

# IQBDAC 2 Channel Audio D to A Converter



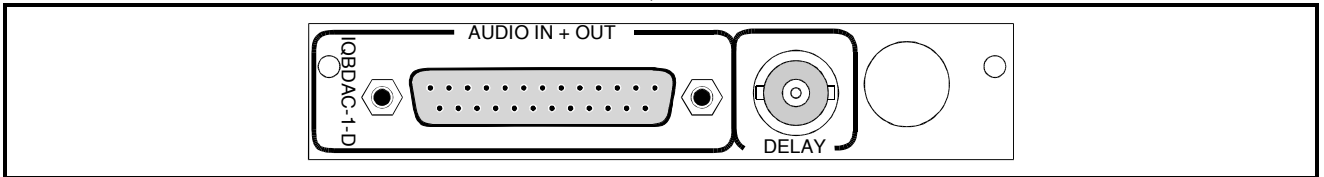
**Module Description**

The IQBDAC converts an AES/EBU audio stream into 2 analog channels with 20-bit resolution. Adjustable audio delay of up to 1.8 seconds as standard. A precision attenuator permits operation at +18, +21 or +24 dB (15, 18 or 21 dB –G

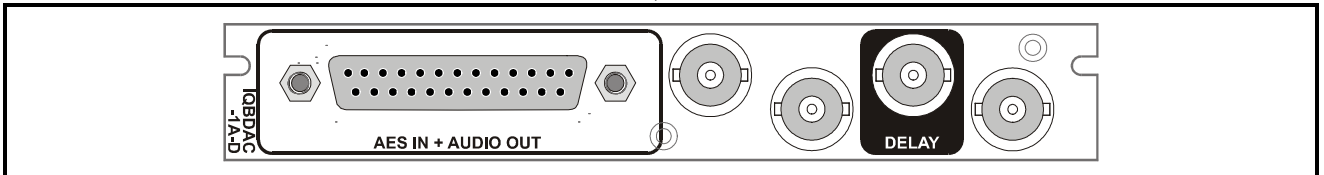
versions) Operates at sample rates of 32 kHz, 44.1 kHz or 48 kHz and a dual crystal locked PLL ensures low clock jitter.

**REAR PANEL VIEWS**

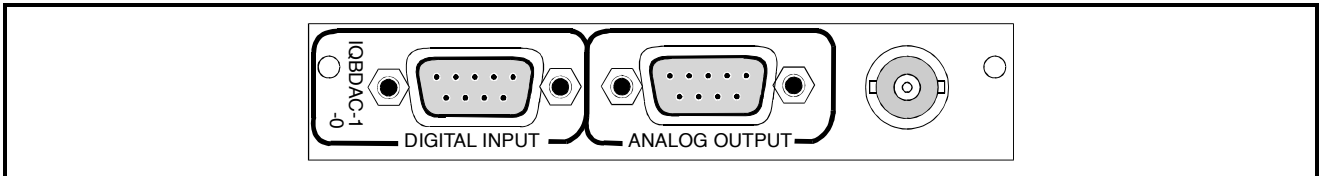
IQBDAC-1-D, IQBDAC--1-G



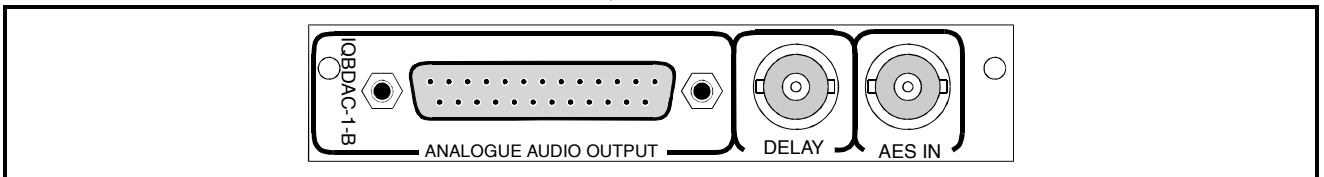
IQBDAC-1A-D, IQBDAC-1A-G



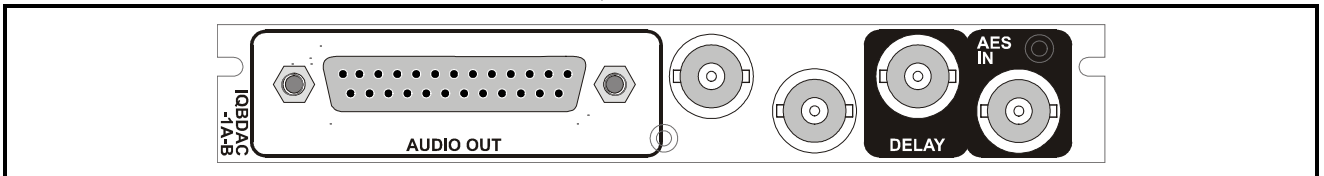
IQBDAC-1-0



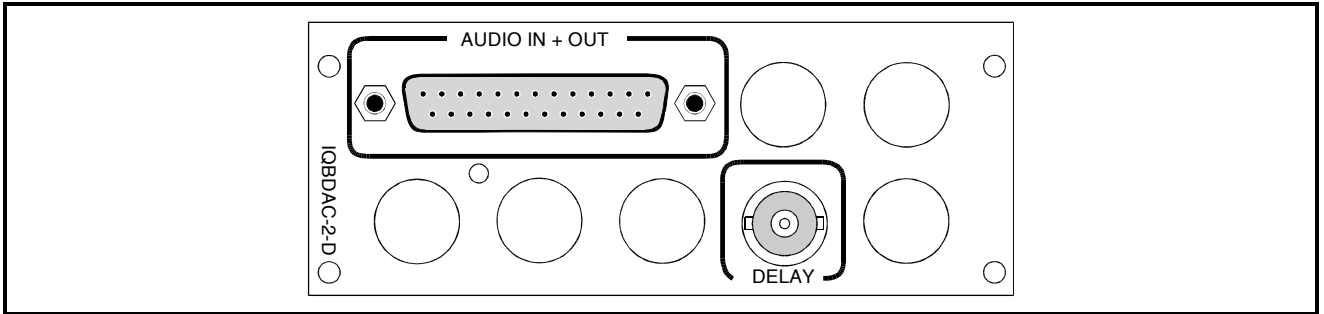
IQBDAC-1-B



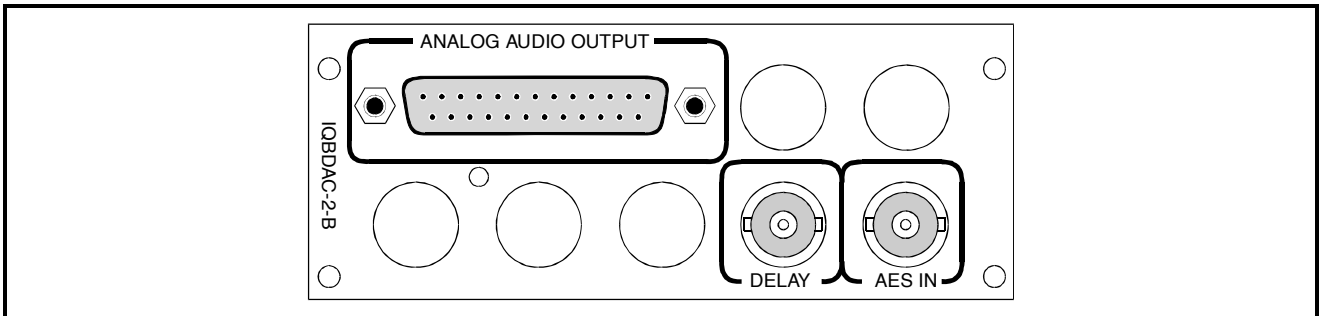
IQBDAC-1A-B



IQBDAC-2-D, IQBDAC-2-G



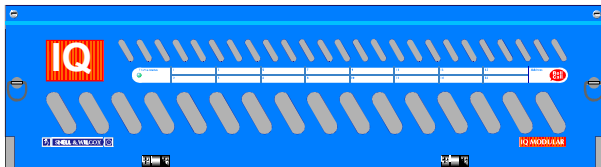
IQBDAC-2-B



**Note that there are two styles of rear panels available. They are not interchangeable between the two styles of enclosures. However, the cards may be fitted into any style of enclosure.**

**'A' Style Enclosure**

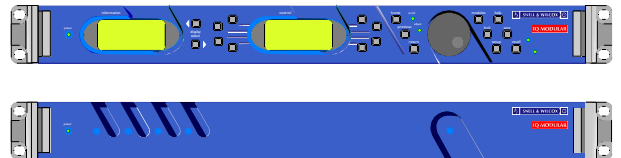
Rear panels **with** the suffix A may only be fitted into the 'A' style enclosure shown below.



