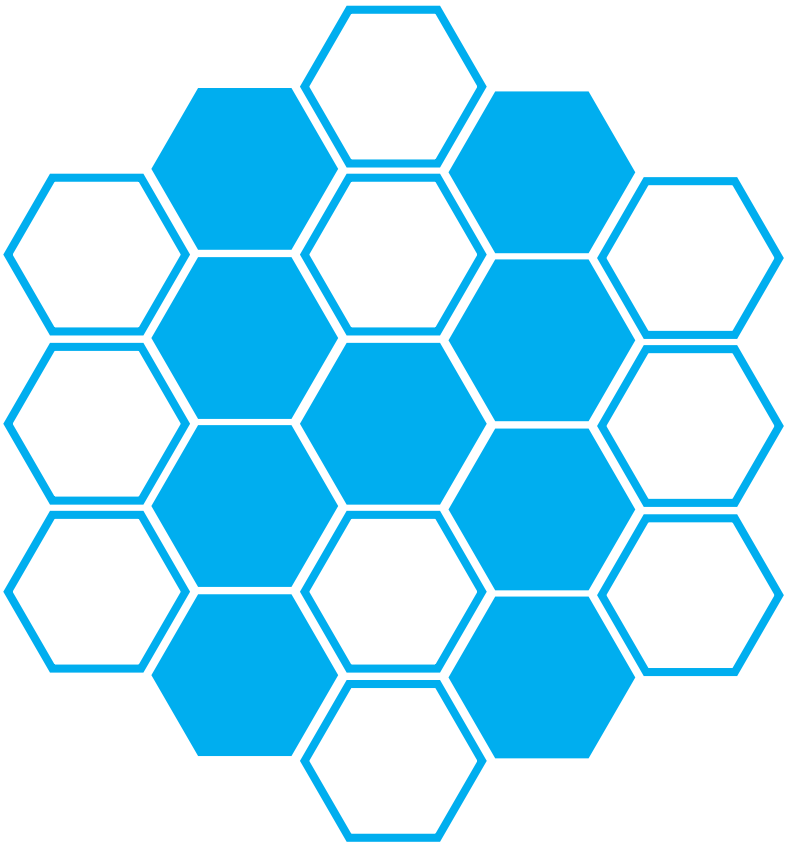
HYDRA2 INSTALLATION MANUAL



HYDRA2

Gigabit Ethernet Networking

CALREC

Putting Sound in the Picture

calrec.com

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Despite considerable effort to produce up to date information, no literature published by the company nor any other material that may be provided should be regarded as an infallible guide to the specifications available nor does it constitute an offer for sale of any particular product.

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HYDRA 2
CONTENTS

HYDRA2
INFORMATION

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IMPORTANT INFORMATION

Should you require any technical assistance with your Calrec product please contact your regional Calrec distributor. Customers within the UK or Ireland should contact Calrec directly.

For a complete list of worldwide distributors by region, go to www.calrec.com or contact us for more information.

For pre-delivery technical enquiries, UK and Ireland customers should contact the Calrec project manager assigned to their order. Post delivery, the Calrec Customer Support team will take care of your technical enquiries.

Our UK customer support team works closely with our global distributor network to provide the highest level of after sales support. Your distributor should be your first point of contact and will often be able to provide an instant solution, be it technical advice, spares or a site visit by an engineer.

Calrec UK customer support and our global technical team provide free of charge technical support and advice to all customers by phone or e-mail.

Telephone: (9:00am-5.30pm)	+44 (0) 1422 842159
Email - Technical:	support@calrec.com
Email - General:	enquiries@calrec.com
Postal Address:	Calrec Audio Ltd. Nutclough Mill, Hebden Bridge, West Yorkshire, HX7 8EZ, UK
Fax:	+44 (0) 1422 842159
Website:	www.calrec.com

Calrec after sales support includes:

- Free of charge comprehensive technical advice and support by phone and e-mail
- Repairs
- Quick supply of replacement or loan hardware in the event of a failure
- Provision of export documentation for the return of faulty parts
- Operational training
- Maintenance / technical training
- Supply of replacement components
- Supply of documentation
- Service contracts

We offer a range service contracts to our UK and Ireland customers, from 24/7 telephone support, regular health checks and extended warranty, amongst other benefits. Please contact our customer support team for more information on service contracts.

Product Warranty

A full list of our conditions and warranties relating to goods services is contained in Calrec's standard terms and conditions. A copy of this is available on request.

Repairs

If you need to return goods to Calrec for whatever reason, please contact your regional distributor, or Calrec customer support beforehand for guidance, as well as to log the details of the problem and receive a reference number. For customers outside the UK and Ireland, shipping via the distributor saves customers from dealing with exportation paperwork. If there is a need to send direct to Calrec, contact us beforehand to log the incoming repair and for assistance with exportation documents.

Standard of Service

Ensuring the highest standards is a priority, if you have any comments on the level of service, product quality or documentation offered to you by Calrec, please contact the Calrec Customer Support team in the UK who will endeavor to address your issues. Calrec welcomes all customer feedback.

For feedback specific to this document, please contact enquiries@calrec.com.

Whenever you contact Calrec Customer Support please have the following information to hand:

- Name
- Company
- Email Address
- Full details of enquiry (e.g. fault report)
- Serial number of faulty hardware (if applicable)

Once this information has been provided, a service ticket will be created to log your enquiry. The service ticket reference number will be given via email.

Serial Numbers

All units produced by Calrec are given a serial number and are booked into a central record system at the time of manufacture. These records are updated whenever a piece of hardware is dispatched to or received from a customer.

When contacting Calrec Customer Support with a hardware inquiry it is important that the correct Calrec serial number is provided to enable the customer support team to provide a high level of service.

After Sales Modifications
Please be aware that any modifications other than those made or approved by Calrec Audio Limited or their agents, may invalidate the console's warranty. This includes changes to cabling provided by Calrec and variations to the recommended installation as detailed in Calrec documentation.

Modifications to this equipment by any party other than Calrec Audio Limited may invalidate EMC and safety features designed into the equipment. Calrec Audio Limited can not be liable for any legal proceedings or problems that may arise relating to such modifications.

If in doubt, please contact Calrec Audio Limited for guidance prior to commencing any modification work.

Installation
In many installations the AC power connectors will not be readily accessible, effectively making the equipment permanently connected. The installation should be carried out in accordance with all applicable installation rules and regulations.

Service Personnel
The AC power disconnect devices are the 2 x IEC (IEC60320-1 C13/C14) couplers located at the rear of each unit. WARNING: The apparatus has a dual power system. It is essential that BOTH AC power IEC couplers are disconnected to prevent exposure to hazardous voltage within the unit.

Third Party Equipment
Integrating third party equipment into a Calrec system may compromise the product's ability to comply with the Class B radiated emission limits set in the EMC (Electro Magnetic Compatibility) standard EN55022.

Calrec Audio Limited can not be responsible for any non-conformities due to use of third party equipment. If in doubt, please contact Calrec Audio Limited for guidance prior to integrating any third party equipment.

ESD (Static) Handling Procedures
In its completed form, this equipment has been designed to have a high level of immunity to static discharges. However, when handling individual boards and modules, many highly static sensitive parts are exposed. In order to protect these devices from damage and to protect your warranty, please observe static handling procedures, for example, use an appropriately grounded anti-static wrist band. Calrec will supply an electrostatic cord and wrist strap with all of it's digital products.

All modules and cards should be returned to Calrec Audio Limited in anti-static wrapping. Calrec Audio Limited can supply anti-static wrapping upon request.

This applies particularly to digital products due to the types of devices and very small geometries used in their fabrication, analog parts can, however, still be affected.

RoHS Legislation
In order to comply with European RoHS (Reduction of Hazardous Substances) legislation, Calrec PCB and cable assemblies are produced with lead-free (tin/copper/silver) solder instead of tin/lead solder.

In the unlikely event of a customer having to carry out any re-soldering on Apollo, Artemis or Hydra2 hardware, it is imperative that lead-free solder is used; contaminating lead-free solder with leaded solder is likely to have an adverse effect on the long-term reliability of the product. Circuit boards assembled with lead-free solder can be identified (in accordance with IPC/JEDEC standards) by a small oval logo (see below) on the top-side of the circuit board near the PCB reference number (8xx-xxx). The same logo is used on the connector hoods of soldered cable assemblies.

If in doubt, please check with a Calrec customer support engineer before carrying out any form of re-soldering

ISO 9001 and RAB Registered
Calrec Audio Ltd has been issued the ISO9001: 2008 standard by the Governing Board of ISOQAR.

The award, for both UKAS and RAB registration (see below), is the most comprehensive of the ISO9000 international standards. Granted in recognition of excellence across design, development, manufacture and after-sales support, the certification follows a rigorous and thorough review of Calrec's internal and external communication and business procedures.

LEAD FREE

e1

LEAD FREE STICKER

Pb
Pb-Free
Lead Free

ISOQAR
QUALITY ASSURED
ISO 9001
ANAB
ACCREDITED
Certificate number 3205/02

HEALTH AND SAFETY

Important Safety Instructions:

- Read these instructions.
- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Do not use this apparatus near water.
- Clean only with dry cloth.
- Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at the plugs, convenience receptacles, and the point where they exit from the apparatus.
- Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/ apparatus combination to avoid injury from tip-over.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operator normally, or has been dropped.
- Warning: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.
- Not intended for outdoor use.
- This equipment must be EARTHED.
- Before starting any servicing operation, equipment must be isolated from the AC power supply. The disconnect devices are the 2 x IEC connectors (IEC 60320-1 C13/C14 couplers).
- Do not allow ventilation slots to be blocked. Do not leave the equipment powered up with the dust cover fitted.

Cleaning

For cleaning the front panels of the equipment we recommend using a soft anti-static cloth, lightly dampened with water if required.

Explanation of Warning Symbols

Triangular warning symbols contain a black symbol on a yellow background, surrounded by a black border.

The lightning flash with arrow head symbol within an equilateral triangle, as shown on this page, is intended to alert the user to the presence of dangerous voltages and energy levels within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock or injury.

The exclamation mark within an equilateral triangle, as shown on this page, is intended to prompt the user to refer to important operating or maintenance instructions in the documentation supplied with the product.

Earthing

This is a Class I product. An Earth connection MUST be provided in each AC power cord.

The Earth Bolt connection at the rear of the console should be connected to Earth using Earth cable at least 6mm^2 in cross section (10 AWG).

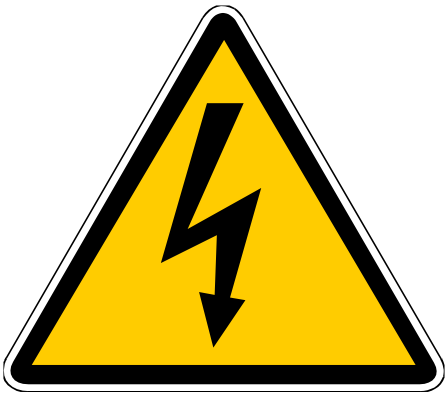
Lithium Battery Replacement

Caution: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type. Batteries must not be exposed to excessive heat such as sunshine, fire or the like

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation.

DANGEROUS VOLTAGES



IMPORTANT INSTRUCTIONS

HYDRA2
ARCHITECTURE & NETWORKING

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OVERVIEW

The Hydra2 system is designed to provide seamless, scalable audio networking of Calrec audio consoles and routers with Calrec audio I/O interfaces. It allows for very large numbers of audio inputs and outputs to be easily connected, shared and controlled, irrespective of their location, as well as providing comprehensive built-in redundancy.

Audio consoles, routers and I/O can be physically added to the network as and when needed. Added hardware automatically syncs with the rest of the system and makes itself available for use.

The Hydra2 Organizer, H2O, is an administrator level user interface designed to provide control over the network without the use of an audio console. Amongst other things, H2O can be used for source to destination cross-point routing, and can change access rights of individual consoles to selected I/O on a port by port, or port group basis—effectively splitting the network to safeguard multi-production environments and to aid control room and resource management.

Hydra2 provides 1-to-n routing; inputs may be routed to any number of destinations. They can be used in multiple places on a console, on multiple consoles, as well as being sent directly to multiple outputs by cross-point routing, all simultaneously.

Hydra2's interconnections are made using SFPs—plug-in gigabit interface modules—to provide copper connections on RJ45s or LC fiber connections in either single-mode or multi-mode. Distances are only limited by the chosen SFP type.

Each connection between Hydra2 units can carry up to 512 channels of audio in each direction simultaneously.

I/O interfaces are available in a range of format types including balanced analog, balanced and unbalanced AES digital, MADI, Dolby-E decoders, SDI embedders and de-embedders. New formats can easily be supported as they arrive. Hydra2 also supports non-audio I/O interfaces in the form of general purpose inputs and outputs (GPIO) for remote control input tallies and output switching.

Connecting I/O to a Hydra2 router via Cat5e or fiber allows it to be located remotely from the router, close to the audio sources and destinations that it interfaces with, minimizing multi-core and individually screened audio cabling, installation time and costs, and maximizing audio quality by reducing the distances over which analog signals are passed over.

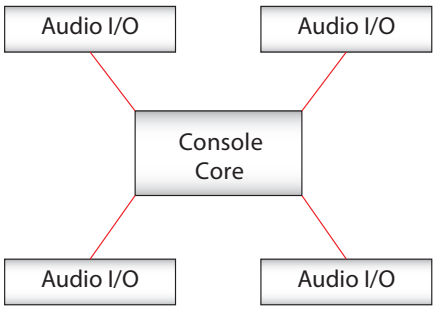
As with all Calrec products, audio quality and product reliability are our top concerns. All Hydra2 hardware and audio interfaces are designed to the highest standards with no compromise to audio performance. All analog preamps and line level paths are designed around our well proven and highly respected circuitry, providing very high headroom with a very low noise floor. Our lossless proprietary network transportation protocol does not compromise the high audio quality within the digital domain whilst maintaining negligible latency. Particular attention is also paid to communications reliability, system status monitoring, power generation and distribution, thermal management and physical robustness. The system is designed with redundancy and fault detection at the forefront, providing backup paths for data and audio in the event of hardware or cable failure, to keep any disruption of audio or control to the absolute minimum. All critical components are fed from dual power supplies

Hydra2 also supports the Ember and SW-P-08 protocols for integration with third party routers and control systems for remote control.

SINGLE CONSOLE NETWORKS

Apollo, Artemis and Summa consoles rely on Hydra2 for the routing of all audio to and from their DSP. A single, standalone console uses a simple Hydra2 network with all I/O boxes having a direct connection to the router card fitted in the console's processing core. This creates a star formation, in that all elements connect to a central point; the router card.

FIGURE 1 - STAR FORMATION



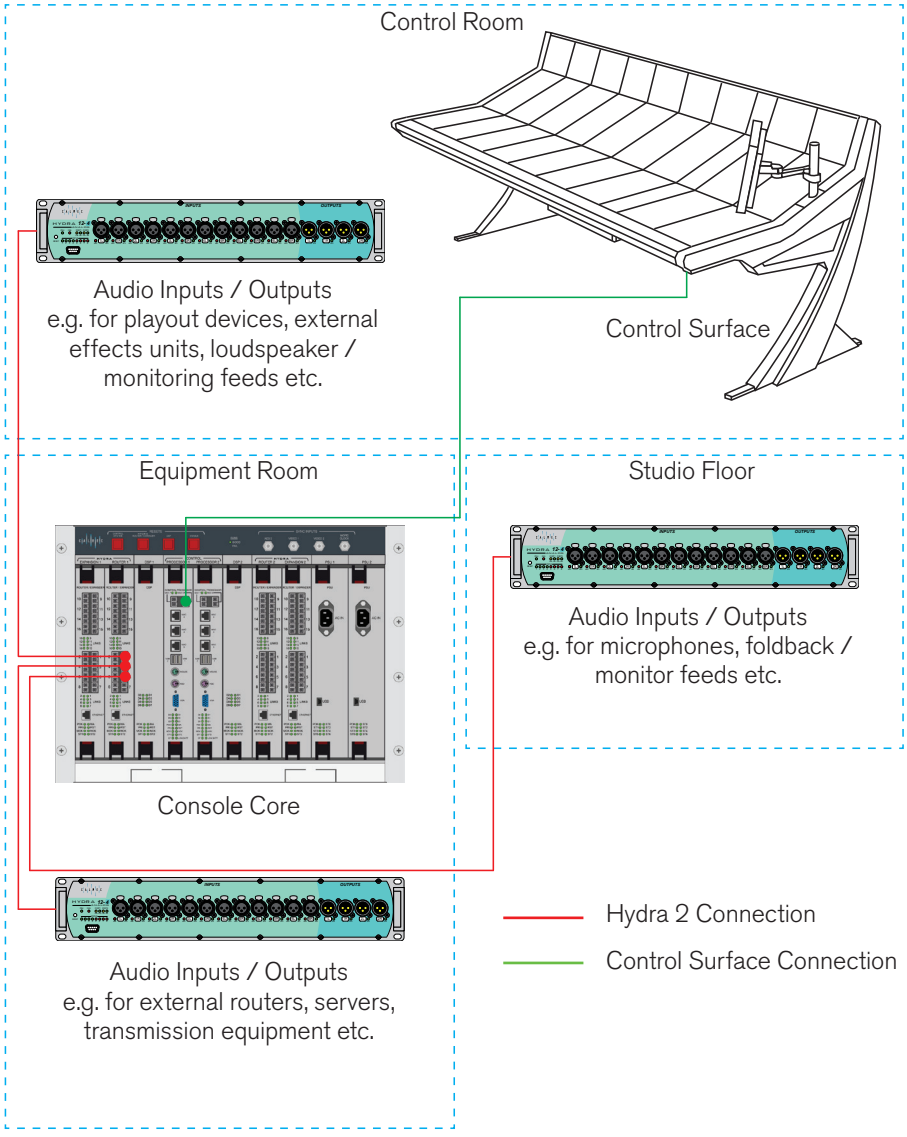
The router card is responsible for directing audio and data across the Hydra2 network and within the processing core itself. When an input port is patched to a fader, the router card requests that the relevant I/O box sends audio from the selected input port and then passes that audio on to the DSP card within the processing rack for use by the console. When an output is patched, the router card takes the output audio from the DSP card and sends it to the relevant I/O box port. When an input to output patch is made, the router requests the input and then sends it directly to the I/O box / output port in question.

The comprehensive routing system and the ability to perform point to point input to output patching reduces the need for I/O to be wired via physical patch points. Any input can be used multiple times in multiple places, simultaneously sending audio to any/all input channels as well as other locations on the console such as direct inputs or monitor inputs, and can be patched directly to multiple output ports if the signal is required by other equipment. Console DSP audio outputs can also be sent to multiple output I/O box ports and be made available to other users on the Hydra2 network via Hydra Patchbays.

Input to output patching provides routing capability without the use of DSP or the need for a control surface.

Multiple port patching to mixed formats of I/O, along with input to output patching, reduces the need for external audio routers, distribution amplifiers, and format convertors such as ADCs / DACs.

FIGURE 2 - EXAMPLE OF A SINGLE CONSOLE NETWORK



MULTI-CONSOLE NETWORKS

Routers from different processing cores can be connected together. Networking consoles in this way gives access to all I/O from all control surfaces and system PCs on the same network.

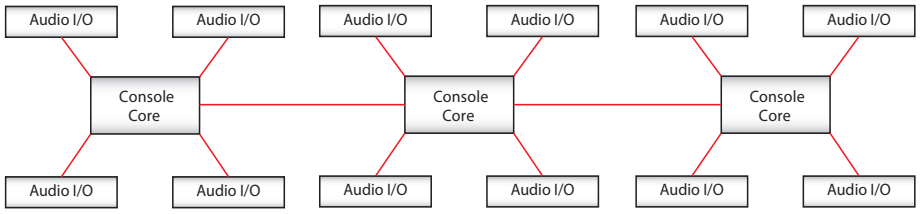
Each console's access to I/O can be managed from the Hydra2 Organizer, removing the right of individual consoles to access I/O by groups of I/O boxes, specific I/O boxes, specific ports, or groups of ports.

Inputs can be used by multiple consoles on the same network simultaneously. Any console with access can patch audio to any output port.

Router to router connections, like I/O vox connections, can be made using any of the 16 front panel Hydra2 main router ports. Note, expansion router cards should NOT be used for connecting racks together. Connecting racks together creates multiple linked star formations, as shown in Figure 1. All 3 routers shown have access to all of the I/O shown. The path from I/O box to console may pass through multiple router cards before reaching the console's own router.

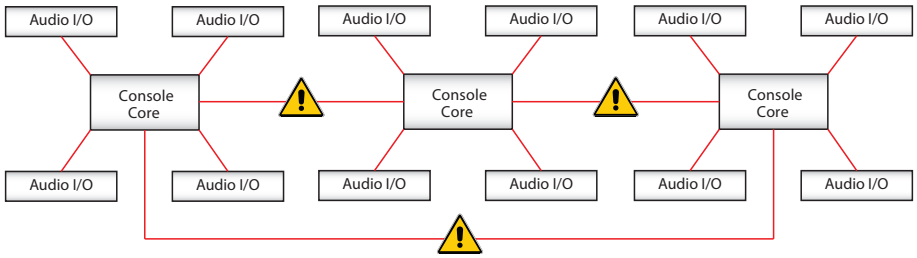
It is important that there is only one path between any two points in the network (not counting secondary paths designed for redundancy, or configured trunks for increased bandwidth). Having multiple paths between two points will cause data collisions and instability. Figure 2 shows an incorrect connection of three processing racks. The addition of a third router-to-router link creates a duplicate path. The route between any two processing racks can be direct or via the other processing rack. Removing any one of the three marked links corrects the problem.

FIGURE 1 - CORRECT CONNECTION OF A THREE STAR FORMATION NETWORK



Three router racks connected with no duplicate paths.

FIGURE 2 - INCORRECT CONNECTION OF A THREE STAR FORMATION NETWORK



Incorrect Connection The additional link creates duplicate paths.

When connecting two or more routers together it is important that one of them, and only one, is configured to be the Master Router.

Please see "Master Routers" on page 15 for more details.

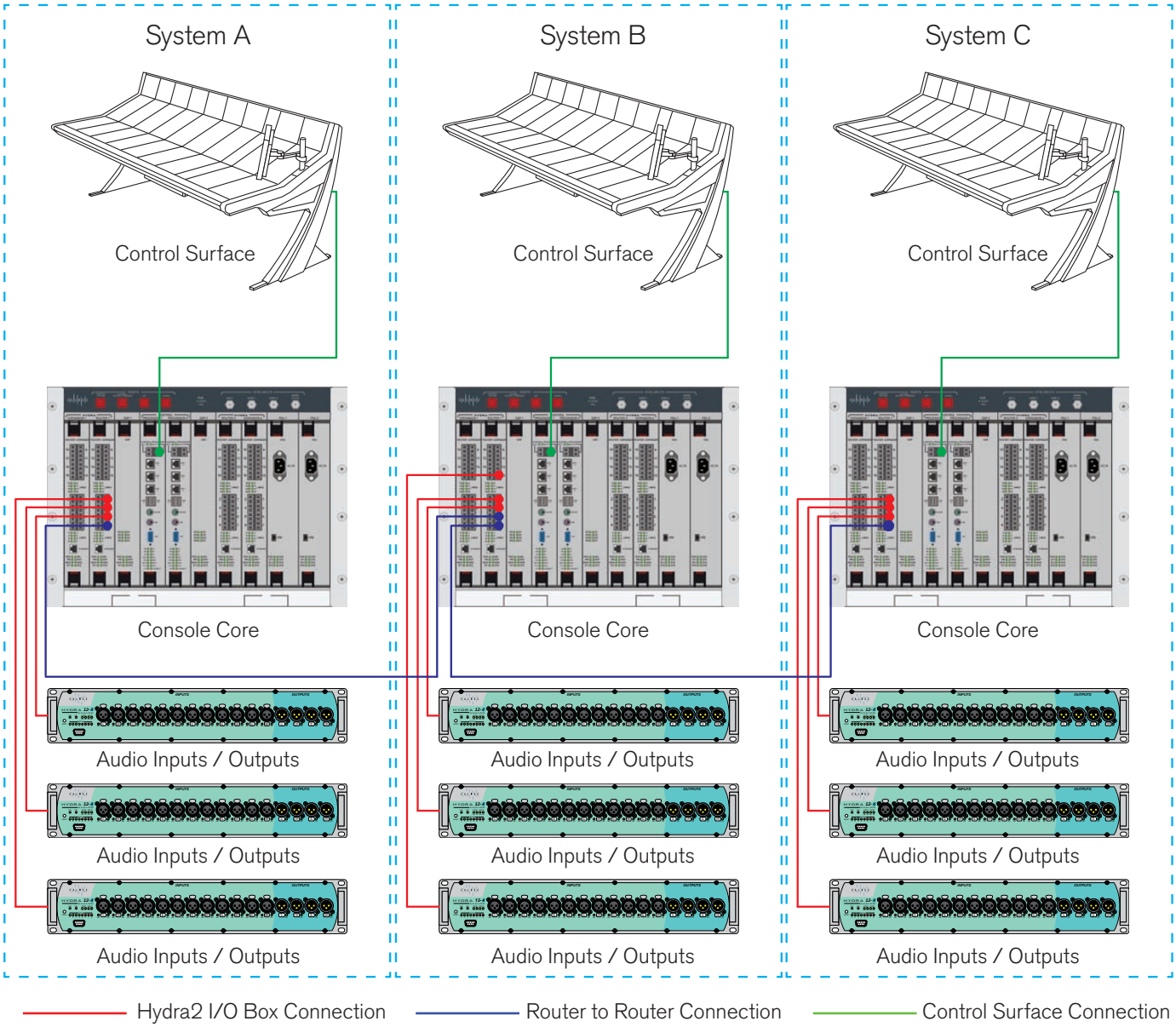
Note, it is important to the ensure IP address compatibility of the systems being connected together and that Hydra2 routers which are networked together are on separate VLANs.

Please see "IP Address Management" on page 23 for more details.

Bandwidth / link capacity

Each Hydra2 link is capable of carrying up to 512 channels of audio in each direction simultaneously. This imposes no limitations over standard I/O box to router connections as standard I/O boxes contain less than 512 inputs and 512 outputs. Modular I/O boxes should not be fitted with card types and quantities that exceed this limitation. In practise, this is only an issue when lots of SDI cards are fitted as they have 32 channels of audio per card which far exceeds any other current modular I/O card type. If a modular I/O box is populated such that it exceeds the limitation, only the first 512 channels or inputs/outputs will pass audio.

FIGURE 4 - EXAMPLE OF A THREE CONSOLE NETWORK



For multi-rack systems, it is important to understand the network topology. A single connection between two routers is also limited to 512 channels in each direction. This imposes a limit on the amount of I/O that can be accessed via other routers' connections at any given time.

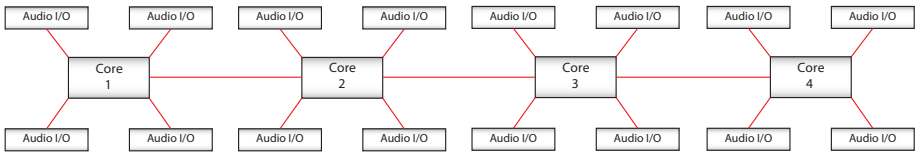
The bandwidth available is determined by usage on either side of the link. In the example shown in Figure 4, If console A is sending 100 channels of audio to outputs connected to console B's rack, Console B and C can then only access 412 channels from inputs connected to the A rack.

Increasing bandwidth - Trunk links
Bandwidth between racks can be increased in multiples of 512 channels by fitting additional links between them and configuring them for use as 'trunk links'. Please contact Calrec Customer Support to discuss 'Trunk Links'

Bandwidth only becomes an issue in large networks with a high volume of router-to-router traffic. In such systems, centrally located routers should be also be considered.

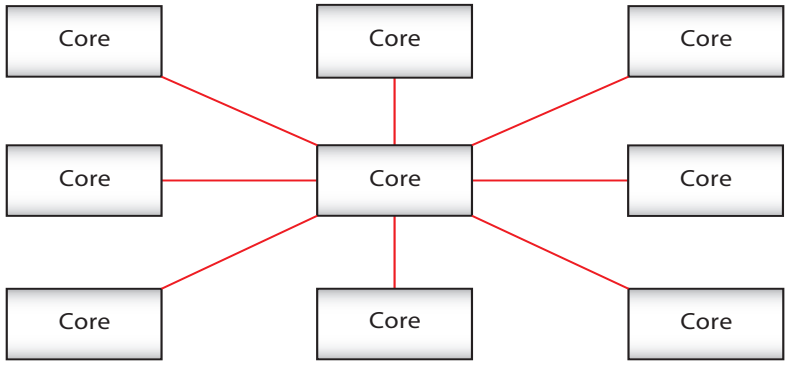
Network topology becomes important when more than 3 consoles are connected together. Connecting to a central point minimizes the number of routers a signal has to pass through and therefore optimizes bandwidth across the network. If the network is large and there are insufficient ports available on the central router, multiple star formations can be linked together.

FOUR RACK SYSTEM CONNECTED IN SERIES - NOT RECOMMENDED



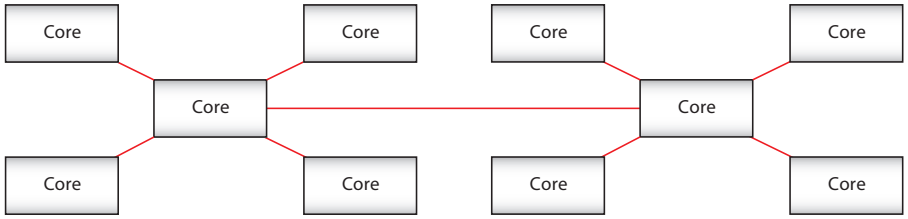
- In order for Core 1 to access I/O connected to Core 4, the signal needs to pass through all four racks. Whilst this connectivity is valid, it is not the most efficient use of router to router links.

RACK STAR FORMATION CONNECTIVITY



- Connecting all the cores to the same central point minimizes the amount of cores that a signal has to pass through. In the above example of a 9 core network (I/O boxes not shown), any rack can access I/O connected to any other core with the signal passing through a maximum of only three cores.

MULTIPLE RACK STAR FORMATION CONNECTIVITY



MASTER ROUTERS

A Master Router needs to be present on any Hydra2 network. In a single core system, there is only one active router card. All of the router cards fitted within such a core will be factory pre-configured as Master Routers so that whichever card is active will be the master.

In a multi-core system, one of the cores needs to be dedicated as the Master Router and the router cards in this core should be configured as such. All other routers on the same network need to be configured as Slaves.

Having more than one Master Router core on a Hydra2 network will result in instability.

Not having an active Master Router on a network will also cause instability.

The core configured to be the Master Router needs to remain powered and active to maintain reliability of the network. No individual system should be used if the Master Router is not active.

Similarly, it is important to understand the network topology to know which I/O boxes are available to which consoles if individual cores (other than the Master) are powered down.

When two or more networks are joined or a network is split, for example if two OB / mobile units are occasionally connected together, it is essential that the Master Routers are managed. If connecting two networks, one of the masters will need to be reconfigured as a slave. When separating two networks, one of the slaves needs to be changed to be a master.

Configuring Master & Slave Routers
Only the active main router card in the dedicated core needs to be configured as the Master, however, it is good practise to set the secondary main router and also the primary and secondary expansion routers as masters as well. This allows for cards to be moved around within the same rack to aid troubleshooting if hardware problems are experienced as well as ensuring the backup is correct in the event of a hot-swap.

Changing the Master/Slave status of a router affects the whole Hydra2 network and as such, should only be carried out by engineers with a good understanding of the network topology.

Please contact our customer support team - support@calrec.com, or your regional Calrec distributor for guidance on changing router master/slave statuses.

ROUTER CORES

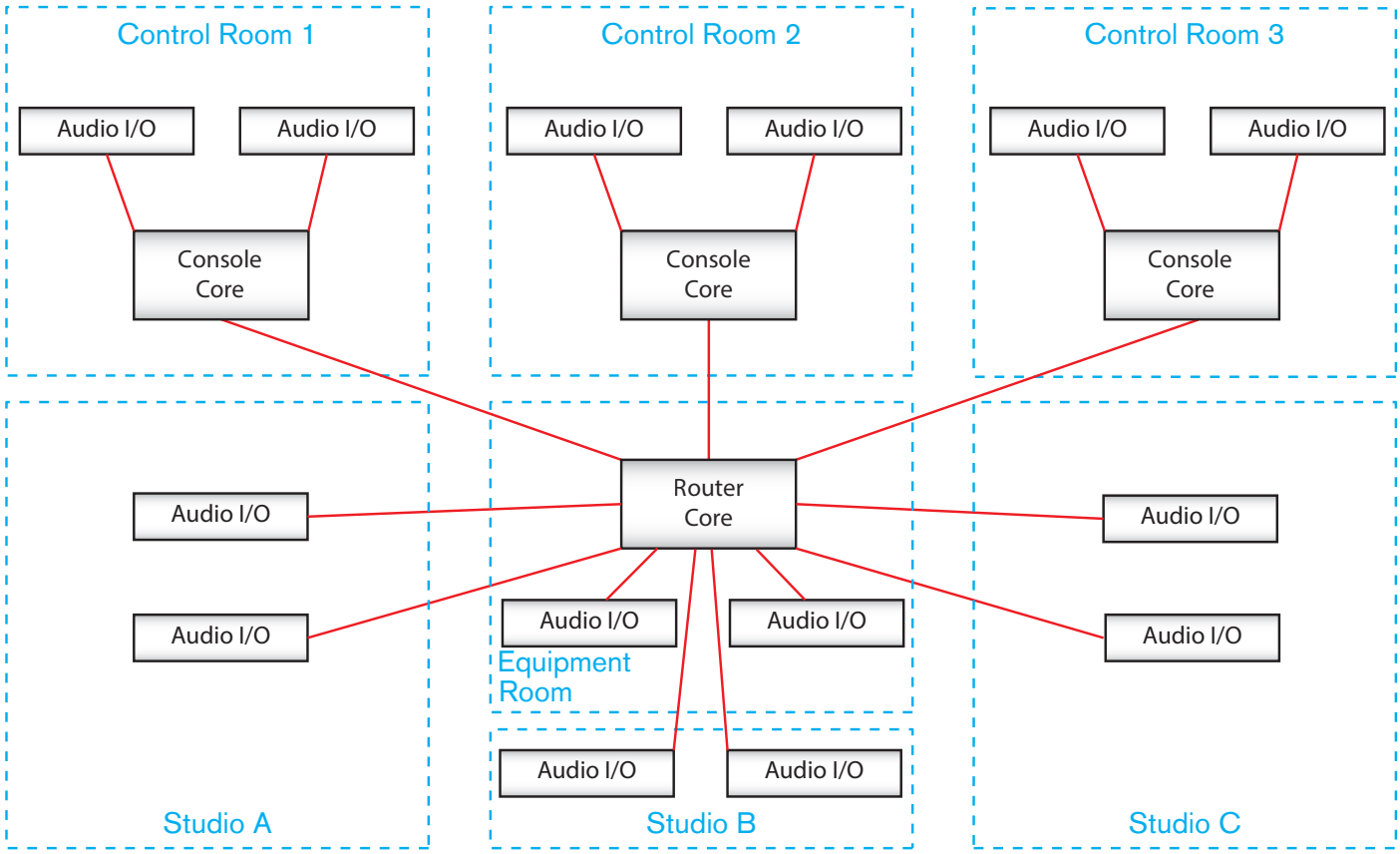
A Router Core is a rack that is not fitted with a DSP mixing engine, and therefore also has no control surface attached.

