Quad speed ADD-ON

ADD-ON Card

SYNAPSE

ADC44-ADC48

4 or 8 channel audio A/D converter with analog and AES/EBU outputs

Installation and operation manual

Original manual V1.0

Preface

- ALWAYS disconnect your entire system from the AC mains before cleaning any component. The product frame (SFR18, SFR08 or SFR04) must be terminated with three-conductor AC mains power cord that includes an earth ground connection. To prevent shock hazard, all three connections must always be used.
- NEVER use flammable or combustible chemicals for cleaning components.
- NEVER operate this product if any cover is removed.
- NEVER wet the inside of this product with any liquid.
- NEVER pour or spill liquids directly onto this unit.
- NEVER block airflow through ventilation slots.
- NEVER bypass any fuse.
- NEVER replace any fuse with a value or type other than those specified.
- NEVER attempt to repair this product. If a problem occurs, contact your local Axon distributor.
- NEVER expose this product to extremely high or low temperatures.
- NEVER operate this product in an explosive atmosphere.

Warranty: Axon warrants their products according to the warranty policy as described in the general terms. That means that Axon Digital Design BV can only warrant the products as long as the serial numbers are not removed.

Date created:	21-06-2017
Date last revised:	21-06-2017

This product complies with the requirements of the product family standards for audio, video, audio-visual entertainment lighting control apparatus for professional use as mentioned below.

CE	EN60950	Safety
	EN55103-1: 1996	Emission
	EN55103-2: 1996	Immunity

Axon Digital Design B.V. ADC44-ADC48 FC Tested To Comply With FCC Standards FOR HOME OR OFFICE USE	This device complies with part 15 of the FCC Rules Operation is subject to the following two conditions: **1.** This device may cause harmful interference, and **2.** This device must accept any interference received, including interference that may cause undesired operation.

Contents

1 Introduction to Synapse

An Introduction to Synapse

Synapse is a modular system designed for the broadcast industry. High density, intuitive operation and high quality processing are key features of this system. Synapse offers a full range of converters and processing modules. Please visit the AXON Digital Design Website at *www.axon.tv* to obtain the latest information on our new products and updates.

Local control Panel

The local control panel gives access to all adjustable parameters and provides status information for any of the cards in the Synapse frame, including the Synapse rack controller. The local control panel is also used to back-up and restore card settings. Please refer to the rack controller manuals for a detailed description of the local control panel, the way to set-up remote control over IP and for frame related settings and status information.

Remote Control Capabilities

The remote control options are explained in the rack controller manual. The method of connection to a computer using Ethernet is described in the ERC/ERS/RRC/RRS manual.

"AXON CORTEX" SOFTWARE WILL INCREASE SYSTEM FLEXIBILITY OF ONE OR MORE SYNAPSE FRAMES

Although not required to use Cortex with a Synapse frame, you are strongly advised to use a remote personal computer or laptop PC with Axon Cortex installed, as this increases the ease of use and understanding of the modules.

2 Unpacking and Placement

Unpacking

The Axon Synapse card must be unpacked in an anti-static environment. Care must be taken NOT to touch components on the card – always handle the card carefully by the edges. The card must be stored and shipped in anti-static packaging. Ensuring that these precautions are followed will prevent premature failure from components mounted on the board.

Placing the card

The Synapse card can be placed vertically in an SFR18 frame or horizontally in an SFR04 and SFR08 frame. Locate the two guide slots to be used, slide in the mounted circuit board, and push it firmly to locate the connectors.

Correct insertion of card is essential as a card that is not located properly may show valid indicators, but does not function correctly.

On power up all LED's will light for a few seconds, this is the time it takes to initialise the card.

3 A Quick start

When Powering-up

On powering up the Synapse frame, all settings of the card will be set to the default state. All LED's will light during this process. After initialisation, several LED's will remain lit – the exact number and configuration is dependent upon the number of inputs connected and the status of the inputs.

Changing settings and parameters

The front panel controls or the Axon Cortex can be used to change settings. An overview of the settings can be found in chapter 5, 6 and 7 of this manual.

Front Panel Control

Front Panel Display and Cursor

Settings are displayed and changed as follows;

Use the cursor 'arrows' on the front panel to select the menu and parameter to be displayed and/or changed.

Press ►	To go forward through the menu structure.
Press ◄	To go back through the menu structure.
Press ▲	To move up within a menu or increase the value of a parameter.
Press ▼	To move down through a menu or decrease the value of a parameter.

Whilst editing a setting, pressing ► twice will reset the value to its default.

Example of changing parameters using front panel control

With the display as shown below

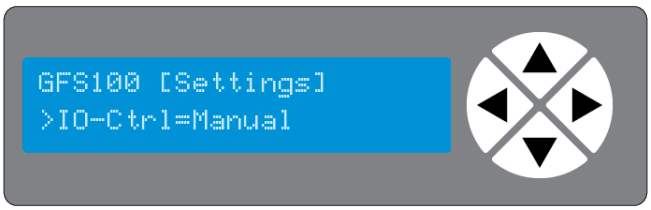
Pressing the ► selects the GFS100 in frame slot 01.

The display changes to indicate that the GFS100 has been selected. In this example the Settings menu item is indicated.

Pressing the ► selects the menu item shown, in this example Settings.

(Pressing ▲ or ▼ will change to a different menu eg Status, Events).

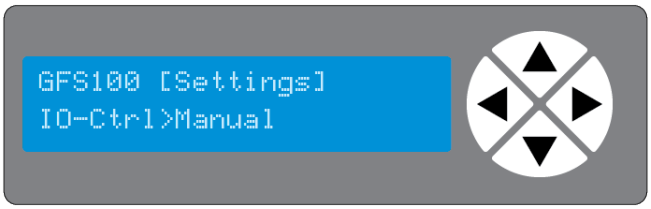
The display changes to indicate that the GFS100 Settings menu item `IO-Ctrl` has been selected and shows that it current setting is `Manual`.



Pressing the ► selects the settings item shown, in this example `IO-Ctrl`.

(Pressing ▲ or ▼ will change to a different setting, eg `#Out-Frmt` or `#Inp_SelA`).

The display changes to indicate that the GFS100 Edit Setting menu item `SDI-Format` has been selected



To edit the setting of the menu item press ▲ or ▼.

All menu items can be monitored and/or changed in this way. Changing a setting has an immediate effect.

Axon Cortex Software

Synapse Cortex can be used to change the settings of Synapse modules from a PC, either locally or remotely. The software enables communication based on TCP/IP between the Setup PC and Synapse frames/modules.

Each Synapse frame is addressed through its rack controller's unique IP address, giving access to each module, its menus and adjustment items. Axon Cortex has access to data contained within the Synapse module and displays it on a GUI. The software has an intuitive structure following that of the module that it is controlling.

