HDR & UHD SOLUTIONS

COLOR SPACE AND HIGH DYNAMIC RANGE CONVERTERS AND UHD PROCESSING MODULES
Visit [www.axon.tv](http://www.axon.tv) for all our other products.

If you require a printed copy of one of our brochures, please contact us at marketing@axon.tv.

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**ABOUT AXON**

Axon is a global leader in broadcast network infrastructure products and solutions. For more than 30 years, major broadcasters, network operators and service providers worldwide have trusted our ground-breaking technology to control and monitor their operations - delivering insight, efficiency and performance at the highest level.

As the industry faces the challenge of managing new standards and multiple formats for an ever-increasing number of complex delivery platforms, Axon continues to offer the widest and most advanced range of ultra compact modular systems for audio and video signal processing available today. We pioneer ever-more reliable, cost-effective and space-saving products that have a big impact in the machine room, and to the bottom line.

We are a company built on innovation and excellence, with a strong team of R&D experts whose experience and dedication is unrivalled. Actively and tirelessly pushing research and development to the foreground, our mission is to develop forward-thinking technologies that anticipate and satisfy the needs of customers – to save time, mitigate risks, dramatically reduce capital and operational costs and deliver competitive advantage.

Through our partnerships and association with leading industry bodies, such as SMPTE and IEEE, and with numerous awards and accolades for delivering game-changing solutions, Axon is a key player in shaping the future of broadcast.

But it is our razor-sharp focus on customer support coupled with passion and belief in the quality of our products that sets Axon apart. Guided from our headquarters in the Netherlands, our reach is growing on every continent with regional offices worldwide – all supported by an extensive network of distributors and specialist systems integrators. Together we are driven to continually bring value to our customers.

Ultimately, we enjoy being a great company to do business with. Axon has the commitment and vision to keep focused on meeting today’s demands and the challenges of the future – always delivering at the very heart of broadcast.
The Road to Enhanced Pictures

While UHD itself is still in the very early stages of rolling out for both production and transmission, broadcasters and particularly the new breed of entertainment distribution services, notably Netflix and Amazon Prime, are looking at techniques to further enhance and improve the viewing experience.

UHD has already brought us more pixels. The next logical step is not to add more pixels but to make sure that what is already there is more vivid. At the moment, the needs of broadcasters, particularly HD, are being met by BT.601 (Recommendation BT.601), which is the CIE 1931 colour space. However, for UHD, we can move up to BT.709 (Recommendation BT.709-5), which uses the CIE 1931 colour space. This means a matrix is needed to convert from BT.601 to BT.709-5.

The whole issue becomes even more complicated if WCG is part of the equation. Higher dynamic range with some sort of backwards compatibility is only possible when everything is working in the same colour space. But because the broadcast market has to be part of the real world, services will have to include WCG, which will mean the whole issue of backwards compatibility in practice is down the drain.

Making the changes

Going from one colour space to another and dealing with different dynamic range systems is challenging. Fortunately there is a long established technique for this involving look-up tables (LUTs). A LUT is a list of parameters - a row of numbers - with an input and an output. It tells you that if you go in with a certain number, you have to come out with a different number.

A LUT has to be made for the different colours. So a single LUT would consist of LUTs for R, G and B. The ultimate goal is to maintain equal and realistic skin colours. If skin colours start to shift any problems with the colour become immediately very apparent. The human eye is very perceptive to skin colour changes.

The technical challenge behind this is the move from the HDTV colour space (BT.709) to the colour space for UHD plus HDR and WCG (BT.2020). In doing this we are going from a relatively small area with a maximum brightness/luminance of 100 nits, all represented in the well-known 10-bit YUV definition that is used in broadcast. Compared to BT.709, BT.2020 has a much larger colour space to work in and up to 10,000 nits, but as broadcasters want/need to be able to continue to use their existing infrastructure, we still need to code this in the same 10-bit YUV infrastructure.

A further complication is that LUTs are handled in a RGB domain. This means a matrix is needed to convert from YCbCr to RGB. By taking the colour corrector in one of our cards, the incoming YCbCr signal is converted into RGB, colour corrected and then outputted as YCbCr using an inverse matrix. The problem is that the matrix going from YCbCr to RGB is different in BT.601 and in BT.709. This means a matrix is needed to convert from YCbCr to RGB for UHD.

A standard set of LUTs are included, along with a piggyback PCB for storing the LUT presets. A selection of presets is available, allowing many different LUTs to be held on the card. These can be switched on the fly, with the ability to use split screen mode allowing many different LUTs to be held on the card. These can be switched on the fly, with the ability to use split screen mode.

