K Series Data Radio
User Manual

Schneider Electric

Contents

Part A – Preface

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 potentialy 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.

Warranty

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 unauthorized 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

This manual covers the operation of the K 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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Brazilian Compliance Notices

ANATEL - Resolução 506

Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferência prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário.

FCC Compliance Notices

FCC Part 15 Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

This device must not be modified in any way or FCC compliance may be void.

FCC Approved Antennas

This device can only be used with Antennas listed in Appendix I of this K Series User Manual. Please Contact TRIO Datacom if you need more information or would like to order an antenna.

RF Exposure

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 26cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

MAXIMUM EIRP

FCC Regulations allow up to 36 dBm effective isotropic radiated power (EIRP). Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain (in dBi) cannot exceed 36 dBm.

FCC Point to Point: More EIRP may be allowed for fixed point to point links. With the transmitter set to 27dBm, an antenna gain (subtracting cable loss) of up to 15 dBi is allowed. For antenna gains of more than 15 dBi in a fixed point to point link, the power must be backed off from 27dBm by 1dB for every 3dB the antenna gain exceeds 15dBi.

Australian Compliance Notices

MAXIMUM EIRP

ACMA Regulations allow up to 30 dBm (1 Watt) of effective isotropic radiated power (EIRP) in the 915MHz license free band and 36 dBm (4 Watts) of EIRP in the 2.4GHz band. Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain cannot exceed the above stated EIRP limits.

EU (ETSI) Compliance Notices

RF Exposure

2.4GHz Model: To satisfy EU (ETSI) requirements, a separation of 3cm should be maintained between the antenna of this device and persons during operation.

MAXIMUM EIRP

ETSI Maximum EIRP for the 2.4GHz band is +20dBm.

SAFETY

Warning: Where a KR240 is to be operated above 65°C ambient, it must be installed in a restricted access location.

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

Applies to models KR900-xxxxx-xHx (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 with locking screws as supplied by TRIO Datacom MUST be used.

WARNING EXPLOSION HAZARD

Revision History

Issue 10-12 (October 2012) - Added details for DIN mounting kit.
Issue 02-13 (February 2013) - Added sensitivity details for various data rates
Issue 03-13 (February 2013) - Added specifications to rear of manual

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, Naturresourcen 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.

Low Voltage Safety (Europe)

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.

The KR240 has been classified as SELV throughout. All ports shall be connected to like circuits and shall not extend beyond the building boundary of the host equipment unless connected via an isolation unit compliant with the requirements of section 7 of EN60950-1.

Part B – K Series Overview

Introduction

The advanced Schneider Electric Trio K Series frequency hopping data radio sets the standard for professional high speed serial data communications in the license free 900MHz and 2.4GHz bands.

With maximum range and virtually unlimited system coverage due to its unique LinkXtend™ network bridging and KwikStream™ high speed repeater capabilities, the industrial strength K Series is ideally suited for the most demanding point to multipoint and point to point wireless SCADA and Telemetry applications.

The highly versatile K Series also offers dual user ports with MultiStream™ data routing and TRIO TVIEW+ network-wide diagnostics compatibility.

Product Range

The TRIO K Series comprises of the following models: the KR900, which operates within the 915MHz license free frequency band (country specific models apply), and the KR240 that can be configured for use in the 2.4GHz license free bands available throughout the world.

KR Series Data Radio

KP Series Data Radio

KB Series Data Radio

Features and Benefits

Outstanding and highly versatile operational capability

- Point to point and point to multi-point operation
- Configurable personality – master-remote-bridge-repeater
- KwikStream™ high speed single radio repeater mode *
- Unlimited coverage networks
- No restriction on the number of radios in any system
- Unique dual antenna LinkXtend™ technology increases usable range
- Repeater and Bridge units support locally connected user devices
- ChannelShare™ collision avoidance for spontaneous remote transmissions allowing simultaneous polling and spontaneous reporting
- Multi-function LED display
- * Up to 140km single repeater system range with 6dB antennas

A Radio and Modem that extend performance boundaries

- License free operation in 900MHz and 2.4GHz ISM frequency bands
- 256k high speed over-air data rate (can be reduced to 128k, 64k or 32k for longer range)
- Robust, frequency hopping spread spectrum technology for superior interference immunity
- Ultra Long Range high performance receiver *
- 1 Watt (+30dBm) maximum allowable transmitter power in the 900MHz ISM Band
- 0.5 Watt (+27dBm) transmitter power in the 2.4GHz ISM Band
- Advanced error free data delivery with CRC
- Multiple security layers including 256-bit AES data encryption (export restrictions may apply)
- Multi-Master synchronization mode for interference reduction with co-located master radios
- High VSWR protection (900MHz Version)
- Fully integrated radio, modem and data multiplexer/router
- * Up to -108dBm @ <1x10-6 BER receiver sensitivity giving up to 70km maximum single hop line-of-sight range with 6dB antennas (900MHz)

Comprehensive and adaptable User Data interfacing, control, and transmission

- Dual independent user configurable data ports

- Separate always on-line system port avoids the need to interrupt user data for configuration access

- Selectable 300 -230 kbps asynchronous RS-232 and RS-485 interfaces

- User selectable Hardware handshaking or 3 wire data port interface

- Suitable for most industry standard data protocols. E.g.: MODBUS, DNP-3, IEC 870-5-101, etc.

- Low latency pseudo full duplex Point-Point mode (for sensitive protocols, e.g., SEL Mirrored Bits®)

- MultiStream™ simultaneous data stream delivery allows for multiple vendor devices/protocols to be transported on the one radio network - compatible with TRIO E Series and M Series

- Flexible data stream routing providing optimum radio channel efficiency

Total command of the radio system with TView+™ Network Management and Remote Diagnostics

- Remote and local fully transparent simultaneous Network Management and Diagnostics

- Network wide access from any radio modem

- Full SCADA style features such as database, trending and networking

- Full graphical Diagnostics presentation (HMI)

- User friendly Windows™ GUI configuration software

- Over-the-air reconfiguration

- Powerful system commissioning and troubleshooting tools

- Integrated graphical spectrum analysis

- Seamless integration with TRIO E Series and M Series diagnostics and remote configuration

- Field upgradeable firmware

A Data Radio for the harshest environments and places

- Reliable operation in environmental extremes

(-40ºC to +70ºC)

- Hazardous Environment Certification – Class I, Division II (Groups A,B,C and D) (900MHz Version)

- FCC & ETSI certification - accepted in multiple regions

- Compact, rugged alloy housing

- Low power consumption with smart sleep mode operation

- 10-30Vdc power supply

- Dual industry standard TNC antenna connectors (KR)

- Dual industry standard SMA antenna connectors (KP & KB)

Order Matrix Trio KR900 | KR240 | KP900 | KP240 | KB900 | KB240 Model Code

	Kyxxx-aabbb-cde represents the part number matrix
Model	**Model Type**
K	K-Series
Code	**Select: Unit Type**
R	Remote station with full enclosure for panel or DIN rail mounting (DIN rail mounting bracket sold separately)
P	Remote station with compact enclosure for panel or DIN rail mounting (DIN rail clips sold separately)
B	Remote station, board-only version for standoff mounting (standoffs not included)
Code	**Select: Generic Frequency Band**
900	900MHz
240	2.4GHz
Code	**Select: Frequency**
	900MHz Frequency Band
00	License-free band 902 to 928 MHz (FCC/IC) - Hopping on 67 channels
01	License-free band 915 to 928 MHz (ACMA) - - Hopping on 31 channels
05	License-free band 921 to 928 MHz (New Zealand)
06	License-free band 902 to 907.5MHz and 915 to 928MHz (Brazil) - Hopping on 43 channels
	2.4 GHz Frequency Band
00	License-free band 2.4GHz, 500mW (FCC/IC/AUS)
01	License-free band 2.4GHz, 100mW (ETSI)
	Note: Other frequency bands available upon request.
Code	**Select: RF Channel Data Rate & Bandwidth (Internal Modem)**
001	32Kbps to 256Kbps
Code	**Select: Encryption (subject to country of use)**
D	No encryption* (standard on all shipments outside of USA, Canada and Australia)
E	Encryption* (standard within USA, Canada and Australia)
Code	**Select: Approvals**
A	CSA Hazardous Environment Class 1, Div 2 (standard on KR900 | KP900 | KB900)
H	ATEX II 3G, Ex nA IIC T4 compliance (standard on KR240 | KP240 | KB240)
Code	**Future Option**
0	None

* Export restrictions may apply. Contact factory for details.

Example: KR900-00001-EH0 specifies Trio KR900 Remote Station, License-free band 902 to 928 MHz (FCC/IC), 32kbps to 256kbps, Encryption and CSA Hazardous Area Approved

Communications Standards:
FCC – Federal Communications Commission (USA)
IC – Industry Canada
ETSI – European Telecommunication Standards Institute
ACMA – Australian Communications Authority

Part C – Network Types

Introduction

Fundamental to understanding the use of K Series Data Radios in your system is the need for a basic understanding of the different types of radio network topologies (known as NETWORK TYPES) and the function of each radio within them (known as RADIO TYPES).

The following table provides a brief overview of each:

Network Types:

Point to Point (PTP): One MASTER radio is configured to communicate with a REMOTE radio in PTP mode.
Point to Point via Bridge (PTP/B): As per PTP mode but with additional network range extension using a LinkXtend™ Bridge.
Point to Multipoint (PTMP): One MASTER radio is configured to communicate with multiple REMOTE radio(s) a PTMP network
Point to Multipoint with Bridges (PTMP/B): As per PTMP network but with additional network range extension using a LinkXtend™ Bridge.

Radio Types:

Master: Defines the Master radio in a network. The function of the master is to provide synchronization of the network and management of the radio protocol. There is always one master per network.
Remote: A remote radio in the network. The function of a remote is to communication with the master either directly or via one or more Bridges.
Bridge: A radio that provides network extension between a MASTER or another BRIDGE and additional REMOTES. A BRIDGE is a device with dual personalities, behaving as a REMOTE to its MASTER for 50% of the time, and then behaving as a MASTER for its REMOTES for the remaining time.

Each type of network is described in the following diagrams.

Point-to-Point Networks (PTP)

A Point to Point (PTP) network has one Master and one Remote radio. The available data bandwidth is shared between the two radios in each direction. Because a PTP network only has two radios, the over-the-air protocol can be optimized to provide best possible bandwidth, latency and security.
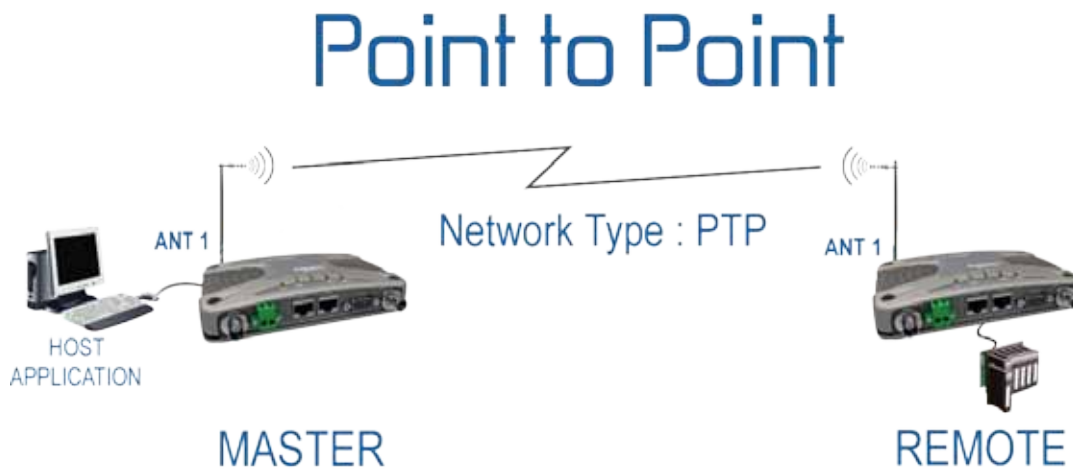
Each hop is divided into two halves. The Master can transmit in the first half and the Remote in the second half. This mode of operation is called Pseudo Full Duplex due to the shared division of available bandwidth. Due to the well defined nature of channel access in PTP mode, data collisions due to the Master and Remote trying to access the channel at the same time do not occur.

Pseudo Full Duplex has the advantage that it appears to the connected device to be a full duplex cable with a specific bandwidth (i.e: even if one device transmits continuously it will not block the other device from sending data). This is useful for applications that expect full duplex communications or that are not designed to be radio modem friendly. The disadvantage of Pseudo Full Duplex is that the bandwidth is divided equally for each direction, even if one direction does not use its available bandwidth.

Receipt of data (in either Master to Remote OR Remote to Master directions) is acknowledged by the receiving radio. This provides the most efficient means of guaranteed data delivery as data does not need to be blindly "re-transmitted" which decreases the available bandwidth. For more on data acknowledgements and retransmissions refer to the section "XXX" in Part D.

It is also possible to create a Point to Point (PTP) network using the Point to Multipoint (PTMP) Network Type and using only one Remote. In the PTMP mode, system bandwidth is not shared equally, but when additional REMOTE sites are added at a future date, the existing radios will not need to be reconfigured making additional Remote site deployment easier.

Point-to-Multipoint Networks (PTMP)

A Point to Multipoint (PTMP) network is normally chosen when one site (i.e.: The HOST) needs to broadcast messages to multiple REMOTE sites.

Because of the broadcast nature of this network topology, the HOST application needs to have an addressed structure. Most industry standard MAS protocols support this style of addressing. The diagram below describes the basic setup of the network.
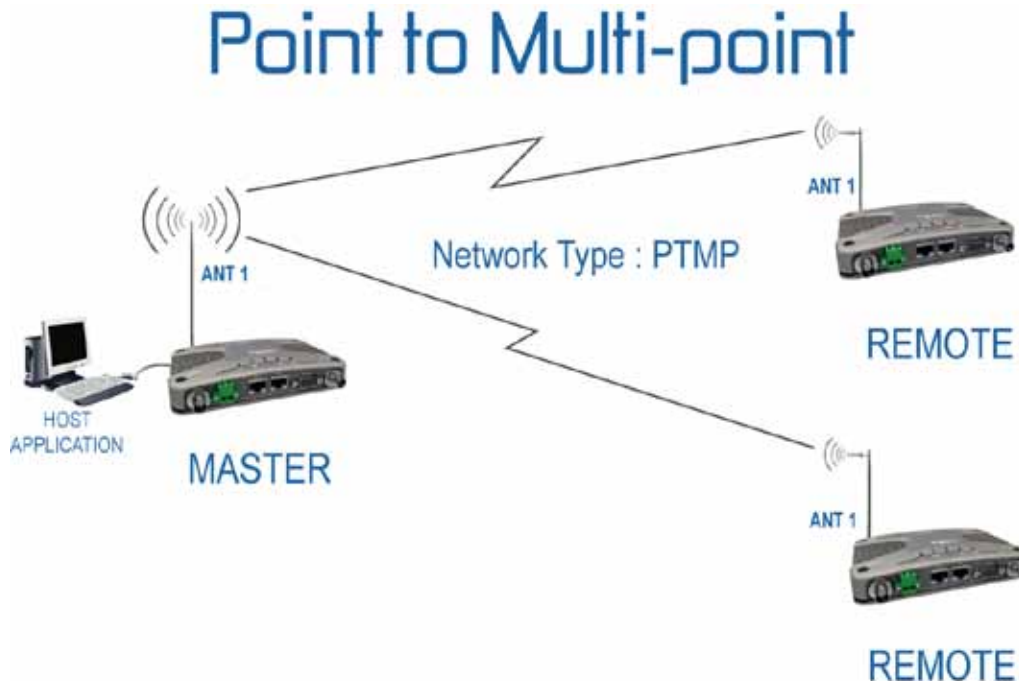
Point to Multipoint (PTMP) operation requires the Master site to have adequate RF coverage of all Remote sites which need to synchronize to the Master. A PTMP offers the best available bandwidth and data latency when multiple remote sites are required.

If used in conjunction with an exception reporting protocol (ie: DNP3) or when multiple applications are used on the network (ie: A DNP3 RTU on Port A and a MODBUS PLC on Port B) it is possible for more than one Remote radio to attempt to access the Master at the same time. This will cause data collisions, which requires the Remote radios to re-try their access to the Master. The result is a reduction in bandwidth and an increase in latency.

To optimize the access to the Master in this scenario, it is strongly recommended to enable the ChannelShare™ collision avoidance feature. The ChannelShare™ feature will minimize data collisions and increase effective throughput using a smart channel access strategy. More information on ChannelShare™ digital collision avoidance technology can be found in Part D of this manual.

The Master radio needs to be located at a site which has adequate RF coverage of all Remote sites. If this is not possible, then Point to Multipoint via KwikStream™ Repeater is the preferred network topology.

The bulk of network specific radio configuration parameters are configured in the Master radio. Remote radios in the network "learn" these configuration options from the Master. Remote radios can be added to the network without need to reconfigure the Master.

System wide diagnostics is available from any one remote to any other radio in the network. If ChannelShare™ digital collision avoidance is not enabled, it is recommend to use Automatic Diagnostics reporting, which synchronises diagnostics reports with SCADA data to prevent data collisions from occurring.

It is recommended that omnidirectional antennas are used for the MASTER site and directional yagi antennas are used for REMOTE radio sites as this will provide maximum system gain legally allowed.

Point-to-Multipoint via KwikStream™ Repeater

A Point to Multipoint via KwikStream™ Repeater network is a variation of the Point To Multipoint network. It is normally chosen when the site where the SCADA (i.e.: data) entry point does not have adequate RF coverage of other Remote sites in the network. The network diagram is shown below.
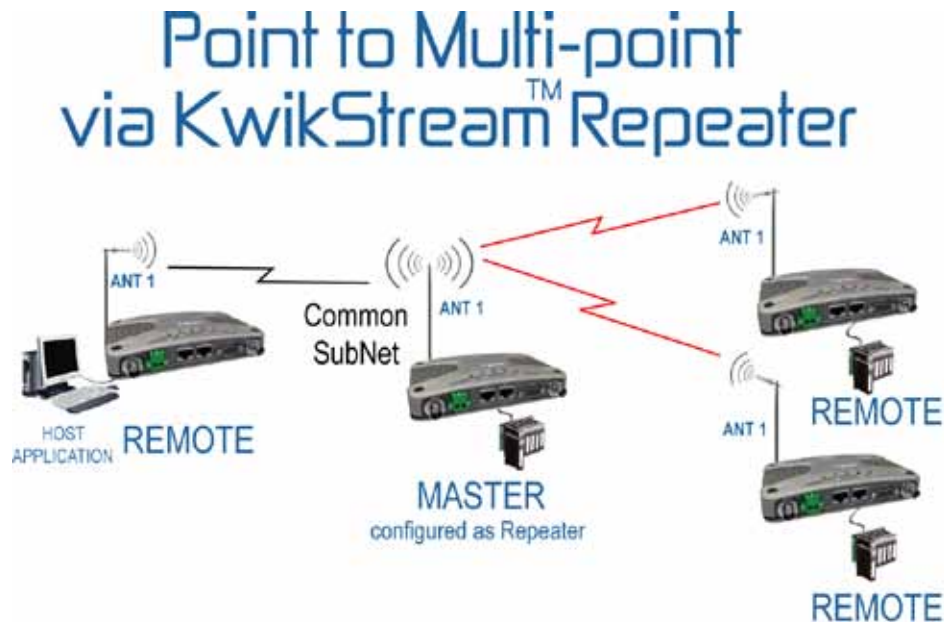
In this network topology, the Master radio is configured as a Repeater. The repeater should be located at a site with adequate RF coverage to each of the remotes. The Repeater still behaves as a Master to the Remotes as in a Point to Multipoint network, but the Repeater is configured to repeat data messages between remotes in the network. It therefore allows peer to peer communication to occur between remotes.

Because the Master radio now needs to "Repeat" data, data latency for messages from the Host Application to/from the Remotes will be longer. However, the Repeater implements a smart repeating technology called KwikStream™ which allows the Repeater to perform multiple transactions within any one hop, ensuring available bandwidth remains high and data latency is kept low. KwikStream™ technology is achieved using a virtual "loop-back" plug ensuring data is repeated quickly and no user port with physical loop back plug is required. A key advantage is that a local RTU/PLC device can be located at the Repeater site and peer to peer communication is supported for this unit.

For more information on KwikStream™ technology please refer to the appropriate section in Part D of this user manual.

All other aspects of the Point to Multipoint network apply to this network topology.

Point to point with LinkXtend™ Bridge (PTP/B)

The typical range of the Point to Point (PTP) Network Type can be extended using the unique dual antenna LinkXtend™ technology. This is achieved using a special radio mode called BRIDGING. . A dual antenna LinkXtend™ bridge allows the maximum range possible from a single radio store and forward technology whilst remaining within legal antenna EIRP limits. A typical Point to Point with Bridge network is shown below.

The Point to Point with LinkXtend™ Bridge (PTP/B) type of network requires one Master, one or more Bridges and one Remote radio. The Bridge operates in two different modes which alternate depending on what hop (odd or even) the hopping pattern is currently on.

During even numbered hops, the Bridge functions as a Remote to the network Master. Using the location of the Bridge in the network as a reference point, any data sent from the Bridge to the Master is sent "Upstream".

During odd numbered hops, the Bridge functions as a Master for the Remote radio. Using the location of the Bridge in the network as a reference point, any data sent from the Bridge to the Remote is sent "Downstream".

Thus a Bridge is a radio which functions both as a REMOTE and a MASTER in a time division multiplexed network.

When implementing this network it is important that the NETWORK TYPE is selected as Point to Point via Bridge (PTMP/B). This ensures the network is divided up into multiple Sub-nets that support the time division multiplexing of the system required by the Bridge. Each Sub-Net uses a completely different hopping pattern so that multiple Bridges in the network will not interfere with each other.

Master to Bridge communication occurs on one Sub-Net whilst Bridge to Remote communication occurs on another Sub-Net. The Master radio is responsible for network timing so that the Bridge is always operating in the correct mode ensuring data is not lost due to collisions between Master and Remote.

Each additional bridge in the network requires the definition of a new Sub-net. For more information on Sub-Nets, refer to Section D of this user manual. Network latency is doubled when compared to the latency of a network without bridges but due to the high speed nature of the K Series family, network latency is seldom an issue.

When Bridge mode is selected the radio can be configured for either a single antenna or dual antenna. Only on sites that require dual antenna LinkXtend™ technology does a bridge need to operate in dual antenna mode. There are no limits to the number of bridges allowed in any one network but additional Bridges will result in extra latency due to the time taken to transport data through the bridge.

It is recommended that omnidirectional and yagi antennas are used for BRIDGES (depending on network design) and directional yagi antennas are used for MASTER and REMOTE radio sites as this will provide maximum system gain legally allowed. However, some sites where Bridges may be located may not require the use of dual antennas and in these situations a single omnidirectional antenna can be used. For more information the dual antenna port feature please refer to Part D of this User Manual.

All other aspects of the Point to Point (PTP) network previously mentioned apply to this type of network.

Point to Multipoint via LinkXtend™ Bridge (PTMP/B)

Note: It is recommended that you first read Part C - Point to Multipoint (PTMP) Networks and Part C - Point to Point with LinkXtend™ Bridges before reading this section.

The typical range of the Point to Multi Point (PTMP) Network Type can also be extended using dual antenna LinkXtend™ technology. This is achieved using Bridges which operate in the same way as described in Point to Point with LinkXtend™ Bridges (PTMP/B) networks. A typical Point to Multi-Point with Bridge network is shown below.
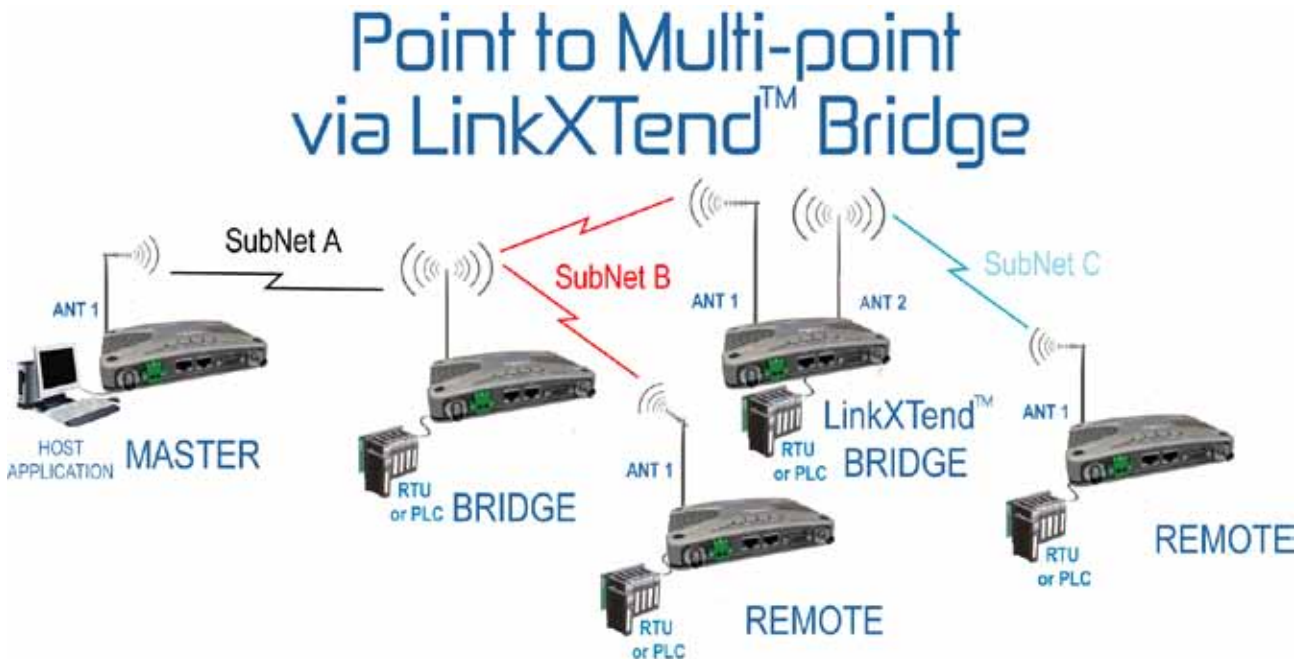
This type of network includes a Master, two or more multiple Bridges and multiple Remote radios.

If used in conjunction with an exception reporting protocol (ie: DNP3) or when multiple applications are used on the network (ie: A DNP3 RTU on Port A and a MODBUS PLC on Port B) it is possible for more than one Remote radio to attempt to access the same Bridge at the same time. This will cause data collisions, and as such the it is recommended to use the ChannelShare™ collision avoidance feature. More information on ChannelShare™ digital collision avoidance technology can be found in Part D of this manual.