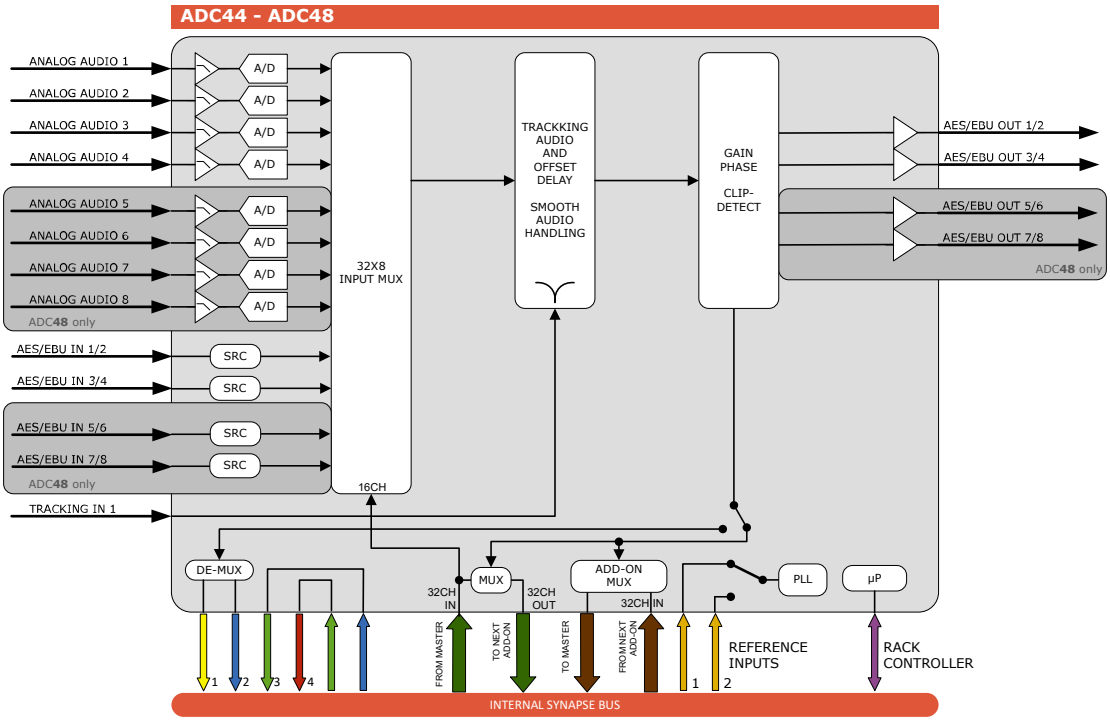
For operation of Axon Cortex, please refer to the Cortex help files.

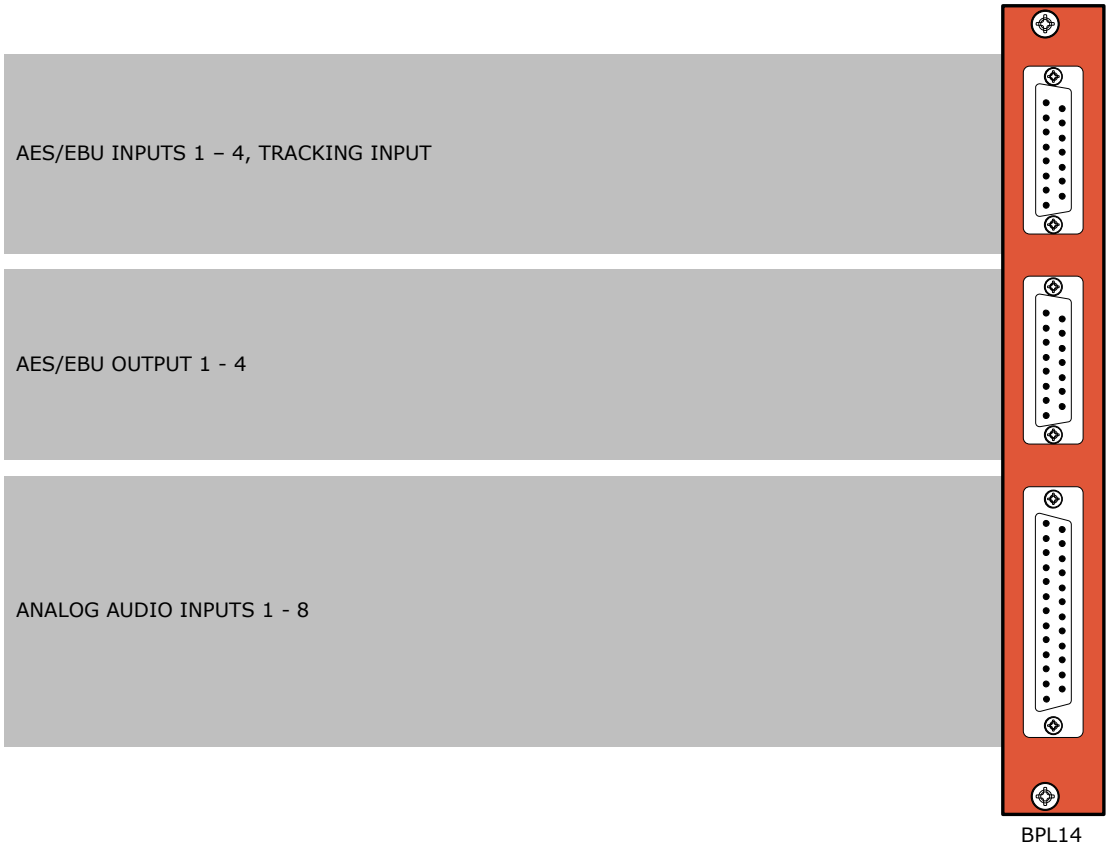
Menu Structure Example

Slot	Module		Item		Parameter		Setting
▲							
▲							
S02			Identity				
▲			▲				
S01	GFS100	►	Settings	►	IO-Ctrl	►	Manual
▼			▼		▼		▼
S00	RRC18		Status		IO_Prst_Act		GPI
			▼		▼		▼
			Events		IO_Prst_Edit		GPI-A
					▼		▼
					#Inp-SelA		GPI-B
					▼		▼
					▼		GPI-C

4 Introduction

4.1 Block schematic & I/O panel





4.2 Features

The ADC44 and ADC48 are multi-functional products. Their basic function is the conversion of analog audio to AES/EBU digital audio. In addition to the analog inputs it has AES/EBU inputs with a sample rate converter (SRC). The ADC44/48 has a tracking audio delay and a delay offset of up to 650ms at 96kHz or 1300ms at 48kHz. It can also perform the Synapse ADD-ON function. In ADD-ON mode the card acts as an analog or digital audio input board that feeds a master card positioned one slot left of the ADD-ON card. Both the normal and Quad Speed Audio bus are supported. The card acts as a analog audio embedder for example if used in combination with the ASV12, SFS11 or GXG100 or in Quad speed mode with the GXG400 (many more options available). The audio data that enters the Synapse bus to a master card is identical to the data present in the local AES/EBU outputs. The AES/EBU 110 Ohms and analog audio signals are available on sub-D connectors.

