Leader

LeaderPhabrix

LPX500

USER MANUAL

Software Release 1.1

Manual Revision 2a

Preface

About this Manual

This User Manual is a guide to the functions provided by your LPX500 unit.

For further information on Leader Electronics of Europe products, please refer to the Leader Electronics of Europe web page:

https://leaderphabrix.com/products/

Notice

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Revision

This manual is a revision-controlled document. Any changes to any page content will be reflected in the overall revision status of the whole manual.

Release	Date	Software Version	Updates Include:
1a	December 2024	1.0	First release of LPX500 User Manual
1b	January 2025	1.0	Minor changes from first review.
1c	February 2025	1.0	Full review implementation.
2a	May 2025	1.1	Introduction of IP Support for SMPTE 2110 and 2022-6

General Safety Information

General Safety LPX

Read this Section Before Using the LPX500

This unit should be used only by persons with sufficient knowledge of electronics who thoroughly understand the contents of this manual.

This unit is not designed or manufactured for households or ordinary consumers.

If unqualified personnel are to use the unit, be sure that the unit is handled under the supervision of qualified personnel (those who have electrical knowledge). This is to prevent the possibility of personal injury or damage to the unit.

Warning

Warnings Concerning the Power Source:

Do not use a power source with a voltage other than the rated power source voltage for the unit. Doing so could lead to fire. Confirm the voltage of the power source before you connect the power cord to it. Only use a power source whose frequency is 50/60 Hz.

Use a power cord that is appropriate for the voltage of the power source. Also, use a power cord that meets the safety standards of the country that you are using it in. Using a power cord that does not meet the standards could lead to fire. If the power cord is damaged, stop using it, and contact your local LeaderPhabrix agent. Using a damaged power cord could lead to electrical shock or fire.

When removing the power cord from the power outlet, do not pull on the cord. Pull from the plug.

Warnings Concerning Grounding:

The unit has a ground terminal to protect the user and the unit from electric shock. Ensure that the product is properly grounded for safe operation.

Warnings Concerning the Panel:

Sections of the panel are made of glass. If the glass breaks, the broken glass may lead to injury. Do not apply a strong shock to the panel, cut it with sharp metal, or damage it in any similar manner.

Avoiding Personal Injury

> **Warning:** The LPX500 is designed for use by qualified personnel only.

No internal user-serviceable parts are provided. Units should be returned to your local LeaderPhabrix agent for servicing.

The operator must NOT remove the case from the unit as this will invalidate the

warranty. Do not spill any liquid onto the unit or its power adapter.

> **Warning:** Do not look directly into the fiber optic connections of cable as this may cause permanent damage to the eyes.

Power Supply

Make sure that the unit is connected to the correct power supply voltage. Only the supplied AC cable should be used with the unit. Do not use a damaged AC cable with the unit as it may cause a shock or fire hazard. Replacement AC cables are available from your local LeaderPhabrix agent.

This unit might have both an AC and a DC power supply cord connected. Make sure to disconnect **all** power supply cords before servicing to avoid electric shock.

Mains AC powered devices are shipped with a three wire electrical cord with a grounding-type plug designed to fit only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding must comply with local and national electrical standards.

Internal Battery

The unit includes a 3 V Lithium battery (type CR1225) to maintain the system clock and ensure memory persistence in the event of mains power loss. Return the unit to LeaderPhabrix in the event that the battery needs replacing.

Installation Environment LPX

Operating Temperature Range

> **Warning:** The unit should only be operated between 0 and 40° Celsius (32 and 104° Fahrenheit), non-condensing. If the unit is operated at a higher temperature, there is a possibility of a fire hazard. If the temperature is changed rapidly from a cold environment to a hot environment, moisture can be created internally which can cause malfunction or damage the unit. Allow the unit to sit for 30 minutes without power applied to reduce any possibility of condensation. If the internal component temperature rises above 85° Celsius (185° Fahrenheit) the unit will switch OFF automatically.

Operating Humidity Range

> **Warning:** Use the unit in an environment with a relative humidity of 85 % or less where there is no threat of condensation forming.
> Do not operate this unit with wet hands. Doing so could lead to electric shock or fire.

Input / Output Terminals

Do not connect the input or output BNC connectors to external power as this can damage the internal circuitry and cause the unit to work incorrectly.

The BNC connectors fitted on this unit are 75 ohm type which are not compatible with 50 ohm plugs.

> **Warning:** The use of 50 ohm plugs will permanently damage the connectors on the unit. The use of 50 ohm plugs is considered to be misuse of the equipment and will therefore invalidate the unit's warranty.

When Not In Use

Disconnect the unit from the power supply and AC power source when not in use.

Maintenance

Wipe the case gently with a soft, lint-free cloth, lightly dampened with a neutral cleaning agent. A screen cleaning cloth may be used to clean the LCD. Do not apply force to the LCD when cleaning or it may be damaged.

> **Warning:** Remove the power supply from the unit and switch OFF before cleaning. Do not allow any water or other liquid to enter the unit while cleaning.

Disposal of Equipment

This product is subject to the European WEEE (Waste Electrical and Electronic Equipment) directive and should be disposed of according to the regulations of each country.

RoHS Compliance LPX

LeaderPhabrix products are designed and manufactured to be RoHS compliant, adhering to the RoHS directive for components and materials. Based on information provided by our suppliers, LeaderPhabrix certifies that all products that it manufactures comply with the provisions of the European Parliament and Council Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (2011/65/EC) and associated regulations collectively known as the RoHS Regulations.

所含有毒有害物质信息

部件号码: LPX500I / LPX500IS / LPX500ISE

此标志适用于在中国销售的电子信息产品,依据2006年2月28日公布的《电子信息产品污染控制管理办法》以及SJ/T11364-2006《电子信息产品污染 控制标识要求》, 表示该产品在使用完结后可再利用。数字表示的是环境保护使 用期限, 只要遵守与本产品有关的安全和使用上的注意事项, 从制造日算起在数 字所表示的年限内, 产品不会产生环境污染和对人体、财产的影响。产品适当使用后报废的方法请遵从电子信息产品的回收、再利用相关法令。详细请咨询各级政府主管部门。

产品中有毒有害物质或元素的名称及含量

部件名称 Parts Name	有毒有害物质或元素 Hazardous Substances in each Part					
	铅 (Pb)	汞 (Hg)	镉 (Cr(Ⅵ))	六价铬 Cr	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
实装基板	×	○	○	○	○	○
主体部	×	○	○	○	○	○
液晶显示模组	×	○	○	○	○	○
开关电源	×	○	○	○	○	○
风扇	×	○	○	○	○	○
线材料一套	×	○	○	○	○	○
附件	×	○	○	○	○	○
包装材	○	○	○	○	○	○
电池	○	○	○	○	○	○

备注)
○:表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 规定的限量要求以下。
×:表示该有毒有害物质或元素至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。

KC Certification for South Korea

This product is designed and manufactured to be KC compliant.

The details below can be used to search the KC registration on the Korean National Radio Research Agency website as follows:

1. Open the registration search page of the Korean National Radio Research Agency website:
    - https://www.rra.go.kr/ko/license/A_c_search.do#
2. Enter the following registration information.
    - KC Registration Number: **R-R-lk3-037**
    - Date of Certification / Registration: **20241211 ~ 20241211**
    - Model Number: **LPX500**
3. Click: **Search**

Table of Contents

1

Getting Started

This chapter describes how to connect your unit to get it up and running and includes the following sections:

Getting Started Quick Reference

What's in the Box?

On receipt of your shipment, proceed as follows:

1. Check the external packaging for any visible signs of damage. Should you find any damage, contact the courier immediately.
2. Carefully open the packaging and check that it contains the following standard items:
   - One LPX500 model; either:
     - Model: **LPX500I** (with 10 GbE IP Waveform Monitor/Analyzer) or
     - Model: **LPX500IS** (with SD, HD, 2K, or 10 GbE IP/SDI Waveform Monitor/Analyzer) or
     - Model: **LPX500ISE** (with SD, HD, 2K, or 10 GbE IP/SDI Waveform Monitor/Analyzer with Eye and Jitter.
   - One IEC power cord.
   - USB stick containing this User Manual in PDF format.
   - Printed Welcome and Getting Started cards (recyclable).
3. Check all optional items against your order form or invoice. The unit's box will contain the fol- lowing optional items, if ordered:
   - Desk-mount kit fitted to the unit
   - SDI cable (1 m length)
   - SFP(s)

   > **Note:** Optional rack-mount kits are shipped in a separate carton.

4. If you suspect optional items are missing, contact your distributor or LeaderPhabrix support at: https://leaderphabrix.com/contact-support/
5. Complete the Product Registration form available at: https://leaderphabrix.com/contact-support/product-registration

Packaging Material

After unpacking the unit and all components, it is recommended to retain the original packaging material (carton and foam inserts) for future use in the event that you need to return the unit to LeaderPhabrix.

If the packaging is to be disposed of, the printed cardboard carton and Getting Started card can be recycled and the packing material is biodegradable after shredding.

LPX500 Mounting Hardware Options

You can install the LPX500 as a standalone unit on a desktop or rack-mount the unit or units using one of the following optional mounting kits:

- To desk-mount a single unit:

- LPX500 desktop kit (adjustable feet and carry handle) (**LPX500-K3**)

- To desk-mount the optional extended monitor:
  - LPX500 desktop kit (two feet for the underside of the monitor) (**LPX500-K4**)
- To rack-mount a single unit:
  - 3U 19 inch rack mount kit (1 x LPX500 Chassis) (**LPX500-K1**)
- To rack-mount two units:
  - 3U 19 inch rack mount kit (1 x LPX500 Chassis and Extended Monitor or 2 x LPX500 Chassis) (**LPX500-K2**)

Desktop Mounting

To desk-mount a standalone unit, fit adjustable feet and handle provided in the LPX500 desktop kit. If an optional extended monitor is to be desk-mounted, fit the two feet to the underside of the monitor. Place the unit (and optional extended monitor) on a clean, level dust-free surface and connect the cables as described in the section *Connecting Cables to the Unit*. Adjust the feet so that the screen is positioned at a comfortable viewing angle. Ensure that the unit is located to allow sufficient airflow for cooling purposes.

Rack Mounting

To rack-mount one or more units in a 19 inch rack, follow the procedure in the instruction guide included with the mounting hardware. Ensure that the unit(s) have an unrestricted airflow and access to the power connectors in the rack.

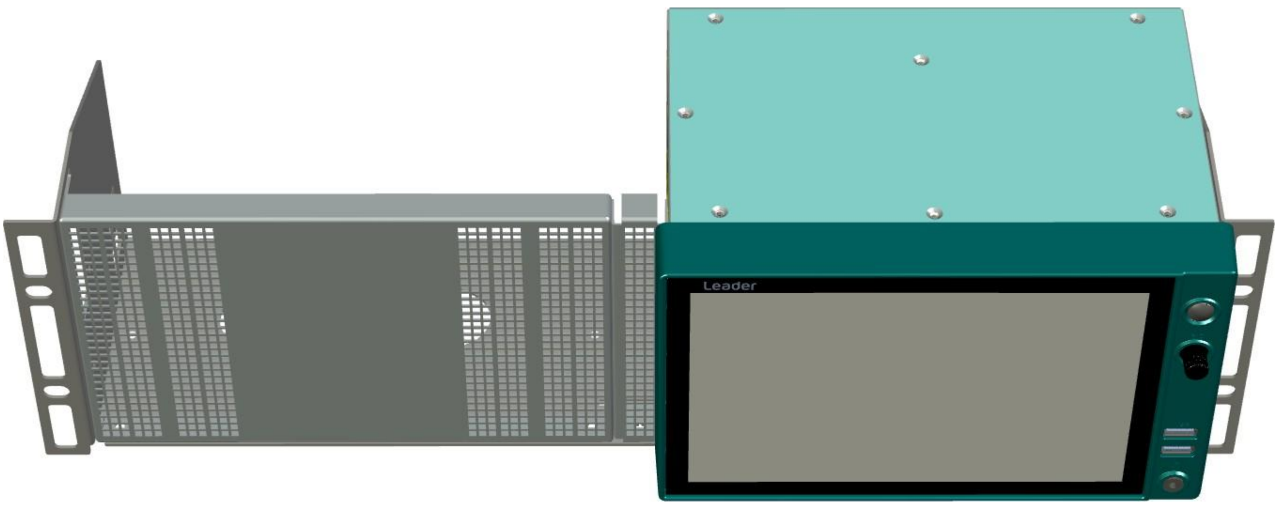


Figure 1-1: Rack Mount Tray for One Unit with Blanking Panel (Option LPX500-K1)

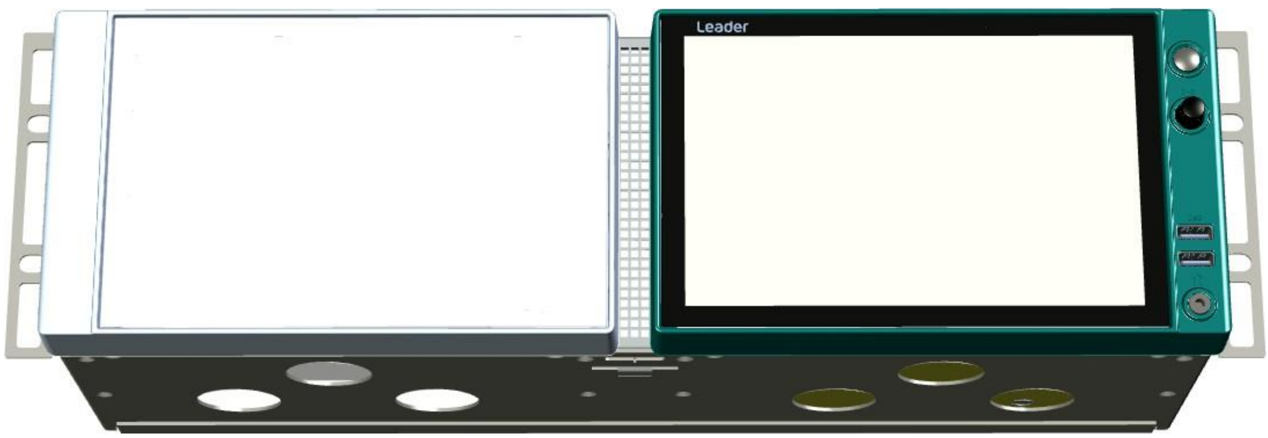


Figure 1-2: Rack Mount Tray with Optional Extended Monitor and Main Unit (Option LPX500-K2)

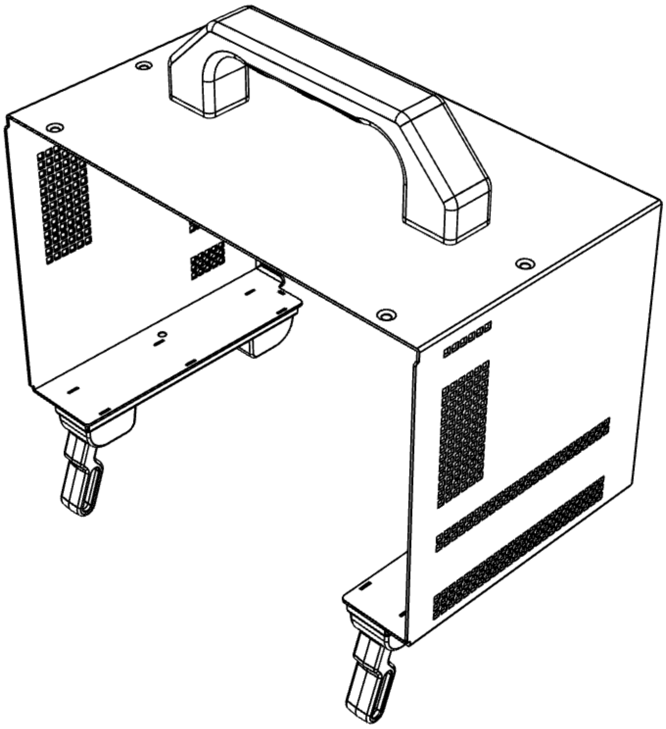


Figure 1-3: Carry Case (Option LPX500-K3)

Rear Panel Connectors

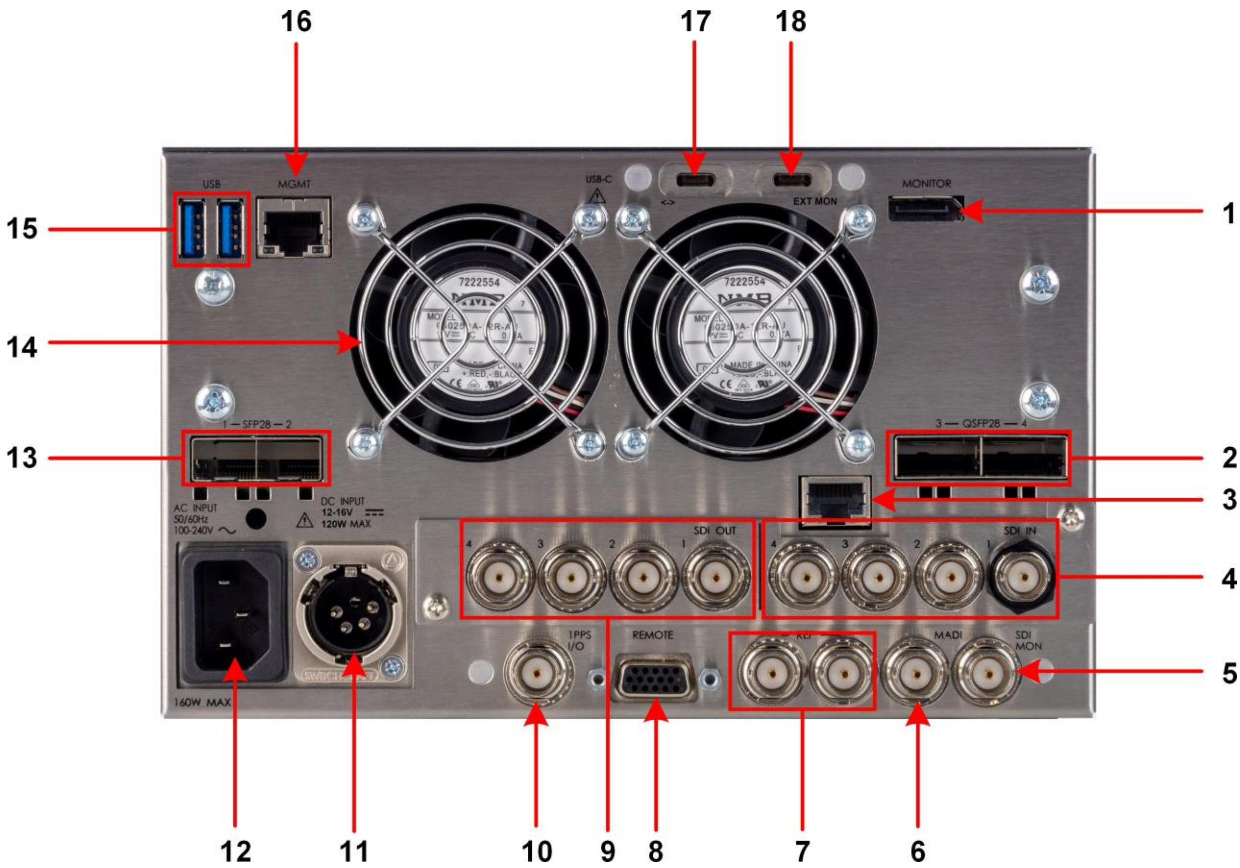


Figure 1-4: Rear Panel Connectors

The rear panel connectors are described in the following table:

Table 1-1 : Key to Rear Panel Connectors (With SDI IO)

No.	Connector	No.	Connector
1	DisplayPort External Monitor Output (To 1920x1080p 50, 59.94, 60)	**10**	1 PPS Input / Output
2	Two QSFP28 Cages 100G (**QSFP28 3** and **QSFP28 4**) (Optional) (Max each: 4 x 25 Gbps)	**11**	DC Power Socket XLR Male
3	Ethernet 1000 Base T Connector Factory Service (Labeled PTP; Not Currently Used)	**12**	IEC Male AC Mains Power Socket
4	Analyzer SDI Inputs Supported formats: SD, HD, 3G, 6G, 12G SDI 75 ohm BNC Connectors x 4 Includes SDI In 1 Eye Signal (fitted with Black Nut.) Supported formats: SD, HD, 3G, 6G, 12G.	**13**	Two SFP28 Cages (**SFP28 1** and **SFP28 2**) (Standard) (25G (Optional), 10G)
5	SDI Mon Instrument Output 75 ohm BNC Connectors Formats: 1080p 50, 59.94, 60 3G-SDI	**14**	Cooling Fans (x2)
6	MADI Audio output (Not Currently Used)	**15**	USB Type A v2.0 and v3.1 Ports
7	Reference IO 75 ohm BNC Connectors Supports reference loop-through.	**16**	Control Network / Management Port Ethernet 1000 Base T
8	Remote Control 15-pin D-type Connector	**17**	Factory Service (Not Currently Used)
9	SDI Generator, Generator Copy SDI or Input SDI Loop Outputs Supported formats: SD, HD, 3G, 6G, 12G. SDI 75 ohm BNC Connectors x 4	**18**	Extended Monitor, dedicated USB Type C v3.1

Connecting Cables to the Unit

After unpacking your unit, you can get it up and running either as a standalone unit on a desktop, or mounted in a rack, using the appropriate mounting kit, if ordered.

