Contents

1 Introduction

This manual covers the theory of operation and installation of the Freeway RS422 router card. The addition of this module to the Freeway product range gives considerable flexibility to new and existing router systems, giving the ability to route control signals with the associated video and audio signals within a single matrix frame. The Freeway RS422 router improves upon the conventional RS422 router design by using configurable ports, rather than fixed destination and source connections; either controller or machine type hardware may be connected to any port, which will configure itself according to the route made. This concept is further extended to allow 'distributive' routing, so that a single controller can control several machines, such a configuration is called a Broadcast Router.

The RS422 router card supports 32 ports, and allows expansion, using a further three cards, to 128 ports, within a single Freeway frame. Details of the RS422 router configuration and methods of control are held in the Freeway control card database, which must contain data on any other routers within the Freeway system. Details on configuring this database via the Windows based editor are contained in the Freeway Editor Users Guide.

■ 1.1 RS422 signal routing

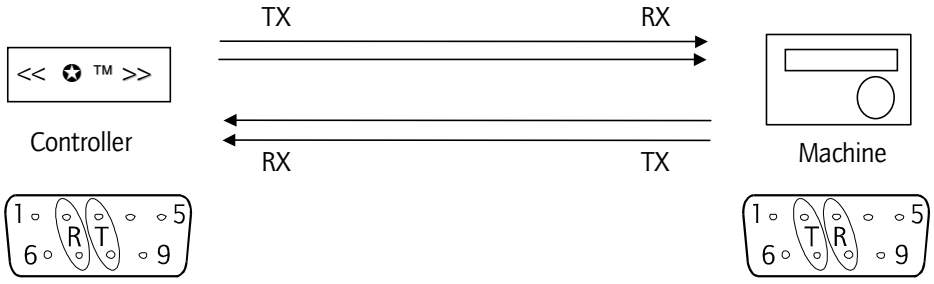
RS422 is the name given to a type of digital control signal used extensively in broadcasting and post production environments. Typical uses of RS422 signals are for machine control, such as for VTRs and Video Servers; and for connecting hardware such as router control panels, Under Monitor Displays or computer serial ports. The signal consists of data travelling in two directions ('bi-directional'), and each signal is balanced on two wires, to enable transmission over long distances without interference.

RS422 control signals are bi-directional in order to allow commands from a controller to be acknowledged by the device under control. Controllers rely on these responses to confirm that a command has been received, or to report failures or errors.

A signal type known as RS485, or Multidrop, can also be routed, this is particular type of RS422, which is capable of addressing up to sixteen independent pieces of hardware 'daisy chained' onto one cable; this format is used extensively by Pro-Bel for connecting control panels and UMDs.

If used for controlling Pro-Bel panels and UMD's, all daisy chained devices must be connected to one port and the controller to another.

The terms Controller and Machine are used to determine which wires are used to receive (RX) and transmit (TX) signals. RS422 connections usually use 9 pin D type connectors, as follows:



Note: The drawing above refers to the pinout of the connectors with respect to the controller /machine.

The Freeway RS422 router has two modes of operation, Distributive (Broadcast) and Non-Distributive (1 to 1), and being a port based router these need to be thought of from two different perspectives, cabling and control.

As far as cabling is concerned when a device is connected to the router the same cable connections are used for both modes whether it is a contoller or a machine. The software within the Freeway router will dynamically configure the ports depending on how the devices are being used.

From a control point of view the router needs to be considered as sources and destinations.

When working in Distributive (Broadcast) mode, controllers are treated as sources and machines are treated as destinations.

The way a device is selected on a control panel (i.e. as a source or as a destination) will determine how its port is configured. If a device can be a controller or a machine then it needs to be entered as a source and a destination in the system database and depending on how it is selected will determine how its port is configured.

■ 1.2 Parking

It is a necessity that the ports on an RS422 router can be 'parked', i.e. not routed to anything. To achieve this, RS422 routers have what is known as a Park Source, which can be selected by a router control panel in order to disconnect a controller from a machine. This is not a true source, and is allocated a source number one greater than the maximum physical number of sources available within the router, which the controller will interpret as the Park Source.