The ADC44 is a 4 channel Analog to Digital converter with 4 analog inputs, 2 AES inputs and 2 AES outputs. The ADC48 is an 8 channel converter with 8 analog inputs, 4 AES inputs and 4 AES outputs

- 24-bit audio conversion
- 8 channel processing selectable from 8 analog or 8 digital channels in ADC48
- 4 channel processing selectable from 4 analog or 4 digital channels in ADC44
- Any input to any output selection (This can be a mix of analog and digital signals)
- AES/EBU inputs with selectable SRC (32 to 96kHz sampling)
- 96kHz and 48kHz sample clock locked to: B&B ref or word clock ref. (In ADD-ON, only 48kHz)
- 96kHz and 48kHz sample clock in free running mode (In ADD-ON, only 48kHz)
- In- and outputs analog reference levels adjustable for 12, 15, 18 and 24dBu
- Adjustable audio gain (in 0.25dB) and phase (0-180 deg)
- Can be used as a Synapse ADD-ON card
- Adjustable audio delay offset up to 1300ms in 1ms increments (@48kHz)
- Tracking audio delay on dedicated BNC input
- Full control and status monitoring through the front panel of the SFR04/SFR08/ SFR18 frame and the Ethernet port (ACP)

Complementary card to:

- All embedding master cards normal ADD-ON bus or Quad Speed bus

4.3 Applications

- Standalone high quality Audio A/D conversion
- Generic analog and digital audio ADD-ON card for dedicated Synapse master cards that have an embedding function
- AES/EBU proc-amp

4.4 Specifications

Analog Audio Input	
Type	Balanced analog audio
Number of inputs	4 on ADC44 or 8 on ADC48
Connector	female sub-D
Impedance	10k Ohms nominal (differential)
Samping rate	48KHz
Signal level	0dB FS → 12dBu, 15dBu, 18dBu or 24dBu
Level control range	+12dB to -60dB 0.25dB increments
Frequency response	< ±0.1dB, 20Hz to 20kHz (broadcast quality)
Dynamic range	100dB @-60 dBFS
THD+N	< 0.002% (>96dB) @ 1kHz, -1dB FS
	< 0.002% (> 96dB) @ 20Hz to 20kHz, -1dB FS
CMRR	> 60dB at 1kHz
AES Audio Input	
Connector	female sub-D (balanced)
Standard	AES-1992 for balanced synchronous or asynchronous PCM/AES
Number of inputs	4 on ADC48, 2 on ADC44
Sample rate	32 kHz to 192 kHz Synchronous 48 kHz in Master/ADD-ON mode
Resolution	24 bits when AES inputs selected, 20 bits in Master/ ADD-ON mode
Minimum input/Output Delay	3.5ms
Impedance	110 Ohms
Level	2V to 7V for balanced operation
AES Audio Output	
Number of outputs	2 on DAC44, 4 on DAC48
Standards	AES-1992 for balanced synchronous or asynchronous PCM/AES
Connector	female sub-D (balanced)
Resolution	24 bits

Sampling rate	48 synchronous or free running
Minimum input/output delay	2.5ms
Maximum input/output delay	1300ms

Miscellaneous

Weight	Approx. 250g
Operating Temp.	0 °C to +50 °C
Dimensions	137 x 296 x 20 mm (HxWxD)

Electrical

Voltage	+24V to +30V
Power	< 11 Watts

5 Settings

5.1 Introduction

The settings menu displays the current state of each ADC44-ADC48 setting and allows you to change or adjust it. Settings can be changed using the front panel of the Synapse frame (SFR18, SFR08 or SFR04) or with Cortex. Also the SCP08 control can be used. Please refer to chapter 3 for information on the Synapse front panel control and Cortex or for instance Cerebrum.

5.2 System control

SRC_1 ~ SRC_4

The AES/EBU inputs are connected to a Sample Rate Converter. This enables the input to use audio sample rates that are non-synchronous to video of the master card (setting *On*). The SRC can be bypassed and the audio is inserted in the card transparently (*Trans*). The default setting is *Trans*.

Lock-Mode

The ADC44-ADC48 can be used as an ADD_ON card (in combination with an embedder/de-embedder card). In this case you are referred to the setting *MasterCard*, which will extract the reference from the master card. It is also possible to use an external signal to lock to. In that case you are referred to the setting:

- *AES1* = Locks to the AES/EBU signal on input 1(default)
- *AES2* = Locks to the AES/EBU signal on input 2
- *Ref1* = The B&B reference input of the rack controller
- *Ref2* = The second B&B reference input of the rack controller (if available)
- *Mastercard* = Locks to the ADD-ON bus input (always use this setting when using quad speed add-on bus functionality).
- *Wordclock* = Locks to a 48k wordclock which is connected to the genlock inputs 1 or 2 of the SFR
- *Free-run* = Free running mode

System_gain_ADC

This setting sets the analog audio level which is provided at a full-scale digital input. The available settings are *+12dBu*, *+15dBu*, *+18dBu* and *+24dBu* (all at high impedance). Default is *+18dBu*

Bus_type

This setting changes the mode of the ADD-ON bus audio to match a *Quad_Speed* or *Normal* audio bus mode. Default is *Quad_Speed*

Norm_Bus_type

For a analog to digital converter this should be set to *Output*. For a digital to analog converter this should be set to *input*.

Masterfade

The ADC44-ADC48 has a fade algorithm that can be enabled by the Master Card. If a de-embedder master card is used to de-embed the audio from the input SDI stream the Framestore synchronizer may drop a frame or re-write a frame. In this case the Mastercard provides a signal (tracking pulse) prior to the event to ramp down and then ramp up the audio to mask any audio irregularities. This tracking signal has to be connected externally via the backpanels. The settings of *Masterfade* are *Tracking1* and *Off*. The default setting is *Off*.

Fade-type

The ADC44-ADC48 can be used as a tracking audio delay. The tracking input must be connected to a tracking output of a Frame synchronizer. The setting *Tracking* has 2 modes, they are as follows;

- *Fast*: Fast tracking and handling of frame drops enabling instantaneous synchronization of audio.
- *Smooth*: Slow correction of frame drops enabling gradual synchronization of audio.

The default setting of *Tracking* is *Fast*.

Sel_Ch1 ~ Sel_Ch8

With these settings you set a source for the corresponding output channel. The ADC44 has 4 channels, The ADC48 has 8. You can set each individual channel to source:

- *Digital*: physical AES/EBU inputs
- *Analog*: physical Analog inputs
- *Master*: audio coming from master card via add-on bus
- *Testtone*: this generates a 1Khz to 8Khz sine which can be used as testtone

Channels 1 till 8 are the physical AES/EBU outputs as well as outputs towards the add-on bus and are by default set to *Analog*.

Ch_1 ~ Ch_8

With these settings you select the actual source channel in the above selected source. The ADC44 has 4 channels, the ADC48 has 8. Default for *Ch_1* till *Ch_8* are set to respectively *1* till *8*.

