Synapse

U4T200-U4T240

4K (3840X2160) ULTRA HD 4 WIRE TOOLBOX WITH LUT BASED COLOR SPACE AND DYNAMIC RANGE CONVERTER AND OPTIONAL DOLBY E PROCESSING

Installation and Operation manual

SFP Flexible I/O

4K ULTRAHD 3840 x 2160

Powered by LINUX

DESIGNED FOR DOLBY E

HDR High Dynamic Range

Quad speed MASTER

3Gb/s Level B compliant

AXON®

THE HEART OF BROADCAST

Synapse

TECHNICAL MANUAL

U4T200
U4T240

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WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE

● ALWAYS disconnect your entire system from the AC mains before cleaning any component. The product frame (SFR18 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: 25-04-2017
Date last revised: 13-06-2019

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 U4T200-U4T240 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.

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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 (RRC, RRS, ERC or ERS) manual. The method of connecting to a computer using Ethernet is also described in these manuals.

!

CHECK-OUT: "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, SFR08 and SFR Mobile 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.

Note 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, the card set will use basic data and default initialisation settings. 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 Synapse 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

```
[No Alarms]
```

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.

Note 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

```
RRC18 [Select Card]
>S01=SFS10
```

Pressing the ► selects the SFS10 in frame slot 01.

The display changes to indicate that the SFS10 has been selected. In this example the `Settings` menu item is indicated.

```
SFS10 [Select Menu]
>Settings
```

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 SFS10 `Settings` menu item `SDI-Format` has been selected and shows that it current setting is `Auto`.

```
SFS10 [Settings]
>SDI-Format=Auto
```

Pressing the ► selects the settings item shown, in this example `SDI-Format`.

(Pressing ▲ or ▼ will change to a different setting, eg `Mode`, `H-Delay`).

The display changes to indicate that the SFS10 `Edit Setting` menu item `SDI-Format` has been selected.

```
SFS10 Edit Setting]
SDI-Format>Auto
```

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	SFS10	▶	Set-tings	▶	Standard_dig	▶	Auto
▼			▼		▼		▼
S00	RRC18		Status		Mode		625
			▼		▼		▼
			Events		Ref-Input		525
					▼		
					H-Delay		
					▼		
					▼		

Note Further information about Front Panel Control and Synapse Cortex can be obtained from the RRC, RRS, ERC and ERS operational manuals and the Cortex help files

4 The U4T200/U4T240 Card

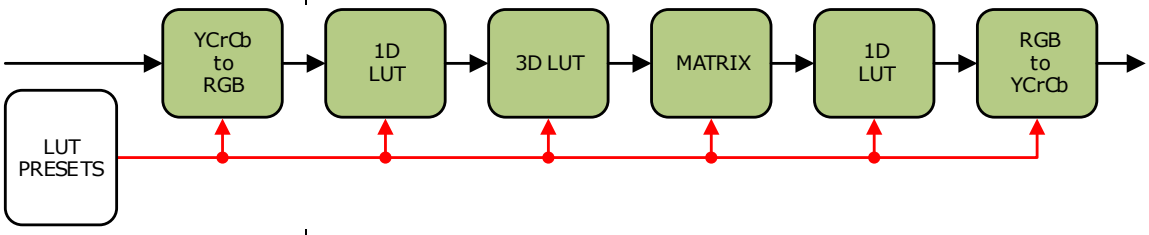
Introduction

The U4T200 and U4T240 are 4k (4 wire) production toolboxes that will ease the challenges of a 4 wire production setup where the left top corner (channel A) is used to carry VANC and HANC data like timecode and embedded audio. We also added a second quadrant audio de-embedder and embedder with full audio shuffling.

The difference between the U4T100/140 and U4T200/240 is the addition of a LUT based color space and dynamic range conversion. The LUT can be stored on 16 presets and selected on the fly.
The unit is compatible with standard LUT tables in either 1D and 3D format

The I/O is capable of handling four times 1080p formatted as level A, level B or 2Si (two sample interleaved). The card can also be used with 1080i, 720p, SD and 1080psf 23.98.

The '240' has an extra Dolby E encoder and decoder on board and will be capable of handling these signals internally. A Quad Speed Audio bus can be used for additional Dolby E processing or other audio processing by using an ADD-ON card like the DEE28.



This topology will give you the opportunity to perform three methods fully preset based across modes:

1 YCrCb to RGB > 1D LUT > RGB to YCrCb
2 YCrCb to RGB > 3D LUT > RGB to YCrCb
3 YCrCb to RGB > 1D LUT > Matrix > 1D LUT > RGB to YCrCb

Features

- LUT based Color space and Dynamic range conversion.
- 16 LUT presets for standard LUT tables (.cube, .LUT, .txt)
- 1D LUT 10bits 1024 RGB values (1024x3 rows)
- 3D LUT 10bits 35.937 RGB values (33x33x33)
- Side by Side split screen mode with slider for evaluation of LUT
- LUT bypass mode
- Compatible with ITU-R BT709 and ITU-R BT.2020 I/O (conversion matrix from YCrCb to RGB and back)
- Extremely low intrinsic latency of 5 lines
- 4 inputs
    - Separate internal processing channels
    - input autophasers
    - Framesyncs and offset delay blocks controllable in

two stages (LeftTop+rest)

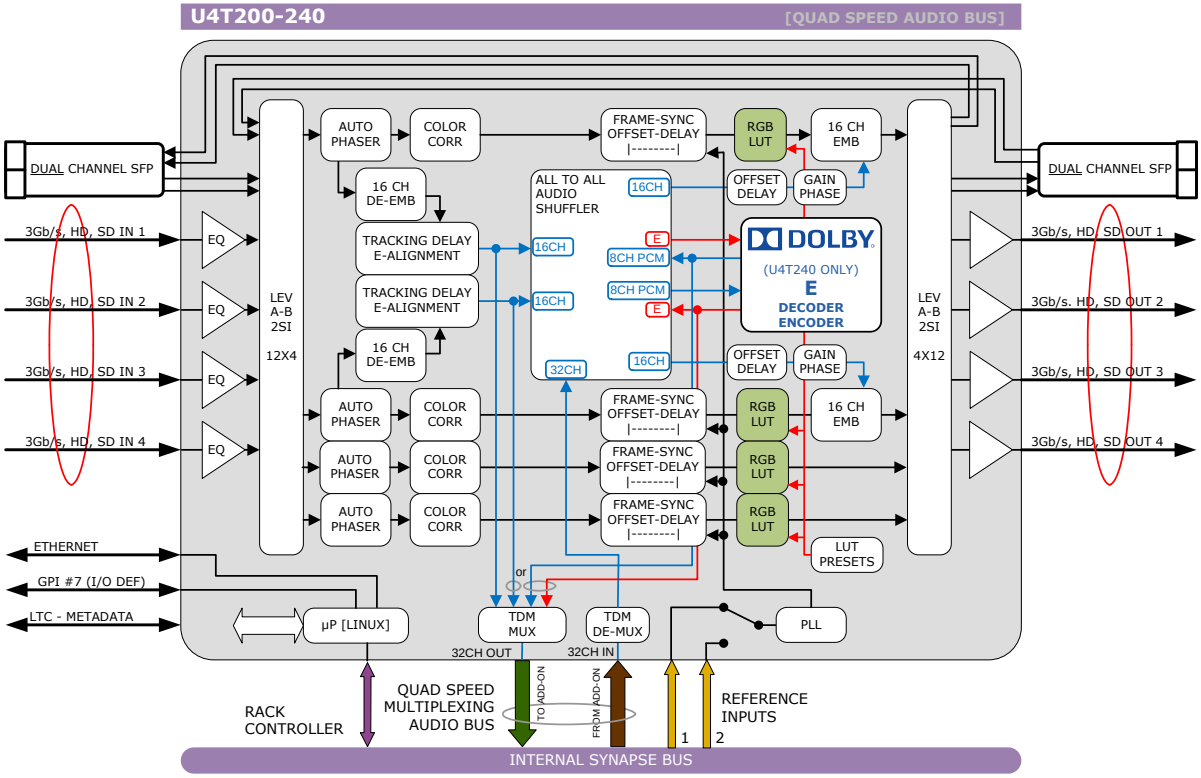
- 4 outputs
- RGB color correction of all 4 processing channels as one
- 4K 4 wire (3840 x 2160)
- Level A,B and 2Si compliant
- Compatible with the following formats
  - 1080p59.94
  - 1080p50
  - 1080i59.94
  - 1080i50
  - 720p59.94
  - 720p50
  - SD 525 and SD 625
  - 1080psf 23.98
- Transparent for 32 channels of embedded audio in first and second video quadrant.
- Full audio shuffling between all audio sources and destinations.
  - Move audio from quadrant 1 to quadrant 2
  - 32 channel Quad Speed Bus connectivity

  Quad Speed Bus out channel 17 to 32 are De-embbeder 2 ***or*** the Dolby Channels
  - All channels (embedded and QSB) can be a source for the Dolby processor
- Full control and status monitoring through the front panel of the SFR04/SFR08/SFR18 frame and the Ethernet port (ACP)

Applications

- All 4k 4 wire challenges
- 4 wire synchronization and alignment
- embedding and de-embedding in all UHD applications
- Encoding and decoding to and from Dolby E embedded data
- Color correction
- Level A to level B or to 2Si conversion in any direction.

Block schematic



5 Settings Menu

Introduction

The settings menu displays the current state of each U4T2x0 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. ***Note:*** All items preceded with a #-sign are part of the presets.

SYSTEM SETTINGS

IO-Ctrl

This function isn't currently not accessible but will be enabled in a software release in the future.

IO_Prst_Act

With this item you can manually change the currently active IO settings. Can be any preset between 1 and 8. By default it is set to 1. All menu settings that are preceded with a '`#` '-prefix under the '`SYSTEM SETTINGS`' header are part of the preset.

IO_Prst_Edit

Here you can select which of the 8 selectable IO settings presets you want to edit. Changing this will not change the active preset, unless the currently active preset is the same you are going to edit. All menu settings that are preceded with a '`#` '-prefix under the '`SYSTEM SETTINGS`' header are part of the preset.

PrstEditView

With this setting set to `Follow Active`, the edit preset settings (like for instance `UP_Prst_editA` and `UP_Prst_editB`) will follow the active preset when the active preset is changed. This to avoid confusion when changing the active. Set to `Independent` the edit preset will not automatically follow active preset changes. By default set to `Follow Active`.

#Inp_SelA

With this item you can select which input you want to use for Channel A. It is possible to select physical inputs; `SDI-1, SDI-2, SDI-3, SDI-4, SFP1-1, SFP1-1, SFP1-2, SFP2-1 or SFP2-2`. You can also choose a `Zoneplate` or `Colorbar` as input. The default for this setting is `SDI-1`.

#Inp_SelB

With this item you can select which input you want to use for Channel B. It is possible to select physical inputs; `SDI-1, SDI-2, SDI-3, SDI-4, SFP1-1, SFP1-1, SFP1-2, SFP2-1 or SFP2-2`. You can also choose a `Zoneplate` or `Colorbar` as input. The default for this setting is `SDI-2`.

#Inp_SelC

With this item you can select which input you want to use for Channel B. It is possible to select physical inputs; `SDI-1, SDI-2, SDI-3, SDI-4, SFP1-1, SFP1-1, SFP1-2, SFP2-1 or SFP2-2`. You can also choose a `Zoneplate` or `Colorbar` as input. The default for this setting is `SDI-3`.

#Inp_SelD

With this item you can select which input you want to use for Channel B. It is possible to select physical inputs; `SDI-1, SDI-2, SDI-3, SDI-4, SFP1-1, SFP1-1, SFP1-2, SFP2-1 or SFP2-2`. You can also choose a `Zoneplate` or `Colorbar` as input. The default for this setting is `SDI-4`.

#Out-FrmtA

With `Out-Frmt` you can set what the output format should be. Possible settings are:

- `1080p60`, `1080p50` (default)
- `1080i60`, `1080i50`
- `720p60`, `720p50`
- `SD525`, `SD625`

#Output-MapA

With output map you can select the output mapping according `level-A` or `Level-B Dual Link`. In `Auto` (default) it follows the detected mapping on the input.

#Inp_Map_A

This sets the input mapping of the 4K inputs. Can be set to 4 channels 4 quadrants (`4Ch_4Quadrants`) or 4 channels sample interleaved (`4Ch_SI`). Default is `4Ch_4Quadrants`.

#4K_Map_A

This sets the output mapping of the 4K outputs. Can be set to 4 channels 4 quadrants (`4Ch_4Quadrants`) or 4 channels sample interleaved (`4Ch_SI`). Default is `4Ch_4Quadrants`.

#F-delayA ~ #F-delayD

`F-Delay` sets the amount of delayed Frames for each corresponding input. The available range is from 0 to 50 frames (dependant on the I/O). Default is `0F`. The preset master for this is `Out-Frmt`, hence the '#'-prefix.

Format	Maximum F-delay
1080p50/p60	50fr
1080i50/i60	50fr
720p50/p60	100fr
SD525/625	250fr

#V-delayA ~ #V-delayD

`V-Delay` setting allows adjustment of the vertical phase of the corresponding output signal with respect to the selected reference input.

The `V-Delay` setting gives a delay in addition to the reference timing. For example: if the `V-Delay` is set to 10 TV HD lines, the output signal will be delayed by reference timing + 10 TV HD lines. The signal is delayed (advanced) with respect to the phase of the reference signal. The available range is from 0 to a maximum of 1124 lines (dependant on I/O format). The default setting is `0ln`. The preset master for this is `Out-Frmt`, hence the '#'-prefix.

