ECLIPSE MADI
USER GUIDE

Contents

1 Introduction

1.1 What is a MADI router?

The Pro-Bel MADI router is a high density audio routing system, which uses audio multiplexing technology to achieve compactness and flexibility. The core routing switcher uses the existing Pro-Bel Eclipse 7U frame, with power supplies, fan module and control card, and has therefore inherited many of that product's features. All input and output signals to the core router are required to be in MADI format, and therefore external equipment will be required to perform this conversion. Pro-Bel has manufactured a range of such equipment for a number of years, known as Transcoders, allowing both analogue and digital formats of audio to be multiplexed into MADI signals. The core router uses a Time Division Multiplexed signal bus, rather than crosspoints, to switch signals, and it is for this reason that such high density can be achieved. A matrix exceeding 900,000 effective crosspoints can be housed in a 7U frame, with the added benefit that the router dimensions can be configured in steps between 7280x112 and 1008x896, using the same hardware.

1.2 The MADI standard

MADI stands for Multichannel Audio Digital Interface, and is also known as AES10. It is a standard that is defined by the Audio Engineering Society, and came about to satisfy the needs of the professional audio industry. The requirement was to connect many channels of audio between different equipment, such as a 48 track tape machine and a mixing console, using a simple, reliable and flexible method. MADI achieves this by multiplexing up to 56 mono channels of audio, for transmission down a 75Ohm coaxial cable or fibre optic link. Usually the audio would already be in a digital format, known as AES, and at a common sample rate, usually 48kHz, however, MADI allows this sample rate to be continuously variable in the range +/-12%. Special integrated circuits were developed to code and decode the MADI signal into its AES components, these circuits are known as TAXI chips, TAXI stands for Transparent Asynchronous T(X)ransmit Interface. These chips are used in the Pro-Bel Transcoders.

1.3 Design features

The MADI router has many of the features associated with Pro-Bel's hardware products, giving it a robustness and ease of maintenance essential in critical signal applications. All modules are 'hot-pluggable'; surge suppression circuitry, and phased power-up allow quick and safe module swapping, this is further aided by the retention of crosspoint and configuration data in non-volatile control card memory. All modules are addressed by their position, rather than by jumper settings, and the careful consideration of power routing and driver voltage levels ensures that mis-plugged modules are not damaged.

If dual control cards are fitted; crosspoint, configuration and database information is synchronized between the two cards. Changeover is automatic in the event of failure, and the tri-state buffering of all control signals ensures that changeover is also transparent to any external systems.

A common AES reference is fed to all crosspoint modules, ensuring that all switching occurs during sample pre-ambles, and hence is 'click-free'. To add flexibility, individual crosspoint modules may be supplied with a separate reference, meaning that a single router frame can support completely independent routers, with isolated signals and different references.

The system is designed with the consideration of possible redundant operation. This may be achieved by using the dual MADI outputs provided as standard on the router, in conjunction with the dual MADI inputs and outputs provided on the Transcoder system. The entire system may be configured to automatically switch from a failed to active component, or manually switched for maintenance operation. For full redundancy, every component in the system (except the fan tray) may be duplicated, with the added benefit that any changeover will be automatic and transparent.

The dual redundant power supply units only supply 5 volts, all modules convert this to the required levels locally, which not only makes the power routing simple, but provides thorough power rail de-coupling between modules.

1.4 Transcoders

The Pro-Bel Transcoders are designed to complement the MADI router, and these are available in three forms. All transcoders have dual MADI inputs and/or outputs. Dual inputs may be configured to automatically switch over in the event of a MADI bitstream failure, enabling dual-redundant core routers to be easily implemented. The dual MADI outputs are duplicate, again giving the option of redundant operation.

All Transcoders are supplied as standard with 75Ohm coaxial interfaces, for driving or equalizing up to 100 metres of cable. As an option, they may be equipped with fibre-optic converters, allowing units to be placed up to 1km from the core router.

1.4.1 5605 AES Transcoder

This 3U frame converts 28 AES signals into one MADI output, and one MADI input back into 28 AES signals. All AES input signals must be synchronised with a supplied AES reference, that is, they must be at exactly the same frequency, reframing is applied at the input stage in order to time-align the signals. This unit is therefore provides a space efficient solution for switching synchronous AES with the MADI router.

1.4.2 5698 Multiformat Multiplexer Transcoder

This 3U unit will convert any combination of analogue audio, synchronous AES or non-synchronous AES audio into a single MADI channel. The unit has two ‘carrier’ cards, to which 28 sub-modules are fitted in the desired combination. Sub-module types are:

- 20 bit stereo Analogue to Digital Converter
- single channel synchronous AES with re-framing
- single channel AES Sample Rate Converter, for asynchronous AES

1.4.3 5699 Multiformat De-multiplexer Transcoder

This 3U unit will convert a single channel of MADI into any combination of analogue audio, or synchronous AES. The unit has two ‘carrier’ cards, to which 28 sub-modules are fitted in the desired combination. Sub-module types are:

- 20 bit stereo Digital to Analogue Converter
- 20 bit mono Digital to Analogue Converter (performs a (A+B)/2 mix)
- single channel synchronous AES

1.5 5604 MADI crosspoint card

At the heart of the system is a new crosspoint card. The 5604 fits horizontally into the Eclipse 7U frame and provides 18 MADI inputs, and 2 MADI dual-outputs, meaning that two feeds of the same output are provided. The last two MADI inputs are designated ‘expansion’ inputs, because they may be optionally used to connect to the outputs of another 5604, providing source expansion. A single 5604 therefore provides a maximum of 18x2 MADI routes, or 1008x112 mono audio routes.

1.5.1 Reference selection

Each 5604 card in the MADI router frame requires a reference signal in order to function

correctly, and in normal operation it is the 5604 in slot 1, the bottom slot, that generates the master reference for the frame. The card in slot 1 will attempt to lock to a reference in the following sequence:

1) the external AES reference

2) the MADI signal on input 1

3) the MADI signal on input 2, then each input in sequence up to input 18

4) it's own internal 48kHz oscillator

All subsequent 5604s, numbers 2 to 8, will derive their reference from this card, however, it this is not possible, they will also hunt for a reference, as follows:

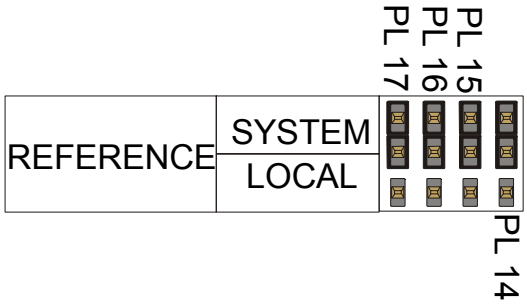
1) the MADI signal on input 1

2) the MADI signal on input 2, then each input in sequence up to input 18

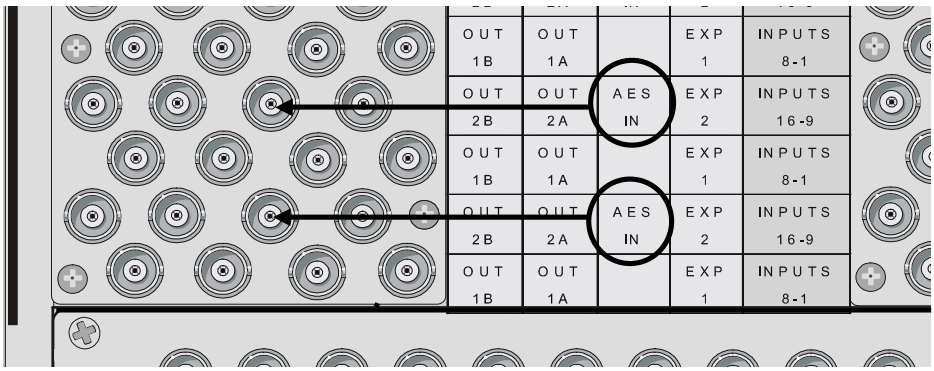
3) it's own internal 48kHz oscillator

The status of the reference is indicated by LEDs on the front edge of the card, as described in Section 1.5.3.

Each crosspoint card may use its own independent external reference signal. This would be an unusual situation, but does give the added flexibility of constructing a frame housing different routers connecting to non-synchronised systems. To achieve this, four jumpers must be moved on the crosspoint card, and a reference supplied to that card on the rear of the frame:



Reference selection jumpers on 5604 MADI crosspoint card: set all to SYSTEM for normal, global reference selection, LOCAL for independent reference



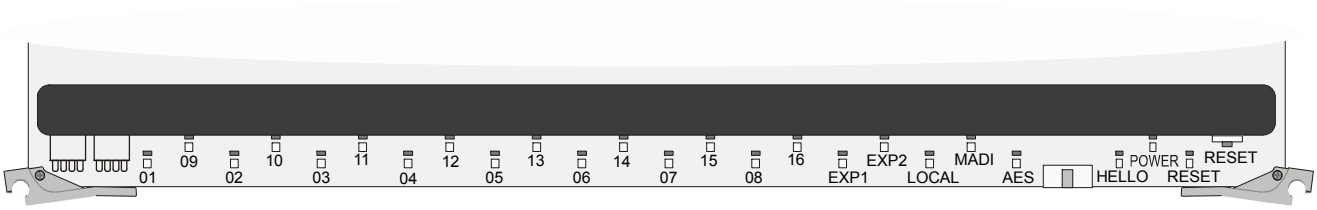
View of section of rear panel showing independent reference inputs for each card (only cards 1 and 2 shown).

1.5.2 Output monitoring

Each 5604 card has an AES3 output monitoring facility which allows two adjacent numbered audio channels to be monitored at the dual AES outputs on the rear of the frame, from either of the two MADI outputs. For instance, if channel 3 is selected then channel 3 will become the left and channel 4 will become the right of the AES output, if channel 56 (the last channel) is selected then channel 56 will become the left and channel 1 will become the right of the AES output. This feature is controlled by the external router control system, such as Aurora, for which an Output Monitoring panel must be configured, which will then route the selected signal to the dual outputs on the rear of the frame.

1.5.3 Description of status LEDs

The following is a view and description of the LEDs on the front edge of the 5604 MADI crosspoint card:



LED label	Function		colour
1 to 16	ON for legal MADI input, OFF for no input or invalid MADI, all channels then filled with silence		GREEN
EXP 1			
EXP 2			
LOCAL	3rd choice: Internal oscillator	Reference selected: ON when locked, flashes when not locked, OFF when no reference detected	YELLOW
MADI	2nd choice: First valid MADI input		
AES	1st choice: External AES		
HELLO	Flashes when a crosspoint is addressed		
POWER	5V being supplied to card		GREEN
RESET	Card held in reset		RED

Note: The reference LED on card 1 will always indicate correctly, but cards 2 to 8 will indicate both MADI and LOCAL if card 1 is locked to MADI or LOCAL. When card 1 is locked to AES, all cards will indicate AES.

1.5.4 Using the 5604 reset button

All 5604 cards have a RESET button, pressing this will cause the card to re-connect all of its crosspoints according to the tally table held in the 2404 control card memory. Under normal conditions, no crosspoints will change, but a 'glitch' will be noticed in the corresponding signal paths.

1.6 Controlling the MADI router

Like the Pro-Bel Eclipse series routers, the MADI router does not have its own control system, it must be connected to an external router controller, such as Pro-Bel's Aurora. The MADI router provides four serial control connections for this purpose, these are configured as RS422 on 9 pin D type sockets, and support Pro-Bels General Switcher protocol.

