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# E-Series Data Radio User Manual

ER450 Remote Data Radio  
EB450 Base Station  
EH450 Hot Standby Base Station



**Schneider**  
Electric

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## **SECTION 1**

### **Part A - Preface**

### **Part B - E Series Overview**

### **Part C - Applications**

### **Part D - System Planning and Design**

### **Part E - Getting Started**

### **Part F - Operational Features**

### **Part G - Commissioning**

### **Part H - Maintenance**

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## Part A – Preface

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### Warranty

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All equipment supplied by Trio Datacom Pty Ltd (As of 1 January 2009) is covered by warranty for faulty workmanship and parts for a period of three (3) years from the date of delivery to the customer. During the warranty period Trio Datacom Pty Ltd shall, at its option, repair or replace faulty parts or equipment provided the fault has not been caused by misuse, accident, deliberate damage, abnormal atmosphere, liquid immersion or lightning discharge; or where attempts have been made by unauthorised persons to repair or modify the equipment.

The warranty does not cover modifications to software. All equipment for repair under warranty must be returned freight paid to Trio Datacom Pty Ltd or to such other place as Trio Datacom Pty Ltd shall nominate. Following repair or replacement the equipment shall be returned to the customer freight forward. If it is not possible due to the nature of the equipment for it to be returned to Trio Datacom Pty Ltd, then such expenses as may be incurred by Trio Datacom Pty Ltd in servicing the equipment in situ shall be chargeable to the customer.

When equipment for repair does not qualify for repair or replacement under warranty, repairs shall be performed at the prevailing costs for parts and labour. Under no circumstances shall Trio Datacom Pty Ltd's liability extend beyond the above nor shall Trio Datacom Pty Ltd, its principals, servants or agents be liable for the consequential damages caused by the failure or malfunction of any equipment.

### Important Notice

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© Copyright 2011 Trio Datacom Pty Ltd All Rights Reserved

This manual covers the operation of the E Series of Digital Data Radios. Specifications described are typical only and are subject to normal manufacturing and service tolerances.

Trio Datacom Pty Ltd reserves the right to modify the equipment, its specification or this manual without prior notice, in the interest of improving performance, reliability or servicing. At the time of publication all data is correct for the operation of the equipment at the voltage and/or temperature referred to. Performance data indicates typical values related to the particular product.

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## 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.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to a potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **WARNING**

**WARNING** indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

### **CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

### **CAUTION**

**CAUTION**, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage.

#### PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Trio Datacom for any consequences arising out of the use of this material.

## Compliance Information



### **Warning - RF Exposure**

The radio equipment described in this user manual emits low level radio frequency energy. The concentrated energy may pose a health hazard depending on the type of antenna used. In the case of:

Non-directional antenna - DO NOT allow people to come within 0.5 metres (20 inches) of the antenna when the transmitter is operating

Directional antenna - DO NOT allow people to come within 6 metres (20 feet) of the antenna when the transmitter is operating.

### **FCC Notice (Hot Standby Controller Only)**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, equipment may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient to relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different to that which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for assistance.

### **IC Notice (Hot Standby Controller Only)**

This Class B digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la class B est conforme a la norme NBM-003 du Canada.  
R&TTE Notice (Europe)

Applies to models Ex450-xxExx-xxx

In order to comply with the R&TTE (Radio & Telecommunications Terminal Equipment) directive 1999/5/EC Article 3 (Low Voltage Directive 73/23/EEC), all radio modem installations must include an external in-line lightning arrestor or equivalent device that complies with the following specifications:

- DC Blocking Capability - 1.5kV impulse (Rise Time 10mS, Fall Time 700mS) (Repetition 10 Times) or 1.0kV rms 50Hz sine wave for 1 minute.

Schneider Electric declares that the E Series radio modem is in compliance with the essential requirements and other relevant provisions of the Directive 1999/5/EC. Therefore Schneider Electric E Series equipment is labelled with the following CE-marking.

**CE0889** 

Important Notices for Class I, Division 2, Groups A, B, C & D Hazardous Locations

Applies to models ER450-xxxx-x|x(CSA Marked)

This product is available for use in Class I, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the US National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code and in Section 18 of the Canadian Standards Association C22.1 (Canadian Electrical Code).

The transceiver has been recognised for use in these hazardous locations by the Canadian Standards Association (CSA) International. CSA certification is in accordance with CSA Standard C22.2 No. 213-M1987 and UL Standard 1604 subject to the following conditions of approval:

1. The radio modem must be mounted in a suitable enclosure so that a tool is required to gain access for disconnection of antenna, power and communication cables.
2. The antenna, DC power and interface cables must be routed through conduit in accordance with the National Electrical Codes.
3. Installation, operation and maintenance of the radio modem should be in accordance with the radio modem's user manual and the National Electrical Codes.
4. Tampering or replacement with non-factory components may adversely affect the safe use of the radio modem in hazardous locations and may void the approval.
5. A power connector retainer with thumbwheel screw as supplied by Schneider Electric MUST be used.

### **WARNING**

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. Substitution of components may impair suitability for Class I, Division 2. Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) and Section 18 of CSA C22.1 for further information on hazardous locations and approved Division 2 wiring methods.



### **WEEE Notice (Europe)**

This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and 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, please contact the dealer from whom you originally purchased the product.

Dieses Symbol auf dem Produkt oder seinem Verpacken zeigt an, daß dieses Produkt nicht mit anderer Vergeudung entledigt werden darf. Stattdessen ist es Ihre Verantwortlichkeit, sich Ihre überschüssige Ausrüstung zu entledigen, indem es rüber sie zu einem gekennzeichneten Ansammlungspunkt für die Abfallverwertung elektrische und elektronische Ausrüstung übergibt. Die unterschiedliche Ansammlung und die Wiederverwertung Ihrer überschüssigen Ausrüstung zu der Zeit der Beseitigung helfen, Naturressourcen zu konservieren und sicherzugehen, daß es in gewissem Sinne aufbereitet wird, daß menschliche Gesundheit und das Klima schützt. Zu mehr Information ungefähr, wo Sie weg von Ihrer überschüssigen Ausrüstung für die Wiederverwertung fallen können, treten Sie bitte mit dem Händler in Verbindung, von dem Sie ursprünglich das Produkt kauften.

### **Related Products**

ER450 Remote Data Radio  
MR450 Remote Data Radio  
EB450 Base/Repeater Station  
EH450 Hot Standby Base Station

### **Other Related Documentation and Products**

E Series Quick Start Guides  
TVIEW+ Management Suite  
Digital Orderwire Voice Module (EDOVM)  
Multiplexer Stream Router (MSR)

### **Revision History**

Issue 5	Feb 2004	Additional radio and Programmer information
Issue 6	Feb 2005	Additional information for Hazardous Locations.
Issue 7	May 2005	Various Updates
Issue 8	Jan 2006	WEEE Updates
Issue 9	Mar 2006	E Series Gen II Updates
Issue 10	Mar 2007	Order Matrix Updated
Issue 11	Jun 2009	Minor Fixes.
Issue 12	Jun 2011	Converted to Sncheider Format

# Part B – E Series Overview

## Definition of E Series Data Radio

The E Series is a range of wireless modems designed for the transmission of data communications for SCADA, telemetry and any other information and control applications that utilise ASCII messaging techniques. The E Series uses advanced “digital” modulation and signal processing techniques to achieve exceptionally high data throughput efficiency using traditional licensed narrow band radio channels.

These products are available in many frequency band and regulatory formats, to suit spectrum bandplans, in various continental regions. The range is designed for both fixed point to point (PTP), and multiple address (MAS) or point to multipoint (PMP) systems.

## E Series Product Range

The E Series range consists of the basic half duplex “Remote” radio modem, an extended feature full duplex Remote radio modem, and ruggedised Base Station variants, including an optional Hot Standby controller to control two base station units in a redundant configuration.

Frequency band variants are indicated by the band prefix and model numbering. (See Model Number Codes)



**ER450 Remote Radio**



**EB450 Base / Repeater Station**



**EH450 Hot Standby Base Station**

## E Series – Features and Benefits

Common Features and Benefits of the E Series Data Radio (Generation II)

- Up to 19200bps over-air data rates using programmable DSP based advanced modulation schemes.
- Designed to various International regulatory requirements including FCC, ETSI and ACA.
- Superior receiver sensitivity.
- Fast data turnaround time <10mS.
- 128-bit AES encryption.
- Flash upgrade-able firmware – insurance against obsolescence.
- Multi-function bi-colour Tx/Rx data LEDs showing Port activity (breakout box style), as well as LEDs indicating Tx, Rx, RF Signal, Data Synchronisation and DC Power status of the radio.
- Rugged N type antenna connectors on all equipment.
- High temperature transmitter foldback protection.
- Two independent configurable data ports and separate system port.
- Higher port speeds to support increased air-rate (up to 57600bps on Port A and 38400bps on Port B).
- Compatible with most industry standard data protocols. eg: MODBUS, DNP-3, IEC 870, SEL Mirrored Bits, etc.
- Independent system port for interruption free programming and diagnostics (in addition to two (2) user ports).
- 9600bps in 12.5 kHz radio channels with ETSI specifications.
- Compatible with legacy systems (Non Packet Digital and Bell 202 Modes)
- Remote over-the-air configuration of any radio from any location.
- Multistream™ simultaneous data streams allows for multiple vendor devices / protocols to be transported on the one radio network.
- Flexible data stream routing and steering providing optimum radio channel efficiency – complex data radio systems can be implemented with fewer radio channels.
- The ability to duplicate data streams – that is, decode the same off-air data to two separate ports.

- Multi-function radio capable of dropping off one stream to a port and forward on or repeat (store and forward) the same or other data.
- Stand-alone internal store and forward operation – buffered store and forward operation even in the ER remote units.
- Unique integrated C/DSMA collision avoidance technology permits simultaneous polling and spontaneous reporting operation in the same system.
- Digital receiver frequency tracking for long term data reliability.
- Network wide non intrusive diagnostics which runs simultaneously with the application.
- Network wide diagnostics interrogation which can be performed from anywhere in the system including any remote site.
- Diagnostics will route its way to any remote or base / repeater site regardless of how many base / repeater stations are interconnected.
- Full range of advanced features available within Network Management and Remote Diagnostics package – BER testing, trending, channel occupancy, client / server operation, etc.
- On board memory for improving user data latency – increased user interface speeds.
- Full CRC error checked data – no erroneous data due to squelch tails or headers.
- Radio utilises world standard HDLC as its transportation protocol.
- Various flow control and PTT control mechanisms.
- Configurable backward compatibility with existing D Series modulation scheme for use within existing networks.
- Digital plug in order wire option for commissioning and occasional voice communications without the need to inhibit users application data.

**Features and Benefits of ER450 Remote Data Radio**

- Optional full duplex capable remote – separate Tx and Rx ports for connection to an external duplexer.
- New compact and rugged die cast case with inbuilt heatsink.
- Low power consumption with use of external shutdown control.
- Rugged N type antenna connectors.
- Data Port “breakout box” style flow LEDs for easier troubleshooting.

**Features and Benefits of EB450 Standard Base / Repeater Station**

- Competitively priced high performance base.
- Incorporates a rugged 5W power amplifier module.

Features and Benefits of EH450 Hot Standby Base / Repeater Station

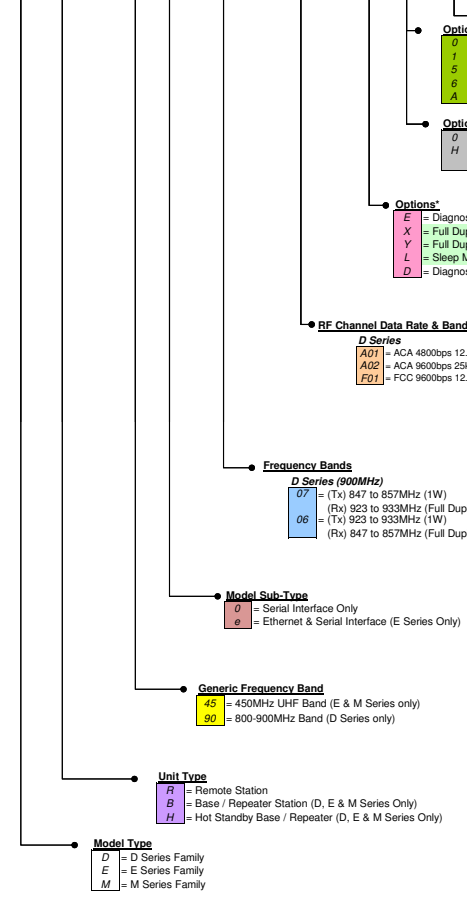
- Individual and identical base stations with separate control logic changeover panel.
- ALL modules are hot swappable without any user downtime.
- Flexible antenna options – single, separate Tx & Rx, two Tx and two Rx.
- Both on-line and off-line units monitored regardless of active status.



# Model Number Codes

## D, E & M Series Data Radios - Part Number Matrix = Tyxxx-aabb-cdef

T y x x z - a a b b b - c d e



- Options - Base Stations\***
- 0 = No Options
  - 1 = 450MHz Band Reject Duplexer [DUPLX450/BR]
  - 5 = 900MHz Band Pass Compact Duplexer [DUPLX900BPC]
  - 6 = 900MHz Band Pass Duplexer (76MHz split)[DUPLX852/930]
  - A = 450MHz 20W RF Power Output
- Options - E and M Series Remotes**
- 0 = No Options
  - H = Hazardous Environment Class 1, Div 2 and Diagnostics Available ONLY and standard on ER & MR450-aa-000 to 004

**Options - Hot Standby Configurations\***

Duplexer	Antenna	Antenna Type
A	-	Separate Tx & Rx
B	-	Separate Tx & Rx
C	-	Separate Tx & Rx
D	-	Separate Tx & Rx
E	-	Separate Tx & Rx
F	-	Separate Tx & Rx

- Options\***
- E = Diagnostics and Encryption - [DIAGS/E or DIAGS/EH] (E Series Only) \*\*\*
  - X = Full Duplex Operation and Diagnostics (E-Series Remotes only)
  - Y = Full Duplex Operation, Diagnostics and Encryption [ERFD450 & DIAGS/E] (E-Series Remotes only) \*\*\*
  - L = Sleep Mode Module + Diagnostics (MR450 only)
  - D = Diagnostics

- RF Channel Data Rate & Bandwidth (Intern; E Series)**
- | D Series  | E Series  |
|---|---|
| A01 = ACA 4800bps 12.5kHz                       | A01 = ACA 4800 <sup>9</sup> / 9600bps 12.5kHz   |
| A02 = ACA 9600bps 25kHz                         | A02 = ACA 9600 <sup>9</sup> / 19k2bps 25kHz     |
| F01 = FCC 9600bps 12.5kHz                       | F01 = FCC 9600 <sup>9</sup> / 19k2bps 12.5kHz   |
| F02 = FCC 19k2bps 25kHz                         | F02 = FCC 19k2bps 25kHz                         |
| E01 = ETSI 4800 <sup>9</sup> / 9600 bps 12.5kHz | E01 = ETSI 4800 <sup>9</sup> / 9600 bps 12.5kHz |

- M Series--**
- 000 = Analog Only 12.5kHz (Local Diags included - No Additional Charge)
  - 001 = 2400bps 12.5kHz / 4800bps 25kHz
  - 002 = 4800bps 12.5kHz / 9600bps 25kHz
  - 003 = FCC 9600bps 12.5kHz
  - 004 = ETSI 4800bps 12.5kHz
  - 241\* = 2400bps 12.5kHz (S Series [24SR]\* Compatible) c/w Local Diags
  - 242\* = 2400bps 25kHz (S Series [24SR]\* Compatible) c/w Local Diags
  - 482\* = 4800bps 25kHz (S Series [48SR]\* Compatible) c/w Local Diags

- Frequency Bands**
- D Series (900MHz)**
- 07 = (Tx) 847 to 857MHz (1W)
  - 08 = (Rx) 923 to 933MHz (Full Duplex)
  - 06 = (Tx) 923 to 933MHz (1W)
  - 05 = (Rx) 847 to 857MHz (Full Duplex)

- E Series (400MHz)**
- 46 = 370 to 388MHz (Tx & Rx)
  - 47 = 390 to 396MHz (Tx & Rx)
  - 48 = 395 to 406MHz (Tx & Rx)
  - 50 = 403 to 417MHz (Tx & Rx)
  - 63 = 406 to 421MHz (Tx & Rx)
  - 64 = 415 to 430MHz (Tx & Rx)
  - 56 = 418 to 425MHz (Tx & Rx)
  - 57 = 428 to 444MHz (Tx & Rx)
  - 55 = 436 to 450MHz (Tx & Rx)
  - 51 = 450 to 465MHz (Tx & Rx)
  - 65 = 455 to 470MHz (Tx & Rx)
  - 52 = 465 to 480MHz (Tx & Rx)
  - 53 = 480 to 494MHz (Tx & Rx)
  - 60 = 490 to 500MHz (Tx & Rx)
  - 54 = 505 to 518MHz (Tx & Rx)

- M Series (400MHz)**
- M = 400 to 470MHz (Tx & Rx) (M Series Only)
  - H = 450 to 520MHz (Tx & Rx) (M Series Only)

- Model Sub-Type**
- 0 = Serial Interface Only
  - e = Ethernet & Serial Interface (E Series Only)

- Generic Frequency Band**
- 45 = 450MHz UHF Band (E & M Series only)
  - 90 = 800-900MHz Band (D Series only)

- Unit Type**
- R = Remote Station
  - B = Base / Repeater Station (D, E & M Series Only)
  - H = Hot Standby Base / Repeater (D, E & M Series Only)

- Model Type**
- D = D Series Family
  - E = E Series Family
  - M = M Series Family

Note: Other frequency bands available on request

**NOTES:**

- \* Additional charges apply. Must be ordered separately. Please refer to price list.
- \*\* Consult factory for availability.
- \*\*\* Export restrictions may apply.
- # Provides compatibility with D and/or M Series radios
- [ ] Items in [ ] parenthesis refer to actual Trio part numbers
- M Series Compatible EB/EH450 Base Stations are Type A01 or F01

**Standards:** ACA - Australian Communications Authority  
 FCC - Federal Communications Commission  
 ETSI - European Telecommunication Standards Institute

Example: **E R 4 5 0 - 5 1 A 0 2 - D H 0**

The example shown specifies: E Series, Remote Radio, generic 450MHz band, with a specific frequency of 450MHz to 465MHz, a 9600/19200bps modem, with a bandwidth of 25kHz, diagnostics and Class 1, Div 2 Hazardous Approval (standard).

# Part C – Applications

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## Generic Connectivity

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The E Series has been designed for SCADA and telemetry applications, and any other applications that use an ASCII communications protocol, and which connect physically using the RS232 interface standard (although converters can be used to adapt other interfaces such as RS422/485, RS530/V35, G703 etc).

Any protocol that can be displayed using a PC based terminal program operating via a serial communications port is suitable for transmission by the E Series radio modems.

An ASCII protocol is any that consists of message strings formed from ASCII characters, that being defined as a 10 or 11 bit block including start and stop bits, 7 or 8 data bits and optional parity bit(s). Port set-up dialogue that includes the expressions "N,8,1", or E,7,2" or similar indicate an ASCII protocol.

Most of the dominant telemetry industry suppliers utilise proprietary ASCII protocols, and also common 'open standard' industry protocols such as DNP3, MODBUS, TCP/IP, and PPP. These are all ASCII based protocols.

## Industries and Applications

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The E Series products are widely used in point-to-point and point-to-multipoint (multiple access) applications for remote interconnection of PLCs, RTUs, dataloggers, and other data monitoring and control devices - including specialist utility devices (such as powerline ACRs). In addition, other applications such as area wide security and alarm systems, public information systems (traffic

flow and public signage systems) and environmental monitoring systems.

## Application Detail

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### SCADA Systems

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This is where one or more centralised control sites are used to monitor and control remote field devices over wide areas. Examples include regional utilities monitoring and controlling networks over entire shires or a greater city metropolis. Industry sectors include energy utilities (gas and electricity distribution), water and sewerage utilities, catchment and environment groups (rivers, dams and catchment management authorities).

### Telemetry Systems

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Dedicated telemetry control systems interconnecting sequential devices either where cabling is not practical or distances are considerable.

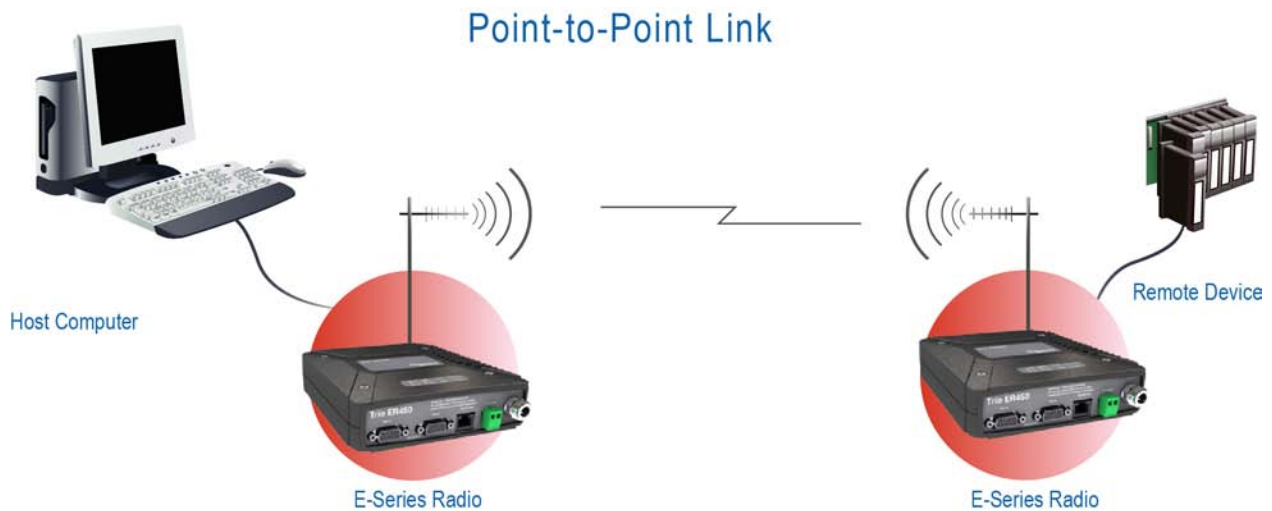
Examples include:

- Ore conveyor or slurry pipeline systems
- Water systems (pump and reservoir interlinking)
- broadcast industry (linking studio to transmitter) etc.

## Systems Architecture

### Point-to-Point

This simple system architecture provides a virtual connection between the two points, similar to a cable. Dependent of the hardware chosen, it is possible to provide a full duplex connection (i.e. data transfer in both directions simultaneously) if required.