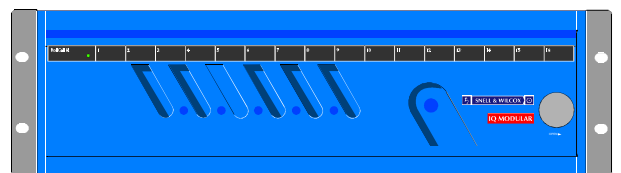
(Enclosure order codes IQH3A-E-0, IQH3A-E-P, IQH3A-0-0, IQH3A-0-P)

**'O' Style Enclosures**

Rear panels **without** the suffix A may only be fitted into the 'O' style enclosures shown below.



(Enclosure order codes IQH1S-RC-0, IQH1S-RC-AP, IQH1U-RC-0, IQH1U-RC-AP, Kudos Plus Products)



(Enclosure order codes IQH3N-0, IQH3N-P)



(Enclosure order codes IQH3U-RC-0, IQH3U-RC-P)

**This manual covers the following versions of the IQBDAC:**

IQBDAC-1-D Audio DAC (with delay), 1xDB25. Balanced AES/EBU. 2 outputs.

IQBDAC-1A-D Audio DAC (with delay), 1xDB25. Balanced AES/EBU. 2 outputs.

IQBDAC-1-0 Audio DAC (with delay), 2xDB9. Balanced AES/EBU. 1 output.

IQBDAC-1-B Audio DAC (with delay), 1xDB25 + BNC. Unbalanced AES/EBU. 2 outputs.

IQBDAC-1A-B Audio DAC (with delay), 1xDB25 + BNC. Unbalanced AES/EBU. 2 outputs.

IQBDAC-1A-G Audio DAC (with delay), 1xDB25. (Special attenuator settings). Balanced AES/EBU. 2 outputs.

**IQBDAC-2-D Audio DAC (with delay), 1xDB25 Balanced AES/EBU. 2 outputs**

**IQBDAC-2-B Audio DAC (with delay), 1xDB25 + BNC. Unbalanced AES/EBU. 2 outputs**

**IQBDAC-2-G Audio DAC (with delay), 1xDB25 Balanced AES/EBU. 2 outputs (Special attenuator settings).**

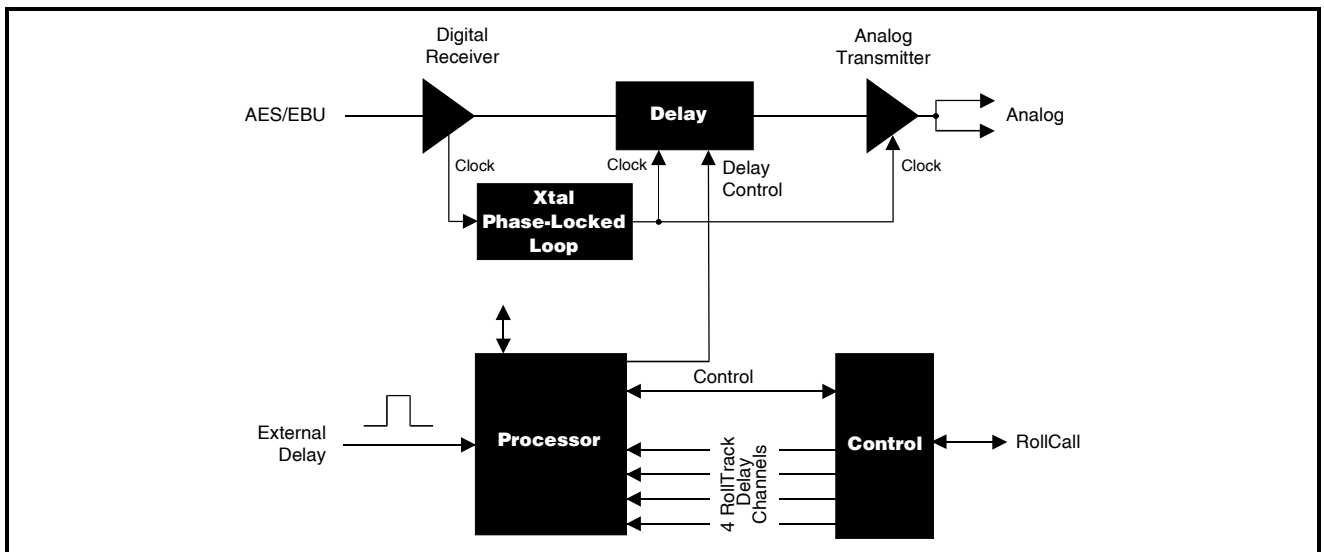
*Note that the products shown in bold are obsolete and not available anymore.*

All balanced connections made via D type connectors, all unbalanced connections made via BNC connectors, all analog inputs are balanced.

Order Code	Input	Outputs	Connector	Delay	Attenuator Settings	Width
IQBDAC-1-0	Balanced	1 Stereo	9 way D	YES	18, 21 and 24 dB	Single
IQBDAC-1-0-N	Balanced	1 Stereo	9 way D	NO	18, 21 and 24 dB	Single
IQBDAC-1-B	Unbalanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Single
IQBDAC-1-B-N	Unbalanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Single
IQBDAC-1-B-NG	Unbalanced	2 Stereo	25 way D	NO	15, 18 and 21 dB	Single
IQBDAC-1-D	Balanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Single
IQBDAC-1-D-N	Balanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Single
IQBDAC-1-G	Balanced	1 Stereo	9 way D	YES	15, 18 and 21 dB	Single
IQBDAC-1-N-G	Balanced	1 Stereo	9 way D	NO	15, 18 and 21 dB	Single
IQBDAC-1A-B	Unbalanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Single
IQBDAC-1A-B-N	Unbalanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Single
IQBDAC-1A-D	Balanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Single
IQBDAC-1A-D-N	Balanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Single
IQBDAC-1A-DNG	Balanced	2 Stereo	25 way D	NO	15, 18 and 21 dB	Single
IQBDAC-1A-G	Balanced	2 Stereo	25 way D	YES	15, 18 and 21 dB	Single
IQBDAC-1A-N-G	Balanced	2 Stereo	25 way D	NO	15, 18 and 21 dB	Single
IQBDAC-1AB-NG	Unbalanced	2 Stereo	25 way D	NO	15, 18 and 21 dB	Single
IQBDAC-2-B	Unbalanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Double
IQBDAC-2-B-N	Unbalanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Double
IQBDAC-2-D	Balanced	2 Stereo	25 way D	YES	18, 21 and 24 dB	Double
IQBDAC-2-D-N	Balanced	2 Stereo	25 way D	NO	18, 21 and 24 dB	Double
IQBDAC-2-G	Balanced	2 Stereo	25 way D	YES	15, 18 and 21 dB	Double
IQBDAC-2-N-G	Balanced	2 Stereo	25 way D	NO	15, 18 and 21 dB	Double

**Note: All balanced connections made via D type connectors, all unbalanced connections made via BNC connectors, all analog inputs are balanced.**

