Contents

1 Introduction

The ***Freeway*** series of routing switchers addresses the needs for installations requiring 'square' router configurations. While this fulfils most applications, there are still instances requiring 'non-square' configurations such as monitoring switchers. In order to satisfy these requirements, a further set of modules offering sixteen input channels is provided as part of the ***Freeway*** family of routing switchers.

Freeway input cards are available in four signal formats; serial digital video, analogue video, AES digital audio and stereo analogue audio. These modules permit ***Freeway*** 32, 64 and 128 router levels to be expanded within standard 3U and 6U frames. Using this approach, it is possible to build routers up to 64x16, 64x32 and 64x48 for both analogue and digital video levels, and 128x16, 128x32 through to 128x112 for the audio levels in steps of sixteen inputs at a time.

As with all other ***Freeway*** signal cards, provision for housing a system controller, either main or backup, has also been allowed for on these input modules. Freeway control modules contain the system database. The Freeway Editor user guide details how to programme or re-configure the database.

2 Installation and configuration

This section provides general installation and configuration information common to all of the ***Freeway*** input cards. Specific requirements relating to each signal type, such as audio connector details are contained within the relevant sub-section of this part of the technical manual. Details relating to operations specific to frames, such as removal and replacement of doors and power supplies are contained within the General Information section of the first part of this handbook.

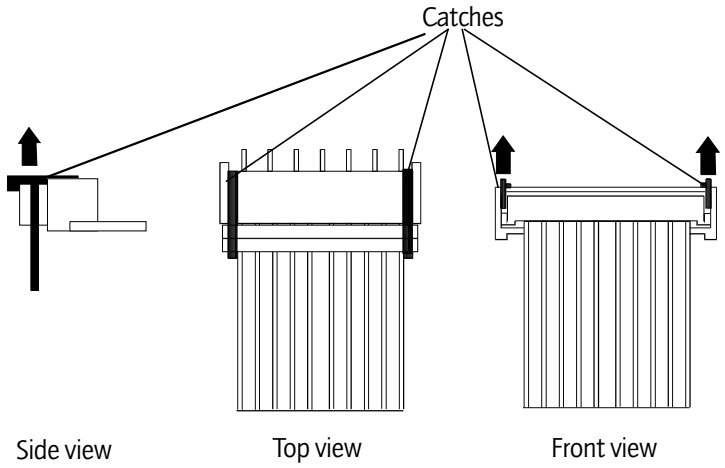
■ 2.1 Removal and replacement of modules

Freeway input cards can be removed from the frame and replaced, powered or un-powered, using the following procedure. When removing the bottom card from a frame, it is necessary to remove the door before continuing. For removal purposes it is advisable to remove any ribbon cables from the card edge first, 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 Setting the level switch

A ***Freeway*** router can comprise of up to eight levels. In order for these to be independently controlled, each must have a different level address. By setting the LEVEL address switch located on the front of each ***Freeway*** module, the control system can identify each level and, where necessary, control it independently. It is desirable in some applications, such as component or RGB routers, to provide married switching across a number of levels. In these instances the LEVEL address should be the same for each router card.

Levels addresses are set as follows:

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

A typical system might be arranged like this:

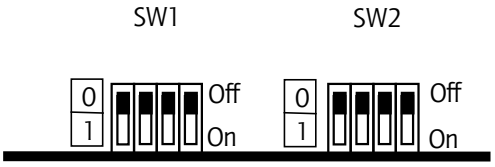
Level 1 Serial Digital Video

Level 2 Analogue Video

Level 3 AES Digital Audio

Level 4 Stereo Analogue Audio

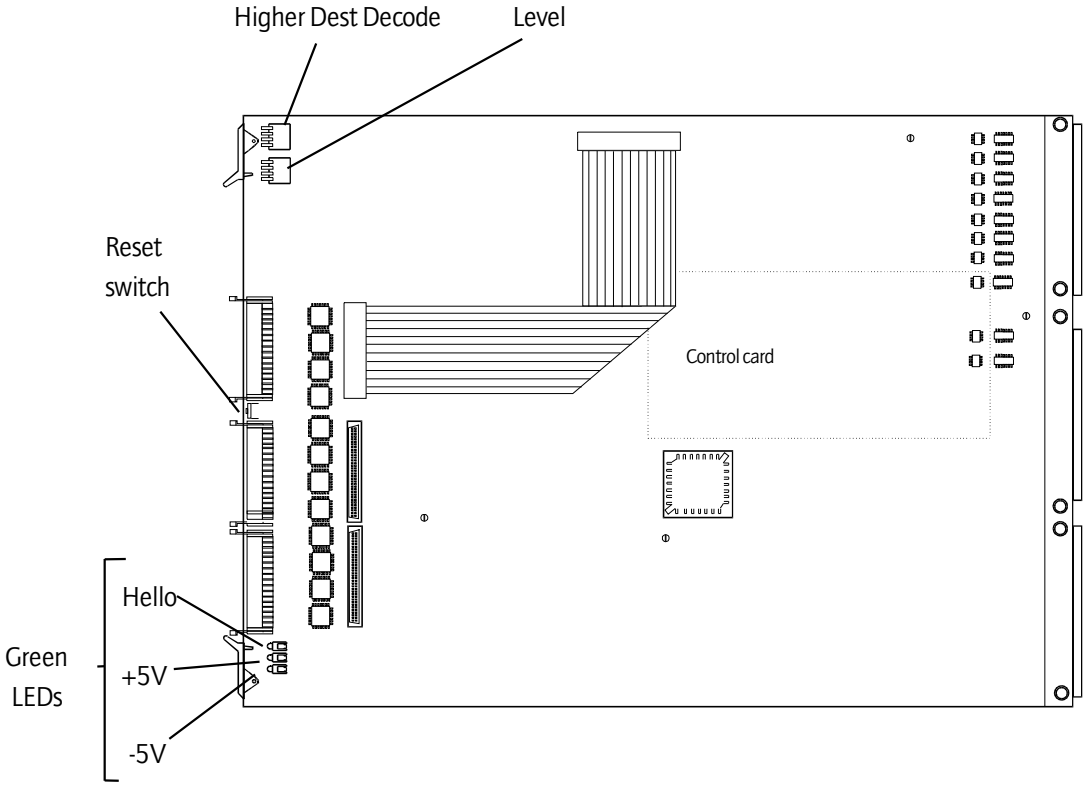
Level 5 Timecode



View from front of card:

switch up for Off

switch down for On



■ 2.3 The Higher Dest Decode switch

The HIGHER DEST DECODE switch, located on the card edge adjacent to the LEVEL address switch, normally identifies the range of destinations being provided from each card on a level by level basis, permitting the module to respond to switch commands issued by the controller.

Freeway input cards, however, are not fitted with crosspoints and therefore do not have any controllable destinations. In this case the HIGHER DEST DECODE switch is redundant, and any switch settings are ignored by the control circuitry.

■ 2.4 LED indications

Two of the three LEDs, located on the card edge, indicate that power is arriving to the board. ***Freeway*** routers operate from two rails only, these are +5V and -5V. Where others are required, they are derived on the ***Freeway*** cards themselves.

The third LED is labelled 'HELLO'. This is useful in determining whether the control system has spoken to a particular board and, specifically, will tell you if the LEVEL and HIGHER DEST DECODE switches are set correctly.

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

When 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.'*

■ 2.5 The Freeway control card

Central to the operation of any ***Freeway*** routing system is the control card. The card, type 2440, is a sub-module which may be fitted to any one of the router cards within the system and is used to provide control to the router and hold configuration data. If required, two cards may be fitted on separate signal modules within a ***Freeway*** system, providing main and backup operation in the event that one microprocessor card should fail. Full details on configuring the control card are given in Section 6 of the general information section o f this Manual.

Each ***Freeway*** module is fitted with the relevant header allowing it to be fitted with a controller, therefore any of the ***Freeway*** input cards may or may not host a control card.

■ 2.6 Resetting the module

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

Initiating a hard reset is similar 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 any panels connected to the system will shut down, and then be restored after initialisation is complete. It should also be noted that resetting the active

controller in a dual control environment will cause the active and idle controllers to changeover.

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

Crosspoint settings may be affected if changes to the level type have been made prior to the reset, as, during initialisation crosspoints are set according to the level type defined for each level.

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

3 Serial digital video

This section details the operation and operational alignment of the serial digital video input card (**3945**) for the ***Freeway*** series of routing switchers.

■ 3.1 Introduction

Freeway serial digital video input modules, like the ***Freeway*** 32 and 64 variants, automatically accommodate data rates between 140 and 360Mbit/s providing full compatibility for all standard definition digital signal formats.

Each input is fitted with an adaptive cable equaliser, providing automatic equalisation for up to 250m of good quality co-axial cable.