#H-delayA ~ #H-delayD

The H-Delay setting allows adjustment of the Horizontal phase of the corresponding output signal with respect to the selected reference input.

The H-Delay setting gives a delay in addition to the reference timing. For example: if the H-Delay is set to 10 pixels, the output signal will be delayed by reference timing + 10 pixels. The signal is delayed (advanced) with respect to the phase of the reference signal. The available range is from 0 to a maximum of 5124 pixels (dependant on I/O format). The default setting is `0px`. The preset master for this is `Out-Frmt`, hence the '#'-prefix.

#Freeze_A

`Freeze` enables the capture of one Video Frame for all 4 channels. The settings of `Freeze` are `On` or `Off`. The default setting is `Off`.

Lock-Mode

`Lock-Mode` determines whether the card is locked to his `input` (`SDI1` or `SDI2`), to the reference (`Ref1` or `Ref2`) or `Auto-SDI` (SDI with automated switchover in case of ref loss). `Ref1` is default

Freeze_Mode

`Freeze_Mode` determines if the card repeats a field or a frame when `Freeze` is enabled on the setting or input loss. The settings are `Field` or `Frame`. Default is `Frame`.

P50-P60_Sync

`P50-P60_Sync` determines if the video drops one or two frames when out of sync in p50 and p60 formats. The `P50-P60_Sync` settings are `One Frame` and `Two Frame`

General Dolby Aligment info:

The Dolby-Aligner aligns all the embedded Dolby-E streams by using the "Dolby-E Reference Line-Position recommendations" of Dolby. This means that the aligner re-aligns the Dolby-E stream on stereo-base within the recommended “ideal line-position” for the different video-formats, even for extreme E-positions:

25/50Hz frame rates:
1920x1080p50: ideal-position is from line 37-46
1920x1080i50: ideal-position is from line 19-23
1280x720p50 : ideal-position is from line 25-31

30/60Hz frame rates:
1920x1080p60: ideal-position is from line 42-52
1920x1080i60: ideal-position is from line 21-26
1280x720p60 : ideal-position is from line 28-35

The earliest and latest valid position where the start of the Dolby-E header "must" be positioned for correct behavior is:
1920x1080p50: earliest: line 26, latest: line 105
1920x1080i50: earliest: line 13, latest: line 53
1280x720p50 : earliest: line 17, latest: line 70
1920x1080p60: earliest: line 35, latest: line 95
1920x1080i60: earliest: line 18, latest: line 48
1280x720p60 : earliest: line 23, latest: line 63

The algorithm of the aligner pulls every single embedded Dolby-E stream within the "ideal line-position" window.
This guarantees correct behavior of all embedded Dolby-streams when drop/repeat video-frames takes place in the synchronizer, and correct Dolby-E processing further in the chain.
(the individual Dolby-E streams can be different positioned within the ideal line-position, this does not affect Dolby-E processing)

DolbyE_Sync_Mode

When `DolbyE_Sync_Mode` is set to "`Off`" the Dolby-Aligner is disabled and the card is in minimum delay-mode. When set to "`Auto`", or a pre-selected embedded Dolby-E stream, the Dolby-Aligner is enabled. A delay of 40ms (25/50Hz) or 33ms (30/60Hz) is added for processing when the Dolby-Aligner is enabled. This is shown in the IO-delay status of the video outputs of the card. `DolbyE-Sync-Mode` must be used in combination with the `P60-P50_Sync Two Frame` setting to align the frame drop or repeat properly to the Embedded Dolby-E frame. This setting can be `Off` for no Dolby-E alignment of the drop or repeat, `Ch1/2` to `Ch 15/16` to manually select the embedded source for the Dolby-E, or `Auto` where the card will look for the first embedded channels providing Dolby-E.

DolbySOF_Offset

This setting changes the "ideal line-position" from its default window to more "early or "late". Default it is set to 0. The offset-range is selectable between -13 and +13, the step-size is in audio-samples.

Delay-Status	It is possible to display (in the status menu `IODelayA` and `IODelayB`) the processing time of the card in the status menu. This setting allows you to switch this function `On` or `Off`. Default setting is `Off`
Inp_Align_Status	It is possible to display (in the status menu `Inp_Align_SDI1_2`, `Inp_Align_SDI1_3` and `Inp_Align_SDI1_4`) the input alignment in the status menu. This setting allows you to switch this function `On` or `Off`. Default setting is `Off`.
SwitchLn_Status	It is possible to display (in the status menu `SwitchLnA` up to and including `SwitchLnD`) the switch line of the input in the status menu. This setting allows you to switch this function `On` or `Off`. Default setting is `Off`.
OSD-Style	The `OSD-Style` setting controls the on screen text when there is no input. The settings of `OSD-Style` are `Off`, `Transp`, `Blink-Transp`, `Masked`, `Blink-Masked`. The `Masked` setting inserts a black background behind the on screen text. Default setting is `Off`.
PatternSpeed	Sets the speed of the test-pattern (see settings `Inp_SelA` and `Inp_SelB`) animation between 0 (still) and 15 (fast). Default 1.
Input_Loss_A	Here you can set what the output of channel A should be when the input is lost. Can be `Freeze`, `Colorbar`, `Zoneplate`, `Black`, `Grey` or `Green`.
QSB17-32	Quadspeed bus selection for channels 17 till 32. When set to `SDI-2` the audio channels from SDI input 2 are routed to the quad speed audio bus on channels 17 till 32. When set to `Dolby` the audio signals out of the dolby CAT1100 board are routed to the quad speed audio bus on channels 17 till 32.
	VIDEO PROC
GainA ~ GainD	With this setting you control the overall gain of the video of the corresponding channel between 50 and 150%. Default is 100%.
R-GainA ~ R-GainD	`R-Gain` controls the Red gain of the corresponding channel. The control range is between 50% and 150%. The default setting is 100%.

G-GainA ~ G-GainD	`G-Gain` controls the Green gain of each corresponding channel. The control range is between 50% and 150%. The default setting is 100%.
B-GainA ~ B-GainD	`B-Gain` controls the Blue gain of the corresponding channel. The control range is between 50% and 150%. The default setting is 100%.
BlackA ~ BlackD	`Black` controls the total R-G-B Black gain of each corresponding channel. The control range is between –128bit and 127bit. The default setting is 0bit.
R-BlackA ~ R-BlackD	`R-Black` controls the Red-Black of each corresponding channel . The control range is between –128bits and 127 bits in steps of 1 bit The default setting is 0 bit.
G-BlackA ~ G-BlackD	`G-Black` controls the Green-Black of each corresponding. The control range is between –128bits and 127 bits in steps of 1 bit The default setting is 0 bit.
B-BlackA ~ B-BlackD	`B-Black` controls the Blue-Black of each channel. The control range is between –128bits and 127 bits in steps of 1 bit. The default setting is 0 bit.
	EMBEDDER
Audio-Phase A	If this setting is set to `Align`, the card ensures audio-phase alignment between multiple audio channels and audio groups, which is necessary for multi-channel (surround) purposes. If errors in the signal-chain occur the de-embedder blocks reset synchronously to maintain audio-phase-alignment. If this setting is set to `Off`, the card eats-all audio including errors. Even if there are DBN/ANC/ECC or channel-sequence errors, the de-embedder will pass them. Be aware that audio-phase-alignment between multiple audio channels and audio groups cannot be maintained if this setting is set to `Off`. *Note:* This setting can be helpful to solve problems in the field using equipment which doesn't follow the standards correctly.
Audio_CtrlA	With this item you select how audio proc amp presets for Channel A are controlled: Manually (`Manual`) or via GPI-triggers (`GPI`, `GPI-A`, `GPI-B` or `GPI-C`). Default is `Manual`

Audio_Prst_ActA

With this item you can manually change the currently active preset of channel. Can be any preset between 1 and 16. By default it is set to 1. All menu settings that are preceded with a '`#Ins`'-prefix are part of the preset.

Audio_Prst_EditA

Here you can select which of the 16 selectable presets you want to edit for Channel A. Changing this will not change the active preset, unless the currently active preset is the same you are going to edit. All menu settings that are preceded with a '`#Ins`'-prefix are part of the preset.

#Silence-TimeA

If the embedded audio contains silence, this can be reported by the card. This setting allows you to determine how many seconds it takes before the card reports the silence. This setting can be set in a range from 1 sec to 255 sec. The default setting is 10sec.

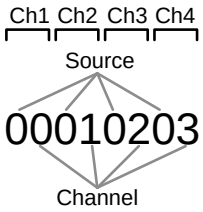
#Silence-LevelA

With this setting you set a loudness threshold for the silence detection. Can be set between -100 and -20 dBFS. When the audio goes below this value, a silence alert is triggered. Default is -60dBFS.

#Enc_in_Ch01/04
~
#Enc_in_Ch05/08

These settings allow you to select the source of the audio channels which need to be encoded by the on board Dolby CAT1100.
You can choose between the following values:

- Source for Ch01/08: SDI-de-embed Ch1 (value '00'), Ch2 (value '01') to Ch16 (value '0F'), Dec1 (value '10') to Dec8 (value '17'), Dec_mon1 (value '1B'), Dec_mon2 (value '1C')



Defaults are (source: SDI_Input_1, channels: straight):

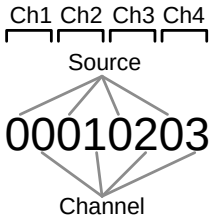
- #Enc_in_Ch01/04 = 00010203
- #Enc_in_Ch05/08 = 04050607

#Dec_in_Main/BUp

This setting allows you to select the source of the CAT1100 decoder input (Ch1 and Ch2) and the Dolby decoder backup input (Ch3 and Ch4).

You can choose between the following values:

- SDI-de-embed Ch1 (value ‘00’), Ch2 (value ‘01’) to Ch16 (value ‘0F’), Dolby encoder Enc1 (value ‘18’) to Enc2 (value ‘19’)



Defaults are (source: SDI_Input_1):

- #Dec_in_Main/BUp = 00010203

#Emb1_GrpSel

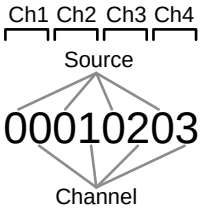
With this setting you can turn on or off the audio embedder groups of embedder 1 individually. An embedder group can be turned off (muted) by setting the corresponding group to ‘_’. For instance `12_4` means group 3 is mutes, `1_3_` means groups 2 and 4 are muted, etc. Default is `1234`.

#Emb1_Ch01/04 ~ #Emb1_Ch13/16

These settings allow you to select the source of the audio channels which need to be embedded into the SDI output.

You can choose between the following sources for each of the sixteen Ch01/16 channels:

SDI-de-embed Ch1 (value ‘00’), SDI-de-embed Ch2 (value ‘01’), to SDI-de-embed Ch16 (value ‘0F’), Dolby decoder out Dec1 (value ‘10’) to Dec8 (value ‘17’), Dolby encoder out Enc1 (value ‘18’), Dolby encoder out Enc2 (value ‘19’), Dolby decoder monitor out Dec_mon1 (value ‘1A’), Dolby decoder monitor out Dec_mon2 (value ‘1B’)



Defaults are (source: SDI_Input_1, channels: straight):

- #Emb1_Ch01/04 = 00010203
- #Emb1_Ch05/08 = 04050607
- #Emb1_Ch09/12 = 08090A0B
- #Emb1_Ch13/16 = 0C0D0E0F

#Emb1_Gain01 ~ #Emb1_Gain16

Adjusts the gain for the corresponding audio channel between -60 and 12dB. Everything below -999 dB means the audio will be muted. Default is 0dB

#Emb1_Delay01 ~ #Emb1_Delay16

Adjusts the delay of the corresponding audio channel between -5000ms and 5000ms. Default is 0ms.

#Emb1_Phase01/16

Adjusts the audio phase of the corresponding individual audio channel to 0 degree (‘`0`’) or 180 degrees (‘`1`’). Default is `0000000000000000` (channel number is counting up from left to right).

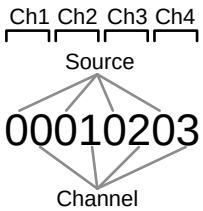
#Emb2_GrpSel

With this setting you can turn on or off the audio embedder groups of embedder 2 individually. An embedder group can be turned off (muted) by setting the corresponding group to ‘_’. For instance `12_4` means group 3 is mutes, `1_3_` means groups 2 and 4 are muted, etc. Default is `1234`.

#Emb2_Ch01/04 ~ #Emb2_Ch13/16

These settings allow you to select the source of the audio channels which need to be embedded into the second SDI output.
You can choose between the following sources for each of the sixteen Ch01/16 channels:

- SDI-de-embed Ch1 (value ‘00’), SDI-de-embed Ch2 (value ‘01’), to SDI-de-embed Ch16 (value ‘0F’), Dolby decoder out Dec1 (value ‘10’) to Dec8 (value ‘17’), Dolby encoder out Enc1 (value ‘18’), Dolby encoder out Enc2 (value ‘19’), Dolby decoder monitor out Dec_mon1 (value ‘1A’), Dolby decoder monitor out Dec_mon2 (value ‘1B’)



Defaults are (source: SDI_Input_1, channels: straight):

- #Emb1_Ch01/04 = 00010203
- #Emb1_Ch05/08 = 04050607
- #Emb1_Ch09/12 = 08090A0B
- #Emb1_Ch13/16 = 0C0D0E0F

#Emb2_Gain01 ~ #Emb2_Gain16

Adjusts the gain for the corresponding audio channel between -60 and 12dB. Everything below -999 dB means the audio will be muted. Default is 0dB

#Emb2_Delay01 ~ #Emb2_Delay16

Adjusts the delay of the corresponding audio channel between -5000ms and 5000ms. Default is 0ms.