The U4T200-240 is designed as a lower cost down-converter. It allows many different LUTs to be held on the card. These can be switched on the fly, with the ability to use split screen mode. A further complication is that LUTs are handled in a RGB domain. This means a matrix is needed to convert from YCbCr to RGB. By taking the colour corrector in one of our cards, the incoming YCbCr signal is converted into RGB, colour corrected and then outputted as YCbCr using an inverse matrix. The problem is that the matrix going from YCbCr to RGB is different in BT.601 and in BT.709. This means a matrix is needed to convert from YCbCr to RGB for UHD.

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The U4T200 and U4T240 have all the features and functions of the U4T100 and U4T140.

The difference between the U4T1100/140 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 or 3D formats.

- Fully features 4K (3840x2160) Ultra HD 4 wire toolbox
- LUT based color space and dynamic range conversion
- 16 LUT presets for standard LUT tables (.cube, .LUT, .TXT extensions)
- 1D LUT 10 bits 1024 RGB values (1024x3 rows)
- 3D LUT 10 bits 39937 RGB values (33x33x33)
- Side by side split screen mode with slider for evaluation of LUT values
- LUT bypass mode
- Compatible with ITU-R BT.709 and ITU-R BT.2020 1/0 (conversion matrix from YCrCb to RGB and back)
- Optional Dolby E encoder and decoder (U4T240)

**Applications:**
- LUT based color space abd dynamic range conversion
- 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 to 2SI conversion in any direction

**I/O Panel:**

The U4T200/240 - 4K (UHD) 4 wire toolbox with LUT based color space and dynamic range converter

The UXU400/410 has all the features and functions of the GXG400/410.

The difference between the GXG400/410 and UXU400/410 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 or 3D formats.

- Fully features 4K (3840x2160) Ultra HD 4 wire toolbox
- LUT based color space and dynamic range conversion
- 16 LUT presets for standard LUT tables (.cube, .LUT, .TXT extensions)
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- Side by side split screen mode with slider for evaluation of LUT values
- LUT bypass mode
- Compatible with ITU-R BT.709 and ITU-R BT.2020 1/0 (conversion matrix from YCrCb to RGB and back)
- Optional cross-input audio shuffler (UXU410)

**Applications:**
- LUT based color space abd dynamic range conversion
- High End Truck dual input frame synchronizer and anything to anything converter
- High End Infrastructure up/down/cross conversion
- High End transmission up/cross conversion
- UHD (4k) up and down conversion from-and-to any supported video standard in the same frequency

**I/O Panel:**
**HDR & UHD Solutions**

### U4D100 - 4K (UHD) 4 wire to 1080p or 1080i Down Converter

The U4D100 is a 4K (3840x2160), 4 wire, to 1080p down-converter. This low latency unit combines and filters the four quadrants into a 1080p (1920x1080) signal.

For the 1080p60 and 1080p50 standards the card is completely transparent for all the ANC data from input 1. For the other standards the card must be locked to input and is only transparent for 2 groups of audio.

- Four 1080p50/59.94 (level B compatible) inputs
- 4 outputs, equal signals (one 1080p50/59.94 output on all 4 outputs)
  - one 1080p50/59.94 signal on all 4 outputs (fully ANC transparent)
  - or one 1080p50/59.94 or 1080p50/59.94 signal on all 4 outputs with 4 groups of audio and no other ancillary data (no ANC transparency!)
- Low latency (20ms @ 50Hz, 16.7ms @ 59.95Hz)
- 4K four wire (3840 x 2160)
- Compatible with 1080p50/59.94 or 1080p50 inputs
- Transparent for 16 channels of embedded audio
- Full control and status monitoring through the front panel of the frame and the Ethernet port (ACP)
- Optional 1 or 2 fiber outputs (replacing 1 or 2 SDI outputs)

**Applications:**
- Down conversion from 4K production sets

**I/O Panel:**
- 3Gb/s INPUT 1 (LEFT TOP)
- 3Gb/s INPUT 2 (RIGHT TOP)
- 3Gb/s PROCESSSED OUTPUT 1 (OPTIONAL FIBER OUTPUT)
- 3Gb/s PROCESSSED OUTPUT 2 (OPTIONAL FIBER OUTPUT)
- GPI
- 3Gb/s PROCESSSED OUTPUT 3
- 3Gb/s PROCESSSED OUTPUT 4
- 3Gb/s INPUT 3 (LEFT BOTTOM)
- 3Gb/s INPUT 4 (RIGHT BOTTOM)

### U4D100 - 1080p to 4K (UHD) 4 Wire Up Converter

The U4U100 is a 1080p to 4k (4 wire) ultra HD up-converter. The low latency unit extracts four quadrants out of a 1080p (1920x1080) and scales each individual part into to 4 full 1920x1080 pictures.

