

Qx Series

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**ADVANCED RASTERIZERS FOR
HYBRID IP/SDI, 4K/UHD, HDR/WCG
GENERATION, ANALYSIS & MONITORING**



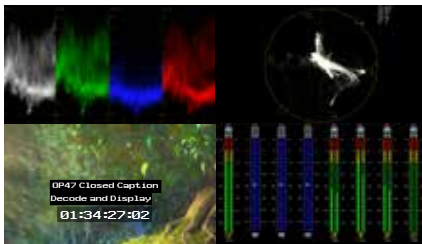
Qx Series

IP/SDI, 4K/UHD, HDR/WCG Generation, Analysis & Monitoring



The Qx rasterizer brings together all the advanced Test & Measurement tools required for transitioning to the next generation of video formats. Designed for HD/3G/6G/12G-SDI and IP ST 2110/2022-7/2022-6 and AMWA NMOS* environments, the instrument set includes tools for rapid fault diagnosis, compliance monitoring and product development.

Out of the box, the Qx offers media analysis for broadcast operator HD-SDI environments, with a flexible user-defined instrument layout displaying up to 16 simultaneous windows, and the ability to rapidly change between bespoke layouts for different operational tasks with user presets.



Picture view, waveform monitor, vectorscope, 32 channel audio metering, decoded channel status information, detection of common Dolby formats, ANC status and payload, on screen display of OP47 and CEA-708-B* closed captions and advanced control and logging are provided as standard.

Human readable event logs can be configured for SDI input standard/status, physical layer timing and jitter, Rest API requests and IP-Tx, IP-Rx, Flow and SFP records. Remote operator GUI access is provided over VNC, and a REST API is available for integrated control, monitoring and automated testing over a network.

The fully flexible architecture offers upgrades for UHD/4K-SDI, SMPTE 2110 and ST 2022-6, HDR, audio and video test signal generation as well as engineering grade data view and ANC packet inspection tools. A factory fitted hardware option provides RTE™ real time SDI eye and jitter analysis with the further option of a highly advanced SDI-Stress toolset.

Advanced High Dynamic Range (HDR) visualization & analysis toolset

The Qx's comprehensive HDR toolset includes a signal generator, CIE chart, Luma false color highlighting or "heat map", waveform monitor and vectorscope. All the main broadcast SDR and HDR production formats are supported: Standard Dynamic Range (SDR) BT.709, BT.2020 as well as HDR BT.2100 HLG, PQ

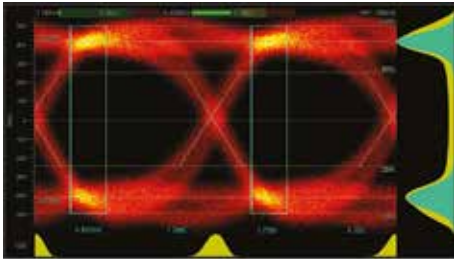


and Sony S-Log3 and SR Live. The Waveform provides a Cd/m² (nits) graticule along with BT.2048 diffuse white markers. The heat-map provides 7 simultaneous programmable color overlay bands with presets for HDR and SDR ranges, plus a user custom preset. The CIE 1931 x,y display provides overlays for BT.709, BT.2020 and ST.2086 gamut (P3).

An extensive set of test patterns include BT.2111 HDR color bars for HLG, PQ and SR Live as well as a full set of SDR 709 patterns mapped via 'display light' to each of the four HDR formats for line checks, comparative monitor set-up and the evaluation of HDR to SDR converters.

Fast, automated 12G-SDI physical layer analysis and SDI-Stress Toolset

The Qx Physical layer Toolset offers the fastest 12G/6G/3G/HD-SDI physical layer testing, with its RTE™ (Real-Time Eye) Technology instantly highlighting any SMPTE compliance issues. Built-in automation control allows testing to be performed faster, more reliably and at lower cost. Included in the option are a full range of SDI eye measurements including amplitude, under/overshoot, transition times and



jitter health indication with both amplitude and time histograms, as well as choice of color, heat-map overlays and infinite persistence display.

The Generator Toolset option provides not only the core full screen SDI Pathological stress patterns (EQ, PLL and check field), but also allows the user to define a combination of the SDI stress and conventional generator patterns up to full frame. These patterns can be duplicated on all four SDI outputs.

The advanced SDI-STRESS option is available for stress testing and R&D evaluations of SDI interfaces up to 12G. It includes the ability under automation control to insert SDI clock jitter, mute any of the SDI outputs, and control the SDI scrambler, sync-bit insertion, pre-emphasis, rise time and driver amplitude. The SDI-STRESS Eye amplitude measurement provides both Shorth mean and mode, with a histogram overlay and a user-defined window for the exploration of eye amplitude.

Pseudo-Random Binary Sequence (PRBS) generation and analysis of PRBS-7, 9, 15, 23, 31 allows for deterministic measurement of link Bit Error Rates (BER).

ST 2110 IP Toolset

The Qx ST 2110 “JT-NM Tested”[†] core IP feature set provides an operator all of the ST 2110 confidence status monitoring in an intuitive and accessible manner. The core toolset supports ST 2059 (PTP), decapsulation of 1 video, 2 audio and 1 ANC Data flows with support for ST 2110-20 (Uncompressed Video), -30 (PCM Digital Audio), -31 (AES3 Transparent transport) and -40 (ANC Data). ST 2022-7 seamless protection (SIPS) is provided for all four flows over two media network interfaces using industry standard SFPs.



Audio reception conforms to ST 2110-30 Class C with support for 48Khz streams from 1 to 8 channels at packet times of 1ms and 1 to 64 channels at packet times of 125us.

Also provided is an indication of the timing relationship of each of the eight ST 2022-7 flows to PTP with status information, as well as a ST 2022-7 status tool that reports the health and relative timing skew of each ST 2022-7 pair all with hardware time stamping.

Advanced Qx ST 2110 measurement tools include the provision of up to four simultaneous Packet Interval Timing measurement and displays, detailed data reporting of flow packet, clock rates and PTP timing relationship, as well as IP Receive statistics that includes the measurements of the ST 2110-21 Network Compatibility model (Cinst) and Virtual Receiver Buffer Model (VRX).