The Point to Multipoint via Bridge network topology should only be chosen when two or more Bridges are required. If only one "Store and Forward" site is required then the Point to Multipoint with KwikStream™ Repeater network topology offers more bandwidth and lower latency. However, the LinkXtend™ dual antenna feature is only available when a Bridge network is selected.

Remote radios can synchronize to any Bridge or the Master in the network. The actual device the remote will synchronize to depends on the Sub-Net ID specified in the remote radio. For more information on Sub-Net refer to Part D of this User Manual.

The bulk of network specific radio configuration parameters are configured in the Master radio. Remotes and Bridges in the network "learn" these configuration options from the Master. Remotes and Bridges can be added to the network without need to reconfigure the Master.

System wide diagnostics is available from any one remote to any other radio in the network. If ChannelShare digital collision avoidance is not enabled, it is recommend to use Automatic Diagnostics reporting, which synchronises diagnostics reports with SCADA data to prevent data collisions from occurring.

Part D – Features

Features Useful for Optimizing Performance.

In addition to the settings made to establish Radio Type, Network Type and Subnet ID there are a number of parameters set into the Master radio to optimize the performance of a radio network.

Over the Air Data

All user data is sent over the air packaged into data packets. A full description of how the data is packaged into packets is beyond the scope of this User Manual. However, some features require more overhead (or management data) than others.

The total amount of data sent in one single hop depends on the hop interval, RF data rate and the amount of data that is waiting to be sent. The larger the total amount of data, the smaller the ratio overhead compared to user data.

In almost all situations the default settings of the radio will provide the adequate performance. However, under some circumstances, it may be necessary to fine tune specific features so an understanding of how these features work is important.

RF Data Rates

The RF Data Rate determines the over the air speed of the modem. Essentially it defines how much bandwidth is available. As the data rate increases the sensitivity of the receiver decreases. For each incremental jump in RF data rate, the RF sensitivity decreases by approximately 3dB. For maximum sensitivity the lowest data rate can be selected. However, it is recommended to use 128k for most systems as this offers the best compromise between RF sensitivity, bandwidth and latency.

The K-Series offers four selectable data rates.

256kbps with BER of 1E-6 @ -102dBm

128kbps with BER of 1E-6 @ -104dBm

64kbps with BER of 1E-6 @ -106dBm

32kbps with BER of 1E-6 @ -108dBm

The configuration setting for RF Data Rates can be found in the "Network Parameters" section of the programmer.

Hopping Intervals

Frequency Hopping Spread Spectrum FHSS) radios like the K Series operate in an unlicensed shared frequency band and collisions can be expected when multiple radios are operating in the same area.

Due to the hopping nature of the radio, the radio "hops" between a specific number of distinct frequencies in a specific pattern. The length of time that the radio remains on any one frequency is called the "Hopping Interval". Data is transferred between radios during this time.

Once the hopping interval has expired, the transmitter (if active) is stopped, and all radios in the system "hop" to the next frequency in the hopping pattern. Whilst the radios are hopping, no data can be transferred between radios.

When two radios in the same area are transmitting on the same unique frequency, a data collisions may occur and this will prevent successful data transfer until one or both radios "hop" onto another frequency.

Shorter hop intervals will reduce the amount of time that any such collisions may impact on the radio link and as such will make the radio link less susceptible to interference. However, the usable bandwidth of the radio will be reduced because the ratio of time spent hopping to a new frequency vs time spent transmitting data is higher.

Longer hop intervals will increase the amount of time that any such collisions may impact on the radio link and as such will make the radio link more susceptible to interference. However, the usable bandwidth of the radio will be increased because the ratio of time spent hopping to a new frequency vs time spent transmitting data is lower.

The radio will default to a Hopping Interval of 100mS. For more systems, this setting provides a good balance between susceptibility to interference vs usable bandwidth.

The configuration setting for Hopping Interval can be found in the "Network Parameters -> Advanced" section of the programmer.

Multi-Master Synchronisation (KR only)

When more than one K Series network share a physical site (i.e: antennas for each network are in close proximity) the two radios can interfere with each other due to receiver blocking and desensitization.

This may happen when one radio at the site is transmitting and the other radio is receiving. The receiving radio will be subject to interference.

To avoid this problem, all co-located master radios can be synchronised to transmit at the same time. This is achieved by configuring one Master radio as the "primary" Master and all other Master radios as the "secondary" Master. With a wire link between Pin 9 on Port B joining all radios and Pin 5 on Port B joining all radios, the "primary" Master sends a synchronisation signal all "secondary" Masters dictating to them when they can transmit and when they must return to receive mode.

To achieve this all Master radios must have the same hopping interval have the appropriate configuration for the General Purpose Pin 9 on Port B (See Port B - Advanced).

Multi-master synchronisation divides each hop interval into half - the first half is a dedicated Master transmit time slot and the second half is a dedicated receive time slot. Because the Masters each have the same hop interval and each hop interval begins at the same time (as synchronised by the primary Master), no Master will transmit when the others are in receive mode.

As such, there is no opportunity for desensitization and interference is limited to a very low statistical probability of two radios transmitting on the same frequency at the same time

Multi-Master synchronisation can also be used in a PTMP system by itself (ie: even if there is only one Master) for the purpose equally sharing the bandwidth in each direction (Master to Remotes and Remotes to Master).

The configuration setting for Multi-Master Synchronisation can be found in the "Port B-> Advanced" section of the programmer.

MultiStream™ and Stream Identification Codes (SIDs)

Introduction

The K Series sends data messages in packets. A feature of the K 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 (i.e: Port A or Port B) 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 user serial ports available on the K Series, or 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.

Technical Operation

Technically an ID tag added to user's data stream. The ID tag value is user selectable, and can be any number from 0 to 256. The addition of an ID tag to the user data stream is transparent and non intrusive. The SID code is added on data entry to the radio modem and removed when data exits radio modem.

In order to add a Stream ID the radio needs to packetize user data. Each user data packet includes overhead and user data. The overhead is made up of a HDLC header, the SID code and a 2-byte checksum. The user data itself is defined by the packet layer rules and can be variable in length. The actual format of the packet is shown below.

HDLC Header (1 bytes)	SID Code (1 bytes)	Variable Length User Data (n bytes)	XSUM (2 bytes)

To summarise, the use of MultiStream™ requires three steps:

(1) Configure the Packet Layer to define how packets are created.

(2) Select User Port Mode (for RTU/PLC/User Interface) or Trunk mode (for Radio to Radio).

(3) Define SID codes for each data stream in system (user, trunk, repeating or bridging).

Packet Layer (SmartPAD)

The "packet layer" defines how much user data is placed into each packet and how the user data is handled by the radio modem. The amount of user data that can fit within any one hop depends on the RF Data Rate, the hopping interval and how many features are enabled. The features that effect the size of data packet that can be sent in a hop include Encryption, Bridging and Multi-Master Sync.

The K Series Packet Layer uses a unique SmartPAD technology which avoids the requirement for the user to optimize the packet layer settings for all the possible variables. Instead, the radio determines an appropriate maximum user data packet size. The only requirement the user needs to choose is how the receiving radio should output the data.

Standard Packet Layer is a general purpose setting and is compatible with most protocols. User data placed into the transmitting radio modem is packetized and transmitted over the air as quickly as possible.

When the user data packets are received, the user data is outputted on the RS-232 data port immediately. As such, this packet layer setting is best chosen for applications that require low latency in user data transmission.

However, as the user data is "packetized" and output from the receiving radio immediately, there may be small time gaps between each packet, so this packet layer setting is not suitable for MODBUS or similar type protocols. For MODBUS or similar type protocols, please use the MODBUS packet layer.

It is also not recommended to use this packet layer setting for protocols that use exception reporting, such as DNP3 as user data from different remote devices may be interleaved (for instance, if two exception reports occur at the same time). For this type of protocol, please use the DNP3 packet layer.

MODBUS Packet Layer ensures that when a received MODBUS message is outputted from a receiving radio modem, the MODBUS message is MODBUS compliant. This means, there are no inter-character gaps that might be interpreted by a MODBUS device as being the "end of message" sequence.

MODBUS messages that are placed into a radio modem for transmitting are packetized (i.e: fragmented) into smaller "packets" of data and then transmitted over-the-air. This ensures that the data latency is as low as possible.

Each data packet (or fragment) sent by the transmitting radio modem is numbered so that the receiving radio can de-fragment the MODBUS message into its original form.

The transmitting modem detects there is no further data being to be sent for transmission when a period of no data (i.e.: no characters) occurs. This time period is 3 character periods (normally 3mS @ 9600bps). The transmitting modem then packetized the remaining data and identifies that packet as the final packet of the sequence already sent.

The receiving radio modem de-fragments the user data packets as they arrive. Unlike the Standard Packet Layer mode, the MODBUS Packet Layer ensures that the user data is not placed onto the user data port until the final packet is received. Instead, it is placed into the receive buffer. As each numbered (fragmented) packet is received, the modem re-constructs the user data message and once the final packet is received, the user data message is output onto the user port in a MODBUS compliant format (ie: no inter-character time gaps).

DNP3 Packet Layer operates in a similar way to the MODBUS packet layer. The key differences are that the DNP3 messages that need to be buffered by the receiving radio modem can be much longer than MODBUS messages (292 bytes for DNP3 compared to 254bytes for MODBUS).

Another important difference is that DNP3 protocol based systems often use exception reporting. This means that multiple messages need to be de-fragmented and buffered at the same time. Only messages that are complete should be output onto the user port.

SLIP Packet Layer is a special packet layer setting, typically used when inter-connecting radios or connecting MSR/9 Stream Routers to radio. SLIP provides a well defined interface where special "FEND" characters defined the start and end of a message. All "Trunk" mode connections should be made using SLIP format.

Port Modes

The user has the choice of selecting one of two different types of Port Mode for either Port A or Port B. The choice of Port Mode will depend on what type of device is being attached to that port.

User Port Mode:

Typically used for interconnection of the SCADA Host or RTU/PLC type devices. The radio will only output received data packets (to the user port) where the packet has the SID code as defined by the Rx SID parameter of the user port. All data transmitted by the radio (from the user port) is "tagged" with the SID code as defined by the Tx SID parameter for that user.

User Port Mode ensures that the SID codes are transparent and non-intrusive to the user data application.

Trunk Port Mode:

Typically used for interconnection of TRIO radios, MSR/9 Stream Routers for the PC running TView+ Diagnostics. Unlike User Port Mode, Trunk Port Mode ensures the actual SID code is attached to the user data as it is transported across a user port (RS-232). This means that devices like the MSR/9 Stream Router, which route data depending on the value of the SID code, can do so.

Any data packets received within the SID range defined by From/To parameter are outputted to Data Port. The radio assumes first byte of transmitted data is SID code. As such, SLIP mode is always used in trunk port mode because the packet boundaries are clearly defined (with FENDs), and there the radio always knows the first byte of a SLIP frame is the SID code.

Refer to the diagram below for a description of how trunk and user port modes are applied.
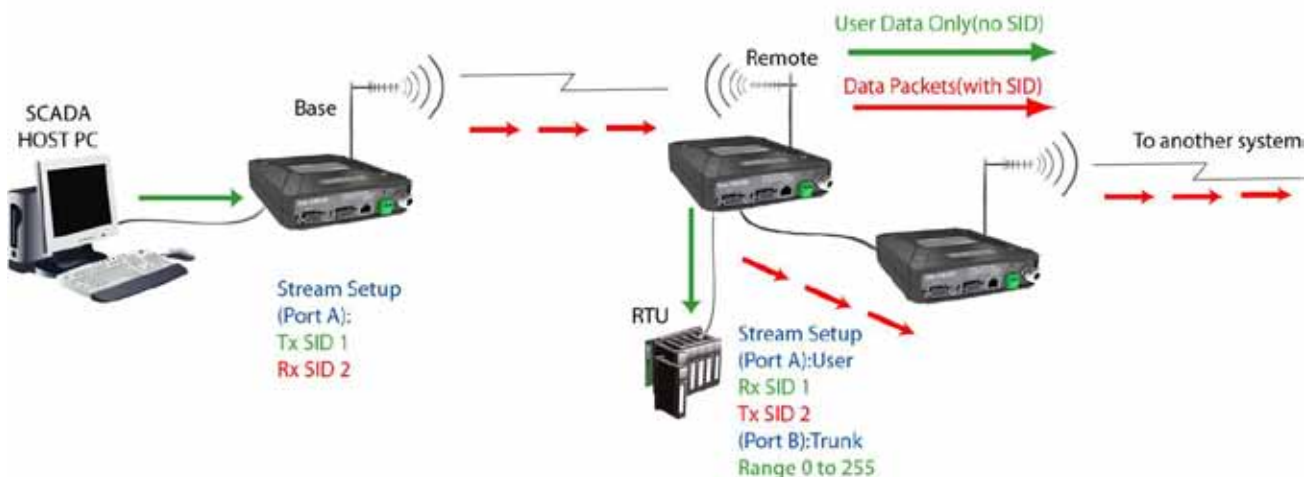
KwikStream™ Repeating

As noted in Part C, for networks using Point to Multipoint topologies, the system designer may choose to use a KwikStream™ repeater. In this mode, the MASTER radio repeats all data received providing "peer to peer" connectivity.

One advantage of KwikStream™ repeating technology is that data is repeated within the same hop, if time allows. This means there is no additional latency when choosing longer hop times with KwikStream™ repeating enabled. KwikStream™ repeating is enabled via the route table as described below.

Configurable Route Table

In networks using KwikStream™ repeaters or bridges, the routing of data from one part of the network to another is controlled by how a user defined packet routing table is configured.

Specific data Streams can be repeated or bridged and this allows network traffic to be handled efficiently. How the data is routed depends on the configuration of the Route Table which can be found under the Unit Parameters -> Stream Setup window.

Route Table Type : Basic

This route table type automatically configures the route table to provide MASTER to REMOTE data communication for poll - response protocol applications. It does not support peer to peer communication (KwikStream™ is not enabled for PTMP networks). If this is required please use "Basic with Peer to Peer" instead.

When selected, Port A on the MASTER radio is mapped to Port A on all REMOTE radios and vice versa. The same rules are applied for Port B, except that a different SID code is used to keep data traffic on each port separate.

This means that one type of application protocol such as DNP3 can be connected to Port A and another type of application protocol such as MODBUS can be connected to Port B. The use of different SID code ensures that DNP3 devices are not sent MODBUS messages and vice versa.

At the MASTER radio, the DNP3 SCADA Host is connected to Port A and the MODBUS Host is connected to Port B. Alternatively, Port B does not need to be connected at all.

The "Basic" route table type offers the most efficient means of data routing because no repeating of data is required.

Route Table Type : Basic with Peer to Peer

This route table type automatically configures the route table to provide MASTER to REMOTE data communication and REMOTE to REMOTE data communication for poll - response protocol applications that also implement peer to peer communication. For PTMP network types, it enables KwikStream™ repeating.

To provide peer to peer communication between REMOTE radios, all data received by the MASTER (or a Bridge if used) needs to be repeated. This means that the network bandwidth is lower than a network using the more efficient Basic route table.

Route Table Type : Custom

This allows the user to define custom rules for the repeating or bridging of data. When adding rules to the table, it is important to understand the difference between repeating and bridging.

Repeat: This type of rule will repeat data on SID codes between the values specified in FROM and TO. Only MASTER and BRIDGE radios can repeat data.

A MASTER radio will REPEAT data from any REMOTE or BRIDGE to other REMOTES or BRIDGES. A BRIDGE radio will repeat data from any REMOTE or BRIDGE to any other REMOTE or BRIDGE.

It is important to note that REPEATING only occurs on the DOWNSTREAM side of a BRIDGE. For more information on UPSTREAM and DOWNSTREAM please refer to Part C of this User Manual.

Bridge: This type of rule will BRIDGE data on SID codes between the values specified in FROM and TO. Only a BRIDGE radio can BRIDGE data.

It is important to note that BRIDGING data copies data from an UPSTREAM network to the DOWNSTREAM network and vice versa. As such, a BRIDGE radio must actually have a BRIDGE rule in order to function as a BRIDGE. For more information on UPSTREAM and DOWNSTREAM please refer to Part C of this User Manual.

Digital Collision Avoidance

ChannelShare™

In some network applications there exists the potential for over the air data collisions between REMOTE radios. This can occur when an exception reporting type of protocol is used (such as DNP3) or when multiple applications are being transported over the radio network (such as MODBUS and DNP3).

In both of these scenarios, the possibility exists for two or more REMOTE radios attempting to access the channel (ie: talk to the MASTER) at exactly the same time. If this occurs, both REMOTE radios are unaware of the other trying to access the MASTER and both will attempt to transmit their data. As such, the MASTER will received a corrupted message from both radios and a re-try will be required.

ChannelShare™ digital collision avoidance is a type of MASTER controlled channel access scheme that decreases the possibility for over the air data collisions to occur. It achieves this by having any REMOTE (or BRIDGE) with data that needs

to be transmitted request permission from the MASTER before transmitting the data. The mechanism which is used to achieve this is called a Token Grant.

Token Grants

When ChannelShare™ digital collision avoidance is enabled, the MASTER radio (or BRIDGE that is behaving as a MASTER for its DOWNSTREAM network) issues "Tokens" to each REMOTE (or BRIDGE) radio that needs to transmit data.

When a REMOTE (or BRIDGE) radio has data packets that need to be sent to a MASTER, it first requests a TOKEN from the MASTER (or BRIDGE) radio. When a TOKEN is requested, the requesting radio includes the amount of data that needs to be transmitted.

When the MASTER radio receives the TOKEN request, it determines a suitable time when the requesting radio can access the channel and transmit its data. The MASTER then grants a TOKEN to the radio wants to access the channel, and the TOKEN includes the serial number of the radio being granted, the starting time and length for which the TOKEN applies. All other radios not granted the TOKEN remain silent during the TOKEN period.

The function of the MASTER is to consider and manage all TOKEN requests and only grant TOKENS in such a way that no two devices accessing the channel will cause a collision.

TOKENS are granted to specific radios, based on their serial number. As such, there is no opportunity for multiple radios to become confused about what TOKEN has been granted.

The process of requesting "permission" to send data and receiving the "OK to Send" response does result in increased data latency and slightly slower data throughput. However, the practical reality of systems where large amounts of exception reporting data need to be handled mean the actual throughput perceived by the user is much higher because the number of over the air data collisions is significantly lower.

All radios in the network also employ a small amount of random channel access backoff timing so that when a TOKEN has expired, requests for TOKENs to be granted are not themselves the subject of a large number of over the air data collisions.

Retries and Retransmissions

No Ack Retries

Data transmitted from a REMOTE to a MASTER is acknowledged by the MASTER. No Ack Retry Limit defines how many times the REMOTE attempts to transmit data to a MASTER if NO acknowledgement arrives from the MASTER for the previous attempt by the REMOTE.

Once the No Ack Retry Limit is reached, the data is discarded by the REMOTE. The important point to note is that the No Ack Retry mechanism does not have any bandwidth penalties as it is only required when interference prevents the successful delivery of data to the MASTER radio.

Retransmissions

Except in PTP modes, data transmitted from a MASTER (or BRIDGE) to a REMOTE is not acknowledged by the REMOTE. Data Retransmissions define how many times the MASTER (or BRIDGE) duplicates (or re-transmits) data to the REMOTES. The theory is that even if the REMOTE is subject to interference, at least one of the messages will be received. Duplicate messages are discarded by the REMOTE. Each data re-transmission results in less usable bandwidth in the MASTER to REMOTE direction. However, in a practical system it is a more efficient method of preventing lost data than waiting for the SCADA system to timeout and try again.

Force Retransmissions Across Hops

For increased reliability and protection from other radios operating in the vicinity, it is possible to force the re-transmissions to occur in different hops. The data is first transmitted in one hop and then the second re-transmission takes place on the next hop. This method ensures that each re-transmission will be sent on a different frequency within the hop pattern of the radio and so avoids fixed frequency interference. However, there is a larger decrease in usable bandwidth in the MASTER to REMOTE direction when re-transmissions are spread across multiple hops. To minimise the loss of bandwidth, it is recommended to choose a shorter hop interval.

Power Saving Management

When Power Saving Management is enabled the MASTER radio instructs all REMOTE radios in the network to go to sleep for a specific number of hopping intervals. The number of hopping intervals that REMOTE radios go to sleep for depends on the level of the Sleep State.

The following sleep settings correspond to the following hops asleep:

o Off = 0

o Light = 1 Hop

o Medium = 2 Hops

o Heavy = 5 Hops

Power Saving Management provides for a reduction in current consumption (in REMOTE radios only) but results in increased data latency as the MASTER must buffer and wait until the REMOTE radios have woken up before sending data.

If data is placed into a REMOTE radio during a sleep period, the REMOTE radio immediately wakes up and sends data to the MASTER. This can be achieved because the MASTER radio never goes to sleep.

As such, there are no data latency penalties in the REMOTE to MASTER direction. The data latency penalty in the MASTER to REMOTE direction is proportional to the sleep level.

Similarly, if the MASTER radio has a lot of data to transmit to REMOTE radios, the REMOTE radios are not told to sleep until all of that data is sent. In other words, priority is still biased towards achieving the lowest possible latency for data transmission.

Security

Frequency Hopping Spread Spectrum radios offer a high level of security because it is not possible to eaves drop on data transactions without knowing the hopping pattern being used and having proprietary knowledge about how the data is encoded.

Unlike 802.11 and WiFi equipment which can be purchased "off the shelf" the TRIO K Series employs many levels of defence against security potential security threats.

Security Layers

The K Series Radio employs several layers of security. Each layer is detailed below.

(1) Network Name : The Network Name is used to derive the hopping pattern. The Network Name must be identical in all radios in the Network.

(2) Trusted Remotes/Masters : If enabled, only serial numbers in the Trusted Remotes/Masters list can be communicated with. Serial numbers are unique and factory set. They cannot be manipulated by the user.

(3) Encryption : All data is encrypted with a 256-bit AES encryption key. If enabled, the same key MUST be used in all radios.

Trusted Masters and Trusted Remotes

Trusted Remotes:

MASTER radios can be configured to communicate only with a list of trusted REMOTE radios. Only if the REMOTE radio serial number is in the "Trusted Remote" list can communication to this remote occur. If the list is empty, then communication can occur with any remote and this security feature is disabled.

Trusted Masters:

REMOTE radios can be configured to communicate only with a list of trusted MASTER radios. Only if the MASTER radio serial number is in the "Trusted Master" list can communication to this MASTER occur. If the list is empty, then communication can occur with any MASTER that has the correct Network Name.

Encryption

When encryption is enabled in a network, all data sent over the air is protected from eavesdropping and can only be read by radios sharing the same Encryption Key.

Encryption must be enabled in each radio in a network. The encryption key is 256 bits long and is entered as string or a hexadecimal number. For maximum security the key chosen should be one that is difficult for an intruder to guess.

Once written into the radio using the programmer, it is not possible to read the encryption key so care must be taken to record the key in a safe place.

Encryption Key : String

For a string type of key, use up to a maximum of 32 printable characters. Please note that the key is case sensitive.
Some examples are:

   TRIO2008

   Murray River Region

Encryption Key : Hexadecimal Number

Hexadecimal numbers can have a value of 0 to 15 and are represented by 0-9 and A, B, C, D, E or F
A hexadecimal key begins with 0x and has up to 64 digits following

Some examples are:

   0x123

   0x123456789ABCDEF

   0x111111112222222233333333344444444 up to 64 digits

Channel Exclusion

The K Series radio hop in a unique pattern using a number of different channels in the Licence Free ISM band. The hopping pattern determines the sequence of channels used. By default, all channels in the licence free band are used in each hopping pattern.

If one or more of the channels in the ISM band suffers from high levels of interference, the radio can be configured so that it will not use that channel. The avoids unnecessary over-the-air data corruption and subsequent retries.

To assist with the identification of channels that are subject to interference, the radio and TVIEW+ K Series Programmer provide a software spectrum analyser feature.

Spectrum Analyzer

The Spectrum Analyzer mode is controlled from the "Network Advanced -> Channel Exclusion" Setup. It is recommend to perform this test on in Master radios.

When activated the radio monitors the signal level found in each channel. This test can be performed either in a single sweep or a continuous repeated sweep.

An adjustable threshold level is combined with the results of the channel sweep, so that channels to be excluded can be recommended to the user.

For example, if the sweep resulted in a noise level of -60dbm being detected in a specific channel, and the threshold for acceptance was set at -70dbm, then that particular channel would be added to the exclusion list.

The number of channels that can be excluded in the hopping pattern depends on the type of radio in us. Please consult Part H - TVIEW+ Management Suite Programmer for more details.

Diagnostics

Introduction

Comprehensive diagnostics information can be obtained from the radio which is useful for both system commissioning and network management. The TVIEW+ Diagnostics software application is capable of monitoring and displaying information from the K Series radio such as Temperature , DC Volts, Received Signal Strength, TX Power and data statistics. Please refer to the TView+ WinDiags User Manual for more information.

It is also possible to retrieve diagnostic information using two distinct methods - Polled Diagnostics and Automatic Diagnostics.

Polled Diagnostics

The TVIEW+ Diagnostics software generates a diagnostics poll command which is based on the serial number of the target radio in question. When received by that radio, the radio responds to the Diagnostics software with an up to date list of diagnostics parameters. The diagnostics poll and response message lengths are small, and unlikely to interfere with user data, but in some circumstances it is advised to enable Digital Collision avoidance.

Automatic Diagnostics

When Automatic Diagnostics is enabled, the radio will append diagnostic data to user data transmissions at regular intervals. The benefit of this method is that the diagnostics data is synchronised with the user data and it prevents any chance of a over-the-air data collision. This means that when automatic diagnostics is enabled, Digital Collision avoidance does not need to be enabled (unless required due to user protocol reasons).

Please refer to the TView+ User Manual for more details.