- One 1080p 50/59.94 input (level B compatible)
- 4 outputs, one for each quadrant
- Low latency (20ms @ 50Hz, 16.7ms @ 59.95Hz)
- 4K four wire (3840 x 2160)
- Compatible with 1080p59.94 or 1080p50 inputs
- Transparent for 16 channels of embedded audio
- Full control and status monitoring through the front panel of the frame and the Ethernet port (ACP)
- Optional 1 fiber input (replacing 1 SDI input)

**Applications:**
- Up conversion for 4K production sets

**I/O Panel:**
- 3Gb/s INPUT 1 (OPTIONAL FIBER INPUT)
- 3Gb/s PROCESSSED OUTPUT 1 (LEFT TOP)
- 3Gb/s PROCESSSED OUTPUT 2 (RIGHT TOP)
- GPI
- 3Gb/s PROCESSSED OUTPUT 3 (LEFT BOTTOM)
- 3Gb/s PROCESSSED OUTPUT (RIGHT BOTTOM)
The functionality of the UDR416 is twofold. Firstly, it is a four channel 3Gb/s, HD, SD SDI reclocking distribution amplifier. Secondly, the UDR416 is a 4K quad 3Gb/s link to single 12Gb/s link converter and back depending on the back panel.

- Back and forth conversion between Quad Link 4K and single link 4K 2SI SDI signals
- BPU01: 4-wire 3Gb/s to 12Gb/s
- BPU02: 12Gb/s to 4-wire 3Gb/s
- Distribution Amplifier functionality
- BPU01: Quad channel DA with 8 outputs and dual 12Gb/s output on BNC or SFP
- BPU02: Quad channel DA with 12 outputs (4x3)
- Input/Carrier detection monitoring via GPI
- Compatible with
  - SD- SDI 270 Mbit/s (SMPTE 259M) and ASI/DVB**
  - HD- SDI 1485 Mbit/s (SMPTE 292M)
  - 3Gb/s SDI 2970 Mbit/s (SMPTE 424M)
  - 12Gb/s SDI (SMPTE 2082)
- Bypass function of the reclocker for non-standard frequencies

** BPU01 only
** Only on positive outputs (see block schematic)

**SPECIFICATIONS**
visit www.axon.tv/UDR416

**Applications**
- 4K generic wideband DA
- 4-wire 4K to 12Gb/s converter with BPU01 I/O panel
- 12Gb/s to 4-wire 4K converter with BPU02 I/O panel
- Quad channel generic wideband 3Gb/s DA

**ORDERING INFORMATION**

**Module:**
- UDR216: 4K, 3Gb/s, HD, SD SDI quad reclocking distribution amplifier and converter

**Standard I/O:**
- **BPU01_UDR416:**
  - 1/0 panel for UDR416 with 4-wire 4K to 12Gb/s conversion
- **BPU02_GDR216:**
  - 1/0 panel for UDR416 with 12Gb/s to 4-wire 4K conversion

**SFP I/O:**
- **BPU01_FIBER_T2_UDR216:**
  - I/O panel for UDR416 with fiber SFP module output options
- **BPU02_FIBER_R1_UDR416:**
  - I/O panel for UDR416 with fiber SFP module input options
- **BPU01_SDI_T2_UDR416:**
  - I/O panel for UDR416 with SDI SFP module output options
- **BPU02_SDI_R1_UDR416:**
  - I/O panel for UDR416 with SDI SFP module input options

**Specifications**
visit www.axon.tv/UO416

**Applications**
- 4K generic wideband DA
- 4-wire 4K to 12Gb/s converter with BPU01 I/O panel
- 12Gb/s to 4-wire 4K converter with BPU02 I/O panel
- Quad channel generic wideband 3Gb/s DA

**ORDERING INFORMATION**

**Module:**
- UDR216: 4K, 3Gb/s, HD, SD SDI quad reclocking distribution amplifier and converter

**Standard I/O:**
- **BPU01_UDR416:**
  - 1/0 panel for UDR416 with 4-wire 4K to 12Gb/s conversion
- **BPU02_GDR216:**
  - 1/0 panel for UDR416 with 12Gb/s to 4-wire 4K conversion

**SFP I/O:**
- **BPU01_FIBER_T2_UDR216:**
  - I/O panel for UDR416 with fiber SFP module output options
- **BPU02_FIBER_R1_UDR416:**
  - I/O panel for UDR416 with fiber SFP module input options
- **BPU01_SDI_T2_UDR416:**
  - I/O panel for UDR416 with SDI SFP module output options
- **BPU02_SDI_R1_UDR416:**
  - I/O panel for UDR416 with SDI SFP module input options
The NGU220 is a Synapse card which can bridge up to 2x 4k/UHD (four-Wire) into a single 10Gb/s Ethernet using TICO compression.

The included up converter also allows 1080i signals to be included into 4K UHD TICO compressed workflow.

Embedding and de-embedding to our Quad Speed audio bus is provided as well as bridging to AES67 from the same Quad Speed audio bus. A typical application for the Quad Speed bus is using a DEE28 Dolby E encoder/decoder card (or two) for Dolby E based workflows.