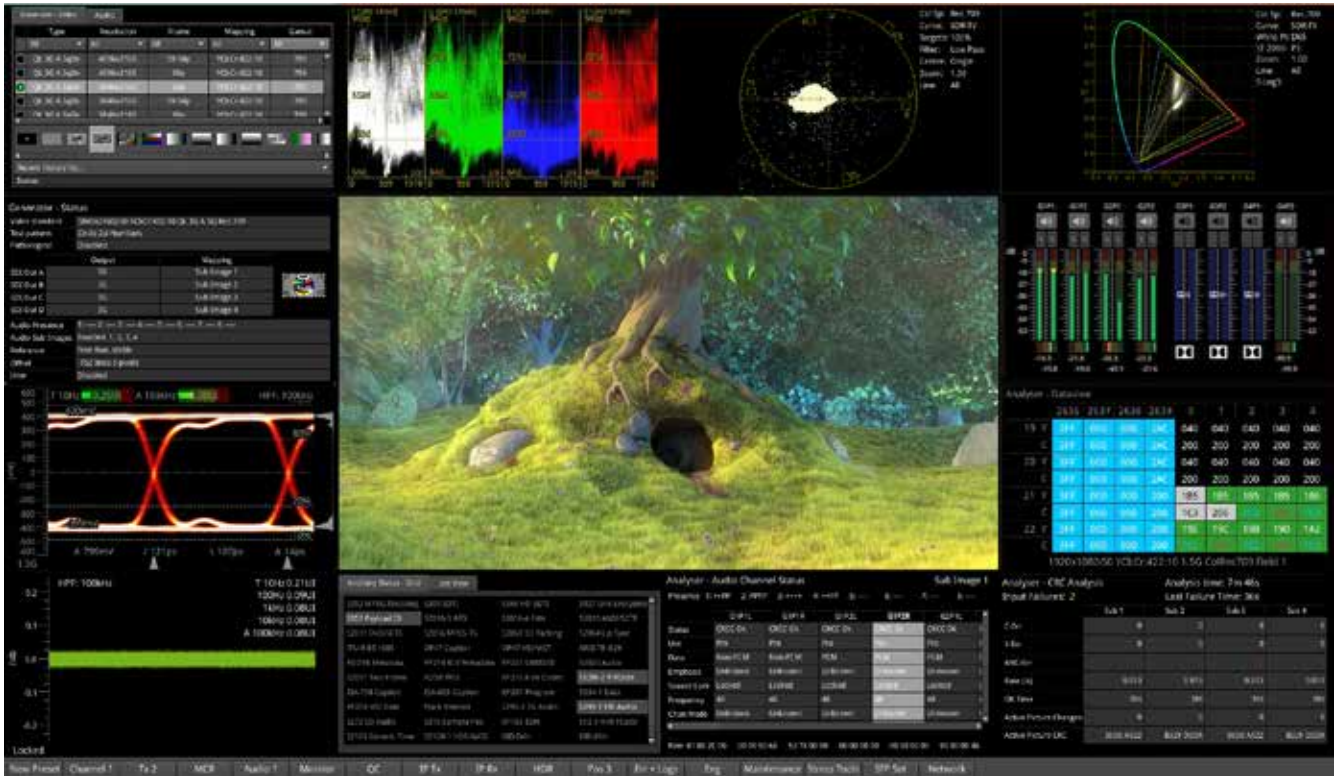
^{*}Upcoming software release

[†]JT-NM Tested - For more details on the JT-NM Tested program at NAB 2019 and its test results please see http://jt-nm.org/jt-nm_tested/

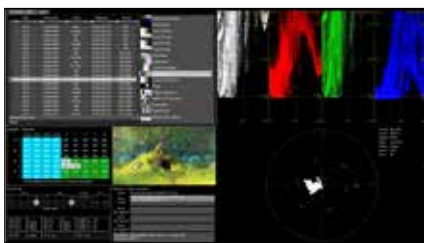
User-defined Instrument Display Layout

Optimized instrument display with scalable windows to suit individual operators

SDI Analysis



Instruments Display



Display Options

- GUI output rate 50, 59.94, 60 to match video format
- User-selectable colors of window frames for Analyzer and Generator tools
- Brightness control for office or controlled lighting environments

Presets

- Multiple display layouts can be saved as presets
- This allows users to save bespoke layouts for different operational tasks
- Useful for rapidly changing between different screen layouts eg. Audio, HDR or IP focus

Up to 16 Instruments

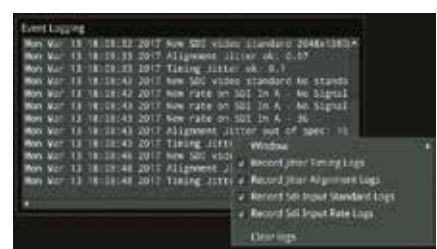
- Fully flexible user-defined instrument layouts
- Display up to 16 instruments on a single 1920x1080 display
- Individual instruments can switch between sixteenth, quarter or full screen (selected instruments)



IP Analysis



Control and Logging



REST API

- The Qx can be controlled remotely over a network via a REST API
- Integrated control, monitoring and automated manufacturer testing

USB File Manager*

- Copy presets, instrument logs, screenshots and user TIFF images via USB memory stick

VNC and Instrument Screenshots

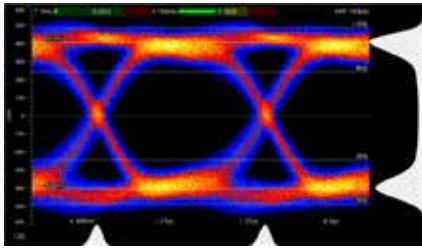
- Interface employs VNC technology to deliver 16 simultaneous scalable instrument windows over a remote network
- SFTP and Browser network access to event logs, screenshots and user presets

Event Logger

- SDI Input standard/status
- SDI physical layer timing and alignment jitter
- Rest API requests
- IP-Tx, IP-Rx, Flow and SFP records
- Reference Locking
- Audio input presence

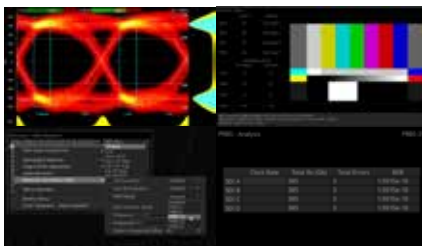
Optional Toolsets

Physical Layer Testing (PHQX01E-3G & PHQX01E-12G Only)



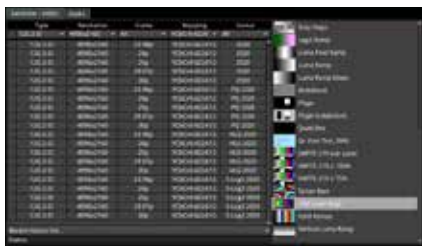
- Factory fitted option for fast 12G/6G/3G/HD-SDI physical layer commissioning, testing and development
- RTE™ (Real-Time Eye) Technology instantly highlights any SMPTE compliance issues including eye amplitude, transition times and under/overshoot
- Built-in controls for automation allows more reliable, faster testing and at lower cost
- A versatile eye display offers single eye with auto centering, or multiple eyes and can be displayed with a choice of color and heat-map overlays with infinite persistence
- Realtime SDI jitter analysis provides simultaneous monitoring across five specified frequency bands, including measurements down to 10Hz, and video trigger options

SDI Stress Testing up to 12G (PHQXO-IP-STRESS)



