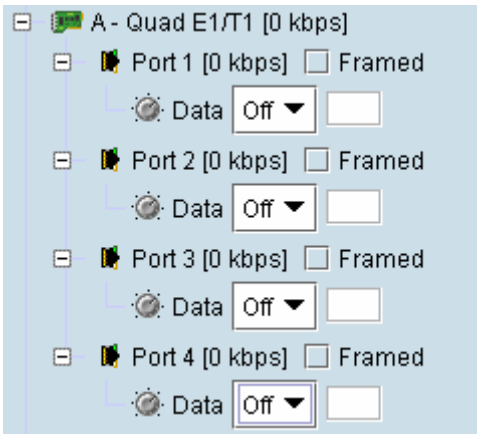
QJET cross connections

Expand the E1 / T1 display by clicking on the relevant icons.



The QJET card can operate in several modes allowing you greater flexibility in tailoring or grooming traffic. The Data type selection are Off, E1, or T1 rates.

Note: An unframed E1 / T1 port requires 5 bits (or 40 kbit/s) of overhead traffic per port for synchronization.

An unframed E1 port with 2048 kbit/s of traffic requires 2088 kbit/s of link capacity.

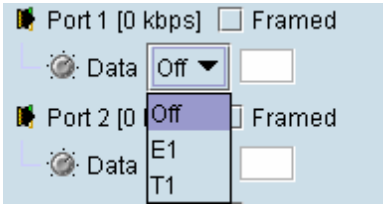
An unframed T1 port with 1544 kbit/s of traffic requires 1584 kbit/s of link capacity.

For each port that you want to put into service, choose the required mode (either Unframed or Framed):

Unframed mode

Leave the Framed checkbox unticked.

Select the required Data type from the drop-down list E1 or T1.

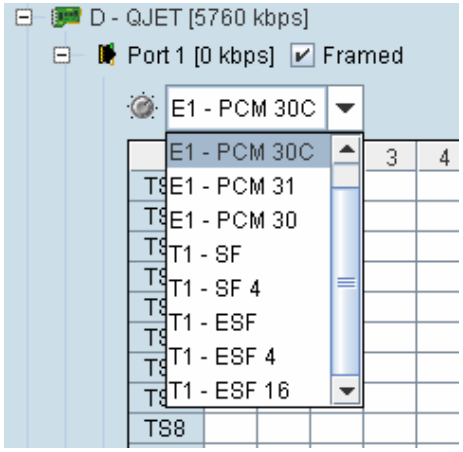


Local drop and insert connections are not possible between Unframed E1 / T1 ports.

Framed mode

Tick the Framed checkbox.

Select the required framed mode from the drop-down list:



Local drop and insert connections are possible between framed E1 ports on the same interface card or E1 ports on different interface cards.

Local drop and insert connections are possible between framed T1 ports on the same interface card or T1 ports on different interface cards.

Local drop and insert connections are not possible between framed E1 ports and framed T1 ports.

E1 Framed Modes

Framed Mode	Description
E1 – PCM 30	Provides 30 timeslots to transport traffic. Timeslot 16 carries channel associated signalling data (CAS).
E1 – PCM 31	Provides 31 timeslots to transport traffic. Timeslot 16 can be used for common channel signalling or to transport traffic.
E1 – PCM 30C	Same as E1 – PCM 30 mode but supports CRC-4.
E1 – PCM 31C	Same as E1 – PCM 31 mode but supports CRC-4.

E1 CRC-4 (cyclic redundancy check) is used to ensure correct frame alignment and also used to gather E1 performance statistics e.g. Errored Seconds (ES), Severely Errored Seconds (SES).

The first three bits of timeslot 0 NFAS (bits 0,1 & 2) and all of timeslot 0 FAS are not transported across the link, but rather terminated and regenerated at each terminal.

The last five bits of timeslot 0 NFAS (bits 3 – 7) are the National Use Bits (NUBs) which can be cross connected locally or over the link.

E1 - PCM 30 mode

E1 - PCM 30 modes are used when access to the signalling bits (ABCD) is required, for example:

- Splitting a PCM 30 E1 into two separate PCM 30 E1s
- Cross connecting signalling from DFXS, DFXO or Q4EM interfaces into an PCM 30 E1
- Drop and Insert connections between PCM 30 E1s

In PCM 30 / PCM 30C mode, the timeslot table left column is used to map timeslot bits and the timeslot table right column is used to map CAS bits (ABCD) for signalling. Timeslot 16 is reserved to transport the CAS multi frame.

One use of this mode is to connect the 4 wire E&M interfaces to third-party multiplexer equipment over the E1 interface using CAS in TS16 to transport the E&M signalling.

To configure this mode correctly, you must have a detailed knowledge of the CAS signalling modes for the third-party equipment to ensure the signalling bits are compatible and configured to interoperate.

E1 - PCM 31 mode

E1 - PCM 31 modes are used to cross connect timeslots bits without the signalling bits (ABCD).

TS16 can be cross connected between E1 ports (to transport the entire CAS multi frame) or used for common channel signalling or to transport traffic.

The timeslot table left column is used to map timeslot bits but the timeslot table right column for CAS bits (ABCD) is not used.

T1 Framed Modes

Framed Mode	Description
T1 - SF	Provides 24 timeslots to transport traffic using the G.704 12 frame Super Frame without signalling. There is no CRC capability with the SF.
T1 – SF 4	Provides 24 timeslots to transport traffic using the G.704 12 frame Super Frame with 4 state signalling (AB bits). There is no CRC capability with the SF.
T1 – ESF	Provides 24 timeslots to transport traffic using the G.704 24 frame Extended Super Frame with CRC and without signalling.
T1 – ESF 4	Provides 24 timeslots to transport traffic using the G.704 24 frame Extended Super Frame with CRC and 4 state signalling (AB bits).
T1 – ESF 16	Provides 24 timeslots to transport traffic using the G.704 24 frame Extended Super Frame with CRC and 16 state signalling (ABCD bits).

For the 24 framed modes of ESF 4 and ESF 16, the Data Link bit is shown in the timeslot table but is currently unavailable for use.

T1 - SF mode

T1 SF mode provides 24 timeslots to transport traffic using the G.704 12 frame Super Frame without demultiplexing the signalling. Complete timeslots can be cross connected including the inherent robbed signalling bits.

The timeslot table left column is used to map timeslot bits but the timeslot table right column for CAS bits (ABCD) is not used.

T1 SF mode is used when access to the signalling bits is not required but are transported between T1s, for example:

- Drop and Insert connections between 12 frame Super Frame T1s or data interfaces

T1 - SF 4 mode

T1 SF 4 mode provides 24 timeslots to transport traffic using the G.704 12 frame Super Frame with four state demultiplexed signalling using the AB bits.

The mapping left column is used to map timeslot bits and the timeslot table right column is used to map the CAS A&B bits for signalling (C&D bits are not used).

T1 SF mode is used when access to the signalling bits is required, for example:

- Cross connecting signalling from DFXS, DFXO or Q4EM interfaces into a 12 frame Super Framed T1 using ‘multiplexed’ signalling from the interface.
- Drop and Insert connections between 12 frame Super Framed T1s or data interfaces

T1 - ESF mode

T1 ESF mode provides 24 timeslots to transport traffic using the G.704 12 frame Extended Super Frame without demultiplexing the signalling. Complete timeslots can be cross connected including the inherent robbed signalling bits.

The timeslot table left column is used to map timeslot bits but the timeslot table right column for CAS bits (ABCD) is not used.

T1 ESF mode is used when access to the signalling bits is not required but are transported between T1s, for example:

- Drop and Insert connections between 24 frame Extended Super Framed T1s or data interfaces

T1 - ESF 4 mode

T1 ESF 4 mode provides 24 timeslots to transport traffic using the G.704 24 frame Extended Super Frame with four state demultiplexed signalling using the AB bits each with a bit rate of 667 bit/s.

The mapping left column is used to map timeslot bits and the timeslot table right column is used to map the CAS A&B bits for signalling (C&D bits are not used).

T1 ESF 4 mode is used when access to the signalling bits is required, for example:

- Cross connecting signalling from DFXS, DFXO or Q4EM interfaces into a 24 frame Extended Super Framed T1 using ‘multiplexed’ signalling from the interface.
- Drop and Insert connections between 24 frame Extended Super Framed T1s or data interfaces

T1 - ESF 16 mode

T1 ESF 16 mode provides 24 timeslots to transport traffic using the G.704 24 frame Extended Super Frame with sixteen state demultiplexed signalling using the ABCD bits each with a bit rate of 333 bit/s.

The mapping left column is used to map timeslot bits and the timeslot table right column is used to map the CAS ABCD bits for signalling.

T1 ESF 16 mode is used when access to the signalling bits is required, for example:

- Cross connecting signalling from DFXS, DFXO or Q4EM interfaces into a 24 frame Extended Super Framed T1 using ‘non-multiplexed’ signalling from the interface.
- Drop and Insert connections between 24 frame Extended Super Framed T1s or data interfaces

Selecting and mapping bits and timeslots

This section describes how to select and map:

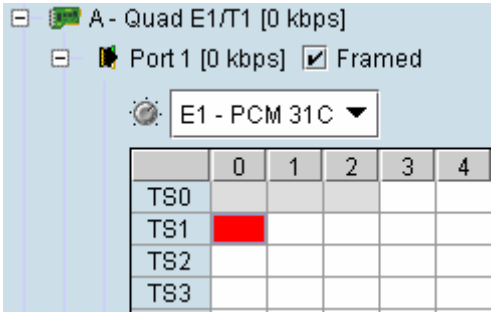
- a single bit
- multiple bits
- a 64 kbit/s timeslot
- multiple timeslots

Selecting a single bit

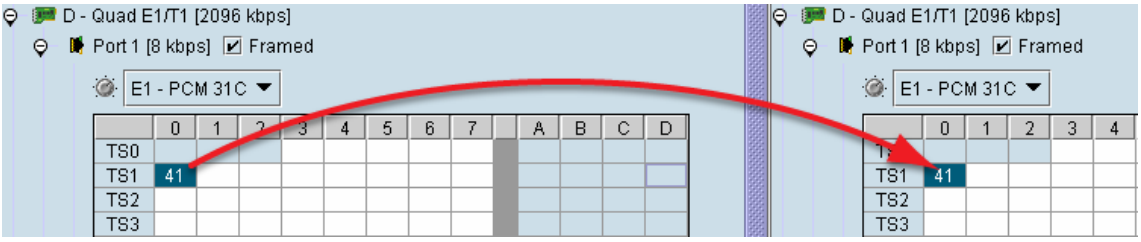
Each timeslot is represented by 8 rectangles (each representing a single bit). Each bit can carry 8 kbit/s.

One or more consecutive bits can be selected in a timeslot if a rate of greater than 8 kbit/s is required.

1. Click on the rectangle that represents the bit you require. It will turn red.



2. Click and drag this bit to the rectangle representing the bit on the interface you want it to be connected to, and release the mouse button.

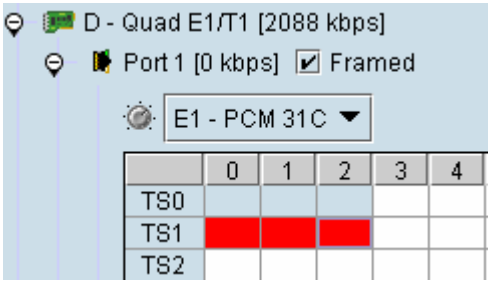


The red rectangle will be replaced by the allocated connection number at each interface.

Selecting multiple bits

It is possible to select multiple consecutive bits if circuit capacity of greater than 8 kbit/s is required.

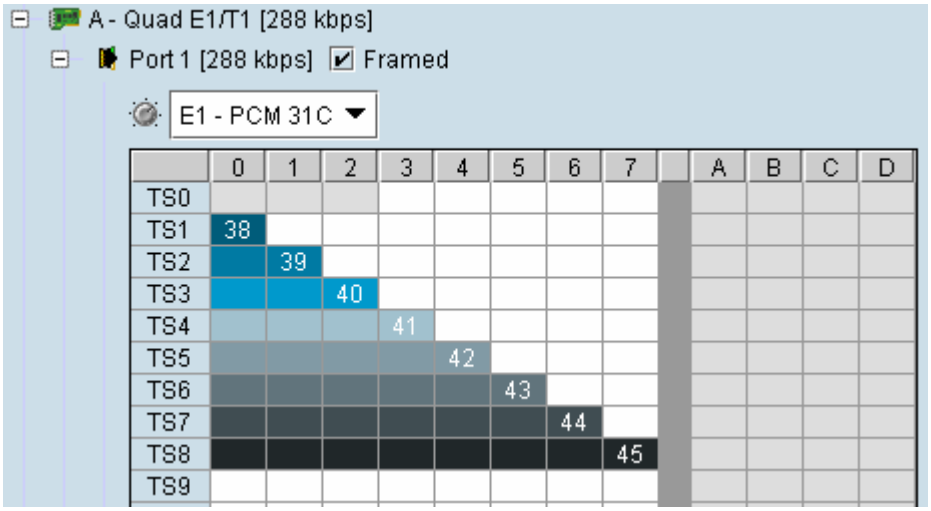
1. Click the first bit, and then hold down the Ctrl key while selecting the remaining bits.



2. Click and drag the whole block by clicking the bit on the left hand side of your selection, and drag to the required interface. Release the mouse button.

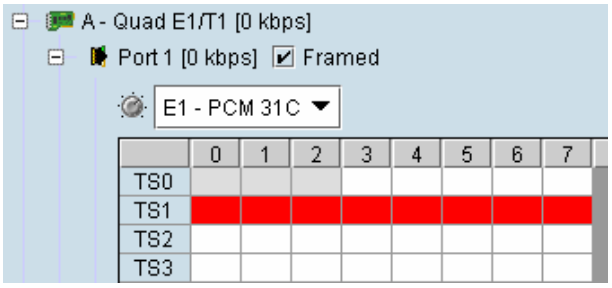
Tip: It is also possible to select multiple bits by holding down the Shift key, and dragging across the required rectangles.

Differing numbers of bits display in different colors when the cross-connect is completed:

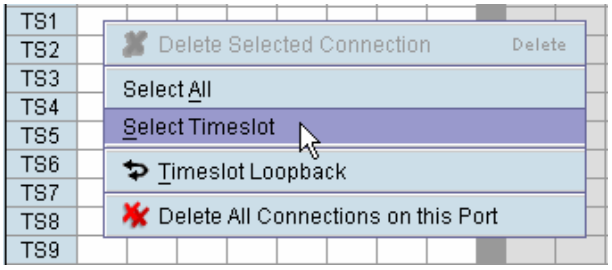


Selecting a 64 kbit/s timeslot

1. Click on the TSX timeslot number (where X is the desired timeslot from 1 to 31).



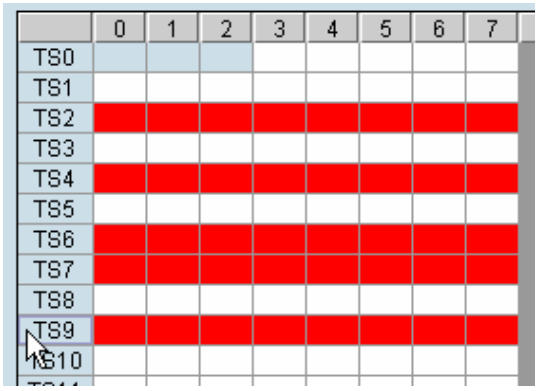
Alternatively, right-click over any of the bits in the timeslot, and click on Select Timeslot.



2. Drag and drop in the normal way to complete the cross connection.

Selecting multiple non consecutive timeslots

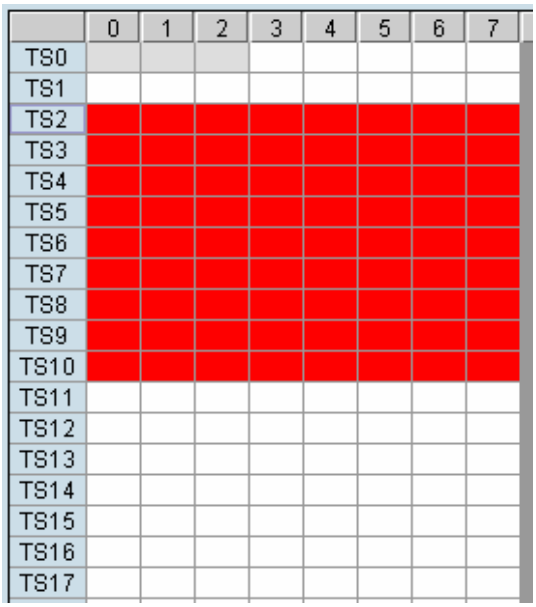
1. Click on one TSn timeslot number (where n is the desired timeslot 1 to 31).
2. Hold down the Ctrl key while clicking on each of the required timeslot numbers.



3. Drag and drop in the normal way to complete the cross connection.

Selecting multiple consecutive timeslots

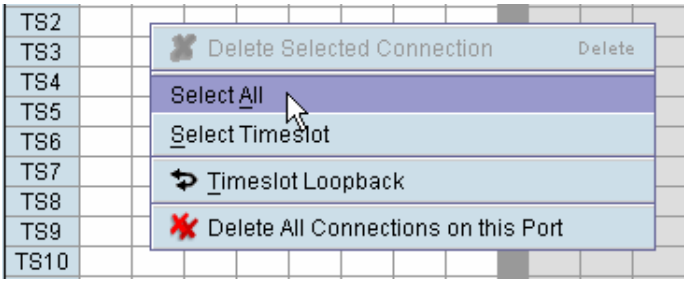
1. Click on the first TSn timeslot number (where n is the desired timeslot 1 to 31).
2. Hold down the Shift key while clicking on the last required timeslot number.



3. Drag and drop in the normal way to complete the cross connection.

Selecting all timeslots in a port

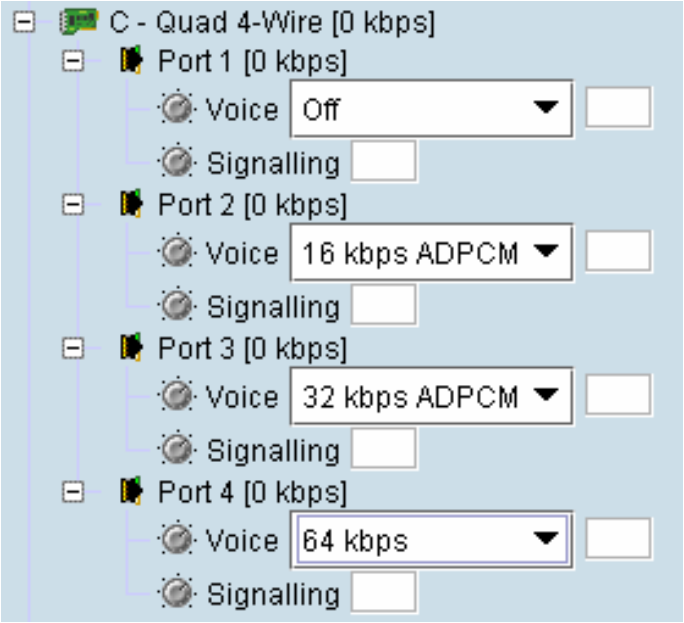
1. Right-click over any of the rectangles.



2. Click Select All.

Q4EM cross connections

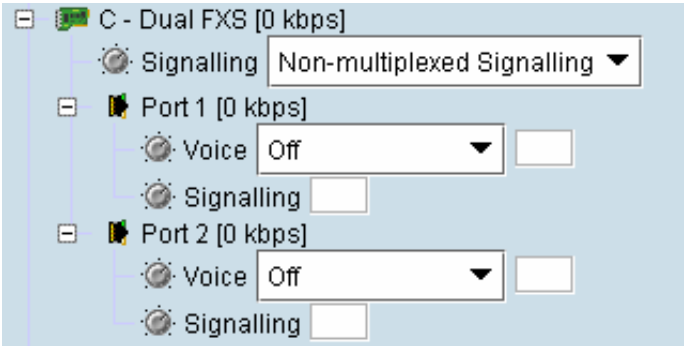
1. Expand the Q4EM display by clicking the relevant ⊞ icon.



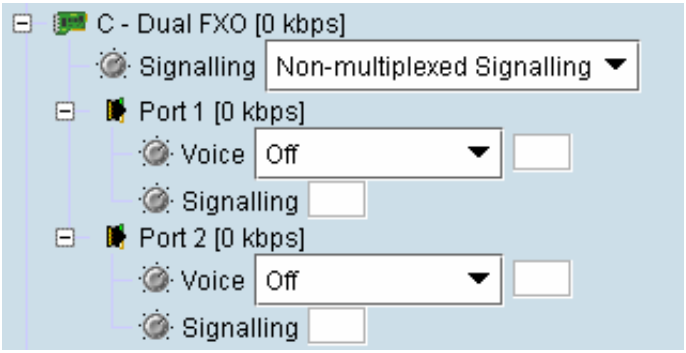
2. Set the Voice capacity by selecting 16, 24, 32, or 64 kbit/s rates.
3. Drag and drop from the **Voice** mapping connection box to the required partner interface to create the voice cross connection.
4. If E&M signalling is required, drag and drop from the **Signalling** mapping connection box to the required partner interface to create the E&M cross connection.

DFXS & DFXO cross connections

1. On one side of the link, expand the DFXS display, as required, by clicking ⊞.



2. On the other side of the link, expand the corresponding DFXO display, as required, by clicking ⊞.



3. For the DFXS card and corresponding DFXO card, select the Signalling **type** as required, according to the table below. The CAS signalling between DFXO / DFXS interfaces uses 4RF proprietary allocation of control bits.

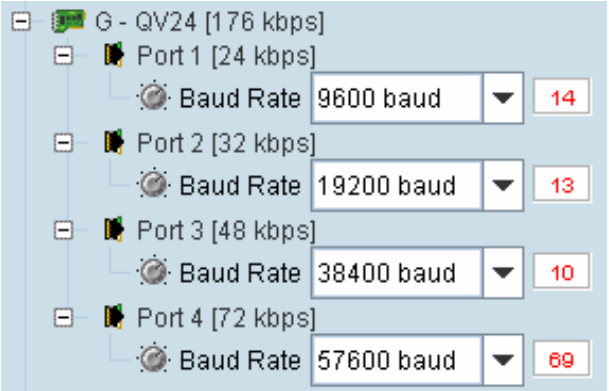
   The **Signalling** type affects both ports of the DFXO / DFXS interface. If a mixture of signalling types is required, then multiple DFXO / DFXS cards are needed.

Signalling	Application	Overhead
Multiplexed (default)	Multiplexers the four ABCD bits from the interface into a single 8 kbit/s channel. Use when interworking DFXO to DFXS, between an XE and a SE radio or when limited bandwidth is available. This signalling type cannot be used for interworking between framed E1 and voice interfaces.	8 kbit/s
Non-multiplexed	Transports each of the four ABCD bits in separate 8 kbit/s channels. Use when interworking DFXO cards to DFXS cards or when signalling bits are mapped into an E1 / T1 timeslot.	32 kbit/s
4 wire compatible	Use when interworking the DFXO card or DFXS card to a Q4EM interface • DFXS to DFXO A bit mapped to off-hook • DFXO to DFXS A bit mapped to fault	8 kbit/s

4. Set the Voice capacity and create the Voice connection by dragging and dropping between the mapping connection boxes of the DFXO and DFXS corresponding ports.
5. Link the **Port** Signalling connection by dragging and dropping between the mapping connection boxes of the DFXO and DFXS corresponding ports. The DFXO / DFXS control signals (off hook, ring, etc) will not function without this connection.

QV24 cross connections

1. Expand the QV24 displays, as required, by clicking the relevant ⊞ icons.



2. Select the Port Baud Rate as required (default is 9600).

3. Drag and drop to the required partner interface to create the V.24 Data connection.

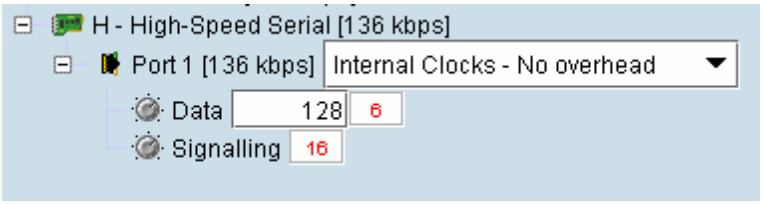
   If the partner interface is a QJET:

   - If the V.24 Baud Rate selected is 38400 is less, drag from the QV24 mapping connection box to the QJET timeslot. The correct QJET capacity for the baud rate selected will automatically be assigned.
   - If the V.24 Baud Rate selected is greater than 38400, select the QJET capacity required, as per the following table, and drag from the QJET to the QV24 mapping connection box.

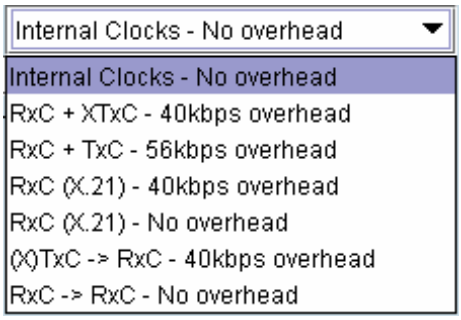
Baud Rate	Bits Required	Bit Rate
300 - 7200	2	16 kbit/s
9600 - 14400	3	24 kbit/s
19200 - 23040	4	32 kbit/s
28800	5	40 kbit/s
38400	6	48 kbit/s
57600	9	72 kbit/s
115200	16	128 kbit/s

HSS cross connections

1. Expand the HSS displays, as required, by clicking the relevant ⊞ icons.



2. Select the **Synchronous Clock Selection** mode (see “HSS synchronous clock selection modes” on page 114).



3. Set the **Data** rate to a value between 8 and 2048 (in multiples of 8 kbit/s).

   The net data rate available to the user is defined by Data Rate – overhead

   e.g. a date rate set to 2048 kbit/s with an overhead of 40 kbit/s provides a user data rate of 2008 kbit/s

4. Drag and drop to the required partner interface to create the HSS Data connection.

   If the partner interface is a QJET, select the capacity on the QJET and drag it to the HSS Data mapping connection box.

   The QJET capacity selected must be the sum of the data rate required plus the overhead rate selected.

5. Drag and drop to the required partner interface to create the HSS Signalling cross connection. A minimum of 8 kbit/s of capacity is required and must be set symmetrically at both ends of the link.

Cross connection example

This is an example of cross connection mapping:

Circuit	Local port	Remote port	Capacity (kbit/s)	Connection numbers
Radio management			64	1
User Ethernet			1024	2
3 wire E&M circuit	Q4EM port 1 (slot C)	Q4EM port 1 (slot C)	72	7/15
Unframed E1 data	QJET port 1 (slot D)	QJET port 1 (slot D)	2088	65
Unframed T1 data	QJET port 2 (slot D)	QJET port 2 (slot D)	1584	66
Loop Interface	DFXO port 1 (slot E)	DFXS port 1 (slot E)	72	8/32
V.24 data circuit 9600	QV24 port 1 (slot G)	QV24 port 1 (slot G)	24	14
HSS data circuit 1024 kbit/s	HSS port 1 (slot H)	HSS port 1 (slot H)	1088	31/16

Symmetrical Connection Wizard

The Cross Connections application has a Symmetrical Connection Wizard which simplifies the cross connection configuration when the terminals are fitted with symmetrical / matching interface types.

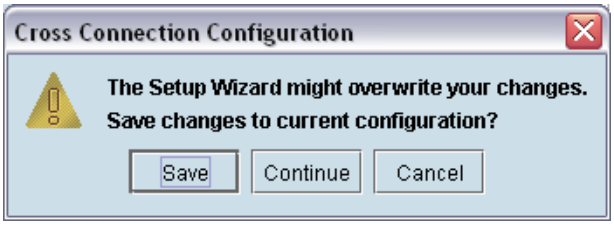
A symmetrical connection is a connection between the local and the remote terminal where the local slot, card type, port and connection details are identical to those of the remote terminal.

The only exception is DFXO / DFXS connections where DFXO cards are considered to match DFXS cards (as they normally interwork).

Framed E1 / T1 CAS connections, drop-and-insert connections, and connections that do not involve entire timeslots, are considered to be asymmetrical.

Starting the wizard

When starting the wizard with unsaved changes, the following popup dialog should appear



Click on 'Save' if you wish to save the current configuration to a file. Clicking on 'Continue' will continue with the wizard and overwrite any changes made when the wizard finishes.

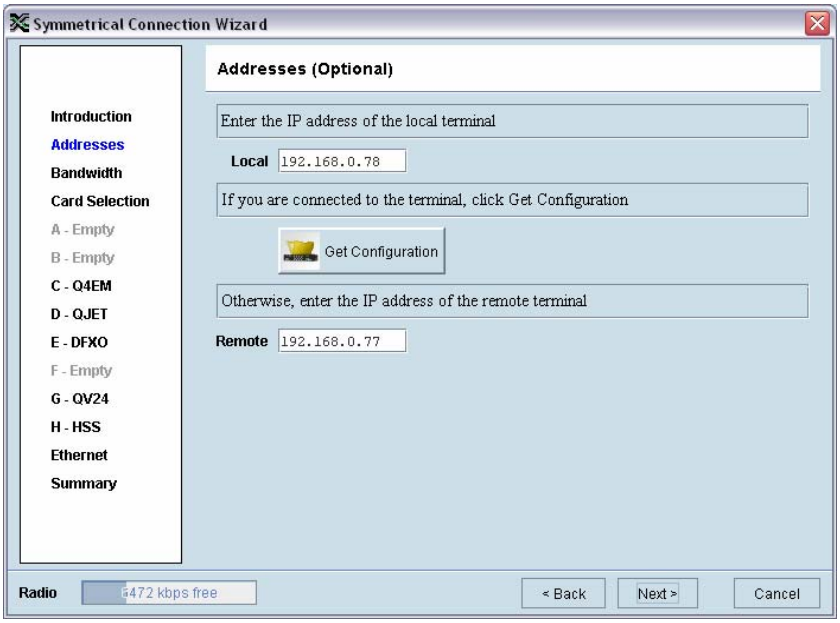
The wizard can be cancelled at any time by clicking on the 'Cancel' button or by closing the window.

Wizard Navigation

Click on the Next button to progress through the wizard. The current stage is indicated in the navigation bar on the left. You can jump directly to a stage by clicking on the stage required.

Setting the IP address

If the local or remote terminal IP addresses have been setup, they will be displayed in the Local and Remote fields. If the IP addresses are not displayed, enter the IP addresses of the local and remote terminals.

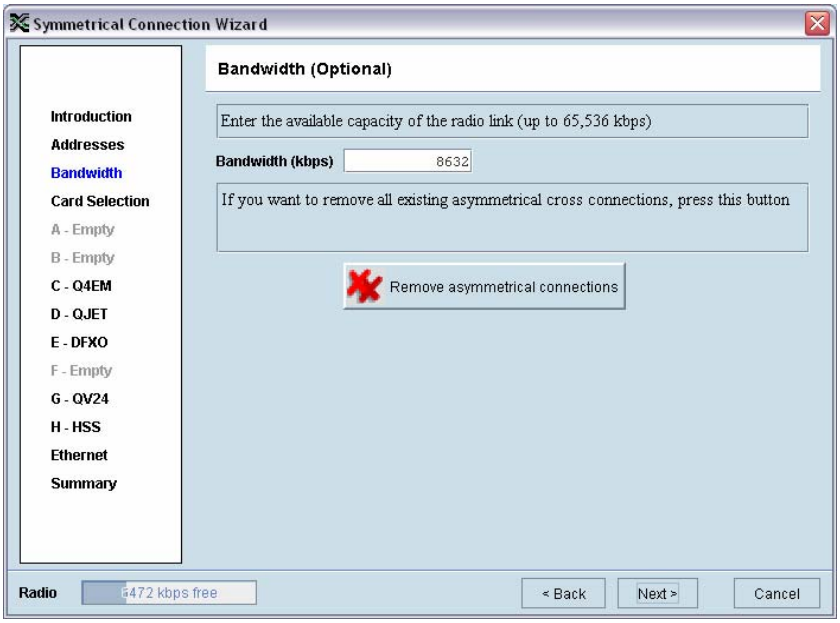


Click on 'Get Configuration' to upload the existing cross connections configuration from the local terminal. The Radio bandwidth bar will show the available bandwidth and will be updated as bandwidth is assigned to cards.