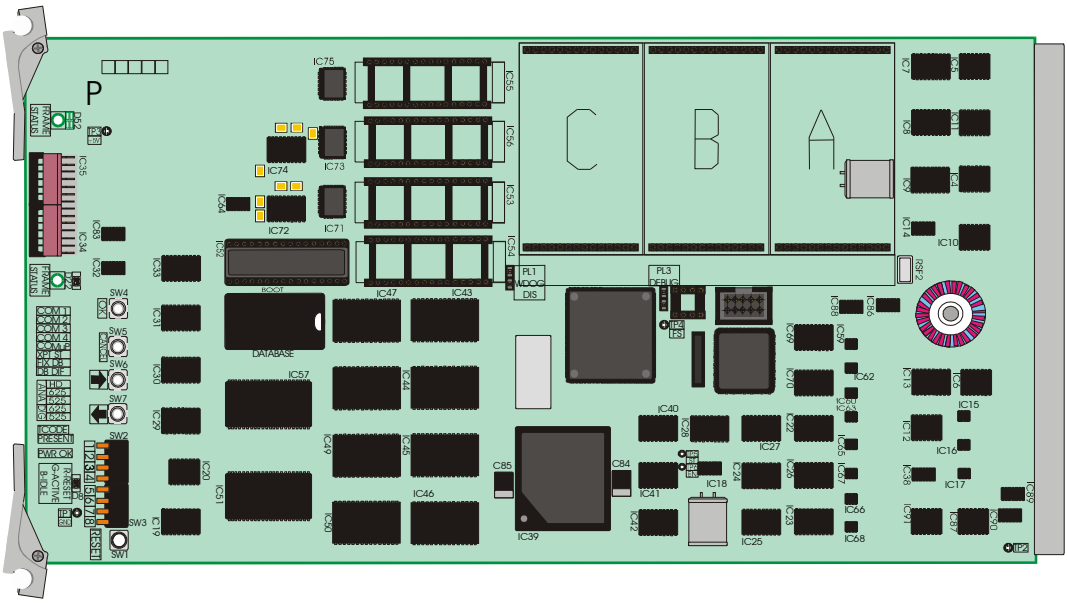
General Switcher protocol allows individual crosspoints to be set and acknowledged, it also supports 'polling' of the current crosspoint status of the router, as a background function. The protocol further supports diagnostics, enabling the control system to interrogate the

fault status of the system.

The General Switcher ports actually connect to the 2404 router control card, which interprets all commands and controls the crosspoints. The way in which crosspoint commands are interpreted is determined by the configuration of the control card, as explained in Section XX. For instance, the router may be configured in stereo pairs, in which case one crosspoint command will result in two crosspoints being set.

The key to controlling a MADI router is in the interaction between the router configuration and the Aurora database, and the user must understand both in order to correctly make routes. These subjects are covered in Section XX.

1.7 The 2404 control card



The 2404 control card is vital to the operation of the MADI router. It is a microprocessor-based module with battery backed-up non-volatile memory (NVRAM). The system code is contained in flash memory, allowing rapid boot-up and easy code upgrades. The NVRAM holds a record of the system crosspoint settings (known as the ‘tally table’), ensuring that the router status is maintained following power interruptions or signal card removal. It also holds an exact record of the router hardware, known as the ‘configuration’, which allows the control card to check that all components are present following a reset or power down. Finally, a local database is also held in this memory, containing details of the system mode of operation and, control port settings. All this data may be accessed either via the control cards built-in screen or using a PC and supplied software. Both these methods are

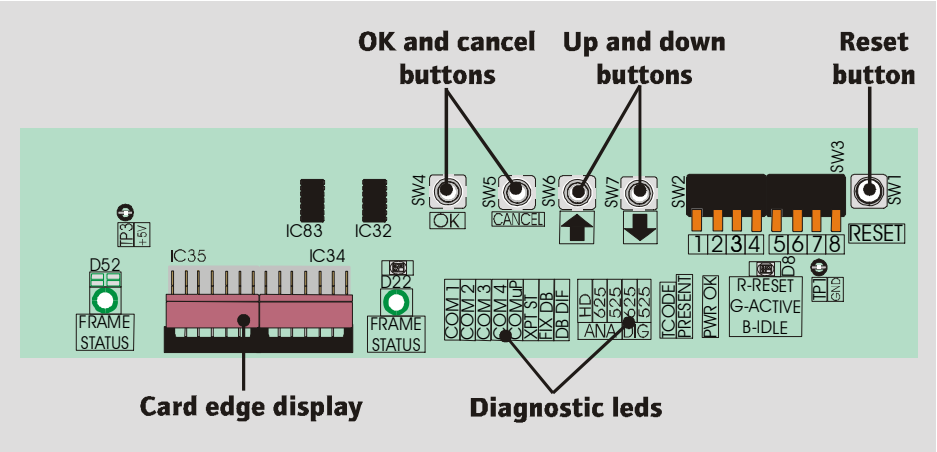
described in Section 4.

The control module connects to all router crosspoint cards using a parallel control bus, this is used to detect card presence and for setting crosspoints. PSUs and fan modules connect to the controller via a serial bus, which passes all status data.

All external communication with the router control system is passed through the control module. The control module also detects the AES and video reference signals, and determines at what point to make a crosspoint switch, in the absence of valid reference signals a 'crash' switch will be implemented.

The card is the same as that used in (later) Eclipse SDV and AES routers, but with updated software. The user can determine that the software is correct by examining the menu structure available through the cards LCD screen.

1.7.1 2404 control module LEDs



The module has yellow LEDs visible from the front with the door open as follows:

Led No	Function
1	Comms on 1st Router port (Flashes when data received)
2	Comms on 2nd Router port (Flashes when data received)
3	Comms on 3rd Router port (Flashes when data received)
4	Comms on 4th Router port (Flashes when data received)
5	Comms on Dual comms port (Flashes when data received)
6	Crosspoint set (flash)
7	Lights when the fixed database is in use
8	Database different (idle system only)
Timecode present led	Lights if timecode is present on the selected input

A tri-colour 'frame status' LED is fitted twice to the module, one of which is piped through the door and is visible with the door closed:

Colour	Description
RED	Indicates an error on either the Active or Idle card. The nature of the error may be interrogated via the card edge display and buttons
GREEN	No errors present and card Active
BLUE	No errors present and card Idle

A tri-colour 'processor status' LEDs is visible from the front with the door open:

Colour	Description
RED	RESET - processor is in reset
GREEN	ACTIVE – Flashes when processor is running on Active card
BLUE	IDLE – Flashes when processor is running on Idle card

1.7.2 2404 module switches and jumpers

The 8 way DIP switch has the following functions:

Switch	Function	Off (Up)	On (Down)	Normal operation
1	Boot prom selection	Main software (Flash)	Monitor software(EPROM)	UP
2	Transition – fixed database only	Switches on frame	Switches on field	UP
3	Sync delay	No delay	1 field or frame	UP
4			2 fields or frames	UP
5	Boot prom function	Hi-cross monitor	Test menu	UP
6	Monitor port baud rate (Test mode)	9600 Baud	38400 Baud	UP
7	Diagnostics	Off	On	UP
8	Not used	Not used	Not used	UP

The on-card jumpers have the following functions, and are left OUT for normal operation:

Jumper	Function	Out	In
PL1	Watchdog disable	Enabled	Disabled
PL3	Flash/RAM. This maps 2M of RAM to the Flash location. This is used for debugging.	Flash	RAM

1.7.3 The 2404 menu buttons

The UP, DOWN, OK and CANCEL buttons are used for accessing the control module menu, which is used for system configuration and diagnostics. This is fully described in Section 4.

1.7.4 Resetting the 2404 module

Pressing the reset button on single control module system will cause the processor to reboot. No data will be lost, all crosspoints and configuration information will be retained, and the module will be fully functioning again within a few seconds.

In a dual processor system, the same applies, but a processor changeover will be invoked, see the next section.

1.8 Dual control card operation

Since the 2404 control module not only holds the system status, but is also the channel of communication with the routing switcher, its failure would render the system inoperable. When dual control modules are fitted, a fully redundant control system is available, where changeover is both transparent and immediate.

When two control modules are fitted in a MADI router, the one in the left hand slot is designated 'Master' and the right hand slot other as 'Slave'.

In a dual control system one module will always be 'ACTIVE' while the other is 'IDLE', as indicated in the LCD display. In the event of the 'ACTIVE' controller failing, the 'IDLE' controller will take over control of the frame and become 'ACTIVE'.

On power up, the control module designated MASTER will become 'ACTIVE'. Every main loop, the software checks whether a changeover has occurred. When a controller changes state from 'IDLE' to 'ACTIVE', a message is issued to the remote control ports, such that any external system, such as Aurora, will be able to report the change.

Most data is synchronized constantly between the dual controllers, using an internal serial link. This data includes the tally table and router configuration, ensuring that in the event of a changeover no crosspoints change and all configuration parameters remain the same. However, the local database is not synchronized, for purposes of security, if data is ever changed in one controller, it must be manually transferred to the other controller, if this is intended. Since all control ports and reference signals connect only to the active controller, using tri-state drivers, a controller changeover will be transparent to the user.

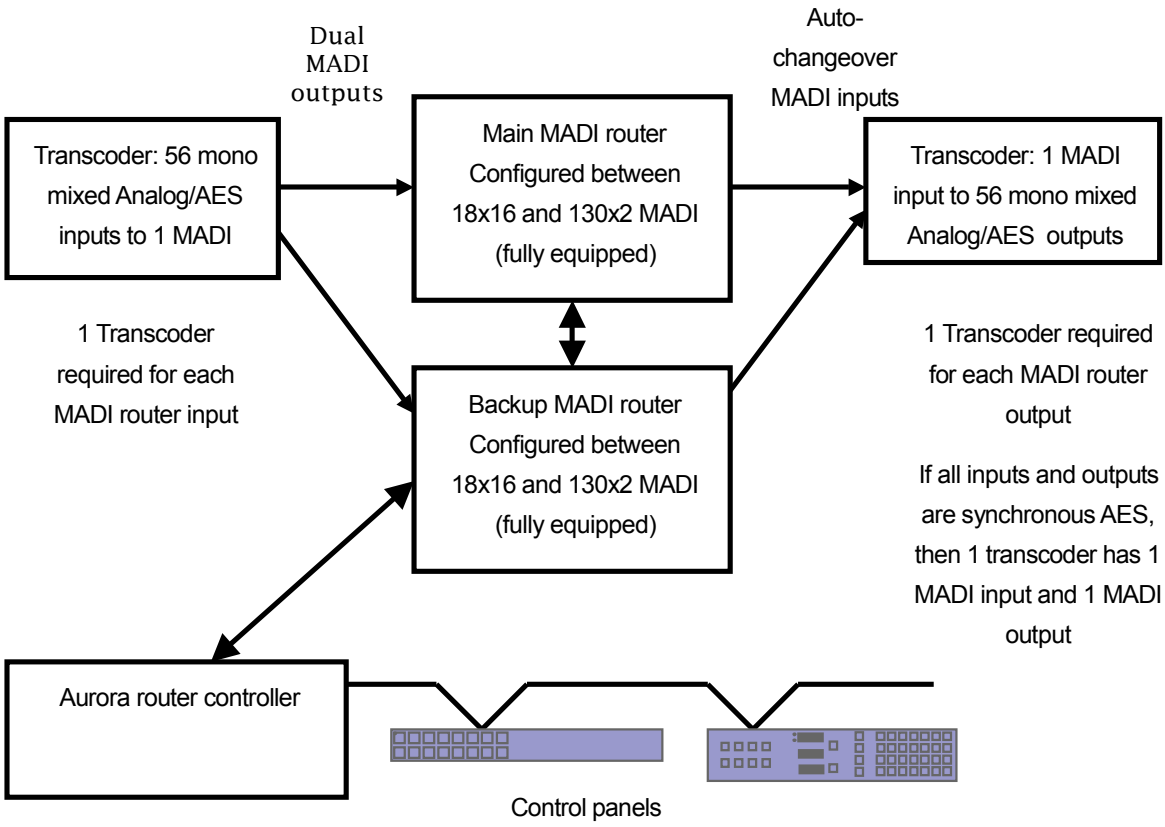
A controller changeover may be forced by the user by either pressing the reset button on the active controller, or by removing the active controller.