## BLOCK DIAGRAM



## Features

- 20-bit sampling resolution
- Two (1st output repeated) stereo pair balanced outputs (25D rear only)
- Operates at 32, 44.1 and 48 kHz
- Up to 1.8 seconds of delay (at 48 kHz), adjustable in 1 ms steps via RollCall
- Headroom set to +18, +21 or +24 dBu (15, 18 and 21 dBu –G versions)
- Dual PLL design for low jitter
- Delay may be programmed to change only during "silence"
- Overflow indication
- Full RollCall remote control permits RollTrack automatic delay tracking

## TECHNICAL PROFILE

**Features****Signal Inputs**

Digital.....	2 Channels (1 Stereo Pair) 1 Balanced AES/EBU Channel (-D Versions)
Delay .....	1 Via BNC (-D, -B Versions)
Standards .....	AES3-1992

**Signal Outputs**

Analog .....	2 x 2 Channels (2 Stereo Pairs) 1 Channel (1 Stereo Pair, -0 Versions)
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**Card Edge Controls (also available via RollCall)**

Analog Attenuator .....	3 Ranges
Delay Time.....	0.01 s to 1.8 s in increments of 0.01 s
Mute.....	On/Off

**Functions Available via RollCall™ Only**

Reporting Digital Input Presence
Logging Digital Input Sample Rate Overflow

**Specifications**

Digital Input (Balanced).....	Level 0.2 V to 7 V pk to pk into 110 ohms Cable length greater than 150 m (Using 110 ohm AES recommended cable)
Digital Input (Unbalanced).....	Cable length greater than 500 m of RG59 or equivalent
Headroom Ranges .....	18 dBu (8.8 V pk to pk) 21 dBu (12.3 V pk to pk) 24 dBu (17.5 V pk to pk) (15, 18 and 21 dB -G versions)
Digital Path .....	32 kHz, 44.1 kHz and 48 kHz 20-bit
Analog Output Impedance ..	50 ohms

Total Harmonic Distortion + Noise	Less than 0.004% at 700 Hz and -1 dBFs
Noise Floor.....	Better than -101 dBFs (20 Hz to 20 kHz)
Channel Amplitude Matching	Better than ±0.1 dBu
Output Level Accuracy .....	Better than ±0.2 dBu
Flatness .....	Better than +0.1 dBu to -0.2 dBu (20 Hz to 20 kHz with reference to 1 kHz)

**Power Consumption**

Module Power Consumption	5.8 W max
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**Performance Information**

Standards .....	EN55103-1:1996 (Environment E2) EN55103-2:1996 (Environment E2) FCC Part 15, Class A (Verification)
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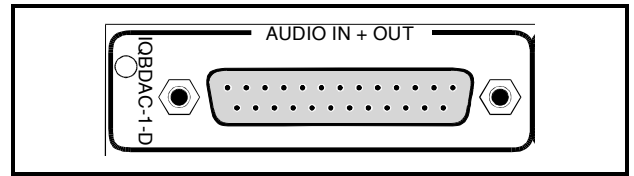
Inrush Current .....	Please refer to IQ Modular Box manual
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Performance Degradation:	Immunity to conducted common-mode RF interference (EN 55103-2 immunity phenomenon 16): When the balanced audio input is subjected to modulated RF interference at a level of 1 V, audio interference may be present at the audio output.
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INPUT AND OUTPUTS

-D Versions

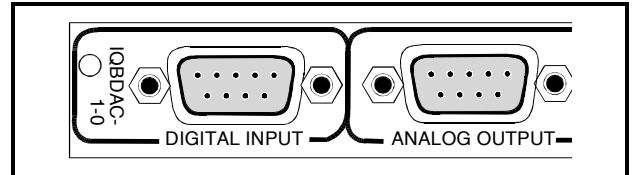
All digital and analogue input and output connections are made via this 25 way female D-type connector.



For connection data consult the tables on page 7.

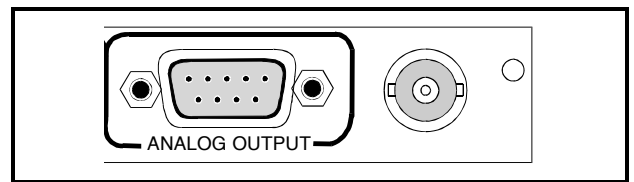
-0 Versions

All digital and analogue input and output connections are made via 9 way female D-type connectors.



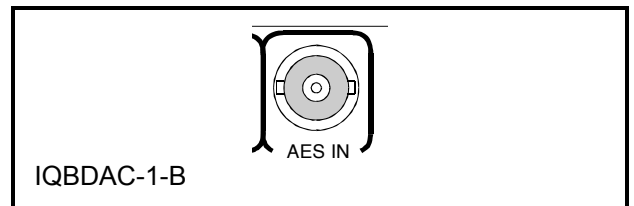
*Note that the BNC connector on this panel has no function.*

For connection data consult the tables on page 7.



-B Versions

This BNC connector accepts an unbalanced AES input.



Delay Input

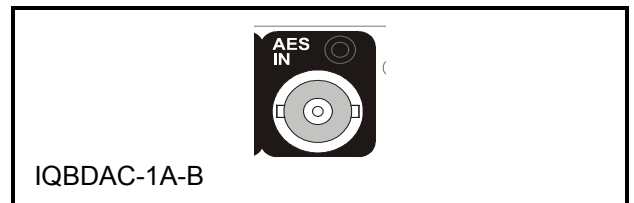
The input/output signal delay time may be set manually using the card edge control, via RollCall™ or may be set by a signal applied to this connector which signal should be a TTL compatible signal.

The audio will be delayed for a period equal to the duration that this signal. Either active positive or negative may be selected from the menu system.

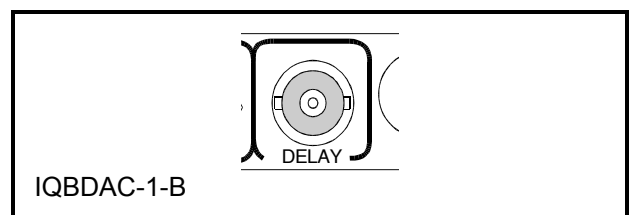
*Note that if no pulse is detected the delay will be set to 0 ms.*

To activate audio delay control from this input it should be selected directly via RollCall™

For more information see Appendix on page 19.



*Note that any other connectors on these modules have no function and connections should not be made to them.*



