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1 Introduction

This manual covers the theory of operation and installation of the Freeway timecode 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 timecode signals with the associated video and audio signals within a single matrix frame. The Freeway timecode router uses digital routing techniques to pass signals rather than the analogue methods used in other routing systems.

The timecode router card supports 32 inputs and 32 outputs, permitting expansion using up to four cards to 128 inputs and 128 outputs, within a single 3U Freeway frame. Details of the timecode 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 is contained in the Freeway Editor Users Guide, which supports a Windows based editor for intuitive configuration of any Freeway router system.

■ 1.1 Timecode signal routing

Timecode is a type of digital time reference signal used extensively in broadcasting and post production environments. Professional tape machines and VTRs use timecode as a tape position indication, as do many other types of broadcast equipment. It is also used as a precise time-of-day reference in all broadcast areas, accurate to one hundredth of a second. Timecode can be transmitted in various forms, sometimes embedded with other signal types, but if it is to be routed as an independent signal the common method is as a balanced, two wire circuit, known as LTC (longitudinal timecode).

■ 1.2 The timecode router

The timecode router can route any input, or source, to any number of outputs, or destinations; this is the same mode of operation as video or audio routers, and is known as Distributive, or Broadcast operation.

2 Installation and configuration

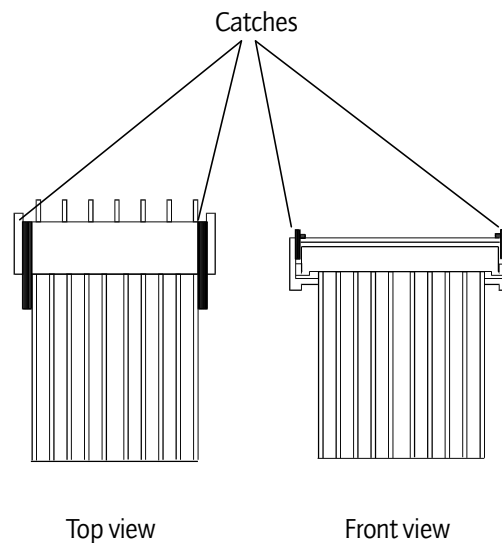
■ 2.1 Removal and replacement of module

The module can be removed from the frame and 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:

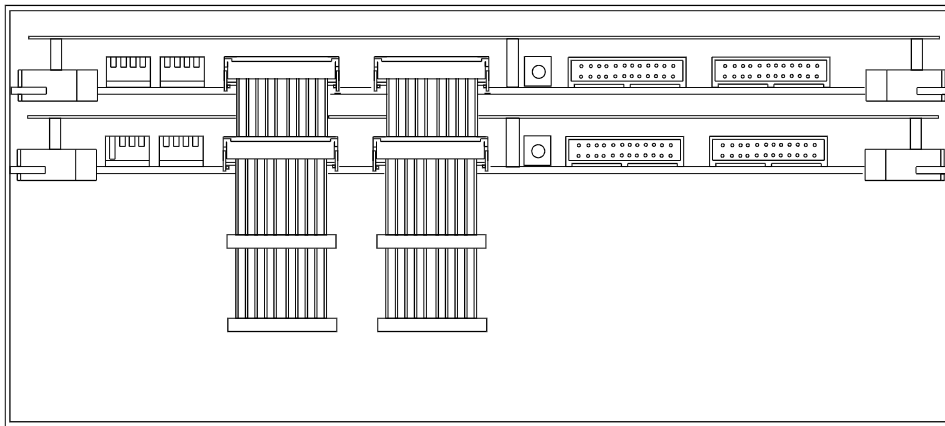
- slide the card along the guide rail of the required slot, gently pushing it fully home until it marries up with the connector on the motherboard