In the event of a second controller, being plugged into a single controller system, all data, except the database, is automatically transferred from the active controller.

Both the Master and Slave modules have an RS232 configuration port, intended for

connection to a PC running the supplied terminal software, see Section 4.2 for full details.

1.9 An example MADI routing system



2 Installation

The MADI router is supplied in a 7U frame with integral power supplies and cooling. All cards and modules are accessible from the front after the door has been opened or removed, and all signal and control cables are connected to rear panels. Ventilation air is taken from the left hand side of the frame, and exhausted on the right hand side, and this must be considered when mounting the unit.

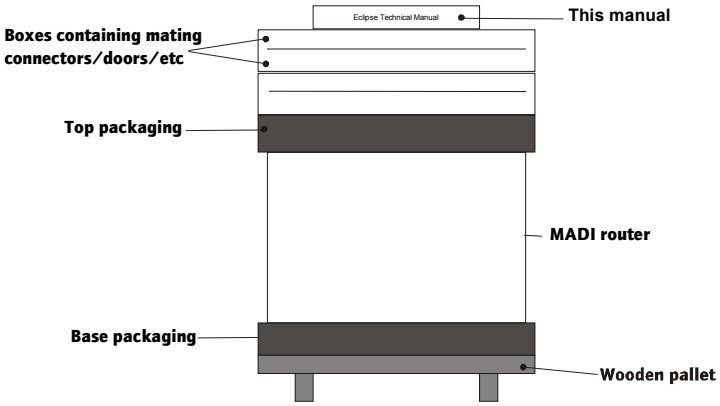
Should you experience any difficulties with any MADI frame, please refer first to Section 10 – Trouble Shooting, and then if you are still having difficulties contact customer support as detailed in Section 12 of this handbook.

2.1 Unpacking the Eclipse router

The MADI router is typically packed as shown below.

The standard MADI router is 7RU high. Expansion frames are also 7U, and each Transcoder frame and ICON rack (for the MADI Distribution Amplifiers) is 3U.

MADI router shown with external cardboard sleeve removed



2.2 Transporting the unit

The unit is intended to be transported on the pallet until it is as close as possible to the equipment rack it is to be installed in.

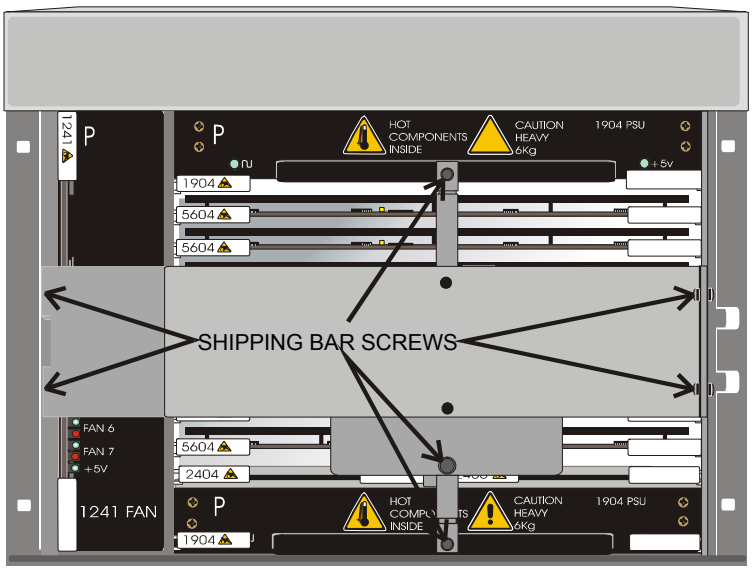
WARNING: This equipment is extremely heavy.

2.3 Preparing for rack mounting

WARNING: This product may contain Electrostatic Devices (ESD). Precautions to minimise the risk of damage, due to electrostatic discharge during handling, are recommended.

- Leave the doors, mating connectors and cables (if supplied) in their own packaging but remove from the main packing box
- Remove the shipping bar from the front of each frame by removing the seven screws as shown below
- Remove the PSU's to minimise the weight of the unit as described on the following page
- The fan unit may also be removed if desired
- Lift the unit into a standard 19" rack and secure using the rack mounting ears
- Refit the PSU's (and fan unit if removed)

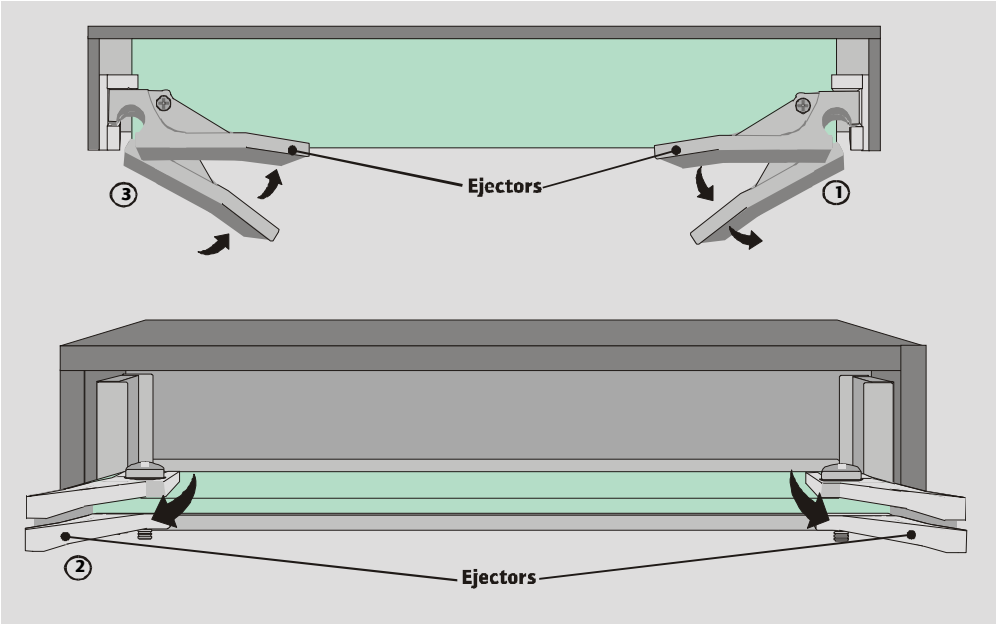
Note: It may be easier to fit the unit onto a shelf in the rack enclosure. This is acceptable practice as no convection cooling is employed in the router.



2.4 Removing and refitting the PSU

The PSU is removed by pulling gently and evenly on the ejectors at the edge of the unit until it disengages from the motherboard. With the ejectors pointing forwards the PSU may then be removed from the rack by pulling the folded handle at the front,.

When removing the PSU be careful to support it underneath. Take care as it is heavy.



To refit the PSU first engage it in the guides, then push it gently into the rack ensuring that the back of the ejectors engage into their slots. Once the PSU is in place push the ejectors inwards as shown in the diagram 3 .

2.5 Removing and refitting the fan

The fan is removed in the same way as the PSU, except that it is fitted vertically within the frame, not horizontally. The ejectors are located at the top and bottom of the fan module.

2.6 Fitting and removing the doors

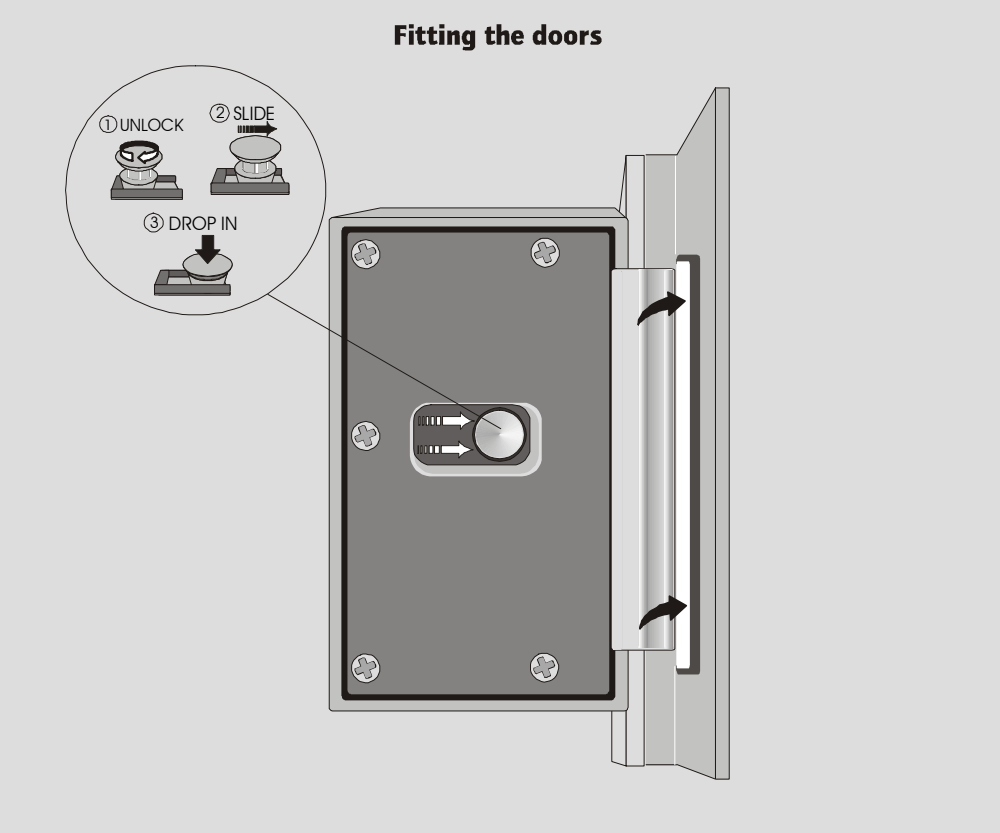
The doors may be fitted now or left until the router is fully configured.

The fan modules provide adequate cooling for the Eclipse router even with the doors removed, although exhaust air may be forced out of the front of the bay.

Doors must be fitted during normal operation i.e. once the installation and configuration phases are complete.

To fit the door, first rotate the peg clockwise to unlock it (if locked) and hold it in the up position. Fit the door over the fixed hinge on the frame and close it to approximately 45 degrees. Now slide the moving latch along the door towards the hinge.