## Connection Details

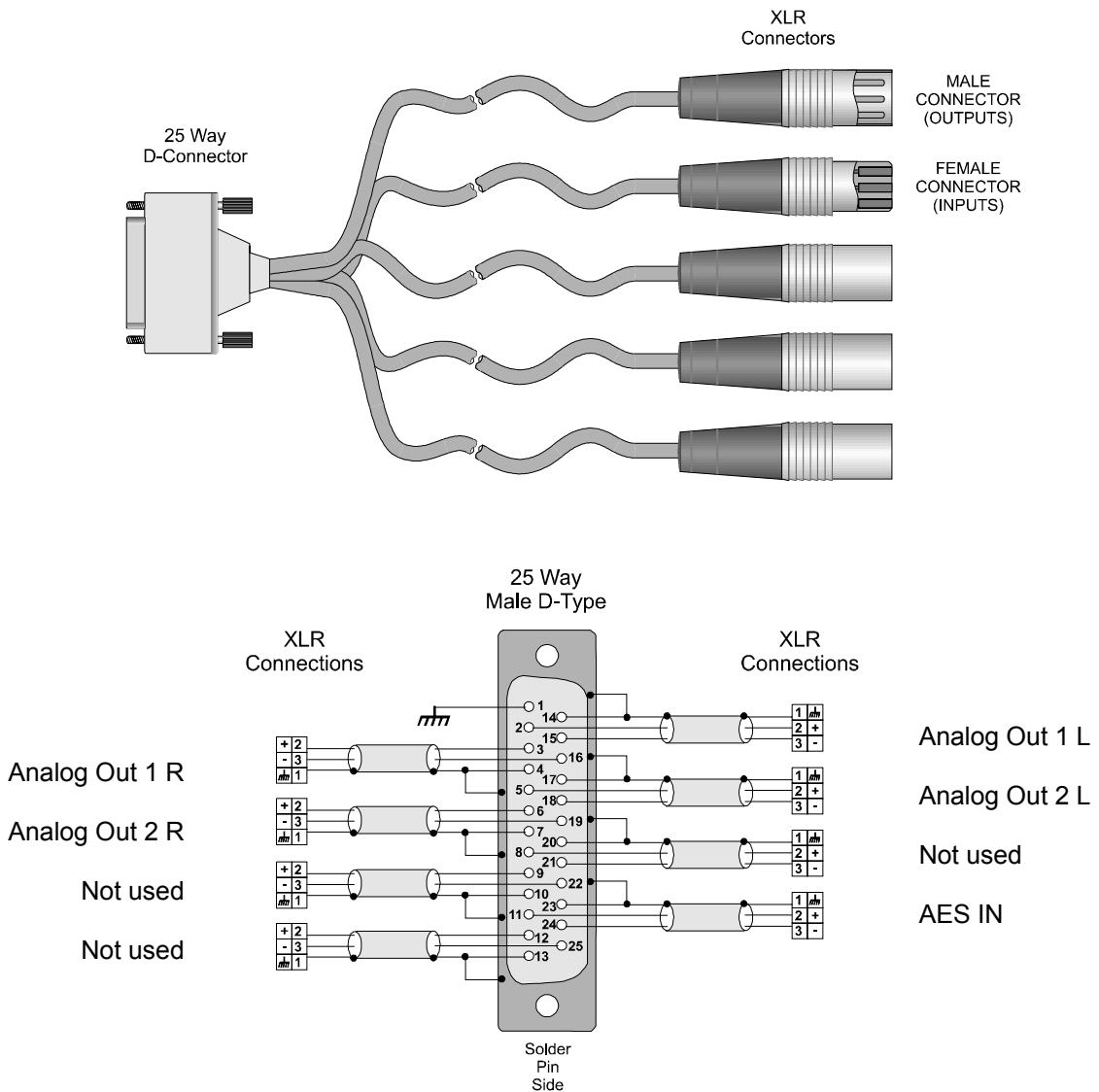
25 Way D Connector Pin Number	Description	Ribbon Cable Strand Number	Standard Pin Assignment
1		1	CHASSIS
14		2	GND1
2	ANALOG OUT 1 Left+	3	1+
15	ANALOG OUT 1 Left-	4	1-
3	ANALOG OUT 1 Right+	5	2+
16	ANALOG OUT 1 Right-	6	2-
4		7	GND2
17		8	GND3
5	ANALOG OUT 2 Left+	9	3+
18	ANALOG OUT 2 Left-	10	3-
6	ANALOG OUT 2 Right+	11	4+
19	ANALOG OUT 2 Right-	12	4-
7		13	GND4 (CH)
20		14	GND5
8		15	5+
21		16	5-
9		17	6+
22		18	6-
10		19	GND6
23		20	GND7
11	AES IN +	21	7+
24	AES IN -	22	7-
12		23	8+
25		24	8-
13		25	GND8

*Note: When assembling cables connect pin 13 of the D-Type to pin 7 of the D-Type to ensure the signal ground and chassis ground are connected.*

9 Way D Connector Pin Number	Description	Ribbon Cable Strand Number	Standard Pin Assignment
<b>INPUT:</b>			
1		1	CH
6	DIGITAL IN GND	2	GND1
2	AES IN +	3	1+
7	AES IN -	4	1-
3		5	2+
8		6	2-
4		7	GND2
9		8	CH
5		9	CH
<b>OUTPUT:</b>			
1		1	CH
6	ANALOG OUT 1 Left GND	2	GND1
2	ANALOG OUT 1 Left +	3	1+
7	ANALOG OUT 1 Left -	4	1-
3	ANALOG OUT 2 Right +	5	2+
8	ANALOG OUT 2 Right -	6	2-
4	ANALOG OUT 2 Right GND	7	GND2
9		8	CH
5		9	CH

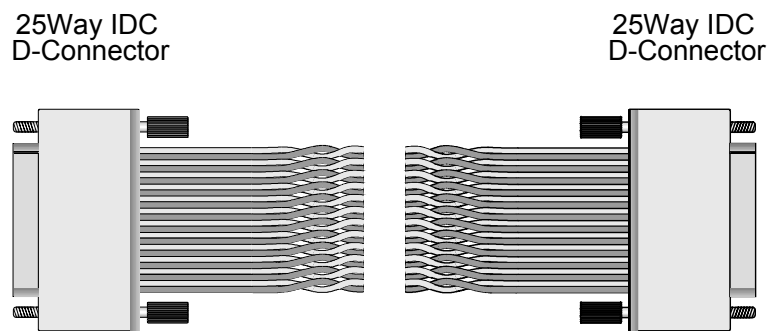


Connection Details to XLR Connectors

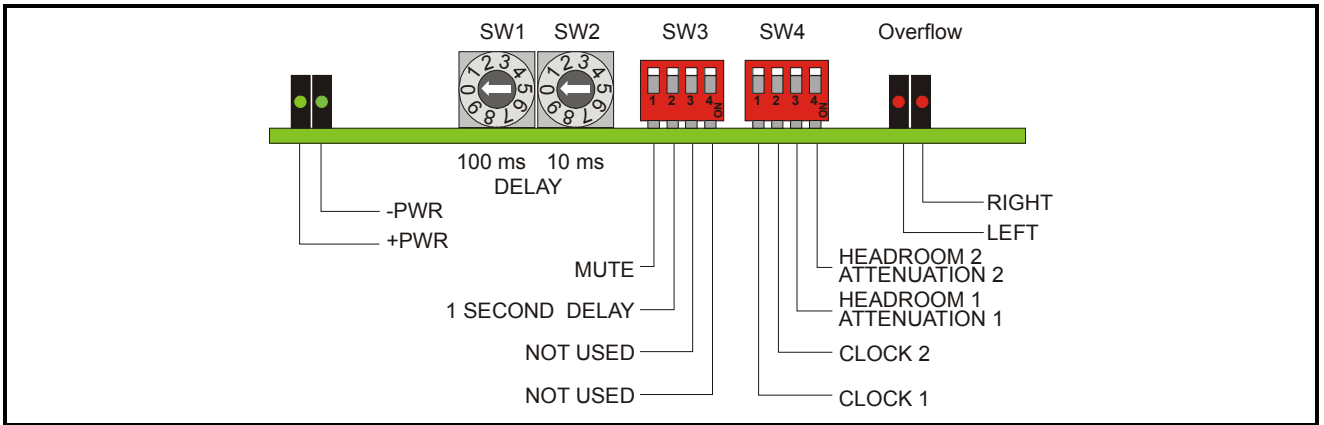


Note: When assembling cables connect pin 13 of the D-Type to pin 7 of the D-Type to ensure the signal ground and chassis ground are connected.

Connection Details via IDC connectors



CARD EDGE CONTROLS (IQBDAC)



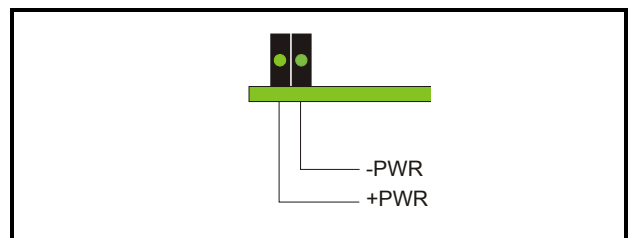
Adjustment of the settings of the **IQBDAC** is available either via card edge controls and/or via a more comprehensive remote control system using RollCall™

Note that the availability of some of the card edge controls will depend on the card version; see feature table for variations.

LED INDICATORS

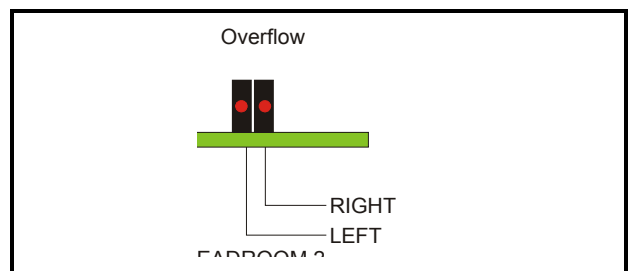
**Power**

These two indicators are illuminated when the positive and negative supplies are present.