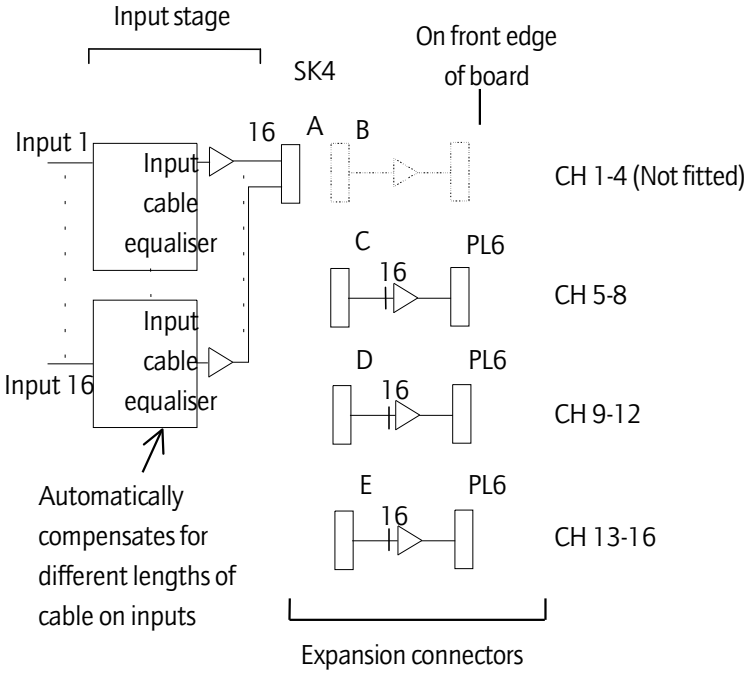
■ 3.2 Theory of operation

Each of the 16 inputs presented to the input module are buffered using a receiver/equaliser. These buffered signals are then passed to the card edge connector allowing them to be bussed across other system modules to the main output card, or cards.

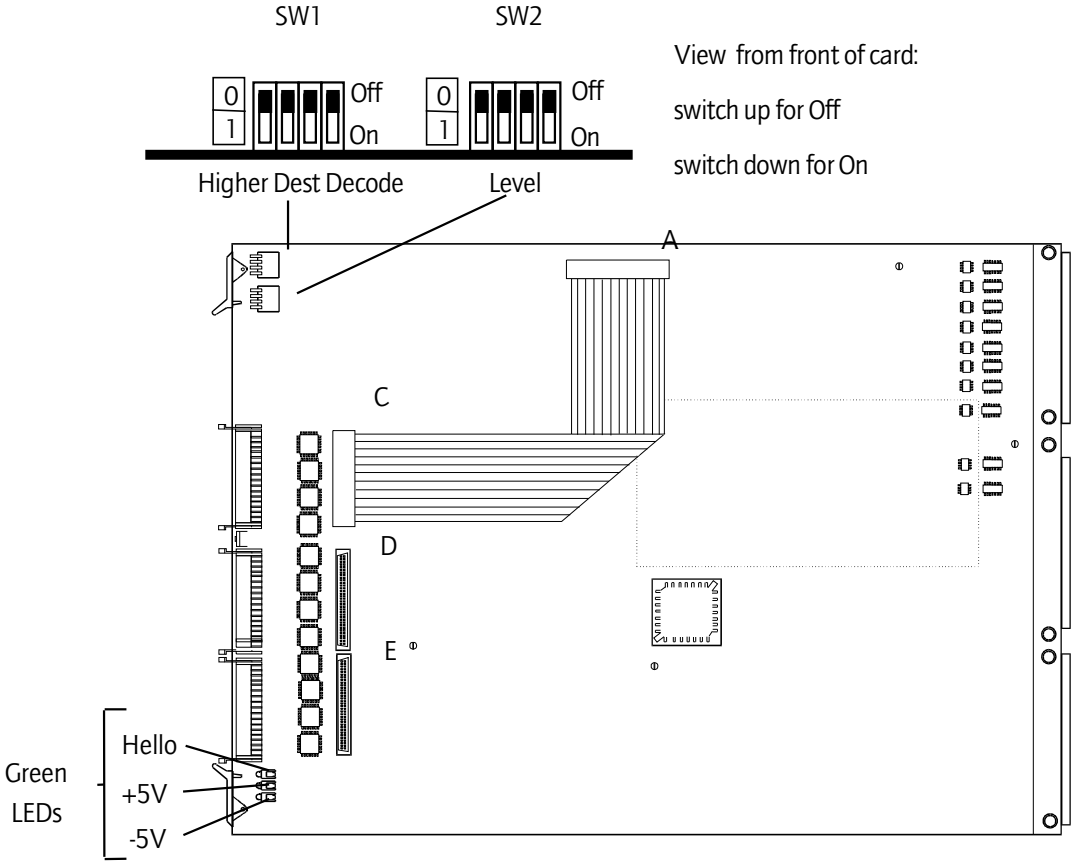
A single ribbon cable fitted to each board determines the input range the card is supplying to the router. The following table details the cable position required for each of the available input ranges.

Inputs	Position
17 - 32	**A** to **C**
33 - 48	**A** to **D**
49 - 64	**A** to **E**

* ***Freeway*** input modules can not be fitted for inputs 1-16 as the first 16 sources will be provided by the main router module.



Internal block diagram

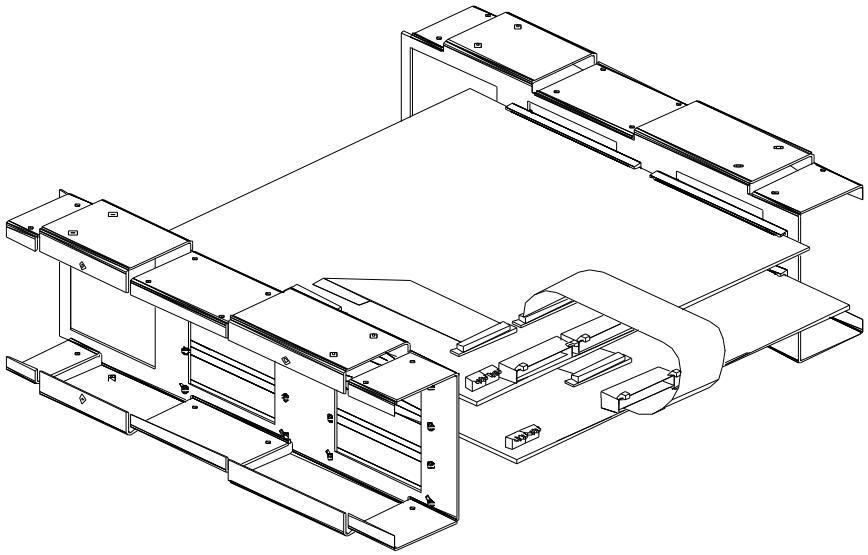


■ 3.3 Expanding digital video systems

Base ***Freeway*** 32 and 64 routers may be expanded, by the addition of ***Freeway*** digital video input cards. It is necessary to fit the expansion module in the slot adjacent to the base router card, or other expansion cards, before connecting the ribbon cables across the front of the modules.

Freeway 32

The following diagram details the cable connections required for expanding the Freeway 32 router from 16x16 to 32x16. With this range it is not possible to expand beyond 32 inputs.



Freeway 32 expansion 16x16 to 32x16

Freeway 64 expansion

The following diagrams detail the cable connections required for expanding Freeway 64 routers, covering the expansion sizes shown in the following table.

Inputs	Outputs 16	32	48	64
16	S			
32	✓	S		
48	✓	✓	S	
64	✓	✓	✓	S

Key

S - Indicates that these router sizes start with a standard Freeway 64 router card.

✓ - Indicates router sizes that can be constructed using the Freeway input cards with base router module

Care must be taken to ensure that the expansion cables are fitted in the correct positions, and that the level and destination assign switches are correctly set, see sections 2.2 and 2.3.

As the Input cards and Freeway 64 router cards interconnect in the same manner. The complete range of possible digital video expansion scenarios can be shown in three drawings.

By referencing the following table, the module positions for each expanded router and the figure detailing the correct interconnections can be found.

Expansion from Cable as shown in	16x16 to 32x16 Fig 1	32x16 to 48x16 Fig 2	48x16 to 64x16 Fig 3	32x32 to 48x32 Fig 2	48x32 to 64x32 Fig 3	48x48 to 64x48 Fig 3
Top slot (1)	3940	3940	3940	3940	3940	3940
(2)	3945	3945*	3945*	3940	3940	3940
(3)		3945*	3945*	3945*	3945*	3940
Bottom slot (4)			3945*		3945*	3945*

For the configurations where 3945 modules are fitted in slots 2, 3 or 4, the connectors and cable assemblies labelled ① , ② or ③ in the relevant diagrams are not required. This is applicable to expansion configurations for 32 inputs and above.

