Qx | QxL

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

Qx rasterizers bring 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 HD/UHD 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. The Qx is now available in two platforms, with a powerful common look and feel providing an accessible user interface and toolsets for full operational flexibility and easy migration from an SDI centric to IP centric operation.

If your focus is on a classical SDI based HD facility and would like to future proof your operation for real-time IP then the classic Qx will address your needs with HD/3G SDI as standard and options for UHD 12G-SDI, HD/3G 2110 and 2022-6 payloads on 10G SFP+ interfaces.

For real-time IP with UHD and some SDI edge workflow then the class leading QxL provides support for HD/3G 2110 and 2022-6 payloads on 10G/25G SFP28 interfaces as standard, with options for IP to SDI gateway factory fitted quad SDI BNC/dual SDI SFP+ with seamless hybrid operation, UHD payloads for both IP* and SDI, and QSFP interfaces*.

Out of the box, the Qx Series offers media analysis for broadcast operator HD/3G 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 audio channel status information, detection of common Dolby formats, ANC status and payload, on screen display of OP47 and CEA-608 in 708 closed captions and Ancillary Time Code (ATC), Loudness monitoring*, and advanced control and logging with human readable event logs, remote operator GUI access over VNC and a full REST API are all provided as standard.

The flexible architecture offers upgrades for UHD/4K, HDR, AV 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, DC offset, transition times and overshoot and 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, Clk, checkfield and combined), 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 simultaneous decapsulation of 1 video, 2 audio and 1 ANC Data flow supported SMPTE protocols include ST 2059 (PTP) 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 handling conforms to ST 2110-30 Class C with support for 48Khz streams from 1 to 10 channels at packet times of 1ms and 1 to 80 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 dual Packet Interval Timing measurement windows, 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 IBC 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**

- 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

**GUI output frame rate 50, 59.94, 60Hz to match video format**

**User-selectable colors of window frames for Analyzer and Generator tools**

**Brightness control for office or controlled lighting environments**

**GUI on HDMI, SDI and ST 2110-20/30 media flows**

**Instruments Display**

**Display Options**

- GUI output frame rate 50, 59.94, 60Hz to match video format
- User-selectable colors of window frames for Analyzer and Generator tools
- Brightness control for office or controlled lighting environments
- GUI on HDMI, SDI and ST 2110-20/30 media flows

**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)
Optimized instrument display with scalable windows to suit individual operators

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

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

IP Analysis

- 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 & PHQXL-01E 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 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 window provides simultaneous monitoring across five specified frequency bands, jitter histogram and video trigger options

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

- Advanced suite of engineering tools for developers and manufacturers evaluating SDI interfaces
- Comprehensive API for rapid automated testing
- Insert up to 128UI peak to peak 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 programable 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 (up to 80 channels at 125us) and support for ST 2110-31 AES encapsulation of Dolby® Audio
- TR-1001: NMOS IS-04 and IS-05 with LLDP and PTP system resource*

ST 2110 Analysis (PHQXO-IP-MEAS)

- Engineering suite of tools for ST 2110 analysis and debug
- Display up to four simultaneous Packet Interval Timing measurements per input for easy visualization of network congestion and sender packet distribution with max, mean and min inter-packet arrival times
- Receive statistics that include 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

ST 2022-6 Packet Interval Profile Generator (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
I/O Options

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
  - Qx, QxL-01, QxL-01E Only

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
  - Qx, QxL-01, QxL-01E Only

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
  - Qx, QxL-01, QxL-01E Only

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
  - Qx, QxL-01, QxL-01E Only

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
  - Qx, QxL-01, QxL-01E Only

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
  - Qx, QxL-01, QxL-01E Only

IP license for ST 2022-6, ST 2110 Decap with ST 2022-7 and PTP [PHQXO-IP-STND]
Analyzer - Picture
- Cursors linked to Waveform and Data View
- ANC Timecode with OSD
- Closed Captions OP47, CEA-608 in 708
- 2 simultaneous Closed Caption decode picture windows
- Paint, Pop and Scroll Display Modes
- Italic and underlined character sets
- Action and title safe areas
- SCTE 104 indicator*

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, NordicNG
- 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)

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

Loudness Monitoring*
- EBU R128 and ITU-R BT.1770
- Indicators for true peak, range, momentary, short term and integrated loudness
- User control of integrated, momentary and short term targets
- User adjustable true peak alarm threshold
- Loudness logging stored automatically

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

*Upcoming software release
Optional Toolsets

**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

- **Inter-packet Timing**
  - Stream health reporting using histogram to visualize the distribution of inter-packet arrival times
  - Simultaneous reporting of ST 2022-7 primary and secondary flow
  - 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 210-21 measurement of Network Compatibility Model (Cinst) and Virtual Receiver Buffer Model (VRX)
  - PCAP export of kernel traffic