### Specifications
- Serial video input
  - SD, HD and 3Gb/s SDI: SMPTE292M, SMPTE259M, SMPTE424
  - DIN1.0/2.3 connector
  - Typical maximum equalized length of Belden 1694A cable of 90m at 2.97Gb/s, 120m at 1.485Gb/s and 250m at 270Mb/s
  - >15dB up to 1.5GHz return loss

- Serial video output
  - DIN1.0/2.3 connector
  - 800mV nominal signal strength
  - 0V ±0.5V DC offset
  - 135ps nominal rise/fall time
  - Return loss >15dB up to 1.5GHz (typ.) and >10dB up to 4GHz (typ.)
  - <0.2UI wideband jitter

- Electrical
  - +24V to +30V voltage
  - <25 Watt power
The NUG220 is a Synapse card that can bridge up to 2x 4k/UHD TICO Compressed streams into dual 1080i/p SDI stream or a dual 4k/UHD four wire stream. The included downconverter bridges the TICO compressed Workflow to an HD (1080i or 1080p) workflow. Embedding and de-embedding to our Quad Speed audio bus is provided as well as bridging to AES67 from the same Quad Speed audio bus. A typical application for the Quad Speed bus is using a DEE28 Dolby E encoder/decoder card (or two) for Dolby E based workflows.

**Applications**
- Ethernet to SDI bridge for TICO compressed UHD workflows
- Tailboard applications
- Point to point (back to back) applications for direct replacement of CWDM systems
- Mobile stage box application with SFR-Mobile
- Embedding onto a TICO compressed stream

**Ordering Information**

<table>
<thead>
<tr>
<th>Module</th>
<th>BPH33_NUG220: I/O panel for NUG220</th>
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**Specifications**

- **Serial video input**
  - SD, HD and 3Gb/s SDI: SMPTE292M, SMPTE259M, SMPTE424
  - DIN1.0/2.3 connector
  - Typical maximum equalized length of Belden 1694A cable of 90m at 2.97Gb/s, 120m at 1.485Gb/s and 250m at 270Mb/s
  - >15dB up to 1.5GHz return loss

- **Serial video output**
  - DIN1.0/2.3 connector
  - 800mV nominal signal strength
  - 0V ±0.5V DC offset
  - 135ps nominal rise/fall time
  - <10% of amplitude overshoot
  - Return loss >15dB up to 1.5GHz (typ.) and >10dB up to 4GHz (typ.)
  - <0.2UI wideband jitter

- **Electrical**
  - +24V to +30V voltage
  - <25 Watt power
**HDR & UHD Solutions**

**HDR & UHD Solutions**

When it comes to speed and flexibility, there is nothing on the market to compare with our new SynView, a powerful, modular multiviewer that can handle both 4K and any IP video format.

Featuring vastly improved specifications, SynView is the industry’s only single field latency (20ms@50Hz and 16,7ms@59.94Hz) multiviewer system to offer external looping for an unlimited amount of input channels. Thanks to its modular architecture it can either be used as a stand-alone unit or it can be combined with over 300 different Synapse signal processing modules to provide a system that truly stands out from the competition.

SynView's unequalled low processing delay and start up time makes it ideal for a wide range of applications, from the smallest to the largest, including fast response production monitor walls; high resolution, high source count monitor walls and OB van preview monitoring and shading.

The system consists of 5 basic models. These versions can be mixed and matched to build a hybrid multiviewer with up to hundreds of inputs and 8 1080p heads (on SDI) or two heads with UHD/4K resolution. Multiple connector panels are available to allow for different I/O configurations.

**Key Features**

- Dual 10Gb Ethernet
- Agnostic IP video channel picker compatible with formats like ST2022-7, ST2110, AVB/TSN etc.
- Linear expandable system in steps of 8 SDI input channels or networked channels
- UHD (4-wire), 3Gbps, HD or SD SDI inputs
- 2x UHD or 8x HD outputs
- Unlimited amounts of inputs per dual UHD output configuration or per 8 3Gb/s SDI output configuration
- Multi card multiview systems can span multiple frames by use of mini SAS-HD cables
- Fast boot time: the only single field latency (20ms@50Hz, 16,7ms@59.94Hz) multiviewer system in the world
- Linear increase of cost (no penalty for a small systems)
- Linear increase of horse power
  - A single card has enough processing power to scale, position, de-embed, overlay and process 8 video channels. When you double the amount of inputs, you double the amount of processing power
  - A 128 channel system has 16 times the processing power of an 8 channel system
- A Synapse based modular system: can be combined with over 300 different available audio and video processing modules
- Each head can have its own customizable background
- Fonts can be changed by uploading .ttf or .otf files

**Blockschematic showing UHD version**
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