for recording information such as where the test was conducted and through what part of the system the test was conducted. eg: via a repeater.

Press “Print” button when ready to send to the default printer.

**Counter Poll History Tab**

This is a database viewing facility. When logging is enabled “Log Counters”, each time the counters are retrieved they will be written to the database. Adjust the **From:** & **To:** fields to view a specified time span or press ALL to obtain complete database period.



## Networking

Monitoring the radio network from other workstations on a LAN network is made easy with the networking facilities provided by the Diagnostics Controller. The radio network controller can be configured as either a Server or Client. The Server will send poll information to each attached client, depending on their access rights.

Client groups can be set up. Each Client can be assigned to one client group. Each radio modem can be assigned to one or more Client groups.

A default Client group called "ALL" is automatically set up containing all radio units in the database.

Client Groups Example:

All	Pumps	Test
Test Unit 1	Pump 1	Test Unit 1
Test Unit 2	Pump 2	Test Unit 2
Test Unit 3	Pump 3	Test Unit 3
Pump 1		
Pump 2		
Pump 3		

In the above example, there are three client groups, ALL (the default), Pumps, and Test. A Radio modem can be a member of more than one group.

Client Examples:

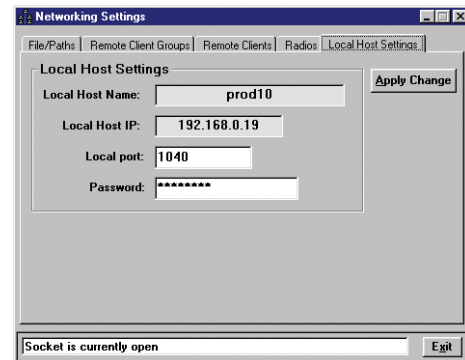
- Central - This is the Diagnostic Server which is attached to the radio network.
- Test Client - This is a Diags controller in client mode.
- Pump Monitor - This is a Diags controller in client mode.

In the above example, the Central workstation, running Diagnostics in Server mode, is polling all the radios in the network and distributing the received messages to the attached clients.

The Test Client and Pump Monitor are receiving Status poll and alarm information from the Central server. The Test Client will only receive poll information for radios found in the "Test Client Group" i.e. Test Units 1, 2 and 3. The Pump Monitor will only receive poll information for radios found in the "Pumps Client Group" i.e. Pumps 1, 2 and 3.

## Networking - Setting

The Server should be configured properly first before any connection attempts are made by clients. It will always be safer to stop any polling that may be in progress when making changes to the Server client set up.



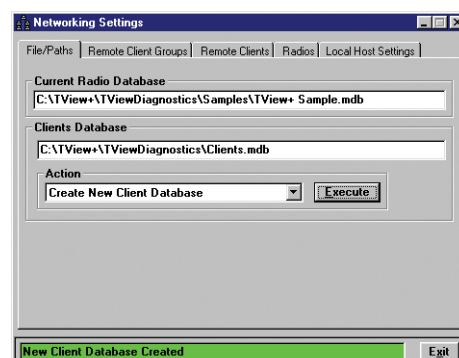
### Local Host Settings Tab

It is assumed that the workstation is running Windows, and has been configured with the TCP/IP network protocol.

- Open or create a radio database.
- Under the Networking menu bar select "Settings" from the menu bar.
- In the Networking window click the "Local Host Settings" button.
- The Local Host settings will appear, which contains the Server Host Name, IP address, Local Port and Password.
- The Local Port is the socket number. Select an unused socket number. Usually a number between 1000 and 2000 would be safe.
- Enter a password. This is required when in client mode, to access incoming data from the server.
- Apply Change.

### Creating Client Database- File/Paths Tab

When in Server mode the Diagnostic controller uses an additional database file (.mdb) to store Client information. This file is linked to the main radio Database file. The link is managed by the Microsoft Jet database engine. This separate linked file configuration permits archiving of the main radio database (.mdb) without losing client configuration data.



- In the Networking window click the "File/Paths" button.
- The "Current Radio Database" is displayed if open.
- Select "Create New Client Database" from the Action drop down list.
- Click "Execute" to create and link the client database.