Proceed as follows to obtain an output to a video display using the connectors shown in *Figure 1-5* below:

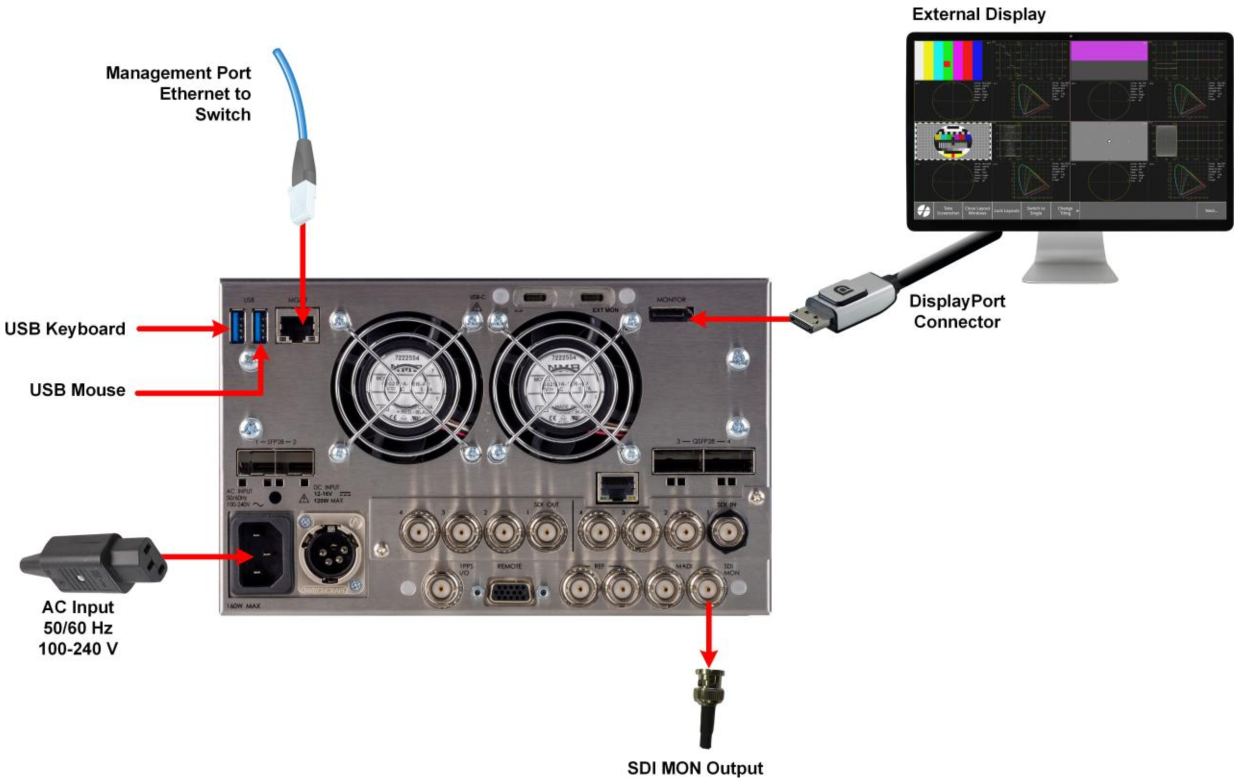


Figure 1-5: Minimum Rear Panel Connectors

Connect the cables to the rear panel as follows:

1. Connect an RJ45 cable to the management port. This enables you to access and control the unit remotely and to set the unit time using NTP.
2. Connect USB mouse/keyboard cables to the USB connectors on the rear of the unit for mouse and keyboard control.
3. You can use the touchscreen to operate the unit, however, If you require an external display, you can connect a suitable 1920 x 1080 capable monitor to either the DisplayPort instrument output or the SDI Copy instrument output. Both display outputs carry the selected audio mon- itoring channel/pair. The monitor output can be configured for 1080p 60, 59.94, 50, 48, or
   47.95 frame rates using the **Output Rate** dropdown available in the **Display Settings** dialog in the Settings tab. Either:
   - Connect a DisplayPort cable to the female DisplayPort connector on the rear of the unit (labeled **MONITOR**) and the other end to your external video monitor to obtain the instru- ment display, or

     > **Note:** If using a DisplayPort to HDMI adapter, be sure to use an **active** adapter. The use of passive adapters is not supported.

- Connect an SDI BNC cable to the SDI Copy instrument output connector on the rear of the unit (labeled **SDI MON**) and the other end to your video monitor to obtain the instru- ment display.

4. When the optional second display is included, connect the supplied USB-C cable between the USB-C **EXT MON** port on the rear of the main unit and the USB-C **Video Input** port on the rear of the second display.
5. Connect the three-pin, IEC C13 female power connector, on the power cord supplied with the unit, to the power socket on the unit.
6. Connect the plug on the other end of the power cord to a mains AC power outlet.
7. Switch on the power.
   The unit will automatically start to power-up.

These are the minimum connections you need to power-up the unit, obtain an output to an external video display and to control the user interface.

Connecting the Optional Extended Monitor to the Unit

Connect the optional extended monitor to the main unit using the dedicated USB v3.1 type C high-speed cable supplied with the display, as shown below.

If you connect the optional extended monitor with the main unit powered-on, you will need to restart the unit.

> **Note:** Using a different cable will prevent the optional extended monitor from booting correctly.

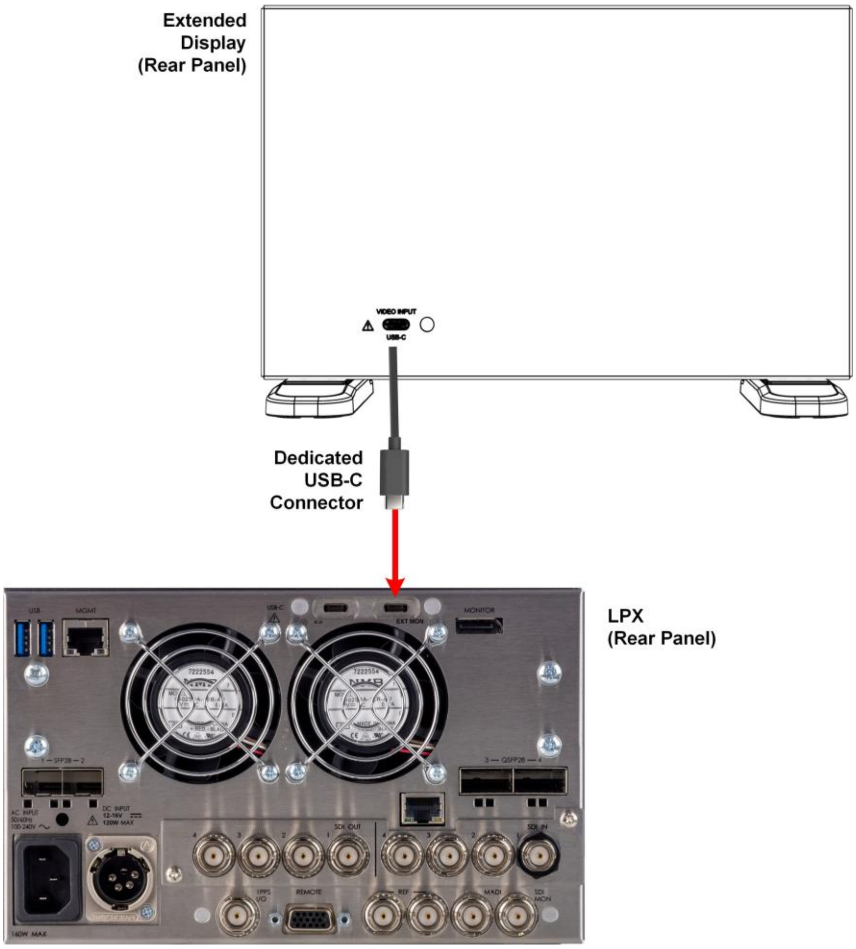


Figure 1-6: Connecting the Optional Extended Monitor to the Main Unit

> **Note:** Do not connect the optional extended monitor to a USB-C interface on a personal computer; it cannot be used as a USB-C external monitor.

Powering-up the Unit

Once connected to a power source, press the Power button on the front panel of the unit.

> **Note:** You may need to wait a few minutes for the unit to complete its boot cycle.

You should see the status LED behind the power button, at the top-right of the unit, light in the following sequence:

- **White (Blinking):** Initial Start-up sequence
- **White (Steady):** Unit running

When the you first press the Power Button on the front panel, the unit's fans will cycle for 20 to 30 seconds at high speed as the system boots, then settle to their normal operating speed.

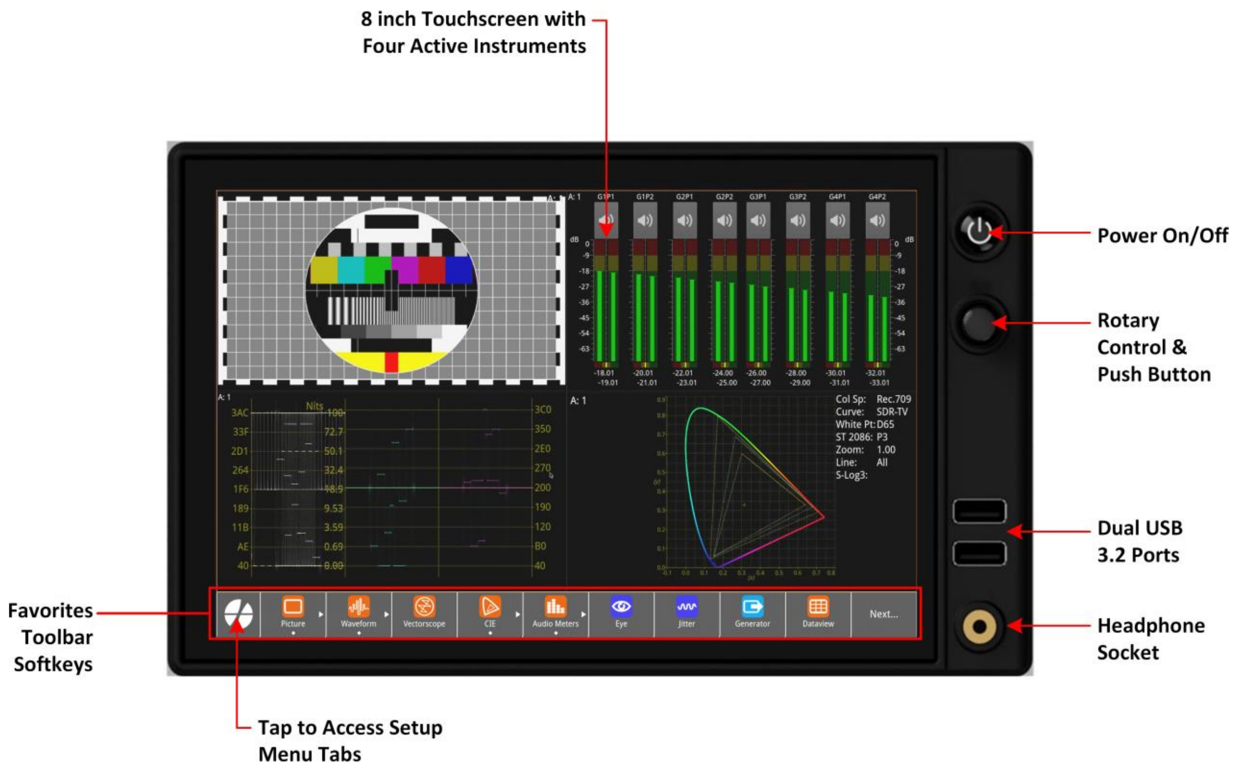


Figure 1-7: LPX500 Front Panel with Four Active Instruments

Video (IP and/or Optional SDI) Interfaces to the Unit

Available LPX500 Chassis Models

You can order the LPX500 in either of the following chassis options:

- Standard Model **LPX500I** provides an IP interface comprising two SFP28 cages, labeled **SFP28 1** and **2**, supporting media data transfer speeds of 10 GbE (optionally up to 25 GbE) and, in addition, two QSFP28 cages labeled **QSFP 3** and **4** for optional transfer speeds of up to 100 GbE.
- Model **LPX500IS** provides both IP and SDI interfaces. The unit includes the same IP SFP interfaces as for the LPX500I and in addition, includes eight SDI BNC connectors (four inputs and four outputs.)
- Model **LPX500ISE** provides the same IP and SDI interfaces as the LPX500IS and, in addition, supports physical layer analysis (Eye and Jitter) on the **SDI In 1** BNC connector (fitted with a black nut.)

Standard IP-Only Configuration

The standard **LPX500I** chassis enables you to analyze up to two (standard) or four (optional) 4K video source inputs simultaneously.

The IP capable model, together with the Audio / Video Test Signal Generator software option **(LPX500-GEN**), includes both Generator and either two or four Analyzers, enabling you to receive and transmit IP video flows.

You can choose either to use your own generic SFP+, SFP28, or QSFP28 transceiver modules to obtain media data transfer speeds of 10 GbE, 25 GbE or 100 GbE, respectively, or use the SFPs available with the following options:

- Option **PHSFP-10GE-SR / -LR**, insert SFP+ transceiver module(s) for a 10 GbE link
- Option **PHSFP-25GE-SR / -LR**, insert SFP28 transceiver module(s) for a 25 GbE link.
- Option **PHSFP-100GE-SR / -LR**, insert QSFP28 transceiver module(s) for a 100 GbE link.

> **Note:** Multirate SFPs are not supported.

For ST 2110 IP input, both **SFP 1** and **2** (or optionally **QSFP 3** and **4**) are available for data decapsulation (receiving). In addition, a stable source of ST 2059 precision time protocol (PTP) must be available to either **SFP 1** or **2** (or **QSFP 3** or **4**).

For ST 2022-6 IP input, both **SFP 1** and **SFP 2** (or optionally **QSFP 3** and **4**) are available for data decapsulation (receiving).

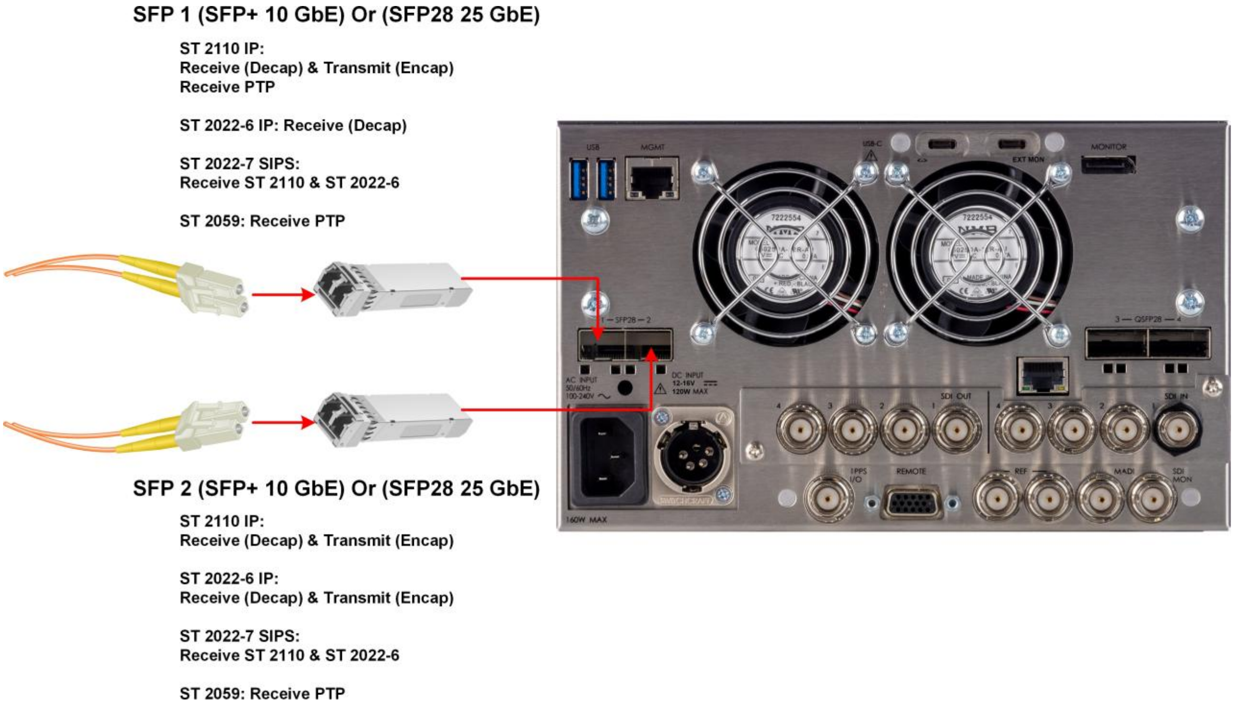


Figure 1-8: IP Interfaces Using SFP+ 1 and 2 (10 GbE) or SFP28 1 and 2 (25 GbE)

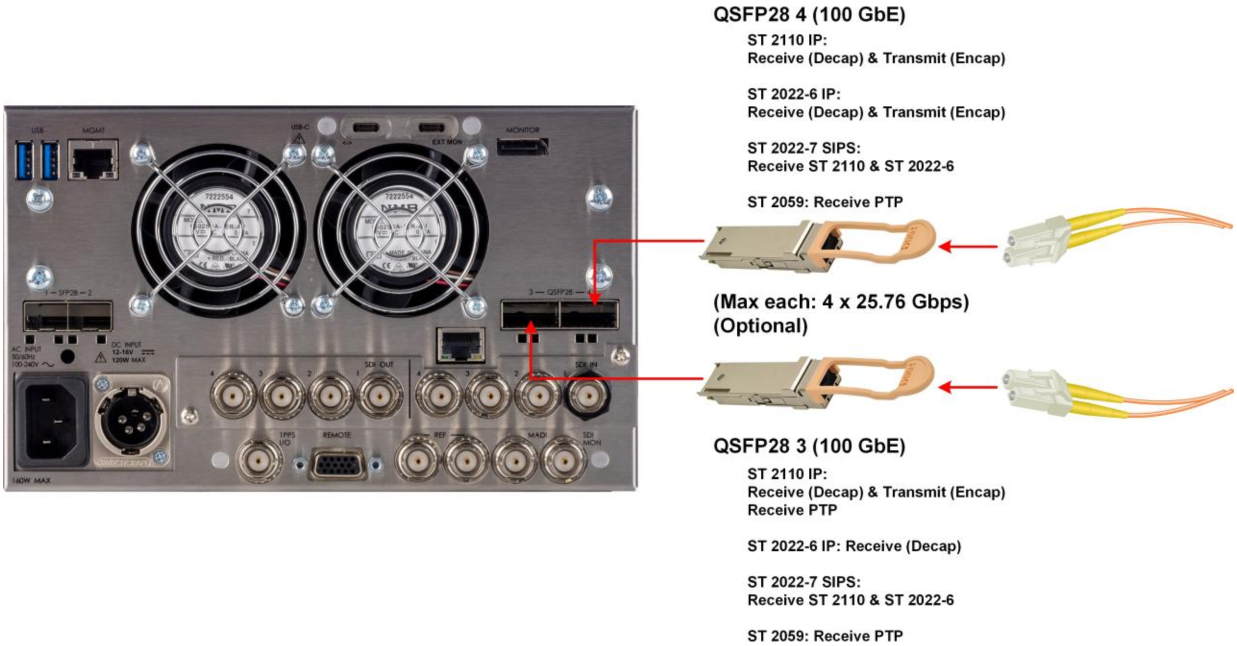


Figure 1-9: IP Interfaces Using Optional QSFP28 3 and 4 (100 GbE)

For ST 2110 IP output, both **SFP 1** and **2** (or optionally **QSFP 3** and **4**) are available for data encapsulation (transmitting).

For ST 2022-6 IP output, only **SFP 2** (or optionally **QSFP 4**) is available for data encapsulation (transmitting).

Optional SDI Connections to the Unit

The **LPX500IS** and **LPX500ISE** chassis options enable you to analyze up to two (standard) or four (optional) 4K video source inputs simultaneously.

An SDI capable model, together with the Audio / Video Test Signal Generator software option **(LPX500-GEN**), includes both Generator and either two or four Analyzers, which enables you to copy the Generator outputs back to the corresponding Analyzer inputs as shown below.

This guide assumes that you connect the unit to itself as shown in the following figure for SDI using the BNC connectors as follows:

- For **single** link SD-SDI and HD-SDI standards, connect **SDI Out 1** to **SDI In 1**, or **SDI Out 2** to **SDI In 2**, or **SDI Out 3** to **SDI In 3** or **SDI Out 4** to **SDI In 4**.
- For **dual** link HD-SDI standards, connect either **SDI Out 1** to **SDI In 1** and **SDI Out 2** to **SDI In 2** or **SDI Out 3** to **SDI In 3** and **SDI Out 4** to **SDI In 4**.
- For **quad** link HD-SDI standards, connect **SDI Out 1** to **SDI In 1**, **SDI Out 2** to **SDI In 2**, **SDI Out 3** to **SDI In 3** and **SDI Out 4** to **SDI In 4**.

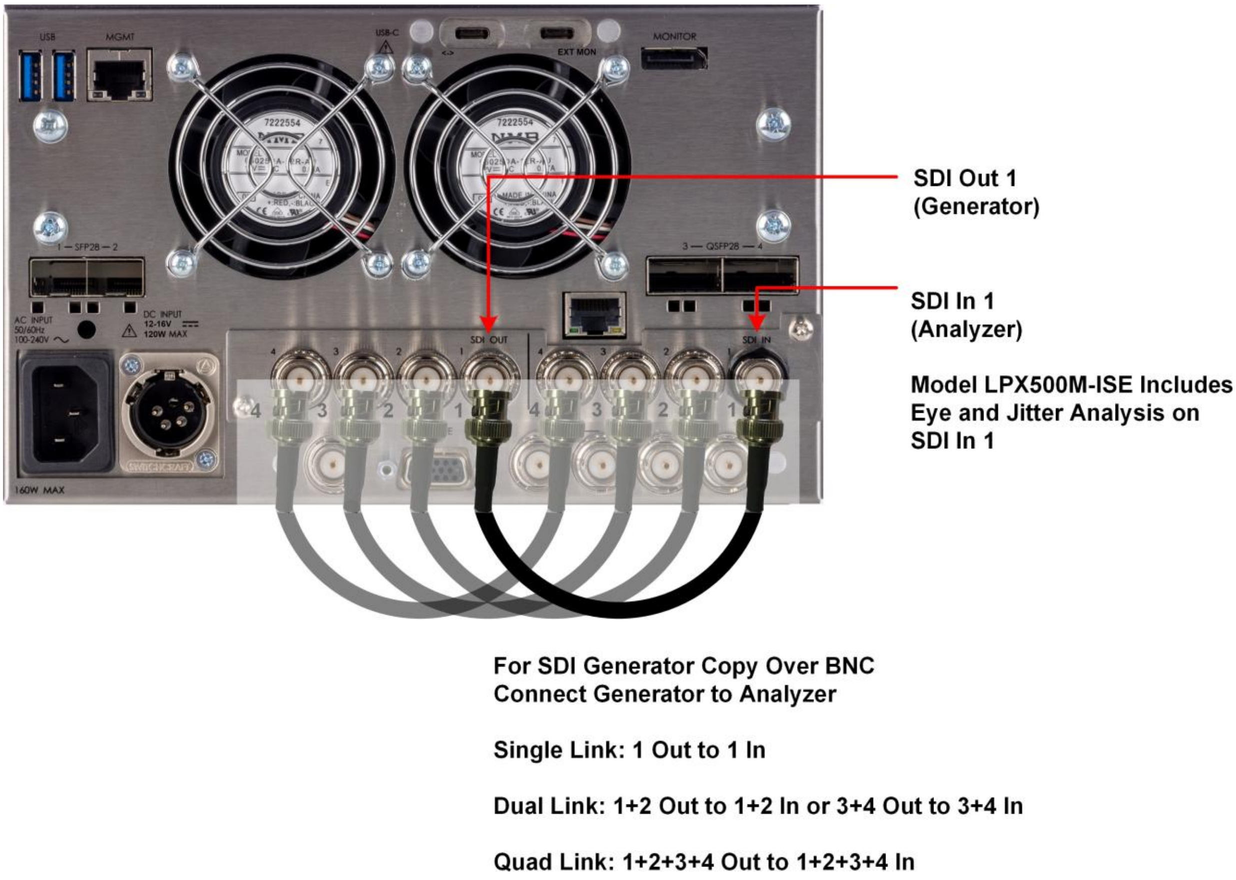


Figure 1-10: Connecting the Internal Generator to the Analyzer Using BNC Connectors

Powering-down the Unit

To power-down the unit, press the Power Button on the front panel and the unit will shutdown after 10 seconds. To shutdown immediately, press the power button twice or click the **SHUT DOWN NOW** button displayed in the Shutdown window. To stop a shutdown, click **Cancel**.