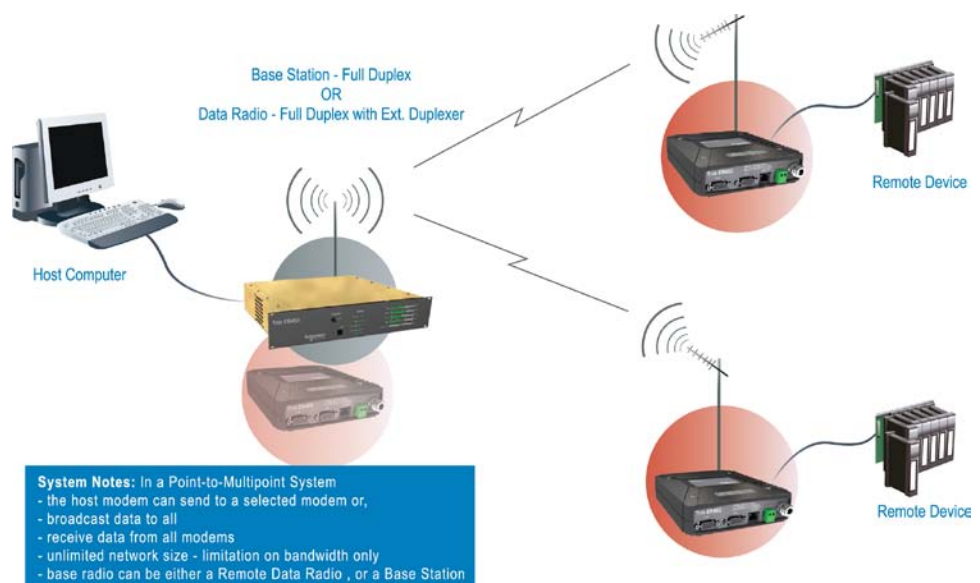


### Point-to-Multipoint Systems

In a multiple access radio system, messages can be broadcast from one (master) site to all others, either using a half duplex radio system or from any site to all others, using a simplex radio channel.

Half duplex systems often utilise a full duplex master, to make the system simpler and for faster operation.

In either case, it will be necessary for the application to support an addressing system, since the master needs to be able to select which remote device it wishes to communicate. Normally, the radio system is allowed to operate “transparently”, allowing the application’s protocol to provide the addressing, and thus control the traffic. Where the application layer does not provide the addressing, the E Series can provide it using SID codes™. (See Part F - Operational Features)



### Digipeater Systems

This configuration is used where all sites are required to communicate via a repeater site. A repeater site is used because it has a position and/or height advantage and thus provides superior or extended RF coverage. The radio modem at the repeater does not have to be physically connected to the application's master site. Information from the application's master is transmitted to the repeater via radio, and the repeater then relays this information to the other field sites. In this scenario, the repeater is the master from an RF point of view, and the application master is effectively a "remote" from an RF point of view, even though it is controlling the data transfer on the system.

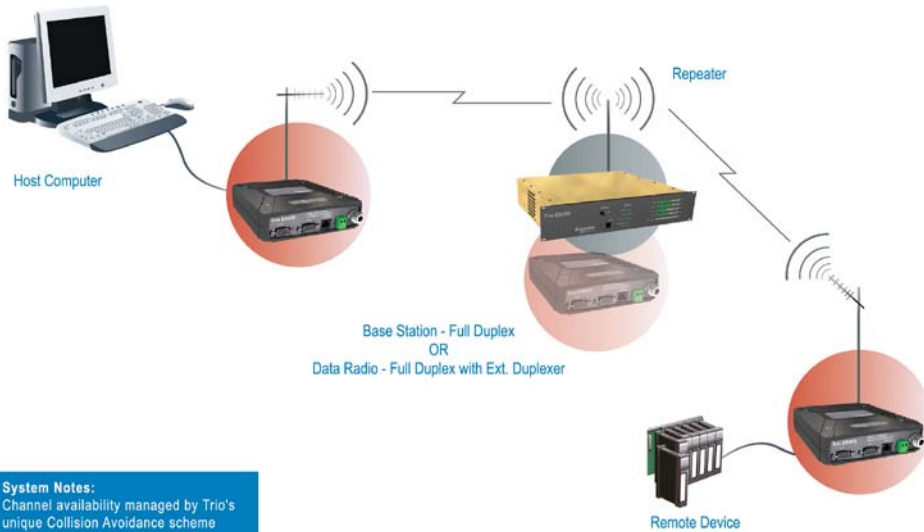
### Backbone Store and Forward Systems

Store and forward is used as a way of extending RF coverage by repeating data messages from one site to another.

This can be done globally using the inbuilt data repeating functions, or selectively using intelligent address based routing features available in some PLC/RTU protocols.

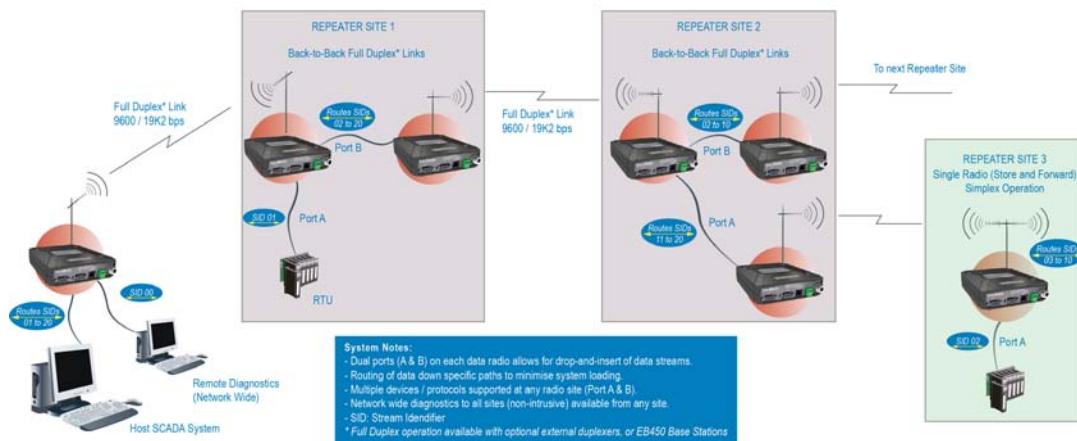
In this case it is necessary for all units on the system to operate in half duplex mode (only key-up when transmitting data), so that each site is free to hear received signals from more than one source.

Digipeater System



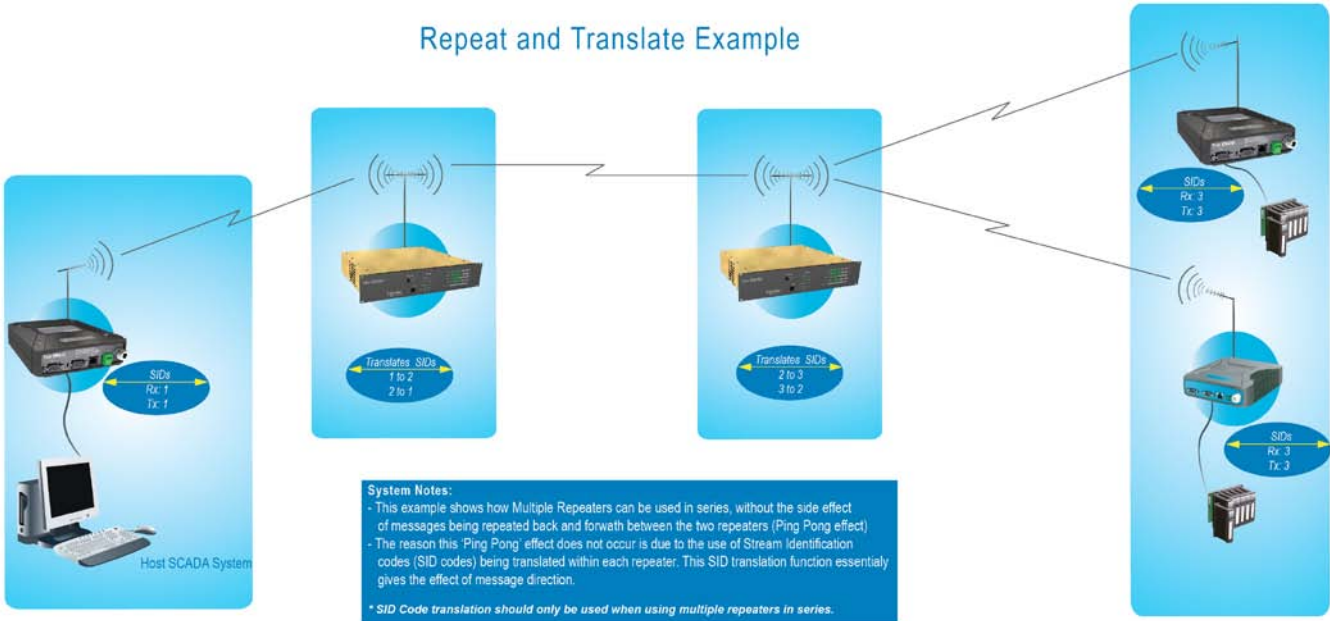
### Backbone Store and Forward System

Typical Store and Forward System



**Repeat and Translate**

This configuration is used where there are multiple repeaters in series required to reach great distances. The use of the translate function in this scenario is effectively avoiding messages being sent back and forth between series of repeater units. The translate function essentially gives a form of message direction.



The repeat/translate function works by identifying the Stream ID (SID) code at the start of each received message and determines whether to change the SID code, ignore the message or repeat the message as is, as defined by the user in the repeat/translate table.

Type	From	To	Type	From	To
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0
Disabled	0	0	Disabled	0	0

Tip  
Disable both data ports to allow up to 2 repeat stream entries.

Ok Cancel

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# Part D – System Planning and Design

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## Selecting Antennas

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### Understanding RF Path Requirements

A radio modem needs a minimum amount of received RF signal to operate reliably and provide adequate data throughput.

In most cases, spectrum regulatory authorities will also define or limit the amount of signal that can be transmitted, and the transmitted power will decay with distance and other factors, as it moves away from the transmitting antenna.

It follows, therefore, that for a given transmission level, there will be a finite distance at which a receiver can operate reliably with respect to the transmitter.

Apart from signal loss due to distance, other factors that will decay a signal include obstructions (hills, buildings, foliage), horizon (effectively the bulge between two points on the earth), and (to a minimal extent at UHF frequencies) factors such as fog, heavy rain-bursts, dust storms, etc.

In order to ascertain the available RF coverage from a transmitting station, it will be necessary to consider these factors. This can be done in a number of ways, including

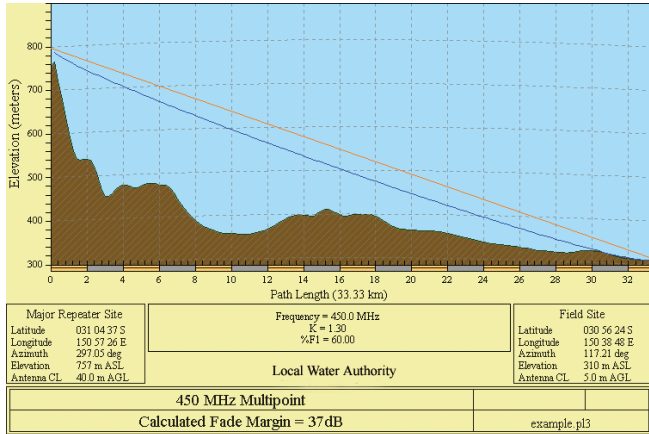
- (a) using basic formulas to calculate the theoretically available signal - allowing only for free space loss due to distance,
- (b) using sophisticated software to build earth terrain models and apply other correction factors such as earth curvature and the effects of obstructions, and
- (c) by actual field strength testing.

It is good design practice to consider the results of at least two of these models to design a radio path.

### Examples of Predictive Path Modelling

#### Clear line of site

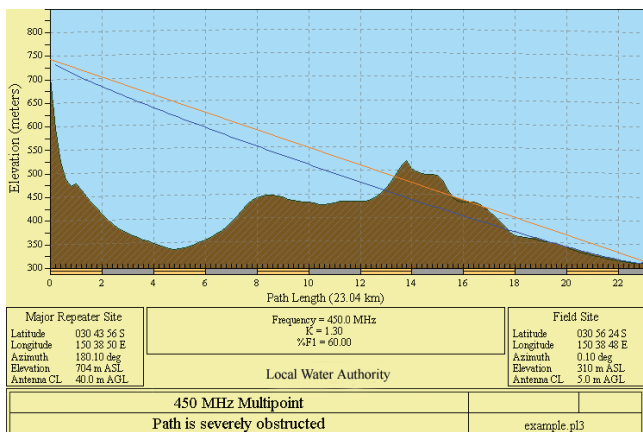
Radio path with good signal levels, attenuated only by free space loss.



goudpath.pl3	Major Repeater Site	Field Site
Elevation (m)	756.69	309.67
Latitude	031 04 37.49 S	030 56 24.00 S
Longitude	150 57 26.34 E	150 38 48.00 E
Azimuth	297.05	117.21
Antenna Type	ANT450/60M	ANT450/9AL
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	11.15
Antenna Gain (dBd)	6.00	9.00
TX Line Type	LDF4-50	LDF4-50
TX Line Length (m)	40.00	5.00
TX Line Unit Loss (dB/100 m)	6.79	6.79
TX Line Loss (dB)	2.72	0.34
Connector Loss (dB)	2.00	2.00
Frequency (MHz)	450.00	
Path Length (km)	33.33	
Free Space Loss (dB)	115.99	
Diffraction Loss (dB)	0.00	
Net Path Loss (dB)	103.75	103.75
Radio Type Model	EB450	ER450
TX Power (watts)	5.00	1.00
TX Power (dBW)	6.99	0.00
Effective Radiated Power (watts)	6.71	4.63
Effective Radiated Power (dBW)	8.27	6.66
RX Sensitivity Level (uv)	0.71	1.26
RX Sensitivity Level (dBW)	-140.00	-135.00
RX Signal (uv)	45.93	102.70
RX Signal (dBW)	-103.75	-96.76
RX Field Strength (uv/m)	453.14	545.42
Fade Margin (dB)	36.25	38.24
Raleigh Service Probability (%)	99.976	99.985

#### Obstructed Radio Path

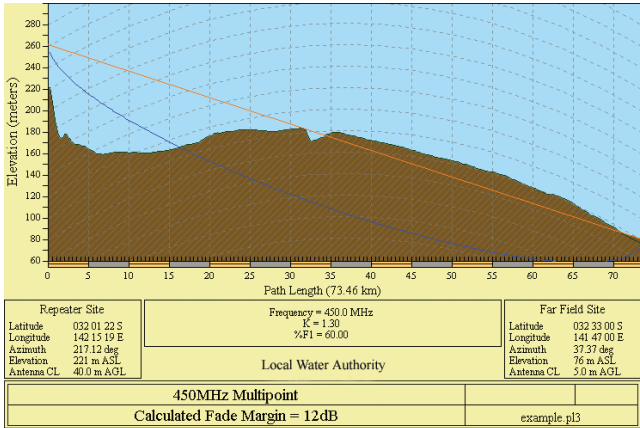
This path has an obstruction that will seriously degrade the signal arriving at the field site.



obstpath.pl3	Major Repeater Site	Field Site
Elevation (m)	703.83	309.67
Latitude	030 43 55.92 S	030 56 24.00 S
Longitude	150 38 49.51 E	150 38 48.00 E
Azimuth	180.10	0.10
Antenna Type	ANT450/60M	ANT450/9AL
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	11.15
Antenna Gain (dBd)	6.00	9.00
TX Line Type	LDF4-50	LDF4-50
TX Line Length (m)	40.00	5.00
TX Line Unit Loss (dB/100 m)	6.79	6.79
TX Line Loss (dB)	2.72	0.34
Connector Loss (dB)	2.00	2.00
Frequency (MHz)	450.00	
Path Length (km)	23.04	
Free Space Loss (dB)	112.78	
Diffraction Loss (dB)	16.71	
Net Path Loss (dB)	117.25	117.25
Radio Type Model	EB450	ER450
TX Power (watts)	5.00	1.00
TX Power (dBW)	6.99	0.00
Effective Radiated Power (watts)	6.71	4.63
Effective Radiated Power (dBW)	8.27	6.66
RX Sensitivity Level (uv)	0.71	1.26
RX Sensitivity Level (dBW)	-140.00	-135.00
RX Signal (uv)	9.70	21.70
RX Signal (dBW)	-117.25	-110.26
RX Field Strength (uv/m)	95.74	115.23
Fade Margin (dB)	22.75	24.74
Raleigh Service Probability (%)	99.470	99.665

**Effect of Earth Curvature on Long Paths**

This path requires greater mast height to offset the earth curvature experienced at such a distance (73km).



longpath.pl3	Repeater Site	Far Field Site
Elevation (m)	221.26	75.58
Latitude	032 01 21.63 S	032 33 00.00 S
Longitude	142 15 19.26 E	141 47 00.00 E
Azimuth	217.12	37.37
Antenna Type	ANT450/6OM	ANT450/9AL
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	11.15
Antenna Gain (dBd)	6.00	9.00
TX Line Type	LDF4-50	LDF4-50
TX Line Length (m)	40.00	5.00
TX Line Loss (dB)	6.79	6.79
Connector Loss (dB)	2.72	0.34
	2.00	2.00
Frequency (MHz)	450.00	
Path Length (km)	73.46	
Free Space Loss (dB)	122.85	
Diffraction Loss (dB)	22.94	
Net Path Loss (dB)	133.55	133.55
Radio Type Model	EB450	ER450
TX Power (watts)	5.00	1.00
TX Power (dBW)	6.99	0.00
Effective Radiated Power (watts)	6.72	4.64
Effective Radiated Power (dBW)	8.27	6.66
RX Sensitivity Level (uv)	0.71	1.26
RX Sensitivity Level (dBW)	-140.00	-135.00
RX Signal (uv)	1.49	3.32
RX Signal (dBW)	-133.55	-126.56
RX Field Strength (uv/m)	14.65	17.64
Fade Margin (dB)	6.45	8.44
Raleigh Service Probability (%)	79.735	86.656



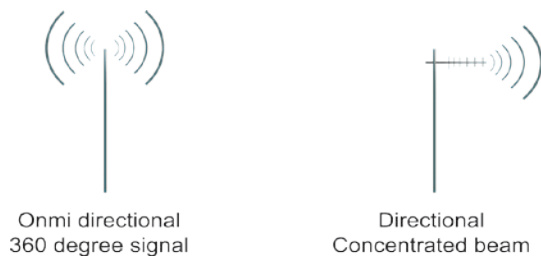
There are basically two types of antennas – omni-directional and directional.

Omnidirectional antennas are designed to radiate signal in a 360 degree segment around the antenna. Basic short range antennas such as folded dipoles and ground independent whips are used to radiate the signal in a “ball” shaped pattern. High gain omni antennas such as the “co-linear” compress the sphere of energy into the horizontal plane, providing a relatively flat “disc” shaped pattern which goes further because all of the energy is radiated in the horizontal plane.

Directional antennas are designed to concentrate the signal into “beam” of energy for transmission in a single direction (i.e. for point-to-point or remote to base applications).

Beamwidths vary according to the antenna type, and so can be selected to suit design requirements. The most common UHF directional antenna is the yagi, which offers useable beam widths of 30-50 degrees. Even higher “gain” is available using parabolic “dish” type antennas such as gridpacks.

### Antenna Gain



By compressing the transmission energy into a disc or beam, the antenna provides more energy (a stronger signal) in that direction, and thus is said to have a performance “gain” over a basic omni antenna. Gain is usually expressed in dBd, which is referenced to a standard folded dipole. Gain can also be expressed in dBi, which is referenced to a theoretical “isotropic” radiator. Either way, if you intend to send and receive signals from a single direction, there is advantage in using a directional antenna - both due to the increased signal in the wanted direction, and the relatively decreased signal in the unwanted direction (i.e. “interference rejection” properties).

### Tuning the Antenna

Many antennas are manufactured for use over a wide frequency range. Typical fixed use antennas such as folded dipoles and yagis are generally supplied with the quoted gain available over the entire specified band range, and do not require tuning. Co-linear antennas are normally built to a specific frequency specified when ordering.

With mobile “whip” type antennas, it is sometimes necessary to “tune” the antenna for the best performance on the required frequency. This is usually done by trimming an antenna element whilst measuring VSWR, or simply trimming to a manufacturer supplied chart showing length vs frequency. These antennas would normally be supplied with the tuning information provided.

### Antenna Placement

When mounting the antenna, it is necessary to consider the following criteria:

The mounting structure will need to be solid enough to withstand additional loading on the antenna mount due to extreme wind, ice or snow (and in some cases, large birds).

For omni directional antennas, it is necessary to consider the effect of the mounting structure (tower mast or building) on the radiation pattern. Close in structures, particularly steel structures, can alter the radiation pattern of the antenna. Where possible, omni antennas should always be mounted on the top of the mast or pole to minimise this effect. If this is not possible, mount the antenna on a horizontal outrigger to get it at least 1-2m away from the structure. When mounting on buildings, a small mast or pole (2-4m) can significantly improve the radiation pattern by providing clearance from the building structure.

For directional antennas, it is generally only necessary to consider the structure in relation to the forward radiation pattern of the antenna, unless the structure is metallic, and of a solid nature. In this case it is also prudent to position the antenna as far away from the structure as is practical. With directional antennas, it is also necessary to ensure that the antenna cannot move in such a way that the directional beamwidth will be affected. For long yagi antennas, it is often necessary to install a fibreglass strut to stabilise the antenna under windy conditions.

### Alignment of Directional Antennas

This is generally performed by altering the alignment of the antenna whilst measuring the received signal strength. If the signal is weak, it may be necessary to pre-align the antenna using a compass, GPS, or visual or map guidance in order to “find” the wanted signal. Yagi antennas have a number of lower gain “lobes” centred around the primary lobe. When aligning for best signal strength, it is important to scan the antenna through at least 90 degrees, to ensure that the centre (strongest) lobe is identified.

When aligning a directional antenna, avoid placing your hands or body in the vicinity of the radiating element or the forward beam pattern, as this will affect the performance of the antenna.

**RF Feeders and Protection**

The antenna is connected to the radio modem by way of an RF feeder. In choosing the feeder type, one must compromise between the loss caused by the feeder, and the cost, flexibility, and bulk of lower loss feeders. To do this, it is often prudent to perform path analysis first, in order to determine how much “spare” signal can be allowed to be lost in the feeder. The feeder is also a critical part of the lightning protection system.

All elevated antennas may be exposed to induced or direct lightning strikes, and correct grounding of the feeder and mast are an essential part of this process. Gas discharge lightning arresters should also be fitted to all sites.

Note: All ETSI installations require the use of a lightning surge arrestor in order to meet EN6095. See Part A - Preface for lightning arrestor specifications.

Common Cable Types @ 450MHz	Loss per meter @ 450MHz	Loss per 10m
RG58C/U	0.4426dB	4.4dB
RG213/U	0.1639dB	1.6dB
FSJ1-50 (¼ superflex)	0.1475dB	1.5dB
LDF4-50 (1/2" heliax)	0.0525dB	0.52dB
LDF5-50 (7/8" heliax)	0.0262dB	0.3dB



**Data Connectivity**

**The V24 Standard**

The E Series radio modems provide two asynchronous V24 compliant RS232 ports for connection to serial data devices.

There are two types of RS232 interfaces – DTE and DCE.

DTE stands for data terminal equipment and is generally applied to any intelligent device that has a need to communicate to another device via RS232. For example: P.C. Comm ports are always DTE, as are most PLC and RTU serial ports.

DCE stands for data communication equipment and is generally applied to a device used for sending data over some medium (wires, radio, fibre etc), i.e. any MODEM.

The standard interface between a DTE and DCE device (using the same connector type) is a straight through cable (i.e. each pin connects to the same numbered corresponding pin at the other end of the cable).

The “V24” definition originally specified the DB25 connector standard, but this has been complicated by the emergence of the DB9 (pseudo) standard for asynch devices, and this connector standard has different pin assignments.