- **Adv. PTP Media Timing**
  - Measurement of the timing relationship of flows against PTP
  - PTP timing vs external analog reference
  - 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

**Packet Interval Profile Generator [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

- **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

- **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

**IP Network Traffic Measurement [PHQXO-IP-MEAS]**

- **Adv. PTP Media Timing**
  - Measurement of the timing relationship of flows against PTP
  - PTP timing vs external analog reference
  - 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

**Data [PHQXO-DATA]**

- **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 graticules with Nits (Cd/m²)
  - BT. 2408 diffuse white markers
  - SDR patterns mapped to HDR Rec. BT. 2020 containers – useful for like 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-SDI-STRESS - requires PHQX01E/PHQXL-01E and PHQXO-GEN license]

Adv. Generator Tools
- Generation of PRBS-7, 9, 15, 23, 31
- SDI scrambler and sync bit insertion on/off
- Control of SDI driver amplitude +/-15%
- 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

SDI Physical Layer Analysis Toolset [Requires PHQXM-01E Mezzanine]

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 with indication of DC offset
- DC coupled and automatic measurements of amplitude, rise and fall time, jitter and undershoot, 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
- Jitter amplitude histogram

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
- Proposed SMPTE pathological stress patterns, Eq, PLL, Clock
- SDI pathological stress patterns, Eq, PLL, SMPTE 12G/6G/3G and CheckField
- User-definable combination of SMPTE or SDI stress and conventional patterns up to full frame

*Upcoming software release
## Specifications

### Formats supported (Generation, Analysis & Monitoring)

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<th>Qx</th>
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<td>IP SMPTE 2110/2022-7</td>
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<tr>
<td>IP SMPTE 2022-6</td>
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<tr>
<td>3G/HD-SDI</td>
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<tr>
<td>12G/6G-SDI</td>
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<tr>
<td>SDI Eye and Jitter Physical Layer Analysis</td>
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<tr>
<td>UHD over 25G IP</td>
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### Software Options Supported

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<thead>
<tr>
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<tbody>
<tr>
<td>Audio/Video Generator (SDI, ST 2022-6, ST 2110)</td>
<td>○</td>
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<tr>
<td>Eye and Jitter Toolset</td>
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<tr>
<td>UHD/4K Upgrade</td>
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<tr>
<td>SDI-STRESS Testing Toolset</td>
<td>○</td>
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<tr>
<td>Data View Analyzer with ANC Inspector</td>
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<tr>
<td>HDR/WCG Support</td>
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<tr>
<td>IP ST 2022-6 Decap, ST 2110-20/30/31/40 Decap with ST 2022-7 and PTP</td>
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<tr>
<td>IP Network Traffic Measurement Toolset</td>
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<td>IP Network Traffic Generation Toolset</td>
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<tr>
<td>Advanced IP Stress Toolset</td>
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### Video inputs / outputs

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<tr>
<th>Qx</th>
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<tr>
<td>4 x SDI inputs, HD/3G, 75 Ohm terminated BNC</td>
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<tr>
<td>4 x SDI inputs, HD/6G/12G, 75 Ohm terminated BNC</td>
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<td>4 x SDI outputs, HD/3G, 75 Ohm BNC</td>
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</tr>
<tr>
<td>4 x SDI outputs, HD/6G/12G, 75 Ohm BNC</td>
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<tr>
<td>RTE™ Real-Time Eye input (12G/6G/3G/HD-SDI) x 1 (SDI input A) BNC</td>
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<tr>
<td>1 x SDI output, HD/3G/12G, 75 Ohm Micro-BNC (shared with instrument out)</td>
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<tr>
<td>2 x SFP+ MSA/NON-MSA cages (supports 12Gbps copper or fiber SDI interfaces)</td>
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### Ethernet IP inputs/outputs (accepts generic SFPs)

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<tr>
<th>Qx</th>
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<tbody>
<tr>
<td>2 x SFP+ 10G Cages (also supports MSA/NON-MSA 12Gbps copper or fiber SDI SFPs)</td>
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<tr>
<td>2 x SFP28 10/25G cages</td>
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<tr>
<td>2 x QSFP28 10/25/40/50/100G cages</td>
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### Audio inputs/outputs

<table>
<thead>
<tr>
<th>Qx</th>
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<tbody>
<tr>
<td>4 x 75 Ohm AES selectable I/O (26 pin high density ‘D’ Type socket)</td>
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<tr>
<td>1 x Stereo analog audio output (26 pin high density ‘D’ Type socket)</td>
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<tr>
<td>8 channel 48kHz PCM audio on HDMI and SDI Instrument output</td>
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### User interface