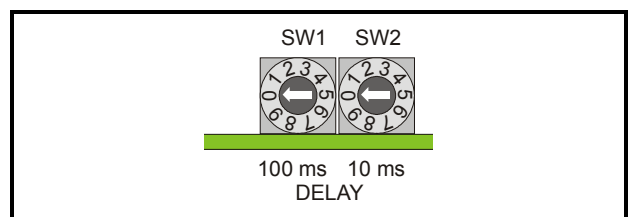
**Overflow**

These three indicators are illuminated when the peak digital value is detected on the Right and Left channels.



**Delay**

These two switches allow the delay period to be manually set. One switch adjusts the time in increments of 100 ms and the other in increments of 10 ms.



SW3

Setting to the down (ON) position enables the function.

- Position 1            Enables the Mute function
- Position 2            Increases delay by 1 second

SW4

This switch has two modes of operation:

1. When the total delay (*physically* set by SW1/SW2 and the 1 second delay of SW3 position 2) is less than 1900 ms, positions 3 and 4 will allow **Attenuation** settings to be made.

Attenuation	Position 3	Position 4
18 dBu	ON	ON
21 dBu	ON	OFF
24 dBu	OFF	ON
18 dBu	OFF	OFF

-G Versions Only

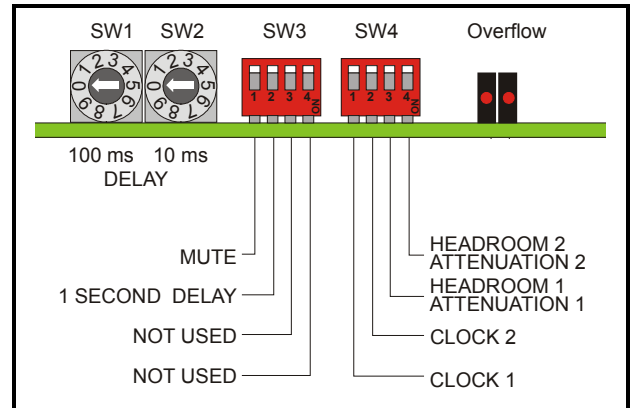
Attenuation	Position 3	Position 4
15 dBu	ON	ON
21 dBu	ON	OFF
21 dBu	OFF	ON
15 dBu	OFF	OFF

2. When the total delay (*physically* set by SW1 and SW2 plus the 1 second delay enabled by SW3 position 2) is greater than 1900 ms, SW4 positions 2, 3 and 4 will allow **delay** selections to be made.

- Position 2            Selects Manual Delay
- Position 3            Selects RollTrack Delay
- Position 4            Selects External Delay

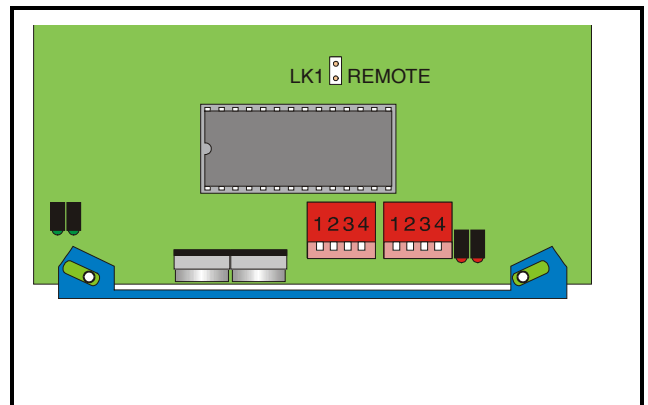
Any additive combination of positions 2, 3 and 4 may be used.

**Note that when setting the delay greater than 1900 ms with SW1 and SW2, the display will show a maximum of 1900 ms, not over 1900 ms.**

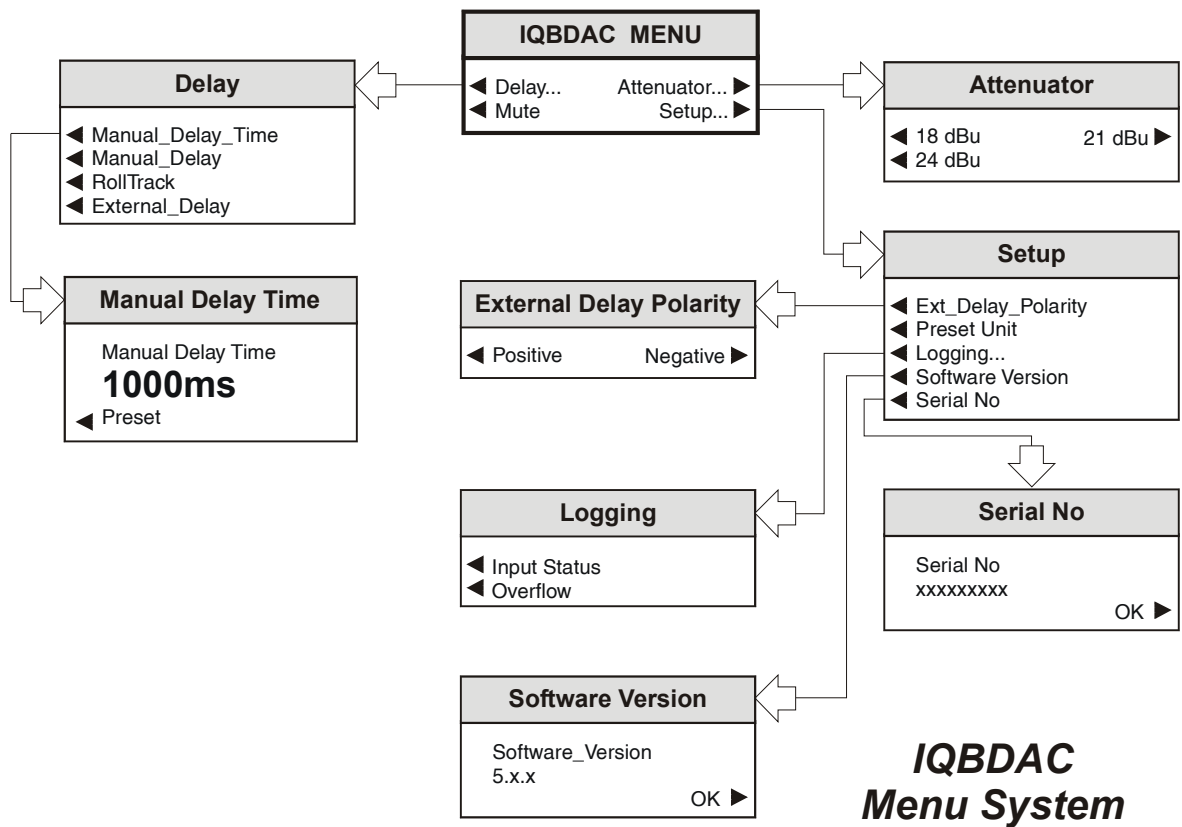


LK1 REMOTE

*Note that the unit will respond to both local and remote control, one system overriding the settings of the other. For cards using the RollCall™ remote control system, activating SW3 and SW4 will override the remote control settings. The RollCall™ control panel will then follow these selections.*



Note that in Mainframes where RollCall™ is not available the link LK1 (Remote) located near the front of the card, should be set to the OFF (unconnected) position. This ensures that when the unit is powered-up the factory default settings of parameters not available as card edge adjustments, are loaded. With the link in the ON (connected) position card will power-up with the last settings sent by the remote control panel.



## OPERATION FROM AN ACTIVE CONTROL PANEL

The card may be operated with an active control panel via the RollCall™ network.

The menus available for this card are shown on the previous page and will appear in the Control display window.

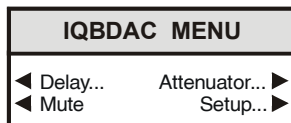
Operational details for the remote control panel will be found in SECTION 1 of the Modular System Operator's Manual.