- Advanced suite of engineering tools for developers and manufacturers evaluating SDI interfaces
- Comprehensive API for rapid automated testing
- Insert up to 16 UI of SDI clock jitter from 10Hz to 10MHz, mute any of the SDI outputs, control the SDI scrambler, sync-bit insertion, pre-emphasis, rise time and driver amplitude, all under automated control
- Pseudo-Random Binary Sequence (PRBS) generation and analysis of PRBS-7, 9, 15, 23, 31 allows for deterministic measurement of link Bit Error Rates (BER)
- Shorth mean RTE™ amplitude measurement with histogram overlay and a user-defined window for eye amplitude exploration
- Realtime reporting of the rate of creation of SDI pathological conditions

UHD/4K Upgrade (PHQXO-UHD)



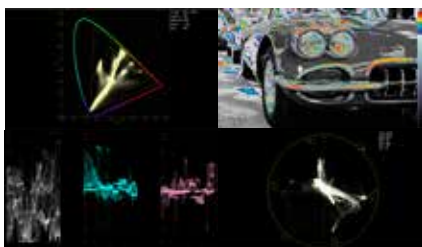
- Support for an additional 36 UHD and 4K SDI formats for a wide range of post production and broadcast applications (see supported formats table on page 15)
- Quad 1.5G and 3G, single 6G, dual 6G and single 12G interfaces at all frame rates including 48 and 49.97Hz
- Extended modes support all color formatting including 4:2:2, 4:2:2:4, 4:4:4, 4:4:4:4 at 10 and 12-bits
- All SDI link configurations fully support Levels A & B with square division and 2 sample interleave (2SI)

Data View Analyzer with ANC Inspector (PHQXO-DATA)



- Sophisticated engineering grade analysis tools providing easily accessible visualization of the data on an SDI interface and associated ANC packets
- Deep SDI data inspection with full freedom to inspect Active Picture, VANC and HANC
- API controls to read back Active Picture Data under automation control
- ANC packet decapsulation and error reporting for detailed analysis and debug of ANC payloads

HDR Generation & Analysis (PHQXO-HDR)



- The comprehensive HDR and Wide Color Gamut (WCG) toolset supports all modern live production formats: SDR BT.709, BT.2020 as well as HDR BT.2100 HLG, BT.2100 PQ and Sony S-Log3 and SR Live
- CIE chart, vectorscope and waveform tools to enhance the visualization and analysis of your HDR/WCG content
- Flexible user-controlled HDR heatmap, highlighting signals beyond SDR with 7 simultaneous programmable color overlay bands with presets for HDR/SDR ranges, plus user custom presets
- HDR test pattern generator with both mapped and ITU-R native HLG, PQ and SR Live patterns for checking BT.709 conformity of a HDR Wide Color Gamut System

Qx Optional Toolsets

Audio and Video Generation (PHQXO-GEN)



- Simultaneously generate and analyze a comprehensive set of SDI and IP formats with an intuitive, user friendly interface
- Moving test patterns with up to 32 channels of embedded audio per link or sub-field (up to 128 channels on 12G interfaces)
- The Generator Toolset option provides not only the core full screen SDI Pathological SDI stress patterns (Eq, PLL and check field), but also allows the user to define a combination of the SDI stress and conventional generator patterns up to full frame
- Import of TIFF files for checking of HDR/WCG graphics or display and evaluation of user-created test images

ST 2110 and ST 2022-6 Monitoring (PHQXO-IP-STND)



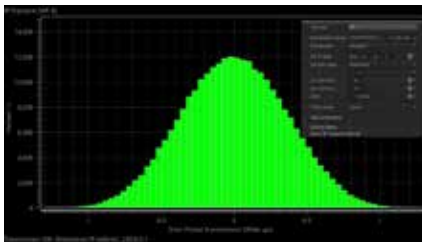
- Operator suite of stream monitoring tools for next generation professional IP media environments
- Simultaneously monitor 1 video, 2 audio and 1 ANC ST 2110 flows with ST 2022-7 seamless IP protection switching (SIPS)
- Easily accessible status reporting of flow health and SIPS and PTP Status
- Operational Audio flexibility with ST 2110-30 Class C (64 channels at 125us) and support for ST 2110-31 AES encapsulation of Dolby® Audio

ST 2110 Analysis (PHQXO-IP-NAT)



- Engineering suite of tools for ST 2110 analysis and debug
- Display up to four simultaneous Packet Interval Timing measurements for easy visualization of network congestion and sender packet distribution with max, mean and min inter-packet arrival times
- Receive statistics that includes the measurements of the ST 2110-21 Network Compatibility model (Cinst) and Virtual Receiver Buffer Model (VRX)
- Advanced measurement of IP flow latency and RTP clock timing relationships for debug of Audio, Video and ANC alignment, source PTP and encapsulation

IP Network Traffic Generation (PHQXO-IP-NGT)



- Advanced ST 2022-6 packet generation tool for evaluating the ability of a receiver to handle a jittered ST 2022-6 flow
- Simulate IP video network packet jitter under a variety of network conditions by providing the ability to adjust the transmission distribution profile
- View the interval timing distribution of the packets being generated, the number of packets being generated each second, against the deviation of each packet interval from the expected interval time

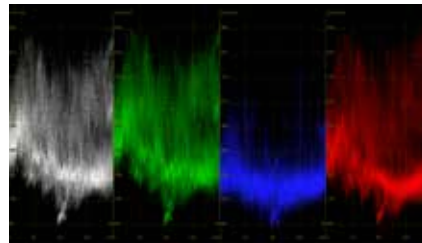
*Upcoming software release

Core Toolset



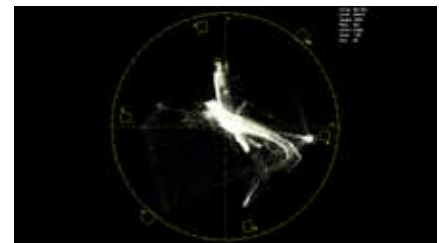
Analyzer - Picture

- Scaling from 1/16 to Full Screen
- Cursors linked to Waveform and Data View
- Tooltip display of pixel location in the image
- ANC Timecode*
- Closed Captions OP47, CEA-708-B*
- 2 simultaneous Closed Caption decode windows*
- Paint, Pop and Scroll Display Modes
- Italic and underlined character sets



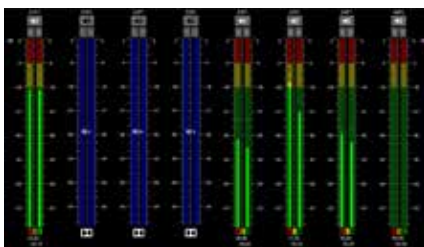
Analyzer - Waveform

- YCbCr, YGBR and GBR parade modes
- Cursor linked to Picture and Data View
- Single line mode linked to Picture Cursor
- Configurable H and V Graticules
- User markers
- Overlay*, Stacked*, Parade, Single line, H & V Mag, Brightness, Persistence and Monochrome controls
- 12-bit processing



