Synapse

# GSU010
# HSU010

3Gb/s, HD and SD basic up-converter and synchronizer

## Installation and Operation manual

Upgradable to 3Gb/s

MASTER Card

AFD ready S2016

3 TRIPLE RATE GB/s, HD, SD

Powered by LINUX

Committed.

AXON®

Synapse

# TECHNICAL MANUAL

GSU010
HSU010

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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.



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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<br>GSU010<br>HSU010<br>Tested To Comply With FCC Standards<br><br>FOR HOME OR OFFICE USE | This device complies with part 15 of the FCC Rules<br>Operation is subject to the following two conditions:<br>(1) This device may cause harmful interference, and<br>(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 RRC18, RRC10, RRC04, RRS18 and RRS04 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 (RRC18/RRC10/RRC04/RRS18/RRS04) manual. The method of connection to a computer using Ethernet is described in the RRC/RRS manual.

**!**

**CHECK-OUT:** "SYNAPSE 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 Synapse Cotrtex installed, as this increases the ease of use and understanding of the modules.

# 2 Unpacking and Placement

## Unpacking

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

## Placing the card

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

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

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

**NOTE:** Please check appendix 2 before connecting any backpanel!

# 3 A Quick Start

**When Powering-up**

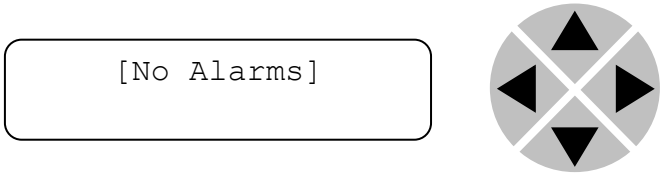
On powering up the Synapse frame, the card set will use basic data and default initialisation settings. All LED's will light during this process. After initialisation, several LED's will remain lit – the exact number and configuration is dependant upon the number of inputs connected and the status of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




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.

## Synapse 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. Synapse 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 Synapse Cortex, please refer to the Cortex manual.

## 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 and RRS operational manuals and the Cortex help files.

# 4 The GSU010 Card

## Introduction

The GSU010 and HSU010 are *low latency* up-converters with 16 channel audio transparency.

The GSU010 is compatible with 270Mb/s, 1.5Gb/s and 3Gb/s for full 1080p/50 or 1080p/59.94 use. The HSU010 are compatible with SD-SDI (270Mb/s) and HD-SDI (1.5Gb/s) and can be future upgraded to 3Gb/s compatibility

## Features

- Low latency conversion process (as low as 1 field in controlled timing environment)
- Compatible with the following input and output formats (auto selecting) (1080p only for GSU) (only one standard can be chosen for both outputs simultaneously):
  - 1080p/59.94
  - 1080p/50
  - 1080i/59.94
  - 1080i/50
  - 1080p/23.98
  - 1080psf/23.98
  - 720p/59.94
  - 720p/50
  - 720p/23.98
  - SD525
  - SD625
- Frame sync with output phase control in Lines and pixels with respect to reference.
- All ARC modes contain:
  - Anamorphic
  - Center Cut
  - V-Zoom
  - LBox-16:9
  - LBox-14:9
  - PBox-4:3
  - PBox-14:9
  - Variable H and V (50—200%)
- Free individual programmable presets banks for:
  - Up converter ARC 16-presets
  - Transparent ARC 16-presets
  - S2016 insertion 16-presets
- 5 GPI inputs assignable to different preset banks
  - Up conversion aspect ratio
  - Transparent aspect ratio (equal in-output)
  - Insertion of AFD (S2016)
- ARC triggers by VI, WSS, WSSext and S2016 (AFD)
- Color corrector
- Transparent for 16 channels of embedded audio
- Video proc-amp
- Color corrector (RGB and total gain, RGB and total black)
- Hue control for NTSC inputs
- WST to OP47 cross conversion
- Timecode cross conversion
- Auxiliary timecode input, allowing for 2 separate timecodes
- CC-608 to CC-708 conversion
- 6 Line Vertical Ancillary Blanking transparency in transparent mode
- Full control and status monitoring through the front panel of the SFR04/SFR08/SFR18 frame and the Ethernet port (ACP)

## Conversion capabilities

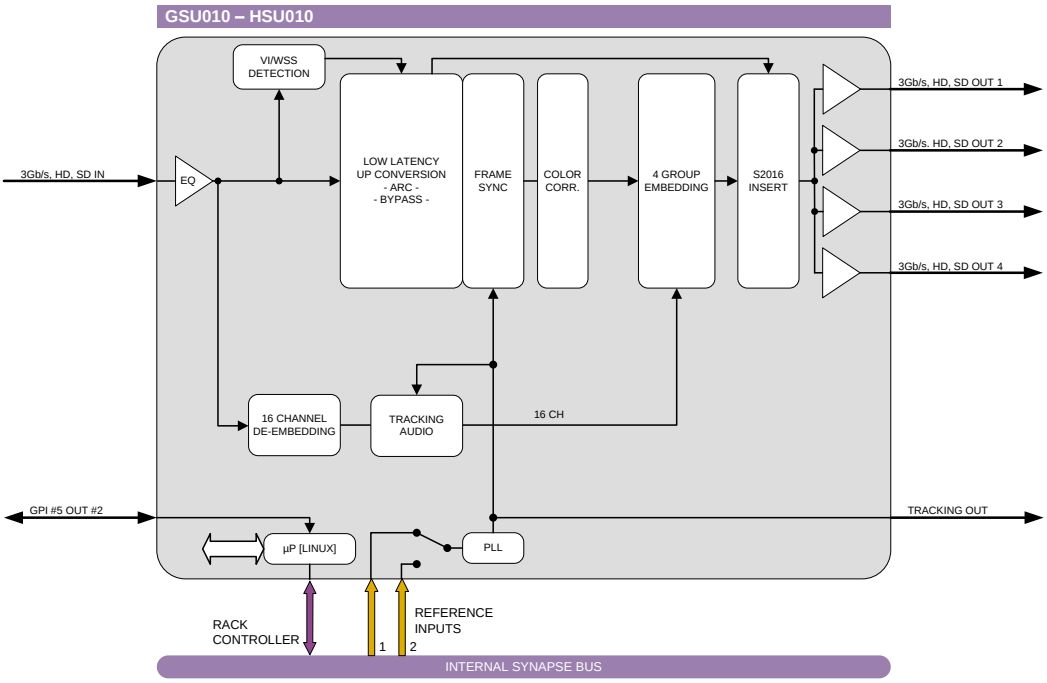
| | CONVERSION | Output | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1080psf23.97 | 1080p23.97 | 1080p50* | 1080p59.94* | 1080i59.94 | 1080i50 | 720p59.94 | 720p50 | 720p23.98 | 480i59.94(525) | 576i50(625) |
| SDI Input | 1080psf23.97 | x | | | | | | | | | | |
| | 1080p23.97 | | x | | | | | | | | | |
| | 1080p50* | | | x | | | | | | | | |
| | 1080p59.94* | | | | x | | | | | | | |
| | 1080i59.94 | | | | | x | | | | | | |
| | 1080i50 | | | | | | x | | | | | |
| | 720p59.94 | | | | | | | x | | | | |
| | 720p50 | | | | | | | | x | | | |
| | 720p23.98 | | | | | | | | | x | | |
| | 480i59.94(525) | x | x | | | x | | x | | x | x | |
| | 576i50(625) | | | x | | | x | | x | | | x |