#Emb2_Phase01/16

Adjusts the audio phase of the corresponding individual audio channel to 0 degree (‘`0`’) or 180 degrees (‘`1`’). Default is `0000000000000000` (channel number is counting up from left to right).

DOLBY GENERAL

Backup_out12

With `Backup_out12` set to `on`, decoder outputs 1 and 2 will contain the assigned backup channels in case the backup switch is activated.

Backup_out34

With `Backup_out34` set to `on`, decoder outputs 3 and 4 will contain the assigned backup channels in case the backup switch is activated.

Backup_out56

With `Backup_out56` set to `on`, decoder outputs 5 and 6 will contain the assigned backup channels in case the backup switch is activated.

Backup_out78

With `Backup_out78` set to `on`, decoder outputs 7 and 8 will contain the assigned backup channels in case the backup switch is activated.

Downmix

Here you can set the downmix mode of the downmix output of the Dolby Decoder. Can be `Lt/Rt` (Left total/right total, a downmix suitable for decoding with a Dolby Pro Logic upmixer to obtain 5.1 channels again), `Lr/Ro` (Left only/right only, a downmix suitable when mono compatibility is required), or Auto (Lt/Rt or Lo/Ro is chosen dependant on the whether or not there's a 5.1 program config or not). Default is `Auto`.

PCM_metadata

With this setting you decide whether you want to keep generating metadata in case the Dolby E is lost. Default is off.

PCM_latency

Here you define the delay in case the Dolby signal is lost. Can be set to SingleFrame (equal to Dolby E decoding) or to minimum.

VIDEO SYNC CONTROL

Dolby E decoders generally require a valid video sync input signal when operating. This signal must be aligned and matched to the timing and rate of the incoming Dolby E signal. Many facilities use a Vsync signal as a reference for timing throughout a larger broadcast chain.

VsyncALIGN

If the Vsync signal is present and properly matched, the DOLBY DECODER/ENCODER can then attempt to perfect the alignment. This option (`vsyncALIGN`) enables latency adjustment of the decoded audio so that the Dolby E stream is aligned exactly to the Vsync signal. The latency adjustment amount is up to plus or minus half the guard band length listed in the following table.

Guard Band Length	Frame Rate
360 samples	23.98 Hz
360 samples	24 Hz
192 samples	25 Hz
160 samples	29.97 Hz
160 samples	30 Hz

VsyncENA

If the option (`vsyncALIGN`) to align a Vsync signal when decoding Dolby E is set, and the signal is not aligned (within the tolerance window), the DOLBY DECODER/ENCODER can then attempt to reconstruct the alignment. This option (`VsyncENA`) adjusts the latency of the decoded audio so that the Vsync signal is aligned exactly to the Dolby E stream. The amount of latency added for the alignment is limited by the corresponding video frame length.

DOLBY D+ DEC

Ad_mix

If the decoder receives an input stream with AD program content, mixing occurs according to the input stream mixing metadata. The user has the option of routing the `mixed` audio, main audio (`Main_only`), or associated audio to the main output (`AD_only`).

Ad_2ch_mix

Same as `Ad_mix`, but for the 2ch monitoring output of the decoder. Here you can set the audio description as your monitoring output.

Operating_mode

The content of the dual-substream inputs (including 7.1 and 5.1+AD) has to be set manually with this setting.

MONITORING

Meta_Prgm_Sel

Here you select which set to metadata you want to monitor in the status menu (all items with an MD prefix).

Loudness_type

Here you set the loudness measure type of the loudness level output sine. Possible are:

- `1770-2+Dial`: ITU-R BS.1770-2 standard including dialogue normalization
- `1770-1+Dial`: ITU-R BS.1770-1 standard including dialogue normalization
- `1770-2`: ITU-R BS.1770-2 standard without dialogue normalization
- `Leq(A)`: A-weighting standard
- `Off`: no loudness monitoring

The loudness measurement standard EBU R 128 [2] was released in 2010, primarily for European audiences. This specification builds upon ITU-R BS.1770-1 [1] by defining three standard measurement windows: momentary (400 ms), short term (3 s), and integrated (entire program).

R 128 also introduced the concept of level gating. Level gating is an alternative gating strategy to speech gating (the method performed by Dialogue Intelligence) that utilizes a two-stage approach: an absolute gate, followed by a relative gate. Level gating makes no attempt to base loudness measurements on a dialogue anchor element, but instead bases its measurement on energy.

R 128 introduces new terminology for the units of loudness measurement: LUFS (loudness units relative to full scale). LUFS is functionally equivalent to LKFS, but represents a confusing discrepancy between the ITU and EBU.

Another new concept introduced by R 128 is the Loudness Range (LRA) descriptor. Loudness Range is essentially a measure of the spread of loudness measurements throughout a program, measured in Loudness Units (LU). Loudness Range is intended to determine the amount of preencoding compression required, for broadcasters that do not use metadata-based DRC (for example, for MPEG-1 Layer II audio). Dolby formats such as Dolby Digital and Dolby Digital Plus use Metadata based DRC, and therefore, LRA is irrelevant for these formats.

Loud_Prgm

Here you select of which dolby program you want to monitor the loudness level of.

Loud-ext_RST

With this setting you reset the loudness measurements for all loudness parameters.

Ld_DDp_Select

This setting selects which stream should be used to measure Loudness. Can be `Main_only`, `Mixed` or `AD_only`. This setting is only valid when there's an audio discription channel.

Ld_PCM_Select

Here you select which loudness parameter you want to monitor (which parameter you want to have as PCM output sine). The following are the parameters included in the loudness packed structure:

- `Int_UGTD` (Integrated ungated loudness): This parameter provides the loudness measurement for the entire program since the last reset, and does not use any gating for the measurement.
- `Int_SPCHGTD` (integrated speech gated loudness): This parameter provides the loudness measurement for the entire program since the last reset, and uses Dialogue Intelligence to speech gate the measurement.
- `Int_LVLGTD` (integrated level gated loudness): This parameter provides the loudness measurement for the entire program since the last reset, and uses level gating per ITU-R BS.1770-2 to gate the measurement.
- `Int_10sUGTD` (ten_second_ungated_loudness): This parameter provides the loudness measurement for the last ten seconds, and does not use any gating for the measurement.
- `Int_10sSPCHGTD` (ten second speech gated loudness): This parameter provides the loudness measurement for the last ten seconds, and uses Dialogue Intelligence to speech-gate the measurement.
- `Int_3sUNGTD` (three second ungated loudness): This parameter provides the loudness measurement for the last three seconds, and does not use any gating for the measurement.

- `MOM` (momentary loudness): This parameter provides the loudness measurement for the last 400 milliseconds, and does not use any gating for the measurement.
- `INT` (integrated loudness): This parameter provides a single, simplified measurement value for the loudness over the entire program. It automatically sets the value to be either the ungated, speech-gated, or level-gated result based on the loudness estimation mode, configured speech threshold, and amount of speech detected. It follows these guidelines:
  - If the loudness estimation mode is set to 0 (ITU-R BS.1770-2 plus Dialogue Intelligence), 1 (ITU-R BS.1770-1 plus Dialogue Intelligence), or 3 (Leq(A) plus Dialogue Intelligence), and the percentage of speech detected exceeds

the configured speech threshold (defaulted to 20%), the value displays the speech-gated result.
  - If the loudness estimation mode is set to 2 (ITU-R BS.1770-2) , the value displays the level-gated result.
  - Otherwise, the value displays the ungated result.

- `S10s` (ten second loudness): This parameter provides a single, simplified measurement value for the loudness over the last ten seconds. It automatically sets the value to be either the ungated or speech-gated result based on the following rules:
  - The value is set to –120dB until dialogue is detected.
  - If ten seconds elapse from the beginning of the program without any dialogue detected, the value is set to the ungated ten-second loudness.
  - Once dialogue is detected:
    - The value is set to the ten-second speech-gated loudness result.
    - When the Dialogue Intelligence algorithm detects that speech has ceased, this value holds the last active speech-gated result until speech becomes active again or the program is reset.

The loudness packed structure provides program loudness information for the last 0.5 seconds and is updated twice each second. The values in this output are dependent on the loudness metering mode as defined by the Loudness_type control parameter. The following table lists valid parameters by mode.

Parameter	1770-3 +Dial	1770-2 +Dial	1770-2	Leq(A
Integrated ungated loudness		X		X
Integrated speech-gated loudness	X	X		X
Integrated level-gated loudness	X		X	
10s ungated loudness	X	X		X
10s speech-gated loudness	X	X		X
3s ungated loudness	X		X	
Momentary loudness	X		X	
Integrated loudness	X	X	X	X
10s loudness	X	X		X

Main_DRC_DD

With this setting you decide whether you want to apply the dynamic range (`None (Dialnorm)`, `RF mode` or `Line mode`) to the output signal of the decoder when the input is Dolby Digital.

Main_DRC_E

With this setting you decide whether you want to apply the dynamic range (`None (Dialnorm)`, `RF mode` or `Line mode`) to the output signal of the decoder when the input is Dolby E.

Main_DRC_PCM

With this setting you decide whether you want to apply the dynamic range (`None (Dialnorm)`, `RF mode` or `Line mode`) to the output signal of the decoder when the input is PCM.

Aux_DRC_DD

With this setting you decide whether you want to apply the dynamic range (`RF mode` or `Line mode`) to the monitoring signal of the decoder when the input is Dolby Digital.

Aux_DRC_E

With this setting you decide whether you want to apply the dynamic range (`RF mode` or `Line mode`) to the monitoring signal of the decoder when the input is Dolby E.

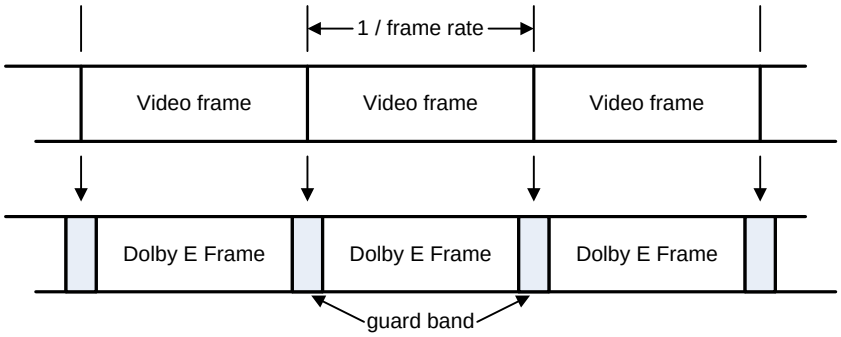
Aux-DRC_PCM

With this setting you decide whether you want to apply the dynamic range (`None (Dialnorm)`, `RF mode` or `Line mode`) to the monitoring signal of the decoder when the input is PCM.

ENCODER

GB_Shift

With this setting you can apply a guard band shift of up to 625 lines. This allows you to make small adjustments to the length of the guard band. The guard band of Dolby E is visualized in the following illustration.



DOLBY E depth.
16 bits if need the E encoder can be forced to encode 16 bits
20 bits if need the E encoder can be forced to encode 20 bits

Prgm

With Prgm is it possible to set the Program configurations.

program config	Description.
`5.1+2 AB`	one 5.1 channel and one stereo
`5.1+2 CD`	one 5.1 channel and one stereo
`5.1+2 EF`	one 5.1 channel and one stereo
`5.1+2 GH`	one 5.1 channel and one stereo
`5.1 A`	one 5.1 channel
`5.1 C`	one 5.1 channel
`2+2 BD`	two stereo programs
`2+2 FH`	two stereo programs

2+2 AC	two stereo programs
2+2 EG	two stereo programs
4X2 BDFH	four stereo programs
4X2 ACEG	four stereo programs
5.1+1+1 ABC	one 5.1 channel and 2 mono
Ext	Use inserted metadata

A, B, C, D, E, F, G and H represents the Metadata as set in the metadata parameters. Default is 5.1+2 (AB)

MD_loss

In case of metadata loss, the selected option in this setting is inserted instead. Default is 5.1+2(AB). Possible values are the same as listed under Pgrm, with the addition of Last (insert last available metadata).

GPI_2_prgm

GPI 2 selects where to switch to. If GPI 2 is turn on it set to this Prgm. Possible values are the same as listed under Pgrm with the addition of the setting Off (switching GPI2 off).

#Metadata_set

With metadata set it is possible to make metadata presets for program streams. This makes it possible to have fixed locations for metadata parameters. E.g. for a Stadium SET_A and B select in Prmg-cnf 5.1+2 (A+B) or in a concert hall SET_C and D select Prgm_cnf 5.1+2 (C+D).
The available sets are A, B, C, D, E, F, G, H. Default is A.
Please note that when you put a card back to default values in Cortex, The metadata set selected in menu item Meta_Prgm_Sel is set.

#Prgm_text

With Program Text it is possible to set a program name with a maximum of 16 characters. This name is included in the metadata.

#Bitstrm

Bitstream describes the audio service contained within the Dolby Digital. A complete audio program may consist of a main audio service (a complete mix of all program audio), an associated audio service comprising a complete mix, or one main service combined with an associated service. To form a complete audio program, it may be (but rarely is) necessary to decode both main service and an associated service using a maximum total bit rate of 512 kbps, refer to the guide to use of the ATSC digital television standard, document A/54 for further information. Although a detailed description follows.