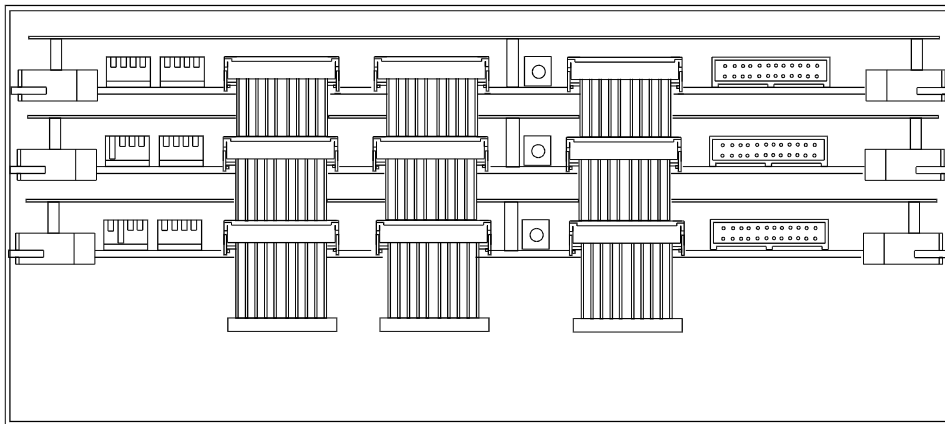
■ 2.2 Expanding from 32X32 to 128X128

The following diagrams show the cable connections required for expanding the router from a single card 32X32 router up to a four card 128X128 router:

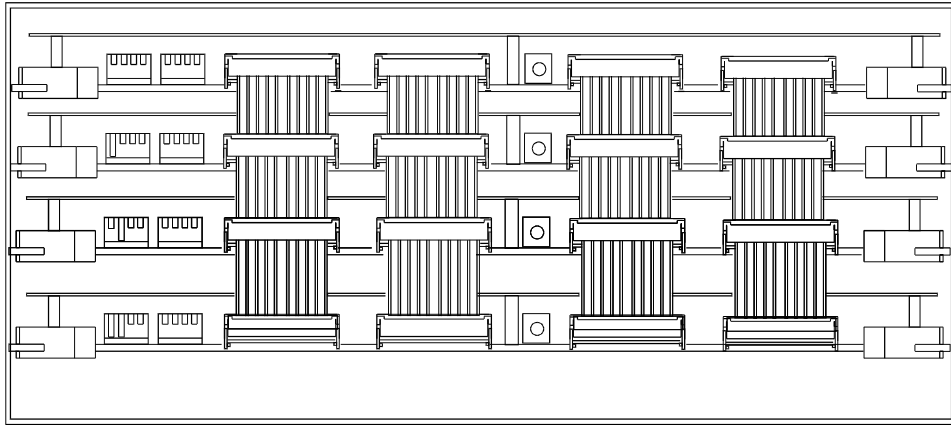
64X64 expansion



96X96 expansion



128X128 expansion



■ 2.3 Setting the level switch

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:

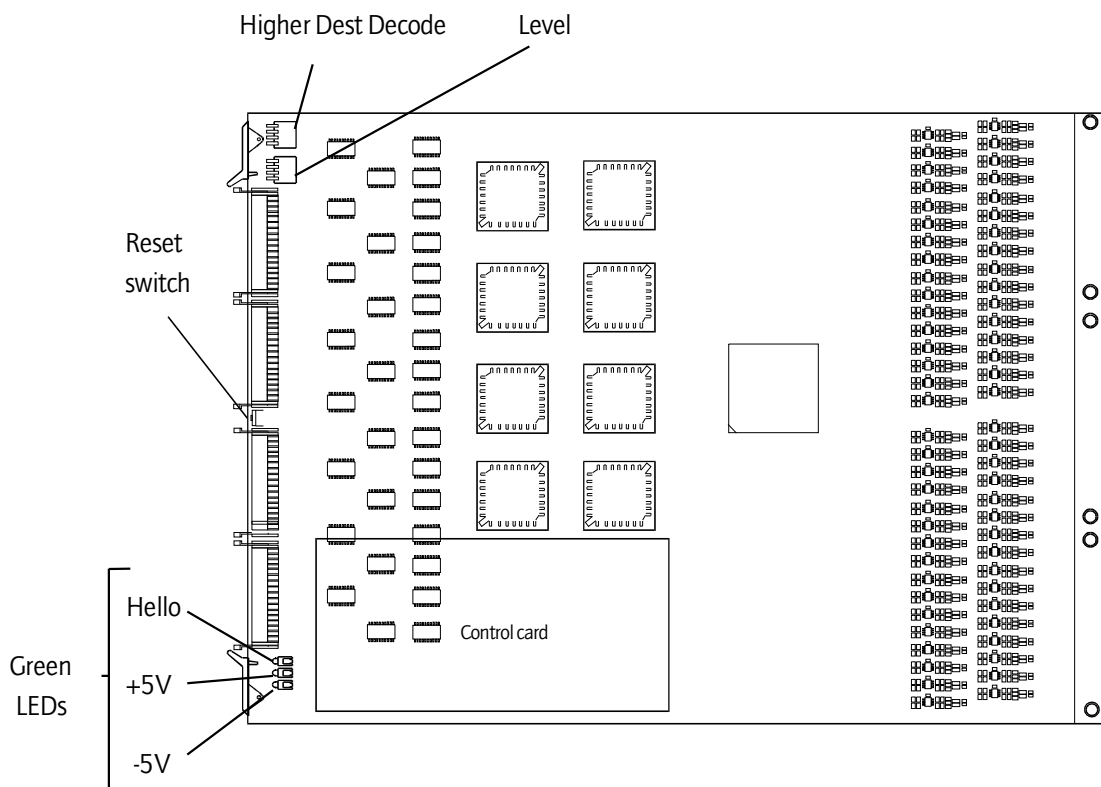
Level 1	Serial Digital Video
Level 2	Analogue Video
Level 3	AES Digital Audio
Level 4	Stereo Analogue Audio
Level 5	Timecode