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<tr>
<td>HDMI 1.4 instrument output, 1920 x 1080, 4:4:4 RGB, Type A</td>
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<tr>
<td>SDI 3Gbit SDR/HDR instrument out, 1920 x 1080, 4:2:2 YCbCr</td>
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<tr>
<td>ST 2110-20 SDR/HDR, ST 2190-30 instrument out, 1920 x 1080, 4:2:2 YCbCr</td>
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<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 75 Ohm BNC high impedance looping reference input, tri-level or B&amp;B with cross lock</td>
<td>○</td>
</tr>
<tr>
<td>1 x 75 Ohm Micro-BNC terminating ref input, Tri/B&amp;B with cross lock</td>
<td>○</td>
</tr>
</tbody>
</table>

### Networking & control

<table>
<thead>
<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/100/1000 BASE-T</td>
<td>○</td>
</tr>
<tr>
<td>8 x bi-directional GPI (26 pin high density ‘D’ Type socket)</td>
<td>○</td>
</tr>
</tbody>
</table>

### Monitoring

<table>
<thead>
<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Beeper</td>
<td>○</td>
</tr>
</tbody>
</table>

### Form factor

<table>
<thead>
<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (Width x Height x Depth - excluding projections)</td>
<td>○</td>
</tr>
<tr>
<td>Weight</td>
<td>○</td>
</tr>
</tbody>
</table>

### Electrical

<table>
<thead>
<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>○</td>
</tr>
<tr>
<td>4 Pin XLR power connector</td>
<td>○</td>
</tr>
<tr>
<td>AC Power adapter</td>
<td>○</td>
</tr>
</tbody>
</table>

### Warranty

<table>
<thead>
<tr>
<th>Qx</th>
<th>QxL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warranty (1 year)</td>
<td>○</td>
</tr>
<tr>
<td>Extended Warranty Package (3 - 5 years)</td>
<td>○</td>
</tr>
</tbody>
</table>

○ Standard  ● Optional
Rear panel

**Qx**

Generate/Copy/Loop or Input SDI Loop Out HD/3G/6G/12G BNC x4
Analyzer SDI inputs HD/3G/6G/12G BNC x4
SDI instrument output
SDI instrument output (up to 48 Gbps payloads)
SFP+ MSA/NON-MSA 12 Gbps copper or fiber
IP / SDI I/O
(SFP+ MSA/NON-MSA 12 Gbps copper, fiber or 10G Ethernet)
HD/3G/6G/12G Eye
Power 10 – 18v

**QxL**

Generate/Copy/Loop SDI Out (up to 48 Gbps payloads)
HD/3G/6G/12G BNC x 4
Analyzer SDI In (up to 48 Gbps payloads)
HD/3G/6G/12G BNC x 4
(SFP+) MSA/NON-MSA 12 Gbps copper or fiber
HD/3G/6G/12G Eye
Power 10 – 18v

Networking (10/100/1000 Base-T)
User interface USB
HD/3G/6G/12G Eye
SDI instrument Out
HD/3G/6G/12G Eye
HDMI2.0b instrument output (to 2160p60)
HDMI instrument out
Micro USB (Factory service)
Stereo Audio out, LTC in, 8x GPI I/O, 4x AES I/O
2 x QSFP28 (100GE, 50GE, 40GE)
2 x SFP28 (10GE, 25GE)
2 x QSFP (100GE, 50GE, 40GE)
SDI FEF
SDI IN
SDI OUT
HDMI
SFP+A
SFP+B
QSFP+4
QSFP+8
GPO
GPI
Audio out
LTC in
8x GPI I/O
4x AES I/O

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## Ordering Qx

<table>
<thead>
<tr>
<th>Qx Chassis (includes PHQXO-SDI-STND)</th>
<th>Qx IP Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQX01-3G Qx 1U ½ rack HD/2K rasterizer, SDI analyzer only</td>
<td>PHQXO-IP-STND IP license for ST 2022-6 Encap and Decap, ST 2110 Decap with ST 2022-7 and PTP</td>
</tr>
<tr>
<td>PHQX01E-3G Qx 1U ½ rack HD/2K rasterizer, SDI analyzer with Eye &amp; Jitter</td>
<td>PHQXO-IP-MEAS* IP Network Traffic Measurement Toolset (requires PHQXO-IP-STND)</td>
</tr>
</tbody>
</table>

### Qx SDI Software Options

<table>
<thead>
<tr>
<th>PHQXO-UHD</th>
<th>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQX01E-12G and PHQXO-GEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXO-SDI-STRESS</td>
<td>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</td>
</tr>
</tbody>
</table>