Bitsteam	**Desciption**
Complete	CM flags the bitstream as the Main Audio service for the program and all elements are present to form a complete audio program. Currently, this is the most common setting. The

	service may contain one (mono) to six(5.10 channels.
M&E	The bitstream is the main audio service for the program, minus a dialogue channel. The dialogue channel, if any, is intended to be carried by an associated dialogue service. Different dialogue services can be associated with a single ME service to support multiple channels.
Visual	This is typically a single channel program intended to provide a narrative description of the picture content to be decoded along with the main audio service. The visual service may also be a complete mix of all program channels, comprising up to six channels.
Hearing	This is typically a single channel program intended to convey audio that has been processed for increased intelligibility and decode along with the main audio service. The Hearing service may also be a complete mix of all program channels.
Dialogue	This is typically a single program intended to provide a dialogue channel for a Main service. If the main service contains more than two channels, the dialogue is limited to only one channel. If the ME service is two channels, the Dialogue can be a stereo pair: the appreciate channels of each service are mixed tighter (requires special decoders)
Commentary	This is typically a single channel program intended to convey additional commentary that can be optionally decoded along with the main audio service. This service differs from dialogue services because it contains an optional, rather than required, dialogue channel. The service may also be complete mix of all program channels, comprising up to six channels.
Emergency	This is a single channel service that is given priority in reproduction. When the E-service appears in the bitstream, it is given priority in the decoder and the main service is muted.
VO_Karaoke	This is a single channel service intended to be decoded and mixed to the center channel. (requires special decoders)

#Dialogue_Lev

Dialogue level sets the average loudness of a dialogue in a presentation. The range is from –31dB to –1dB.
The default setting is –27dB

#Ch_mod

This setting sets the channel mode of the dolby signal. Default is 1/0(C). Possible settings are:

- 1/0(C)
- 2/0(LR)
- 3/0(LCR)
- 2/1(LRS)
- 3/1(LCRS)
- 2/2(LRSlSr)
- 3/2(LCRSlSr)

#Line

Line sets the Dynamic range metadata of presets (Default is `None`).

- `None`, no dynamic range compression is applied unless downmixing could cause overload, in which case protection dynamic range is automatically applied.
- `Film stnd`, applies more compression to a subjectively loud film that requires dynamic range restriction.
- `Film Light`, applies light compression to a subjectively quiet film that does not require dynamic range restriction.
- `Music Stnd`, applies more compression to music that is not compressed and requires dynamic range restriction.
- `Music light`, applies light compression to music that is already compressed and does not require excessive dynamic range restriction.
- `Speech`, Appropriate for programs with predominantly dialogue.

#RfMode

`RfMode` has the same options as Line, but each option is 11 dB more sensitive to avoid overloading the RF input of a television. Possible are: `None`, `Film stnd`, `Film light`, `Music stnd`, `Music light` and `speech`. Default is `None`.

#D Srnd

`Dolby Surround`. Determines when a Dolby Digital decoding product also contains a Dolby Pro Logic decoder, whether the two-channel encoded bistream contains a Dolby Surround (Lt/Rt) program that requires Pro Logic decoding. Decoders can use this flag to automatically switch on Pro-logic decoding as required.

- `Not indic`, Not Indicated
- `Not Srnd`, Not Dolby surround; the bitstream contains information that was not Dolby Surround encoded.

`Dolby Srnd`, Dolby Surround; the bitstream contains information that was Dolby Surround encoded. After Dolby Digital decoding, the bitstream is pro logic decoded.

#Pref dwnmx

Preferred Down mix. This parameter allows the user to select either Lt/Rt or the Lo/Ro downmix in a consumer decoder that has stereo outputs. Consumer receivers are able to override this selection, but this parameter provides the opportunity for a 5.1 channel soundtrack to play in `Lo/Ro` mode without user intervention. This is especially useful on music material. `NOT indicated`, `Lt/Rt` and `Lo/Ro` are the possible mix types. Default is `Lt/Rt`.

#Lt/RT C dwnmx

Lr/Rt Center Mix Level. This setting indicates the level shift applied to the center channel when adding to the left and right outputs when downmixing to a Lt/rt output. Its operation is similar to the surround downmix level in the Universal metadata. `+3dB`, `+1.5dB`, `0dB`, `-1.5dB`, `-3.0dB`, `-4.5dB`, `-6.0dB` and `-999dB`. Default is -3.0dB.

#Lt/RT S dwnmx

LtRt Surround Mix level. This setting indicates the level shift applied to the surround channels when downmixing to a Lt/Rt output. Its operation is similar to the surround downmix level in the universal metadata. `-1.5dB`, `-3.0dB`, `-4.5dB`, `-6.0dB` and `-999dB`. Default is `-3dB`.

#Lo/Ro C dwnmx

Lo/Ro Center mix level. This setting indicates the level shift applied to the center channel when adding to the left and right outputs when downmixing to a Lo/Ro output. When Extended BSI parameters are active, this parameter is used and the Center Mix Level parameter in the universal parameters is not.`+3dB`, `+1.5dB`, `0dB`, `-1.5dB`, `-3.0dB`, `-4.5dB`, `-6.0dB` and `-999dB`. Default is `-3dB`.

#Lo/Ro S dwnmx

Lo/Ro Surround Mix level. This setting indicates the level shift applied to the surround channels when downmixing to a Lo/Ro output. When extended BSI parameters are active, this parameter is used, and the surround mix level parameter in the universal parameters is not. `-1.5dB`, `-3.0dB`, `-4.5dB`, `-6.0dB` and `-999dB`. Default is `-3dB`.

#Srnd EX

Surround EX. This setting is used to identify the encoded audio as surround EX encoded material. This parameter is only used if the encoded audio has two surround channels. An amplifier or receiver with Dolby Digital EX decoding can use this parameter as a flag to switch the decoding on or off automatically. The behavior is similar to the Dolby Surround Mode parameter. `Not Indic`, `NotDolbySrnd`, `DolbySrnd`. Default is `NotDolbySrnd`.

#DC filter

DC filter. This setting determines whether a DC blocking 3Hz highpass filter is applied to the main inputs channels of a Dolby Digital encoder prior encoding. This parameter is not carried to the consumer decoder. It is used to remove DC offsets in the program audio and would only be switched off in exceptional circumstances. `On` this function is active, `OFF` this function is not active. Default is `On`.

#LFE filter

LFE lowpass filter. This setting determines whether a 120Hz 8 order lowpass filter is applied to the LFE channel input of a Dolby Digital encoder prior to encoding. It is ignored if the LFE channel is disabled. This parameter is not sent to the consumer decoder. The filter removes frequencies above 120Hz that would aliasing when decoded. This filter should only be switched off if the audio to be encoded is known to have no signal above 120 Hz. `On` (active) or `OFF` (not active). Default is `On`.
LFE filter is automatically switched on when ACMOD is 3/2.

#Lowpass Filter

Lowpass Filter. This setting determines whether a lowpass filter is applied to the main input channels of a Dolby Digital encoder to encode. This filter removes high frequent signals that are not encoded. At the suitable data rates this filter operates above 20 kHz. In all cases it prevents aliasing on decoding and is normally switched on. This parameter is not passed to the consumer decoder. `On` this function is active, `OFF` this function is not active. Default is `On`.

#Srnd 3Db atten

Surround 3dB attenuation. This setting determines whether the surround channels are attenuated 3 dB before encoding. The attenuation actually takes place inside the Dolby Digital encoder. It balances the signals levels between theatrical mixing rooms (dubbing stages) and consumer mixing rooms (dvd or tv studios) Consumer mixing rooms are calibrated so that all five main channels are at the same sound pressure level (SPL). For compatibility reasons with older film formats, theatrical mixing rooms calibrate the surround channels 3dB lower in SPL that the front channels. The consequence is that signal levels on tape are 3dB louder. Therefore, to convert to a consumer mix from theatrical calibration it is necessary to reduce the surround levels by 3dB. `On` = this function is active, `OFF` = this function is not active. Default is `Off`.

#Srnd_Ph_Shift

Surround Phase Shift. This setting takes care that the Dolby Digital encoder applies a 90-degree phase shift to the surround channels. This allows a Dolby Digital decoder create a Lt/Rt downmix simply. For most material the phase shift has a minimal impact when the Dolby Digital program 1 decoded to 5.1 channels, but provides a Lt/Rt output that can be Prologic decoded to L, C, R, S if desired. However, for some phase-critical material (such as music) this phase shift is audible when listening in 5,1 channels. Likewise, some material downmixes to a satisfactory Lt/Rt signal without needing this phase shift. It is therefore important to balance the needs of the 5.1 mix and

the Lt/Rt downmix for each program. `On` this function is active, `OFF` this function is not active. Default is `On`.

DolbyE Depth

If needed the E encoder can be forced to encode in 16 bits or in 20 bits. Default is 20 bits.

If 16-bit depth is selected, and a program config of more than 6 channels is also selected (via internal or external metadata), then an 'appropriate' 6 channel program config will be automatically used instead. For example: bit depth = 16 bit, program config set to 5.1+2, then the Dolby E encoder will use Program Config 5.1 for encode. Therefore the +2 channels for the encode will be dropped.

Category

Only used by Axon or Dolby

Parameter

Only used by Axon or Dolby

GPIO options

Contact _1 ~ Contact_8

In this card it is possible to make the 8 available GPI contacts part of a GPI pool that can control the various functions in the card separately (all `Xx_Ctrl` items of the menu). With these item you can select which pool the corresponding GPI is part of. You can also choose to not use the corresponding GPI at all by setting it to `Off`. Possible settings are:

- `GPI A`: part of GPI-A pool, triggered once Take A is closed.
- `GPI B`: part of GPI-B pool, triggered once Take B is closed.
- `GPI C`: part of GPI-C pool, triggered once Take C is closed.

Please refer to 'Appendix 3: GPI's explained' for a more elaborate explanation of the GPI settings and status items.

GPI_A-Take ~ GPI_C-Take

Selects a take contact for the corresponding GPI pool. Possible settings are:

- `Off`: No take contact is defined, and values on the GPI contact are taken instantly.
- `Contact_1 ~ Contact_8`: The selected contact is used as a Take command for the corresponding pool. Closing the selected contact results in the card latching the value provided on the selected contacts for that pool.

Please refer to 'Appendix 3: GPI's explained' for a more elaborate explanation of the GPI settings and status items.

GPI_A-mode ~ GPI_C-mode

Selects the mode for the corresponding GPI pool. Possible settings are:

- `Prio`: Each contact triggers another value, so values are one-hot encoded.
- `Prio_latched`: This mode functions like `Prio` Mode, but the card latches the value. Each contact triggers another value, so values are one-hot encoded. Use this mode when using pushbuttons.
- `Binary`: Values are coded in a binary fashion, with code "00000" coding for a starting value of 1, as can be seen in the GPI status items.

Please refer to 'Appendix 3: GPI's explained' for a more elaborate explanation of the GPI settings and status items.

LUT CONTROL

Split-Screen

This setting turns the split screen `On` or `Off` showing a horizontal split video. The left side shows the input video through the lut and matrix conversions. The right side shows the input video transparent. The position of the split can be set with the `H-Split` setting. Default is `Off`.

H-Split

When the `Split-Screen` setting is set to `On` this setting controls the horizontal split position of the video. The setting uses percentages from `0%` to `100%` where `0%` shows the full right side and `100%` shows the full left side. The left side shows the input video through the lut and matrix conversions. The right side shows the input video transparent. Default is `50%`.

Lut-Prst_Act

With this setting you can manually change the currently active lut settings. Can be any preset between 1 and 16. By default it is set to 1. All menu settings that are preceded with a '`#` '-prefix under the '`LUT CONTROL`' header are part of the preset.

Lut-Prst_Edit

Here you can select which of the 16 selectable lut setting presets you want to edit. Changing this will not change the active preset, unless the currently active preset is the same you are going to edit. All menu settings that are preceded with a '`#` '-prefix under the '`LUT CONTROL`' header are part of the preset.

#Input-Matrix

With this setting you can specify the color container standard of the input video. The setting can be set to `Rec.709`(HD) or `Rec.2020`(UHD). Default is `Rec.709`.

#1D_LUT_Pre	This setting controls the 1D lut before the 3D lut and the matrix converter. There are 16 preset locations where a 1D lut file can be uploaded to using ftp or webDAV.
#3D_LUT	This setting controls the 3D lut. There are 16 preset locations where a 3D lut file can be uploaded to using ftp or webDAV.
#Matrix_Conv	This setting controls the color conversion to convert between the ITU BT.709(HD) and BT.2020(UHD) recommendations by using a matrix conversion. This matrix conversion does not specify the color space container like the input and output matrices do. The settings are `709to2020`, `2020to709` and `Transparent`. Default is `Transparent`. Note: The setting `2020to709` clips colors that are out of bounds of the BT.709 color space.
#1D_LUT_Post	This setting controls the 1D lut after the 3D lut and the matrix converter. There are 16 preset locations where a 1D lut file can be uploaded to using ftp or webDAV.
#Output-Matrix	With this setting you can specify the color container standard of the output video. The setting can be set to `Rec.709`(HD) or `Rec.2020`(UHD). Default is `Rec.709`.
	NETWORK
IP_Conf0	With this setting you can let the card obtain an IP address automatically via `DHCP`, or appoint a `manual` set IP address. By default this setting is set to `Manual`.
mIP0	When `IP_Conf0` is set to `manual`, you can type in the preferred IP address here. By default it is set to 172.16.1.2
mNM0	With `IP_Conf0` set to `manual`, with this setting you can set a Netmask. Default is 255.255.0.0
mGW0	With `IP_Conf0` set to `manual`, this setting let you set a Standard Gateway. Default is set to 172.16.0.1
NetwPrefix0	Here you can set the proper network prefix if required.