#### Adding Client Group(s)

- Click the Remote Client Groups tab.
- Enter the group name in the field provided.
- Click on the Add button to add the group name to the database.

#### Deleting a Client Group

- Click on the "Remote Client Groups" tab.
- Select the group you wish to delete.
- Click on the "Delete" button to delete the group name from the database.

#### Adding a Client

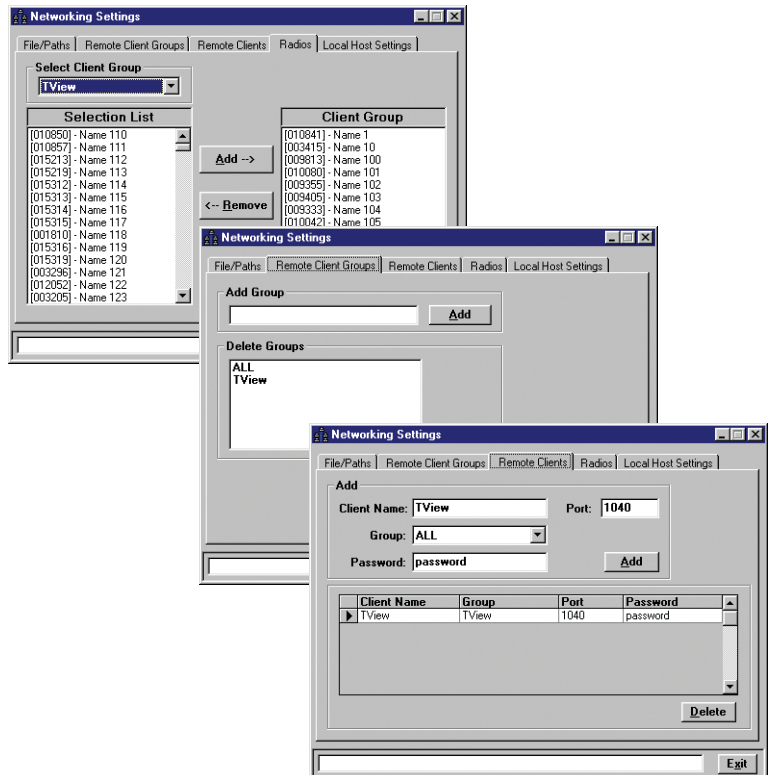
- Click on the Remote Clients tab.
- Enter Client Name. This can be either the remote clients Host name or IP address. Entering the client Host name requires extra processing to resolve the name into an IP address. Entering the IP address directly in the Client name field is more efficient, although more cryptic.
- Select a client group.
- Enter the clients password.
- Enter the client Port. This is the socket number used at the remote client.
- Click the Add button to add the client to the database.

#### Deleting a Client

- On the Remote Client Tab, select a client to delete by clicking on the record selector (left most column).
- Click the delete button to delete the client from the database.

#### Adding Radio(s) to a Client group

- On the Radios tab select a Client Group.
- Using the "Add and/or Remove" buttons to add or remove radios from the Client Group.
- Under Networking on the menu bar, Select the "Server Mode" button. This will place the diagnostic controller into Server mode.
- The Diagnostic Controller Server is now ready distribute messages to client workstations.



#### Setting Up a Client

In Client mode, the diagnostics controller basically just mirrors the display of the server. Poll information can not be stored locally, polling functions are not available via the remote server, and most of the tools normally provided are disabled.

It is assumed that the workstation is running Win95/98/NT, has been configured with the TCP/IP network protocol and has been added to the Diagnostic Server's Client Groups.

- Under Networking on the menu bar, select "Settings".
- The Network settings window will appear, which contains the Client Host Name and IP address, which are view only.
- Enter the **Client password** as stored at the Diagnostic Controller Server.
- Enter the **Local Port Address** (socket number) as stored in the Diagnostic Controller Server database.
- Click the "Apply Change" button.
- Under Networking on the menu bar, Select the "Client Mode" button. This will place the diagnostic controller into client mode.

A local Diagnostic session can be operated while in client mode, both status messages will appear on screen.