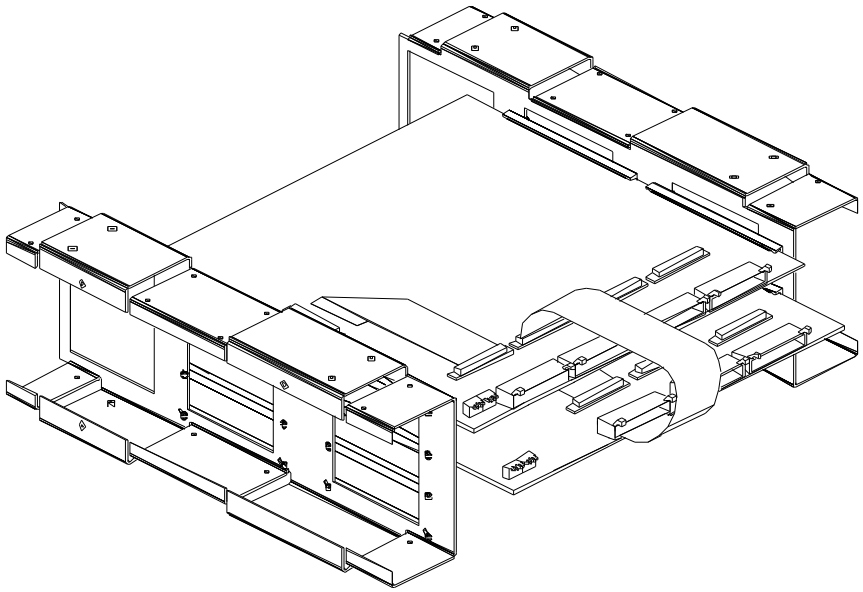


Figure 1: 32x16 Expansion

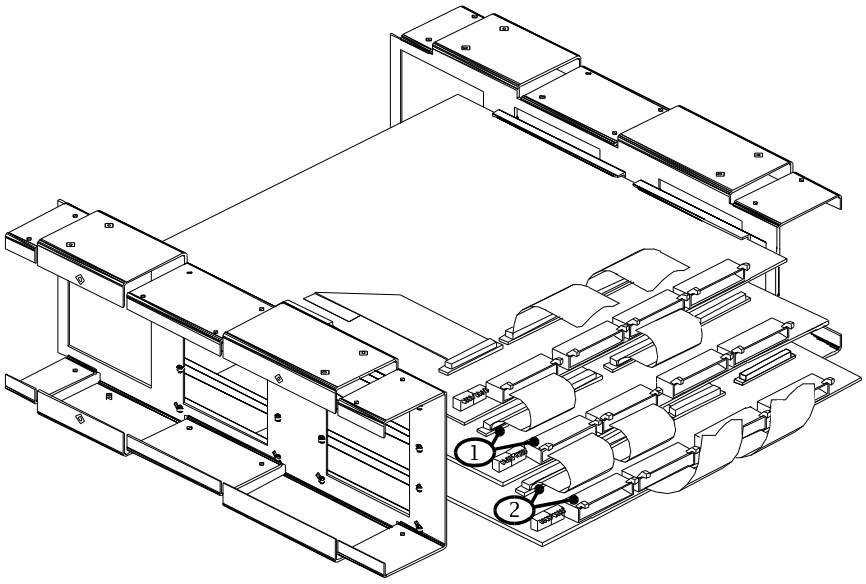


Figure 2: 48 x16 or 48 x 32 Expansion

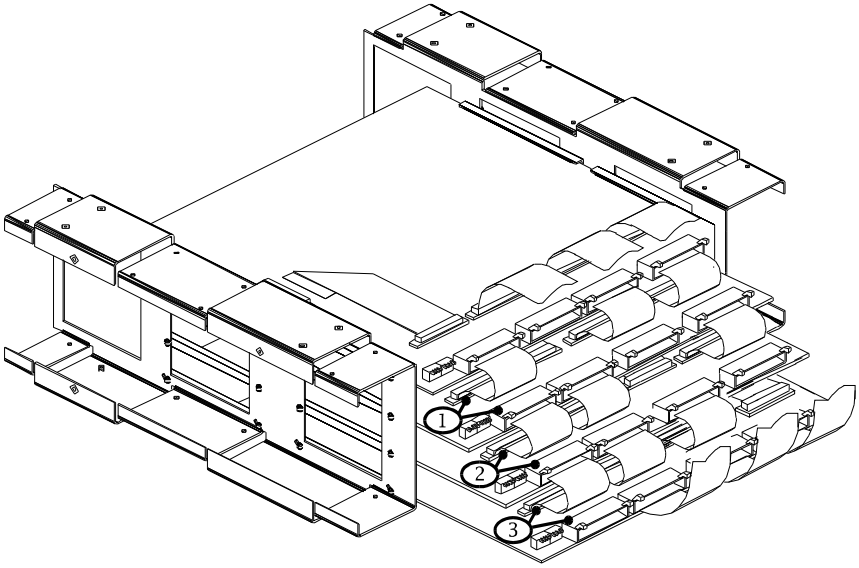


Figure 3: 64 x16, 64 x 32 or 64 x 48 Expansion

■ 3.4 Specification

The following specification refers to a single ***Freeway*** 16 channel serial digital video input module.

■ Inputs

Number and type:	16: Unbalanced NRZI coded serial data
Standard:	Serial EBU Tech 3267E. SMPTE 259M-ABCD
Input Impedance:	75Ω
Data rate:	140 to 360Mbit/s
Return loss:	>13dB 10MHz to 360MHz
Amplitude:	800mV p-p nominal
DC offset:	<5V
Equaliser:	Adaptive automatic for up to 250m cable (typ. Belden 8281, PSF 1/2M or equivalent)

4 Analogue video

This section details the operation and operational alignment for the analogue video input card (**3745**) for the ***Freeway*** series of routing switchers.

■ 4.1 Introduction

Freeway analogue video input cards provide 16 channel expansion modules for use with Freeway 32 and 64 routing systems.

The circuitry employed within these modules is, like the Freeway 32 and 64 router cards, transparent to all encoded vertical interval data ensuring they are fully compatible with sound in sync (SIS) signals.

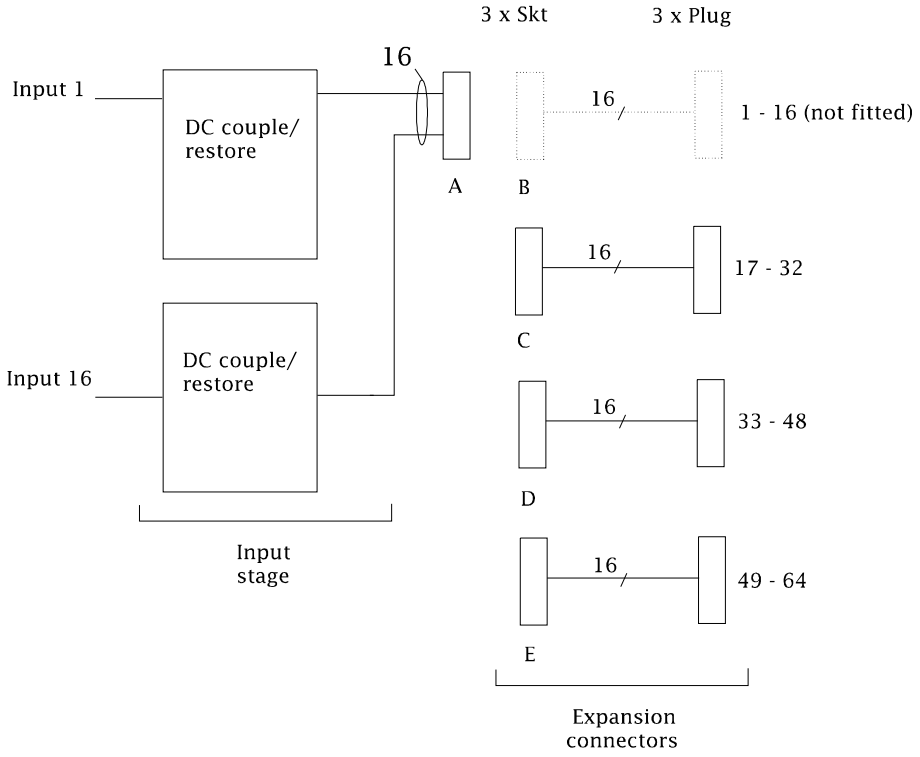
■ 4.2 Theory of operation

User selectable jumper links on the card enable each of the 16 inputs to be set for DC coupled or restored operation. Each of these inputs are then buffered before being passed to the card edge connector permitting them to be bussed to other system modules such as the main output card, or cards.

A single ribbon cable and submodule , type 3741, fitted to each board determines the input range the card is supplying for the router. The following table and diagram details the cable position required for each input range. While these modules may be used to expand any of the video routers in the Freeway family, it is important to remember they only permit expansion to the maximum allowable size for the router range, that is 32 for Freeway 32 and 64 for Freeway 64.

Input/ Output range*	Position
17 - 32	**A** to **C**
33 - 48	**A** to **D**
49 - 64	**A** to **E**

* ***Freeway*** input modules can not be fitted for inputs 1-16 as these are provided by the main router module..