■ 1.3 Manual and Auto Parking

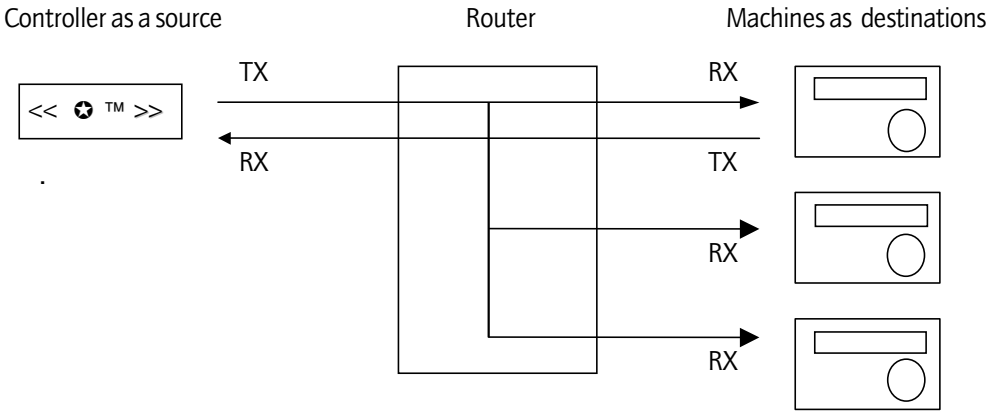
RS422 router control software also allows for two types of parking, Manual Parking and Automatic Parking. This is configured in the Freeway database and controls the way in which routes can be changed. Auto Parking allows routes to be freely changed, between controllers, machines, or to be parked, effectively allowing any user to move routes. Manual Parking adds security to the system by only permitting the connection of controllers or machines that are disconnected, or parked, thereby requiring that users must disconnect routes before either controller or machine can be re-routed.

■ 1.4 The RS422 Broadcast Router

Distributive operation

Audio and Video routers are able to route one Source to many Destinations, this is known as Distributive, or Broadcast operation. Such routing is not usually permissible with RS422 signals which are 'point to point' in nature, it makes no operational sense to connect many controllers to one machine, and it is also electrically compromising. Point to point operation of RS422 routers is usually governed by the controlling software, and is often known as 'non-distributive'. However, it is possible to permit distributive routing of RS422 signals within the Freeway system by selecting this mode within the database. In this condition, controllers are treated as if they are sources, and consequently a single controller may communicate with several machines. In such a situation it must be ensured that the data flow is not electrically contentious, i.e. data may be sent to all machines, but must only receive it from one. The Freeway RS422 router allows this mode of operation in an option called RS422 Broadcast Router.

Operationally, it is the first route made between a machine and a controller that connects all four wires, and thereby provides the necessary responses. All subsequent machines connected to the controller will only connect two wires such that they receive commands but have no response connection:



Rules for using the RS422 Broadcast Router

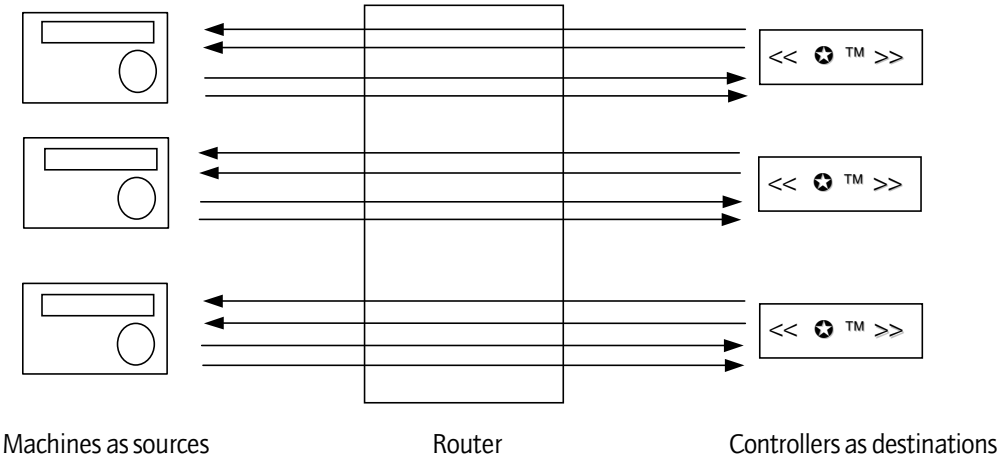
The user must consider the following rules of operation when making connections through the broadcast router:

- ports selected as a source will be configured as a controller
- ports selected as a destination will be configured as a machine
- a park source must be defined in the database (see 1.2 Parking)
- to free a controller, all machines connected must be parkedthe crosspoint set between a parked controller and a parked machine will be bi-directional
- adding a machine to a routed controller will only connect the machine RX driver
- in manual park mode, only parked controllers and machines can be routed
- in auto park mode, a routed controller may be re-routed, and will park all machines already connected
- in auto park mode, a machine re-routed from one controller to another will clear the route with the first controller
- parking a machine with a bi-directional link to a controller will park all machines using the controller and free the controller

- a level configured as a broadcast router cannot be associated (married to) other level types within the system database. Special source/destination associations need to be set up so that the broadcast level types can be controlled independently from other level types
- when a bi-directional route isprotected /unprotected, both the controller and the machine are protected/unprotected
- when a listen only route is protected/unprotected only the machine is protected/unprotected
- when a bi-directional route is protected/unproteced there is no automatic protect/unprotect of listen only machines using the same controller
- when a listen only route is protected/unprotected there is no automatic protect/unprotect of the bi-directional and listen only routes using the same controller
- when attempting to make/clear a bi-directional route both the controller and machine must be unprotected. See exception below
- when attempting to make/clear a listen only route the machine must unprotected. See exception below
- if a bi-directional route is cleared/changed only unprotected listen only machines will be automatically cleared. See exception below
- **Exception**: Protects are ignored if routes being made were made from a salvo instigated by a 'master' control panel set to ignore protects in salvos

■ 1.5 The RS422 Non Distributive Port Router

When the RS422 router card is selected to Non-Distributive operation in the Freeway database, only point to point routes are permitted between any single machine and any one controller. The RS422 router card software will configure any port selected as a Destination to be a controller and any Source as a machine. Full four wire control will then be established on any selected route. Any of the RS422 router ports can be either a machine or a controller, and consequently a port cannot be routed to itself. If the router is selected to manual parking, a controller or machine cannot be re-routed until they have been parked.

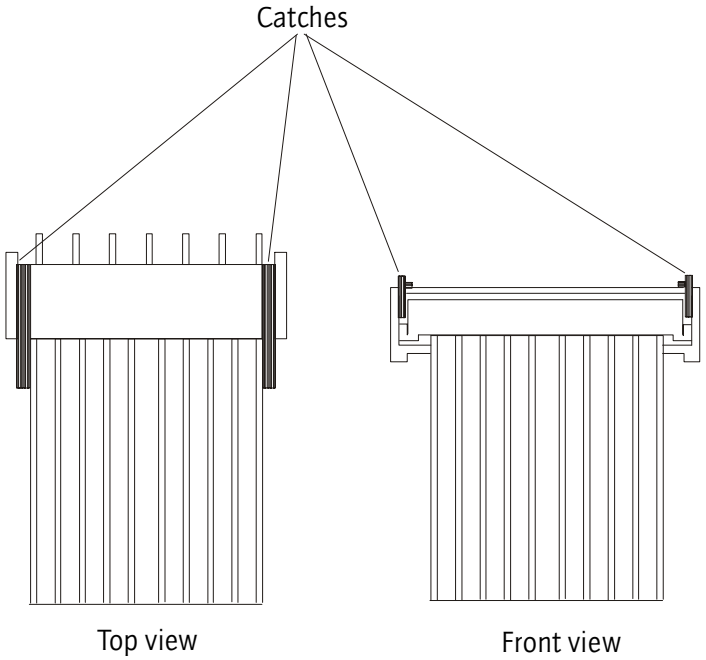


2 Installation and configuration

■ 2.1 Removal and replacement of module

The module can be removed from the frame or replaced, powered or un-powered, using the following procedure. When removing the bottom card it is necessary to remove the door before continuing. For removal purposes it is advisable to remove the ribbon cables first and then the cards.