The wiring standard is “unbalanced”, and provides for three basic data transfer wires (TXD, RXD, and SG – signal ground).

**Hardware Handshaking**

Hardware handshake lines are also employed to provide flow control, however (in the telemetry industry) many devices do not always support all (or any) flow control lines.

For this reason, the E Series modems can be configured for full hardware flow control, or no flow control at all (simple 3 wire interface).

Note: that when connecting devices together with differing handshake implementations, it is sometimes necessary to “loop” handshake pins in order to fool the devices handshaking requirements.

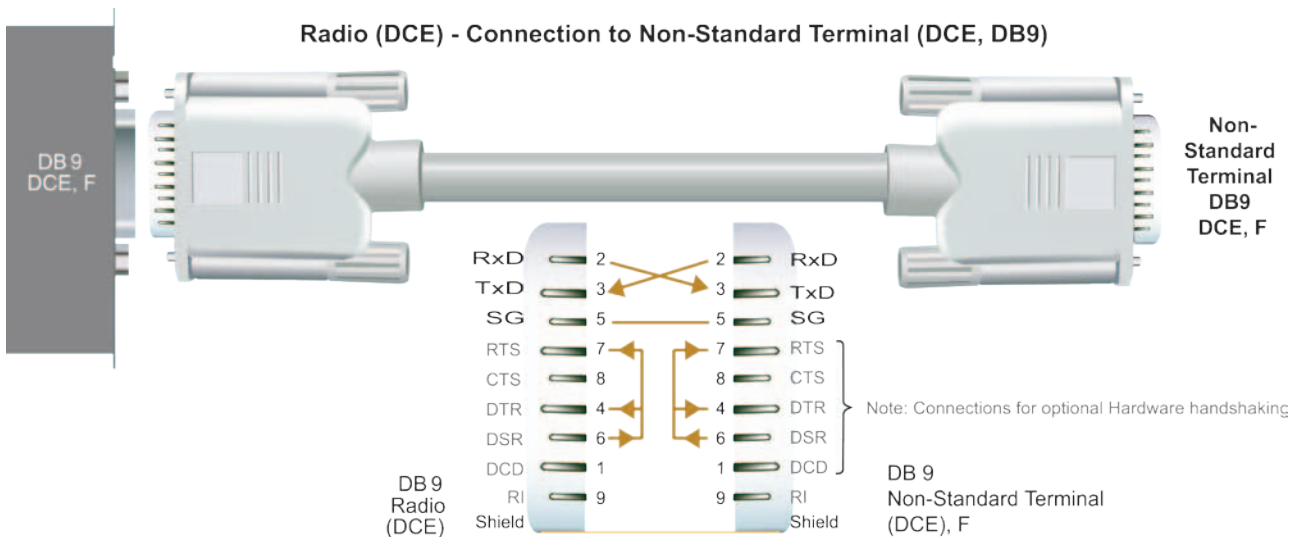
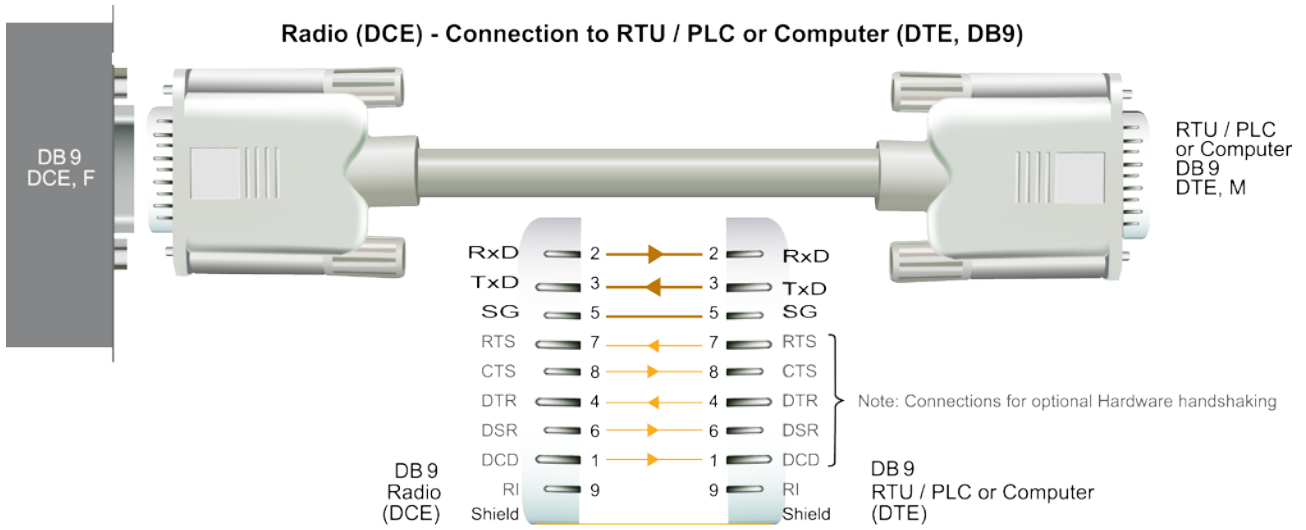
In telemetry applications (particularly where port speeds can be set to the same rate as the radio systems over-air rate) then flow control, and therefore handshaking, is usually NOT required. It follows that any devices that CAN be configured for “no flow control” should be used in this mode to simplify cabling requirements.

Handshaking lines can generally be looped as follows:

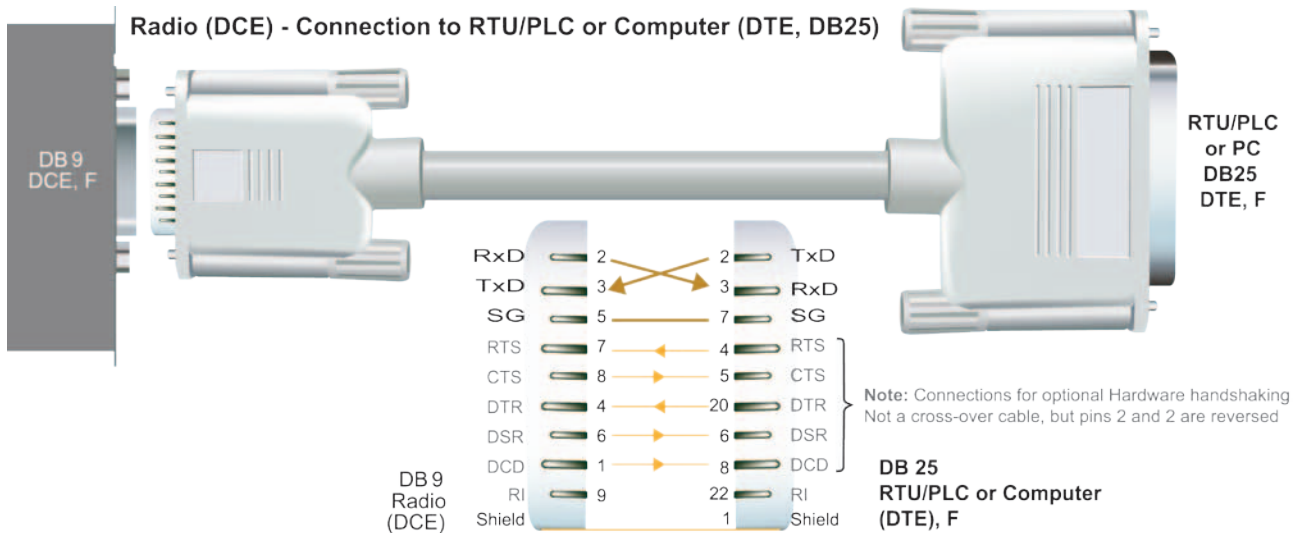
DTE (terminal) – loop RTS to CTS, and DTR to DSR and DCE.

DCE (modem) - loop DSR to DTR and RTS (note-not required for E Series modem when set for no handshaking).

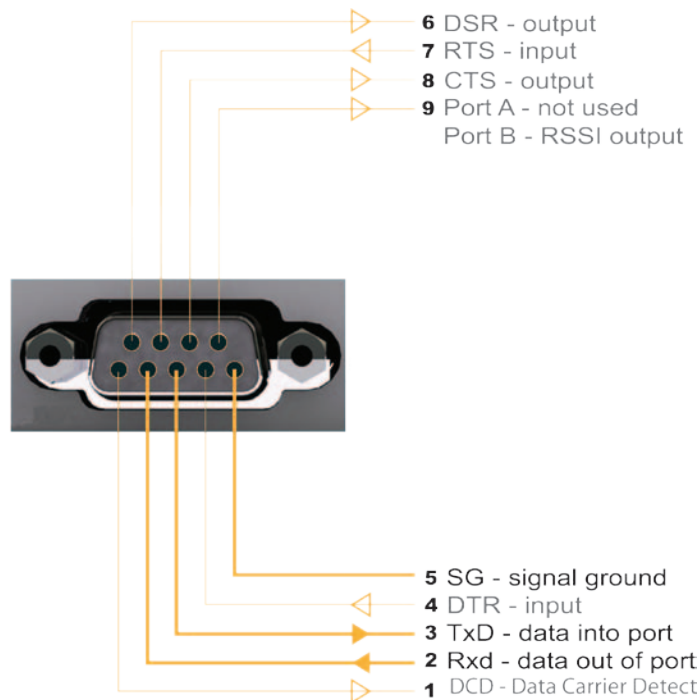
Cable Wiring Diagrams



Cable Wiring Diagrams



**RS232 Connector Pin outs (DCE)  
Port A and B, Female DB9**



## Power Supply and Environmental Considerations

### General

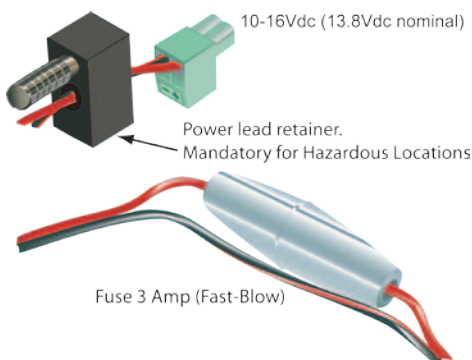
When mounting the equipment, consideration should be given to the environmental aspects of the site. The cabinet should be positioned so that it is shaded from hot afternoon sun, or icy cold wind. Whilst the radios are designed for harsh temperature extremes, they will give a longer service life if operated in a more stable temperature environment. In an industrial environment, the radio modems should be isolated from excessive vibration, which can destroy electronic components, joints, and crystals.

The cabinet should provide full protection from moisture, dust, corrosive atmospheres, and residues from ants and small vermin (which can be corrosive or conductive). The radio modem will radiate heat from the in-built heatsink, and the higher the transmitter duty cycle, the more heat will be radiated from the heatsink. Ensure there is sufficient ventilation in the form of passive or forced air circulation to ensure that the radio is able to maintain quoted temperature limits.

### Power Supply

The power supply should provide a clean, filtered DC source. The radio modem is designed and calibrated to operate from a 13.8VDC regulated supply, but will operate from 10-16 volts (filtered) DC.

The power supply must be able to supply sufficient current to provide clean filtered DC under the full current conditions of the radio modem (i.e. when transmitting full RF power). See Section L - Specifications for more details of the power supply requirements.



### Solar Applications

In solar or battery-backed installations, a battery management unit should be fitted to cut off power to the radio when battery levels fall below the minimum voltage specification of the radio. In solar applications, a solar regulation unit **MUST ALSO** be fitted to ensure that the radio (and battery) is protected from excessive voltage under full sun conditions.

When calculating solar and battery capacity requirements, the constant current consumption will be approximately equal to the transmit current multiplied by the duty cycle of the transmitter, plus the receive current multiplied by the (remaining) duty cycle of the receiver.

The Tx/Rx duty cycle will be entirely dependent on the amount of data being transmitted by the radio modem, unless the device has been configured for continuous transmit, in which case the constant current consumption will be equal to the transmit current only (at 100% duty cycle).

Note: Operation below the minimum specified supply voltages could result in poor radio performance. If the supply voltage falls below 7.2Vdc the radio will shut down. Normal radio startup will not occur until 10Vdc is supplied.

### Site Earthing

## CAUTION

Ensure that the chassis mounting plate, power supply (-) earth, RTU terminal device, and lightning arrester are all securely earthed to a common ground point to which an earth stake is attached. Pay particular attention to 24Vdc PLC systems using DC-DC converters to supply

## CAUTION

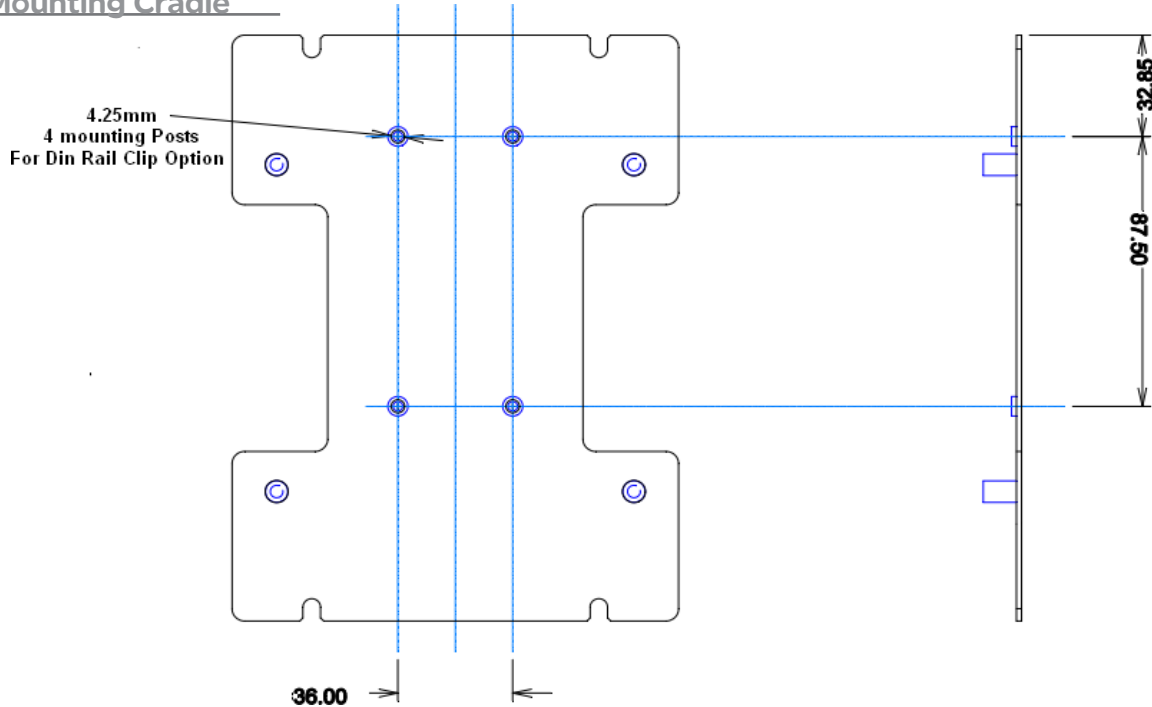
Caution: There is NO readily serviceable internal fuse, and therefore the radio modem **MUST** be externally fused with a fuse and fuse holder (ER450: 3 amp fast-blow fuse, EB450: 5 amp fast-blow fuse, EB450(20W): 8 amp fast blow fuse, EH450: 1 amp slow blow fuse).

Physical Dimensions - Remote Data Radio - ER450



**Physical Dimensions - ER450 Mounting Cradle/Din Rail Mount (Optional)**

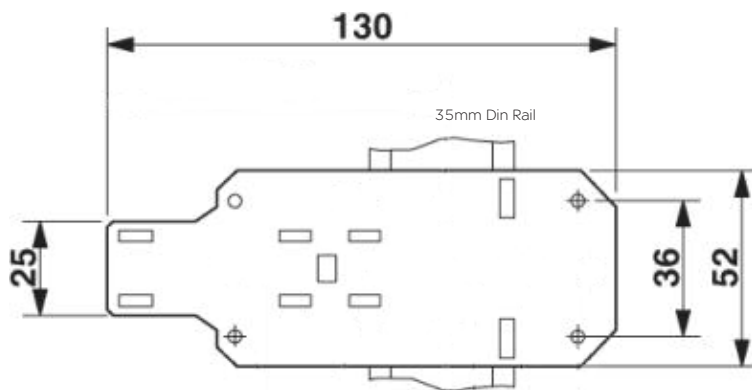
**Mounting Cradle**



**ER450 Mounting Cradle**

The ER450 mounting cradle comes standard with the x4 mounting posts. If you want to purchase a new unit equipt with the Din Rail mount, you can either request to have the units sent with the Din Rail mount already screwed onto the mounting cradel or have the Din Rail mount supplied seperately along with x4 screws and x4 washers (screws: 3x8 Pan head, Washers: 3mm Sping washers). In the case of attaching the Din rail mounts to older radios, please ensure that you radio's mounting cradle has the x4 mounting posts.

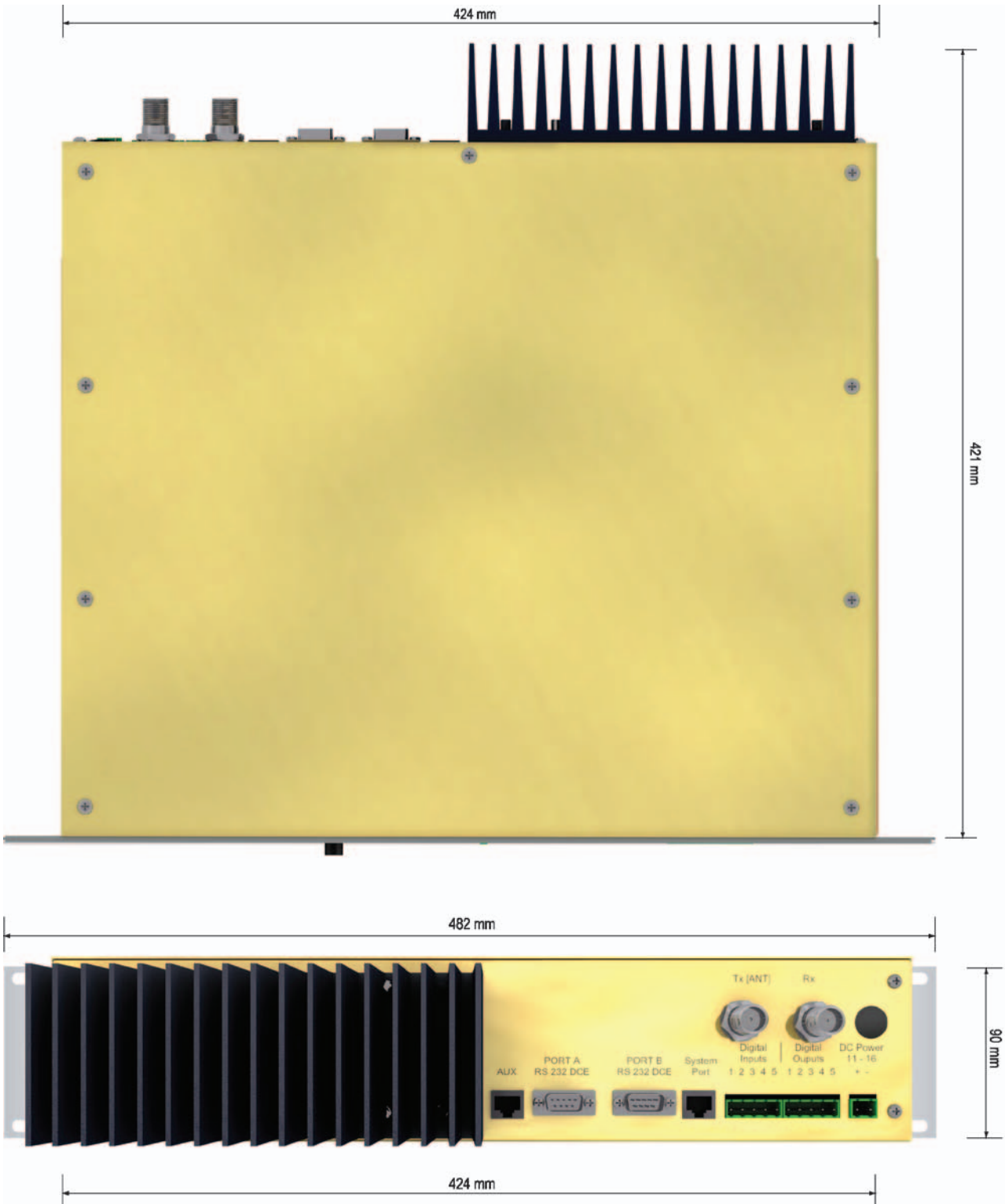
**Din Rail Mount (Optional)**



**Din Rail Mount**

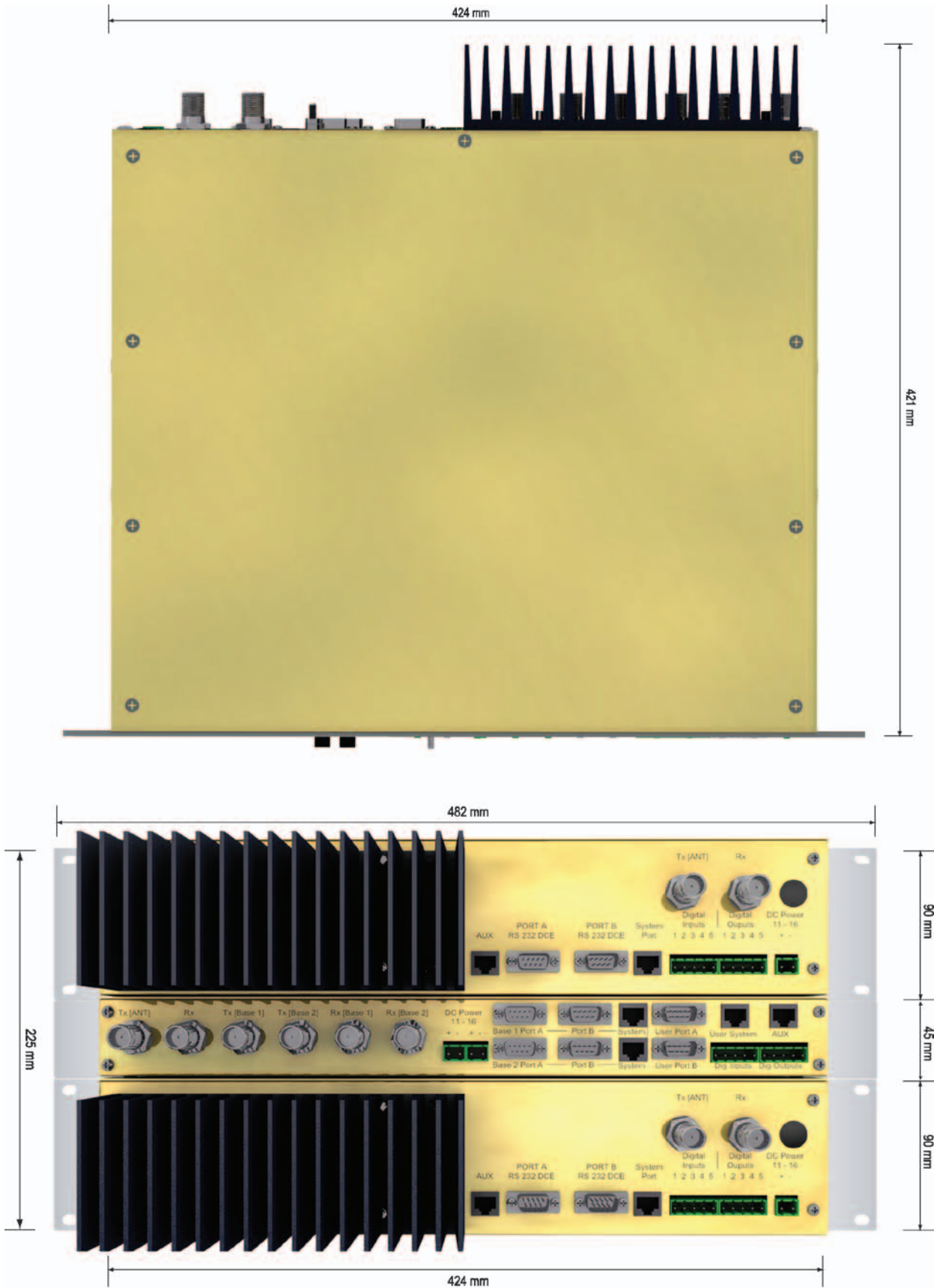
The Din Rail Mount is an optional feature. The Mount is screwed onto the Bottom of an ER450 Mounting Cradle giving the unit the ability to be simply 'clipped' and Locked onto 35mm Din Rail.