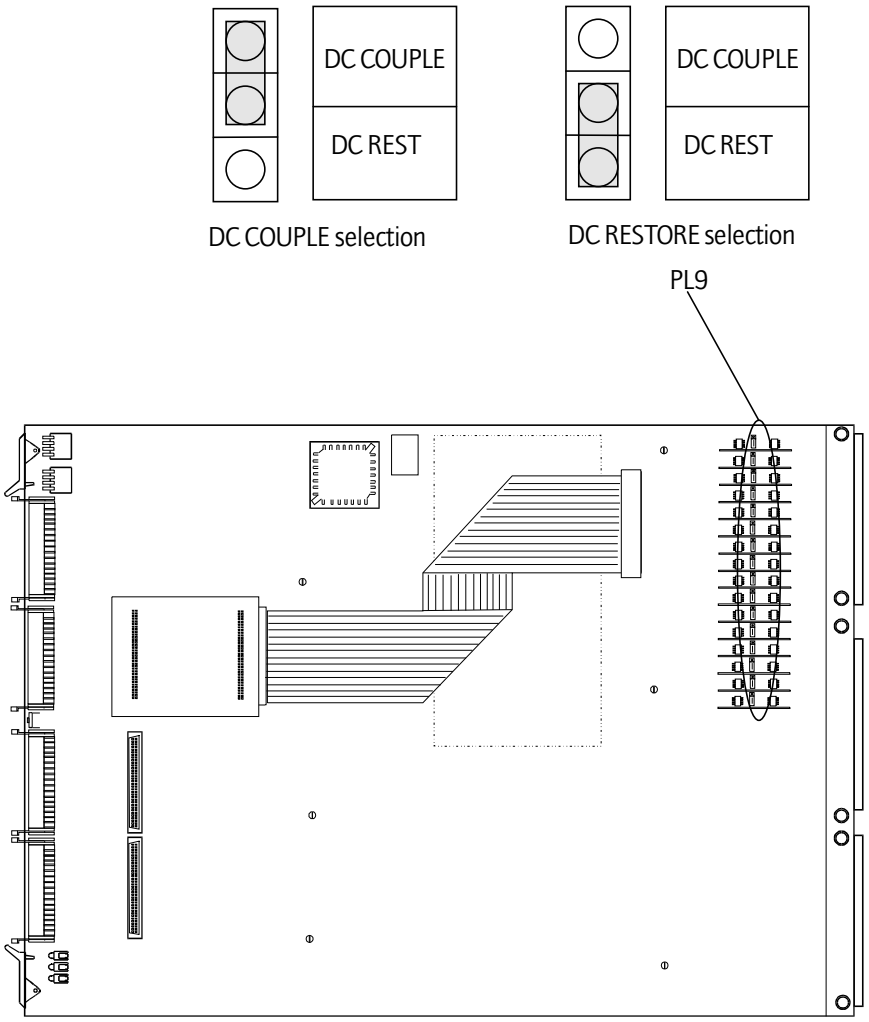
Internal block diagram

■ 4.3 Setting inputs for DC coupled or restored

In traditional television applications a DC restore function is nearly always appropriate in order to remove DC variations between signals. Without this function, switching between signals with different *DC components* may cause frame-roll due to corruption of the sync field-block.

However in other applications, such as a wideband analogue router, the DC restore function is definitely *not* appropriate. These include the routing of computer type RGB graphics signals and medium bit rate telecom signals. In these cases a stable DC path must be provided.

To cater for all circumstances, ***Freeway*** provides a user selectable input stage offering DC restored, or DC coupled operation. Where DC coupled operation is selected, all circuitry downstream of the input stage is DC coupled. This is selectable on an input by input basis via PL9.



■ 4.4 Base card cable connection

In order to compensate for variations in frequency response which inevitably occur with different numbers of sources connected to the signal ribbon on the front of analogue video ***Freeway***, special cables are supplied for use with Freeway router cards. These should be installed as shown in either the Freeway 32 or 64 handbook sections.

■ 4.5 Expanding analogue video systems

Base ***Freeway*** 32 and 64 routers may be expanded, by the addition of ***Freeway*** analogue video input cards. It is necessary to fit the expansion module in the slot adjacent to the base router card, or other expansion cards, before connecting the ribbon cables across the front of the modules.

The following diagrams detail the cable connections required for expanding both the Freeway 32 router from 16x16 to 32x16 and for Freeway 64 routers covering the expansion sizes shown in the following table.

	Outputs			
Inputs	16	32	48	64
16	S			
32	✓	S		
48	✓	✓	S	
64	✓	✓	✓	S

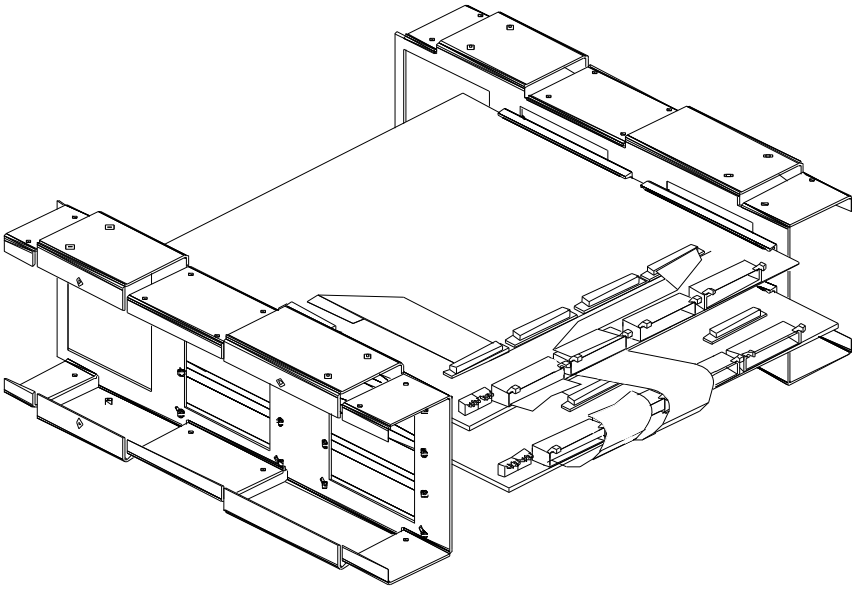
Key

S - Indicates router sizes that can be achieved using standard Freeway modules

✓ - Indicates router sizes that can be constructed using the Freeway input cards

Care should be taken to ensure that the expansion cables are fitted in the correct positions, and that the level and destination assign switches are correctly set, see sections 2.2 and 2.3.

Freeway 32 expansion - 16x16 to 32x16



Freeway 64 expansion

As the Input cards and Freeway 64 router cards interconnect in the same manner, the complete range of possible analogue video expansion scenarios can be shown in three drawings, Figures 1 to 3. By referencing the table below, the module positions for each expanded router and the drawing number detailing the correct interconnections can be found.

From To Cable as	16x16 to 32x16 Fig 1	32x16 to 48x16 Fig 2	48x16 to 64x16 Fig 3	32x32 to 48x32 Fig 2	48x32 to 64x32 Fig 3	48x48 to 64x48 Fig 3
Top slot	3740	3740	3740	3740	3740	3740
	3745	3745	3745	3740	3740	3740
		3745	3745	3745	3745	3740
Bottom slot			3745		3745	3745