* = GSU models only

## Applications

- Truck input up converter/synchronizer
- Infra structure up conversion

## Block schematic



# 5 Settings Menu

## Introduction

The settings menu displays the current state of each GSU-HSU010 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 card has separate presets for the input and output settings under the '`SYSTEM SETTINGS`' header. With this item you select how the IO presets are controlled: Manually (`manual`, default), via GPI-triggers (`GPI`, `GPI-A`, `GPI-B` or `GPI-C`) or by the input format (`SDI1-Format`). The input formats are mapped to the presets as followed:

| Format: | Preset: |
|---|---|
| 1080i60 | Preset 1 |
| 1080i50 | Preset 2 |
| 1080p30 | Preset 3 |
| 1080p25 | Preset 4 |
| 1080p24 | Preset 5 |
| 720p60 | Preset 7 |
| 720p50 | Preset 8 |
| 720p30 | Preset 9 |
| 720p25 | Preset 10 |
| 720p24 | Preset 11 |
| SD525 | Preset 12 |
| SD625 | Preset 13 |
| 1080p50 | Preset 14 |
| 1080p60 | Preset 15 |

### 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.

**#Inp_SelA**

With this item you can select which input you want to use. Can be `SDI-1` (SDI input 1), a `Zoneplate` or `Colorbar` as input. Can also be set to `Off` to switch off the outputs entirely. The default for this setting is `SDI-1`.

**#Out-Ctrl**

This setting controls the output format of the card. When set to `Manual`, the output format corresponds to the `Out-Frmt` setting. When set to `Auto`, the output format follows the input format. Possible settings are:

- `Manual` (default)
- `Auto`

**#Out-Frmt**

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

- `1080i60` (default), `1080i50`
- `1080p50`, `1080p60`
- `1080p24`
- `1080psf24`
- `720p60`, `720p50`
- `720p24`
- `SD525`, `SD625`

**#Output_Map_A**

With this setting you can configure the output as `LevelA` or `LevelB` (according to SMPTE S425) when the output format is 1080p50 or 1080p60.

**#V-delay**

`V-Delay` setting allows adjustment of the vertical phase of the 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 1125 lines (dependant on I/O format). The default setting is `0ln`. The preset master for this is `Out-Frmt`, hence the '#'-prefix.

**#H-delay**

The H-Delay setting allows adjustment of the Horizontal phase of the 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.

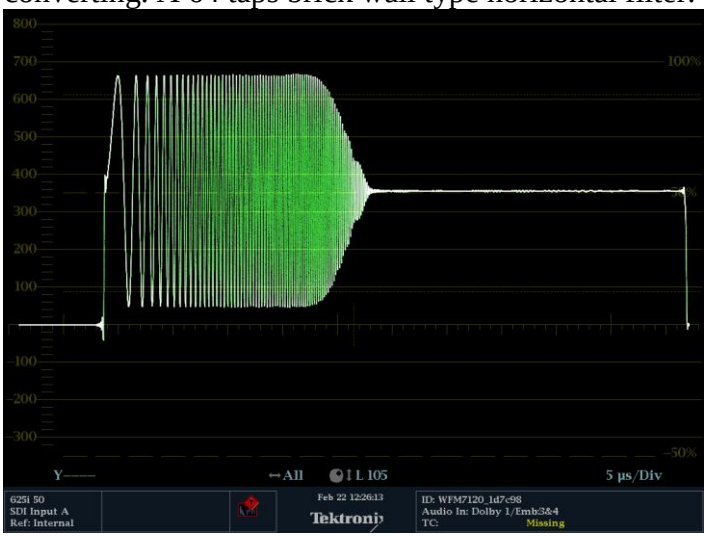
**#Freeze_A**

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

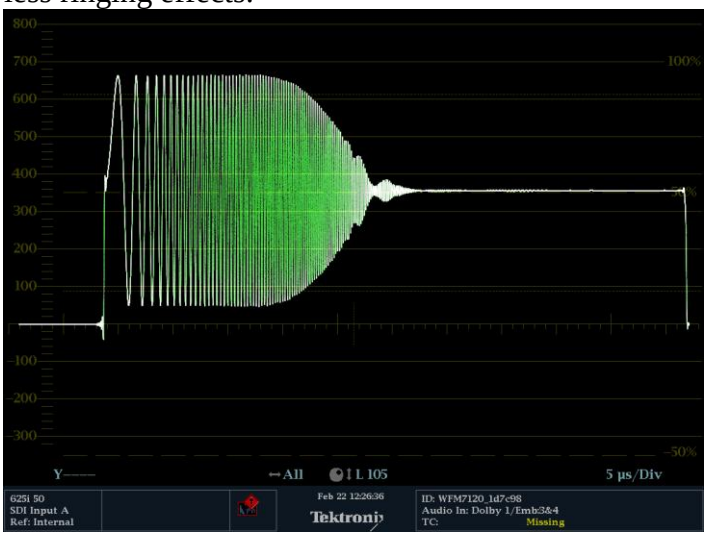
**#LowPassFilt_A**

Here you can set the horizontal and vertical video low-pass filter for channel A. These are the possible settings:

- `Off`: the normal broadband filters will be used when the card is converting. A 64 taps brick wall type horizontal filter:




- `H_only`: a less steep filter with no aliasing Y and soft for C for less ringing effects:




- `V_only`: vertical filters will be active which “soften” the image and prevents “ring”-effects in down converted content.
- `H_And_V`: same horizontal filter as described under `H_Only` will be active, together with the vertical filters described under `V_only`.

- `H2_Only`: less steep filter with aliasing and soft for C for less ringing, more sharpness but with aliasing:


- `H2_And_V`: same horizontal filter as described under `H2_Only` will be active, together with the vertical filters described under `V_only`.