SmartPath™

The K-Series radio provides unique features to enhance connectivity and redundancy in both fixed and mobile applications. Typical SCADA and Telemetry systems require a high degree of radio link reliability. Using SmartPath™ features together with a small amount of system planning, the system designer can create a network topology that provides for multiple alternative radio link paths. This type of network is often referred to as a MESH network and a typical example is shown below.
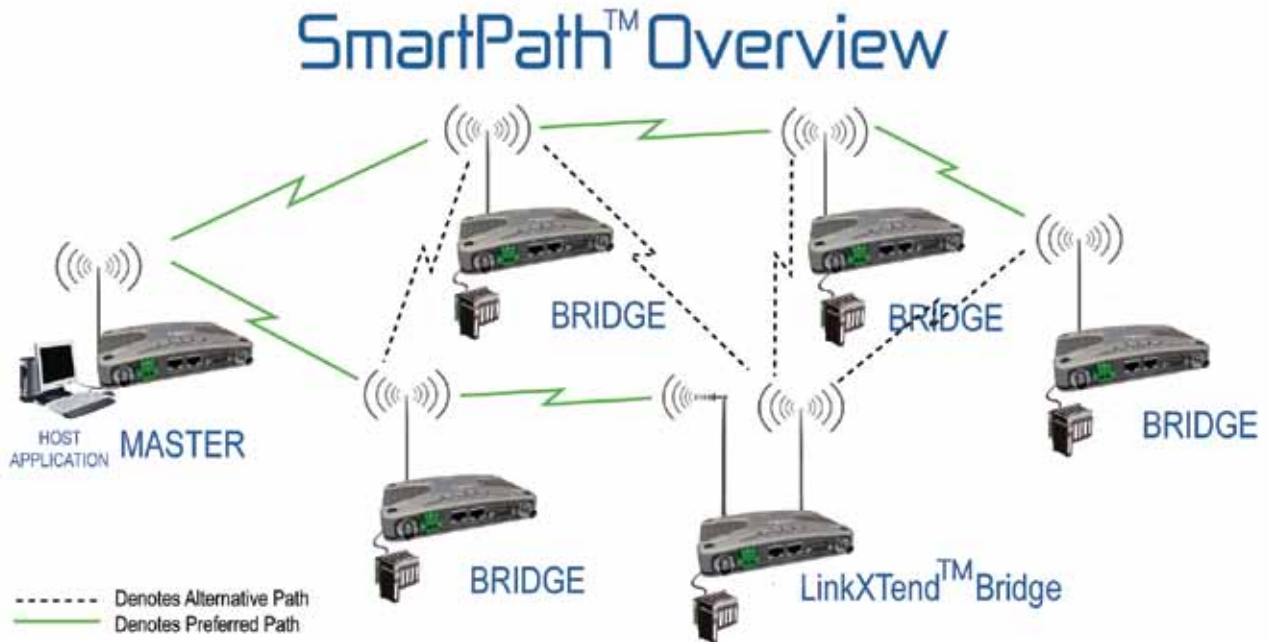
SmartPath™ has been optimized for SCADA and Telemetry systems, providing an ideal balance between connectivity (ie: link reliability), latency, bandwidth and system design effort. Many peer to peer MESH networks are optimized for short range, high density networks. As a result, much of their over-the-air bandwidth can be consumed in radio protocol management overhead (ie: keeping track of where peers are in the network, re-configuration of priority paths, etc).

SmartPath™ only re-configures the network topology when it is required. During normal operation, the system designer can utilise all of the over-the-air bandwidth and minimise message latency. Should one of the critical path radios fail, those radios dependent on that failed radio will search for alternative paths via other radios. The system designer can optimise radio path connectivity using a preferred/alternative arrangement. In applications where radios are mobile or roaming, SmartPath™ can provide an unlimited number of coverage areas including the ability to reliably hand-over coverage from one radio to another based on usable received signal strength.

SmartPath™, Network Name & Hopping Patterns

A fundamental rule of all K-Series radios (remotes or bridges) is that they will only synchronise to networks which have a matching Network Name. When implementing a network with Bridges, each section of the Network is broken up into smaller "SubNets" which is described in Part C of this User Manual.

To prevent interference between each Subnet, a unique hopping pattern is required for each Subnet. To make configuration management easier for the user, the K-Series (by default) derives the hopping pattern from the Network Name. Note: Only the Master (or a Bridge in Master Mode) derives the hopping pattern from the Network Name. A remote (or Bridge in Remote mode) will find any Master on any hopping pattern, and then check to see if the Network Names match.

SmartPath™ allows the user to provide alternative paths for radios in any one network. To implement this, the Network Name must be identical in all radios which may need to provide an alternative path. In this scenario, the hopping pattern can no longer be derived from the Network Name since the Network Name needs to be the same in all radios. Failure to break the link between Network Name and Hopping Pattern would result in the hopping pattern being the same in all radios in all Sub-
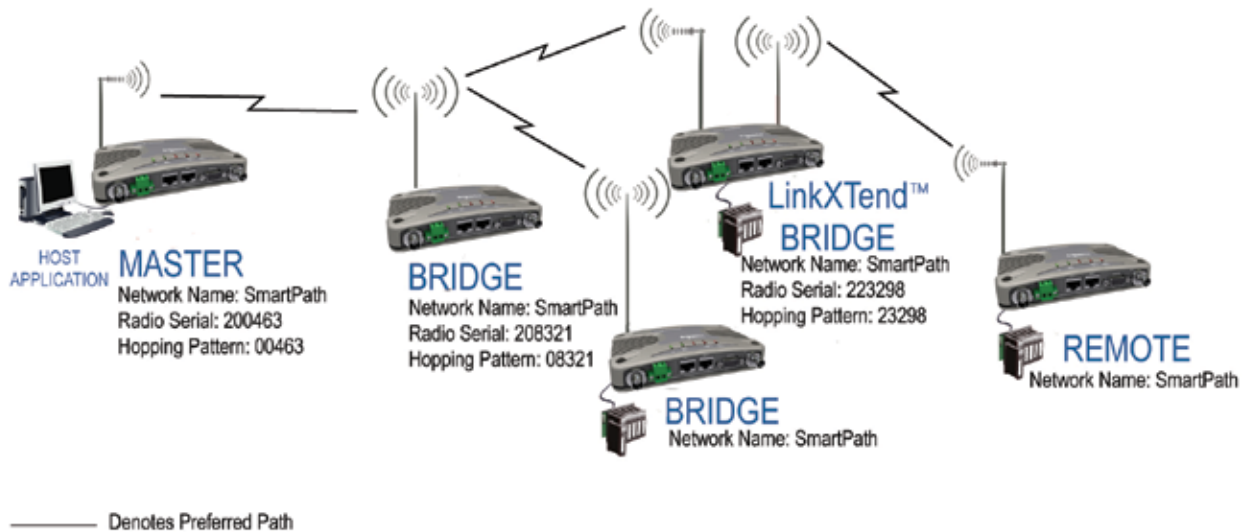
Nets when the desired outcome is to have a unique hopping pattern for each SubNet.

To overcome this problem, an option is provided to allow the generation of the hopping pattern from the serial number of the Master or Bridge radio.

Shown above is a diagram showing a typical SmartPath™ enabled system. The following points should be noted:

      (a) The Network Name is common to every radio in the system.

      (b) The hopping pattern is generated from the Master (or Bridge) serial numbers.

      (c) Radios which normally function as remotes, but can provide an alternative path, are now configured as Bridges.

SmartPath™ and Preferred/Alternative Masters

SmartPath™ allows system designers to create redundant connection paths that help to negate single point failures. Consider the PTMP network shown below. In this network, the system designer requires that Remote radios quickly re-synchronize to an alternative Master should the preferred Master no longer be accessible. When the preferred Master has been restored and is accessible, the network needs to resolve itself to match the preferred topology with a balance in the number of remotes associated with each Master.

Point to Multi-point with Preferred & Alternative Masters

Notes:
Network Name: All radios in network have the same Network Name.
Hopping Pattern: All Master/Bridge Radios generate Hopping Patterns from Serial Number of radio.

- - - - - - - Denotes Alternative Path
——————— Denotes Preferred Path
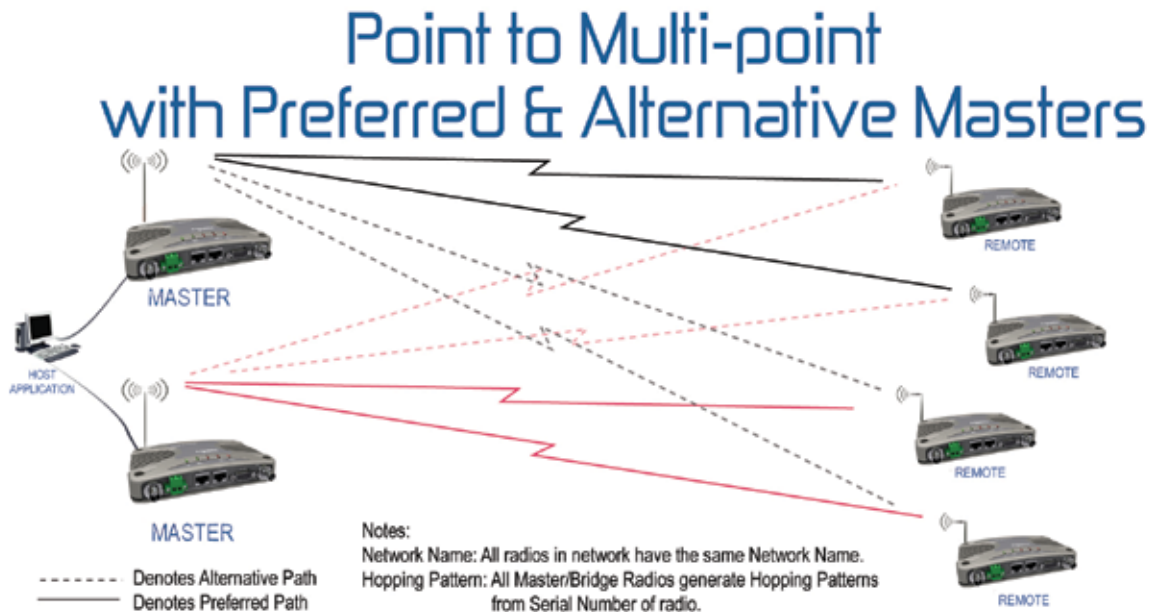
Typically, a PTMP system has one Master that communicates with several (many) remotes. If that Master fails, then the remotes configured to associate with that Master will lose connectivity. With SmartPath™ technology, the system designer can install multiple redundant Master sites and the remotes can be configured to associate with any of those Masters.

The designer can also configure a preferred Master as well as up to three alternative Masters should the preferred Master fail. The system designer only then needs to ensure that the alternative Masters have adequate overlapping signal strength at each remote site. If the Master radios are located at the same site, Multi-Master synchronisation should be activated to prevent unnecessary interference between each Master. Refer to Part D of this User Manual for more information on Multi-Master synchronisation.

The use of SmartPath™ preferred/alternative mode ensures that during normal operation, remotes are evenly distributed across available Masters. This assists the network designer in balancing the load by limiting how many remotes are associated with each Master. Only during a failure of one Master would those remotes reacquire an alternative Master. The channel loading on the remaining Master site would increase and the user may observe an increase in response time (ie: increase latency due to the larger number of remote sites). In SCADA and Telemetry applications this is a much preferred outcome as opposed to total loss of remote site connectivity.

The time taken to acquire an alternative Master is proportional to the hopping interval and the number of channels the radio hops over. In general, the nominal synchronisation time can be calculated by multiplying the number of channels the radio hops over by the hopping interval.

When the faulty Master site has been restored to correct operation, the Remote radios will resolve themselves to match the preferred topology. This happens because when a Remote radio is associated with an alternative Master, it will break synchronisation after a predefined time (normally 10 to 30mins) and attempt to find the preferred Master. This time is known as the Master Reacquisition Time and is explained in the following example.

SmartPath™ PTMP using LinkXtend™ Bridges

SmartPath™ allows the user to create multiple redundant connection paths in complex PTMP systems using LinkXtend™ bridges. Consider the PTMP with LinkXtend™ network shown below. The system designer requires that each unit synchronises to the network as quickly as possible, even if the topology is not initially the preferred one. Over time the network needs to resolve itself to match the preferred topology.
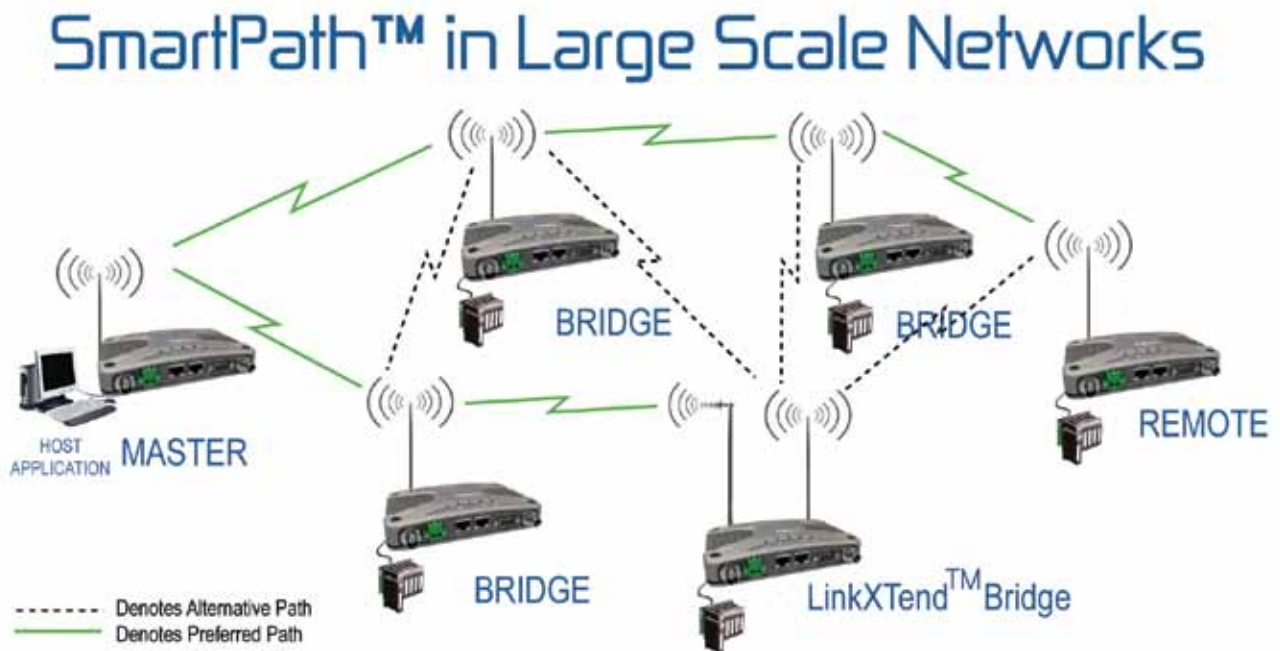
Similar to the previous example, each Bridge or Remote in the network is configured to associate with multiple Masters. Due to the split personality of the Bridge (Half-Master/Half-Remote) each Bridge site in the network is capable of providing an alternative path to the Master for any other radio in the network.

The system designer can configure a preferred Master, but may also specify up to three alternatives should the preferred Master fail. The alternative Masters for a specific site would be any other Master or Bridge radios that have adequate signal strength. All sites that need to provide alternative paths should be configured as Bridges. The Bridges can be single or dual antenna bridges depending on RF requirements.

The use of SmartPath™ preferred/alternative mode ensures that during normal operation, the network remains in the optimum or preferred topology. This assists the network designer in balancing connectivity vs latency. Only during a failure of a site in the preferred topology will other sites that are dependent on that failed site need to reacquire alternative paths. When operating via alternative paths, the user may observe an increase in response time (ie: increase latency due to the larger number of hops via bridges). In SCADA and Telemetry applications this is a much preferred outcome as opposed to total loss of remote site connectivity.

Master Re-Acquisition Time

SmartPath™ is optimized to provide remote synchronisation (ie: connectivity) as quickly as possible. This is important for SCADA systems where minimization of outage time is critical. In order to provide synchronisation as quickly as possible, a Remote configured for SmartPath™ will synchronise to the first available Master (or Bridge) it can find, regardless of whether or not that Master (or Bridge) is the preferred unit. The time taken to find an available Master (or Bridge) will depend on the hopping interval. Smaller hopping intervals will result in faster synchronisation times. A more detailed discussion on hopping intervals can be found in Part D of this User Manual.

On startup, if a Remote synchronises to its preferred Master (or bridge) first, then it will remain synchronised unless a loss of signal from the Master (or Bridge) occurs.

However, if the Remote synchronises to an alternative Master (or Bridge) first, it will remain synchronised to the alternative Master (or Bridge) for a limited length of time. This time is specified in the "Master Reacquisition Time" configuration parameter. This time is normally 10 to 30 minutes but can be configured from 1 to 255 minutes. When the time expires, the Remote will automatically de-synchronise and look for another Master.

The Remote is not guaranteed to find the preferred Master on first attempt, but statistical variation will ensure that eventually the Remote will find its preferred Master if it's signal can be received. Once found, the Remote will no longer search for any other Master. This mechanism provides the best balance between connectivity and orientation of the network topology in preferred way. Over time, the network resolves itself to match the user defined preferred topology.

SmartPath™ and Roaming Remotes

SmartPath™ allows the user to design networks that permit Remote radios to roam. In a roaming network, a remote is typically installed on a moving vehicle or object, such as a truck or a train. Master radios are installed at key locations where good RF coverage can be provided. The desired outcome is for connectivity to any available Master. In this scenario, there is no requirement to configure a preferred or alternative list of Masters. The trusted Master list remains empty, and the roaming remote radio will associated with any Master it can find that has the appropriate network name.
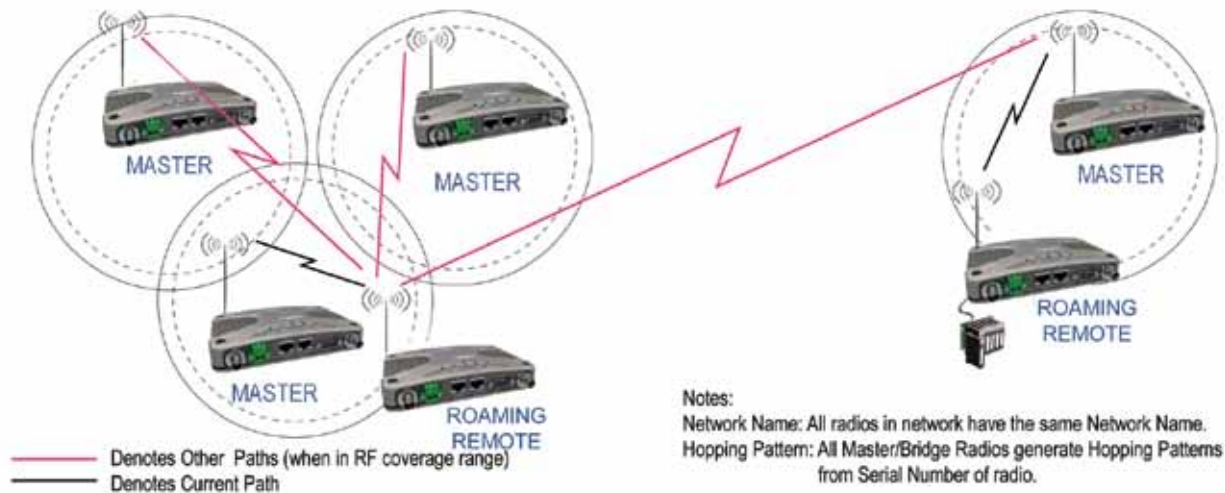
RSSI Threshold and Roaming Remotes

SmartPath™ has a feature that allows the user to prevent excessive Master hand-overs due to inadequate RF signal strength. Refer to the diagram shown above. In this scenario, several Masters have been positioned or located together to provide over-lapping coverage. The outer circle represents the range of usable signal strength from that Master. To prevent Remote radios from synchronising to Masters that do not currently provide adequate levels of received signal strength, RSSI Threshold filter facility can be enabled.

The RSSI Threshold defines the minimum acceptable received RSSI level before a radio will synchronise to a Master. When a Remote finds an acceptable Master in the network, it first checks to ensure that the received RSSI is above the RSSI Threshold. If the received RSSI is below the threshold, the Remote radio will continue to search for other Masters. Once synchronised to a Master, the Remote will remain synchronised until the RSSI level is 10dB below the threshold (ie: a 10dB hysteresis is applied). When the RSSI drops below this value, the remote searches for new acceptable Masters with a received signal strength above the RSSI Threshold.

For example, if the RSSI threshold is configured to be -80dBm, then when a remote detects the current Master is being received at -90dBm, the remote will drop synchronisation with that Master and start searching for another Master with a signal strength of -80dBm or better. This ensures that Remotes which are in the range of other Masters with more usable signal strength do not remain associated with their existing Master at very low or inadequate signal strengths.

SmartPath™ and Hybrid Networks

SmartPath™ allows the system designer additional flexibility to create a redundant backbone based on preferred and alternative paths while deploying remote radios where no configuration is required. This is shown in the network diagram below.
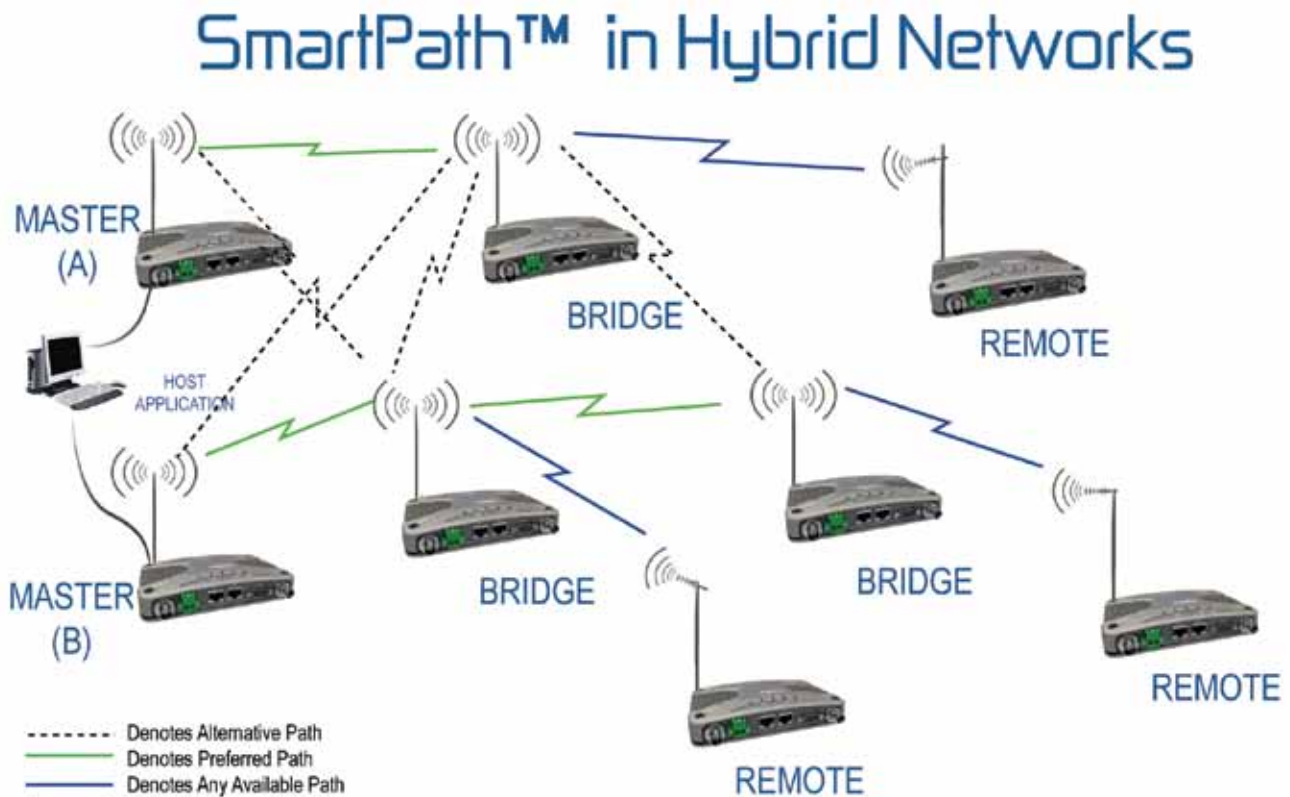
Two Masters are installed to provide redundancy at the Master radio level. These Masters may be located at different sites, or they may be co-located. If co-located, the user should implement Multi-Master synchronisation to prevent interference between Masters.

Three key sites in the network (typically sites where good RF coverage can be provided) are configured as Bridge radios. These can be single antenna Bridge radios or dual antenna LinkXtend™ bridges depending on the path profile and link requirements. The system designer could then configure preferred and alternative paths between the Masters and Bridges as required.

Configurationless Remotes

In some system designs, there will be occasions where radios located on the fringe of the network do not need to provide an alternative path. Since these radios will not be carrying additional network traffic, there is no need to configure a preferred or alternative path. Instead the Remote radio is configured to synchronise to any available Master radio that has the configured Network name. The system designer can deploy Bridge radios to provide overlapping RF coverage which would allow a remote to have two possible paths to a Master. It is recommend to use the RSSI Threshold feature to prevent a Remote radio from associating with a Master that has poor signal strength. There is no limit to the number of possible Masters (or Bridges) a Remote radio can associate with in this mode of operation.

The benefit of configuring Remotes in this mode of operation is that they are essentially Configurationless. Apart from the user configuring the required User Port, TX Power and Network Name, there is no other configuration required. The user does not need to enter preferred or alternative Masters and this allows Remote radios to be pre-configured before deployment into the system.