Setting the bandwidth

If the Cross Connections Application is opened from SuperVisor, the Total Capacity of the radio link will be shown in the Bandwidth field.

If the Cross Connections Application is opened as a stand alone application, the Total Capacity of the radio link will be need to be entered in the Bandwidth field.

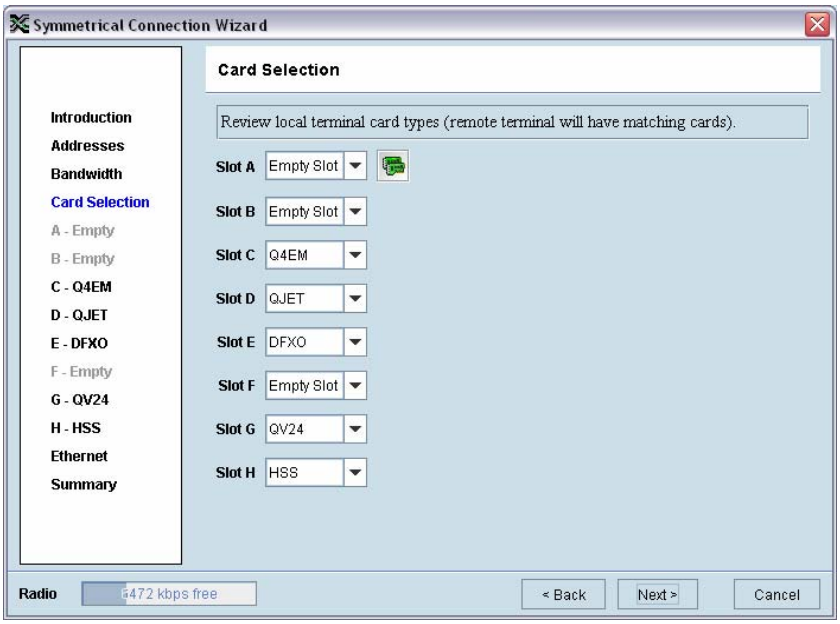


The 'Remove asymmetrical connections' button will be active if there are existing asymmetrical cross connections. If you want to remove existing asymmetrical cross connections, click on this button. The Radio bandwidth bar will update accordingly.

Card Selection

If the Cross Connections Application is opened from SuperVisor, existing cards installed in the local terminal that match cards installed in the remote terminal will be displayed. Mismatched cards will be shown as 'Empty Slot'.

If the Cross Connections Application is opened as a stand alone application, select the card types that will be fitted in the terminal.

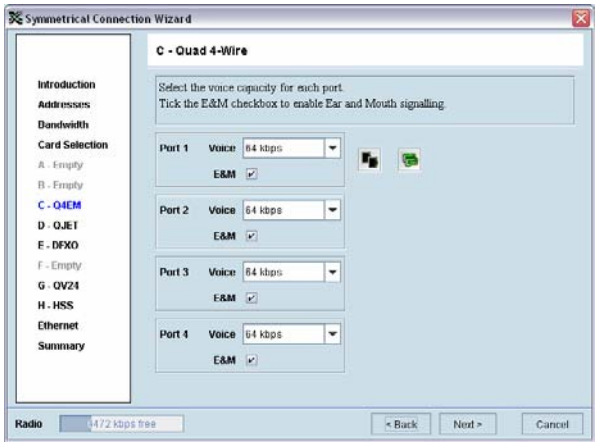


To copy the card type selected in Slot A to all the other slots (B – H), click on the Copy Card button. This assumes that the same interface card types are fitted in all the card slots.

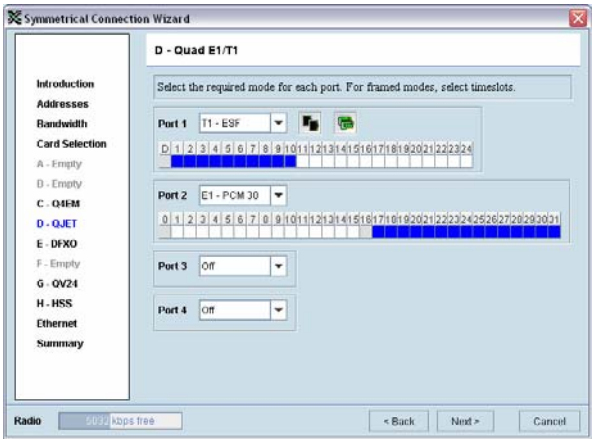
Interface configurations

Setup the interface configurations as per the wizard instructions. Existing asymmetrical connections will be replaced with symmetrical connections if an interface parameter is changed.

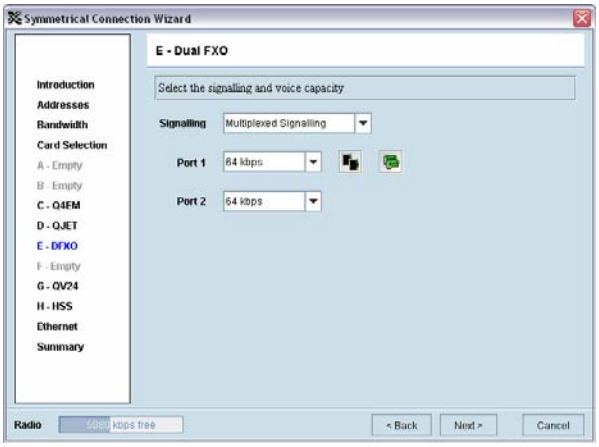
Q4EM



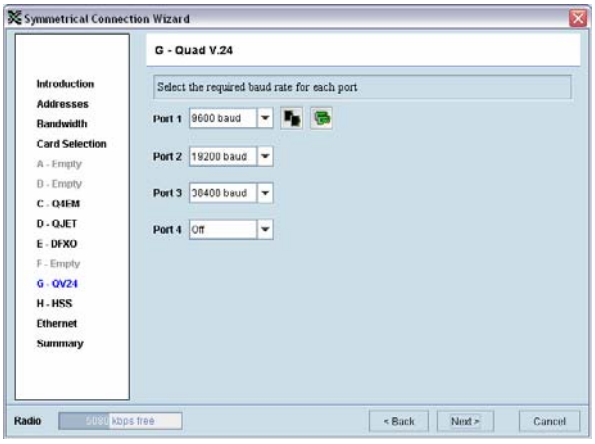
QJET



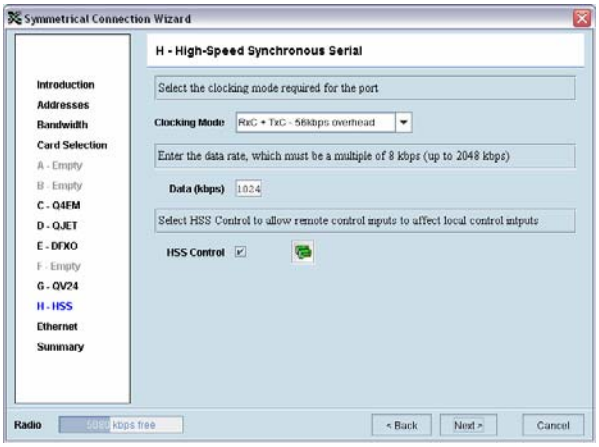
DFXO / DFXS



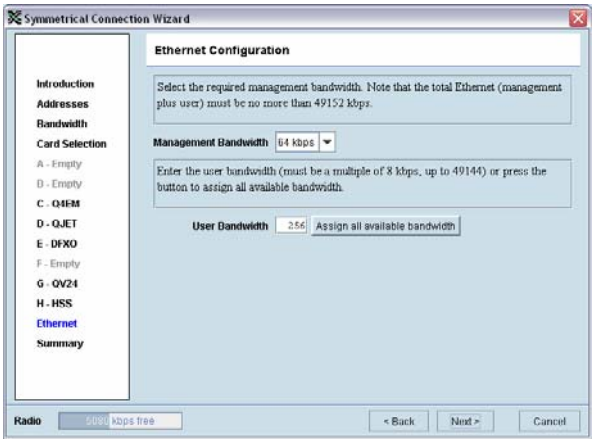
QV24



HSS



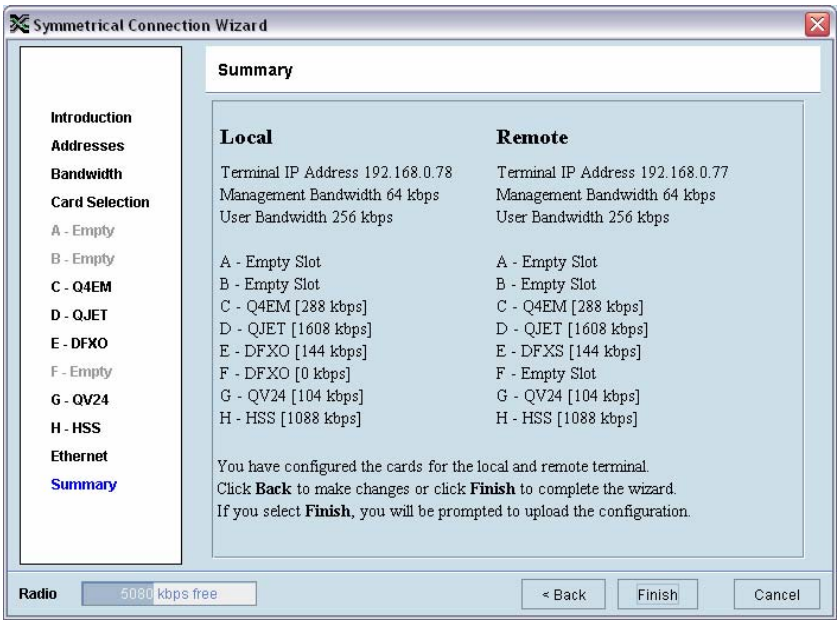
Ethernet



To copy the port configuration selected in Port 1 to all the other ports on the card, click on the Copy Port button.

To copy the card configuration to all other cards of the same type fitted in the terminal, click on the Copy Card button. This can save time when setting up multiple cards of the same type.

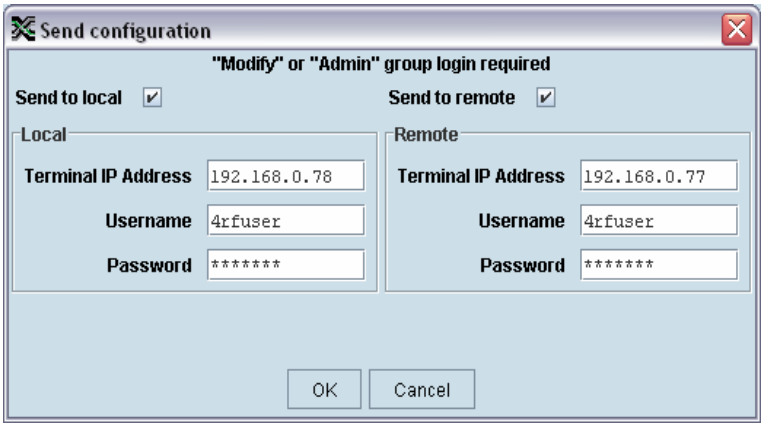
Symmetrical connection summary



Click Finish.

Send symmetrical connection configuration

Click OK to send the configuration to the terminals.



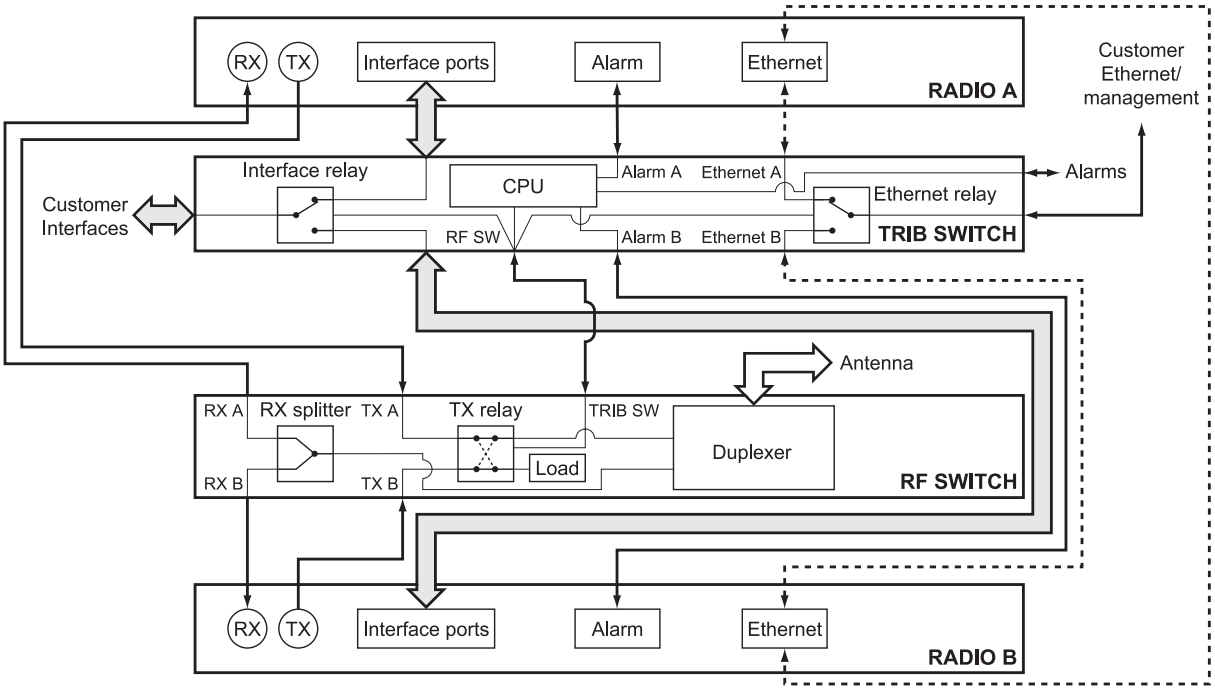
The process is completed.

Note: The wizard may change the connection numbers of existing connections.

11. Protected terminals

Monitored Hot Stand By (MHSB)

This section describes configuring the protected terminal in MHSB mode. A protected terminal in MHSB mode comprises two radios interconnected using the tributary and RF switches as shown below:

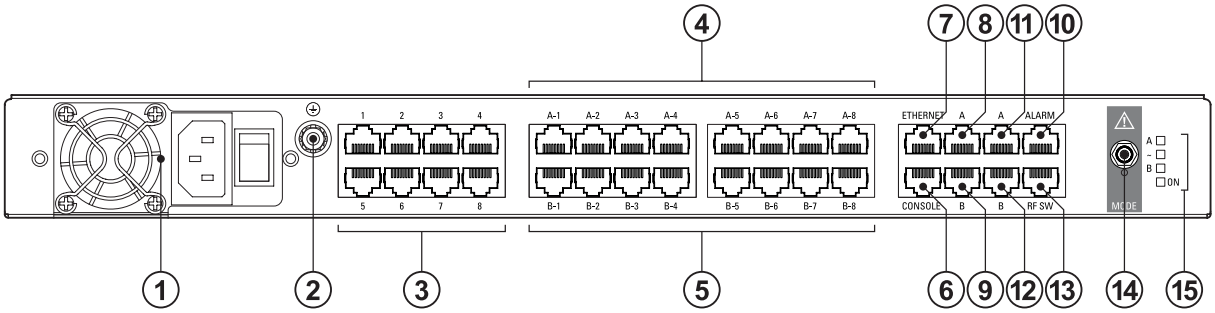


The MHSB switch protects terminals against any single failure in one radio. It also monitors the alarm output of each radio and switches between radios if major radio link alarms occur.

The MHSB switch uses a CPU to monitor the alarm status received from both the connected radios' alarm ports. When a relevant major radio link alarm is detected on the active radio (that is, transmitter, receiver, power supply or modem), the CPU switches a bank of relays that switches all the interfaces and the transmit port from the main radio to a functioning stand-by radio. The stand-by radio now becomes the active radio.

The tributary switch and the RF switch are both a 19-inch rack-mount 1U high chassis. The total rack space required is 6U. The MHSB switch option is available for the following bands: 300, 400, 700, 900, 1400, 2000, and 2500 MHz.

Tributary switch front panel

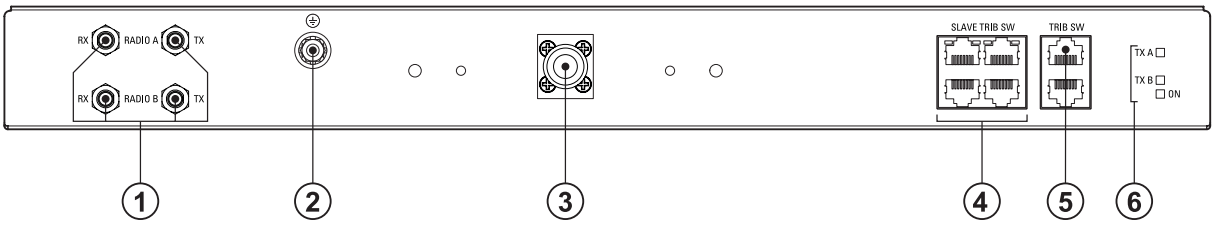


No.	Description	Explanation
1	Power supply input	Input for DC power or AC power
2	Protective earth	M5 terminal intended for connection to an external protective conductor for protection against electric shock in case of a fault
3	Interface ports	Port for connecting to customer interface equipment
4	Radio A interfaces	These connect to the interface ports on radio A
5	Radio B interfaces	These connect to the interface ports on radio B
6	Console	For factory use only
7	Ethernet	Port for connecting to customer Ethernet network. This port is also used to set up and manage the radios remotely over an IP network
8	Radio A Ethernet	Connects to an Ethernet port on radio A
9	Radio B Ethernet	Connects to an Ethernet port on radio B
10	Alarms	Alarm input/output connections for customer equipment
11	Radio A alarms	Connects to the alarm port on radio A
12	Radio B alarms	Connects to the alarm port on radio B
13	RF SW	Provides power and signalling to the RF switch
14	Mode switch	Three-position locking toggle switch to set the MHSB switch into automatic mode or radio A / radio B test mode
15	LEDs	Mode and status LEDs

Tributary protection switch LEDs

LED	Colour	Appearance	Explanation
A	Green	Solid	The radio is active and is OK
	Green	Flashing	The radio is in standby mode and is OK
	Red	Solid	The radio is active and there is a fault
	No colour (off)	-	The tributary switch is in 'slave' mode and the switching is controlled by the master tributary switch
	Red	Flashing	The radio is in standby mode, and there is a fault
B	Green	Solid	The radio is active and is OK
	Green	Flashing	The radio is in standby mode and is OK
	Red	Solid	The radio is active and there is a fault
	No colour (off)	-	The tributary switch is in 'slave' mode and the switching is controlled by the master tributary switch
	Red	Flashing	The radio is in standby mode, and there is a fault
~	Green	Solid	The tributary protection switch is in 'auto' mode
	Green	Flashing	The tributary protection switch is in 'slave' mode
	Red	Solid	The tributary protection switch is in 'manual' mode (A or B)
On	Blue	Solid	Indicates that there is power to the tributary protection switch

RF switch front panel



No.	Description	Explanation
1	Radio QMA	QMA connectors for connecting the protected radios
2	Protective earth	M5 terminal intended for connection to an external protective conductor for protection against electric shock in case of a fault
3	Antenna port	N-type female connector for connection to the antenna feeder cable. This view shows an internally mounted duplexer. If an external duplexer is fitted, the antenna port will be on the external duplexer
4	Slave tributary switch outputs	Connects to secondary tributary switch for control of additional interfaces
5	Tributary switch	Connects the RF switch to the tributary switch (the master if more than one tributary switch is required)
6	LEDs	Status LEDs

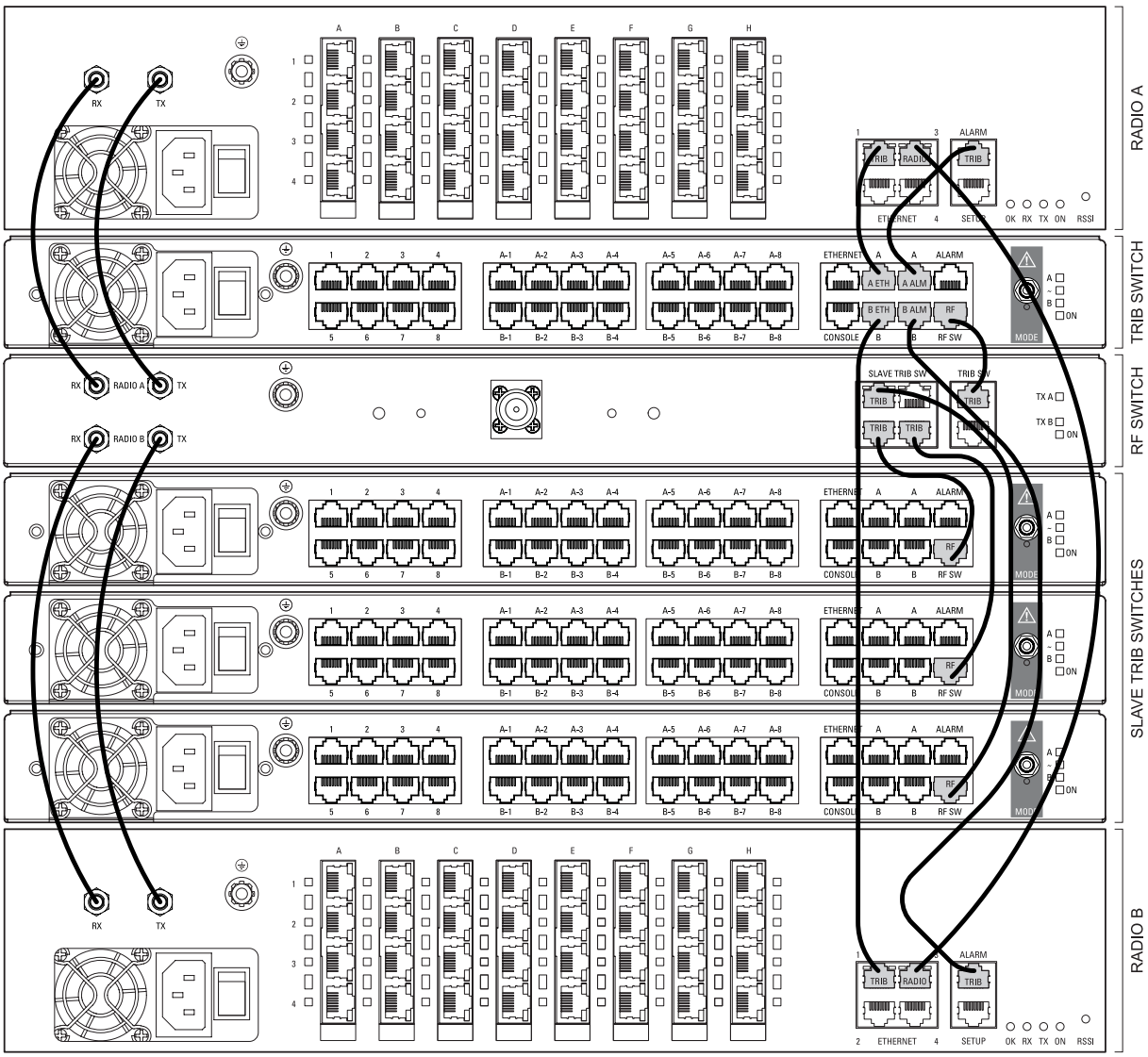
RF protection switch LEDs

LED	Colour	Appearance	Explanation
Tx A	Green	Solid	RF is being received from radio A
Tx B	Green	Solid	RF is being received from radio B
On	Blue	Solid	Indicates that there is power to the RF protection switch

Slave tributary switches

Each tributary switch protects up to eight ports. Up to three slave tributary switches may be added to a MHSB terminal to protect up to 32 ports. Each slave tributary switch is interconnected by means of the slave tributary switch ports on the RF switch, as shown below.

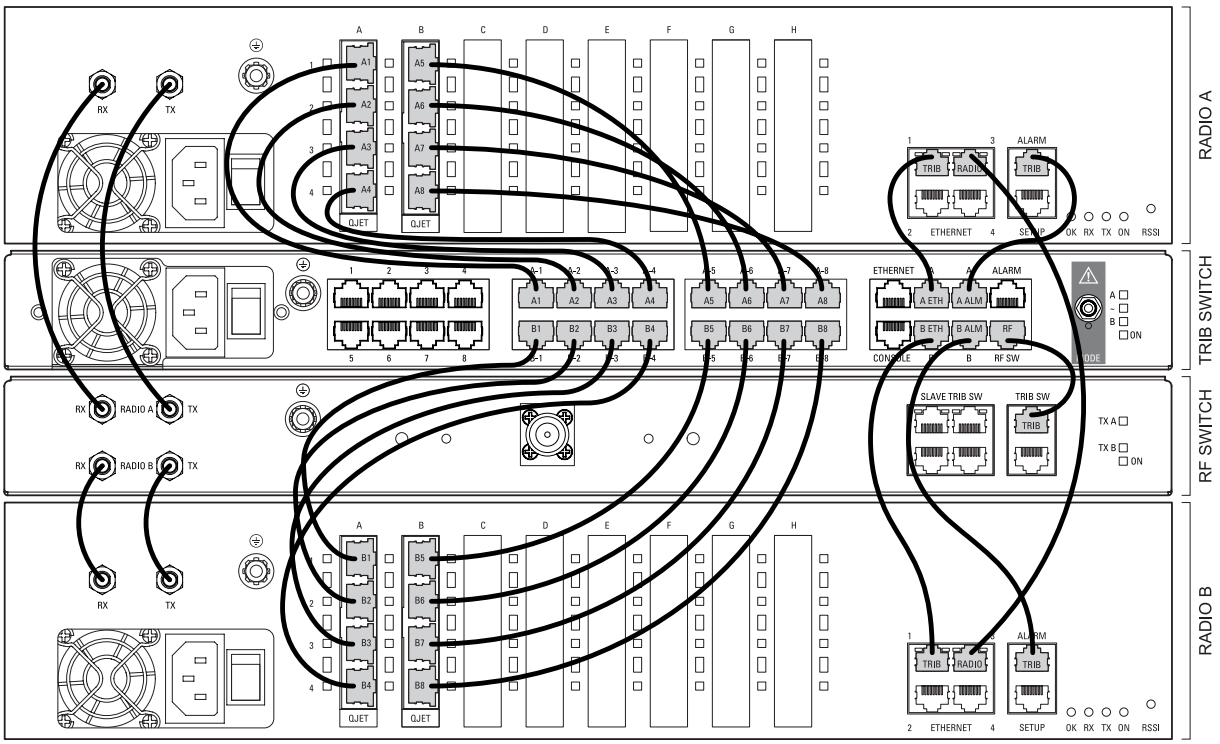
Note: A tributary switch that is operating as a slave (rather than a master) has a RJ-45 V.24 loopback connector plugged into the console port. If the connector is missing, contact Customer Support. Alternatively, you can make this connector. Follow the standard pinouts for a V.24 RJ-45 connection (see "QV24 Interface connections" on page 228).



MHSB cabling

The two radios are interconnected as follows:

Caution: Do not connect Transmit to Receive or Receive to Transmit as this may damage the radio or the MHSB switch.



Cables supplied with MHSB

The following cables are supplied with a MHSB terminal:

- Ethernet interface: RJ-45 ports standard TIA-568A patch cables .
- Alarm interface: RJ-45 ports standard TIA-568A patch cables.
- RF ports: two QMA male patch cables are supplied.

MHSB power supply

See “DC power supply” on page 32 and “AC power supply” on page 35.

Configuring the radios for protected mode

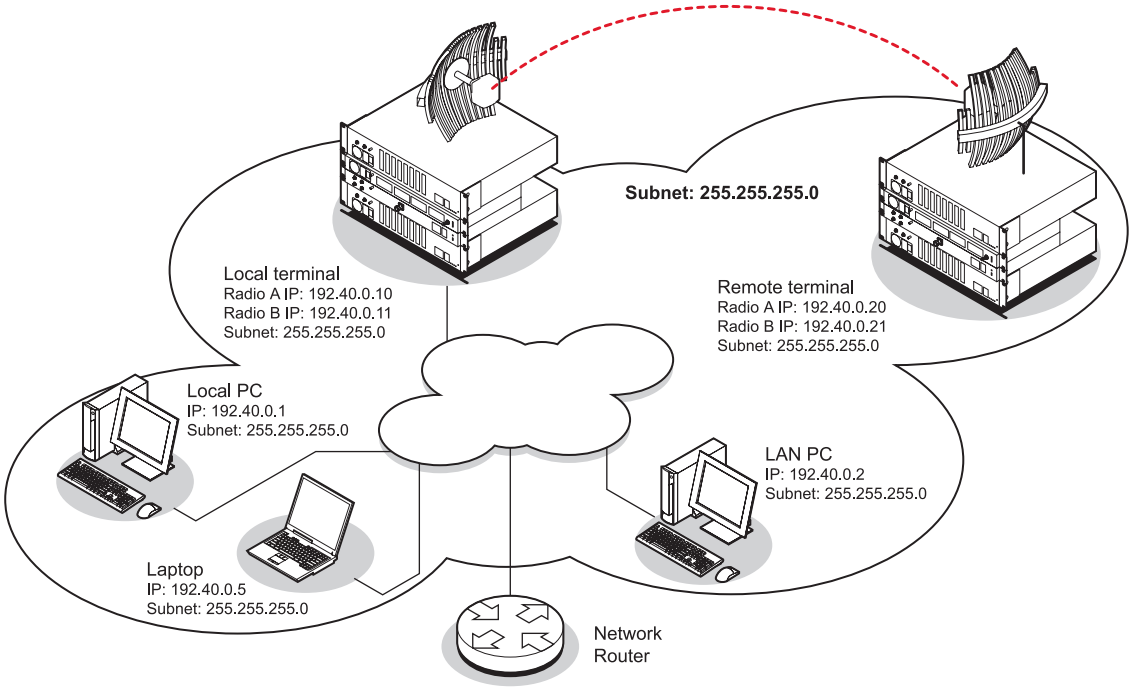
The MHSB switch does not require any special software. However, the radios connected to the MHSB switch must be configured to work with the MHSB switch. This sets the alarm outputs and inputs to function in MHSB mode.

You must configure the interfaces of both radios connected to the MHSB switch identically. To perform this, you can either connect directly to the radio or use the test mode of the MHSB switch.