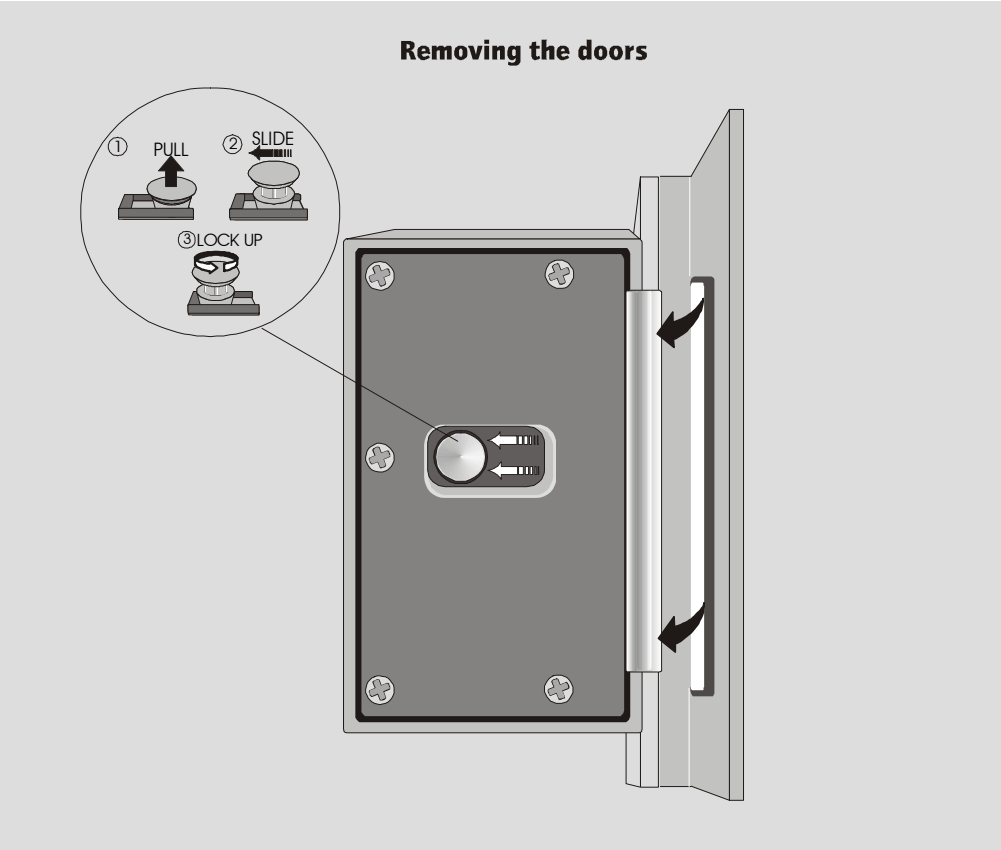
The peg will click into the door holding the moving latch over the hinge.



To remove a door pull up the peg located near the hinge assembly and slide the moving

latch along the door away from the hinge.

The peg may be locked in the up position by rotating it anti-clockwise. With the moving latch in this position the door may be lifted off the hinge and away from the frame.



2.7 Fitting and removing signal modules

Crosspoint and control modules are fitted and removed from the front of the frame in the same way as detailed for the PSUs. (Section 2.3).

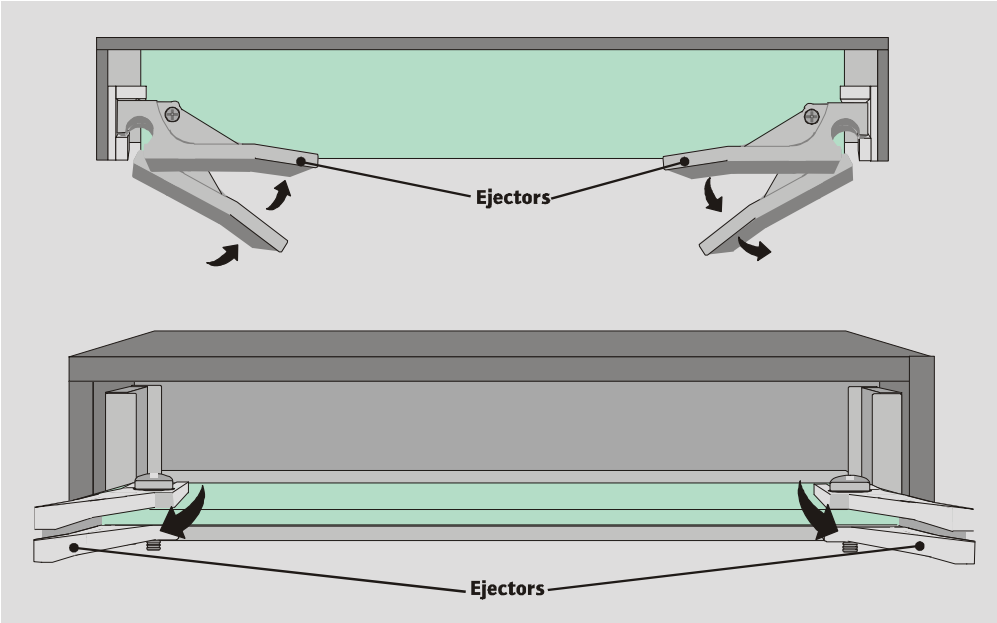
When fitting or removing these modules please note the following:

- Be careful to align the module in the guides
- Ensure the module is fitted on the correct position
- Remove and refit the module by means of ejectors in the same way as the PSU

Due to the high density connector, some force may be required to fit the modules. Ensure that this is applied evenly to both ejectors.

A guiding system is incorporated with the connector to guarantee pin alignment.

Make sure that the module is pushed fully home.



2.8 Ventilation

Each frame employs an internal fan assembly providing horizontal cross ventilation to

maintain a cool, internal, air temperature. Frames may therefore be mounted directly on top of each other, or other equipment, without the need for vertical separation. Care should however be taken when mounting frames directly above other equipment to ensure that they are not subjected to excessive heat from that equipment, and that cooling vents in equipment directly above or below them are not obstructed.

It is therefore essential during the installation process to observe the following points:

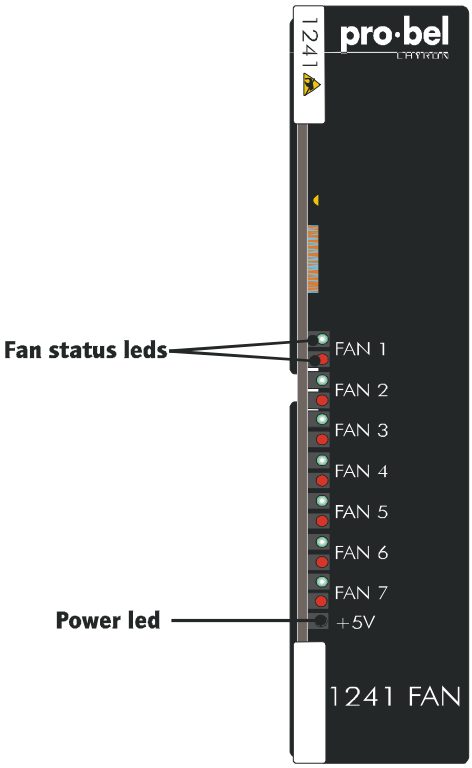
- Do not obstruct the vents on the unit to allow cooling to take place, allow at least 40mm free space on each side of the frame
- Ensure that both the fans and vents have access to the ambient temperature room air
- Do not obstruct cooling vents in equipment directly above or below the frame.
- The door must be fitted and closed to ensure adequate cooling when the unit is powered

2.9 Fan module

The 1241 fan module has seven DC powered radial fans which have their current consumption constantly checked in order to detect failure due to stalling, disconnection or burning out. In order to minimize inrush current when the fan module is powered up, it features phased start up. Two fans start after approximately 0.5 seconds, two more after about 1 second, and the final three after about 1.5 seconds. Two LEDs for each fan are located on the front of the card as follows:

- Green: power is supplied to the fan
- Red: any fan fault

Any faults are also reported to the Alarms connector on the rear of the frame, and also as serial data to the 2404 control module.



2.10 Power supplies

MADI router frames are fitted with single or dual redundant, auto-sensing, 1904 power supply units and will operate from mains voltages between 100 and 230 Vac, with frequencies of 47 to 63Hz. These PSU's automatically adapt to the supplied mains (line) input voltage, therefore no user adjustment of the PSU is required. The supplies are rated at 500 Watts and provide a single 5 Volt DC rail.

The PSU's are plug-in modules which connect to an IEC mains input connector on the rear of the frame. There is no power isolator switch provided on the frame. For additional safety, the IEC connector is fitted with an integrated fuse holder.

Cooling for the power supplies is provided by the fan module.

For EMC and safety reasons the mains, chassis and signal earths are permanently connected together within the frame.

With the front door opened, two leds are visible on each PSU, one indicating that the mains input is active and the other for the 5 Volt rail status.

Alarm relay contacts are available on the rear of the frame. All PSU fault conditions are also reported to the control module and indicated as an error.

2.11 Rear panel control connections and switches

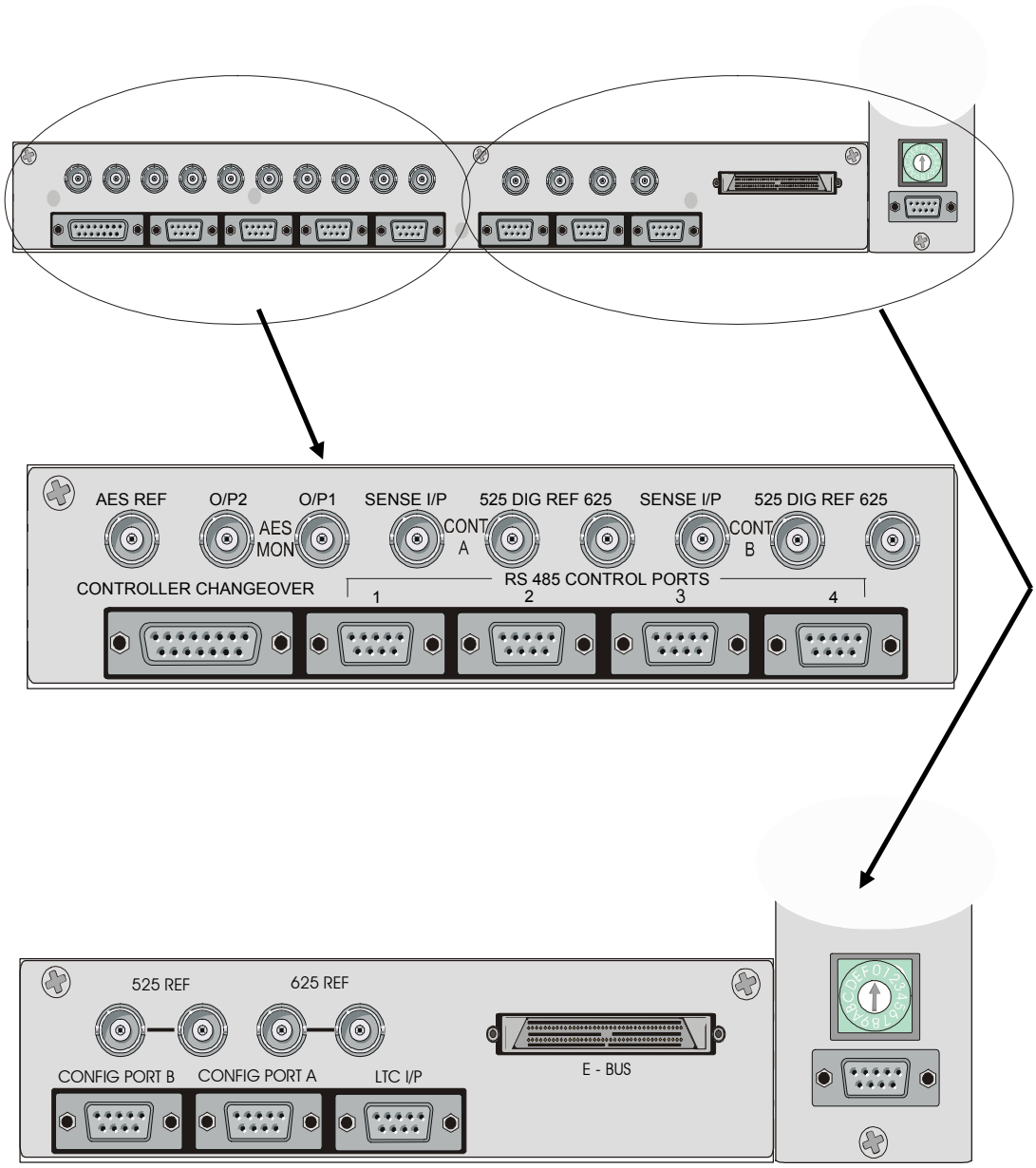
MADI routers frames have a common set of rear control connections and switches, as follows:

- Four 9 pin D type sockets configured as RS422 General Switcher protocol ports (labelled as 'RS485 control ports')
- A rotary Hex switch, for configuring the router
- Two 9 pin D type sockets configured as RS232, for configuring the main and backup control cards (labelled as 'config port A', 'config port B')
- 9 pin D type socket for a timecode (LTC) input (for timed switching, if supported by the control protocol))
- 9 pin D type socket for power supply and fan alarm relay contact outputs
- BNC for an unbalanced AES reference
- a loop through analogue 625 line black and burst reference input*
- a loop through analogue 525 line black and burst reference input*
- a loop through digital 625 line black and burst reference input*

- a loop through digital 525 line black and burst reference input*
- 2 auto-sensing BNC inputs, not active on a MADI router
- 2 BNCs for AES output monitoring
- multi-way 'E-Bus' connector for frame expansion

*not supported on a MADI router

The rear panel is laid out as follows:



2.12 Control connector pinouts

The connectors on the rear panel are wired as follows:

2.12.1 'RS485-A, B, C and D' connector pinouts

9 way 'D' type fixed sockets on frame.