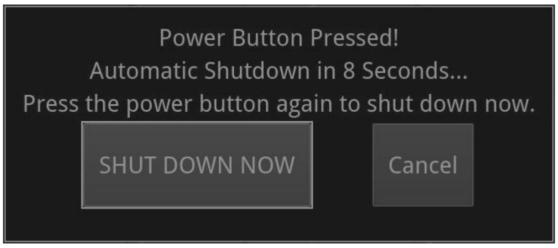


Figure 1-11: Unit Shutdown Dialog

2

Working with the User Interface

This chapter describes how to use the key features of the user interface and includes the following sections:

- Overview of the LPX500 Components
- Using the LPX500 Front Panel
- Using the LPX500 Controls
- Launching an Instrument or Instruments
- Overview of the Instrument Windows
- Working with the Instruments
    - Working with Instrument Tabs
- Managing System State Presets
- Working with Layouts
- Customizing the Favorites Toolbar
- Icon Quick Reference

Overview of the LPX500 Components

Introduction

The LPX500 is a highly-flexible, modular test and measurement device, which you can custom-build from a diverse palette of both standard and optional components.

This chapter introduces these components - the Toolsets, Instruments and Options available - which you can combine to create a solution that meets the specific demands of your media test and measurement environment.

Dual and Quad Analyzer Configurations

The standard LPX500 model provides two (dual) analyzers supporting the simultaneous analysis and display of two independent

The optional LPX500 chassis models (**LPX500IS** and **LPX500ISE**) both provide two (dual) analyzers which support the simultaneous analysis and display of two independent 4K SDI source inputs. With the optional software upgrade to four (quad) analyzers (option: **LPX500-QUAD**) the units can support the simultaneous analysis and display of up to four independent 4K SDI source inputs.

For more information, see *Managing Multiple Analyzers*.

Extended Monitor Configuration

The primary user interface of the standard LPX500 model is an integrated, eight inch, 1920 x 1200 LCD, multi-gesture touchscreen. You can use left or right swipes, tap, or tap and hold gestures to operate the unit from the touchscreen.

A second, optional compact screen unit (option: **LPX500-EM**) can extend the unit's local display capabilities, allowing you to control the unit from either physical screen.

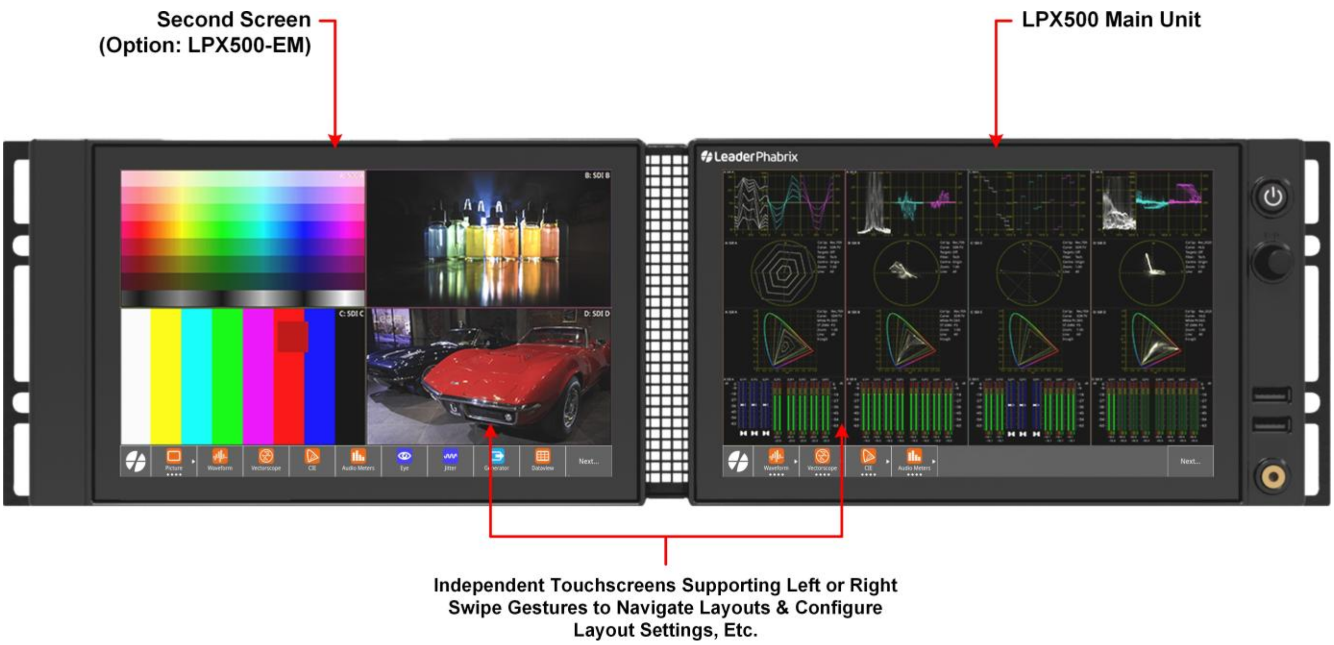


Figure 2-1: LPX500 Main Unit and Second Screen in Optional Rack Mount

Dual integrated noVNC clients also enable you to choose which of the displays you access remotely over noVNC.

> **Note:** Remote access using an external monitor connected to either the DisplayPort or SDI MON connectors currently uses an output from the main unit's display only.

Toolsets and Instruments

In essence, each **Instrument** is a standalone utility or application designed to provide a specific solution to a test and measurement task. For example, the LPX500 provides instruments to analyze the picture display or waveform; generate video or audio test signals; decode auxiliary data; provide status information, and so on. You can adapt or modify the functioning of all instruments using the configuration parameters available in the instrument options menus.

The **Toolsets** group together instruments at a higher functional level to assist with defining your ideal configuration.

It is important to note that non-standard Toolsets may require the purchase of additional hardware or software options to enable you to install the license for that Toolset.

The LPX500 provides a flexible, user-configurable feature to define and maximize the way instrument windows are displayed on the main unit and optional extended monitor. Referred to as **Layouts**, this facility enables you to define up to 16 screen layouts on the main unit (and extended monitor if available.) Each layout can display up to 16 instrument windows simultaneously, without overlapping. These enhanced layouts provide a huge canvas of extended screen real-estate, while enabling you to navigate smoothly between different layouts using swipe gestures.

Furthermore, by saving different operational configurations for specific tasks as system **Presets**, you can switch easily between bespoke configurations for rapid fault diagnosis, compliance monitoring and product development.

To summarize, you might use presets to switch the main functionality of the unit, for example, to change between signal types such as HD and UHD, and then use layouts saved in that preset to navigate between various different views of your instruments.

The unit enables you to analyze both IP (ST 2022-6 or ST 2110) and, optionally, SDI source inputs simultaneously. Some of the unit's instruments have been designed specifically to analyze IP input signals and others for SDI input signals whereas other instruments are generic. You can switch analyzers between IP and SDI sources as required.

Standard LPX500 Toolsets

Standard Toolset

The standard or core Toolset provides the following Instruments and associated utilities:

- Analyzer - Ancillary Status
- Analyzer - Audio Channel Status
- Analyzer - Audio Meters
- Analyzer - Loudness Monitor
- Analyzer - Picture
- Analyzer - Vectorscope
- Analyzer - Waveform
- Analyzer - Dataview
- Analyzer - ANC Inspector
- Event Logging
- Network and Automation
- System IO for IP Inputs
- Supporting standard utilities:
    - USB File Manager
    - VNC Remote Connection

Standard IP Monitoring Toolset for ST 2110 and ST 2022-6 IP Inputs

The Standard IP Monitoring Toolset for ST 2110 and ST 2022-6 IP inputs provides the following Instruments and tools:

<table>
<tr><th rowspan="2">IP Monitoring Toolset Instruments</th><th colspan="2">SMPTE Standard Supported by Instrument</th></tr>
<tr><th>ST 2110 Input</th><th>ST 2022-6 Input</th></tr>
<tr><td>Analyzer - 2022-7 Status</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Analyzer - 2110 Format Setup

Note: For ST 2022-6 use Analyzer - Video Standard (SDI & 20222-6 for anlysis.</td><td>Yes</td><td>No</td></tr>
<tr><td>Analyzer - LLDP Data</td><td>Yes</td><td>Yes</td></tr>
<tr><td>IP Media Latency tool
(Tab in Video Timing & System Reference Instrument)</td><td>Yes</td><td>No</td></tr>
<tr><td>IP Receive - Flows</td><td>Yes</td><td>Yes</td></tr>
<tr><td>NMOS Group including the following instruments:
• NMOS Status Overview and Configuration
• NMOS Receivers - IS05
• NMOS Receivers - SDP
• NMOS Senders - IS05
• NMOS Senders - SDP</td><td>Yes</td><td>No</td></tr>
<tr><td>PTP Info</td><td>Yes</td><td>No</td></tr>
<tr><td>SFP 1 / 2 or QSFP 3 / 4 - Info</td><td>Yes</td><td>Yes</td></tr>
<tr><td>SFP 1 / 2 or QSFP 3 / 4 - Network Stats</td><td>Yes</td><td>Yes</td></tr>
<tr><td>SFP IP Network</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Stats - 2022-6 Flow Group 1 to 2

Optionally: Stats - 2022-6 Flow Group 1 to 4</td><td>N/A</td><td>Yes</td></tr>
</table>

Additional IP Toolsets

Packet Interval Profile Generator Toolset for ST 2022-6 IP Generation

The ST 2022-6 Packet Interval Profile Generator Instrument Toolset provides the following Instrument:

> **Note:** This Toolset to generate ST 2022-6 IP output requires the software option: **LPX500-GEN**.

- 2022-6 Transmit (SFP 2) or (QSFP (ST 2022-6 Output Only).

Advanced Toolsets

SDI and Reference Toolset

> **Note:** This Toolset requires one of the factory-fitted, hardware chassis options: **LPX500IS** or **LPX500ISE**, which include the circuit boards mounted with SDI BNC connectors.

The SDI and Reference Toolset provides the following Instruments:

- CRC Analysis SDI In 1 to 4
- Analyzer - Video Standard
- Stats - SDI In 1, 2, 3, 4
- System IO
- Video Timing & System Reference
- Eye - SDI In 1 (Also requires **LPX500ISE**)
- Jitter SDI In 1 (Also requires **LPX500ISE**).

Video and Audio Generation Toolset

The Video and Audio Test Signal Generation Toolset provides the following Instruments:

> **Note:** This Toolset requires the software option: **LPX500-GEN**.

- Generator (Includes separate dialogs to configure Video and Audio signal generation).
- 2110 Transmit (ST 2110 IP Output Only).

Media-related Toolsets

Production Toolset

The Production Toolset provides the following Instrument:

> **Note:** This Toolset requires the software option: **LPX500-DIAM**.

- Analyzer - RGB Vector (Includes diamond display).

Advanced HDR Visualization and Analysis Toolset

The Advanced High Dynamic Range (HDR) Toolset provides the following Instruments and tools:

> **Note:** This Toolset requires the software option: **LPX500-HDR**.

- False Color Highlighting (Additional submenu item in Analyzer - Picture instrument)
- Analyzer - CIE Chart
- Additional HDR submenu items in the Generator and Analyzer - Waveform Instruments.

UHD Formats Toolset

The UHD Formats Toolset provides the following:

> **Note:** This Toolset requires the software option: **LPX500-UHD**. For SDI, this toolset requires one of the factory-fitted, hardware chassis options: **LPX500IS** or **LPX500ISE**.

- Support for UHD/4K formats for SDI (including some HD-SDI / 2K extended mode formats)

> **Note:** This Toolset requires the software option: **LPX500-UHD**. For SDI, this toolset requires one of the factory-fitted, hardware chassis options: **LPX500IS** or **LPX500ISE**. In addition, for ST 2110 input, this toolset requires **LPX500-IP-25G** or **LPX500-IP-100G**.

- Support for UHD/4K formats for both IP and SDI (including some HD/2K extended mode formats)

EUHD Mode Formats Toolset

The UHD Extended Mode Formats Toolset (EUHD) provides the following:

> **Note:** This Toolset requires the software options: **LPX500-UHD** and **LPX500-EUHD**.

> **Note:** This Toolset requires the software options: **LPX500-UHD** and **LPX500-EUHD**. For ST 2110 input, this toolset requires **LPX500-IP-25G** or **LPX500-IP-100G**.

- Support for analysis of extended mode UHD/4k formats: YCbCr / RGB 444; 8, 10, 12 bit; 47.95P to 60P.

Using the LPX500 Front Panel

Overview of the Front Panel

The front panel of the unit features a number of controls providing various methods to access the user interface. You can choose to control the unit using either touch, function buttons, rotary control, navigation controls, or mouse cursor. You can use any combination of methods to best suit your task objectives. Some of the unit's controls have similar (or the same) outcomes so the methods you choose to perform a task depend on your personal preferences and whether accessing the unit locally or remotely.

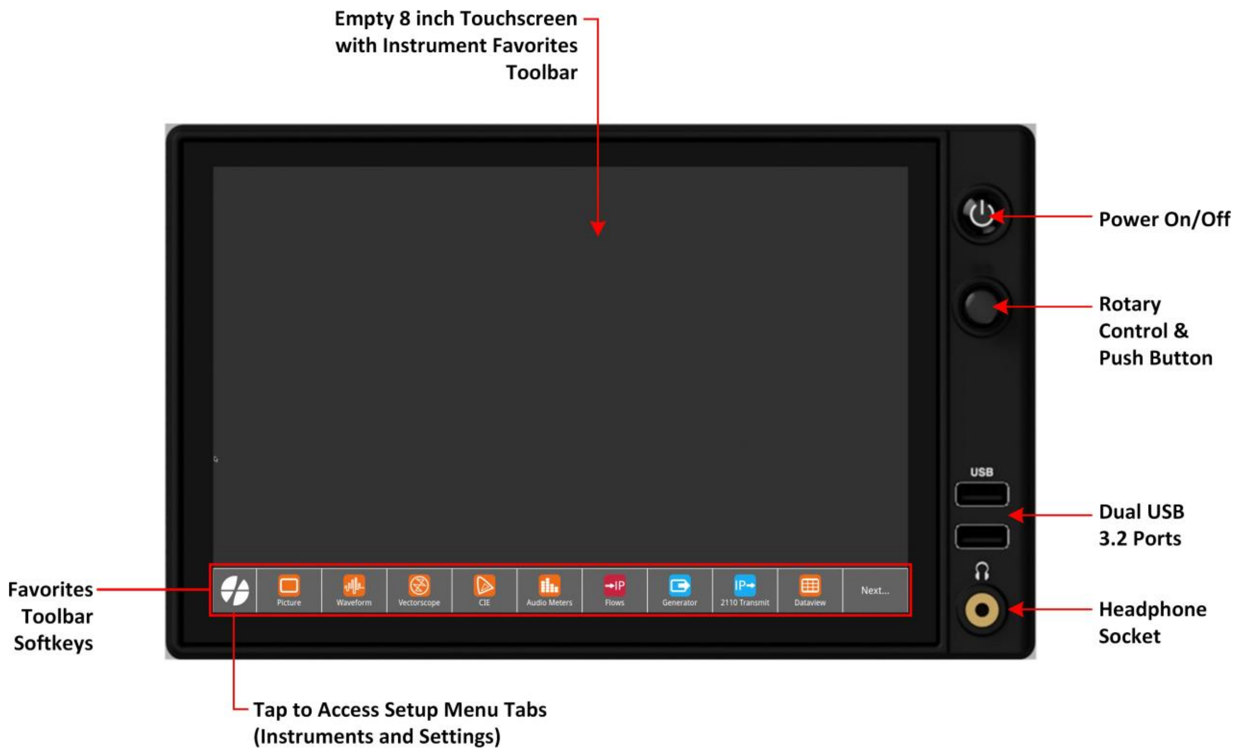


Figure 2-2: Active Layout Screen After Initial Start-up (Includes LPX500-GEN License)

The default **Active Layout** is the first layout displayed out-of-the-box or after applying the default settings and gives you immediate access to a default list of nine test and measurement instruments in the **Instrument Favorites Toolbar**. Tap any of the softkeys to open that instrument on the active layout. The instrument you choose will open in one quarter screen size in the top-left quadrant of the screen.

The default layout displayed first is always of type **Multi Unlinked**; this type of layout will be described later in this *User Manual*. For details, see the section *Working with Layouts*.

Note: When accessing the unit remotely, using either the DisplayPort output or noVNC, the Favorites Toolbar is not initially displayed. Instead, to access the Toolbar menus, move your mouse cursor down to the bottom edge of the screen and the Favorites Toolbar will pop-up at the bottom of the display. If this is not the case, you will need to enable the Function Bar Popup parameter in the Display Settings, see *Setting up the Display*.

Once disabled, you can only re-enable this function using the front panel touchscreen, or by restoring the default settings.

In addition to using the softkeys (each representing a different instrument) in the instrument favorites toolbar, several other methods are available to launch instruments, as follows:

- Tap to open the Setup menus, open the Instruments tab and tap an instrument launch but- ton to select that instrument.

  Tap to exit the Setup menus and return to the active layout.

- Tap to open the Setup menus, open the Instruments tab, turn the rotary control to the left or right to scroll through the instrument launch buttons and pages, then press to select an instrument.
- If working remotely or locally using a mouse, move your mouse cursor to the bottom edge of the screen then click to open the Setup Menus. Click one of the instrument launchers avail- able in the Instruments tab.

Figure 2-3. shows the screens available when using the softkey to switch between the current screen (referred to as the **Active Layout**) and the system Setup Menu panels. In addition, it also shows how to use the Next... softkey to cycle through the favorites toolbars.

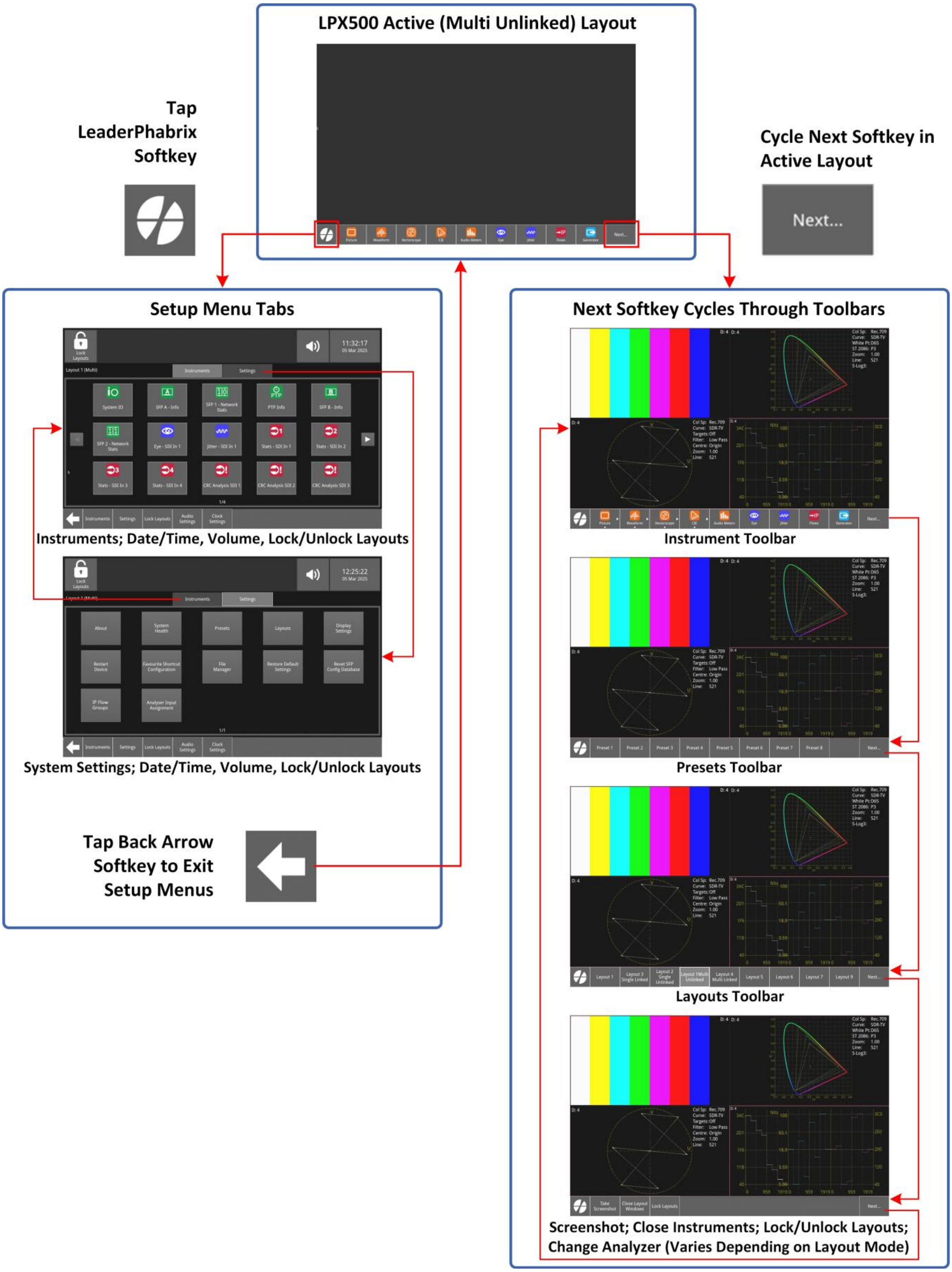


Figure 2-3: Using the LeaderPhabrix Softkey to Access Settings and Next Softkey to Cycle Through Toolbars

Using the LPX500 Controls

Overview

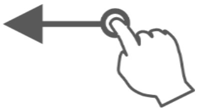
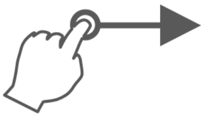
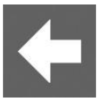
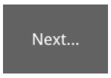
The LPX500 user interface offers a variety of different controls to provide flexibility and to suit different working styles and environments. It is recommended to use the most appropriate method for the task in hand, depending on whether you are working locally, using the touchscreen, or remote from the unit.

> **Note:** Where possible in this user manual, we use the terms **tap** or **click** for alternative methods to select an item and the terms **tap and hold** or **right-click** to display the options menu for an instrument. In addition, the term **swipe** describes a single finger, horizontal movement from the left of the screen to the right, right to left, or down from the top of the screen.