IP address setup

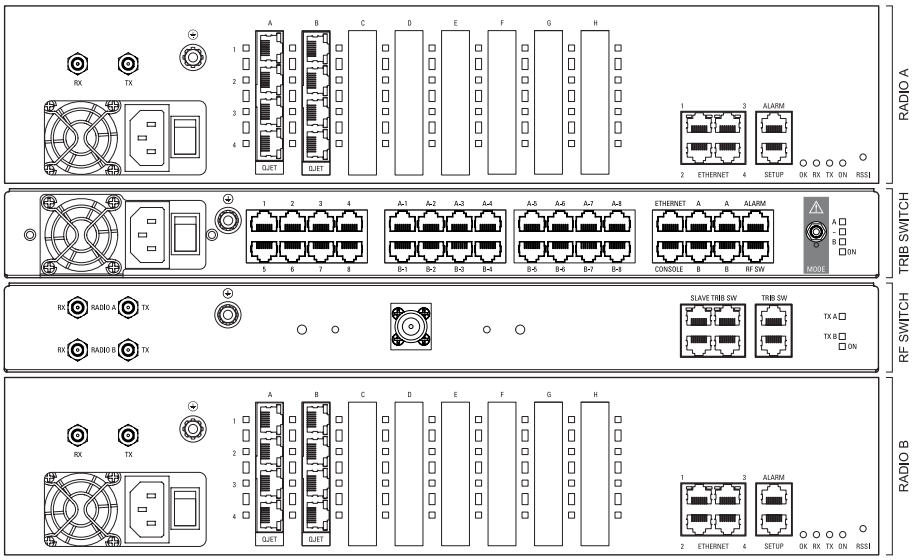
Before configuring the link, you must ensure that the two independent links have correctly configured IP address details.

All four radios in the protected link must be on the same subnet.



Mounting the MHSB radios and switch

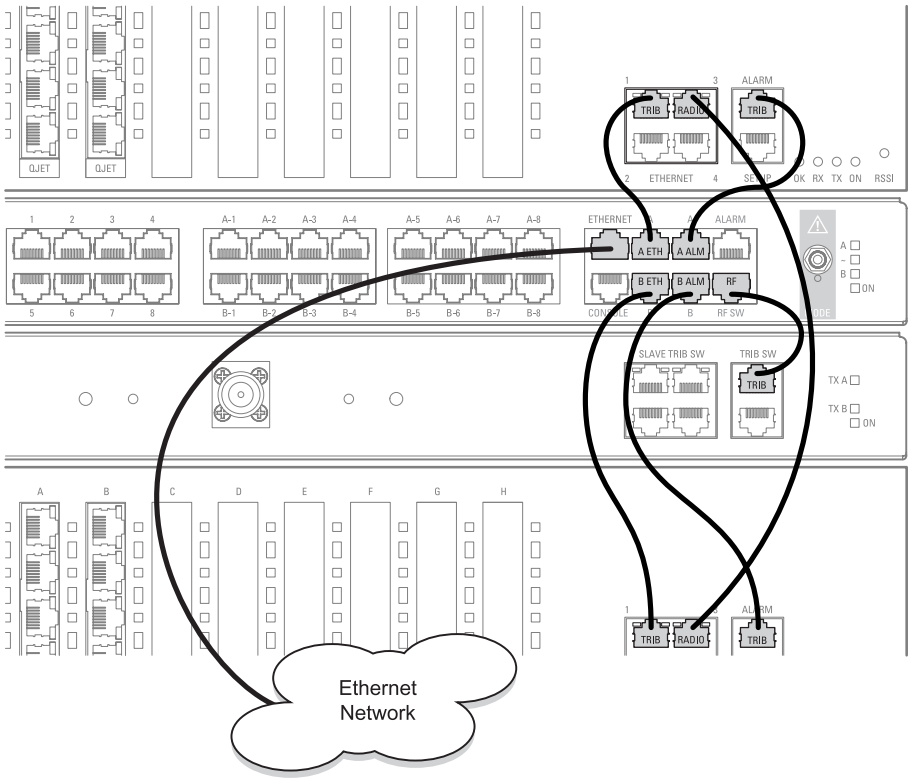
Once the IP addresses are correctly configured, it is important to connect the A and B radios' Ethernet and Alarm ports correctly. In general, mount radio A above the MHSB switch and radio B below the MHSB switch:



There is an Ethernet connection between any of the four Ethernet ports on each radio and the Ethernet port on the Tributary switch. There is also a connection between radio A and radio B, which ensures Ethernet traffic is maintained if a radio loses power.

The Ethernet port on the protection switch can be connected to an Ethernet hub or switch to allow multiple connections.

Important: The management Ethernet capacity on each of the four radios in the protected terminal must be identical for remote communications to work and there should only be one IP connection to the management network (via the tributary switch Ethernet port).



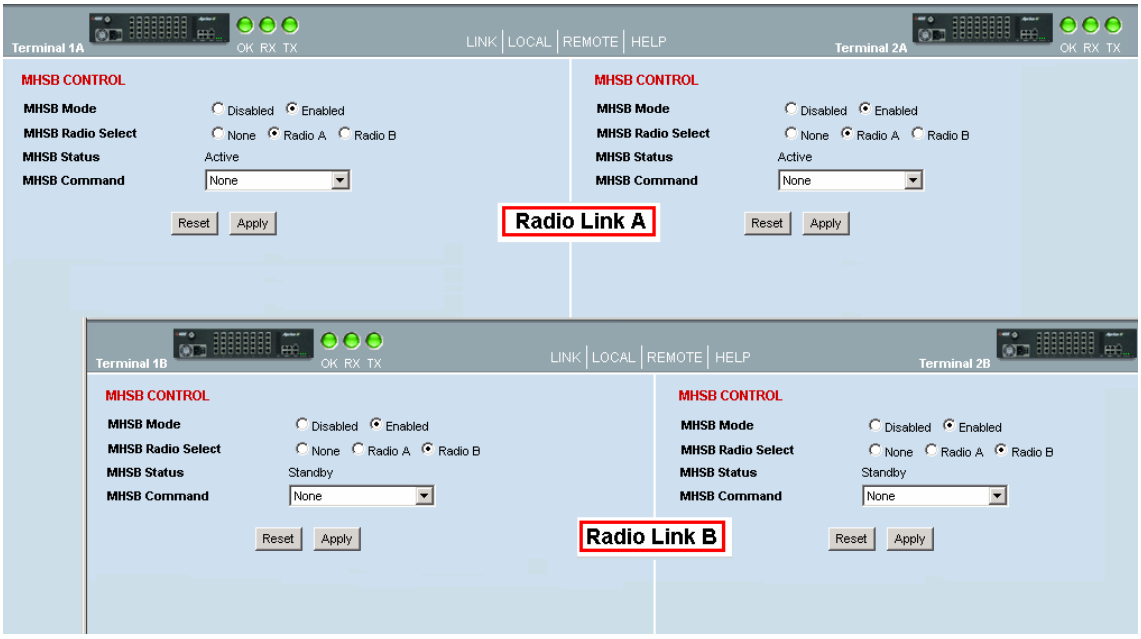
Configuring the terminals for MHSB

It is recommended that you configure the local and remote A side first, then the local and remote B side. Both the local A and B radios must be configured identically, and both the remote A and B radios must be configured identically.

Tip: As illustrated below, you may find it helpful to have two browser sessions running simultaneously. You can then easily see both the A and B sides of the protected link.

To configure MHSB operation:

1. Select Link > Maintenance > MHSB.



2. Enable MHSB mode.
3. Select whether the radio is A or B.

   Ensure that the radio connected to the A side of the protection switch (normally above the MHSB switch) is set to Radio A and the radio connected to the B side of the protection switch (normally below the MHSB switch) is set to Radio B.

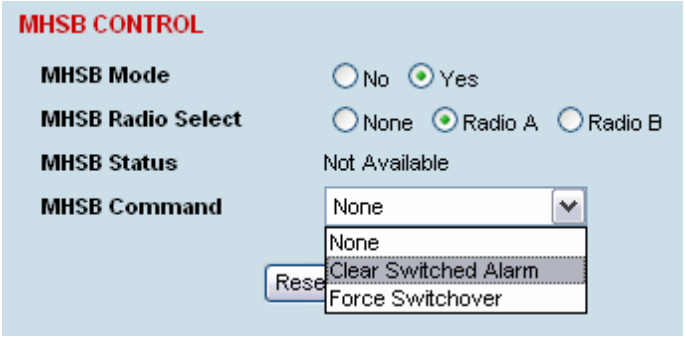
   In the event of a power outage, the radios will switch over to the A side of the protection switch when the power is restored. The A side is also the default active side.

4. When you have made your changes, click Apply to apply changes or Reset to restore the previous configuration.
5. Repeat steps 2 to 4 for the other side of the protected link.

Clearing MHSB alarms

If a switchover event occurs, the OK LED on the front panel and on the Terminal status and menu bar in SuperVisor changes to orange.

1. Select Clear Switched Alarm from the MHSB Command drop-down list.



2. Click Apply to apply changes or Reset to reset the page.

Note: When MHSB mode is enabled, external alarm input 2 is used by the protection system to carry alarms from the protection switch to the radio. In MHSB mode, therefore, only external alarm input 1 is available for user alarms.

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12. In-service commissioning

Before you start

When you have finished installing the hardware, RF and the traffic interface cabling, the system is ready to be commissioned. Commissioning the terminal is a simple process and consists of:

1. Powering up the terminals
2. Configuring both the local and remote terminals using SuperVisor
3. Aligning the antennas
4. Synchronizing the terminals
5. Testing the link is operating correctly. As a minimum, conduct the suggested tests to ensure correct operation. More extensive testing may be required to satisfy the end client or regulatory body requirements.
6. Connecting up the client or user interfaces

What you will need

- Appropriately qualified commissioning staff at both ends of the link.
- Safety equipment appropriate for the antenna location at both ends of the link.
- Communication equipment, that is, mobile phones or two-way radios.
- SuperVisor software running on an appropriate laptop, computer, or workstation at one end of the link.
- Tools to facilitate loosening and re-tightening the antenna pan and tilt adjusters.
- Predicted receiver input levels and fade margin figures from the radio link budget (You can use Surveyor (see "Path planning" on page 19) to calculate the RSSI, fade margin, and availability).

Applying power to the terminals

Caution:

Before applying power to a terminal, ensure you have connected the safety earth and antenna cable.

Apply power to the terminals at each end of the link.

When power is first applied, all the front panel LEDs will illuminate red for several seconds as the system initializes.

After the system is initialized, the OK LED on the front panel should illuminate green and if the terminals are correctly configured, the TX and RX LED should also be illuminated green.

If the RX LED is:

- Red — the antennas are may be significantly mis-aligned with no signal being received.
- Orange — the antennas may be roughly aligned with some signal being received.
- Green — the antennas are well-aligned and adequate signal is being received to create a reliable path.

If the TX LED is:

- Red — there is a fault in the antenna or feeder cable, or the transmitter is faulty.
- Green — this means the transmitter is working normally.

Review the link configurations using SuperVisor

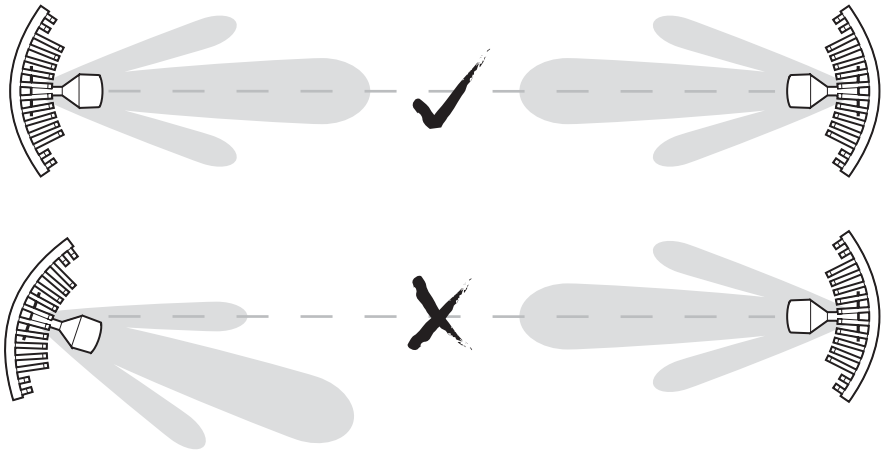
1. Connect a PC, with SuperVisor installed, to both terminals in the link.
2. Log into the link.
3. Select Link > Summary and confirm the following basic information:
   - Terminal IP address(es)
   - Terminal TX and RX frequencies
   - RSSI (dBm)
   - TX power (dBm)
   - SNR (dBm)

Note: If the terminals have not already been configured, refer to "Configuring the terminal" on page 61, "Configuring the traffic interfaces" on page 77, and "Configuring the traffic cross connections" on page 121.

Antenna alignment

For any point-to-point link, it is important to correctly align the antennas to maximize the signal strength at both ends of the link. Each antenna must be pointing directly at the corresponding antenna at the remote site, and they must both be on the same polarization. The antennas are aligned visually, and then small adjustments are made while the link is operating to maximize the received signal.

Directional antennas have a radiation pattern that is most sensitive in front of the antenna, in line with the main lobe of the radiation pattern. There are several other lobes (side lobes) that are not as sensitive as the main lobe in front of the antenna.



For the link to operate reliably, it is important that the main lobes of both antennas are aligned. If any of the side lobes are aligned to the opposite antenna, the received signal strength of both terminals will be lower, which could result in fading. If in doubt, check the radiation patterns of the antennas you are using.

Checking the antenna polarization

Check that the polarization of the antennas at each end of the link is the same.

Antenna polarization of grid antennas are normally indicated by an arrow or with “H” and “V” markers (indicating horizontal and vertical).

On Yagi antennas, ensure the orientation of the elements are the same at each end of the link.

Transmit frequency and power, and antenna polarization would normally be defined by a regulatory body, and typically licensed to a particular user. Refer to your license details when setting the antenna polarization.

Visually aligning antennas

1. Stand behind the antenna, and move it from side to side until it is pointing directly at the antenna at the remote site. The remote antenna may be made more visible by using a mirror, strobe light, or flag.

   If the remote end of the link is not visible (due to smoke, haze, or local clutter, etc), align the antenna by using a magnetic compass. Calculate the bearing using a scale map of the link path.

   When setting the antenna on the desired bearing ensure that you use the appropriate true-north to magnetic-north offset. Also ensure that the compass reading is not affected by standing too close to metallic objects.

2. Once the antenna is pointing at the remote antenna, tighten the nuts on the U-bolt or antenna clamp just enough to hold it in position. Leave the nuts loose enough so that small adjustments can still be made. Check that the antenna is still pointing in the correct direction.
3. Move the antenna up or down until it is pointing directly at the remote site.
4. Tighten the elevation and azimuth adjustment clamps.
5. Mark the position of the antenna clamps so that the antenna can be returned to this rough aim point easily when accurately aligning the antennas.
6. Repeat steps 1-5 at the opposite site.

Note: Low gain antennas need less adjustment in elevation as they are simply aimed at the horizon. They should always be panned horizontally to find the peak signal.

Accurately aligning the antennas

Once the antennas are visually aligned, accurately align both antennas by carefully making small adjustments while monitoring the RSSI. This will give the best possible link performance.

Note: Remember that it is important to align the main radiation lobes of the two antennas to each other, not any side lobes. It may be easier to perform this procedure if you can communicate with someone at the remote site by telephone, mobile, or two-way radio.

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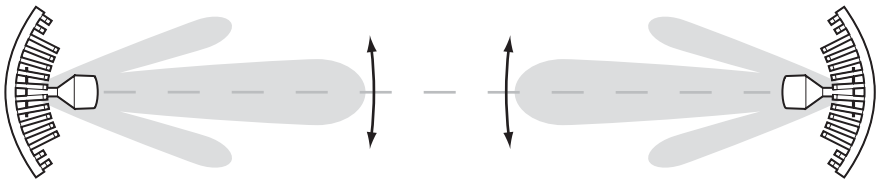
1. Connect a laptop PC running SuperVisor software and power up the terminals at both ends of the link. Select Link > Performance > Summary so that you can see the RSSI indication for the local terminal. Alternatively, use the RSSI test point on the front panel together with a multimeter (see "Measuring the RSSI" on page 168).
2. Move the antenna through a complete sweep horizontally (known as a 'pan') either side of the point established in the visual alignment process above. Note down the RSSI reading for all the peaks in RSSI that you discover in the pan.
3. Move the antenna to the position corresponding to the maximum RSSI value obtained during the pan. Move the antenna horizontally slightly to each side of this maximum to find the two points where the RSSI drops slightly.
4. Move the antenna halfway between these two points and tighten the clamp.
5. If the antenna has an elevation adjustment, move the antenna through a complete sweep (known as a 'tilt') vertically either side of the point established in the visual alignment process above. Note down the RSSI reading for all the peaks in RSSI that you discover in the tilt.
6. Move the antenna to the position corresponding to the maximum RSSI value obtained during the tilt. Move the antenna slightly up and then down from the maximum to find the two points where the RSSI drops slightly.
7. Move the antenna halfway between these two points and tighten the clamp.
8. Recheck the pan (steps 2-4) and tighten all the clamps firmly.



9. Perform steps 1-8 at the remote site.

Measuring the RSSI

Measure the RSSI value with a multimeter connected to the RSSI test port on the front of the terminal (see "Front panel connections and indicators" on page 27).

1. Insert the positive probe of the multimeter into the RSSI test port, and clip the negative probe to the chassis of the terminal (earth).
2. Pan and tilt the antenna until you get the highest VDC reading. The values shown in the table below relate the measured VDC to the actual received signal level in dBm regardless of bandwidth and frequency.

RSSI test port value (VDC)	RSSI reading (dBm)
0.000	- 100
0.025	- 99
0.050	- 98
0.075	- 97
0.100	- 96
0.125	- 95
0.150	- 94
0.175	- 93
0.200	- 92
0.225	- 91
0.250	- 90
0.275	- 89
0.300	- 88
0.325	- 87
0.350	- 86
0.375	- 85
0.400	- 84
0.425	- 83
0.450	- 82
0.475	- 81
0.500	- 80
0.525	- 79
0.550	- 78
0.575	- 77
0.600	- 76
0.625	- 75
0.650	- 74

RSSI test port value (VDC)	RSSI reading (dBm)
0.675	- 73
0.700	- 72
0.725	- 71
0.750	- 70
0.775	- 69
0.800	- 68
0.825	- 67
0.850	- 66
0.875	- 65
0.900	- 64
0.925	- 63
0.950	- 62
0.975	- 61
1.000	- 60
1.025	- 59
1.050	- 58
1.075	- 57
1.100	- 56
1.125	- 55
1.150	- 54
1.175	- 53
1.200	- 52
1.225	- 51
1.250	- 50
1.275	- 49
1.300	- 48
1.325	- 47

RSSI test port value (VDC)	RSSI reading (dBm)
1.350	- 46
1.375	- 45
1.400	- 44
1.425	- 43
1.450	- 42
1.475	- 41
1.500	- 40
1.525	- 39
1.550	- 38
1.575	- 37
1.600	- 36
1.625	- 35
1.650	- 34
1.675	- 33
1.700	- 32
1.725	- 31
1.750	- 30
1.775	- 29
1.800	- 28
1.825	- 27
1.850	- 26
1.875	- 25
1.900	- 24
1.925	- 23
1.950	- 22
1.975	- 21
2.000	- 20

Synchronizing the terminals

After you have completed the alignment of the two antennas, you must ensure the two terminals are synchronized.

The terminals are synchronized when:

- the OK LED is green, which indicates that no system alarms are present, and
- the RX LED is green, which indicates a good signal with no errors, and
- the TX LED is green, which indicates that there are no transmitter fault conditions.

Checking performance

The amount of testing performed on the completed installation will depend on circumstances. Some customers may need to prove to a local licensing regulatory body that the link complies with the license provisions. This may require special telecommunications test equipment to complete these tests. Most customers simply want to confirm that their data traffic is successfully passing over the link, or that the customer interfaces comply with known quality standard.

However, the most important performance verification checks are:

- Receive input level
- Fade margin
- Long-term BER

Checking the receive input level

The received signal strength at the local terminal is affected by many components in the system and has a direct relationship with the resulting performance of the link. A link operating with a lower than expected signal strength is more likely to suffer from degraded performance during fading conditions. The receive input level of a link is normally symmetrical (that is, similar at both ends).

1. Compare the final RSSI figure obtained after antenna alignment with that calculated for the link.
2. If the RSSI figure is in excess of 3 dB down on the predicted level, recheck and correct problems using the table below and then recheck the RSSI. Alternatively, recheck the link budget calculations.

Possible cause	**Terminal(s)**
Is the terminal operating on the correct frequency?	Local & remote
Is the remote terminal transmit power correct?	Remote
Are all the coaxial connectors tight?	Local & remote
Is the antenna the correct type, that is, gain and frequency of operation?	Local & remote
Is the antenna polarized?	Local & remote
Is the antenna aligned?	Local & remote
Is the path between the terminals obstructed?	

Note: If following the above steps does not resolve the situation, contact Customer Support for assistance.

3. Record the RSSI figure on the commissioning form.
4. Repeat steps 1 to 2 for the other end of the link.

Checking the fade margin

The fade margin is affected by many components in the system and is closely related to the received signal strength. A link operating with a lower than expected fade margin is more likely to suffer from degraded performance during fading conditions. A reduced fade margin can be due to operating the link too close to the noise floor, or the presence of external interference. The fade margin of a link can be asymmetrical (that is, different at each end).

Possible causes of low fade margin are as follows:

Problem	Terminal
Low receive signal strength (see above table)	Local and Remote
Interfering signals on the same, or very close to, the frequency of the local terminal receiver.	Local
Intermodulation products that land on the same or very close to the frequency of the local terminal receiver.	Local or Remote
Operating near the local receiver noise floor	Local

To check the fade margin:

1. Confirm (and correct if necessary) the receive input level (see the previous test).

   Note: If the receive input level is lower than expected, the fade margin may also be low.

2. Select Link > Performance > Summary and check the current BER of the link in its normal condition is better than 10^{-6} (If necessary, clear out any extraneous errors by clicking Reset Counters).
3. Check the signal to noise (S/N) indication on the Link > Performance > Summary page. This shows the quality of the signal as it is being processed in the modem. It should typically be better than 30 dB. If it is less than 25 dB, it means that either the RSSI is very low or in-band interference is degrading the S/N performance.
4. Temporarily reduce the remote site's transmit power using either an external attenuator or SuperVisor (Remote > Terminal > Basic).

   Note: Ideally, the transmit power of the remote site should be reduced by up to 20 dB, which will require the use of an external 50 ohm coaxial attenuator capable of handling the transmit power involved. In the absence of an attenuator, reduce the transmit power using SuperVisor.

5. Check and note the current BER of the link in its now faded condition (Again, if necessary, clear out any extraneous errors (introduced by the power reduction step above) by clicking Reset Counters).
6. Compare the unfaded and faded BER performance of the link (steps 2 and 4). Continue to reduce the remote transmit power until either the BER drops to 10^{-6} or the remote transmitter power has been reduced by 20 dB.

   Note: The fade margin of the link is expressed as a number (of dB) that the link can be faded (transmitter power reduced) without reducing the BER below operating specifications ($1 * 10^{-6}$ BER). A 20 dB fade margin is adequate for most links.

7. Record the fade margin and SNR results on the commissioning form.

Note: If the transmit power is reduced using SuperVisor rather than an external attenuator, the fade margin should be recorded as “Greater than x dB” (where x = the power reduction).

8. Restore the remote terminal transmit power to normal.
9. Repeat steps 1 to 7 for the other end of the link.

Note: If following all the guidelines above does not resolve the situation, contact Customer Support for assistance.

Checking long-term BER

The BER test is a measure of the stability of the complete link. The BER results of a link can be asymmetrical (that is, different at each end).

1. Select Link > Performance > Summary and check the current BER and error counters of the link. (If necessary, clear out any extraneous errors by selecting Reset Counters).
2. Wait 15 minutes, and check the BER display and error counters again. If there are a small number of errors and the BER is still better than 10^{-9}, continue the test for 24 hours. If there are a significant number of errors, rectify the cause before completing the 24 hour test.

Note: It is normal to conduct the BER test in both directions at the same time, and it is important that no further work be carried out on the equipment (including the antenna) during this period.

3. The BER after the 24 hour test should typically be better than 10^{-8}.
4. Record the BER results on the commissioning form.

Bit Error Rate tests

A Bit Error Rate (BER) test can be conducted on the bench, (see “Bench setup” on page 37).

Attach the BER tester to the interface port(s) of one terminal, and either another BER tester or a loopback plug to the corresponding interface port of the other terminal.

This BER test can be carried out over the Ethernet, E1/T1, V.24 or HSS interfaces. It will test the link quality with regard to user payload data.

Caution: Do not apply signals greater than -20 dBm to the antenna as they can damage the receiver. In a bench setup, there must be 60 - 80 dB at up to 2 GHz of 50 ohm coaxial attenuation (capable of handling the transmit power) between the terminals’ antenna connectors.

Additional tests

Depending on license requirements or your particular needs, you may need to carry out additional tests, such as those listed below.

Refer to the relevant test equipment manuals for test details.

Test	Test equipment required
TX power output measurements (at TX and duplexer outputs)	Power meter
TX spectrum bandwidth	Spectrum analyzer
TX spectral purity or harmonic outputs	Spectrum analyzer
TX center frequency	Frequency counter or spectrum analyzer
Bulk capacity BER test	BER tester
LAN throughput or errors	LAN tester
G.703 / HDB3 waveforms	Digital oscilloscope
Serial interface BER	BER tester
Audio quality	PCM4 or SINAD test set

Checking the link performance

For a graphical indication of the link performance, you can use the constellation analyzer.

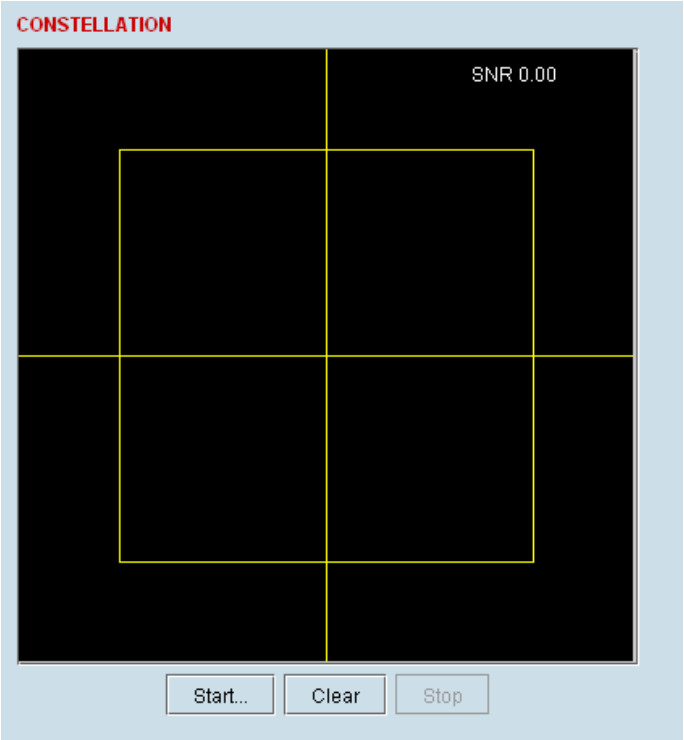
The 'dots' are a graphical indication of the quality of the demodulated signal. Small dots that are close together indicate a good signal. If the dots become spaced further apart, this indicates that the signal quality is degrading. This signal quality degradation can be caused by low Rx signal level due to, for example:

- external interference
- failure of any of the following: modem, receiver, far end transmitter, an antenna (either end), a feeder or connector (for example, due to water damage)
- path issues such as multi-path fading or obstructions

To check the performance of the link using the constellation analyzer:

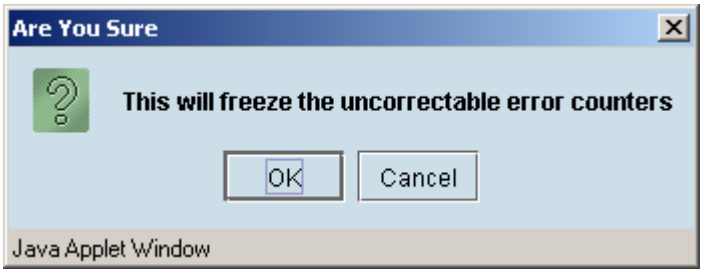
1. Select Link or Local or Remote > Performance > Constellation.

   A blank constellation diagram appears:



2. Click Start to start the constellation analyzer.

   While the constellation analyzer is running, the terminal will temporarily stop collecting error performance statistics. If you want to run the constellation analyzer anyway, click OK when you see this warning message:



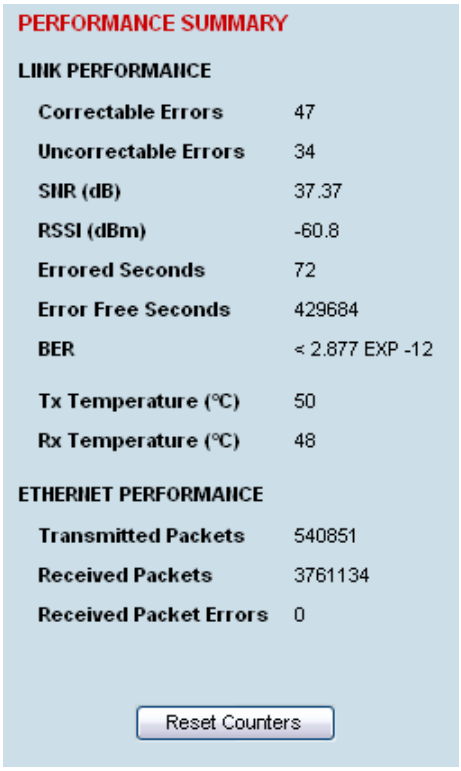
3. Click Stop to stop the constellation analyzer.

   The terminal automatically resumes collecting error performance statistics.

Viewing a summary of the link performance

To view the performance summary for a terminal:

Select Link or Local or Remote > Performance > Summary.



Field	Explanation
Link Performance	
Correctable errors	The total number of correctable blocks since the last reset
Uncorrectable errors	The total number of uncorrectable blocks since the last reset
SNR (dB)	The Signal to Noise Ratio of the link in dB
RSSI (dBm)	The Received Signal Strength Indication at the Rx input in dBm
Errored seconds	The total number of operational seconds with errored traffic since the last reset
Error free seconds	The total number of error free operational seconds since the last reset
BER	The system will report an estimated Bit Error Rate up to a maximum of 1 x 10^{-12}
TX temperature	The measured temperature in the transmitter module in °C
RX temperature	The measured temperature in the receiver module in °C
Ethernet performance	
Transmitted packets	The total number of transmitted Ethernet packets
Received packets	The total number of received Ethernet packets
Received packet errors	The total number of packets received with errors

If you want to reset the error counters, click Reset Counters.

13. Maintenance

There are no user-serviceable components within the terminal.

All hardware maintenance must be completed by 4RF or an authorized service centre.

Do not attempt to carry out repairs to any boards or parts.

Return all faulty terminals to 4RF or an authorized service centre.

For more information on maintenance and training, please contact Customer Services.

Caution: Electro Static Discharge (ESD) can damage or destroy the sensitive electrical components in the terminal.

Routine maintenance

Every six or twelve months, for both ends of the link, you should record the RSSI and SNR levels as well as checking the following:

Item	What to check or look for
Equipment shelter environment	Water leaks Room temperature Excessive vibration Vermin damage
Terminal mounting	Firmly mounted
Antenna cable connections	Tight and dry
Antenna cable and its supports	Not loose or suffering from ultra-violet degradation
Antenna and its mounting hardware	Not loose, rusty or damaged
Safety earth	Connections tight Cabling intact
DC system	Connections tight Voltage in normal limits
Batteries (if installed)	Connections tight Electrolyte levels normal

Terminal upgrades

You can upgrade all software for both terminals remotely (through a management network), which eliminates the need to physically visit either end of the link.