#### Diags Client

A Client only version of this software is also available. This must be used in conjunction with standard software running in "Server Mode".

Local Com ports are disabled permanently in this version.

## Interpreting Poll Results

### General

The results returned by the poll requests give an indication of system performance. When a new modem is added to the database, default values are assigned for the limits of the returned results. The user can assign different values to these limits as required, which is determined by the fault tolerance level of their systems.

### RSSI

The default RSSI limits are set at -30 to -105 dBm(-110 dBm for Base/ Repeater Station). Above -30 dBm the front end of the receiver will saturate and it is unlikely that signal levels much higher than this will ever be reported. Below -105/-110 dBm the error rate may become too high for some applications. In the modem the RSSI measurement is made periodically each 100mS, while R F carrier is being detected.

### Transmitter power

The transmitter power limits are set at between 0mW and 20,000mW. The modems will normally be operating at a power level of 1 watt. The above limits are set to  $\pm 3$ dB of the nominal (3dB represents a factor of 2 for power measurements).

The effect of a change in transmittal power can be transposed to the receiver BER curves (3dB down at the transmitter is 3dB down at the receiver). The amount of variation tolerated will be determined by the RF path loss of the data link being used.

If the modem is set to low power, then the transmittal power will be nominally 200mW. Suggested limits for this would be 100mW and 400mW ( $\pm 3$ dB).

For base station units or remote units set to high power, the nominal transmitter power is 5 watts. Suggested limits on these would be 2.5 watts to 10 watts ( $\pm 3$ dB).

In the modem the reported transmit power measurement is given from a measurement made of the last transmission made by the modems. When the PTT is ON a periodic measurement is made of the transmit power. The modem stores this away and reports it when requested.

Parameter	Resolution	Absolute accuracy @ RT	Drift over Temp. range	Notes
Temperature	0.1 degC	+/- 4 degC	+/- 1 degC	
Supply Voltage	0.1 volts	+/- 0.5V	+/- 0.08V	+/- 0.45%
Rx Signal Strength	0.1 dBm	+/- 3 dB	+/- 2 dB	
Frequency Error	1Hz	+/- 200Hz	+/- 2500Hz	
Tx Power (Remote)	0.1 dBm	+/- 1.5 dB	+/- 0.3 dB	Note 1
Tx Reverse Power(Remote)	0.1 dBm	+/- 3 dB	+/- 1 dB	
Tx Power (Base)	0.1 dBm	+/- 0.8 dB	+/- 1 dB	Note 2
Tx Reverse Power (Base)	0.1 dBm			

Notes:

1. Remote Tx power measurements will vary due to power setting variation which can have an initial error of +/- 0.5 dB and final error of +/- 0.2 dB
2. Base Tx power measurements will vary due to power setting variation by the exciter which can have an initial/final error of +/- 0.2 dB and overshoot by the PA <1 dB.

### Temperature

The modem is specified to operate within the temperature range of -30°C to 65°C. The defaults limits are set to -30°C and 60°C. At 65°C the modem goes into a high temperature foldback mode, when the power is reduced to the low power mode. This is to reduce the risk of damage to the final stage of the transmitter at excessive temperatures.

The modem will operate outside this temperature range but it is not recommended.

### Supply Voltage

The modem is specified to operate over a DC supply range of 11V to 16V. The default levels are set to 11.5V to 15.5V. The modem will not operate correctly outside these bounds and damage may occur with high voltage levels being applied.

### Frequency

The frequency limits are set to  $\pm 3000$ Hz. This is basically the difference between the different ends of a data link. If the difference gets much greater than this, data errors may occur (the modem will have a degree of long term frequency drift of 1ppm / annum due to the physical properties of internal components).



# Part K – Appendices

## Appendix A - Application and Technical Notes

TN-4	Remote Diagnostics
AN-D3	SID Code Addressing Scheme for Small to Medium Sized Data Radio Systems
AN-D4	Trunked Multi-Stream Applications of the D Series Product Range

## Appendix B - Slip Protocol

The SLIP protocol, is a data transport protocol, originated and used extensively in UNIX(tm) based systems, and thus also closely associated with TCP/IP networked systems. Although not truly a "standard" it is so widely used that it has become the defacto standard for serial interface in UNIX and many other networked systems. SLIP is a method of framing messages containing binary data, on asynchronous channels. The asynchronous serial channel is configured for eight bit character size, no parity, and one stop.