6 Status Menu

Introduction

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

SFP STATUS

SFP1-Vendor

These status item display the name of the vendor of the SFP input/output module A.

SFP1-Type

These status items display the type name/number of SFP input/output module A.

SFP1-Temp-Stat

These indicate whether the temperature of SFP input/output module A is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. Can also be `NA` in case Temperature monitoring is not available or the module is not inserted.

SFP1-Volt-Stat

These indicate whether the voltage usage of SFP input/output module A is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. Can also be `NA` in case Voltage monitoring is not available or the module is not inserted.

Port1/2-Enabled

These item indicate whether the corresponding output port on SFP output module A is `enabled`, `disabled` or `NA` (Not available, when no input signal is available or an input module is inserted.)

Port1/2-Power

These status items indicate the current transmitter power of the specified port on SFP output module A between 0mW and 6.55mW. When a receiver is installed or no SFP module is inserted this value is 0.

Port1/2-Power-Stat

These indicate whether the output power of the specified port on SFP output module A is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. Can also be `NA` in case of an input module or no module is inserted.

Port1/2-Bias

These status items indicate the current laser bias of the specified port on SFP module A is between 0mA and 300mA. When there is a non fiber SFP or an input module is inserted, this value will be 0.

Port1/2-Bias-Stat

These indicate whether the laser bias of the specified port on SFP output module A is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. This can also be `NA` in case laser bias monitoring is not available or no output module is inserted.

Port1/2-Wavelength

Indicates the current wave length of the corresponding output port on the SFP output module A between 0nm and 2000nm. When there is a non fiber SFP or RX module installed, this value will be 0.

SFP2-Vendor	These status item display the name of the vendor of the SFP input/output module B.
SFP2-Type	These status items display the type name/number of SFP input/output module B.
SFP2-Temp-Stat	These indicate whether the above indicated temperature of SFP input/output module B is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. This can also be `NA` in case Temperature monitoring is not available or the module is not inserted.
SFP2-Volt-Stat	These indicate whether the above indicated voltage usage of SFP input/output module B is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. This can also be `NA` in case Voltage monitoring is not available or the module is not inserted.
Port3/4-Enabled	These item indicate whether the corresponding output on SFP output module is `enabled`, `disabled` or `NA` (Not available, when no input signal is available or an input module is inserted)
Port3/4-Power	These status items indicate the current transmitter power of the specified port on SFP output module B between 0mW and 6.55mW. When an input module is inserted or no SFP module is inserted this value is 0.
Port3/4-Power-Stat	These indicate whether the output power of the specified port on SFP output module B is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. Can also be `NA` in case of an input module or no module is inserted.
Port3/4-Bias	These status items indicate the current laser bias of the specified port on SFP output module B is between 0mA and 300mA. When there is a non fiber SFP or RX SFP installed, this value will be 0.
Port3/4-Bias-Stat	These indicate whether the laser bias of the specified port on SFP output module B is `Too_High`, `High`, `OK`, `Low` or `Too_Low`. This can also be `NA` in case laser bias monitoring is not available or no module is inserted.
Port3/4-Wavelength	Indicates the current wave length of the corresponding output port on SFP output module B between 0nm and 2000nm. When there is a non fiber SFP or RX module installed, this value will be 0.

sInp1 ~ sInp8	This status item indicates the presence and the format of a valid signal on physical input 1 to 8. This is displayed as: ▪ 1080P60 ▪ 1080p50 ▪ 1080i60 ▪ 1080i50 ▪ 1080p30 ▪ 1080p25 ▪ 1080p24 ▪ 1080psf24 ▪ 720p60 ▪ 720p50 ▪ 720p30 ▪ 720p25 ▪ 720p24 ▪ SD525 SD625
sInpA ~ sInpD	This status item indicates the presence and the format of a valid signal on processing channel A to D. This is displayed as: ▪ 1080P60 ▪ 1080p50 ▪ 1080i60 ▪ 1080i50 ▪ 1080p30 ▪ 1080p25 ▪ 1080p24 ▪ 1080psf24 ▪ 720p60 ▪ 720p50 ▪ 720p30 ▪ 720p25 ▪ 720p24 ▪ SD525 ▪ SD625
sInpA_CRC_EDH ~ sInpD_CRC_EDH	This item indicates CRC and EDH errors on processing channel A to D. Can be: ▪ Off ▪ OK ▪ Error ▪ NA ▪ NoPCM
sInpA_Map ~ sInpD_Map	This item indicates what the mapping of the signal is on processing channel A to D. Can be: ▪ Level A ▪ Level B ▪ NA

SwitchLnA ~ SwitchLnD	Displays the switch line of the processing channels A to D. Can be a value between `0` and `1025`.
Inp_Align_SDI1_2 ~ Inp_Align_SDI1_4	Displays the difference in ns of the SDI inputs in reference to `SDI1`. Can be a value between `-400.000ns` and `400.000ns`.
IODelayA ~ IODelayD	Displays the total delay in ms of outputs A to D. Can be a value between `0ms` and `16383ms`.
FunctionA	Displays the current mode/function of processing channel A. Can be: ▪ `Up` ▪ `Down` ▪ `Cross` ▪ `Trans` ▪ `Na` ▪ `TestPattern`
Ref-Format	Displays whether there is a correct reference and what the connected reference format is: Can be. ▪ `NA` ▪ `NTSC/480i` ▪ `PAL/576i` ▪ `720p` ▪ `1080i` ▪ `1080p`
GPI	Displays the currently closed GPI contacts. This is displayed as for instance 1_3_ when contacts 1 and 3 are closed and for instance _234 when contacts 2, 3 and 4 are closed.
GPIA	Displays the current value of GPI pool A
GPIB	Displays the current value of GPI pool B
GPIC	Displays the current value of GPI pool C
SDIADemFrmt01/02 ~ SDIADemFrmt15/16	These status items indicate the detected audio format of each audio pair in the de-embedder of SDI input 1. Can be one of the following formats: ▪ `N/A` ▪ `PCM` ▪ `Null` ▪ `AC-3` ▪ `TimeStmp` ▪ `MPEG-1` ▪ `MPEG-2` ▪ `SMPTE-KLV`

- Dolby E
- Caption data
- UserDef
- Rsvd
- Enh Ac-3

EmbStat_A

Displays the status of the individual audio channels of the embedder output. Displayed as for instance SC_PPPPPPPPPPPPP, when channel 1 is Silence, channel 2 is Clipped, channel 3 is NA (not available) and channel 4 to 16 are Present

AddOnFrmtInA1/2 ~ AddOnFrmtInD3/D4

These status items indicate the detected audio format of each audio pair in the add-on bus. Can be one of the following formats:

- N/A
- PCM
- Null
- AC-3
- TimeStmp
- MPEG-1
- MPEG-2
- SMPTE-KLV
- Dolby E
- Caption data
- UserDef
- Rsvd
- Enh AC-3

AddOnFrmtIn01/02 ~ AddOnFrmtIn31/32

These status items indicate the detected audio format of each audio pair from the quad speed addon bus. Can be one of the following formats:

- N/A
- PCM
- Null
- AC-3
- TimeStmp
- MPEG-1
- MPEG-2
- SMPTE-KLV
- Dolby E
- Caption data
- UserDef
- Rsvd
- Enh Ac-3

SOF-E_A1/2A

Displays the start line of a Dolby E frame. Can be a value between 0 and 1124 (dependant on input and output format).

NET STATUS

IP_Addr0

This item displays the status of the IP address. It can be manual, DHCP asking, DHCP Leased or DHCP Infin.

MAC0 This item displays the MAC address of the card.

IP0 This item displays the current IP address of the card.

NM0 This item displays the current Netmask of the card.

GW0 This item displays the current Standard Gateway of the card.

7 Events Menu

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

The events reported by the U4T200-U4T240 are as follows;

Announcements

`Announcements` is not an event. This item is only used for switching the announcement of status changes on/off. 0=off, other =on

Input_A

Input_A can be selected between 0 .. 255. 0= no event, 1..255 is the priority setting.

Ref-Status

Reference can be selected between 0 .. 255. 0= no event, 1..255 is the priority setting.

Active_Out_A

Active output A can be selected between 0 .. 255. 0= no event, 1..255 is the priority setting.

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 Synapse Set-up 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 card are:

Event Menu Item	Tag		Description
Announcements	0 or NA	0 or NA	Announcement of report and control values
Input_A	01_{hex}=INPA_LOSS	81_{hex}=INPA_RETURN	input A lost or returned
Reference	03_{hex}=REF_LOSS	83_{hex}=REF_RETURN	reference lost or returned
Acive_Out_A	19_{hex}=IN_B->OUT_A	99_{hex}= IN_A->OUT_A	Input B or input A on outputs A

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 RRC 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 LED Indication

Error LED

The error LED indicates an error if the internal logic of the card is not configured correctly or has a hardware failure.

Input_x LED

This LED indicated the presence of a valid SDI video signal on input x.

ANC Data LED

Indicates the presence of embedded audio within the input signal.

Reference LED

Indicated the presence of a valid reference signal on the selected reference input connector (ref-1 or ref-2).

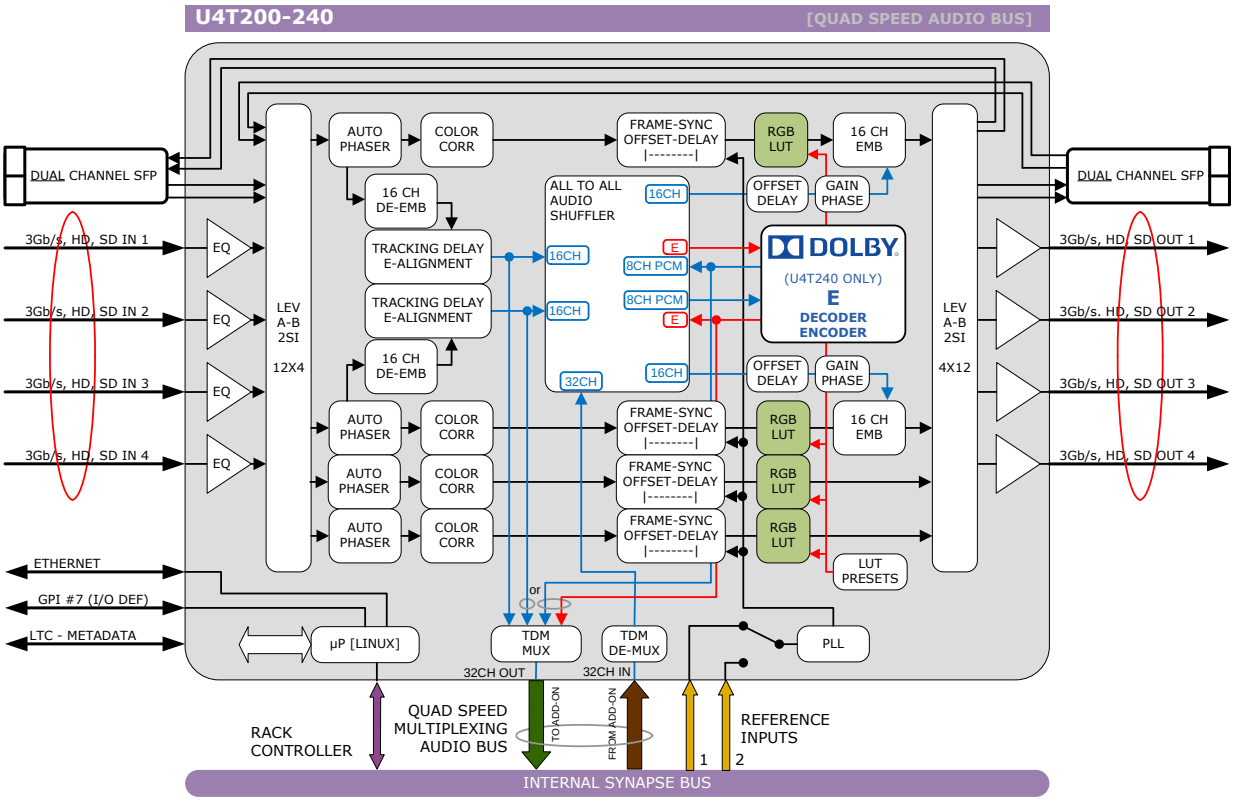
Data Error LED

This LED indicates a CRC error.