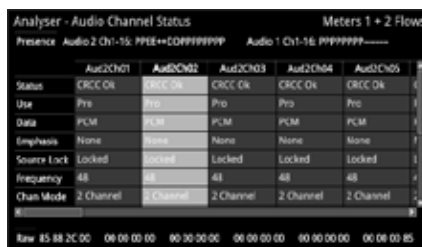
Analyzer - Vectorscope

- 75% and 100% Targets for ITU-R Rec. 709, Rec. 2020 and HDR formats
- User targets linked to Waveform
- 0.5x to 4x Mag, center on chosen target
- Single line mode linked to Picture Cursor
- Tooltip display of Cb, Cr and Hue Angle
- IQ axis on/off
- 12-bit processing



Analyzer - Audio Meters

- 32 channel audio metering, embedded/AES
- Metering Ballistics: PPM-I, PPM-II, Vu, Vu-Fr
- Scales: dBFS, dBu -18, dBu -20, BBC, DIN45406, NordicN9
- Adjustable peak hold times: Off, 0.1 s to Inf
- Audio pair phase meters, numerical level
- Detection of Dolby DE, DD, DD+, DE line pos
- Stereo/mono audio preview bus



Audio Status

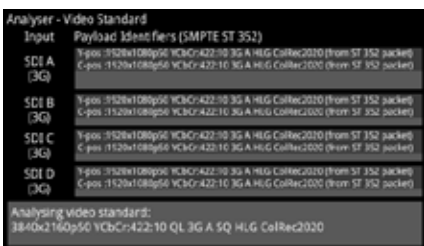
- 32 channel indication of audio type and presence, PCM, Dolby DE, DD, DD+
- Decoded channel status information for up to 128 channels
- Clear indication of useful audio parameters including CRCC, PCM/data, sample frequency, word length
- Channel Status data view (Hex)



Analyzer - Ancillary Status

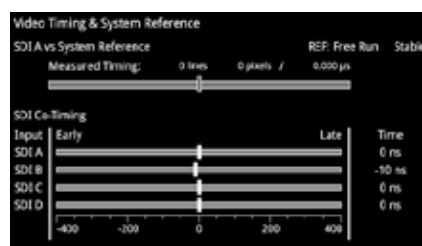
- SMPTE ST 291 VANC/HANC ancillary data presence/status window
- Grid View – clear visual overview, present/absent/fault indication
- List View – ANC present list with location and status information for Checksum, Parity, DBN
- Link to ANC Inspector
- Tool tip provides ST 291 ANC-type overview

NEW



Analyzer - Video Standard

- Display of detected SMPTE S352 Payload ID for each SDI Link and Subframe
- Manual over-ride of S352 ID
- Selection of SMPTE video format
- Indication of S352 errors



SDI Video Timing & System Reference

- Measurement of the timing of inputs against reference
- Indication of reference status and stability
- Indication of the relative co-timing of input SDI channels
- Graphical and numeric display



Network & Automation

- Reporting of Qx Management/Control Port information and Interface Status
- Reporting of IP and MAC Address and mDNS Hostname
- Reporting of REST API and VNC Server Status and user control enable/disable
- Configuration of Static IP address/Mask, Gateway and DNS Server

Core Toolset



Analysier - CRC Analysis
Analysis time: 2h 58m
Input Failures: 257
Last Failure Time: 11m 6s

	Sub 1	Sub 2	Sub 3	Sub 4
C-CRC-Err	0	0	0	0
F-CRC-Err	0	0	0	0
ANC-CS-Err	1	0	0	0
Rate (Hz)	0.002	0.000	0.000	0.000
On Time	0m 53s	11m 6s	11m 6s	11m 6s
Active Picture Changes	0	0	0	0
Active Picture CRC	1C10 C1C3	1E4F 7821	E03D C1C5	1E4F 7823

System IO

SDI In/Out	Signal	SDI In/Out	Signal	Length In/Out	Den
SDI In A	3G	SDI In A	3G	Length In A	7m
SDI Out B	No Signal	SDI In B	No Signal	Length In B	0m
SDI Out C	No Signal	SDI In C	No Signal	Length In C	0m
SDI Out D	No Signal	SDI In D	No Signal	Length In D	0m

EXT REF: 425/90 SFP B Type: 12G SCL 7x7x SFP A Type: 12G SCL 10x6



CRC Analysis

- Check for CRC errors on Y, C and ANC
- Reporting of the number of SDI input failures, the last failure time, total analysis time and error rates
- Detect active picture changes and view the active picture CRC to observe any changes in the expected active picture CRC value

System IO

- Shows the status of signal inputs and outputs, external reference, cable length, and connector details
- SDI mode: Select BNC or SFP I/O, cable type, loop through and generator copy outputs
- IP mode: Active IP SFP receive inputs and transmit outputs are indicated

AES IO Config

- 4 versatile bi-directional AES unbalanced interfaces
- Audio meter monitoring pair, or generator audio outputs or an AES input
- SDI Input to AES Output audio conversion for both PCM and Dolby encoded audio
- AES Input signals can be routed to other AES outputs providing a single loop output or up to 3 copy outputs

Optional Toolsets

IP license for ST 2022-6, ST 2110 Decap with ST 2022-7 and PTP [PHQXO-IP-STND]

SFP IP Network

	SFP A (Media Rx)	SFP B (Media Tx)
SFP Module	Present	Present
Carrier Signal	Present	Present
Interface	Up	Up
MAC Addr	00:1F:3F:81:4E:53	00:1F:3F:02:4E:53
IP Addressing Mode	Static	Static
IP Addr	192.168.1.20/24	192.168.1.30/24
Gateway	192.168.1.1	192.168.1.1
Total Tx pkts	624	17736450632
Total Rx pkts	918540895	4796

PTP Info

Qx Status	Master ID	Time
Normal	08:00:00:00:00:00	08:00:00:00:00:00
Listening on Borealis	Domain	0
Slave Mode	Multicast (M/M)	Priority 1: 128
Local PTP State	Slave	Priority 2: 128
Appl Freq adjustment	-5428 ppb	Clock Class: 248
Appl Freq adj delta	0 ppb	Clock Accuracy: > 10^-5
Estimated Phase Offset	0 ns	Variance: 15652
Last Sync message	One step	Clock Source: Hand Set

SFP A: PTP Locked

IP Receive Multi Flows

Locked	Protocol	Type	Src IP	Src Port	Dest	Sequence	Offset	Len	Flags
0	IP	IP	192.168.1.20	2001	192.168.1.30	0	0	1500	0x00000000
0	IP	IP	192.168.1.20	2001	192.168.1.30	0	0	1500	0x00000000

SFP IP Network

- Reporting of presence of SFPs, SFP MAC and IP addresses (flow source IP address), and interface status
- Tx and Rx packet counters for indication of traffic activity
- User configuration of SFP IP Addresses, Masks and Gateway Addresses