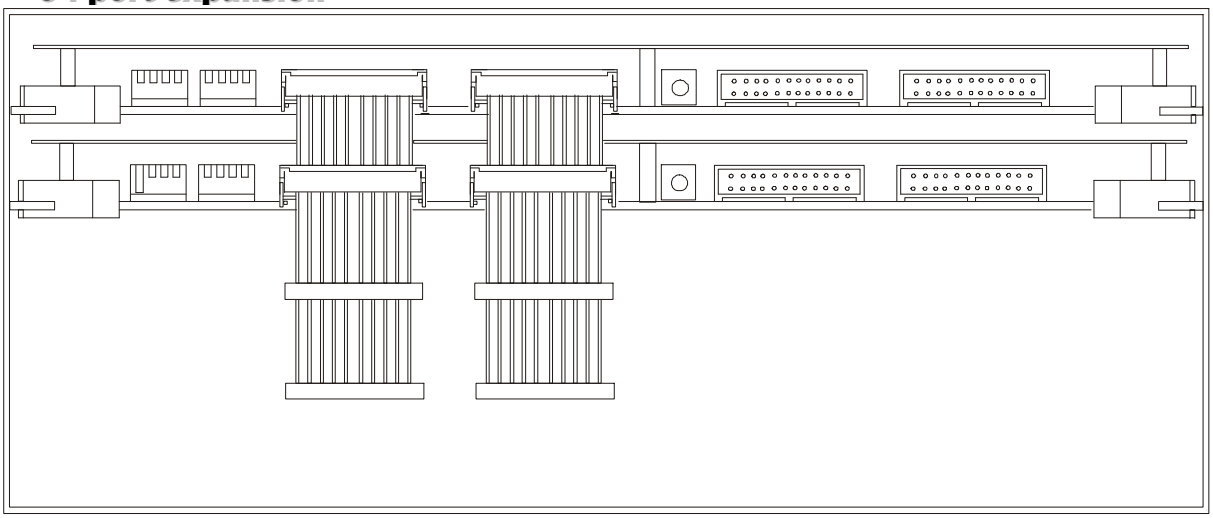
- release the ribbon cables by pushing the catches up on either end of the connector as shown
- lift up the card ejector on the module and gently pull the card out
  Replacement is the reverse of above:
- slide the card along the guide rail of the required slot, gently pushing it fully home until it marries up with the connector on the motherboard



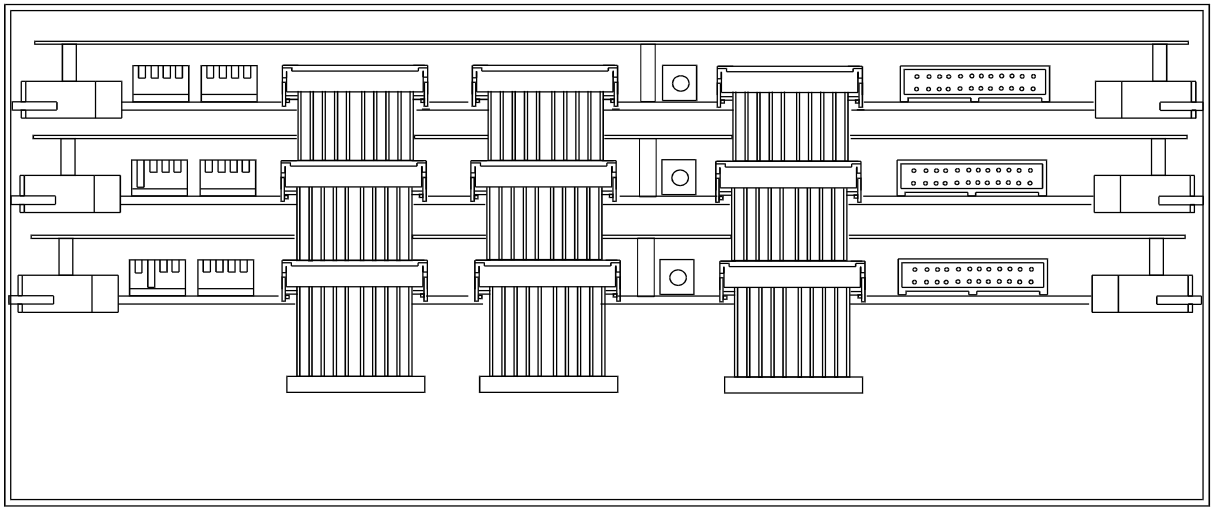
■ 2.2 Expanding from 32 ports to 128 ports