A Router Core can be used as an independent unit in its own right, controlled via the H20 GUI, or by an SW-P-08 controller. Router Cores can also be used to increase the capacity of I/O connections across a Hydra network by providing an extra 16 or 32 router ports.

Router Cores can be used as a central point for shared I/O resources and console router connections, dedicated as the Master Router, and located in an equipment room, powered 24/7, ensuring that the network is always active and that any console that is powered on has access to all their own I/O, as well as all I/O connected to the central Router Core, and I/O connected to other console cores that are powered on.

The consoles / control rooms shown below have access to the studio floor and equipment room I/O without it being routed via other consoles' racks.

HYDRA2 NETWORK WITH A STANDALONE MASTER ROUTER



NETWORK CONSIDERATIONS AND ROUTER CAPACITY

Each core contains a Hydra2 router card fitted in the Main router slot which provides a capacity of 8192 audio input channels and 8192 audio output channels (Apollo, Artemis Shine/Beam) or 4096 audio input channels and 4096 audio output channels (Artemis Light / Summa).

8U Router Overview

The Apollo and Artemis (Shine/Beam) router (RY5710) is described as an 8192^2 router, which means up to 8192 separate sources can be routed to 8192 destinations. Although the router is described this way, there can be up to 12288 inputs (6144 inputs for 4U router), as described later in this section. Hydra2 routers can also be networked together to scale the available inputs up as required. Only one source can supply audio to each destination, but a single source can supply audio to all destinations, hence it is a '1-*n*' router.

4U Router Overview

The Artemis Light and Summa (RY5912) router is described as a 4096^2 router. The considerations described above for RY5710 are also valid for this router but the maximum number of routes which can be made is 4096.

8U Rack Considerations

For an Apollo/Artemis 8U rack with a DSP card installed, 2048 destinations are reserved to pass audio internally, via the rack backplane, to and from the DSP mixing engine, leaving 6144 destinations available for external signals via the router card's front panel ports.

Expansion Router Cards

Expansion router cards can be fitted into 8U processing cores (Apollo, Artemis Shine/Beam). A router card fitted in the expansion slot increases connectivity by doubling the number of front panel Hydra2 ports available, it does not act as an independent router or increase the total capacity. In order for an expansion router to be fully functional, there must be a router card fitted in the main router slot as well.

When an Expander card is fitted into a rack, 2048 destinations are reserved for access via the Expander card's front panel ports, therefore for a rack with a DSP and an Expander card fitted, 4096 destinations are available through the router and 2048 through the expander; the addition of an expander card, expands the number of ports for connecting I/O boxes, not the number of destinations.

2048 sources can be routed from each DSP or Expander card to destinations on the router (routes made from sources to destinations that are on the expander only **do not** use this capacity). The number of sources available increases by 2048 when a DSP or Expander card is fitted:

- neither = 8192 sources
- DSP = 10240 sources
- Expander = 10240 sources
- DSP and Expander = 12288 sources

4U Rack Considerations

For an Artemis Light or Summa rack with a DSP card installed, 2048 destinations are reserved to pass audio internally, via the rack backplane, to and from the DSP mixing engine, leaving 2048 destinations available for external signals via the router card's front panel ports. The Artemis Light / Summa core does not support expansion router cards.

The number of sources available increases by 2048 when a DSP card is fitted, from 4096 to 6144.

8U Rack Configuration	Cards in Rack	Router Destination Allocation	Available Sources
Router Core Rack - Router Only	Router	8192	8192
Router Core Rack with Expander	Router Expander	6144 2048	8192 + 2048
Console Core Rack	Router DSP	6144 2048	8192 + 2048
Console Core Rack with Expander	Router Expander DSP	4096 2048 2048	8192 + 2048 + 2048

Trunk Links

When console cores are connected together they can share the I/O which is connected to each others' router cards, as with all SFP connections to the router card front ports the bandwidth limit of this connection is 512. Connections between cores potentially carry more traffic than core to I/O box connections, and as such should always be made to main router card ports, not to expansion card ports. 'Trunk Links' can be added which are extra connections between the two cores' router cards which each increase the bandwidth by 512. e.g. one link plus one 'trunk link' equals a bandwidth of 1024. Up to three 'trunk links' can be added equating in total to a bandwidth of 2048.

Trunk links should only be fitted if the network is configured appropriately. Please contact Calrec support (support@calrec.com), or your regional Calrec distributor for guidance on trunk link configuration.

Capacity

Each individual front panel router/expansion port is capable of passing 512 channels of audio inputs and 512 channels of audio outputs as long as the total number being used per card does not exceed the maximum available for the card slot.

With router capacity at this scale, it is not easy to reach these limitations unless doing so intentionally for test purposes using high density I/O on a large multi-console network. If the number of routes made reaches the maximum for a router card slot, or individual front panel router port, further routes cannot be made via that slot/port without removing some of the existing ones. Warning messages are generated when this is the case.

Fixed Format I/O box bandwidth

The fixed format I/O box destination count is dependent on the number of I/O cards within a given box. Each I/O card within a box is allocated 32 destinations, for example, a 12/4 analog I/O box has one card and so is allocated 32 destinations, whereas a MADI box is considered to have two cards for each MADI port. A breakdown is given in the table below.

Modular I/O Box Bandwidth

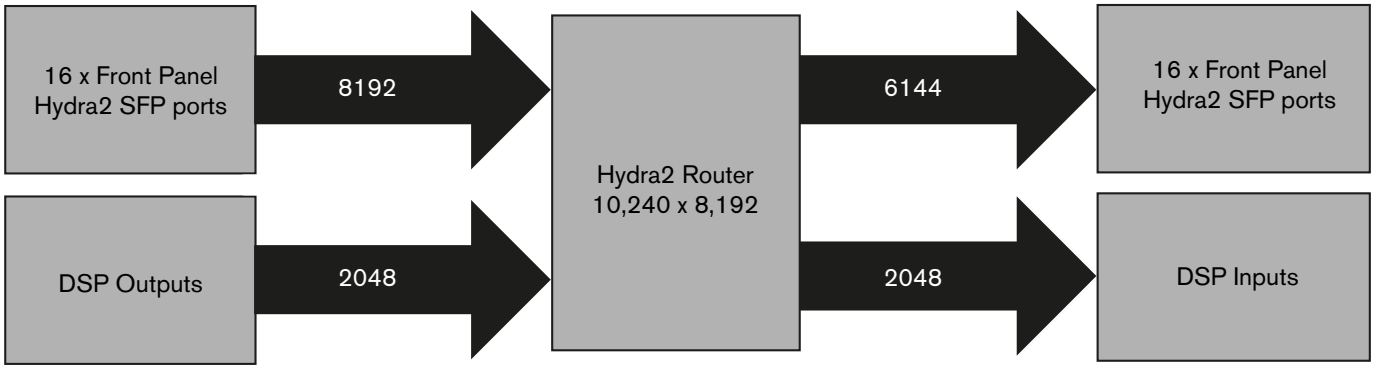
The maximum bandwidth of any port on a router is 512 signals, so 512 sources and destinations is the maximum count that any modular I/O box should be populated with (20 card slots are available). The table below shows the source and destination allocation for each modular I/O card type.

Fixed Format I/O Box Type	Source / Destination Allocation
AD5872—12 / 4 Analog I/O Box	32
AD5871—24 / 8 Analog I/O Box	64
AD5870—48 / 16 Analog I/O Box	128
AE5743 / 5991 / 5991—32 / 32 Analog I/O Box	128
JB5606—16 / 16 AES I/O Box	64
JB5783 / 5962—32 / 32 AES I/O Box	128
JM5736 / 5831 / 5990—MADI interface	128

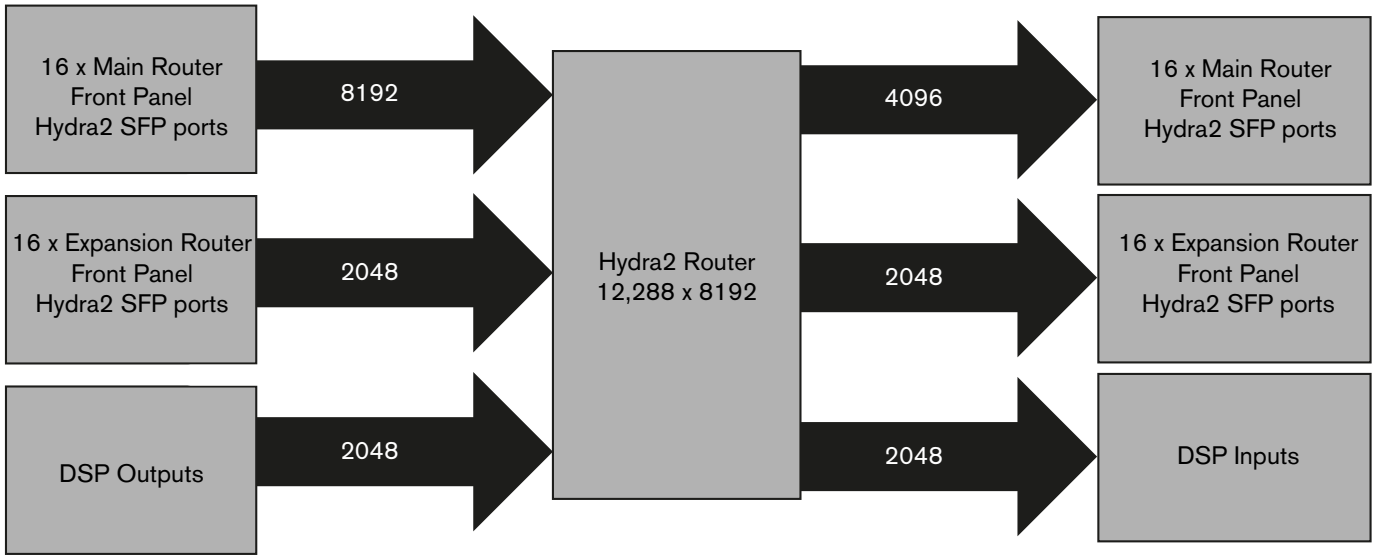
Modular I/O card type	Source Allocation	Destination Allocation
AD5838	8	0
AD6057	8	0
AD5840	4	0
AL5870	2	2
AL5875	1	3
DA5839	0	8
DA5867	0	8
JB5860	8	0
JX5869	8	0
JD5842	16	16
JB5837	0	8
JB5868	0	8
BI6192	64	64
VI5872	0	32
VO5841	32	0
VO5873	Up to 64 (32SDI + 8 per DolbyE decoder)	Up to 8 (2 per Dolby E decoder)

8U PROCESSING CORE ROUTER CAPACITY

Apollo/Artemis-Shine/Artemis-Beam Console Core (no Expansion Router)

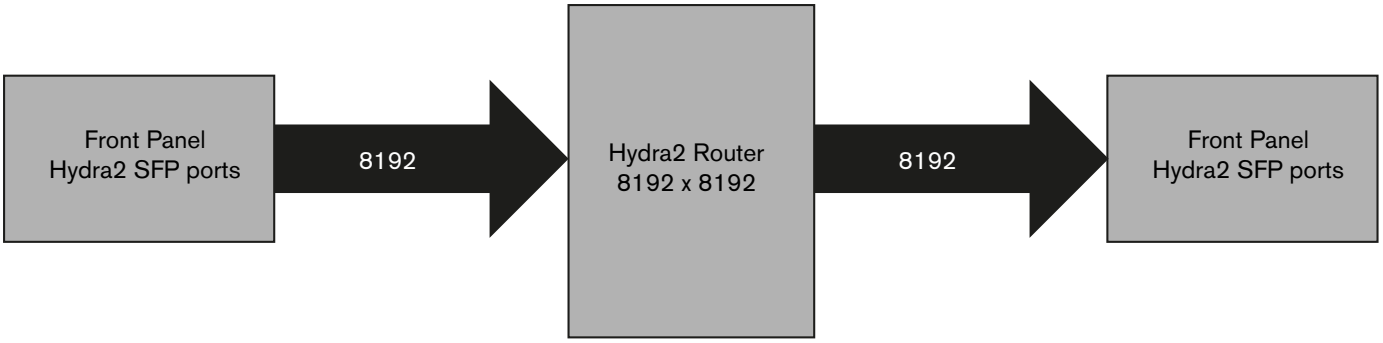


Apollo/Artemis-Shine/Artemis-Beam Console Core with Expansion Router card fitted.

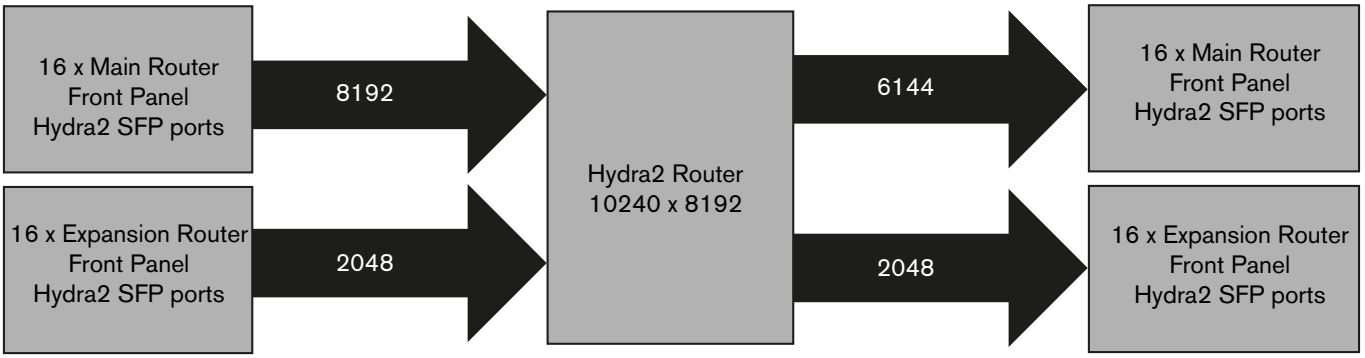


8U PROCESSING CORE ROUTER CAPACITY - NO DSP

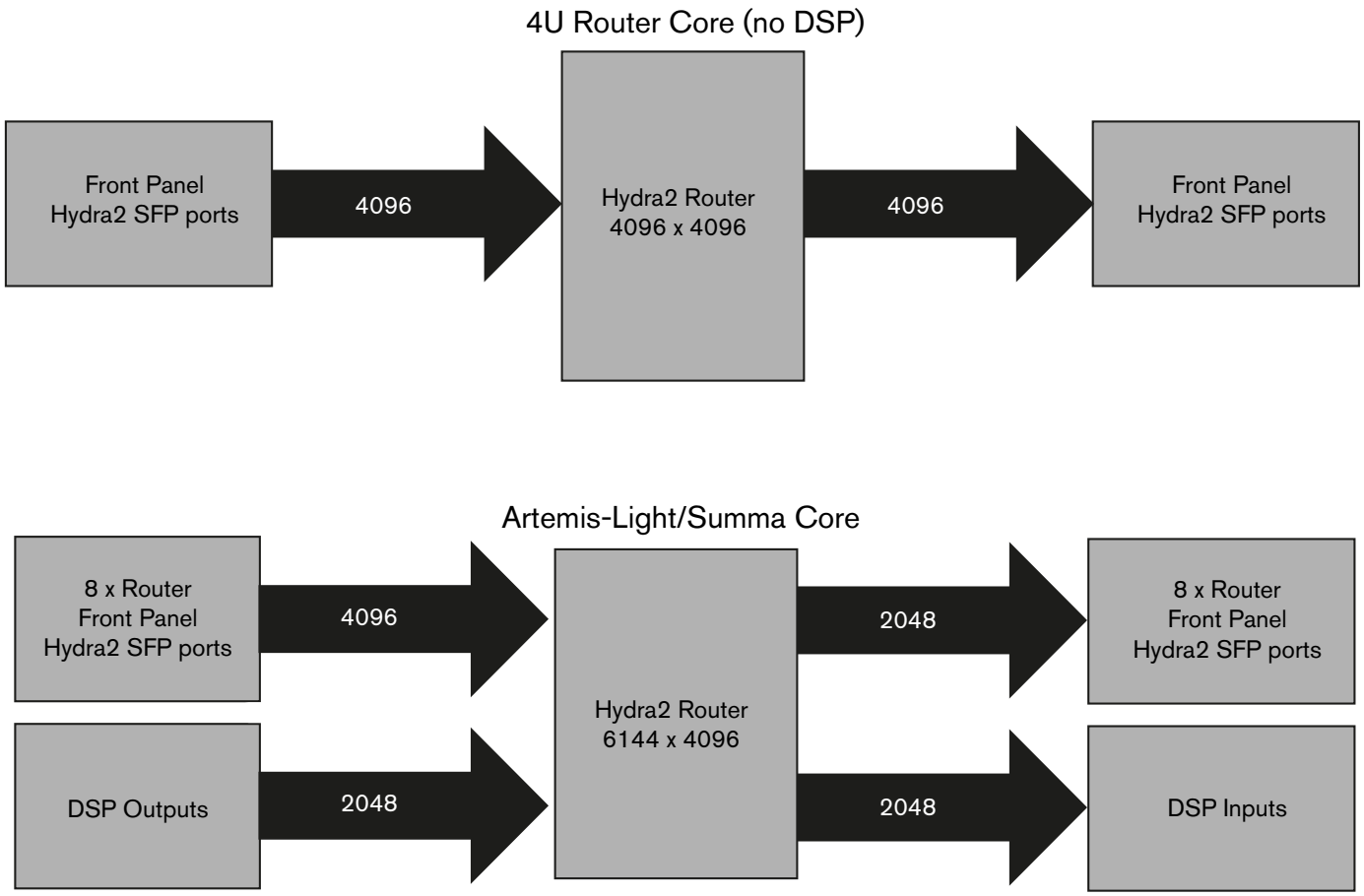
8U Router Core (no DSP, no Expansion)



8U Router Core with Expansion fitted (no DSP)



4U PROCESSING CORE ROUTER CAPACITY



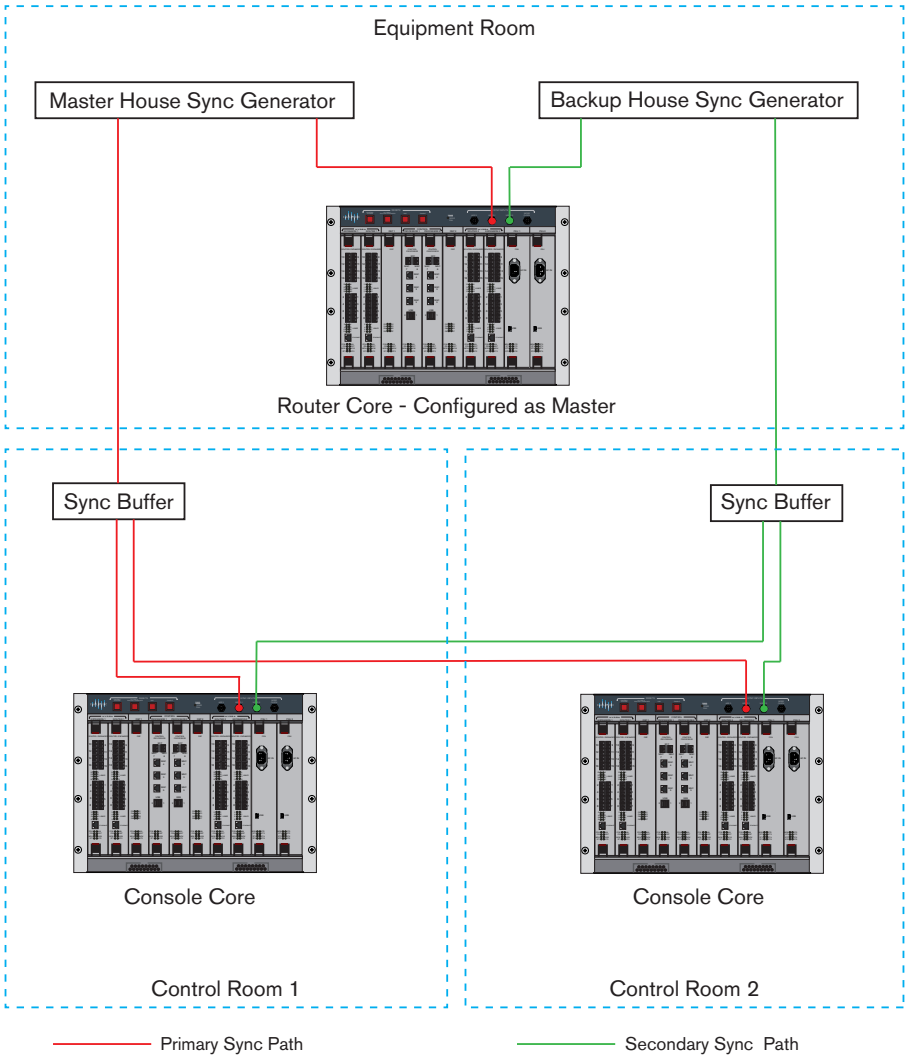
SYNC IN MULTI-CORE SYSTEMS

In a multi-core system each core requires its own sync connection. The router in each core in turn provides sync over the network to the I/O boxes connected to it.

It is vitally important that all cores on the same network are locked to a sync derived from and locked to the same source. If any routers are clocked by free running sync, or if they are derived from different sources, both network audio and communications will be compromised.

Cores running on different syncs can cause instability leading to the loss of I/O boxes and unreliable error messaging.

If sync is being distributed via equipment such as regenerators / buffers, it is important to ensure that they are all set to lock to the correct input from the master sync generator.



IP ADDRESS MANAGEMENT

In an Apollo/Artemis/Summa/Hydra2 system, each hardware element is allocated a unique IP address, be it a Router card, Control Processor, or an I/O box.

IP addresses follow the format of: AAA.BBB.XXX.YYY.

AAA is given a value unique to the customer/owner of the system.

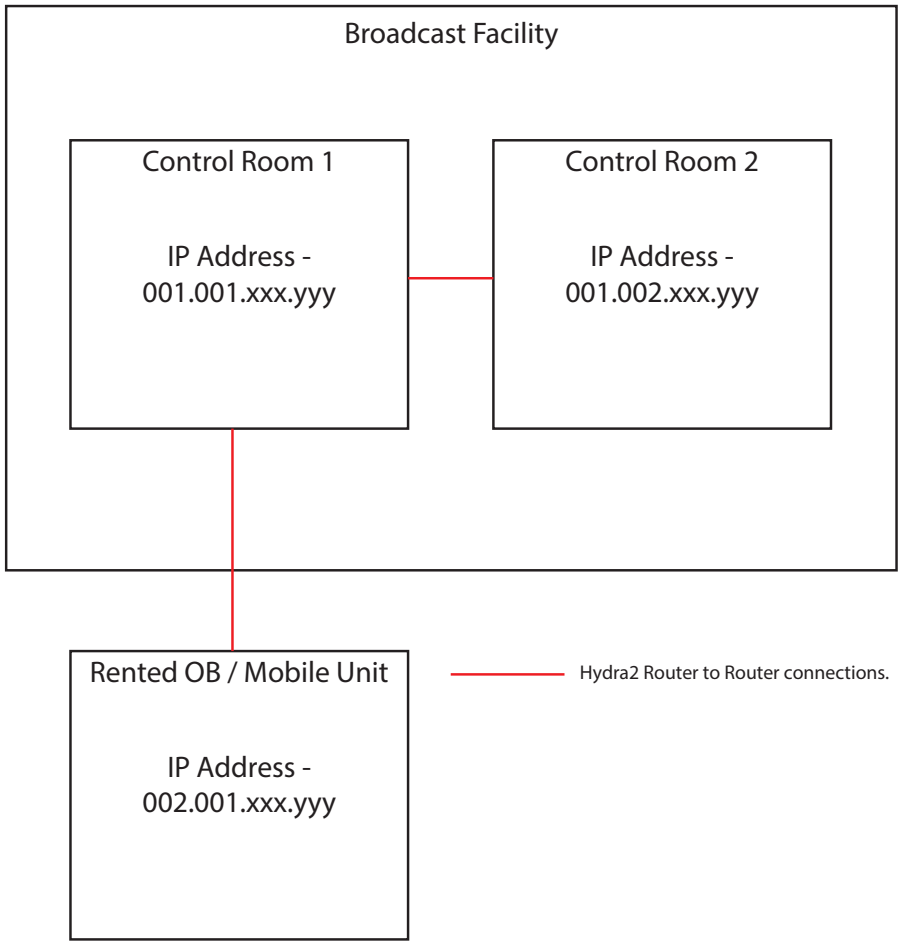
BBB is given a value unique to each core owned by a customer.

AAA.BBB is set by the configuration of the active Control Processor card within a core. Physically changing a Control Processor could change the IP address of all hardware associated with that rack, including the I/O boxes connected to it if the replacement card is not correctly configured.

XXX.YYY is automatically set for each element within and connected to the core, including rack cards, control surface elements and I/O boxes, but not other cores, or items connected via other cores. XXX is set by the type of hardware, YYY is set by the location / port that the hardware is connected to.

By maintaining this format of IP allocation, it ensures that systems can be connected together without address conflicts, as shown in Figure 1.

FIGURE1 - MULTI-CORE IP'S



Confirming IPs

To confirm the IP addresses associated with a processing rack, login to the PC associated with that rack with administrator privileges and launch the Calrec Program Updater application.

On startup, the Program Updater scans all the hardware it can find and lists it. The first hardware element detected by the program updater is the configuration PC itself, followed by the Control Processor and then the remaining hardware associated with that core. All hardware listed is part of the same system and will have the same number for the first two bytes, AAA.BBB.

Another system owned by the same customer will have the same first byte, AAA but a different second byte BBB.

A system owned by a different customer will have a different first byte AAA, but may have the same second byte BBB.

Changing IPs

The first two bytes of the IP address are set by the Master Control Processor. Changing the IP requires logging in to the card's Linux environment and editing a configuration file. This should only be carried out by competent technicians. Please contact our Customer Support team for guidance on IP address changing if required.

HYDRA2 CONNECTIONS AND REDUNDANCY

Each core is fitted with a primary/ normally active router card in slot 2, and a secondary/backup router card in slot 7. In an 8U core, optional expansion router cards can be fitted—primary in slot 1, secondary in slot 8.

Hydra2 Connectivity

All I/O boxes have a primary/normally active port 1, and a secondary/backup port 2.

Port 1 of each I/O box should connect to one of the front panel primary router or primary expansion router ports.

To provide redundancy, port 2 of each I/O box should be connected to secondary router / expansion cards in the same core as the primary connection.

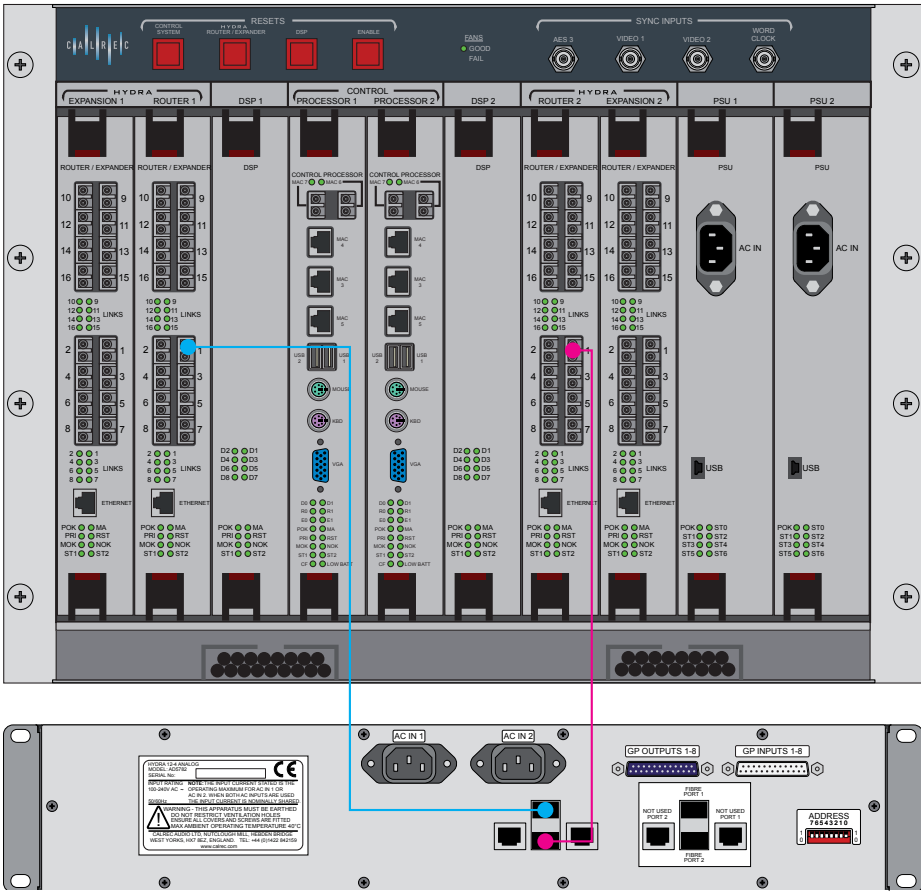
Redundancy is provided when connecting cores together by fitting a normally active link between the primary router in one core to the primary router in the other core, and a backup connection fitted between the secondary router of one core to the secondary router of the other. Core-to-core connections should always be made to the main primary / secondary routers, not expansion cards.

All Hydra2 connections—on I/O boxes and on router cards—are made via SFPs (small format pluggable) modules. Please refer to “SFP - Overview” on page 30 for information on connection types, pin-outs and length limitations.

Core Redundancy

Standard cores provide complete redundancy by being fitted with a full set of backup hardware—a secondary router, Control Processor and PSU, as well as expansion router and DSP card if primaries of these are fitted.

FIGURE 1 - CONNECTIONS FROM CORE TO IO BOX



Sophisticated hardware and software status monitoring, along with highly flexible comms and data routing allow for secondary cards to quickly and automatically take over from primaries if problems are detected. During a hot-swap situation, the minimum amount of hardware required swaps over to the secondary cards in order to minimize disruption and to retain maximum redundancy in the unlikely event of a further failure.

DUAL ROUTER CORE REDUNDANCY

Dual Router Core redundancy is an option for 8U Router Core systems (racks that do not contain a DSP mix engine), to physically split the location of the primary and secondary cards, providing protection against serious infrastructure problems, such as complete loss of power to an equipment bay/room, flooding or fire.

Systems that employ router cores normally use them as centralized distribution points within a wider Hydra2 network. Where router cores are used, one of them is normally dedicated as the Master Router for the network—upon which all other router and console cores are dependant. Therefore, providing locational redundancy for router cores in this way further secures reliability across the network as a whole.

Card layout and types

A dual core router comprises of 2 x 8U racks—the "Core A" rack houses the primary cards, and the "Core B" rack houses the secondary cards. The primary cards are fitted in the normal primary slots of Core A. The secondary cards are fitted in the normal secondary slots of Core B. (The secondary slots in Core A, and primary slots in Core B are inactive.)

Power supplies are an exception to this - both racks are fitted with 2 x PSUs each in order to maintain power redundancy to both cores.

DSP cards cannot be fitted in a Dual Router Core—racks providing a mixing console DSP engine (an Apollo, Artemis or Summa core) need to be housed in a single enclosure, though they can be connected to a Dual Router Core.

In addition to the standard cards - Routers, Control Processors and PSUs, a Redundant Core Link (RCL) card is required in both Core A and Core B - an RCL card should be fitted in the secondary Control Processor slot of Core A, and the primary Control Processor slot of Core B. The RCL cards provide a backup data link between the two cores.

All primary and secondary cards are identical in hardware and run the same software, allowing them to be freely interchanged between linked cores. Other than the RCL cards, all hardware and software, and the rack enclosures/ backplanes themselves are the same as are used in standard router cores and Apollo/Artemis console cores.

Connectivity

I/O boxes and other router or console processing cores connect as normal—I/O port 1's and primary routers from other cores connect to the primary router which is fitted in Core A. I/O secondary ports and other cores' secondary routers connect to the secondary router which is fitted in Core B.

Two additional connections are required to provide a primary and secondary comms link between Core A and Core B - the MAC7 ports of the Core A and Core B Control Processors should be connected together to form the primary link, and the single front panel port of the RCL cards in Cores A and B should also be connected together to form the secondary link (see diagram overleaf for further clarity). These are SFP ports, and therefore can be RJ45 copper or various fiber formats. Please refer to "SFP - Overview" on page 30 for further information on type and specification.