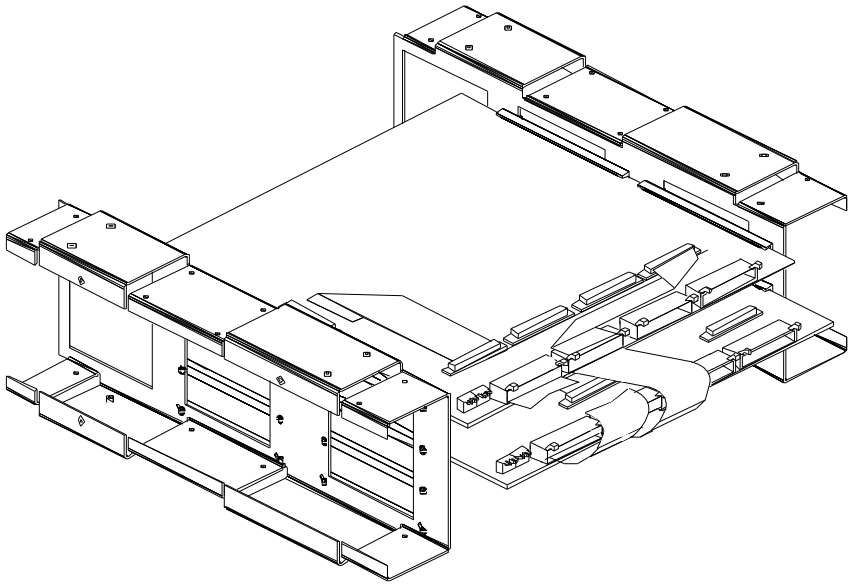


Figure 1: 32x32 Expansion

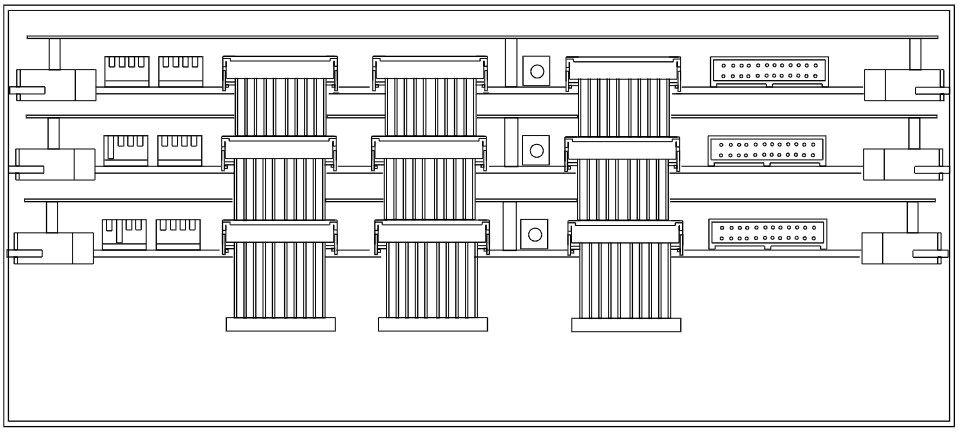


Figure 2: 48x16 or 48x32 expansion

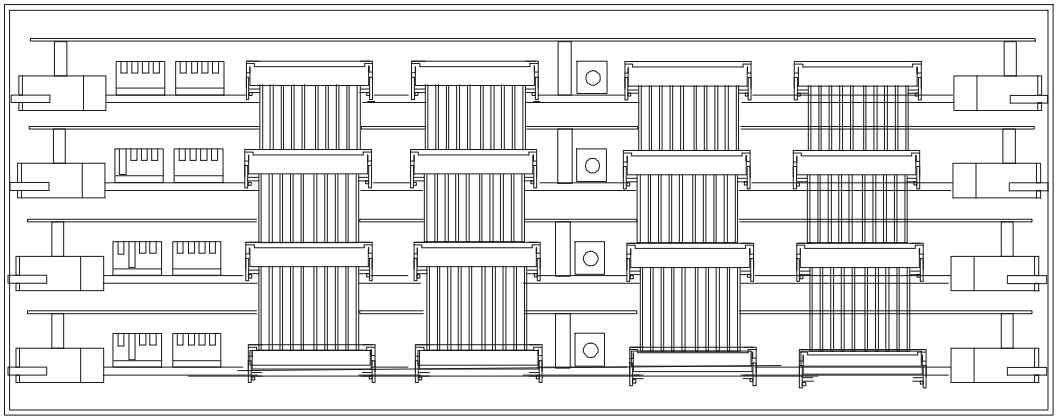


Figure 3: 64x16, 64x32 and 64x48 expansion

■ 4.6 Specification

The following specification refers to a single ***Freeway*** 16 channel analogue video input module.

■ Inputs

Number and type:	16: unbalanced on BRCS, 1V pk-pk amplitude
Impedance:	75Ω
Return loss:	Better than 40dB to 3.58MHz and 4.43MHz
Superimposed DC:	±1V max
Coupling:	DC or sync-tip restored

5 Analogue and AES digital audio

This section of the manual covers the installation, operation and operational alignment of the digital (**4945**) and analogue (**4745**) audio input cards for the ***Freeway*** series of routing switchers.

■ 5.1 Introduction

Both the analogue and digital audio ***Freeway*** input cards provide 16 channel, input expansion for the Freeway 32 and 128 audio router range. The addition of these modules to the Freeway audio range enhances the overall system flexibility with the ability to construct non square routers.

As with the rest of the Freeway analogue audio range, the input modules are fitted with 20 bit ADC's, converting the analogue signals presented to the module into the digital domain for distribution inside the router. By utilising this same internal digital architecture, the possibility of format-independent signal routing is retained. For example, a 16x16 analogue audio router can be expanded using two digital input cards providing a router with 32 digital and 16 analogue inputs and 16 analogue outputs. This mixed format router permits digital sources to be routed to analogue destinations saving on external audio converters.

5.1.1 AES digital audio

Freeway AES input modules may be set to operate in either synchronous or asynchronous environments. When operated as a reframing router, ***Freeway*** provides silent, 'click-less' switching between digital audio signals matching the reference input at rates of 32 to 48kHz. Operation at rates between 22.05 and 96kHz is supported by configuring the router in transparent mode. In order for these cards to function correctly, other modules used to construct the router must be configured for the same operating mode.

To promote flexible integration within any digital audio environment, modules may be ordered for operation with balanced or unbalanced (75Ω) inputs.

Other features include:

- reclocking and reframing architecture
- optionally transparent for multi-standard 22.05-96kHz operation

5.1.2 Analogue audio

The ***Freeway*** analogue audio input modules provide stereo operation, while incorporating signal processing features useful to mixed mono/stereo environments, like; left or right to both and channel swap. The transformerless input circuits are level adjustable to a maximum of +24dBu.

■ 5.2 Theory of operation

This section is divided into AES card and analogue card operation. However there is a common element between the modules which is covered as a precursor to this.

Both input module types have been designed to use the common, digital, data bus format shared by the ***Freeway*** analogue and digital audio router modules for interconnection within the frame. This permits modules to be used within mixed analogue/ digital routers.

5.2.1 AES digital audio

The AES card can be configured to operate either synchronously or asynchronously.

In order to be able to switch synchronously between digital audio sources, switches must occur at AES frame boundaries. In order to achieve this, all signals presented to the crosspoint bus must be co-timed, irrespective of their timing at the router input. This re-timing process, known as re-framing, buffers each input and locks it to the AES reference frequency. This will only work for signals of the same sample rate as the reference input supplied to the frame.

While this method of operation is preferred, it does impose some operational restrictions; First, only signals of the same sample rate as the reference input can be re-framed. Secondly, The routing of signals with sample rates above 48kHz is prohibited as the operating range of the reframing circuits prevent them from working above this frequency. Finally, the internal data format within ***Freeway*** means that the AES data has to be decoded - along with its channel status data, and then is encoded back to AES before leaving the router.

This process is not transparent to channel status data, and results in all of the AES outputs being re-written with default channel status as follows;

- Professional mode
- Emphasis not indicated
- Normal audio
- Stereo
- 48kHz

Because of these restrictions, ***Freeway*** has three operational modes permitting it to provide routing solutions for most digital audio applications. These modes are known as Mode 1, 2 and 3. In all cases, while the input cards can be set to operate in any of these modes, care must be taken to ensure that other cards within the audio router are set to operate in the same mode. Details for setting the router cards can be found in the relevant section of this handbook.

MODE 1 operation (Asynchronous 1)

In mode 1, the AES/EBU digital audio router is compatible with audio data from 22.05kHz to 96kHz. This mode enables the card to operate as a non-reclocking input module providing transparent operation. Unless great care is taken to time align each input to the router, this mode will result in audible glitches when switching, and is incompatible with analogue I/O cards.

MODE 2 operation (Asynchronous 2)

In mode 2, the card operates in a manner in which it simply reclocks the received audio data, in order to eliminate jitter, prior to switching. This mode, like mode 1 ensures transparency to all audio and channel status data. Mode 2 should be used where transparency is paramount and where the digital audio signal is at any recognised sample rate, with the exception of 22.05kHz and 96kHz. Unless great care is taken to time each input to the router, this mode will, like mode 1, result in audible glitches when switching and is also incompatible with analogue I/O cards.

Note that if the unit is configured in either mode 1 or mode 2, there is no compatibility with the bus data-format of the analogue audio level.

MODE 3 operation

This is the preferred operational mode, resulting in click-less, synchronous AES routing conforming to AES output timing. Channel status is 'over-written' with default channel status into the AES output data stream. When operated in mode 3, the router provides 'click-less' switching while integrating seamlessly with an analogue audio router card in a 'format-independent' router.

Balanced/ unbalanced operation

To promote flexible integration within any digital audio environment, systems are available with either balanced (50 way 'D' type) or unbalanced (BNC) inputs and outputs.

5.2.2 Analogue audio

The ***Freeway*** analogue audio input module employs high impedance, transformer-less input stages providing operation with signal levels of up to +24dBu.

Input signals are treated as stereo and passed to the crosspoint bus. As such there is no breakaway capability of left and right channels within these pairs. Advanced signal handling within the ***Freeway*** analogue audio modules, however, provides the switcher with the ability to 'modify' these stereo pairs. The audio modify functions provided for inputs are;

- channel swap
- left to both
- right to both,

In order to ensure that the internal bus is compatible with the digital signal modules, all input signals arriving on the module are converted between the analogue and digital domain using 20 bit converters. Once in the digital domain, these signals are presented to the digital crosspoint bus, permitting them to be passed to other ***Freeway*** audio routing modules.

5.3 4945 AES module installation and configuration

After setting the module as detailed in section 2 of this handbook, the card can now be configured for its correct audio operating mode.

The AES router card does not require customer alignment and has no user-serviceable adjustments beyond the card edge level / destination assign switches and the link changes required to program the operational modes. As each channel is individually configurable, a great deal of operational freedom is provided. However, beware of mixed-mode operation as, the result of switching a signal in one mode to a destination configured for another mode can result in high levels of noisy audio modulation. This can have potentially damaging effects on downstream audio equipment, especially loudspeakers (and ears!).

Remember, unless there is an overriding good reason to adopt another mode, mode 3 is the preferred operational mode for all channels.

5.3.1 LED indications

Sixteen miniature LEDs appear at the front edge of the AES router card. These LEDs are intended for input-status monitoring and may be used to determine whether audio signal (or audio modulation) is present on each of the 16 inputs to the card. The functionality of these LEDs change according to the operational mode the card is set for.

In mode 1, the LEDs indicate the presence of audio input data, irrespective of audio modulation.

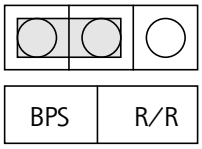
In mode 2, because the reclocking circuits free-run, the LEDs remain permanently lit, irrespective of the condition of the AES input signals and even if there is no input present.