**Note:** When the card is in **transparent** mode, the filters will be entirely bypassed.

**Pos-Prst_Act**

Active preset control for the position controls #H-Pos-A and #V-Pos-A. With this item you can manually change the currently active positioning settings. Default setting is 1.

**Pos-Prst_Edit**

Edit preset control for the position controls #H-Pos-A and #V-Pos-A. Here you can select which of the 8 selectable positioning settings presets you want to edit. Default setting is 1.

**#H-Pos-A**

Controls the horizontal positioning offset in pixels for channel A. Only works correctly when zooming in, for instance when downconverting using Center-Cut aspect ratio conversion.

**#V-Pos-A**

Controls the vertical positioning offset in pixels for channel A. Only works correctly when zooming in, for instance when downconverting using Center-Cut aspect ratio conversion.

**#VANC_Trans**

Enables or disables the transfer from input to output of selected Vertical Ancillary (VANC) lines. When the input format is the same as the output format, the card is able to carry up to 6 lines containing packets inserted in the Luminance Channel of the Vertical Ancillary space to the output. With settings `#VANC_Trans_Ln0` to `#VANC_Trans_Ln5` the user may select which lines to carry through to the output. The possible settings of `#VANC_Trans` are `On` or `Off`. The default setting is `Off`.

**#VANC_Trans_Ln0 ~ #VANC_Trans_Ln5**

Selects a line to carry from input to output. You can choose 5 lines. Refer to `#VANC_Trans`. Can be any line from line 7 through 41. If for instance line 7 is selected, line 7 from the input is carried to line 7 at the output.

**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`

**Lock-Mode**

`Lock-Mode` determines whether the card is locked to his `input` (input 1), to the reference (`Ref1` or `Ref2`) or `freerun` (not locked). By default it is set to `Ref1`. Can also be set to `RefAuto`.

When set to `RefAuto` the card chooses ref1 as its source. Whenever ref1 fails, it will switch to ref 2 (only for SFR08 and SFR18 frames and only when ref2 offers the same ref format as ref 1). When ref 1 is back up again, it will only automatically switch back to ref 1 when ref 2 fails.

**Ref-Type**

Sets the type of incoming reference. Can be either Bi-Level or `Tri-Level`. Default is `Bi-Level`.

**PrstEditView**

With this setting set to `Follow Active`, the edit preset settings (like for instance `UP_Prst_editA`) 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`.

**PatternSpeed**

Sets the speed of the test-pattern (see setting `Inp_SelA`) animation between 0 (still) and 15 (fast). Default is 1.

**SD-AR-Det**

This card can switch between presets on the changes of the aspect ratio. Aspect ratio information can be taken out of the `VI` (video index), `WSS` (widescreen signaling) or `WSS-extended` (extended form of widescreen signaling). With this setting you can select which of the above protocols should be used to detect aspect ratio changes. By default it is set to `VI`.

**NoWSS/VI_prstA**

With this setting you can set to which preset the card should jump when no WSS or VI information is found. Can be any preset between `1` and `16` or `Hold` (holds current active preset). By default it is set to `Hold`.

**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`.

## UP-CONV

**Up_CtrlA**

With this item you select how the presets in up converter mode are controlled: Manually (`manual`), via GPI-triggers (`GPI`, `GPI-A`, `GPI-B` or `GPI-C`) or via changes of the SD Aspect Ratio (`SD-AR`). By default it is set to `Manual`.

**Up_Prst_actA**

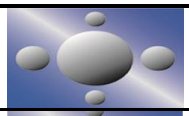
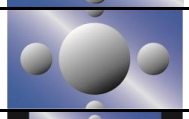
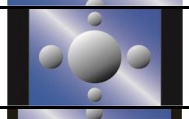
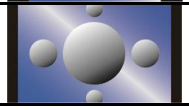
With this item you can manually change the currently active preset in up converter mode. Can be any preset between 1 and 16. By default it is set to 1. All menu settings that are preceded with a '`#Up`'-prefix are part of the preset.

**UP_Prst_editA**

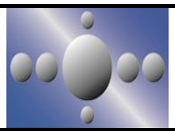
Here you can select which of the 16 selectable presets you want to edit in up converter mode. Changing this will not change the active preset, unless the currently active preset is the same you are going to edit. All menu settings that are preceded with a '`#Up`'-prefix are part of the preset.

**#Up_ArcA**

With this item you set the Aspect Ratio of the output in up converter mode. Can be `Anamorphic`, `V-Zoom`, `PBox-4:3`, `PBox-14:9` or `Variable` (custom set AR, set by H-scale and V-scale settings). The following table shows examples of the possible aspect ratios when the input source is 4:3.

| **Setting:** | **Result on 16:9 screens:** |
|---|---|
| `Anamorphic` |  |
| `V-Zoom` |  |
| `PBox-4:3` |  |
| `PBox-14:9` |  |
| `Anam-702` | Anamorphic scaling based on 702 active pixels instead of 720 pixels |
| `Variable` | Dependant on `Up_H-scale` and `UP_V-scale` settings. |

| | |
|---|---|
| **#Up_H-scaleA** | The horizontal scaling of the TV picture in up converter mode is set using `#Up_H-scaleA`. `#Up_H-scaleA` can be set within the range of 50% to 200% of the input signal (only used when `#Up_ArcA` is set to `variable`). Default value is 100%. |
| **#Up_V-scaleA** | Sets the vertical scaling of the TV picture in up converter mode. Can be set within the range of 50% to 200% of the input signal (only used when `#Up_ArcA` is set to `variable`). Default value is 100%. |
| **#Up_H-EnhA** | With this item you can set the horizontal picture enhancement in up converter mode between 0 and 100%. By default set to 0%. |
| **#Up_ColorConvA** | `ColorConvA` optimizes the color conversion in up converter mode. As the color coding of HD (709) and SD(601) are different, it is necessary to convert these when Channel A is up-converting. The best result is generated when the up-converter is active and the `601to709` setting is selected. It is also possible to switch the filter `off`. The default setting is `601to709`. |
| | **TRANSPARENT** |
| **Tr_CtrlA** | With this item you select how the presets are controlled in Transparent mode: Manually (`manual`), via GPI-triggers (`GPI`, `GPI-A`, `GPI-B` or `GPI-C`) or via changes of the HD Aspect Ratio (`S2016`). By default it is set to `Manual`. |
| **Tr_Prst_ActA** | With this item you can manually change the currently active preset in Transparent mode. Can be any preset between 1 and 16. By default it is set to 1. All menu settings that are preceded with a '`#Tr`'-prefix are part of the preset. |
| **Tr_Prst_EditA** | Here you can select which of the 16 selectable presets you want to edit in Transparent mode. Changing this will not change the active preset, unless the currently active preset is the same as the one you are going to edit. All menu settings that are preceded with a '`#Tr`'-prefix are part of the preset. |
| **#Tr_ArcA** | With this item you set the Aspect Ratio of the output in Transparent mode. Can be `Anamorphic` or `Variable` (custom set AR, set by H-scale and V-scale settings). The following table shows examples of the possible aspect ratios. |

| Setting: | Result: | |
|---|---|---|
| Anamorphic |  | With 16:9 source on 4:3 screens |
| Variable | Dependant on Tr_H-scale and Tr_V-scale settings. | |