Boot-up and configuration.

At boot-up, the Control Processors check to see if they have an RCL card fitted in their neighboring Control Processor slot, or on their MAC7 port link. If either is true, the system will boot in Dual Router Core Redundancy mode. If both are false, it will boot in standard redundancy mode.

As with a standard, self-contained rack, both the primary and secondary Control Processors have identical configuration settings. The IP addresses assigned to cards in both cores are in the same range, and use the same IP allocation as a standard core.

Sync

Both core A and core B need to be connected and locked to a commonly derived sync source, as is the case for all router / console cores in any Hydra2 network.

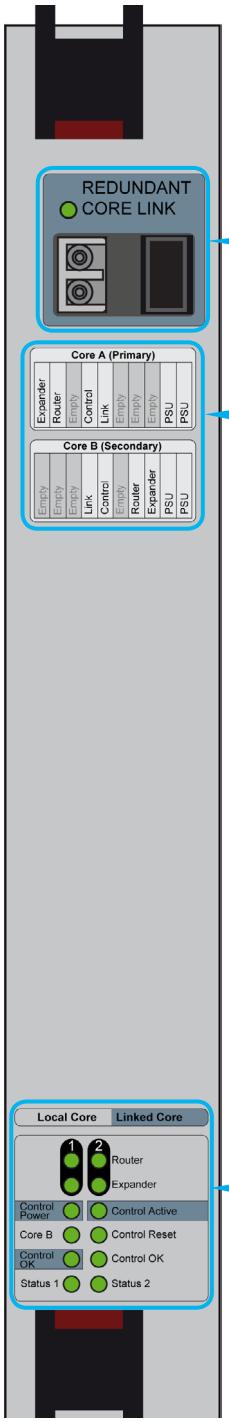
From software version 1.12.1, the H2O Manage Clients screen allows for router cores to be configured as "Dual Router". Cores configured as Dual Routers will display the sync status of both Core A and Core B. Both operate on the same sync priority list (I.E. Core A cannot be given a different priority list of sync types to that of Core B), however they can independently switch and will therefore lock independently depending on the sync type being fed into each.

Two padlock icons are displayed for Dual Router Cores within their H2O sync status table to indicate the currently locked source—the actively controlling router's icon is colored gold, the non-controlling router is silver. Clicking "reset to first" will cause both the core A and core B to attempt to lock to the top entry in the list, moving down until a viable source is found.

Resets

The reset buttons for both Core A and Core B are independent of each other and only reset the cards fitted within each Core.

REDUNDANT CORE LINK CARD



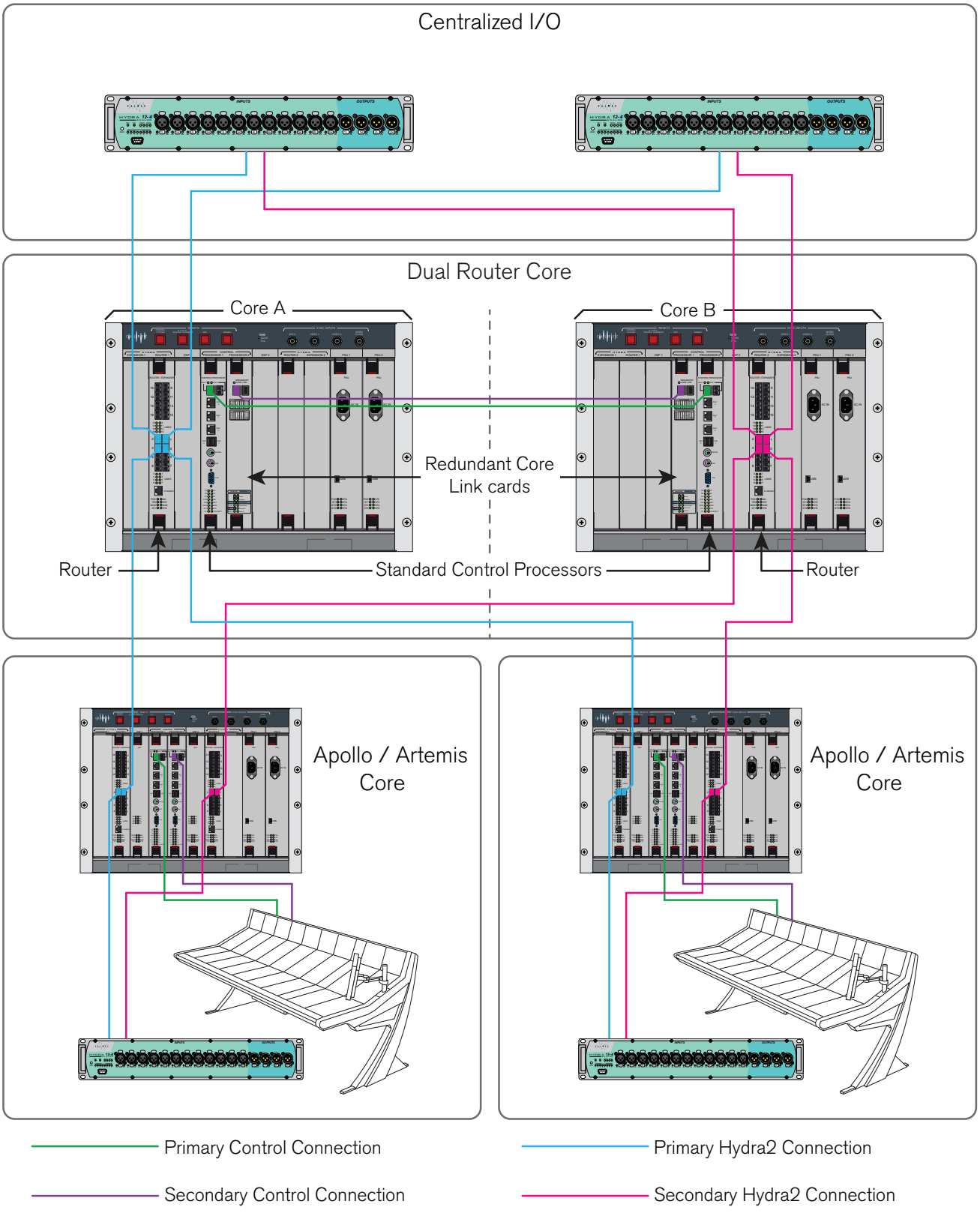
SFP slot & activity LED for comms connection with Control Processor fitted in the linked core. Note, the right hand SFP slot is inactive and blanked off.

Card map - shows the valid card slots for all card types in both Core A and Core B.

Status LEDs

Router 1 / Expander 1	Primary router / expansion router heartbeat, inactive if RCL card is fitted in Core B.
Router 2 / Expander 2	Secondary router / expansion router heartbeat, inactive if RCL card is fitted in Core A.
Control Power	Lights solid to indicate that the Control Processor fitted in the linked core is powered.
Control Active	Lights solid if the Control Processor in the linked core is actively in control. Off if the linked Control Processor is in standby / backup mode.
Core B	Lights solid green when fitted in Core B, off if fitted in Core A.
Control Reset	Lights momentarily during a control reset.
Control OK	Lights solid to indicate Control Processor has booted. Left hand LED (with shaded background) refers to the Control Processor fitted in the linked core. Right hand LED refers to the Control Processor fitted in the adjacent slot to this card.
Status 1	Displays own heartbeat.
Status 2	Unused.

DUAL ROUTER CORE REDUNDANCY - CARD POPULATION AND CONNECTIVITY EXAMPLE



HYDRA2
CONNECTION INFORMATION

CALREC

Putting Sound in the Picture

SFP - OVERVIEW

The connections between control surface and processing rack, as well as all Hydra2 network connections—connections between I/O boxes and routers, and router to router connections between different racks— are made via SFP modules (Small Form-factor Pluggable).

SFPs can be provided for RJ45 copper connections, as well as for singlemode or multimode fiber on LC connectors. This allows for each port's connection type to be chosen depending on the distance of the run or to match the infrastructure present. SFPs can easily be changed on a port by port basis as and when required.

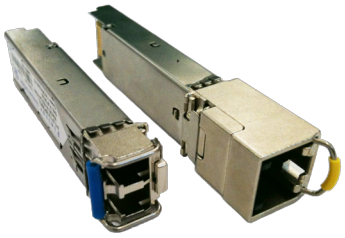
The correct quantity of SFPs are supplied pre-fitted. The type of each connection—copper, singlemode fiber or multimode fiber, should be specified at the time of order to ensure the correct SFP types are supplied. Additional SFP modules can be ordered if required. If a system is to be connected to an existing Hydra2 network, please discuss this with your Calrec project leader, sales person or local distributor to ensure the correct SFP and port provision for the additional router to router connections.

SFP slot orientation

SFP modules plug into front panel slots on core and modular I/O controller cards, and rear panel slots on fixed format I/O boxes. The modules can be fitted or removed whilst the system is powered and without removing or opening any card or box cases.

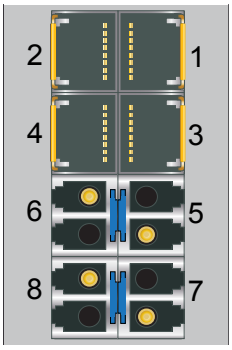
Note the orientation of the SFP modules, as shown in the illustrations on this page—modules fitted in even numbered router ports (left hand column) are fitted the opposite way around to those in the odd numbered router ports (right hand column). Likewise for fixed format I/O boxes, the primary SFP module is the opposite way around to the secondary SFP module. The modules are orientated so that the release catch for the RJ45 / LC connector plugs, once inserted, are on the outside edge.

SFP MODULES



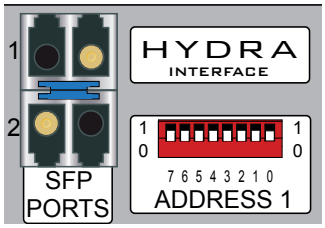
- Both SFP types above have a handle latching mechanism, shown here in the locked position. The unit on the left is a singlemode duplex LC fiber module. The unit on the right is a copper RJ45 module.

ROUTER CARD SFP ORIENTATION



- Router card shown with copper SFPs fitted in ports 1-4, singlemode fiber (button release) in ports 5-8.

FIXED FORMAT I/O BOX SFPS



- I/O box shown with singlemode fiber SFPs (button release) fitted.

For modular I/O box controller cards, both SFP slots are orientated so that the release catch on the cable / fiber connector are on the right-hand side.

MODULAR I/O BOX SFPS

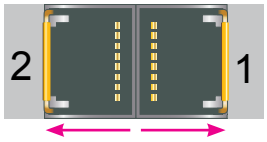
- Modular I/O controller card SFPs are both orientated the same way (Button release singlemode fiber SFPs shown).

SFP latching and extraction

Calrec source SFP modules from various manufacturers. All types used conform to the same specification, however the latching mechanism on them can vary slightly.

The standard copper SFP, and some fiber SFPs as shown in the photograph on the previous page have latch / extraction handles. On insertion, the handles should be set against the outer edge (the same side as the release catch on the RJ45 / LC connector plug that fits into the SFP) to lock them into place and prevent accidental removal if cables are pulled.

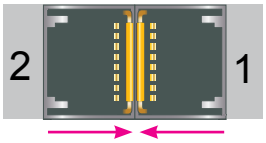
SFPS WITH HANDLES - LATCHED



- Both SFPs shown are locked in place—Latch / extraction handles in outer position (or “down” position for fiber).

To remove this style of SFP, remove the cable / fiber and slide the handle (copper) or lift the handle out (fiber) to the inside edge position as shown in the diagram below. The module can then be removed by pulling on the handle.

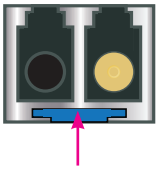
SFPS WITH HANDLES - UNLATCHED



- Both SFPs free to remove—Latch / extraction handles in inner (or “lifted” for fiber) position.

Other SFPs automatically latch into place when they are inserted fully and have a release button on their inside edge. The fiber SFPs shown in the orientation diagrams and below are of this type and have blue release buttons. To remove, depress the button using a small flat blade screwdriver or similar tool. The SFP module will then be free to be removed.

AUTO-LATCHING SFP



- Depress the release button to remove.

SFP slot covers

Dust covers should be fitted to all SFP slots that do not have SFP modules fitted in them in order to keep them clean and maintain connection reliability.

Loose SFP storage

SFP modules are small yet reasonably expensive devices. When removing or changing SFPs, take care to keep track of them and store loose modules in a clean, dry, and anti-static environment. Fiber SFPs should always have a dust cover fitted into their optical transceiver end when no fiber is connected to them.

Calrec will not be liable for lost or missing SFP modules, or damage due to poor storage.

RJ45 COPPER SFP CONNECTIVITY

Hydra2 network connections and control surface to processing rack connections made via copper SFP modules require shielded F/UTP Category 5e or Category 6 cables with shielded RJ45 mating connectors.

Calrec do not supply these cables as it is often preferable to terminate them after they have been run through cable ducting to avoid damaging the terminations, and to be able to cut them to the precise length required.

Shielded cables and connectors

Shielded cabling and connectors are required in order to meet EMC (Electro-magnetic compatibility) standards to comply with the Class B radiated emission limits set in the standard EN55022, as well as to guarantee performance in electrically noisy environments.

F/UTP Cat5e/Cat6 cable has an overall foil shield around the conductor cores. Shielded RJ45 connector plugs have a metallic shield around them which should be clamped / bonded to the shield within the cable. The shield on the connector mates with the chassis of the RJ45 socket that it is plugged into, providing an earth to the cable shield.

The method of attaching the connector shield to the cable shield can vary. Please refer to the connector manufacturer's information for further guidance.

SHIELDED RJ45 CONNECTOR

Conductive connector mating screen clamped / bonded to cable shield

Maximum cable length

The maximum length of Cat5e/Cat6 cables is 100m / 328ft. This is the absolute maximum and needs to include any patch points and cables that may be in the path. Hydra2 cable runs can NOT be extended using Ethernet switches, hubs or repeaters. If a run between Hydra2 hardware exceeds the maximum recommended distance for copper cabling, fiber and optical SFPs should be used instead.

Cable routing considerations

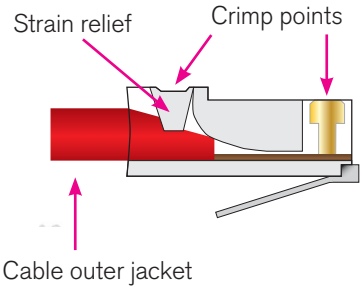
The layout and twist rate of the data cores within Cat5e/Cat6 cables are integral to their performance at high speed over distance. Poor installation practise can seriously impact upon this. The following are general good rules of practise, please refer to the cable manufacturer's information for comprehensive installation rules:

- When running Cat5e / Cat6 network cabling, it is important to avoid kinking the cable. Kinks can seriously impair performance. Cable manufacturers advise that kinked cables should be discarded and replaced as the damage caused cannot be addressed simply by straightening the outer appearance.
- Cables should not be bent in tight angles, this too can seriously impair performance. Please refer to the cable manufacturer's specification on minimum bend radii.
- Excessive pulling force when routing cables can deform the twist rate of the cable cores, causing irreparable damage. Cable manufacturers specify a maximum pulling tension.
- Cable ties should not be over-tightened as this also deforms the internal structure of the cable. Cable ties should be tight enough only to support the cable weight but not so tight as to cause any visible deformation to the cable's outer jacket. Large, heavy bundles of cables can be difficult to support using cable-ties without causing damage. "Velcro" style hook-and-loop cable straps can be a good alternative to plastic cable ties.
- Whilst neatly bundled parallel cable runs are tidy and aesthetically pleasing, they increase the chance of cross-talk, which can impact on performance. Avoid neat bundling of network cables over any kind of distance—the majority of a cables length is normally unseen, running under floor or through ducting where they should be loosely laid rather than neatly bundled.

Termination and strain relief

Poor termination and lack of strain relief is one of the most common causes of high speed network cable problems. To properly strain relief the data cores, the outer jacket of the cable should be inserted into the RJ45 housing and held in place once crimped by the strain-relief point, as shown in the following diagram. This also maintains the integrity of the twist rate and shield into the termination, and therefore the full length of the cable

STRAIN RELIEVED RJ45 TERMINATION



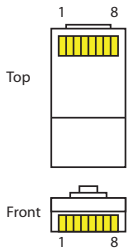
- Note, this is a simplified diagram that does not include the shield.

conforms to its intended specification. Slide on outer boots offer additional strain-relief protection but are not sufficient on their own. In order to be able to crimp the cable jacket inside the RJ45 and land the data cores on the terminals, the amount that the jacket is stripped back in relation to the cores needs to be quite accurate. Cables with exposed data cores should not be used as they will be unreliable.

Termination—pin-out

Hydra2 network cables use the standard gigabit Ethernet pin-out. Performance relies on the positive and negative leg of each signal pair using cores that are twisted together. Calrec recommends that "straight-through" or "pin-for-pin" cables are used. "Cross-over" style cables can be used, however they must be gigabit standard cross-over. Older pin-outs, designed for use with slower Ethernet standards only use two of the four pairs, even though all four pairs are terminated. Cross-over variants of this style only cross the pairs that are used (A and B). Gigabit cross-over cables require that the blue (C) pair is crossed with the brown (D) pair as well as the orange (A) pair being crossed with the blue (B) pair.

RJ45 PIN NUMBERING



STANDARD HYDRA2 RJ45 PIN-OUT

Pin	Color	Signal
1	Orange-White	A+
2	Orange	A -
3	Green-White	B+
4	Blue	C+
5	Blue-White	C -
6	Green	B -
7	Brown-White	D+
8	Brown	D -

- For standard wiring, both ends of the cable should be terminated as above.

Testing / certification

Calrec strongly recommend that all Hydra2 network cabling is properly tested or certified prior to on-site commissioning of the system. Simple test devices that only check the pin-out of the terminations are not sufficient to prove the performance and reliability of high speed data cabling. Certification level test equipment can give a simple pass / fail response but in doing so will test various important factors as well as pin-out. Certification type tests include determining cable length, measuring skew (timing differences between pairings due to variations in length caused by intentional differences in twist rate), measuring for loss, signal to noise ratio and BERT error checking on data.

Cables that fail certification tests or fail to perform, may appear to function fine in other applications, such as a PC LAN connection where errors leading to retries and therefore delays are acceptable and often unnoticed.

Temporary / reusable cables

Cabling that is not part of a permanent infrastructure, such as temporary runs used for outside broadcasts should be carefully coiled and uncoiled to avoid 'kinking' and they should be regularly tested. Cables showing any sign of damage should be replaced.

FIBER SFP CONNECTIVITY

Optical SFP modules for fiber connectivity can be used for console to processing rack, router to router, and router to I/O connections.

Fiber connectivity is required when the cable run between units exceeds the 100m maximum permissible length for Cat5e/Cat6 copper cabling. Fiber can also be used for shorter runs if it is the preferred medium.

Note, this section only concerns fiber connections made via SFPs. Like all I/O boxes, MADI units have pluggable SFPs for their Hydra2 connections to routers, but they also have fiber connectors that pass the actual MADI audio format in and out of the system. The MADI I/O format fiber connectors are of a fixed type which has no relation to SFP choice. Different MADI I/O box build-types are available to provide various types of MADI fiber interface. Please refer to “Fixed Format I/O Overview” on page 44 for more details on MADI I/O options.

Singlemode vs multimode

The core within multimode fiber is relatively thick when compared to singlemode. Light travels through multimode fiber at multiple angles, “bouncing” off the sides of the core as it travels through it, taking multiple paths or “modes” of varying length from one end to the other, resulting in pulses being lengthened as they travel. Singlemode fiber has a very fine core through which light travels in a single, direct path from one end to the other. without affecting pulse length. The result is that singlemode fiber has a higher bandwidth capacity and, importantly, low signal loss allowing much longer distances to be achieved. Light can be transmitted into multimode fiber using LEDs or low powered lasers whilst singlemode requires a higher powered laser.

Calrec recommends the use of singlemode fiber whenever possible in order to maximize the flexibility in the location of hardware and maintain uniformity across the system by using a single type. If a multimode infrastructure is in place, fiber length, the number of inter-connects and equipment location become more important.

SFP modules are available for both singlemode and multimode fiber types. It is important to select the correct SFP for the type of fiber being used in the installation. If using a mixture of singlemode and multimode fiber, it is important to ensure the correct SFPs are matched to the correct fiber type.

Identification

The release button / handles of fiber SFPs are color coded—blue for singlemode, black for multimode. Blue LC connectors, as shown below, should be used to terminate singlemode fiber, and beige colored ones for multimode.

Duplex Connectors / terminations

Standard Calrec fiber SFPs, multimode and singlemode, all use duplex LC connectors. The duplex termination requires two fibers per connection, one is a send path, the other is a receive path. When terminating the fiber, the send from one end should connect to the receive of the other and therefore they are "cross-over", terminated A to B and B to A.

Single strand, bi-directional SFPs

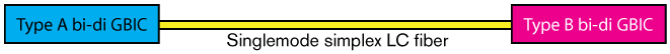
To reduce the amount of fiber, Calrec can supply singlemode SFPs that send and receive over a single, or simplex LC connector. In order to be able to pass data in both directions over a single strand, the light travelling in one direction needs to be of a different wavelength to the light travelling in the other direction. Therefore, bi-directional SFPs come as either type A, or type B, and they need to be paired up - A fiber should connect between a type A and a type B, and not between two bi-directional SFPs of the same type / wavelength. SFP modules are color coded to aid identification between type As & type Bs.

SFP / fiber specifications

Specifications are shown in the table below. The maximum distances shown assume a single point to point connection with no intermediary interconnections. Losses should be measured across the total signal path including interconnects - between points of transceiver connection. Losses need to be less than the optical power budget of the SFP transceivers being used.

DUPLEX LC FIBERS CORRECTLY TERMINATED A TO B & B TO A

BI-DIRECTIONAL LC FIBER CORRECTLY CONNECTED, TYPE A TO TYPE B



SFP / FIBER SPECIFICATIONS

SFP type	Connector	Power Budget	Fiber type	Max Distance
SX Multimode	LC Duplex	7.5dB	62.5/125µm	275m
			50/125µm	550m
LX Singlemode	LC Duplex	8dB	8/125µm	10km
LX Singlemode bi-di	LC Simplex	TBC	9/125µm	10km
LH Singlemode	LC Duplex	23dB	8/125µm	70km

FIBER – GENERAL RULES

Testing / certification
Calrec strongly recommends that all fibers are properly tested or certified prior to on-site commissioning of a system. A certain amount of signal loss occurs over the length of a fiber path. If the total loss of a path exceeds the optical power budget of the SFPs in use, the system will be unreliable.

Areas of loss
Signal loss occurs in various areas. Splice loss occurs in terminations—at the point where the fiber meets the connector. Typically splice loss should be <0.3dB per termination. Poor termination results in higher loss.

Connector loss occurs at the point where the connector meets the SFP / optical transceiver, or another connector, such as extension interconnects or patch-points. Connector loss should typically be <0.5dB per interconnect. Dust or other contamination between interconnects and scratches on the end surface contact point of the fiber will substantially increase the amount of loss. As such, dust covers should always be fitted to optical transceivers when no fiber is connected and to fiber connectors that are not landed.

As well as splice and connector loss, the fiber itself has inherent loss over distance, typically fiber loss will vary from 3.5 dB per km for multimode down to 0.4 dB per km for singlemode. Poor installation practise and lack of care can damage the fiber and result in substantially increased losses.

Fiber handling practise
It is important to follow the fiber manufacturer's guidelines when handling fiber and installing fiber runs. Some of the main points of concern are:

- Minimum bend radii—fiber should not be bent through tight angles. Tight angles can cause significant losses and permanent damage to the fiber. Fibers may pass initial installation testing but can fail at a later date due to stresses on the core of the fiber caused by tight bends.
- Twists, snags and kinks—Twists in fiber runs add stresses to the core which can cause damage over time. Avoid snagging on other cables or conduit which will cause excessive tensions when pulling and can cause kinks and excessive bends in the fiber. When routing through angled conduit, provide enough clearance around corners to avoid the fibers being pulled sharply around the inside of the angle.
- Pulling—observe the manufacturers maximum pulling tension specification. Use pulling tools and lubrication where appropriate. Never pull on the connector.
- Strain relief—fibers should be adequately strain relieved to prevent tension on terminations, however use of plastic cable ties can crush the internal construction of the cable. Hook-and-loop "Velcro" straps are harder to over-tighten, offer more gentle support and a greater surface area to dissipate the pressure.
- Crushing—never place heavy items on top of unprotected fiber.

Ruggedized fiber
For temporary / re-usable fiber runs , or runs unprotected by conduit, fiber that is likely to be exposed to the elements, snagging or to being stood on, should always be of a ruggedized / armored type to protect the internal construction of the core.

WARNING

Never look into the end of an optical transceiver or fiber when in use. Laser radiation can be harmful to the human eye and should be avoided.

Remember that when disconnecting a fiber, the transmitting device at the other end may still be active.

Cleaning and preventative maintenance
Contamination of transceiver and fiber mating contact points causes signal loss and can cause permanent damage through scratching.

Dust covers should be fitted to all fiber connectors and SFP optical transceivers when they are not mated. It is also important to ensure that dust covers themselves are kept clean.

When handling fibers without dust covers, do not allow the ends to come into contact with any surface, including fingers.

Specialist materials should be used for the cleaning of mating contact points to avoid further contamination or scratching. The following items are low cost and readily available from camera shops and laboratory suppliers:

- Canned compressed air—it is important to use specialist filtered, clean, dry air, free of contaminants and moisture.
- Isopropyl alcohol. Use with cotton swabs or lint-free wipes to ensure no residue is left.
- Lint free wipes / long fiber, low ash lens paper—needs to be free from chemical additives. Ensure wipes and swabs are stored in a clean environment and are not reused.

Cleaning fiber optic cables and connectors

There are multiple ways to clean fiber-optic cables and connectors. Included below are some helpful tips to properly clean fiber optic cables.

- Do not allow the end of the fiber optic cable to make contact with any surface including fingers.
- Do not excessively bend the fiber cable. Bending the cable may cause internal breaks along the fiber resulting in poor performance or instability.
- Optics and optic coatings are easily chipped and/or scratched. Use of finger cots or powder free surgical gloves while handling fiber optic cables will help ensure cleanliness.
- Only fresh (dry) spectroscopic grade Isopropyl Alcohol should be used as a cleaning solvent.
- Ensure that the module power is off and that other light sources are disabled.

Cleaning procedure

1. Blow the fiber surface with a stream of Clean Dry Air, this will dislodge larger loose particles.
2. Place 1-3 drops of spectroscopic grade Isopropyl Alcohol in the centre of a lens tissue.
3. Hold the fiber by the connector or cable, place the wet portion of the lens tissue on the optical surface and slowly drag it across.
4. Examine the surface of the fiber end under high intensity light using a direct magnifying inspection microscope or an indirect video inspection tool if available. If streaks or contaminants still remain, repeat the process using a fresh lens tissue.
5. Immediately install a protective cover over the end of the cable to avoid re-contamination or insert the fiber back into the previously cleaned receptacle for immediate use.

Additional notes

Do not tip the can of Clean Dry Air whilst aerosol spraying as liquid may be released contaminating the surface of the fiber.

Do not use dry lens paper as dry lens paper is extremely abrasive.

Do not use Acetone as a cleaning solvent on the fiber optical surfaces.

To ensure the purity of the Isopropyl Alcohol, do not insert the lens tissue, swabs, etc into the liquid, instead, drip the liquid on to the material.

Cleaning optical transceivers

The best way to clean a transceiver port is to remove particles using a stream of Clean Dry Air.

Included below are some helpful tips to properly clean fiber optic modules.

- Always handle optical SFP modules in an ESD safe manner using the proper safety precautions.
- Ensure that the module power is off and handle the modules with care.
- Always use Clean Dry Air or an approved canned compressed air supply.
- Always hold the can of compressed air upright. Tipping may release liquids into the air stream.
- Do not touch the inner surfaces of the module including the Optical Sub-Assemblies (OSA), or insert any foreign objects into the ports.
- Use of finger cots or powder free surgical gloves are not required but may be used for cleanliness.

Cleaning procedure

1. With the clean dry air, blow the inner barrel of the Transmitter and Receiver Optical Sub-Assemblies (OSA). This will dislodge loose particles.
2. Examine the surface of the OSA lens under high intensity light using the inspection microscope. If contaminants still remain, repeat the process.

Following these guidelines should provide a successful installation and ensure optimum reliability and system performance.

For further information or advice please feel free to contact Calrec.

AWACS OVER SNMP

All Calrec consoles feature AWACS (Advanced Warning And Correction System). AWACS messages can be managed centrally using an SNMP (Simple Network Management Protocol) server.

All Calrec console and Master Router PCs provide an SNMP agent to forward error and warning messages to a central SNMP server, allowing equipment faults to be monitored and managed from a central location. A connection can also be made to a second SNMP server if required for redundancy.

Connecting to the SNMP server

A USB to ethernet adapter is provided with each console PC for connecting to your central SNMP server. If multiple SNMP servers are used this connection should be made to a network switch to allow multiple onwards connections.

Router cores are provided with a rack mount PC which has a spare ethernet port to be used for connecting to your central SNMP server.

In both cases the ethernet ports used must be configured to be in range of your central SNMP server before configuration can continue.

Configuring the SNMP Agent

Each console/router core PC's SNMP agent must be configured individually. This can be done from the local PC by opening Google Chrome and entering 'localhost' in the address bar as shown here. SNMP agents can also be configured remotely by entering the IP address of the PC where the SNMP agent is running, including the port number (default: 80).

The SNMP Agent interface has 3 tabs. The Current AWACS Status tab shows a list of the current AWACS errors and warnings for the console or router that you are accessing.

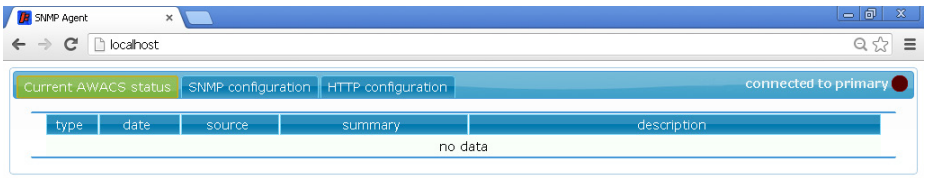
Enter the IP address of the facility's main SNMP server within the SNMP configuration tab under 'address 1'; this is where the SNMP agent and SNMP server are connected together. If a seccond SNMP server is used enter it's IP address under 'address 2'. After making any changes, click SUBMIT & RESTART.

The HTTP configuration tab allows you to set the port number for access to the SNMP agent configuration interface, the default is port 80. If changes are made here, the port will need to be specified when accessing the SNMP agent interface, for example, if the port is changed to 10, type 'Localhost:10' in Chrome's address bar to access the SNMP agent interface. After making any changes, click SUBMIT & RESTART.

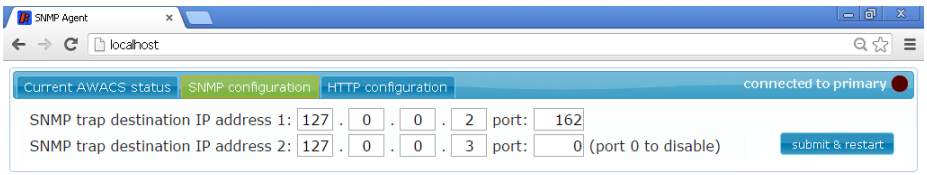
Scope of AWACS over SNMP

Only AWACS error and warning messages are sent via SNMP, information messages are not sent. When errors are corrected, the relevant AWACS messages are cleared from the PC Main application and are simultaneously cleared from the SNMP server.

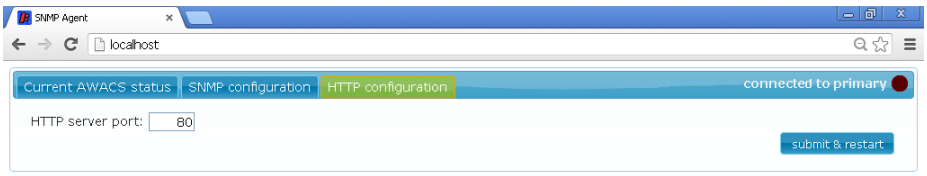
SNMP AGENT - CURRENT AWACS STATUS TAB



SNMP AGENT - SNMP CONFIGURATION TAB

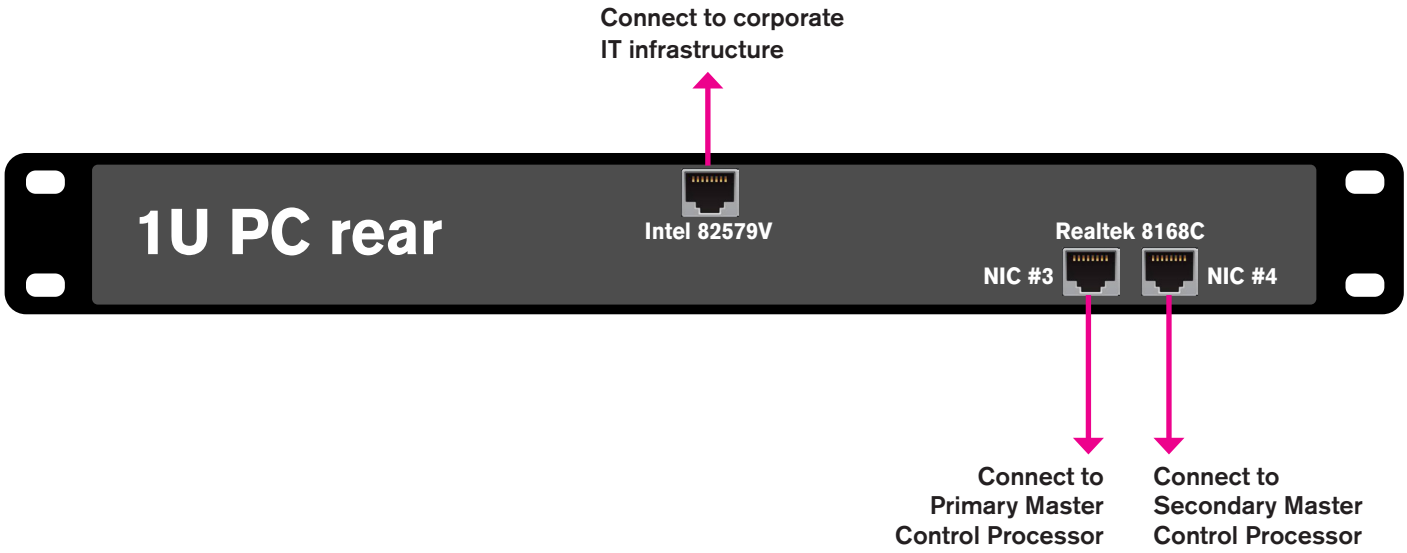


SNMP AGENT - HTTP CONFIGURATION TAB



ROUTER CORE PC CONFIGURATION

1U PC REAR CONNECTIONS



All Router Cores are supplied with a 1U rack mounted PC and 1U keyboard and screen for accessing the various components of the Router Core and the wider Hydra2 Network.