In mode3, the preferred operational mode, the LEDs are illuminated when audio signal is present at the corresponding input. They will however be off when digital silence is present as an input.

For diagnostic purposes, the AES router card is fitted with a dual-coloured LED. This indicates whether or not the internal reference signal (TAES) is present. Green indicates that it is, while flashing red indicates that it is not. Should the AES reference be missing, this may cause audio disturbances during switching and must be rectified. The reference present LED, although mounted towards the rear of the card, can be seen when the board is housed within the frame simply by looking into the frame from the front, between the installed modules.

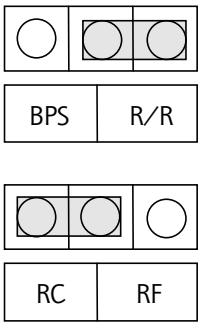
5.3.2 Configuring mode 1

In order to set the card to operate in this mode, links on the input stages must be set in the BPS (Bypass) position, as shown in the following diagram. (Note that when BPS is selected, the position of the links for the RC/RF selectors, also in the input area is irrelevant.) The operation of the circuit may be determined easily from examination of the ***Freeway*** audio system diagram in Chapter 5.2 of this section.



5.3.3 Configuring mode 2

In this mode, the input data is reclocked by the input stage receiver, before being passed to the crosspoint bus. The operation of the circuit may be determined from examination of the ***Freeway*** audio system diagram in chapter 5.2 of this section. In order to configure this mode, the links marked BPS/RR in the input stage area must be set to the R/R position. (The R/R stands for Reclock or reframe). Next, the links marked RC/RF must be set in the RC (i.e. Reclock) position. The position of these links is illustrated below.

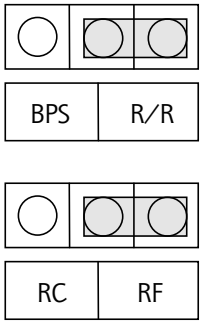


5.3.4 Configuring mode 3

In this mode the input stage works in a reframing mode, therefore the BPS/RR input stage links must be set in the R/R position, while the links marked RC/RF must be set to the RF (i.e. Reframe) position.

The operation of the circuit may be determined from examination of the ***Freeway*** audio system diagram (Section 5.2). The position of each of these links on the 4945 card is illustrated in the following diagram.

However, once again, beware of setting the router for mixed mode operation; ideally all channels should be configured the same way.



■ 5.4 Rear panel connections for AES

The AES input card uses a standard 16x16 Freeway audio router rear panel. While the connector panel is fitted with two connectors, one for inputs and the other for outputs, it is necessary in this instance to use only the input connector.

Refer to the diagram below for pinout details

Inputs			
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 –

5.5 4942 AES reference generator card

5.5.1 Theory of operation

Both the AES and analogue audio router require a source of digital audio reference to function correctly. Without this reference, the clock circuitry on the 4945 and 4745 cards will free-run resulting in pathological operation.

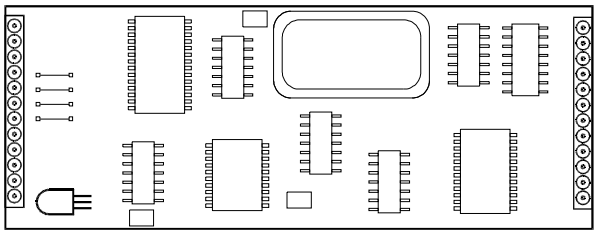
The 4942 card receives and locks to the incoming studio AES reference when present. If no AES reference is provided, the card generates it's own internal reference using a precision oscillator. In either case, the resultant reference is used to control the reframing circuits on the 4945 card and to drive the ADCs on the 4745 card.

When the 4942 card operates in the external-reference locked mode, it generates a reference signal which is used throughout the frame (signal = TAES) which is phase-advanced in relation to the incoming AES reference signal. Any delay through the router is compensated for, ensuring that the signals leaving the switcher conform to the requirements of the AES 11-1997 standard *(Synchronisation of digital audio equipment in studio operations).*

5.5.2 Installation and configuration

For diagnostic purposes, the 4942 card carries a dual-coloured LED which remains lit green while a reference is present and goes red, if the reference signal is not present. This LED is brightly illuminated in either condition and may therefore be seen when the board is housed within the frame by looking between the cards from the front.

The 4942 card has no test points or user-serviceable adjustments.



Ref present

(dual coloured LED)

5.6 4745 Analogue Audio module installation and configuration

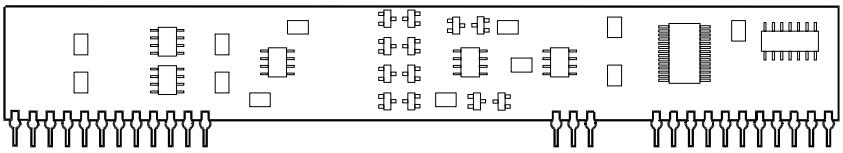
5.6.1 LED indications

In addition to the power and 'HELLO' LED's on the card edge, 16 miniature LEDs appear in the front right hand corner of the 4745 card. These LEDs are intended to be used for input-status monitoring and may be used to determine whether audio signal (or audio modulation) is present on each of the 16 inputs to the card. When an input's dynamic gate is set permanently OFF, these LEDs flag the presence of audio data, irrespective of audio modulation and therefore remain permanently lit. When the dynamic gate is set to ON, these LEDs indicate the presence of audio signal modulation and remain off when digital silence is forced as a result of the operation of the gate. In this mode the LEDs only illuminate when an audio signal is dynamically UNGATED. The setting and operation of the gate circuitry modes is covered in section 5.6.3.

For diagnostic purposes, the 4745 card carries a dual-coloured LED which remains lit green when the internal reference signal (TAES) is present. If, for some reason the internal TAES reference signal is not present, the LED flashes red. This indicates a fault condition which must be rectified to ensure correct system operation. This LED, although mounted towards the rear of the 4745 card, when illuminated in either condition can be seen by looking between the cards from the front of the frame.

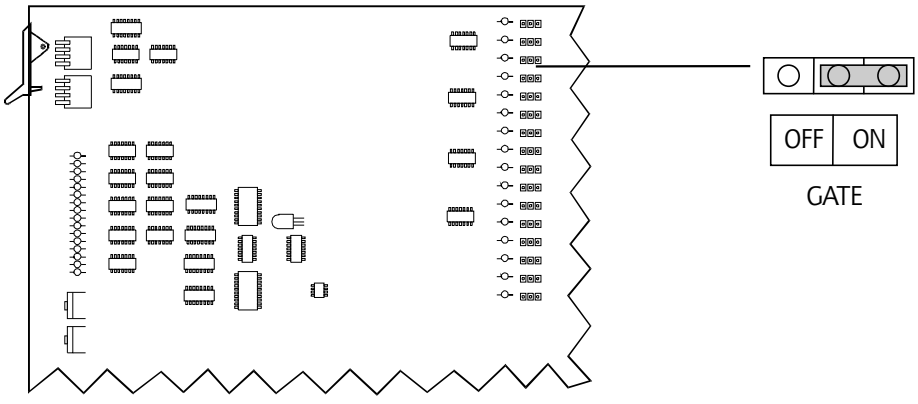
5.6.2 ADC submodule

The 4741 sub-module comprises a stereo common-mode rejection amplifier driving a 20 bit stereo ADC and side-chain circuitry. Signals arriving at the 4741 module (over and above the audio signals) include bit-rate and word-rate clocks, feeds and reset pulses. The two important signals leaving the sub-module include the digitally encoded PCM audio data and the side-chain gate-drive.



5.6.3 Setting Gate and Mute jumpers

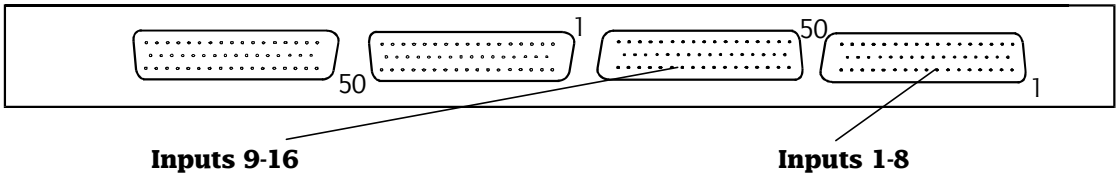
Freeway incorporates a digital amplitude-driven signal gate for each analogue input. This circuit is arranged so that signals below a threshold of approximately -75dBFS (coded PCM) are forced to digital silence. Hysteresis and a time-constant of 2 seconds ensure the gate does not 'chatter' on signals which dwell at low amplitude. With the gate ON, signal to noise ratio is increased to over 100dB. Gate operation is selected according to the position of the links illustrated in the following figure.



■ 5.7 Rear panel connections for analogue audio

The analogue input card uses a standard 16x16 Freeway audio router rear panel. While the connector panel is fitted with four connectors, two are for inputs and two for outputs, it is necessary in this instance to use only the input connectors.