**#Tr_H-scaleA**

The horizontal scaling of the TV picture in Transparent mode is set using #Tr_H-scaleA. #Tr_H-scaleA can be set within the range of 50% to 200% of the input signal (only used when #Tr_ArcA is set to variable). Default value is 100%.

**#Tr_V-scaleA**

Sets the vertical scaling of the TV picture in Transparent mode. Can be set within the range of 50% to 200% of the input signal (only used when #Up_ArcA is set to variable). Default value is 100%.

**#Tr_H-EnhA**

With this item you can set the horizontal picture enhancement in Transparent mode between 0 and 100%. By default set to 0%.

## INSERTER

This card can insert several data values in the VBI of the outputs. With the following settings you can choose what you want to insert.

**S2016-Line**

With this setting you select a line in the VBI to where the AFD (SMPTE 2016) data should be written. Lines 0 till 31 are selectable. By default it is set to line 17.

**Timecode_Inp**

With this card it is possible to copy the embedded timecode information of either input SDI-1 or input SDI-2 to the output. With this setting you select which input you want to use, or switch the timecode inserting Off (default).

**VITC_Ln_In**

With this setting you can select what line of the input you want to copy the VITC data from (only when input is SD). Can be any line between line 7 and line 22. Default is line 19.

**VITC_Ln_Ctrl**

Here you can choose whether you want to select the line, to where you want to copy the timecode data to, manually (manual) or use the information in the ATC_DBB package to select the lines (ATC_DBB package contains information about the line duplication as well). Default is Manual.

| | |
|---|---|
| **VITC_Ln_625** | When `VITC_Ln_Ctrl` is set to `Manual`, with this setting you can select a line between 7 and 22 when the output is SD625. Default is line 19. |
| **VITC_Ln_525** | When `VITC_Ln_Ctrl` is set to `Manual`, with this setting you can select a line between 7 and 22 when the output is SD525. Default is line 10. |
| **VITC_Ln_Dup** | set to `On`, the VITC line is duplicated to the above selected line + 2 . |
| **ATC_Dem_Sel** | ATC source de-embed selection. Previously, the first ATC found in a field would be transcoded to the output. Now, the user can select whether to de-embed LTC, VITC or the first ATC found. |
| **ATC_Emb_Sel** | ATC_Emb_Sel: ATC destination embed selection. Previously, timecode was transcoded into VITC. Now the user can select whether to transcode to VITC or LTC. |

## AUXILIARY TIMECODE

An additional (Auxiliary) timecode input functionality is available. The original timecode from the source is still carried through to the output. If applicable given the conversion the card is performing, the timecode is translated from VITC to ATC or viceversa.

The Auxiliary timecode source can be selected (`Aux_TC_SRC`) from any video source on the card. Like the original timecode, it is translated from VITC to ATC or viceversa if applicable, so the type of timecode matches the output format of the card. The timecode is delayed according to the `Aux_TC_DLY` setting.

Because devices need to be able to distinguish between the two timecodes, devices need to be able to handle both the timecodes. When VITC is inserted into an SD signal, both timecodes can be inserted into different lines. For instance, when SD625 is set as the output format, the original timecode gets inserted into the line set by `VITC_Ln_625`. The auxiliary timecode is inserted into the line set by `Aux_Ln_625`.When SD525 is set as the output format, both timecodes are inserted according to settings `VITC_Ln_525` and `Aux_Ln_525`.

When the output is set to any HD or 3Gb/s format, the timecode is inserted as an ATC packet. The user can select whether to insert the timecode packet as LTC, or as VITC. This is controlled by setting `ATC_Emb_Sel` for the original timecode, and setting `AUX_Emb_Sel` for the auxiliary timecode. Because these are inserted into different lines, devices can distinguish between the

| | |
|---|---|
| | two.<br><br>The Axon devices can be set to de-embed either or any of the two, both for the original timecode input and the auxiliary timecode input. This can be set by `AUX_Dem_Sel` and `ATC_Dem_Sel`. When receiving an SD signal, the input line can be set separately for both normal timecode and auxiliary timecode, by `VITC_Ln_In` and `Aux_VITC_Ln_In`. The other applicable timecode settings, such as `VITC_Ln_Ctrl` and `VITC_Ln_Dup` control both the normal timecode insertion as well as the auxiliary timecode insertion. |
| **Aux_TC_SRC** | With this setting you can set the timecode source of the second timecode inserter. Can be `SDI-1`, `SDI-2`, `Analog` input or `Off`. |
| **AUX_Dem_Sel** | Auxiliary ATC source de-embed selection. Previously, the first ATC found in a field would be transcoded to the output. Now, the user can select whether to de-embed LTC, VITC or the first ATC found. |
| **AUX_Emb_Sel** | Auxiliary ATC destination embed selection. Previously, timecode was transcoded into VITC. Now the user can select whether to transcode to VITC or LTC. |
| **Aux_VITC_Ln_In** | Auxiliary VITC read line. The Auxiliary timecode readline can differ from the normal VITC read line. This means, that from an SD source, two different timecode lines can be transcoded to the output. |
| **Ins_CtrlA** | With this item you select how the inserter presets are controlled: Manually (`manual`), via GPI-triggers (`GPI`, `GPI-A`, `GPI-B` or `GPI-C`), via changes of the SD Aspect Ratio (`SD_AR`) or the HD aspect ratio (`S2016)` (AFD)). Default is `Manual`. |
| **Ins_Prst_ActA** | With this item you can manually change the currently active inserter preset. 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. |
| **Ins_Prst_EditA** | Here you can select which of the 16 selectable inserter 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 '`#Ins`'-prefix are part of the preset. |