PC Connections

The Intel Ethernet port should be connected to your corporate LAN and the two Realtek ethernet ports should be connected to your Router Core processing rack as shown in the diagram above. The MAC5 RJ45 port on the front of the Master control processor card should be used.

Configuring Ports

The Intel 82579V port should be configured to interface with your corporate IT structure for the purpose of communicating AWACS messages using the SNMP protocol.

Pre-installed software

The following software comes pre-installed on every Router Core 1U PC:

- Calrec Program Updater
- Customer Data Backup Utility
- SNMP client
- Google Chrome

The following admin software is pre-installed on all Router Core 1U PCs:

- WinSCP
- PUTTY
- logmein

Calrec Program Updater

Calrec Program Updater is used to update primary and secondary control processors, routers and processor switches without the need for swapping network cables.

Program Updater is also used to gather console logs from both primary and secondary control processors and routers

Customer Data Backup Utility

Calrec's Customer Data Backup Utility is used for backing up and restoring core databases and promoting/demoting master routers within the Hydra2 network

SNMP Client

The SNMP client allows AWACS messages to the reported to a central SNMP server where the status of the active processor is automatically tracked. AWACS messages can also be viewed using the SNMP client's browser via Google Chrome.

Google Chrome

Google Chrome is used to access Calrec's network management tool H20 and to configure the SNMP client as described on the previous page.

Antivirus Protection

Antivirus protection is not pre-installed on console and router core PCs as standard but if you wish to protect your PC you can install a package of your choice. . Exceptions will need to be configured within the antivirus software to allow the following to communicate with the Calrec system:

- C:\Calrec\WindowsService\DeskPcWs.exe
- C:\Calrec\ProgramUpdater\Calrec.ProgramUpdater.exe

HYDRA2
3RD PARTY REMOTE CONTROL

CALREC

Putting Sound in the Picture

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SW-P-08 REMOTE CONTROL

The Hydra2 router allows for cross-point matrix routing of Hydra inputs direct to Hydra outputs without using console DSP or control surface space. Control over input to output cross-point routing can be from the console PC, a standalone PC running the Hydra2 Organizer or via 3rd party controllers supporting the SW-P-08 protocol.

As well as physical Hydra2 I/O ports, the H2O application and SW-P-08 controllers also have access to Hydra patchbays, enabling them to change sources on console DSP inputs and access to console DSP outputs.

The following 3rd party SW-P-08 systems have been proven with, and are supported by Calrec:

- L-S-B VSM
- Colledia BNCS
- Grass Valley Jupiter
- Evertz
- NVision
- Axon Cortex
- Harris Edge

Please refer to the relevant manufacturer's guidance for specific information relating to their products.

Connection

The 3rd party SW-P-08 controller should be connected to the single front panel RJ45 "Ethernet" on the main (not expansion) Router card. A secondary, backup connection can be made to the secondary main router card. Systems requiring both SW-P-08 and Ember control need to use the same single Ethernet port and therefore an Ethernet switch is required. The two control systems are separated by using different TCP socket port settings.

On Hydra2 networks with more than one processing rack, the SW-P-08 connections should be made to the router cards in the processing rack configured as the Master Router. Slaved processing racks do not support SW-P-08 connections. Connections made to the Master Router can be given access to any I/O on the network, irrespective of which processing rack the I/O is connected to.

The Ethernet port on the router cards is a gigabit connection which uses standard Ethernet straight-through or cross-over pin-outs and pairings. Screened Cat5e cable should be used to guarantee performance.

The default IP address of the SW-P-08 ports are the same as that of the router cards themselves—xxx.yyy.5.0 for the primary and xxx.yyy.6.0 for the secondary. xxx.yyy is different for each processing rack and can be checked using the Calrec Program Updater application on the PC associated with the rack in question. The user must be logged into Windows as **CalrecAdmin** with the password **calrec** in order to run the Calrec Program Updater which can be found in the Calrec folder in the Windows Start menu. Upon launch, the application checks for the presence of local hardware and reports back with IP addresses. All hardware associated with the same processing rack has the same first two bytes of IP address. The router cards themselves can be identified in the list by their unit number being prefixed with "RY". IP addresses for the SW-P-08 connections can be aliased if required to make them more suitable for use with the 3rd party network, however this should be carried out by a Calrec Engineer and so such should be discussed prior to commissioning.

As well as addressing the routers by IP, the SW-P-08 controller needs to be configured to use the TCP socket port of 51000.

Configuration

SW-P-08 configuration requires the use of the Hydra2 Organizer GUI. Please refer to the H2O user guide for information

EMBER REMOTE CONTROL

The EMBER protocol is a sophisticated data exchange mechanism that has potential for controlling many functions across varied equipment types.

EMBER control has been incorporated into Calrec's Apollo, Artemis and Hydra2 range to allow remote control functionality both over consoles and the wider Hydra2 network.

Currently, Calrec support the use of the following EMBER controllers:

- L-S-B VSM
- Colledia BNCS

Please refer to the relevant manufacturer's guidance for specific information relating to their products.

Currently, EMBER has the ability to control the following features when connected to a Calrec Apollo/Artemis/Hydra2 network:

- Loading of shows and user memories onto control surfaces.
- Loading / removing alias files used by consoles, instructing them to use different pre-defined sets of I/O ports. (Please refer to the console operator manual for more information on the use of alias files.)
- EMBER controllers can view and edit the H20 based Hydra2 I/O box and port labels.
- Inserting SMPTE2020 metadata into Hydra2 SDI embedder outputs - Metadata sets can be uploaded and edited using the H20 application. EMBER controllers can select any of the available metadata sets for insertion to, or removal from any of the SDI embedder outputs on the network.
- EMBER controllers can selectively mute any of the audio channels within the SDI output of Hydra2 embedders.

Connection

The 3rd party EMBER client should be connected to the single front panel RJ45 labelled "Ethernet" on the main (not expansion) router card. A backup secondary connection can be made to the secondary main router card. Systems using both EMBER and SW-P-08 control require the use of an external Ethernet switch to allow both control systems to connect to the same Ethernet port. The two control systems are separated by using different TCP socket port settings.

On Hydra2 networks with more than one processing rack, the EMBER connections should be made to the router cards in the processing rack configured as the Master Router. Slaved processing racks do not support EMBER connections. Connections made to the Master Router can be given access to any console and I/O on the network, irrespective of which processing rack they are connected to.

The Router card Ethernet ports are gigabit connections, which use standard Ethernet straight-through or cross-over pin-outs and pairings. Screened Cat5e cable should be used to guarantee performance.

The default IP address of the Ethernet ports are the same as that of the router cards themselves—xxx.yyy.5.0 for the primary and xxx.yyy.6.0 for the secondary. xxx.yyy is different for each processing rack and can be checked using the Calrec Program Updater application on the PC associated with the rack in question. The user must be logged into Windows as **CalrecAdmin** with the password **calrec** in order to run the Calrec Program Updater, which can be found in the Calrec folder in the Windows Start menu. Upon launch, the application checks for the presence of local hardware and reports back with IP addresses. All hardware associated with the same processing rack has the same first two bytes of IP address. The router cards themselves can be identified in the list by their unit number being prefixed with "RY". IP addresses for the SW-P-08 connections can be aliased if required to make them more suitable for use with the 3rd party network, however this must be carried out by a Calrec Engineer and so should be discussed prior to commissioning.

As well as addressing the routers by IP, the EMBER controller needs to be configured to use the TCP socket port of 61000.

HYDRA2
FIXED FORMAT I/O

CALREC

Putting Sound in the Picture

FIXED FORMAT I/O OVERVIEW

A range of different fixed format I/O boxes are available to provide the quantity and type of signal format required where it is needed.

Each type of fixed format I/O box contains a set number of inputs and outputs, all of the same type / signal format. The term 'fixed format' differentiates this type of I/O box from modular I/O racks which can be custom populated with mixed signal formats in varying quantities.

Mounting

All Hydra2 I/O boxes are fitted with racking angles, designed for mounting into standard 19" equipment bays.

Airflow

Units can sit, or be mounted directly on top of, and beneath other equipment—no spacing above or below is required for cooling. Airflow is via the side panels, which should be left unobstructed. All units, other than MADI I/O, have fan assisted airflow. A single, high specification, low noise fan is mounted to the right hand side panel, expelling air from the unit. Fans are run under-voltage to further increase reliability and reduce acoustic noise, ensuring suitability for locating within studios.

Power

All units are fitted internally with 2 x AC PSUs, each with its own IEC mains input connector, to provide redundancy against both internal PSU failure, and external AC mains loss. Where possible, the two IEC connectors / PSUs should be fed from separate AC sources. Units are supplied with IEC 'Y-split' cables to maintain redundancy by allowing both PSUs to be fed from a single AC outlet / cable, if that is all that is available.

Hydra2 network connections

I/O boxes interface with the Hydra2 network via rear-mounted, hot-pluggable SFP slots to allow Cat5e copper, singlemode, or multimode fiber connectivity. All units have 2 x Hydra ports - a primary / normally active, and a secondary / backup. Port 1 of an I/O box should connect to a primary Hydra2 router card, port 2 should connect to the secondary router card fitted in the same rack. Note, any fixed RJ45s (as oppose to pluggable SFPs) on the rear of Hydra2 I/O boxes are not functional.

GPIO

Most fixed format I/O units can be fitted with an optional GPIO card that provides 8 inputs and 8 outputs whose functions are assignable by any control surface on the network. A range of functions can be assigned, including Autofader and path Cut/On trigger inputs, fader open/start and error alert outputs.

Reset

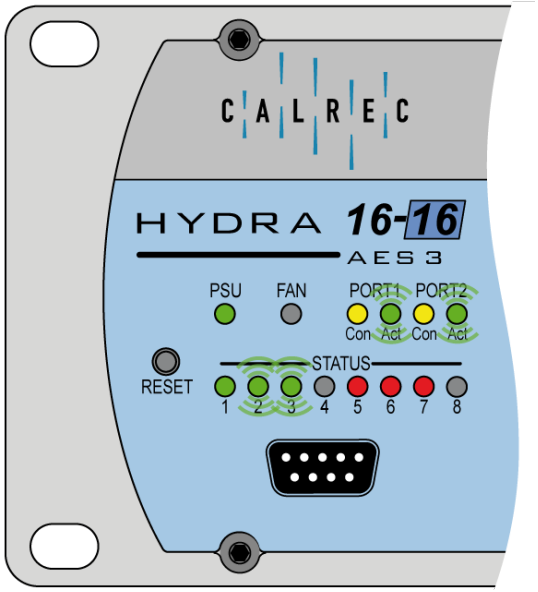
The reset button can be used to perform a 'soft' or 'hard' reset.

Press RESET to perform a soft reset.

Press RESET and hold until the FAN FAIL LED is illuminated to perform a hard reset.

Note: Splats may be emitted from analog outputs during a hard reset. Please ensure loudspeakers are disconnected/powered down before performing a hard reset.

FRONT PANEL STATUS LED'S - NORMAL CONDITION



In normal operation, front panel LEDs should be as shown above:

- PSU - ON solid green
- Fan - OFF
- Port 1/2 Con - ON solid yellow
- Port 1/2 Act - FLASH (fast) green
- Status 1 - ON solid green
- Status 2 - FLASH (slow) green*
- Status 3 - FLASH (slow) green*
- Status 4 - No function**
- Status 5 - ON solid red
- Status 6 - ON solid red
- Status 7 - ON solid red
- Status 8 - OFF

FRONT PANEL STATUS LED INFORMATION

LED	Description	Display
PSU	Power Supply Status	**ON SOLID GREEN**—Normal, indicates both PSUs are functioning. **OFF**—One or both PSUs is faulty or has no AC input.
FAN	Fan Status	**OFF**—Normal, internal fan is functioning. **FLASHING RED**—Fan is faulty.
Port 1/2 Con	Hydra port Connection	**ON SOLID YELLOW**—Normal, indicates a valid Hydra2 port connection is made. **OFF**—Hydra2 port connection is not valid.
Port 1/2 Act	Hydra Port Activity	**FLASHING GREEN**—Under normal operation, once the connection is established, this LED should be flashing in a regular pattern, approx 10 times per second. **OFF**—No activity on the Hydra link.
Status 1	Unit Booted & Initialized	**ON SOLID GREEN**—Normal, indicates the unit has booted and the Hydra2 ports are enabled. **OFF**—Unit has failed to boot.
Status 2	Primary Router Heartbeat	**FLASHING GREEN***—Normal, should flash approx 2 times per second. Indicates a valid link between port 1 and a Hydra2 primary router. **OFF or ON SOLID**—Failed link between port 1 and Hydra2 primary router.
Status 3	Secondary Router Heartbeat	**FLASHING GREEN***—Normal, should flash approx 2 times per second. Indicates a valid link between port 2 and a Hydra2 secondary router. **OFF or ON SOLID**—Failed link between port 2 and Hydra2 secondary router.
Status 4	No Function**	
Status 5	Primary Control Data	**ON SOLID RED**—Normal, indicates primary control data connections are established between port 1 and a Hydra2 primary router. **OFF**—Primary control data has failed / cannot be established.
Status 6	Secondary Control Data	**ON SOLID RED**—Normal, indicates secondary control data connections are established between port 2 and a Hydra2 secondary router. **OFF**—Secondary control data has failed / cannot be established.
Status 7	Primary Audio / Sync active	**ON SOLID RED*****—Normal, audio and sync input to the unit active from port 1. **OFF**—Unit is not actively receiving audio / sync via port 1.
Status 8	Secondary Audio / Sync active	**OFF**—Normal, unit is not using audio / sync input from port 2 (secondary / backup) . **ON SOLID RED*****—Unit is using audio and sync from port 2, indicates a problem with the primary path.

- Primary and secondary heartbeat LEDs are often seen to flash synchronously—together, in time with each other, however, this is not important. As long as each LED is flashing approximately twice per second, both ports have an active and reliable comms path with a Hydra router. Under normal boot-up, from power on or reset, the heartbeats will start off in sync with each other. Over time, slight differences in timing between them will lead to the heartbeats being out of sync with each other - this is normal operation. Heartbeats will be out of sync with each other from the start if the system is already booted and the Hydra connections are physically plugged in one at a time.

** The function of status LEDs can be subject to change with software versions. Under some software versions, status LED 4 may light to indicate a PSU issue during bootup and is primarily used by Calrec Engineers for troubleshooting rather than for guidance during normal operation.

*** Status LEDs 7 and 8 may be lit at the same time if an I/O box is receiving signals on its secondary connection.

I/O BOX IDENTIFICATION

Each I/O box on a Hydra2 network needs to be given a unique ID in the form of a number between 0 and 255. The Hydra ID, or "HID" for each box is set using a DIP switch accessible from the rear of fixed format I/O boxes.

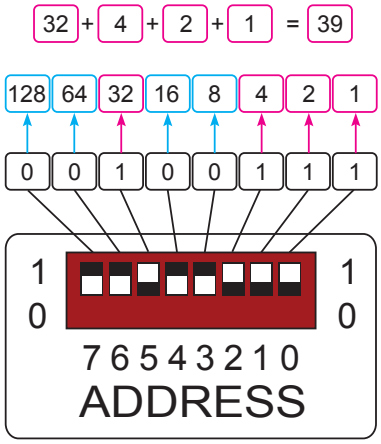
Label pockets are fitted to the front panel of I/O boxes to aid visual identification.

The 8 way DIP switch is set as an 8 bit binary representation of the HID value with the left hand switch used for the most significant bit, and the right hand switch for the least significant bit. A switch in the down/off position represents a binary 0 and a switch set in the up/on position representing a binary 1. Each individual switch / binary bit equates to a decimal value, starting at 1 for the least significant bit. The remaining switches are double the value of their less significant neighbor, making the 8th / most significant bit equate to a decimal value of 128. The overall decimal value is the sum of the decimal values of each binary '1'

All fixed format I/O box ID switches are orientated the same way, though some boxes, such as MADI units, use a different style switch with more pronounced labelling. Ignore any labels on the switch itself and always refer to the Calrec labelling on the surrounding panel, which will show the most significant bit switch on the left and the binary 1 position as up.

Care should be taken when setting HIDs to avoid accidentally duplicating the same ID on more than one box. Duplicate box IDs can cause network conflicts. I/O boxes should be disconnected from the network before changing their HIDs, and reset or power cycled once the DIP switch is set to ensure the new HID is active before reconnecting to the network.

STANDARD SWITCH FOR HID SETTING



- The above diagram shows how each switch relates to a decimal value. The setting shown in the example provides a decimal HID value of 39

If replacing an I/O box for any reason, choosing a box of the same type as the original and setting it with the same ID makes it a drop-in replacement that will work with existing user memories and settings, requiring no further configuration.

When connecting additional I/O boxes to a network it is important to be aware of the existing I/O HIDs in order to select a unique number and avoid creating a conflict.

Address 2

Some I/O boxes, such as MADI units, are fitted with 2 banks of DIP switches - Address 1 and Address 2, to provide a 16 bit ID and therefore a greater range of values. Please note that only ID values between 0 and 255 are currently supported. Any DIP switches labelled Address 2 should all be set to the off position.

FIXED FORMAT GPIO – SW5739

The SW5739 is an optional GPIO card that can be fitted in most fixed format I/O boxes.

GPIO are General Purpose Inputs and Outputs. GPIO are often used to connect different pieces of equipment together to allow a function on one to be triggered by a selection on the other, for example, to make a CD player start playing automatically when its fader is opened on the mixing console or to light an “on-air” sign when a mic fader is opened

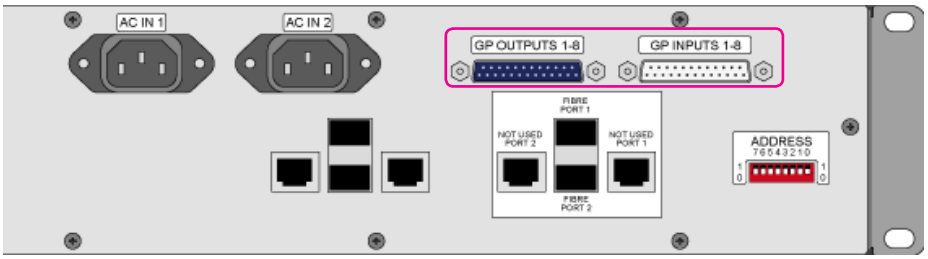
Currently, the only fixed format I/O box types that can NOT be fitted with a GPIO card are the 1U MADI units, and the rear interfacing AES unit, due to physical space limitations. All other fixed format I/O units available can have the GPIO option fitted. Different GPIO cards, with a different connector and pin-out, are available for modular I/O racks.

One SW5739 card can be fitted in each compatible I/O box, providing 8 inputs, and 8 outputs per unit. Multiple I/O boxes can be fitted with GPIO cards to make up the total quantities of GPIO required in each location.

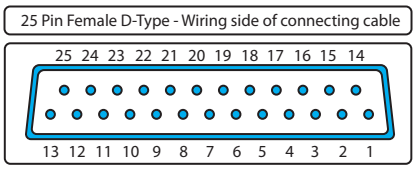
Fixed format I/O boxes with GPIO cards fitted have D-type connectors on the rear panel. Units without a GPIO card will have these connectors blanked off.

The function assigned to each GPIO input and output is selected from any control surface on the network. GP output functions include fader starts, assignable button presses, error alerts, and more. GP input functions include path Cut/On, Auto-fader triggers and more. Please refer to the console Operators Manual for details on GPIO assignment.

FIXED FORMAT GPIO CONNECTORS (REAR PANEL)



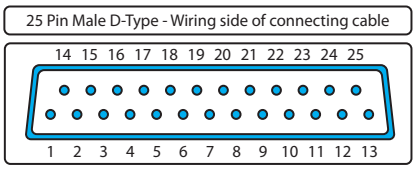
GP OUTPUTS CONNECTOR PIN-OUT



Function		Pin
Relay 1	Common	1
	Normally Open	14
	Normally Made	2
Relay 2	Common	15
	Normally Open	3
	Normally Made	16
Relay 3	Common	4
	Normally Open	17
	Normally Made	5
Relay 4	Common	18
	Normally Open	6
	Normally Made	19
Relay 5	Common	7
	Normally Open	20
	Normally Made	8
Relay 6	Common	21
	Normally Open	9
	Normally Made	22
Relay 7	Common	10
	Normally Open	23
	Normally Made	11
Relay 8	Common	24
	Normally Open	12
	Normally Made	25
Ground		13

- Calrec connector is male, requiring female terminated cable

GP INPUTS CONNECTOR PIN-OUT



Function		Pin
Opto 1	+	1
	-	14
Opto 2	+	15
	-	3
Opto 3	+	4
	-	17
Opto 4	+	18
	-	6
Opto 5	+	7
	-	20
Opto 6	+	21
	-	9
Opto 7	+	10
	-	23
Opto 8	+	24
	-	12
+5V		2
		5
		8
		11
Ground		16
		19
		22
		25
		13

- Calrec connector is female, requiring male terminated cable

Relay Specification

- 30V 100mA maximum

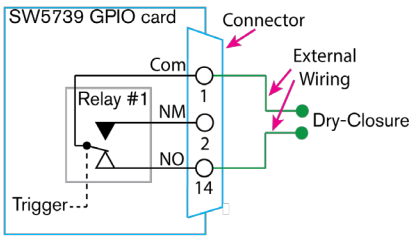
Opto-input specification

- +/- 5-24 V DC or AC (50-60Hz)

GP outputs

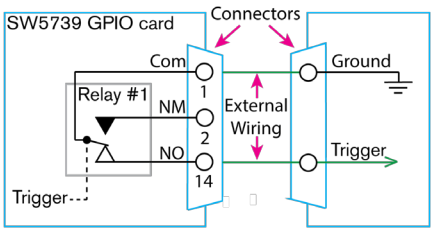
Relays are used for GP outputs. All 3 relay contacts are made available on the GP output connector to provide flexibility in use—they can be wired to produce a standard closure when activated, to produce a default closure that becomes open when active, or to pass a ground or voltage that is made or broken when activated. Having all 3 contacts also allows audio or other signals to be fed through the relay and switched by GPIO control if required. The Common pin is always connected to one of the other two pins by the relay—when the relay is NOT activated, Common is connected to the Normally Made pin. When the relay becomes active (the assigned GP function is triggered), the Common pin becomes connected to the Normally Open pin. To create a dry closure, Some typical wiring examples are shown on this page.

GP OUTPUT WIRING EXAMPLE #1



- Wiring shown provides a dry-closure on activation

GP OUTPUT WIRING EXAMPLE #2

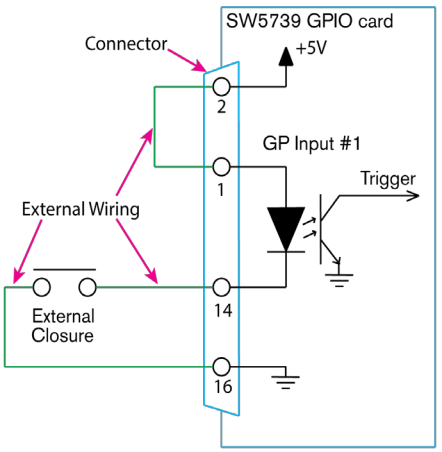


- Wiring shown provides a ground on activation. Note, the ground is provided by the device being triggered.

GP inputs

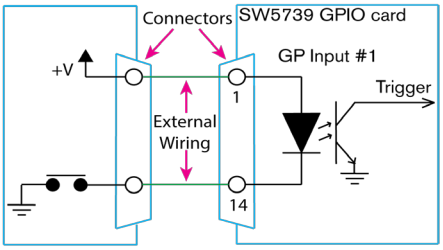
Opto-isolated inputs allow for mixing console functions to be triggered remotely by other equipment. Applying voltage across the + and - pins of an opto will trigger it. If using a dry (no voltage) closure as a trigger, one side of the closure should be wired to one of the opto's pins, the other side of the closure should be wired to ground, and the other side of the opto should be wired to +ve voltage. Both voltage and ground should be sourced from the GPIO card itself where possible. If the 3rd party kit sends a single logic line, as opposed to a closure pair, both pieces of equipment will need to share the same ground reference, or +ve voltage will need to be supplied by the 3rd party kit. Common wiring examples are shown on this page.

GP INPUT WIRING EXAMPLE #1



- In this example, the 3rd party equipment provides a dry closure. Voltage and ground are supplied by the GPIO card

GP INPUT WIRING EXAMPLE #2



- In this example, the 3rd party equipment provides a single tally line which is grounded on activation. Voltage is supplied by the 3rd party. If voltage is instead supplied by the GPIO card, the two pieces of equipment MUST have the same ground reference.

SW5739 GPIO COMPATIBILITY

I/O Type	GPIO Compatible
AD5780	Yes
AD5781	Yes
AD5782	Yes
AE5732	Yes
AE5991	Yes
AE5992	Yes
JB5606	Yes
JB5783	Yes
JB5962	No
JM5736	No
JM5890	No
JM5831	No

FIXED FORMAT ANALOG I/O OVERVIEW

A range of fixed format analog I/O units are available offering various quantities of inputs and outputs via either XLR or EDAC connectors.

Input gain & impedance

All fixed format analog inputs accept mic and line level signals. Input impedance is automatically switched dependant on the gain setting of each input. The gain of each input can be controlled from -18 to +78dB remotely from any mixing console on the network that has been granted access. The impedance can be set globally to changeover at +18, 20, 22 or 24dB of input gain.

Phantom power

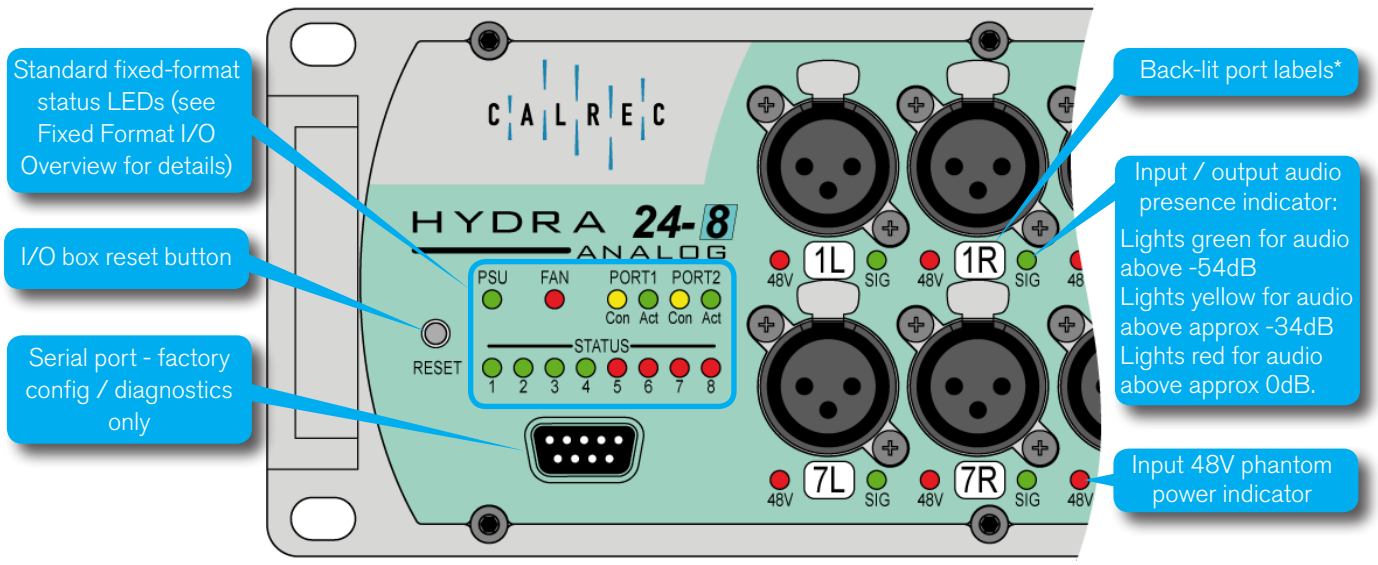
Phantom power can be switched on or off to each mic / line input remotely from any mixing console on the network which has been granted access.

Analog reference level

The analog-to-digital, and digital-to-analog conversion level is set globally across the Hydra2 network. The most common values used are +4dBU analog = -20dBFS digital, and 0dBU analog = -18dBFS digital.

FIXED FORMAT ANALOG I/O SPECIFICATIONS

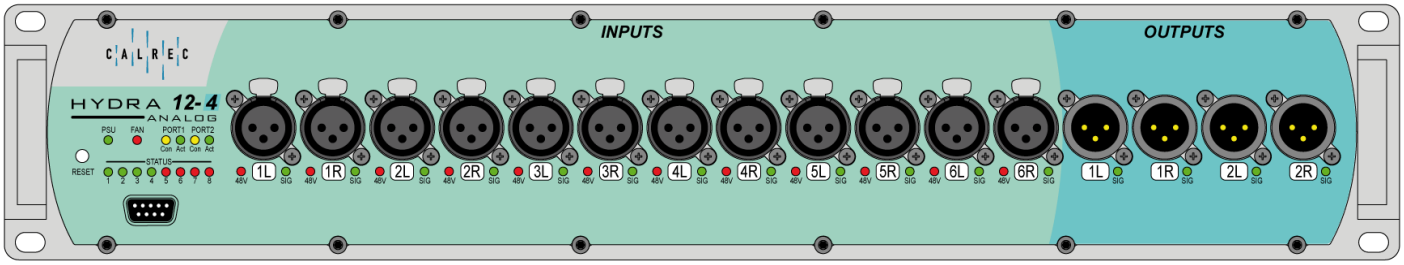
Format	Analog
Type	Balanced
Input Gain Range	-18 dB to +78 dB, remotely controlled per input
Phantom Power	48 V remotely switchable per input
Input Impedance	2 kΩ @ Mic Level / 10 kΩ @ Line level (auto-switching)
Output Impedance	<40 Ω
ADC / DAC	24 bit



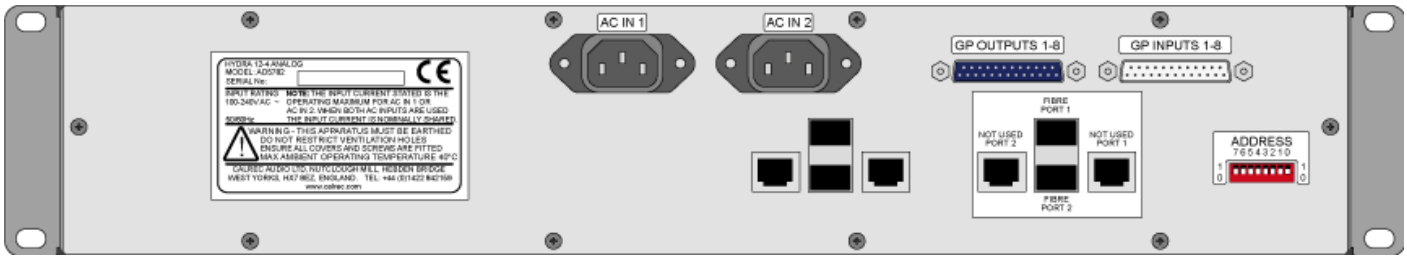
- Ports are labelled 'L' & 'R', however all ports can be used as discrete and independent mono if required. In addition, any two ports, not just adjacent ones, can be paired together for stereo processing within mixing console DSP.