Refer to the following diagrams for pinout details



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

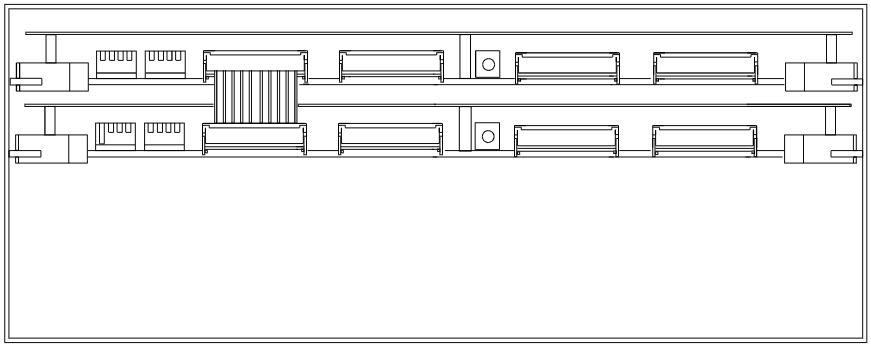
Pin	Function	Pin	Function
1	Chassis	50	Chassis
34	Gnd	42	Gnd
18	1L +	26	5L +
2	1L –	10	5L –
3	Gnd	11	Gnd
35	1R +	43	5R +
19	1R –	27	5R –
36	Gnd	44	Gnd
20	2L +	28	6L +
4	2L –	12	6L –
5	Gnd	13	Gnd
37	2R +	45	6R +
21	2R –	29	6R –
38	Gnd	46	Gnd
22	3L +	30	7L +
6	3L –	14	7L –
7	Gnd	15	Gnd
39	3R +	47	7R +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

■ 5.8 Expanding audio systems

Base ***Freeway*** audio modules may be expanded, with the addition of audio input modules up to the maximum allowable size for the router type being expanded, i.e. 32x16 for Freeway 32 and 128x16 for Freeway 128. It is necessary to fit the expansion module in the slot adjacent to the base router card or other input card before connecting the ribbon cables across the front of the modules. As both the analogue and digital audio variants utilise a common internal, digital, signal bus it is possible to expand an AES base router with analogue input modules, and conversely AES expansion cards may be used with an analogue base router.

Freeway 32 expansion

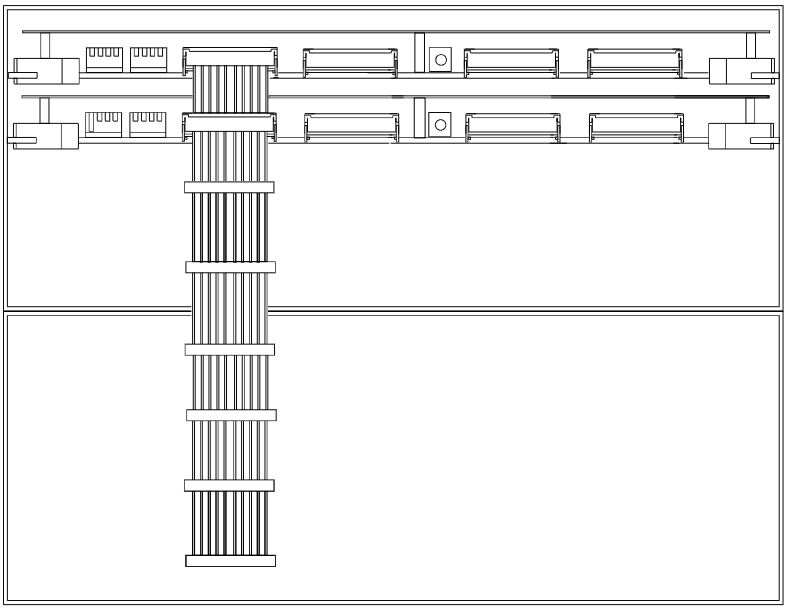
For Freeway 32, there is only one configuration using the input cards permitting expansion from 16x16 to 32x16. The following diagram shows the cable connections required for this expansion. Care should be taken to ensure that the level and destination assign switches are set correctly, see sections 2.2 and 2.3.



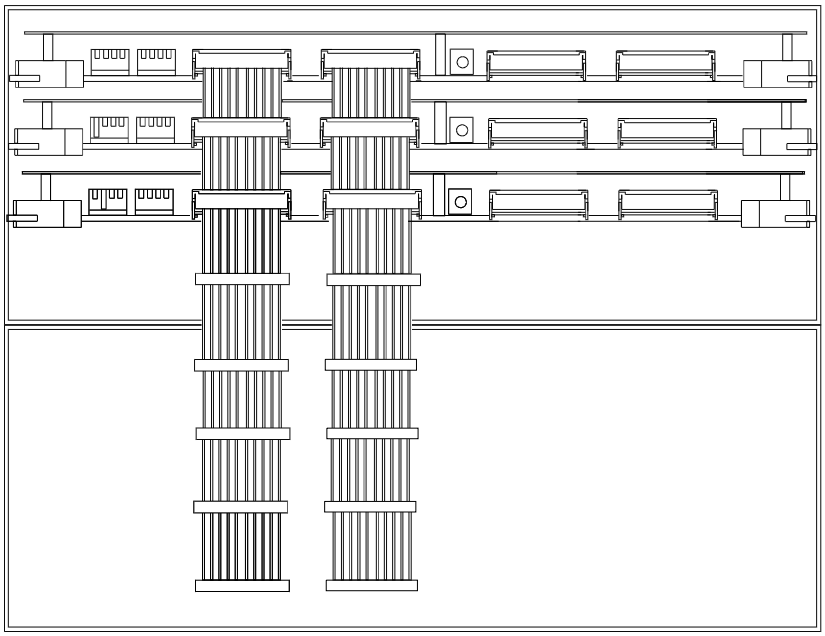
Freeway 128 expansion

The following diagrams show the cable connections required for expanding base routers from 16x16 for all possible combinations. Care should be taken to ensure that the level and destination assign switches are set correctly, see sections 2.2 and 2.3.

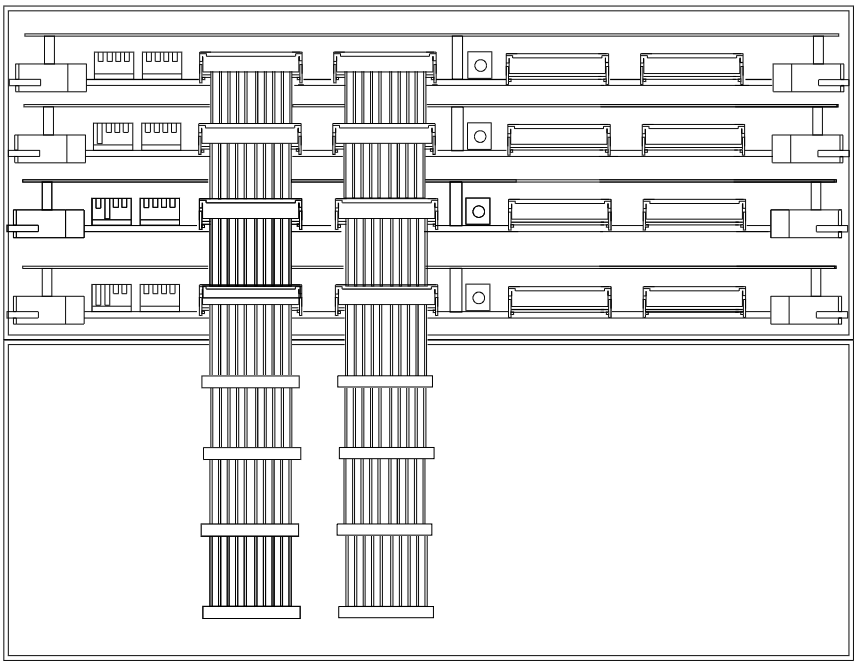
Freeway 128 can be expanded from 16x16 up to 128x128 in a single 6U frame, however it is possible to expand from 16x16 to 64x64 in a single 3U frame using the same ***Freeway*** 128 modules.