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|---|---|
| **#VI-InsertA** | You can turn VI insertion `on` or `off` . Default is `Off`. |
| **#VI-DataA** | With the `#VI-InsertA` setting set to `on`, you can select VI values with this setting, which you want to be inserted. possible are all VI values between `4:3_0` and `4:3_7` and the settings between `16:9_0` and `16:9_7`. Default is `4:3_0`. |
| **#WSS-InsertA** | You can choose which type of WSS data you want to insert in with this setting, or switch WSS insertion entirely `off` (default value). You can set it to `Standard` or `Extended`. |
| **#WSS-StndA** | With the `#WSS-InsertA` setting set to `Standard`, you can select WSS standard values with this setting, which you want to be inserted. possible are all WSS values between `1_vid` and `8_vid` and the settings between `1_flm` and `8_flm`. Default is `1_vid`. |
| **#WSS-ExtndA** | With the `#VI-InsertA` setting set to `on`, you can select VI values with this setting, which you want to be inserted. possible are all WSS values between `4:3_0` and `4:3_7` and the settings between `16:9_0` and `16:9_7`. Default is `4:3_0`. |
| **#S2016-InsertA** | You can turn S2016 (AFD) insertion `on` or `off` . Default is `Off`. |
| **#S2016-DataA** | With the `#S2016-InsertA` setting set to `on`, you can select AFD values with this setting, which you want to be inserted. possible are all AFD values between `AFD0` and `AFD15`. |
| **#OP47-SDP-Emb_A** | With this setting you set in which line the OP47 data should be inserted. Can be any line between line 8 and line 16. Can also be switched off (causing the OP47 data to not be inserted at all). |
| **#CC_Ena_A** | This setting sets the Closed Captioning transparency for channel A `On` or `Off`. Default is `Off`. |
| | **VIDEO PROC** |
| **GainA** | With this setting you control the overall gain of the video between 50 and 150%. Default is 100%. |
| **R-GainA** | `R-GainA` controls the Red gain. The control range is between 50% and 150%. The default setting is 100%. |

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|---|---|
| **G-GainA** | G-GainA controls the Green gain. The control range is between 50% and 150%. The default setting is 100%. |
| **B-GainA** | B-GainA controls the Blue gain. The control range is between 50% and 150%. The default setting is 100%. |
| **BlackA** | BlackA controls the total R-G-B Black gain. The control range is between –128bit and 127bit. The default setting is 0bit. |
| **R-BlackA** | R-BlackA controls the Red-Black. The control range is between –128bits and 127 bits in steps of 1 bit. The default setting is 0 bit. |
| **G-BlackA** | G-BlackA controls the Green-Black. The control range is between –128bits and 127 bits in steps of 1 bit. The default setting is 0 bit. |
| **B-BlackA** | B-BlackA controls the Blue-Black. The control range is between –128bits and 127 bits in steps of 1 bit. The default setting is 0 bit. |
| **CVBS-Hue** | This item adjusts the HUE of the CVBS input. Can be set between -90 and +90 degrees. Default is 0 degrees. |
| | **AUDIO PROC AMP** |
| **Audio-Bus-IO** | This setting can change the Audio bus order from the normal 1234 (=default) to 1324. The 1324 order is of use to route the 1st group of audio from the 2nd input to the 2nd channel of a slave card (like the DIO48). |
| **Audio_Ctrl** | With this setting you select how the audio presets should be controlled. Can be either Manually (Manual), via GPI-triggers (GPI, GPI-A, GPI-B or GPI-C), via the SD aspect ratio (SD-AR) or via the HD aspect ratio (S2016). |
| **Audio_Prst_act** | With this item you can manually change the currently active audio preset. Can be any preset between 1 and 16. By default it is set to 1. All menu settings that are preceded with a '#Emb'-prefix are part of the preset. |

| | |
|---|---|
| **Audio_Prst_Edit** | Here you can select which of the 16 selectable audio 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 '`#Emb`'-prefix are part of the preset. |
| | **EMBEDDER** |
| **#EmbA_Grp** | With this setting you select in to which audio group (= 4 audio channels) of the outputs you want to embed the first 4 forwarded audio channels coming from the de-embedders/add-on bus. Can be `group1`, `group2`, `group3` or `group4`. You can also choose to not use these 4 audio channels for anything by setting this item to `off`. By default it is set to `Group1`. |
| **#EmbA1_Inp ~ #EmbA4_Inp** | With these settings you can select where the corresponding audio channels (channel A1 till channel A4) of the outputs are coming from. In this card you can only choose to get the audio from the de-embedder (`Demb-input`) or to mute the corresponding channel (set to `off`). Defaults here are `Off`. |
| **#EmbB_Grp** | With this setting you select in to which audio group (= 4 audio channels) of the outputs you want to embed the second 4 forwarded audio channels coming from the de-embedders/add-on bus. Can be `group1`, `group2`, `group3` or `group4`. You can also choose to not use these 4 audio channels for anything by setting this item to `off`. By default it is set to `Group2`. |
| **#EmbB1_Inp ~ #EmbB4_Inp** | With these settings you can select where the corresponding audio channels (channel B1 till channel B4) of the outputs are coming from. In this card you can only choose to get the audio from the de-embedder (`Demb-input`) or to mute the corresponding channel (set to `off`). Defaults here are `Off`. |
| **#EmbC_Grp** | With this setting you select in to which audio group (= 4 audio channels) of the outputs you want to embed the third group of 4 forwarded audio channels coming from the de-embedders/add-on bus. Can be `group1`, `group2`, `group3` or `group4`. You can also choose to not use these 4 audio channels for anything by setting this item to `off`. By default it is set to `Group2`. |

| | |
|---|---|
| **#EmbC1_Inp ~ #EmbC4_Inp** | With these settings you can select where the corresponding audio channels (channel C1 till channel C4) of the outputs are coming from. In this card you can only choose to get the audio from the de-embedder (`Demb-input`) or to mute the corresponding channel (set to `off`). Defaults here are `Off`. |
| **#EmbD_Grp** | With this setting you select in to which audio group (= 4 audio channels) of the outputs you want to embed the last 4 forwarded audio channels coming from the de-embedders/add-on bus. Can be `group1`, `group2`, `group3` or `group4`. You can also choose to not use these 4 audio channels for anything by setting this item to `off`. By default it is set to `Group2`. |
| **#EmbD1_Inp ~ #EmbD4_Inp** | With these settings you can select where the corresponding audio channels (channel D1 till channel D4) of the outputs are coming from. In this card you can only choose to get the audio from the de-embedder (`Demb-input`) or to mute the corresponding channel (set to `off`). Defaults here are `Off`. |
| **#EmbD1_Inp_Ch ~ #EmbD4_Inp_Ch** | With these settings you can select which Channel of the selected input should be embedded to the corresponding output channel. Can be any channel between `Ch_1` and `Ch_16`. Defaults for C1 till C4 are respectively `Ch_13` till `Ch_16`. |
| | **GPI-CTRL** |
| **Contact _1 ~ Contact_5** | In this card it is possible to make the 5 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:<br>▪ `GPI A`: part of GPI-A pool, triggered once Take A is closed.<br>▪ `GPI B`: part of GPI-B pool, triggered once Take B is closed.<br>▪ `GPI C`: part of GPI-C pool, triggered once Take C is closed.<br>Please refer to 'Appendix 3: GPI's explained' for a more elaborate explanation of the GPI settings and status items. |