When *Analog* or *Digital* is selected in the corresponding *Sel_Chx* setting, you can choose channel 1 till channel 8. When *Master* is selected, you can choose channel 1 till channel 32. When *testtone*

is selected, you can choose 1 to have a 1kHz tone, 2 for a 2Khz tone, 3 for a 3KhZ tone, up to 8 for a 8Khz tone.

5.3 Process control

Gain-CH_1 ~ Gain-CH_8

The setting menu items *Gain-CH_1* until *Gain-CH_8* control the output gain of each respected channel The DAC/ADC44 has 4 channels, the DAC/ADC48 has 8. Ch_1 is the left channel of the first AES/EBU output and Ch_2 is the right channel of the first AES/EBU output. Ch_3 and Ch_4 refer to the left and right channel of the second AES/EBU output, etc. *Gain-CH_1* until *Gain-CH_8* have an adjustment range between *–60.0dB* and *+12.0dB*. Everything below -60dB is indicates as *-999dB*, meaning the audio is muted. The default setting of is *0dB*.

Delay-CH_1 ~ Delay-CH_8

These settings allow you to delay the audio of each pair of channels in a range of *0ms* to *1299.9ms* in steps of 0.01ms. Default is *0ms*.

Phase-Ch_1 ~ Phase-Ch_8

The phase of each channel can be adjusted using these settings. The setting of each corresponding channel can be set to *0 deg* (degrees) and *180 deg*. The default setting is *0 deg*.

5.4 In bus control

Override_17/24

If you want to pass processed audio from one quad speed add-on card to the other you have to use this setting. You can choose to override input channels 17/24 on the add-on bus of the next card (right side) with output channels 1 to 8 or pass the master-card audio (*off*).

Override_25/32

With this setting you can choose whether you want to override input channels 25/32 on the add-on bus of the next add-on card (right side) with output channels 9 to 16 or pass the master-card audio.

5.5 Out bus control

Slot1/2 ~ Slot21/32

These menu items are to fill the Quad speed audio bus with the appropriate outputs. You can fill any of the 16 audio pairs (32 channels in total) with the audio that is set to

Out1/2, *Out3/4*, etc till *Out7/8*. You can also switch the concerning pair to *off*, making the this audio pair empty.

Enable_RMS_stat With this setting you can enable (*on*) or disable (*off*) the RMS status items (RMS_PROC_1 ~ RMS_PROC_8) in the status menu of the ADC44-ADC48. By default it is set to *off* to prevent lots of data traffic.

6 Status

6.1 Introduction

The status menu indicates the current status of each item listed below.

6.2 ADC44-ADC48 status items

lock	This status item indicates what the ADC44-ADC48 is locked to at the moment. Can be *AES1*, *AES2*, *Mastercard*, *Ref1*, *Ref2*, *Wordclock*, *Free-run* or *No_Lock*
Ref_present	This indicates whether a reference signal is present (*Ok*) or not (*NA*).
Ref_format	If a reference is present, this status item indicates whether the reference is 50Hz (*525*) or 60Hz (*625*). When there's no reference, this indicates *NA*.
AES_Inp_1 ~ AES_Inp_8	The status items *AES_Inp_1* till *AES_Inp_4* indicate the condition of a digital audio signal at the input of each corresponding channel. This is indicated as *OK* (if the input signal is OK) or *NA* (not available).
Ana_Inp_1 ~ Ana_Inp_8	The status items *Ana_Inp_1* till *Ana_Inp_4* indicate the condition of an analog audio signal at the input of each corresponding channel. This is indicated as *OK* (if the input signal is OK) or *NA* (not available).
Master_Inp_1 ~ Master_Inp_32	These items indicate the condition of a digital audio signal on each corresponding add-on bus input channel. This is indicated as *OK* (if the input signal is OK) or *NA* (not available).
RMS_PROC_1 ~ RMS_PROC_8	When the setting *Enable_RMS_stat* is set to *on* these status items will indicate the current RMS level of each individual audio channel between -200dBFS and 0dBFS.
Backplane-type	*Backplane-type* is used to indicate whether a backpanel is connected with Analog inputs, Analog outputs or if no backpanel is connected at all (*NA*).

7 Events Menu

7.1 Events

Introduction

An event is a special message that is generated on the card asynchronously. This means that it is not the response to a request to the card, but a spontaneous message.

What is the goal of an event?

The goal of events is to inform the environment about a changing condition on the card. A message may be broadcast to mark the change in status. The message is volatile and cannot be retrieved from the system after it has been broadcast. There are several means by which the message can be filtered.

Events

Announcements

The following event(s) are reported by the ADC44-ADC48. *Announcements* is not actually an event. This item is only used for switching the announcement of status changes on/off. 0=off, other =on

Input_1

Input_1 reports the loss of the audio at the input of channel 1 and can be set between 0 and 255. 0= no event, 1 to 255 is the priority setting.

Input_2

Input_2 reports the loss of the audio at the input of channel 2 and can be set between 0 and 255. 0= no event, 1 to 255 is the priority setting.

Input_3

Input_3 reports the loss of the audio at the input of channel 3 and can be set between 0 and 255. 0= no event, 1 to 255 is the priority setting.

Input_4

Input_4 reports the loss of the audio at the input of channel 1 and can be set between 0 and 255. 0= no event, 1 to 255 is the priority setting.

Reference

Reference can be set between 0 and 255. 0= no event, 1 to 255 are the priority setting. If the reference is lost an Event will be generated at the set priority.

What information is available in an event?

The message consists of the following items;

1. A message string to show what has happened in text, for example: “INP_LOSS”, “REF_LOSS”, “INP_RETURN”.
2. A tag that also shows what happens, but with a predefined number: e.g. 1 (= loss of input), 2 (= loss of reference), 129(= 1+128 = return of input). For a list of these predefined tags see the table on the next page.

3. A priority that marks the importance of an event. This value is defined by the user and can have any value between 1 and 255, or 0 when disabled.
4. A slot number of the source of this event.

The message string

The message string is defined in the card and is therefore fixed. It may be used in controlling software like Cortex or Cerebrum to show the event.

The tag

The tag is also defined in the card. The tag has a fixed meaning. When controlling or monitoring software should make decisions based on events, it is easier to use the tag instead of interpreting a string. The first implementation is the tag controlled switch in the GPI16.

In cases where the event marks a change to fault status (e.g. 1 for Loss of Input) the complement is marked by the tag increased by 128 (80_{hex}) (e.g. 129 (81_{hex}) for Return of Input).