A specific binary code called FEND (Frame End, hexadecimal value=C0) is reserved to define a frame boundary. Should this same code occur in the data message to be transferred across the channel controlled under SLIP, then an escape sequence is used so that the message byte will not be confused for a FEND. This escape sequence, involves replacing the message hexadecimal C0 code with a two byte sequence FESC, TFEND. FESC (Frame Escape) is the binary code hexadecimal DB, and TFEND (Transposed FEND) is binary code hexadecimal DC. Likewise, if the FESC character ever appears in the user data, it is replaced with the two character sequence FESC, TFESC (Transposed FESC). The TFESC is the binary code hexadecimal DD. The following table clarifies this.

Abbreviation	Description	Hex.Value
FEND	Frame end	C0
FESC	Frame escape	DB
TFEND	Transposed frame end	DC
TFESC	Transposed frame escape	DD

As characters arrive at the SLIP receiver, they are appended to a buffer containing the current frame. Receiving a FEND marks the end of the frame, and consequently, succeeding bytes are considered part of the next frame.

Receipt of a FESC code puts the SLIP receiver into "escaped mode", causing it to translate a following TFESC or TFEND back to a FESC or FEND code, appending it to the buffer, and resuming it's normal state. Receipt of any byte other than TFESC or TFEND while in escaped mode, is an error. No translation occurs, and the SLIP receiver leaves escaped mode. A TFESC or TFEND received while not in escaped mode is treated as an ordinary character and stored accordingly. Reception of consecutive FEND characters, causes no action to be taken (i.e. is not interpreted as zero length frames).

An example of a typical SLIP frame is shown below. The message consists of the string DA,C4,C0,C5,DB,20,BD,DC,DD. The SLIP frame will be:-

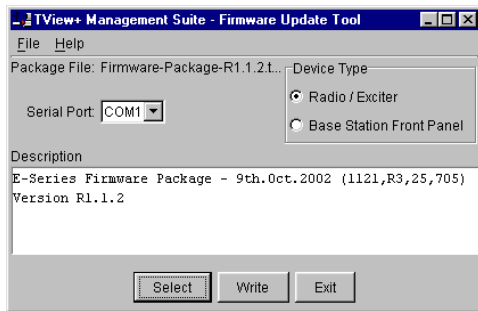
```
DA,C4,<FESC>,<TFEND>,C5,<FESC>,<TFESC>,20,BD,DC,DD,<FEND>
==> DA,C4,DB,DC,C5,DB,DD,20,BD,DC,DD,C0
```

## Appendix C - Firmware Updates

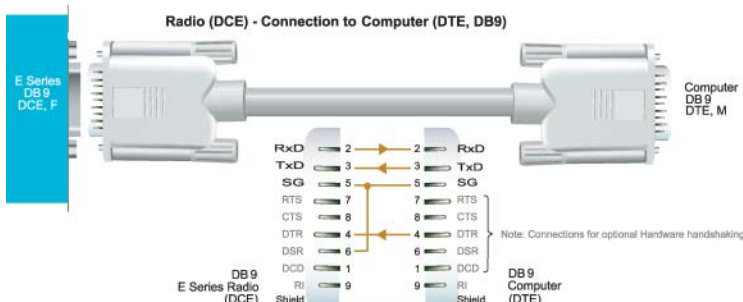
### Radio/Base Firmware Update

Firmware update is performed on a unit connected locally to the PC. It is recommended that all cabling to the unit be disconnected prior to commencing firmware update to minimise any interruption to the process or disturbances of signals on cables still connected. All other TVIEW+ Management Suite utilities should also be exited during the firmware update process. The steps to update the firmware as follows:

1. Start the firmware update utility from the TView+ front panel.
2. Disconnect power from the unit by turning off the power supply or removing the power connector to the unit.
3. Connect the serial cable from the PC to Port B on the unit
4. Select the unit type from the options on the top right of the firmware update main window. Please note that "Exciter" refers to the radio contained inside the base station.
5. Select the file containing the firmware update package using the "Select" button at the bottom of the main window. After opening the file the browse window will close and a description of the firmware package will appear in the main window.