Part E – System Planning and Design

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 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.
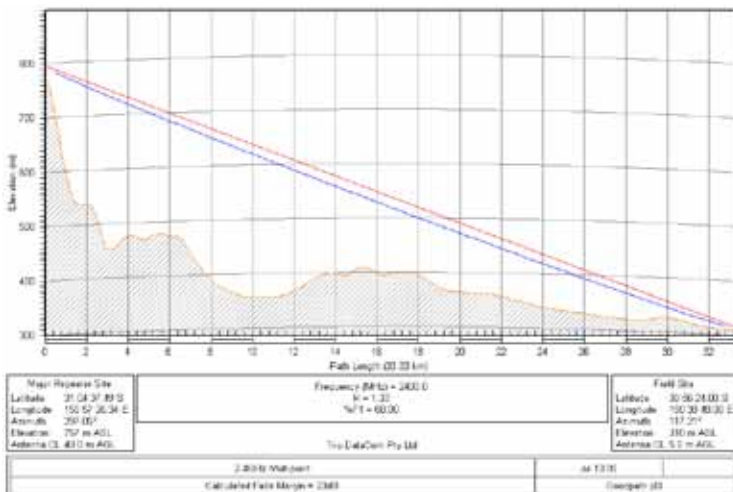
Obstructed Radio Path

This path has an obstruction that will seriously degrade the signal arriving at the field site.
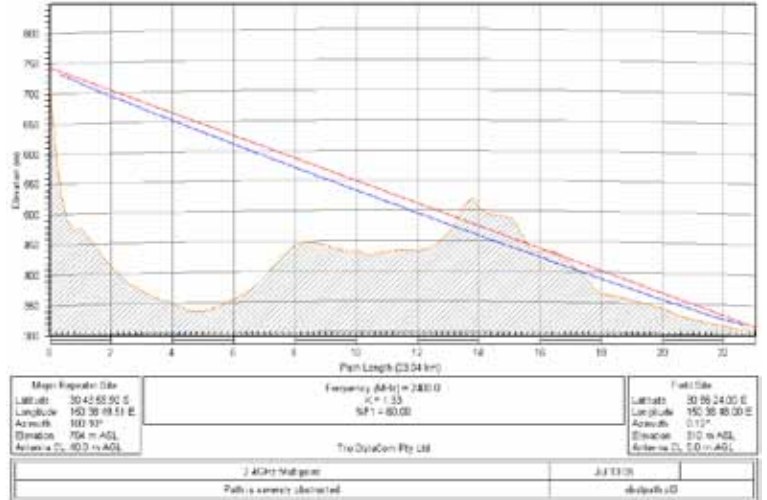
GOODPATH2400.pl4	Major Repeater Site	Field Site
Elevation (m)	756.69	309.67
Latitude	31 04 37.49 S	30 56 24.00 S
Longitude	150 57 26.34 E	150 38 48.00 E
True azimuth (°)	297.05	117.21
Vertical Angle (°)	-0.94	0.72
Antenna Model	6dB Omni	16dB Grid Reflector
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	18.15
(dBd)	6.00	16.00
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)	2400.00	
Polarization	Vertical	
Path Length (km)	33.33	
Free Space loss (dB)	130.53	
Diffraction loss (dB)	0.00	
Net Path loss (dB)	111.29	111.29
Radio Model	HR240	HR240
TX power (watts)	1.00	1.00
(dBm)	30.00	30.00
Effective Radiated Power (Watts)	1.34	23.23
(dBm)	31.28	43.66
RX Sensitivity (µv)	1.26	1.26
(dBm)	-105.00	-105.00
RX Signal (µv)	19.28	19.28
(dBm)	-81.29	-81.29
RX Field Strength (µv/m)	1014.39	243.90
Fade Margin (dB)	23.71	23.71
Rayleigh Fade Probability (%)	0.42	0.42
Log Normal Fade Probability (%)	3.88E-03	3.88E-03

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	32 01 21.63 S	32 33 00.00 S
Longitude	142 15 19.26 E	141 47 00.00 E
True azimuth (°)	217.12	37.37
Vertical Angle (°)	-0.37	-0.03
Antenna Model	6dB Omni	15dB Grid Reflector
Antenna Height (m)	40.00	5.00
Antenna Gain (dBi)	8.15	17.15
(dBd)	6.00	15.00
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)	2400.00	
Polarization	Vertical	
Path Length (km)	73.46	
Free Space loss (dB)	137.39	
Diffraction loss (dB)	34.02	
Net Path loss (dB)	153.18	153.18
Radio Model	HR240	HR240
TX power (watts)	1.00	1.00
(dBm)	30.00	30.00
Effective Radiated Power (Watts)	1.34	18.45
(dBm)	31.28	42.66
RX Sensitivity (µv)	1.26	1.26
(dBm)	-105.00	-105.00
RX Signal (µv)	0.16	0.16
(dBm)	-123.18	-123.18
RX Field Strength (µw/m)	8.16	2.20
Fade Margin (dB)	-18.18	-18.18

Location - Woodland (sigma = 6 dB)

Antennas

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

Omnidirectional antennas are designed to radiate signal in a 360 degrees 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 a "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 directional antenna is the yagi, which offers useable beam widths of 15-40 degrees. Even higher "gain" is available using parabolic "dish" type antennas such as gridpacks.

Onmi directional
360 degree signal

Directional
Concentrated beam

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).

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, 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 arrester in order to meet EN6095.

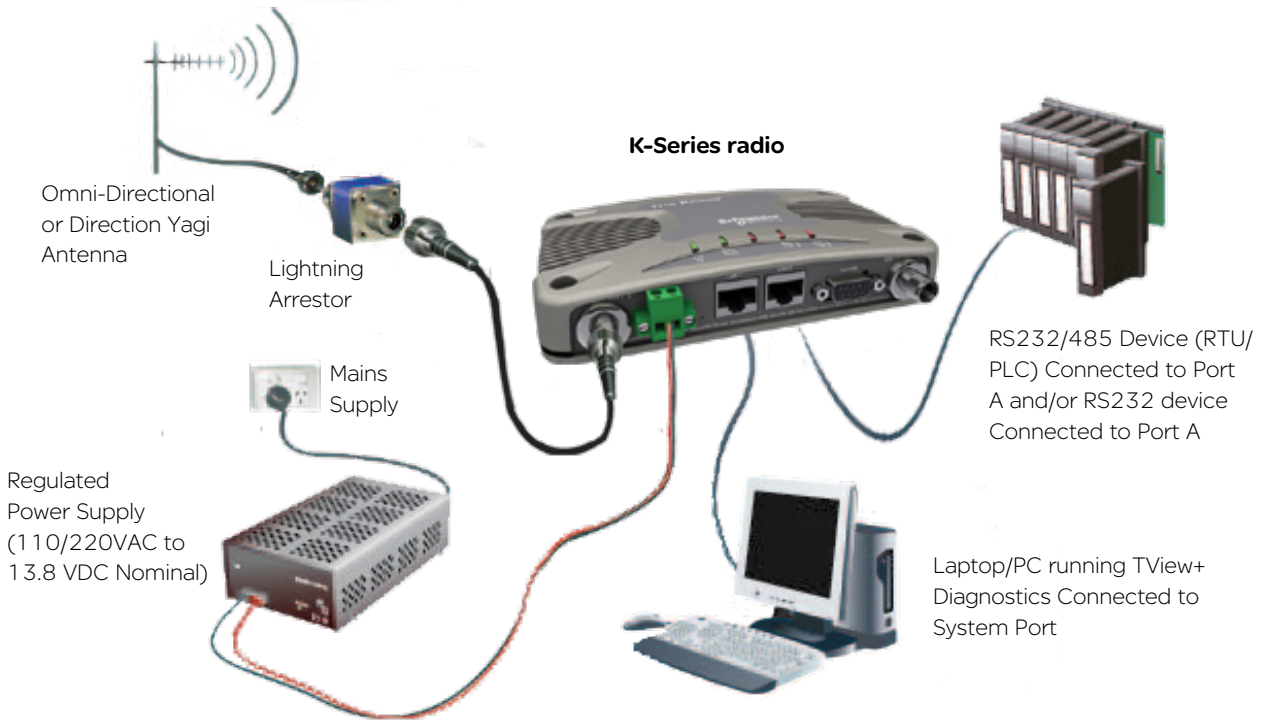| Common Cable Types @ 915MHz	Loss per 30.5m @ 2.4GHz	Loss per 30.5m
RG213/U	7.4dB	14dB
FSJ1-50 (¼ superflex)	5.6dB	9.9dB
LDF4-50 (1/2" heliax)	2.2dB	3.5dB
LDF5-50 (7/8" heliax)	1.2dB	2dB

Band Pass Filter (900MHz Only)

The K Series radio is a robust, industrial strength radio designed for harsh RF environments, and in the majority of applications there is no requirement for additional protection from interference. In some circumstances, particularly when the radio is operated in very close proximity (ie: less than 25m of separation) to 900MHz GSM/CDMA mobile phone base stations or other radios operating close to the 900 MHz ISM band, the K Series radio may be subject to exceptionally high levels of RF interference.
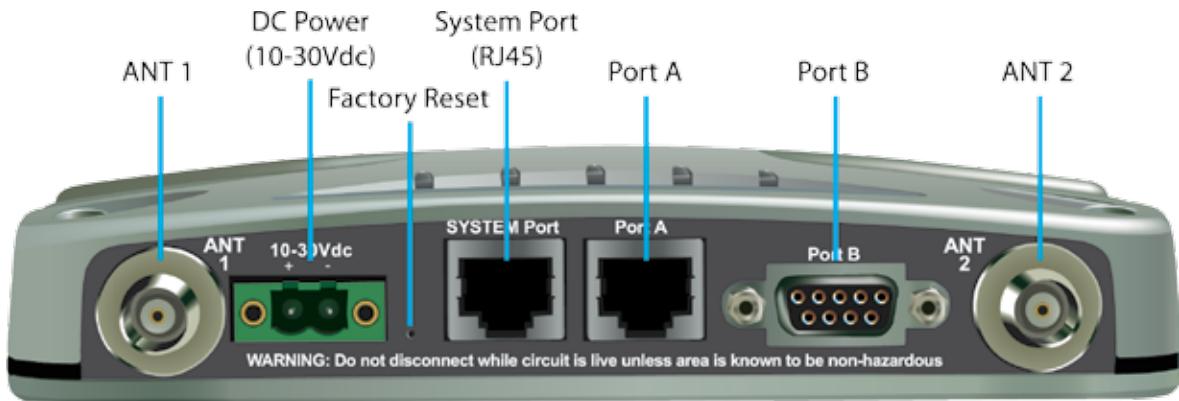
These high levels of RF interference can result in a degradation of radio performance, and it is strongly recommended that an external RF band pass filter be installed to reduce the interference to an acceptable RF level. Please contact the factory for recommendation of a suitable RF band pass filter for your country or region.
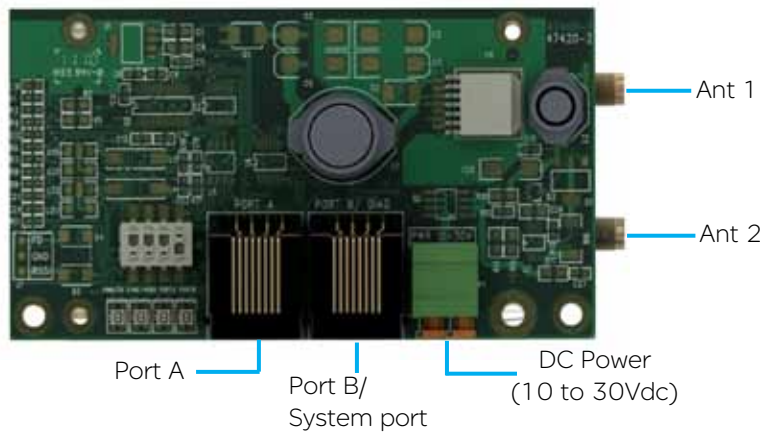
Part F – Getting Started

Typical Radio Setup

Omni-Directional
or Direction Yagi
Antenna

Lightning
Arrestor

K-Series radio

Mains
Supply

Regulated
Power Supply
(110/220VAC to
13.8 VDC Nominal)

RS232/485 Device (RTU/
PLC) Connected to Port
A and/or RS232 device
Connected to Port A

Laptop/PC running TView+
Diagnostics Connected to
System Port

KR Series Connections Layout

ANT 1

DC Power
(10-30Vdc)

Factory Reset

System Port
(RJ45)

Port A

Port B

ANT 2

ANT
1

10-30Vdc
+   -

SYSTEM Port

Port A

Port B

ANT
2

WARNING: Do not disconnect while circuit is live unless area is known to be non-hazardous

KP & KB Series Connections Layout

Ant 1

Ant 2

Port A

Port B/
System port

DC Power
(10 to 30Vdc)

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 cause data errors and destroy electronic components, solder 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 Requirements

The power supply should provide a clean, filtered DC source. The radio modem is designed to operate from 10-30 volts (filtered) DC supply.

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).

K-Series current consumption:
 Tx: Nominal 13.8 V @ 500mA (Max 1A)
 Rx: Nominal 13.8 V @ 120 mA
 Safe Operating Voltage 10-30 VDC (24V DC @ 300 mA)

The current requirement is typically 200mA @ 13.8V in receive mode, and will vary in transmit mode according to RF output power level
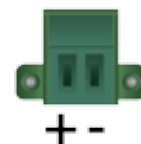

CAUTION

The KR radio is designed to self protect from permanent damage if the voltage exceeds 30 V DC. The replaceable internal fuse has a rating of 3 Amps. Only Lead Free solder and soldering equipment should be used to replace the fuse.

Replacement Fuse: TRIO Part No: SM%FUSSQ3A

CAUTION

The KP and KB radio must be fitted with an external fuse as they are not designed to self protect from permanent damage if the voltage exceeds 30 V DC or if reverse polarity is applied. Using a 3 Amp fuse is recommended.

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.

Note: Operation below the minimum specified supply voltages could result in poor radio performance.

Site Earthing

The radio must not be allowed to provide a ground path from chassis to (DB9) signal ground or (-) battery ground. 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.

CAUTION

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.

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 DC power plug is correct using a multimeter.

KR power plug

＋ -

KP & KB power plug (PCB mounted)

＋ -
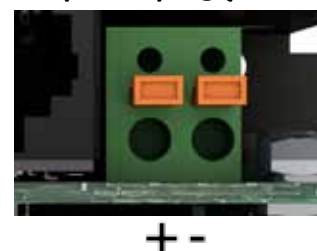
Physical Dimensions – Remote Data Radio – KR900/KR240

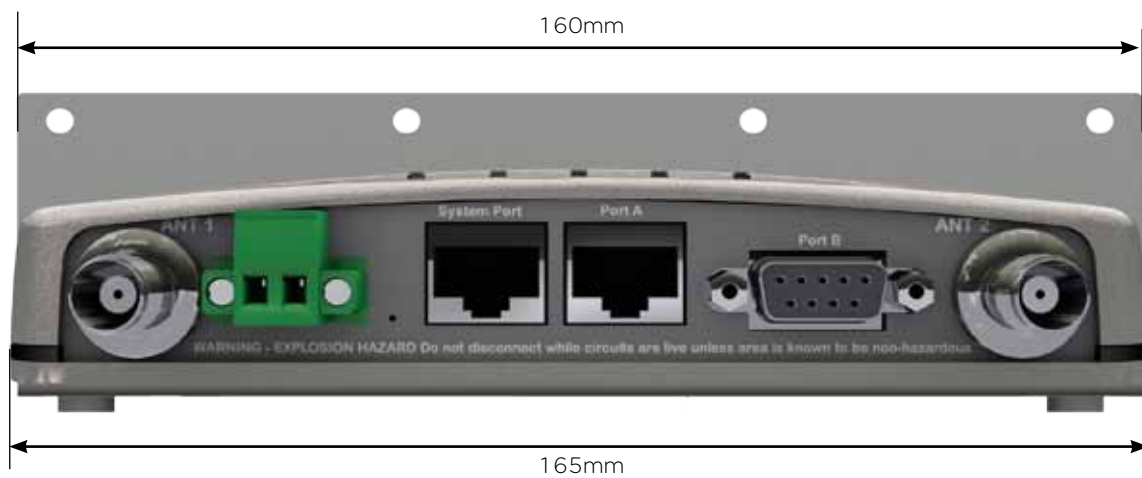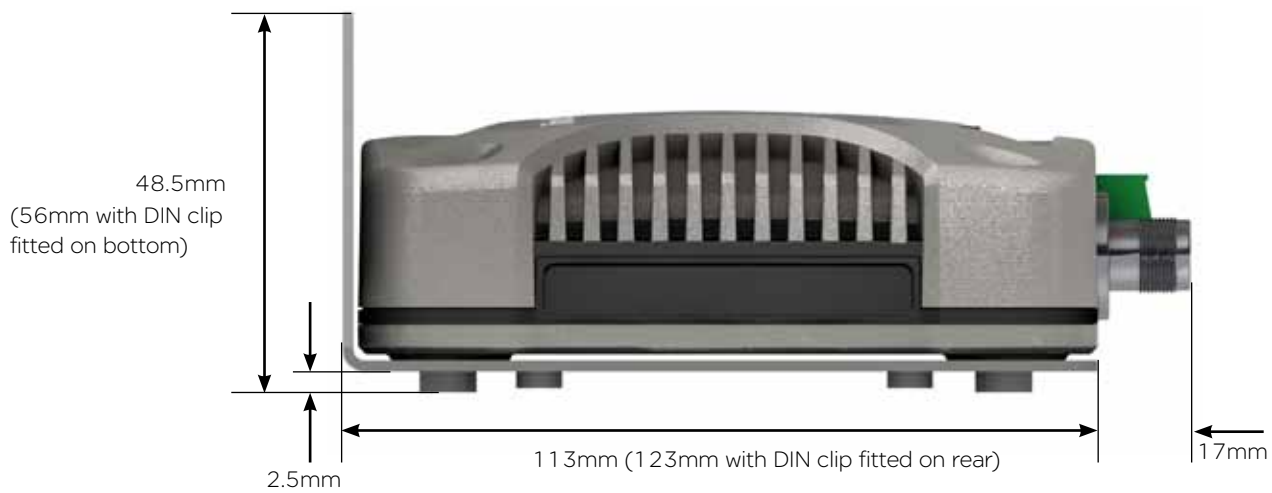Note : Drawings not to scale.

DIN mounting kit

An optional DIN mounting kit is available for the K-Series. The Mount is screwed onto the bottom of K-Series giving the unit the ability to be simply 'clipped' and Locked onto 3.5mm Din Rail.
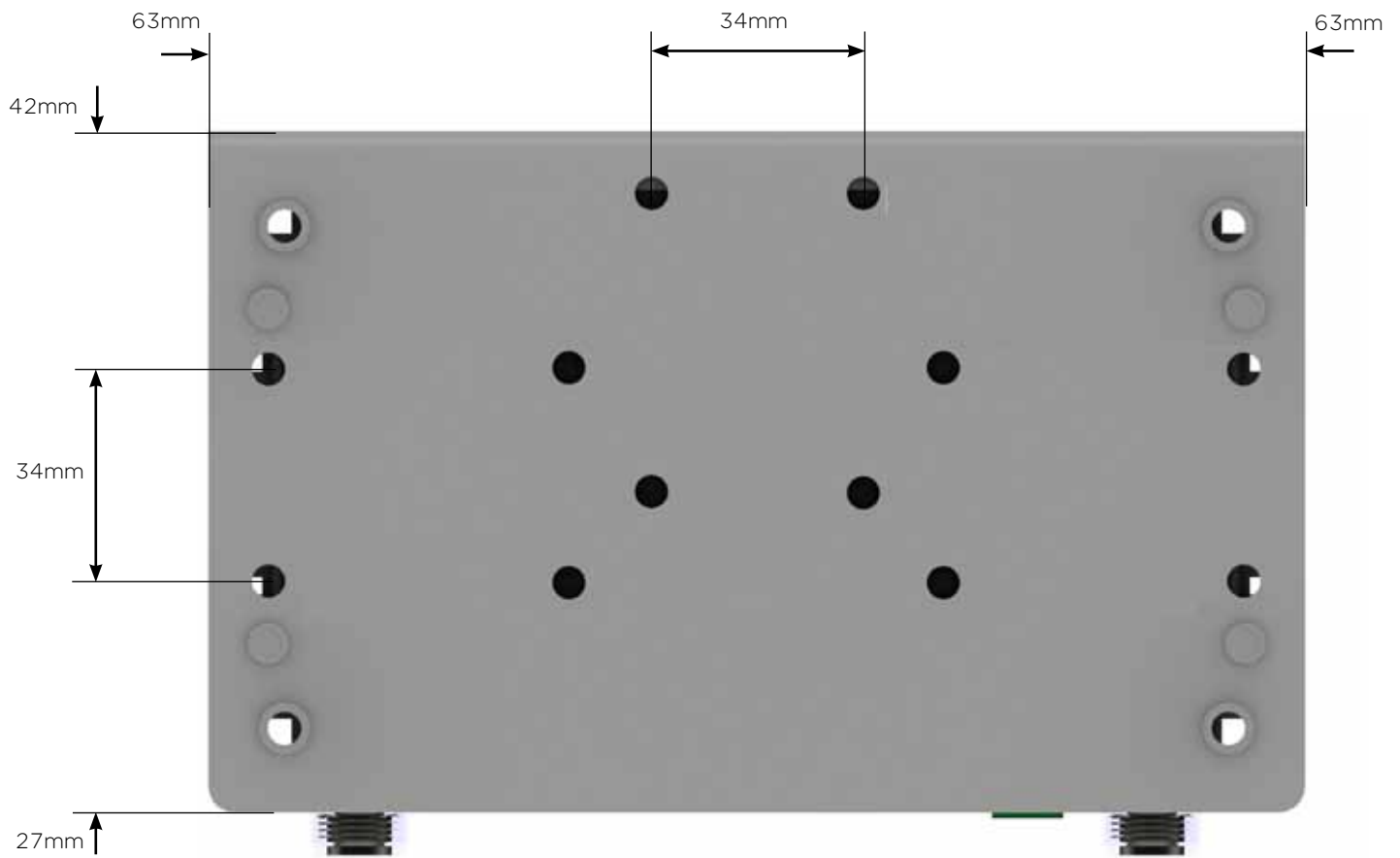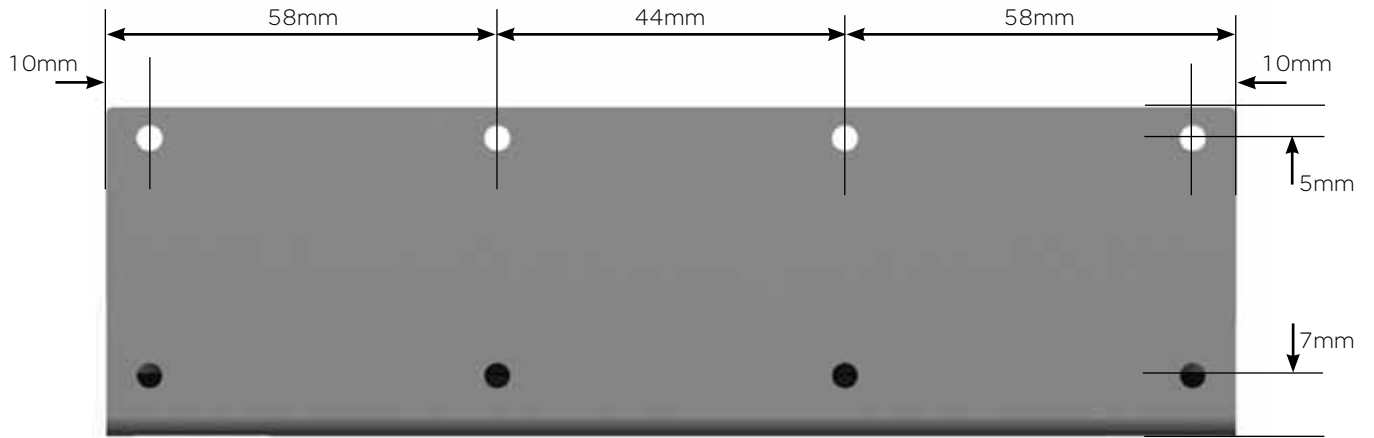
Each Din kit supplies:
 A DIN rail mounting bracket
 A Phoenix DIN rail clip
 x4 Countersunk M4X8 screws (to mount DIN rail clip to bracket)
 x4 M4 nuts (to mount DIN rail clip to bracket)
 x4 Pan head M3X6 screws (to mount Spread spectrum radio to bracket)
 x4 Pan head M4X2.5 screws (to mount M-Series to bracket)

DIN rail mounting bracket

48.5mm
(56mm with DIN clip fitted on bottom)

2.5mm

113mm (123mm with DIN clip fitted on rear)

17mm

160mm

165mm

Note : Drawings not to scale.

DIN rail clip

The DIN rail clip has a spring loaded latch to allow easy installation/removal of the radio device being installed.

The DIN rail clip can be fitted to the DIN rail mounting bracket x5 different ways to allow as much installation flexibility as possible.
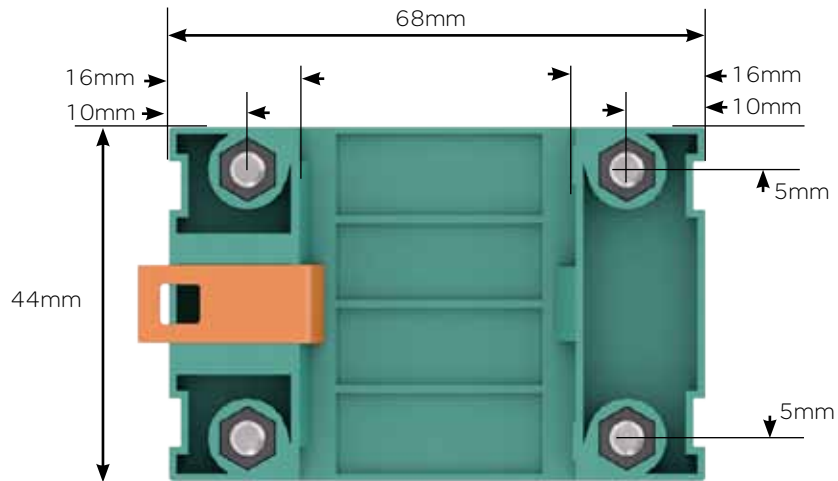
Rear mount DIN rail clip

The DIN rail clip can be fitted on the rear of the DIN rail mounting bracket two ways shown below.
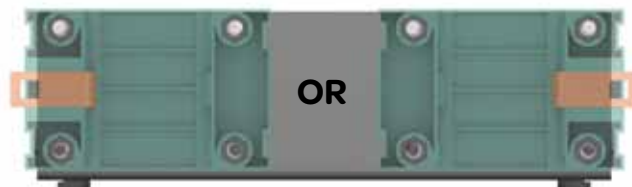
Examples of rear fitted DIN clips:

Bottom mount DIN rail clip

The DIN rail clip can be fitted on the bottom of the DIN rail mounting bracket three different ways shown below.
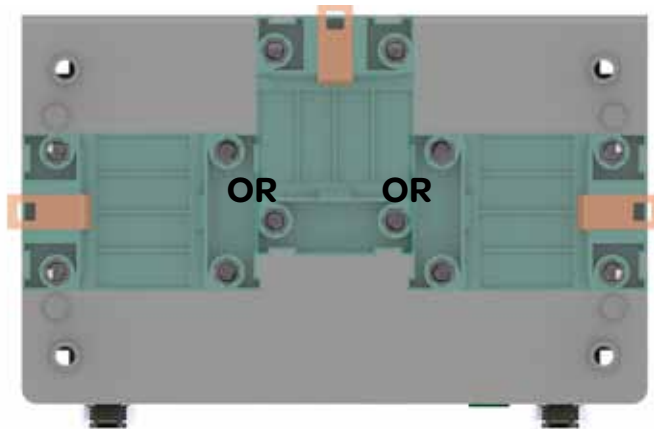
Examples of bottom fitted DIN clips:

130mm

56mm

Trio KP900

Schneider Electric

39mm

Note : Drawings not to scale.