The main controls are summarized in the following table and include:

- Touchscreen control using either the unit's built-in touch-sensitive display or the optional, extended touch-sensitive display.
- Mouse control, generally for working on an external display, either showing the rasterized output (DisplayPort or SDI MON output) or for remote access to the interface using noVNC.
- Rotary control, generally to move the spotlight and select spotlit objects.
- Mouse control for working locally, with a USB mouse connected directly to the unit. When you move the mouse cursor to the bottom of the screen, the toolbar appears by default, allowing you to select the softkeys. You can disable this action in the Display Settings dialog if necessary.

Table 2-1 : Symbols for LPX500 Controls and Gestures in this User Manual

LPX500 Control	Symbol	Description	Action Term Used in this Manual
Touch		Touchscreen control using the touch-display(s). You can tap any part of the built- in display or optional second display to per- form an action.	Tap or Double-tap or Tap and hold
Swipe Left		Touchscreen control using the touch-sensitive display(s). Slide a finger from right to left of the screen.	Swipe Left
Swipe Right		Touchscreen control using the touch-sensitive display(s). Slide a finger from left to right of the screen.	Swipe Right
Mouse		Mouse control for use on an external dis-play or for remote access to the interface. The mouse scroll wheel has similar func-tions to the Rotary Control.	Click or Double-click or Right-click
LeaderPhabrix Softkey		On unit touchscreen display, tap to access Setup Menus (Instruments and Settings).	Tap or click
Back Softkey		On unit touchscreen display, tap to return to the active layout from the Setup Menus (Instruments and Settings).	Tap or click
Softkeys		Displayed in a series of Toolbars at the bottom of the touchscreen. Tap to select the action or function displayed by the softkey label.	Tap or click
Navigation Controls			
Rotary Control		Rotary control to move the spotlight left or right by turning the shaft and pressing to select the spotlit item. In addition, when working with audio instruments, you can use the rotary control to adjust the audio volume to connected headphones.	Turn or Press

Using the Touchscreen Controls

The touch-sensitive screen on the front panel of the LPX500 provides a softkey toolbar along the bottom of the active layout, which gives you access to a default set of favorite instruments, various favorite toolbars, the Setup menu tabs and additional functions, see *Figure 2-3*.

You can tap any of the instrument softkeys in the favorites toolbar to launch that instrument in the active layout. For more information about the instruments, see the section *Working with the LPX500 Instruments*.

You can configure the instruments displayed in your favorites toolbar in the **Settings** tab of the **Setup** menus, see the section *Customizing the Favorites Toolbar*. To open the Settings panel, tap at the left-hand side of the toolbar, then select the Settings tab.

Note: softkey is displayed at the left of all toolbars unless the instrument-toolbar toolbar is displayed when the spotlight is on an

Use the softkey to cycle through the favorites toolbars, for example:

- To launch a group of instruments from a previously saved preset, tap then select a pre- set from the available list. The presets toolbar is displayed only when presets have been cre- ated.
- To display a different screen layout from a previously saved layout, tap to display the layouts toolbar, then select a layout from the available softkeys.
- To take a screenshot of the current active screen, or to close all active instruments, lock / unlock layouts or change the Analyzer source input tap again.

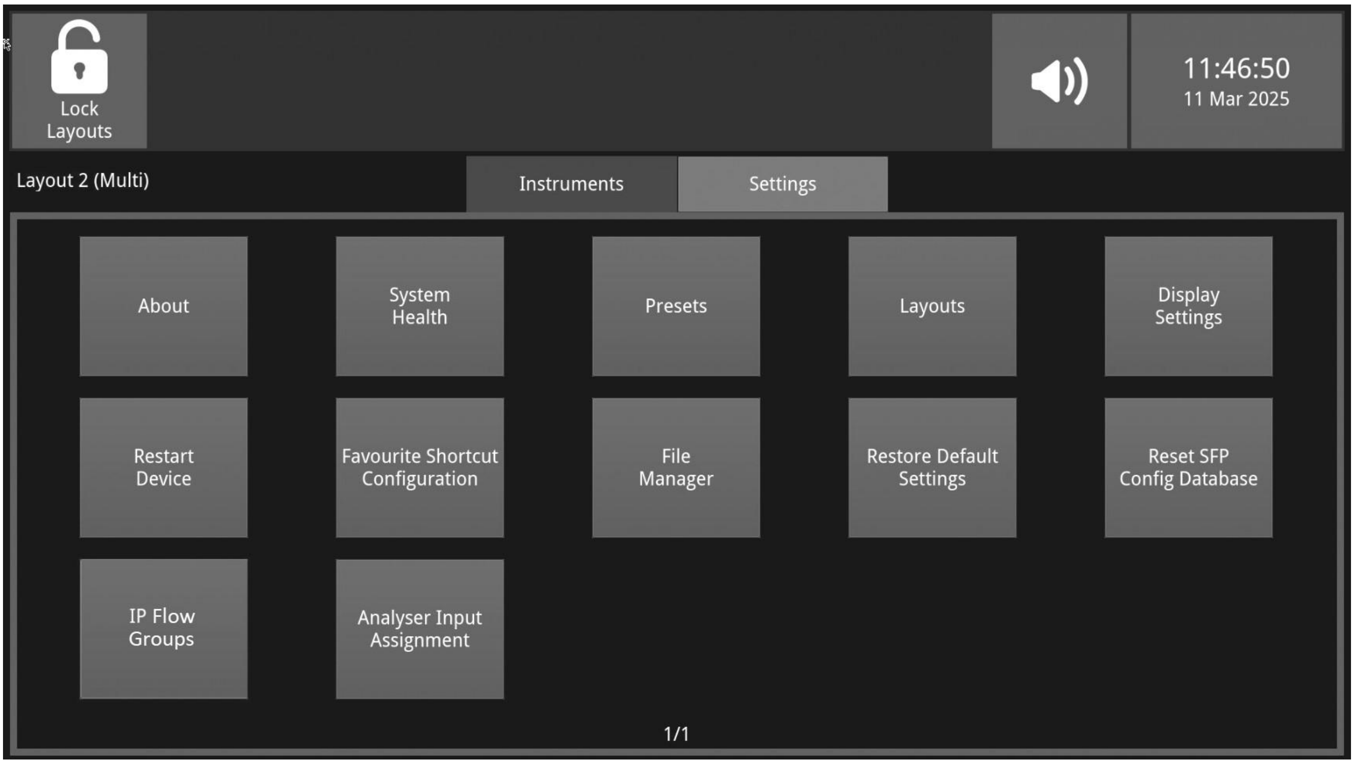


Figure 2-4: Settings Tab in the Setup Menus

Alternatively, tap  to launch the Setup Menu where you can do the following:

- Lock or unlock the current Layout.
- Adjust the volume of the audio output, or mute / unmute the audio output using the Audio dia- log.
- Set the system date and time.
- Identify the active layout to which instruments will be loaded from the layout launcher.
- Open the **Instruments** tab to launch an instrument from all available, licensed instruments.
- Open the **Settings** tab to launch the following:
    - Display information about your unit in the **About** dialog (serial number, software version, licensed instruments, hardware versions, etc.)
    - View the **System Health** dialog (temperatures and fan speed).
    - Manage your presets in the **Presets** configuration dialog - you can add, load, update, rename, delete, or move presets.
    - Manage your screen layouts in the **Layouts** configuration dialog - you can add, duplic- ate, switch, rename, delete, or move layouts.
    - Open the **Display Settings** dialog to:
        - Set the display output rate
        - Adjust the user interface brightness
        - Adjust the backlight brightness of the display
        - Enable or disable the on-screen keyboard
        - Enable or disable the popup of the toolbar softkeys when using a remote display, noVNC access, or when using a mouse on the unit's touchscreen.
        - Choose whether to display system temperature measurements in units of degrees Celsius (**°C**) or Fahrenheit (**°F**)
        - Enable or disable instrument window frames for Analyzer and Generator windows
        - Set different border colors to differentiate analyzer instruments connected to each of the two or (optionally) four Analyzers
        - Set the border color for Generator instruments.
    - Restart the unit.
    - Configure the instruments displayed in the Favorites Toolbar in the **Favorite Shortcut Configuration** dialog.
    - Open the **File Manager**.
    - Restore factory **Default Settings** to revert to the factory configuration of the unit.
    - Assign physical inputs to each of the two or (optionally) four **Analyzers**.

> **Note:** When using the second screen some elements of the Settings menu are disabled and only available from the LPX500 main unit, for example, File Manager.

Note: When using the second screen some elements of the Settings menu are disabled and only available from the LPX500 main unit, for example, File Manager.

The following figure shows the Instruments tab of the Setup menus containing the first page of instrument launchers.

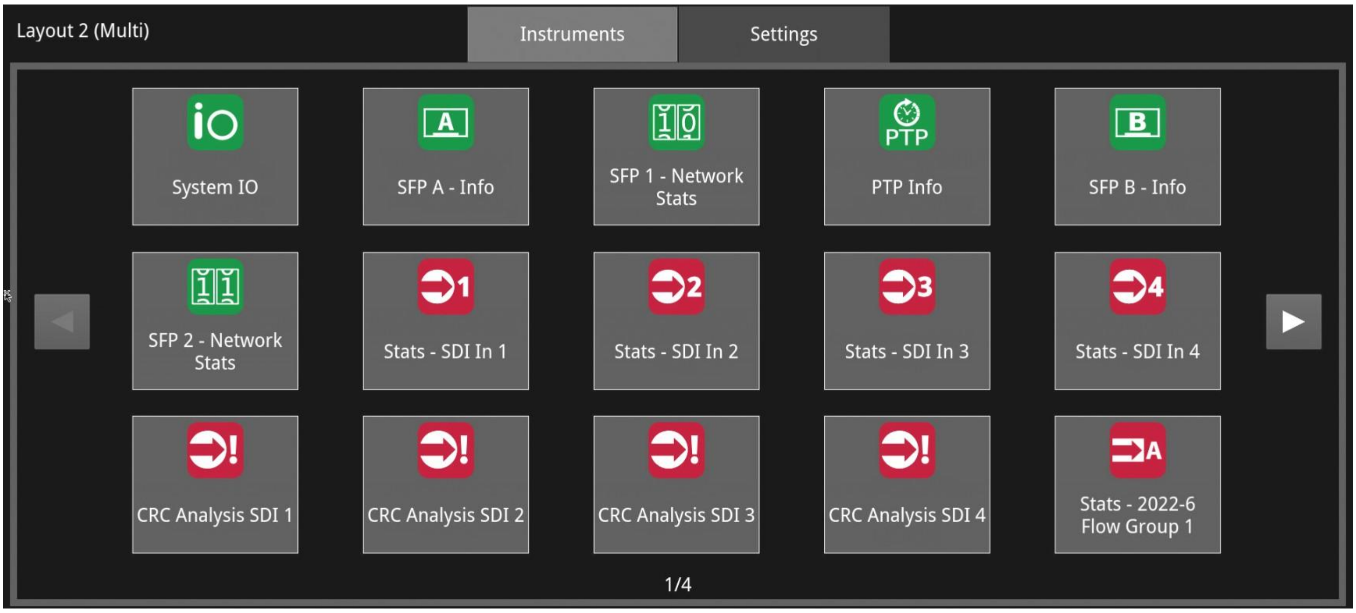


Figure 2-5: Instruments Tab (Page 1) in the Setup Menus for Unlinked Layouts

Note: The layout label, below the lock / unlock layouts icon, identifies the target active layout for instruments launched from the Instruments tab, the type of layout and whether the layout is linked.

The following figure shows how to use the touch controls from the active layout to display either the Instruments or Settings tabs of the Setup menus, to launch an instrument or system utility, or to cycle through the various toolbars. Additional touch controls for some elements you might use in the user interface of active instruments are also shown.

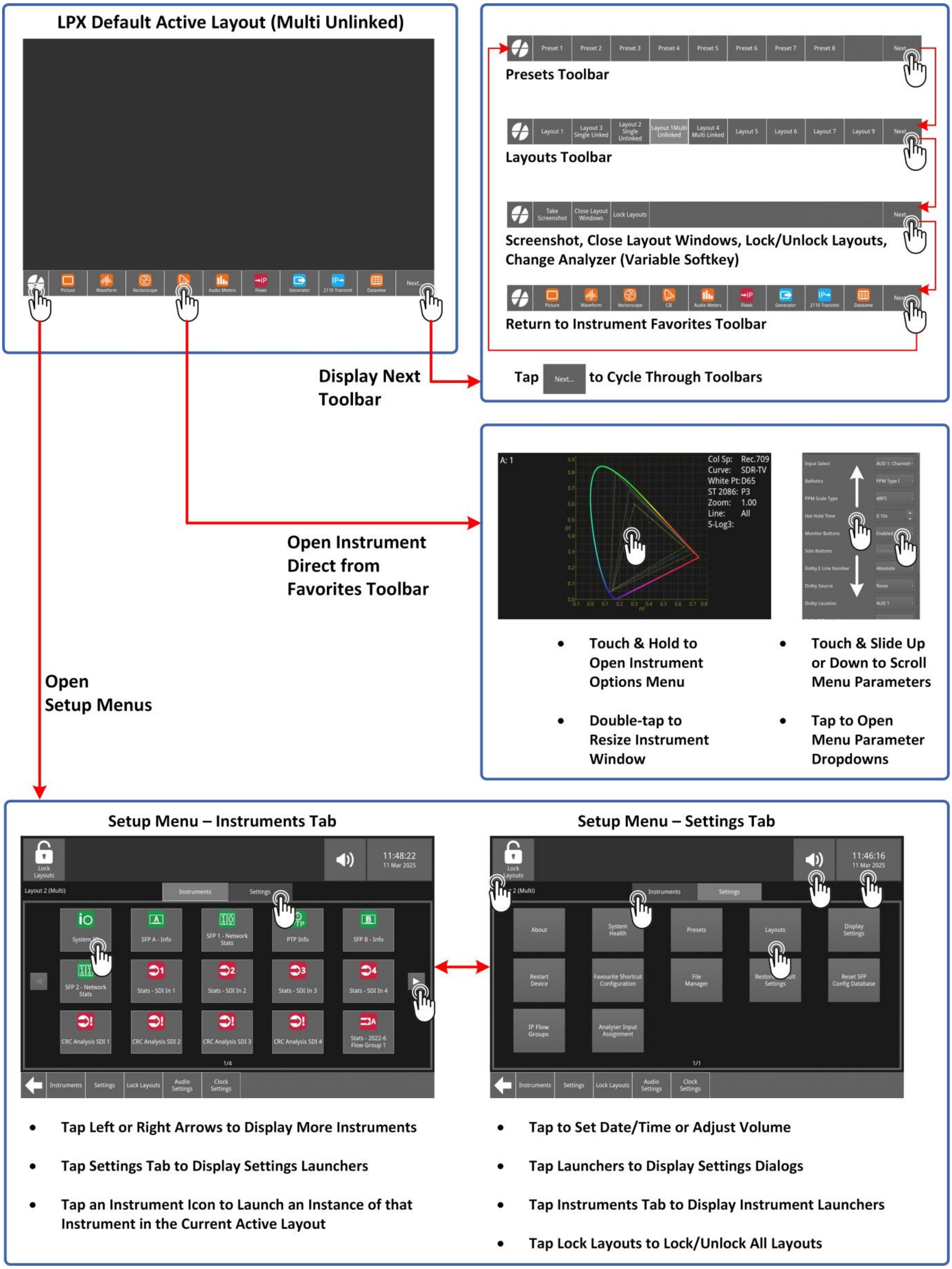


Figure 2-6: Touch Control Using the Instrument Favorites Toolbar from the Active Layout

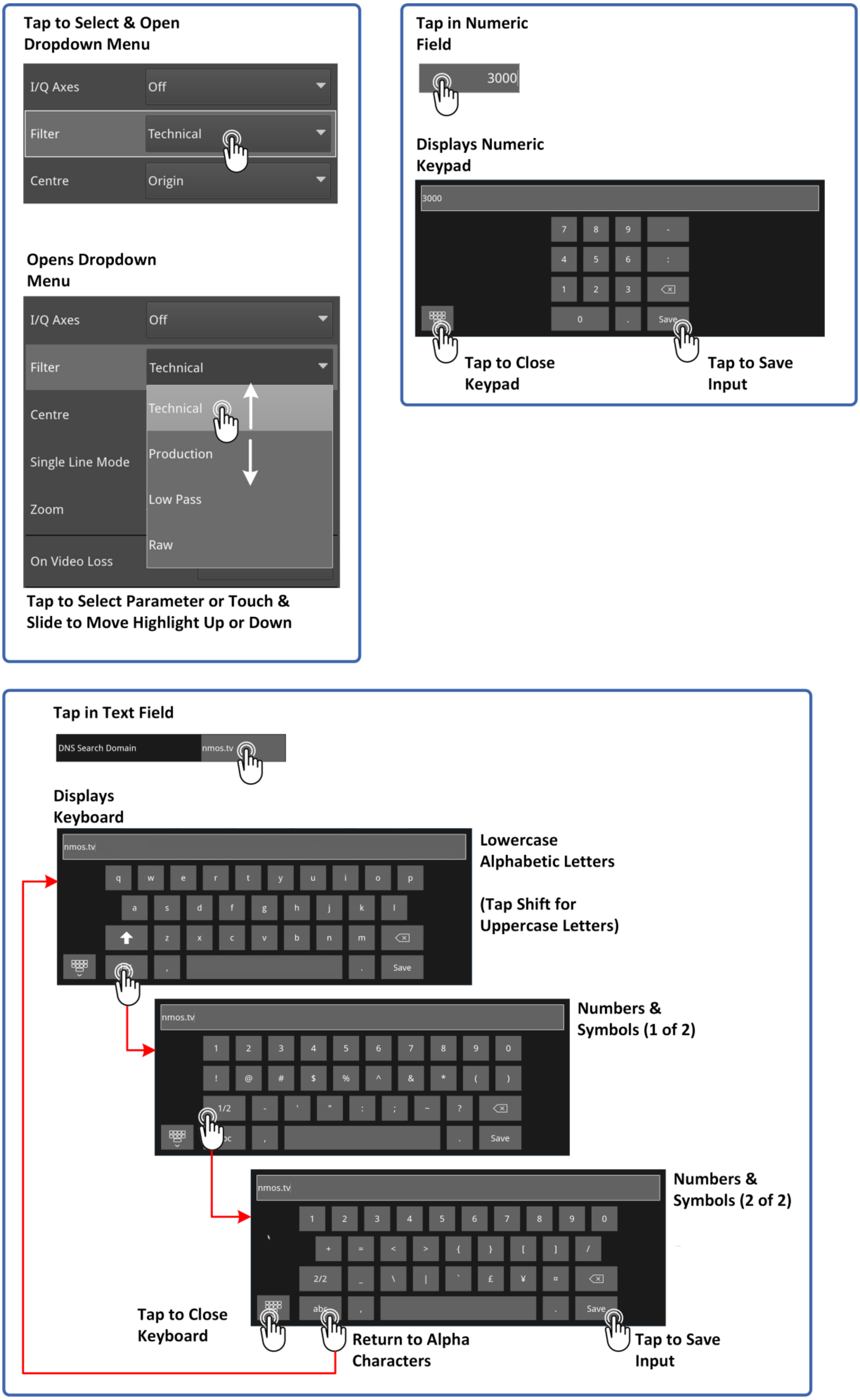


Figure 2-7: Touch Control of User Interface Tools

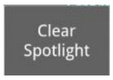
Table 2-2 : Comparison of Touch and Mouse Actions in the LPX500 User Interface

	Equivalent Actions			
	Single tap	Double-tap	Touch and hold (or long touch)	Touch, hold and drag
 (Right handed Mouse Setup)	Left click	Double-click	Right-click	Left-click, hold and drag

Working with the Spotlight

The LPX user interface includes a **Spotlight** feature to highlight the currently active component. This may be an entire instrument, a configurable parameter or system control in the instrument's options menu, or even a softkey in one of the toolbars. The spotlight is shown as a thicker white border around the spotlit item.

You can change the position of the spotlight by tapping the touchscreen, using the rotary control, or clicking with the mouse cursor.

When you open a new instrument into a layout, the spotlight will automatically be on that instrument. When the spotlight is on an instrument, the **instrument-specific softkeys** are displayed in the toolbar. To remove the spotlight from an instrument, tap the 

softkey. This removes the white border from the instrument and returns the favorites toolbar to its last used state.

In the options menu of an instrument, tap inside the menu to activate the spotlight and move up or down the parameters using the rotary control. Press the rotary control to select a parameter then move the spotlight through the parameter options.

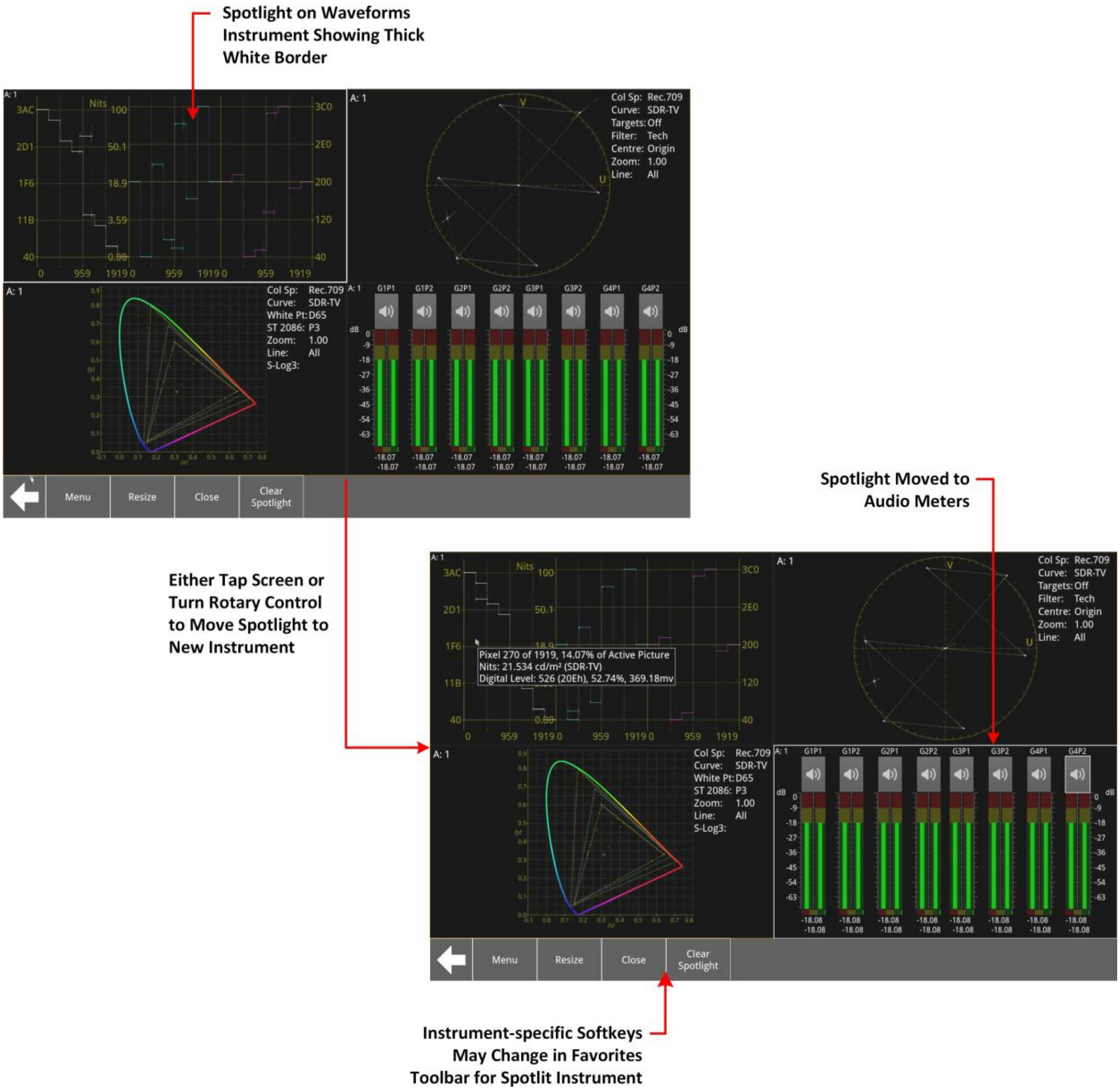


Figure 2-8: Moving the Spotlight to a Different Instrument

Using the Rotary Control

The rotary control, located below the on/off button on the front panel, provides an alternative method for moving the spotlight in the user interface, for selecting items and for adjusting the headphone volume, if connected, when working in audio modes. In most instruments, you can select the control or spotlit option by pressing the rotary control.