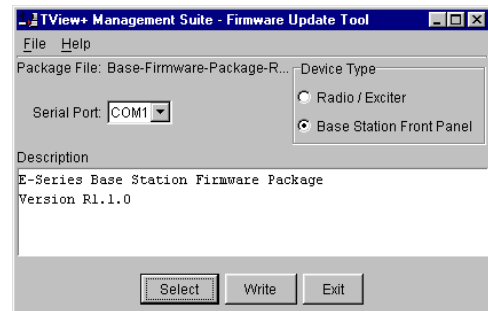
6. Initiate the firmware updating process using the "Write" button at the bottom of the main window. Another logging window will appear.
7. Reconnect power to the unit when prompted in the logging window. The status LEDs on the unit including power should all be extinguished and the transfer of firmware should commence. If this does not occur steps 6 & 7 should be repeated.
8. The logging window will display the progress of each firmware block transferred and when complete a success dialogue box appears. Type OK to close this dialogue box and type "Exit" in the main window to exit the firmware update utility.
9. Disconnect the cable from Port B and re power the unit to enable the new firmware.



### Base Station Display Firmware Update

Installation Instructions:

1. Update of the front panel firmware uses the firmware update utility supplied with the TVIEW+ Management Suite.
2. Start the firmware update utility from the TVIEW+ front panel.
3. In the firmware update utility select device type as "Base Station Front Panel"
4. Select the file containing the firmware update package using the "select" button at the bottom of the main window. After opening the file the browse window will close and a description of the firmware package will appear in the main window.



5. Ensure that the base station is powered.
6. Connect the "TVIEW+ cable" to the front or rear system port of the base station.
7. On the base station front panel depress and hold the "Display On/Off" button, then momentarily depress the firmware update switch using a suitable probe before releasing the "Display On/Off" button. The firmware update switch is located behind the small hole (not labelled) in the front panel below the "Display On/Off" button.
8. Initiate the firmware update process using the "Write" button at the bottom of the main window. Another logging window will appear.
9. The logging window will display the progress of each firmware block transferred and when complete a success dialogue box appears. Click OK to close this dialogue box and click "Exit" in the main window to exit the firmware update utility.
10. Repower the base station to enable the new firmware.

# Part L – Specifications

## Specifications: E Series Digital Data Radio

### Radio

**Frequency Range:** 380-520 MHz (various sub-frequency bands available)

**Frequency Splits:** Various Tx/Rx frequency splits - programmable

**Channel Selection:** Dual synthesizer, 6.25 kHz channel step

**Channel Spacing:** 12.5 or 25 kHz

**Frequency Stability:** ±1ppm (-30 to 60 C ambient, opt. -30 to 70 C) Higher frequency stability options are available (with external GPS reference)

**Aging:** ≤ 1ppm/annum

#### Half / Full Duplex:

ER450: Half duplex or Full duplex (with external duplexer and ERFD450 option)  
EB/EH450: Full duplex (optional internal or external duplexer available for single antenna operation)

**Configuration:** All configuration via Windows based software

### Transmitter

**Tx Power:** 0.1 - 5W (+37 dBm) ±1 dB software adjustable with over-temperature protection. EB/EH450: 100% Duty Cycle.

**Modulation:** Narrow band digital filtered binary GMSK

**Occupied Bandwidth:** Designed to FCC, ETSI, ACA requirements

**Tx Keyup Time:** < 1 mSecond

Timeout Timer: Programmable 0-255 seconds

**Tx Spurious:** ≤ -37 dBm

**PTT Control:** Auto (on Data) / RTS line (Port A or B) / System Port (Override)

### Receiver

**Sensitivity:** -118 dBm for 12 dB SINAD

**Selectivity:** Better than 80 dB

**Intermodulation:** Better than 75 dB

**Spurious Response:** Better than 80 dB

**AFC Tracking:** Digital receiver frequency tracking

**Mute:** Programmable digital mute

Local regulatory conditions may determine the performance and suitability of individual versions in different countries. It is the responsibility of the buyer to confirm these regulatory conditions. Performance data indicates typical values related to the described unit.