AD5782 ANALOG MIC / LINE 12 IN/4 OUT – XLR

FRONT PANEL VIEW



REAR PANEL VIEW

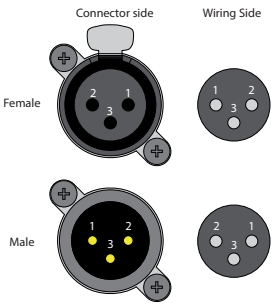


UNIT SPECIFICATIONS

Format	Analog
Inputs	12 Mic / Line
Outputs	4 Line Level
Audio Connectors	XLR (Inputs - Female, Outputs - Male)
GPIO compatible	Yes
Height	2U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	11.5 lbs (5.2 kg)
Input Power	100-240 V AC, 0.45-0.25 A RMS, 50/60 Hz
Acoustic Noise	26 dB-SPL A-Weighted, 1 m from source

- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

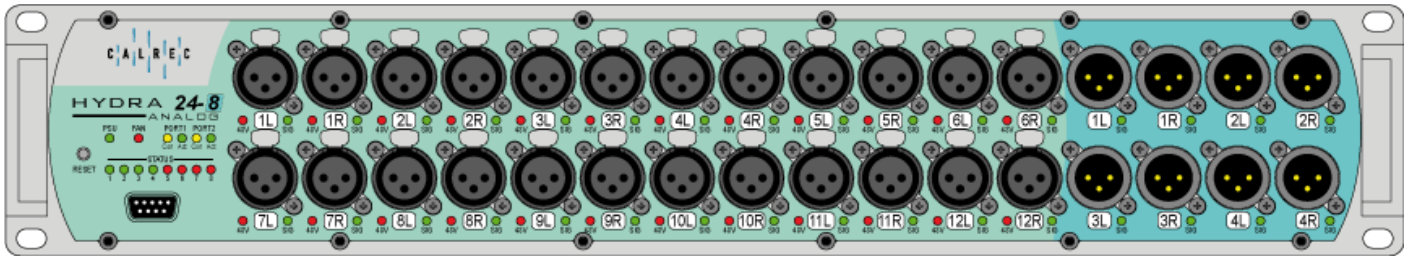
XLR CONNECTORS



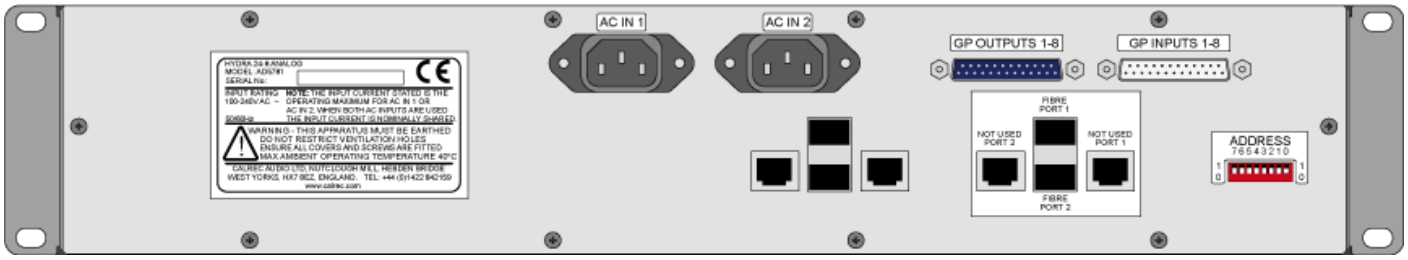
Function	Pin
Positive	2
Negative	3
Ground	1

AD5781 ANALOG MIC / LINE 24 IN/8 OUT – XLR

FRONT PANEL VIEW



REAR PANEL VIEW

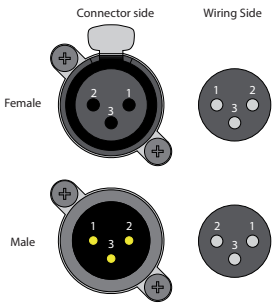


UNIT SPECIFICATIONS

Format	Analog
Inputs	24 Mic / Line
Outputs	8 Line Level
Audio Connectors	XLR (Inputs - Female, Outputs - Male)
GPIO compatible	Yes
Height	2U
Width	19” rackmount (483 mm)
Depth	9” (230 mm)
Depth inc rear mating connectors	12” (300 mm)
Approx Weight	12.5 lbs (5.7 kg)
Input Power	100-240 V AC, 0.60-0.31 A RMS, 50/60 Hz
Acoustic Noise	26 dB-SPL A-Weighted, 1 m from source

- See “Fixed Format I/O Overview” on page 44 and “Audio Performance Specification” on page 100 for further detail.

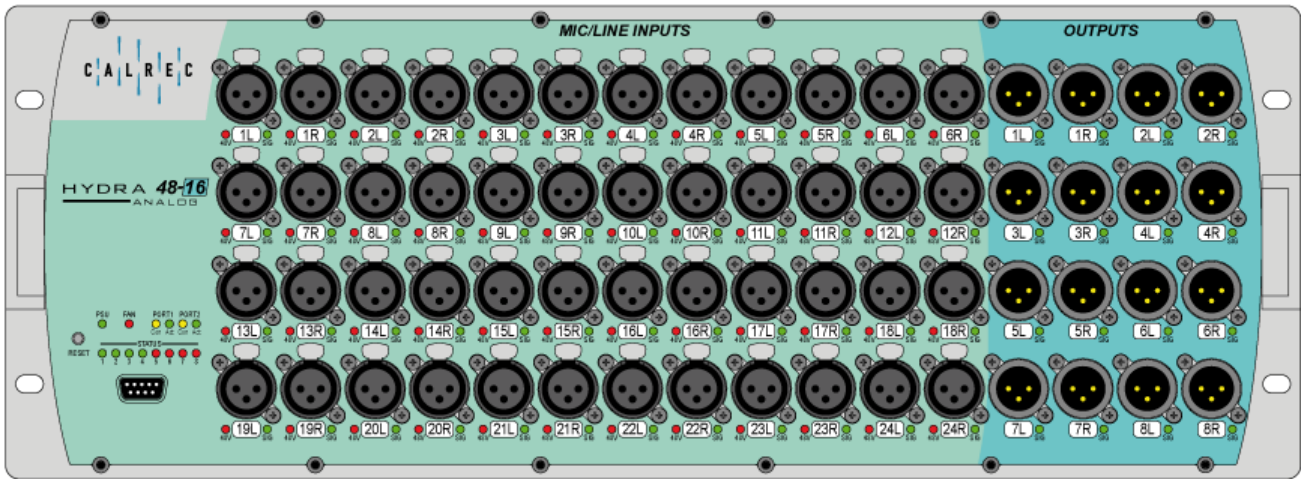
XLR CONNECTORS



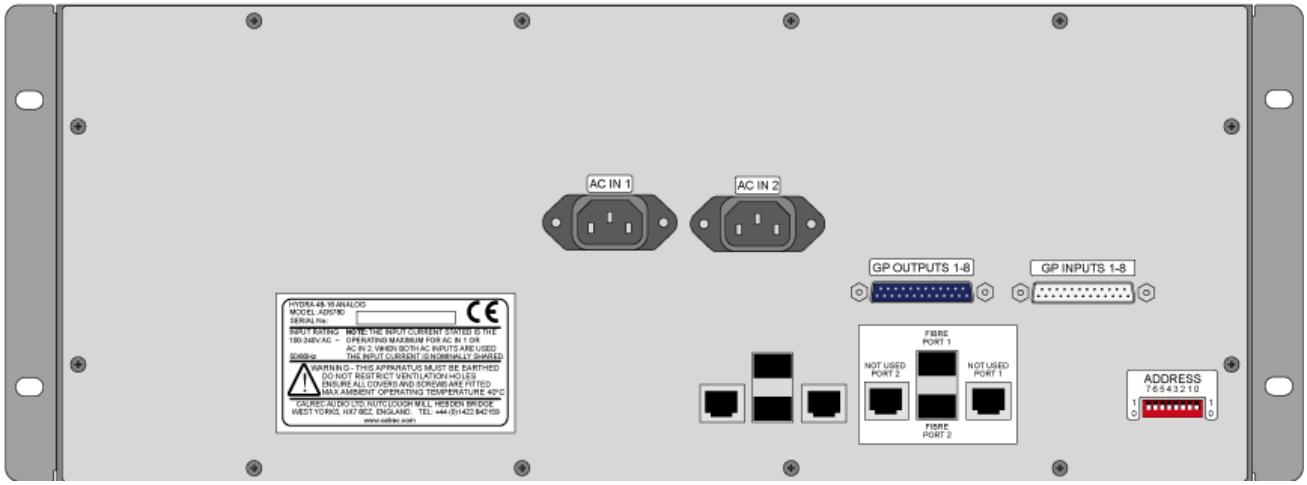
Function	Pin
Positive	2
Negative	3
Ground	1

AD5780 ANALOG MIC / LINE 48 IN / 16 OUT – XLR

FRONT PANEL VIEW



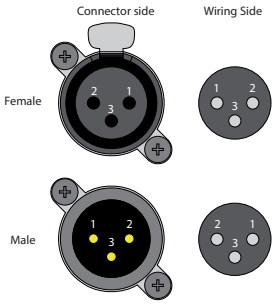
REAR PANEL VIEW



UNIT SPECIFICATIONS

Format	Analog
Inputs	48 Mic / Line
Outputs	16 Line Level
Audio Connectors	XLR (Inputs - Female, Outputs - Male)
GPIO compatible	Yes
Height	4U
Width	19” rackmount (483 mm)
Depth	9” (230 mm)
Depth inc rear mating connectors	12” (300 mm)
Approx Weight	16.1 lbs (7.3 kg)
Input Power	100-240 V AC, 1.05-0.51 A RMS, 50/60 Hz
Acoustic Noise	27 dB-SPL A-Weighted, 1 m from source

XLR CONNECTORS

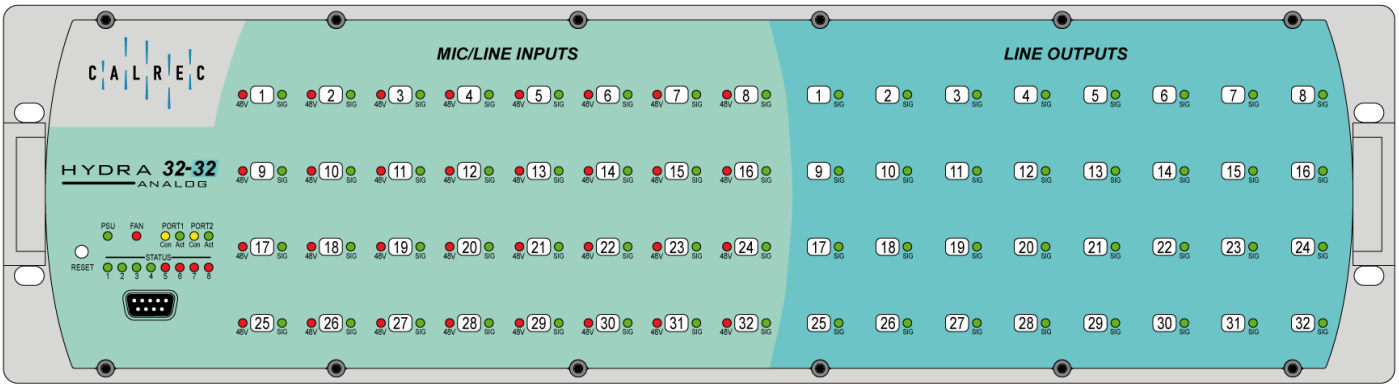


Function	Pin
Positive	2
Negative	3
Ground	1

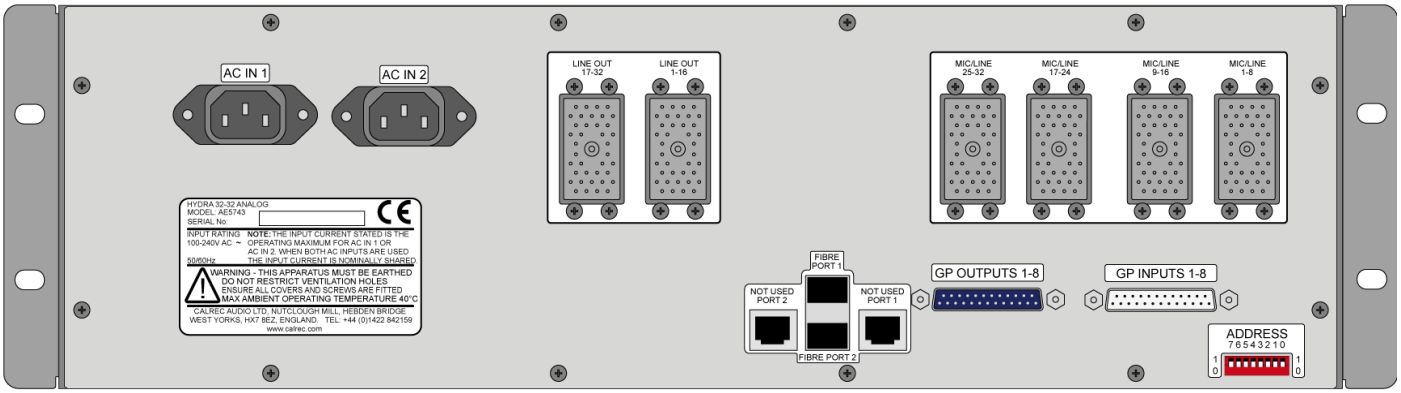
- See “Fixed Format I/O Overview” on page 44 and “Audio Performance Specification” on page 100 for further detail.

AE5743 ANALOG MIC / LINE 32 IN / 32 OUT – EDAC (STANDARD PIN-OUT)

FRONT PANEL VIEW



REAR PANEL VIEW



- Audio interface EDAC connectors are mounted on the rear panel of the unit

UNIT SPECIFICATIONS

Format	Analog
Inputs	32 Mic / Line
Outputs	32 Line Level
Audio Connectors	38 pin Male EDAC (Inputs & Outputs)
GPIO compatible	Yes
Height	3U
Width	19” rackmount (483 mm)
Depth	9” (230 mm)
Depth inc rear mating connectors	12” (300 mm)
Approx Weight	11.5 lbs (5.2 kg)
Input Power	100-240 V AC 1.05-0.51 A RMS 50/60 Hz
Acoustic Noise	27 dB-SPL A-Weighted, 1 m from source

- See “Fixed Format I/O Overview” on page 44 and “Audio Performance Specification” on page 100 for further detail.

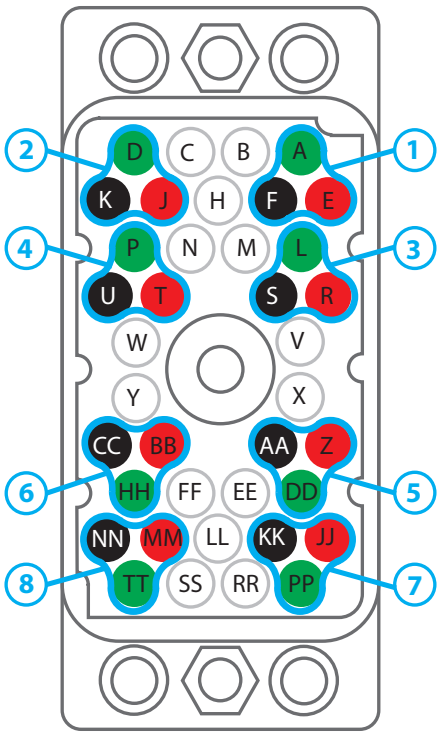
AE5743 – EDAC PIN-OUT - INPUTS

Mic / Line 1-8	
Signal	**Pins + / - (screen)**
Input 1	E / F (A)
Input 2	J /K (D)
Input 3	R / S (L)
Input 4	T / U (P)
Input 5	Z / AA (DD)
Input 6	BB / CC (HH)
Input 7	JJ / KK (PP)
Input 8	MM / NN (TT)

Mic / Line 9-16	
Signal	**Pins + / - (screen)**
Input 9	E / F (A)
Input 10	J /K (D)
Input 11	R / S (L)
Input 12	T / U (P)
Input 13	Z / AA (DD)
Input 14	BB / CC (HH)
Input 15	JJ / KK (PP)
Input 16	MM / NN (TT)

Mic / Line 17-24	
Signal	**Pins + / - (screen)**
Input 17	E / F (A)
Input 18	J /K (D)
Input 19	R / S (L)
Input 20	T / U (P)
Input 21	Z / AA (DD)
Input 22	BB / CC (HH)
Input 23	JJ / KK (PP)
Input 24	MM / NN (TT)

Mic / Line 25-32	
Signal	**Pins + / - (screen)**
Input 25	E / F (A)
Input 26	J /K (D)
Input 27	R / S (L)
Input 28	T / U (P)
Input 29	Z / AA (DD)
Input 30	BB / CC (HH)
Input 31	JJ / KK (PP)
Input 32	MM / NN (TT)



- 38 pin EDAC - viewed from male mating side / female wiring side

Positive / Phase

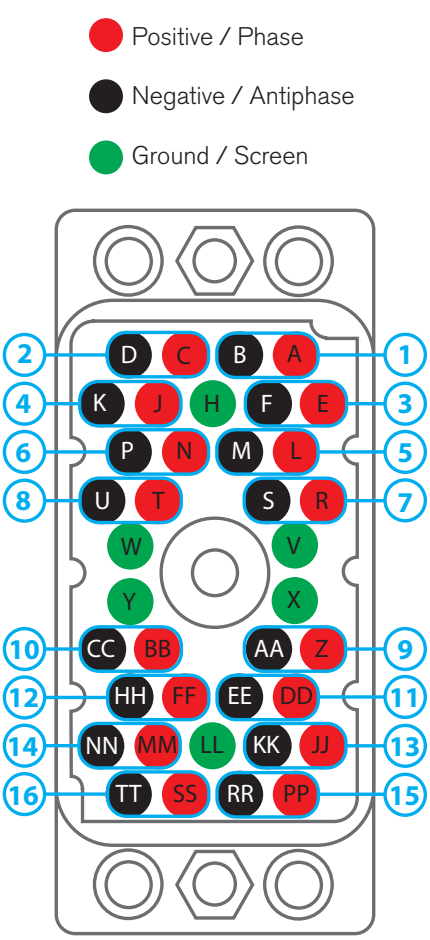
Negative / Antiphase

Ground / Screen

AE5743 – EDAC PIN-OUT - OUTPUTS

Line Out 1-16	
Signal	**Pins + / -**
Output 1	A / B
Output 2	C / D
Output 3	E / F
Output 4	J / K
Output 5	L / M
Output 6	N / P
Output 7	R / S
Output 8	T / U
Output 9	Z / AA
Output 10	BB / CC
Output 11	DD / EE
Output 12	FF / HH
Output 13	JJ / KK
Output 14	MM / NN
Output 15	PP / RR
Output 16	SS / TT
Screen	H , V, W, X, Y, LL

Line Out 17-32	
Signal	**Pins + / -**
Output 17	A / B
Output 18	C / D
Output 19	E / F
Output 20	J / K
Output 21	L / M
Output 22	N / P
Output 23	R / S
Output 24	T / U
Output 25	Z / AA
Output 26	BB / CC
Output 27	DD / EE
Output 28	FF / HH
Output 29	JJ / KK
Output 30	MM / NN
Output 31	PP / RR
Output 32	SS / TT
Screen	H , V, W, X, Y, LL



- 38 pin EDAC—viewed from male mating side / female wiring side

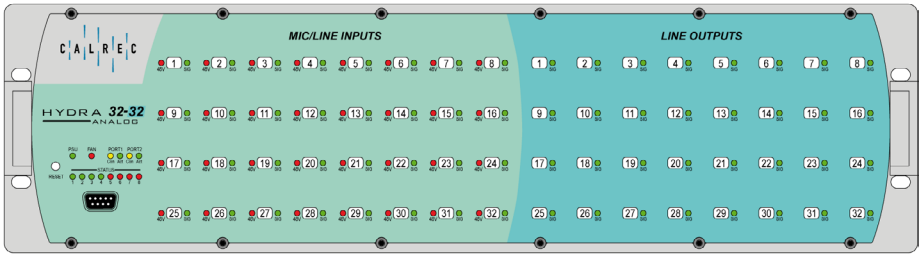
- Note, All EDAC connectors on the I/O box, for both inputs and outputs are **male**, requiring that interfacing cables are terminated with **female** connectors. The AE5743 provides 8 inputs per connector, each with its own screen/ground pin. Input connector pins not listed in the tables are also grounded. The output connectors provide 16 outputs each. Only 6 earth pins are available in each output connector. If the installation dictates that individually screened 2 core cable must be used for line level outputs, and that they must have screens terminated at the source rather than destination, multiple cable screens will need to be landed on each connector pin.

AE5991 – ANALOG MIC / LINE 32 IN / 32 OUT – EDAC ("STYLE 1" PIN-OUT)

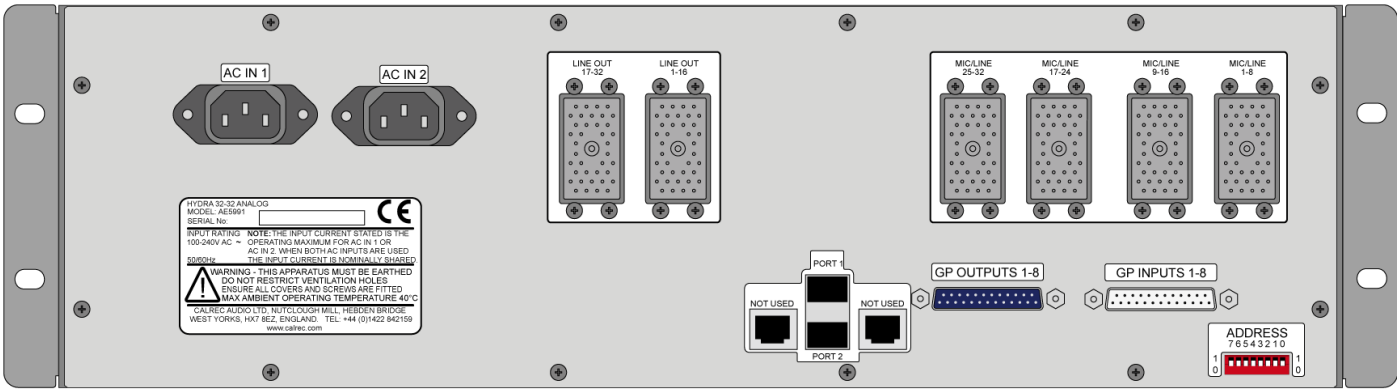
The AE5991 provides 8 inputs / 16 outputs per EDAC connector, with a pin-out that matches Calrec Alpha / Sigma / Omega / Zeta "Style 1" connectivity, allowing customers replacing such products to utilize their existing cabling.

As with all fixed format EDAC boxes, the audio interface connectors are rear panel mounted.

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

Format	Analog
Inputs	32 Mic / Line
Outputs	32 Line Level
Audio Connectors	38 pin Male EDAC (Inputs & Outputs)
GPIO compatible	Yes
Height	3U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	11.5 lbs (5.2 kg)
Input Power	100-240 V AC 1.05-0.51 A RMS 50/60 Hz
Acoustic Noise	27 dB-SPL A-Weighted, 1m from source

- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

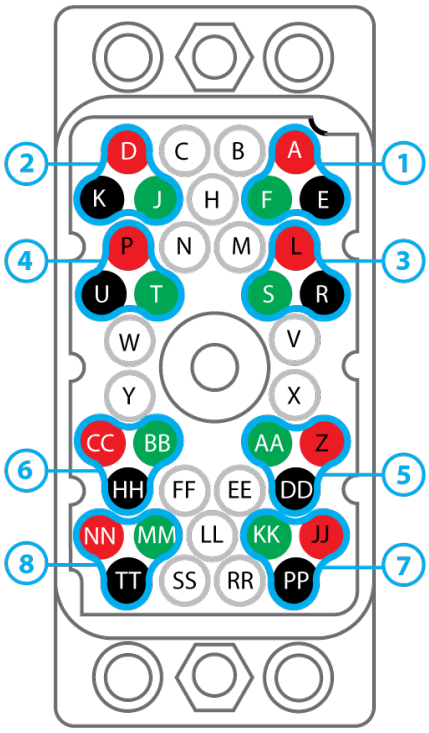
AE5991 – EDAC PIN-OUT – INPUTS ("STYLE 1")

Mic / Line 1-8	
Signal	**Pins + / - (screen)**
Input 1	A / E (F)
Input 2	D / K (J)
Input 3	L / R (S)
Input 4	P / U (T)
Input 5	Z / DD (AA)
Input 6	CC / HH (BB)
Input 7	JJ / PP (KK)
Input 8	NN / TT (MM)

Mic / Line 9-16	
Signal	**Pins + / - (screen)**
Input 9	A / E (F)
Input 10	D / K (J)
Input 11	L / R (S)
Input 12	P / U (T)
Input 13	Z / DD (AA)
Input 14	CC / HH (BB)
Input 15	JJ / PP (KK)
Input 16	NN / TT (MM)

Mic / Line 17-24	
Signal	**Pins + / - (screen)**
Input 17	A / E (F)
Input 18	D / K (J)
Input 19	L / R (S)
Input 20	P / U (T)
Input 21	Z / DD (AA)
Input 22	CC / HH (BB)
Input 23	JJ / PP (KK)
Input 24	NN / TT (MM)

Mic / Line 25-32	
Signal	**Pins + / - (screen)**
Input 25	A / E (F)
Input 26	D / K (J)
Input 27	L / R (S)
Input 28	P / U (T)
Input 29	Z / DD (AA)
Input 30	CC / HH (BB)
Input 31	JJ / PP (KK)
Input 32	NN / TT (MM)



- 38 pin EDAC - viewed from male mating side / female wiring side

Positive / Phase

Negative / Antiphase

Ground / Screen

AE5991 – EDAC PIN-OUT – OUTPUTS ("STYLE 1")

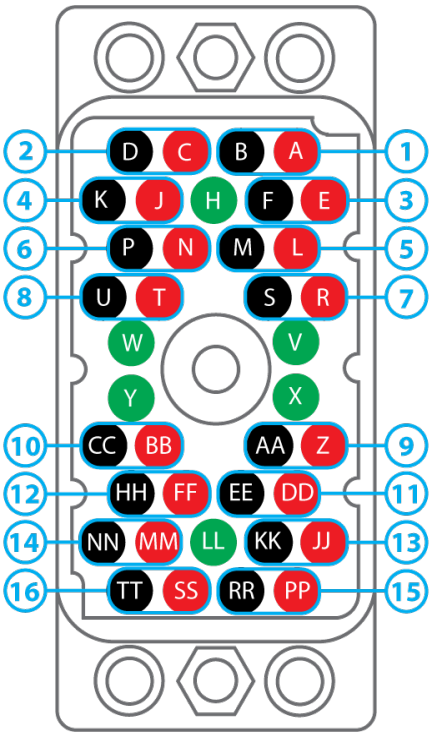
Line Out 1-16	
Signal	**Pins + / -**
Output 1	A / B
Output 2	C / D
Output 3	E / F
Output 4	J / K
Output 5	L / M
Output 6	N / P
Output 7	R / S
Output 8	T / U
Output 9	Z / AA
Output 10	BB / CC
Output 11	DD / EE
Output 12	FF / HH
Output 13	JJ / KK
Output 14	MM / NN
Output 15	PP / RR
Output 16	SS / TT
Screen	H , V, W, X, Y, LL

Line Out 17-32	
Signal	**Pins + / -**
Output 17	A / B
Output 18	C / D
Output 19	E / F
Output 20	J / K
Output 21	L / M
Output 22	N / P
Output 23	R / S
Output 24	T / U
Output 25	Z / AA
Output 26	BB / CC
Output 27	DD / EE
Output 28	FF / HH
Output 29	JJ / KK
Output 30	MM / NN
Output 31	PP / RR
Output 32	SS / TT
Screen	H , V, W, X, Y, LL

Positive / Phase

Negative / Antiphase

Ground / Screen



- 38 pin EDAC—viewed from male mating side / female wiring side

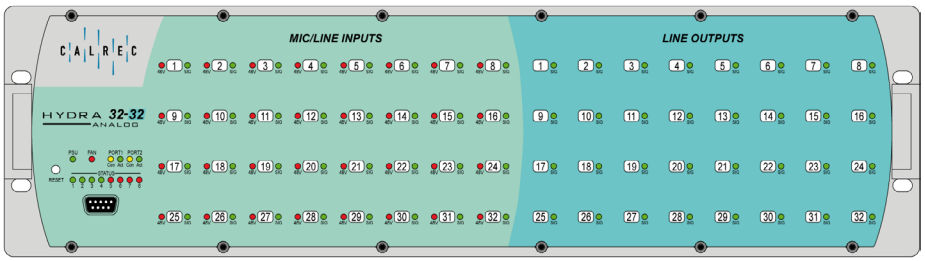
- Note, all EDAC connectors on the I/O box, for both inputs and outputs are **male**, requiring that interfacing cables are terminated with **female** connectors. The AE5991 provides 8 inputs per connector, each with its own screen/ground pin. Input connector pins not listed in the tables are also grounded. The output connectors provide 16 outputs each. Only 6 earth pins are available in each output connector. If the installation dictates that individually screened 2 core cable must be used for line level outputs, and that they must have screens terminated at the source rather than destination. Multiple cable screens will need to be landed on each connector pin.

AE5992 – ANALOG MIC / LINE 32IN / 32OUT – EDAC ("STYLE 2" PIN-OUT)

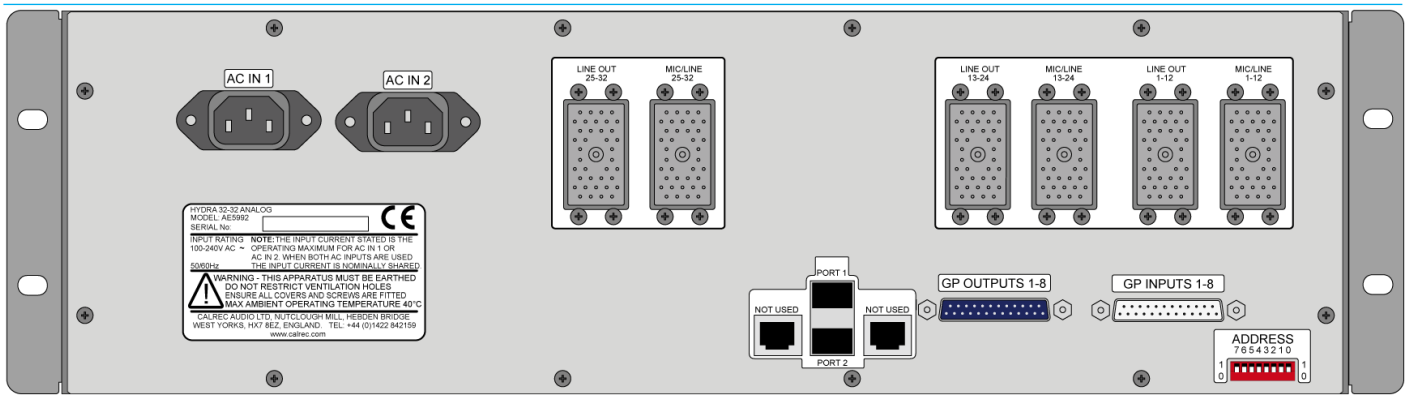
The AE5992 provides 12 inputs and 12 outputs per EDAC connector, with a pin-out that matches Calrec Alpha/Sigma/Omega/Zeta "Style 2" connectivity, allowing customers replacing such products to utilize their existing cabling, and to simplify wiring to 12-pair jack-field connectors.

As with all fixed format EDAC boxes, the audio interface connectors are rear panel mounted.

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

Format	Analog
Inputs	32 Mic / Line
Outputs	32 Line Level
Audio Connectors	38 pin Male EDAC (Inputs & Outputs)
GPIO compatible	Yes
Height	3U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	11.5 lbs (5.2 kg)
Input Power	100-240 V AC 1.05-0.51 A RMS 50/60 Hz
Acoustic Noise	27d B-SPL A-Weighted, 1 m from source

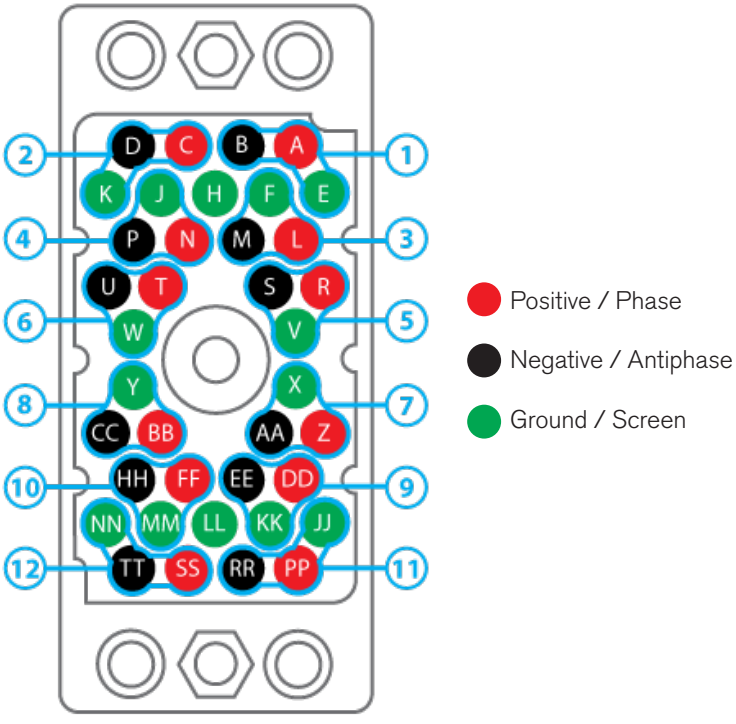
- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

AE5992 – EDAC PIN-OUT – INPUTS ("STYLE 2")

Mic / Line 1-12	
Signal	Pins + / - (screen)
Input 1	A / B (E)
Input 2	C / D (K)
Input 3	L / M (F)
Input 4	N / P (J)
Input 5	R / S (V)
Input 6	T / U (W)
Input 7	Z / AA (X)
Input 8	BB / CC (Y)
Input 9	DD / EE (KK)
Input 10	FF / HH (MM)
Input 11	PP / RR (JJ)
Input 12	SS / TT (NN)

Mic / Line 13-24	
Signal	Pins + / - (screen)
Input 13	A / B (E)
Input 14	C / D (K)
Input 15	L / M (F)
Input 16	N / P (J)
Input 17	R / S (V)
Input 18	T / U (W)
Input 19	Z / AA (X)
Input 20	BB / CC (Y)
Input 21	DD / EE (KK)
Input 22	FF / HH (MM)
Input 23	PP / RR (JJ)
Input 24	SS / TT (NN)

Mic / Line 25-32	
Signal	Pins + / - (screen)
Input 25	A / B (E)
Input 26	C / D (K)
Input 27	L / M (F)
Input 28	N / P (J)
Input 29	R / S (V)
Input 30	T / U (W)
Input 31	Z / AA (X)
Input 32	BB / CC (Y)



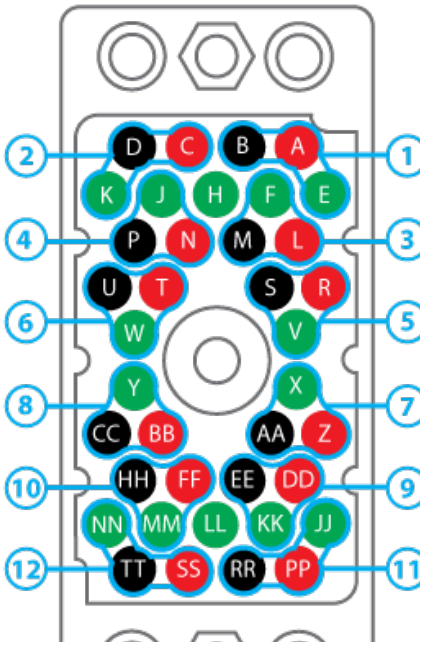
- 38 pin EDAC - viewed from male mating side / female wiring side

AE5992 – EDAC PIN-OUT – OUTPUTS ("STYLE 2")

Line Out 1-12	
Signal	Pins + / - (screen)
Input 1	A / B (E)
Input 2	C / D (K)
Input 3	L / M (F)
Input 4	N / P (J)
Input 5	R / S (V)
Input 6	T / U (W)
Input 7	Z / AA (X)
Input 8	BB / CC (Y)
Input 9	DD / EE (KK)
Input 10	FF / HH (MM)
Input 11	PP / RR (JJ)
Input 12	SS / TT (NN)

Line Out 13-24	
Signal	Pins + / - (screen)
Input 13	A / B (E)
Input 14	C / D (K)
Input 15	L / M (F)
Input 16	N / P (J)
Input 17	R / S (V)
Input 18	T / U (W)
Input 19	Z / AA (X)
Input 20	BB / CC (Y)
Input 21	DD / EE (KK)
Input 22	FF / HH (MM)
Input 23	PP / RR (JJ)
Input 24	SS / TT (NN)

Line Out 25-32	
Signal	Pins + / - (screen)
Input 25	A / B (E)
Input 26	C / D (K)
Input 27	L / M (F)
Input 28	N / P (J)
Input 29	R / S (V)
Input 30	T / U (W)
Input 31	Z / AA (X)
Input 32	BB / CC (Y)



Positive / Phase

Negative / Antiphase

Ground / Screen

- 38 pin EDAC - viewed from male mating side / female wiring side

- Note, All EDAC connectors on the I/O box, for both inputs and outputs are **male**, requiring that interfacing cables are terminated with **female** connectors.