Depending on the current context of the user interface, the direction in which you turn the rotary control can change the direction of movement of the spotlight.

For example, turning the rotary control clockwise in the instrument panel, moves the spotlight to the right and turning counter-clockwise moves the spotlight to the left. In an open options menu, however, turning the rotary control clockwise moves the spotlight down the parameter list and turning counter-clockwise moves the spotlight up.

If you position the spotlight in a numeric field with a spinbox control, you can increase the displayed value by rotating the control clockwise, or decrease the value by rotating counter-

> **Note:** Some features of the rotary control may not be fully enabled in the current software release.

clockwise.

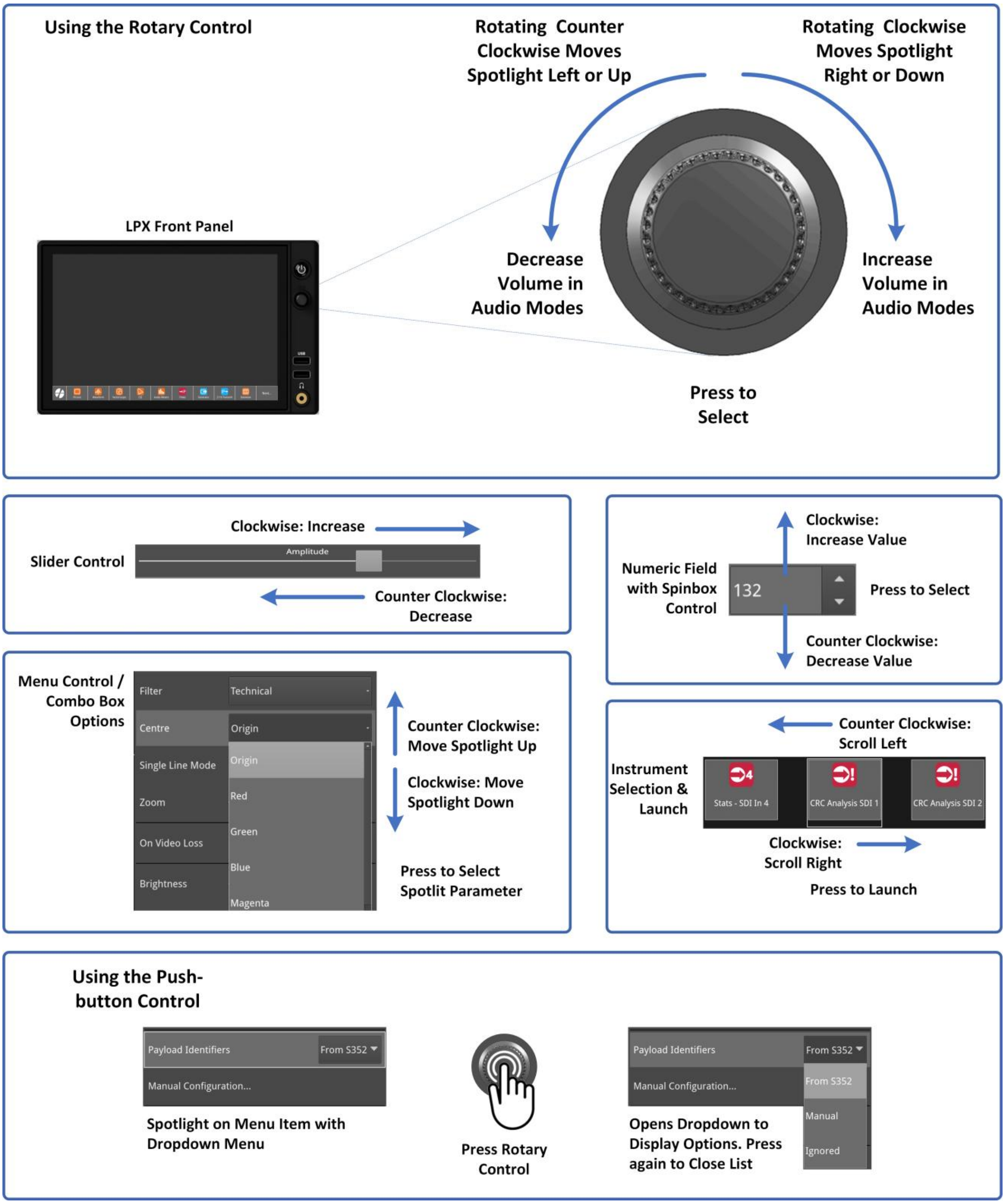


Figure 2-9: Using the Rotary Control with Instrument Software Controls

Mouse Control

Mouse control is primarily optimized for working on the rasterized DisplayPort output to an external screen or for remote access to the unit over noVNC or a VNC client application. All tasks that you can perform using touch control locally on the unit can be done using the mouse on the remote display.

You can, if necessary, connect a USB mouse directly to the unit, to work locally on the touchscreen of the unit. By default, moving the cursor to the bottom of the touchscreen raises the toolbar slightly, however, you can disable this feature in the Display Settings dialog.

> **Note:** When controlling the unit over the DisplayPort output, a USB mouse must be connected to one of the unit's USB ports.

Click to display the Setup Menus from the active layout, make any configuration changes, then click to return to the active layout. Use the Setup Menus to select Instruments, manage Presets and Layouts, assign analyzers, and configure system settings.

As with the Rotary Control, you can scroll the mouse wheel forward to move the spotlight up / left or scroll backward to move the spotlight down / right. In addition, press down on the scroll wheel to select a spotlit item.

Once an instrument is open in the active layout, right-click the mouse cursor in the instrument window to display the context-sensitive, options menu. This displays a more compact options menu than the touch-enabled menu, see *Figure 2-35*. You can now configure the parameters for that instrument as usual.

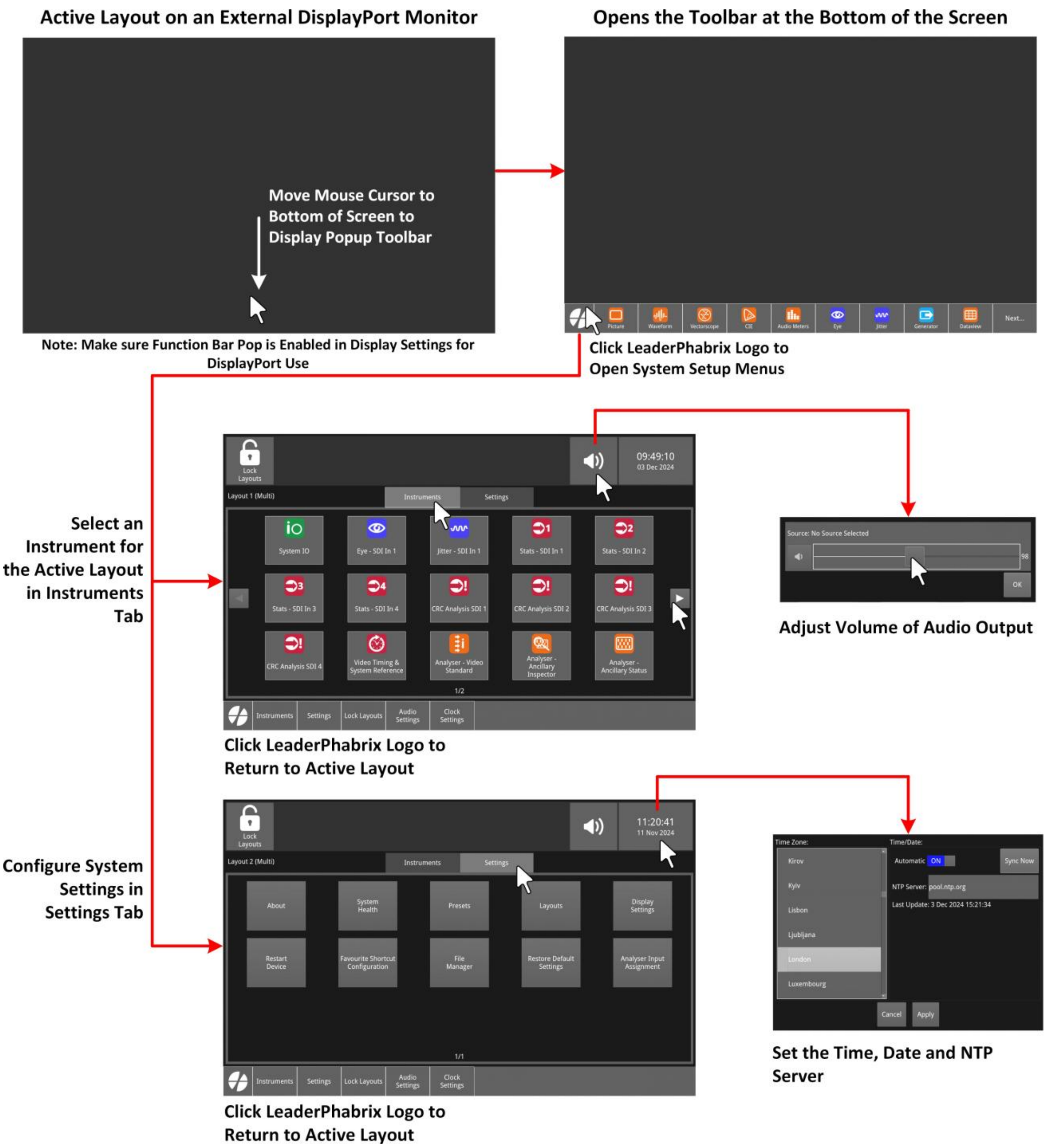


Figure 2-10: Using the Mouse on an External Display or Over a noVNC Connection

Launching an Instrument or Instruments

Overview

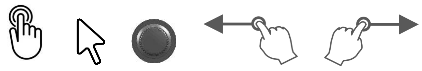
You can launch instruments in a number of ways from the active layout screen, for example, you can either use the favorites toolbar, choose instruments from the **Instruments** tab in the Setup menus, or open an existing preset of saved layouts and instruments.

The method you choose also depends on whether you are working locally, using the touchscreen, or remotely on either an external display or using noVNC with a mouse and external keyboard.

Each available Instrument has a designated, color-coded icon displayed in the launch buttons of the Instruments tab and in the instrument favorites toolbar. For more information, see the section *Instrument Icon Quick Reference*.

Certain utilities, used mainly for administrative tasks, are available from the **Settings** tab of the Setup menus, rather than as icons in the Instruments panel, for example, the File Manager.

You can page through the list of available instruments using one of the following access methods:

Required Action	Available Methods
Page left or right through the available Instruments in the Instruments tab and select one.	Local Access:  Remote Access: 

Launching an Instrument from the Favorites Toolbar

Unlocked Layouts

A default **Favorites Toolbar** is preconfigured with up to nine frequently used Instruments (depending on the available licensed options.) Each one of the favorite softkeys in the toolbar represents a different Instrument.

If necessary, you can change the composition of instruments displayed in the favorites toolbar in the **Settings** tab of the Setup menus, see the section *Customizing the Favorites Toolbar*.

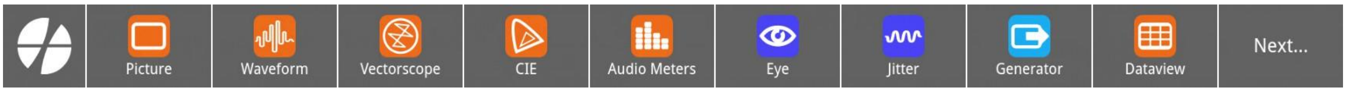


Figure 2-11: Favorites Toolbar (Unlocked Layout)

Required Action	Available Methods
To launch an instrument from the favorites toolbar.	Local Access: Remote Access:

If you launch an instrument to a layout that is not in your favorites list, that instrument is added to the favorites toolbar so that you can quickly identify it in the layout if it becomes hidden.

When you change between layouts, the shortcut softkeys in the favorites toolbar will change to reflect the instruments open in the active layout in addition to the favorites softkeys.

Locked Layouts

When a layout is locked, the favorites toolbar changes to display softkeys only for those instruments that are currently used in the active layout.

Figure 2-12: Favorites Toolbar (Locked Layout)

Figure 2-12 shows the favorites toolbar for a locked layout displaying four active instruments.

When you change between layouts, the shortcut softkeys in the favorites toolbar will change to reflect the instruments open in the active layout.

About the Instrument Launcher Pages

All standard and optional licensed instruments are displayed in the pages that you can access from the **Instruments** tab of the Setup menus. You can navigate between the pages using the left or right arrow buttons in the left and right margins of the pane or swipe left or right to display next or previous pages. When an arrow button is grayed-out, you cannot move further in that direction.

You will see the following standard instrument pages displayed in the instrument panel of the Instruments tab, without any optional software installed:

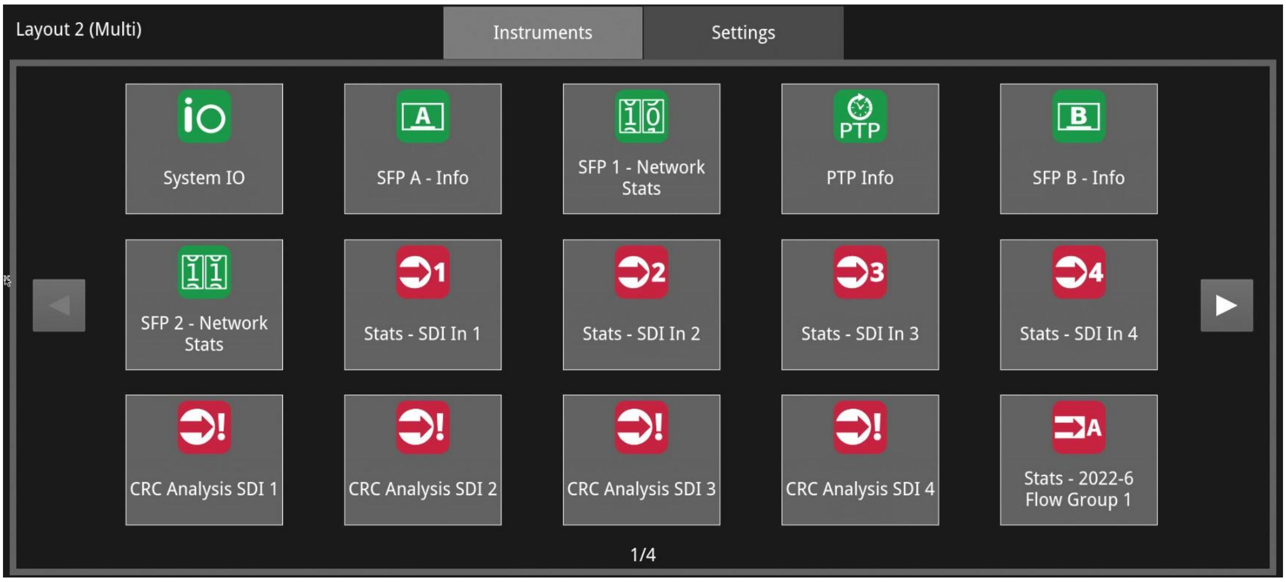


Figure 2-13: Standard Instruments Tab - Page 1 of 4

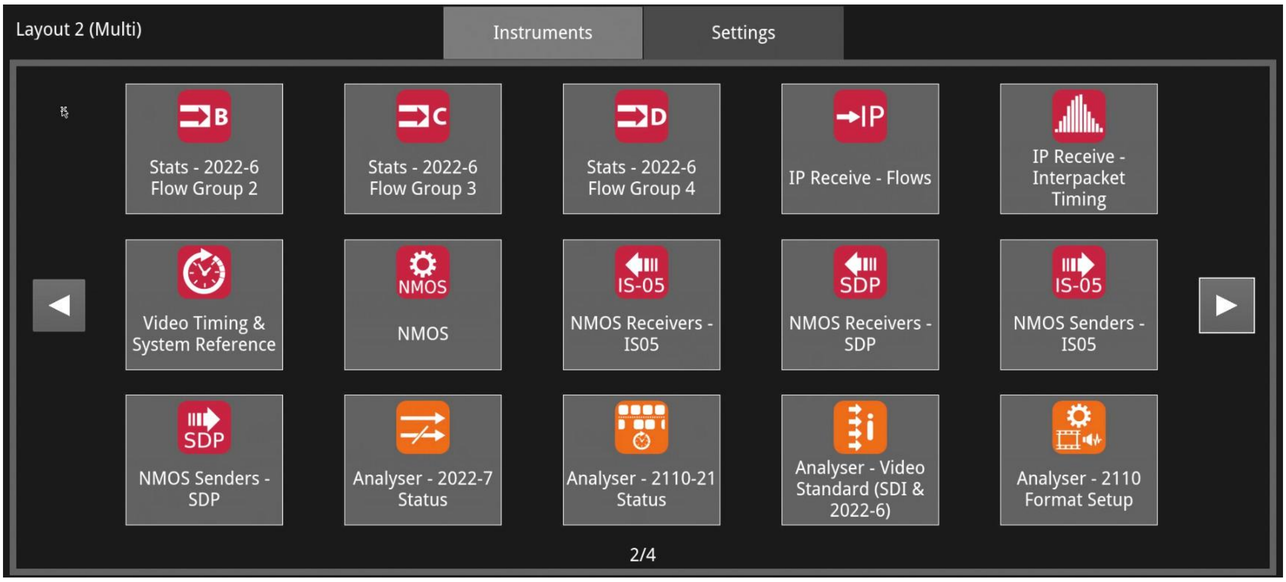


Figure 2-14: Standard Instruments Tab - Page 2 of 4

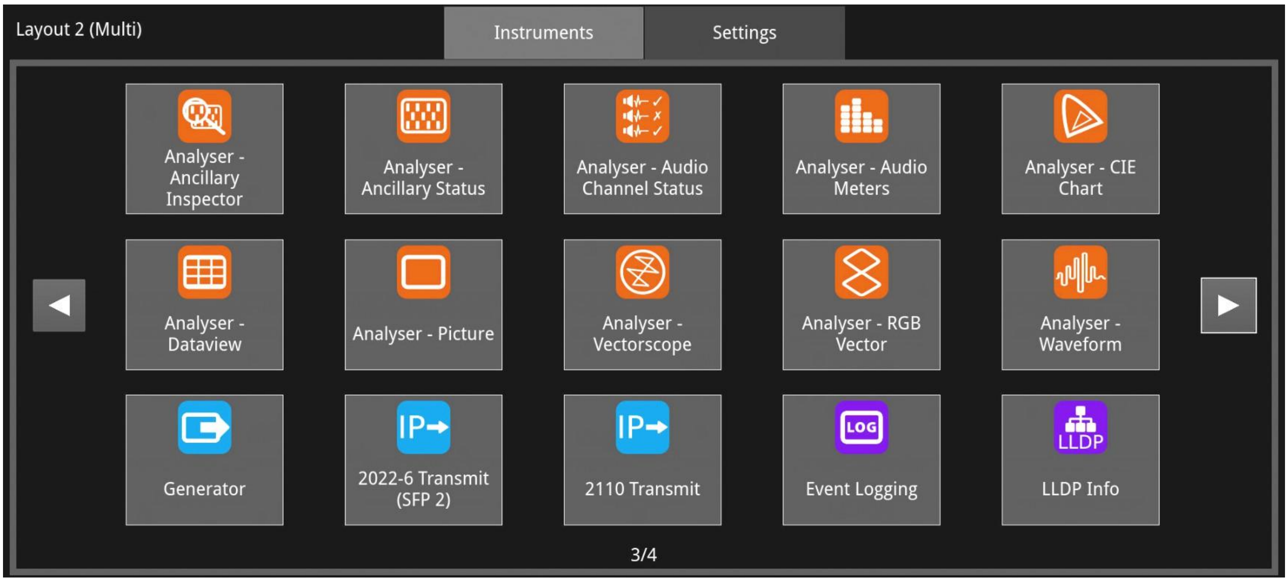


Figure 2-15: Instruments Tab - Page 3 of 4

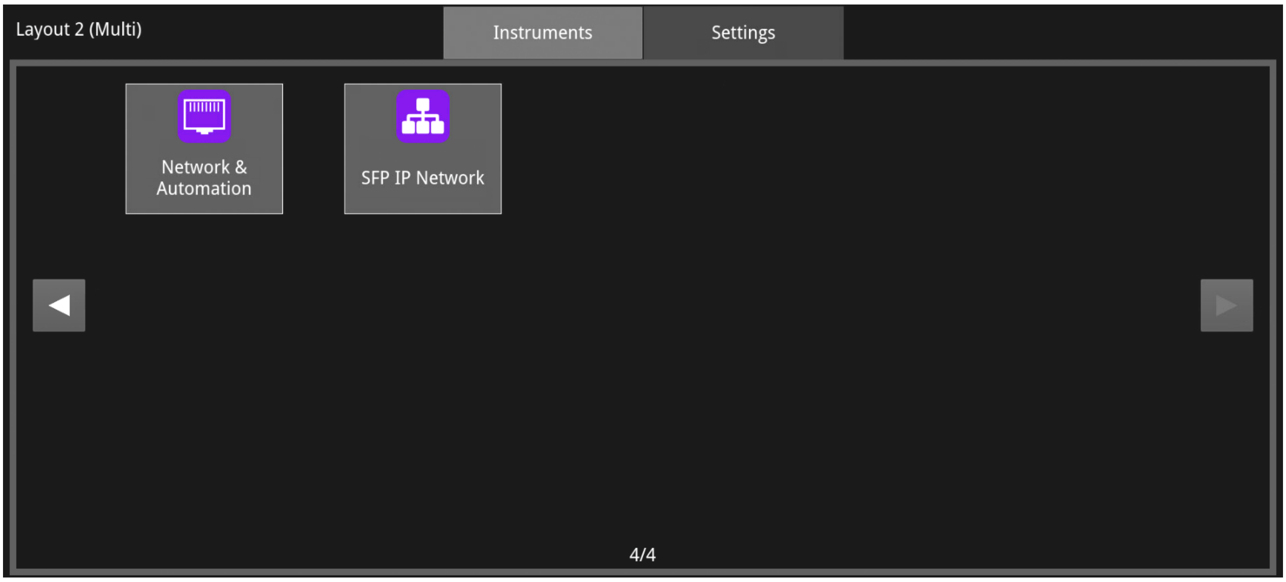


Figure 2-16: Instruments Tab - Page 4 of 4

Launching an Instrument from the Instruments Tab of the Setup Menus

The **Instruments** tab of the Setup menus is another point from which to launch a new instrument into the active layout. All instruments available under your current license are available for selection.