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|---|---|
| **GPI_A-mode ~ GPI_C-mode** | Selects the mode for the corresponding GPI pool. Possible settings are:<br>▪ `Prio`: Each contact triggers another value, so values are one-hot encoded.<br>▪ `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.<br>▪ `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.<br>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:<br>▪ `Off`: No take contact is defined, and values on the GPI contact are taken instantly.<br>▪ `Contact_1 ~ Contact_5`: 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.<br>Please refer to 'Appendix 3: GPI's explained' for a more elaborate explanation of the GPI settings and status items. |
| | **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.

## sInp1

This status item indicates the presence and format of a valid signal in input 1. This is displayed as:

- 1080P60
- 1080p50
- 1080i60
- 1080i50
- 1080p30
- 1080p25
- 1080p24
- 1035i60
- 720p60
- 720p50
- 720p30
- 720p25
- 720p24
- SD525
- SD625
- NA

## sInp1_VI

Displays the detected VI value found in input1. This is displayed as follows:

- 4:3_0
- 4:3_1
- 4:3_2
- 4:3_3
- 4:3_4
- 4:3_5
- 4:3_6
- 4:3_7
- 16:9_0
- 16:9_1
- 16:9_2
- 16:9_3
- 16:9_4
- 16:9_5
- 16:9_6
- 16:9_7
- NA (no VI detected)

**sInp1_WSS-Stnd**

This status item displays the detected standard WSS value of input 1. this is displayed as follows:

- `1_vid`
- `2_vid`
- `3_vid`
- `4_vid`
- `5_vid`
- `6_vid`
- `7_vid`
- `8_vid`
- `1_flm`
- `2_flm`
- `3_flm`
- `4_flm`
- `5_flm`
- `6_flm`
- `7_flm`
- `8_flm`
- `NA` (no standard WSS detected)

**sInp1_WSS-Extd**

This item displays the detected extended WSS value of input 1. This is displayed as follows:

- `4:3_0`
- `4:3_1`
- `4:3_2`
- `4:3_3`
- `4:3_4`
- `4:3_5`
- `4:3_6`
- `4:3_7`
- `16:9_0`
- `16:9_1`
- `16:9_2`
- `16:9_3`
- `16:9_4`
- `16:9_5`
- `16:9_6`
- `16:9_7`
- `NA` (no WSS extended detected)

**sInp1_S2016**

This item displays the detected SMPTE 2016 (AFD) values of input 1. This is displayed as follows:

- AFD0
- AFD1
- AFD2
- AFD3
- AFD4
- AFD5
- AFD6
- AFD7
- AFD8
- AFD9
- AFD10
- AFD11
- AFD12
- AFD13
- AFD14
- AFD15
- NA (no S2016 detected)

**sInp1_CRC_EDH**

This item indicates CRC and EDH errors on input 1. Can be:

- Off
- OK
- Error
- NA
- NoPCM

**sInp1-Map**

Displays the mapping of the 3Gb/s input, if the format is 1080p50 or 1080p60. Can be Level A or Level B. NA is indicated if the input is not 3Gb/s.

**IODelayA**

Displays the total delay in ms of outputs A1 and A2. can be a value between 0ms and 5000ms.

**FunctionA**

Displays the current function outputs A1 and A2. For the card it can only be Up, Trans, TestPattern or NA.

**Ref**

Displays whether a correct reference is found (Present) or not (NA)

**Contact_Status**

Displays the currently closed GPI contacts. This is displayed as for instance 10100 when contacts 1 and 3 are closed and for instance 01110 when contacts 2, 3 and 4 are closed.

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|---|---|
| **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 |
| **OP47-Det-A** | Displays whether or not there's OP47 detected on channel A |
| **WST-Det-A** | Displays whether or not there's WST (teletext) detected on channel A |
| **CC_Det_A** | Displays whether or not there's Closed Captioning detected on channel A |
| **SDI1DemFrmt01/02 ~ SDI1DemFrmt15/16** | 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:<br>▪ N/A<br>▪ PCM<br>▪ Null<br>▪ AC-3<br>▪ TimeStmp<br>▪ MPEG-1<br>▪ MPEG-2<br>▪ SMPTE-KLV<br>▪ Dolby E<br>▪ Caption data<br>▪ UserDef<br>▪ Rsvd<br>▪ Enh Ac-3 |
| | **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 card 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.