**MENU DETAILS**

(see IQBDAC Menu System Drawing)

## MAIN MENU

The main, or top level menu allows various sub-menus to be selected by pressing the button adjacent to the required text line.

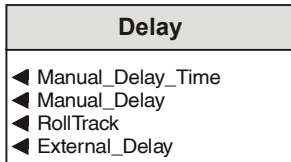


Note that where a menu item is followed by three dots (...) this indicates that a further sub-menu may be selected.

Whenever a menu item is selected the parameters of that selection will be displayed in the Information window of the front panel. Where the selection is purely a mode selection and does not enable a sub-menu, the text will become reversed (white-on-black) indicating that the mode is active. If the mode is not available for selection the text will remain normal.

◀ **Delay N**

This selection enables a sub-menu that allows the delay source and the delay between the input signal and the output signal to be set.



The total delay time will be the sum of the *enabled delay functions*.

Any of the following may be selected:

- Nothing checked ..... No delay
- Manual delay ..... Manual delay only
- External delay ..... External delay only
- RollTrack ..... RollTrack delay only

The following combinations may also be used:

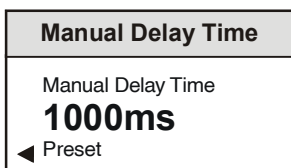
- Manual delay + RollTrack delay
- Manual delay + External delay
- RollTrack delay + External delay
- Manual delay + RollTrack delay + External delay

Preset is to Manual.

◀ **Manual\_Delay\_Time** (not on -N Versions)

The spinwheel is used to adjust the delay time when this function is enabled. The time will be shown as a numerical value and by the bargraph display.

*Note that when the audio delay is being controlled remotely the bargraph will indicate the current delay setting.*



The range of adjustment is ±1800 ms in increments of 1 ms.

The preset value is 0 ms.

◀ **Manual Delay**

This selection allows the manual delay time to be set using the Manual Delay Time function or the card edge controls.

◀ **RollTrack**

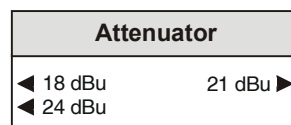
When this function is selected the delay time is set to the Manual value **plus** the value received via the RollTrack system on channels 14+15+16+17.

Data is transmitted at regular intervals from a RollTrack compatible device but if data is not received by this unit from a channel within 60 seconds, the delay time for that channel will assume a value of zero.

◀ **External Delay**

This selection allows an external TTL signal connected to the 'Delay' BNC to set the delay. This function can be set to respond to either a positive (active high) or negative (active low) pulse. Use the Ext Delay Polarity function in the Set-up menu to select polarity.

◀ **Attenuator**



This sub-menu allows the headroom to be set to 18 dBu, 21 dBu and 24 dBu. Preset is to 18 dBu.

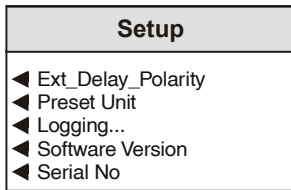
(15, 18 and 21dBu –G versions)

◀ **Mute**

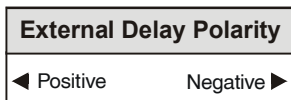
The output signal will be muted when this toggle ON/OFF function is used.

**Setup ▶**

This selection reveals a sub-menu that allows various functions to be set.



**◀ Ext Delay Polarity**



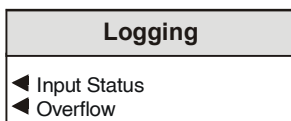
This selection allows the polarity of the external TTL signal connected to the `Delay` BNC to be selected as responding to either a positive (active high) or negative (active low) pulse.

**◀ Preset Unit**

Selecting this item sets all adjustment functions that include a prset facility, to their preset values. Note that this is a momentary action and the text will not become reversed

**◀ Logging**

If a logging device is attached to the RollCall™ network, information about various parameters will be reported to the logging device assigned in the Remote Control Interface system.



The parameters that may be selected for logging are as follows:

- Input Status
- Overflow

**◀ Software Version**

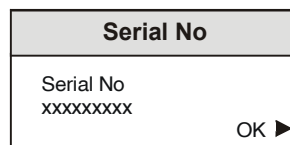
Selecting this item reveals a display showing the version of the software fitted in the module.



Select OK to return to the System Menu.

**◀ Serial Number**

Selecting this item reveals a display showing the serial number of the module.



Select OK to return to the System Menu.

**RollCall PC Control Panel Screens for the IQBDAC**

**Control**

This screen contains the main controls for the unit.

**Mute**

The output signal will be muted when this toggle function is used.

**Attenuator**

This item allows the headroom to be set to 18 dBu, 21 dBu and 24 dBu.

Preset is to 18 dBu.

**Delay (not on -N Versions)**

This item allows the delay source to be selected.

The total delay time will be the sum of the *enabled delay items*.

Any of the following may be selected, by means of checkboxes:

- Nothing checked ..... No delay
- Manual ..... Manual delay only
- External delay..... External delay only
- RollTrack ..... RollTrack delay only

The following combinations may also be used:

- Manual delay + RollTrack delay
- Manual delay + External delay
- RollTrack delay + External delay
- Manual delay + RollTrack delay + External delay


Preset is to Manual.

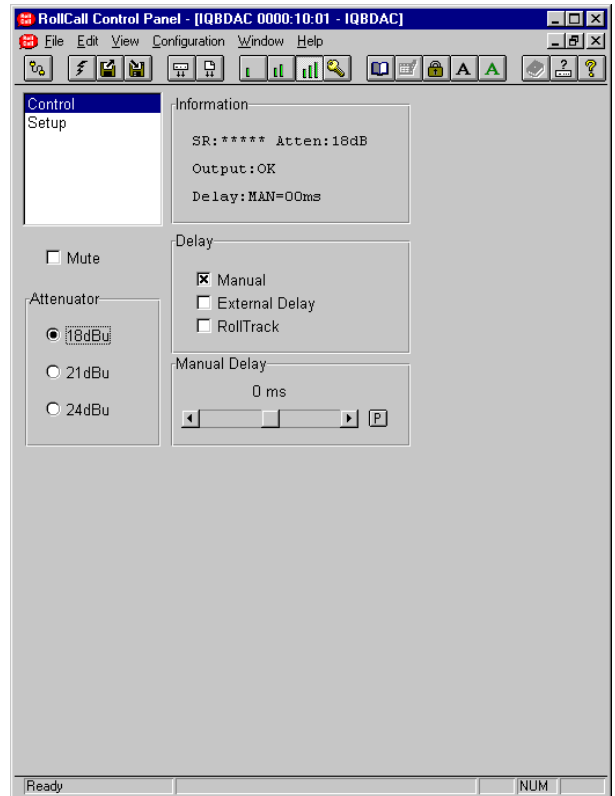
**Manual Delay**

The scrollbar may be used to adjust the delay time when this function is enabled. The time in milliseconds will be shown as a numerical value above the scroll bar

*Note that when the audio delay is being controlled remotely the delay will be indicated here.*

The range of adjustment is  $\pm 1800$  ms in increments of 1 ms.

Selecting Preset  will return to the preset value of 0 ms.





**Setup**

**Logging**

If a logging device is attached to the RollCall™ network, information about the selected item will be reported to the logging device assigned in the Remote Control Interface system.

**Software Version**

This item shows the version of the software fitted in the module followed by the serial number of the module.

**External Delay Polarity**

This item allows the polarity of the external TTL signal connected to the `Delay` BNC to be selected as responding to either a positive (active high) or negative (active low) pulse.

**Preset Unit**

Selecting this item sets all adjustment functions that include a preset facility, to their preset values.