Defining Tags

The tags defined for the ADC44-ADC48 are:

Event Menu Item	Tag		Description
Announcements	0 or NA	0 or NA	Announcement of report and control values
Input_1..4	01_{hex} = INP_LOSS	81_{hex} = INP_RETURN	Channel 1-4 input lost or returned
Reference	02_{hex} = REF_LOSS	82_{hex} = REF_RETURN	Reference lost or returned
Audio-Data	05_{hex} = AUDIO_ERROR	85_{hex} = AUDIO_OK	Audio data error or ok

The Priority

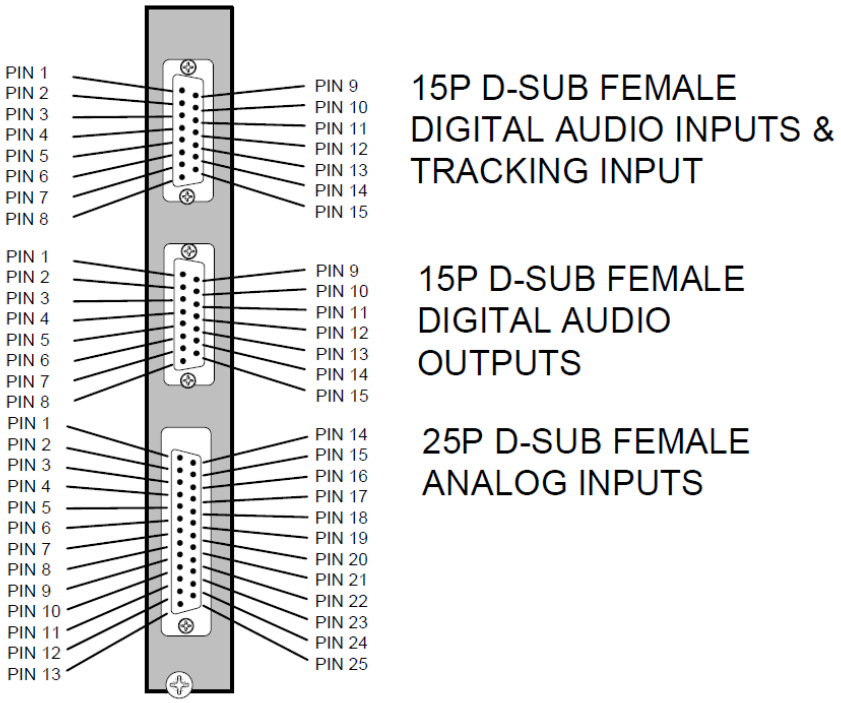
The priority is a user-defined value. The higher the priority of the alarm, the higher this value. Setting the priority to Zero disables the announcement of this alarm. Alarms with priorities equal or higher than the Error Threshold setting of the ERC/ERS will cause the error LED on the Synapse rack front panel to light.

The Address

Together with the message string or the tag, the slot number or address of the card is relevant to be able to assign the event to a certain card.

8 Pin Description

8.1 BPL14



	ADC48	ADC44
15P D-SUB FEMALE		
PIN 1	AES1+ IN	AES1+ IN
PIN 2	GND	GND
PIN 3	AES2- IN	AES2- IN
PIN 4	AES3+ IN	
PIN 5	GND	GND
PIN 6	AES4 - IN	
PIN 7	TRACKING 1 IN	TRACKING 1 IN
PIN 8	TRACKING 2 IN	TRACKING 2 IN
PIN 9	AES1- IN	AES1- IN
PIN 10	AES2+ IN	AES2+ IN
PIN 11	GND	GND
PIN 12	AES3- IN	
PIN 13	AES4 - IN	
PIN 14	GND	GND
PIN 15	GND	GND
15P D-SUB FEMALE		
PIN 1	AES1+ OUT	AES1+ OUT
PIN 2	GND	GND
PIN 3	AES2- OUT	AES2- OUT
PIN 4	AES+3 OUT	
PIN 5	GND	GND
PIN 6	AES4- OUT	
PIN 7	GND	GND
PIN 8	GND	GND
PIN 9	AES1- OUT	AES1- OUT
PIN 10	AES2+ OUT	AES2+ OUT
PIN 11	GND	GND
PIN 12	AES3- OUT	
PIN 13	AES4+ OUT	
PIN 14	GND	GND
PIN 15	GND	GND

	ADC48	ADC44
25P D-SUB FEMALE		
PIN 1	A1pos OUT	A1pos OUT
PIN 2	GND	GND
PIN 3	A2neg OUT	A2neg OUT
PIN 4	A3pos OUT	A3pos OUT
PIN 5	GND	GND
PIN 6	A4neg OUT	A4neg OUT
PIN 7	A5pos OUT	
PIN 8	GND	GND
PIN 9	A6neg OUT	
PIN 10	A7pos OUT	
PIN 11	GND	GND
PIN 12	A8neg OUT	
PIN 13		
PIN 14	A1neg OUT	A1neg OUT
PIN 15	A2pos OUT	A2pos OUT
PIN 16	GND	GND
PIN 17	A3neg OUT	A3neg OUT
PIN 18	A4pos OUT	A4pos OUT
PIN 19	GND	GND
PIN 20	A5neg OUT	
PIN 21	A6pos OUT	
PIN 22	GND	GND
PIN 23	A7neg OUT	
PIN 24	A8pos OUT	
PIN 25	GND	GND

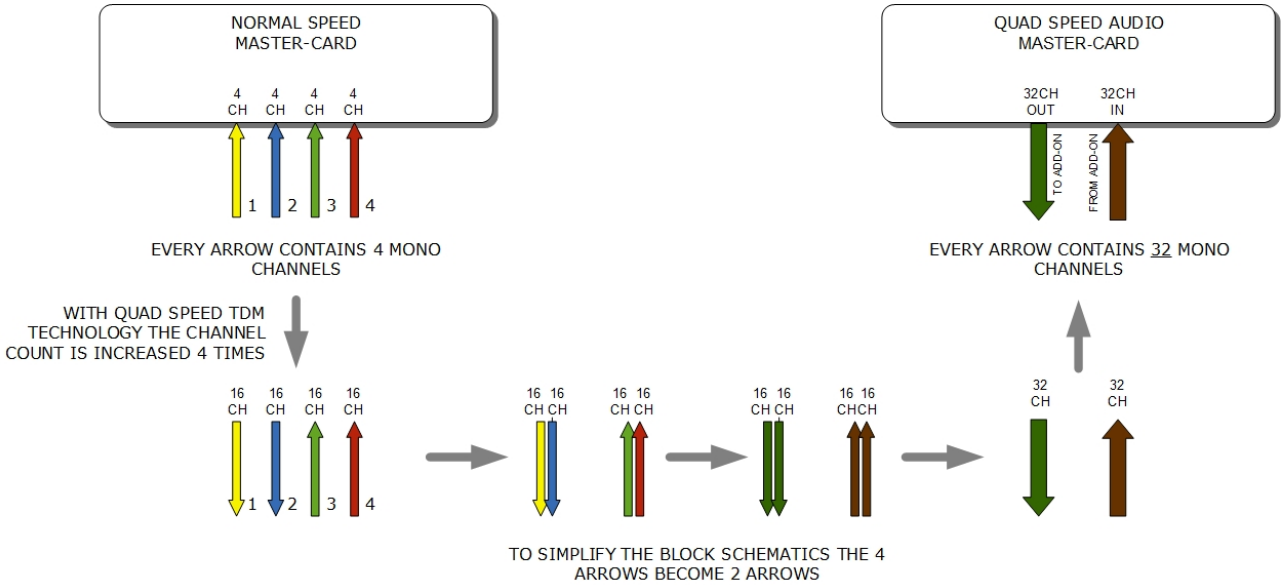
9 Appendix 1

9.1 Quad Speed bus explained

32 channels Quad Speed bus

The internal audio ADD-ON bus needed an upgrade for some applications. We wanted more channels (32 per video stream seem possible in the near future). And we want the bus to be bidirectional, so 32 channels in and 32 channels out at the same time.