These ports are configured as RS422 using 'General Switcher' protocol. The pinout for these modes is as follows.

pin	Function
1	CHASSIS
2	Tx-
3	Rx+
4	0V
5	n/c
6	0V
7	Tx+
8	Rx-
9	CHASSIS

2.12.2 Configuration RS232 connector pinouts

This connector is configured so that is may be directly connected, pin for pin, with the COM port of a PC.

9 way 'D' type fixed sockets on frame.

Pin	Function
1	N/C
2	Rx
3	Tx
4	N/C
5	0V

6	DTR COMMON
7	RTS
8	CTS
9	N/C

2.12.3 Alarms pinouts

9 way 'D' type fixed socket on frame. Note that the following states are for a powered frame which is functioning correctly:

Pin	Function
1	PSU1* Relay normally open
2	PSU1* Relay normally closed
3	PSU2 Relay common
4	Fan Relay normally open
5	Fan Relay normally closed
6	PSU1 Relay common
7	PSU2* Relay normally open
8	PSU2* Relay normally closed
9	Fan Relay common

The relay contacts will change state to indicate any power or fan failure within the frame

2.12.4 Changeover port

15 way D type fixed socket for connecting to a change over panel with lamps for status indication and a key switch for active/idle change over. The outputs may be used as alarm indications to signal a processor changeover.

Pin	Function	Input or Output
1	Low to set A active	Input
2	Low to set A idle	Input
3	A active lamp drive (Low)	Output
4	A idle lamp drive (Low)	Output
5	A fail lamp drive (Low)	Output
6	Low to set B active	Input
7	Low to set B idle	Input
8	B active lamp drive (Low)	Output
9	B idle lamp drive (Low)	Output
10	B fail lamp drive (Low)	Output
11	Not connected	
12	Not connected	
13	+5V	
14	0V	
15	0V	

2.13 Using the AES reference

In order to perform ‘click-less’ switching of digital audio signals, a ‘cut’ must be made during a point in the data stream when no audio is present. For this to happen all the digital audio signals must be ‘re-framed’, or time-aligned synchronous with the AES reference, at the input stage. In a MADI router, all audio signals will have been reframed at the Transcoder stage using a reference signal applied independently to these frames, but is also important

to provide the same reference to the router frame in order to minimize jitter and ensure clean switching.

2.14 Using the video reference

The presence of any video reference on the MADI router frame will be detected by the control module and used to switch sources at the appropriate point. An audio cut is performed at the first audio pre-amble following a television field boundary (as derived from the video reference input). The router will switch each input according to the reference configured in the control module database, see Section 4. A choice may also be made between field or frame switching, this is also configured in the control module database.

3 Configuring the router

The MADI router configuration must be considered in two forms:

- the hardware configuration
- software configuration

Hardware configuration determines the dimensions of the router. Up to eight 5604 crosspoint cards may be fitted into a 7U frame, and these can be configured in one of four ways, giving different maximum router sizes. The hardware is configured using a HEX switch and interconnecting leads, as described in the next section.

Software configuration is achieved through the 2404 control card menu, which gives three choices of operation: Mono, Auto Stereo or Manual Stereo. Auto stereo maps the router into fixed stereo pairs, meaning that the control system only has to set one crosspoint to connect a stereo path, this makes routing simple, but inflexible. Manual stereo requires the control system to make two paths for each stereo pair, this is complex to control, but more flexible. This is described later in this chapter.

3.1 Hardware configuration

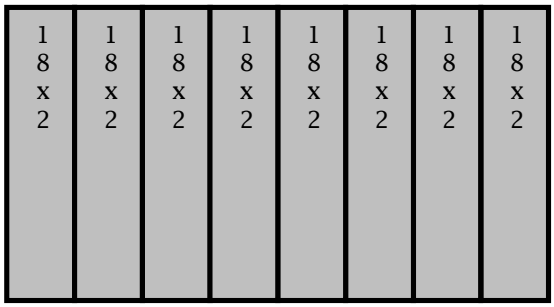
A 5604 is an 18x2 MADI crosspoint, the last 2 MADI inputs being designated ‘expansion’ inputs. Crosspoint cards may be configured in ‘source expansion’ mode, where the outputs of one card feed the expansion inputs of the next, or ‘destination expansion’ mode where the same sources are fed to several cards. In destination expansion mode, MADI Distribution Amplifiers must be used to copy the input signal to more than one card. MADI DAs are provided externally to the router, in an ICON frame.

The user must select the desired mode using the HEX switch on the rear of the frame, and then connect cabling as required between the crosspoint cards and MADI DAs.

It is convenient to consider each 5604 card as an array of crosspoints, represented by a rectangular box. Then all configurations may be described by the following diagrams:

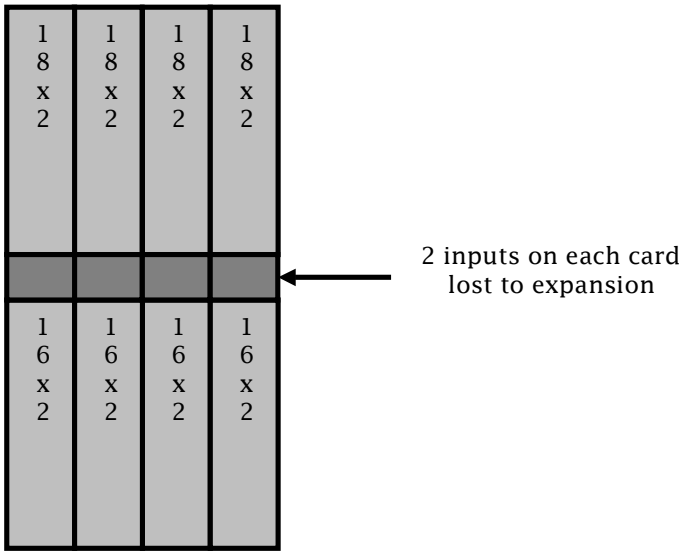
HEX switch position 0

18x16 MADI, 1008x896 mono, 18 MADI DAs



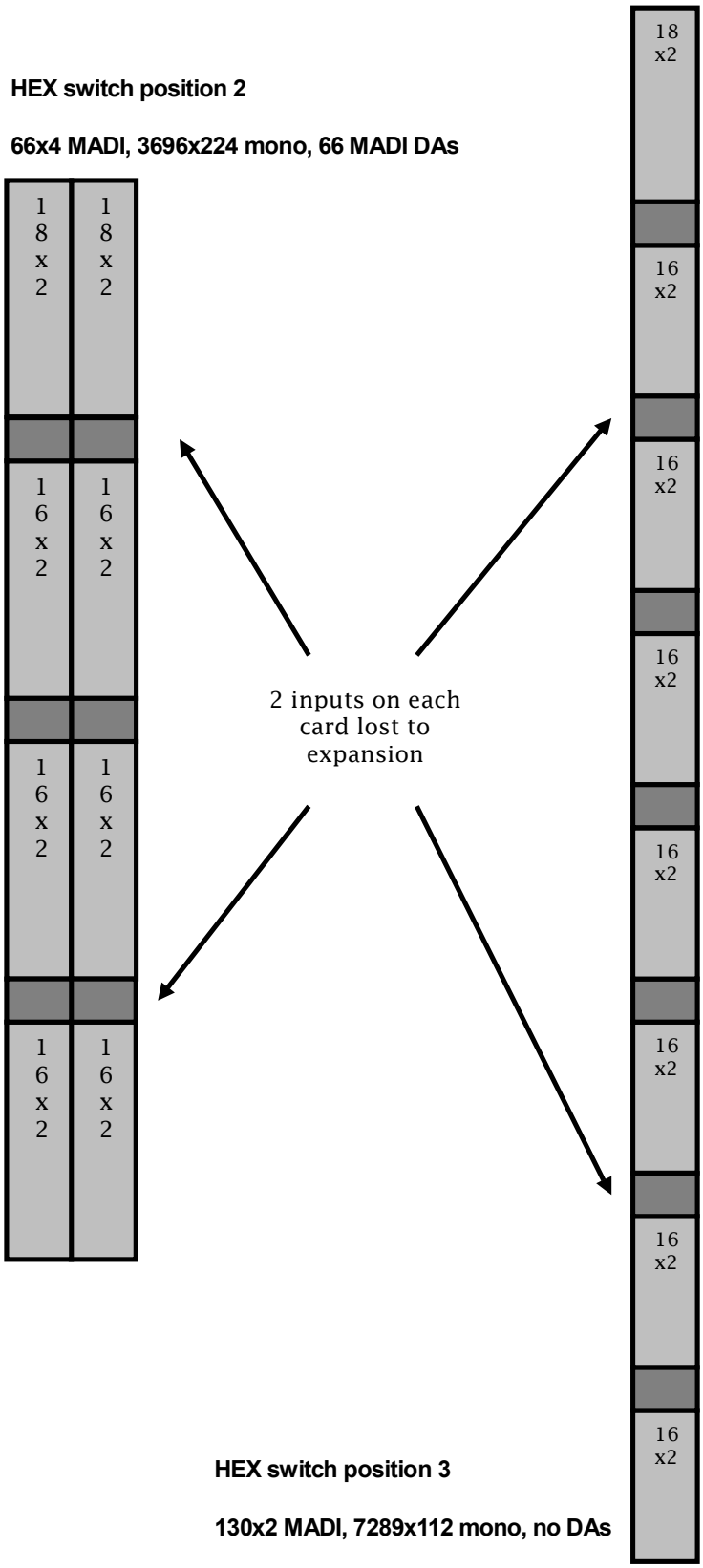
HEX switch position 1

34x8 MADI, 1904x448 mono, 34 MADI DAs



This diagrams represent a fully equipped 7U MADI router, but crosspoint modules may be removed from any configuration to achieve the required dimensions. The full range of possible configurations is given in the next section.