Physical Dimensions - Base Station - EB450





Physical Dimensions - Hot Standby Base Station - EH450



# Part E – Getting Started

## ER450 Quick Start Guide

### Introduction

Welcome to the ER450 Quick Start Guide. This guide provides step-by-step instructions, with simple explanations to get you up-and-running.



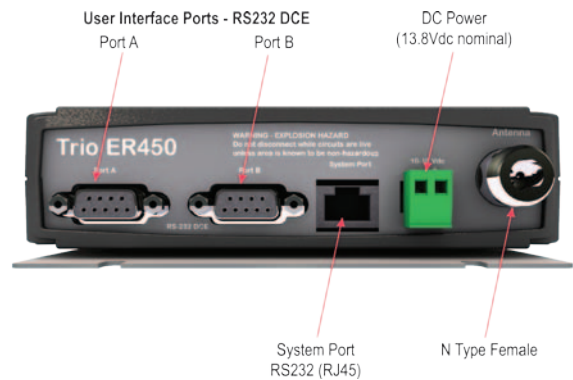
## Mounting and Environmental Considerations

The ER450 radio comes complete with a mounting cradle and is attached to a panel or tray by means of screws or bolts, using the hole slots provided.

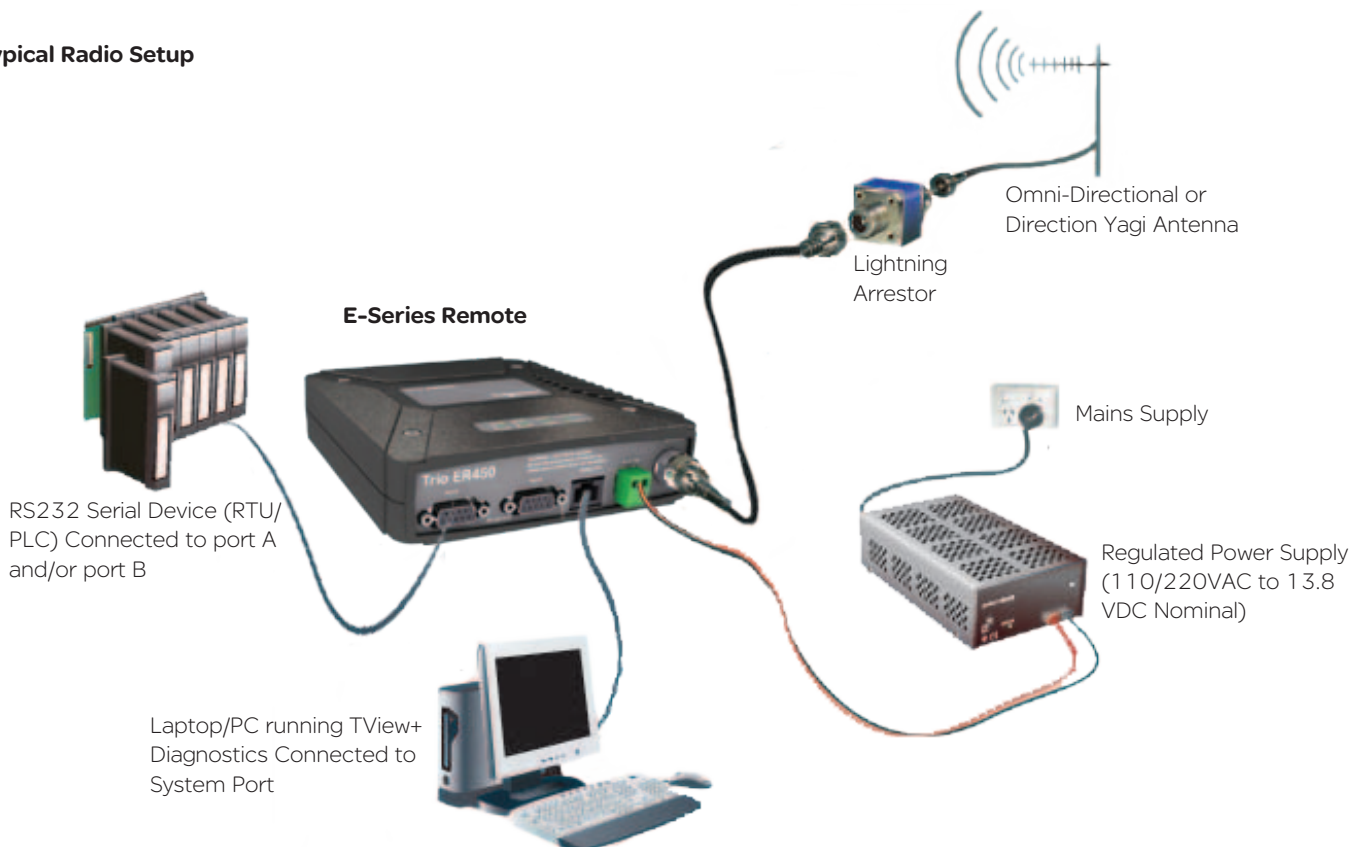
Note: In high power or high temperature applications, it is desirable to mount the radio with the heatsink uppermost to allow ventilation for the heatsink.

The radio should be mounted in a clean and dry location, protected from water, excessive dust, corrosive fumes, extremes of temperature and direct sunlight. Please allow sufficient passive or active ventilation to allow the radio modem's heatsink to operate efficiently.

## ER450 Connections Layout



## Typical Radio Setup



### Connecting Antennas and RF Feeders

The RF antenna system should be installed in accordance with the manufacturers notes.

The RF connector used on the E Series radios are N Type female connectors. Always use good quality low loss feeder cable, selected according to the length of the cable run. Ensure all external connections are waterproofed using amalgamating tape.

Preset directional antennas in the required direction using a compass, GPS, or visual alignment and ensure correct polarisation (vertical or horizontal).



### Communications Ports

#### System Port – RJ45

The System Port (available front and rear on EB/EH450) is a multi-function interface used for:

- Programming / Configuration of the radio
- Remote Diagnostics connections

To access these functions use the TVIEW+ Cable assembly (RJ45 Cable and RJ45 to DB9 Adaptor).

The TVIEW+ Cable is a standard CAT 5 RJ-45 (Male) to RJ-45 (Male) patch cable. It is intended for RS232 serial communications only and should not be connected directly into an Ethernet port of a PC. The Cable must be used in conjunction with the RJ-45 to DB9 Adaptor.



TVIEW+ Adaptor Configuration:

System Port	Description	DB9 Female
Pin 1	System port data out (RS232)	Pin 2
Pin 2	System port data in (RS232)	Pin 3
Pin 3	Factory Use Only - Do not connect	No Connection
Pin 4	Shutdown	No Connection
Pin 5	Programming Use Only (Grounded)	Pin 5
Pin 6	Factory Use Only - Do not connect	No Connection
Pin 7	Ground	Pin 5
Pin 8	External PTT	No Connection

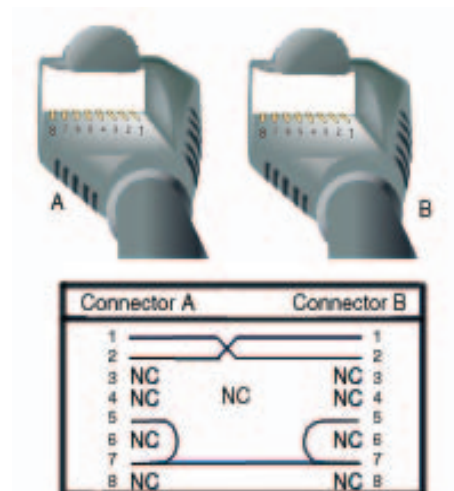
Special user pinouts:

- Shutdown (Pin 4) - Active low for power save function. In order to put the radio into Shutdown mode, tie pin 4 to a digital output on a SCADA Pack, RTU or similar device. When it is desired to turn the radio off, switching this digital output must connect the radio's pin 4 to ground. The (earth) ground of both devices would also need to be tied together as a common reference. (pin 7 on the radio's System port) A 2 wire cable between SCADA Pack and radio system port is all that's required, with an RJ-45 connector on the radio end. The Shutdown pin may be left floating for the radio to remain powered.
- External PTT (Pin 8) - Provides a manual PTT override facility for enabling the transmitter. For testing this can be activated by connecting PTT (Pin 8) to Gnd (Pin 7).



#### Cross Over cable (Trunking System Port to System Port)

Some circumstances require a user to trunk the system ports of two units using an RJ45 cross over cable. Follow the diagram below to create the cross over cable.



**User Interfaces – Ports A & B**

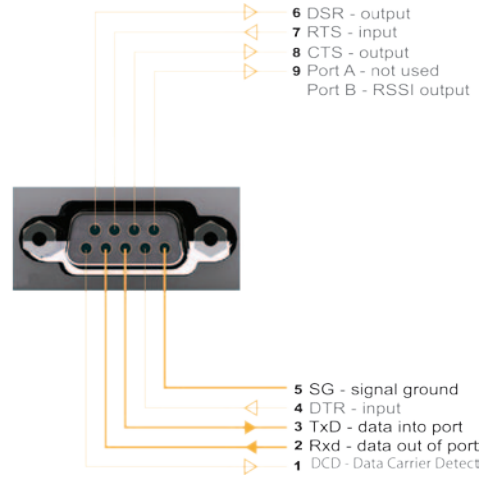
Each user port (A & B) is wired as a RS232 DCE, configurable for no handshaking (3-wire) interface, or for hardware or software (X-on/X-off) flow control. In most systems flow control is not required, in which case only 3 wires need to be connected between the radio and the application device.

**Typical pins used:**

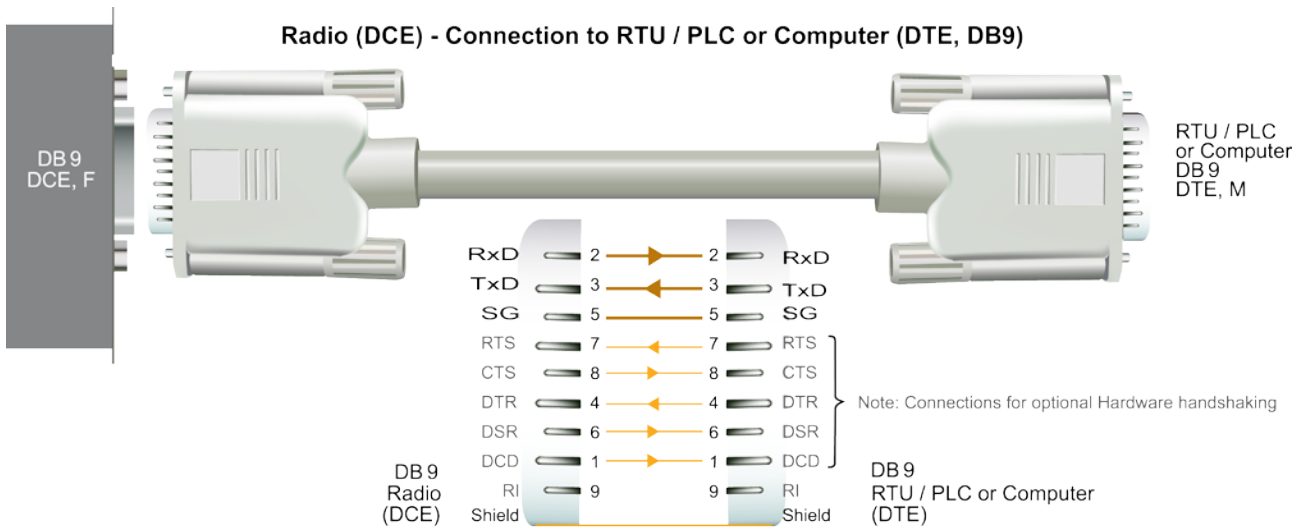
- Pin 2 (RxD) - data output from the radio modem,
- Pin 3 (TxD) - data input to the radio modem,
- Pin 5 (SG) - signal ground.

See Part D – System Planning and Design - Data Connectivity, for further details of other cable configurations.

**RS232 Connector Pin outs (DCE)  
Port A and B, Female DB9**



**Radio (DCE) - Connection to RTU / PLC or Computer (DTE, DB9)**



**Activating the Transmitter**

In most systems, the transmitter by default is controlled automatically by the radio when it has data to transmit.

In some systems, such as full duplex point-to-point links or full duplex point-to-multipoint base stations, it is desirable to run the transmitter all the time (hot keyed).

Two mechanisms are provided to do this:

- The radio modem can be configured to transmit continuously whenever powered, or

- The radio modem can be configured to transmit whenever an external RTS signal (Pin 7) is applied to one (or either) user ports. (To simulate an external RTS input, loop pins 6 to 7).

To operate in these modes, the radio must be configured via the programming software.

**CAUTION**

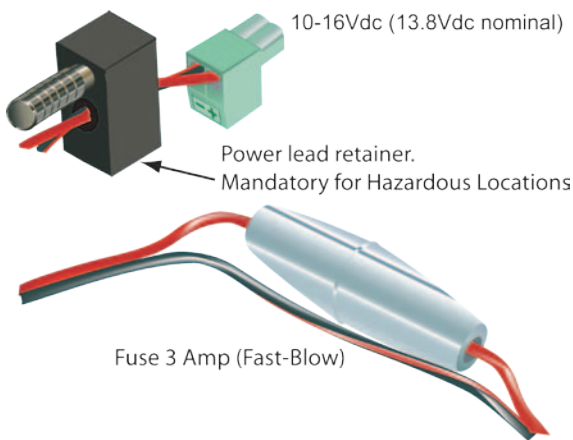
Caution: When the radio is configured to transmit continuously, ensure an RF load is present BEFORE applying power to the unit.

**Power Supply Requirements**

The E Series radio modem is designed and calibrated to operate from a filtered 13.8Vdc regulated supply, but will operate from a 10-16Vdc (11-16Vdc for EB450 & EH450) range. See Section L - Specifications for more details on power supply requirements

**CAUTION**

Caution: There is NO readily serviceable internal fuse, and therefore the radio modem MUST be externally fused with a fuse and fuse holder (ER450: 3 amp fast-blow fuse, EB450: 5 amp fast-blow fuse, EB450(20W): 8 amp fast blow fuse, EH450: 1 amp slow blow fuse).



The radio is designed to self protect from permanent damage if the voltage exceeds 16Vdc or if reverse polarity is applied. The radio may need to be returned for service if this occurs.

The radio modem can also be damaged if there is any potential difference between the chassis-ground, RS232 signal ground, power (-) input, or antenna coaxial shield. Before connecting any wiring, ensure all components are earthed to a common ground point (please pay particular attention to 24V PLC power systems where converters are used).

Connect the antenna and RS 232 plugs BEFORE applying power to the unit.

Lastly, before inserting the power plug, please re-check that the polarity and voltage on the power plug is correct using a multimeter.

**TVIEW+ Management Suite**

Radio Configuration

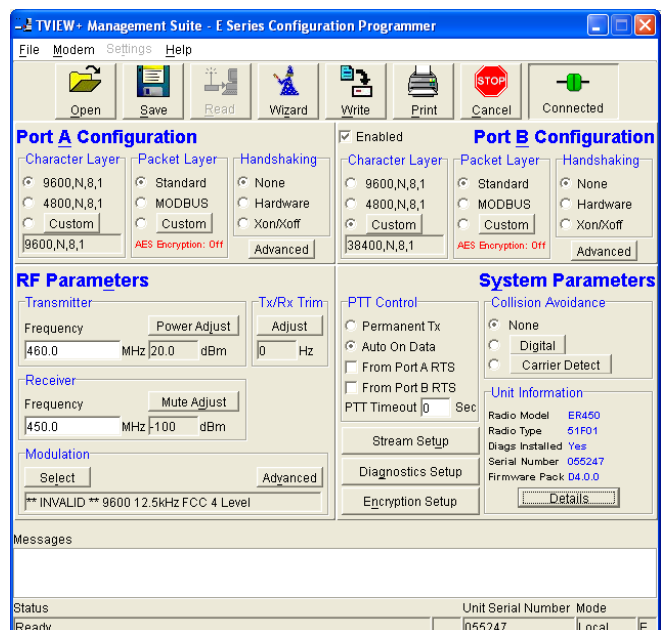
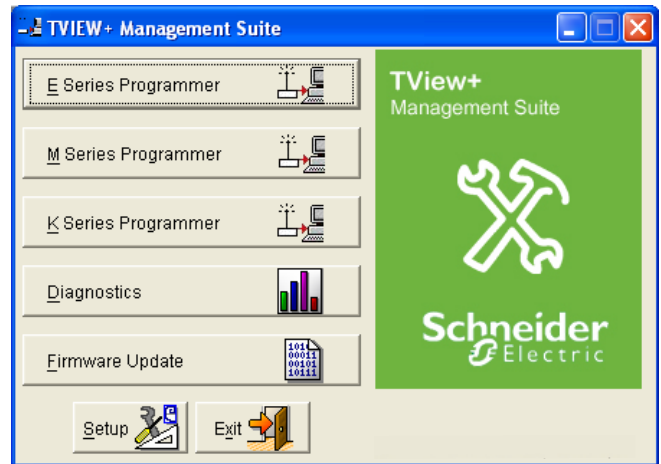
This TVIEW+ Management Suite allows a number of features including: Configuration (Local - serial, or Remote - over-the-air), Remote Diagnostics Facilities and Firmware Upgrades.

The configuration wizard can be used to provide Quick Start generic templates for the types of systems architecture you wish to employ.

Example: Local configuration session –

- 1 Attach the programming cable from the PC to the System Port of the radio
- 2 Launch TVIEW+ & Select “Programmer”
- 3 Select “Read” the radio
- 4 Change the configuration as required
- 5 Select “Write” the parameters back to the radio

Refer to Parts I & J – TVIEW+ Management Suite for detailed operation of advanced features.

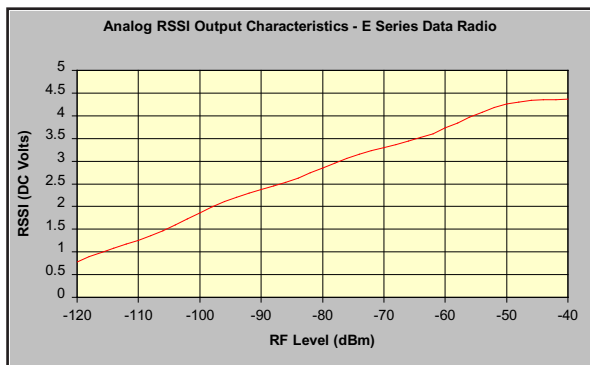
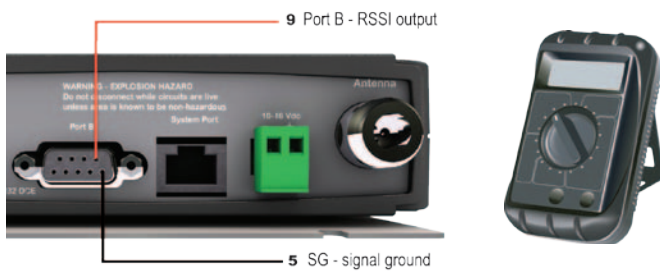


### Optimising the Antenna for best RX signal

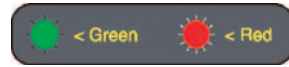
Once the unit is operational, it is important to optimise the antenna tuning.

In the case of a directional antenna, it will be necessary to align the antenna for the best received signal.

This can be done by using the (0-5Vdc) output on Pin 9 of Port B to indicate signal strength (RSSI). This voltage can be converted to dBm using the chart below.



### LED Indicators & Test Outputs

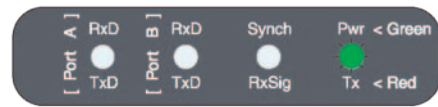


LED Legend

#### Radio is Powered

If all the LEDs are off, no power is reaching the radio modem.

Successful power-up is indicated by the "PWR" LED indicating a continuous (healthy) GREEN state. Note that this LED is turned RED when the transmitter is active.



#### Radio Errors

Internal radio management software monitors many aspects of the radio hardware. Under certain circumstances radio faults may prevent normal operation. In the event that these fault conditions occur, the radio will enter an ERROR state and this will be indicated by flashing ALL LEDs RED, then flashing a pattern of GREEN LEDs. The pattern of all GREEN LEDs represents the specific type of error that has occurred. See Table below.

Port A	Port B	Synch/ RXSig	Pwr/TX	Error Diagnosis
OFF	OFF	OFF	ON	External Supply Voltage out of spec. (1)
ON	OFF	ON	OFF	RX VCO Out of Lock. (2)
ON	OFF	OFF	ON	TX VCO Out of Lock. (3)

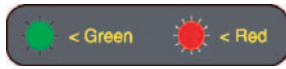
All other patterns indicate serious hardware errors. Please record this pattern and return the result with the service return information.

Note (1): If external voltage is too high (>16Vdc) radio damage may occur. If the external voltage is too low (<10Vdc) the radio may not operate within specifications.

Note (2) and (3): If the radio receiver or transmitter frequencies are programmed outside the specified frequency ranges (model type dependent), then normal radio operation may not be possible. In this case, use TVIEW+ to set the receiver and/or transmitter frequencies to be within the specified range. If this error occurs and the frequencies are within the specified frequency ranges (model type dependent), the radio will need to be returned for service.

**Received Signal Indicator**

**LED Legend**



The “RX/SYNC” LED is used to indicate the state of the receiver.

If the LED is off, no signal is being received.

A RED indication shows that an RF carrier is being received, but no data stream can be decoded. This will briefly happen at the very start of every valid received transmission or may indicate the presence of interference, or another user on the channel.

A continuous GREEN indication shows that the modem is locked and synchronised to the incoming signal, and has excellent Bit Error Rate (BER). Any losses of synchronisation (BER errors) are shown as a visible RED flicker of the LED.

Note: This might only be apparent on a PTMP slave when only receiving.



**Data Flow “breakout” LEDs**

There are also two LEDs to indicate data flow into and out of the two user ports.

Input data to be transmitted is shown as a RED flash, and received data to be output to the port is shown as a GREEN flash.