The new interface needed to be compatible with all existing hardware (frames) and in the implementation of the master card it sometimes needed to be backward compatible with the original ADD-ON bus.



So the Master card is now firmware enhanced to run 32 channels in either direction (64 channels total) instead of 16 channels in one direction

Quad Speed bus features

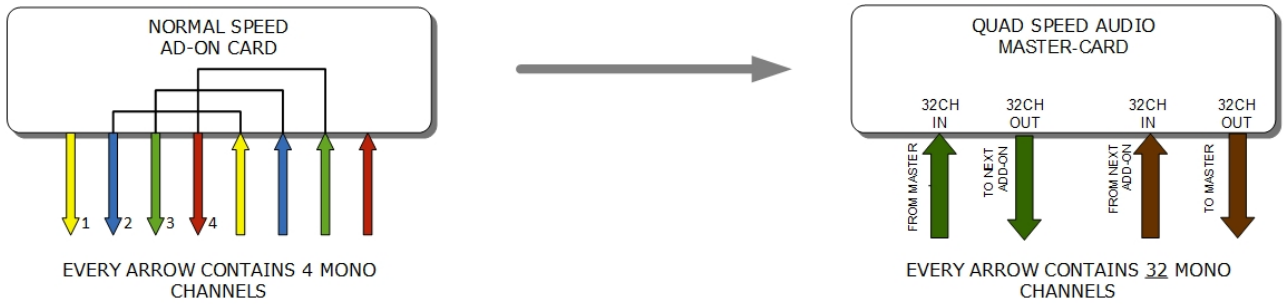
Some Master cards will have two modes and some Master cards will only have either the Quad Speed mode or the normal add-on bus.

Dual mode Master cards have a menu item to select the appropriate mode. If a mode is selected, all add-on cards to that master card need to be in the same mode.

The following features and rules apply for cards in Quad Speed mode:

- Up to 32 channels output from the master card with looping to up to 3 ADD-ON cards

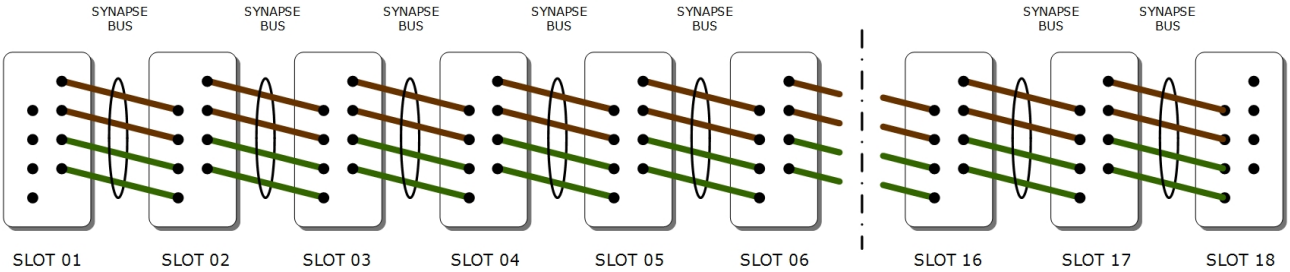
    - The ADD-ON card just picks the channels it wants to process
    - Some ADD-ON cards will have the possibility to re-inject processed audio onto the next ADD-ON card
- Up to 32 channels input on the master card
    - If the master card can handle less than 32 channels, the lowest channel numbers will be used, as the ADD-ON card will always generate 32 channels (where some channels can be empty or silent)
- Channel shuffling is done in the ADD-ON card
    - The Master Card has only one setting to enable the quad speed audio bus
- Every Quad-Speed ADD-ON card takes 32 channels from the 'right hand ADD-ON card' and adds (or overwrites) the local processed channels.
    - This can be done for any of the channels that are processed in the ADD-ON card
- Some Master Cards are switchable between normal and quad-speed bus
- Channel designations on the block schematics:
    - Channel 1-32 (or less) are injected into the dark green large arrow from Master Card to ADD-ON card and looped on to the next ADD-ON card via the dark green arrow
    - The ADD-ON card injects up to 32 channels into the brown large arrow
    - An ADD-ON card will also actively loop extra processed channels into the next ADD-ON card, and finally into the Master Card
- The cross looping of the original design is now a straight loop
- The quad speed bus can also work in one direction
    - You can use a Quad Speed audio bus to de-embed audio from the master and present on the ADD-ON card as AES/EBU, Bitstream (like Dolby) or analog audio
    - If applicable the ADD-ON card can also be used as in injection point of physical audio streams



The ADD-ON cards also provide a looping function from one ADD-ON to the next. This is however a more intelligent looping with optional re-insertion and muxing of signals.

Cascading cards

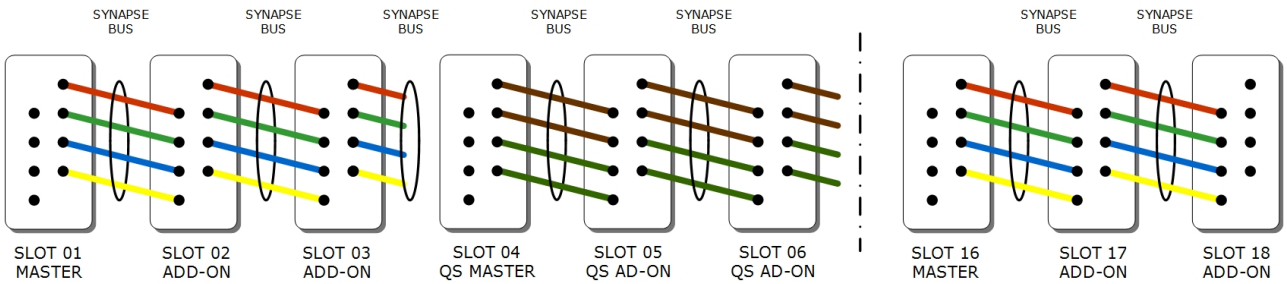
Cascading of Quad Speed cards works identical to normal add-on cards. Every connection in the example below transports 16 mono audio channels (= 32 channels per color). It shows the inter slot connections 'in quad Speed mode' as part of the frame bus PCB.



The system makes use of the same passive copper traces on the internal bus PCB as normal add-on bus cards.