KB additional PCB

The KB is supplied with an extra section of PCB attached to the side and rear of the main board (shown below as the shaded region of PCB). This extra PCB gives flexibility when installing the KB by supplying different mounting dimensions. The extra PCB is pre-scored, which allows easy removal if un-desired. (Dimensions with extra PCB LxWxH: 63mm x 129mm x 31mm) (Dimensions without extra PCB LxWxH: 55mm x 98mm x 31mm)
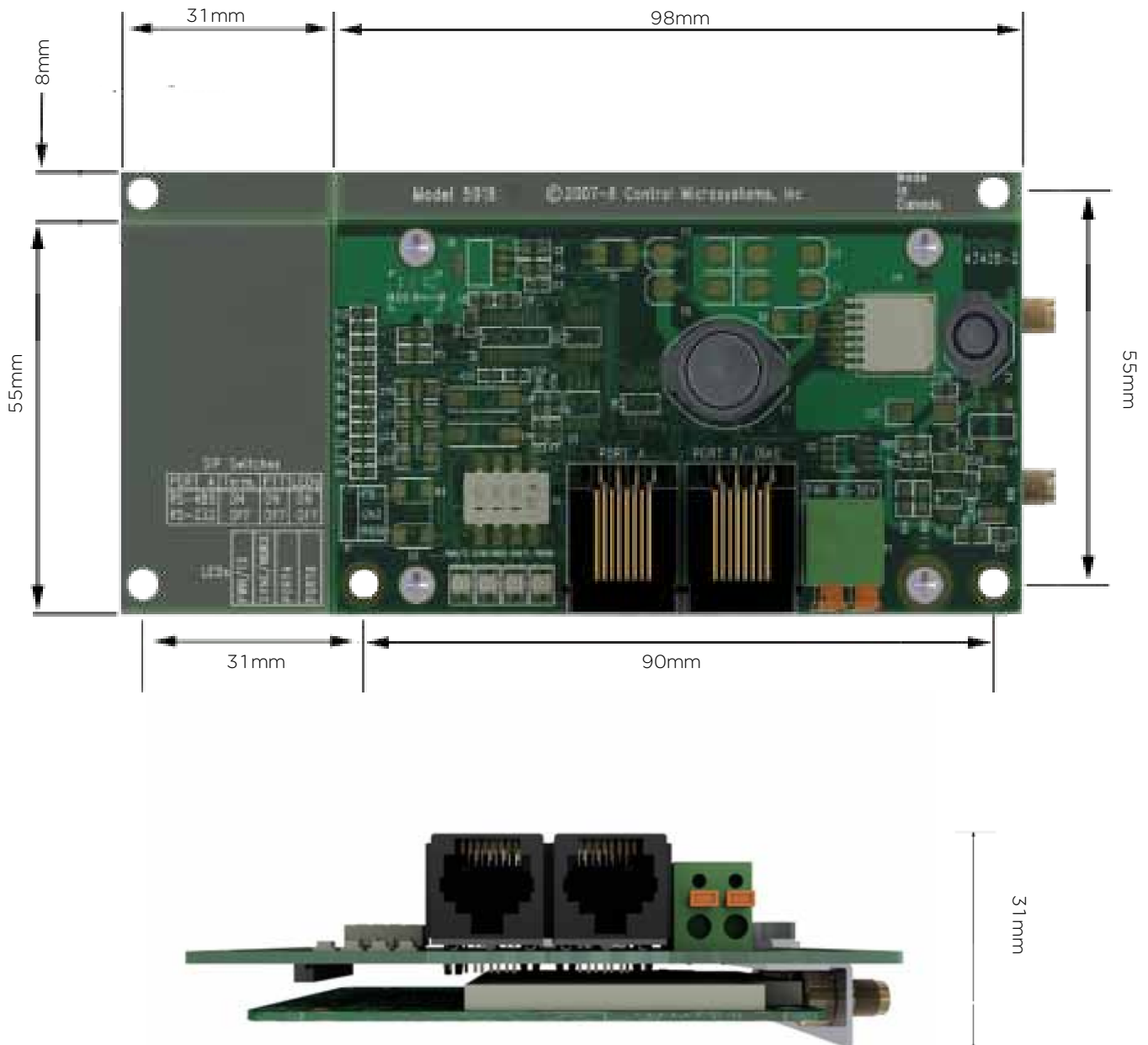
Note : Drawings not to scale.

Connecting RF antennas and feeders

The RF antenna system should be installed in accordance with the manufacturers notes. Antenna gain must be considered when setting Transmit Power. Refer to Compliance notices at the end of this document.

The RF connectors vary between the different types of K-Series types. The KR has TNC Type female connectors, the KP & KB both have SMA 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 polarization (vertical or horizontal).

Performing Factory Default Reset

The factory default reset restores all configuration parameters to their factory defaults and it is recommended to apply a reset when using TView+ wizards or when re-configuring radios for a new network.

Factory defaults are performed differently between the K-Series models.

KR900/KR240 Factory default

The factory default reset will only be activated when the DC power is cycled while the hidden push-button is pressed. The reset cannot be activated accidentally.

To activate the factory default reset, perform the following sequence

(1) Remove the power supply.

If the power supply has a switch, first connect the DC power supply and then to turn the switch off.

(2) Locate the Reset Push-button Switch Hole.

Please refer to the K Series Connections for the location of the Factory Reset push-button switch hole. The button is located behind a small hole next to the power connector.

(3) Insert a straightened paper clip or similar object into the hole and press gently. The push-button switch is located just inside the hole and can be felt moving when pressed.

(4) Hold the push-button switch pressed.

(5) Turn on the power. All LEDs will indicate green for 5 seconds.

(6) Release the push-button switch.

(7) The radio is now reset to factory defaults and ready to be configured using TView+ Programmer.

KP900/KP240 & KB900/KB240 Factory default

To activate the factory default reset, perform the following sequence

(1) Remove the power supply.

If the power supply has a switch, first connect the DC power supply and then turn off the switch off.

(2) Jumper the FD (factory default) pin 1 to the GND (ground) pin 2.

Please refer to part F - KP & KB Series Connections Layout of this user manual for the location of the Jumper header.

(5) Turn on the power. All LEDs will indicate green for 5 seconds.

(6) Remove the jumper from the FD and GND pins.

(7) The radio is now reset to factory defaults and ready to be configured using TView+ Programmer.

Data Connections

The V24 Standard

The K 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 K Series modems can be configured for full hardware flow control, or Handshaking 'None' (simple 3 wire interface). Trio recommends 'None' in most systems if possible.

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 K Series modem when set for no handshaking).

Radio mode – Bridge

When a K-Series is set to Bridge mode and Hardware handshaking is selected, the handshaking must be satisfied for the internal bridging/routing function to pass data between upstream / downstream and the port/s, even if no device is connected to the user port. Trio recommends setting Hardware Handshaking to 'None' and using a 3 wire interface only.

KR User Port A – Pinout and Cables

User port A is configurable for RS232 or RS-485 operation with options for no hardware handshaking or hardware flow control using RTS & CTS.

RS-485 Operation is selected by changing internal jumper links.

In most systems flow control is not required, in which case only 3 wires need to be connected between the radio and the external device.
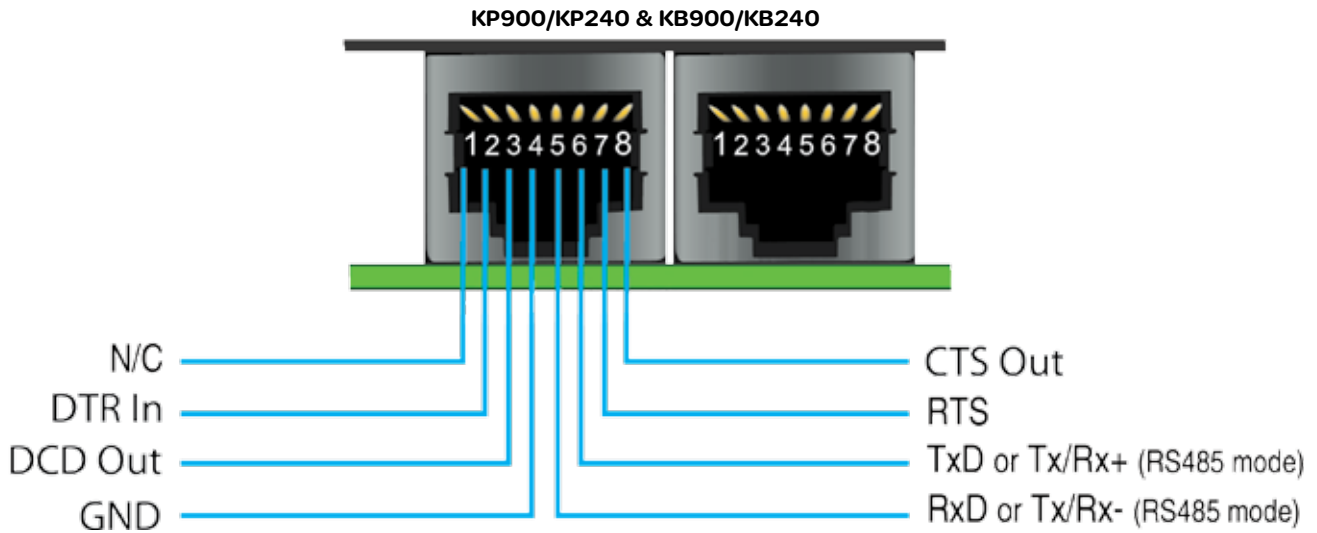
3 Wire Connection:

*   Pin 5 (RxD) - data output from the radio modem

*   Pin 6 (TxD) - data input to the radio modem

*   Pin 4 (SG) - signal ground

Refer to the diagram below for details on Port A pin-out.

Notes about RS-485

Port A can be configured as an RS-485 port if required. To do this, remove the lid of the K Series product and locate the 5 jumpers at the rear of the K Series main PCB. These jumpers are covered by a plastic retaining clip and labelled X10, X7, X6, X8 and X13.

Remove the Retaining Clip.

To convert Port A to RS-485 mode, the first 4 jumpers need to be moved to the RS-485 position (X10, X7, X6 and X8) as noted at the top of the group of jumpers. X13 provides a facility for terminated or unterminated RS-485. In a multi-drop arrangement, unterminated is the normal connection.

RS-232 is the default position (with all jumpers located on the left side, when the K Series connectors are facing you).

Replace the retaining clip. This ensures that the links are secured in position. To complete the configuration of RS-485 mode, changes need to be made using the TView+ K Series programmer to correctly configure of the operation of the DCD to support RS-485 - See Part H of the K Series User Manual for more information on how to do this.

KR900/KR240

KR900/KR240

KP and KB User Port A – Pinout and Cables

The port A pinouts are configured as DTE (Terminal) instead of DCE. This is to allow use of a Schneider Electric SCADAPack RTU programming cable to communicate through Port A.

User port A is configurable for RS232 or RS-485 operation with options for no hardware handshaking or hardware flow control using RTS & CTS.

RS-485 Operation is switched on by selecting DIP switch 1 on the ON position. The DIP switch is located at the rear of the LEDs.

In most systems flow control is not required, in which case only 3 wires need to be connected between the radio and the external device.

3 Wire Connection:
- Pin 5 (RxD) - data input to the radio modem
- Pin 6 (TxD) - data output from the radio modem
- Pin 4 (SG) - signal ground

Refer to the diagram below for details on Port A pin-. out

Notes about RS-485

Port A can be configured as an RS-485 port if required. To do this, Switch 1, on the DIP switch, located at the rear of the LEDs, must be set to the on position.

Instructions on how to use the DIP switch are printed on the exterior housing of the KP.

KP900/KP240 & KB900/KB240

KP900/KP240 & KB900/KB240
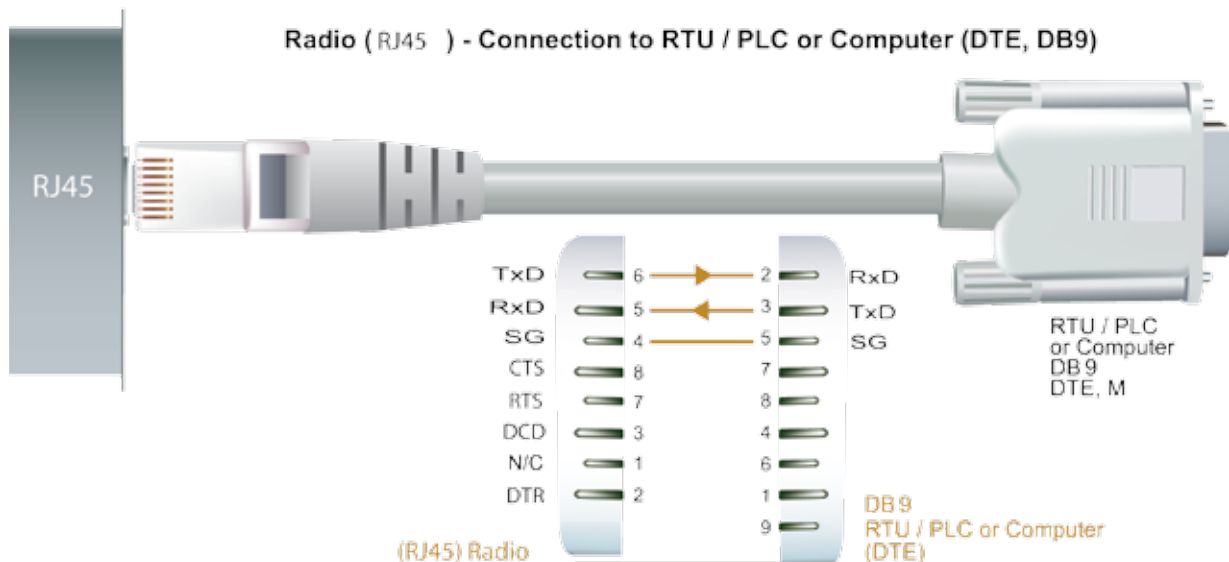
KR User Port B - Pinout and Cables

User port B is configurable for RS-232 operation with options for no hardware handshaking or hardware flow control using RTS & CTS.

In most systems flow control is not required, in which case only 3 wires need to be connected between the radio and the external device.

3 Wire Connection:

- Pin 2 (RxD) - data output from the radio modem

- Pin 3 (TxD) - data input to the radio modem

- Pin 5 (SG) - signal ground

Refer to the diagram below for details on Port B pin-out.

Radio (DCE) - Connection to RTU / PLC or Computer (DTE, DB9)
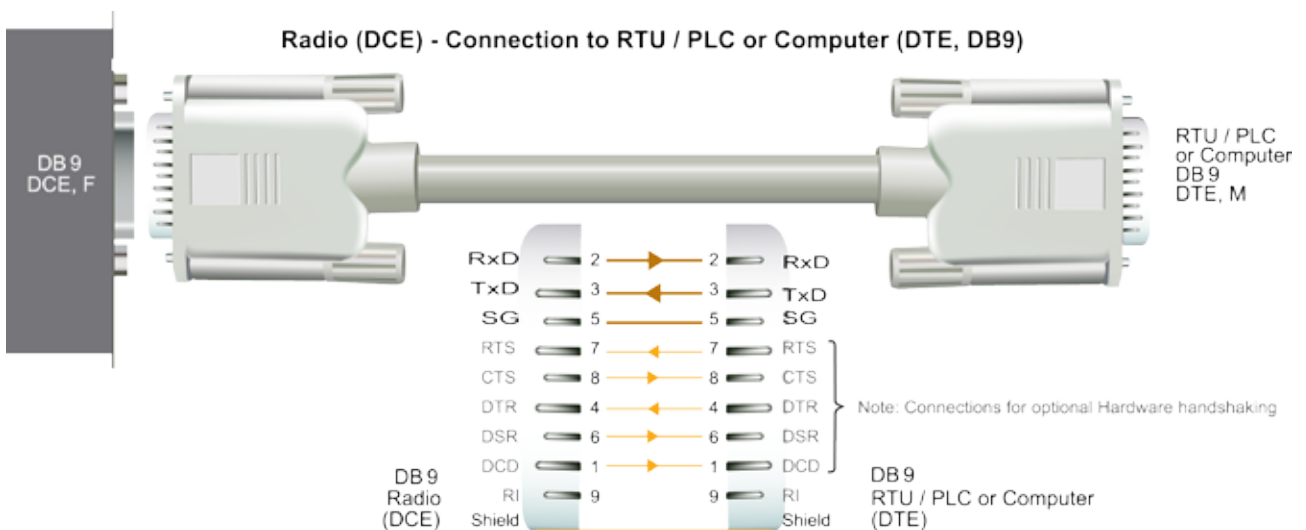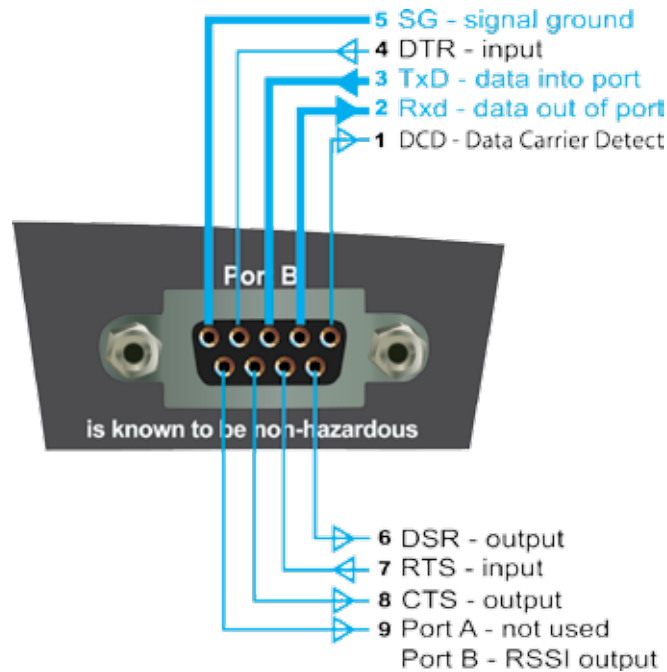
KP & KB User Port B - Pinout and Cables

Port B & System/Diag Port - RJ45

The port B and system port pinouts are configured as DTE (Terminal) instead of DCE. This is to allow use of a Schneider Electric SCADAPack RTU programming cable to configure the radio.

The Port B & System/Diag port on the Trio KP900/240 and KB900/240 is designed with two independent ports, integrated within the single RJ-45 socket. Port B can be used for RS232 serial communications only. The system/diag port is used for programming / configuration of the radio and can be used for remote diagnostics connections.

The following image shows the pin outs of port B and system diag port. A non-standard cable is required to configure the KP or KB and access diagnostics. Contact your local sales representative for details on this cable.

Port B & System/Diag - RJ45

Diagnostics/Programming Interface Cable

Port B Typical Interface Cable
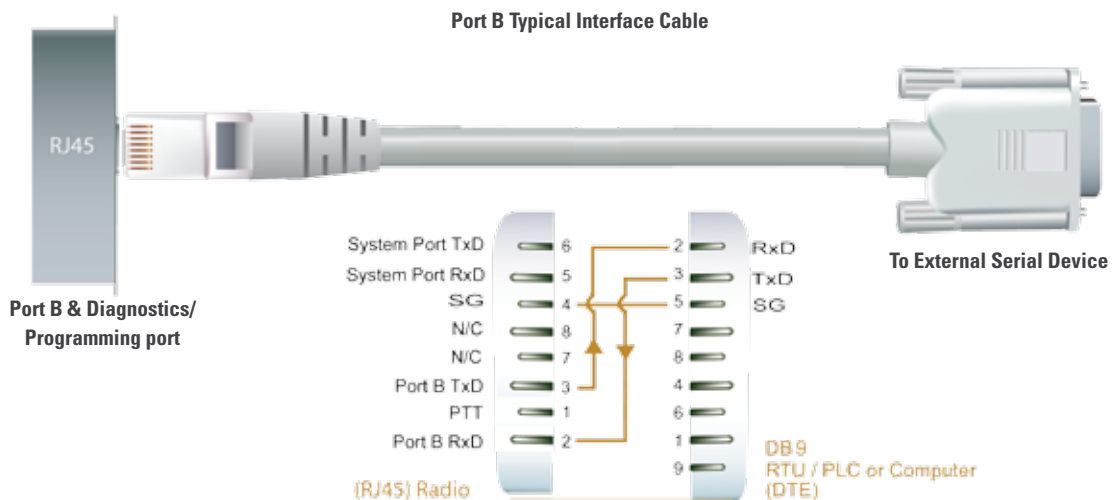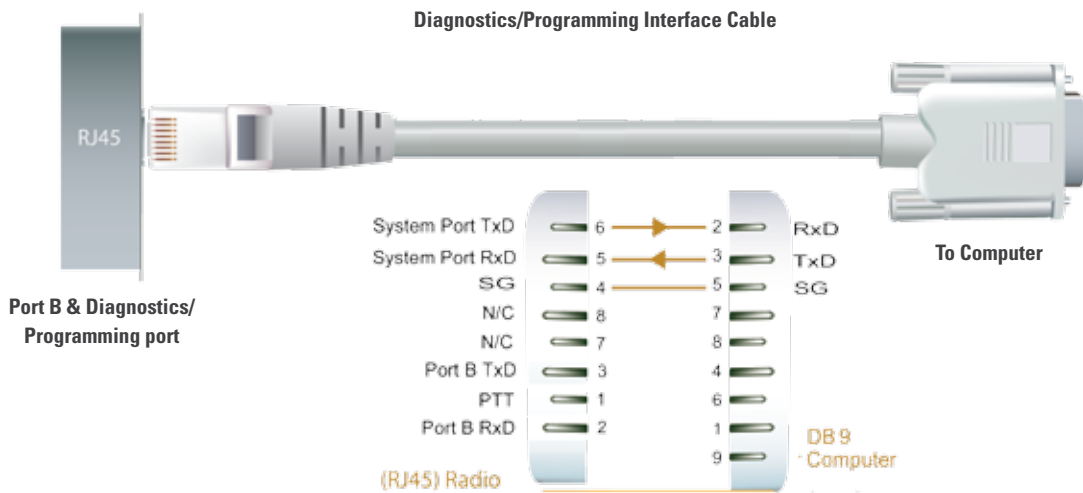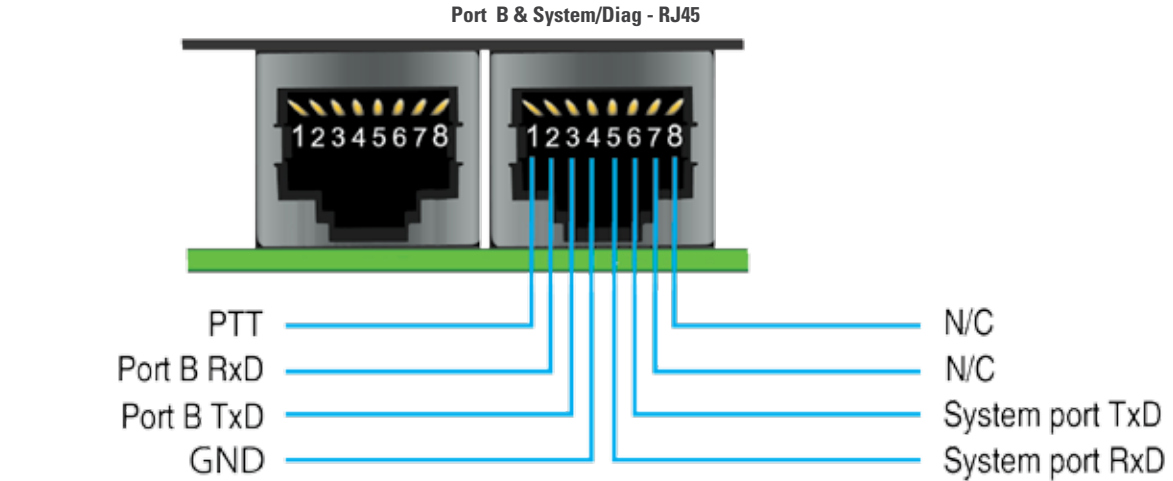
KR Systems Port - RJ 45

The System Port is a multi-function interface used for:

- Programming / Configuration of the radio

- Remote Diagnostics connections

To access these functions use the TVIEW+E&K 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.

Should you wish to make your own TVIEW+E&K Cable assembly you can do so using the pin out detailed in the

System Port	Description	DB9F
Pin1	System Data Out	Pin2
Pin2	System Data In	Pin3
Pin3	Reserved	N/C
Pin4	Shutdown	N/C
Pin5	Programming Only	Pin5
Pin6	Reserved	N/C
Pin7	Ground	Pin5
Pin8	External PTT	N/C

table below:

Special user pinouts:

- Shutdown (Pin 4) - Active low for power save function

- External PTT (Pin 8) - Provides a manual PTT override facility for enabling the transmitter. This can be useful for Tx PWR or VSWR testing. For testing this can be activated by connecting PTT (Pin 8) to GND (Pin 7).