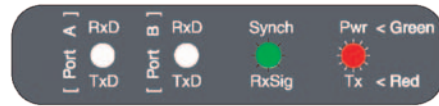
If data is alternately flowing in and out quickly, then the indicator appears orange.

**Verifying Operational Health**

It is possible to verify the operation of the radio modem using the indicators provided by the unit. The state of the transmitter and receiver, and data flow can be interpreted by the indicator LEDs (see below).

Note: Port A and Port B’s RxD and TxD will be Active on Data Flow

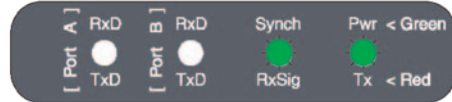
Full Duplex – PTP Master or Slave



Full Duplex – PTMP Master Tx



Half Duplex – PTMP Slave Rx



Half Duplex – Master or Slave (Tx)



Half Duplex – Master or Slave (Rx)



## EB450 Quick Start Guide

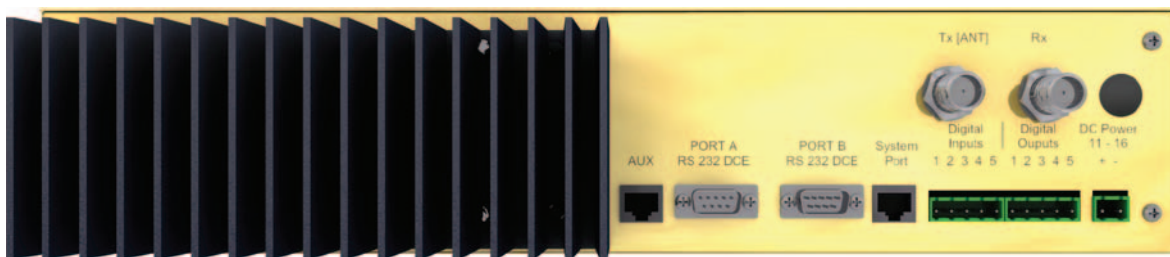
### Introduction

Welcome to the Quick Start Guide for the EB450 Base / Repeater Data Radio. This guide provides step-by-step instructions, with simple explanations to get you up-and-running.

### 20W Power Amplifier option

The 20W power amplifier is primarily used for the purpose of overcoming Tx combiner losses. In such cases of a 20W power amplifier being required, an Rx preamp may also be required.

Note: 20W power amplifier options may not be available in all Countries. please contact the factory to confirm availability.



### Mounting and Environmental Considerations

The EB450 Base Station is housed in a 2RU 19" rack enclosure. The 4 mounting holes on the front panel should be used to secure the unit to the rack.

The radio should be mounted in a clean and dry location, protected from water, excessive dust, corrosive fumes, extremes of temperature and direct sunlight. Please allow sufficient passive or active ventilation to allow the radio modem's heatsink to operate efficiently.

All permanent connections are made at the rear of the unit. This includes: Power, Antenna, Communications Ports, Digital I/O and System Port. The front panel has an additional System Port connection point for easy access.

### Full Duplex Considerations

The EB450 is designed for continuous full duplex transmission. An automatic thermostatically controlled fan will operate whenever the internal temperature exceeds 40 degrees Celsius and turn off again when the temperature goes below 35 degrees Celsius.

### External Duplexer Considerations

The EB450 is normally supplied with separate Tx and Rx ports for connection to an external duplexing system.

Depending on the frequency band of operation and the Tx/Rx frequency split, internal band reject duplexers are available.

### Connecting Antennas and RF Feeders

See ER450 Quick Start Guide

### Communications Ports

See ER450 Quick Start Guide Section

### Power Supply and Protection

See ER450 Quick Start Guide Section

### TVIEW+ Management Suite - Radio Configuration

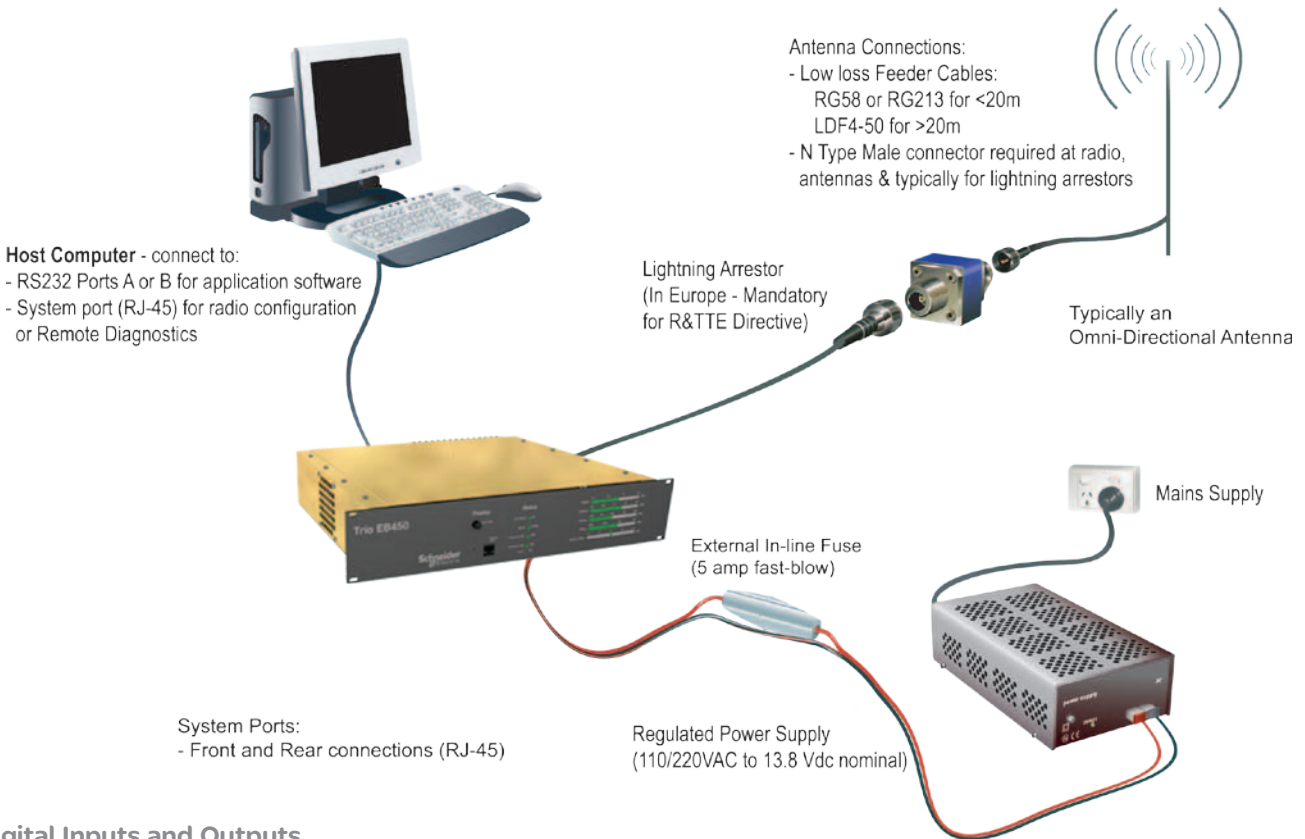
See ER450 Quick Start Guide Section

### Optimising the Antenna for VSWR and best RX signal

See ER450 Quick Start Guide Section



**Typical Radio Setup**



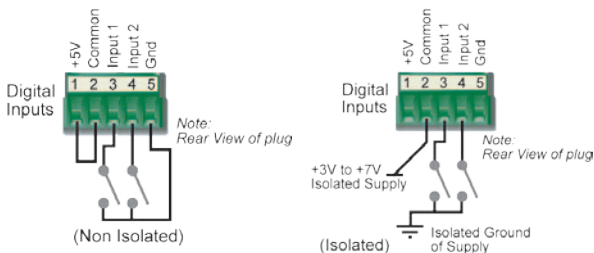
**Digital Inputs and Outputs**

The EB450 provides a facility for two channels of digital user inputs and outputs (Digital User I/O). Information on how to control and monitor this I/O using TVIEW+ Diagnostics can be found in Part J - TVIEW+ Management Suite - Remote Diagnostics & Network Controller.

All user I/O is optocoupled for isolation between the EB450 and uses equipment. When using the I/O facility the I/O electrical characteristics and ratings must be observed. Failure to observe these ratings may result in equipment damage.

**Inputs**

Two User Inputs are available. They have identical interface characteristics. Each input has an internal resistance of 470 Ohms. Some form of switching contact (ie: switch, relay) is normally used to change the state of the input. Both an isolated and non-isolated input configuration is possible.



TVIEW+ Diagnostics will recognise an input as being ON when the switch is closed. If the switch is open (or not connected) TVIEW+ diagnostics will recognise the inputs as being OFF.

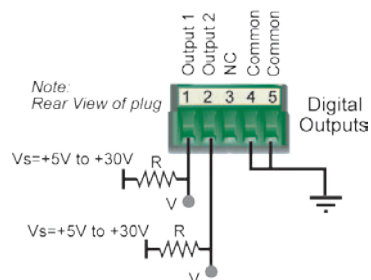
**Outputs**

Two User Outputs (Open Collector) are available. They have identical interface characteristics. The maximum current allowed through each output is 20ma. External resistors must be used keep the current below this value.

Each output has an internal resistance of 100 Ohms. Ohms law can be used to calculate the resistance required for a specific voltage (keeping the current below 20mA). Nominally 1k Ohm is used for a +13v8 supply and 330 Ohms for a +5v supply.

When the OUTPUT is OFF,  $V = V_s$ . No current will flow when output is off.

When the OUTPUT is ON,  $V =$  nominally 2.3 volts . Current is set by resistor.

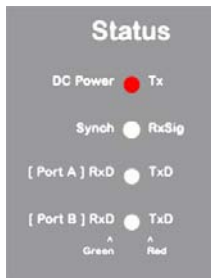


## LED Indicators & Test outputs

### Radio is Powered

If all the LEDs are off, no power is reaching the radio modem.

Successful power-up is indicated by the “PWR” LED indicating a continuous (healthy) GREEN state. Note that this LED is turned RED when the transmitter is active.



### Hardware Error

A hardware error is indicated on the status LEDs by all LEDs flashing RED at a rate of 1Hz. This indicates internal communications to the exciter inside the basestation has been lost and the base station needs to be returned to repair.

### Received Signal Indicator

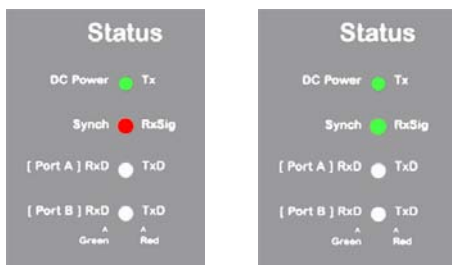
The “RX/SYNC” LED indicates the state of the receiver.

If the LED is off, no signal is being received.

A RED indication shows that an RF carrier is being received, but no data stream can be decoded. This will briefly happen at the very start of every valid received transmission or may indicate the presence of interference, or another user on the channel.

A continuous GREEN indication shows that the modem is locked and synchronised to the incoming signal, and has excellent Bit Error Rate (BER). Any losses of synchronisation (BER errors) are shown as a visible RED flicker of the LED.

Note: This might only be apparent on a PTMP slave when only receiving.



### Data Flow “breakout” LEDs

There are also two LEDs to indicate data flow into and out of the two user ports.

Input data to be transmitted is shown as a RED flash, and received data to be output to the port is shown as a GREEN flash.

If data is alternately flowing in and out quickly, then the indicator appears Orange.

## Bar Graph Indicators

The bar graph indicators on the front panel provide variable information regarding the performance of the Base Station. To enable / disable the bar graph display depress the Display ON / OFF button. The display will turn off automatically after 5 minutes.

DC Supply:

Indicates the supply input voltage at the exciter module. Typically 13.8Vdc.

Indication: <10Vdc no LED’s on, 10-10.9Vdc LED’s RED, 11-15.6Vdc All LED’s GREEN, >=15.7Vdc last LED RED.

Tx Power:

Indicates forward RF power output as measured at the TX antenna port. Typically +37dBm or +43dBm for a 20W version.

Indication: <20dBm no LED’s on, 20-40.6dBm (1 1.5W) LED’s GREEN, >=40.7dBm last LED RED.

Tx Drive:

Indicates exciter drive level. Typically +20dBm.

Indication: <10dBm no LED’s on, 10.0-25.9dBm LED’s GREEN, >=26.0dBm last LED RED.

Rx Sig:

Indicates receive signal strength. Typically -85 to -65dBm.

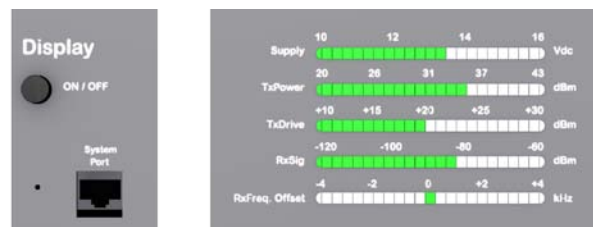
Indication: <-120dBm no LED’s on, -120 to -110.1dBm LED’s RED, >=-110dBm LED’s GREEN.

RxFreq. Offset:

Indicates offset of receiver AFC - useful in determining frequency drift. Typically 0kHz.

Indication: Single GREEN LED to indicate current value, <-3.6kHz or >+3.6kHz LED is RED. No signal, all LED’s OFF.

Note: 5 second peak hold circuitry.



## Test Mode

The Bar Graph indicators have a Test Mode, which cycles all LED’s for correct operation (before returning to their normal operation). To activate this mode, simply depress the ON / OFF button while applying power to the unit.

## EH450 Quick Start Guide

### Introduction

Welcome to the Quick Start Guide for the EH450 Hot Standby Base / Repeater Station. This section provides additional step-by-step instructions to install, commission and operate the EH450 Hot Standby Base Station. This document should be read in conjunction with the EB450 Base Station Quick Start Guide.

The EH450 is a fully redundant, hot standby digital data radio base / repeater station providing automatic changeover facilities.

The EH450 is designed as a modular solution, comprising 2 identical EB450 base station units (standard) linked to a central, fail-safe monitoring and changeover controller (Hot Standby Controller). Either base station may be taken out for maintenance without the need for any system down time. The

automatic changeover is triggered by out of tolerance (alarm) conditions based on either RF and/or user data throughput parameters.

### Features and Benefits

- Individual and identical base stations with separate control logic changeover panel
- Modules are hot swappable without user downtime
- Flexible antenna options – single, separate Tx & Rx, two Tx and two Rx
- Both on-line and off-line units monitored regardless of active status
- Also refer to the common Features and Benefits list of the E Series Data Radio



Base / Repeater Unit



Base / Repeater Unit



Hot Standby Controller Unit

Note: RF connectors not used on ETSI version

### Rear View



## **Operational Description**

The Hot Standby Controller (HSC) unit is a 1RU rack mounted module that interfaces to two physically separate base stations (each 2RU rack mounted modules) via a number of RF and data cables.

Both base stations are operating simultaneously and both units are constantly receiving signals, however only data from one base station, the “online” base station is directed to the user equipment. The online base station is the only base station transmitting at any time. The Hot Standby Controller has the following functions:

- Diplex the transmit and receive paths (Assuming internal duplexer fitted), TX Only.
- Amplify and split the incoming signal two ways so both base stations receive at once.
- Monitor status reports from both base stations to identify faults and swap over the online base station if required.
- Switch the antenna via internal coaxial relay duplexer to the online base station transmitter and inhibit the offline base station from transmitting.
- Switch the User A and B data ports through to the online base station.

An optocoupler based switch in the base station controller directs data to and from ports A and B on the rear panel directly to ports A and B on the on-line base station without any involvement from the Hot Standby controller microcontrollers (apart from selecting the on-line base). This provides protection of the system from failure of the microcontroller.

As well as ports A and B, each base has a system port. The system port of each base station is interfaced to the microcontroller on the Hot Standby controller. This allows the microcontroller in charge of selecting the base station to receive diagnostic messages from each base station to decide their health.

The base station has it’s own system port on the rear panel and this is interfaced to the Hot Standby Controller Module. The HSC will route diagnostics at the rear panel system port to and from the system ports of the base stations.

## **Warning**

The base station front panel system port has priority over the rear panel port, which is used for communication between the base station and the Hot Standby Controller. This is to permit service personnel to reconfigure the base station module without disconnection from the Hot Standby Controller. It should be noted however, that when the front panel port is accessed, a changeover event will occur due to lost communications with the Hot Standby Controller.

## **Mounting and Environmental Considerations**

The EH450 Hot Standby Base Station is housed as a 5RU 19” rack mounted set, encompassing 2 x 2RU Base Station units and 1 x 1RU Hot Standby Controller unit. The mounting holes on the front panels should be used to secure the units to the rack.

The unit should be mounted in a clean and dry location, protected from water, excessive dust, corrosive fumes, extremes of temperature and direct sunlight. Please allow sufficient passive or active ventilation to allow the radio modem’s heatsink to operate efficiently.

All permanent connections are made at the rear of the unit. This includes: Power, Antenna, Communications Ports, Digital I/O and System Port. The front panel has an additional System Port connection point for easy access.

The Base Station front panel system ports must not be used while in this configuration.

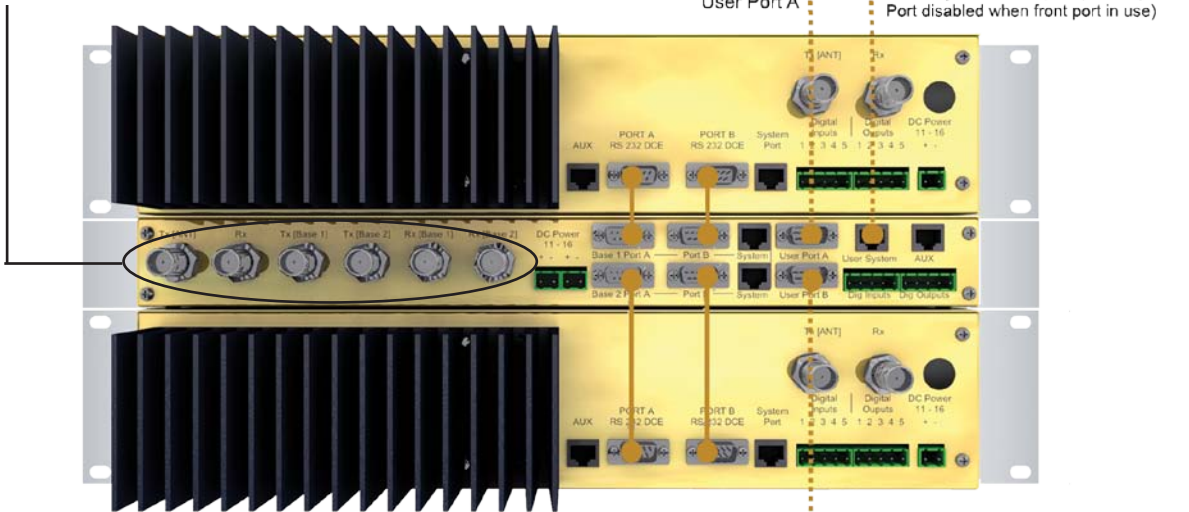
**Communications Ports**

The A & B Data Ports and System Ports of each Base Station connect directly to the Hot Standby Controller units corresponding ports with the cables provided. Ensure all clamping screws on the Data Port cables are firmly secured and the System Port cables are clipped in correctly. See figure below for further details.

The Hot Standby Controller units A & B Data Ports connect directly to you application device and the System Port connects directly to your local PC. See ER450 Quick Start Guide Section for further details.

Note: Only the front or rear User System Port can be used at any one time on the Hot Standby Controller.

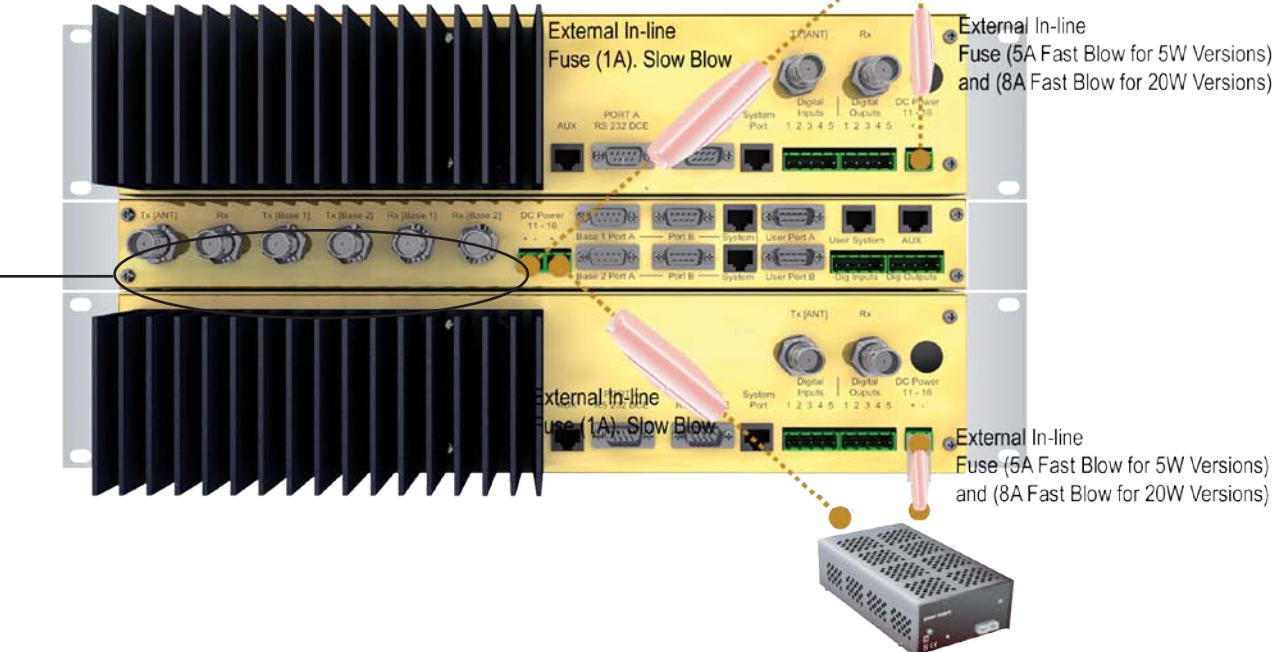
**Note: RF Connectors not used on ETSI version**



**Power Supply and Protection**

The EH450 has facilities for dual power supplies to provide for a redundant system. A separate power supply should be used for each of the Base Station units. The Hot Standby Controller unit has connections for dual power supplies and it is recommended that the power supplies from each of the Base Stations also be used to power the Hot Standby Controller unit. See Figure below for further details. See ER450 Quick Start Guide Section for detailed wiring information.