Information subject to change without notice.  
All rights reserved. Issue 0802

### Diagnostics (Optional)

Network wide operation from any remote terminal.

Non intrusive protocol - runs simultaneously with the application.

Over-the-air re-configuration of user parameters.

Programmable exception reporting of alarms.

Storage of data error and channel occupancy statistics.

In-built Error Rate testing capabilities.

### Connections

**User Data Ports:** 2 x DB9 female ports wired as DCE (modem)

**System Port:** RJ45 (front and rear for EB/EH450) for diagnostic, configuration and re-programming

#### Antenna:

ER450: N female bulkhead. Separate N (Tx) and SMA (Rx) connectors for full duplex.\*

EB/EH450: 2 x N female bulkhead (separate Tx and Rx ports).  
1 x N female bulkhead (with optional internal duplexer)

**Power:** 2 pin locking, mating connector(s) supplied

**LED Display:** Multimode Indicators for Pwr, Tx, Rx, Sync, TxD and RxD data LEDs (for both port A and B)

### Modem

**Data Serial Port #1:** RS232, DCE, 600-76,800 bps asynchronous

**Data Serial Port #2:** RS232, DCE, 300-38,400 bps asynchronous

**System Port:** RS232, 19,200 bps asynchronous

**Flow Control:** Selectable hardware/software/3 wire interface

**RF Channel Data Rate:** 4800/9600/19,200 bps Half / Full duplex\*

**Data Buffer:** 16 kbyte of on-board RAM

#### Bit Error Rate:

< 1x10<sup>-6</sup> @ -110 dBm (4800 bps)  
< 1x10<sup>-6</sup> @ -108 dBm (9600 bps)  
< 1x10<sup>-6</sup> @ -106 dBm (19,200 bps)

\* With ERFD450 full duplex option plus external duplexer for single antenna operation

**Collision Avoidance:** Unique supervisory channel C/DSMA collision avoidance system

**Multistream™:** Trio DataCom unique simultaneous delivery of multiple data streams (protocols)

**Data Turnaround Time:** <10mS

**Firmware:** Field upgradeable Flash memory

### General

**Power Supply:** 13.8 Vdc nominal (10-16 Vdc)

#### Transmit Current:

ER450: 750 mA nominal @ 1 W  
1500 mA nominal @ 5 W  
EB450: 1.3 A nominal @ 1 W  
2.5 A nominal @ 5 W  
EH450: 2.0 A nominal @ 1 W  
3.2 A nominal @ 5 W

#### Receive Current:

ER450: <120 mA  
EB450: <230 mA  
EH450: <350 mA

#### Sleep Mode (ER450 only):

Hardware: External control, < 1 mA  
Software: User configurable modes

#### Dimensions:

ER450: 170 mm x 150 mm x 49 mm (55 mm with cradle). Diecast enclosure  
EB450: 19" 2 RU rack mount  
485 x 90 x 420 mm  
EH450: 19" 5 RU rack mount  
485 x 225 x 420 mm

**Mounting (ER450 only):** Snap lock mounting (cradle supplied)

#### Weight:

ER450: 1 kg  
EB450: 5 kg (excluding opt. duplexer)  
EH450: 13 kg (excluding opt. duplexer)

### Options

ERFD450 Full Duplex Operation (ER450) with separate N (Tx) and SMA (Rx) connectors

DUPLX450BR External Duplexer, Band Reject (for single antenna operation)

EDOVM Digital Order Wire Voice Module

NEMA 4/R Stainless Steel Enclosure (ER450), IP65, NEMA 4 rated

DIAGS/E Network Management and Remote Diagnostics Facilities per Radio Modem (E Series)

# Part M – Support Options

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## Website Information

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The Trio DataCom website support contains links to e-mail and telephone support, tech notes, manuals, software updates.

Please go to [www.trio.com.au/support.htm](http://www.trio.com.au/support.htm).

## E-mail Technical Support

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E-mail your questions to [support@trio.com.au](mailto:support@trio.com.au).