**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 |

## 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_A LED**

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

**Input_B LED**

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

**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.

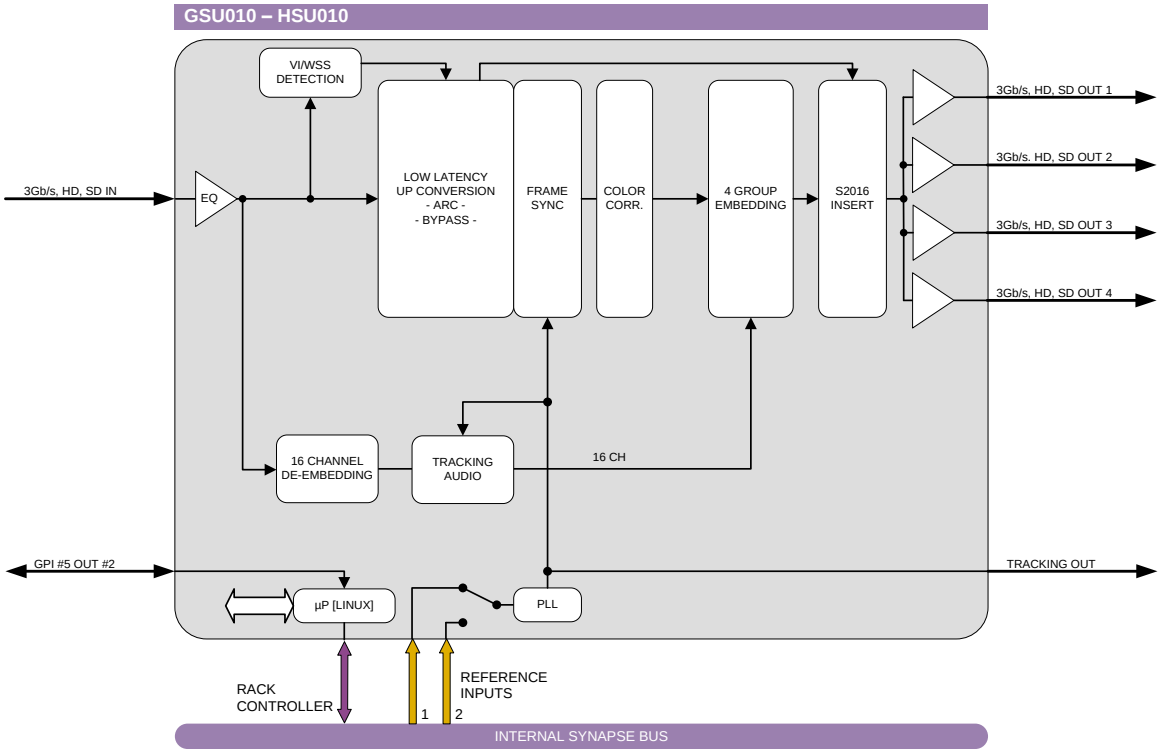
**Connection LED**

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

**Error LED**

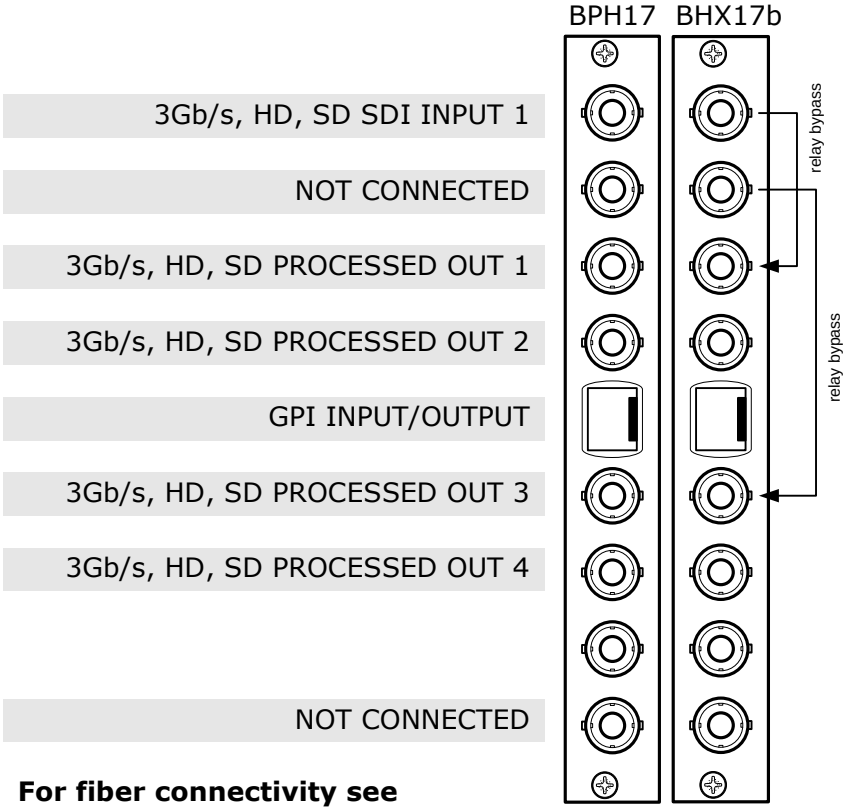
The error LED indicates an error if the internal logic of the card is not configured correctly or has a hardware failure.

# 9 Block Schematic



# 10 Connector Panels

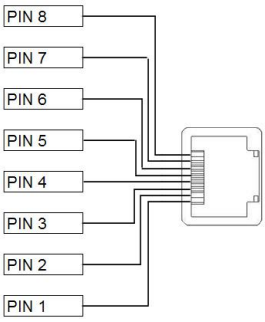
The GSU-HSU010 can be used with the BPH17 or the BHX17b. The following table displays the pinout of these backpanels in combination with the card.




**For fiber connectivity see www.axon.tv**

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

**GPI pinning**

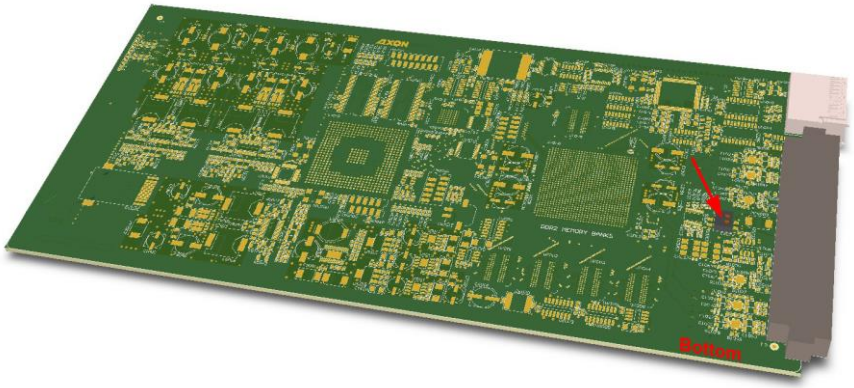



| Pin | Function |
|---|---|
| 1 | GPI in 1 |
| 2 | GPI in 2 |
| 3 | GPI in 3 |
| 4 | GPI in 4 |
| 5 | GPI in 5 |
| 6 | GPI out 1 |
| 7 | GPI out 2 |
| 8 | Ground |

## Appendix 1 Card dip-switches for BHX and fiber configuration

There are dip-switches on the circuit board of the card itself. With these dip-switches you can change the power-voltages that is put on the backpanel. By default the switches are set to off, putting no power on the backpanel. The picture below displays where the switch is positioned on the card.

| | |
|---|---|
| ! | **When using a 'normal' BPH17 (passive) backpanel with this card, the dipswitch on the card itself must be switched <u>OFF</u>.** |




### Using BPH17 with fiber I/O

When using a BPH17 backpanel with fiber I/O, you must first set the **top-side** dip-switch on the **synapse board** to 'on'. This will pass 30 volt to the backpanel. If this is not done, the relays won't work at all.