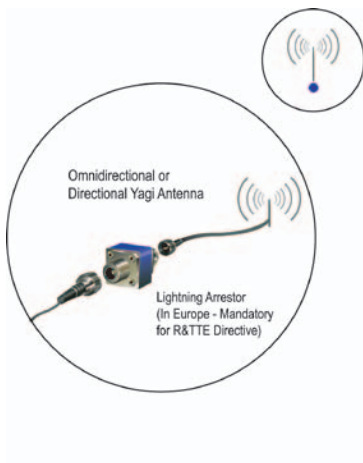
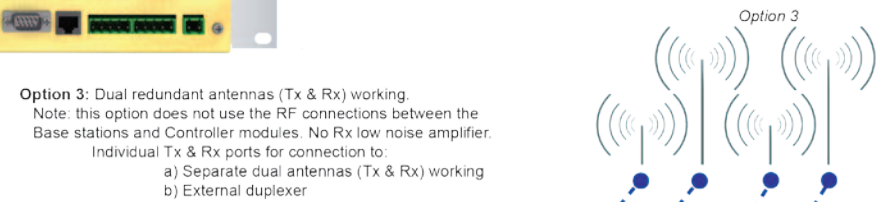
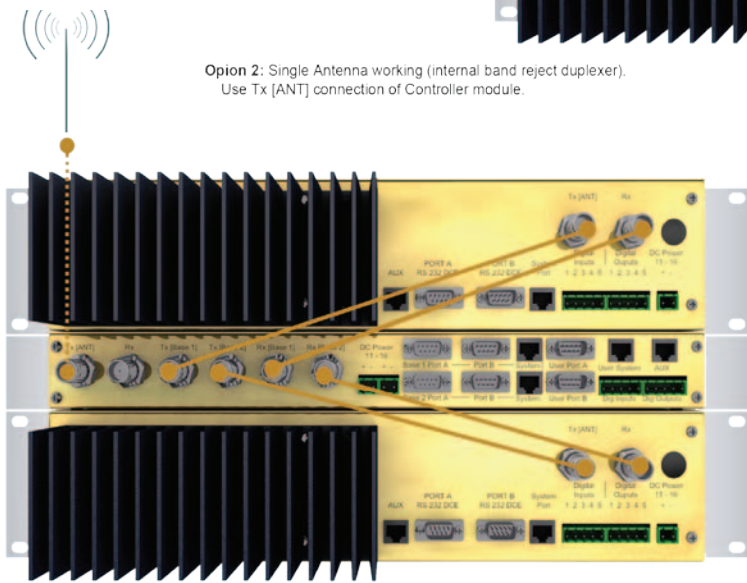
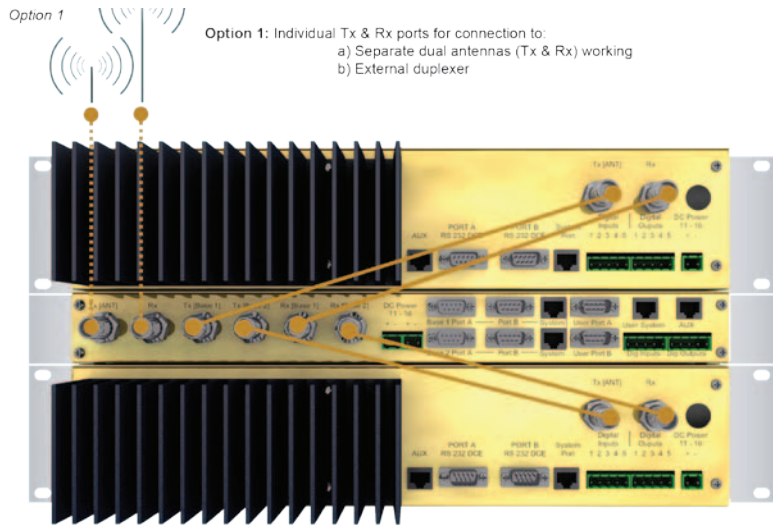
**Note: RF Connectors not used on ETSI version**



### Connecting Antennas and RF Feeders

There are 3 primary antenna connection options. All connectors used are standard N Type sockets. See figures below for further details.

See ER450 Quick Start Guide for detailed wiring information.



## Front Panel Operation



### Switches

#### Select Switch

The 3 position switch (1 / Auto / 2) on the front panel provides the following functionality:

- Position 1: base station 1 is forced into operation
- Position Auto: changeover hardware will select the online base station
- Position 2: base station 2 is forced into operation

The select switch is also used to identify the target base station for configuration programming.

Adjacent to the select switch are two LEDs: These LEDs indicate the current active base station.

#### Select LEDs

- Green - Auto Mode
- Red - Remote Force
- Amber - Local Force

2 Green Firmware Download

2 Amber Test Mode

2 Red Fatal Error - refer User Manual

#### Reset Switch

This is a momentary close switch which when depressed will reset all LED alarm indications.

### System Port

There are two system port connection points, one on the rear panel and one on the front panel. Both have the same functionality and can be used for local diagnostics, firmware front panel downloads and hot standby controller testing. To access the system port use the diagnostic/programming cable supplied.

Note: When connection is made to front panel system rear system port is disabled.

### Alarm Status LEDs

There are 10 alarm LEDs on the front panel, five for base 1 and five for base 2. These LEDs provide a general indication of base station status. More detailed base station status information is available by using the diagnostic utility software.

The indicated alarms for each base station are:

Freq.	=>	Frequency Error
RxSig	=>	Receive Signal (RF) Error
Data	=>	Receive Data Error
TxPower	=>	Transmit Power (RF) Error
Supply	=>	DC Voltage Error

The status of each alarm is represented as follows:

OFF	=>	Unknown
Green	=>	No Error
Red	=>	Current (active)

Error condition

Amber	=>	Recovered Error condition
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Any active or recovered error LEDs will turn to green after the reset alarms switch has been pushed or remotely reset.

# Part F - Operational Features

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## Multistream functionality (SID codes)

The E Series sends data messages in packets. A feature of the E Series is that an address can be embedded in each packet. This address is called the stream identifier code (SID).

By configuring a user serial port for a specific SID code, it is possible to steer messages to similarly configured ports between radio modems. In effect, it is possible to use the multiple serial ports available on the E Series, to enable multiple protocols to share the same RF channel. The SID codes also facilitate the use of other features such as TView diagnostics. Unique selective routing, repeating, and data splitting functions available in the radio modems configuration allow data steering and bandwidth management in complex systems.

See Part I - TView+ Management Suite - Programmer and Part J - TView Remote Diagnostics and Network Controller for details.

## Collision Avoidance (digital and RFCD based)

Where multiple “unsynchronised” protocols coexist on a common “multiple access” radio channel, there is always a possibility that both “hosts” may poll different “remote” devices at the same time. If both devices attempt to answer back to the single master radio at the same time, it follows that a collision could occur on the radio channel.

To facilitate the operation of multiple protocol operation on the radio channel, a transparent collision management system has been implemented : See Part I - TView+ Management Suite - Programmer for details.

## Digital Collision Avoidance System

If the “multiple access master” has been configured for full duplex operation, it is possible to use the inbuilt collision avoidance signalling system.

Once the master radio receives a valid incoming data stream from a remote, a flag within the “outbound” data stream is used to alert all other remote devices that the channel has become busy. Remote devices wishing to send data will buffer the message until the channel status flag indicates that the channel is clear. A pseudo-random timing value is added to the retry facility to ensure that waiting remotes do not retry at the same time.

## RF Carrier Detect RSSI based Collision Avoidance

In half duplex systems, the receiver’s RF carrier detect is used to inhibit the transmitter whilst a signal is being received.

## Digipeater Operation

A feature of the E Series radio modems is the ability to internally repeat data packets to provide stand alone repeater facilities without the need for external intelligence.

This is done by programming “SID Codes” to “Repeat” a stream or range of streams. Wizard templates can be used to simplify setup of this and other features.

See Part I - TVIEW+ Management Suite for details.

## TVIEW+ Diagnostics

The E Series has an inbuilt remote configuration and diagnostics utility.

This facility allows transparent remote access to the key configuration and operating parameters of the radio.

See the TView+ Diagnostics User Manual for more information.

## Poor VSWR Sensing

To protect the transmitter, forward and reverse power are measured on each transmission.

If a VSWR of 3:1 or greater is measured, transmitter output power is reduced to +31 dBm. (ER only)



## Part G - Commissioning

Check DC power connector for correct voltage (10-16VDC) and polarity, BEFORE plugging in the power connector.

### Power-up

Upon power up, the radio will self test and shortly after the green power LED will be displayed.

Failure of the power LED to light indicates no power, or failure of the fuse due to incorrect polarity or over-voltage.

Other failure such as fatal internal errors will initiate error modes as detailed in Part E - Getting Started: LED Indicators and Test Outputs.

### LED Indicators

Will depend on the system architecture. If the device is a remote site receiving a base station with a constant carrier, then the RXSIG/SYNC LED should be green to indicate healthy reception of the wanted signal.

If the site has been configured as a constantly transmitting base station, then the PWR/TX LED should show red.

In other types of systems, TX and RX bursts would be indicated by the RX or TX LED's as above.

Data flow to and from the user ports is indicated by the TXD/RXD LEDs for each port.

(See Part E – Getting Started: LED Indicators and Test Outputs.)

### Data Transfer Indications

Bi-colour LEDs are provided to indicate RS232 data being transmitted and received on each data port. A RED flash indicates a byte (or bytes) of incoming data from the serial line which will be transmitted to air, and a green flash indicates a byte of data received "off air" being released onto the serial line.

If data is being sent to the radio modem and the Data LED does not flash RED, this may indicate a wiring or configuration problem. Check that the TX and RX data lines are correctly wired (see Part E – Getting Started: LED Indicators and Test Outputs).

Also check that character set and parity settings (i.e. N,8,1 etc) are set identically at the terminal and the radio modem. Note that some incorrect settings of the character set parameter can still produce transmittable data, even though the data will not be understood by the application.

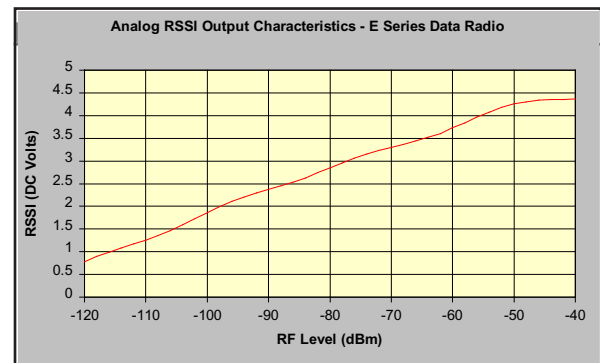
### Antenna Alignment and RSSI Testing

Once the RXSIG LED is lit, it is possible to confirm RX signal strength and align a directional antenna by monitoring the RSSI output.

This DC voltage appears at Pin 9 of Port B.

A ground reference can be obtained from chassis ground or Pin 5 of Port A or B.

The chart below shows Pin 9 voltage as it relates to signal strength.



Once communications has been established, it is possible to confirm the packet error rate performance of the radio path, and thus estimate the BER figure.

There are a number of tools provided to do this. The easiest is to use the "indicative packet error test" provided within the TVIEW+ Diagnostics under "statistical performance tools". Alternatively, it is possible to use hyper terminal, or other packet test instruments or PC programs to run end to end or perform "loopback" testing.

Please note that when using a "loopback plug" some understanding of the packetising process is necessary, since each "test message" must be carried in a single packet for meaningful results to be obtained.

Note also that in PTMP systems, allowance must be made for collision potential if other data is being exchanged on the system.

### VSWR Testing

VSWR testing is achieved using specialized VSWR testing equipment, or a "ThruLine" power meter that measures forward and reverse power.

VSWR is the ratio between forward and reflected transmitter power, and indicates the health and tuning of the antenna and feeder system.

VSWR should be better than 2 to 1, or expressed as a power ratio, <6dB or no more than 25%. To activate the radio's transmitter for VSWR testing, use:

- An RTS loop
- A system port PTT plug with pins 7&8 shorted.

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# Part H - Maintenance

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## Routine Maintenance Considerations

The E Series hardware itself does not require routine maintenance. However all radio products contain crystal frequency references, and the stability of these crystals changes with time. The effect of this is that the product will slowly drift off frequency, and eventually it will require re-calibration. E Series radios are designed with high quality, low drift specification references, to ensure a long maintenance free lifespan. The length of this lifespan will depend on the severity of temperature extremes in the operating environment, but is normally 3–5 years. Extended frequency drift can be detected using TVIEW+ Diagnostics “Freq error” parameter.

Generally, re-calibration is achieved by replacing the radio in the field with a spare, and returning the radio to a service centre for re-calibration and specification testing at moderate cost.

Routine maintenance should be performed on external equipment subject to greater environmental stresses including antennas, RF feeder cables, backup batteries and cooling fans (if required). This maintenance should include testing of site commissioning figures such as received signal strength, VSWR, P/S voltage etc.

# Part I – TVIEW+ Management Suite - Programmer

## Introduction

This manual covers the installation and operation of the E Series TVIEW+ Management Suite which incorporates 3 utilities:

- Programmer for configuration of the radio RF parameters, system parameters and data ports
- Diagnostics\* for real-time monitoring and logging of radio performance parameters
- Firmware Update for loading new firmware releases into the radio data modem

All utilities can be run on any IBM compatible computer running Windows 2000® and above. This section describes use of the programmer and firmware Update utilities in detail. Users should refer to the separate WinDiags User Manual for information about this utility.

The programmer is used to set configuration parameters within the ER450 data radio modem and EB450 base station. The utility permits configuration of modems connected directly to the PC as well as over the air to a remote unit. Configuration parameters can be saved to a disk file for later retrieval, or used for clone programming of other modems.

All configuration parameters are held in non-volatile memory (NVRAM) on the Data Radio Modem. Configuration is fully programmable via the Systems Port using the programming adaptor and cable supplied. Disassembly of the unit is not required for any reason other than for servicing.

The diagnostics utility permits monitoring and logging of radio performance parameters for both E Series\* as well as M Series\* data radio modems and base stations. It supports homogeneous systems of radios as well as mixed systems of both E and M series radios.

The firmware update utility permits field upgrade of the firmware in an ER450 data radio modem, EB450 base station and EH450 hot standby unit connected directly to the PC. A special serial adaptor cable is required to be connected to Port B to load firmware into the unit.

\* Requires the optional DIAGS Network Management and Remote Diagnostic Facility to be installed - per radio.

## Installation

### Unit Connection

#### Programmer and Diagnostics Utilities

The unit is connected to the PC using the supplied DB9-RJ45 adaptor cable (part no. TVIEW+ Cable) for local configuration changes or diagnostic monitoring. The cable should be connected to the RJ45 System Port of the unit and a valid PC serial port (e.g. COM 1) DB9 connector.

(See Part E - Getting Started: Communications Ports)

#### Firmware Update Utility

The unit to be updated with firmware connects to the PC using the DB9-DB9 adaptor (part no. DRPROG). The cable should be connected to the DB9 Port B connector on the unit and a valid PC serial port (See Appendix C for details) DB9 connector.

## Software

Please take a moment to read this important information before you install the software.

The installation of this Software Suite is a 2 step process.

Step 1 completes the typical installation of the TVIEW+ Management Suite and will install the Programming Software together with the E Series Documentation.

Step 2 installs the Diagnostic Software and is optional. This step is only required if your radios have Remote Diagnostics enabled.

#### STEP 1: Installation - TVIEW+ Management Suite

Note: If a previous version of the TVIEW+ Management Suite has been installed on your PC, you must uninstall it via Control Panel "Add/Remove Programs".

- Close down all other programs currently running.
- Place the CD-ROM in the drive on the PC.
- Using Windows Explorer locate the files on the CD-ROM.
- In Windows Explorer double click on the file called TVIEW+\_ (Version#)\_install.exe
- After the installer starts follow directions.

STEP 2: Installation - TView Diagnostic Software (Optional)

Note: If a previous version of the “TView WinDiags” software has been installed on your PC, you must uninstall it via Control Panel “Add/Remove Programs”.

- Close down all other programs currently running.
- Place the CD-ROM in the drive on the PC.
- Using Windows Explorer open the “Diagnostics” directory on the CR-ROM.
- Double click on the file called setup.exe
- After the installer starts follow directions.

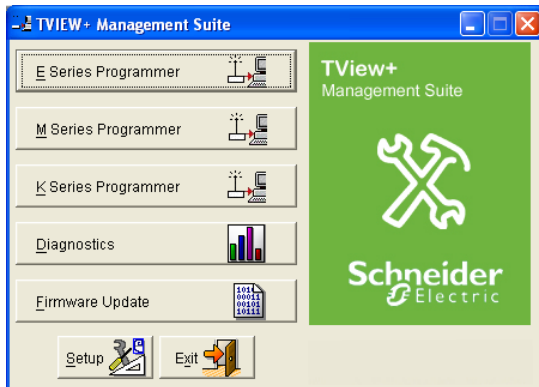
**Other:**

The current E Series Manuals are supplied and installed as part of the TVIEW+ Management Suite installation in Adobe Acrobat format.

Adobe Acrobat Reader is provided on the CD-ROM for installation if required.

**TVIEW+ Front Panel**

When started the TVIEW+ front panel appears. The larger buttons permit each of the five utilities to be started. The diagnostics button may be greyed out if this utility has not been installed or found in the correct file directory. Access to Advanced Set-up Parameters and an exit facility are provided by the remaining 2 buttons.



**Programmer - Main Window**

When first started the programmer is in file mode as indicated by the mode field at the bottom right of the panel shown below. In this mode it is possible to open a previously saved configuration file, or configure various programming options and save the configuration to a file.

Note: Modulation type is not available in this mode.

To commence programming a unit (radio remote or base station) a session must first be established by using the “READ” function. If you have a Hot Standby Set-up and are locally connected to the Hot Standby Controller, The programmer will read the currently ‘active’ Base. To select which base you want ‘active’ there is a switch on the front panel of the Hot Standby Controller that controls active base toggling.

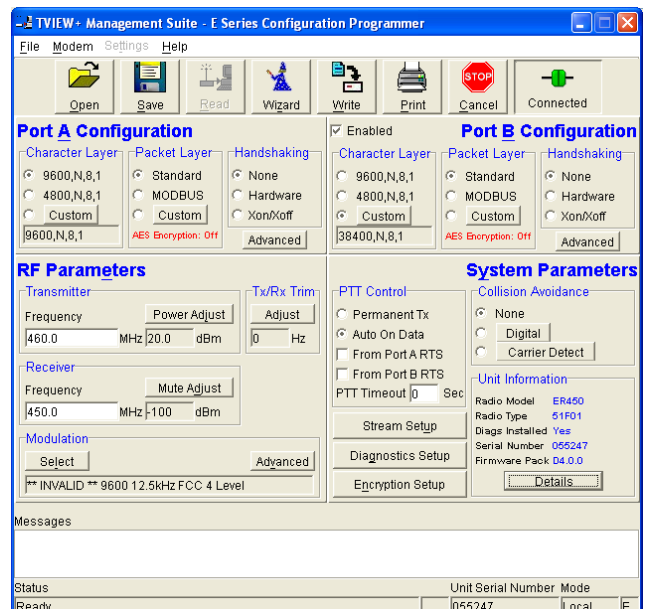
The READ function reads the current configuration from the unit and displays it in the main window. The “mode” displays changes to local or remote depending on the type of session selected at the read function. Several options in the main window may be blanked out until a session has been established with a unit.

Note: Changing any item on the menu will in general not take effect until data is written back to the unit using the “WRITE” function.

The procedure to follow for normal programming of unit is:

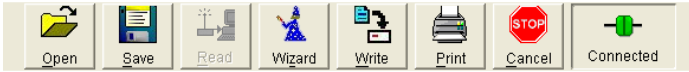
- Read unit
- Configure parameters (or Open a previously saved configuration file)
- Write unit

Several modems of the same radio type can be programmed with the same configuration using the clone facility described in Clone Mode. It is important to note that when using this facility the cloned radio should be of the same type to ensure it does not operate outside its capability.



**Pull Down Menus and Toolbar Buttons**

The items on the pull-down menus can be selected either directly with a mouse or using the ALT key in combination with a HOT KEY (e.g. ALT-F to select the file menu). Several of the functions within each menu are also available on the toolbar (click once to select).



**File Menu**

The file menu allows the user to load (open) or save configuration data as well as to quit the program. The files are saved with an “.cfg” file extension

Open (also available on the toolbar)

This function is used to load an existing configuration file that can be used to directly program the radio or to use as a starting point to edit configuration parameters. Note that a session must be established with the unit by initially reading the configuration parameters from the unit prior to being written to a unit.

If in file mode the modulation type will not be displayed. If in local/remote mode and a file that was saved from local/remote mode is opened, then modulation type will be imported and used, but only if it is valid for the connected hardware. If not, then the unit’s read modulation type will be used.

Save (also available on the toolbar)

This function is used to save the current configuration parameters to a file for future recall.

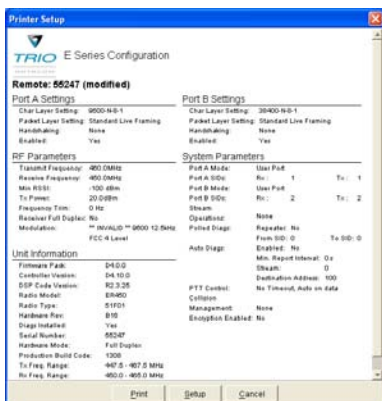
If in “file mode” only basic RF, Port and System parameters are saved and re called. If in local/remote mode then modulation type is saved and re called.

Print (also available on the toolbar)

This function prints out the configuration data to the default printer in a standard format. There are no options for this item.

This should be used if a complete record is required for site/unit configuration. Firmware/Modulation/Diags/Hardware type are all printed.

Exit (also available on the toolbar)



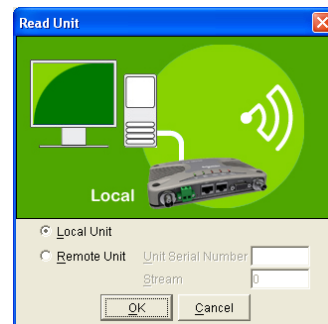
This function terminates the program. The user is requested to confirm this selection before exiting the application.

**Modem Menu**

This radio menu allows configuration data to be read from and written to the unit (remote radio or base station) using the selected PC serial port connection (see Settings menu). The action of reading the configuration establishes a session with the unit. Communications is maintained with the unit to ensure that the session remains open. If the session has been lost due to data transmission errors or disconnection of the programming cable it will need to be re-established to ensure any updated configuration is written successfully to the unit.

Read (also available on the toolbar)

This function establishes a session with the unit, reads configuration data from the unit and displays it in the programmer main window. When selected a dialogue window appears prompting the user to choose whether the unit to read is local (connected directly to the serial port or remote (connected over the air to the unit connected to serial port). Unit no. (Serial no.) must be entered and the stream SID code is “on” (default =0)). After configuration data is read from the unit it is available for editing and writing back to the unit or saving to a file. The progress of data transfer to or from the unit is indicated by a message window as well as a rotating indicator in the bottom right hand corner of the main window.

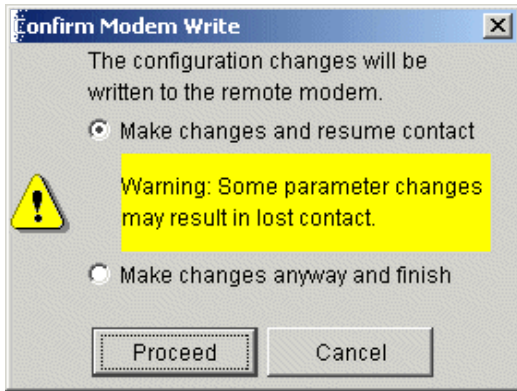


Write (also available on the toolbar)

This function writes configuration data displayed in the main window to the unit and reboots the unit. When selected a dialogue window appears prompting the user to confirm whether to proceed. A progress indicator in the bottom right hand corner of the main window is displayed while data is being read. This selection is only available if a session has been previously established and maintained with the unit.