Connection LED

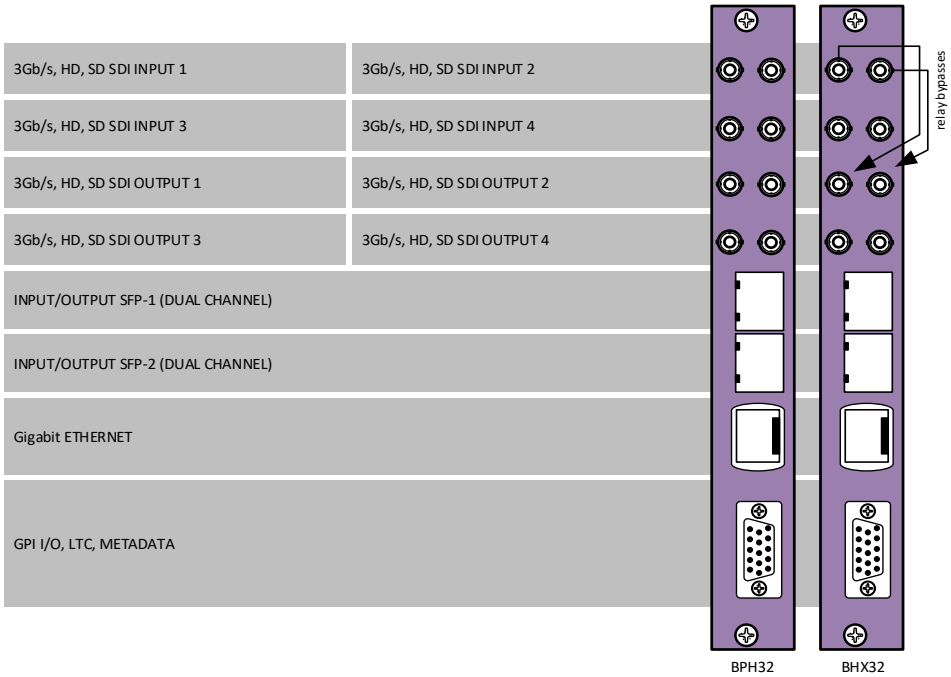
This LED illuminates after the card has initialized. The LED lights for 0.5 seconds every time a connection is made to the card.

9 Block Schematic



10 Connector Panels

The U4T200 and U4T240 can be used with the BPH32 or the BHX32. The following table displays the pinout of these backpanels in combination with the card.



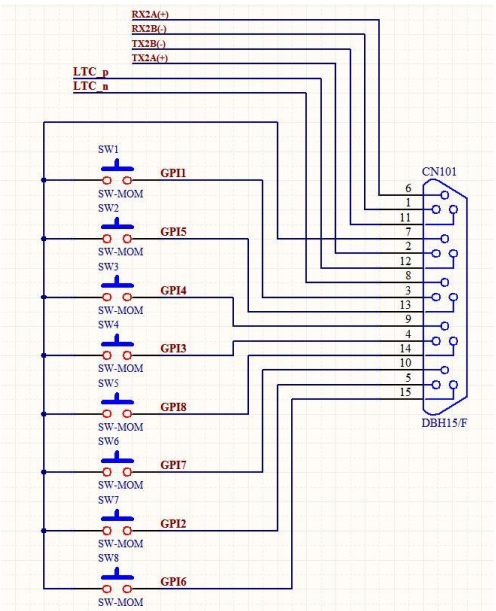
Note Unused inputs and outputs must be terminated with the correct impedance

D-sub pinning

Note: GPI's work in a latching mode

Of the 15-pole subD connector:

pin 01 = RX2B
pin 02 = TX2A
pin 03 = GPI_1
pin 04 = GPI_3
pin 05 = GPI_2
pin 06 = RX2A
pin 07 = GND
pin 08 = LTC-
pin 09 = GPI_4
pin 10 = GPI_7
pin 11 = TX2B
pin 12 = LTC+
pin 13 = GPI_5
pin 14 = GPI_8
pin 15 = GPI_6



Appendix 1 Reprogramming GXGxxx modules

Before you start

Functionality explanation

A Synapse card's functionality is decided by 2 parts: the hardware platform and the software (a.k.a. firmware) that resides on the hardware platform. Changing the firmware of the cards means changing the way the card functions. To keep improving quality and to answer our customer's demands, Axon sometimes releases new software revisions of Synapse cards. These software revisions are formatted in 1 file per revision, with a .spf extension. Customers can download these .spf files from our website, or receive them via e-mail from our support so they can upgrade or reprogram their own cards.

Choosing .spf files

Not all .spf files are compatible with all hardware platforms. To know for certain that you are choosing a compatible .spf file you have to know the hardware revision of your card. This revision number can be found in the menu of the card via the control panel on the frames (select card, select 'about', check HW number) or via Cortex (Axon's control software) (select frame, select card, select 'Identity', check 'hardware rev').

Knowing the hardware revision number, you can go to our website (www.axon.tv) and go to our download firmware section. Here you select the card you wish to upgrade. You will see a list of available firmware upgrades of this particular card. The firmware files that are compatible with your card should display your card's hardware revision number in table next to "Hardware versions". If this is not the case you will not be able to upgrade your card with that file.

Requirements

For reprogramming or upgrading cards, you need the Cortex program installed on a PC or laptop which is connected to the same network to which the card is connected also. You can download the program free of charge from our website. For this this card you need to use Cortex version v1.091 or later. Updating the card must be done locally (direct connection) through the Ethernet of the backplane. The bottom Ethernet connection must be used.

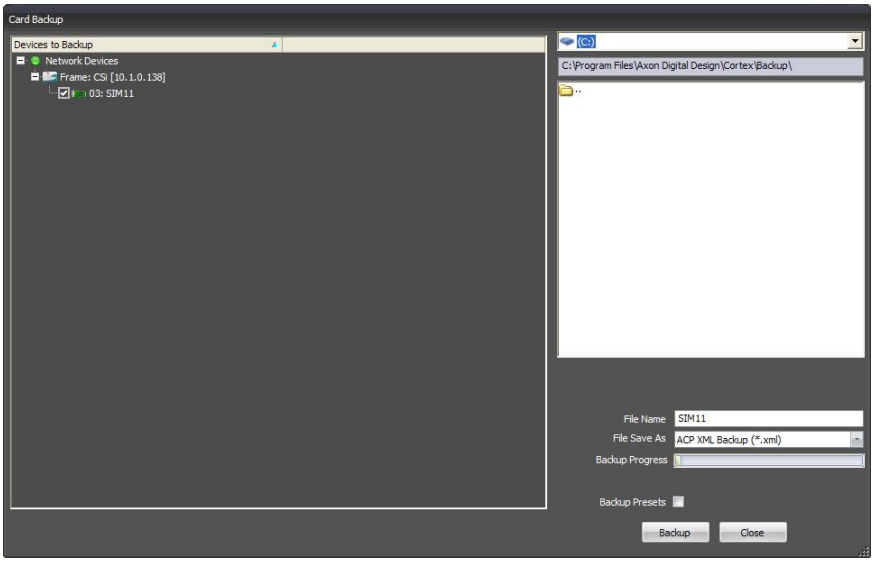
Using Cortex help files

This manual describes how to upgrade cards using Cortex. When you are using Cortex and require card further instructions, please refer to the Cortex help files (select 'Card' in the menu > select 'Upload Firmware' (the firmware uploading window will open) > press F1).

Precautions

Backup your settings

It is advised to back up the settings before upgrading the card. To do this, select the frame and card you want to upgrade. Then choose “Card” in the menu and select “Backup card”. An exact copy of the card’s menu can be stored as .xml file in the following window. The next image displays the window where this is done.



At your own risk

During the upgrade process, the card will stop functioning for a period of time. Make sure the card you are going to upgrade is currently ***not*** being used by anyone in your company.

N

Use cortex version 1.09.01 or later. This software can be downloaded from our website. www.axon.tv

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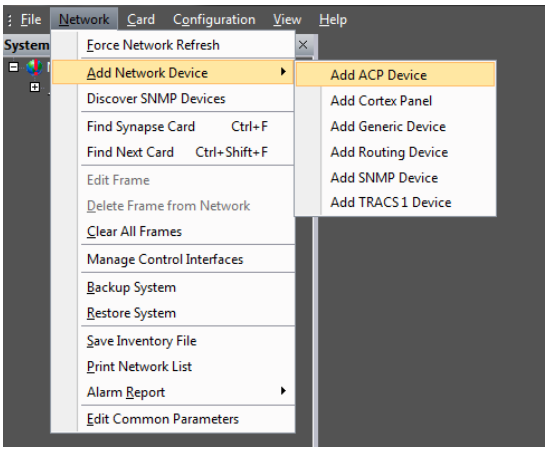
Setting up card

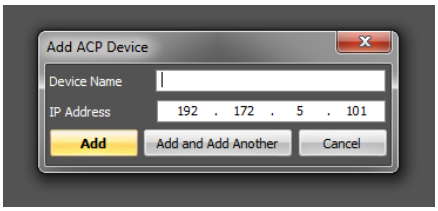
To be able to program the card direct we need to perform two steps. One is setting up of the IP address of the card and second will be making the board recognized as stand alone entity.

To set-up the IP address of the card goto the system view within the Cortex program. Select the HLDxxx and goto the device view tab. Within the device tab you will be able to setup the IP address, netmask and gateway.

The next step is to make the card available as a stand alone card within the system. To add this card you need to go to the network tab at the top of the cortex program. Then go to add network device and choose add ACP device.

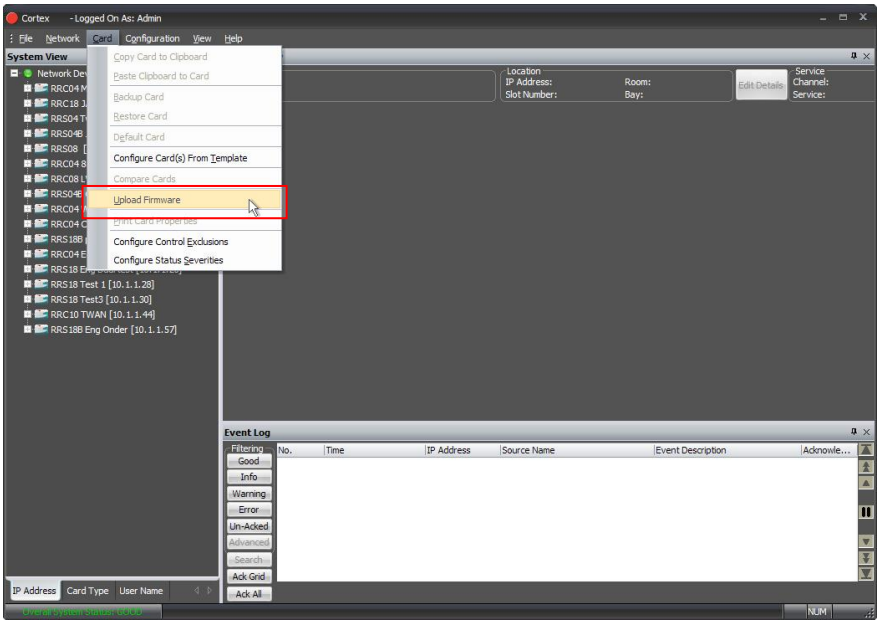


Fill out the name of the card and also the ip address.

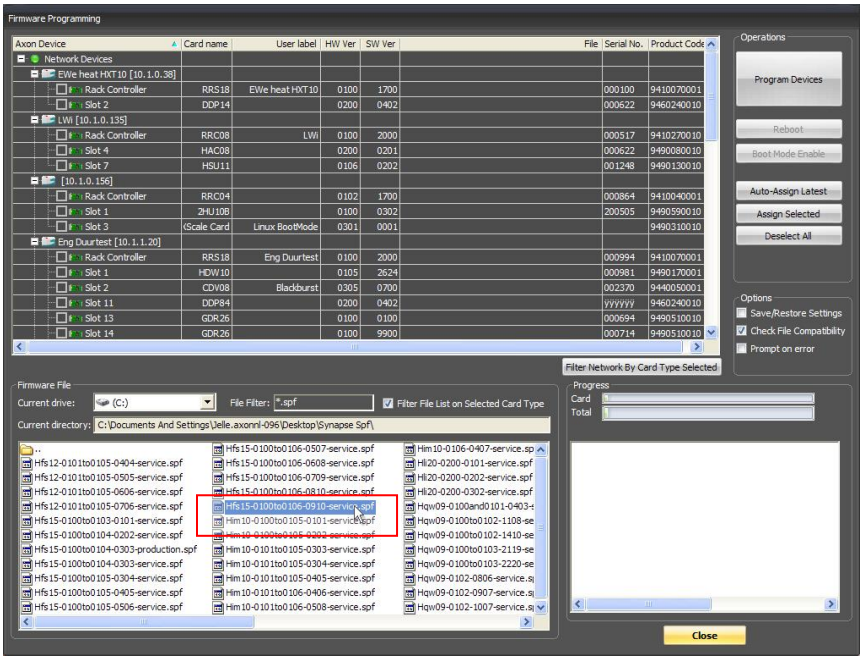


Upload firmware

You can start upgrading the card. To do this, click ‘Card’ in the top menu and select ‘Upload Firmware’ from the dropdown box as displayed below.

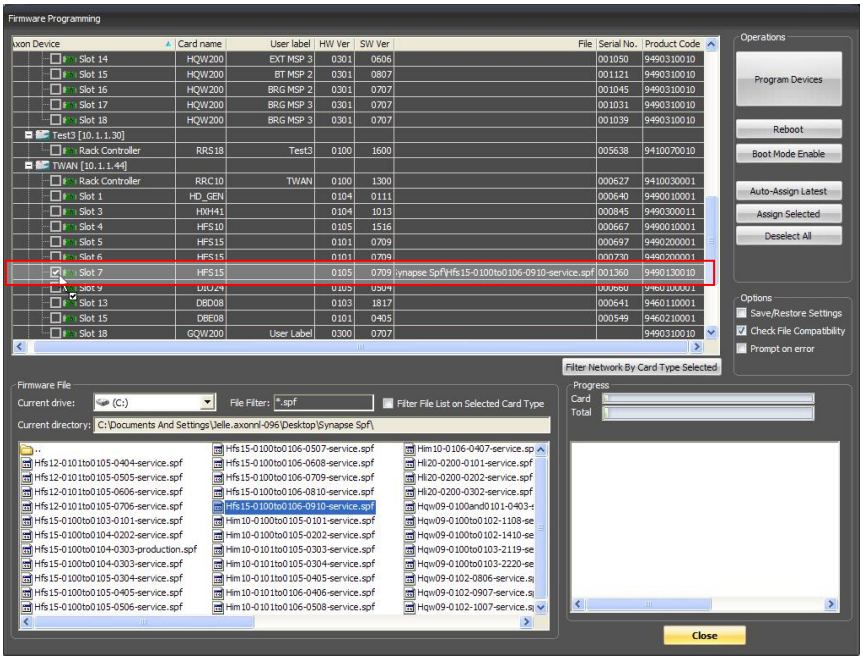


A new window will open, showing you the firmware upload functions. ***At first you must select which .spf file you want to load***. You do this in the buttom dialog as shown below.