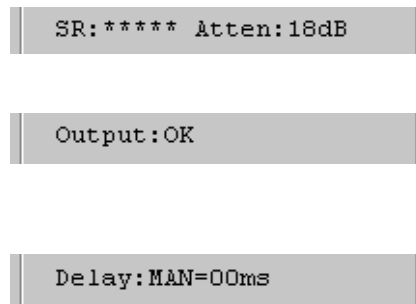
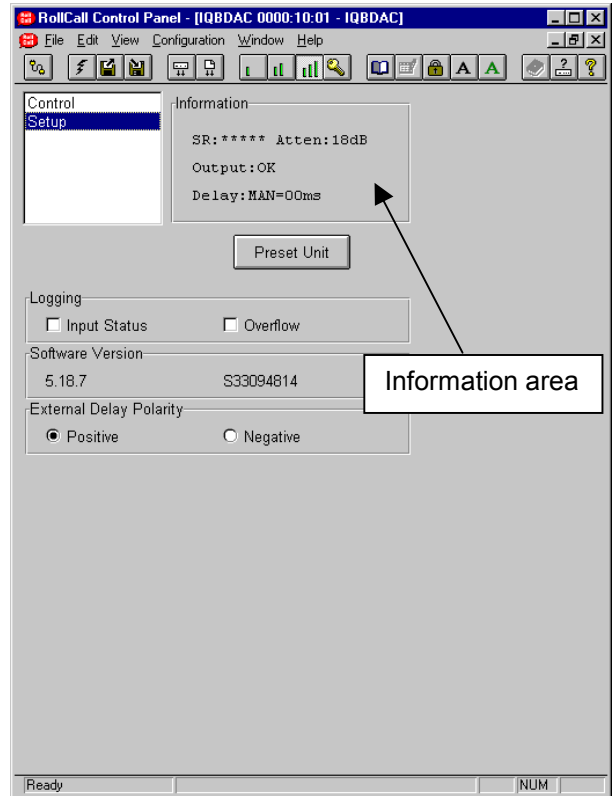
**Information Area**

This area shows the status of the unit in an abbreviated form.

The first line shows the internal sample rate (SR) and the selected value of attenuation.

The second line shows the state of the output.

The third line shows the delay source(s) selected and the delay time in milliseconds.



## Appendix

### Delay Function

In addition, by *physically* selecting a total delay of 1900 ms or greater on the front switches, the attenuation select switches SW4 positions 2, 3 and 4, change their operation to become "Manual delay", "RollTrack delay" and "External delay" on/off selection respectively.

Only when any of these switches are moved, their settings are latched into memory (so accidentally cycling through a delay of 1900 ms will not change the delay selection).

When the delay is set back to a value of 1800 ms or less the switches resume their normal operation of attenuation selection.

## RollTrack Audio Delay Tracking

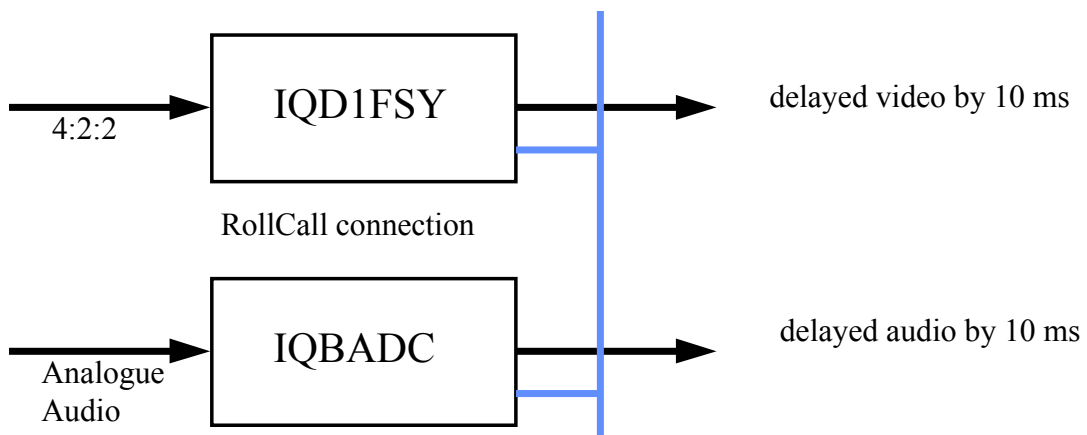
RollTrack is a feature of RollCall™ (Snell & Wilcox’s proprietary remote control system), that allows devices to communicate across the RollCall network with no direct user intervention.

RollTrack Audio Delay Tracking enables Snell & Wilcox RollCall™ compatible audio delay products to track delay introduced by RollCall™ compatible video processing products.

The current products that implement RollTrack Audio Delay Tracking are:

Audio Delay Modules	Video Modules	Other Products	
IQBAAD	IQD1FSY	ALCHEMIST	MDD3000
IQBADC	IQDMSDS	CPP100	MDD550
IQBDAC	IQDAFS	CPP200	MDD560
IQBDAD	IQDMSDS	NRS500	MDD570
IQBSYN	IQDMSDP	HD5050	MDD2000
IQBADCD	IQDSYN		

The simplest configuration is a single video unit and a single audio delay in a RollCall™ system. The audio delay will have the same delay as through the video path. If the delay changes the audio delay will track.



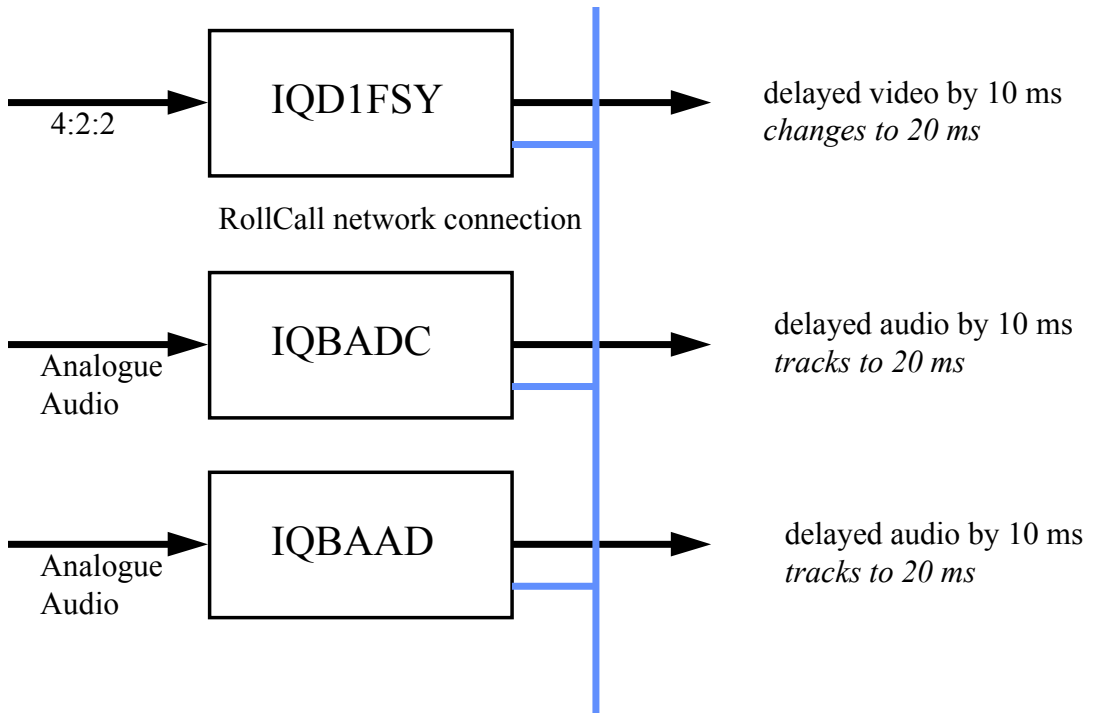
The next level of configuration is where there are multiple Frame Synchronizers (for example) each connected through RollCall™ to their own tracking Audio Delay. (It is worth stating that the synchronizers and audio delays do not have to be in the same enclosure; the addressing scheme, discussed later, allows for the units to be positioned anywhere in the RollCall™ domain.)

The maximum number of video units and audio delays in a RollCall™ system is set by the maximum limit of the number of modules in a RollCall™ network and is currently 3840 on a single network without bridges.