The instruments are arranged across several separate pages, which you can display by tapping the previous page (left) ◀ or next page (right) ▶ arrow icons in the left and right margins. When an instrument is already available in the active layout, you will see a small white spot displayed below the icon for that instrument.

Tap or click  to access the Setup menus and open the **Instruments** tab.

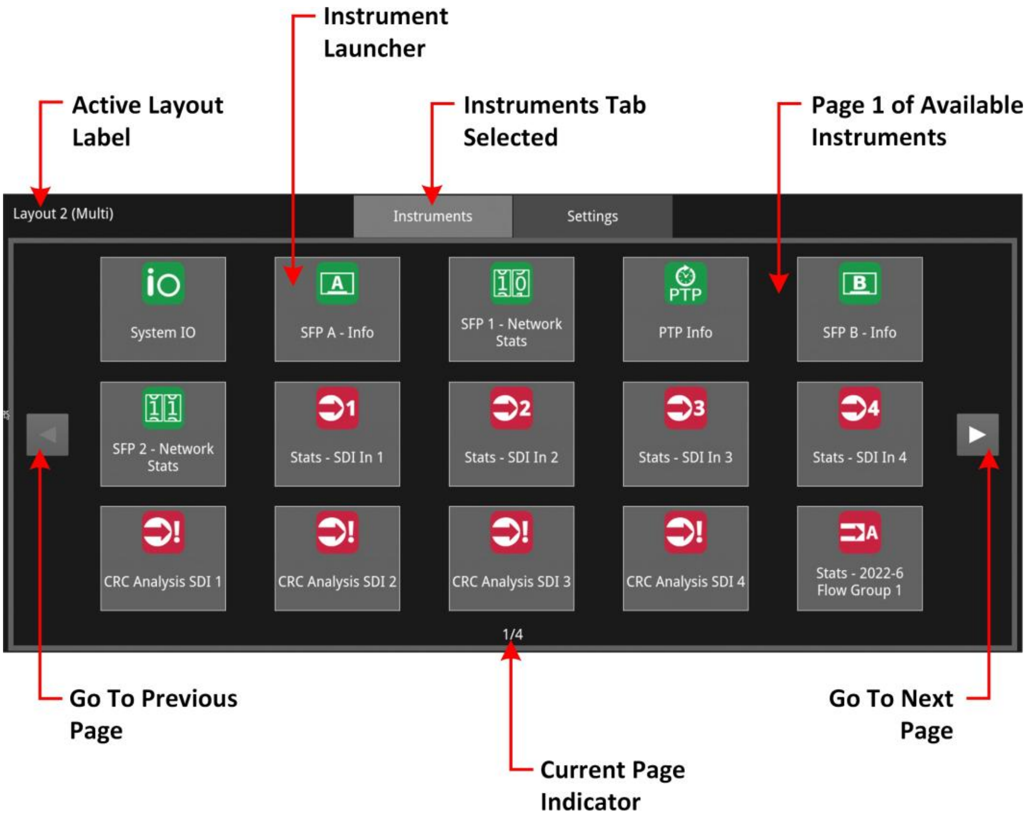


Figure 2-17: Page 1 of the Instruments Tab in the Setup Menus

You can check whether an instrument is active in any layouts by checking the **Instruments** tab in the Setup Menus. When a single instrument is open in the active layout, a white spot is displayed below the launcher icon for that instrument. If multiple instances of an instrument are open the number of activity spots represents the number of open instruments.

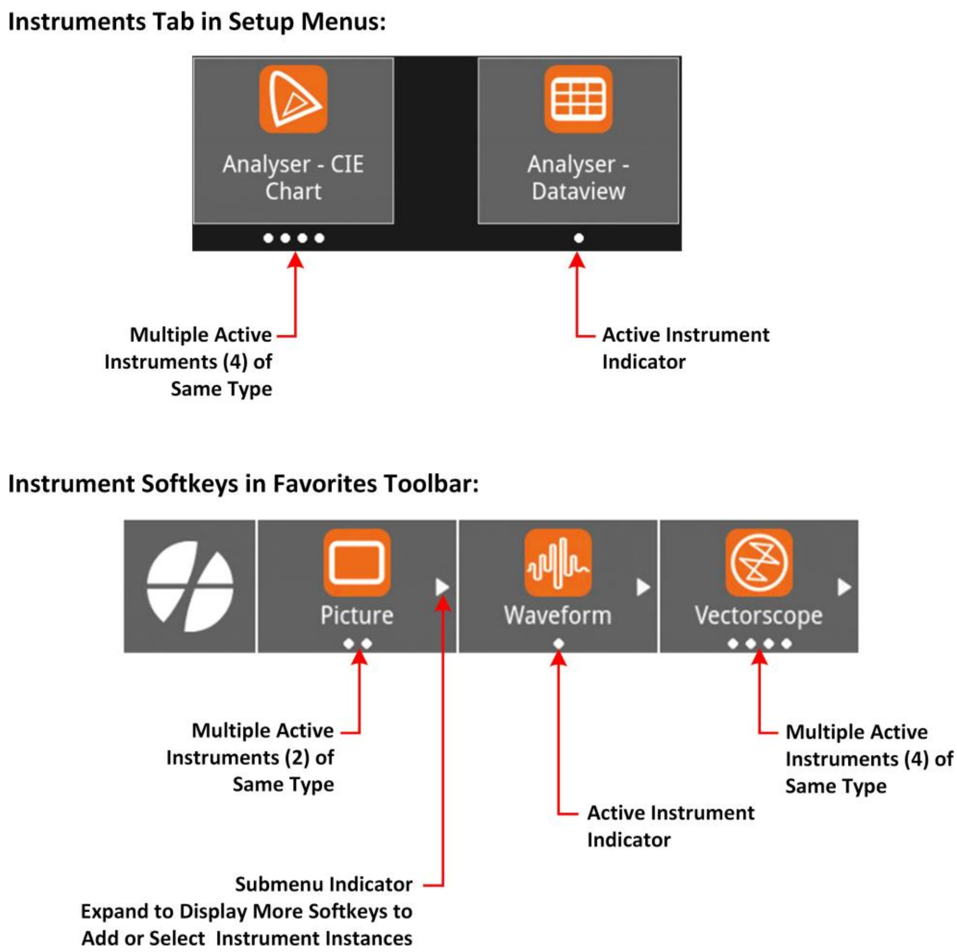


Figure 2-18: Active Instrument Indicators in the Instruments Tab and Favorites Toolbar

Required Action	Available Methods
To launch an instrument from the instruments tab.	Local Access: Remote Access:

When you launch an instrument instance from the Instruments tab, the instrument window opens on the active layout, with the spotlight on the instrument you have just added. If you return to the instruments tab, you will see a white spot displayed below the instrument's icon to show that it is active, see *Figure 2-18*.

Launching Multiple Instances of an Instrument

An active instrument instance has one white spot displayed below its icon in the toolbar or Instruments tab. When you launch multiple instances of an instrument the number of spots below the icon reflects the number of instances of that instrument type. Multiple analyzers (either dual or quad) enable you to launch multiple instances of some instruments.

When it is possible to launch more than one instrument instance, you will see the submenu indicator (shown above) displayed in the toolbar softkey. Tap the softkey to display a submenu enabling you to launch additional instruments or to spotlight any of the active instruments.

For example, depending on the number of available analyzers and the selected layout mode, you could launch the following:

- Standard Dual Analyzers:
    - Single Layouts: One instance of each instrument in each layout. All analysis instruments use the same input source.
    - Multi Layouts: Up to two analysis instruments for each analyzer. Each analysis instrument can select its own input source.
- Optional Quad Analyzers:.
    - Single Linked Layouts: One instance of each instrument in each layout. All analysis instru- ments use the same input source.
    - Single Unlinked Layouts: One instance of analysis instrument in each layout. All analysis instruments use the same input source.
    - Multi Unlinked Layouts: Up to four analysis instruments for each analyzer. Each analysis instrument can select its own input source.
    - Multi Linked Layouts: Four instances of analysis instruments in each layout. Each ana- lyzer group is allocated a different input source.

> **Note:** Eye and Jitter instruments always use the source input from **SDI In 1**, so you can only launch one instance of these instruments per layout. With a second screen installed, and an Eye or Jitter window open in the active layout on the main unit, you can launch an Eye or Jitter instrument on the second display but you will see the message: **Analyzer A Eye in Use**. To display data in the Eye or Jitter window on the second display, close the instrument on the main unit.

The first instance of an instrument opens straight into the active layout and the toolbar softkey shows a single spot. In addition, if you can launch another instance, you will also see the submenu indicator.

When you tap or click on the instrument's softkey in the toolbar to launch additional instances you will notice that the unit opens a further, nested set of softkeys.

To launch another instance of the instrument, tap or click the instrument in the instrument toolbar, then tap or click the softkey in the nested menu displaying the plus symbol (**+**), see *Figure 2-18*. When the maximum number of instruments is open in a layout, the plus symbol (**+**)

> **Note:** You can also launch multiple instruments from the Instruments tab, without using the nested softkeys in the toolbar.

is no longer displayed.

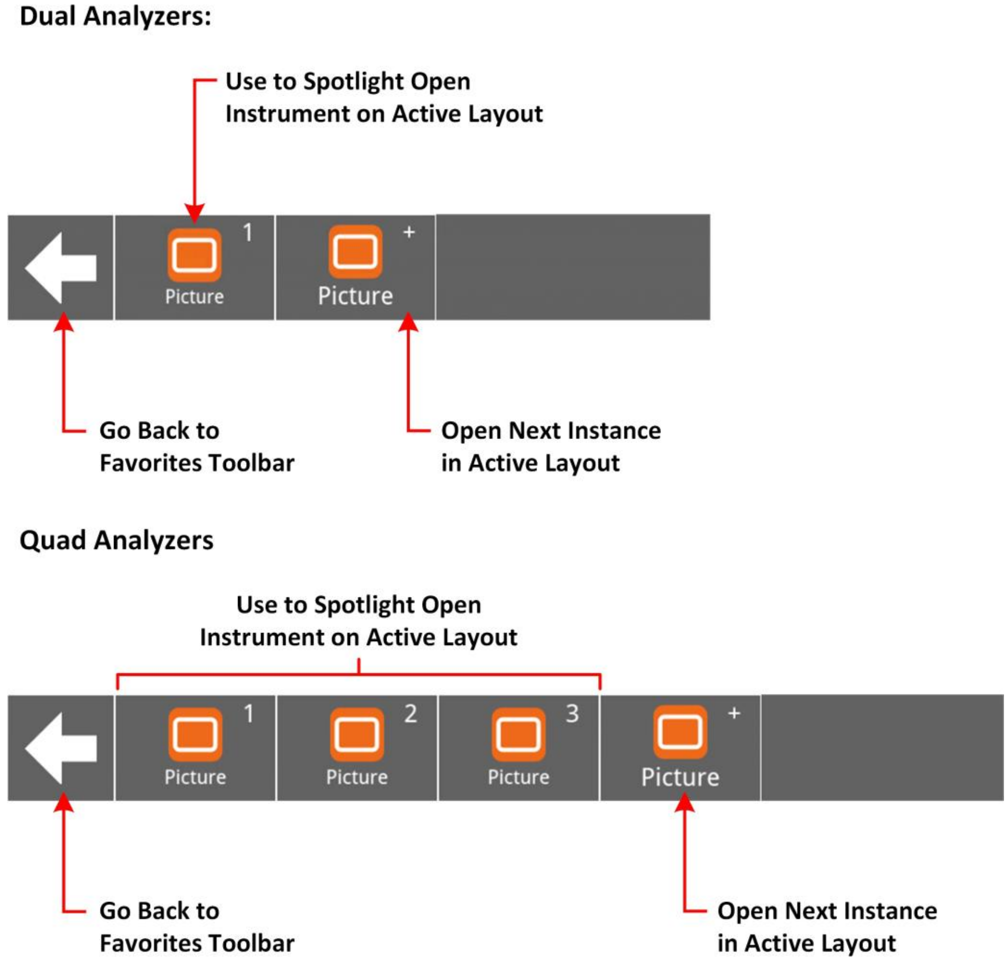


Figure 2-19: Favorites Toolbar - Nested Menu to Open Multiple Instances of an Instrument

You can tap the numbered softkeys in the nested menu to spotlight each instance of the instrument on the active layout. For an overview of the steps involved to open four instances of a Picture window, see the following figure.

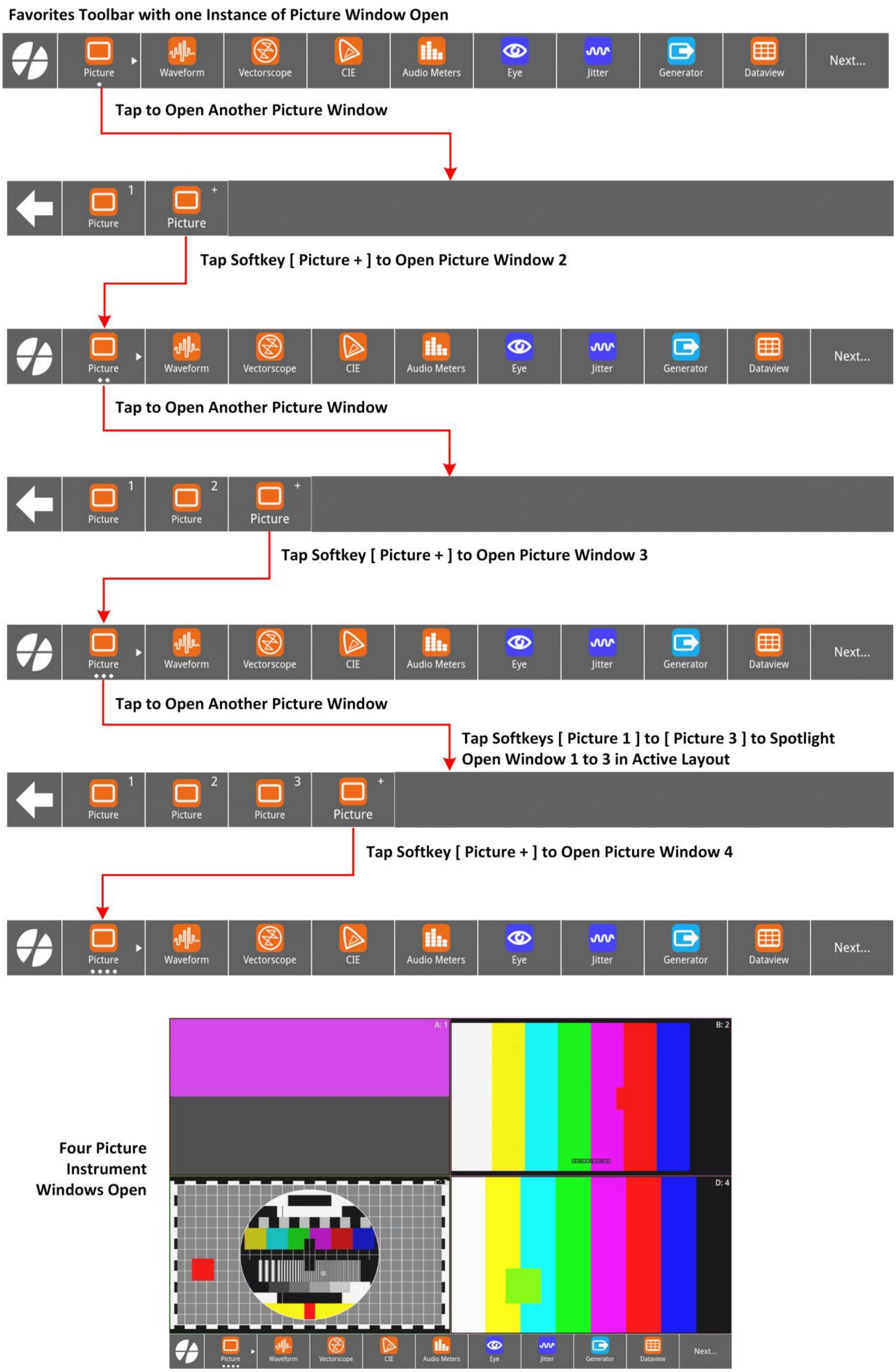


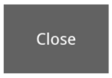
Figure 2-20: Process to Open Multiple Instances of an Instrument from the Toolbar

If you need to locate an active instrument on the active layout, especially if you have overlapping windows, open the favorites toolbar, then tap or click the softkey corresponding to

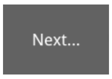
> **Note:** If you have opened multiple instances of an instrument, you can identify any instance of that instrument from the Favorites toolbar nested menu, see *Figure 2-18*.

that instrument.

Once you have opened an instrument on the active layout, you can use the instrument as displayed or change any configurable parameters in the instrument's options menu.

On finishing with an instrument, tap or click the instrument window, then tap or click the 

softkey. You can also open the instrument's options menu and either select **Close "*Instrument Name*"**, or tap the close instrument icon  in the menu toolbar.

If you need to close all instrument windows simultaneously, from the instrument favorites toolbar, tap or click 

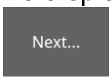
until the 

softkey is displayed, then tap this softkey.

About Presets

The unit displays any system configuration presets you save as softkeys in the presets toolbar, which you can access from the active layout. A **preset** contains a previously saved configuration of layouts, instruments and their settings.

To display the presets toolbar from the instruments toolbar of the active layout, tap or click



then choose the desired preset from the available list.

You can manage presets using the **Presets** dialog available from the Settings tab of the Setup menus. For more information on managing your presets, see the section *Managing System State Presets*.

About Layouts

The **layouts** feature gives you access to multiple screens of instrument windows enabling you to extend the screen real estate available on your unit, and access to the analyzers, providing the best possible viewing experience on the unit's display(s) or external monitor.

When adding a new layout, you can choose between **Single** or **Multi** display modes. In addition, for either display mode, with optional quad analyzers, you can enable the **Linked Layout** function which allows quick switching between Single and Multi display modes. The two display modes can be considered as follows:

- **Single Display Mode:** All analysis instruments use the same input source.
- **Multi Display Mode:** Each analysis instrument can select its own input source.

Multi linked layouts, available only on units with the quad analyzer option (**LPX500-QUAD**) are restricted to a subset of analysis instruments and provide predefined screen formats. For more information see *Working with Layouts*.

The layouts feature enables you to configure up to 16 separate screen layouts of instrument windows, in various configurations, to the left or right of the active layout, with up to 16 non-overlapping windows visible on a single layout. An optional second display (option: **LPX500-EM**), allows you to configure further layouts, independent of the main unit, doubling the possible number of screen layouts to 32.

On starting the system, you are initially presented with one screen layout - the **active layout** - to which you can add a further 15 layouts using the **Layouts** dialog in the Settings tab of the Setup menus.

You can open instrument windows on each available layout and navigate between layouts using any of the following methods:

- Use left-to-right or right-to-left swipe gestures to navigate to next layouts to the left or right, respectively.
- Tap the softkeys in the Layouts toolbar
- Use the Layouts dialog in the Settings tab to switch to a different layout.
- When working remotely, either over noVNC or on a remote display, use the mouse cursor to click the previous or next layout buttons in the center left or right of your screen.

Use left-to-right or right-to-left swipe gestures to navigate quickly between available layouts.

> **Note:** Always start the swipe gesture in the active screen border at the left or right side of the screen.

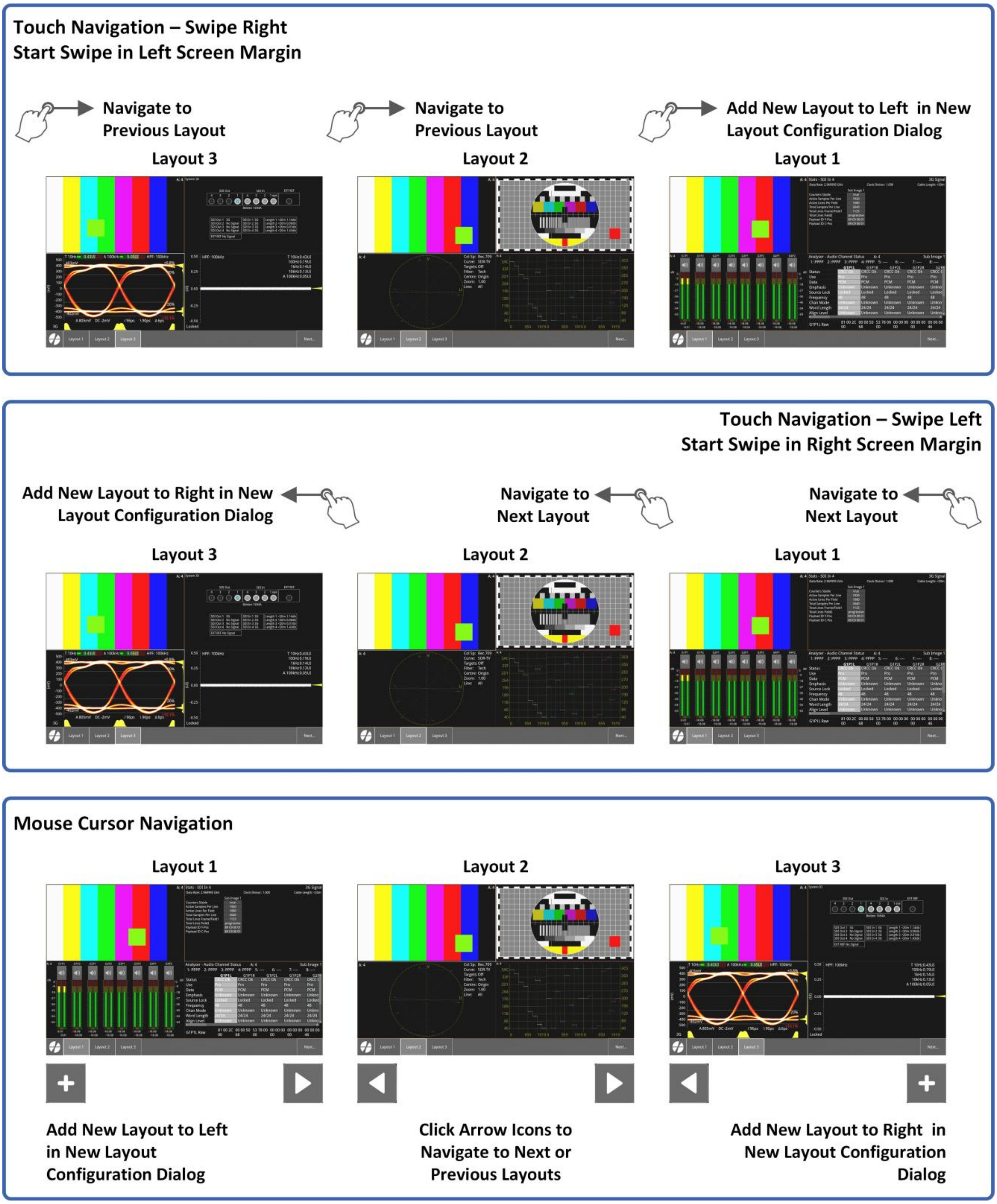


Figure 2-21: Navigating Between Basic Layouts Using Swipe Gestures or the Mouse Cursor

> **Note:** The arrow and plus icons shown above, are displayed for both touch and mouse navigation through your layouts.