The following diagrams show the cable connections required for expanding the router from a single card 32 port router up to a four card 128 port router:

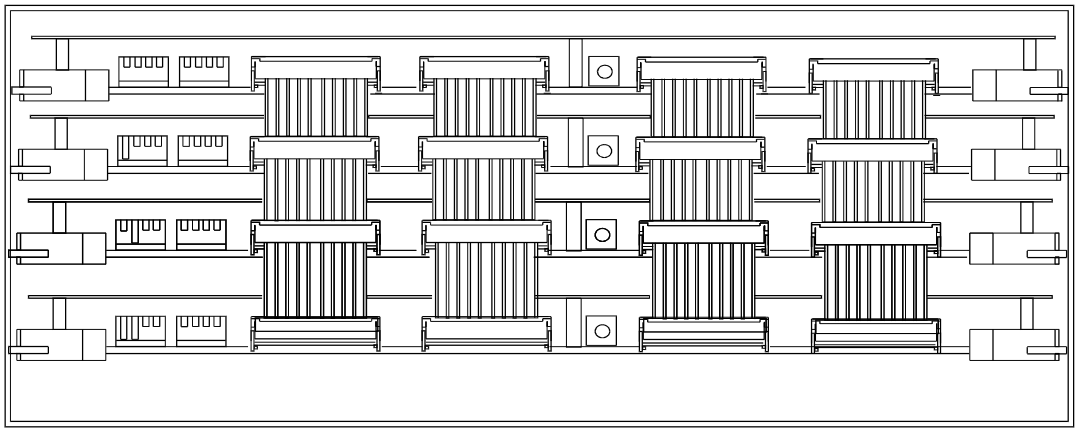
64 port expansion



96 port expansion



128 port expansion



■ 2.3 Setting the level switch

The card edge controls and indicators on the router card are limited to the Level and Higher Destination Decode switches and a 3 LED array, both of which are described in part one of the Freeway Series User guide.

For separate routers to be controlled independently, each must have a different level address set. This operation is achieved by means of the DIL switch marked level on the front of each Freeway card.

The levels are set thus:

SW 1	SW 2	SW 3	SW 4	Level No
0	0	0	0	1
1	0	0	0	2
0	1	0	0	3
1	1	0	0	4
0	0	1	0	5
1	0	1	0	6
0	1	1	0	7
1	1	1	0	8

The maximum total number of independent levels is 8. A typical system might be arranged like this:

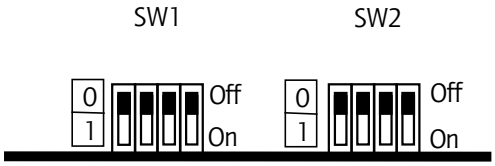
Level 1 Serial Digital Video

Level 2 Analogue Video

Level 3 AES Digital Audio

Level 4 Stereo Analogue Audio

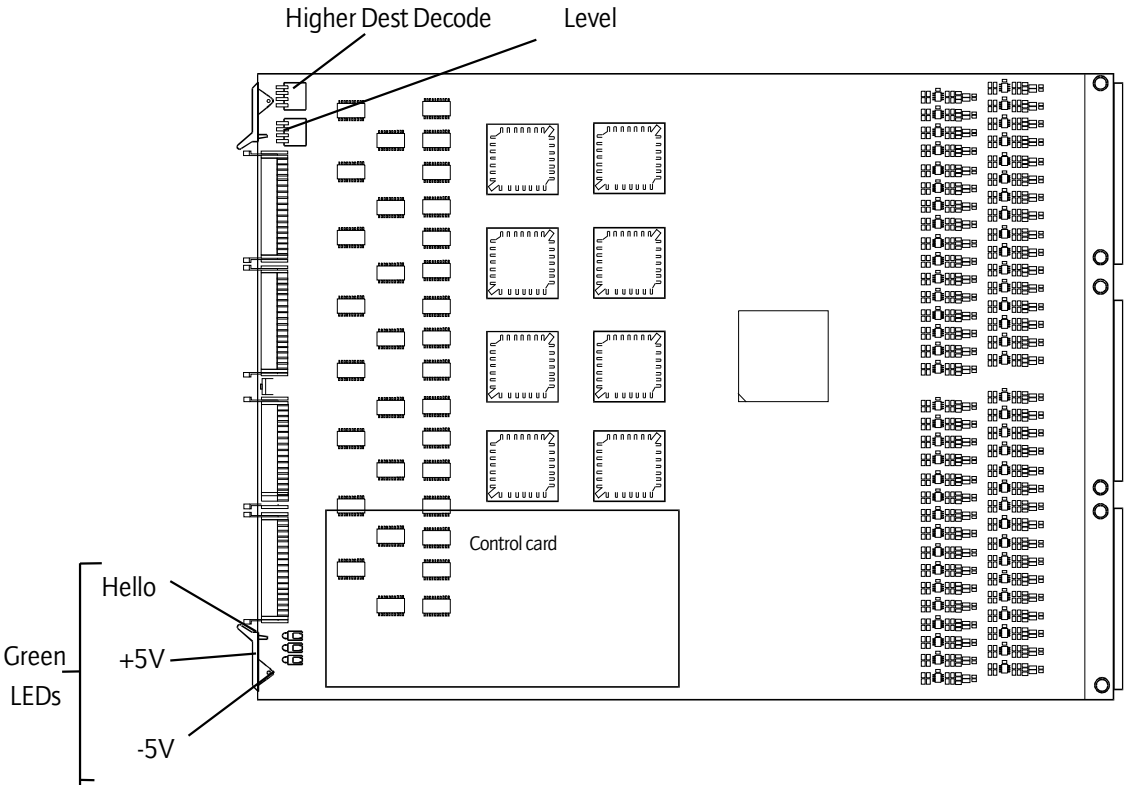
Level 5 RS422 control



View from front of card:

switch up for Off

switch down for On



■ 2.4 Setting the Higher Dest Decode switch

The switch marked 'HIGHER DEST DECODE' tells each card what range of ports it's assigned to. This switch must be set correctly for each card according to the configuration of the system and how the rear connectors are used. The range is assigned as follows:

SW 1	SW 2	SW 3	SW 4	Port Range
0	0	x	x	1-32
1	0	x	x	33-64
0	1	x	x	65-96
1	1	x	x	97-128

■ 2.5 LED indications

Two of the three LEDs indicate that power is arriving at the board. Freeway routers operate from two rails only (where others are needed these are generated on the Freeway cards themselves). The two rails are +5V and -5V.

The third LED is labelled 'HELLO'. This is useful in determining if the control system has spoken to a particular board and, specifically, to tell you if you set the 'level' and 'higher dest decode' switches correctly.

When the control system sends a command (say in response to a button push), the appropriate part of the router responds, depending on how the board configuration switches are set.

If a board receives a command on which it should act, it 'winks' the 'HELLO' LED. Meaning, *'Hello, I've just received a command that's relevant according to my programmed place in the scheme of things.'*

2.6 The Freeway control card

Central to the operation of the Freeway router is the control card. The card is a sub-module fitted to any one of the router cards in the system and is used to control and configure the router. Optionally, two cards may be fitted to provide backup in the event that one microprocessor card should fail. Full details on configuring the control card are given in Section 6 of the Freeway Technical Manual.

The Freeway RS422 card may or may not therefore host a control card. If it does, then a card reset may be performed as described in the following section.

2.7 Resetting the module

There are physically two RESET switches available to perform a hard reset of the Freeway controller. One is located on the edge of the 2440 sub-module and the other is remotely located on the front edge of the host card on which the 2440 is sited. Pressing either has the same effect.