FIXED FORMAT DIGITAL AES3 I/O OVERVIEW

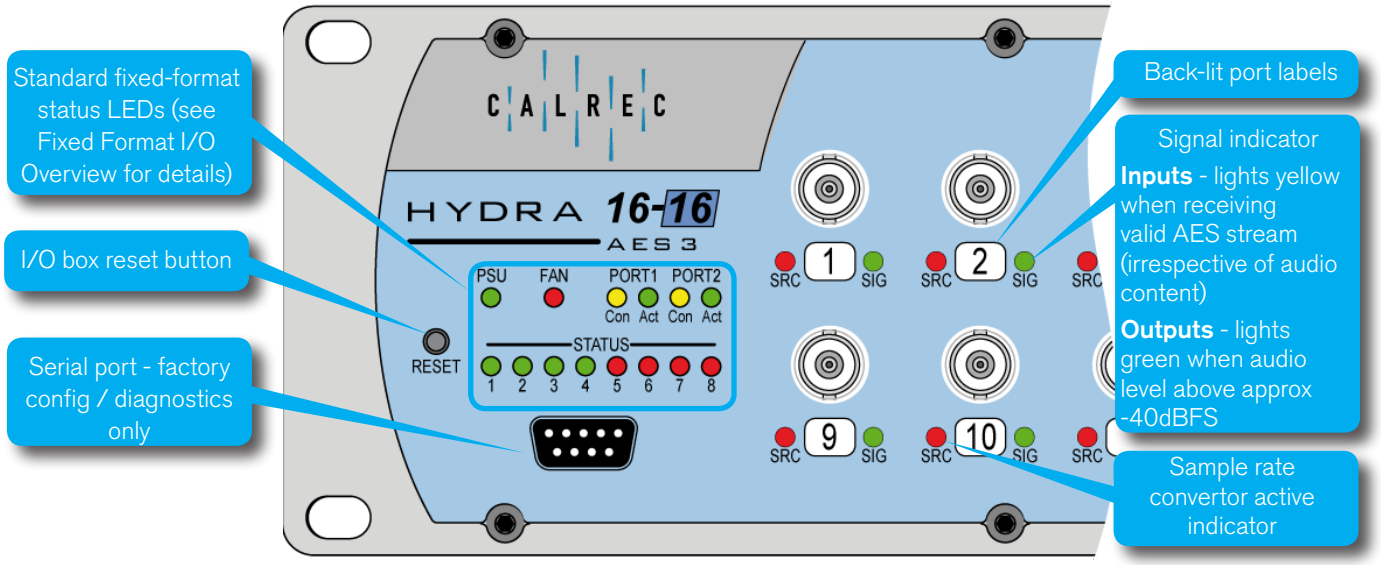
A range of fixed format digital AES3 I/O units are available offering various quantities of inputs and outputs via unbalanced 75 Ω BNC connections.

Balanced 110 Ω AES I/O is an option for modular I/O racks only.

Sample rate convertors
SRCs can be switched in on each input remotely by any control surface on the Hydra2 network which has been granted access.

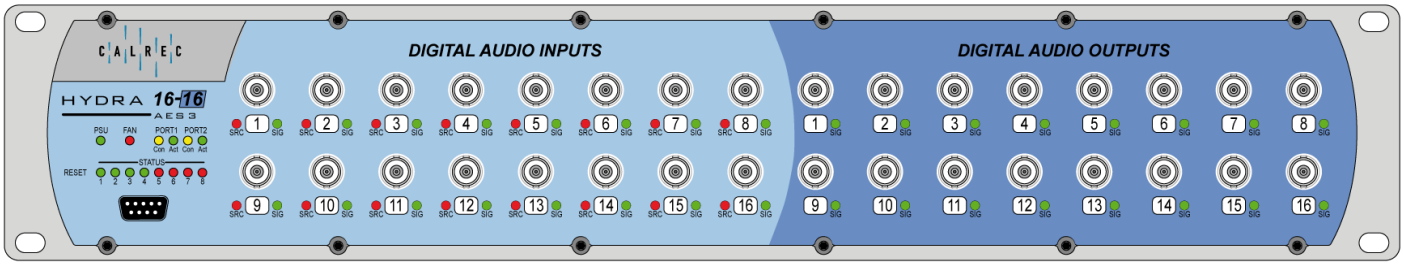
FIXED FORMAT DIGITAL AES3 I/O SPECIFICATIONS

Format	Digital
Type	AES3 - 24 bit, Unbalanced.
Impedance	75 Ω
Connector Type	BNC
Input Signal Range	0.3-1.2 V Pk-Pk
Output Signal	1 V Pk-Pk (nominal)

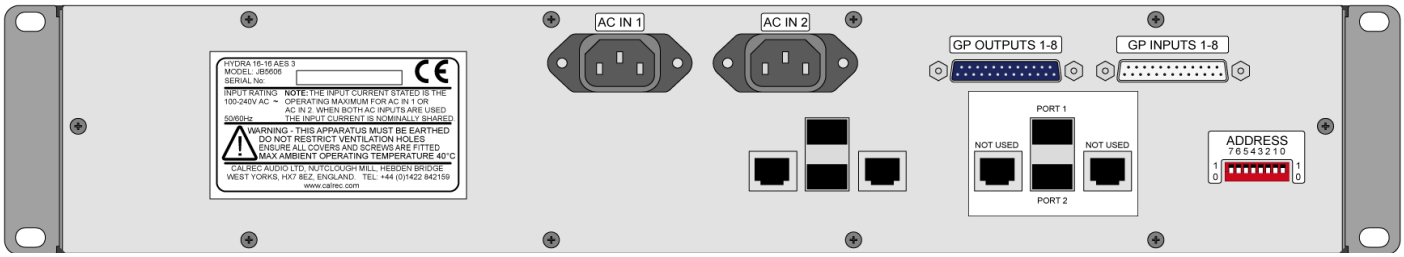


JB5606 – DIGITAL AES3 16 IN/16 OUT – BNC

FRONT PANEL VIEW



REAR PANEL VIEW



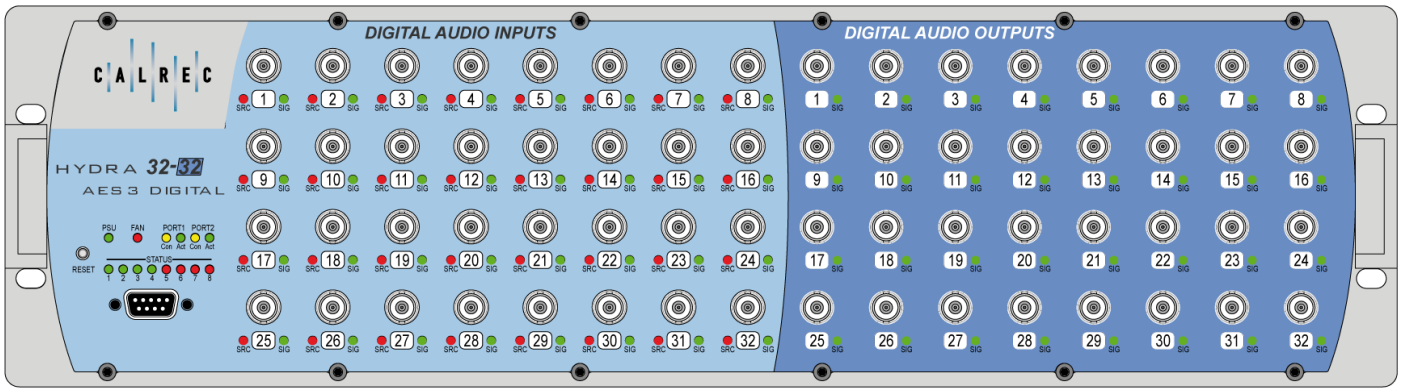
UNIT SPECIFICATIONS

Format	Digital AES3 unbalanced
Inputs	16
Outputs	16
Audio Connectors	BNC
GPIO compatible	Yes
Height	2U
Width	19” rackmount (483 mm)
Depth	9” (230 mm)
Depth inc rear mating connectors	12” (300 mm)
Approx Weight	8.6 lbs (3.9 kg)
Input Power	100-240 V AC, 0.24-0.13 A RMS, 50/60 Hz
Acoustic Noise	26 dB-SPL A-Weighted, 1 m from source

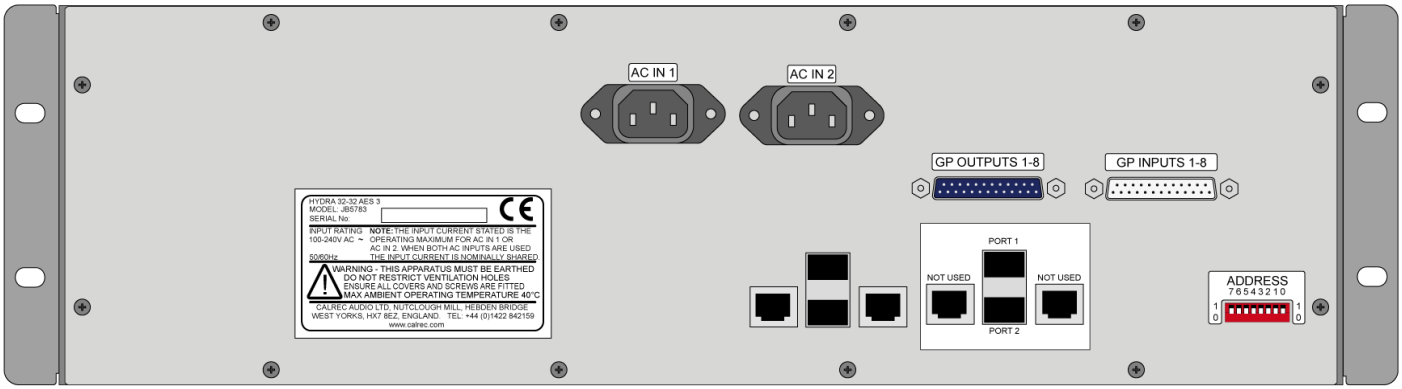
- See Fixed Format Digital AES3 I/O Overview and Audio Performance Specification sections of this document for further detail.

JB5783 – DIGITAL AES3 32 IN / 32 OUT – BNC

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

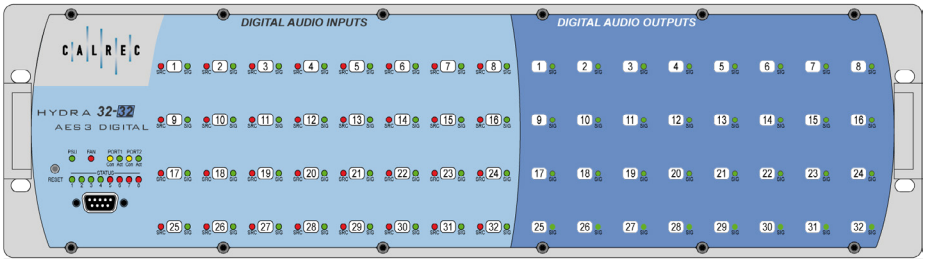
Format	Digital AES3 unbalanced
Inputs	32
Outputs	32
Audio Connectors	BNC
GPIO compatible	Yes
Height	3U
Width	19” rackmount (483 mm)
Depth	9” (230 mm)
Depth inc rear mating connectors	12” (300 mm)
Approx Weight	14.3 lbs (6.5 kg)
Input Power	100-240 V AC, 0.38-0.20 A RMS, 50/60 Hz
Acoustic Noise	26 dB-SPL A-Weighted, 1 m from source

- See “Fixed Format I/O Overview” on page 44 and “Audio Performance Specification” on page 100 for further detail.

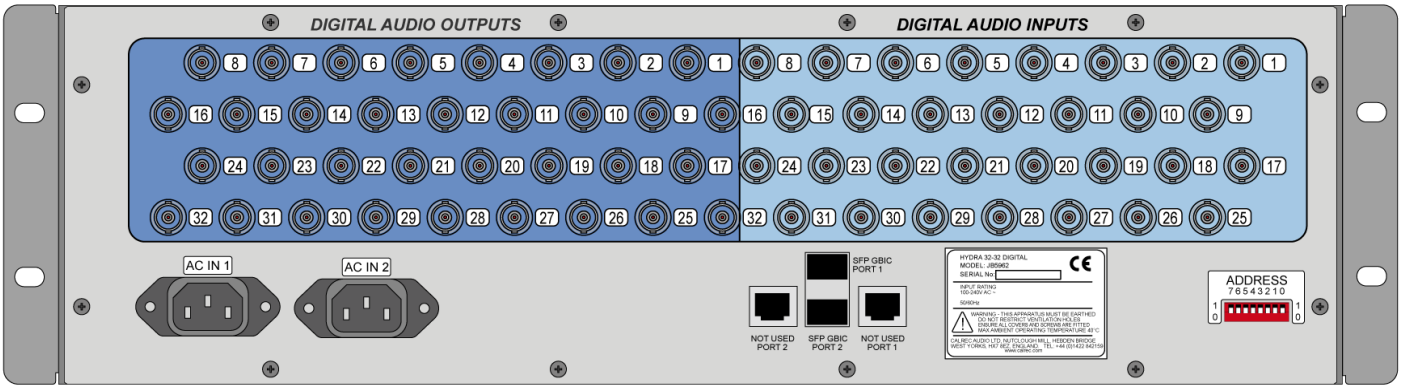
JB5962 – DIGITAL AES3 32 IN / 32 OUT – BNC

The JB5962's audio interface BNC connectors are rear panel mounted. This unit type cannot be fitted with a GPIO card.

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

Format	Digital AES3 unbalanced
Inputs	32
Outputs	32
Audio Connectors	BNC
GPIO compatible	**NO**
Height	3U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	14.3 lbs (6.5 kg)
Input Power	100-240 V AC, 0.38-0.20 A RMS, 50/60 Hz
Acoustic Noise	26 dB-SPL A-Weighted, 1 m from source

- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

FIXED FORMAT MADI I/O OVERVIEW

A range of MADI I/O units are available offering various fiber connection types for the MADI audio interface.

Connectivity

Like all I/O boxes, Hydra2 network components interface via pluggable SFP modules, allowing the connection type to the Calrec routing network to be changed as and when needed. The actual MADI audio I/O fiber connections, used to interface with other MADI systems however, are of a fixed type that cannot be changed. The type of MADI I/O fiber connections required dictates the I/O box that should be ordered.

Other than MADI I/O fiber connectivity, all MADI I/O box types are identical. In addition to fiber connectivity, all MADI I/O boxes also have MADI inputs and outputs via BNC connectors for coaxial copper use.

I/O & audio channels

All MADI units have 2 x MADI inputs (labelled "Rx"—receive) and 2 x MADI outputs (labelled "Tx"—transmit), providing a total maximum of 128 channels of inputs and 128 channels of outputs, simultaneously, per MADI I/O box. The I/O is grouped under two "ports"—each port consisting of 1 x MADI input stream, & 1 x MADI output stream. Each port can be selected independently to operate in the standard 64 channel mode, or 56 channel mode to match the equipment being interfaced with. The input for each port can be independently selected to receive via either the copper or fiber connector. Outputs from the box are fed to both copper and fiber connectors simultaneously, irrespective of this setting.

Fans / airflow

MADI I/O units are not fitted with fans. Cooling is by natural airflow through the side panels which should not be obstructed.

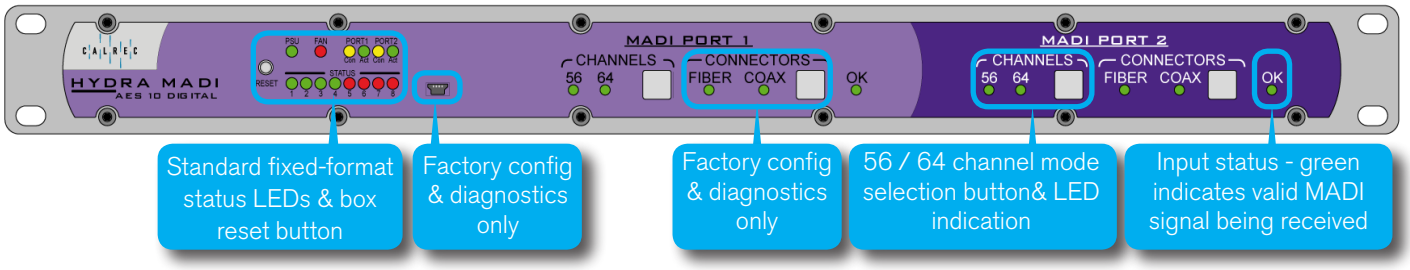
GPIO

Due to the compact 1U enclosure, MADI I/O boxes can NOT be fitted with a GPIO card.

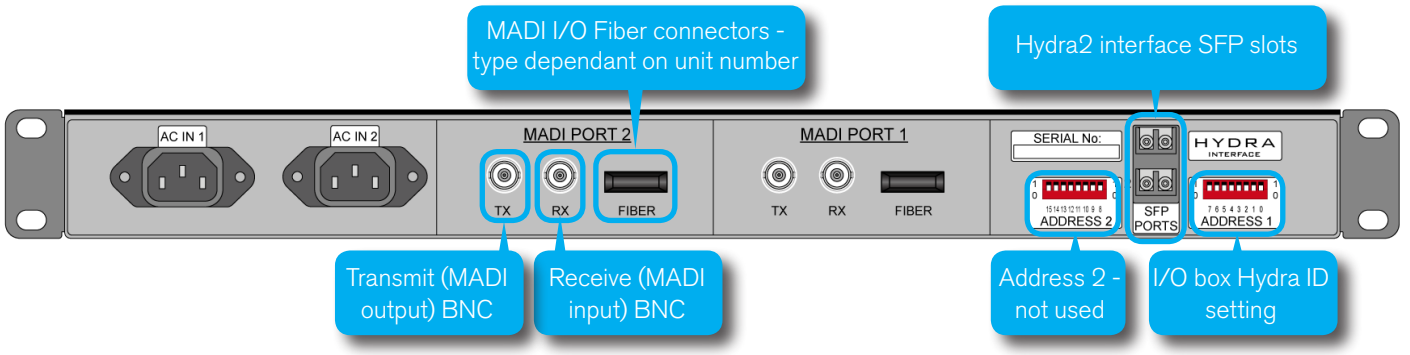
Sample rate conversion & sync

There is no sample rate conversion available for MADI I/O. To guarantee audio performance, equipment being connected to MADI I/O should be locked to the same derived sync source as the Calrec router.

FRONT PANEL VIEW

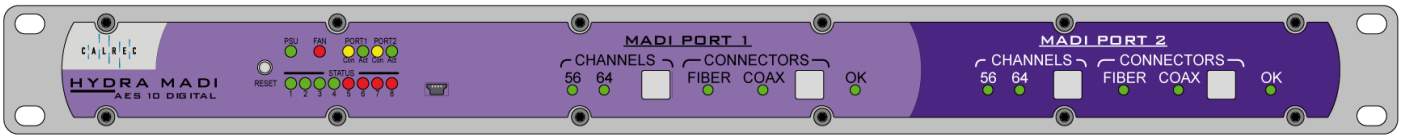


REAR PANEL VIEW

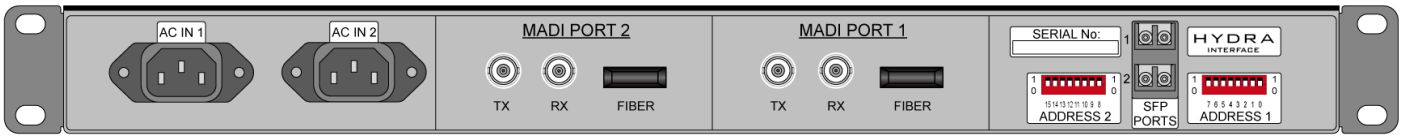


JM5736 – MADI I/O – (MULTIMODE SC)

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

Format	MADI (AES10)
Inputs	2 x MADI (2 x 64 / 56 channels)
Outputs	2 x MADI (2 x 64 / 56 channels)
Audio Connectors	BNC & Multimode SC Fiber
GPIO compatible	**NO**
Height	1U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	7.5 lbs (3.4 kg)
Input Power	100-240 V AC, 0.20-0.12 A RMS, 50/60 Hz
Acoustic Noise	N/A - No fans fitted in this unit

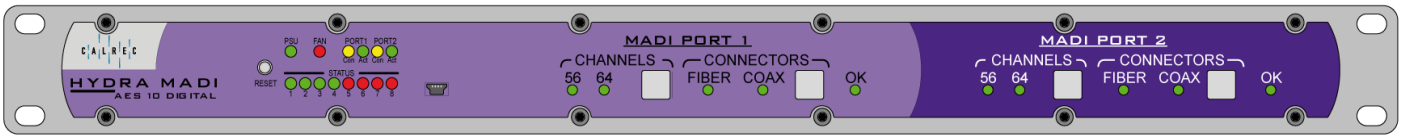
- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

MULTIMODE SC FIBER CONNECTORS

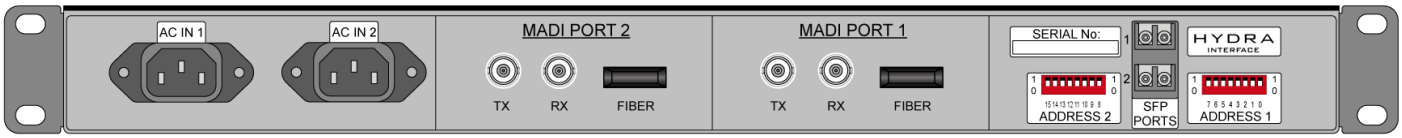
- Image above shows 2 x SC multimode (color coded beige for multimode) connectors fitted into duplex housing. The Duplex housing is optional, but ensures correct polarity when connecting to I/O box.

JM5890 – MADI I/O – (MULTIMODE ST)

FRONT PANEL VIEW



REAR PANEL VIEW



UNIT SPECIFICATIONS

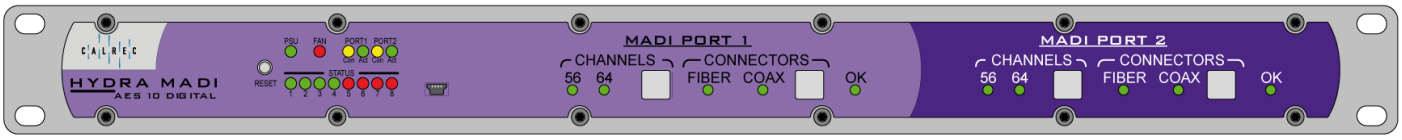
Format	MADI (AES10)
Inputs	2 x MADI (2 x 64 / 56 channels)
Outputs	2 x MADI (2 x 64 / 56 channels)
Audio Connectors	BNC & Multimode ST Fiber
GPIO compatible	**NO**
Height	1U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	7.5 lbs (3.4 kg)
Input Power	100-240 V AC, 0.20-0.12 A RMS, 50/60 Hz
Acoustic Noise	N/A - No fans fitted in this unit

- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

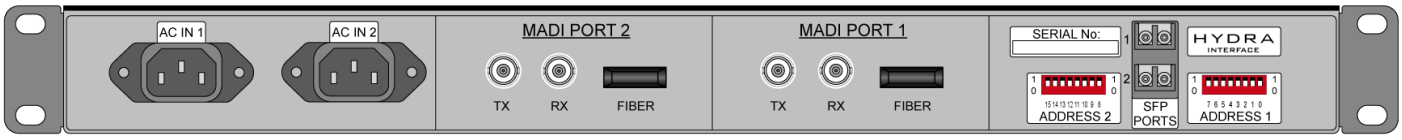
MULTIMODE ST FIBER CONNECTORS

JM5831 – MADI I/O – (SINGLEMODE SC)

FRONT PANEL VIEW



REAR PANEL VIEW

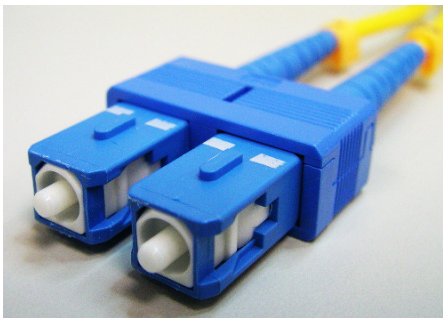


UNIT SPECIFICATIONS

Format	MADI (AES10)
Inputs	2 x MADI (2 x 64 / 56 channels)
Outputs	2 x MADI (2 x 64 / 56 channels)
Audio Connectors	BNC & Singlemode SC Fiber
GPIO compatible	**NO**
Height	1U
Width	19" rackmount (483 mm)
Depth	9" (230 mm)
Depth inc rear mating connectors	12" (300 mm)
Approx Weight	7.5 lbs (3.4 kg)
Input Power	100-240 V AC, 0.20-0.12 A RMS, 50/60 Hz
Acoustic Noise	N/A - No fans fitted in this unit

- See "Fixed Format I/O Overview" on page 44 and "Audio Performance Specification" on page 100 for further detail.

SINGLEMODE SC FIBER CONNECTOR



- Image above shows 2 x SC singlemode (color coded blue for singlemode) connectors fitted into duplex housing. The Duplex housing is optional, but ensures correct polarity when connecting to I/O box.

HYDRA2
MODULAR I/O

CALREC

Putting Sound in the Picture

calrec.com

MODULAR I/O RACK

Modular I/O racks are 3U rack-mount enclosures with 20 I/O card slots that can be populated with a mixed range of I/O cards, allowing for a custom selection of I/O quantities and formats.

Modular I/O racks connect to a Hydra2 network in the same way as Fixed Format I/O. Multiple modular I/O racks can co-exist on a Hydra2 network alongside fixed format I/O, if required, in order to make up the quantity of I/O in the format and location needed.

Power

Each modular I/O rack is fitted with 2 x rear mounted AC PSUs, each with its own AC IEC input, operating from 100–240 V AC 50/60 Hz. Either PSU can power the whole rack; two are fitted in order to provide redundancy. Where possible, each PSU should be fed from a separate AC source in order to provide redundancy against both PSU failure and external AC mains loss. Units are supplied with an IEC 'Y-cord' to allow both PSUs to be fed if only a single AC outlet is available.

Earthing

Chassis earth studs are fitted to each PSU cover. These should be connected to ground using earth cable of at least 6mm^2 cross-section (10 AWG).

Airflow and mounting

The unit is a 19" rack-mount enclosure designed for mounting into standard equipment bays. Rear/side supports should be considered in order to avoid excessive stress on the front racking angles, particularly if fitted into a mobile installation

A recessed air-intake grill runs across the bottom of the rack. The rack can be mounted directly under or on top of another unit or surface—the recessed design of the intake allows sufficient air to be drawn in from the sides (see diagram) to cool the rack. Both side facing inlets should be left unobstructed.

Low noise fans fitted to the PSU modules pull air through the rack, venting to the rear. The fan grills at the rear of the rack should be unobstructed with sufficient clearance for air to vent. Fans on both PSUs will operate, even if only one PSU is active, to ensure even airflow in the event of a PSU failure. To minimize fan noise and longevity, modular I/O fan speed is under variable control depending on the temperature within the rack. SDI cards run notably hotter than other card types and therefore a rack populated with a large number of SDI cards will generate the most fan noise.

Recess Kit

Recess kits are supplied as standard with Modular IO boxes, which allow them to be fitted, either flush to the front of the rack, or recessed as shown in the diagram on the next page.

Hydra IDs

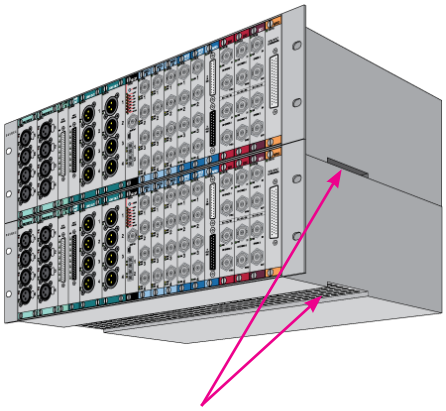
Unlike fixed format I/O, the Hydra ID is set using a DIP switch on the interface card fitted within the rack which needs to be removed in order to change the HID. Please refer to the Modular I/O Hydra2 Interface section for more details.

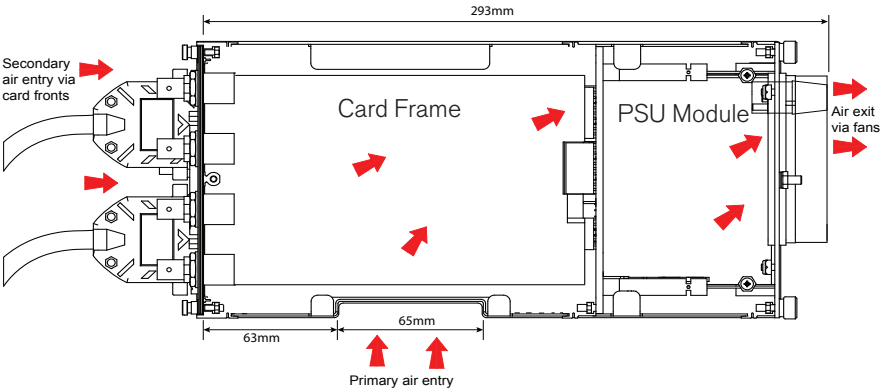
Fitting and removing cards

It is essential to ensure EMC precautions are observed before removing or handling modular I/O cards. Any static should be discharged from the person by touching an earthed piece of metal, or preferably by wearing an ESD wrist-strap prior to handling. Cards should only be handled by their edges or front panels and should be worked on ESD protected benches and stored in EMC protected bags. Failure to observe EMC precautions will invalidate warranty.

Cards are secured by top and bottom front panel screws and can be removed by pulling on the screws once they are unfastened. Do not pull on connectors or cables.

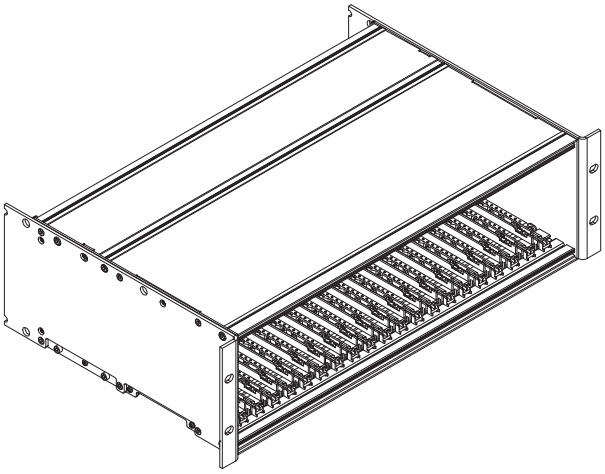
MODULAR I/O RACK AIRFLOW & SIDE VIEW CROSS-SECTION

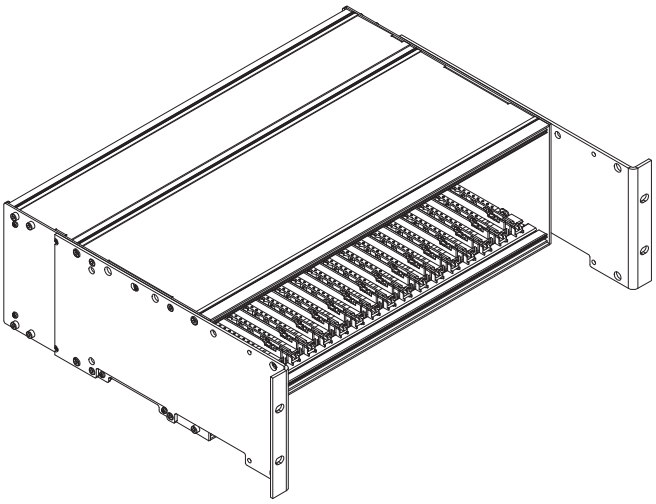


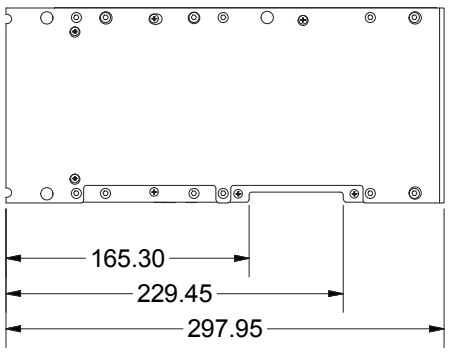


- Recessed air intake grills allow sufficient air to be drawn in from the sides, enabling units to be rack mounted directly above or below other units without space between them.