Connecting the programmer

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

Example: Local configuration session -

1   Attach the programming cable from a PC RS232
    Port to the System Port

2   Launch TVIEW+ & Select "K Series Programmer"

3   Select Basic Mode or Advanced Mode

4   Click on the "Read" icon

5   Change the configuration as required

6   Click on "Write" to write the parameters back to the
     radio
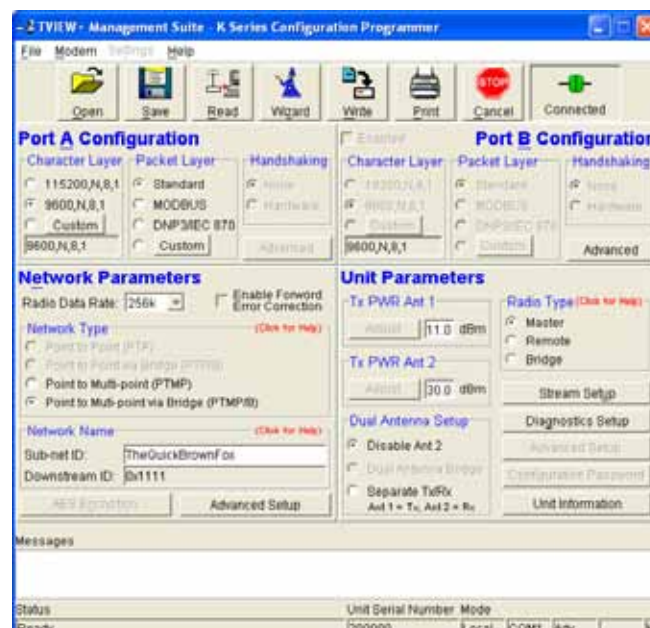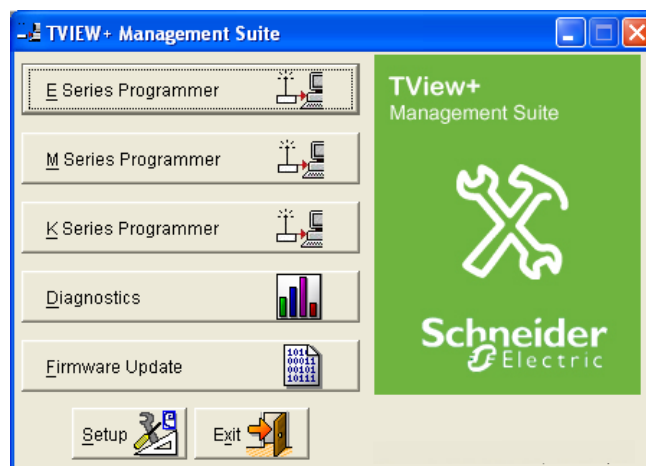
Part G – Commissioning

Activating the Transmitter

- External PTT (KR - Pin 8) (KP & KB - PIN 1) - Provides a manual PTT override facility for enabling the transmitter. This can be useful for Tx PWR or VSWR testing. For testing this can be activated by pulling the external PTT pin to Gnd (KR - Pin 7) (KP & KB Pin 4).
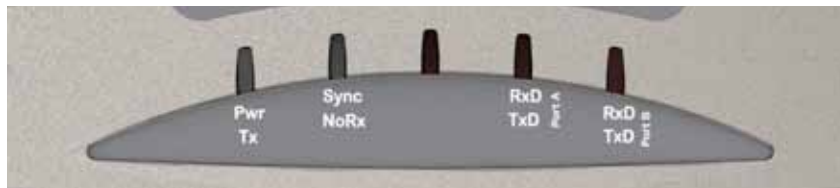
KR radios
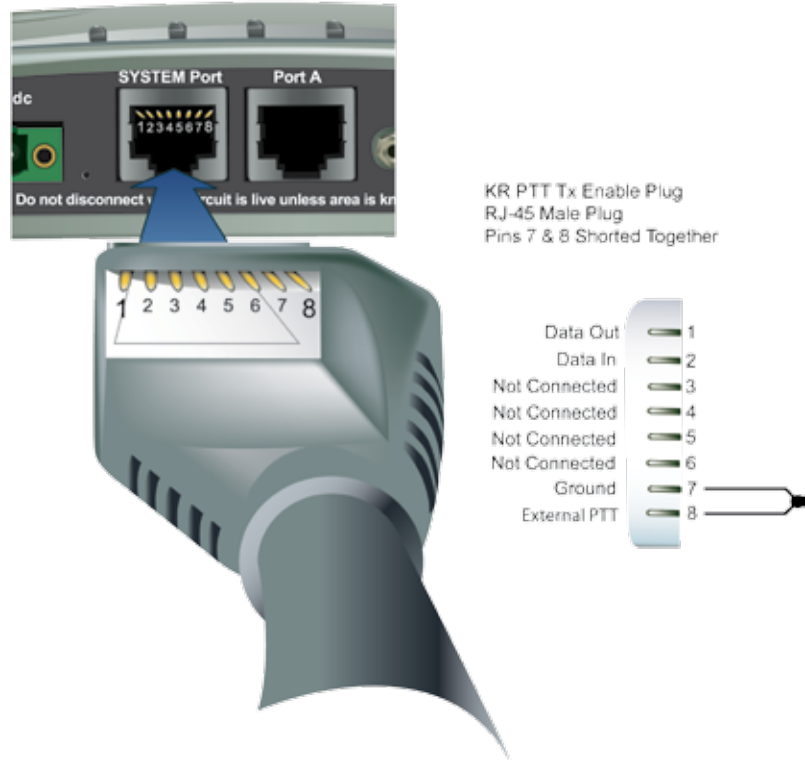
KP & KB Radios
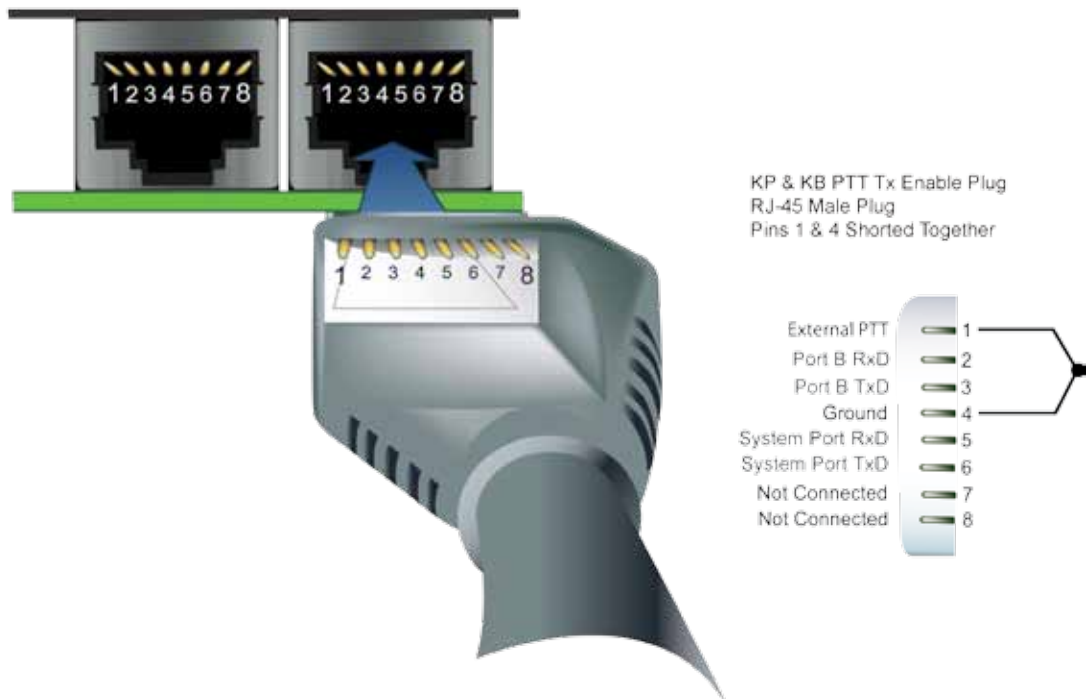
LED Indicators

KP LEDs

KR LEDs

DC Power

If all the LEDs are off, no DC power is reaching the radio modem or the fuse is open. Successful power-up is indicated by the "Pwr/Tx" LED showing a continuous GREEN state for REMOTES or an alternating Red/Green for Masters.

When the transmitter is active the "Pwr/Tx" LED turns RED .

Received Signal Indicator

The "Sync/NoRx" LED is used to indicate the state of the receiver.

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

A regular flashing GREEN LED shows that the modem is synchronised to its Master. The GREEN LED also flashes when the modem is receiving data.

A regular flashing RED indicates the REMOTE not synchronised to a MASTER or BRIDGE. Check the antenna, RF signal levels and ensure the SubNet names are correct.

Port A and Port B Data Flow

The RxD/TxD LEDs indicate data flow into and out of the two user ports. Data being received at the port for Radio Transmission is indicated by a RED flash, and data being sent from the Port is shown as a GREEN flash

The Pwr/Tx LED will flash RED when data is being Transmitted.

Firmware Updating and Factory Default Information LEDs

In some circumstances a firmware update or factory default might be required. A special LED sequence is shown during this phase.

	Pwr / Tx	Sync / NoRx	Not Used	Port A RxD / TxD	Port B RxD / TxD
Firmware upgrade	Amber	Amber	Amber	Amber	Amber
Factory Defaults	Green	Green	Green	Green	Green

Firmware Upgrade : All LEDs flash AMBER (as shown in table above) - 1 second ON and 1 second OFF

Factory Default : Factory Default LEDs (as shown in table above) are permanently GREEN during factory default reset.

Error LED Indications

In some circumstances the radio will indicate an error state. This is shown as all LEDs flashing RED for 1 sec and then a pattern of green LEDs for 1 sec. The pattern of green LEDs indicate the type of error. Please consult the table for more information.

	Pwr / Tx	Sync / NoRx	Link 1 / Activ 1	Link 2 / Activ 2	RxD / TxD	Problem
High VSWR	Green			Green		Ant 1 or 2 has high VSWR
High Temperature	Green	Green		Green		Internal Temperature too high
DC Voltage out of Spec	Green	Green		Green	Green	DC Voltage Out of Spec

For all other patterns of error LEDs the radio must be returned to the factory for repair.

Optimising the Antenna for best RX signal

Once the unit is operational, it is important to optimize the antenna tuning. In the case of a directional antenna, it will be necessary to align the antenna for the best received signal. For each type of radio, the RSSI output functions as per the following:

Master : RSSI voltage is only present if it is receiving valid data from downstream (from Remotes or Bridges).

Bridge : Only looks at the upstream received signal. If you need to measure downstream RSSI you would need to temporarily convert it to a Master talking to the remote with the remote sending data back.

Remotes : RSSI voltage is only present if the unit is in Sync and receiving signal from a Master or a Bridge.

Measuring RSSI on a KR

To measure the RSSI output voltage (0-5Vdc) on a KR take a voltage metre and measure across Pin 9 (RSSI output) and Pin 5 (GND) of Port B. This voltage can be converted to dBm using the chart below. This DC voltage is peak-held with a hold time of 4 seconds.
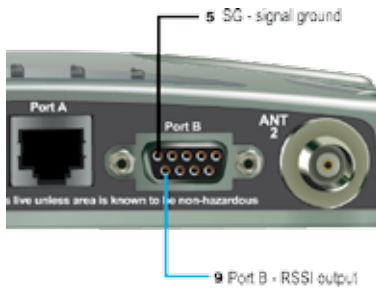
Measuring RSSI on a KP or KB

To measure the RSSI output voltage (0-5Vdc) on a KP or KB, take a voltage metre and measure across J1 Pin 1 (RSSI output) and J1 Pin 2 (GND). J1 is accessible through the open end of the enclosure. This voltage can be converted using the chart below. This DC voltage is peak-held with a hold time of 4 seconds.
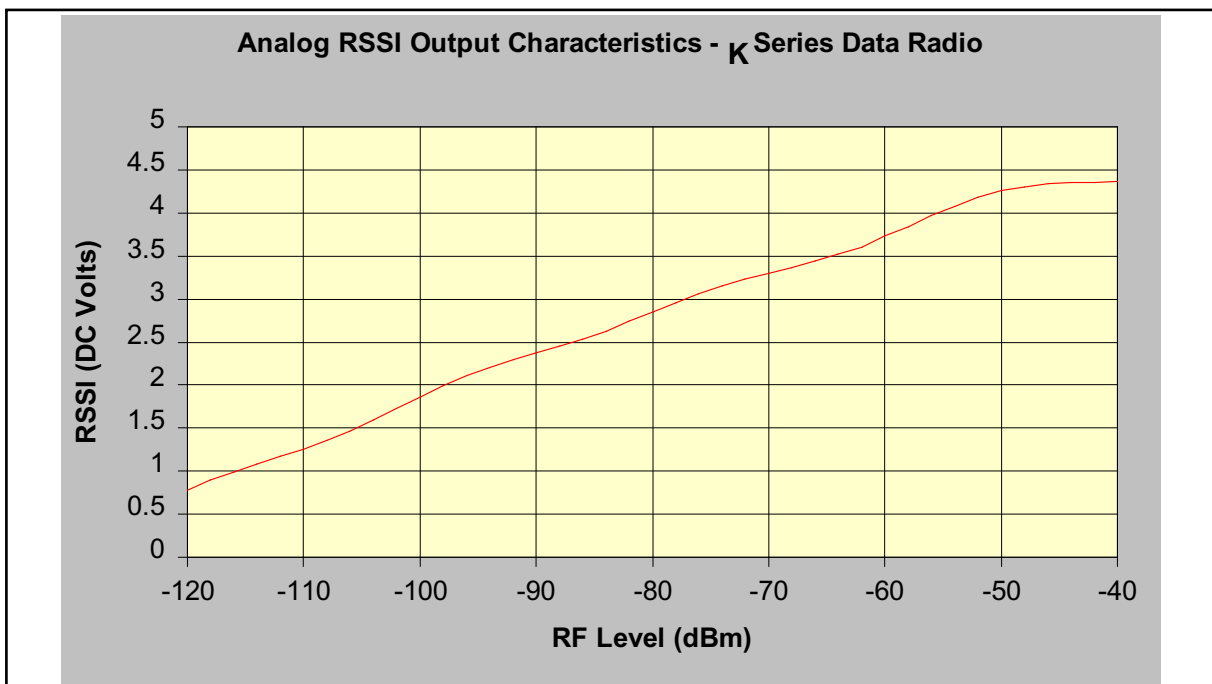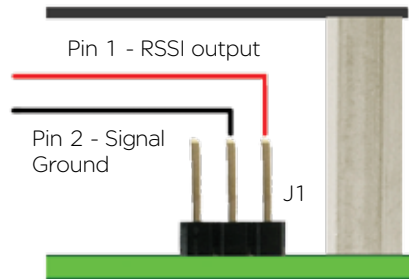

Chart is Approximate Only.

Part H – Tview+ Programmer

Introduction

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

- Programmer for configuration of the radio network parameters, unit 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 K Series data radio modem. 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 (TVIEW+ E&K CABLE). 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 K Series* as well as E&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 a K Series data radio modem unit connected directly to the PC or connected remotely as part of an operational radio network.

* Requires the optional DIAGS/K 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+ E&K 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: System Port - RJ45)

Firmware Update Utility

Firmware updating is performed using this utility via the TVIEW+ E&K CABLE. See Appendix for details on Firmware Updates.

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 K 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 CD-ROM.

- Double click on the file called setup.exe

- After the installer starts follow directions.

Other:

The current K 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+ Main Menu

When started the TVIEW+ front panel appears. The larger buttons permit each of the three 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 local help and an exit facility are provided by the remaining 2 buttons.
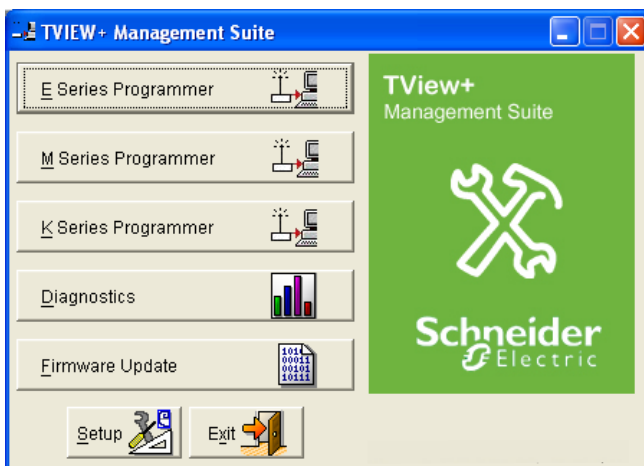
K Series Programmer

Programmer Mode

When first started, the K Series programmer will present a window requesting the user to select the desired programming mode. The window is shown below:
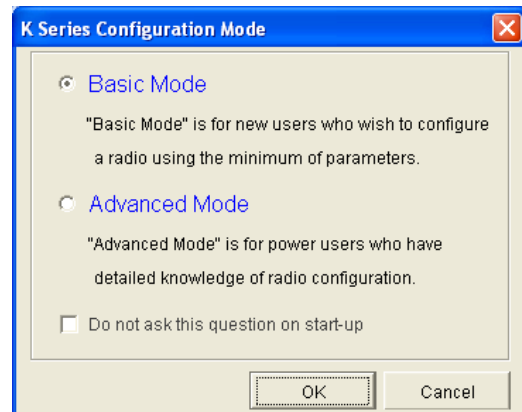

The two programming modes available are as follows:

Basic Mode: Provides access to configure the most common parameters such as User Port baud rates, TX power, etc. Use of this mode does not require advanced knowledge of the product.

Advanced Mode: Provides access to configure all of the parameters in the K Series radio modem. Some areas require advanced knowledge of the product.

Note: If you enabled "Do not ask this question on start-up" the K Series programmer will launch directly into the last known programmer mode. This option is reset when you exit TVIEW+.

Main Window - Basic Mode

When first started, the K Series programmer will start in file mode as indicated by the mode field at the bottom right of the panel shown in the window below.
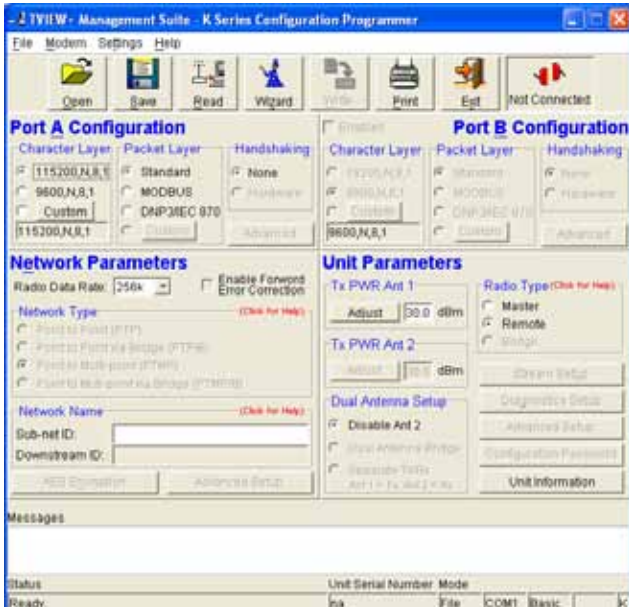
In this mode it is possible to open a previously saved configuration file, or configure various programming options and save the configuration to a file. The programmer Wizard can also be initiated and it is highly recommended to use the Wizard if you are not familiar with the various settings.

To commence programming a radio a session must first be established by using the "READ" function. This 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 from unit

- Configure parameters (or Open a previously saved configuration file or Run Wizard)

- Write to unit

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 as shown below (click once to select).
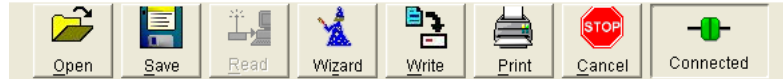
File Menu

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.

Save (also available on the toolbar)

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

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 paper record is required for unit configuration. Please ensure that the configuration has also been saved to file as this contains more information than the printed configuration report.

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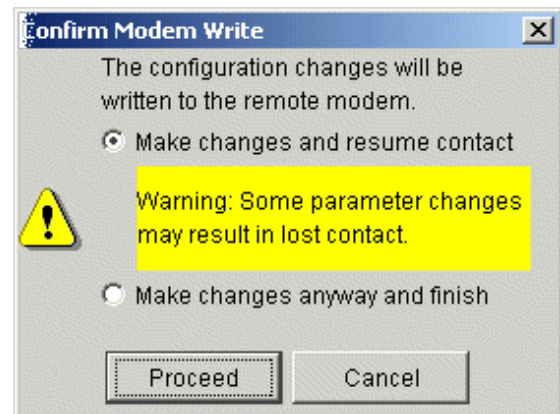
Choose "Make changes and resume contact" to safeguard changes. Some parameter changes (such as frequency change) will, by definition, automatically result in lost contact.

Choose "Make changes anyway and finish" to complete intentional changes which will result in lost contact.
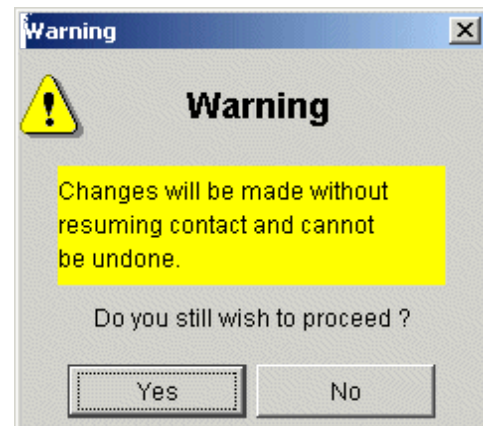
After configuration data has been written, the session with the unit is closed and the programmer reverts to file mode.

Note: In general, any change made on the programmer screen must be written to the unit (using the write function) to become permanently stored.

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.

Configuration Wizards

This programmer facility provides a convenient mechanism for configuring a radio to a known working state based on the identification of where the radio fits into a typical system type.

It can also be useful if you are unsure of the current configuration and would like to return the radio to a known working state.

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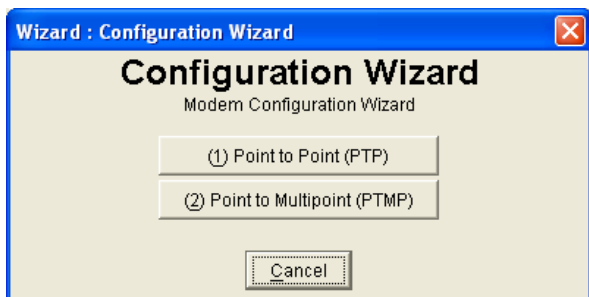
select the desired configuration that can then be written to the unit (remote radio or base station).

The first part of the Wizard requires the user to choose the desired application. For more information on Applications refer to the information found in Part C - Applications.

There are four Application types to choose from:

(1) Point to Point (PTP)

(2) Point to Multipoint (PTMP)

which are available in "Basic Mode" and

(3) Point to Multipoint with KwikStream™ Repeater (PTMP)

(4) Point to Multipoint with LinkXtend™ Bridges (PTMP/B)

which are available in "Advanced Mode".

When you click on the desired Wizard, a second Window will appear which allows the user to select the type of radio being configured in the system (PTMP example shown below).

Note: The Wizard only configures the key radio parameters required for each type of radio operation (Master, Bridge, Remote or a Master configured as a Repeater).

After the Wizard is applied, the user will need to do the following:

(1) Check the Port A user port settings to make sure the Speed and Data format matches the settings in the external equipment being connected.

(2) Check the TX power and ensure that the maximum EIRP limits are not being violated.

(3) Specify a unique Network ID for your system. The Network ID is a name that is used to generate a unique hopping pattern for your system. By choosing a unique name you ensure that the hopping pattern your system uses is different from other system, thus minimising inter-system interference.

It is a good idea to record your Network ID because it needs to be the same for all radios in your system. You can learn more about Network ID's in the section below - Network Names Part H
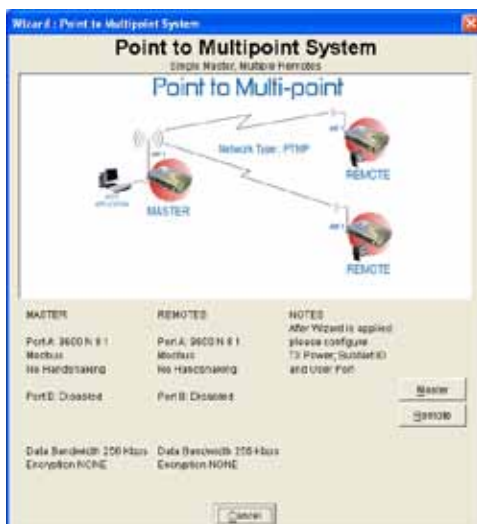
Port A and Port B Configuration

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 can 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:

- 115200,N,8,1 (data speed = 115200 bps, no parity, 8 data bits, 1 stop bit)

- 9600,N,8,1 (data speed = 9600 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.

Note: It is recommend that you run the User Port Data Speed as fast as possible to take advantage of the high speed over the air data transmission.
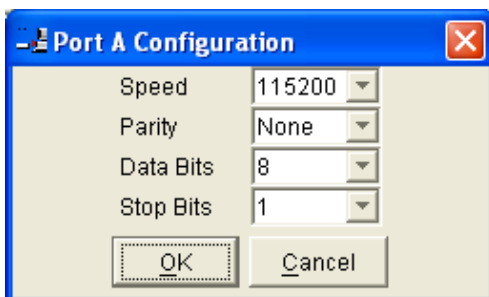
Packet Layer

For details on the operation of the packet layer in the K Series radio please consult Part D Overview of Packet layer.

There are three standard configurations and a custom configuration which can be selected by selected the appropriate control button to the left of the description.

The packet layer configuration options which can be selected are:

Standard

This is a general purpose setting that will transmit data to the receiving unit as quickly as possible. It is suitable for most protocols except DNP3 and Modbus.

MODBUS

This setting configures the packet layer to be compliant with the MODBUS protocol requirements. If you are unsure of your protocol, it is recommend to choose this setting as it compatible with most major types of protocol.

DNP 3

This setting configures the packet layer to be support DNP3 and its exception reporting capabilities.

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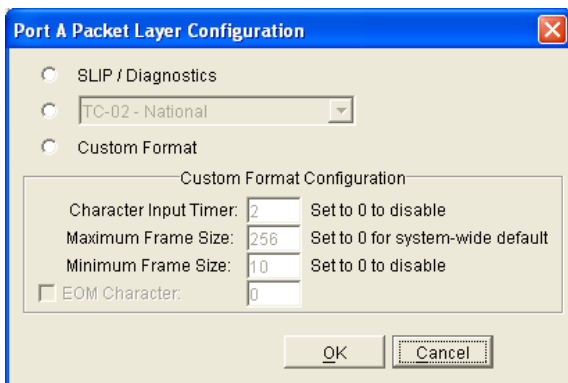
The diagnostics controller package uses the SLIP protocol to communicate between base station and remote modems.

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 protocol format.

For the modem to successfully transmit its packets (or frames) of user data over the radio channel, it must be told on what basis to delineate user data bytes placed into the data port. Once the last byte of user data has been placed into 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.

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.

Handshaking

The K Series digital data radio is a fully transparent radio modem and as such does not require any form of handshaking. Hardware handshaking is offered for legacy equipment which requires handshaking.

Normally legacy equipment that requires hardware handshaking can be satisfied by looping CTS-RTS and or DTR-DSR. This is sometimes referred to as fooling the device into thinking the hardware handshaking is satisfied.

Hardware Handshaking can be enabled on either port should it be required. Details of the two handshaking methods are given below.

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)

• 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 1ms, 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.

• DCD

The function of the DCD line for each port is set under Port Configuration Advanced

Advanced (Port A)

This button provides access to the advanced features of the Port A configuration. When selected the following dialogue box appears.
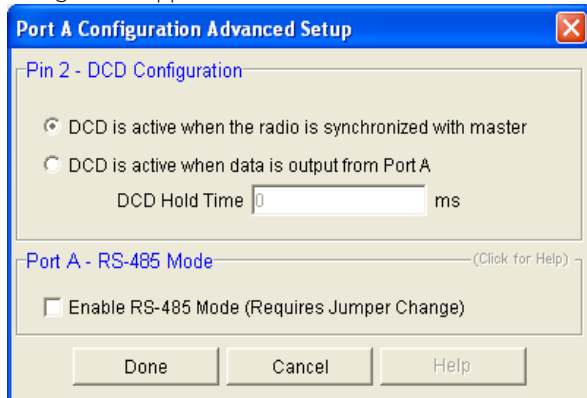
DCD Configuration

If Port A Handshaking is set to "None", then DCD will always be active when the radio is synchronized with the master. This signal could be used by external equipment to determine if a link failure has occurred.