### Qx SDI/IP Software Options

<table>
<thead>
<tr>
<th>PHQXO-GEN Audio/Video Generator (SDI, ST 2022-6, ST 2110*)</th>
<th>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXO-SDI-STRESS</td>
<td>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHQXO-GEN Audio/Video Generator</th>
<th>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</th>
</tr>
</thead>
</table>

### Qx Fitting Kits

<table>
<thead>
<tr>
<th>PHQXK1</th>
<th>Qx 19&quot; rack mount kit (1x Qx chassis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXK2</td>
<td>Qx 19&quot; rack mount kit (2x Qx chassis)</td>
</tr>
<tr>
<td>PHQXK3</td>
<td>Qx Mounting kit – 9.5” rack (1x Qx chassis)</td>
</tr>
</tbody>
</table>

### Qx Extended Warranty

| PHQX-3YEAR | 3 Year Warranty** |
| PHQX-5YEAR | 5 Year Warranty** |

## Ordering QxL (Preliminary Information - subject to change)

<table>
<thead>
<tr>
<th>QxL Chassis (includes PHQXO-IP-STND)</th>
<th>QxL IP Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXL QxL 1U ½ rack HD/2K IP rasterizer, analyzer only</td>
<td>PHQXO-IP-STND IP license for ST 2022-6 Encap and Decap, ST 2110 Decap with ST 2022-7 and PTP</td>
</tr>
<tr>
<td>PHQXL-01 QxL 1U ½ rack HD/2K IP/SDI rasterizer, analyzer only</td>
<td>PHQXO-IP-MEAS* IP Network Traffic Measurement Toolset (requires PHQXO-IP-STND)</td>
</tr>
<tr>
<td>PHQXL-01E QxL 1U ½ rack HD/2K IP/SDI rasterizer, analyzer with Eye/Jitter</td>
<td>PHQXO-IP-NGT ST 2022-6 Packet Interval Profile Generator (requires PHQXO-IP-STND, PHQXO-GEN)</td>
</tr>
</tbody>
</table>

### QxL SDI Software Options

<table>
<thead>
<tr>
<th>PHQXO-UHD</th>
<th>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXO-SDI-STRESS</td>
<td>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</td>
</tr>
</tbody>
</table>

### QxL SDI/IP Software Options

<table>
<thead>
<tr>
<th>PHQXO-GEN Audio/Video Generator</th>
<th>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQXO-SDI-STRESS</td>
<td>PHQXO-SDI-STRESS Advanced SDI Stress Testing Toolset (requires PHQXO-GEN)</td>
</tr>
</tbody>
</table>

### QxL Fitting Kits

<table>
<thead>
<tr>
<th>PHQXK1</th>
<th>Qx 19” rack mount kit (1x Qx chassis)</th>
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</thead>
<tbody>
<tr>
<td>PHQXK2</td>
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</tr>
<tr>
<td>PHQXK3</td>
<td>Qx Mounting kit – 9.5” rack (1x Qx chassis)</td>
</tr>
</tbody>
</table>

### QxL Extended Warranty

| PHQXL-3YEAR | 3 Year Warranty** |
| PHQXL-5YEAR | 5 Year Warranty** |

* Upcoming Software Release
** One year warranty included as standard
# Formats Supported

<table>
<thead>
<tr>
<th>SMPTE Stnds. Link (Content)</th>
<th>Interface</th>
<th>Resolution</th>
<th>Sampling Structure</th>
<th>Pixel Depth</th>
<th>Frame/Field Rate</th>
<th>HDR</th>
<th>SDI</th>
<th>2022-6</th>
<th>2110</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 1049 (ST 296)</td>
<td>4K</td>
<td>3840 x 2160</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 292 (ST 297)</td>
<td>4K</td>
<td>2048 x 1080</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>30p, 29.97p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 2412 (ST 298)</td>
<td>4K</td>
<td>3840 x 2160</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>30p, 29.97p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 292 (ST 299)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>3840 x 2160</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>30p, 29.97p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>2048 x 1080</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>30p, 29.97p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1280 x 720</td>
<td>4:2:2 (YCbCr)</td>
<td>10</td>
<td>30p, 29.97p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ST 3655 (ST 3654)</td>
<td>4K</td>
<td>1920 x 1080</td>
<td>4:4:4:4 (YCbCrRGBA)</td>
<td>10</td>
<td>60p, 59.94p, 50p, 25p, 24p, 23.98p</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

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Dimensions & Installation

Desktop

Single Rack mount tray with cover
PHQXK1

Dual Rack mount
PHQXK2

For more information about IP, 4K/UHD and HDR contact:

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