The unique identification of the destination unit (a decimal number) for various modules is as follows:

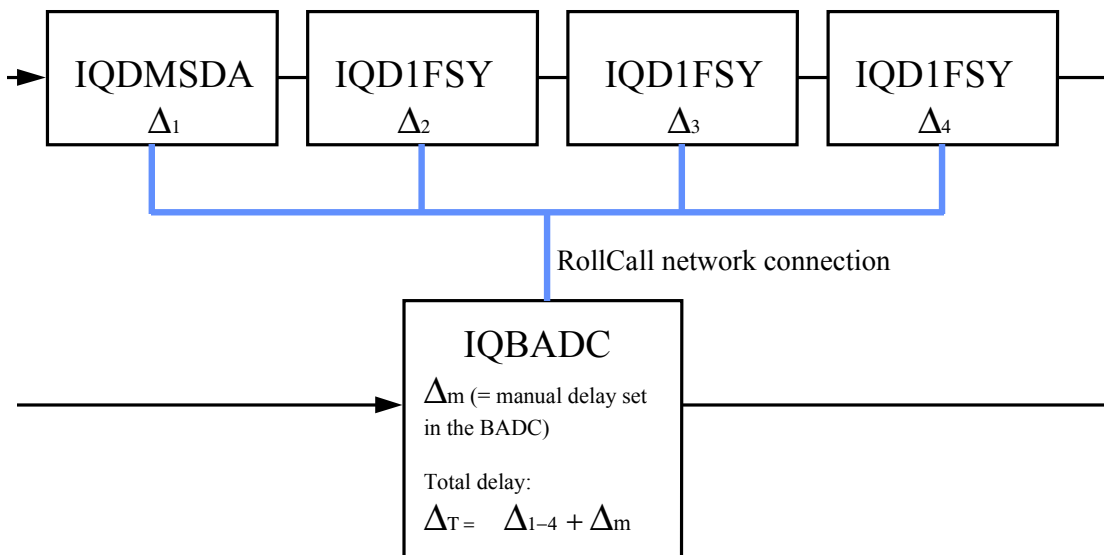
Module	ID
IQBADC	51
IQBDAC	52
IQBAAD	53
IQBDAD	54
IQBSYN	89
<b>IQBADCD</b>	<b>107</b>

The next level of complexity is a *vertical delay cluster* where a video unit can have up to eight audio delays tracking - of the same or different types.



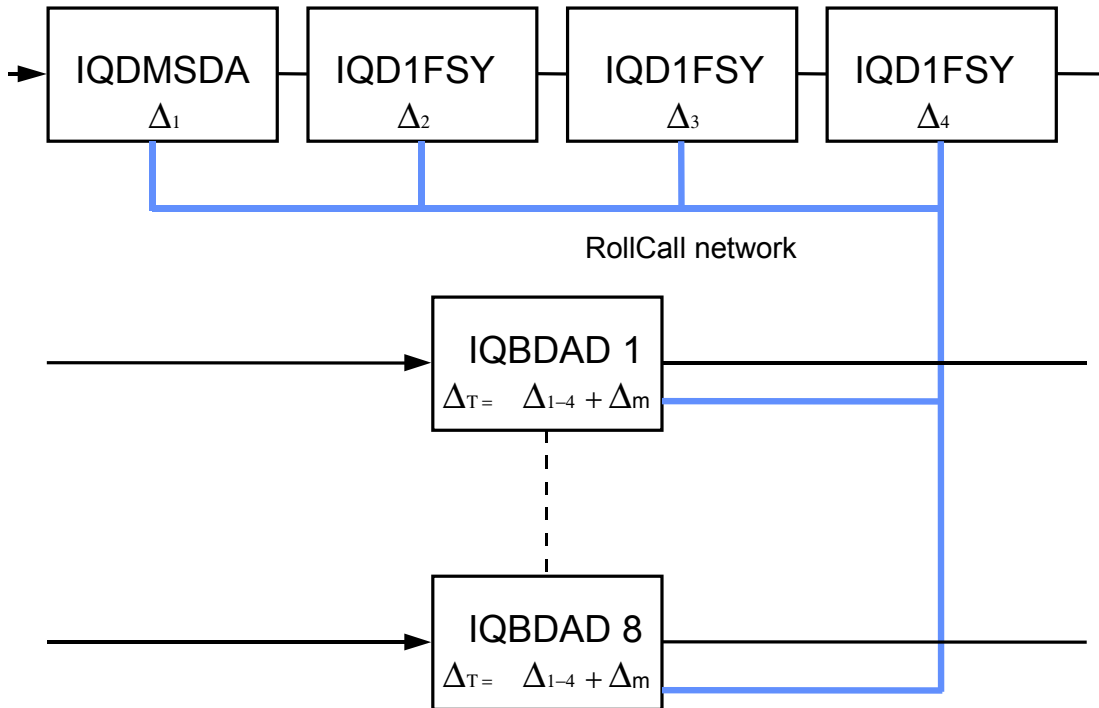
From one to eight audio delay products can be connected via RollCall™ to a single frame synchronizer, for example. If the synchronizer delay changes, then however many audio delays are connected will track the delay. The audio delays can also have a manual delay which will be added to the RollTrack delay.

The next level of complexity is a *horizontal delay cluster* where an audio delay can track up to four video units.



The total delay time through the audio delay is then the sum of the individual delays introduced by the video units plus the manual delay of the audio unit. The manual delay can be set to compensate for any fixed propagation delay in the video path or may be set to zero.

The next level of complexity is a *matrix delay cluster* where each audio delay (up to eight) can track up to four video units. This configuration is in effect a four by eight matrix of video units and audio delay units. The total delay time through the audio delay units is then the sum of the individual delays introduced by the video units plus the manual delay of the audio unit.



As any of the delay times change in the video path so will the audio delay time track this delay. A virtual connection is made between from, say, an IQD1FSY to an IQBDAD by:

- selecting the *Setup...* Menu of the IQD1FSY
- then selecting the *Audio\_Delay...* Menu
- then choosing from *Unit\_1* to *Unit\_8*
- then entering the unique network address of the IQBDAD in the form *nnnn:xx:yy\*z\*d*
- where *nnnn* = network address and in most cases will be 0000(hex);
- xx* = IQ enclosure address (hex);
- yy* = slot address of the IQBDAD (hex)
- z* = the connection (or channel) number (decimal) - see table below.
- d* = the unique identification of the destination unit (decimal) The ID entered must match the receiving units own ID or else the command will be ignored. If the ID value is set to 00, the receiving unit does not perform an ID match and will always accept the incoming command
- then selecting the *Delay...* Menu of the IQBDAD
- then selecting *RollTrack*

Example of Network Addresses with Channel Numbers and ID Numbers

	D1FSY 1	D1FSY 2	D1FSY 3	D1FSY 4
<b>Audio delay 1</b>	0000:10:01*14*54	0000:10:01*15*54	0000:10:01*16*54	0000:10:01*17*54
<b>Audio delay 2</b>	0000:10:03*14*54	0000:10:03*15*54	0000:10:03*16*54	0000:10:03*17*54
<b>Audio delay 3</b>	0000:10:05*14*54	0000:10:05*15*54	0000:10:05*16*54	0000:10:05*17*54
<b>Audio delay 4</b>	0000:10:07*14*54	0000:10:07*15*54	0000:10:07*16*54	0000:10:07*17*54
<b>Audio delay 5</b>	0000:10:09*14*54	0000:10:09*15*54	0000:10:09*16*54	0000:10:09*17*54
<b>Audio delay 6</b>	0000:10:0B*14*54	0000:10:0B*15*54	0000:10:0B*16*54	0000:10:0B*17*54
<b>Audio delay 7</b>	0000:10:0D*14*54	0000:10:0D*15*54	0000:10:0D*16*54	0000:10:0D*17*54
<b>Audio delay 8</b>	0000:10:0F*14*54	0000:10:0F*15*54	0000:10:0F*16*54	0000:10:0F*17*54

The most complex system would be an array of matrix delay clusters