Eclipse MADI



3.1.1 Table of router dimensions

This table shows details of different mono audio router dimensions when using MADI crosspoint cards in a 7U frame:

SOURCES * DESTS	1008	1904	2800	3696	4592	5488	6384	7280
112	0/1/0	1/2/0	2/3/0	2/4/0	3/5/0	3/6/0	3/7/0	3/8/0
224	0/2/18*	1/4/34*	2/6/50*	2/8/66*				
336	0/3/18	1/6/34						
448	0/4/18	1/8/34						
560	0/5/18	Not Available						
672	0/6/18							
784	0/7/18							
896	0/8/18							

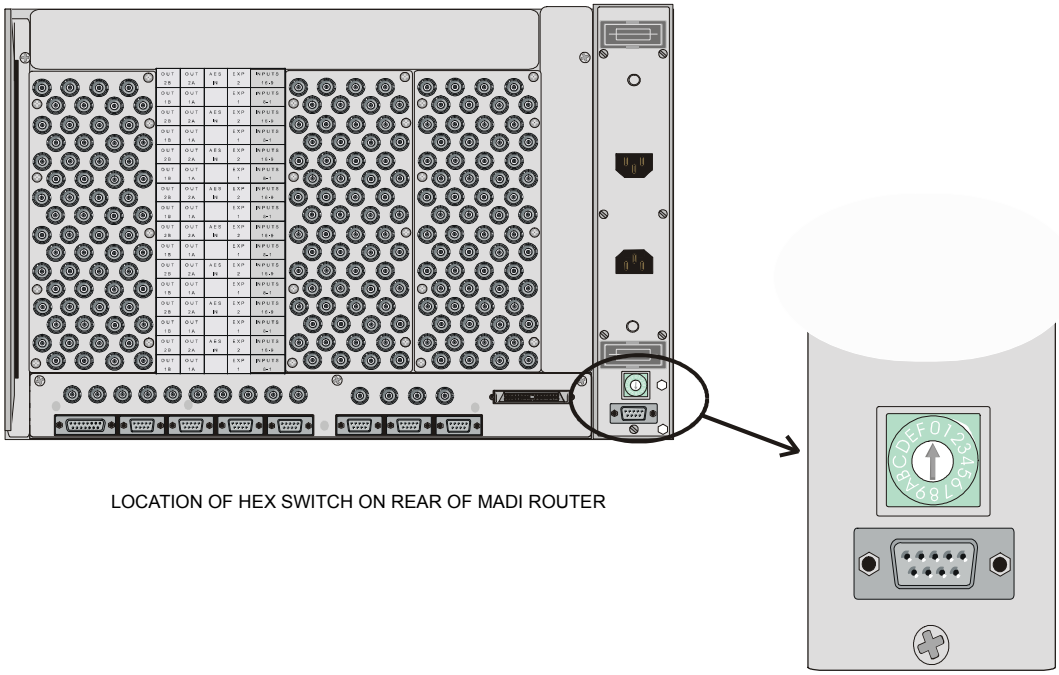
Use the table by locating the cell corresponding to the desired maximum router dimensions, the numbers in the cell correspond to the following:

HEX switch setting / number of 5604 crosspoint cards / number of MADI DAs

*the asterisk indicates that the dual outputs of the transcoder may be used instead of separate Distribution Amplifiers, since the input only needs copying once.

3.1.2 Location of the HEX switch

As previously detailed, the HEX switch is fundamental to the configuration of the MADI router, and must be set correctly.



LOCATION OF HEX SWITCH ON REAR OF MADI ROUTER

3.1.3 Connecting the expansion and DA cables

When the HEX switch is in position 1, 2 or 3, it is necessary to use the expansion inputs on some of the 5604 crosspoint cards, which are always numbers 17 and 18. Slots in the MADI router frame are numbered from the bottom, and where required, the outputs of cards in even numbered slots are connected to the expansion inputs of the card in the lower odd numbered slot.

For instance, where card numbers 1 and 2 require interconnection to form a 34x2 MADI router, card number 2 outputs connect to card 1 expansion inputs, 17 and 18. MADI inputs 1 to 16 are present on card 1, and 17 to 34 are on card 2.

Where MADI Distribution Amplifiers are required, Pro-Bel will supply an ICON frame(s) with the requisite number of 3404 modules, which is a 10 output device. Cables will also be supplied.

The following tables specify all expansion cable requirements for MADI router configurations:

HEX switch position 0

5604's required	3404's required	MADI Size	Router Size	Expansion Connections
1	None	18 x 2	1008 x 112	None
2	18	18 x 4	1008 x 224	None
3	18	18 x 6	1008 x 336	None
4	18	18 x 8	1008 x 448	None
5	18	18 x 10	1008 x 560	None
6	18	18 x 12	1008 x 672	None
7	18	18 x 14	1008 x 784	None
8	18	18 x 16	1008 x 896	None

HEX switch position 1

5604's required	3404's required	MADI Size	Router Size	Expansion Connections
2	None	34 x 2	1904 x 112	Card 2 O/ps to Card 1 Exp i/ps
4	34	34 x 4	1904 x 224	Card 2 O/ps to Card 1 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps
6	34	34 x 6	1904 x 336	Card 2 O/ps to Card 1 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps Card 6 O/ps to Card 5 Exp i/ps
8	34	34 x 8	1904 x 448	Card 2 O/ps to Card 1 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps Card 6 O/ps to Card 5 Exp i/ps Card 8 O/ps to Card 7 Exp i/ps

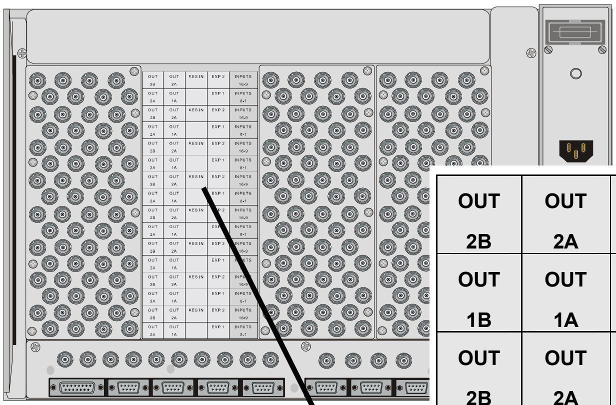
Hex switch position 2

5604's required	3404's required	MADI Size	Router Size	Expansion Connections
4	none	66 x 2	3696 x 112	Card 2 O/ps to Card 1 Exp i/ps Card 3 O/ps to Card 2 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps
8	66	66 x 4	3696 x 224	Card 2 O/ps to Card 1 Exp i/ps Card 3 O/ps to Card 2 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps Card 6 O/ps to Card 5 Exp i/ps Card 7 O/ps to Card 6 Exp i/ps Card 8 O/ps to Card 7 Exp i/ps

HEX switch position 3

5604's required	3404's required	MADI Size	Router Size	Expansion Connections
8	none	130 x 2	7280 x 112	Card 2 O/ps to Card 1 Exp i/ps Card 3 O/ps to Card 2 Exp i/ps Card 4 O/ps to Card 3 Exp i/ps Card 5 O/ps to Card 4 Exp i/ps Card 6 O/ps to Card 5 Exp i/ps Card 7 O/ps to Card 6 Exp i/ps Card 8 O/ps to Card 7 Exp i/ps

For completeness, the following is a copy of the label reproduced on the rear of the router frame, showing the MADI input and output connections. Cables for linking outputs to expansion inputs are supplied as required with the router:



OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1
OUT 2B	OUT 2A	AES IN	EXP 2	INPUTS 16-9
OUT 1B	OUT 1A		EXP 1	INPUTS 8-1

View from the rear of the MADI router.

Crosspoint card slots are numbered from the bottom, and each card has two rows of BNC connectors associated with it. The labels in white are the connectors to the right of the label panel, labels in gray are those to the left.

3.2 Software configuration

There is a choice of three configurations available through the 2404 control card menu, which must be chosen to match operational requirements. This configuration will determine the manner in which the external control system will switch the router, and must therefore be considered in conjunction with the control system configuration.

Section 4 describes how to access the control card menu. One of the following modes must be selected:

- Mono mode
- Auto Stereo
- Manual Stereo

3.2.1 Mono mode

In this mode the router appears as one continuous block of sources and destinations to the external control system. All crosspoints in the physical router are accessible to the control system, and if stereo pairing is required this must be implemented by the external control system.

3.2.2 Auto stereo mode

In this mode the 2404 control card will 'map' incoming commands into real crosspoint values, using a fixed formula that switches a stereo pair from a single command. The formula can be written:

Real left source or destination = incoming source or destination X 2

Real right source or destination = (incoming source or destination X 2) + 1

When it is considered that source and destination numbering starts at zero within the software, an example of this formula would be:

Incoming crosspoint 1,1 sets 1,1 and 2,2

Incoming crosspoint 2,2 sets 3,3 and 4,4

Incoming crosspoint 10,10 sets 19,19 and 20,20 etc.

Therefore, all odd numbered sources and destinations on the router are Left channels, and even numbered sources and destinations are Right channels. The user must connect source and destination equipment as consecutive left/right pairs, unfortunately this means that mono equipment can only be accommodated by using a pair of inputs or outputs.

3.2.3 Manual stereo mode

This mode allows the external control system to set stereo pairs, if required, using a 'block offset' to distinguish between left and right. The block offset is equal to exactly half of the configured dimensions of the router, and must be used by the external control system in order to correctly set crosspoints.

The formula is as follows:

Real left source or destination = incoming source or destination X 2

Real right source or destination = ((incoming source or destination – block offset)X2) +1

If an example is considered for a router size of 1008X896, configured for Manual Stereo Mode, and therefore the block offset is 504X448 (i.e. half the physical router size), crosspoints would be set as follows:

Incoming crosspoints 1,1 and 505,449 set 1,1 and 2,2

Incoming crosspoints 2,2 and 506,450 set 3,3 and 4,4

Incoming crosspoints 504,448 and 1008,896 set 1007,895 and 1008,896 etc.

Therefore, all odd numbered sources and destinations on the router are Left channels, and even numbered sources and destinations are Right channels. The user must connect source and destination equipment as consecutive left/right pairs. This configuration has the advantage that the external control system may also set mono routes and non-standard, or broken-away, stereo pairs.

3.2.4 Other control module settings

There are several other configuration parameters to be considered for the system accessible through the 2404 module menu. For details on using the menu, see Section 4. These configuration options may be summarised as:

- Use of the 525 or 625 line video reference signal
- Switching on the video field or frame
- Choice of 'fixed' or 'editable' control module database
- Inhibiting of destinations for each control port

3.2.4.1 Fixed database settings

If the 'fixed' database is selected using the 2404 control module menu, the following parameters will be configured:

- All RS485 control ports 38400 baud General Switcher protocol (for connecting to Aurora)

- All control ports control all destinations

3.3 Using Aurora to control the MADI router

The Aurora database must be configured to reflect the mode of operation configured in the 2404 control card. Therefore there are three options to consider:

3.3.1 Controlling the mono mode

This mode is intended for a purely mono environment, and the Aurora database should be configured to set single crosspoints on a single level. The router can be controlled using a single matrix port, with no offsets assigned.

3.3.2 Controlling the auto stereo mode

Since all stereo mapping is performed by the MADI router control card, the Aurora database only needs to have a single level of routing configured, equivalent in size to half of the actual physical router. The router can be controlled using a single matrix port, with no offsets assigned.

3.3.3 Controlling the manual stereo mode

In this mode, the Aurora database must have two levels configured, both being controlled through the same matrix port, but with the block offset numbers assigned to the second level source and destination offsets.

Aurora may now address two levels of routing independently, allowing for normal stereo routing, broken-away stereo pairs, or mono. All this may be achieved by constructing the Aurora Source and Destination Association tables appropriately.