This dialogue provides a facility for reversing any remote configuration changes that cause unexpected results resulting in the device reverting to previous configuration if contact is lost.

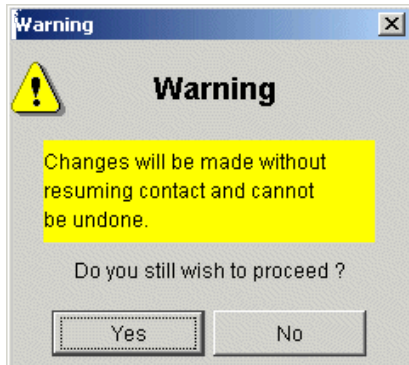
Choose “Make changes and resume contact” to safeguard changes. Some parameter changes (such as frequency change) will, by definition, automatically result in lost contact.



Choose "Make changes anyway and finish" to complete intentional changes which will result in lost contact.

After configuration data has been written, the session with the unit is closed and the programmer reverts to file mode.

Note: In general, any change made on the programmer screen must be written to the unit (using the write function) to become permanently stored. However, changes to Power adjust, Mute adjust and Tx/Rx trim take



immediate effect to allow test and adjustment prior to permanent storage via the write function.

Cancel Session (also available on the toolbar)

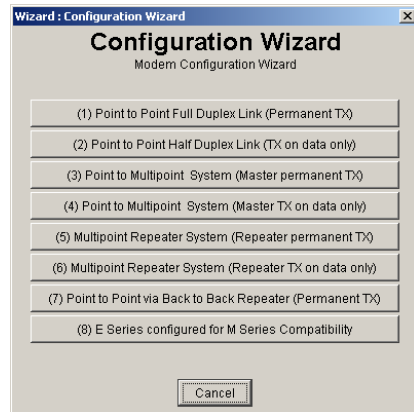
This function closes the session with unit and puts the programmer back into file mode. All configuration changes are discarded including changes to Power Adjust, Mute Adjust and Tx/Rx Trim.

Wizard (also available on toolbar)

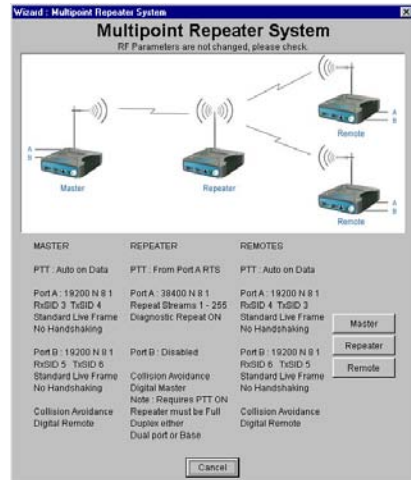
This function permits the user to select standard configurations after the configuration from a unit has been read or a file opened.

The user is prompted via a series of dialogue windows to select the desired configuration that can then be written to the unit (remote radio or base station).

Clone Mode



This function permits writing of the same configuration data to several units. This feature is normally used for configuring data radio modems connected locally.



The procedure is:

- Read the configuration from the first unit.
- Configure the parameters (or open a previously saved configuration file).
- Select Clone Mode (Modem menu).
- Write the configuration to the first unit.
- Connect the next unit.
- Write the next unit which establishes a session and recognises the unit serial number and type, which then configures the unit
- Repeat the last 2 steps for the remaining units.

Settings

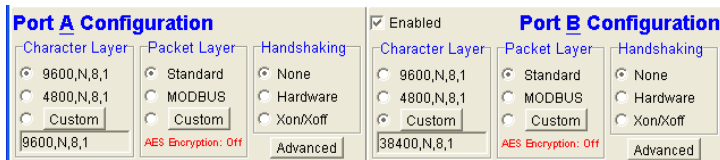
This menu permits selection of the PC serial port (COM1 to COM99 if available) to be used for communications with the unit. COM1 is the default selection and if a different port is to be used it must be set before establishing a session by reading the configuration from a unit. Whilst a session is established with a unit this menu can not be accessed.

Help

This menu permits selection of help information using the Contents key. Warnings regarding use of the programmer software using the Warnings key and version detail using the About key.

**Port A and Port B Configuration**

Data from these two user ports is multiplexed for transmission over the air. Each port can be configured separately for the Character layer (Data speed, number of data bits, number of stop bits, parity), Packet layer and Handshaking (flow control). Port B must be enabled if required by setting the check box at the top of its configuration section.



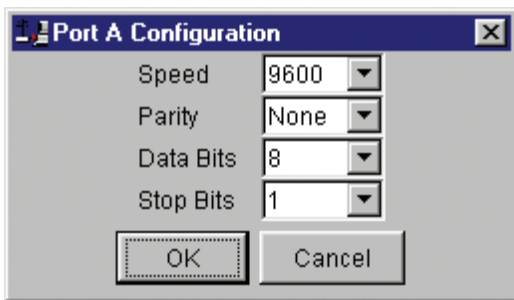
The following description is common to both ports.

**Character Layer**

There are two standard formats and a custom format that can be selected by checking the appropriate control button to the left of the description. The standard formats are:

- 9600,N,8,1 (data speed = 9600 bps, no parity, 8 data bits, 1 stop bit)
- 4800,N,8,1 (data speed = 4800 bps, no parity, 8 data bits, 1 stop bit)

A non-standard format can be selected via the Custom button that displays a dialogue box to permit selection of data speed, parity, number of data bits and stop bits. Once selected the OK button should be used to complete the selection. The custom selection is also displayed in the main window below the Custom button.



**Packet Layer (Packet Modes Only)**

There are two standard configurations and a custom configuration which can be selected by checking the appropriate control button to the left of the description. There are essentially two basic modes of operation for the packet assembler and disassembler (PAD).

The first is where the PAD operates in a standard mode with data received at the port being immediately sent over the radio channel.

The second is a store and forward or delayed mode where whole data packets are received from the port before being sent over the radio channel.

In both cases data is sent over the radio channel in variable length frames and delineation of these frames is dependent on the configuration selected as well as the characteristics of the data stream received at the data port.

The packet layer configuration options that can be selected are:

Standard (live framing)

With standard live framing data received from the host by the modem is immediately placed into a frame and transferred onto the radio channel. This minimises “store and forward” delays in the data transmission.

If a stream of characters is received by the modem, then several characters at a time may be placed into the same frame. The number of characters in the frame depends mainly on the respective baud rates of the user port and the primary channel baud rate of the modem, as well as the level of overheads experienced on the radio channel and the user data stream.

The number of data bits associated with the user data stream will also have an effect on the average size of a frame. For instance the number of stop bits, and number of data bits per character.

The system designer must choose the best compromise of all the above items to ensure the most efficient method of data transmission.

Note: The first few characters are always packetised and sent by itself regardless of all the above variables.

**Modbus**

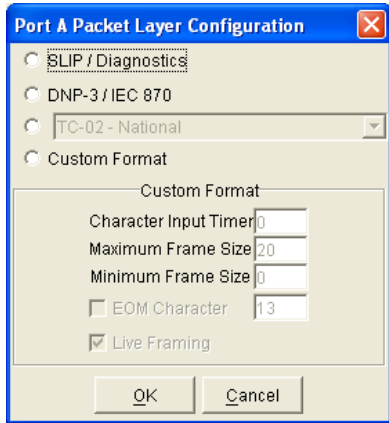
This selection configures the PAD driver with options automatically set to implement the MODBUS protocol, e.g. 5 mSec timer.

**Custom**

Other configurations of the PAD driver can be selected via the Custom button which displays a dialogue box to permit selection of several configuration options as follows:

**SLIP / DIAGNOSTICS**

SLIP is a well known protocol for transferring binary data packets over a data link. Each data packet is delineated by <FEND> characters, and a substitution mechanism exists that allows these characters to be included in the data packet. Appendix B describes the SLIP protocol which is used extensively in UNIX™ based systems, and is closely associated with TCP/IP networks.



The diagnostics controller package uses the SLIP protocol to communicate between base station and remote modems.

**DNP-3 / IEC870**

This selection configures the PAD driver to implement the DNP-3 Protocol and IEC870 Protocol.

**Pull Down Menu Selection**

The PAD driver can be configured for a number of vendor specific protocols by selecting the desired option.

**Custom Format**

This selection permits PAD driver to be configured in a variety of ways and requires a greater understanding of the system design.

For the modem to successfully transmit its packets (or frames) of data over the radio channel, it must be told on what basis to delineate data packets received at the data port. Once the end of a data packet has been received at the port the data frame is closed and transmission over the radio channel commences. Delineation of data packets can be configured to occur via any combination of:

- A pre-defined minimum time delay between packets received at the port. Typically the time delay would reflect the absence of a couple of characters in the data stream at the specified user port baud rate.
- Limiting the maximum number of characters which can be put in the data frame sent over the radio channel.
- Receipt of a selected end of message (EOM) character at the port. An ASCII carriage return (character 13) is often used for this purpose.

As each data frame to be transmitted over the radio channel has overhead data consisting of checksums and SID codes. The system designer must determine the best compromise between the ratio of overhead versus user data which depends on packet size and user data packet transmission latency.

The fields which can be configured are:

- **Character Input timer:** Set the input timer value in ms or enter zero to disable. Range 0 - 255.
- **Maximum Frame Size:** Set the maximum number of characters or enter zero to disable. Range 0 - 4095.
- **Minimum Frame Size:** Set the maximum number of characters or enter zero to disable. Range 1 - 255. Only available when AES Encryption is on.
- **EOM Character:** Select the check box to the left of the description to enable and enter the EOM character as a decimal value. Range 0 - 255.
- **LIVE Framing:** Select the check box to the left of the description to enable live framing mode.

Note : When AES encryption has been turned ON, the packet layer is modified to suit the fixed format requirements of AES encryption. This may result in changes to the data latency and throughput in some modes.

**Handshaking (Packet Modes Only)**

If the standard PAD is selected (i.e. any settings apart from SLIP/Diagnostics), then flow control can be either hardware handshaking, XON/XOFF protocol or none.

Note: Handshaking is not supported when using Bell 202 modes. The XON/XOFF flow control is not supported when using the SLIP/Diagnostics protocol.

The Handshaking section of the screen allows the selection of either of the handshaking methods as well as allowing handshaking to be disabled.

Details of the two handshaking methods are given below.

**Hardware**

The modem acts as Data Communications Equipment (DCE) and supplies to the host controller the following interface signals:

Data Set Ready	(DSR)
Data Carrier Detect	(DCD)
Clear To Send	(CTS)
Receive Data Output	(RXD)

The host controller must act as Data Terminal Equipment (DTE) and supplies to the modem the following interface signals :

Data Terminal Ready	(DTR)
Request To Send	(RTS)
Transmit Data Input	(TXD)

- DCD

DCD has several modes of operation. It is set to TRUE when data is being transferred from the modem to the host - RXD line active. The signal is asserted approximately 500ms before the start bit of the first character in the data stream and remains for approximately 1 character after the last bit in the data stream. The other modes of operation are dependent on the advanced settings.

- DSR

DSR is permanently set to TRUE.



- CTS

The CTS is a signal from the modem to the host informing the host that the modem is able to accept incoming data on the TXD line. It responds to the actions of the RTS line similar to the operation of a “standard” line modem.

The CTS is FALSE if the RTS line is FALSE. Once the RTS line is set to TRUE (signalling that the host wants to send some data to the modem on the TXD line), then the CTS will be set TRUE within 1 ms, if the modem is capable of accepting more data.

The CTS line will be set to FALSE if the transmit buffer in the modem exceeds 4075 bytes, or the number of queued frames exceeds 29 to ensure that no overflow condition can occur.

- RTS

The RTS line is used for two reasons. The first is to assert the CTS line in response to RTS. The RTS line can also be used to key up the transmitter stage of the modem.

- DTR

The DTR line is used for flow control of data being sent from the modem to the host controller. When the host is able to accept data it sets this line to TRUE, and if data is available within the modem, it will be sent to the host. If the host cannot accept any more data, then it sets the DTR to FALSE, and the modem will stop all transmissions to the host.

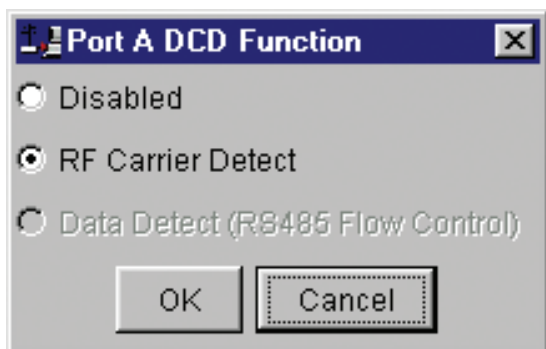
- Xon/Xoff

If the flow control mechanism is XON/XOFF then the modem uses the standard ASCII control codes of DC1 {^Q=11(Hex)=17(Dec)} for XON and DC3 {^S=13(Hex)=19(Dec)} for XOFF. The DTR input line is totally ignored.

Note: There is no substitution mechanism employed in the XON/XOFF protocol, so care must be taken when transferring binary data to ensure that invalid flow control characters are not generated.

**Advanced**

This button provides access to the advanced features of the port configuration. When selected a dialogue box appears which permits selection of the source for the port DCD output signal.



Disabled

This selection disables the DCD output on the port. This selection is not permissible if hardware based flow control has been selected.

RF Carrier Detect

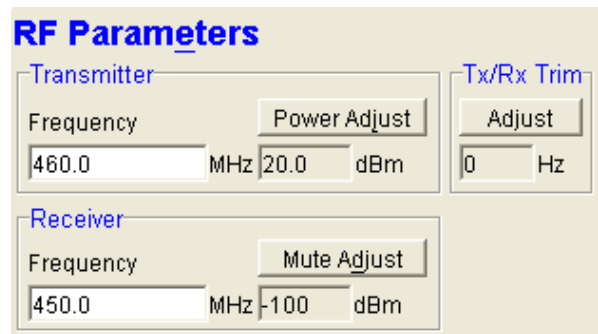
This selection causes DCD to be asserted at the onset of an RF signal that is higher than the mute setting. This will generally occur several milliseconds before data is transmitted from the port.

Data Detect (RS485 Flow Control)

This selection causes DCD to be asserted when data is about to be transmitted from the port. This option is not available if handshaking is set to “None” or “Xon/Xoff”.

**RF Parameters**

This section of the main window permits adjustment of transmitter and receiver, radio channel modulation scheme, frequency trim and advanced features.



**Transmitter**

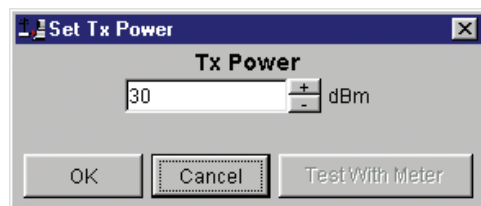
The transmitter can be configured for transmit frequency and power level.

Frequency

The required transmit frequency in MHz can be entered in the display field. The programmer checks that the selected frequency is in the range for the particular model of radio and provides warnings if it is not.

Power Adjust

The currently selected transmit power is displayed below the button in dBm. The power level can be adjusted by selecting this button which displays a dialogue box. The up/down keys, or a typed in value, can be used to select the required power level in dBm steps. There are two methods for setting the power.



- Using Factory Calibration

To use the factory calibration of the radio the desired power is set immediately using the OK button in the dialogue box. This method permits the transmit power to be set without energising the transmitter. Note that although the transmit power has been adjusted it must be written to NVRAM using the modem "Write" function to ensure it is retained after a power on reset.

- Using a Power Meter

To overcome manufacturing variations in the power setting a more accurate setting of power can be achieved by the selecting the "Test With Meter" button in the dialogue box. This displays another dialogue box warning the user that the transmitter is about to be energised and that the power meter used should be able to handle at least 10 Watts from the modem.

Selecting OK in this warning dialogue box will energise the transmitter which will also be indicated by the red transmit LED on the unit. The power is adjusted using the up/down keys until the required power level is obtained. Selecting OK will retain the power setting and turn the transmitter off.

Note: Although the transmit power has been adjusted it must be written to NVRAM using the modem "Write" function to ensure it is retained after the modem is rebooted.

Selecting "stop test" will stop and leave you in power adjust box. "Cancel" will stop test and take you back to the main window.

### Receiver

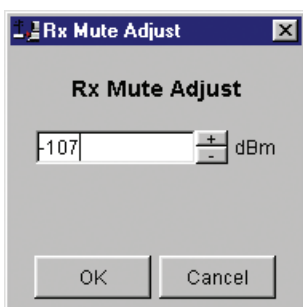
The receiver can be configured for receive frequency and mute level.

#### Frequency

The required receive frequency in MHz can be entered in the display field. The programmer checks that the selected frequency is in the range for the particular model of radio and provides warnings if not.

#### Mute Adjust

The currently selected mute level is displayed in the main window below the button in dBm. The mute level can be adjusted by selecting this button which displays



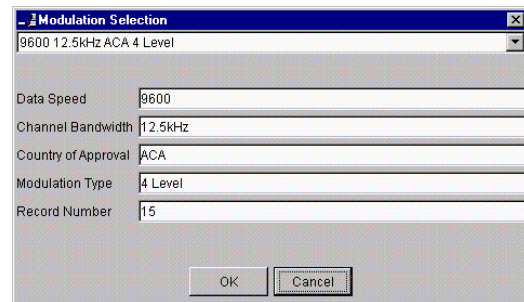
a dialogue box. The up/down keys, or a typed in value, can be used to select the required mute level in dBm steps. Whilst a session is in progress with a unit the mute level adjustment is live. Selecting OK will retain the mute level setting. Note that although the mute level has been adjusted it must be written to NVRAM using the modem "Write" function to ensure it is retained after the modem is rebooted.

Whilst the modem is capable of receiving extremely weak radio signals, and successfully extracting the data content from the waveforms the mute level should be set to assist the modem in filtering out unwanted signals. Unwanted signals can be the result of background noise or interference. The mute level should be set at a level above these unwanted signals and at a level low enough to detect the wanted signal. Detection of a received signal above the mute level is indicated by the "RxSig" LED on the unit.

### Modulation

The radio modem utilises a DSP to control the modulation of transmit signals and demodulation of received signals. This provides greater flexibility in the ability of the radio modem to support new modulation schemes whilst maintaining compatibility with existing modulation schemes.

The currently selected modulation scheme is displayed in the main window below the select button. The modulation scheme can be adjusted by selecting this button which displays a dialogue box. The desired modulation scheme can then be selected from the pull-down menu in the dialogue box and retained using the OK button.



The type of modulation available for selection is dependent on the model of radio. Modulation types are sorted using the following criteria : Country of Approval (FCC, ETSI, ACA), Radio Channel Bandwidth (12.5kHz or 25kHz), Radio Mode (E Series, M Series, D Series or Legacy) and over the air speed (2400bps, 4800bps, 9600bps, 19k2bps).

Only modulation schemes suitable for the radio model in use are available for selection. Please consider the following notes when choosing a modulation:

#### Country of Approval :

FCC : for use in North America and other countries who use FCC approved radios.

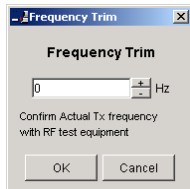
ACA : for use in Australia only.

ETSI : for use in Europe and other countries who use ETSI approved radios.

Legacy Modulation Schemes: Some modulation types are specifically for backwards compatibility. These include Bell 202 modes and D Series compatibility modes. These legacy modes should only be chosen when backward compatibility is required as their performance is inferior to the generic modulation schemes (bandwidth and RF sensitivity).

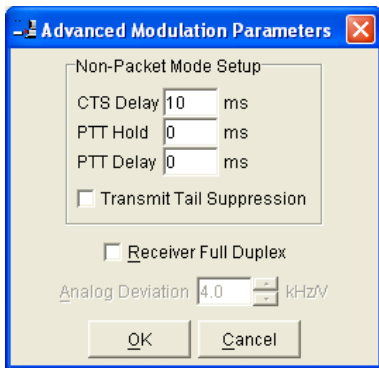
**Tx/Rx (Frequency) Trim**

The currently selected frequency trim, which is common to both transmitter and receiver, is displayed in the main window below the button in Hz. The frequency trim can be adjusted live by selecting this button which displays a dialogue box. The up/down keys can be used to select the required frequency offset in steps pre-determined by the radio modem. Selecting OK will retain the frequency trim setting. Note that although the frequency trim has been adjusted it must be written to NVRAM using the modem "Write" function to ensure it is retained after the modem is rebooted.



This facility permits correction for drifts in the frequency reference caused by component aging. For example, a standard crystal may vary in fundamental frequency operation over 1 year by one part per million. An adjustment range of 1 10ppm, displayed in Hz, has been allowed for and if this is insufficient the unit should be returned to the dealer/factory for re-calibration.

**Advanced**



This button permits setting of advanced features. When selected a dialogue box appears which permits configuration of various parameters.

Non-Packet Mode Setup (Non-Packet and Bell 202 Mode Only)

CTS Delay : the amount of time between RTS enabled to CTS active.

PTT Hold : the amount of time the transmitter will remain enabled after RTS is disabled.

Note: When replacing an MDS4710 radio operating in Bell 202 mode, the E Series radio needs to have PTT Hold set to 10mS to account for the extra delay in the radio when compared to an MDS radio.

PTT Delay : the amount of time between RTS enabled and the transmitter becoming active.

Transmit Tail Suppression : Minimises garbage characters at end of transmission. (Available in Bell 202 Mode only.)

Receiver Full Duplex

This check box should only be ticked when the radio is operating in "full duplex" mode and with a "full duplex" hardware platform. For standard half-duplex remotes this option should not be ticked. For other modes please consult the factory for further information.

Note: This parameter is set in the factory to the correct state and should not be altered without factory consultation.

**System Parameters**

This section of the main window configures the PTT control, collision avoidance, stream setup for routing of data, advanced features and provides unit information.

**PTT (Press To Transmit) Control (Packet Modes Only)**

RF transmission can be configured to occur permanently, automatically on data received at Port A or Port B, or RTS being asserted on Port A or Port B. A PTT timeout facility can be configured to limit the period for which the transmitter is enabled. Each option is selected by setting the control to the left of the description on the main window. When PTT is active the "Tx" LED on the unit is illuminated and RF power is being fed to the antenna.

Permanent Tx

This will cause the transmitter to be permanently enabled (keyed) and displays another dialogue box warning the user that the transmitter will be energised immediately after the configuration is written to the unit. Selecting OK confirms this setting. The other PTT selections are disabled when this option is selected.

Note: This option is only available for full duplex units when being programmed locally.

Auto On Data

This will cause the transmitter to be enabled (keyed) automatically on data received at Port A or Port B and included in a complete frame for transmission over the radio channel. The maximum period for which the transmitter will be enabled is limited by the PTT timeout setting.

From Port A RTS

This will cause the transmitter to be enabled (keyed) on Port A RTS being asserted. The maximum period for which the transmitter will be enabled is limited by the PTT timeout setting. Applications which rely on establishing a link ahead of data being transferred require this method of activation.

From Port B RTS

This will cause the transmitter to be enabled (keyed) on Port B RTS being asserted. The maximum period for which the transmitter will be enabled is limited by the PTT timeout setting. Applications which rely on establishing a link ahead of data being transferred require this method of activation.

PTT Timeout

The PTT timeout facility is used to disable the transmitter if it exceeds the designated time. The timeout value can range from 1 to 255 seconds and the facility is disabled by setting a zero value.