To select which .spf you would like to upload into the card, you click the ‘Current drive’ button and select the folder which holds your .spf files.

When you selected the .spf file, check the card(s) in which you want to load this .spf file. You can load multiple cards with the same .spf file at the same time. When the selected .spf file can not be loaded in the card you try to check an error message will appear in the bottom right box. Selecting a card is done as displayed on the next page.



Testing

When all previous instructions have been completed the card should be functioning properly. We advise however to test the card's functionallity before you are going to put it into real on-air use.

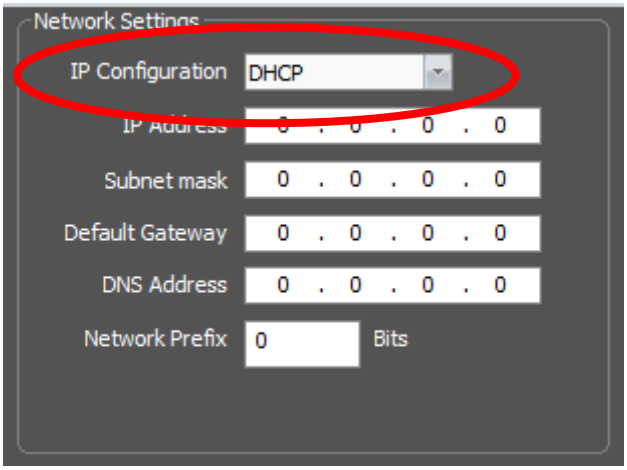
Appendix 2 Uploading LUT tables using Cortex

Introduction

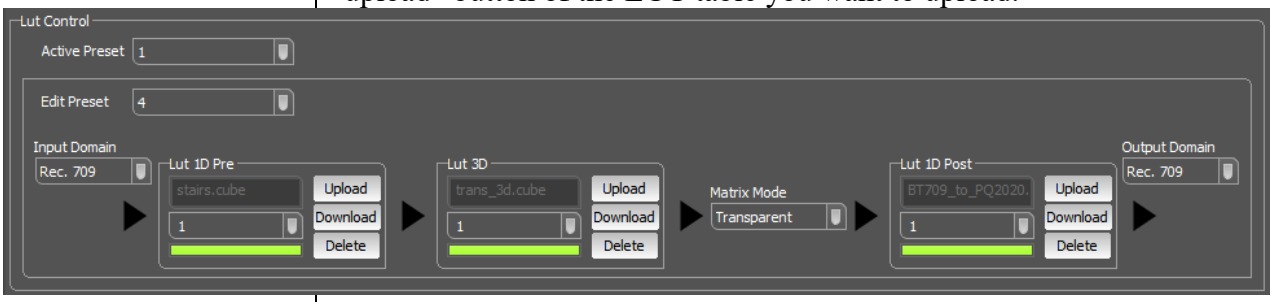
The most common and easy way to upload LUT tables is to use Cortex, which contains a GUI view to upload tables. Cortex is downloadable via our website free of charge.

Uploading files

Configure the IP address of the UXU network interface using Cortex 1.01 or higher. Use DHCP or fixed IP address on your network and configure the subnet mask. Please note that the UXU might be on the same network as the rack controller. The IP addresses shown in the screenshot below are just examples, replace these addresses with the correct addresses if needed.



In the ‘Lut Control’ groupbox in the UXU Cortex GUI, press the “upload” button of the LUT table you want to upload.



Select a .CUBE file containing the LUT table you want to upload and click ‘Open’. Then click the ‘Upload’ button in the Cortex GUI.

Appendix 3 Uploading LUT tables using WebDav or FTP

Introduction

The most common and easy way to upload LUT tables is to use Cortex, which contains a GUI view to upload the specific files. If you are not using Cortex, you can still upload LUT tables.

To upload files to the UXU without using Cortex, connect the card using its Ethernet port to a computer that supports WebDAV (Web Folders).

WebDAV

WebDAV is an abbreviation for "Web-based Distributed Authoring and Versioning" (published as an open standard under RFC 2518). WebDAV is a set of extensions to the HTTP protocol which allows users to collaboratively edit and manage files on a web server. This is achieved by making use of a WebDAV compatible client / application.

For example, it is possible to use recent versions of Microsoft's Internet Explorer (versions 6.0 and higher). Using a WebDAV compatible client, the user connects to the server and is able to browse and manage files in a similar way as with a network share or an FTP server.

In other words, what this protocol does is that it makes it possible to browse, create, remove, upload, download, rename, etc. files and directories on a web server. One of the most important advantages of this technology is that it uses port 80 for network traffic. This means that if you are able to surf the site from your workstation, you can also use WebDAV to administer it. It does not require firewall reconfiguration.

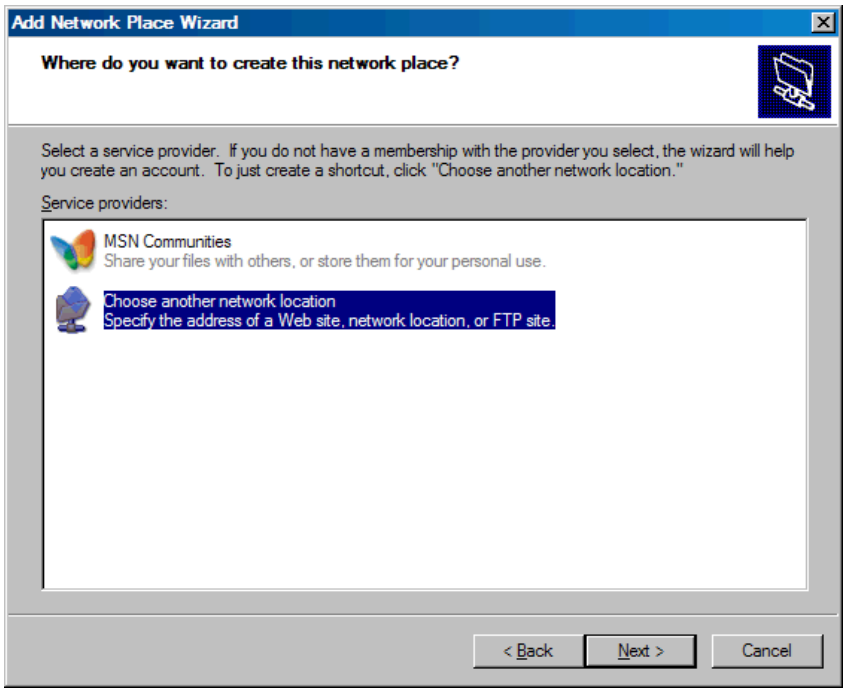
FTP

FTP (File Transport Protocol) is a very commonly used network protocol used to exchange and manipulate files over a TCP computer network. This protocol is also compatible with the UXU cards. An FTP client may connect to an FTP server (in this case the logo/text inserter) to manipulate files on that server.

Uploading files using Windows

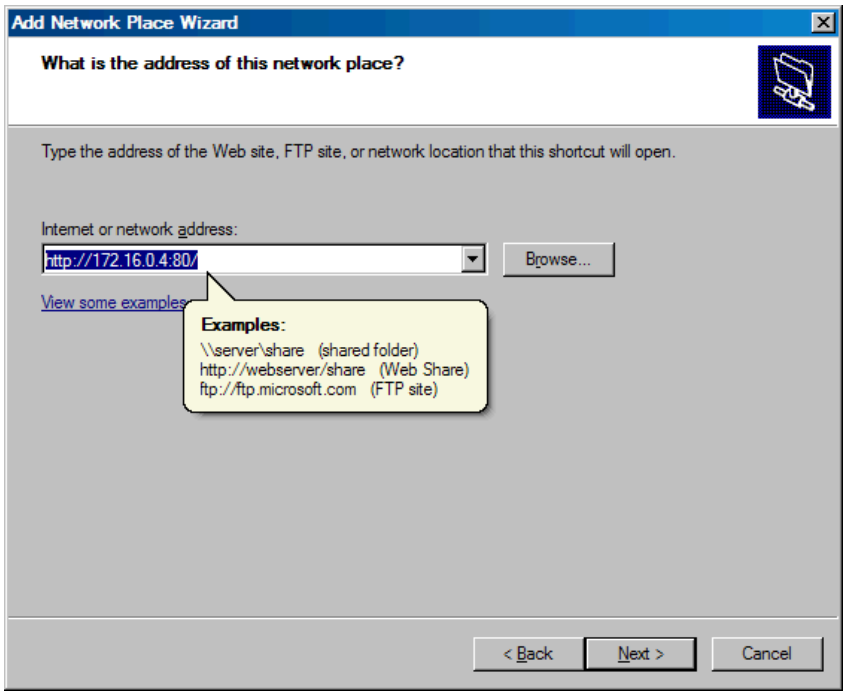
Go to `'My Network Places'` from the Windows Start Menu, or via `'My Computer' -> 'Other Places'`. Select `'Network Tasks' -> 'Add a network place'` This opens the `'Add Network Place'` wizard.

Click `'Next'` and select `'Choose another network location'`. Click Next again. You should be looking at a screen as displayed on the next page.



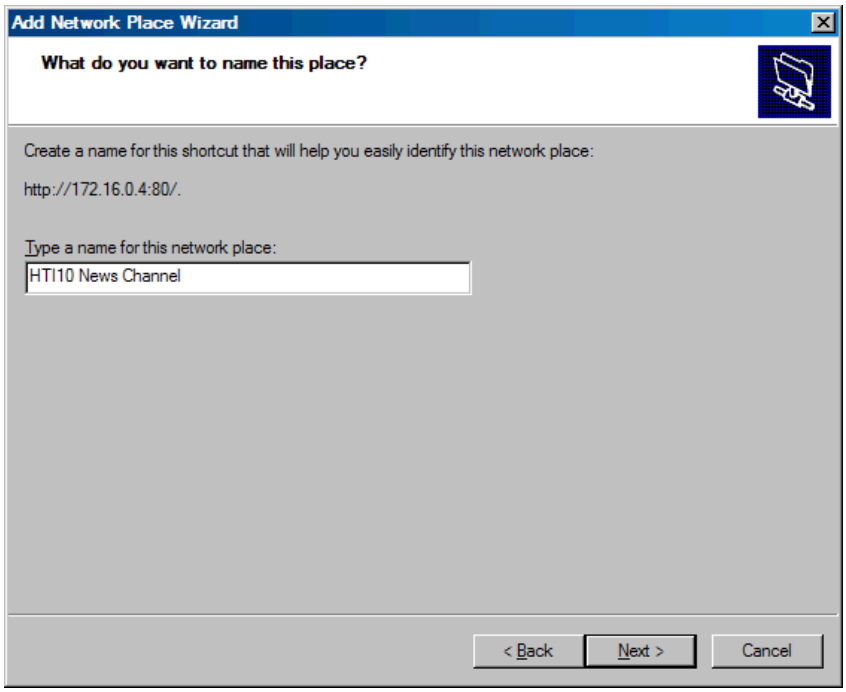
The wizard now asks for the network address. Fill in ‘`http://`’ followed by the IP address of the H-SLI card (see `IP0` status item in the menu), followed by '`:80/`' in order to access the card via WebDav. Fill in ‘ftp://’ followed by the IP address of the card will access the card via FTP.