If Port A Handshaking is set to "Hardware", then DCD operation can be changed to be active when data is being output from the Data Port. In this mode, a DCD "Hold Time" can be configured, to keep DCD active after the end of each data packet. This time can be any value from 0 to 65,535 mS.
This operation is useful in networks where the received data is being forwarded to keyed transmitters or multidrop RS485 networks

Port A – RS–485 Mode

Enable (using tick box) this option if you require RS-485 mode of operation on Port A.

Note: When using RS-485 mode internal jumper blocks need to be changed on the radio.

Port A Pin 6 becomes RS485 + and Pin 5 becomes RS485 –

This is documented in Part E - Getting Started - User Port A - Pinout and Cables. See Table of Contents for page number.

Advanced (Port B Only) – KR only

This button provides access to the advanced features of the port B configuration for the KR only. When selected the following dialogue box appears.
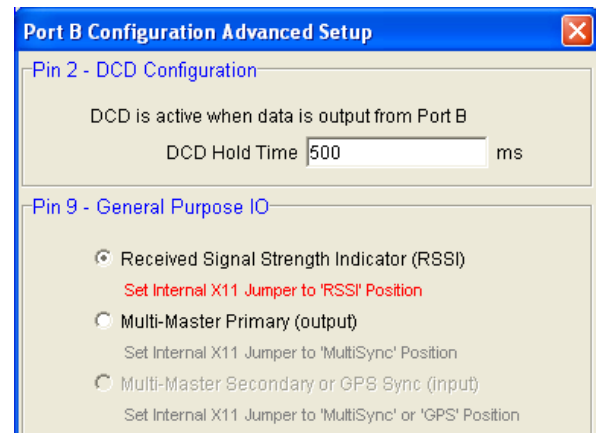
DCD Configuration

With this parameter, the DCD "Hold Time" can be configured, to keep DCD active after the end of each data packet. This time can be any value from 0 to 255 mS. This operation is useful in networks where the received data is being forwarded to keyed transmitters or multidrop RS485 networks

General Purpose IO

Pin 9 of Port B is designed to be a multipurpose IO pin
The selection of each Pin 9 function is dependent on the users applications. There are three possible options for this configuration
Note the default position of the internal jumper X11 is for RSSI

Received Signal Strength Indicator (RSSI) - Output:
This function provides a DC voltage output that varies depending on the average received signal strength. Refer to "Optimizing the Antenna for Maximum Signal Strength" on page 27 for details.

The following options apply only to MASTER and BRIDGE radio types

Multi-Master Primary - Output: This function provides a mechanism to synchronise MASTER radios in different systems such that all MASTERs will transmit at the same time and receive at the same time.

The benefit of using Multi-Master synchronisation is that there is no restriction on the separation of antennas at sites where multiple masters have been installed. It is not possible for one MASTER transmitter to de-sense the receiver of another MASTER

When synchronising multiple MASTER radios, only one can be the primary sync source. Ensure that this setting is enabled on the primary synch MASTER.

Multi-Master Secondary/GPS Sync - Input: All other MASTER radios in the system need to synchronised to the primary MASTER. These MASTERS need to have this setting to ensure correct operation.

Network Parameters

This section of the main window permits adjustment of Network (ie: System Wide) specific parameters.

Radio Data Rate

The Radio Data Rate determines the data speed used by the modem for "over-the-air" data communications. There are four data speeds available. The choice of speed is governed by several factors such as:

> Range: Lower speed networks provide better coverage (ie: longer range)

> Bandwidth: Systems that are transferring lots of data need higher bandwidth and thus higher speeds.

The four speeds available are 32kbps, 64kbps, 128kbps and 256kbps.

Network Type

The Network Type is chosen depending on the requirements of the System Design. For detailed information on Network Types please refer to Part C - Applications on page 9.

The four choices available are:

- Point to Point

- Point to Multipoint

- Point to Point via Bridge

- Point to Multipoint with Bridges

Network Name

The Network Name is a text string (20 characters) which is used by the radio modem to generate a hopping pattern for the system. All printable characters can be used and the string is case sensitive. It is recommended that the System Designer choose a unique but meaningful name for the system. Typical example would be "Sewer Pump A", etc.

In systems without BRIDGES, such as Point to Point (PTP) and Point to Multipoint, only one Network Name needs to be specified, which is referred to as the SubNet.

Both MASTER and REMOTE radios in these types of systems need to have the same SubNet ID Network Name.

In systems with BRIDGES, requirements for the Network Name are different. Because a BRIDGE is essentially a split personality device (ie: it behaves as a REMOTE radio for half of the time and a MASTER radio for half of the time), the Network Names for a network with BRIDGES are divided up into Upstream and Downstream.

MASTER radios in a network with BRIDGES only require the specification of a DownStream Network ID.

REMOTE radios in a network with BRIDGES only require the specification of an UpStream ID.

BRIDGES require the specification of both Upstream and Downstream Networks IDs. The Upstream network ID is the Network Name defined in the MASTER of the system. The Downstream ID is the Network Name defined in the REMOTES of the systems.

256-bit AES Encryption (if enabled)

If 256-bit AES encryption is available (consult factory for detail) then its use can be enabled via this dialogue box.

If the Current Status is set to "Enabled", an encryption key needs to be provided. This "key" must be the same in all radios in the network. It can be up to 32 characters long.

Note: For security reasons, the encryption key is not saved as part of a "saved" radio configuration. The encryption key needs to be specified for each new radio configuration session.

Format of Encryption Key

The key can be entered as an ASCII character sting up to 32 characters long. e.g. TrioKeyCode , or as a hexadecimal number with up to 32 digits with each digit consisting two values in the range 0- 9 and A, B, C, D, E or F e.g. 0x120045AF   (hexadecimal keys always begin with 0x...)

Advanced

The Advanced Network Parameters dialogue box allows the configuration of Advanced features that the System Designer may want to change.

Custom Hop Patterns

Custom Hop Patterns: This option allows the user to remove specific channels that are suffering from interference.

Please refer to Part H Channel Exclusion.

Hopping Pattern Seed: This option allows the users to decide how the hopping pattern seed is generated. In most systems, it is convenient to generate the seed from the Network Name.

When implementing a SmartPath™ topology, the seed must be generated from the Serial Number of the radio. For more information on SmartPath™ refer to Part D : SmartPath™, in this user manual.

Network Timing

This option allows the System Designer to choose the Hopping Interval. In general, the shorter the Hopping Interval, the lower the opportunity for interference to occur on one single channel. The longer Hopping Interval, the more bandwidth that is available (due to the radio hopping less frequently).

Network Settings - Master Specific

Data Retransmissions: This option allows the System Designer to choose how many times data is retransmitted from the Master to Remote radios. More retransmissions give better tolerance to interference. Data Retransmissions decrease the available downstream bandwidth (i.e.: from Master to Remotes) by half for each increase in number.

Network Settings - Remote Specific

Sleep State: In order to conserve power, particularly in solar powered applications, the remote radios can be configured to sleep for a number of hopping intervals then wake to listen for any messages from the Master radio, then sleep again. The number of hopping intervals and so the length of time that the remotes sleep depends on the settings Light, Medium or Heavy.

No Ack Retry Limit: For every data packet transmitted from a Remote to a Master, the correct reception of that packet is acknowledged by the Master. This setting determines the number of times the Remote will retry if no acknowledgment is received.

Digital Collision Avoidance: If you wish to enable Digital Collision Avoidance select the Enabled button. For optimal performance please select the number of remotes in your network from the drop down list

For a complete description of the Network settings please refer to Part D of this User Manual.

Channel Exclusion

This button opens the Channel Exclusion dialogue which allows selection of a number of channels which will be excluded from any Frequency Hopping Pattern

The number of channels which can be excluded depends on country specific models of the K Series radio. Even if only one channel needs to be excluded, you must exclude a bank of channels as noted below. This is because the K Series uses a highly advanced hopping algorithm that requires a prime number of hopping channels to be in the pattern (after channel exclusion).

Country	Total	Excluded Channels
Australia (915-928MHz)	**31**	**2, 8**
New Zealand (924-928MHz)	**17**	**4, 6, 10 or 12**
Brazil (902-907.5MHz and 915MHz to 928MHz)	**43**	**None allowed**
United States/Canada FCC (902-928MHz)	**67**	**6, 8 or 14**
2.4GHz (Europe)	**73**	**2,6,12,14,20, 26,30,32,36, 42,44,50,54 or 56**
2.4GHz (International)	**197**	**6,16,24,30, 40,48,58,66, 70,84,90,96, 100,108 or 118**

Channel numbers can be added to the list manually using the "Add Channels" and <Enter> (return key). Clear will remove channels from the list

Spectrum Analyzer

The Spectrum Analyser is a tool which suspends normal operation and places the K Series in a special receive only mode. In this mode the radio will perform single or continuous sweeps and listen for interference or other activity of each channel in the band.

The Spectrum Analyser presents the results as a graph indicating the Signal Level in each of the channels
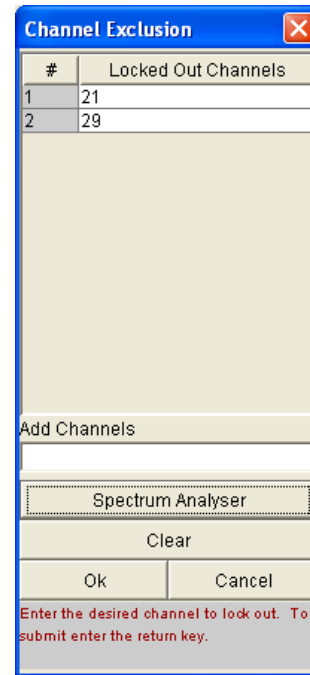
A threshold adjustment is provided and channels with a level above this threshold , up to the number allowed, will be excluded. The channels shown as rejected will automatically be added to the Channel Exclusion list

When the Spectrum Analyser is stopped normal radio operation will re-commence

Site Testing

When testing a site for interference the Master site is the most important because the operation of the entire network depends on this site. The Master radio is used in this case to perform the Spectrum Analysis.

At the Remote Radio sites the remote radios can be used for the Spectrum Analysis, but care must be taken to ensure that the master radio is turned off (not transmitting) to avoid interpreting valid Master transmissions as interference
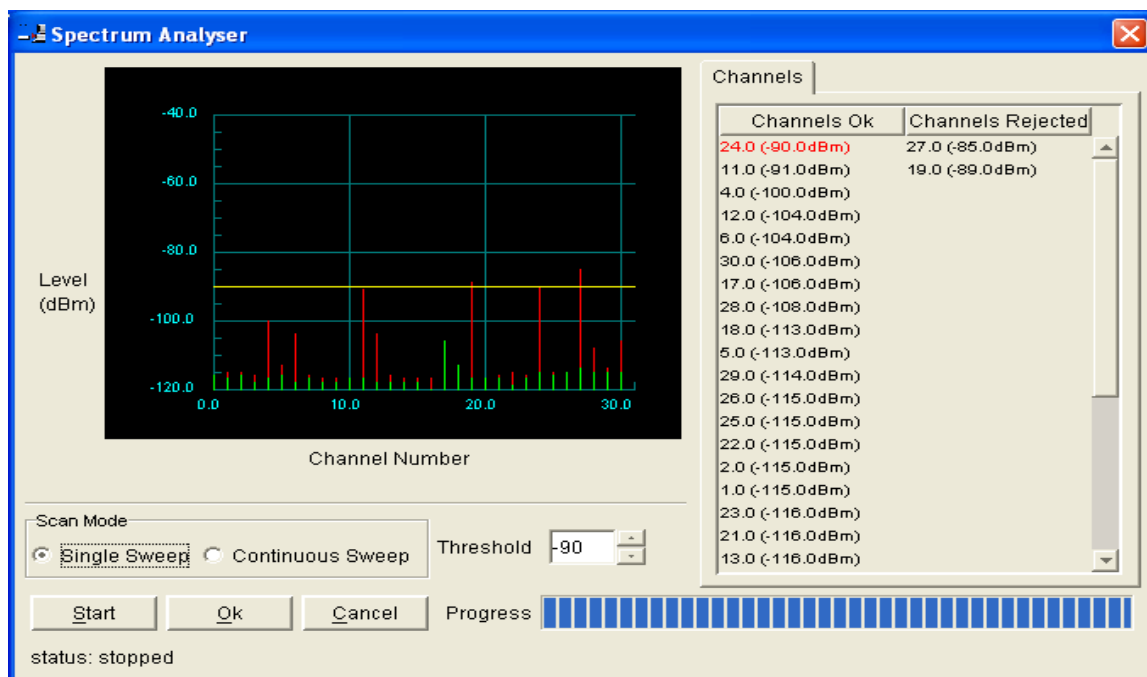
Unit Parameters

Tx PWR Ant 1

This parameter configures the TX power on Antenna 1. In most applications, Antenna 1 is the only antenna used.

Tx PWR Ant 2

This parameter configures the TX power on Antenna 2. See notes below on when Antenna 2 is applicable.

Dual Antenna Setup

Disable Ant 2: Normally Antenna 2 is disabled. Antenna 2 is only used in Dual Antenna LinkXtend™ bridges or Separate TX/RX antenna applications.

Dual Antenna Bridge: When a Dual Antenna LinkXtend™ bridge is required this option should be selected.

Note: Upstream communications (i.e.: comms with the Master) occurs on Antenna 1. Downstream (i.e.: with the Remotes) occurs on Antenna 2.

For a system diagram of Point to Multipoint via LinkXtend™ Bridge please see Part C Network Types

Separate Tx/Rx: The radio can also be configured for operation in a separate TX/RX antenna mode. In this mode, all TX activity occurs on Antenna 1 and all RX activity occurs on Antenna 2. This means the System Designer can choose to use external power amplifiers for the TX path and external mast-head amplifiers for the receive path.

Radio Type

Master: Select this option when you would want the radio to operate as a Master. The Master radio is the radio which provides timing synchronisation for the entire network. There must be one Master radio per network. There cannot be more than one Master radio per network.

Many parameters are inherited by all other types of radios from the master. For more information on how the Master radio fits into a system please refer to Part C - Applications of this User Manual.

Remote: Select this option when you want the radio to operate as a Remote radio.

Bridge: Select this open when you want the radio to operate as a Bridge. If you require a Dual Antenna LinkXtend™ bridge ensure that you also select "Dual Antenna Bridge" under Dual Antenna Setup.

Stream Setup

The Stream Setup dialogue box determines the way that different streams of data will be handled at data ports Port A and Port B.

Data Streams are identified by Stream Identifier Codes known as SIDs. Please refer to Part D Features for a detailed explanation

The default port settings are shown below

Port A has Tx SID = 3   Rx SID =3
So for those radios left at this default setting, Data transmitted from Port A will be directed to Port A of a receiving radio
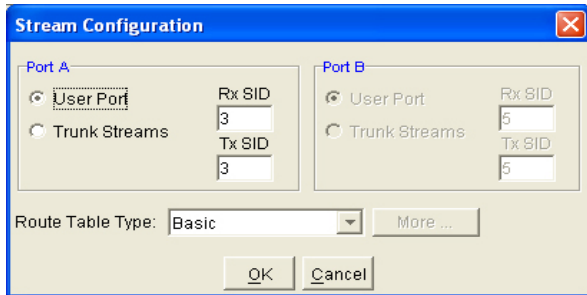
Each port is independent and supports multiple options which are described in the following sections.

User Port

This option is selected by clicking on the User Port button and entering a number in the Rx SID and Tx SID fields to the right.
Use this option when you are connecting a PLC or RTU or a SCADA host

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 TRIO Diagnostics software, connecting 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.

Route Table Type

The K Series Radio provides a pre-configured SID route table to assist the System Designer in routing data via the radios.

The options are:

Basic: This options maps Port A of each radio together. This means data placed into Port A on a MASTER will appear out of Port A on all REMOTES or BRIDGES and vice versa for Port B. Data in the other direction (i.e.: from Remote to Masters) maps in an identical fashion.

Basic with Peer to Peer: This option is similar to the Basic option noted above, with the exception that data is repeated by the MASTER or BRIDGE(s) such that Peer to Peer remote communication can be achieved.
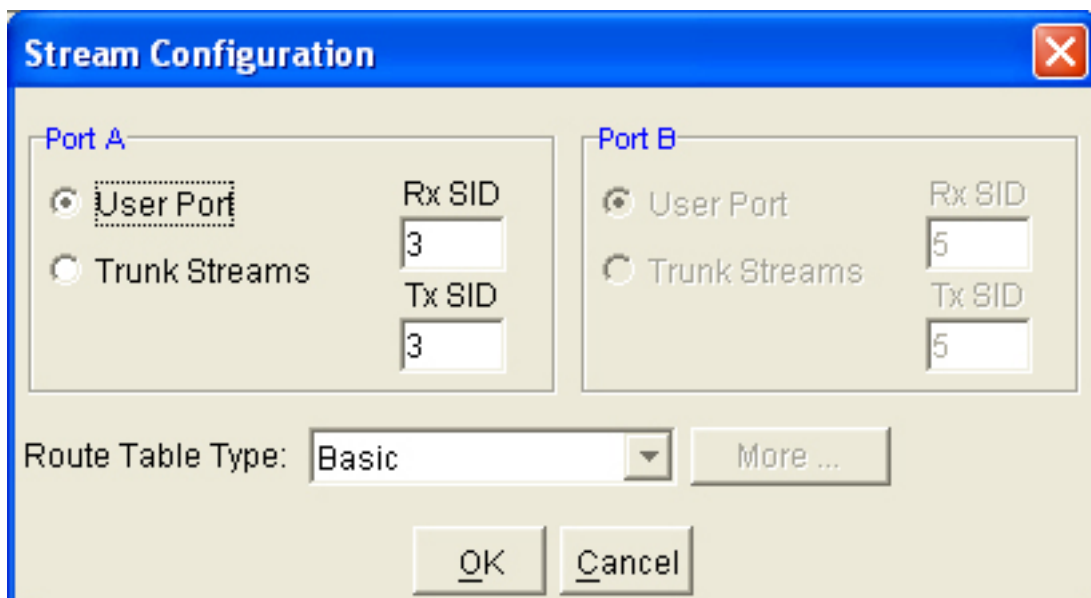
Bridge and Repeat Streams

This button brings up a dialogue box to permit
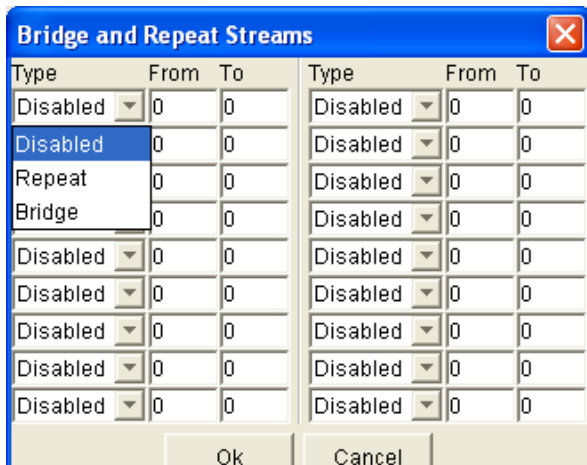
Repeat Range

Any K Series MASTER or BRIDGE radio is capable of repeating data which can be useful when Peer to Peer communication is required. The System Designer can choose to repeat specific SIDs if required by enabling a Repeat Range. Each Repeat range is specified by a From and To range. Up to 16 individual ranges are available.

Bridge Range

Any K Series BRIDGE radio is capable of bridging data between Upstream and Downstream Networks. Bridging operates in a similar way to repeating except that data is "Repeated" from Upstream to Downstream and Vice Versa. This option allows the system designer to Bridge specific SID ranges but not others.

Diagnostics Setup

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 system wide diagnostics and thus this option should be selected if this is required.
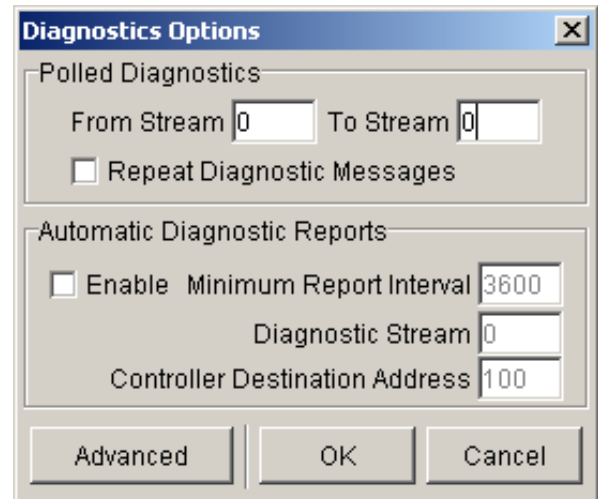
Automatic Diagnostic Reports

This option is configured in the MASTER radio. When the REMOTE radios synchronize with the MASTER, the settings are learnt by all the remotes in the system.

Once the settings have been learnt, the remotes will attach diagnostic message to transmitted user data with the parameters originally set in the MASTER.

Because the diagnostics messages are attached to data being transmitted, collisions are reduced

Automatic Diagnostic Settings

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 K Series radio if it was not purchased with the original order. Enter the 8 digit key-code supplied by TRIO to enable diagnostics. If diagnostics is already installed this option will be "greyed out".

Unit Advanced Setup

This area of the programmer allows the System Designer to enable Trusted Master/Remote features as well as configure SmartPath™ preferred/alternative Masters and RSSI threshold. For detailed information on Trusted Master/Remote and SmartPath™, refer to Part D - Features, of this user manual.
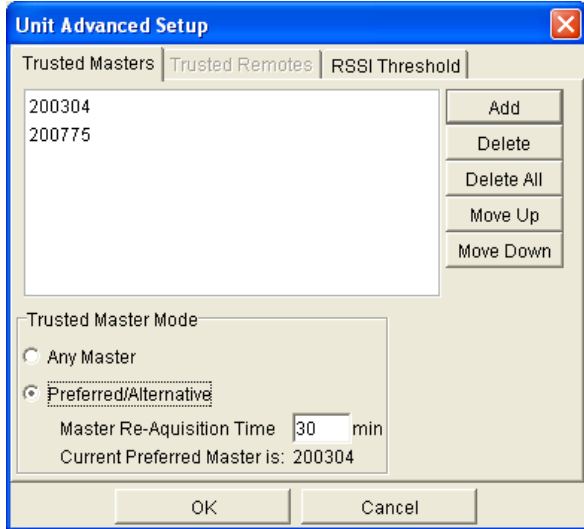
Trusted Masters (valid only for Bridges or Remotes):

This configuration parameter allows the user to configure up to 4 trusted Masters. If there are no trusted Master radios specified then the remote radio will associate with any Master radio that has the correct Network Name.

Trusted Master Mode:

Any Master : In this mode, the remote or bridge radio can associated with any Master that has the correct Network Name.

Preferred/Alternative: In this mode, the remote or bridge radio can associated with any Master in the list specified. The first master in the list is the preferred Master. All others are alternatives. Once all available Masters have been entered into the list, the user may move the order of the Masters up/down to achieve the desired preferred/alternative hierarchy.

Master Re-Acquisition Time: This parameters configures the amount of time a remote or bridge radio will remain associated with an alternative Master. Once this time has expired, the radio will search for the preferred Master.

Trusted Remotes (valid only for Masters and Bridges):

This configuration parameter allows the user to configure up to 63 trusted Remotes. If there are no trusted Remote radios specified then the Master radio will allow any Remote radio that has the correct Network Name.
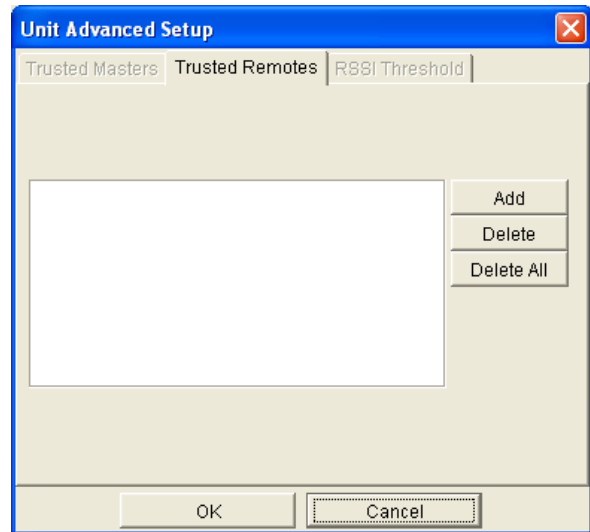
RSSI Threshold:
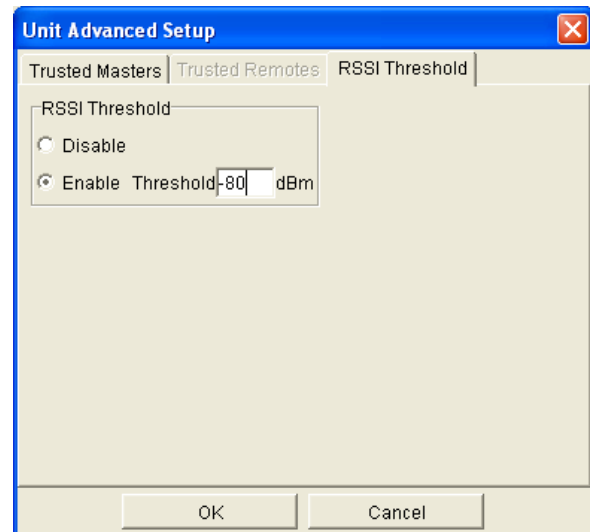
RSSI Threshold : This configuration parameter enables the RSSI Threshold facility as described in Part D - SmartPathTM, of this user manual.

When enabled, a remote or bridge radio will only associate with a Master radio if the received signal is above the Threshold.

Configuration Password

To create a password for your units configuration, click on the Configuration Password Button. You will notice a window appears prompting you to fill in a new configuration password.


After you enter this password, you will need to re-enter the password for confirmation. Once the password has been set, you must write it to the radio and then next time any user attempts to read the configuration of the unit, they will have to enter the configuration password you just set.

Note: Configuration passwords are not saved within saved configurations, it must be set in a live programming session.