The best method of upgrading a terminal is to use the TFTP server method (see “Upgrading the terminal using TFTP” on page 177). This method downloads all the required image files into the terminal and then activates the correct files following a terminal reboot.

A terminal can also be upgraded by download all the required system software files (see “Upgrading the terminal by uploading system files” on page 182”).

Upgrade process

To minimize disruption of link traffic and prevent your terminals from being rendered inoperative, please follow the procedures described in this section together with any additional information or instructions supplied with the upgrade package.

Before upgrading the terminal, ensure that you have saved the configuration file (see "Saving the terminal's configuration" on page 66) as well as the cross connection configuration (see "Saving cross connection configurations" on page 130).

The Remote terminal upgrade process will be faster if the bandwidth allocated to the management ethernet capacity is maximized.

The terminal software must be identical at both ends of the link.

At the end of the terminal upgrade process, the versions of image files (kernel software, and firmware) that were in use before the upgrade are still in the terminal. You can restore them, if required, by editing the image tables and reactivating the old files (see “Changing the status of an image ” on page 188).

IMPORTANT NOTE: Ensure you are logged into the Near end terminal before you start an upgrade.

Installing RF synthesizer configuration files

If you are upgrading from software version 5_x_x or greater, refer to “Upgrading the terminal using TFTP” on page 177).

If you are upgrading from a software version prior to 7_1_x, you will need to install new RF synthesizer files, refer to “Configuration files” on page 182. You can then upgrade the terminal using TFTP (on page 177).

Frequency Band	Synthesizer File(to be installed)
300 MHz	XE_300_400_synth.cfg
400 MHz	XE_300_400_synth.cfg
700 MHz	XE_600_700_800_900_synth.cfg
800 MHz	XE_600_700_800_900_synth.cfg
900 MHz	XE_600_700_800_900_synth.cfg
1400 MHz	XE_1400_synth.cfg
2000 MHz	XE_2000_2500_synth.cfg
2500 MHz	XE_2000_2500_synth.cfg

If you are upgrading from software version 3_x_x or 4_x_x, refer to “Upgrading the terminal by uploading system files” on page 182.

Upgrading the terminal using TFTP

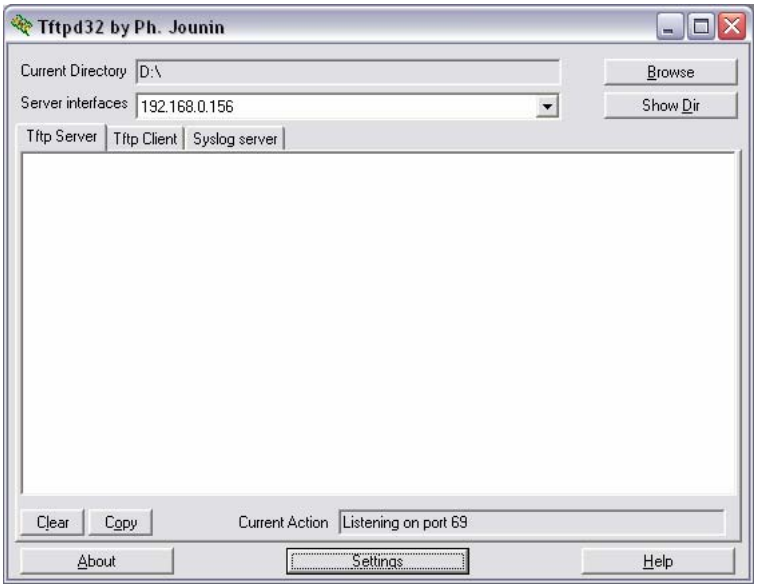
Before upgrading the terminal, ensure that you have saved the configuration file (see "Saving the terminal's configuration" on page 66) as well as the cross connection configuration (see "Saving cross connection configurations" on page 130).

Upgrading the terminal using the TFTP (Trivial File Transfer Protocol) server involves these steps:

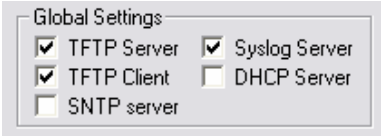
1. Run the TFTP server.
2. Login to the Near end terminal / local terminal (see “IP addressing of terminals” on page 47).
3. Run the TFTP upgrade process on the Remote terminal.
4. Reboot the Remote terminal.
5. Run the TFTP upgrade process on the Local terminal.
6. Reboot the Local terminal.
7. Clear the Java and web browser caches.

Step 1: Run the TFTP server

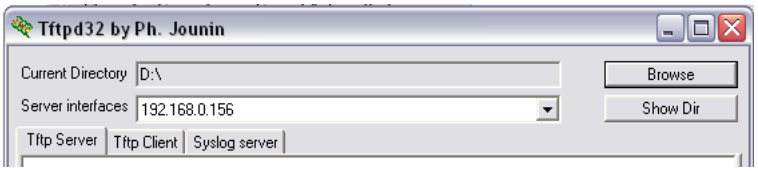
1. Double-click tftpd32.exe (located in the TFTPD directory) from the Aprisa CD supplied with the product. Leave the TFTPD32 application running until the end of the upgrade process.



2. Click Settings and make sure that both SNTP server and DHCP server are not selected (no tick), and click OK.



3. Click Browse and navigate to the root directory on the Aprisa CD (for example, D:\) supplied with the product, then click OK.



4. Note down the IP address of the TFTP server (shown in the Server Interfaces drop-down list in the TFTPD32 window) as you will need it later.

Step 2: Log into the Local terminal

Use SuperVisor to log into the Near end terminal (now the Local terminal) (see “IP addressing of terminals” on page 47) with either 'modify' or 'admin' privileges.

Step 3: Run the TFTP upgrade process on the Remote terminal

1. Select Remote > Maintenance > Upload > TFTP Upgrade.

2. Enter the IP address of the TFTP server (that you noted earlier)
3. Enter the version number of the software that you are upgrading to as a three digit number separated by underscores, for example, 7_3_2.
4. Click Apply and check the TFTP server for download activity.

   The Upgrade Result changes from 'Executing' to either 'Succeeded' or 'Failed'.

   Note: This may take several minutes when upgrading the remote terminal.

   If the upgrade has failed:

   - The TFTP server IP address may be set incorrectly
   - The 'Current Directory' on the TFTP server was not pointing to the location of the upload config file e.g. 'Rel_7_3_2.cfg' .
   - There may not be enough free space in the image table to write the file. Inactive images can be deleted (and the terminal rebooted) to free up space for the new image (see “Changing the status of an image file” on page 188).

Step 4: Reboot the Remote terminal

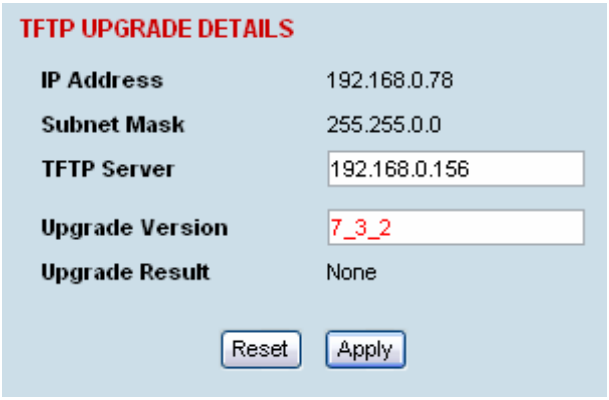
Reboot the remote terminal before proceeding with the next step of the upgrade process (see “Rebooting the terminal” on page 189).

1. Select Remote > Maintenance > Reboot and select [Hard Reboot]

   Communications to SuperVisor remote page will fail until the remote terminal reboot has completed.

Step 5: Run the TFTP upgrade process on the Local terminal.

1. Select Local > Maintenance > Upload > TFTP Upgrade.



2. Enter the IP address of the TFTP server (that you noted earlier)
3. Enter the version number of the software (that you are upgrading to) for example, 7_3_2.
4. Click Apply and check the TFTP server for download activity.

   The Upgrade Result changes from 'Executing' to either 'Succeeded' or 'Failed'.

Note: This may take several minutes when upgrading the remote terminal.

Step 6: Reboot the Local terminal

Reboot the local terminal before proceeding with the next step of the upgrade process (see “Rebooting the terminal” on page 189).

1. Select Local > Maintenance > Reboot and select [Hard Reboot]
2. Log back into the Local terminal when the reboot has completed.

Step 7: Clear the Java and web browser caches

After upgrading the terminal you should clear the Java and web browser caches. The files stored in them may cause the SuperVisor and Cross Connections applications to display incorrectly.

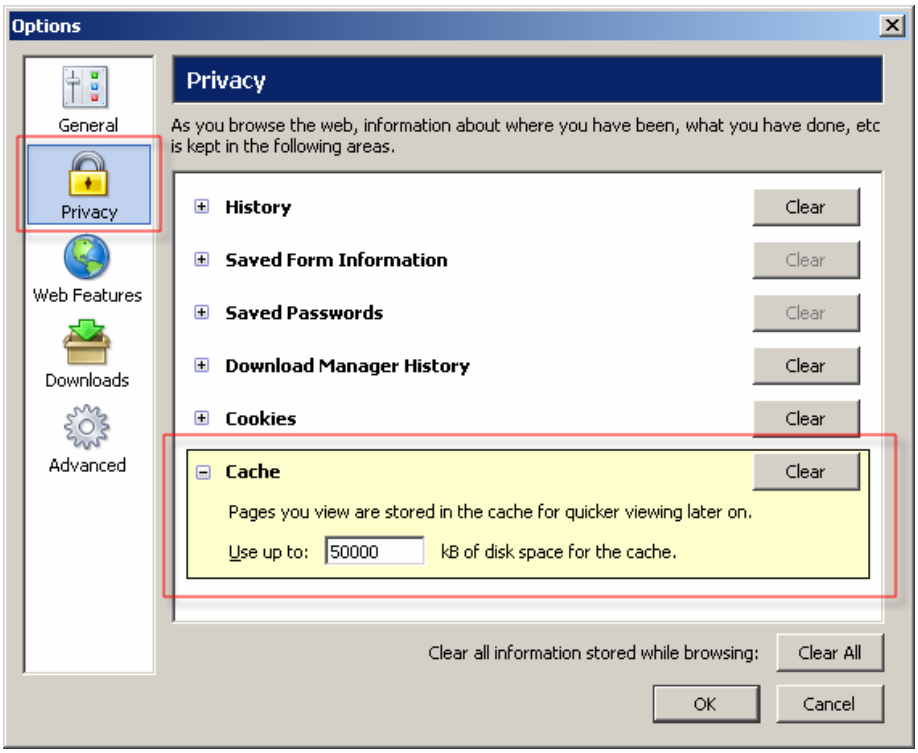
To clear the Java cache (Windows XP):

1. Select Start > Control Panel.
2. Select Java Plug-in

3. Click the Cache tab.
4. Click Clear and then click OK to confirm.

To clear your web browser cache (Mozilla Firefox 1.x and above):

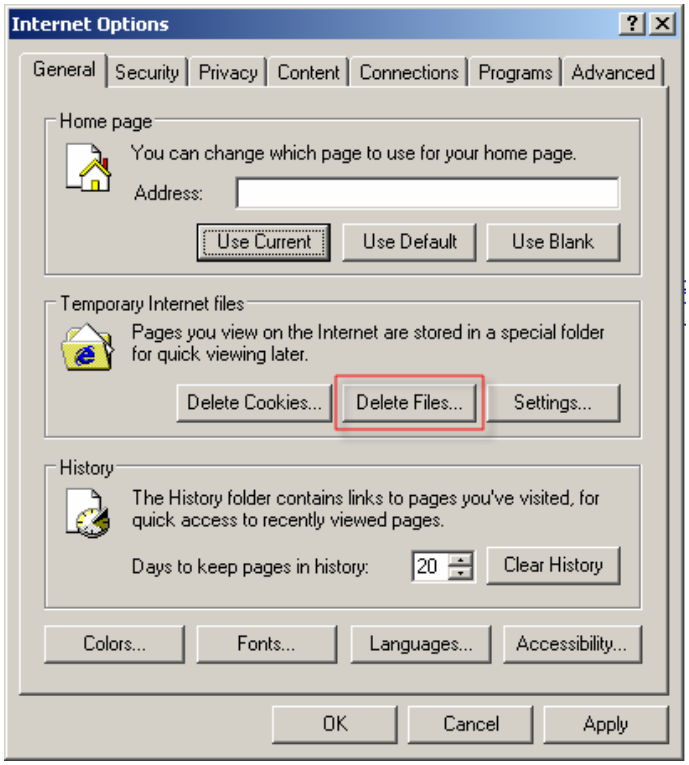
1. Select Tools > Options.
2. Select Privacy and then click Cache.



3. Click Clear to clear the cache, and then click OK to confirm.

To clear your web browser cache (Internet Explorer 6.x and above):

1. Select Tools > Internet Options.



2. On the General tab, click Delete Files, and then click OK to confirm.

Upgrading the terminal by uploading system files

A terminal can also be upgraded by uploading specific system files: configuration files, kernel image files, software image files or firmware image files.

Note: You should only upgrade components that need changing. It is not always necessary, for instance, to replace kernel or software files when upgrading a single firmware file. If interdependency exists between file types, this will be made clear in the documentation that accompanied the update package.

Configuration files

Configuration files (.cfg) are compressed archives containing a script to instruct the terminal on how to handle the other files in the archive.

Uploading of configuration files can only be performed to the Local Terminal (not via the link to the Remote Terminal).

RF synthesizer configuration files

The RF synthesizer configuration archive contains files that provide values for the transmitter and receiver synthesizers to operate across the supported frequency bands.

Synthesizer configuration filenames have the following format:

XE_(frequency bands)_synth.cfg e.g. XE_300_400_synth.cfg

Modem configuration files

The Modem configuration archive contains files that provide values for the Modem to operate at the various supported channel sizes and modulation types.

Modem configuration filenames have the following format:

modem_(version number).cfg e.g. modem_7_1_4.cfg

Cross-connect configuration files

The Cross-connect configuration archive contains the Cross Connections application program that can be launched from within SuperVisor.

Cross-connect configuration filenames have the following format:

C-crossconnect_(version number).cfg e.g. C-crossconnect_7_1_4.cfg

To upload a configuration file:

1. Select Local > Maintenance > Config Files > Upload Configuration
2. Browse to the location of the file required to be uploaded into the terminal *.cfg.
3. Click on Upload.

The normal response is Succeeded if the file has been loaded correctly.

A response of ‘Failed’ could be caused by:

- Not enough temporary space in the filesystem to uncompress the archive and execute the script
- A file or directory expected by the script not being present on the filesystem

4. Reboot the terminal using a ‘Hard Reboot’ (see “Rebooting the terminal” on page 189).

Image Files

Image files (.img) are loaded into the terminal and either contains code that is executed by the system processor, or contain instructions to configure the various programmable logic elements. The image file types that can be uploaded are:

- Kernel image files
- Software image files
- Firmware image files

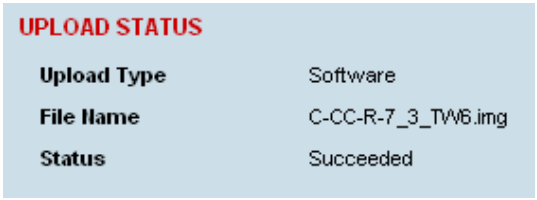
Note: The Bootloader image file C-CC-B-(version number).srec and Flash File System image file C-CC-F-(version number).img can only be changed in the factory.

Uploading of image files can only be performed to the local terminal (not via the link to the remote terminal).

To upload and activate an image file:

1. Upload the required image file.

   If the Upload Status page show ‘executing’, then ‘writing to flash’, then ‘Succeeded’, then the file has been written into the image table correctly.



   If the Upload Status is ‘Failed’, there may not be enough free space in the image table to write the file. Inactive images can be deleted (and the terminal rebooted) to free up space for the new image (see “Changing the status of an image file” on page 188).

2. Set the status of the image to ‘activate’ (see “Changing the status of an image ” on page 188).

   This actually sets the status to ‘Selected’ until after a terminal reboot.

3. Reboot the terminal using a ‘Hard Reboot’ (see “Rebooting the terminal” on page 189).

   This activates the selected image. The image table status will now show ‘Active’.

   The previous image file status will now show as ‘Inactive’.

Kernel image files

Kernel image files contain code that forms the basis of the microprocessor's operating system. There can only ever be two kernel image files in the image table, the active and the inactive.

Kernel filenames have the following format:

C-CC-K-(version number).img e.g. C-CC-K-7_1_4.img

To upload a kernel image file;

1. Select Local > Maintenance > Upload > Kernel
2. Browse to the location of the file required to be uploaded into the terminal *.img.
3. Click on Upload.

4. Activate the image (see "Changing the status of an image file" on page 188).
5. Reboot the terminal using a 'Hard Reboot' (see "Rebooting the terminal" on page 189).

Software image files

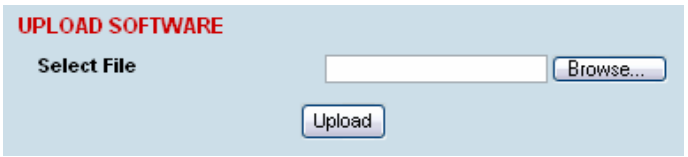
Software image files contain code that forms the basis of the terminal's application and management software (including the Web-based GUI). There can only ever be two software image files in the image table, the active and the inactive.

Software image filenames have the following format:

C-CC-R-(version number).img e.g. C-CC-R-7_1_4.img

To upload a software image file;

1. Select Local > Maintenance > Upload > Software
2. Browse to the location of the file required to be uploaded into the terminal *.img.
3. Click on Upload.



Software image files may take one or two minutes to upload as they can be quite large (≈ 2 Mbytes). The size of this file has caused some Microsoft Internet Explorer proxy server setups to abort during the software update process. To avoid this problem, either set the proxy file size limit to 'unlimited' or avoid the use of the proxy altogether.

4. Activate the image (see "Changing the status of an image file" on page 188).
5. Reboot the terminal using a 'Hard Reboot' (see "Rebooting the terminal" on page 189).

Firmware image files

Firmware image files contain instructions to configure the various programmable logic elements in the terminal. There can only ever be two firmware image files for the same HSC version in the image table, the active and the inactive.

Firmware image filenames have the following format:

C-fpga_Ef-x-y-z.img e.g. C-fpga_E5-0-6-4.img

where f indicates the function (motherboard, interface card, etc).

Function Number	Function
1	Motherboard 1
2	Motherboard 2
5	QJET
7	Q4EM
8	DFXO
9	DFXS
A	Modem
B	QV24
C	HSS

where x indicates the HSC (hardware software compatibility) version.

Revision Number	Revision
0	revision A hardware
1	revision B hardware
2	revision C hardware
3	revision D hardware

where y indicates the firmware major revision number

where z indicates the firmware minor revision number

To upload a firmware image file;

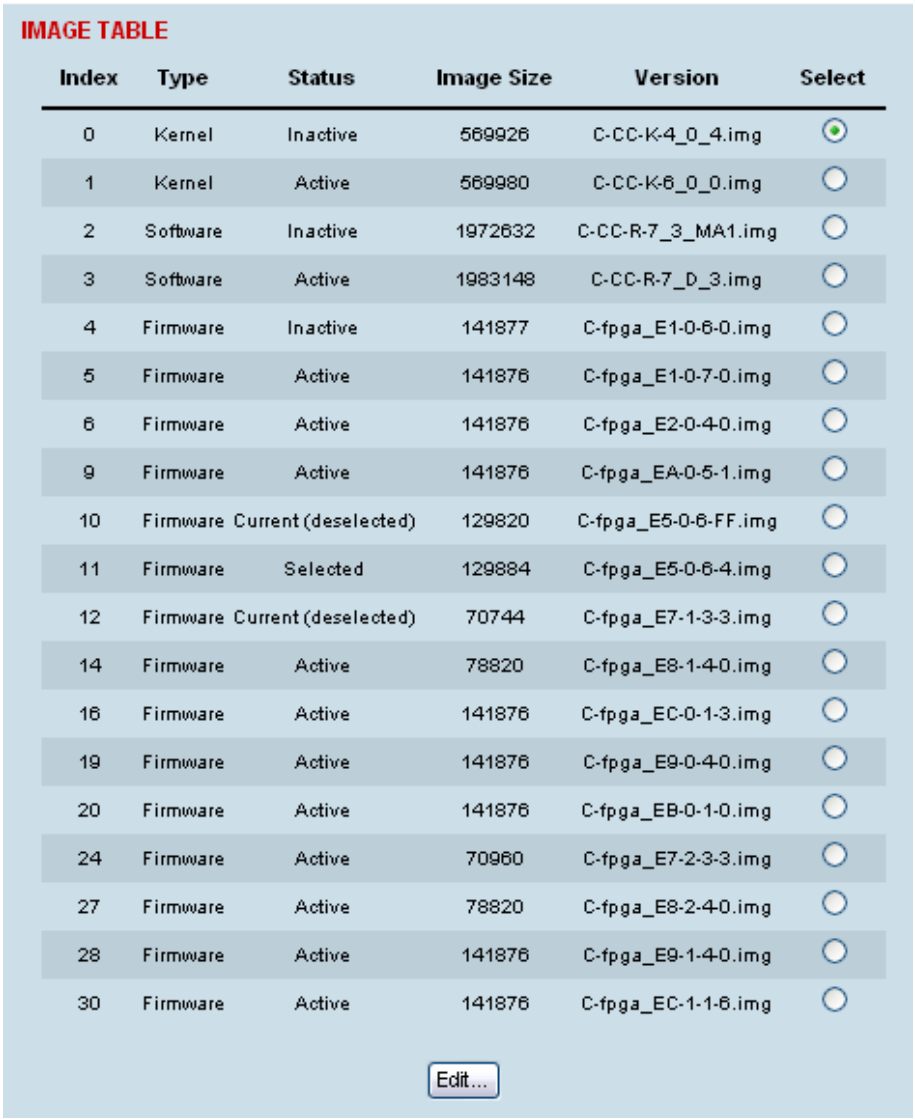
1. Select Local > Maintenance > Upload > Firmware
2. Browse to the location of the file required to be uploaded into the terminal *.img.
3. Click on Upload.

4. Activate the image (see “Changing the status of an image file” on page 188).
5. Reboot the terminal using a ‘Hard Reboot’ (see “Rebooting the terminal” on page 189).

Viewing the image table

To view the image table:

1. Select Link or Local or Remote > Maintenance > Image Table.



The image table shows the following information:

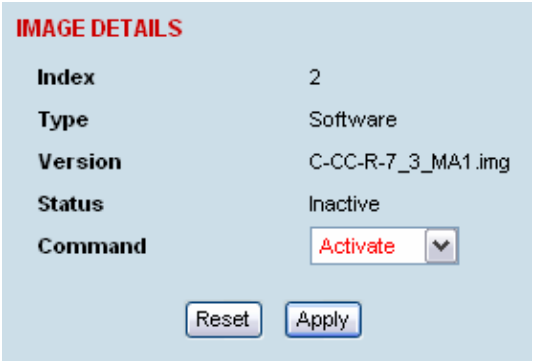
Heading	Function
Index	A reference number for the image file
Type	The image is not currently being used by the system and could be deleted.
Status	The status of the image; 'Active', 'Inactive', ‘Selected’, ‘Current (de-selected)’
Image Size	The image file size
Version	The image file name and version details

Note: Configuration file details do not appear in the image table.

Changing the status of an image file

To change the status of an image:

1. Select Link or Local or Remote > Maintenance > Image Table.
2. Select the image you wish to change and click Edit.



3. On the Image Details, select the status from the Command drop-down list and click Apply.

Status	Function
Active	The image is currently being used by the system.
Inactive	The image is not currently being used by the system and could be deleted.
Selected	The image is not currently being used by the system but has been activated and will become active following a terminal reboot.
Current (deselected)	The image is currently being used by the system but as another image has been selected, it will become inactive following a terminal reboot.

Rebooting the terminal

The local or remote terminals can be rebooted by SuperVisor.

You can specify a ‘Soft Reboot’ which reboots the terminal without affecting traffic or a ‘Hard Reboot’ which reboots the terminal (similar to power cycling the terminal).

You can specify an immediate reboot or setup a reboot to occur at a predetermined time.

To reboot the terminal:

1. Select Link or Local or Remote > Maintenance > Reboot.

2. Select the **Reboot Type** field:

- None:

  Do nothing.
- Soft Reboot:

  Reboots the software but should not affect customer traffic.
- Hard Reboot:

  Reboots the systems and affects customer traffic.

3. Select the **Reboot Command** field:

- None:

  Do nothing.
- Reboot Now:

  Execute the selected reboot now.
- Timed Reboot:

  Set the **Reboot Time** field to execute the selected reboot at a later date and time. This feature can be used to schedule the resulting traffic outage for a time that has least customer impact.
- Cancel Reboot:

  Cancel a timed reboot.

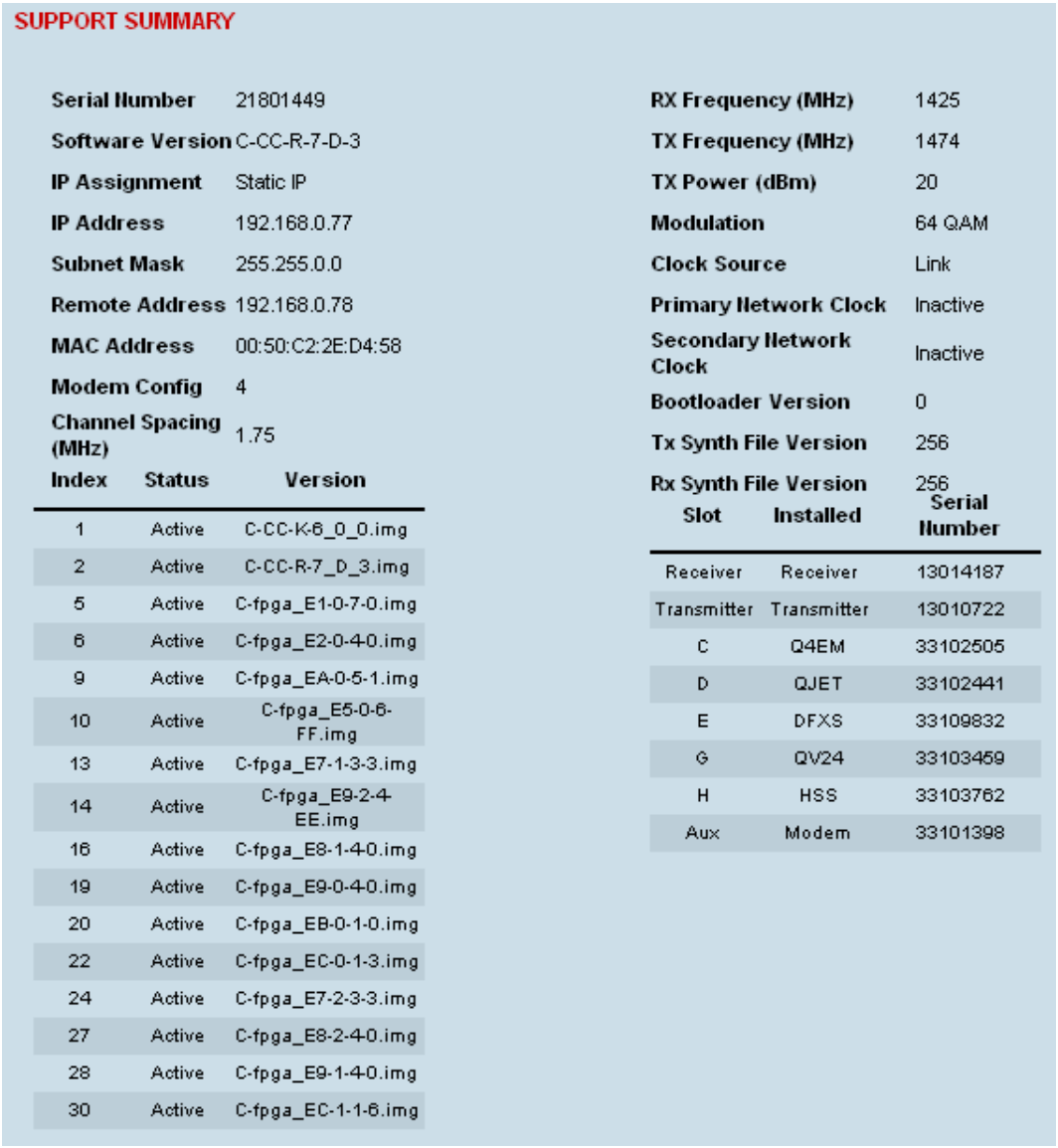
4. Click Apply to execute the reboot or Reset to restore the previous configuration.

Support summary

The support summary page lists key information about the terminal, for example, serial numbers, software version, frequencies and so on.

To view the support summary:

Select Link or Local or Remote > Maintenance > Support Summary.



SUPPORT SUMMARY

Serial Number	21801449
Software Version	C-CC-R-7-D-3
IP Assignment	Static IP
IP Address	192.168.0.77
Subnet Mask	255.255.0.0
Remote Address	192.168.0.78
MAC Address	00:50:C2:2E:D4:58
Modem Config	4
Channel Spacing (MHz)	1.75

Index	Status	Version
1	Active	C-CC-K-6_0_0.img
2	Active	C-CC-R-7_D_3.img
5	Active	C-fpga_E1-0-7-0.img
6	Active	C-fpga_E2-0-4-0.img
9	Active	C-fpga_EA-0-5-1.img
10	Active	C-fpga_E5-0-6-FF.img
13	Active	C-fpga_E7-1-3-3.img
14	Active	C-fpga_E9-2-4-EE.img
16	Active	C-fpga_E8-1-4-0.img
19	Active	C-fpga_E9-0-4-0.img
20	Active	C-fpga_EB-0-1-0.img
22	Active	C-fpga_EC-0-1-3.img
24	Active	C-fpga_E7-2-3-3.img
27	Active	C-fpga_E8-2-4-0.img
28	Active	C-fpga_E9-1-4-0.img
30	Active	C-fpga_EC-1-1-6.img

RX Frequency (MHz)	1425
TX Frequency (MHz)	1474
TX Power (dBm)	20
Modulation	64 QAM
Clock Source	Link
Primary Network Clock	Inactive
Secondary Network Clock	Inactive
Bootloader Version	0
Tx Synth File Version	256
Rx Synth File Version	256

Slot	Installed	Serial Number
Receiver	Receiver	13014187
Transmitter	Transmitter	13010722
C	Q4EM	33102505
D	QJET	33102441
E	DFXS	33109832
G	QV24	33103469
H	HSS	33103762
Aux	Modem	33101398

Installing interface cards

Caution: You must power down the terminal before removing or installing interface cards.

Interface cards are initially installed in the factory to the customers' requirements however, during the life of the product, additional interface cards may need to be installed.

Unless the terminals are protected (see "Protected terminals" on page 163), installing new interface cards involves a substantial interruption of traffic across the link. Staff performing this task must have the appropriate level of education and experience; it should not be attempted by inexperienced personnel.

To install an interface card:

1. Switch off the power to the terminal.
2. Prepare the terminal for new interface cards (see "Preparing the terminal for new interface cards" on page 192).
3. Install the interface card (see "Installing an interface card" on page 194).
4. Power up the terminal.
5. Configure the slot (see "Configuring a slot" on page 196).