ST 2110 PTP Info

- Control of PTP domain and communication mode (multicast, hybrid w/o negotiation)
- Indication of lock status
- Grandmaster information including master ID and time source
- Indication of estimated frequency and phase lock offsets
- Indication of one step or two step traffic

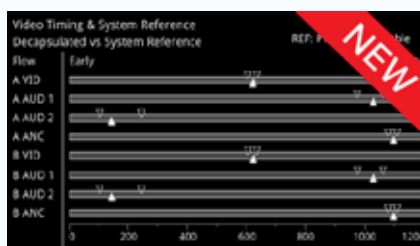
IP Receive Multi Flows

- Reporting of the IP Flows available to the receiver and user selection of the required flows
- Indication of Qx locked status, Protocol, Src and Dst IP and Port Numbers, SSRC, Packet Counts, Sequence, payload and CRC errors
- Configuration of Multicast Destination IP addresses and subsequent Multicast Join requests

ST 2022-7 Status

ST 2022-7 Status

- Indication of the health of ST 2022-7 seamless protection
- Warning of ST 2022-7 flow-pair mis-match
- Warnings of errors on flows and errors on reconstructed output and error rates/second
- Relative measure of Path Differential of flows on SFPB (Blue Network) relative to SFP A (Amber Network)
- Class A, B, C, D markers



IP Flow Timing and System Reference

- Measurement of the timing relationship of selected flows against PTP
- Indication of PTP lock status and stability
- Indication of the relative co-timing of the selected flows

IP Event Logging

Time	Event	Details
2022-07-15 10:00:00	PTP Lock	PTP Lock Status: Locked
2022-07-15 10:00:01	IP Flow	Flow ID: 1, Protocol: IP, Src: 192.168.1.20, Dst: 192.168.1.30

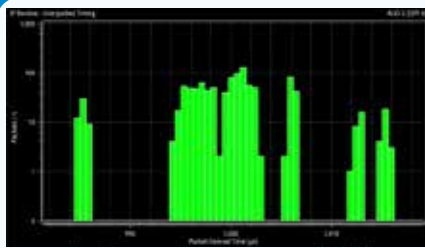
IP Event Logging

- Event logs of: PTP, IP Interfaces, Rx Traffic, Tx Traffic, SFP records

Optional Toolsets

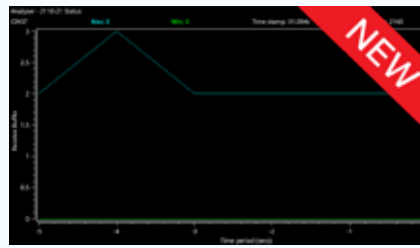


Network Traffic Analysis [PHQXO-IP-NAT]



Inter-packet Timing

- Stream health reporting using histogram to visualize the distribution of inter-packet arrival times
- Packet counts (log or linear scales) mapped against arrival times (us)
- Easy diagnosis of congestion with max, mean and min inter-packet arrival times



IP Receive Statistics

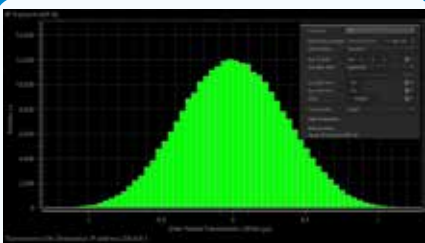
- Reporting of receiver flow video statistics and stability
- ST 2022-6 measurement of total and active samples per line and lines per frame and indication of ST 352 Payload ID
- ST 2110-21 measurement of Network Compatibility Model (Cinst) and Virtual Receiver Buffer Model (VRX)

	Min	Mean	Max	From V23	RTP pps : line	RTP pps : frame
A.VID	735.36 µs	740.61 µs	756.67 µs	50 : 50801	1800.02	1800.02
A.AJD 1	1.03 ms	1.04 ms	1.08 ms	1000 : 48000	48.00	48.00
A.AJD 2	154.23 µs	166.82 µs	226.73 µs	8000 : 48000	6.00	6.00
A.ANC	19.99 ms	25.01 ms	20.01 ms	50 : 50801	1800.02	1800.02
B.VID	736.45 µs	745.73 µs	757.73 µs	50 : 50801	1800.02	1800.02
B.AJD 1	1.03 ms	1.04 ms	1.08 ms	1000 : 48000	48.00	48.00
B.AJD 2	154.65 µs	167.47 µs	210.15 µs	8000 : 48000	6.00	6.00
B.ANC	19.99 ms	25.01 ms	20.01 ms	50 : 50801	1800.02	1800.02

Adv. PTP Media Timing

- Data showing the relationship of the transmitter encapsulation and media to PTP
- Measured number of RTP packets and RTP clock rate per second
- Measured RTP clocks per packet per second
- Flow to PTP min and max timing measurements

Network Traffic Generation [PHQXO-IP-NGT] (Requires PHQXO-GEN)



IP Transmit (ST 2022-6)

- Configuration of Transmission flow addresses, port numbers and SSRC
- Injection of Inter-packet jitter onto outgoing flow
- Gaussian or uniform distribution
- Flow control on/off

Data [PHQXO-DATA]

Analyzer - Data View

- Allows analysis of complex faults particularly in an R&D environment
- Detailed view of data words in the SDI stream with tooltip hint
- Navigate function for rapid access to a required line, pixel or TRS word
- Color coding to help identification
- Cursor linked to Picture and Waveform

Version ID	Value
Payload Identifier	0x01: ST 2086-10 2140 Line 1105/6h
Picture Rate	30: 30
Progressive Picture	1h: True
Progressive Transport	1h: True
Sampling Structure	0h: 4:2:2 (P/Cr/Cb)
Image Aspect Ratio	0h: 16:9

ANC Inspector

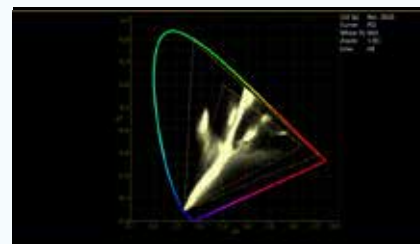
- Ancillary data packet analyzer
- Link from ANC Status window
- User-defined DID/SDID windowed search
- Trigger on error, single shot, continuous
- ANC packet capture with Hex view
- ANC packet decode view

HDR Toolset [PHQXO-HDR]



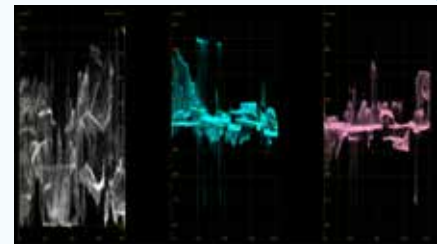
False Color Highlighting

- Programmable 'Heat Map' to highlight luminance zones providing quick identification of shadows, skin or mid-tones or specular highlights
- 7 simultaneous programmable color overlay bands
- Presets for HDR and SDR ranges plus user custom



Analyzer - CIE Chart

- CIE 1931 x,y display
- Single line mode linked to picture cursor
- Pan and zoom
- ITU-R BT. 709, BT. 2020 and ST 2086 gamut overlays
- Tooltip co-ordinate display
- Support for BT. 1886, BT. 2100 HLG and PQ, Sony S-Log3, SR Live



HDR Waveform and Gen.