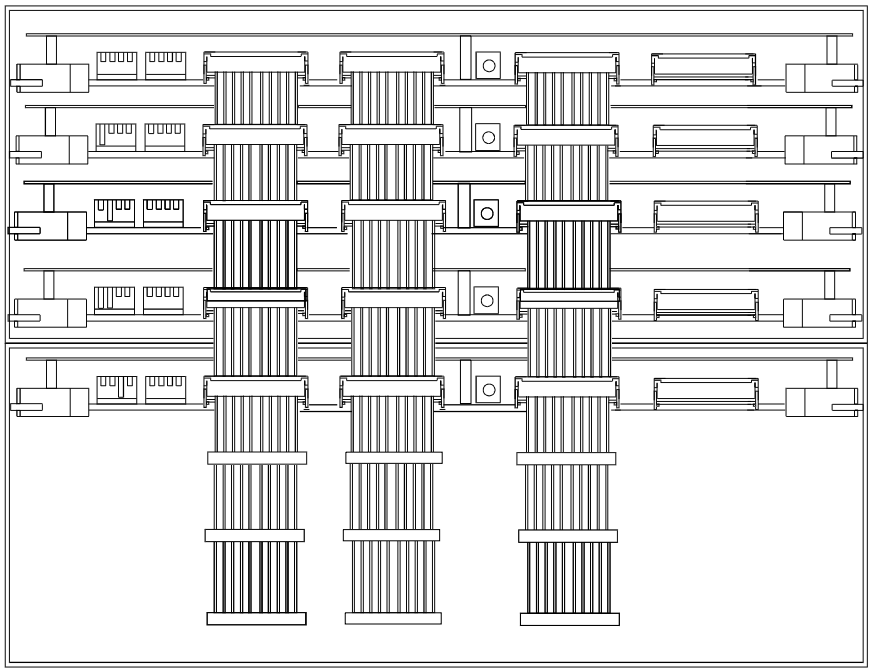
32x16 Expansion



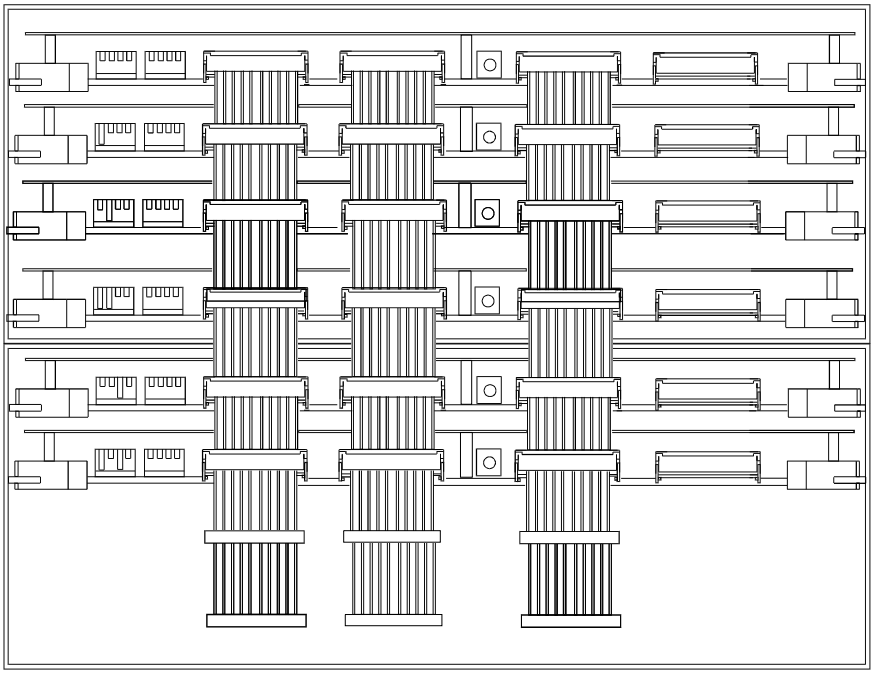
48x16 or 48x32 Expansion



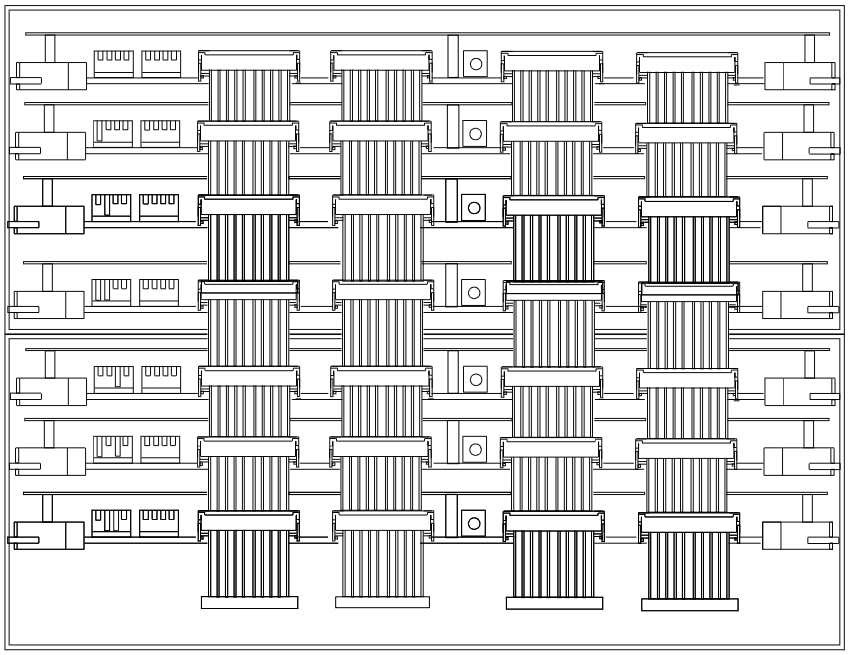
64x16, 64x32 or 64x48 Expansion



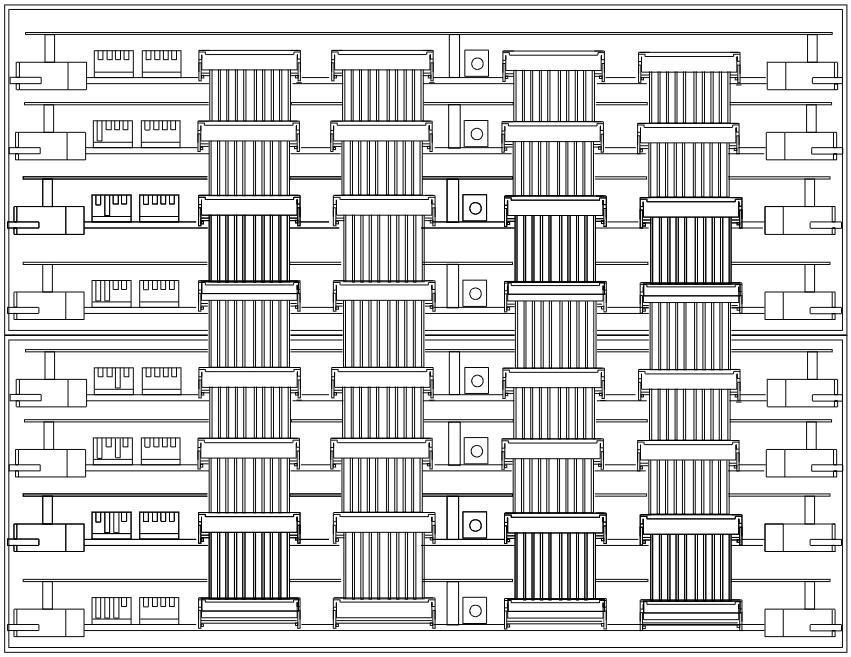
80x16, 80x32, 80x48 and 80x64 expansion



96x16, 96x32, 96x48, 96x64 and 96x80 Expansion



112x16, 112x32, 112x48, 112x64, 112x80 and 112x96 Expansion



128x16, 128x32, 128x48, 128x64, 128x80, 128x96 and 128x112 Expansion

■ 5.9 Specification

■ Digital input

Input impedance	110Ω balanced operation; 75Ω - unbalanced
Sample rate	22.05 to 96kHz (non re-clocking, non re-framing)
	32 to 48kHz (re-clocking and re-framing)
Wordlength	16 to 24bit
Non re-clocking performance'	Transparent to all bi-phase mark data
Re-frame performance	TBC's all inputs

■ Analogue input

Input impedance	> 10k
Max level	+24dBu (not achievable into a 600Ω load)
Gain stability	+/- 0.1dB/24 hours
Frequency response	+/- 1dB 20Hz to 22kHz
THD + N	< 0.1% at 1kHz, +18dBu
	< 0.1% at 1kHz, 0dBu
Dynamic range	>100dB: *THD+N on -60dBFS tone referred to full scale* (AES17-1991)
Signal to noise ratio	>100dB (gate operative)
Gate closure level	≈-55dBu (ie - 75dBFS), TC = 2 seconds, +2dB hysteresis
Crosstalk	<-90dB all hostile at 10kHz

6 Problem solving

Card does not work at all

Things that may affect general system operation:

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

The ERROR LED is lit on the 2440 control card

There is a handshake error (faulty module)

- check router has been re-configured correctly

Noisy or distorted signals present

Things that affect the signals.

Wrong output data mode configuration

- check that the destination on the AES card is configured correctly

Brief loss of power or reference

- try resetting the ADC and DAC chips on the analogue audio modules

Reference present LED flashing RED

- check audio level is fitted with a 4942 reference generator module
- check router has a valid AES reference

7 Optional hardware and spare parts

The following order codes relate to options and spare parts available for use with ***Freeway*** 32 routing systems.

Extra PSU, 1941	FRE-N000-BPSU
Extra μP card, 2440	FRE-N000-RCPU

Spare parts

3U Freeway frame	FRE-3000-0FRM
6U Freeway frame	FRE-6000-0FRM
Serial digital video signal card, 3945	FRE-N000-DVIP
Serial digital video rear connector card, 1739	FRE- N000-DVRC
Analogue video signal card, 3745	FRE- N000-AVIP
Analogue video rear connector card, 1739	FRE- N000-AVRC
AES signal card, 4945	FRE- N000-DAIP
Balanced AES rear connector card, 1463	FRE- N00B-DARC
Unbalanced AES rear connector card, 1749	FRE- N00U-DARC
Stereo analogue audio signal card, 4745	FRE- N000-AAIP
Stereo analogue audio rear connector card, 1747	FRE- N000-AARC