   A slot can be configured before installing a new interface card, or after the interface card is installed and the terminal power cycled.
6. Configure the cross connections. (see "Configuring the traffic cross connections" on page 133)

Preparing the terminal for new interface cards

To prepare the terminal for a new interface card:

1. Remove the terminal from service by first switching off the terminal power. For an AC powered terminal, remove the AC power connector. For a DC powered terminal, switch off the DC circuit breaker or supply fuse.

2. Remove all other cables from the terminal, marking their locations first, if necessary, to aid later restoration. The safety earth connection must be the last cable removed.

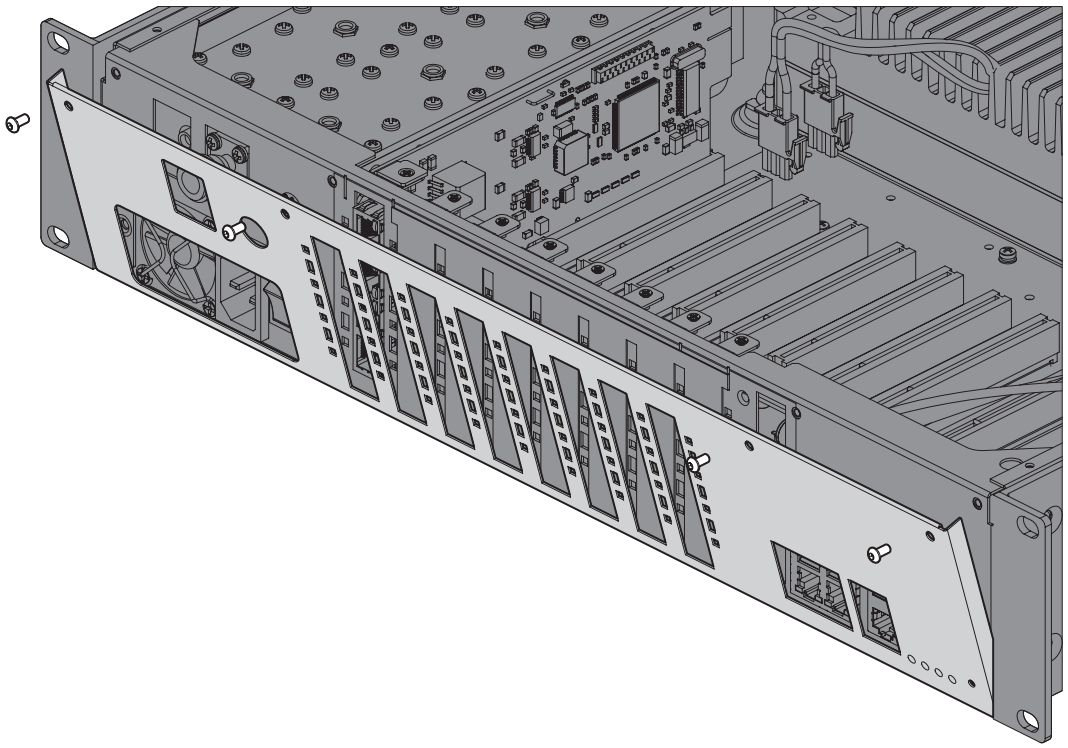
3. Ensure you have unobstructed access to the top and front of the terminal. Remove the terminal from the equipment rack, if required.

4. Remove the top cover of the terminal by removing two socket screws from the rear.

   Note: The top cover slides back towards the rear of the chassis.

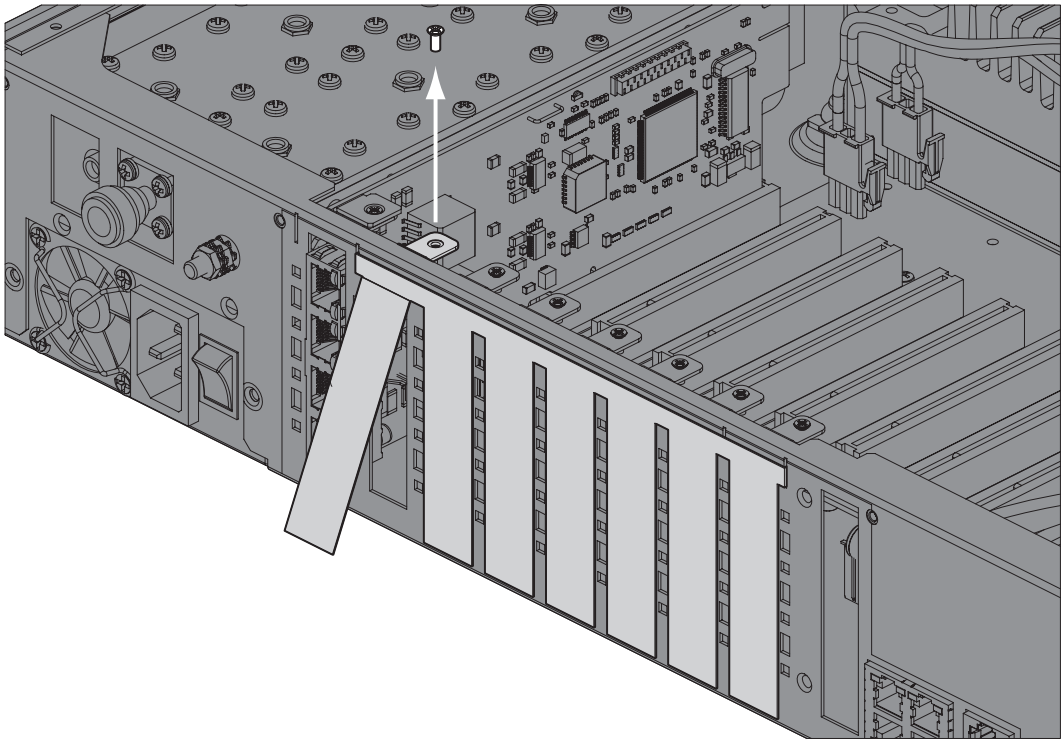
5. Remove the front fascia by removing the four front panel socket screws.

   Note: The front fascia first hinges out to clear the antenna connector and earth stud, and is then removed by unclipping from the chassis and sliding downwards. See illustration below.

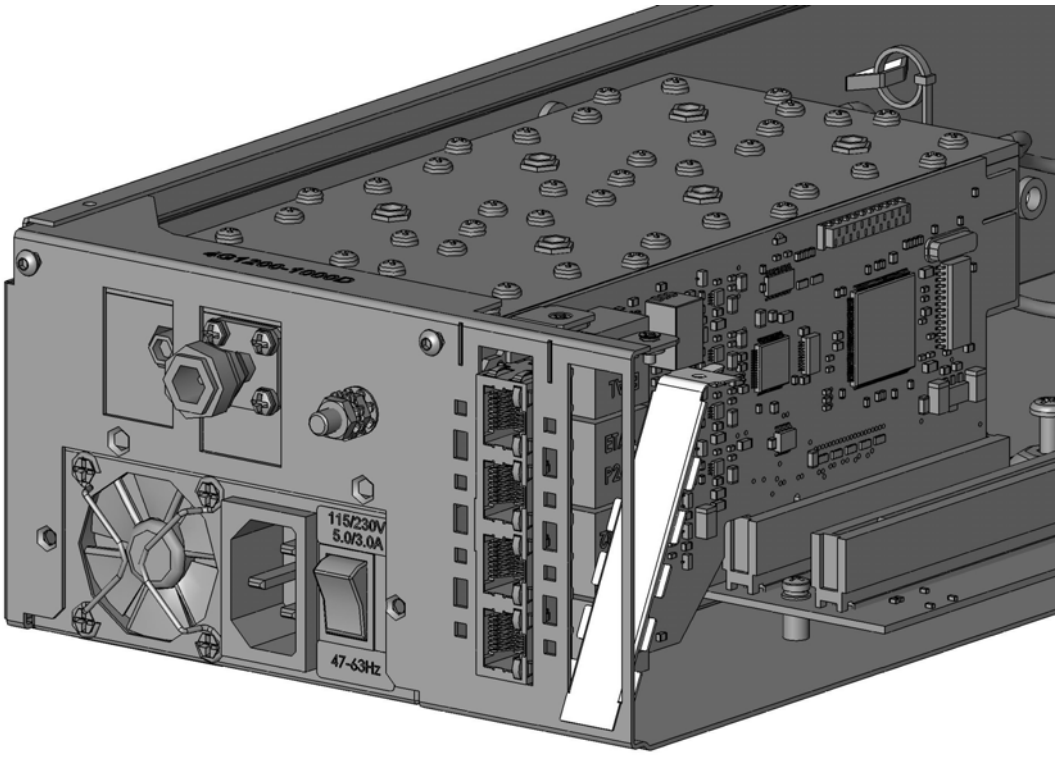


6. Remove the card securing screw from the required interface slot.
7. There are two types of interface slot blanking plates, the seven tab break off and the single slot type (newer type).

   If the blanking plate is the seven tab break off, remove the slot blanking tab by folding the tab to and fro until it breaks off.



   If the blanking plate is the single slot type, unclip the blanking plate from behind the slot (assuming that the card securing screw has already been removed).



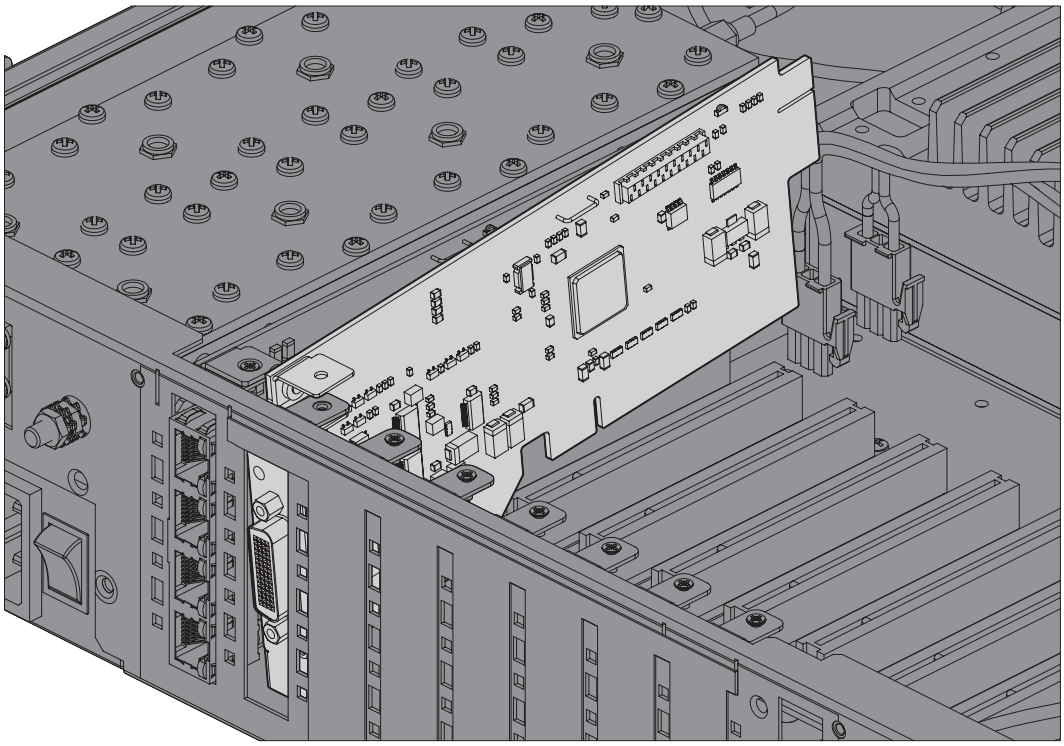
Installing an interface card

To install an interface card:

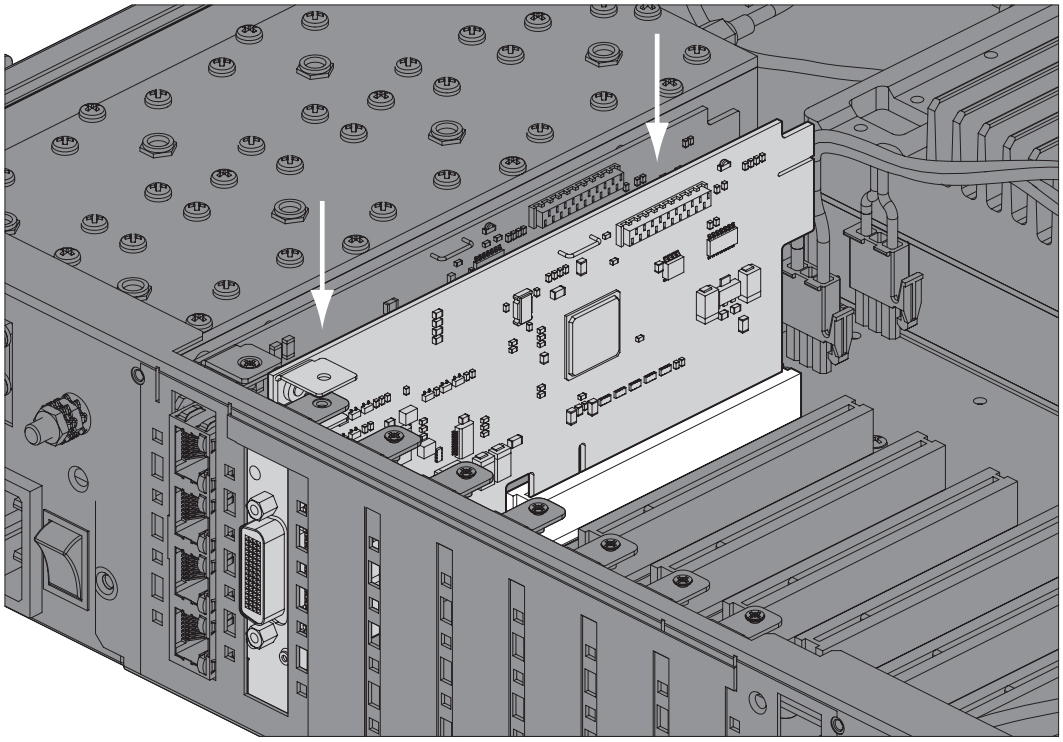
1. Remove the interface card from its packaging and static-safe bag.

Caution: To avoid static damage to the terminal or the interface card being installed, use a static discharge wristband or similar antistatic device.

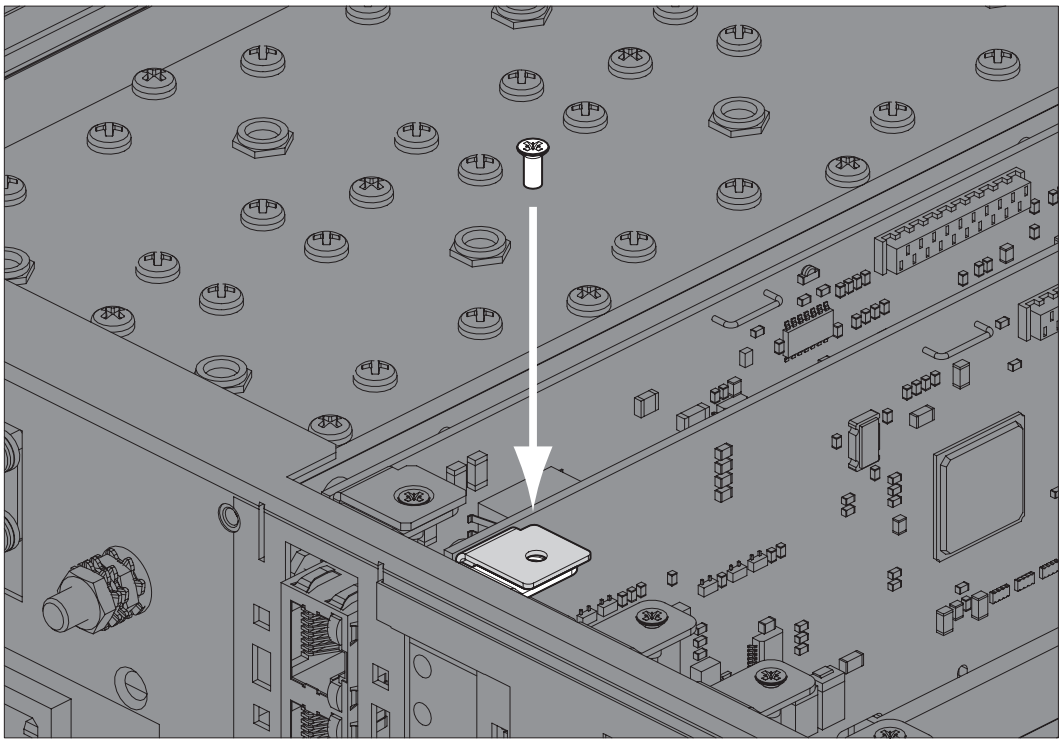
2. Offer the interface card into the chassis at an angle until the front panel of the card engages in the chassis.



3. Rotate the card in the chassis until it is level, and both parts of the card interface bus connector engage with the socket. Push down evenly on the interface card to seat it into the socket.

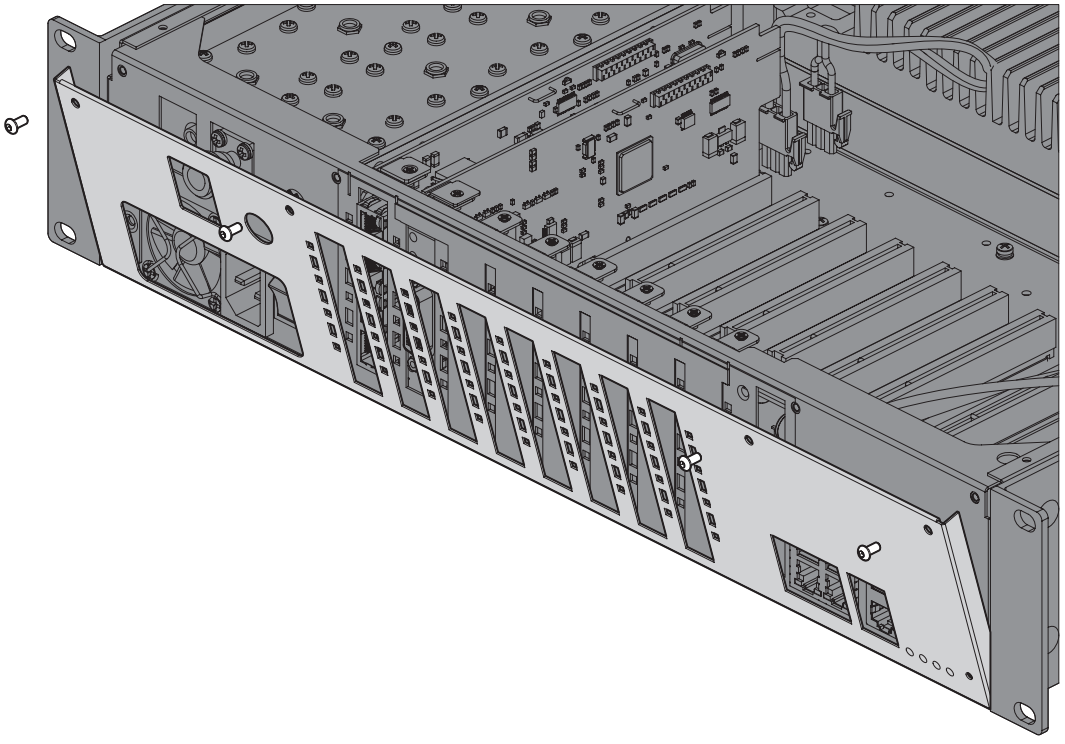


4. Replace the card securing screw.



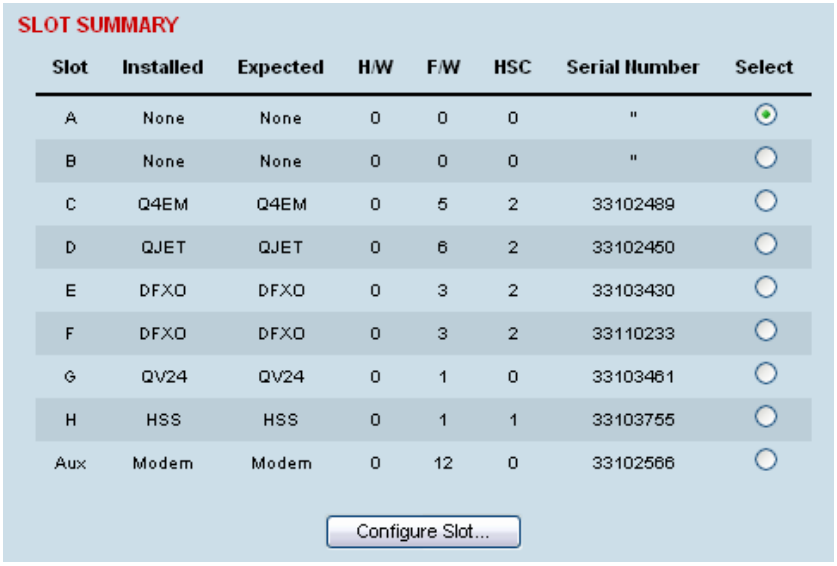
Note: Some interface cards may not have the bracket to accept the card securing screw.

5. Replace the fascia and top covers, restore all cables, and power up the terminal.

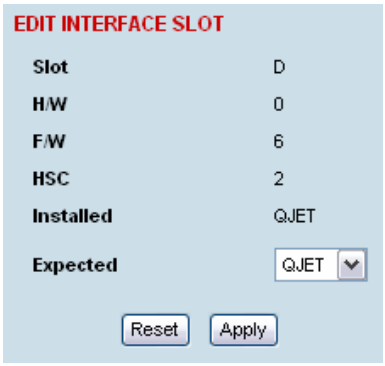


Configuring a slot

1. Select Link or Local or Remote > Interface > Slot Summary.



2. Select the required slot and click Configure Slot.



'Slot' shows the slot the interface card is plugged into in the terminal (A – H).

Details of the interface card currently installed in the slot are:

'H/W' (hardware revision).

'F/W' (firmware revision)

'HSC' (hardware software compatibility) A number used by the system software to determine which FPGA 'firmware image file' to use in the interface card installed.

'Installed' field shows the actual interface card installed in the slot. If there is no interface card installed in the slot, this field will show 'none'.

'Expected' shows interface card type that had been previously installed. Interface cards can be setup before they are installed in the terminal or after they are installed in the terminal.

3. To setup a new interface card in a slot, select the interface card type you want to fit (or has been fitted) from the 'Expected' drop-down menu.

Note: The transmitter, receiver and modem are configured in other sections (see "Configuring the terminal" on page 61).

4. Click Apply to apply changes or Reset to restore the previous configuration.

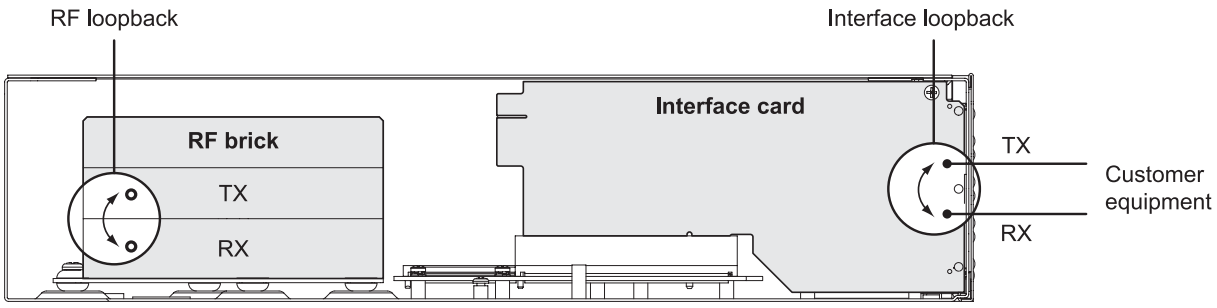
14. Troubleshooting

Loopbacks

Loopbacks are used as a tool for testing or as part of the commissioning process and will affect customer traffic across the link.

The terminal supports three types of loopbacks:

- RF radio loopback
- Interface loopbacks, set at the interface ports
- Timeslot loopbacks



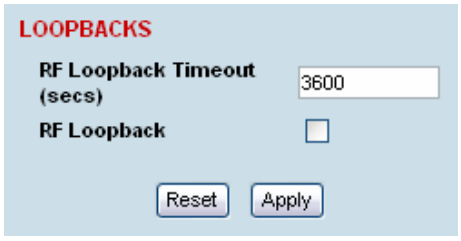
RF radio loopback

The RF radio loopback provides a loopback connection between the radio Tx and radio Rx. Each terminal is looped back independently.

All traffic entering the transmit stage of the local terminal is turned around and delivered to the receiver section. This loopback will affect all traffic through the terminal.

To enable or disable the RF loopback:

Select Link or Local or Remote > Maintenance > Loopbacks.



- To enable the RF loopback, click the RF Loopback checkbox (tick the box).

Note: An RF loopback will automatically disable after the period set (in seconds) in the Loopback Timeout field. The default entry is 3600 seconds (60 minutes).

- To disable the RF loopback, click the RF Loopback checkbox (untick the box).

Click Apply to apply changes or Reset to restore the previous configuration.

Note: When the RF loopback is selected, both the RX and TX LEDs will flash.

Interface loopbacks

The interface loopback provides a loopback connection for the customer-connected equipment. All traffic arriving from the customer interface is looped back.

These loopbacks are applied on a port-by-port basis and can only be enabled on active ports i.e. has to be activated by assigning traffic to it by the Cross Connections application.

The interface card green LED flashes while the loopback is active.

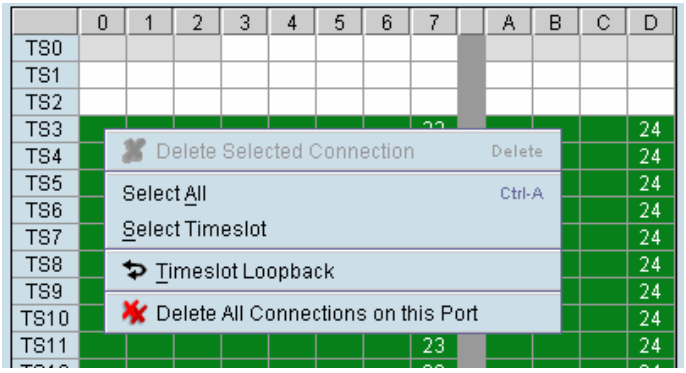
Loopback type	Description
QJET (whole tributary)	The QJET interface loopback will loop back the selected E1 / T1 port.
QJET (individual timeslot)	The Cross Connections application can loopback framed E1 / T1 timeslots (see "Timeslot loopbacks" on page 198).
Q4EM port	The Q4EM interface loopback will loop back the port 4 wire analogue path to the customer.
DFXO port	The DFXO interface loopback will loop back the port digital paths to return the port analogue signal back to the customer.
DFXS port	The DFXS interface loopback will loop back the port digital paths to return the port analogue signal back to the customer.
HSS port	The HSS interface loopback will loop back the port data to the customer.
QV24 port	The QV24 interface loopback will loop back the port data to the customer.
Ethernet	No loopback possible.

Timeslot loopbacks

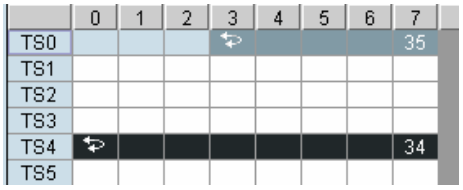
You can loopback framed E1 / T1 timeslots in the Cross Connections application.

1. Open the Cross Connections application.

2. Right-click the timeslot you want to loop back.



3. Select Timeslot Loopback - the looped timeslot will display in black:



Alarms

The LEDs (OK, RX, and TX) on the front panel illuminate either orange or red when there is a fault condition:

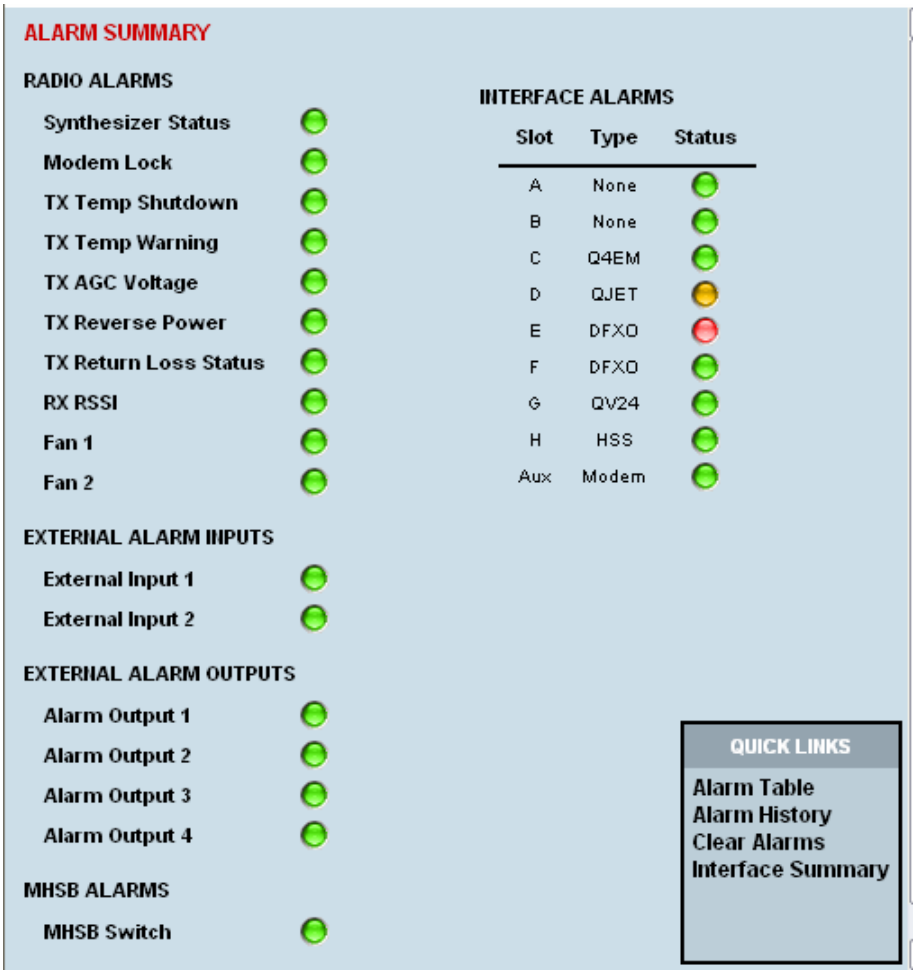
- Orange indicates a minor alarm that should not affect traffic across the link.
- Red indicates a major alarm condition that could affect traffic across the link.

A major or minor alarm can be mapped to the external alarm outputs (see “Configuring the external alarm outputs” on page 76).

Diagnosing alarms

To view the Alarm Summary and their current states:

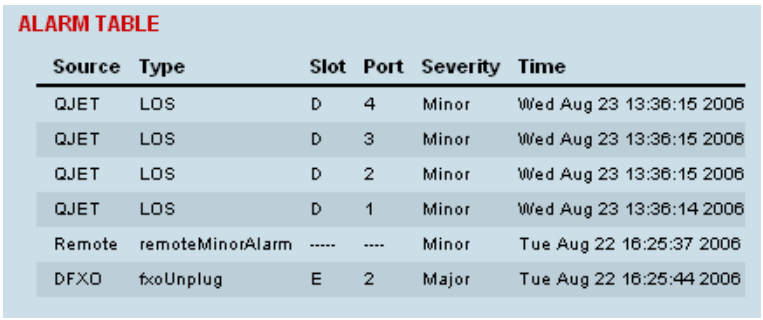
Select Link or Local or Remote > Alarms > Summary.