- Waveform HDR gratitudes with Nits (Cd/m²)
- BT. 2408 diffuse white markers
- SDR patterns mapped to HDR Rec. BT. 2020 containers – useful for like set-up of HDR and SDR monitors and line checks
- Full Rec. 2020 patterns
- Support for BT. 1886, BT. 2100 HLG and PQ, Sony S-Log3, SR Live

Optional Toolsets

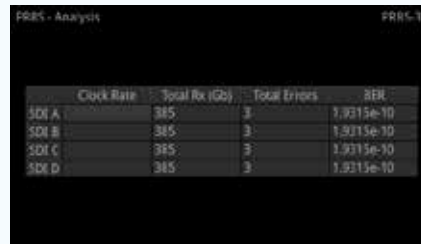


SDI-STRESS Toolset [PHQXO-STRESS]



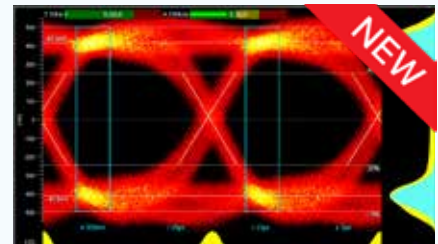
Adv. Generator Tools

- Generation of PRBS-7, 9, 15, 23, 31
- SDI scrambler and sync bit insertion on/off
- Control of SDI driver amplitude +/-10%
- Control of jitter insertion frequency, amplitude and type
- Control of pre-emphasis, rise/fall time



PRBS Analyzer

- Indication of PRBS cumulative received data and PRBS type
- Reported cumulative errors
- Calculated Bit Error Rate (BER)



Advanced Eye Analysis

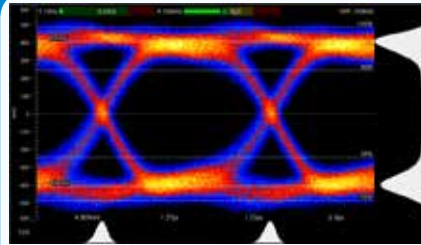
- Choice of Shorth Mean or Mode amplitude measurements
- User-definable time measurement window for exploring amplitude measurement

Physical Layer Analysis Toolset [PHQXM-01E - Hardware Upgrade]



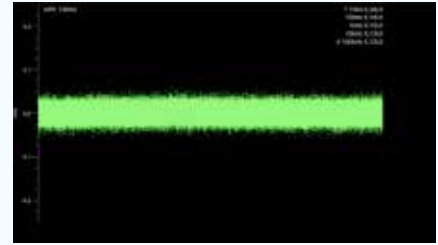
Pathological Detector

- Generator status indication of rate at which the video pattern generator is creating SDI pathological conditions
- Indication of PLL and EQ pathological rates/second
- Detection on each active SDI link
- Realtime GPI outputs of pathological detect for external equipment triggering



SDI EYE Analysis

- Real-Time Eye (RTE) for testing SMPTE compliance
- DC coupled and automatic measurements of: amplitude, rise and fall time, jitter and under/overshoot, visual rise time indication
- Amplitude and time histograms
- Single or multiple eyes with choice of color, heat-map overlay and infinite persistence



SDI Jitter Analysis

- Realtime SMPTE jitter measurements down to 10Hz
- 10Hz, 100Hz, 1kHz, 10kHz, 100kHz filters
- H, 2H, F, V Trigger
- Infinite persistence modes
- +/- 0.25 to +/- 8 UI vertical scale adjustment

Generator Toolset [PHQXO-GEN]



Video Generation

- 12G/6G/3G/1.5G 4K/UHD and 2K/HD SDI signal generation
- Support for Single, Dual and Quad links with single, square and 2SI sub-images, Level A and B
- Moving test patterns
- 422, 444, 4224 and 4444, YCbCr and RGB Formats
- Import and display of TIFF images



Audio Generation

- 32 channel audio generation, 128 channel embedder
- Choice of fixed tones or chromatic scale – to help with channel identification
- Choice of fixed or ramp levels – to help with channel identification
- Custom config of number of active audio groups and channels
- Master gain control



Pathological Generation

- SDI pathological stress patterns, Eq, PLL and CheckField
- User-definable combination of SDI stress and conventional patterns up to full frame