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 destinations 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	Destination 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 all 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 Timecode 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 control frame. 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.

However, 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.

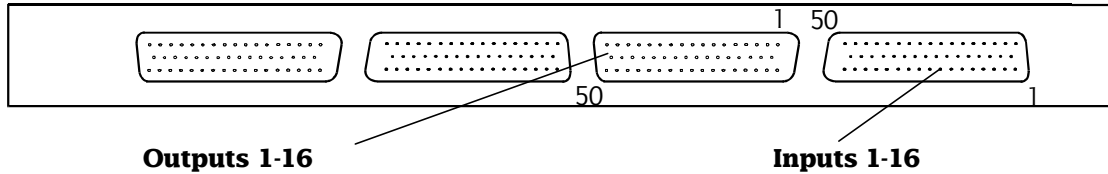
It is also advisable to perform a reset after database parameters are changed as certain changes only take effect after a reset, i.e. changing level type, panel type, source overrides, and controllable destinations.

■ 2.8 Rear panel connections for timecode

The rear panel has 4 connectors on a 1758 panel:

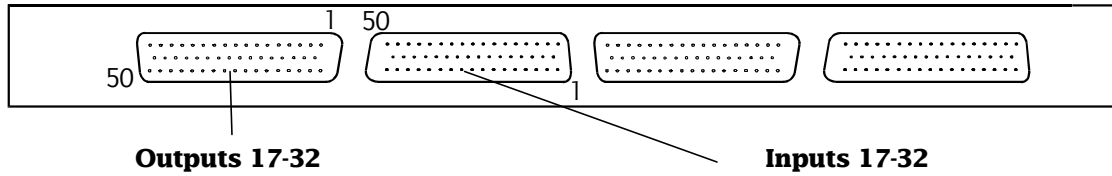
- two 50 way 'D' type fixed plug for inputs
- two 50 way 'D' type fixed socket for outputs

Refer to the following diagrams for pinout details .



Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	1 Gnd	42	9 Gnd
18	1 +	26	9 +
2	1 -	10	9 -
3	2 Gnd	11	10 Gnd
35	2 +	43	10 +
19	2 -	27	10 -
36	3 Gnd	44	11 Gnd
20	3 +	28	11 +
4	3 -	12	11 -
5	4 Gnd	13	12 Gnd
37	4 +	45	12 +
21	4 -	29	12 -
38	5 Gnd	46	13 Gnd
22	5 +	30	13 +
6	5 -	14	13 -
7	6 Gnd	15	14 Gnd
39	6 +	47	14 +
23	6 -	31	14 -
40	7 Gnd	48	15 Gnd
24	7 +	32	15 +
8	7 -	16	15 -
9	8 Gnd	17	16 Gnd
41	8 +	49	16 +
25	8 -	33	16 -

Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	1 Gnd	42	9 Gnd
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3	2 Gnd	11	10 Gnd
35	2 +	43	10 +
19	2 -	27	10 -
36	3 Gnd	44	11 Gnd
20	3 +	28	11 +
4	3 -	12	11 -
5	4 Gnd	13	12 Gnd
37	4 +	45	12 +
21	4 -	29	12 -
38	5 Gnd	46	13 Gnd
22	5 +	30	13 +
6	5 -	14	13 -
7	6 Gnd	15	14 Gnd
39	6 +	47	14 +
23	6 -	31	14 -
40	7 Gnd	48	15 Gnd
24	7 +	32	15 +
8	7 -	16	15 -
9	8 Gnd	17	16 Gnd
41	8 +	49	16 +
25	8 -	33	16 -



Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	17 Gnd	42	25 Gnd
18	17 +	26	25 +
2	17-	10	25-
3	18 Gnd	11	26 Gnd
35	18+	43	26+
19	18-	27	26-
36	19 Gnd	44	27 Gnd
20	19+	28	27+
4	19-	12	27-
5	20 Gnd	13	28 Gnd
37	20+	45	28+
21	20-	29	28-
38	21 Gnd	46	29 Gnd
22	21+	30	29+
6	21-	14	29-
7	22 Gnd	15	30 Gnd
39	22+	47	30+
23	22-	31	30-
40	23 Gnd	48	31 Gnd
24	23+	32	31+
8	23-	16	31-
9	24 Gnd	17	32 Gnd
41	24+	49	32+
25	24-	33	32-

Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	17 Gnd	42	25 Gnd
18	17 +	26	25 +
2	17-	10	25-
3	18 Gnd	11	26 Gnd
35	18+	43	26+
19	18-	27	26-
36	19 Gnd	44	27 Gnd
20	19+	28	27+
4	19-	12	27-
5	20 Gnd	13	28 Gnd
37	20+	45	28+
21	20-	29	28-
38	21 Gnd	46	29 Gnd
22	21+	30	29+
6	21-	14	29-
7	22 Gnd	15	30 Gnd
39	22+	47	30+
23	22-	31	30-
40	23 Gnd	48	31 Gnd
24	23+	32	31+
8	23-	16	31-
9	24 Gnd	17	32 Gnd
41	24+	49	32+
25	24-	33	32-

For each additional Timecode 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: Inputs & outputs 33 to 64 Card three: Inputs & outputs 65 to 96

Card four: Inputs & outputs 97 to 128

3 Theory of operation

The 5741 timecode Freeway router card can be considered in four sections, 32 inputs, 32 outputs, a crosspoint array, and control.

Timecode inputs and outputs

The timecode router card is fitted with 32 inputs and 32 output drivers, interfacing between the unbalanced crosspoints and the balanced source and destination ports.

Crosspoints

The 128X32 crosspoint array is bi-directional and unbalanced, and is configured using eight 32X16 crosspoint chips. The card's 32 sources and 32 destinations are connected directly to a 32X32 block of crosspoints, and the additional 96 inputs are connected to the card's front edge ribbon cable connectors for port expansion. The connectors are configured such that each additional 5741 card connects to the next block of 32 crosspoint inputs, allowing full data transfer between the 32 sources and destinations on each card, and a maximum system size of 128X128 on four cards. The Higher Dest Decode switch on each card must be set appropriately in order that the correct data is accessed from the interconnecting ribbons, this information is detailed in Section 2.4.

Control

Routing information is received by the Freeway control card, which may be resident on any of the Freeway router cards in the system, including the timecode card. Control data is passed on a backplane bus to all router cards, and cards respond only to data addressed to their own level number, this is set by the card level switch, as detailed in Section 2.3. The data is interpreted by the programmable logic device IC150, which then sets the crosspoint.

4 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

5 Specification

The following specification refers to a single 32x32 router module.

■ Inputs

Number and type:	32: balanced 2 wire to SMPTE 12M
Input Impedance:	1k Ω
Input sensitivity:	500mV peak to peak
Input Common Mode Rejection:	\pm 12V max
Connectors:	Two 50 way D type plugs

■ Outputs

Number and type:	32: balanced 2 wire typically 2V p/p into 10 k Ω
Output impedance:	less than 50 Ohms
Connectors:	Two 50 way D type sockets

■ Power requirement

Maximum current::	1.4A
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■ Operating temperature

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

■ Optional hardware

The following order codes relate to options and spare parts available for use with Freeway routing systems.

1941 Extra PSU	FRE-OPTN-BPSU
2440 Extra μP card	FRE-OPTN-RCPU

Spare parts

5741 Timecode routing card	FRE-SPAR-TCXP
1758 Timecode rear connector card	FRE-SPAR-TCRP
6540 Freeway Frame	FRE-SPAR-OFRM
Replacement User Manual	FRE-SPAR-TECH