When e-mailing questions to our support staff, make sure you tell us the exact model number (and serial number if possible) of the Trio equipment you are working with. Include as much detail as possible about the situation, and any tests that you have done which may help us to better understand the issue. If possible, please include your telephone contact information should we wish to further clarify any issues.

## Telephone Technical Support

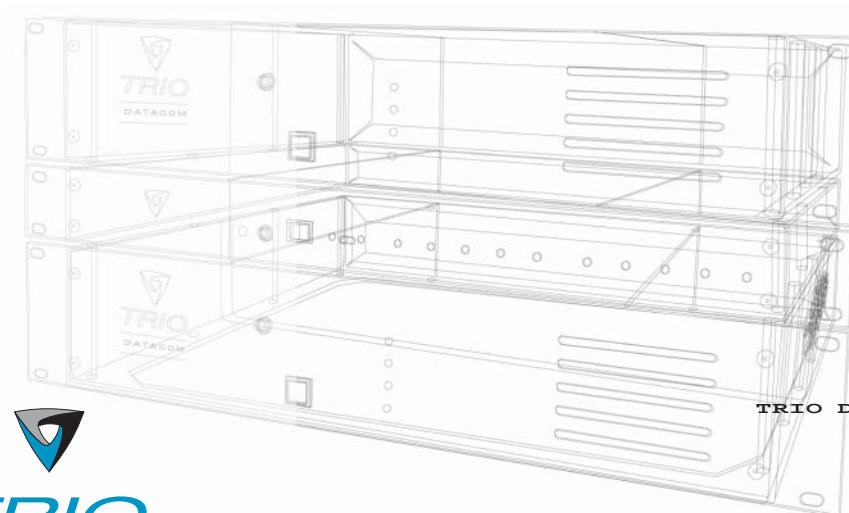
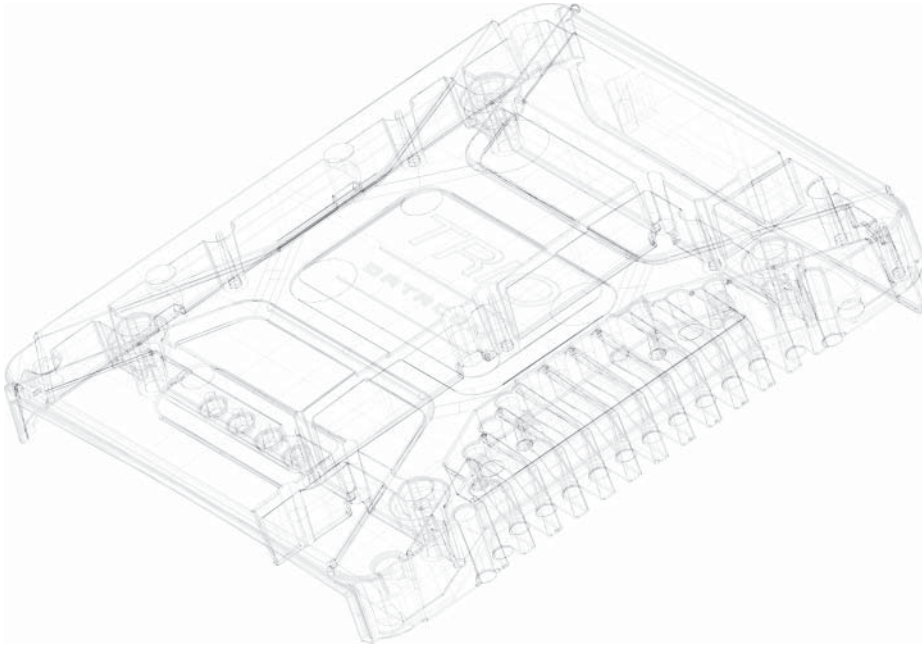
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Telephone support is available at our head office telephone number Aus: (+61) 3 9775 0505 during Eastern Australian business hours (9am-5pm).

## Contacting the Service Department

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The Service department may be contacted by e-mail to [service@trio.com.au](mailto:service@trio.com.au), or by telephone during Eastern Australian business hours.



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