Clone Mode

In particular circumstances, you may find your self requiring the same configurations in multiple radios. Rather than reading each unit and configuring each unit exactly the same, you can simply use Clone Mode.
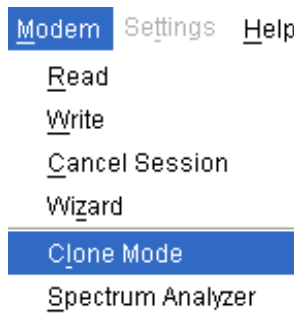

To use clone mode you need to first create and write the configuration to a radio. once written, read the unit again and goto -> Modem -> Clone Mode

Plug the next radio in and press the write button. The cloned configuration will be written to the radio. simply repeat this process to quickly configure your radios.

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.
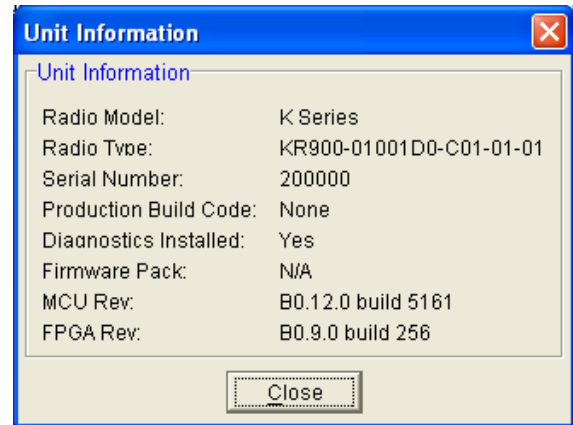
Radio Type refers to the type of unit.

Radio Model refers to unit specific model information.

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.

Production Build Code is a factory set ID that may be requested by technical support to identify how the radio was produced.

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

Firmware Pack refers to the firmware package version installed in the radio.

MCU Rev refers to the Microcontroller firmware version installed in the radio.

FPGA Rev refers to the FPGA firmware version installed in the radio.

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.

Part I – Firmware Updating

Firmware Update Overview (R2.x.x or later)

Note: These instructions apply only to K Series running firmware packs R2.x.x or later.

From time to time there might be enhancement/ improvements to the firmware. Using TVIEW+ K Series Programmer, please check the current MCU & FPGA firmware version is by reading the unit and opening the Unit Information window. Check release notes on our website http://www.triodatacom.com/scada_supp.php for newer firmware that may be beneficial to your system.

Firmware updates are performed on a unit connected locally to the PC or remotely via an operational radio link. For a local upgrade, it is recommended that all cabling to the unit be disconnected prior to commencing the 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 closed during the firmware update process.

For a remote upgrade please ensure that the radio link is operating correctly and that other traffic using the link is minimized.

There are two devices inside the K series radio which require firmware to operate. The firmware for each device has a separate version number but both types of firmware are included together as a single ".tpk" file called a firmware pack. This ensures that both devices remain up to date when a firmware upgrade is performed.

Note: Before upgrading K Series radios with firmware Serial Numbers earlier than 200600 or earlier please contact support@triodatacom.com as these units may require an alternative firmware upgrade procedure.

Connection to PC
Some types of USB to Serial adapters may not be compatible with firmware updating. Ensure that you are using the latest version of USB-Adapter drivers or use a genuine serial port instead
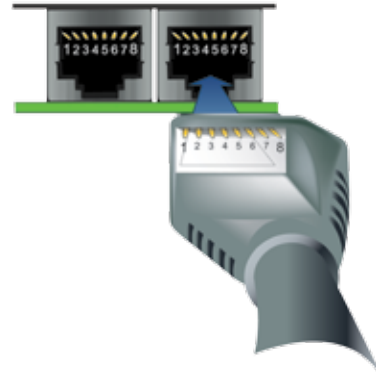
Connection to a KR
Connect the TVIEW+ E&K Series diagnostics/ programming cable from the PC Serial (COM) port to the systems port on the radio as shown.
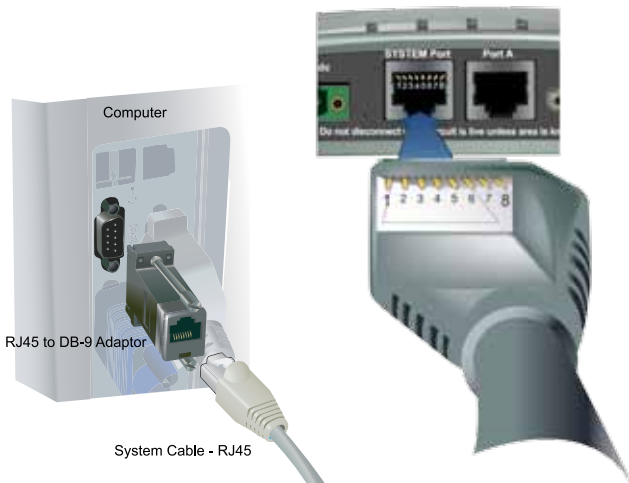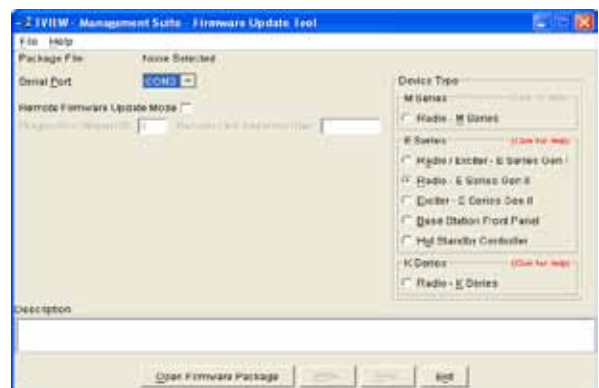

Connection to a KP or KB

Connect the KP/KB programming cable from the PC Serial (COM) port to the system port/Port B only on the radio as shown.

K Series Local Firmware Update
(1) Click on the "Firmware Update" button to start the firmware update utility from the TVIEW+ front panel.
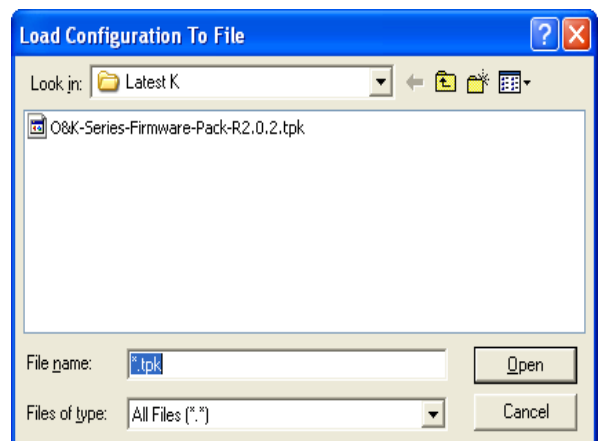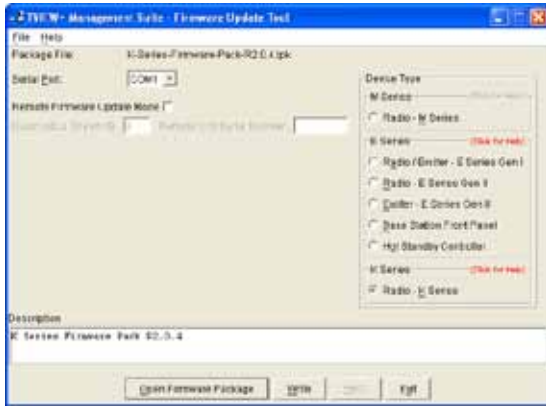

(2) Select the appropriate Serial Port.

(3) Ensure the "Remote Firmware Update Mode" button unticked.
Diagnostics Stream ID and Remote Unit Serial Number are NOT required for local mode and will be greyed out.
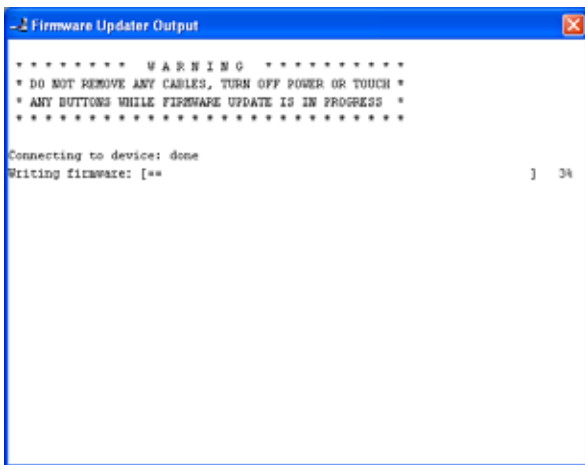
(4) For the "Device Type" select "Radio - K Series" and then click on the "Open Firmware Package" button.


(5) Select the firmware package and click on the "Open" button.

(6) Verify that the correct firmware package has been opened by checking the version in the Description window. Now click on the "Write" button.

(7) The firmware update tool will now attempt to connect to the radio. All four LEDs should now show a constant orange state. Wait until the firmware update process is "Done". If an FPGA update is required, the radio may enter a mode where it will transfer the new firmware into its internal non-volatile flash memory. This may take up to 7 minutes and all four LEDs will be orange.
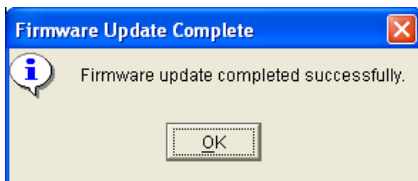
(8) When internal programming is complete the radio will begin operating with the same settings as it had before the upgrade.

The original configuration is not lost.

The successful conclusion of the complete upgrade process is indicated by the Pwr/Tx and Sync/No Rx LEDs showing Master, Bridge or Remote operation.

Remote Firmware Update Overview (R2.x.x or later)

Note: These instructions apply only to K Series running firmware packs R2.x.x or later.

The process for Remote Upgrading is similar to that for Local Upgrading and has in built protection against radio network failure.

However extra care must be taken when planning a remote upgrade which may take many minutes depending on other radio traffic.

When the upgrade process is complete and the uploaded file is verified, the radio will enter a self-programming mode which will result in the radio becoming non-operational for a period of up to 5 minutes. If the radio is the network master then the entire network will be non-operational until the radio has loaded the new firmware into its non-volatile memory.

Note: During the uploading of the firmware file the remote radio remains operational and the process can be canceled from the PC running the Firmware Upgrade. If the firmware upgrade process is cancelled, a programming session cannot be resumed for approximately 5 minutes.

(1) Click on the "Firmware Update" button to start the firmware.
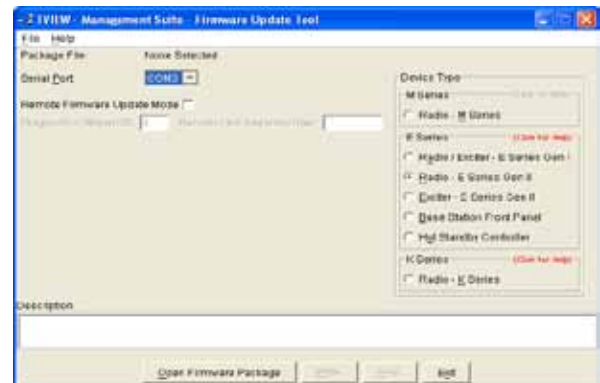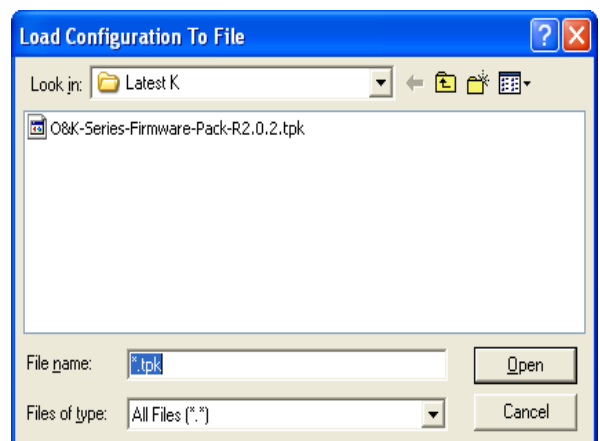

(2) Select the appropriate Serial Port COM Port if required.

(3) Ensure the "Remote Firmware Update Mode" button ticked.
Diagnostics Stream ID and Remote Unit Serial Number are NOT required for local mode and will be greyed out.

(4) For the "Device Type" select "Radio - K Series" and then click on the "Open Firmware Package" button.
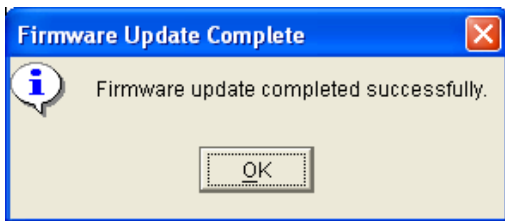
(5) Select the firmware package and click on the "Open" button.

(6) Verify that the correct firmware package has been opened by checking the version in the Description window. Now click on the "Write" button.

(7) Wait until the firmware update process indicates the firmware update is "Done".

(8) If an FPGA update is required, the remote radio may enter a mode where it will transfer the new firmware into its internal non-volatile flash memory. This may take up to 7 minutes and all four LEDs will be orange (on the remote radio).

During this operation, the radio is offline and can not communicate. It is important to note that the radio will only take 7 minutes IF an FPGA firmware update is required. This is not normally the case as the MCU firmware is where most of the firmware updates occur. If an MCU firmware upgrade is required, then the wait time will only be a few seconds.

(9) When internal programming is complete the radio will begin operating with the same settings as it had before the upgrade. The original configuration is not lost

Confirmation of Remote Upgrade

After a successful remote firmware upgrade, the radio will begin operating with the same configuration settings that it had before the upgrade. If the radio is a Master, then the entire network will need to re-synchronize to the Master. Depending on the hope time this may take up to 20 seconds.

To confirm correct operation of the radio and restoration of the network, it is recommended that the TVIEW+ K Series Programmer be used to perform a remote read of the radio and the new firmware version viewed under Unit Properties

(1) Start the K series programmer.
     see TVIEW+ Main Menu Part H for details

(2) Perform a READ operation.
     Select Remote Unit.
     Enter Serial Number of radio.
     Enter Stream ID used for Programming and Diagnostics.
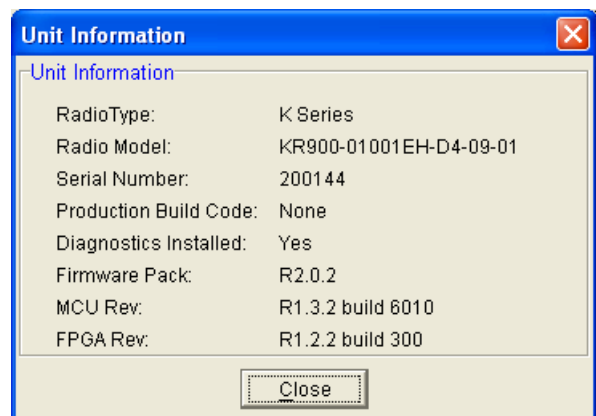
(3) When READ is complete, select Unit Information.
     Confirm successful Upgrade by checking that
     the Firmware Pack Revision Number matches the
     firmware pack your were intending to upgrade too.

Part J – FCC Approved Antennas

Part Number   Description

Yagi Antennas

Part Number	Description
BMY890K	10dBd, 900MHz Yagi Directional Antenna Bluewave, Marathon Series
BMY890G	6.5dBd, 900 MHz Yagi Directional Antenna Bluewave, Marathon Series
BGY890K	10dBd, 900 MHz Yagi Directional Antenna Bluewave, Guardian Series
BGY890G	6.5dBd, 900MHz Yagi Directional Antenna Bluewave, Guardian Series
BXY24XI	6dBd, 2,4GHz Yagi Directional Antenna Bluewave, Sentinel Series
BXY24XK	8dBd, 2,4GHz Yagi Directional Antenna Bluewave, Sentinel Series
BXY24XM	10dBd, 2,4GHz Yagi Directional Antenna Bluewave, Sentinel Series

Omni Antennas

Part Number	Description
BMO902J	9dBd, 900MHz Omni Directional Antenna Bluewave, Marathon Series
BMO902H	7dBd, 900 MHz Omni Directional Antenna Bluewave, Marathon Series
BMO902G	6dBd, 900 MHz Omni Directional Antenna Bluewave, Marathon Series
BGO902G	6dBd, 900MHz Omni Directional Antenna Bluewave, Guardian Series
BXO24XD	1dBd, 2.4GHz Omni Directional Antenna Bluewave, Sentinel Series
BXO24XG	4dBd, 2.4GHz Omni Directional Antenna Bluewave, Sentinel Series
BXO24XJ	7dBd, 2.4GHz Omni Directional Antenna Bluewave, Sentinel Series
BXO24XM	10dBd, 2.4GHz Omni Directional Antenna Bluewave, Sentinel Series
ANT2G4WHIP	0dBd, 2.4GHz Omni Directional Antenna TRIO Datacom, Whip Series

Panel Antennas

Part Number	Description
BXL24XM	10dBd, 2.4GHz Panel Directional Antenna Bluewave, Sentinel Series

CAUTION

Changes or modifications not expressly approved by TRIO Datacom could void the user's authority to operate the equipment.

Fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the above table must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions). Please contact TRIO Datacom Inc. if you need more information.

Part K – Support Options

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 1650
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

Schneider electric Australia - Customer care

Available: Monday to Friday 8:30am - 5:00pm Australian Eastern Standard Time

Direct Worldwide: +1 300 369 233

Email: technicalsupport@au.schneider-electric.com

Part L – Specifications

>	Trio KR900	KR240

Radio	
Frequency Range	902-928MHz or 2.4-2.48335GHz, (region-specific versions available)
Frequency Accuracy	12.5ppm (900MHz) 13.0ppm (2.4GHz)
Radio Modes	Half Duplex, Pseudo Full Duplex
Configuration	All configuration via Windows based software
Selectivity	Better than 50dB
Spurious Response	Better than 70dB
Tx Power	• 900MHz : 0.01 - 1W (+30dBm) 0.5dB steps configurable with over-temperature and high VSWR protection • 2.4GHz : 0.01 - 500mW (+27dBm) 0.5dB steps configurable with over-temperature protection.
Modulation	2 Level GFSK
Connections	
Serial Data Port A	1 x RS232/RS485 RJ-45. 600-230,000bps asynchronous
Serial Data Port B	1 x RS232 DB9 female DCE. 300-38,400bps asynchronous
Serial Data Port Flow Control	Configurable hardware / 3-wire interface
Serial Data Port DCD Control	Configurable DCD operation : activated on Master synchronisation or from user data output.
System Port	1 x RS232 RJ45: 19,200bps, for configuration and diagnostics
Antenna	2 x TNC female bulkhead connectors for LinkXtend or separate TX/RX antennas
Power	2-pin locking, mating connector supplied
LED Display	Multimode Indicators for Pwr, Tx, Rx, Sync, TxD and RxD data LEDs (for both port A and B)
Modem	
RF Channel Data Rate	32,000/64,000/128,000 or 256,000bps
Bit Error Rate	Max sensitivity < 1×10^{-6} @ -108dBm
Operating Modes	Master, remote, repeater or network-bridge
Network Types	Point-to-Point, Point-to-Multipoint, Point-to-Multipoint with Repeaters / Store n' Forward, Mesh
Channelshare™	Trio's unique supervisory collision avoidance system
MultiStream™	Simultaneous data stream delivery allows for multiple vendor devices/protocols to be transported on the one radio network
SmartPath™	Technology for enhanced redundancy in network configuration (Mesh)
Firmware	Local and over-the-air flash-based firmware
Security	
Encryption*	256-bit AES
Password Protection	Password protected configuration sessions
Trusted Unit	Optional Trusted Access point-Trusted Remote operation

* Export restrictions may apply. Contact factory for details.

Specifications continue on the next page.

>	Trio KR900 | KR240
Diagnostics	

Diagnostics Overview	• TView+ configuration, network management and diagnostic Windows GUI software
	• Spectrum Analyser and Channel Lockout facilities
	• Network-wide operation from any remote terminal
	• Non intrusive protocol – runs simultaneously with the application
	• Over-the-air re-configuration of user parameters.
	• Storage of data error and channel occupancy statistics
	• In-built Error Rate testing capabilities
	• Diagnostics parameters available
	   • Transmitter Power
	   • Received Signal Strength
	   • DC Supply Voltage
	   • Received Frequency Error
	   • Radio Temperature

General	
Operating Temperature Range	-40 to + 70ºC (-40 to +158ºF)
Power Supply	10-30Vdc (13.8Vdc nominal)
Transmit Current	• 900MHz : 730mA nominal @ 1W • 2.4GHz : 570mA nominal @ 0.5W
Receive Current	• 900MHz: <120mA nominal @ 13.8Vdc • 2.4GHz: <100mA nominal @ 13.8Vdc
Sleep Mode	Software Controlled
Housing & Dimensions	Rugged die-cast, 100 x 34 x 165mm (4.0 x 1.4 x 6.5in.)
Mounting	Integrated Mounting Holes or DIN Rail mounting (optional)
Weight	0.5kg (1.1lbs.)
Warranty	3 years on parts and labor
Approvals and Certifications	
Europe (ETSI)	ETSI EN60950, EN50392 EN300328 EN301489 (2.4GHz only)
FCC	FCC PART 15
Industry Canada	IC RSS210
Australia	ACMA AS/NZS 4268
Hazardous Locations	• 900MHz : CSA Class I, Division II, Groups (A,B,C,D) for Hazardous Locations ANSI/UL equivalent) • 2.4GHz : ATEX II 3G Ex nA IIC T4
Note: Not all product features are available in every mode of operation. Disclaimer: Schneider Electric reserves the right to change product specifications. For more information visit www.schneider-electric.com.	

>	Trio KP900 | KP240 | KB900 | KB240
Radio	
Frequency Range	902-928MHz or 2.4-2.48335GHz, (region-specific versions available)
Frequency Accuracy	12.5ppm (900MHz) 13.0ppm (2.4GHz)
Radio Modes	Half Duplex, Pseudo Full Duplex
Configuration	All configuration via Windows based software
Selectivity	Better than 50dB
Spurious Response	Better than 70dB
Tx Power	• 900MHz : 0.01 - 1W (+30dBm) 0.5dB steps configurable with over-temperature and high VSWR protection • 2.4GHz : 0.01 - 500mW (+27dBm) 0.5dB steps configurable with over-temperature protection.
Modulation	2 Level GFSK
Connections	
Serial Data Port A	1 x RS232/RS485 RJ-45. 600-230,000bps asynchronous
Serial Data Port B	1 x RS232 RJ-45. 300-38,400bps asynchronous (shared with System Port)
Serial Data Port Flow Control	Configurable hardware (Serial Data Port A only) / 3-wire interface
Serial Data Port DCD Control	Configurable DCD operation : activated on Master synchronisation or from user data output.
System Port	1 x RS232 RJ45: 19,200bps, for configuration and diagnostics (shared with Serial Data Port B)
Antenna	2 x SMA female bulkhead connectors for LinkXtend or separate TX/RX antennas
Power	2-pin locking, mating connector supplied
LED Display	Multimode Indicators for Pwr, Tx, Rx, Sync, TxD and RxD data LEDs (for both port A and B)
Modem	
RF Channel Data Rate	32,000/64,000/128,000 or 256,000bps
Bit Error Rate	BER 1×10^{-6} for 256k @ -102dBm, 1×10^{-6} for 128k @ -104dBm, 1×10^{-6} for 64k @ -106dBm, 1×10^{-6} for 32k @ -108dBm
Operating Modes	Master, remote, repeater or network-bridge
Network Types	Point-to-Point, Point-to-Multipoint, Point-to-Multipoint with Repeaters / Store n' Forward, Mesh
Channelshare™	Trio's unique supervisory collision avoidance system
MultiStream™	Simultaneous data stream delivery allows for multiple vendor devices/protocols to be transported on the one radio network
SmartPath™	Technology for enhanced redundancy in network configuration (Mesh)
Firmware	Local and over-the-air flash-based firmware
Security	
Encryption*	256-bit AES
Password Protection	Password protected configuration sessions
Trusted Unit	Optional Trusted Access point-Trusted Remote operation
* Export restrictions may apply. Contact factory for details. Specifications continue on the next page	

>	KP900	KP240	KB900	KB240

Diagnostics	

Diagnostics Overview	• TView+ configuration, network management and diagnostic Windows GUI software
	• Spectrum Analyser and Channel Lockout facilities
	• Network-wide operation from any remote terminal
	• Non intrusive protocol – runs simultaneously with the application
	• Over-the-air re-configuration of user parameters.
	• Storage of data error and channel occupancy statistics
	• In-built Error Rate testing capabilities
	• Diagnostics parameters available
	   • Transmitter Power
	   • Received Signal Strength
	   • DC Supply Voltage
	   • Received Frequency Error
	   • Radio Temperature

General	
Operating Temperature Range	-40 to + 70ºC (-40 to +158ºF)
Power Supply	10-30Vdc (13.8Vdc nominal)
Transmit Current	• 900MHz : 500mA nominal @ 1W • 2.4GHz : 800mA nominal @ 0.5W
Receive Current	• 900MHz: <110mA nominal @ 13.8Vdc • 2.4GHz: <100mA nominal @ 13.8Vdc
Sleep Mode	Software Controlled
Housing & Dimensions	• KPxxx : Corrosion resistant zinc plated steel with black enamel paint 130 x 39 x 56mm (5.1 x 1.5 x 2.2in.) • KBxxx : Bare board 129 x 31 x 55mm (5.08 x 1.22 x 2.17in.)
Mounting	Integrated Mounting Holes or DIN Rail mounting (optional)
Weight	0.5kg (1.1lbs.)
Warranty	3 years on parts and labor

Approvals and Certifications	
IC	RSS 139 (RSS 210)
Hazardous Locations – North America	CSA$_{US}$, suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations (900MHz only) Temperature Code T4 per CSA Std C22.2 No. 213-M1987 / UL1604
Europe	ATEX: II 3G Ex nA IIC T4 per EN 60079-15, protection type n (Zone 2) (2.4GHZ 100mW ETSI version only)
Safety	CSA C22.2 No. 142-M1987 and UL916 in Canada and USA
EMC	FCC Part 15, Subpart B, Class A Verification EN61000-6-4: 2007 Electromagnetic Compatibility Generic Emission Standard Part2: Industrial Environment C-Tick compliance. Registration number N15744
Immunity	EN61000-6-2: 2005 Electromagnetic Compatibility Generic Standards Immunity for Industrial Environments

Note: Not all product features are available in every mode of operation.

Disclaimer: Schneider Electric reserves the right to change product specifications. For more information visit www.schneider-electric.com.