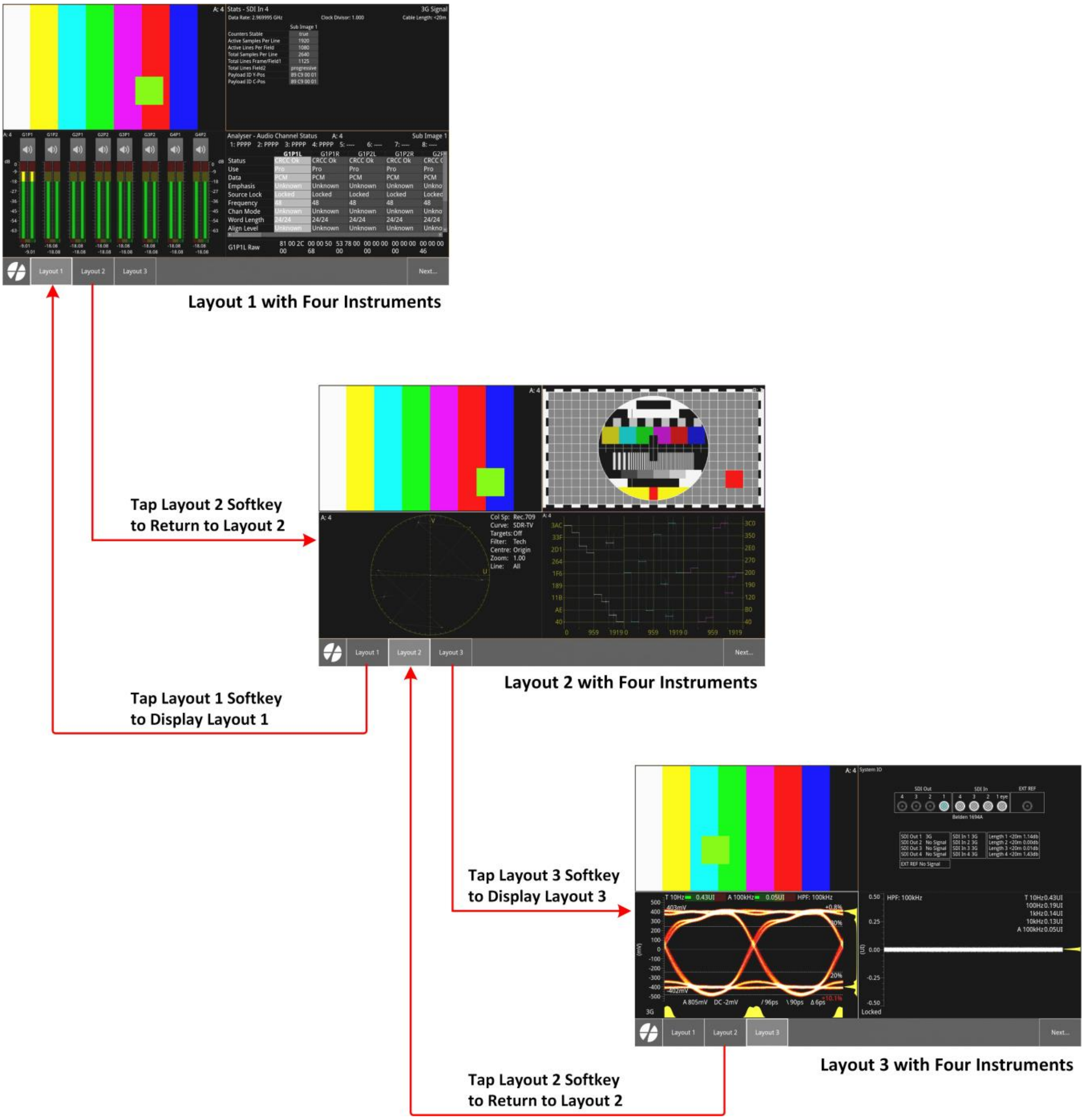
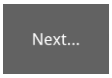
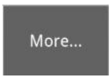


Figure 2-22: Navigating Between Basic Layouts Using Softkeys in the Layouts Toolbar

The unit displays the name of any layout you define in a softkey of the layouts toolbar. You can access any layout by tapping the corresponding softkey in the Layouts toolbar.

To display a different layout from the active layout, tap or click 

until the layouts toolbar is available then choose the softkey for the desired layout from the list.

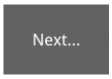
If you have saved more than nine layouts, you may need to tap 

to display additional layouts in the toolbar. You can manage your layouts in the **Layouts** dialog available from the Settings tab. For more information on managing layouts, see the section *Working with Layouts*.

> **Note:** When you save a preset of your current configuration, all defined layouts are saved to that preset.

Loading Presets

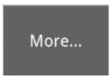
A **Preset** is a customized configuration consisting of layouts, instruments and their settings that you have previously saved. You can use a preset to launch multiple layouts with instruments already configured appropriately for the task you want to perform.

All saved presets are listed in the presets toolbar. From the active layout tap 

to display the presets toolbar.

To launch a suite of layouts and instruments saved to a preset, tap the corresponding preset softkey.

Figure 2-23: Using the Presets Toolbar

If you have saved more than nine presets, the 

softkey is displayed, enabling you to view or select additional presets.

Launching a Preset from the Presets Dialog

In addition to the presets toolbar, you can also launch any presets from the **Presets** dialog available from the Settings tab. Click  to display the Setup menus, open the **Settings** tab and select **Presets** to open the presets dialog. Select the preset you want to use, then click **Load Preset**.

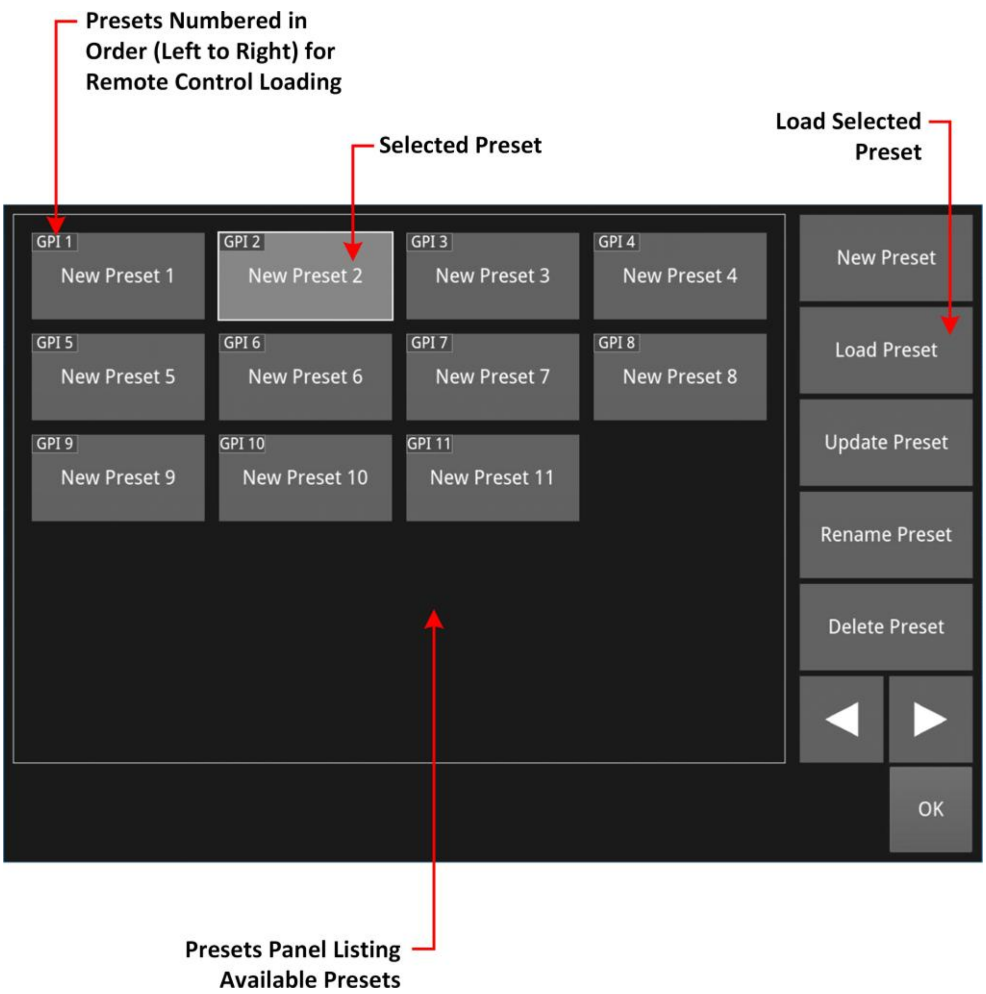


Figure 2-24: Loading a Preset from the Presets Dialog Panel

You can use the presets dialog to manage your saved presets, for example you can add, load, update, rename, delete or re-order presets. For further information on managing your presets, see the section *Managing System State Presets*.

System Time and Date Display

The system date and time are displayed in the top-right corner of the Setup menus.

To modify the system time and/or date, in the Setup menus tap or click the time and date display, see *Figure 2-25*.

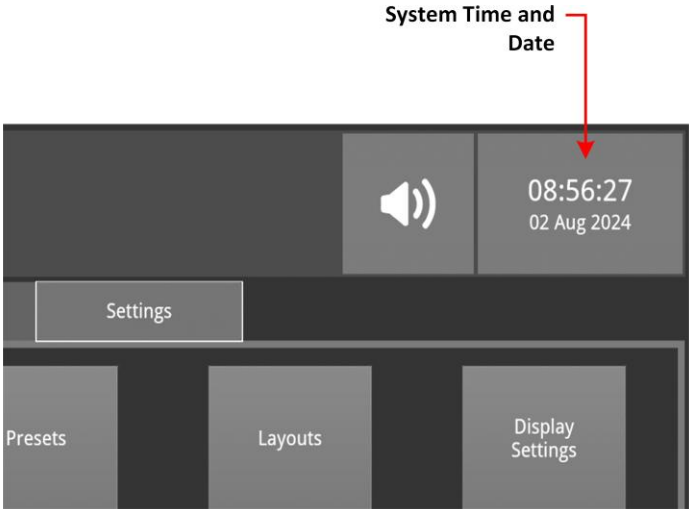


Figure 2-25: Accessing the Time and Date Dialog from the Setup Menus

This opens the Time and Date dialog. For more information on setting the system time and/or date, see the section *Setting the Time, Date and NTP Server*.

Using the Volume Control Dialog

Open the Volume Control dialog using the button at the top-right of the Setup menus, see *Figure 2-26*. You can use this dialog to control the volume of the audio monitoring output.

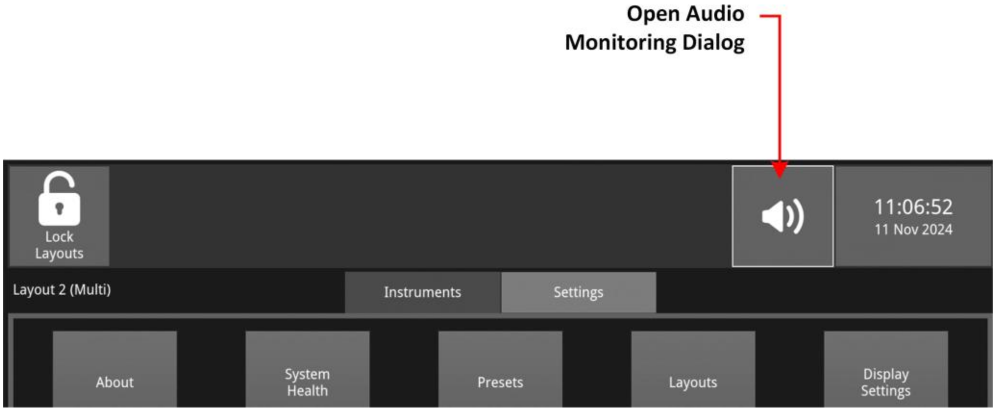


Figure 2-26: Accessing the Audio Monitoring Dialog in the Setup Menus

The Analyzer - Audio Meters instrument provides the audio monitoring source, which can be output to any of the following:

- Connected headphones
- Monitor connected to the DisplayPort
- Monitor connected to SDI MON.

Headphones are enabled when connected to the headphones socket on the front panel of the unit.

You can mute or adjust the output volume to connected headphones, the DisplayPort or SDI MON connector using the mute control or slider control respectively.

Tap or click  to display the Setup menus then tap or click the speaker icon to open the Volume Control dialog.

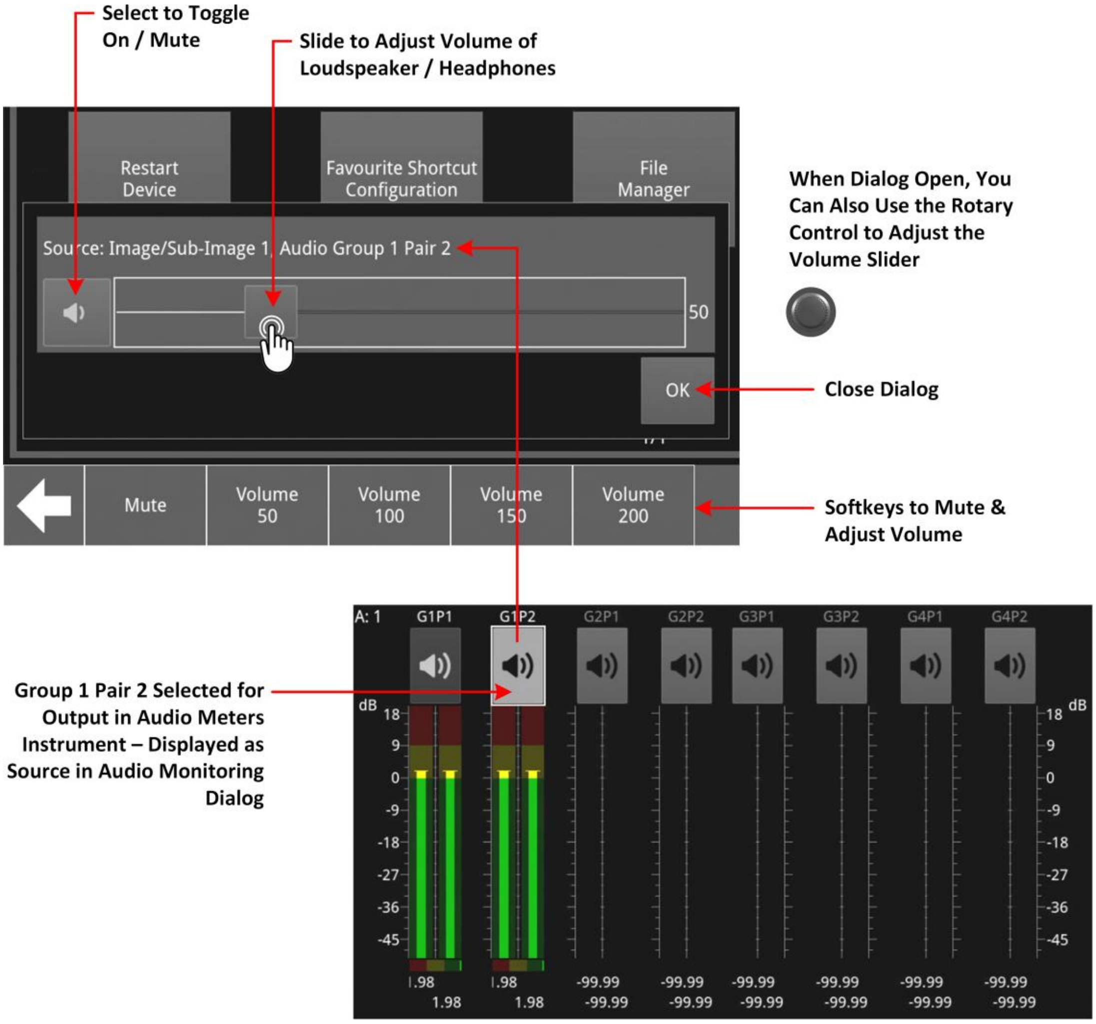
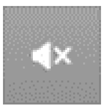


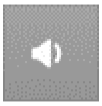
Figure 2-27: Using the Audio Monitoring Dialog

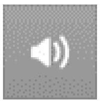
To adjust the volume of the audio monitoring output, drag the slider left to decrease or right to increase the volume, or turn the rotary control left or right. In addition, the softkeys enable you to adjust the volume in precise steps.

The audio monitoring dialog controls the audio monitoring output of the unit, whether monitoring using headphones, the DisplayPort, or SDI instrument monitor output (SDI MON). Tap or click the audio icon to mute or unmute the audio monitoring output. The audio monitoring icon changes to display the current status of the audio output as shown in the following table:

Table 2-3 : Audio Output Monitoring Icon States

Audio Icon State	Description
	Audio source muted (inactive).

	Standard state, audio source active (unmuted). Volume range: 1 to 99

Audio Icon State	Description
	High volume, audio source active (unmuted). Volume range: 100 to 200

Use the **Analyzer - Audio Meters** instrument to select the audio monitoring source, for more information, see the section *Analyzer - Audio Meters*.

> **Note:** The audio output from the DisplayPort, SDI Mon and Headphone jack is stereo, by default. If mono audio is selected (using the solo control in the audio meters) then you will hear the audio on left and right of the audio monitoring device.

Using the Instrument Favorites Toolbar

The nine softkeys in the **Instrument Favorites** toolbar provide quick access to a default set of instruments. Each softkey in the favorites toolbar represents an instrument, which you can start with a single tap or click of a softkey. When working remotely, use the mouse cursor to click the softkey representing the instrument you want to start.

You can customize the instruments available using the Favorite Shortcut Configuration dialog in the Settings tab of the Setup Menu, for more information see the section *Customizing the Favorites Toolbar*.

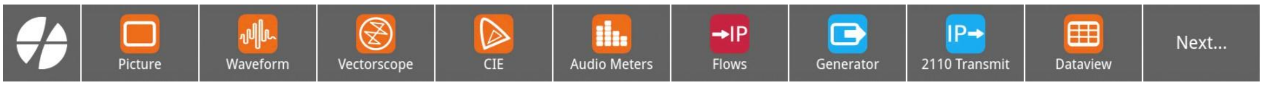
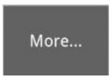
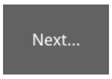


Figure 2-28: Instrument Favorites Toolbar (with Generator Option)

Once you add more than nine instruments to the favorites toolbar, the ninth instrument softkey is replaced by a 

softkey, showing that there are more instrument softkeys available for selection. When you open an instrument from the Instruments tab of the setup menus, that instrument is also added to the favorites toolbar as a softkey.

The 

softkey at the right-hand end of the instrument favorites toolbar enables you to cycle through additional toolbars, which provide softkeys to select presets, layouts and other functions.

> **Note:** The behavior of the softkeys changes depending on the type of layout and whether your layout is locked or unlocked as shown in the following figures.