Specifications



Qx 3G/12G

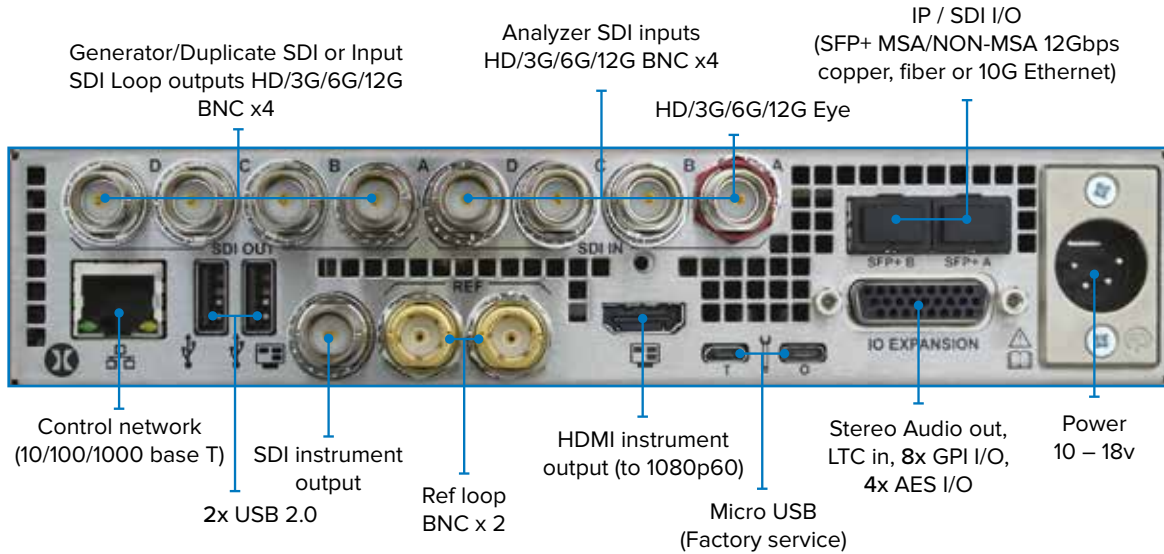


Qx 3G/12G with Eye/Jitter

Formats supported (Generation, Analysis & Monitoring)		
IP SMPTE 2110/2022-7	○	○
IP SMPTE 2022-6	○	○
3G/HD-SDI	●	●
12G/6G-SDI	○	○
Software Options Supported		
Audio/Video Generator (SDI, ST 2022-6, ST 2110)	○	○
Eye and Jitter Toolset	○	●
UHD/4K Upgrade	○	○
SDI-STRESS Testing Toolset	○	○
Data View Analyzer with ANC Inspector	○	○
HDR/WCG Support	○	○
IP ST 2022-6, ST 2110 Decap with ST 2022-7 and PTP	○	○
IP Network Traffic Analysis Toolset	○	○
IP Network Traffic Generation Toolset	○	○
Advanced IP Stress Toolset	○	○
Video inputs / outputs		
4 x SDI inputs, HD/3G, 75 Ohm terminated BNC	●	●
4 x SDI inputs, HD/3G/6G/12G, 75 Ohm terminated BNC	○	○
4 x SDI outputs, HD/3G, 75 Ohm BNC	●	●
4 x SDI outputs, HD/3G/6G/12G, 75 Ohm BNC	○	○
RTE™ Real-Time Eye input (12G/6G/3G/HD-SDI) x 1 (SDI input A) BNC	○	●
SFP+ MSA/NON-MSA 12 Gbps copper or fiber SDI, 10 G Ethernet	○	○
Audio inputs / outputs		
4 x 75 Ohm AES selectable I/O (26 pin high density 'D' Type socket)	●	●
1 x Stereo analog audio output (26 pin high density 'D' Type socket)	●	●
8 channel 48kHz PCM audio on HDMI and SDI Instrument output	●	●
User interface		
HDMI 1.4 instrument output, 1920 x 1080, 4:4:4 RGB, Type A	●	●
Reference		
2 x 75 Ohm BNC high impedance looping reference input, tri-level or B&B with cross lock	●	●
Networking & control		
10/100/1000 BASE-T	●	●
8 x bi-directional GPI (26 pin high density 'D' Type socket)	●	●
Monitoring		
Internal Beeper	●	●
Form factor		
Size (Width x Height x Depth - excluding projections)	253 x 44 x 211 mm	253 x 44 x 211 mm
Weight	1.9 kg	1.9 kg
Electrical		
Power consumption	50W typical, 70W max	50W typical, 70W max
4 Pin XLR power connector	12V nominal (10V-18V)	12V nominal (10V-18V)
AC Power adapter	90-264VAC, 120W	90-264VAC, 120W
Warranty		
Warranty (1 year)	●	●
Extended Warranty Package (3 - 5 years)	○	○

● Standard
○ Optional

Rear panel



Ordering

Qx Chassis

PHQX01-3G	Qx 1U ½ rack HD/2K rasterizer, analyzer only
PHQX01-12G	Qx 1U ½ rack UHD/4K rasterizer, analyzer only
PHQX01E-3G	Qx 1U ½ rack HD/2K rasterizer, analyzer with Eye & Jitter
PHQX01E-12G	Qx 1U ½ rack UHD/4K rasterizer, analyzer with Eye & Jitter

Qx Fitting Kits/Cables

PHQXC-1	12G-SDI Test Cable 1m
PHQXK1	Qx 19" rack mount kit (1x PHQX01/01E)
PHQXK2	Qx 19" rack mount kit (2x PHQX01/01E)
PHQXK3	Qx Mounting kit – 9.5" rack (1x PHQX01/01E)

Qx SDI Software Options

PHQXO-UHD	UHD/4K upgrade for PHQX01-3G or PHQX01E-3G
PHQXO-SDI-STRESS	Advanced SDI Stress Testing Toolset (requires PHQX01E-12G and PHQXO-GEN)

Qx Extended Warranty

PHQX-3YEAR	PHQX01 3 Year Warranty**
PHQX-5YEAR	PHQX01 5 Year Warranty**
PHQX-3YEAR	PHQX01E 3 Year Warranty**
PHQX-5YEAR	PHQX01E 5 Year Warranty**

Qx SDI/IP Software Options

PHQXO-GEN	Audio/Video Generator (SDI, ST 2022-6, ST 2110*)
PHQXO-DATA	Data View Analyzer with ANC inspector
PHQXO-HDR	HDR/WCG support, CIE 1931 chart, HDR Heatmap

Qx IP Options

PHQXO-IP-STND	IP license for ST 2022-6 Encap and Decap, ST 2110 Decap with ST 2022-7 and PTP
PHQXO-IP-NAT	IP Network Traffic Analysis Toolset (requires PHQXO-IP-STND)
PHQXO-IP-NGT	IP Network Traffic Generation Toolset (requires PHQXO-IP-STND)
PHSFP-10GE-SR	10GBASE-SR Ethernet short range SFP+
PHSFP-10GE-LR	10GBASE-LR Ethernet long range SFP+

* Upcoming software release

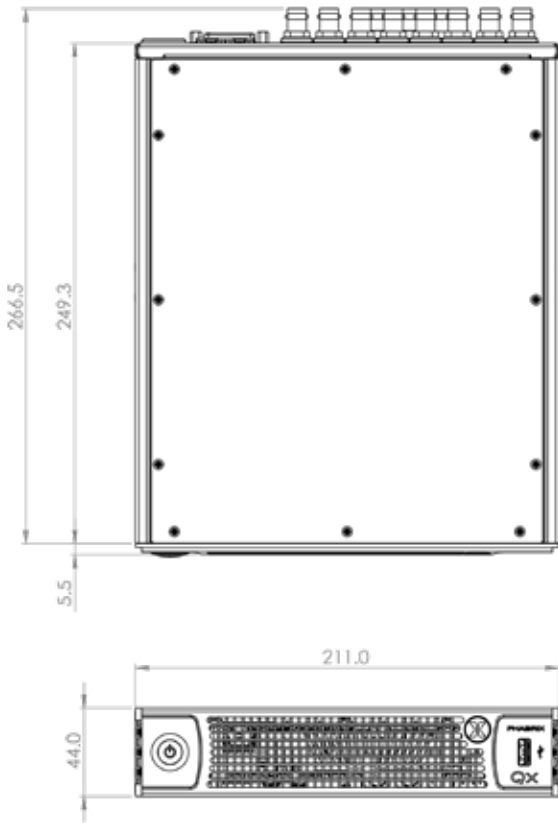
** One year warranty included as standard