Alarm	Explanation
Synthesizer Status	The selected transmit frequency is outside the tuning range of the transmitter synthesizer
Modem Lock	The terminal modem is not synchronized with the modem at the other end of the link
TX Temp Shutdown	The transmitter power amplifier temperature is greater than 75°C. The transmitter has shut down to prevent damage.
TX Temp Warning	The transmitter power amplifier temperature is greater than 70°C. The transmitter will continue to operate in this condition, but if the power amplifier temperature increases above 75°C, a major alarm condition is set and the transmitter will shut down to prevent further damage.
TX AGC Voltage	The transmitter power amplifier automatic gain control is out of limits for normal operation
TX Reverse Power	There is excessive reflected power at the transmitter port of the terminal, indicating a low return loss in the path between transmitter port and the antenna.
TX Return Loss Status	Indicates the difference between the transmitted power and the amount of power being reflected back into the terminal. The alarm will trigger when there is too much reflected power from the antenna that will degrade link performance.
RX RSSI	The RX RSSI alarm threshold is determined by the RSSI Thresholds for each of the modulation types (see “Configuring the RSSI alarm threshold” on page 73)
Fan 1	The internal cooling fan 1 is not operating
Fan 2	The internal cooling fan 2 is not operating
External Input 1 -2	Indicates an active alarm state on the the external alarm input
Alarm Output 1 - 4	Indicates an active alarm state on the the external alarm output
MHSB Switch	Indicates that the MHSB has switched over. The MHSB alarm is only shown if MHSB mode is enabled (see “Configuring the terminals for MHSB” on page 160).

To view detailed alarm information:

Select Link or Local or Remote > Alarms > Alarm Table



The Alarm Table shows the source of the alarm and the type, the slot (and port, if applicable) where the alarm originated, the severity and the date and time the alarm occurred.

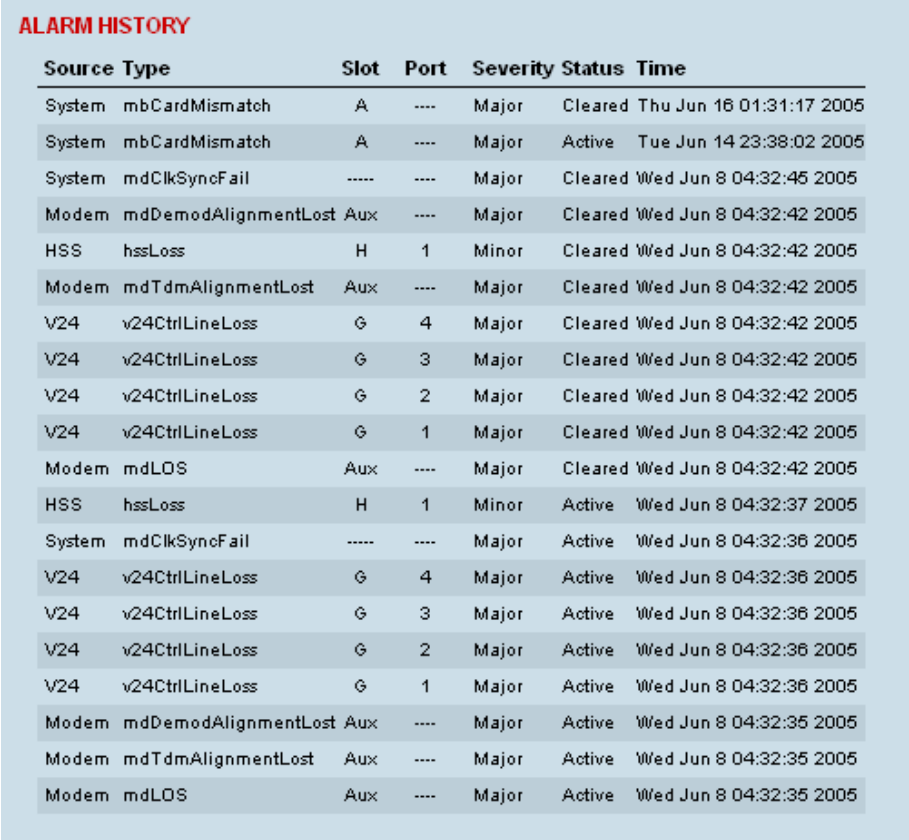
To further diagnose the cause of the alarm (see “Identifying causes of alarms” on page 204, and “Alarm types” on page 229).

Viewing the alarm history

The alarm history page shows the historical alarm activity for up to 50 alarms. This page refreshes every 30 seconds.

To view the alarm history:

Select Link or Local or Remote > Alarms > Alarm History.



ALARM HISTORY

Source	Type	Slot	Port	Severity	Status	Time
System	mbCardMismatch	A	----	Major	Cleared	Thu Jun 16 01:31:17 2005
System	mbCardMismatch	A	----	Major	Active	Tue Jun 14 23:38:02 2005
System	mdClkSyncFail	-----	----	Major	Cleared	Wed Jun 8 04:32:45 2005
Modem	mdDemodAlignmentLost	Aux	----	Major	Cleared	Wed Jun 8 04:32:42 2005
HSS	hssLoss	H	1	Minor	Cleared	Wed Jun 8 04:32:42 2005
Modem	mdTdmAlignmentLost	Aux	----	Major	Cleared	Wed Jun 8 04:32:42 2005
V24	v24CtrlLineLoss	G	4	Major	Cleared	Wed Jun 8 04:32:42 2005
V24	v24CtrlLineLoss	G	3	Major	Cleared	Wed Jun 8 04:32:42 2005
V24	v24CtrlLineLoss	G	2	Major	Cleared	Wed Jun 8 04:32:42 2005
V24	v24CtrlLineLoss	G	1	Major	Cleared	Wed Jun 8 04:32:42 2005
Modem	mdLOS	Aux	----	Major	Cleared	Wed Jun 8 04:32:42 2005
HSS	hssLoss	H	1	Minor	Active	Wed Jun 8 04:32:37 2005
System	mdClkSyncFail	-----	----	Major	Active	Wed Jun 8 04:32:36 2005
V24	v24CtrlLineLoss	G	4	Major	Active	Wed Jun 8 04:32:36 2005
V24	v24CtrlLineLoss	G	3	Major	Active	Wed Jun 8 04:32:36 2005
V24	v24CtrlLineLoss	G	2	Major	Active	Wed Jun 8 04:32:36 2005
V24	v24CtrlLineLoss	G	1	Major	Active	Wed Jun 8 04:32:36 2005
Modem	mdDemodAlignmentLost	Aux	----	Major	Active	Wed Jun 8 04:32:35 2005
Modem	mdTdmAlignmentLost	Aux	----	Major	Active	Wed Jun 8 04:32:35 2005
Modem	mdLOS	Aux	----	Major	Active	Wed Jun 8 04:32:35 2005

Field	Explanation
Source	The component within the terminal that generated the alarm
Type	The type of alarm (see "Alarm types and sources" on page 229)
Slot	The slot where the alarm originated, if applicable
Port	The port where the alarm originated, if applicable
Severity	Whether the alarm was a major or minor alarm
Status	Whether the alarm is active or cleared
Time	The date and time when the alarm occurred

To clear the alarm history:

Select Local or Remote > Alarms > Clear History

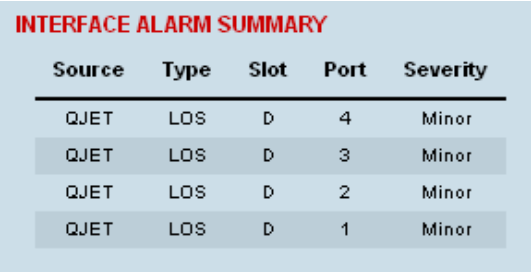
The alarm history for up to 100 alarms can be seen using SNMP (see “SNMP (Simple Network Management Protocol)” on page 67).

Viewing interface alarms

To view the alarms for a particular interface:

1. Select Link or Local or Remote > Interface > Interface Summary.
2. Select the desired interface card slot from the Interface Summary and click Alarms.

   This opens a page as shown below with a summary of the alarms on the interface card:



INTERFACE ALARM SUMMARY

Source	Type	Slot	Port	Severity
QJET	LOS	D	4	Minor
QJET	LOS	D	3	Minor
QJET	LOS	D	2	Minor
QJET	LOS	D	1	Minor

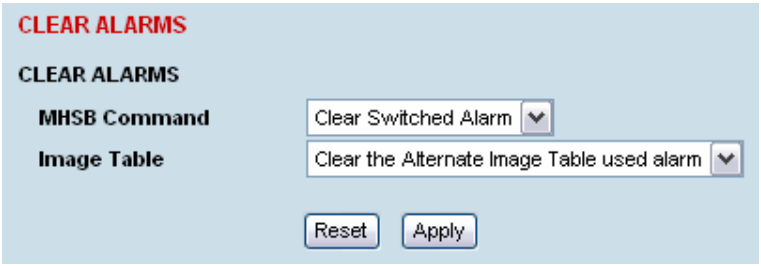
The following fields are displayed:

- Source: The type of interface card that generated the alarm
- Type: The type of interface alarm
- Slot: The slot of the interface card that generated the interface alarm
- Port: The port that generated the interface alarm
- Severity: Whether the interface alarm was major or minor

3. Return to the Interface Summary page by either selecting Options > Interface Summary or clicking Back in the browser window.

Clearing alarms

Select Link or Local or Remote > Alarms > Clear Alarms



MHSB Command

If a MHSB switchover event occurs, the OK LED on the front panel changes to orange.

To clear the MHSB switchover alarm:

Select Clear Switched Alarm from the MHSB Command drop-down list and click on Apply.

Image Table Alarm

An image table alarm appears if a problem occurred during the boot process which may have left the image table in an inconsistent state.

To clear the two types of image table alarms:

- The alternate image table alarm: this indicates that a backup image table has been used. This will match the actual image table unless immediately following a software upgrade.
- The default image table alarm: this indicates that the image table has been rebuilt from defaults. In some circumstances this will mean that an incorrect build of software is running on the terminal.

In either case, in addition to clearing the image table alarm, you should verify that the active images in the image table are correct for their software release.

Identifying causes of alarms

The following are possible causes of an alarm.

LED	Colour	Possible causes
OK	Orange	A minor system alarm is set
	Red	A major system alarm is set
RX	Orange	Low RSSI or AGC limits have been exceeded
	Red	Receiver power supply or synthesizer failure
TX	Orange	AGC, transmitter temperature, forward power or reverse power limits have been exceeded
	Red	Transmit power supply or synthesizer failure

OK LED		
Colour	Alarm condition	Suggested action
Orange	Fan failure	Check that the fans are not blocked and can spin freely.
Orange	Interface card mismatch	Using SuperVisor, check that the expected interface card and the fitted interface card are the same.
Red	Modem lock	A modem lock alarm is generally seen when other conditions such as low RSSI are present. If there are no other alarms indicated, check the following: The terminal clocking is set up correctly. Both terminals are using the same modulation. Both terminals are using the same version of software. External RF Interference from equipment operating in adjacent channels. Check the constellation pattern for evidence of disturbances in the RF path. Compare RSSI with the expected values from the original path engineering calculation. Investigate any large differences. If the fault persists, contact your local representative.
Red	Interface alarms	Check that the E1 or Ethernet interface cables are fitted correctly and the equipment they are connected to is functioning correctly.

RX LED		
Colour	Alarm condition	Suggested action
Orange	Low RSSI	Check that all antenna and feeder cables are firmly connected and not damaged or kinked Check there is no damage to the antenna Check the TX power and alarm status of the remote terminal
Orange	Receiver AGC	Contact your local 4RF representative
Red	Receiver power supply	Contact your local 4RF representative

TX LED		
Colour	Alarm condition	Suggested action
Orange	Reverse power	Check that all antenna and feeder cables are firmly connected and not damaged or kinked Check there is no damage to the antenna Check that the Receiver and Transmitter ports are correctly connected to the High and Low ports of the duplexer
Red	Transmitter temperature	Check operation of cooling fan or fans Ensure the air grills on the sides of the terminal are clear Ensure the ambient air temperature around the equipment is less than 50˚C

E1 / T1 alarm conditions

The QJET interface yellow LED indicates:

- **Loss of signal (LOS)**

  A loss of signal alarm occurs when there is no valid G.703 signal at the E1 / T1 interface RX input from the downstream system.

  This alarm masks the LOF and AIS received alarms.

- **Loss Of Frame alignment (LOF)**

  A loss of frame alignment alarm occurs when the E1 / T1 interface RX input receives a valid G.703 signal (code and frequency) but does not receive a valid G.704 signal i.e. no frame alignment word, from the downstream system (in framed E1 / T1 modes only) (red alarm in framed T1 modes).

  This alarm masks the AIS received alarm.

- **Alarm Indication Signal (AIS)**

  An AIS received alarm occurs when AIS is received from the downstream system.

  An E1 / T1 interface will output AIS to the downstream system if the normal upstream traffic signal is not available e.g. loss of modem synchronization, loss of RF signal across the link (blue alarm in framed T1 modes).

- **Remote Alarm Indicator (RAI)**

  A remote alarm indicator occurs when RAI is received from the downstream system when it has an active LOS or LOF alarm (TS0 NFAS bit 3 in framed E1 modes and yellow alarm in framed T1 modes).

- **TS16 Loss of signal (TS16LOS)**

  A TS16 loss of signal alarm occurs when there is no valid TS16 signal at the E1 interface RX input from the downstream system (in E1 PCM 30 modes only).

- **TS16 Remote Multi-frame Alarm Indicator (RMAI)**

  A remote multiframe alarm indicator occurs when RMAI is received from the downstream system when it has an active TS16LOS alarm (TS16 F0 bit 6 in E1 PCM 30 modes only).

- **TS16 Alarm Indication Signal (TS16AIS)**

  A TS16 Alarm Indication Signal alarm occurs when AIS is received from the downstream system in TS16.

  An E1 interface will output the TS16 AIS signal to the downstream system if the normal TS16 multi-frame signal is not available (in E1 PCM 30 modes only).

The QJET interface green LED indicates:

The QJET interface green LED flashes when the E1 / T1 port loopback is active.

System log

SuperVisor automatically keeps a log, known as 'syslog', which captures all alarms, errors and events for each terminal.

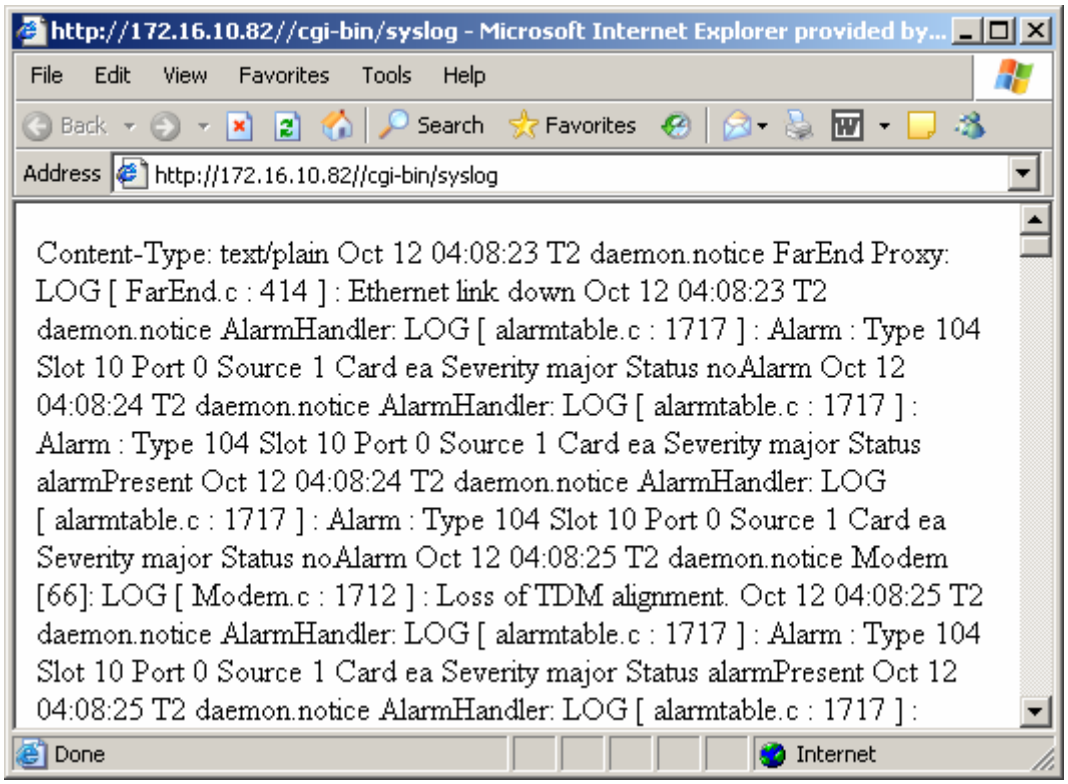
You can specify that the ‘syslog’ is saved to a particular file (see "Setting up for remote logging” on page 209). You can then email this file to customer service, if requested, to enable them to fault-find more accurately.

Checking the syslog

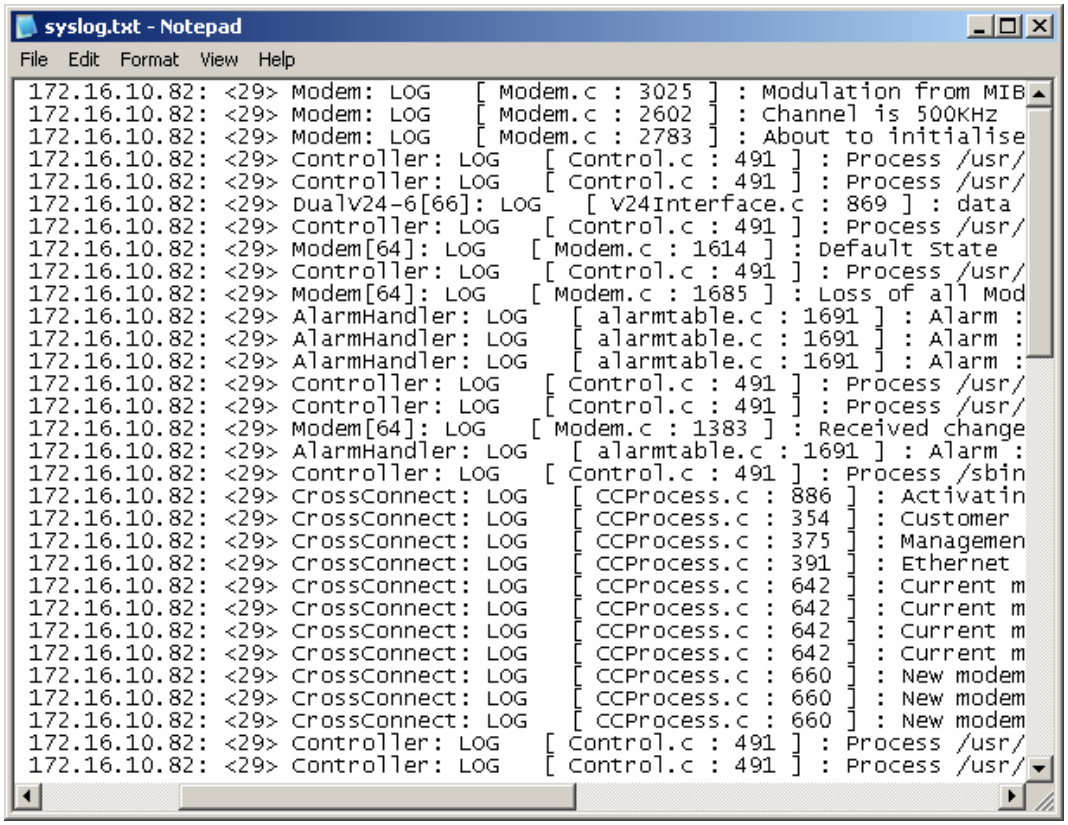
To view the Syslog:

1. Select Local > Performance > Logging > Syslog.

   This opens a new window:



2. The system log is quite hard to decipher in Internet Explorer. If you're using Internet Explorer, select View > Source, which opens the file in a more legible layout in Notepad (see illustration below). Save or print this file, as required.



3. If you want to save the system log, you can save it from within Notepad (or Internet Explorer). Select File > Save As. Navigate to where you want to save the file. Enter a meaningful filename and select 'Text File' from the Save As Type drop-down list. Click Save.

You can specify that this file is automatically saved to a computer (see "Setting up for remote logging" on page 209).

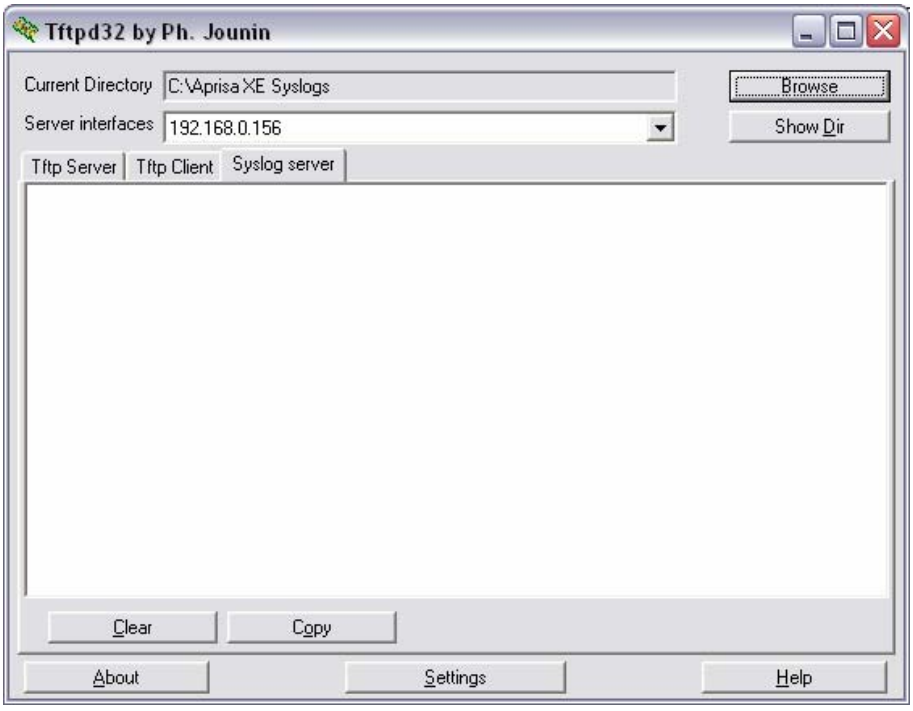
Setting up for remote logging

Note: When setting up to save the system log to a specific computer, be aware that the file is constantly updated and may get quite large quite quickly.

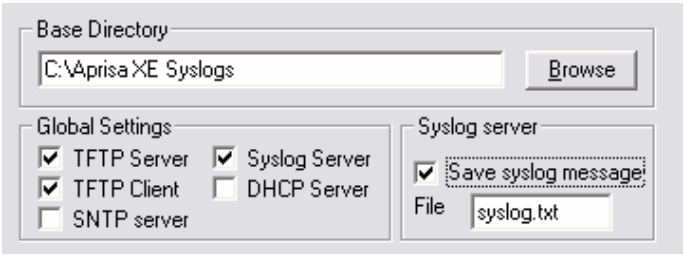
To set up a terminal for remote logging:

1. Copy the TFTP server application (tftpd32.exe, which is located in the TFTPD directory) from the terminal product CD into a suitable directory on the PC (for example, C:\Program Files\TFTP Server).
2. Create another directory where you want the system logs to be saved for example;

   C:\Aprisa XE Syslog
3. Double-click tftpd32.exe.



4. Click Settings and make sure that both ‘Syslog Server’ and ‘Save syslog message’ boxes are ticked.



5. Click Browse and select a directory where you want the Syslog file to be saved (created in step 2).
6. Click OK to close the Settings dialog box.

7. In SuperVisor, select Link or Link or Local or Remote > Terminal > Advanced.

8. In the Remote Syslog Address field, enter the IP address of the PC on which the Syslog server is running.

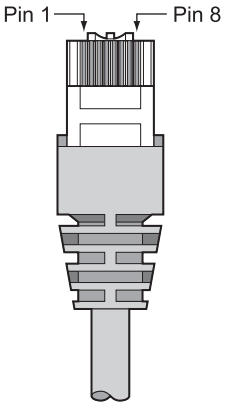
9. In the Remote Syslog Port field, enter 514.

10. Reboot the terminal (Link or Local or Remote > Maintenance > Reboot).

11. Open the directory where the system logs are being saved to. You should see a file called syslog.txt.

15. Interface connections

RJ-45 connector pin assignments

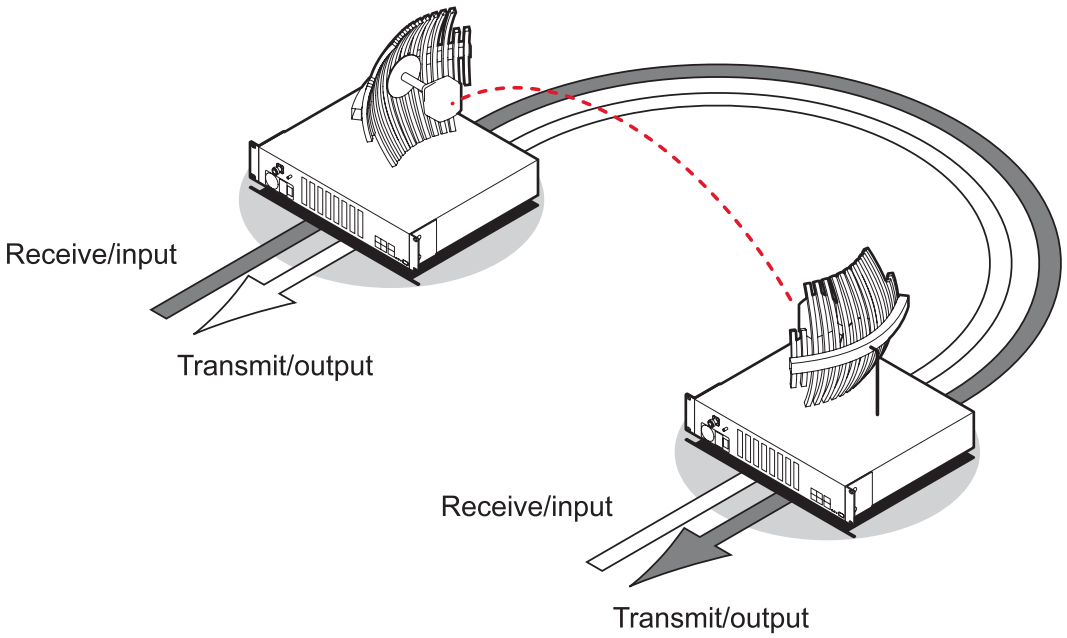


RJ-45 pin numbering

Interface traffic direction

All interface traffic directions and labels used in this manual refer to the direction relative to the terminal. Refer to the diagram below.

The traffic direction describes the transmit / receive paths and the direction of handshaking and clocking signals, depending on the interface.



QJET Interface connections

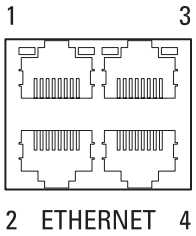
Pin number	Pin function	Direction	TIA-568A wire colour
1	Transmit	Output	Green/white
2	Transmit	Output	Green
3	Not used		Orange/white
4	Receive	Input	Blue
5	Receive	Input	Blue/white
6	Not used		Orange
7	Not used		Brown/white
8	Not used		Brown

RJ-45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Normal operation
Yellow	On	Loss of signal (LOS) or Alarm Indication Signal (AIS) or Loss Of Frame alignment (LOF) in Framed modes
Green	Flashing	Port in loopback

The standard QJET interface is 120 ohm balanced.

External Balun transformers can be used to provide a 75 ohm unbalanced interface.

Ethernet interface connections



Pin number	Pin function	Direction	TIA-568A wire colour
1	Transmit	Output	Green/white
2	Transmit	Output	Green
3	Receive	Input	Orange/white
4	Not used		Blue
5	Not used		Blue/white
6	Receive	Input	Orange
7	Not used		Brown/white
8	Not used		Brown

RJ-45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Ethernet activity

Q4EM Interface connections

Pin number	Pin function	Direction	TIA-568A wire colour
1	M	Input	Green/white
2	M_1	Input	Green
3	Receive (Ra/R)	Input	Orange/white
4	Transmit (Tb/R1)	Output	Blue
5	Transmit (Ta/T1)	Output	Blue/white
6	Receive (Rb/T)	Input	Orange
7	E	Output	Brown/white
8	E_1	Output	Brown

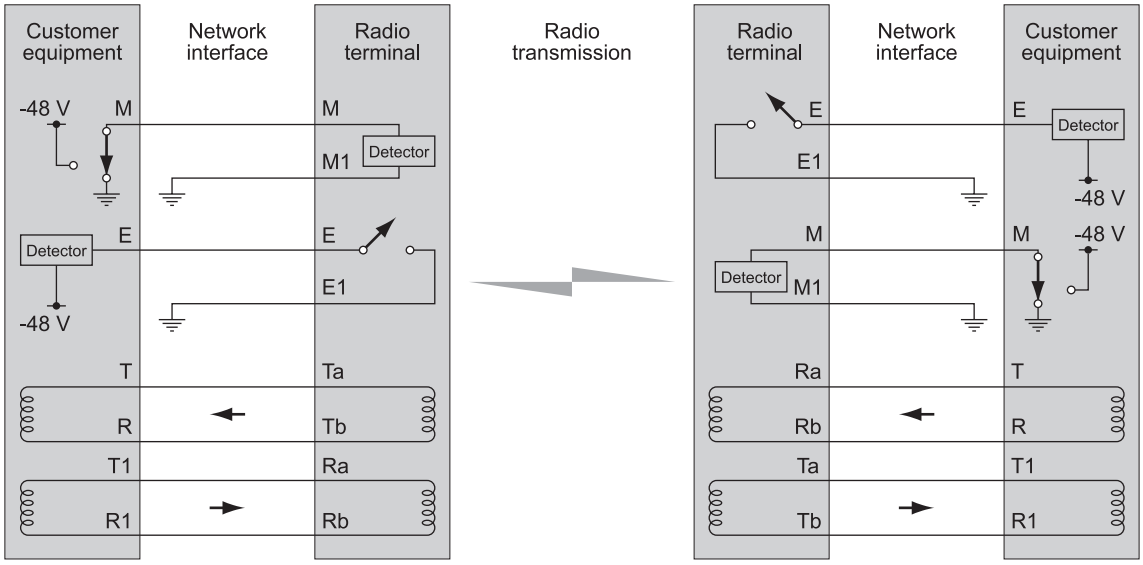
RJ-45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Normal operation (M signal)
Yellow	On	Alarm condition (E signal)
Green	Flashing	Port in loopback

E&M Signalling types

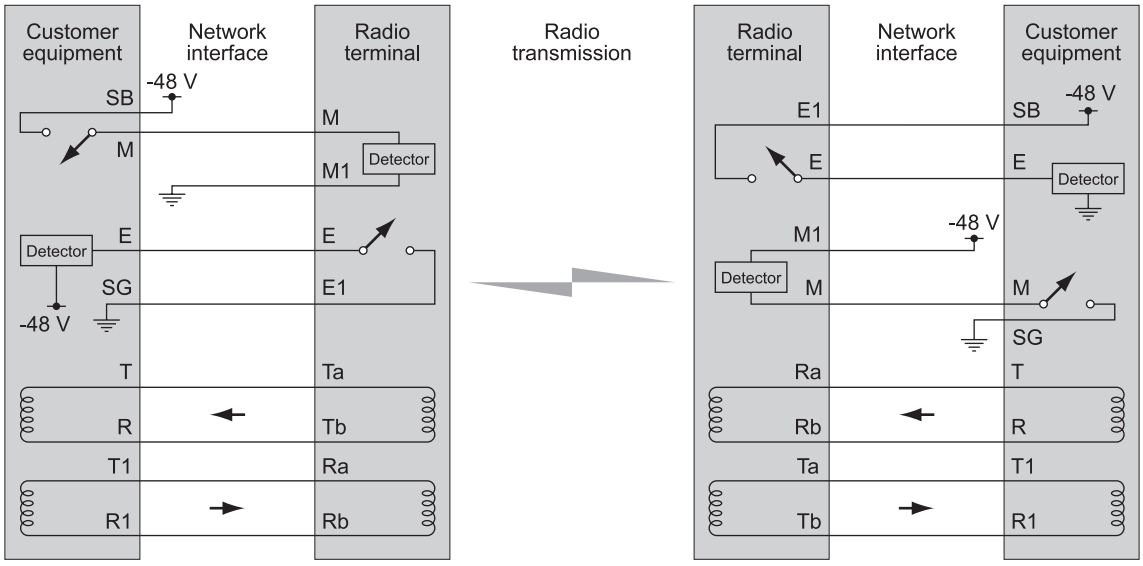
The Q4EM E&M signalling leads are optically isolated, bi-directional lines which can be externally referenced to meet any of the EIA-464 connection types I, II,IV or V (as shown below).