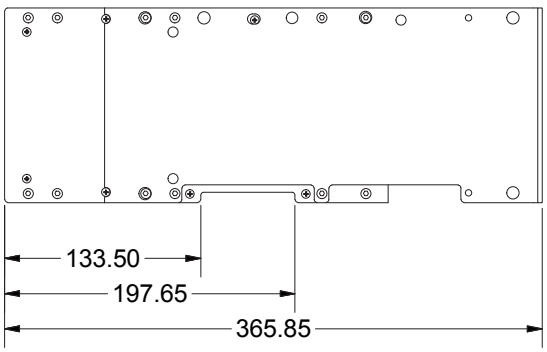
MODULAR I/O RECESS KITS





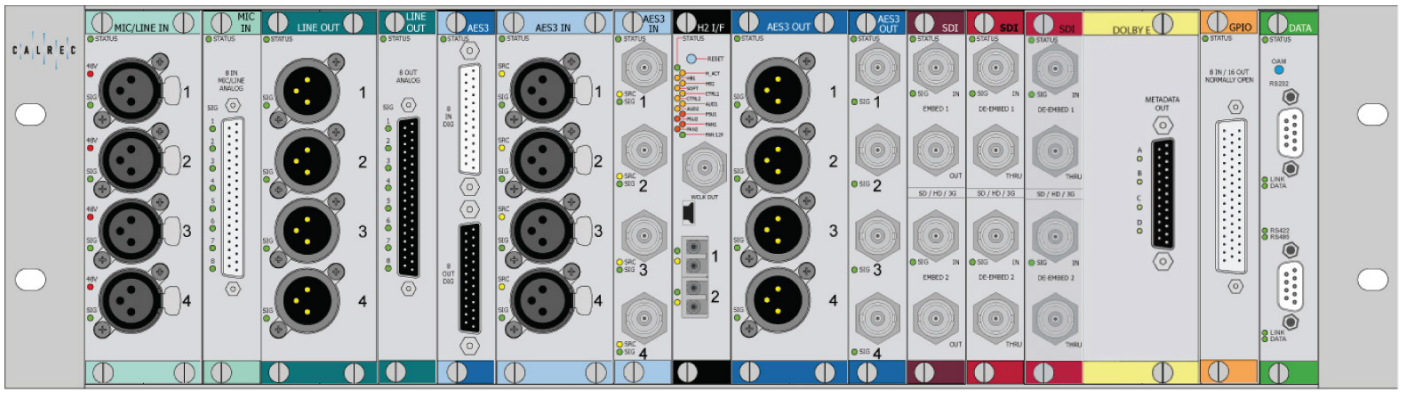


- Unrecessed



- Recessed

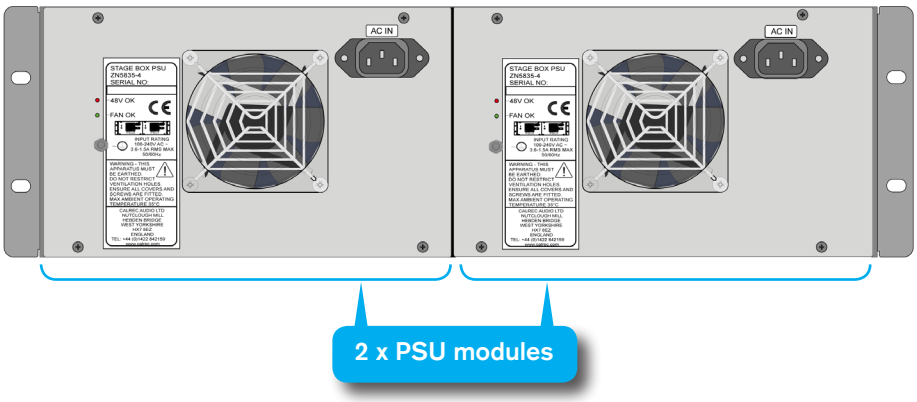
MODULAR I/O RACK - EXAMPLE SHOWING VARIED CARD TYPE POPULATION



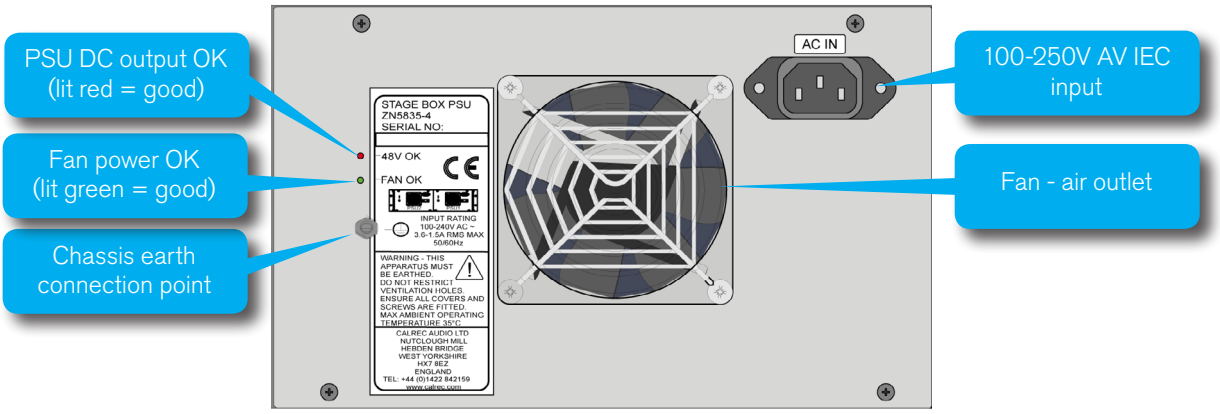
MODULAR I/O RACK SPECIFICATIONS

Height	3U
Width	19" (483 mm)
Depth	293 mm (11.6")
Approx. depth inc. rear mating connectiors	350 mm (13.8")
Input Power (maximum)	100-240 VAC 1.52–0.68 A RMS 50/60 Hz. Consumption dependant on I/O population.

MODULAR I/O RACK - REAR VIEW



PSU DETAIL



MODULAR I/O HYDRA2 INTERFACE

Hydra2 interface card
The central card slot of a modular I/O rack is reserved for a Hydra2 interface card. This card connects the I/O to a Hydra2 network. Unlike fixed format I/O, the Hydra2 interface connectors are on the front of the modular I/O rack.

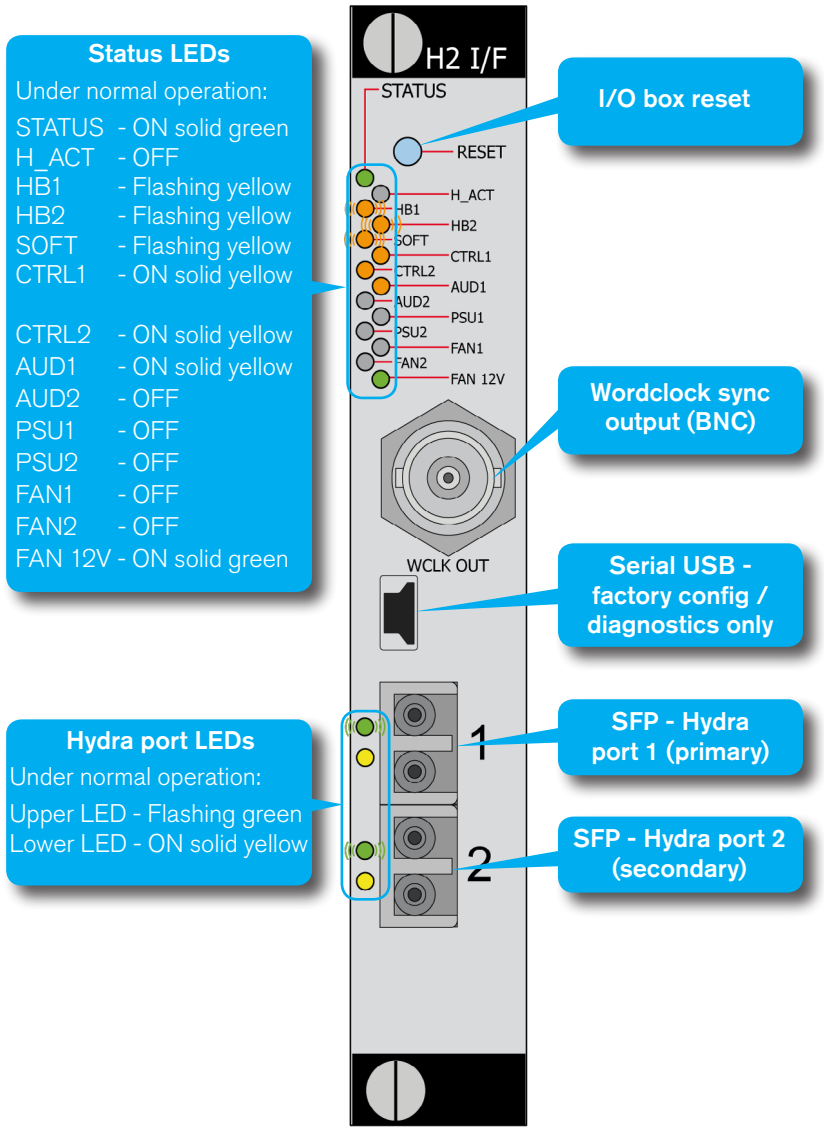
Two Hydra2 interface ports are provided for redundancy - port 1 connects to a primary Calrec router, port 2 to the secondary router in the same core. Hydra2 network components interface via via pluggable SFP modules, the correct type of SFP should be ordered to match the installation requirements—Cat5e copper, singlemode, or mulitmode fiber. Please refer to the section on SFPs for more details.

Modular I/O box ID setting
The ID for modular I/O boxes is set using the DIP switches on the controller card and is only accessible by removing the card. Ensure ESD precautions are observed before removing any modular I/O box cards.

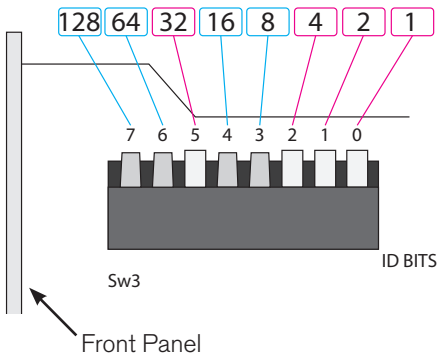
ID switches on modular I/O controller cards are orientated differently. Ignore any labelling on the switch itself and refer to the Calrec labelling printed on the circuit board around the switch to clarify its orientation. When viewing the card from the side, the most significant bit is on the left and the least significant bit on the right. Pulling a switch towards you sets it as a binary 1, away from you as a binary 0. The illustrations on this page show the ID switch on the modular I/O controller card from the side and top views. The decimal value of 39 is used for this example.

Note, always use a non-conductive tool to set the DIP switches to avoid damaging the card.

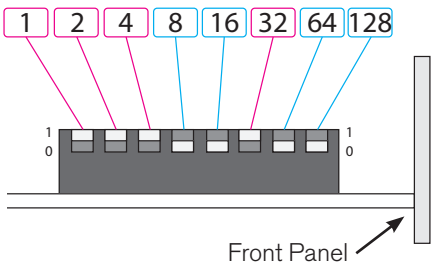
MODULAR I/O HYDRA2 INTERFACE CARD



MODULAR I/O CONTROLLER - SIDE



MODULAR I/O - VIEWED FROM TOP



MODULAR I/O HYDRA INTERFACE LED INFORMATION

LED	Description	Display
STATUS	Boot Status	**ON SOLID GREEN**—Normal, indicates card has booted. **FLASHING GREEN**—Card is booting. **OFF**—Unit has failed to boot.
H_ACT	N/A	**OFF**—Normal, no function assigned to LED.
HB1	Primary Connection Heartbeat	**FLASHING YELLOW**—Normal, flashes approx twice per second. Indicates a valid link between port 1 and a primary router. **OFF or ON SOLID**—Failed or invalid link between port1 and primary router.
HB2	Secondary Connection Heartbeat	**FLASHING YELLOW**—Normal, flashes approx twice per second. Indicates a valid link between port 2 and a secondary router. **OFF or ON SOLID**—Failed or invalid link between port2 and secondary router.
SOFT	Software Heartbeat	**FLASHING YELLOW**—Normal, flashes approx twice per second. Indicates card software is running. **OFF or ON SOLID**—Card software is not running.
CTRL1	Primary Control Data	**ON SOLID YELLOW**—Normal, indicates control data connection between port 1 and primary router. **OFF**—No primary control data connection.
CTRL2	Secondary Control Data	**ON SOLID YELLOW**—Normal, indicates control data connection between port 2 and secondary router. **OFF**—No secondary control data connection.
AUD1	Primary Audio / Sync Active*	**ON SOLID YELLOW**—Normal, using sync and audio inputs via port 1. **OFF** —Unit is not using sync or audio via port 1.
AUD2	Secondary Audio / Sync Active*	**OFF**—Normal, unit is not using sync or audio via port 2. **ON SOLID YELLOW**—Unit is using sync and audio from port 2, indicates a problem with the primary path.
PSU1	PSU #1 Fail Indicator	**OFF**—Normal, I/O rack PSU #1 is functioning **ON SOLID RED**—PSU #1 has failed or is not receiving AC mains power.
PSU2	PSU #2 Fail Indicator	**OFF**—Normal, I/O rack PSU #2 is functioning **ON SOLID RED**—PSU #2 has failed or is not receiving AC mains power.
FAN1	Fan #1 Fail Indicator	**OFF**—Normal, Fan #1 (fitted to PSU #1) is functioning **ON SOLID RED**—Fan #1 has failed.
FAN2	Fan #2 Fail Indicator	**OFF**—Normal, Fan #2 (fitted to PSU #2) is functioning **ON SOLID RED**—Fan #2 has failed.
FAN 12V	Fan DC Power	**ON SOLID GREEN—**Normal, 12V DC power rail for fans is active. **OFF**—DC power for fans has failed or is inactive.
Port1 Green	Port 1 Activity	**FLASHING GREEN—**Under normal operation, once connection has been established, this LED should display a regular flashing pattern, approx 8 times per second. **OFF**—No activity detected on primary Hydra link.
Port1 Yellow	Port 1 Connection	**ON SOLID YELLOW**—Normal, indicates a valid Hydra2 port connection is made.
Port2 Green	Port 2 Activity	**FLASHING GREEN—**Under normal operation, once connection has been established, this LED should display a regular flashing pattern, approx 8 times per second. **OFF**—No activity detected on secondary Hydra link.
Port2 Yellow	Port 2 Connection	**ON SOLID YELLOW**—Normal, indicates a valid Hydra2 port connection is made.

- AUD1 & AUD2 LEDs may be lit at the same time if the box is receiving some signals on its secondary connection

MODULAR I/O CARD OPTIONS

A wide range of cards are available to fit in modular I/O racks, offering various signal formats and connector types.

Card Slots

Up to 20 I/O cards can be fitted in each modular I/O rack. Some card types physically take up more than one card slot space.

Card slots are labelled alphabetically from the left. Characters F, I, O, Q, U & Y are omitted as they are easily confused with other characters or numbers. Slot labels are printed on the upper rail of the rack and are still visible when cards are fitted through a circular cut-out in the top left corner of the card's front panel. Cards that take up more than one slots space are identified by the left-most card slot of the space they occupy. The card slot character is used as part of the default I/O port labels.

Changing I/O card types

On connecting to a Hydra2 network, modular I/O boxes along with their I/O card population are automatically detected. The box configuration is saved to the Hydra2 database along with any port labels that have been edited in order to allow users to patch sources/ destinations to/from an I/O box even if the box itself is offline.

If required, additional cards can be fitted into empty card slots. After resetting the I/O box, the new cards will be automatically detected and added to the Hydra2 database.

If a card is removed from an I/O box, it will still remain in the Hydra2 database and displayed on each console, and in H2O. The card, or a different card of the same type can be fitted, and operation will be normal.

If the type of card fitted in a slot is changed, both the old and the new card type will be present in the Hydra2 database, and displayed on each console and in H2O which can lead to confusion.

If a card is changed for a different type, or if a card is to be permanently removed, the I/O box should be physically disconnected from the network, and then removed from the required list on each console, and removed from the IO box list in H2O, before being reconnected. On connection, it will be automatically recognized with its correct current configuration and just need adding to the required list on each relevant console.

MODULAR I/O CARD OPTIONS

Card	Type	Inputs	Outputs	Connector	Width (slots)
AD5838	Analog Line In	8	0	D-Type	1
AD6057	Analog Mic/Line In	8	0	D-Type	1
AD5840	Analog Mic/Line In	4	0	XLR	2
AL5870	Analog Mic In / Split	2	2	XLR	2
AL5875	Analog Mic In / Split	1	3	XLR	2
DA5839	Analog Line Out	0	8	D-Type	1
DA5867	Analog Line Out	0	4	XLR	2
JB5860	Digital AES In Unbalanced	4	0	BNC	1
JX5869	Digital AES In Balanced	4	0	XLR	2
JD5842	Digital AES In/Out Balanced	8	8	D-Type	1
JB5837	Digital AES Out Unbalanced	0	4	BNC	1
JB5868	Digital AES Out Balanced	0	4	XLR	2
BI6192	Dante interface	64	64	RJ45	1
VI5872	SDI embedder / Out	2	2	BNC	1
VO5841	SDI de-embedder / In	2	2	BNC	1
VO5873	SDI de-embedder / in with Dolby Decoder Support	2	2	BNC	3
WY5858	GPIO	8	8	D-Type	1
WY5859	GPIO	8	16	D-Type	1

- Input / output quantities shown in grey indicate I/O that is local to the card and cannot be accessed by / is not fed from the Hydra2 domain, e.g. analog split outputs and video content.

HYDRA2
MODULAR I/O CARDS

CALREC

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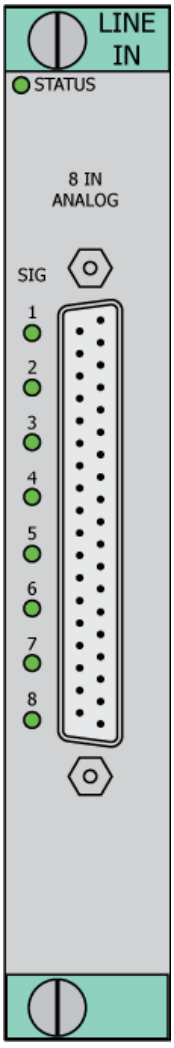
AD5838 – 8 x ANALOG LINE LEVEL INPUTS

The AD5838 provides 8 balanced line level analog inputs to the Hydra2 network in a 1 slot-wide module. The audio interface is via a 37 pin female D-Type connector.

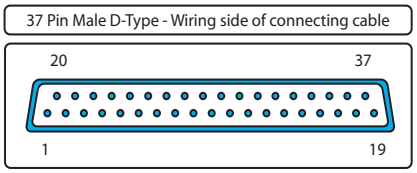
Front panel LEDs indicate audio signal presence for each input, lighting green for signals above -60dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



WIRING INFORMATION



Function		Pin
In 1	+	21
	-	3
	Ground	2
In 2	+	23
	-	5
	Ground	4
In 3	+	25
	-	7
	Ground	6
In 4	+	27
	-	9
	Ground	8
In 5	+	29
	-	11
	Ground	10
In 6	+	31
	-	13
	Ground	12
In 7	+	33
	-	15
	Ground	14
In 8	+	35
	-	17
	Ground	16
Ground		18, 20, 36

- Card connector is female, requiring male terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Line Level
Inputs	8
Outputs	N/A
Input Impedance	10 kΩ
ADC	24 bit

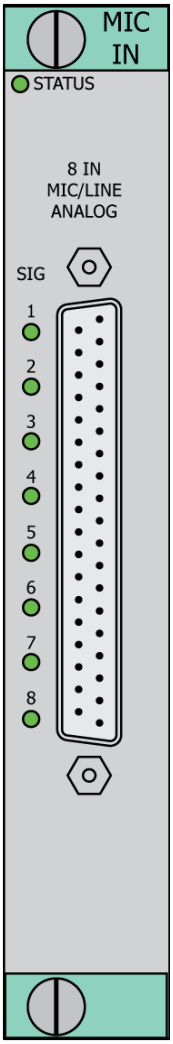
AD6057 – 8 x ANALOG MIC / LINE LEVEL INPUTS

The AD6057 provides 8 balanced mic / line level analog inputs to the Hydra2 network in a 1 slot-wide module. The audio interface is via a 37 pin female D-Type connector.

Front panel LEDs indicate audio signal presence for each input, lighting green for signals above -60dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



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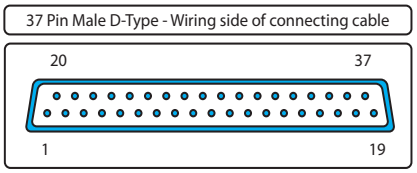


Function		Pin
In 1	+	21
	-	3
	Ground	2
In 2	+	23
	-	5
	Ground	4
In 3	+	25
	-	7
	Ground	6
In 4	+	27
	-	9
	Ground	8
In 5	+	29
	-	11
	Ground	10
In 6	+	31
	-	13
	Ground	12
In 7	+	33
	-	15
	Ground	14
In 8	+	35
	-	17
	Ground	16
Ground		18, 20, 36

- Card connector is female, requiring male terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Mic/Line Level
Inputs	8
Outputs	N/A
Input Gain Range	-18dB to +78dB, remotely controlled per input
Phantom Power	48V remotely switchable per input
Input Impedance	5 kΩ
ADC	24 bit

AD5840 – 4 x MIC/LINE IN (XLR)

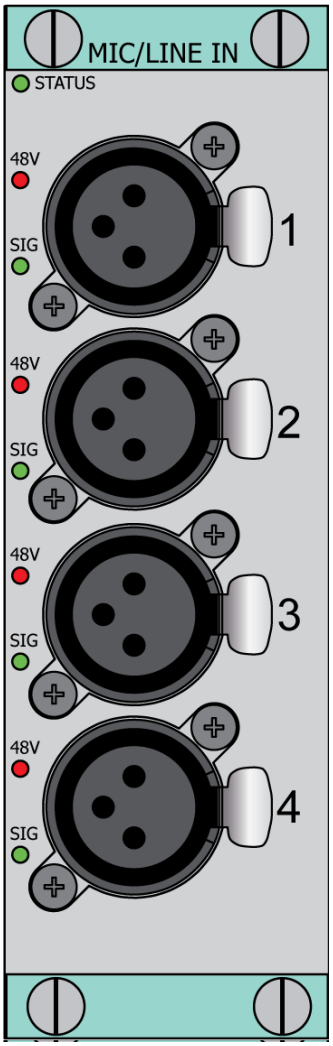
The AD5840 provides 4 balanced mic / line level analog inputs to the Hydra2 network in a 2 slot-wide module. The audio interface is via 4 female XLR connectors.

Front panel LEDs indicate audio signal presence for each input, lighting green for signals above -60dBFS.

Each input also has front panel LED indicators which light red when 48 V phantom power is on.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



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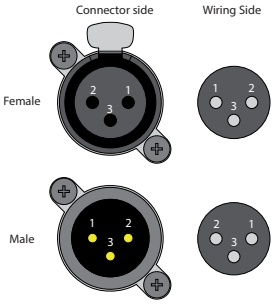


Function	Pin
Positive	2
Negative	3
Ground	1

- Card connectors are female, requiring male terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Mic/Line Level
Inputs	4
Outputs	0
Input Gain Range	-18 dB to +78 dB, remotely controlled per input
Phantom Power	48 V remotely switchable per input
Input Impedance	2 kΩ @ Mic Level / 10 kΩ @ Line level (auto-switching)
ADC	24 bit

AL5870 – 2 x MIC/LINE IN WITH SPLITS (XLR)

The AL5870 provides 2 balanced mic / line level analog inputs to the Hydra2 network along with a pre-gain analog "split" output for each input in a 2 slot-wide module. Input connectors are female XLR, outputs are male XLR.

The pre gain analog split outputs are active, irrespective of the Hydra2 interface card status, as long as the rack is powered.

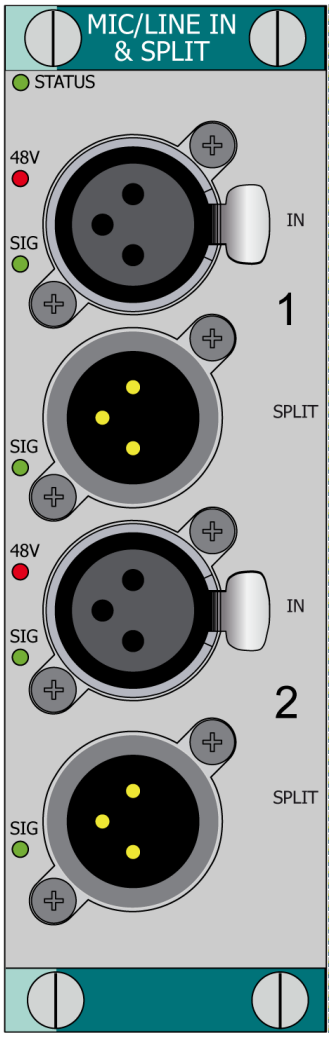
Front panel LEDs indicate audio signal presence for each input and split output, lighting green for signals above -60dBFS.

Each input also has front panel LED indicators which light red when 48V phantom power is on.

This module supports phantom power detection, allowing for power to the mic input to be controlled by the device being fed from the split output. This feature is enabled per input / split using PCB mounted DIP switches fitted to the card. When active, if +24V DC or greater is detected on a split output (i.e. phantom power is being fed by the device connected to the split), the card will automatically switch its own phantom power to the corresponding mic input. If phantom power has been switched in this way, the 48 V LED indicator will briefly blink off approximately every two seconds.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



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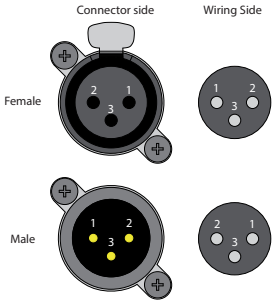


Function	Pin
Positive	2
Negative	3
Ground	1

- Card input connectors are female, requiring male terminated interface cabling.
- Card Split output connectors are male, requiring female terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Mic/Line Level
Inputs	2
Outputs	2 (Pre-gain input splits)
Input Gain Range	-18 dB to +78 dB, remotely controlled per input
Phantom Power	48 V remotely switchable per input
Input Impedance	2 kΩ @ Mic Level / 10 kΩ @ Line level (auto-switching)
ADC	24 bit

AL5875 – 1 x MIC/LINE IN WITH 3 SPLITS (XLR)

The AL5875 provides 1 balanced mic / line level analog input to the Hydra2 network along with a 3 pre-gain analog "split" outputs of the input signal in a 2 slot-wide module. The input connector is a female XLR, outputs are male XLR.

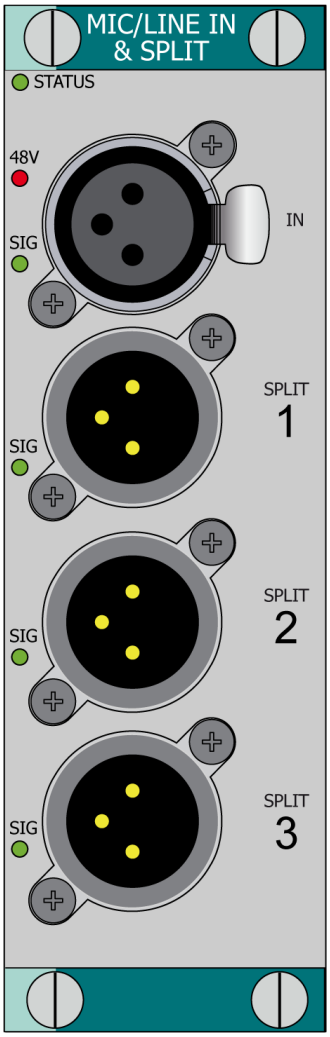
The pre gain analog split outputs are active, irrespective of the Hydra2 interface card status, as long as the rack is powered.

Front panel LEDs indicate audio signal presence for the input and split outputs, lighting green for signals above -60dBFS.

The input also has a front panel LED indicator that lights red when 48V phantom power is on.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



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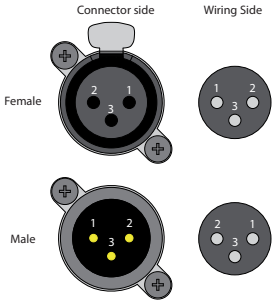


Function	Pin
Positive	2
Negative	3
Ground	1

- Card input connector is female, requiring male terminated interface cabling.
- Card Split output connectors are male, requiring female terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Mic/Line Level
Inputs	1
Outputs	3 (Pre-gain input splits)
Input Gain Range	-18 dB to +78 dB, remotely controlled per input
Phantom Power	48 V remotely switchable per input
Input Impedance	2 kΩ @ Mic Level / 10 kΩ @ Line level (auto-switching)
ADC	24 bit

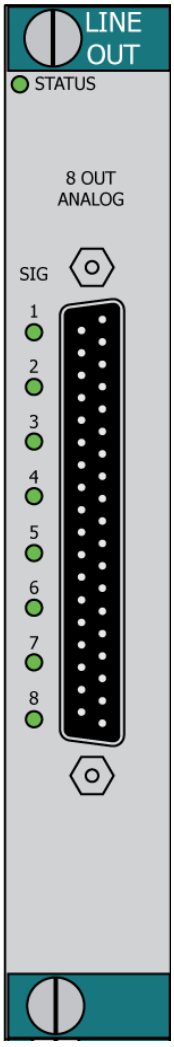
DA5839 – 8 x ANALOG LINE OUT (D-TYPE)

The DA5839 provides 8 balanced analog line level outputs from the Hydra2 network in a 1 slot-wide module. The audio interface is via a 37 pin male D-Type connector.

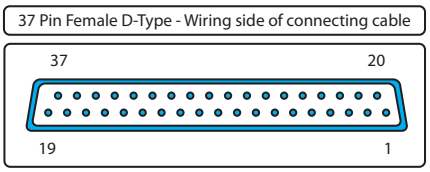
Front panel LEDs indicate audio signal presence for each output, lighting green for signals above -60dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



WIRING INFORMATION



Function		Pin
Out 1	+	21
	-	3
	Ground	2
Out 2	+	23
	-	5
	Ground	4
Out 3	+	25
	-	7
	Ground	6
Out 4	+	27
	-	9
	Ground	8
Out 5	+	29
	-	11
	Ground	10
Out 6	+	31
	-	13
	Ground	12
Out 7	+	33
	-	15
	Ground	14
Out 8	+	35
	-	17
	Ground	16
Ground		18, 20, 36

- Card connector is male, requiring female terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Line Level
Inputs	N/A
Outputs	8
Output Impedance	<40 Ω
DAC	24 bit

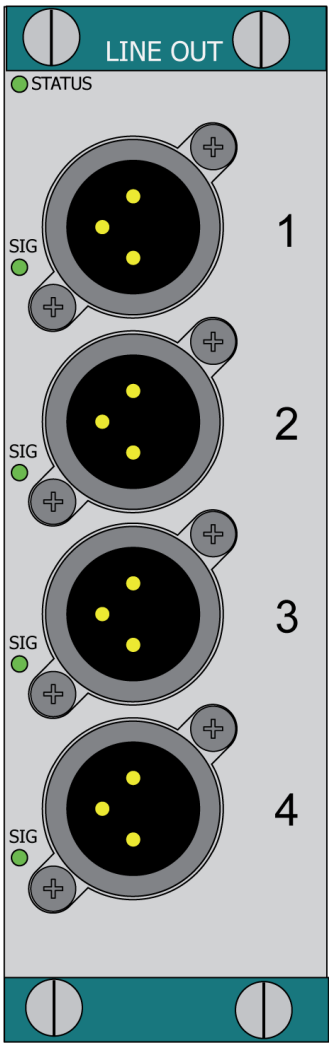
DA5867 – 4 x LINE OUT (XLR)

The DA5867 provides 4 balanced analog line level outputs from the Hydra2 network in a 2 slot-wide module. The audio interface is via male XLR connectors.

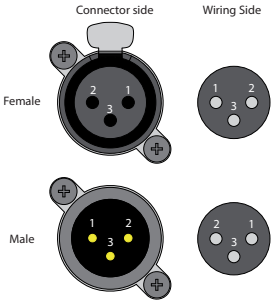
Front panel LEDs indicate audio signal presence for each output, lighting green for signals above -60dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



WIRING INFORMATION



Function	Pin
Positive	2
Negative	3
Ground	1

- Card connector is male, requiring female terminated interface cabling.

SPECIFICATION

Format	Analog
Type	Balanced Line Level
Inputs	0
Outputs	4
Output Impedance	<40 Ω
DAC	24 bit

JB5860 – 4 x DIGITAL AES INPUT (BNC)

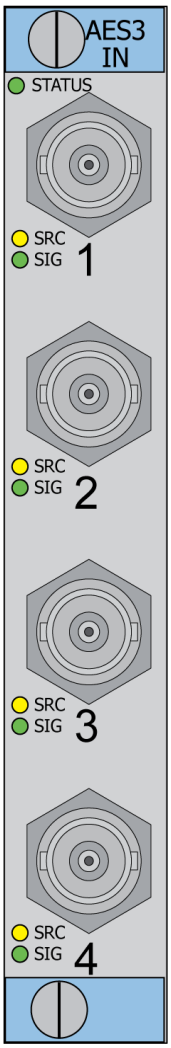
The JB5860 provides 4 unbalanced digital AES3 inputs to the Hydra2 network in a 1 slot-wide module. The audio interface is via BNC connectors.