4 The control module menu

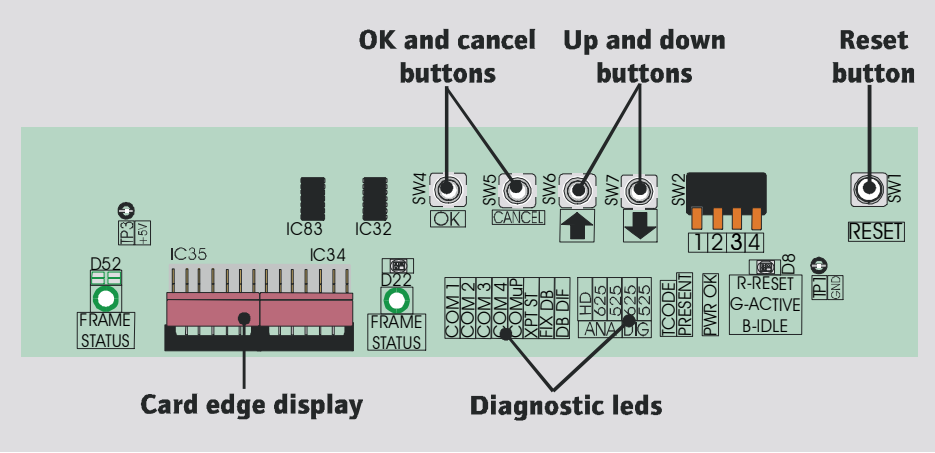
As described earlier, the 2404 control module is vital to the functioning of the router. The module has two main functions that will be explained in this Chapter:

- System fault indication
- System configuration

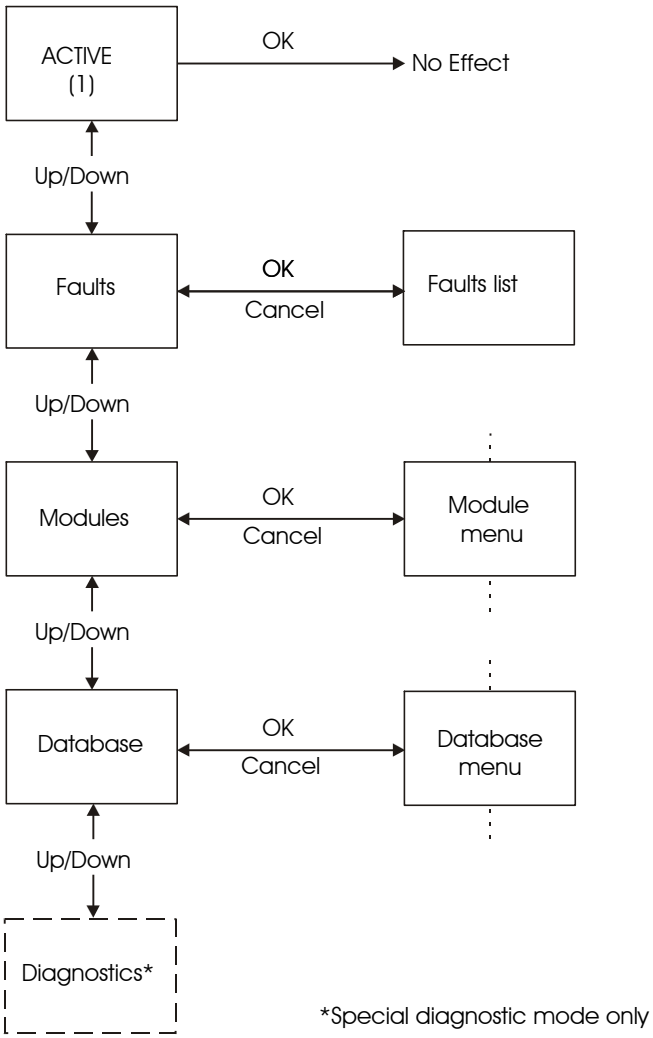
There are two ways of accessing the control module, using the built-in LCD screen and using the supplied terminal software on a PC.

4.1 Using the LCD screen

The LCD is visible from the front of the control module with the door open or removed. In a dual processor system the module on the left will normally be the Active processor, unless a changeover has occurred, this will be clearly indicated by the displays reading 'ACTIVE 1' and 'IDLE 1'. Four buttons are used to progress through the menu structure, UP, DOWN, OK and CANCEL, these are accessible from the front edge of the module:



Using the DOWN button the active processor, up to four menu headings may be viewed, clicking OK will access that menu, and CANCEL will escape from it, as follows:



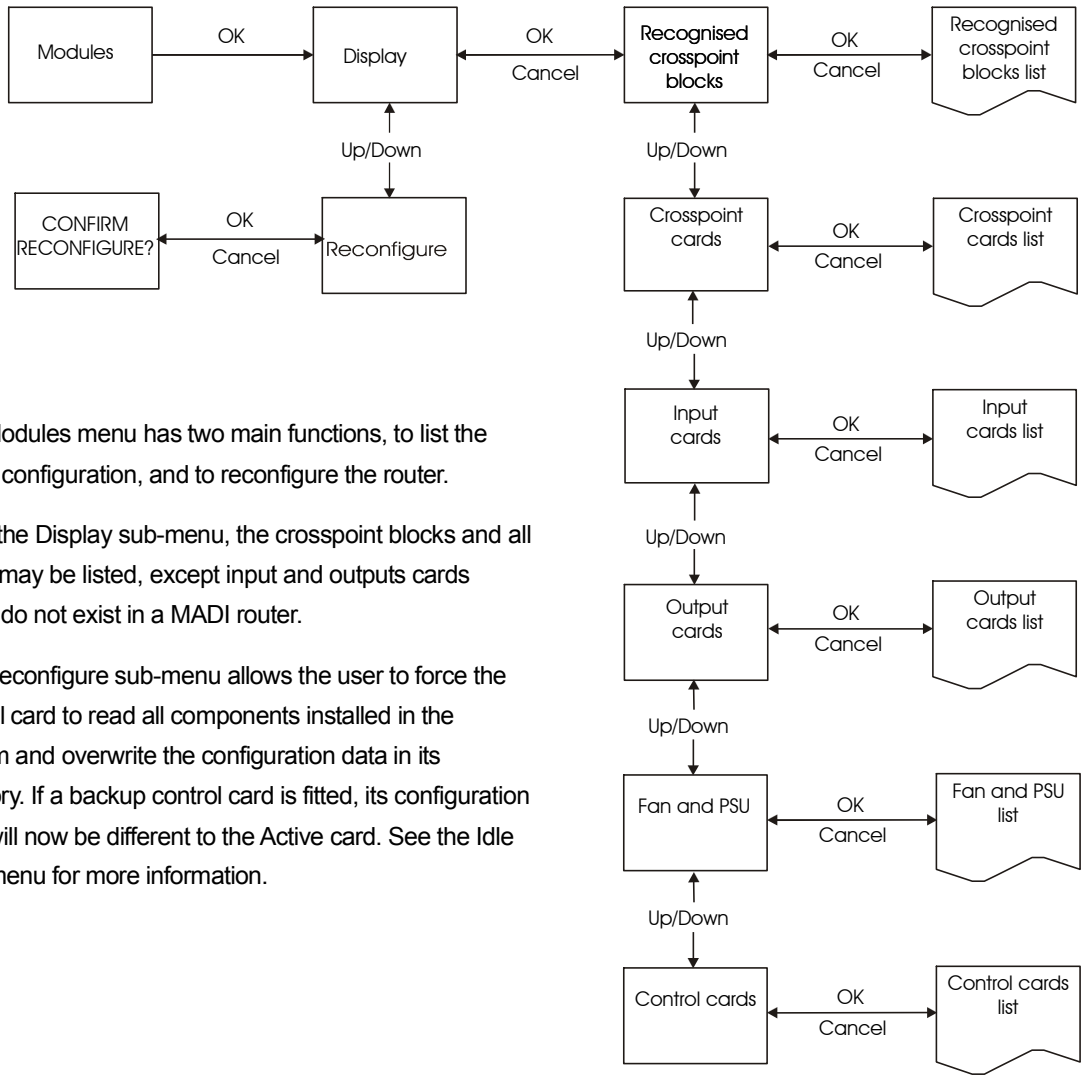
4.1.1 The FAULTS menu

If any faults in the system are seen by the control module, the LCD will move automatically to the FAULTS menu and indicate a number, e.g. 'FAULTS 2'. The user must click OK and use the UP and DOWN buttons to view the faults, the words will scroll across the screen to give a full description. For instance:

- MADI FRAME 1 PSU T (VOLTS): means the top PSU is not supplying any voltage

- MADI FRAME 1 CTL R (NC): means that the Right hand control card is present, but has not been configured (NC) in the system, the user will have to Reconfigure the system through the Modules menu to clear this fault.
- MADI FRAME 1 XPT 2: means that crosspoint card 2 (slot 2 from the bottom) is missing or has failed.
- CARD 1 IP 1: means MADI input 1 on crosspoint card 1 is not present.
- CARD 1 IP E1: means MADI expansion input 1 on crosspoint card 1 is not present.

4.1.2 The MODULES menu

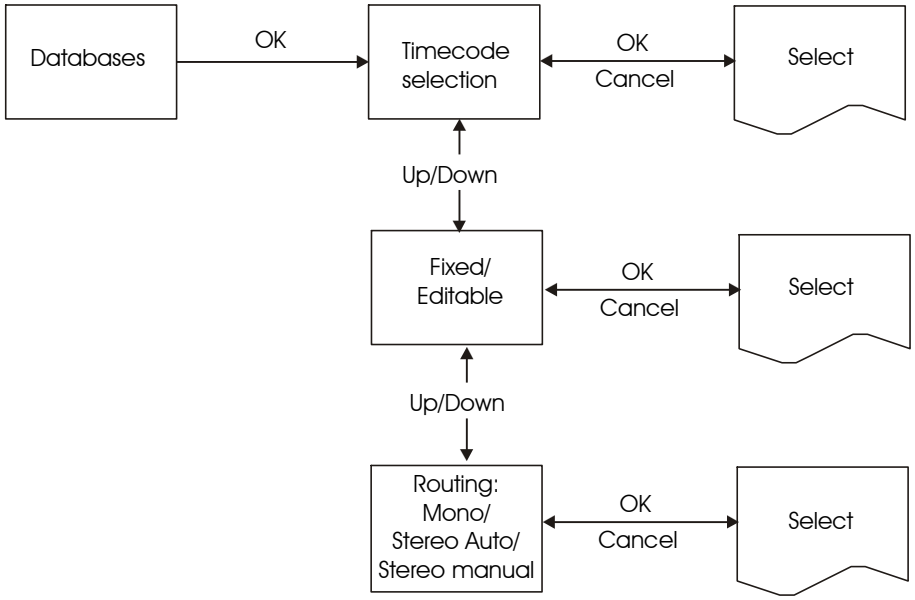


The Modules menu has two main functions, to list the router configuration, and to reconfigure the router.

From the Display sub-menu, the crosspoint blocks and all cards may be listed, except input and outputs cards which do not exist in a MADI router.

The Reconfigure sub-menu allows the user to force the control card to read all components installed in the system and overwrite the configuration data in its memory. If a backup control card is fitted, its configuration data will now be different to the Active card. See the Idle card menu for more information.

4.1.3 The DATABASE menu



In a MADI router, the main function of the Database menu is to select the routing mode to be Mono, Stereo Auto or Stereo Manual. This setting is fundamental to the operation of the router when controlled from an external control system, and is fully explained in Section 3.2.