Initiating a hard reset is akin to powering down and powering up the frame housing the control card. The controller re-boots and follows the usual power-up sequence. It should be noted that the panels will shut down and then be restored after initialisation has completed. It should also be noted that resetting the active controller in a dual control environment will cause system changeover.

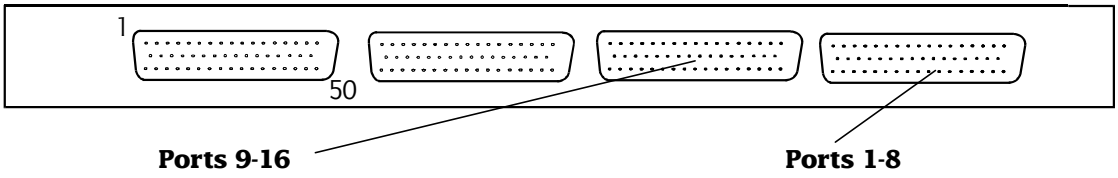
If no changes have been made to the database, then no crosspoints will be changed.

Crosspoint settings may change if the level type for a level was changed prior to the reset, as during initialisation the crosspoints are set according to the level type for that level.

It is also advisable to perform a reset after database parameters are changed as certain changes only take effect after a reset, i.e. changing level type, panel type, source overrides, and controllable destinations.

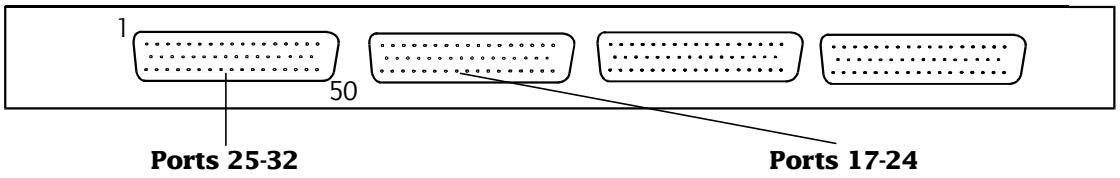
■ 2.8 Rear panel connections for RS422

The rear panel has four 50 way 'D' type fixed sockets, providing connections for 32 ports, each with an A and B circuit pair. A and B configure themselves to be receive (RX) or transmit (TX) circuits according to user selection (see Section 2.2). The pinout details for ports 1 to 32 are as follows:



Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	A9 Gnd	42	A13 Gnd
18	A9 +	26	A13 +
2	A9-	10	A13-
3	B9 Gnd	11	B13 Gnd
35	B9+	43	B13+
19	B9-	27	B13-
36	A10 Gnd	44	A14 Gnd
20	A10+	28	A14+
4	A10-	12	A14-
5	B10 Gnd	13	B14 Gnd
37	B10+	45	B14+
21	B10-	29	B14-
38	A11 Gnd	46	A15 Gnd
22	A11+	30	A15+
6	A11-	14	A15-
7	B11 Gnd	15	B15 Gnd
39	B11+	47	B15+
23	B11-	31	B15-
40	A12 Gnd	48	A16 Gnd
24	A12+	32	A16+
8	A12-	16	A16-
9	B12 Gnd	17	B16 Gnd
41	B12+	49	B16+
25	B12-	33	B16-

Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	A1 Gnd	42	A5 Gnd
18	A1 +	26	A5 +
2	A1-	10	A5-
3	B1 Gnd	11	B5 Gnd
35	B1+	43	B5+
19	B1-	27	B5-
36	A2 Gnd	44	A6 Gnd
20	A2+	28	A6+
4	A2-	12	A6-
5	B2 Gnd	13	B6 Gnd
37	B2+	45	B6+
21	B2-	29	B6-
38	A3 Gnd	46	A7 Gnd
22	A3+	30	A7+
6	A3-	14	A7-
7	B3 Gnd	15	B7 Gnd
39	B3+	47	B7+
23	B3-	31	B7-
40	A4 Gnd	48	A8 Gnd
24	A4+	32	A8+
8	A4-	16	A8-
9	B4 Gnd	17	B8 Gnd
41	B4+	49	B8+
25	B4-	33	B8-



Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	A25 Gnd	42	A29 Gnd
18	A25 +	26	A29 +
2	A25-	10	A29-
3	B25 Gnd	11	B29 Gnd
35	B25+	43	B29+
19	B25-	27	B29-
36	A26 Gnd	44	A30 Gnd
20	A26+	28	A30+
4	A26-	12	A30-
5	B26 Gnd	13	B30 Gnd
37	B26+	45	B30+
21	B26-	29	B30-
38	A27 Gnd	46	A31 Gnd
22	A27+	30	A31+
6	A27-	14	A31-
7	B27 Gnd	15	B31 Gnd
39	B27+	47	B31+
23	B27-	31	B31-
40	A28 Gnd	48	A32 Gnd
24	A28+	32	A32+
8	A28-	16	A32-
9	B28 Gnd	17	B32 Gnd
41	B28+	49	B32+
25	B28-	33	B32-

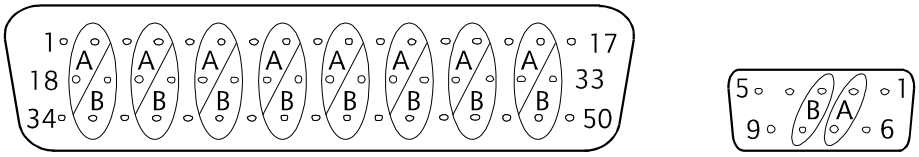
Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	A17 Gnd	42	A21 Gnd
18	A17 +	26	A21 +
2	A17-	10	A21-
3	B17 Gnd	11	B21 Gnd
35	B17+	43	B21+
19	B17-	27	B21-
36	A18 Gnd	44	A22 Gnd
20	A18+	28	A22+
4	A18-	12	A22-
5	B18 Gnd	13	B22 Gnd
37	B18+	45	B22+
21	B18-	29	B22-
38	A19 Gnd	46	A23 Gnd
22	A19+	30	A23+
6	A19-	14	A23-
7	B19 Gnd	15	B23 Gnd
39	B19+	47	B23+
23	B19-	31	B23-
40	A20 Gnd	48	A24 Gnd
24	A20+	32	A24+
8	A20-	16	A24-
9	B20 Gnd	17	B24 Gnd
41	B20+	49	B24+
25	B20-	33	B24-

For each additional RS422 card fitted in a system, there will be an additional connector panel located in the corresponding position on the rear of the frame. The pinout sequence is exactly the same on each connector, with the appropriate offset applied:

Card two: ports 33 to 64 Card three: ports 65 to 96
Card four: ports 97 to 128

■ 2.9 Breakout cable connections

RS422 connections are usually wired using 9 pin 'D' type connectors. A breakout cable using one 50 way male D type connector and eight 9 way female D type connectors is available, part number 1748, to provide direct interfacing between the Freeway rear panel and other equipment. It is wired as follows:



50 way D type	9 way D type
Circuit	**pin number**
A Ground	6
A Signal +	7
A Signal -	2
B Ground	4
B Signal +	3
B Signal -	8

Refer to Section 2.7 for 50 way D type pinout details.

3 Problem solving

The green LEDs on the routing card are off?

There is no power on the card.

- check that there is power from the PSUs
- check cable interconnections
- ensure that the card is properly seated in the frame

The HELLO LED on the card remains off?

No command has been received by the board.

- check the power
- check that the 'level' and 'higher dest decode' switches are set correctly
- check cable interconnections
- check that level is configured in database

The router will not pass data?

Commands are received but not implemented.

- check all LEDs as above
- check the wiring of the ports
- use an RS422 checker to confirm presence of data on ports
- park ports before routing (manual parking mode)

4 Specification

The following specification refers to a single, 32 port, router module.

■ Ports

Number and type:	32: balanced 4 wire (bi-directional) to EIA standard RS422A
Input Impedance:	3kΩ
Input sensitivity:	150mV
Input Common Mode Rejection:	±12V max
Max Output current:	40mA
Connectors:	Four 50 way D type sockets

■ Power requirement

Maximum current:	1.4A

■ Operating temperature

Range:	0°C to 40°C
Cooling:	internal fans