The maximum amount of add-on cards in Quad Speed mode is 3. These 3 ADD-ON cards will all run on the same clock in the same phase as the master card. This guarantees that audio channels that are processed in different add-on cards will still operate in the same phase, something very important when processing multiple discrete surround channels.

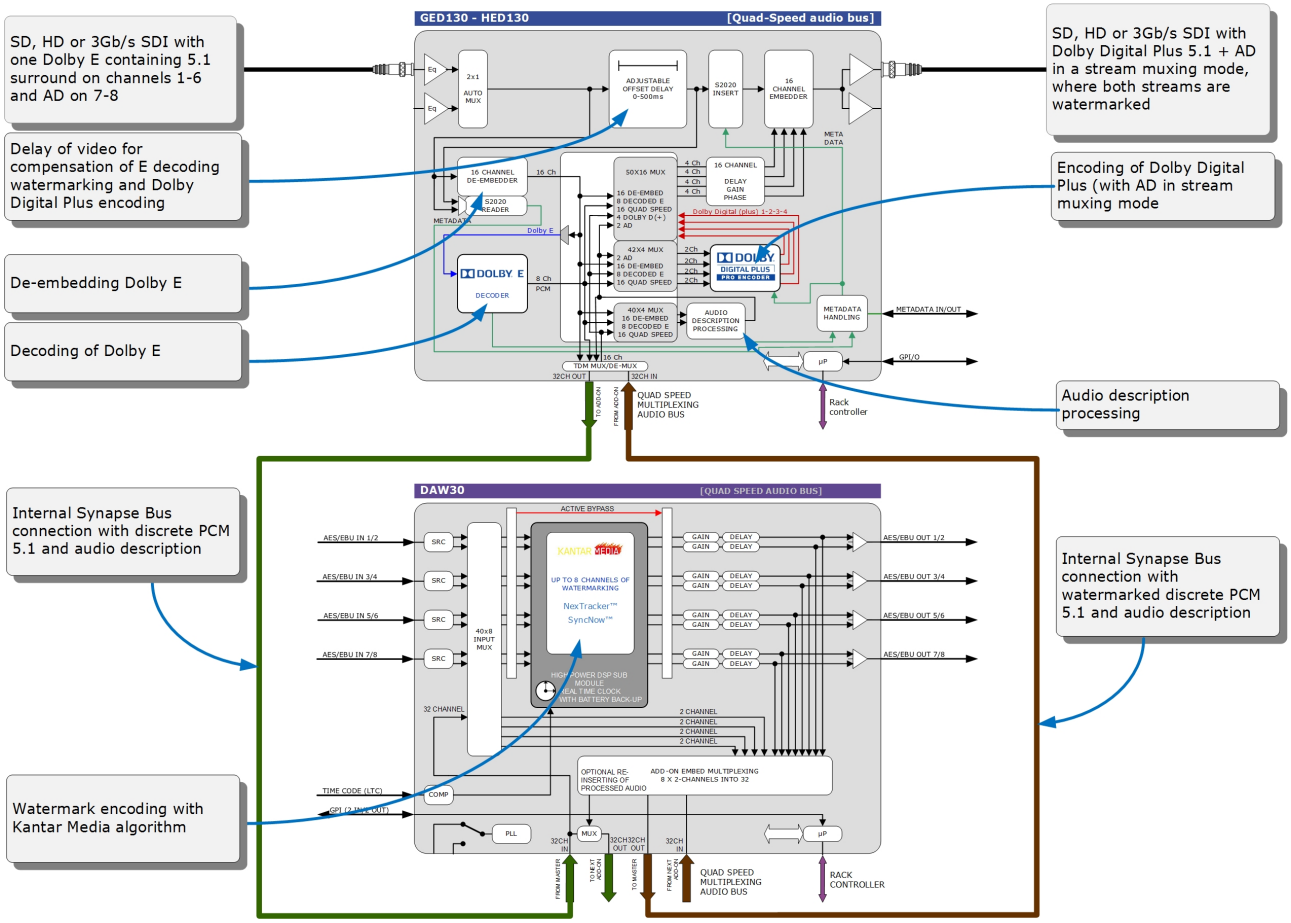
You can mix normal speed Master cards with Quad Speed master cards in one frame as the Master card breaks the connection to the left hand card. All cards to the right of the master must be in the same mode as the master.



Mixing normal ADD-ON with Quad Speed ADD-ON combo's in one frame is allowed

Example 1

The following schematic is an Example where we combine a master card that performs embedded domain Dolby E to Dolby Digital Plus encoding. Between the E-decoding and Dolby Digital Plus encoding we want to watermark the left, right and center channel of a the decoded discrete 5.1 surround channels and watermark a PCM channel used as a voice over for audio description.