The M1 lead associated with the M wire detector can be externally referenced to earth or battery as required.

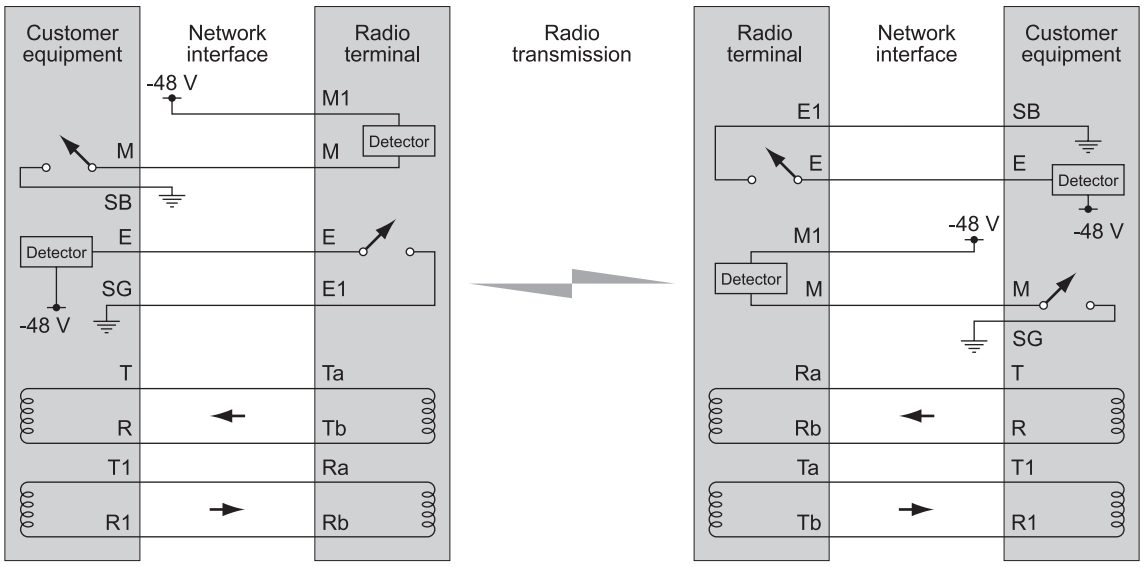
The E1 lead associated with the E wire output can be externally referenced to earth or battery as required.



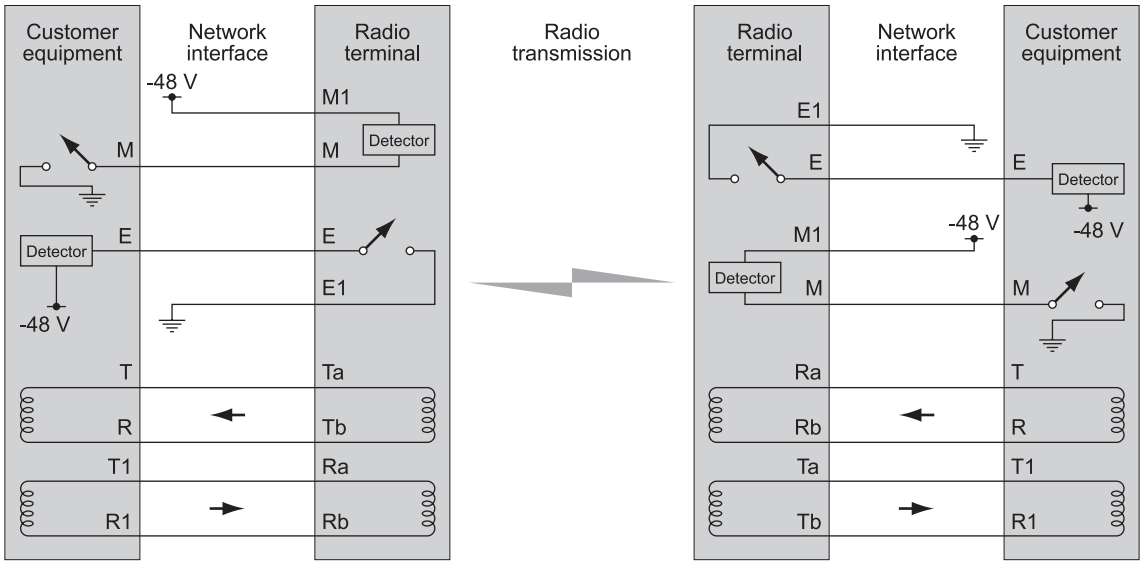
4-Wire E&M Type I



4-Wire E&M Type II

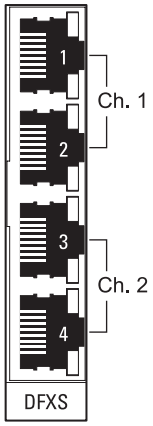


4-Wire E&M Type IV



4-Wire E&M Type V

DFXS Interface connections

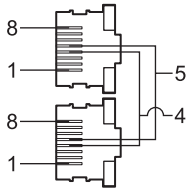


The subscriber interface connects the terminal to the customer's 2 wire telephone via a 2 wire line.

Each 2 wire channel has two access points: one connects to a customer; the other is a local test port.

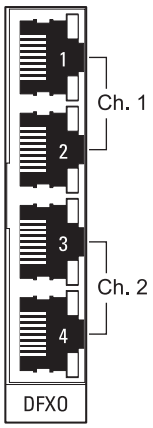
Warning: If there is a power failure at either terminal, any telephone connected at the DFXS will not operate.

Please ensure that a separate telephone that is not dependent on local power is available for use in an emergency.

RJ-45	Pin number	Pin function	Direction	TIA-568A wire colour
	1	Not used		Green/white
	2	Not used		Green
	3	Not used		Orange/white
	4	Ring	Bi-directional	Blue
	5	Tip	Bi-directional	Blue/white
	6	Not used		Orange
	7	Not used		Brown/white
	8	Not used		Brown

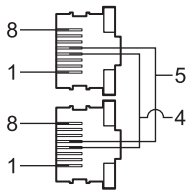
RJ-45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Normal operation
Yellow	Flashing	Loopback in place
Yellow	On	Alarm condition
Both LEDs	Flashing	Loss of CAS signals

DFXO Interface connections



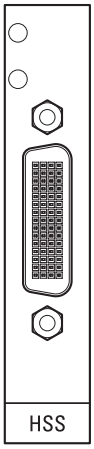
The DFXO interface connects the terminal to the telephone network via a 2 wire line.

Each DFXO channel has two access points: one connects to a customer; the other is a local test port.

RJ-45	Pin number	Pin function	Direction	TIA-568A wire colour
	1	Not used		Green/white
	2	Not used		Green
	3	Not used		Orange/white
	4	Ring	Bi-directional	Blue
	5	Tip	Bi-directional	Blue/white
	6	Not used		Orange
	7	Not used		Brown/white
	8	Not used		Brown

RJ-45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Normal operation
Yellow	Flashing	Loopback in place
Yellow	On	Alarm condition

HSS Interface connections



The connector on the high-speed synchronous serial interface is a high density LFH-60 (as used on standard Cisco WAN port serial interface cables and equivalents).

The interface specification (X.21 / V.35 etc) is automatically changed by simply changing the type of interface cable connected to the HSS.

LED indicators		
LED	**Status**	**Explanation**
Top green LED	On	Normal operation
Top green LED	Flashing	Loopback in place
Lower green LED	On	Normal operation

Synchronous cable assemblies

Sync EIA/TIA-232 for DTE (Part number: Cab Sync 232MT)

Pin number	Pin function	Direction
1	Ground	-
2	TXD	Input
3	RXD	Output
4	RTS	Input
5	CTS	Output
6	DSR	Output
7	Circuit DCD	-
8	DCD	Output
15	TXC	Output
17	RXC	Output
18	LTST	Input
20	DTR	Input
24	TXCE	Input

Sync EIA/TIA-232 Cable Assembly for DCE (Part number: Cab Sync 232FC)

Pin number	Pin function	Direction
1	GND	-
2	TXD	Output
3	RXD	Input
4	RTS	Output
5	CTS	Input
6	DSR	Input
7	Circuit Ground	-
8	DCD	Input
15	TXC	Input
17	RXC	Input
18	LTST	Output
20	DTR	Output
24	TXCE	Output

EIA/TIA-449 Serial Cable Assembly for DTE (Part number: Cab Sync 449MT)

Pin number	Pin function	Direction
1	Shield Ground	-
4 22	SD+ SD-	Input Input
5 23	ST+ ST-	Output Output
6 24	RD+ RD-	Output Output
7 25	RS+ RS-	Input Input
8 26	RT+ RT-	Output Output
9 27	CS+ CS-	Output Output
10 37	LL SC	Input _
11 29	DM+ DM-	Output Output
12 30	TR+ TR-	Input Input
13 31	RR+ RR-	Output Output
17 35	TT+ TT-	Input Input
19 20	SG RC	- -

EIA/TIA-449 Serial Cable Assembly for DCE (Part number: Cab Sync 449FC)

Pin number	Pin function	Direction
1	Shield Ground	_
4 22	SD+ SD-	Output Output
5 23	ST+ ST-	Input Input
6 24	RD+ RD-	Input Input
7 25	RS+ RS-	Output Output
8 26	RT+ RT-	Input Input
9 27	CS+ CS-	Input Input
10 37	LL SC	Output _
11 29	DM+ DM-	Input Input
12 30	TR+ TR-	Output Output
13 31	RR+ RR-	Input Input
17 35	TT+ TT-	Output Output
19 20	SG RC	- -

V.35 Serial Cable Assembly for DTE (Part number: Cab Sync V35MT)

Pin number	Pin function	Direction
A	Frame Ground	
B	Circuit Ground	
C	RTS	Input
D	CTS	Output
E	DSR	Output
F	RLSD	Output
H	DTR	Input
K	LT	Input
P S	SD+ SD-	Input Input
R T	RD+ RD-	Output Output
U W	SCTE+ SCTE-	Input Input
V X	SCR+ SCR-	Output Output
Y AA	SCT+ SCT-	Output Output

V.35 Serial Cable Assembly for DCE (Part number: Cab Sync V35FC)

Pin number	Pin function	Direction
A	Frame Ground	
B	Circuit Ground	
C	RTS	Output
D	CTS	Input
E	DSR	Input
F	RLSD	Input
H	DTR	Output
K	LT	Output
P S	SD+ SD-	Output Output
R T	RD+ RD-	Input Input
U W	SCTE+ SCTE-	Output Output
V X	SCR+ SCR-	Input Input
Y AA	SCT+ SCT-	Input Input

X.21 Serial Cable Assembly for DTE (Part number: Cab Sync X21MT)

Pin number	Pin function	Direction
1	Shield Ground	-
2 9	Transmit+ Transmit-	Input Input
3 10	Control+ Control-	Input Input
4 11	Receive+ Receive-	Output Output
5 12	Indication+ Indication-	Output Output
6 13	Timing+ Timing-	Output Output
8	Circuit Ground	

X.21 Serial Cable Assembly for DCE (Part number: Cab Sync X21FC)

Pin number	Pin function	Direction
1	Shield Ground	-
2 9	Transmit+ Transmit-	Output Output
3 10	Control+ Control-	Output Output
4 11	Receive+ Receive-	Input Input
5 12	Indication+ Indication-	Input Input
6 13	Timing+ Timing-	Input Input
8	Circuit Ground	

EIA-530 Serial Cable Assembly for DCE (Part number: Cab Sync 530FC)

Pin number	Pin function	Direction
2 14	BA(A), TXD+ BA(B), TXD-	Output Output
3 16	BB(A), RXD+ BB(B), RXD-	Output Outputcc
4 19	CA(A), RTS+ CA(B), RTS-	Output Output
5 13	CB(A), CTS+ CB(B), CTS-	Input Input
6 22	CC(A), DSR+ CC(B), DSR-	Input Input
1 -	Shield -	
8 10	CF(A), DCD+ CF(B), DCD-	Input Input
15 12	DB(A), TXC+ DB(B), TXC-	Input Input
17 9	DD(A), RXC+ DD(B), RXC-	Input Input
18 7	LL Circuit Ground	Output -
20 23	CD(A), DTR+ CD(B), DTR-	Output Output
24 11	DA(A), TXCE+ DA(B), TXCE-	Output Output
25	TM, not used	Output

EIA-530 Serial Cable Assembly for DTE (Part number: Cab Sync 530MT)

Pin number	Pin function	Direction
2 14	BA(A), TXD+ BA(B), TXD-	Input Input
3 16	BB(A), RXD+ BB(B), RXD-	Output Output
4 19	CA(A), RTS+ CA(B), RTS-	Input Input
5 13	CB(A), CTS+ CB(B), CTS-	Output Output
6 22	CC(A), DSR+ CC(B), DSR-	Output Output
1 -	Shield -	
8 10	CF(A), DCD+ CF(B), DCD-	Output Output
15 12	DB(A), TXC+ DB(B), TXC-	Output Output
17 9	DD(A), RXC+ DD(B), RXC-	Output Output
18 7	LL Circuit Ground	Input -
20 23	CD(A), DTR+ CD(B), DTR-	Input Input
24 11	DA(A), TXCE+ DA(B), TXCE-	Input Input
25	TM, not used	Input

Cable WAN connectors

Cisco LFH-60 cable name	WAN connector	Connector gender	Label on WAN end
232FC	DB-25	female	'to DTE'
232MT	DB-25	male	'to DCE'
449FC	DB-37	female	'to DTE'
449MT	DB-37	male	'to DCE'
V35FC	M34	female	'to DTE'
V35MT	M34	male	'to DCE'
X21FC	DB-15	female	'to DTE'
X21MT	DB-15	male	'to DCE'
530FC	DB-25	female	'to DTE'
530MT	DB-25	male	'to DCE'

QV24 Interface connections

Pin number	Pin function	Direction	TIA-568A wire colour
1	RTS	Input	Green / white
2	DTR	Input	Green
3	TXD	Input	Orange / white
4	Ground		Blue
5	DCD / Ground	Input	Blue / white
6	RXD	Output	Orange
7	DSR	Output	Brown / white
8	CTS	Output	Brown

RJ-45 connector LED indicators		
LED	Status	Explanation
Green	On / flashing	Transmit data
Yellow	On / flashing	Receive data

16. Alarm types and sources

Alarm types

Note: If you need to contact customer support about any of these alarms, please supply the reference number.

Transmitter alarms

Ref	Type	Explanation
A1	txADCChZeroHi	The transmitter AGC voltage is high
A2	txADCChZeroLo	The transmitter AGC voltage is low
A3	txADCChOneHi	The transmitter Forward Power Monitor reading is high
A4	txADCChOneLo	The transmitter Forward Power Monitor reading is low
A5	txADCChTwoHi	The transmitter Reverse Power Monitor reading is high
A6	txADCChTwoLo	The transmitter Reverse Power Monitor reading is low
A7	txADCChThreeHi	The transmitter temperature is greater than 75°C and the transmitter has shut down
A8	txADCChElevenHi	The transmitter temperature is greater than 70°C.
A9	txADCChFourHi	The transmitter synthesizer tuning voltage is high
A10	txADCChFourLo	The transmitter synthesizer tuning voltage is low
A11	txADCChSevenHi	The transmitter digital 5 VDC power supply voltage is high
A12	txADCChSevenLo	The transmitter digital 5 VDC power supply voltage is low
A13	txADCChEightHi	The transmitter reference 7 VDC power supply voltage is high
A14	txADCChEightLo	The transmitter reference 7 VDC power supply voltage is low
A15	txADCChNineHi	The transmitter 9 VDC power supply voltage is high
A16	txADCChNineLo	The transmitter 9 VDC power supply voltage is low
A17	txADCChSixHi	The transmitter 11 VDC power supply voltage is high
A18	txADCChSixLo	The transmitter 11 VDC power supply voltage is low
A19	txADCChFiveHi	The transmitter 28 VDC power supply voltage is high
A20	txADCChFiveLo	The transmitter 28 VDC power supply voltage is low
A21	txSynthLD	The transmitter synthesizer frequency is not set
A22	tx5VFail	The transmitter 5 VDC power supply has failed
A23	tx11VFail	The transmitter 11 VDC power supply has failed
A24	tx28VFail	The transmitter 28 VDC power supply has failed
A25	txEEFail	The transmitter on-board memory has failed
A26	txTSensorFail	The transmitter temperature sensor has failed
A27	txReturnLoss	The transmitter return loss is high
A28	txAmplifierBalance	One side of the transmitter amplifier has failed
A29	txMibFail	The transmitter MIB is corrupt in EEPROM
A30	txADCChSixHi	The transmitter VCO voltage is high
A31	txADCChSixLo	The transmitter VCO voltage is low
A32	txADCChEightHi	The transmitter digital -5 VDC power supply voltage is high
A33	txADCChEightLo	The transmitter digital -5 VDC power supply voltage is low

Receiver alarms

Ref	Type	Explanation
B1	rxADCChEightHi	The AGC voltage is high
B2	rxADCChEightLo	The AGC voltage is low
B3	rxRSSIHi	The receiver maximum input level has been exceeded
B4	rxRSSILo	The RSSI is below the alarm threshold setting (see page 73)
B5	rxADCChSixHi	The synthesizer tuning voltage is high
B6	rxADCChSixLo	The synthesizer tuning voltage is low
B7	rxADCChSevenHi	The -1.5 VDC power supply is high
B8	rxADCChSevenLo	The -1.5 VDC power supply is low
B9	rxADCChTwoHi	The 3.3 VDC power supply is high
B10	rxADCChTwoLo	The 3.3 VDC power supply is low
B11	rxADCChOneHi	The digital 5 VDC power supply voltage is high
B12	rxADCChOneLo	The digital 5 VDC power supply voltage is low
B13	rxADCChZeroHi	The 9 VDC power supply voltage is high
B14	rxADCChZeroLo	The 9 VDC power supply voltage is low
B15	rx12VFail	The 12 VDC power supply has failed
B16	rxSynthLD	The synthesizer frequency is not set
B17	rxEEFail	The on-board memory has failed
B18	rxADCChNineHi	The 28 VDC power supply voltage is high
B19	rxADCChNineLo	The 28 VDC power supply voltage is low
B20	rxOff	The receiver is off
B21	rxADCChFiveHi	The receiver temperature is too high
B22	rxMibFail	The receiver MIB is corrupt in EEPROM

MUX alarms

Ref	Type	Explanation
C1	muxInit	A MUX card failed to program
C2	muxMibEEFail	The MIB EEROM is corrupt
C3	muxCharEEFail	The character data is corrupt

Modem alarms

Ref	Type	Explanation
D1	mdLOS	The modem has loss of synchronization with the far end
D2	mdDemodAlignmentLost	The modem is unable to synchronize to the payload framing
D3	mdTdmAlignmentLost	The modem is unable to synchronize to the system bus timing
D4	mdRefAFail	The modem reference clock A has failed
D5	mdRefBFail	The modem reference clock B has failed
D6	mdClkSyncFail	The modem is unable to synchronize to the system clock
D7	mdEEFail	The modem EEPROM is corrupt

Motherboard alarms

Ref	Type	Explanation
E1	mbFan1Fail	Fan 1 failure
E2	mbFan2Fail	Fan 2 failure
E3	mbCardMismatch	The expected interface card is different to the card that is fitted
E4	mbHwHsc	A MUX card has an unsupported HSC number

QJET alarms

Ref	Type	Explanation
F1	e1AIS	The E1 interface RX input has received an Alarm Indication Signal from the downstream equipment.
F2	e1RAI	The E1 interface interface RX input has received a Remote Alarm Indication alarm (RAI) from the downstream equipment. A remote alarm indicator signal is sent from the downstream equipment when it has an active LOS or LOF alarm.
F3	e1LOS	The E1 interface Loss Of Signal alarm (LOS)
F4	e1CRC4	The E1 interface Cyclic Redundancy Check 4 alarm indicates a loss of or corrupted CRC data.
F5	e1LOF	The E1 interface Loss Of Frame alignment (LOF)
F6	e1RMAI	The E1 interface interface RX input has received an RMAI from the downstream equipment. A TS16 remote alarm indicator signal is sent from the downstream equipment when it has an active TS16 LOS or LOF alarm.
F7	e1TS16AIS	The E1 interface RX input has received a TS16 Alarm Indication Signal from the downstream equipment.
F8	e1TS16LOS	The E1 timeslot 16 Loss Of Signal alarm
F9	t1AIS	The T1 interface RX input has received an Alarm Indication Signal from the downstream equipment (AIS Received alarm)
F10	t1RAI	The T1 interface interface RX input has received a Remote Alarm Indication alarm (RAI) from the downstream equipment.
F11	t1LOS	The T1 interface Loss Of Signal alarm (LOS)
F12	t1LOF	The T1 interface Loss Of Frame alignment (LOF)

DFXO alarms

Ref	Type	Explanation
G1	fxoCodecOvld	Codec receive signal overload detected
G2	fxoBillToneOvld	Billing tone overload detected
G3	fxoUnplug	Exchange line unplugged from interface
G4	fxoCurrentOvld	Loop current overload detected (greater than 100 mA)

DFXS alarms

Ref	Type	Explanation
H1	fxsCalibError	The phone was off-hook during the initialization phase
H2	fxsDCDCError	DC-DC converter low battery voltage error
H3	fxsCasLock	Loss of CAS lock

HSS alarms

Ref	Type	Explanation
J1	hssLoss	Loss of control pattern
J2	hssRxFifoFull	HSS RX FIFO overrun
J3	hssRxFifoEmpty	HSS RX FIFO underrun
J4	hssTxFifoFull	HSS TX FIFO overrun
J5	hssTxFifoEmpty	HSS TX FIFO underrun
J6	hssRxClockInvalid	The RX clock is invalid
J7	hssTxClockInvalid	The TX clock is invalid

QV24 alarms

Ref	Type	Explanation
K1	v24CtrlLineLoss	The V.24 control lines are not in sync

External alarm inputs

Ref	Type	Explanation
L1	externalAlarm1	There has been an alarm on external alarm input 1
L2	externalAlarm2	There has been an alarm on external alarm input 2

Remote terminal alarms

Ref	Type	Explanation
M1	remoteMajorAlarm	There has been a major alarm on the remote terminal
M2	remoteMinorAlarm	There has been a minor alarm on the remote terminal

Cross connect alarms

Ref	Type	Explanation
N1	ccNoBandwidth	There is insufficient bandwidth for the current cross connection configuration

MHSB alarms

Ref	Type	Explanation
P1	mhsbSwitchToStandby	The terminal has switched from active to standby

17. Country specific settings

The following table shows the country-specific settings for the DFXO / DFXS interface cards. If the country you want is not listed, contact the local telephone company for assistance.

Country	DFXO / DFXS Termination / balance impedance	DFXO loop current limiter	DFXO on-hook speed	DFXO ringing impedance	DFXO ringing detection threshold
Argentina	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Australia	TN12 220Ω + (820Ω ‖ 120nF)	On	26 ms	> 10 MΩ	16 Vrms
Austria	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Bahrain	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Belgium	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Brazil	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Bulgaria	220Ω + (820Ω ‖ 120nF)	On	3 ms	> 10 MΩ	16 Vrms
Canada	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Chile	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
China	600Ω and China 200Ω + (680Ω ‖ 100nF)	On	< 500 µs	> 10 MΩ	16 Vrms
Colombia	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Croatia	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Cyprus	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Czech Republic	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Denmark	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Ecuador	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Egypt	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
El Salvador	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Finland	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
France	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Germany	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Greece	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Guam	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Hong Kong	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Hungary	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Iceland	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
India	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Indonesia	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Ireland	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Israel	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Italy	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Japan	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Jordan	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Kazakhstan	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Kuwait	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Latvia	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Lebanon	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Luxembourg	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms

Macao	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Malaysia	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Malta	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Mexico	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Morocco	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Netherlands	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
New Zealand	BT3 (370Ω + (620Ω ‖ 310nF))	On	< 500 µs	> 10 MΩ	16 Vrms
Nigeria	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Norway	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Oman	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Pakistan	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Peru	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Philippines	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Poland	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Portugal	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Romania	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Russia	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Saudi Arabia	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Singapore	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Slovakia	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Slovenia	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
South Africa	TBR21 270Ω + (750Ω ‖ 150nF)	On	< 500 µs	30 kΩ	16 Vrms
South Korea	600Ω	On	< 500 µs	30 kΩ	16 Vrms
Spain	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Sweden	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Switzerland	TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
Taiwan	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Thailand	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
UAE	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
UK	BT Network 320Ω + (1050Ω ‖ 230nF) and TBR21 270Ω + (750Ω ‖ 150nF)	On	3 ms	> 10 MΩ	16 Vrms
USA	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms
Yemen	600Ω	On	< 500 µs	> 10 MΩ	16 Vrms

18. Specifications

RF specifications

Frequency Bands ETSI [R1]	Frequency Band	Frequency Band Limits	Synthesizer Step Size
	300 MHz band	330 - 400 MHz	6.25 kHz
	400 MHz band	400 - 470 MHz	6.25 kHz
	600 MHz band	620 - 715 MHz	12.5 kHz
	700 MHz band	698 - 806 MHz	25 kHz
	800 MHz band	805 - 890 MHz	25 kHz
	900 MHz band	850 - 960 MHz	25 kHz
	1400 MHz band	1350 - 1550 MHz	12.5 kHz
	2000 MHz band	1900 - 2300 MHz	62.5 kHz
	2500 MHz band	2300 - 2700 MHz	62.5 kHz

Frequency Bands FCC [R1]	Frequency Band	Frequency Band Limits	Synthesizer Step Size
	400 MHz band	330 - 512 MHz	6.25 kHz
	900 MHz band	850 - 960 MHz	25 kHz

Modulation	16 / 32 / 64 QAM and QPSK (software configurable)
Frequency stability	±3 ppm
Antenna connector	N-type female 50 Ω

Note R1 Contact 4RF for other frequency options

System performance specifications

Capacity ETSI [C2]

Channel size		QPSK	16 QAM	32 QAM	64 QAM
25 kHz [C3]	Gross		72 kbit/s	96 kbit/s	112 kbit/s
	E1		1 timeslots	1 timeslots	1 timeslots
	Wayside		8 kbit/s	32 kbit/s	48 kbit/s
50 kHz [C3]	Gross	80 kbit/s	168 kbit/s	208 kbit/s	256 kbit/s
	E1	1 timeslots	2 timeslots	3 timeslots	4 timeslots
	Wayside	16 kbit/s	40 kbit/s	16 kbit/s	0 kbit/s
75 kHz [C4]	Gross	128 kbit/s	264 kbit/s	312 kbit/s	400 kbit/s
	E1	2 timeslots	4 timeslots	4 timeslots	6 timeslots
	Wayside	0 kbit/s	8 kbit/s	56 kbit/s	16 kbit/s
150 kHz [C4]	Gross	264 kbit/s	536 kbit/s	672 kbit/s	808 kbit/s
	E1	4 timeslots	8 timeslots	10 timeslots	12 timeslots
	Wayside	8 kbit/s	24 kbit/s	32 kbit/s	40 kbit/s
200 kHz [C5]	Gross	336 kbit/s	680 kbit/s	840 kbit/s	
	E1	5 timeslots	10 timeslots	13 timeslots	
	Wayside	16 kbit/s	40 kbit/s	8 kbit/s	
250 kHz	Gross	408 kbit/s	824 kbit/s	1032 kbit/s	1240 kbit/s
	E1	6 timeslots	12 timeslots	16 timeslots	19 timeslots
	Wayside	24 kbit/s	56 kbit/s	8 kbit/s	24 kbit/s
500 kHz	Gross	792 kbit/s	1592 kbit/s	1992 kbit/s	2392 kbit/s
	E1	12 timeslots	24 timeslots	31 timeslots	1 E1
	Wayside	24 kbit/s	56 kbit/s	8 kbit/s	304 kbit/s
1 MHz	Gross	1624 kbit/s	3256 kbit/s	4072 kbit/s	4888 kbit/s
	E1	25 timeslots	1 E1	1 E1	2 E1
	Wayside	24 kbit/s	1168 kbit/s	1984 kbit/s	712 kbit/s
1.75 MHz	Gross	2872 kbit/s	5752 kbit/s	7192 kbit/s	8632 kbit/s
	E1	1 E1	2 E1	3 E1	4 E1
	Wayside	784 kbit/s	1576 kbit/s	928 kbit/s	280 kbit/s
3.5 MHz	Gross	5720 kbit/s	11448 kbit/s	14312 kbit/s	17176 kbit/s
	E1	2 E1	5 E1	6 E1	8 E1
	Wayside	1544 kbit/s	1008 kbit/s	1784 kbit/s	472 kbit/s
7 MHz [C6]	Gross	11832 kbit/s	23672 kbit/s	29592 kbit/s	35512 kbit/s
	E1	5 E1	11 E1	14 E1	17 E1
	Wayside	1392 kbit/s	704 kbit/s	360 kbit/s	16 kbit/s
14 MHz [C6]	Gross	23992 kbit/s	47992 kbit/s	59992 kbit/s	65464 kbit/s
	E1	11 E1	22 E1	28 E1	28 E1
	Wayside	1024 kbit/s	2056 kbit/s	1528 kbit/s	7000 kbit/s

Note C2 The capacities specified are for Unframed E1 and so require 2088 kbit/s to transport via the radio. The management ethernet capacity must be subtracted from the gross capacity (default 64 kbit/s).

Note C3 Available only in the 300 and 400 MHz bands.

Note C4 Available only in the 300, 400 and 1400 MHz bands.

Note C5 Available only in the 700, 800 and 900 MHz bands.

Note C6 Available only in the 2000 and 2500 MHz bands.