Front panel LEDs indicate AES signal presence for each input, lighting green when receiving a valid AES carrier signal (irrespective of audio content).

Each input also has an “SRC” LED indicator which lights yellow when the sample rate convertor is active.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



SPECIFICATION

Format	Digital
Type	AES3 (75 Ω unbalanced)
Input Range	0.3V-1.2 V Pk-Pk
Audio Connector	BNC
Inputs	4
SRC	24 bit, remotely switchable per input.

JX5869 – 4 x DIGITAL AES INPUT (XLR)

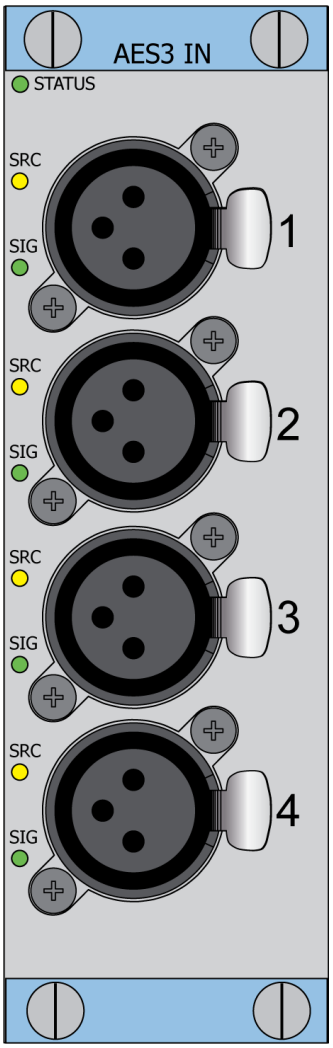
The JB5896 provides 4 balanced digital AES3 inputs to the Hydra2 network in a 2 slot-wide module. The audio interface is via female XLR connectors.

Front panel LEDs indicate AES signal presence for each output, lighting green when receiving a valid AES carrier signal (irrespective of audio content).

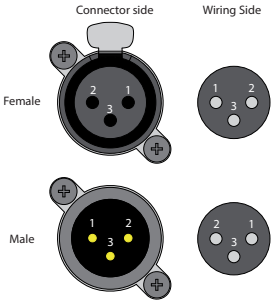
Each input also has an “SRC” LED indicator which lights yellow when the sample rate convertor is active.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



WIRING INFORMATION



Function	Pin
Positive	2
Negative	3
Ground	1

- Card connector is female, requiring male terminated interface cabling.

SPECIFICATION

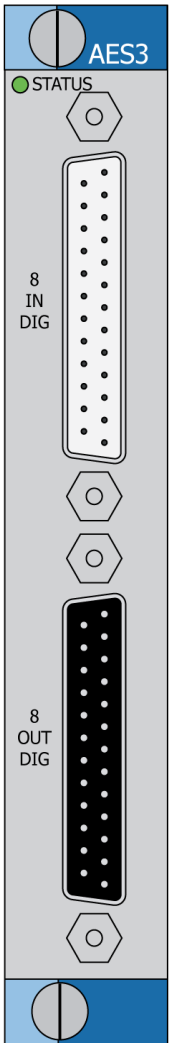
Format	Digital
Type	AES3 (110 Ω balanced)
Input Range	0.2 V - 7.0 V Pk-Pk
Audio Connector	Female XLR
Inputs	4
SRC	24 bit, remotely switchable per input.

JD5842 – 8 IN, 8 OUT DIGITAL AES (D-TYPE)

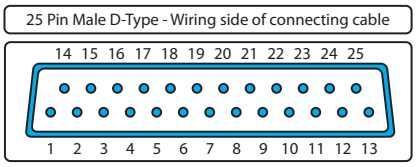
The JD5842 balanced digital AES3 card provides 8 inputs and 8 outputs to / from the Hydra2 network in a 1 slot-wide module. Audio interfacing is via 25 pin D-Type connectors, female for inputs, male for outputs.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



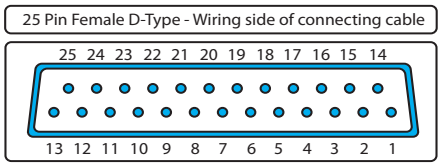
INPUT WIRING INFORMATION



Function		Pin
Input 1	+	14
	-	2
	Ground	1
Input 2	+	3
	-	16
	Ground	15
Input 3	+	17
	-	5
	Ground	4
Input 4	+	6
	-	19
	Ground	18
Input 5	+	20
	-	8
	Ground	7
Input 6	+	9
	-	22
	Ground	21
Input 7	+	23
	-	11
	Ground	10
Input 8	+	12
	-	25
	Ground	24
Ground		13

- Input connector is female, requiring male terminated interface cabling.

OUTPUT WIRING INFORMATION



Function		Pin
Out 1	+	14
	-	2
	Ground	1
Out 2	+	3
	-	16
	Ground	15
Out 3	+	17
	-	5
	Ground	4
Out 4	+	6
	-	19
	Ground	18
Out 5	+	20
	-	8
	Ground	7
Out 6	+	9
	-	22
	Ground	21
Out 7	+	23
	-	11
	Ground	10
Out 8	+	12
	-	25
	Ground	24
Ground		13

- Output connector is male, requiring female terminated interface cabling.

SPECIFICATION

Format	Digital
Type	AES3 (110 Ω balanced)
Input Range	0.2 V - 7.0 V Pk-Pk
Output Voltage	3.5 V nominal into 110 Ω
Audio Connectors	Inputs - 25 pin female D-Type Outputs - 25 pin Male D-Type
Inputs	8
Outputs	8
SRC	24 bit, remotely switchable per input.

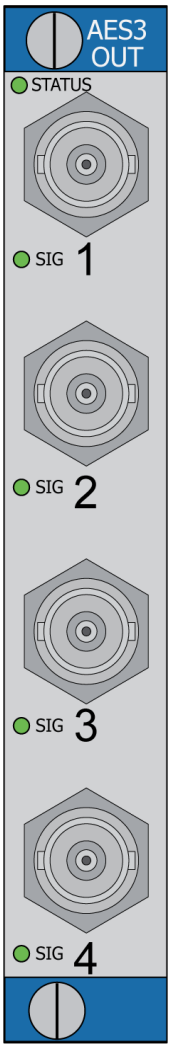
JB5837 – 4 x DIGITAL AES OUTPUT (BNC)

The JB5837 provides 4 unbalanced digital AES3 outputs from the Hydra2 network in a 1 slot-wide module. The audio interface is via BNC connectors.

Front panel LEDs indicate audio presence for each output, lighting green when outputting signal over -60 dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



SPECIFICATION

Format	Digital
Type	AES3 (75 Ω unbalanced)
Output	1 V Pk-Pk nominal into 75 Ω
Audio Connector	BNC
Outputs	4

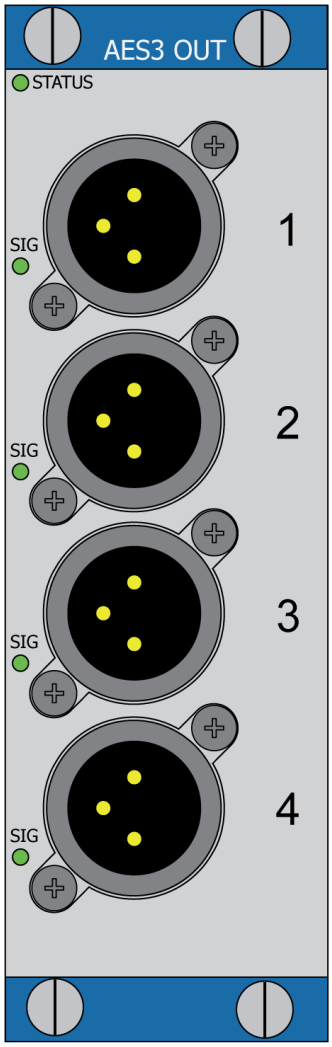
JB5868 – 4 x DIGITAL AES OUTPUT (XLR)

The JB5868 provides 4 balanced digital AES3 outputs from the Hydra2 network in a 1 slot-wide module. The audio interface is via XLR connectors.

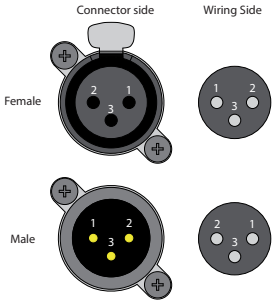
Front panel LEDs indicate audio presence for each output, lighting green when outputting signal over -60 dBFS.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



WIRING INFORMATION



Function	Pin
Positive	2
Negative	3
Ground	1

- Card connector is male, requiring female terminated interface cabling.

SPECIFICATION

Format	Digital
Type	AES3 (110 Ω unbalanced)
Output	3.5 V Pk-Pk nominal into 110 Ω
Audio Connector	XLR
Outputs	4

BI6192 – DANTE INTEGRATION WITH NETWORK REDUNDANCY

The BI6192 provides an interface for routing audio in and out of a Hydra2 network into a Dante network. The interface is via RJ45 connectors housed within a 1-slot wide module.

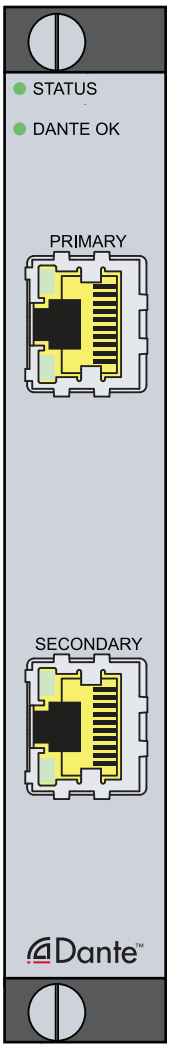
Dante is a self-configuring, plug and play, digital audio networking technology developed by Audinate. Dante uses standard internet protocols. The Calrec Dante modular I/O card operates over Gigabit (Giga/E) Ethernet.

The BI6192 provides 64 input channels and 64 output channels (for a Dante network operating at 48 kHz or 44.1 kHz) or 32 input channels and 32 output channels (for a 96 kHz Dante network) with sample-rate conversion permanently enabled on all channels.

Two RJ45 ports (primary and secondary) are provided to give full redundancy on the Dante portion of the network.

For more information please see Audinate's Dante documentation here www.audinate.com/resources/technical-documentation.

FRONT PANEL VIEW



SPECIFICATION

Format	Digital
Type	Dante
Connector	RJ45
Inputs	64 (at 48 kHz or 44.1 kHz), 32 (at 96 kHz)
Outputs	64 (at 48 kHz or 44.1 kHz), 32 (at 96 kHz)

VI5872 – 2 x SDI EMBEDDER (BNC)

The VI5872 provides 2 SDI outputs, into which audio can be embedded from the Hydra2 network. This is a 1 slot-wide module with SDI interfacing via BNC connectors.

Any console, H2O user or 3rd party SW-P-08 controller on the Hydra2 network can select audio to be embedded into the SDI outputs. Each SDI output can carry up to 16 channels of embedded audio.

Each SDI output is paired with an SDI input. A valid SDI signal must be fed into an input connector in order for the corresponding output to function. The output can only pass video content from its corresponding input—video content cannot be re-routed by the Hydra2 system. Any audio in the incoming SDI signal is stripped and discarded—all audio in the output stream is routed from the Hydra2 network. Audio channels within the output stream will be silent unless Hydra2 patches are made to them. If any of the audio content from the SDI input needs to be maintained, the signal should first pass through a de-embedder card (VO5841 / VO5873).

3rd party EMBER controllers, such as L-S-B's VSM & Colledia's BNCS have the ability to insert SMPTE2020 metadata into each SDI output stream's VANC space.

Front panel LEDs for each input will light up green to indicate a valid SDI signal is being received.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

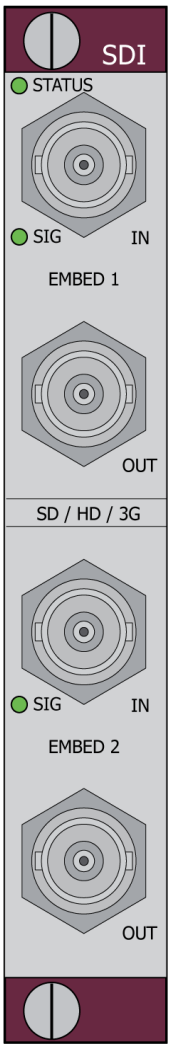
Maximum channel count

As Hydra2 links are limited to 512 channels of audio in each direction, each I/O box can be populated with cards that provide a maximum of 512 input channels, and 512 output channels.

This limitation only becomes a factor when a large number of SDI cards are fitted in the same modular I/O rack. Channels are counted across the card slots from left to right. If, for example, SDI embedder (audio output) cards are fitted in the first 16 card slots, the output channel count will be at its maximum (16 channels of audio per SDI output x 2 SDI outputs per card x 16 cards = 512 channels) - Any output cards fitted in the remaining 4 slots will not pass audio, irrespective of whether audio is being routed to any or all of the SDI outputs. The remaining card slots could however be fitted with input cards as inputs and outputs have separate channel count quota's.

Note, the channel count totals mono audio channels and therefore each SDI stream has a channel count of 16 and each digital AES port has a channel count of 2.

FRONT PANEL VIEW



SPECIFICATION

Format	SDI
Type	SD / HD / 3G
SDI Connector	BNC
Outputs	2 x SDI (16 audio channels each)
Inputs	2 x SDI in (audio discarded)

VO5841 – 2 x SDI DE-EMBEDDER (BNC)

The VO5841 provides 2 SDI inputs, the audio from which can be de-embedded and distributed across the Hydra2 network. This is a 1 slot-wide module with SDI interfacing via BNC connectors.

All 16 channels of audio can be de-embedded from SD, HD or 3G SDI signals.

For each SDI input, there is an SDI "thru" connector which passes on the incoming SDI signal, unchanged, with its original audio channels included.

Front panel LEDs for each input light up green to indicate a valid SDI signal is being received.

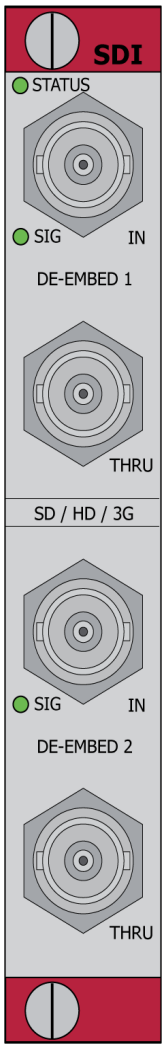
The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

Maximum channel count
As Hydra2 links are limited to 512 channels of audio in each direction, each I/O box can be populated with cards that provide a maximum of 512 input channels, and 512 output channels.

This limitation only becomes a factor when a large number of SDI cards are fitted in the same modular I/O rack. Channels are counted across the card slots from left to right. If, for example, SDI de-embedder (audio input) cards are fitted in the first 16 card slots, the input channel count will be at its maximum (16 channels of audio per SDI output x 2 SDI outputs per card x 16 cards = 512 channels).

Any input cards fitted in the remaining 4 slots will not pass audio, irrespective of whether audio is being used from any or all of the SDI inputs. The remaining card slots could however be fitted with output cards as inputs and outputs have separate channel count quota's. Note, the channel count totals mono audio channels and therefore each SDI stream has a channel count of 16 and each digital AES port has a channel count of 2.

FRONT PANEL VIEW



SPECIFICATION

Format	SDI
Type	SD / HD / 3G
SDI Connector	BNC
Inputs	2 x SDI (16 audio channel in each)
Outputs	2 (SDI "Thru")

VO5873 – DOLBY E DECODER & 2 x SDI DE-EMBEDDER

The VO5873 can be fitted with up to 4 Dolby E decoder cards, each of which can be assigned to decode a Dolby E signal being input by any card or I/O box on the Hydra2 network. This is a 3 slot-wide card.

In addition to the Dolby E decoders, this card also offers the same functionality as the VO5841 by providing 2 SDI inputs, the audio from which can be de-embedded and distributed across the Hydra2 network. As with the VO5841, this card type can de-embed all 16 channels within SD, HD or 3G SDI signals and provides a "thru" output to pass on the SDI input signal unchanged along with its original audio content. SDI inputs and outputs are via BNC connectors.

Although physically located on the same card as SDI inputs, the decoders are in fact fully assignable in their own right, able to decode any Dolby E signal fed into any input / I/O box (other than analog) on the Hydra2 network, whether coming in as a standard AES pair, or embedded into a MADI or SDI stream.

Each decoder card is capable of decoding one encoded signal. The decoder cards themselves (Calrec stock code 491-102) are optional extras and the quantity required should be stated at order.

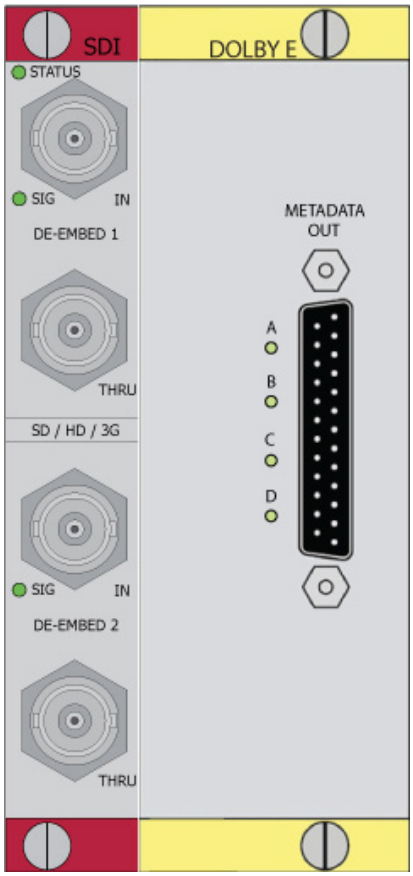
Metadata from the signals being decoded is available via a 25 pin male D-type connector.

LEDs A–D light up green to indicate if decoder cards are fitted in the 4 available slots.

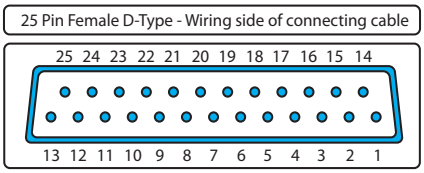
Front panel LEDs for each input light up green to indicate a valid SDI signal is being received by each SDI input.

The standard modular I/O status LED flashes green once the card has booted and lights solid green once a connection between the card and the Hydra2 interface has been established.

FRONT PANEL VIEW



METADATA WIRING INFORMATION



Function		Pin
Metadata Out 1	+	1
	-	14
	Ground	3
Metadata Out 2	+	2
	-	15
	Ground	16
Metadata Out 3	+	4
	-	17
	Ground	6
Metadata Out 4	+	5
	-	18
	Ground	19

SPECIFICATION

Format	SDI
Type	SD / HD / 3G
SDI Connector	BNC
Inputs	2 x SDI (16 audio channel in each)
Outputs	2 (SDI "Thru")

WY5858 – GPIO, 8 IN / 8 FULL CHANGEOVER OUT

GPIO cards can be fitted to provide General Purpose interfacing for logic control such as remote / fader starts for playback devices, triggering autofades on a control surface, and much more.

Access to each general purpose input and output can be given to any console on the Hydra2 network.

The function of each general purpose input and output is configurable and assignable from any Apollo/Artemis/ Summa console which has been granted access.

This is a one slot wide module. Inputs and outputs are all on 1 x female 50 pin D-type connector.

LEDs

The Status LED strobes to indicate that the local software is running. The LED illuminates solidly when connection is established to the Hydra2 Interface Module in the same modular I/O chassis.

GP Inputs

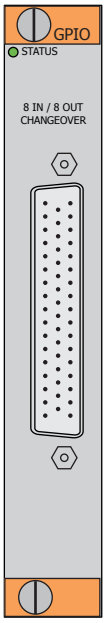
8 opto-isolated inputs allow for remote control of console functions. Applying between 3 and 50 Volts, AC or DC across the + & - pins of the opto will trigger them.

If using a dry closure to trigger a GP input, note that the incoming closure should be wired to one side of an opto input only. The other side of the opto should be pulled up by linking it to the 5V pin on the connector. The other side of the closure should be wired to the 0V pin. An example of wiring a closure to GP input #1 is shown in Figure 2.

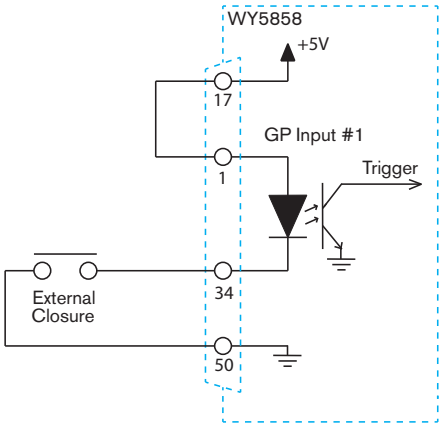
GP Outputs

The WY5858 version provides 8 changeover relays with access to both the normally open, and normally closed contacts for each. A closure pair is achieved by wiring one leg to either NO or NC and the other leg to a common pin for that specific relay. If external equipment requires a ground for activation, rather than a closure, the common pin for that relay should be connected to a ground from the external equipment.

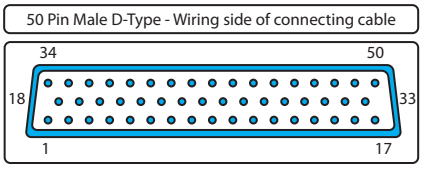
FRONT PANEL VIEW



INPUT WIRING EXAMPLE



GP INPUT PINS



Function		Pin
GPI 1	+	1
	-	34
GPI 2	+	18
	-	2
GPI 3	+	35
	-	19
GPI 4	+	3
	-	36
GPI 5	+	20
	-	4
GPI 6	+	37
	-	21
GPI 7	+	5
	-	38
GPI 8	+	22
	-	6
Supply	+5 V	17
Supply	0 V	50

GP OUTPUT PINS

Function		Pin
GPO 1	NO	39
	NC	7
	Common	23, 40
GPO 2	NO	24
	NC	41
	Common	8, 25
GPO 3	NO	9
	NC	26
	Common	42, 10
GPO 4	NO	43
	NC	11
	Common	27, 44
GPO 5	NO	28
	NC	45
	Common	12, 29
GPO 6	NO	13
	NC	30
	Common	46, 14
GPO 7	NO	47
	NC	15
	Common	31, 48
GPO 8	NO	32
	NC	49
	Common	16, 33

WY5859 – GPIO, 8 IN / 16 OUT

GPIO cards can be fitted to provide General Purpose interfacing for logic control such as remote / fader starts for playback devices, triggering autofades on a control surface, and much more.

This is a one slot wide module. Inputs and outputs are all on 1 x female 50 pin D-type connector.

Access to each general purpose input and output can be given to any console on the Hydra2 network.

The function of each general purpose input and output is configurable and assignable via Apollo/Artemis/Summa console's which have been granted access.

LEDs

The Status LED strobes to indicate that the local software is running. The LED illuminates solidly when connection is established to the Hydra2 Interface Module in the same modular I/O chassis.

GP Inputs

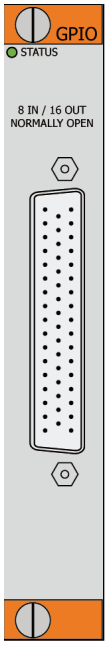
8 opto-isolated inputs allow for remote control of console functions. Applying between 3 and 50 Volts, AC or DC across the + & - pins of the opto will trigger them.

If using a dry closure to trigger a GP input, note that the incoming closure should be wired to one side of an opto input only. The other side of the opto should be pulled up by linking it to the 5V pin on the connector. The other side of the closure should be wired to the 0V pin. An example of wiring a closure to GP input #1 is shown in Figure 2 on the previous page.

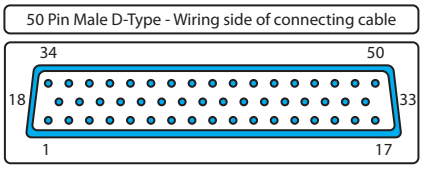
GP Outputs

The WY5859 version provides 16 normally open contact closure pairs. If external equipment requires a ground for activation, rather than a closure, one side of the relay should be connected to a ground from the external equipment and the other side of the relay used as the trigger.

FRONT PANEL VIEW



GP INPUT PINS



Function		Pin
GPI 1	+	1
	-	34
GPI 2	+	18
	-	2
GPI 3	+	35
	-	19
GPI 4	+	3
	-	36
GPI 5	+	20
	-	4
GPI 6	+	37
	-	21
GPI 7	+	5
	-	38
GPI 8	+	22
	-	6
Supply	+5 V	17
Supply	0 V	50

GP OUTPUT PINS

Function		Pin
GPO 1	NO +	39
	NO -	23
GPO 2	NO +	7
	NO -	40
GPO 3	NO +	24
	NO -	8
GPO 4	NO +	41
	NO -	25
GPO 5	NO +	9
	NO -	42
GPO 6	NO +	26
	NO -	10
GPO 7	NO +	43
	NO -	27
GPO 8	NO +	11
	NO -	44
GPO 9	NO +	28
	NO -	12
GPO 10	NO +	45
	NO -	29
GPO 11	NO +	13
	NO -	46
GPO 12	NO +	30
	NO -	14
GPO 13	NO +	47
	NO -	31
GPO 14	NO +	15
	NO -	48
GPO 15	NO +	32
	NO -	16
GPO 16	NO +	49
	NO -	33

HYDRA2
SPECIFICATION

CALREC

Putting Sound in the Picture

calrec.com

AUDIO PERFORMANCE SPECIFICATION

AES3 INPUT SPECS

Formats Supported	AES/EBU (AES3) 24-bit. Also suitable for use with SPDIF (IEC958 type 2) signals
Interface	75 Ω unbalanced (BNC), 0.3 V–1.2 V Pk–Pk 110 Ω balanced (XLR or D-Type), 0.2 V–7.0 V Pk–Pk
Sample Rate Conversion (SRC)	24-bit switchable on all AES inputs
SRC THD+N	-117 dB @ 1 kHz, 0.00014%

AES3 OUTPUT SPECS

Formats Supported	AES/EBU (AES3) 24-bit
Interface	110 Ω transformer balanced 3.5 V Pk–Pk (nominal) into 110 Ω load 75 Ω unbalanced 1 V Pk–Pk (nominal) into 110 Ω load
Signal to Noise Ratio	22 Hz to 20 Hz – Better than -120 dB

ANALOG INPUT SPECS

Analog to Digital Conversion	24-bit
Input	Electronically Balanced
Input Impedance	2 kΩ for Mic gains* 10 kΩ for Line gains*
Sensitivity	+18 / -78 dB on Mic/Line Inputs
Equivalent Input Noise	-127 dB (150 Ω source)**
Distortion	-1 dBFS @ 1 kHz – Better than 0.006% -20 dBFS @ 1 kHz – Better than 0.003% -60 dBFS @ 1 kHz – Better than 0.3%
Frequency Response	20 Hz to 20 kHz +/- 0.5 dB on Mic/Line inputs
Input CMR (Common Mode Rejection)	>75 dB (Typical 85 dB) on Mic/Line inputs
Notes	Analog input for 0 dBFS can be pre-set globally to +28, +24, +20, +18 or +15 dBU Pre-fader headroom on mic inputs is adjustable globally from +24 to +36 dB in 2 dB steps For analog inputs/outputs the system can handle analog levels of up to +27 dBu from analog input to analog output at line up. These levels must be attenuated in the system before they are fed to digital outputs.

* The AD6057 8 x mic/line modular I/O card has a fixed input impedance of 5K

** 126dB for AD6057

ANALOG OUTPUT SPECS

Digital to Analog Conversion	24-bit
Output Balance	Electronically Balanced, 20 Hz to 20 kHz Better than -35 dB, typically -45 dB
Output Impedance	<40 Ω
Distortion	-1 dBFS @ 1 kHz – Better than 0.006% -20 dBFS @ 1kHz – Better than 0.003% -60 dBFS @ 1 kHz _ Better than 0.3%
Frequency Response	20 Hz to 20 kHz +/- 0.25 dB
Notes	Analogue output for 0 dBFS matches input setting into > 1 kΩ (+24 dBu max into 600 Ω)

AUDIO PERFORMANCE DATA

Digital to Digital (AES3) Distortion	-1 dBFS, 20 Hz to 10 kHz – Better than 0.0001%
Digital to Digital (AES3 with SRC) Distortion	-1 dBFS, 20 Hz to 10 kHz – Better than 0.0002%
Frequency Response (Digital Input to Output)	There is no filtering on digital outputs. A signal routed from digital input to output is unchanged.
Frequency Response (Analog Input to Output)	20 Hz to 20 kHz +/- 0.5 dB
Fader Off Isolation	22 Hz to 22 kHz – Better than -132 dB

SYNCHRONIZATION INPUTS

48 Hz Synchronization	NTSC/PAL Video Tri-Level Internal Crystal Reference TTL Wordclock (48 Hz) AES/EBU (AES3) Digital Input (48 kHz)

OPERATIONAL SPECIFICATION

FIGURE 1 - HYDRA2 FIXED FORMAT SPECIFICATIONS

Powering	The 1U, 2U, 3U and 4U Racks have two AC power inlets each powering an internal PSU. Although the racks will operate with one inlet supply we recommend both inlets are powered. This will ensure continued operation should a PSU or AC source fail. The operating AC supply voltage is 100V 240V +/10%. The peak inrush current is limited (cold start). Figures are available for all units. This reduces the chance of a nuisance trip or fuse blow from power up. The RMS quiescent current figures are available for all types of I/O rack.
Power Factor	All rack units have less than 75W of input power. The internal power supplies fitted have passive filtering (as opposed to active power factor correction) to reduce the harmonics to within the limits of the standard EN6100032. At the time of writing the standard does not apply to equipment <75W. If the lower limit is ever reduced the units will be compliant and as such are future proof.
Heat Output and Efficiency	The Heat output from the racks depends on the supply voltage and loading. Typically it is 0.55 times the RMS VA (Volts x Amperes) at 230V and 0.7 times the RMS VA at 115V. The heat output figures are available for all types of I/O racks. The low power PSU efficiency again is dependant on supply voltage and loading, generally >70%.
Cooling	The 2U, 3U & 4U racks keep their operating temperature under control with fan assistance. Operation is not dependant on the fan; it is there to extend the operating life of the unit. There is an 80mm low power, low speed and low noise fan mounted in the right side of the racks from front. The fan is speed monitored so if it slows down or stops a warning is given. The air intake is at the left side of the racks viewed from front and the air outtake on the right. At least 50mm (2") clearance must be maintained for these vents. The 1U I/O racks have sufficient surface area to radiate the heat out so no fan is required. Any racks may be mounted in an open bay providing the ambient air temperature is within limits (see below). The racks may also be housed in any air conditioned bay.
Operating Ambient Air Temperature	0°C 40°C
Relative Humidity	5% – 90% Noncondensing

FIGURE 2 - HYDRA2 MODULAR I/O SPECIFICATIONS

Powering	The 3U Stagebox I/O Rack has two pluggable AC-48V DC power modules fitted in the back of the unit. Each power module has four retaining screws, the screws can be released or tightened by hand or with an appropriate sized cross head or straight blade driver. Although the rack will operate with one inlet supply we recommend both inlets are powered. This will ensure continued operation should a PSU or AC source fail. When both power modules have an AC supply the load is shared. The operating AC supply voltage is 100V - 240V +/-10%. The inrush current to each power module is actively limited. At 115V the maximum current is 6.5A and at 230V the maximum current is 13A. This reduces the chance of a nuisance trip or fuse blow from power ups, dips and interruptions. The power requirement (VA) depends on the type and quantity of I/O modules fitted (up to 20 maximum). The highest it can be is 200W. The RMS quiescent current figures for a given input voltage are available for all configurations of I/O rack.
Power Factor	The internal power supplies fitted have active power factor correction to ensure the harmonics are within the limits of the standard EN61000-3-2. A good power factor brings the apparent power down closer to the real power and is more efficient. It also provides a more sinusoidal current flow with a much reduced peak magnitude in the AC distribution cables, this produces much less low frequency noise from the cables that could otherwise couple into sensitive signal paths.
Heat Output and Efficiency	The Heat output from the rack depends on the type and quantity of I/O modules fitted. The highest it can be is 185W. A good rule of thumb for these units is 0.9 x VA (RMS). The PSU efficiency is dependant on loading. The efficiency improves with more I/O modules fitted. Most configurations will be between 75 - 88%.
Cooling	The 3U rack keeps its operating temperature under control with fan assistance. Each of the two power modules has an 80mm fan mounted externally on its rear panel. The speed of the fans is under internal temperature control. Racks equipped with Mic Input and/or AES modules are lower power so the fans will run slow for use in studios etc. Racks equipped with higher density Line In/Out and/or SDI modules are higher power so the fans will run faster as required. This configuration of rack is intended for use where fan noise isn't an issue. The rack has been designed so that if an AC source or a PSU should fail, both fans will continue to run normally so the cooling is maintained. The fans are speed monitored so if one goes too slow or stops a warning is given. The air intake is at the underside of the rack but the design of the rack allows air in from the sides to the same area when mounted against a flat surface. It is essential that the rack is not mounted on anything like carpet or soft furnishings as this will restrict or block the air intake. The air outtake is directly from the fans on the rear of the unit. At least 50mm (2") clearance must be maintained for the side and rear vents. The rack may be mounted in an open bay providing the ambient air temperature is within limits (see below). The rack may also be housed in any air conditioned bay.
Operating Ambient Air Temperature	0°C - 35°C
Relative Humidity	5% – 90% Non-condensing

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