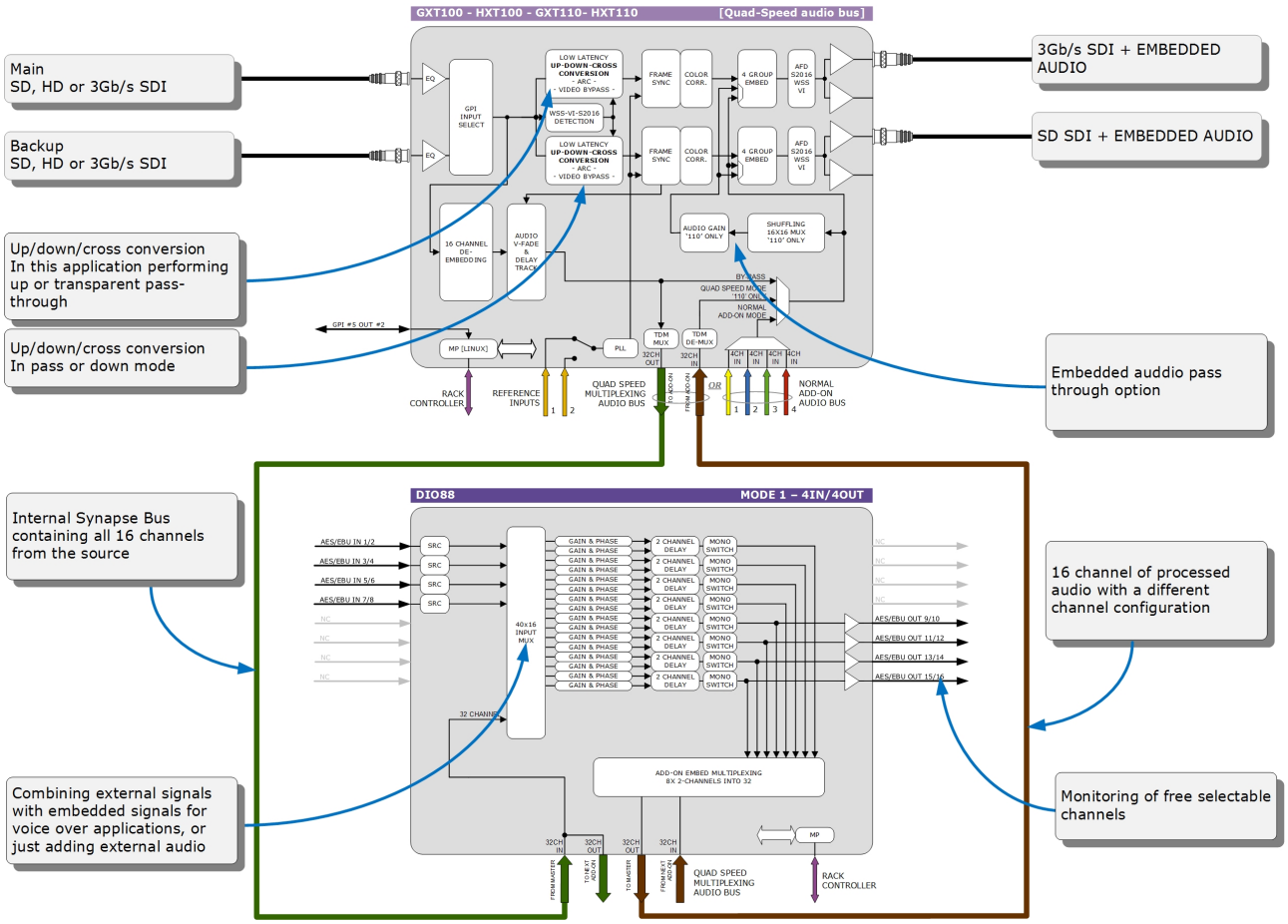


Embedded domain Dolby E to Dolby Digital Plus with Watermarking. The only connections to the outside world are two BNC cables.

Example 2

Another example of the Quad Speed audio Add-on bus shows a transmission application where a dual up/down/ cross output card is connected to a DIO88 in a setup where

the embedded audio combined with external audio and convenient PCM monitoring is available.



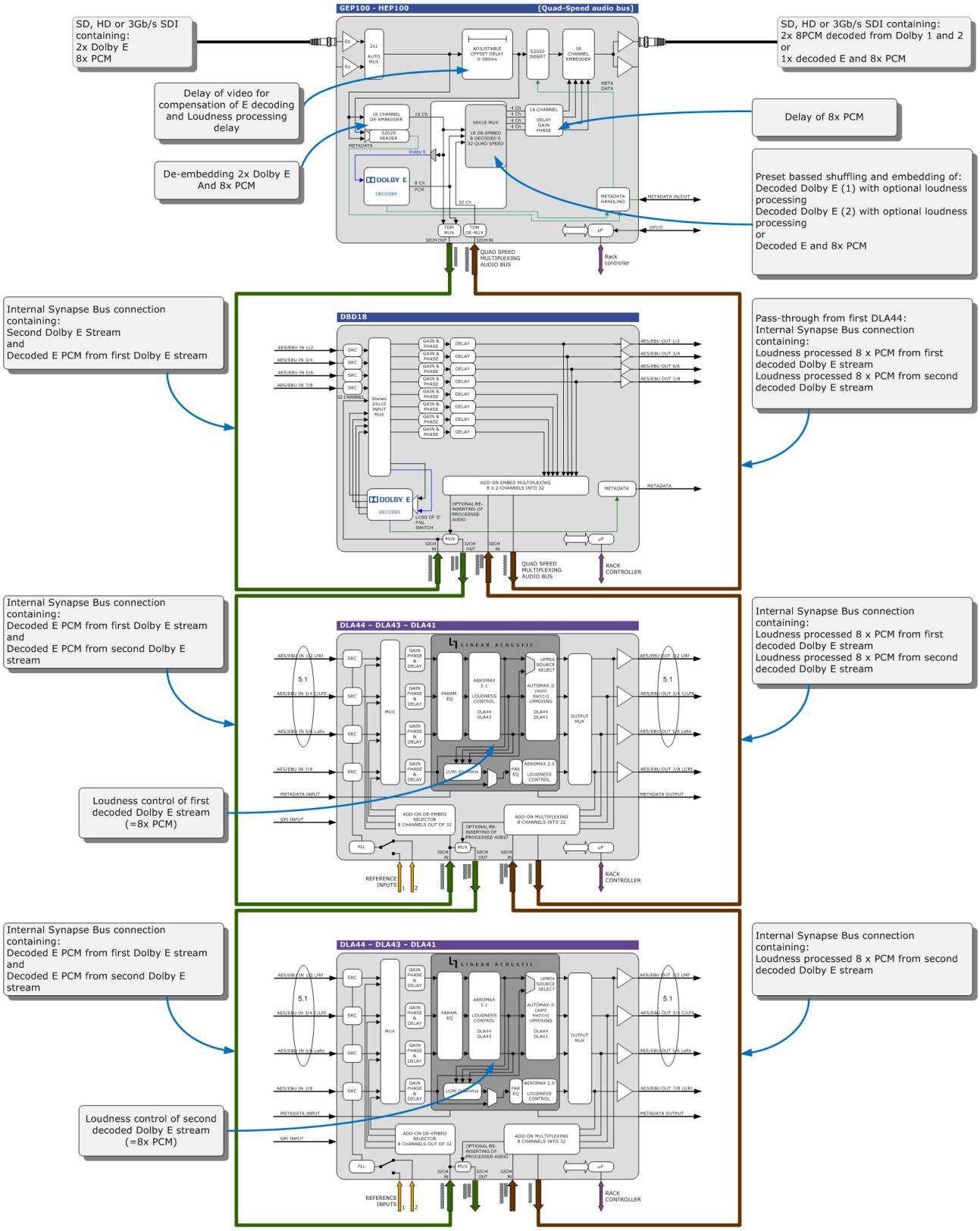
Embedded domain Dolby E to Dolby Digital Plus with Watermarking. The only connections to the outside world are two BNC cables.

Example 3

In the following example (next page) you will see a 4 cards application that performs a massive amount of processing divided over 1 master card and 3 ADD-ON cards. This is a typical 'ingest' configuration and is used where the infrastructure does not use Dolby E (two in this example) but PCM + s2020. The input is a SD, HD or 3Gb/s SDI containing 2 Dolby E streams and 8 mono PCM streams. The output is the same SDI stream but with a selection of 16 channels selected out 8 original PCM channels and 16 PCM channels that are decoded from the Dolby E streams. The combo performs the following processing:

- De-embedding of 8x PCM and 2x Dolby E
- Decoding of two independent Dolby E streams
- Loudness processing of up to 16 channels sourced by any of the 8x PCM or decoded Dolby E streams
- Upmixing of a 2.0 to 5.1 if a Dolby E stream is not available
- Physical monitoring of all processed PCM streams

- Preset based shuffling of all source channels into 16 channels with the appropriate offset delays
- S2020 metadata insertion sourced from the E decoders, embedded s2020, generated presets or an external feed
- Video delay to compensate for audio propagation delay
- Embedding of up to 16 channels



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Hercules 28
NL-5126 RK Gilze
The Netherlands
+31 161 850 450
+31 161 850 499
www.axon.tv
info@axon.tv