Capacity FCC [D1]

Channel size		QPSK	16 QAM	32 QAM	64 QAM
25 kHz[D2] (20 kHz occ bw) (part 90)	Gross		56 kbit/s	72 kbit/s	88 kbit/s
	T1		0 timeslots	1 timeslots	1 timeslots
	Wayside		56 kbit/s	8 kbit/s	24 kbit/s
100 kHz[D3] (part 101)	Gross	136 kbit/s	280 kbit/s	352 kbit/s	424 kbit/s
	T1	2 timeslots	4 timeslots	5 timeslots	6 timeslots
	Wayside	8 kbit/s	24 kbit/s	32 kbit/s	40 kbit/s
200 kHz[D4] (part 101)	Gross	312 kbit/s	632 kbit/s	792 kbit/s	
	T1	4 timeslots	9 timeslots	12 timeslots	
	Wayside	56 kbit/s	56 kbit/s	24 kbit/s	
250 kHz[D5] (part 27)	Gross	408 kbit/s	824 kbit/s	1032 kbit/s	1240 kbit/s
	T1	6 timeslots	12 timeslots	16 timeslots	19 timeslots
	Wayside	24 kbit/s	56 kbit/s	8 kbit/s	24 kbit/s
500 kHz[D5] (part 27)	Gross	792 kbit/s	1592 kbit/s	1992 kbit/s	2392 kbit/s
	T1	12 timeslots	1 T1	1 T1	1 T1
	Wayside	24 kbit/s	8 kbit/s	408 kbit/s	808 kbit/s

Note D1 The capacities specified are for Unframed T1 and so require 1584 kbit/s to transport via the radio. The management ethernet capacity must be subtracted from the gross capacity (default 64 kbit/s).

Note D2 Available only in the 400 MHz band (available in 1Q2007)

Note D3 Available only in the 900 MHz band (available in 1Q2007).

Note D4 Available only in the 900 MHz band

Note D5 Available only in the 2000 and 2500 MHz bands (available in 1Q2007)

Receiver sensitivity [R1]

Channel size	QPSK	16 QAM	32 QAM	64 QAM
25 kHz		-105 dBm	-102 dBm	-99 dBm
50 kHz	-109 dBm	-103 dBm	-100 dBm	-97 dBm
75 kHz	-107 dBm	-101 dBm	-98 dBm	-95 dBm
100 kHz	-106 dBm	-100 dBm	-97 dBm	-94 dBm
150 kHz	-104 dBm	-98 dBm	-95 dBm	-92 dBm
200 kHz	-102 dBm	-96 dBm	-93 dBm	
250 kHz	-101 dBm	-95 dBm	-92 dBm	-89 dBm
500 kHz	-99 dBm	-93 dBm	-90 dBm	-87 dBm
1 MHz	-96 dBm	-90 dBm	-87 dBm	-84 dBm
1.75 MHz	-94 dBm	-88 dBm	-85 dBm	-82 dBm
3.5 MHz	-90 dBm	-84 dBm	-81 dBm	-78 dBm
7 MHz	-87 dBm	-81 dBm	-78 dBm	-75 dBm
14 MHz	-84 dBm	-78 dBm	-75 dBm	-72 dBm

Note R1 Typical performance specified at the antenna port for 10^{-6} BER.
The receiver is typically 1 dB more sensitive for a BER of 10^{-3}.

System Gain [S1,S2]

Channel size	QPSK	16 QAM	32 QAM	64 QAM
25 kHz		136 dB	132 dB	128 dB
50 kHz	144 dB	134 dB	130 dB	126 dB
75 kHz	142 dB	132 dB	128 dB	124 dB
100 kHz	141 dB	131 dB	127 dB	123 dB
150 kHz	139 dB	129 dB	125 dB	121 dB
200 kHz	137 dB	127 dB	123 dB	
250 kHz	136 dB	126 dB	122 dB	118 dB
500 kHz	134 dB	124 dB	120 dB	116 dB
1 MHz	131 dB	121 dB	117 dB	113 dB
1.75 MHz	129 dB	119 dB	115 dB	111 dB
3.5 MHz	125 dB	115 dB	111 dB	107 dB
7 MHz	122 dB	112 dB	108 dB	104 dB
14 MHz	119 dB	109 dB	105 dB	101 dB

Note S1 Typical performance specified at the antenna port for 10^{-6} BER.
The system gain is typically 1 dB greater for a BER of 10^{-3}.
Note S2 Figures reduce by 4 dB for 32 QAM and 8 dB for 64 QAM.
Figures increase by 10 dB for QPSK (9 dB for the 2000 and 2500 MHz bands).

Note: The default Modem Interleaver Mode setting is on for channel sizes of 250 kHz and greater and off for channel sizes of 200 kHz and less (see “Modem Interleaver Mode” on page 63).

Typical end-to-end link delay (ETSI) - interleaver off [L1]

Channel size	QPSK	16 QAM	32 QAM	64 QAM
25 kHz		48.3 ms	38.7 ms	34.2 ms
50 kHz	41.8 ms	22.8 ms	19.2 ms	16.4 ms
75 kHz	34.8 ms	18.5 ms	16.2 ms	13.5 ms
100 kHz	26.2 ms	14.6 ms	12.0 ms	10.5 ms
150 kHz	17.4 ms	9.8 ms	8.2 ms	7.4 ms
200 kHz	13.6 ms	7.9 ms	6.9 ms	
250 kHz	10.8 ms	6.5 ms	5.5 ms	4.9 ms
500 kHz	5.8 ms	3.9 ms	3.4 ms	3.2 ms
1 MHz	3.67 ms	2.61 ms	2.59 ms	2.55 ms
1.75 MHz	2.93 ms	2.33 ms	2.12 ms	2.03 ms
3.5 MHz	2.40 ms	2.11 ms	2.05 ms	2.08 ms
7 MHz	2.20 ms	1.89 ms	1.77 ms	1.71 ms
14 MHz	2.08 ms	1.83 ms	1.75 ms	1.64 ms

Typical end-to-end link delay (ETSI) - interleaver on [L1]

Channel size	QPSK	16 QAM	32 QAM	64 QAM
25 kHz		163.0 ms	126.9 ms	110.8 ms
50 kHz	146.7 ms	75.4 ms	62.1 ms	51.5 ms
75 kHz	103.0 ms	52.8 ms	45.5 ms	36.4 ms
100 kHz	78.8 ms	41.1 ms	33.2 ms	28.2 ms
150 kHz	50.9 ms	26.6 ms	21.9 ms	18.9 ms
200 kHz	40.5 ms	21.5 ms	18.0 ms	
250 kHz	33.1 ms	17.7 ms	14.5 ms	12.4 ms
500 kHz	17.4 ms	9.5 ms	8.2 ms	7.1 ms
1 MHz	9.31 ms	5.50 ms	4.79 ms	4.44 ms
1.75 MHz	6.04 ms	3.87 ms	3.47 ms	3.16 ms
3.5 MHz	3.79 ms	2.84 ms	2.44 ms	2.54 ms
7 MHz	2.67 ms	2.23 ms	1.92 ms	1.86 ms
14 MHz	2.11 ms	2.01 ms	1.86 ms	1.89 ms

Note L1 The end to end link delays are measured from E1 interface to E1 interface
The delay figures are typical and can vary w hen the system re-synchronizes

Transmitter ETSI

Modulation Type	Frequency bands	Power output range (in 1 dB steps)
QPSK	300, 400, 600, 700, 800, 900 & 1400 MHz bands	+21 to +35 dBm
QPSK	2000, 2500 MHz bands	+20 to +34 dBm
16 QAM	all bands	+17 to +31 dBm
32 QAM	all bands	+16 to +30 dBm
64 QAM	all bands	+15 to +29 dBm

Transmitter FCC

Modulation Type	Frequency bands	Power output range (in 1 dB steps)
QPSK	400 MHz band	+21 to +35 dBm
QPSK	900 MHz band	+15 to +29 dBm
16 QAM	400 MHz band	+17 to +31 dBm
16 QAM	900 MHz band	+15 to +29 dBm
32 QAM	400 MHz band	+16 to +30 dBm
32 QAM	900 MHz band	+15 to +29 dBm
64 QAM	400 MHz band	+15 to +29 dBm

Receiver

Maximum input level		-20 dBm
Dynamic range [B1]		58 to 87 dB (at 10^{-6} BER) depending on modulation type and channel size
C/I ratio (carrier to interference ratio)		C/I ratio = $C_{dB} - I_{dB}$
	Co-channel	better than 16 dB at QPSK
		better than 20 dB at 16 QAM
		better than 23 dB at 32 QAM
		better than 27 dB at 64 QAM
	1st adjacent channel	better than -5 dB
	2nd adjacent channel	better than -30 dB

Note B1 Typical performance specified at the antenna port for 10^{-6} BER.
The dynamic range is typically 2 dB greater for a BER of 10^{-3}.

Duplexer ETSI [F1]

Passband	Frequency Bands	TX / RX Split
500 kHz	300, 400 MHz bands	> 5 MHz
2 MHz	300, 400 MHz bands	> 9.45 MHz
3.5 MHz	300, 400 MHz bands	> 20 MHz
7 MHz	700 MHz band	> 30 MHz
	600 MHz band	> 45 MHz
	800, 900 MHz bands	> 40 MHz
	1400 MHz band	> 48 MHz
14 MHz	2000 MHz band	> 91 MHz
	2500 MHz band	> 74 MHz

Duplexer FCC / IC [F1]

Passband	Frequency Bands	TX / RX Split
500 kHz	400 MHz band	> 3 MHz
1 MHz	900 MHz band	> 9 MHz

Note F1 Bandpass duplexer
Contact 4RF for other duplexer options

Interface specifications

Ethernet interface

General	Interface	RJ-45 * 4 (Integrated 4-port switch)
	Cabling	CAT-5 UTP, supports auto MDIX (Standard Ethernet)
	Maximum line length	100 metres on cat-5 or better
	Bandwidth allocation	n x 8 kbit/s up to max available. n x 64 kbit/s is recommended for higher bandwidth terminals □ 500 kHz, 32 QAM. Maximum is 16384 kbit/s (or limited by radio bandwidth).
	Maximum packet size	'Standard' Ethernet packets: max 1518 octets Tagged and double-tagged packets: max 1526 octets
	Data buffer size	Up to 256 frames
	Address table size	2048 IP addresses
	WAN protocol	HDLC
	Ethernet mode	10Base-T or 100Base-TX Full duplex or half duplex (Auto-negotiating and auto-sensing)
	VLAN tagging	IEEE 802.1Q VLAN tagging
	QoS	IEEE 802.1p Ipv4 TOS DiffServ Ipv6 traffic class
	Spanning Tree	Forwards 802.1D Spanning Tree Protocol packets up to 1526 bytes in length.
Diagnostics	Hardware	Green LED (solid): Link OK Green LED (flashing): Data traffic

QJET Quad E1 / T1 interface

General	Standard	G.703 and G.704
	Interface	RJ-45
	Line termination impedance	E1 120 Ω balanced T1 100 Ω balanced
	Maximum line length	E1 typically up to 1.7 km (43 dB of loss at 1024 kHz in standard 0.4 mm^2 cable). T1 typically up to 1.7 km (36 dB of loss at 772 kHz in standard 0.4 mm^2 cable).
	Bandwidth allocation	Framed E1s require a link bandwidth of 2048 kbit/s. Unframed E1s require a link bandwidth of 2088 kbit/s. Framed T1s require a link bandwidth of 1544 kbit/s. Unframed T1s require a link bandwidth of 1584 kbit/s.
	Line code	E1 HDB3 or AMI T1 B8ZS or AMI
	Tx Waveform Shaper (T1 only)	0 ~ 133 ft 133 ~ 266 ft 266 ~ 399 ft 399 ~ 533 ft 533 ~ 655 ft
	Stability	±50 ppm
	Jitter performance	G.823 (sections 2 & 3)
Diagnostics	Hardware	Green LED: Link OK Yellow LED: Loss of signal

Q4EM Quad 4 wire E&M interface

General	Audio	64 kbit/s (PCM A-Law as per ITU G.711) 32, 24 & 16 kbit/s (ADPCM as per ITU G.726 and ANSI TI.303)
	E&M signalling	8 kbit/s per port
	Maximum line length	400 metres
Analogue	Transmission performance characteristics	ITU G.712 E4 for an operating level range of -14 dBr to +4 dBr
	Input level range	-14.0 dBr to +4.0 dBr in 0.5 dB steps
	Output level range	-14.0 dBr to +4.0 dBr in 0.5 dB steps
	Default output level	0 dBr
	Default input level	0 dBr
	Maximum level	+3.14 dBm0
	Port impedance	600 Ω
	Return loss	better than 25 dB over the frequency range 200 - 3600 Hz
	Transformer isolation	3.88 kV
	End to end gain Frequency response	0 dB ± 0.1 dB (300-3000 Hz) 0 dB ± 0.5 dB (250-3400 Hz)
	Audio line protection	Secondary protection
	Signal to total distortion	> 30 dB (0 dBm0 to -30 dBm0) > 22 dB (-45 dBm0)
Signalling	E&M	Mode independent (external power supply / ground reference required)
	Pulse distortion	4:1 multiplexed < 2.250 ms Non-multiplexed ≤ 250 µs
	M loop current	5.0 to 6.5 mA (constant current)
	M detection voltage	9 VDC
	M maximum voltage	60 VDC
	E circuit impedance	45 Ω closed > 100 kΩ open
	Maximum E circuit current	100 mA
	E maximum voltage	60 V
	E&M circuit protection	E: Current limited to 120 mA, overvoltage to 350 V M: Current limited to 6.5 mA, overvoltage to 100 V
Diagnostics	Hardware	Green LED: M circuit active Yellow LED: E circuit active

DFXO Dual foreign exchange office interface

General	Audio	64 kbit/s (PCM as per ITU G.711) 32, 24 and 16 kbit/s (ADPCM as per ITU G.726 and ANSI TI.303)
	Signalling allocation	8 or 32 kbit/s allocated for CAS
	Companding	A-Law or µ-Law
	Maximum line length	600 metres (2000 feet) on 0.4 mm / 26 AWG copper pair
	Calling line ID (CLI)	Support provided for ETSI: EN 300 659-1 & 2 and BT: SIN 227 and 242
	Fax	Conforms to G3 standard for 64 kbit/s PCM and 32 kbit/s ADPCM compression
Analogue	Transmission performance characteristics	ITU G.712 E2 for an operating level range of -6 dBr to +1 dBr
	Input level range	-10 dBr to +1.0 dBr in 0.5 dB steps
	Output level range	-10 dBr to +1.0 dBr in 0.5 dB steps
	Default Input level	-4.0 dBr
	Default Output level	-1.0 dBr
	Maximum level	+3.14 dBm0
	Line impedance / Hybrid balance impedance options	600 Ω 900 Ω 600 Ω + 2.16 µF 900 Ω + 2.16 µF 270 Ω + 750 Ω || 150 nF (TBR-21) 220 Ω + 820 Ω || 120 nF (TN12) 370 Ω + 620 Ω || 310 nF (BT3) 320 Ω + 1050 Ω || 210 nF (BT Network) 200 Ω + 680 Ω || 100 nF (China)
	Return Loss	better than 20 dB over the frequency range 200 - 3600 Hz
	Trans hybrid loss	better than 30 dB between 300 - 3400 Hz (with matched external line and hybrid balance impedance)
	Common mode rejection ratio	better than 40 dB over the frequency range 50 - 3600 Hz
	Echo Canceller	provides up to 64 ms of echo cancellation

Signalling	Pulse dialing	Transparent decadic signalling at 7 - 14 PPS with break period limits of 60 - 73 %
	Pulse distortion	4:1 multiplexed < 2.250 ms Non-multiplexed ≤ 250 µs
	Reversals	Line polarity reversal detection
	Metering level sensitivity	12 kHz / 16 kHz billing tone detection with a selectable level sensitivity of -17dBm to -40 dBm in 1dB steps into 200 Ω (60 mV rms to 5 mV rms into 200 Ω).
	Metering level maximum	The maximum level of metering signal the DFXO can tolerate without voice band interference is 0.8 Vrms into 200 Ω.
	Loop resistance on-hook	>1 MΩ
	Ringing detection threshold	Options of 16 Vrms, 26 Vrms or 49 Vrms
	Ringing detection frequency	15 to 50 Hz sine wave
	Ringing input impedance	Option of >10 MΩ or 30kΩ
	Ringing DC offset range tolerance	0 to -75VDC
	Ringing input voltage maximum	up to 100 Vrms
Physical	Physical interface	Dual RJ-45 per port (1 line port, 1 monitor port)
Diagnostics	Green LED	On: Normal operation Solid: Off-hook Flashing: Ringing
	Yellow LED	On: Alarm Flashing: Loopback

DFXS Dual foreign exchange subscriber interface

General	Audio	64 kbit/s (PCM as per ITU G.711) 32, 24 and 16 kbit/s (ADPCM as per ITU G.726 and ANSI TI.303)
	Signalling Allocation	8-32 kbit/s allocated for CAS
	Compression coding	A-Law or µ-Law
	Maximum line length	600 metres (2000 feet) on 0.4 mm / 26 AWG copper pair
	Calling line ID (CLI)	Support provided for ETSI: EN 300 659-1 & 2 and BT: SIN 227 and 242
	Fax	Conforms to G3 standard for 64 kbit/s PCM and 32 kbit/s ADPCM compression
Analogue	Transmission performance characteristics	ITU G.712 E2 for an operating level range of -6 dBr to +2.5 dBr
	Input level range	-9.0 dBr to +3.0 dBr in 0.5 dB steps
	Output level range	-9.5 dBr to +2.5 dBr in 0.5 dB steps
	Default Input level	+1.0 dBr
	Default Output level	-6.0 dBr
	Maximum level	+3.14 dBm0
	Line impedance / Hybrid balance impedance options	600 Ω 900 Ω 600 Ω + 2.16 µF 900 Ω + 2.16 µF 220 Ω + (820 Ω || 120 nF) (TN12) 270 Ω + (750 Ω || 150 nF) (TBR21) 370 Ω + (620 Ω || 310 nF) (BT3)
	Return Loss	better than 20 dB over the frequency range 200 - 3600 Hz
	Trans hybrid loss	better than 30 dB between 300 - 3400 Hz (with matched external line and hybrid balance impedance)
	Common mode rejection ratio	better than 40 dB over the frequency range 50 - 3600 Hz

Signalling	Feed voltage output	-48 V (160 + 160 Ω voltage source current limited)
	Loop current limit	35 mA
	Seize signal	Loop start only (no ground start)
	Loop detect threshold	10 - 12 mA (step function between on hook and off hook)
	Non loop current	4 - 6 mA (step function between on hook and off hook)
	Pulse dialing	Transparent decadic signalling at 7 - 14 PPS with break period limits of 60 - 73 % (with loop current > 23 mA)
	Pulse distortion	4:1 multiplexed < 2.250 ms Non-multiplexed ≤ 250 µs
	Reversals output	Line polarity reversal output (optional)
	Metering output voltage	12 kHz / 16 kHz billing tone generation with four selectable output voltages of 100 mV, 200 mV, 300 mV and 400 mV rms into 200 Ω sourced via the Line Impedance setting but limited to a maximum open circuit voltage of 1 Vrms.
	Ringer waveform	Sinusoidal with a maximum total distortion of 10% (into 3 REN load)
	Ringer voltage (open circuit)	Five selectable ringer output voltages sourced via an internal ringing resistance of 178 Ω per port. The ringing output is a composite balanced AC ringing voltage with a differential DC offset voltage. 60 Vrms + 0 VDC 55 Vrms + 10 VDC 50 Vrms + 18 VDC 45 Vrms + 22 VDC 40 Vrms + 24 VDC
	Ringer frequency output	Options of 17, 25 or 50 Hz ±5%
	Ringer power output	60 Vrms source into a load of 2 REN 45 Vrms source into a load of 3 REN (1 REN ≈ 6930 Ω in series with 8 µF)
	Ring Trip	Ring Trip will ocurr in < 150 ms following DC loop of > 15 mA
	Ring Trip Immunity	Ring Trip will not ocurr if the DFXS outputs ringing into a load of 500 Ω in series with 4.4µF or less.
Physical	Physical interface	Dual RJ-45 per port (1 line port, 1 monitor port)
	Line protection	Secondary protection (4RF recommends the use of external primary protection in lightning prone areas)
Diagnostics	Green Led	Green LED On: Normal operation Solid: Off-hook Flashing: Ringing
	Yellow LED	On: Alarm Flashing: Loopback

QV24 Quad V.24 asynchronous data interface

General	Interface	ITU-T V.24/EIA/TIA RS-232E
	Bandwidth allocation	8-120 kbit/s in 8 kbit/s steps (dependent on rate selected)
	Control line allocation	8 kbit/s
	Maximum line length	10 metres
	Data clamp	Mark hold when out of sync.
	Control line clamp	Off when loss of sync.
	Clock	Internally generated from 2.048 MHz system clock (synchronized at both ends)
Async parameters	Transparent mode	Operation is completely transparent but limited to 0-600 bit/s
	Standard mode data bits	7,8
	Standard mode parity	Transparent (enable / disable)
	Standard mode stop bits	1,2
	Data rates (bit/s)	300, 600, 1200, 2400, 4800, 7200, 9600, 12800, 14400, 19200, 23040, 28800, 38400, 57600 and 115200
Control signals	End-to-end	CTS-RTS, DSR-DTR
Diagnostics	Green LED	RD data traffic
	Yellow LED	TD data traffic

HSS Single high speed synchronous data interface

General	Interfaces	ITU-T V.24 EIA/TIA RS-232E ITU-T V.35 ITU-T V.36 EIA/TIA RS-449 ITU-T X.21 EIA/TIA 530
	Bandwidth allocation	8-2048 kbit/s in 8 kbit/s steps (dependent on rate selected) 8 kbit/s for control lines
	Maximum line length	3 metres
	Clock	Internally generated from 2.048 MHz system clock (synchronized at both ends) on DCE to DCE mode. Clock provided by external DCE when in DTE mode. Remote DCE outputs clock-timed by incoming clock at DTE.
Diagnostics	Top Green LED	On: Normal operation Flashing: Loopback
	Lower Green LED	On: Normal operation

External alarm interfaces

Alarm inputs	Detector type	Isolated current detectors
	Detection current	5.0 to 6.5 mA (constant current)
	Detection voltage	9 to 60 VDC or AC rms
Alarm outputs	Contact type	Isolated semiconductor relay type contacts
	Maximum current	100 mA
	Maximum voltage	0 to 60 VDC or AC rms
	Ouput impedance	45 Ω closed > 100 kΩ open
Overall	Latency	The latency for an alarm presented on an external alarm input to the alarm being output on an external alarm output is < 2 seconds

Auxiliary interfaces

Management	Configuration and management	Embedded web server and / or SNMP accessed via Ethernet interface or across link
Test points	RSSI	Front panel test point for measuring the RSSI voltage

Power specifications

AC Power supply

Nominal voltage	Input voltage range	Power consumption	Max VA	Frequency
115 VAC	103 - 127 Vrms	63 - 180 W	400 VA	47 - 63 Hz
230 VAC	207 - 254 Vrms	63 - 180 W	400 VA	47 - 63 Hz

DC Power supply

Nominal voltage	Input voltage range	Power consumption	Maximum input current
±12 VDC	10.5 to 18 VDC	63 - 180 W	18 A
±24 VDC	20.5 to 30 VDC	63 - 180 W	8 A
±48 VDC	40 to 60 VDC	63 - 180 W	4 A

Power consumption

Power Consumption (min – max)	63 - 180 W Input power (dependent on interface cards fitted and modulation type / output power level)
Terminal only:	
QPSK + 19 dBm	65 W
QPSK + 29 dBm	68 W
QPSK + 32 dBm	72 W
QPSK + 35 dBm	75 W
64 QAM + 15 dBm	63 W
64 QAM + 29 dBm	71 W
Interface cards:	
QJET four port E1 card	1.9 W (all states)
Q4EM four port 4W E&M card	0.75 W (all states)
QV24 four port V.24 card	0.75 - 1 W (all states)
DFXO two port 2W FXO card	0.75 W (all states)
DFXS two port 2W FXS card	One DFXS card installed with both ports idle (on hook): 3.8 W Plus: 1.3 W / line off-hook (200 ohm copper loop plus 450 ohm telephone) 2.6 W / line ringing (60 Vrms 25Hz source via 50 ohm copper loop into a 1 REN load) 4.1 W / line ringing (45 Vrms 25Hz source via 50 ohm copper loop into a 3 REN load)
HSS single port high speed data	1 W (all states)
MHSB:	
Tributary and RF switch	16 W not switched
	28 W switched

MHSB specifications

MHSB protection

RF switch	TX relay loss	≈ 1.5 dB
	Splitter loss	≈ 3.5 dB
	Switching time	< 25 ms seconds from detection of alarm condition
	RF path restore time	< 10 seconds
Tributary switch	Ports	8

General specifications

Environmental

Operating range	-10 to +50˚ C
Storage range	-20 to +70˚ C
Humidity	Maximum 95% non-condensing
Altitude	Up to 5000 metres

Mechanical

19-inch rack mount	2 U high (internal duplexer) 3 U high (external duplexer)
Width	434 mm (without mounting brackets attached) 483 mm (with mounting brackets attached)
Height	88 mm
Depth	372 mm
Colour	Pure black
Weight	≈ 8 kg (per terminal)

ETSI performance

Radio	EN 301 751, EN 300 630 EN 302 217 Parts 1, 2.1, and 2.2
EMI/EMC	EN 301 489 Parts 1 & 4
Safety	EN 60950
Environmental	ETS 300 019 Class 3.2

19. Product end of life

End-of-life recycling programme (WEEE)

The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly.

4RF Communications has implemented an end-of-life recycling programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive (EU Waste Electrical and Electronic Equipment 2002/96/EC).

The WEEE symbol explained

This symbol appears on Electrical and Electronic Equipment (EEE) as part of the WEEE (Waste EEE) directive. It means that the EEE may contain hazardous substances and must not be thrown away with municipal or other waste.

WEEE must be collected separately

You must not dispose of electrical and electronic waste with municipal and other waste. You must separate it from other waste and recycling so that it can be easily collected by the proper regional WEEE collection system in your area.

Return and collection programmes in your area

Contact your local or regional authority for information about the return and collection programmes available in your area.

Your role in the recovery of WEEE

By separately collecting and properly disposing of WEEE, you are helping to reduce the amount of WEEE that enters the waste stream.

One of the aims of the WEEE directive is to divert EEE away from landfill and encourage recycling. Recycling EEE means that valuable resources such as metals and other materials (which require energy to source and manufacture) are not wasted. Also, the pollution associated with accessing new materials and manufacturing new products is reduced.

EEE waste impacts the environment and health

Electrical and electronic equipment (EEE) contains hazardous substances which have potential effects on the environment and human health. If you want environmental information on the Aprisa XE terminal, contact us (on page 15).

20. Abbreviations

ADC	Analogue to Digital Converter
ADPCM	Adaptive Differential Pulse Code Modulation
ADSL	Asymmetrical Digital Subscriber Line
AGC	Automatic Gain Control
AMP	Amplifier
BER	Bit Error Rate
CAS	Channel Associated Signalling
CPE	Customer Premises Equipment
CLI	Calling Line Identification
DAC	Digital to Analogue Converter
dB	Decibels
dBc	Decibels relative to carrier power
dBm	Decibels relative to 1 mW
dBr	Decibels relative to the tramsmission reference point
DCE	Data Communications Equipment
DS0	Digital Signal 0 - 64 kbit/s Timeslot
DTE	Data Terminal Equipment
DTI	Digital Trunk Interface
E&M	Ear and Mouth
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
ESD	Electro-Static Discharge
ETSI	European Telecommunications Standards Institute
FAS	Frame Alignment Signal (E1 frame)
FEC	Forward Error Correction
FFE	Feed Forward Equalizer
F/W	Firmware
FXO	Foreign Exchange Office
FXS	Foreign Exchange Subscriber
GSM	Global System for Mobile communications
HSC	Hardware Software Compatibility
HSS	High-Speed Synchronous Serial
H/W	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IP	Internet Protocol
I/O	Input/Output
ISP	Internet Service Provider
kbit/s	Kilobits per second
kHz	Kilohertz
LAN	Local Area Network
LED	Light Emitting Diode
LOS	Loss of Signal
mA	Milliamps
MAC	Media Access Control
Mbit/s	Megabits per second
MHSB	Monitored Hot Standby
MHz	Megahertz
MIB	Management Information Base
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
ms	milliseconds
NFAS	Not Frame Alignment Signal (E1 frame)
NMS	Network Management System
OSI	Open Systems Interconnection
PABX	Private Automatic Branch Exchange
PBX	Private Branch Exchange
PC	Personal Computer
PCM	Pulse Code Modulation
PCA	Printed Circuit Assembly
PLL	Phase Locked Loop
POP	Point of Presence
POTS	Plain Old Telephone Service
ppm	Parts Per Million
PSTN	Public Switched Telephone Network
PMR	Public Mobile Radio
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAI	Remote Alarm Indicator
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RSSI	Received Signal Strength Indication
RX	Receiver
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
SWR	Standing Wave Ratio
TCP/IP	Transmission Control Protocol/Internet Protocol
TCXO	Temperature Compensated Crystal Oscillator
TETRA	Terrestrial Trunk Radio
TFTP	Trivial File Transfer Protocol
TMR	Trunk Mobile Radio
TX	Transmitter
UTP	Unshielded Twisted Pair
VCO	Voltage Controlled Oscillator
VDC	Volts DC
VoIP	Voice over Internet Protocol
WEEE	Waste Electrical and Electronic Equipment

21. Acknowledgments and licensing

The Aprisa XE product software runs the GNU Linux Operating System and incorporates several other packages in accordance with the free software philosophy.

The following list identifies the licensed software used:

BusyBox

Description: Tiny versions of common UNIX utilities

Reference: http://busybox.net/

License Type: GNU General Public License (GPL)

DropBear SSH Server

Description: Small and secure SSH Server

Reference: http://matt.ucc.asn.au/dropbear/

License Type: MIT Style License

GoAhead WebServer 2.1

Description: Embedded Web Server

Reference: http://webserver.goahead.com/

License Type: Private License

Linux Kernel

Description: Linux Kernel version 2.4.26

Reference: http://www.kernel.org/

License Type: GNU General Public License (GPL)

Net-SNMP

Description: Various tools relating to SNMP

Reference: http://www.net-snmp.org/

License Type: CMU/UCD and BSD License

uClibc

Description: C library for embedded Linux systems

Reference: http://uclibc.org/

License Type: GNU Lesser General Public License (LGPL)

U-Boot

Description: Bootloader

Reference: http://u-boot.sourceforge.net/

License Type: GNU General Public License (GPL)

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Dropbear SSH Server (MIT License)

Dropbear—a SSH2 server

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Net-SNMP

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Part 2: Networks Associates Technology, Inc. (BSD)

Part 3: Cambridge Broadband Ltd (BSD)

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GoAhead WebServer (Private License)

GoAhead WebServer

22. Commissioning Forms

APRISA XE COMMISSIONING FORM

Site name		
Terminal name		
IP address	A:	B:
Serial number	A:	B:
Installation date		
Channel spacing		

Remote site name		
Remote terminal name		
Remote IP address	A:	B:

RX frequency	
TX frequency	
TX power	
Modulation	
RSSI	
Fade margin	
SNR	
BER	period

Cross-connection configuration file saved	☐

Notes

Name
Signature
Date

APRISA XE COMMISSIONING FORM

Site name		
Terminal name		
IP address	A:	B:
Serial number	A:	B:
Installation date		
Channel spacing		

Remote site name		
Remote terminal name		
Remote IP address	A:	B:

RX frequency	
TX frequency	
TX power	
Modulation	
RSSI	
Fade margin	
SNR	
BER	period

Cross-connection configuration file saved	☐

Notes

Name
Signature
Date

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