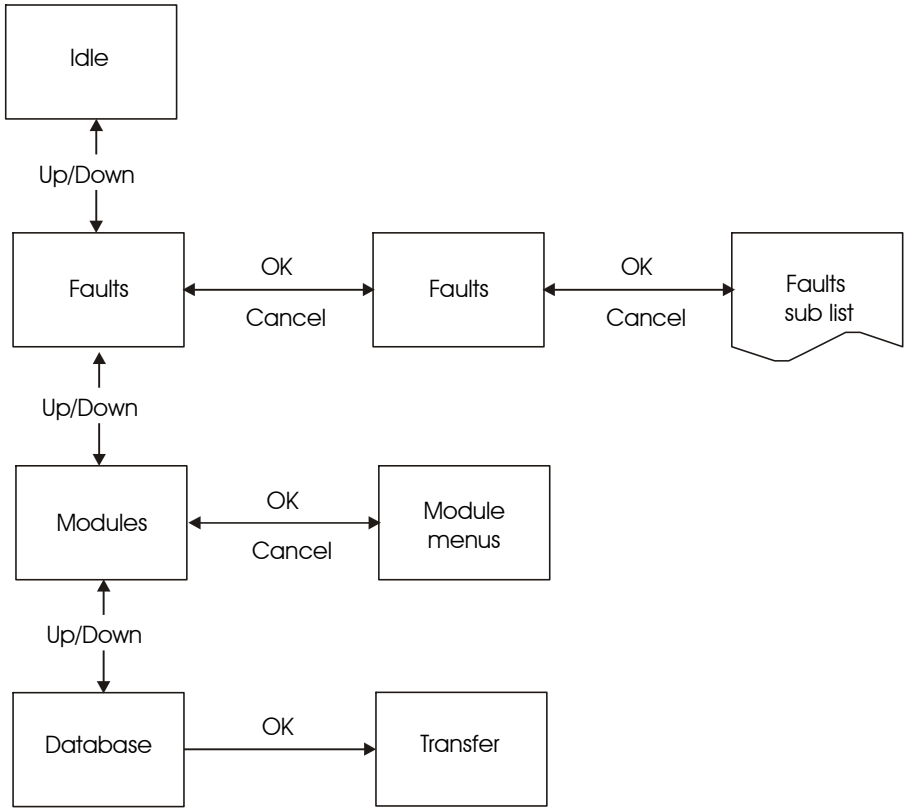
Of secondary importance is the choice of Fixed or Editable database. Fixed database is the normal setting, which will configure the following parameters:

- RS485 control ports to be 38400 BAUD, even parity, 8 data bits, 1 stop bit (compatible with Aurora matrix ports)
- All destination inhibits for all control ports OFF

If the user wishes to change either of these settings, the editable database must be selected and the desired settings entered on the configuration terminal, see the next section.

The timecode input is only used if timecode switching is implemented in the General Switcher protocol.

4.1.4 The IDLE card menu



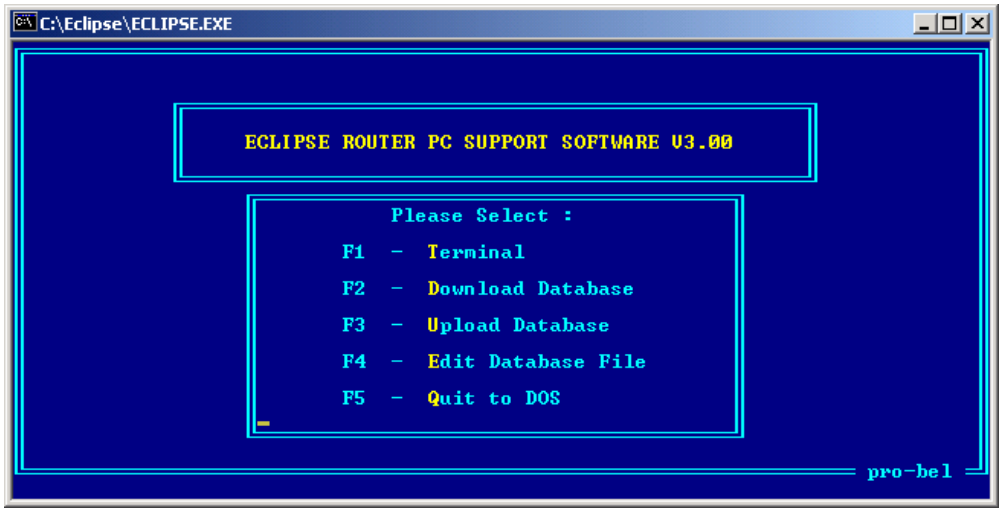
The only use of the Idle control card menu is for invoking a database transfer from the Active card. This operation may be necessary after a system reconfiguration, or the insertion of a replacement backup control card.

4.2 Using the terminal program

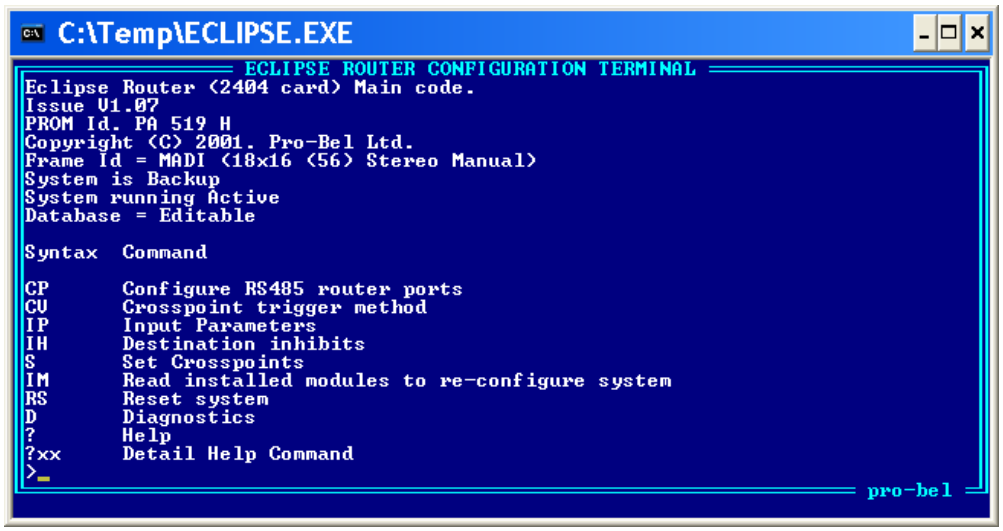
Some fundamental configuration settings can only be done from the 2404 LCD menu, such as the mono/stereo mode and the choice of fixed or editable database. All other settings can be achieved using the terminal program, supplied with the router. A few extra features are also supplied, such as the ability to set crosspoints and the configuration of the editable database.

The ‘ECLIPSE.EXE’ and ‘DV64EG1.ECL’ programs must be installed on a PC with a COM port, preferably in a separate directory. Connect COM port 1 of the PC to the Active

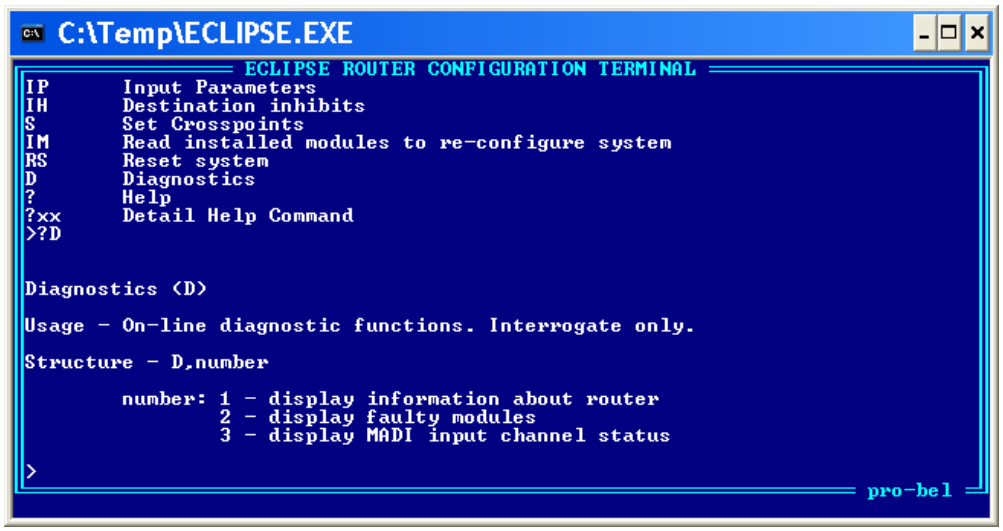
processor ‘CONFIG’ port on the rear of the frame using a pin to pin cable with a 9 pin D type socket at one end, and a 9 pin D type plug at the other. Execute the ‘ECLIPSE.EXE’ file, a screen will appear, as follows:



To test the connection, press F1, followed by ‘Enter’, and a menu should appear, as follows:



Any of the options listed may be executed by typing in the letters followed by ‘enter’. Help text may be accessed by typing ‘?’ followed by the option letters. Such as:


C:\Temp\ECLIPSE.EXE
ECLIPSE ROUTER CONFIGURATION TERMINAL
IP Input Parameters
IH Destination inhibits
S Set Crosspoints
IM Read installed modules to re-configure system
RS Reset system
D Diagnostics
? Help
?xx Detail Help Command
>?D
Diagnostics (D)
Usage - On-line diagnostic functions. Interrogate only.
Structure - D,number
number: 1 - display information about router
2 - display faulty modules
3 - display MADI input channel status
>
pro-bel

5 Trouble shooting

The following information is intended as a brief guide for diagnosing faults associated with a MADI router.

It should be noted that MADI router frames contain no user serviceable parts, therefore should this product require servicing, you should refer to Pro-Bel or your local distributor.

All the following assume that at least one power supply is powered and functioning, that the frame is correctly cooled and ventilated and that all cards are fully seated in their sockets.

5.1.1 The ACTIVE control module is showing a red status LED

- Use the 2404 module menu buttons to view the fault(s)
- If necessary, reconfigure the system using the menu to read all installed cards

5.1.2 The IDLE control module reports ‘database different’

- Use the IDLE card menu to transfer the database from the Active card

5.1.3 The external control system does not control the router

- Check that the control system is connected to one of the RS485 control ports
- Check that the 2404 control module is not configured to inhibit any destinations for the control ports in the database
- Check that the 2404 control module configuration includes all installed cards
- Check cable interconnections
- Check electrical characteristics and protocol of controlling device (General Switcher protocol)

5.1.4 Some routes make, but not others

- Check that the relevant input, output and crosspoint cards exist in the frame
- Make sure the 2404 card has all modules in it’s configuration
- Check that all crosspoint cards are receiving a reference

5.1.5 Routes do not switch ‘cleanly’

- Check that video and audio references are plugged to the correct rear connections
- Check that the transcoder frames are using the correct reference

6 Specification

6.1 General

6.1.1 Control

RS485 ports:	2; independently configurable for either; driving chains of 16 multidrop devices (panels/under monitor displays) OR for external control
RS232 ports:	1; for 2404 card configuration and diagnostics
Parallel ports	1; E-bus for frame expansion

6.1.2 Reference

Analog video	1 each of 525/625 line PAL/NTSC looping, high impedance
Digital audio	unbalanced AES (75ohm BNC)

6.1.3 Power Supplies

Supply:	100Vac to 240Vac auto sensing
Power:	500W max

6.1.4 General

Frame size:	7U x 19' rack mounting x 500mm deep
Weight:	30Kg max

6.1.5 Temperature range

Operating:	0°C to +40°C
Storage:	-10°C to +70°C

6.2 MADI

Each 5604 MADI card:18 MADI inputs, 2 MADI outputs, 1 AES reference input to AES 11–1991.

All MADI to AES 10 – 1991, 75 Ohm +/- 20%, level 600mV nominal p-p