The timeout value chosen for this should be set according to system requirements which may include:

- Prevention of a remote unit remaining keyed up and locking out all other remote units in a point to multipoint system.
- Limiting the period a remote unit remains keyed up to prevent battery drain in a low power application.

Note: If a PTT timeout occurs before completion of a data transmission data will be lost.

Stream Setup (E&M Modes Only)

This button brings up a dialogue box to permit editing of Stream Identifier (SID) codes which are used by the modem as the addressing mechanism for data stream routing. A SID code can be placed at the start of each data frame as it is sent over the radio channel. The receiving modems use this code to determine how to route the data message. The modem supports simultaneous operation of both Port "A" and Port "B" over the one radio link, along with the inclusion of a diagnostics data stream.

Each port is independent and supports multiple options which are described in the following sections.

The following diagram illustrates the structure of the stream routing function for each data port.

User Port

This option is selected by clicking on the User Port button and filling in the RXSID and TXSID fields to the right. The radio comes preconfigured with default values.

In User Port mode all SID code operations are performed transparently to the user data. Data placed into a user port which has been assigned a specified SID code, will only be received by a modem at the other end of the radio link that has a user port assigned with the same SID code. The SID code is added by the radio modem to the user data stream and removed by the radio modem when user data is outputted to a data port.

In this way, Port "A" and Port "B" can be assigned different SID codes, thereby separating the data streams.

Two SID codes values are available for each user port RXSID and TXSID. The RXSID codes apply to the data being received by the modem, and the TXSID codes apply to the data being transmitted by the modem. This allows for different transmit and receive codes if required, but generally they would be both the same.

A situation where Tx and Rx SID codes may be different is in a repeater configuration. In this type of application all data messages sent to the repeater will be "repeated". Thus by having different Tx and Rx codes, a control unit will not "hear" its own transmission, and remotes will not hear the reply from any other remote. For more information please consult the Schneider Electric Trio E Series training material available as a power point slide from our website at [www.trio.com.au](http://www.trio.com.au)

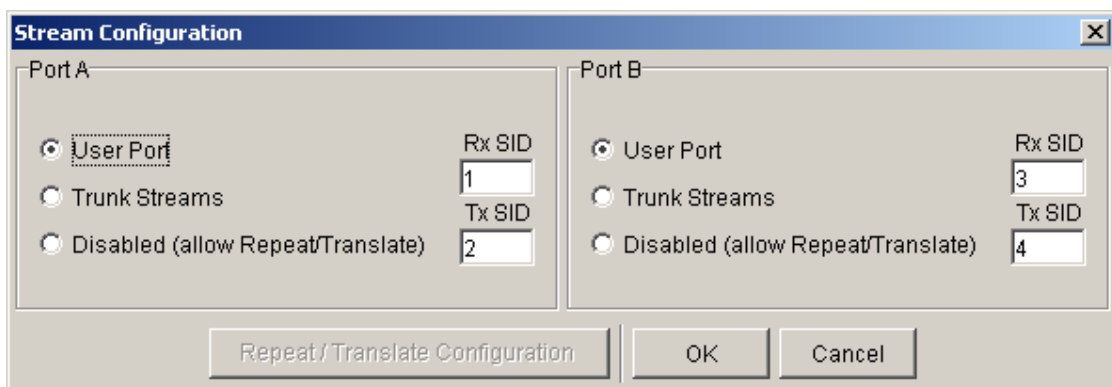
The diagnostics facility (when installed) also uses SID codes. The diagnostics data simply uses a different data stream to the user data, but is processed internally by the modem. If access to the diagnostics facility is required, similar to when the diagnostics utility is used with the modem, then the data port concerned and the diagnostics stream, must have the same SID codes assigned to them. Alternatively the System port can be used, which is 19.2K, Slip.

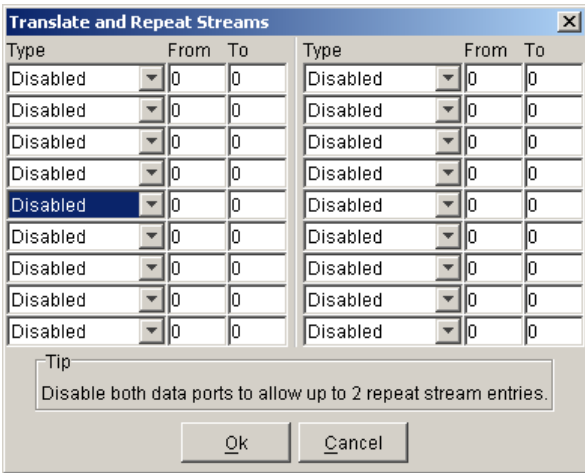
Trunk Streams

In the Trunk Streams mode, data that is inputted into the modem for transmission must have a SID code appended to the start of the data packet. This mode requires the use of a "SLIP" interface as configured using the packet layer.

Trunk Steam mode is normally used in conjunction with TView Diagnostics software, when connection to a MSR Stream Router or when connecting radios together such as a back-to-back connections as used in multiple point to point links.

In Trunk Stream mode a range of SID codes can be transmitted and received via a data port. This range is specified when this mode is selected. In a typical application, such as a back to back connection as used in a multiple point to point links, where all data (including diagnostics) from one radio needs to be "trunked" through to the other radio, the range used is 0 to 255. Trunked mode allows a configurable selection of data streams to be "trunked" to other equipment yet the data remains separated as the SID codes are appended to each packet of data outputted.





Repeat/Translate Configuration

The modem is capable of operating in a repeater mode. Each user port can be configured as a separate repeater. The associated user ports are effectively disconnected from the “outside world” when in repeater mode. Data received from the radio channel is passed directly to the transmitter, and placed back onto the radio channel. This feature requires a firmware revision of R2.1 2.1 or later.

The repeater must receive a complete frame of data before it is retransmitted. In some systems this store and forward delay may be significant, and careful selection of maximum frame sizes configured at the source unit must be considered to minimise the delay.

To enable the mode select “Repeat Range” in the Type field and specify the range of SID codes for which will be repeated.

Maximum of 2 repeat ranges can be used, ensure there is no overlap of SID ranges.

Translate Streams

This function is similar to repeat streams however it also translates the SID code from one value to another as the repeating function occurs.

This mode can be used to controlled data repeating in systems where more than one repeater is required, such as store and forward system or pipe-lines. If translate is not used then a ‘Ping Pong’ effect would occur between to adjacent sites.

Maximum of 16 translates can be used. Do not translate from the same SID more than once.

Diagnostics SID codes can also be translated. You must configure each radio in TView+ Diagnostics to operate using the SID code you want.

Diagnostics Setup (Packet Modes Only)

Polled Diagnostics

The Diagnostics Processor can be configured to listen for diagnostics on a range of SID codes. The factory default is SID code 0 (From Stream 0 To Stream 0). The diagnostics responses are sent back over the same stream as the questions.

Diagnostics Repeat

This option can be toggled on and off by clicking the button. Some applications will require that a repeater unit in a point to multipoint system repeats diagnostics frames only.

This will be the case when the system diagnostics controller is connected to a remote unit in the system, and it polls the system population from this point. The master unit must retransmit any diagnostic frames that are not addressed to itself onto the remainder of the population.

Automatic Diagnostic Reports

This option allows the configuration of automatic diagnostics. This feature requires a firmware revision of R2.1 2.1 or later. This option automatically appends diagnostics messages when user data is transmitted. This option can be toggled on and off by clicking the “Enable” button.

Minimum Report Interval : Specifies the amount of time before a diagnostics message is appended to the next user data message.

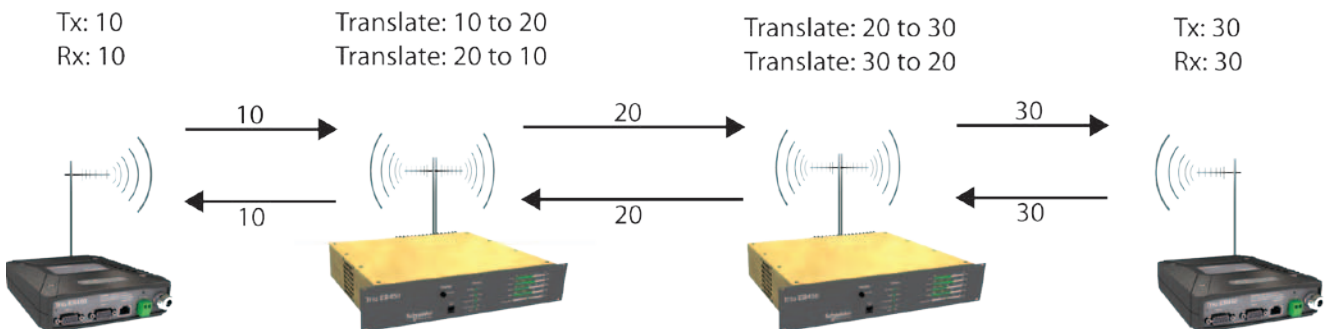
Diagnostic Stream: Specifies the SID code used for the automatic diagnostics message.

Controller Destination Address: Specifies the address of the Diagnostics Controller Software that is receiving the automatic messages and displaying them. This value must match that specified in the TVIEW diagnostics software configuration.

Advanced

The Advanced button can be used to install diagnostics into the E-Series radio if it was not purchased with the original order. Enter the 8 digit key-code supplied by Schneider Electric to enable diagnostics. If diagnostics is already installed this option will be “greyed out”.

SID Translation Example



**Encryption Setup (Packet Modes Only)**



128 bit AES Encryption can be enabled in the radio. AES Encryption is a feature available in the E Series Generation II product (firmware pack 4.x.x and above). Radios that have 128-bit AES encryption enabled can only communicate with other radios that have AES encryption enabled and use the same encryption key.

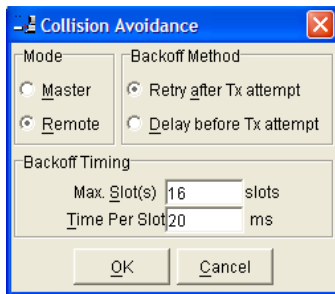
AES Encryption is enabled by selecting the Enabled button and entering an "Encryption key". The "Encryption key" must be between 8 and 16 characters long. The key can contain ASCII or hexadecimal characters. When entering hexadecimal characters, the format must be "0xDD" where DD is a sequence of hexadecimal digits. (0-9,A-F).

When a radio configuration is read from a radio that already has AES encryption enabled, the encryption key will be shown as "\*\*\*\*\*" in the programmer to indicated encryption is enabled. Since there is no mechanism to see the encryption in plain text you must ensure the encryption key is recorded in a safe and secure place for future reference.

Note : When AES encryption is enabled in the radio, both Port A & B packet layer settings may be modified to ensure compatibility with AES encryption mode.

Note : AES encryption is subject to export restrictions and may not be available in all countries.

**Collision Avoidance (Packet Modes Only)**



In a point to multipoint system the master unit (usually a base station) can transmit at any time and the remotes will all receive the broadcast signal. However, if more than one remote unit transmits at a time, then a collision will occur during the multiple transmissions, resulting in a loss of data from one or more units.

Two collision avoidance mechanisms have been included in the modem. The standard (Digital) method utilises a signalling channel which is embedded in overhead data transmitted over the radio channel. The second method utilises detection of a carrier signal to postpone transmission of data. Both methods require configuration of several options for successful operation.

The desired option for collision avoidance is selected by checking the control button to the left of the description on the main window.

None

When selected this turns off all collision avoidance mechanisms. This should only be used in point to point applications.

Digital

This is the standard method of collision avoidance and utilises a channel busy indication bit in the signalling channel transmitted to all remotes for control. 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 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 must be permanently keyed.
- 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

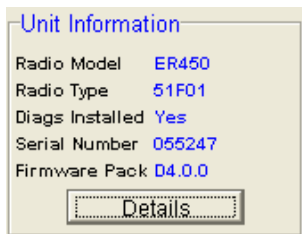
This method of collision avoidance utilises a carrier transmitted to all remotes to indicate that the radio channel is busy. When selected a dialogue box appears and several options must be configured:

- 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 a exciter inside a base station unit. Gen II will be noted where Gen II hardware is detected.

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.
- Tx and RX Frequency Range indicates the frequency range for which the radio is capable of being operated in.

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.

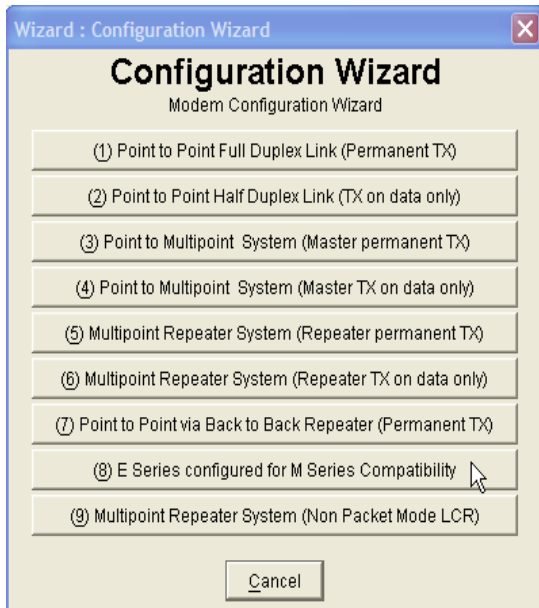
Additional fields located on the status bar include:

- 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.

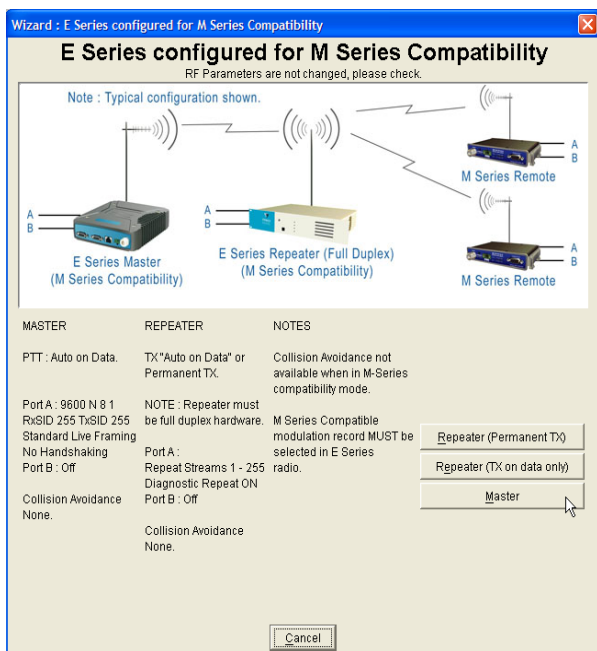
### Configuring E-Series for use with M-Series

Connect the E Series Master radio to the computer using the TView+ Programming and Diagnostics cable Described in the previous section.

Read the E-Series unit. Using the Wizard facility is the quickest way to configure the bulk of the radio configuration parameters. Click on the Wizard button to activate the Wizard menu. Click on Wizard Button number 8: "E Series Configured for M Series compatibility."



Select Master by clicking on the "Master" button. This will pre-configure the radio to a known working configuration suitable for communication with the M Series.



The screen then returns to the normal E Series configuration screen.

Frequencies, TX Power and Modulation Type can now be configured. The following menu will be shown.

- (a) Enter an appropriate TX frequency.
- (b) Enter an appropriate RX frequency.

Note : If using half duplex (ie:different) TX & RX frequencies the Remote M Series radio must have the opposite frequency settings with respect to the Master.

- (c) Change the TX power to 20 dBm.
- (d) Select the appropriate modulation - Normally "9600 12.5kHz M-Series"

Note : The modulation setting must be identical in both E Series

Master and M Series Remote radios for correct operation to occur.

This now completes the E Series configuration programming.



# Part J – Appendices

## Appendix A - Firmware Updates

### Firmware Update Overview

Firmware updates are 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.

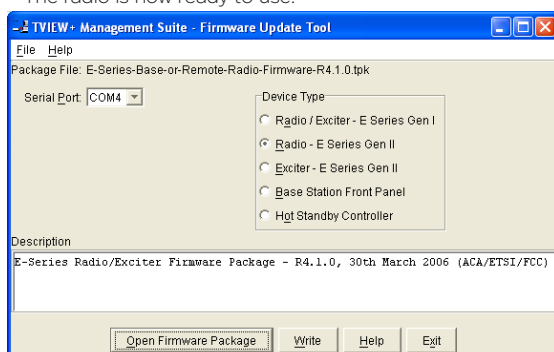
The procedure to update the firmware is different for both E Series Generation I and Generation II radios. Please ensure you have the latest release of the TView+ Management Suite before you attempt a firmware upgrade. This can be obtained from the Trio website at [http://www.triodatacom.com/scada\\_supp.php](http://www.triodatacom.com/scada_supp.php)

### Firmware Update for E Series Remote Radios - Gen II (Serial No 56000 or above)

1. Click on the “E Series Firmware Update” Start the firmware update utility from the TView+ front panel.
2. Connect the TView+ E Series diagnostics/programming cable from the PC Serial (COM) port to the systems port on the radio as shown below. Select the appropriate COM Port if required.



3. Select the “Device Type” as “Radio - E Series Gen II” from the options on the top right of the firmware update main window.
4. Select the file containing the firmware update package using the “Open Firmware Package” 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. Initiate the firmware updating process using the “Write” button at the bottom of the main window. Another information window will appear. Wait until the firmware update process indicates the firmware update is “Done”. The radio is now ready to use.

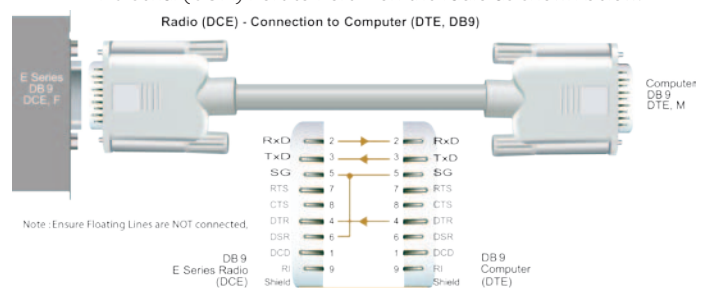


### Firmware Update for E Series Base Station Exciters - Gen II (Serial No 56000 or above)

1. Click on the “E Series Firmware Update” Start the firmware update utility from the TView+ front panel.
2. Connect the TView+ E Series diagnostics/programming cable from the PC Serial (COM) port to the systems port on the base station front panel. Select the appropriate COM Port if required.
3. Select the “Device Type” as “Exciter - E Series Gen II” from the options on the top right of the firmware update main window.
4. Select the file containing the firmware update package using the “Open Firmware Package” 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. Initiate the firmware updating process using the “Write” button at the bottom of the main window.
6. Depress the Base Station F/W Update switch on the Front Panel of the Base Station using a suitable probe. This switch is located below the “Display ON/OFF” button and to the left of the Systems Port. In order to depress the switch a small object such as a paperclip is required.  
Note: The base station will display all LEDs as AMBER indicating the firmware update is in progress.
7. Another information window will appear. Wait until the firmware update process indicates the firmware update is “Done”.
8. Remove DC power to the base station and re-apply power to ensure the base station returns to normal operating mode.

### Firmware Update for E Series Remote Radios and Base Station Exciters - Gen I (Serial No 56000 or below)

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 an E Series Gen I Firmware Update cable from the PC serial (COM) Port to Port B on the radio as shown below.



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.

Note: The firmware update of a base station exciter will result in the base station flashing all LEDs RED with the fan on. This error condition will only occur whilst the firmware update is in progress.

- Select the file containing the firmware update package using the “Open Firmware Package” 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.
- Initiate the firmware updating process using the “Write” button at the bottom of the main window. Another logging window will appear.
- 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.

**Note: Remote radio status LEDs including power will all be off.**

- 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.
- Disconnect the cable from Port B and re power the unit to enable the new firmware.

### Base Station Display Firmware Update

Installation Instructions:

- Update of the front panel firmware uses the firmware update utility supplied with the TView+ Management Suite.
- Start the firmware update utility from the TView+ front panel.
- In the firmware update utility select device type as “Base Station Front Panel”
- Select the file containing the firmware update package using the “Open Firmware Package” 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.
- Ensure that the base station is powered.
- Connect the “TView+ cable” to the front or rear system port of the base station.
- 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.

Note: Display Status LEDs will be lit in this Mode.

- Initiate the firmware update process using the “Write” button at the bottom of the main window. Another logging window will appear.
- 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.

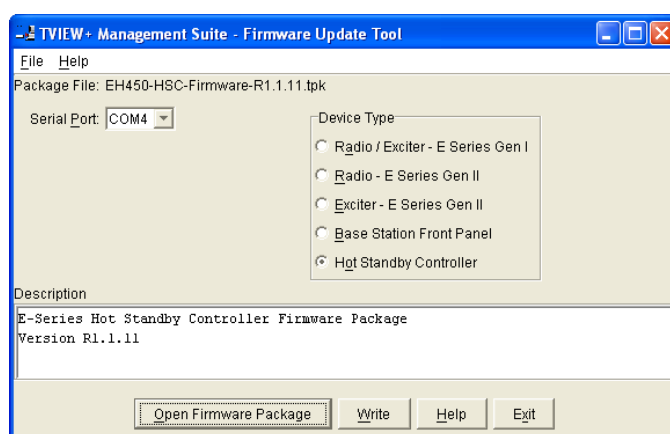
Note: If a mismatch occurs between selected file and device type, an error message will appear.

- Re power the base station to enable the new firmware.

### Hot Standby Controller Firmware Update

#### Installation Instructions:

- Update of the hot standby firmware uses the firmware update utility supplied with the TView+ Management Suite.
- Start the firmware update utility from the TView+ front panel.
- In the firmware update utility select device type as “Hot Standby Controller”.
- Select the file containing the firmware update package using the “Open Firmware Package” 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.



- Ensure that the hot standby controller is powered.
- Connect the “TView+ cable” to the front or rear system port of the hot standby controller. .
- On the hot standby controller front panel, depress and hold the “Reset Alarms” button, then momentarily depress the firmware update switch using a suitable thin probe. Now release the “Reset Alarms” button. The two LEDs either side of the “Select” switch should turn green indicating the hot standby controller is in firmware updating mode.

Note : The firmware update switch is located behind the small hole (not labelled) in the front panel to left of “Reset Alarm” button.

- Initiate the firmware update process using the “Write” button at the bottom of the main window. Another logging window will appear.
- 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.

Note: If a mismatch occurs between selected file and device type, an error message will appear.

- Repower the hot standby controller to enable the new firmware.

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## Part K – Support Options

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### E-mail Technical Support

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.

#### **Technical Support: Europe, Africa, Middle East**

Available: Monday to Friday 8:30am - 5:30pm  
Central Europe Standard Time

Direct Worldwide: +31 (71) 579 1655  
Email: euro-support@controlmicrosystems.com

#### **Technical Support: The Americas**

Available: Monday to Friday 8:00am - 6:30pm  
Eastern Standard Time

Toll free within North America: 1-888-226-6876  
Direct Worldwide: +1 (613) 591-1943  
Email: technicalsupport@controlmicrosystems.com

#### **Technical Support: Asia Pacific**

Available: Monday to Friday 8:30am - 5:30pm  
Australian Eastern Standard Time

Direct Worldwide: +61 3 8773 0100  
Email: support@triodatacom.com