### Using BHX17b

When using the backpanel with bypass relay (BHX17b), you must first set the **bottom-side** dip-switch **on the card** to 'on'. This will pass 5 volt to the backpanel. If this is not done, the relays won't work at all.

On the BHX17b itself there are also 2 dipswitches (see picture on the next page). The bottom dipswitch is not connected. With the top switch you can choose the Bypass function. There are 2 possible function indications "on" (printed on the dip switch itself) and "off":

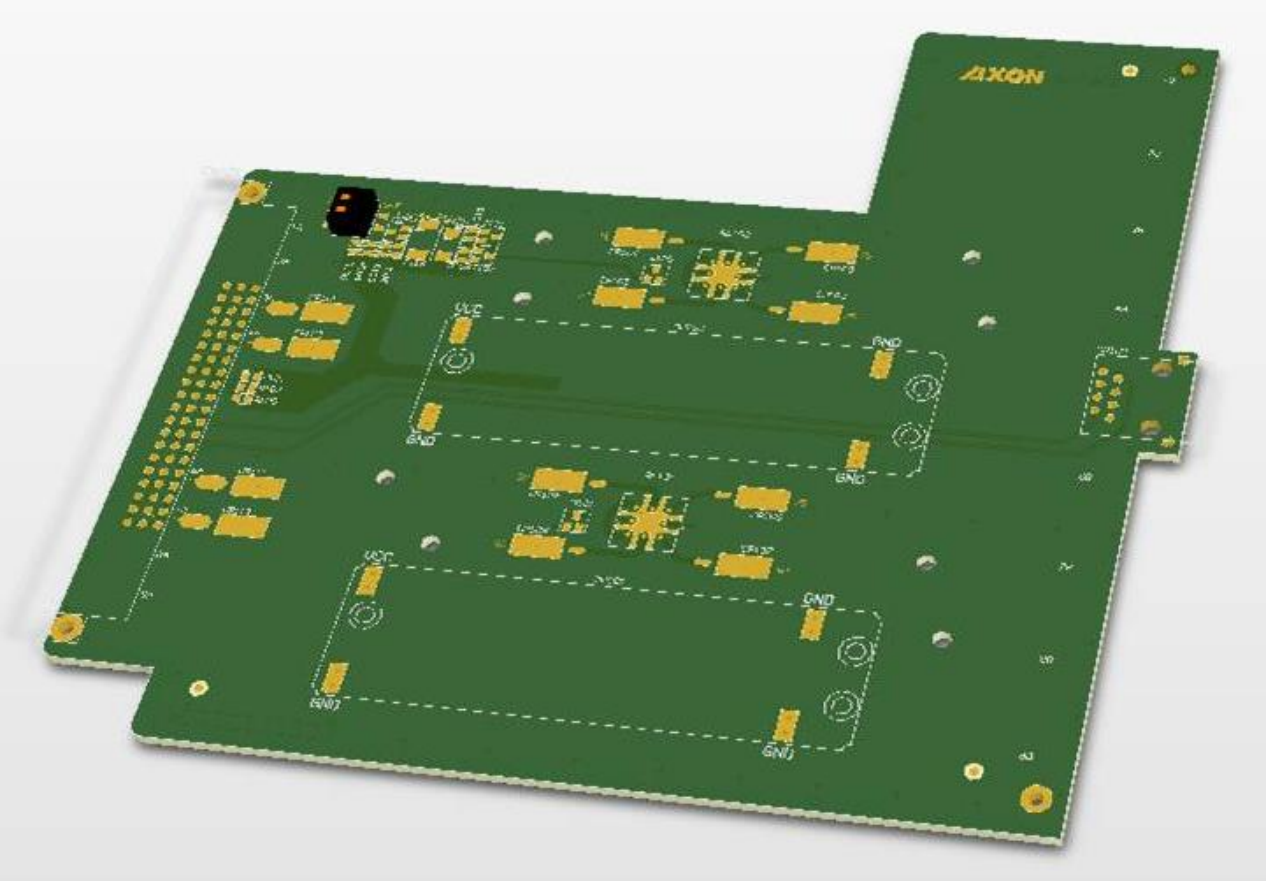
"**Direct Backpanel Switchover**" dipswitch set to **ON**:
Will make the BHX-backpanel switch over to the processed signal as soon as it detects the trigger signal from the connected synapse card. This setting will minimize the bypass time and ensures fast recovery of processed signals.
The **ON** setting is recommended if the BHX-backpanel is used in combination with synapse cards:

- which have a short initialization time, or
- which have a delayed trigger-signal onboard.

"**Direct Backpanel Switchover**" dipswitch set to **`OFF` (default)**: Will make the BHX-backpanel switch after about 15 seconds from the moment the BHX-backpanel detects the trigger signal from the connected synapse card. This setting will allow more time for complex synapse cards to finish initialization and stabilize proper signal processing before the backpanel switches over to the processed signal.
The **`OFF`** setting is recommended if the BHX-backpanel is used in combination with synapse cards:

- which are more complex and thus need longer initialization time and do NOT have a delayed trigger-signal onboard.

Note: In case of power failure or when the synapse board is extracted from the frame the bypass is immediately active.



# Appendix 3 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:

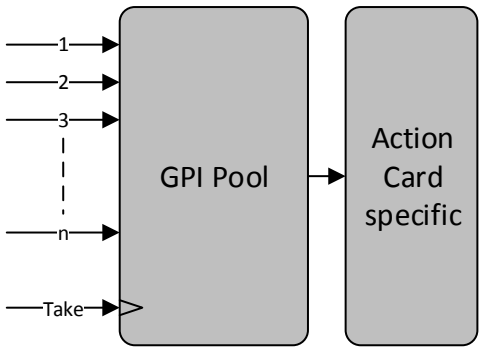
- Input selection
- Output mode
- Up conversion aspect ratio for channel A and B
- Down conversion aspect ratio for channel A and B
- Cross conversion aspect ratio for channel A and B
- Transparent aspect ratio (equal in-output) for channel A and B
- Insertion of VI, WSS, AFD (S2016) for channel A and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

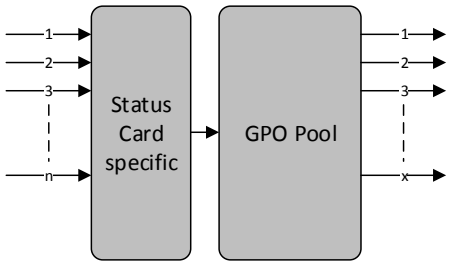
In binary mode, the contacts are interpreted as a binary value of concatenated contacts available in a pool. E.g. assigning two contacts to a GPI pool translates to the following output values.

| 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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