For example if the IP address of the card is 172.16.0.4, enter ‘`http://172.16.0.4:80/`’ or ‘`ftp://172.16.0.4/`’ and click ‘`Next`’. Should result in the following example screen:

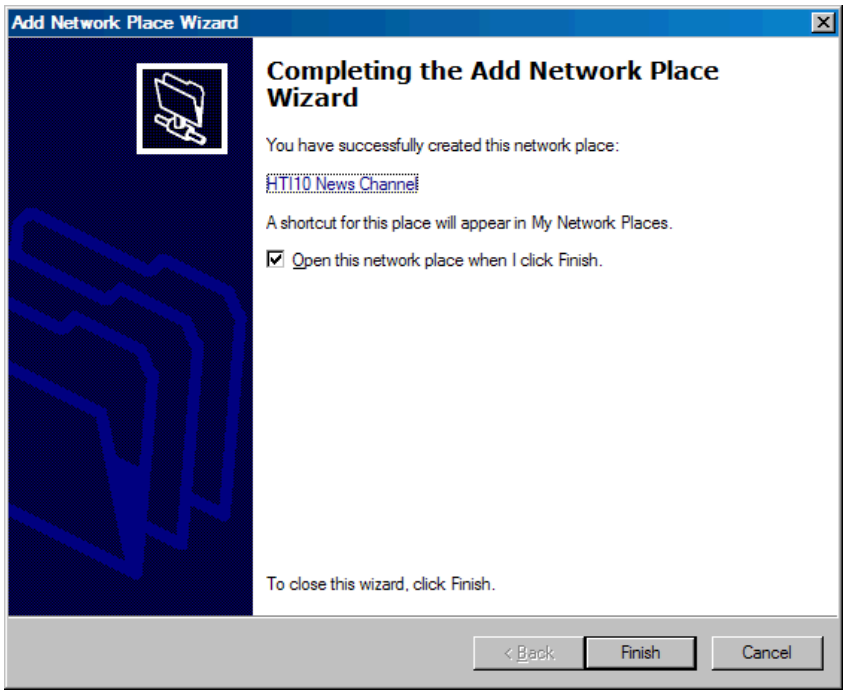


The wizard now asks for a name. Type a useful name for your own use,

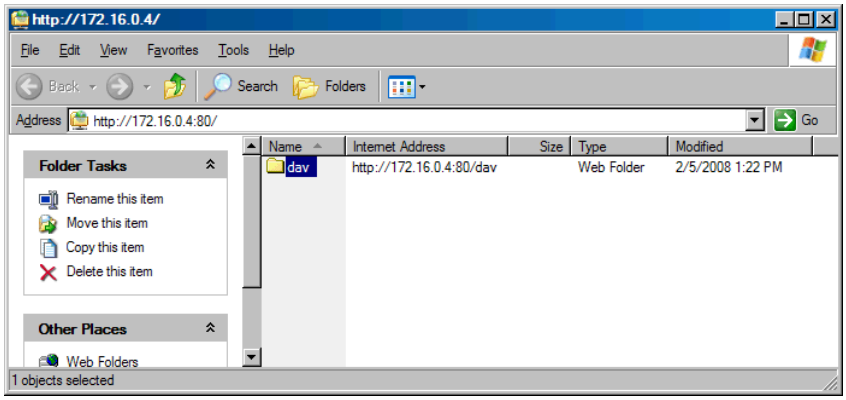
such as UXU News Channel.



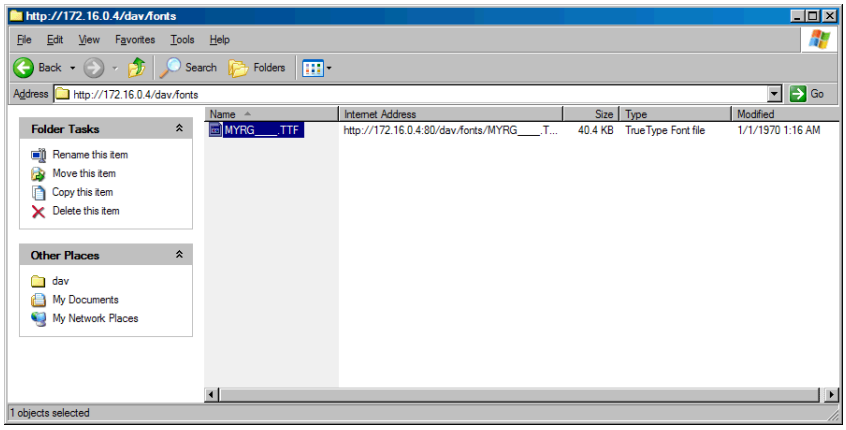
Click `'Next'`, and Click `'Finish'` on the following screen:



A new Explorer window will appear that shows the contents of the WebDAV Web Folder or FTP folder on the UXU card. Looking as follows:



Double-click on the `'dav'` folder`in case you accessed it via WebDav. You can now use the most common file operations such as Delete, Move, Copy to upload files as you are used to in any Windows environment. You can simply drag and drop your LUT files in this map.



Appendix 4 GPI's explained

Introduction

This appendix describes the functionality of the GPI's generally used within the Synapse based products.

General functionality

The physical contacts of a General Purpose Interface can be assigned by the user. In our cards the General Purpose Interface contacts (GPI contacts) will be named as General Purpose Input (GPI) or General Purpose Output (GPO). The GPI inputs and outputs are assignable to different preset banks. These preset banks (GPI pools) can be used to switch multiple settings at once.
Some examples of these functions:

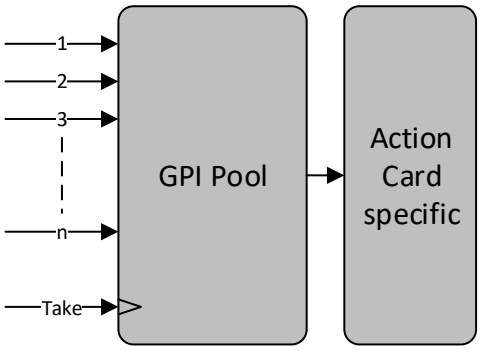
- Input selection
- Output mode
- Up conversion aspect ratio for channel A and B
- Down conversion aspect ratio for channel A and B
- Cross conversion aspect ratio for channel A and B
- Transparent aspect ratio (equal in-output) for channel A and B
- Insertion of VI, WSS, AFD (S2016) for channel A and B
- Audio shuffling, gain and phase

Contact assignment

The physical contacts can be assigned as input or output. In the menu of a card, these will be called `Contact_N` depending on the amount of contacts available. Contacts could be Inputs, outputs or bi-derictional I/O. The `Contact_N` menu item will be used to assign this specific contact to input or output pools. The choices are `Off`, `GPI_A`, `GPI_B`, `GPI_C`, …, `GPI_N`, `GPO_A`, `GPO_B`, `GPO_C`, …, `GPO_N` depending on the amount of contacts and pools.

Pools

A GPI/GPO pool is a place where contacts are collected to form an output trigger.



Take

The GPI contacts not only can be used as GPI contact but also can be assigned as Take contact. The menu item is called `GPI_n-Take`. Where n is the amount of GPI pools in the product. Every pool can only have one Take contact. There will be no restrictions in assigning the contact to a GPI pool and Take function at the same time. The values will be 1 to x. When assigning a take pin to a pool set to `Prio_Latched` mode, the pool will behave the same as when set to `Prio` mode with a take pin assigned. This is because the take pin overrules the latched functionality of the `Prio_Latched` mode.

Debounce time

The input contacts need to be debounced to assure signal stability. The debounce time can be set in the `GPI-DebounceTime` object in a range of `1-40` ms. This value will be applied to all contacts. In software implementations setting a custom debounce time is not supported due to technical limitations.

Pool Mode: GPI

Every GPI pool can be set up to process the input contacts in three ways. This setting is called `GPI_n-Mode` and can be set into priority `(Prio)`, priority latched (`Prio_Latched`) and `Binary` mode. N is defined as a character in the range from A-Z depending on the number of pools. The default output value of a pool is always 0. This translates to preset 1 in Axon products.
In priority mode, the contact which has the highest priority defines the pool value. Priority is defined as ranging from the least significant bit (low priority) to the most significant bit (high priority). This is essentially a one-hot coding of preset values.
If a pool has three contacts connected and all inputs are high, the output value of the pool will be 3. Another example is when three contacts are connected to a pool with the first and third contact are low and the second contact is high the output value is 1.

Input 1	Input 2	Input 3	Pool value	Preset nr
0	0	0	1	1
1	0	0	1	1
X	1	0	2	2
X	X	1	3	3

Table 1 Pool value in prio and prio_latched mode

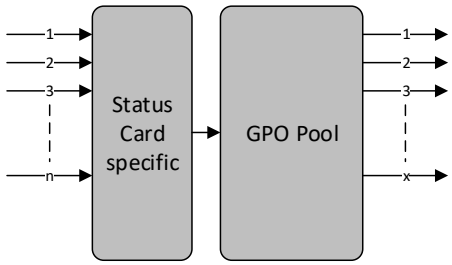
In binary mode, the contacts are interpreted as a binary value of concatenated contacts available in a pool. E.g. assigning two contacts to a GPI pool translates to the following output values.

Input 1	Input 2	Pool value	Preset nr
0	0	1	1
0	1	2	2
1	0	3	3
1	1	4	4

Table 2 Pool value in binary mode

Pool Mode: GPO

Every GPO pool can be set up to process the input values in two ways. This setting is called `GPO_n-Mode` and can be set into Priority (`Prio`) or `Binary` mode. N is defined as a character in the range from A-Z depending on the number of pools. The default output value of a pool is always 0.



Every GPO pool can be set up to process the input values in two ways. This setting is called `GPO_n-Mode` and can be set into Priority (`Prio`) or `Binary` mode. N is defined as a character in the range from A-Z depending on the number of pools. The default output value of a pool is always 0.

In priority mode, the value is translated to one-hot encoding on the output contacts. See table below.

Preset nr	Output 1	Output 2	Output 3	Pool value
1	1	0	0	1
2	0	1	0	2
3	0	0	1	3

Table 3 Pool value in priority mode

In binary mode the input value is exposed on the output contacts as binary value.

Preset nr	Output 1	Output 2	Pool value
1	0	0	1
2	0	1	2
3	1	0	3
4	1	1	4

Table 4 Pool value in binary mode

`GPO_n-Source` is the setting with which a function is assigned to a GPO pool. E.g. when the output format needs to be reflected on the output contacts, this setting may be set to something like `Output_Format`. The contents of the enumeration are product specific.

Statuses: Contact direction

This status `Contact-Dir` shows the direction of the physical contacts. The value will be presented as a concatenated string containing one character per pin: `I` for Input, `O` for output and _ for unassigned contacts.

Statuses: Contact status

`Contact-Status` shows the current logical value of the physical contacts, formatted as a concatenated string containing one character per pin: `1` for asserted, `0` for non-asserted and _ for unassigned.

Statuses: GPI status

`GPI_n` is an integer which reflects the value of the pool.

Statuses: GPO status

`GPO_n` is an integer which reflects the value of the pool.

Example 1: Two pools in binary mode

We are controlling the up-converter presets using Pool A (`Up_CtrlA` set to `GPI_A`) and the output mode setting using Pool B (`Out-mode-Ctrl` set to `GPI_B`). Both pools are working in priority mode. The GPI's need to be set-up in the following way:

- Set GPI_A-Mode to Prio
- Set Contact_1 to GPI_A
- Set Contact_2 to GPI_A
- Set Contact_3 to GPI_A
- Set Contact_4 to GPI_A
- Set GPI_B-Mode to Prio
- Set Contact_5 to GPI_B

Pool A now consists of GPI 1, GPI 2, GPI 3 and GPI 4 in a priority mode, controlling the up-converter preset. Pool B consists only of GPI 5 (also in priority mode), controlling the output mode setting.Pool A now works as follows:

Contact_1 status	Contact_2 status	Contact_3 status	Contact_4 status	GPI_A value
0	0	0	0	Up-conv Preset 1
1	0	0	0	Up-conv Preset 1
0	1	0	0	Up-conv Preset 2
0	0	1	0	Up-conv Preset 3
0	0	0	1	Up-conv Preset 4
0	1	1	0	Up-conv Preset 3 (highest gets priority)
1	1	1	1	Up-conv Preset 4 (highest gets priority)

Table 5 Pool value in priority mode

Pool B now works as follows:

Contact_5 status	GPI_B value
0	A out only
1	B out only

Table 6 Pool value in priority mode

Example 2: One pool in binary mode and one in priority mode

Let's say we would like to control the GXG up-converter presets using Pool A (`Up_CtrlA` set to `GPI_A`) in binary mode and the audio presets using Pool B (`Audio_Ctrl` set to `GPI_B`) in priority mode. We could do the following:

- Set GPI_A-Mode to binary
- Set Contact_1 to GPI_A
- Set Contact_2 to GPI_A
- Set GPI_A-Take to Contact_3
- Set GPI_B-Mode to Prio
- Set Contact_4 to GPI_B
- Set Contact_5 to GPI_B

Pool A now consists of GPI 1, GPI 2 and GPI 3 (as take) in binary mode, controlling the up-converter preset. Pool B now consists of GPI 4 and GPI 5 in priority mode, controlling the audio presets.
Pool A now works as follows:

Contact _1 status	Contact _2 status	Preset value (when Contact_3 (take) is closed)
0	0	Up-converter Preset 1
1	0	Up-converter Preset 2
0	1	Up-converter Preset 3
1	1	Up-converter Preset 4

Table 7 Pool value in binary mode

Pool B now works as follows:

Contact _4 status	Contact _5 status	Preset value
0	0	Audio Preset 1
1	0	Audio Preset 1
0	1	Audio Preset 2
1	1	Audio Preset 2 (because highest gets priority)

Table 8 Pool value in priority mode

Example 3: Two pools in priority mode

Let's say we would like to control the up-converter presets using Pool A (`Up_CtrlA` set to `GPI_A`) in priority mode and the audio presets using Pool B (`Audio_Ctrl` set to `GPI_B`) in priority mode. We could do the following settings:

- Set GPI_A-Mode to Prio
- Set Contact_1 to GPI_A
- Set Contact_2 to GPI_A
- Set GPI_B-Mode to Prio
- Set Contact_3 to GPI_B
- Set Contact_4 to GPI_B

Pool A now consists of GPI 1 and GPI 2 in a priority mode, controlling the Up converter preset. Pool B now consists of GPI 3 and GPI 4 in a priority mode, controlling the audio presets.

Pool A now works as follows:

Contact_1 status	Contact_2 status	Preset value
0	0	Up-converter Preset 1
1	0	Up-converter Preset 1
0	1	Up-converter Preset 2
1	1	Up-converter Preset 2 (because highest gets priority)

Table 9 Pool value in priority mode

Pool B now works as follows:

Contact_3 status	Contact_4 status	Preset value
0	0	Audio Preset 1
1	0	Audio Preset 1
0	1	Audio Preset 2
1	1	Audio Preset 2 (because highest gets priority)

Table 10 Pool value in priority mode

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