Formats Supported

SMPTE Stnds. Link (Content)	Interface	Resolution	Sampling Structure	Pixel Depth	Frame/Field Rate	HDR	SDI	2022-6	2110
ST 292 (ST 296)	HD	1280 x 720	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 30p, 29.97p, 25p,	●	●	●	●
ST 292 (ST 274)	HD	1920 x 1080	4:2:2 (YCbCr)	10	60, 59.94, 50i	●	●	●	●
ST 292 (ST 274)	HD	1920 x 1080	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	●	●	●	●
ST 292 (RP 211)	HD	1920 x 1080	4:2:2 (YCbCr)	10	30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	●
ST 292 (ST 2048-2)	HD	2048 x 1080	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	●
ST 425-1 (ST 274)	3G Level A (I)	1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	●	●	●	●
ST 425-1 (ST 2048-2)	3G Level A (I)	2048 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	●	●	●	●
ST 425-1 (ST 296)	3G Level A (2)	1280 x 720	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	60p, 59.94p, 50p, 30p, 29.97p	-	●	●	-
ST 425-1 (ST 274)	3G Level A (2)	1920 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	-
ST 425-1 (ST 2048-2)	3G Level A (2)	2048 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	-
ST 425-1 (ST 274)	3G Level A (3)	1920 x 1080	4:4:4 (YCbCr/RGB)	12	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	-
ST 425-1 (ST 2048-2)	3G Level A (3)	2048 x 1080	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	-
ST 425-1 (ST 274)	3G Level A (4)	1920 x 1080	4:2:2 (YCbCr)	12	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	-
ST 425-1 (ST 2048-2)	3G Level A (4)	2048 x 1080	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	-
ST 425-1 (ST 274)	3G Level B-DL	1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	●	●	●	N/A
ST 425-1 (ST 2048-2)	3G Level B-DL	2048 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	●	●	●	N/A
ST 425-1 (ST 274)	3G Level B-DL (I)	1920 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	N/A
ST 425-1 (ST 2048-2)	3G Level B-DL (I)	2048 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	N/A
ST 425-1 (ST 274)	3G Level B-DL (II)	1920 x 1080	4:4:4 (YCbCr/RGB)	12	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	N/A
ST 425-1 (ST 2048-2)	3G Level B-DL (II)	2048 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	12	30psf, 29.97psf, 25psf, 24psf, 23.98psf, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	N/A
ST 425-1 (ST 274)	3G Level B-DL (III)	1920 x 1080	4:4:4 (YCbCr/RGB)	12	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	N/A
ST 425-1 (ST 2048-2)	3G Level B-DL (III)	2048 x 1080	4:4:4 (YCbCr/RGB)	12	30psf, 29.97psf, 25psf, 24psf, 23.98psf, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	N/A
ST 425-1 (ST 274)	3G Level B-DL (IV)	1920 x 1080	4:2:2 (YCbCr)	12	60i, 59.94i, 50i, 30p, 29.97p, 25p, 24p, 23.98p, 30psf, 29.97psf, 25psf, 24psf, 23.98psf	●	●	●	N/A
ST 425-1 (ST 2048-2)	3G Level B-DL (IV)	2048 x 1080	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30psf, 29.97psf, 25psf, 24psf, 23.98psf, 30p, 29.97p, 25p, 24p, 23.98p	●	●	●	N/A
ST 425-3 Annex B1 (ST 2036-1)	Quad-link HD-SQ	3840 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-3 Annex B1 (ST 2048-1)	Quad-link HD-SQ	4096 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-10 M1 (ST 2036-1)	6G-2SI	3840 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-10 M1 (ST 2048-1)	6G-2SI	4096 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2036-1)	Quad-link 3G-A (I) 2SI	3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○	○	-	-
ST 425-5 (ST 2048-1)	Quad-link 3G-A (I) 2SI	4096 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○	○	-	-
ST 425-5 (ST 2036-1)	Quad-link 3G-A, B (I) 2SI	3840 x 2160	4:4:4 (YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2048-1)	Quad-link 3G-A, B (2) 2SI	4096 x 2160	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2036-1)	Quad-link 3G-A, B (3) 2SI	3840 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2048-1)	Quad-link 3G-A, B (3) 2SI	4096 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2036-1)	Quad-link 3G-A, B (4) 2SI	3840 x 2160	4:2:2 (YCbCr)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 (ST 2048-1)	Quad-link 3G-A (4) 2SI	4096 x 2160	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2036-1)	Quad-link 3G-A, B (I) SQ	3840 x 2160	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	10	60p, 59.94p, 50p	○	○	-	-
ST 425-5 Annex B (ST 2048-1)	Quad-link 3G-A, B (I) SQ	4096 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○	○	-	-
ST 425-5 Annex B (ST 2036-1)	Quad-link 3G-A, B (2) SQ	3840 x 2160	4:4:4 (YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2048-1)	Quad-link 3G-A, B (2) SQ	4096 x 2160	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2036-1)	Quad-link 3G-A, B (3) SQ	3840 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2048-1)	Quad-link 3G-A, B (3) SQ	4096 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2036-1)	Quad-link 3G-A, B (4) SQ	3840 x 2160	4:2:2 (YCbCr)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 425-5 Annex B (ST 2048-1)	Quad-link 3G-A, B (4) SQ	4096 x 2160	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2036-1)	Dual-link 6G-2SI (I)	3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2048-1)	Dual-link 6G-2SI (I)	4096 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2036-1)	Dual-link 6G-2SI (II)	3840 x 2160	4:4:4 (YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2048-1)	Dual-link 6G-2SI (II)	4096 x 2160	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2036-1)	Dual-link 6G-2SI (III)	3840 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2048-1)	Dual-link 6G-2SI (III)	4096 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2036-1)	Dual-link 6G-2SI (IV)	3840 x 2160	4:2:2 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2081-11 M1, ST 425-5 (ST 2048-1)	Dual-link 6G-2SI (IV)	4096 x 2160	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2036-1)	12G-2SI (I)	3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2048-1)	12G-2SI (I)	4096 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2036-1)	12G-2SI (II)	3840 x 2160	4:4:4 (YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2048-1)	12G-2SI (II)	4096 x 2160	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2036-1)	12G-2SI (III)	3840 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2048-1)	12G-2SI (III)	4096 x 2160	4:4:4 (YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2036-1)	12G-2SI (IV)	3840 x 2160	4:2:2 (YCbCr)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-
ST 2082-10 M1, ST 425-5 (ST 2048-1)	12G-2SI (IV)	4096 x 2160	4:2:2 (YCbCr) 4:2:2:4 (YCbCrA)	12	30p, 29.97p, 25p, 24p, 23.98p	○	○	-	-

● Standard
○ Optional

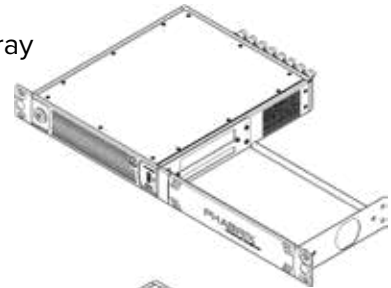
Dimensions & Installation



Desktop



Single Rack mount tray
with cover
PHQXK1



Dual Rack mount
PHQXK2





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