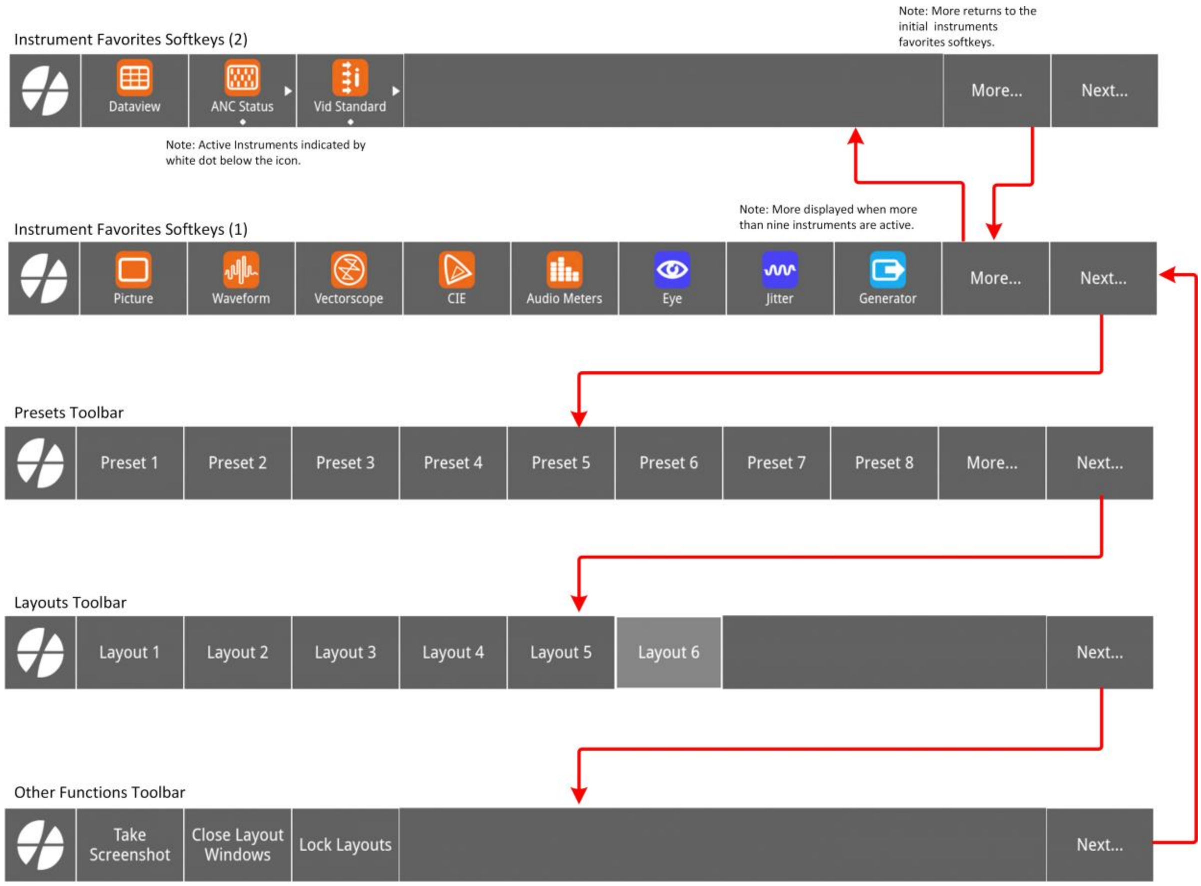


Figure 2-29: Navigating the Toolbars for Multi Unlinked Layouts (Unlocked)

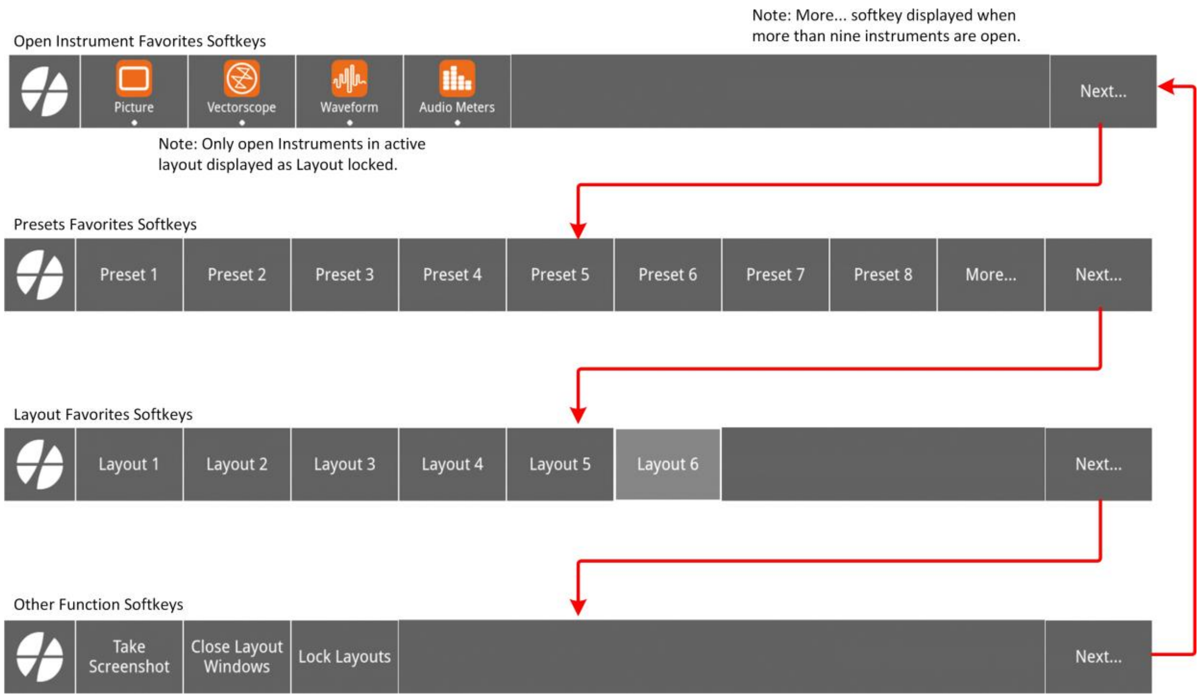


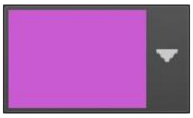
Figure 2-30: Navigating the Toolbars for Multi Unlinked Layouts (Locked)

Overview of the Instrument Windows

Each Instrument window border and its corresponding icon is assigned a color and the icon and Instrument border are displayed in the assigned color to indicate that it is part of one of the following *groups* of Instruments:

- **System:** Instruments or utilities required to operate the unit or to display system information, for example, Network & Automation, and Event Logging. Border color: gray (this is fixed and can- not be changed).
- **Analyzers:** Instruments used to analyze characteristics of the video signal and its associated components. Default border colors for the two (or optionally four) analyzers:

Table 2-4 : Default Analyzer Border Colors

Default Analyzer Border Color	Description
	Analyzer instruments assigned to **Analyzer A** display instrument borders in **Orange**
	Analyzer instruments assigned to **Analyzer B** display instrument borders in **Purple**
	Analyzer instruments assigned to **Analyzer C** display instrument borders in **Green** (With optional **LPX500-QUAD** license.)
	Analyzer instruments assigned to **Analyzer D** display instrument borders in **Deep Pink** (With optional **LPX500-QUAD** license.)

- **Generators:** Optional instruments used to generate a video or audio signal. Default border color: **cyan**.

The color-coding provides easy identification of analysis Instruments and the actual Analyzer they are using. You can enable or disable the Instrument borders, or modify the assigned color in the **Display Settings** dialog available in the **Settings** tab. For more information on setting-up the display, see the section *Setting-up the Display*.

In addition, when the spotlight is on an instrument, it will be the only window displaying a thick, white border.

Figure 2-31: Multi Layout with 16 Active Instruments

Figure 2-32: Single Linked Layout with Four Instruments All Using the Same Analyzer (A: 1)

Figure 2-33: Multi Linked Layout with Four Instruments Using All Four Analyzers (Optional)

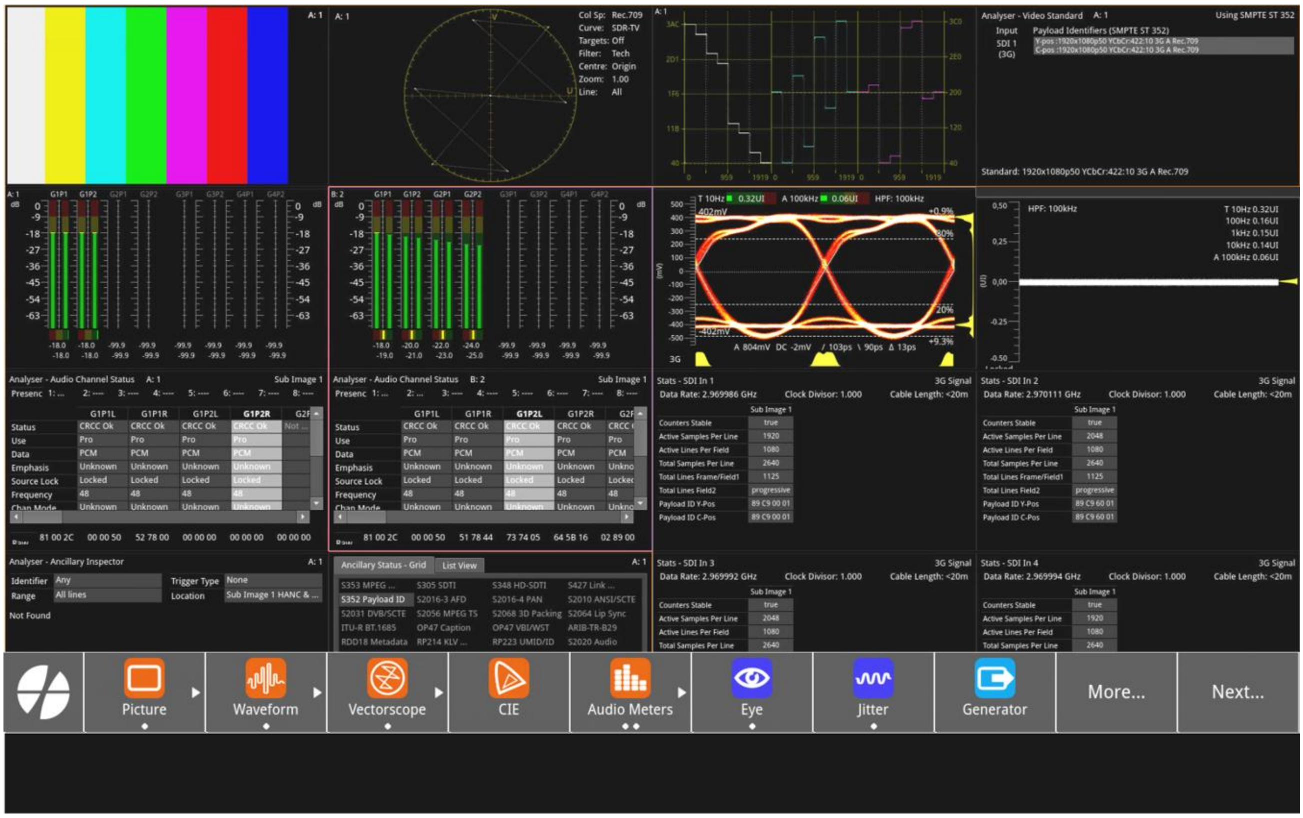


Figure 2-34: Multi Layout with 16 Instruments on Remote Display with Toolbar Popup Enabled in Display

Changing the Border Color of Instrument Windows

If desired, you can change the border color of analyzer instruments as described in the Section: *Setting-up the Display*.

> **Note:** The borders and icons of system instruments are always colored light gray.

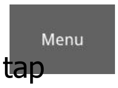
Instrument borders automatically merge by group color. For example, in a default Multi unlinked layout, if you position one analysis instrument next to another, then the border will expand to outline all instruments in contact with each other in the common analysis group, to help group recognition.

In addition, signal connectors displayed in instrument windows (for example, in the **System IO** instrument) are displayed in the color defined for the Generator to indicate outputs.

Working with the Instruments

Each instrument includes a popup submenu, which gives you access to the configuration parameters of that instrument. In this *User Manual* this is referred to as the instrument's **Options Menu**.

The unit displays two different menu formats, depending on how you select the menu; you can either:

- Tap and hold anywhere inside the instrument's border to open the touch-enabled menu.
- Right-click the mouse cursor anywhere inside the instrument's border to open the mouse- enabled, compact menu.
- Tap the instrument to spotlight it, then tap  in the Instrument toolbar to open the touch- enabled menu.

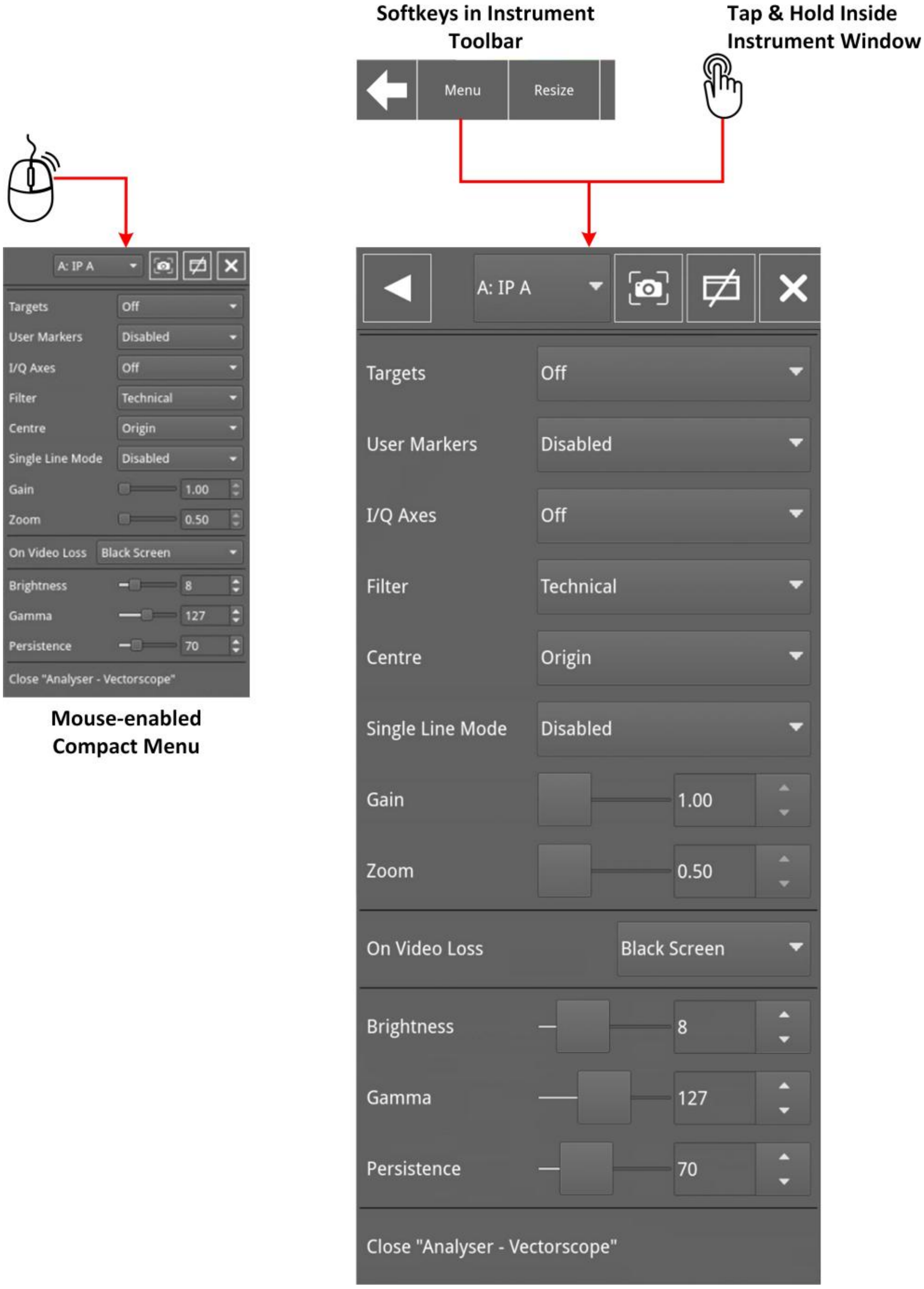


Figure 2-35: Side-by-side Comparison of Mouse- and Touch-enabled Menus

The touch menu opens on the opposite side of the screen from the instrument, by default, but you can tap or click the arrow icon at the top of the menu, or use the Flip Menu softkey in the toolbar, to flip the menu to the other side of the screen if required.

Figure 2-36: Instrument Options Menu Showing Control Icons in Menu Toolbar

Required Action	Available Methods
Open the context-sensitive Options Menu for an active Instrument	Local Access: Menu Remote Access:

In addition to listing the Instrument-specific parameters, all options menus include a toolbar at the top of the menu containing controls for the following operational commands:

- **Take Screenshot:** Saves an image of the current active display to the unit's SSD storage. You can access screenshots using the File Manager or by connecting to the unit using a web browser.
- **Dismiss Menu:** Closes the options menu, saving any changes.
- **Close "*Instrument*":** Closes the instrumentinstance, removing it from the active layout. Any instances of the instrument in the same or other layouts remain open.
- A: IP A or A: SDI A **Switch Analyzer Input**: Opens a dropdown list of available Ana- lyzers, for IP or optionally SDI source inputs, that you can use to switch the input source to the analyzer instrument for Single or Multi unlinked layouts. For more information, see [Working with Layouts](#).
- **Flip Menu:** Flip the menu to the opposite side of the screen.

The following figure shows an example of the options menu for an **Analyzer - Audio Meters** Instrument:

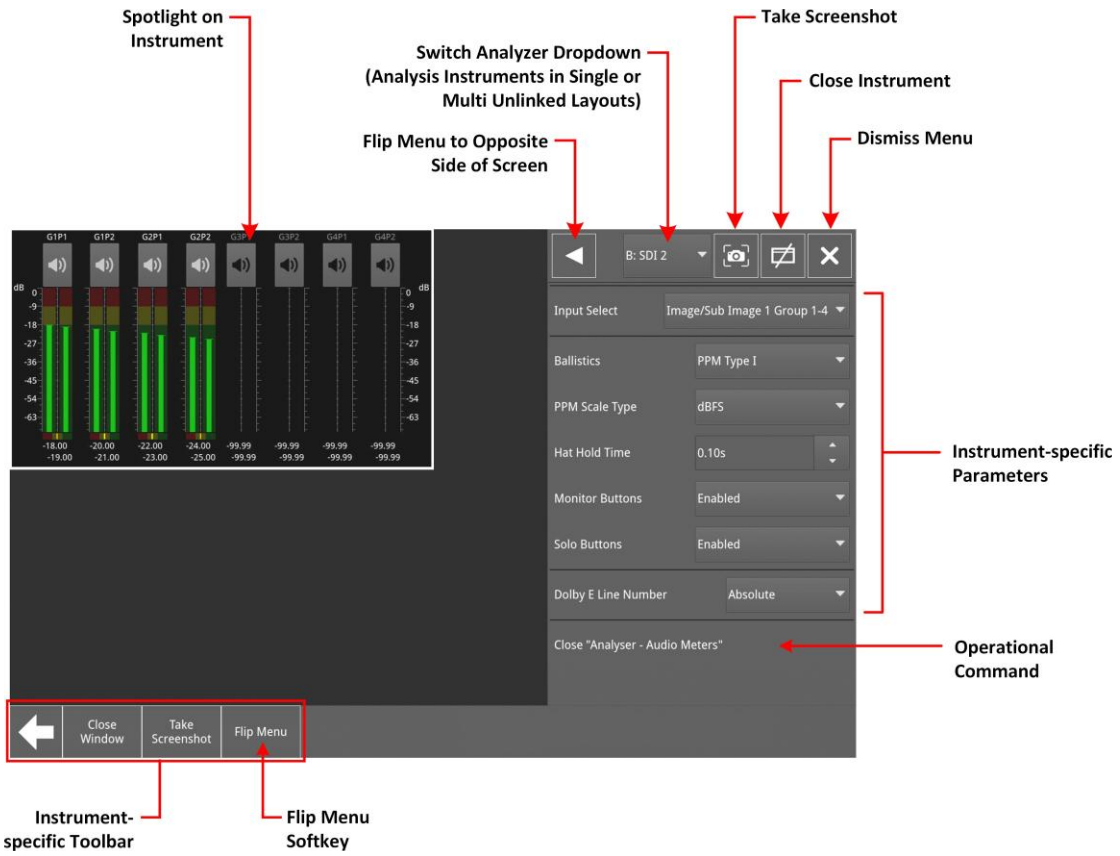


Figure 2-37: Instrument Popup Options Menu Displayed

When an Options Menu includes one or more system controls, tap or click the control (for example, **Reset errors and running time** in the CRC Analysis instrument) to initiate that action; there are no parameters to set for a system control.

> **Note:** When the spotlight is on an instrument, the softkeys change to display an **Instrument- specific Toolbar**. This includes the default softkeys **Menu**, **Resize**, **Close** and **Clear Spotlight**, together with any optional softkeys required for the operation of the instrument. With the menu open, the softkeys change to display **Close Window**, **Take Screenshot** and **Flip Menu**.

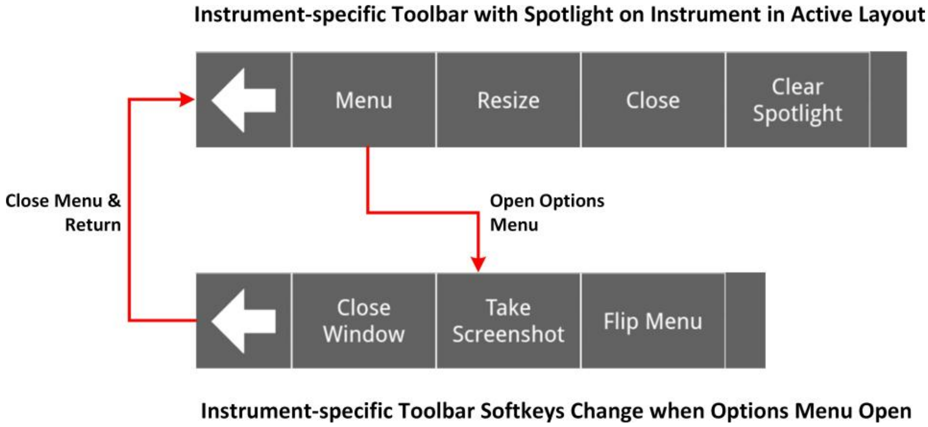


Figure 2-38: Softkeys in the Instrument-specific Toolbar

Some dialog windows (About, False Color Ranges (optional), SDI Driver Calibration, etc.) do not have Options menus. To dismiss these windows, simply tap or click anywhere outside the window.

Selecting Option Menu Parameters and Entering Values

You can select most parameter settings in the instrument Options menus by selecting the desired setting from a dropdown listbox. For example, you might enable or disable the function of a parameter by selecting **Enable** or **Disable** from a dropdown list.

Other parameters require you to enter a numeric value, for example, the Gamma setting in the **Analyzer - Vectorscope** Instrument, or the magnification factor in the **Analyzer - Waveform** instrument.

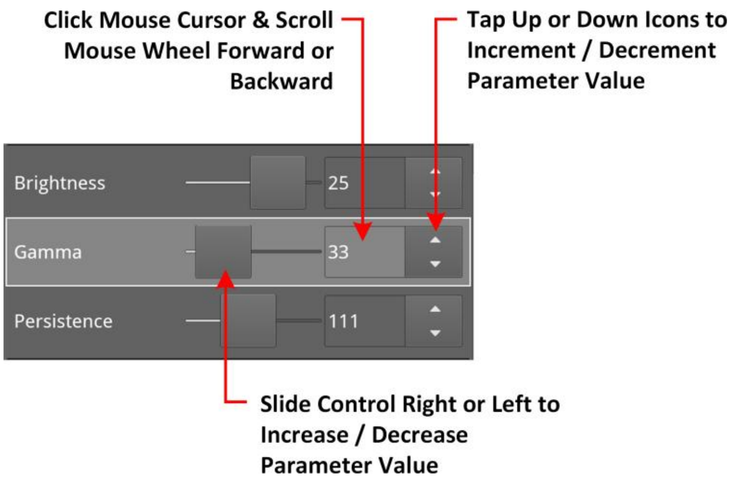


Figure 2-39: Adjusting Numeric Values in the Analyzer - Vectorscope Instrument

You can adjust a numeric value using one of the following methods:

- Tap and hold or click the slider button and drag left or right to decrease or increase the value, respectively.
- Select the parameter using the rotary control, then turn the control clockwise or counter-clock- wise to increase or decrease the value, respectively.
- Click the cursor in the numeric field and scroll the mouse wheel backward or forward to decrease or increase the value, respectively.

Another method to enter numeric data is available when you choose to define a static IP address manually for the unit using the **Network & Automation** Instrument. If you select the IP addressing mode **Static** from the dropdown list in the IP Parameters dialog, the unit displays a numeric keypad, as shown in *Figure 2-40*.

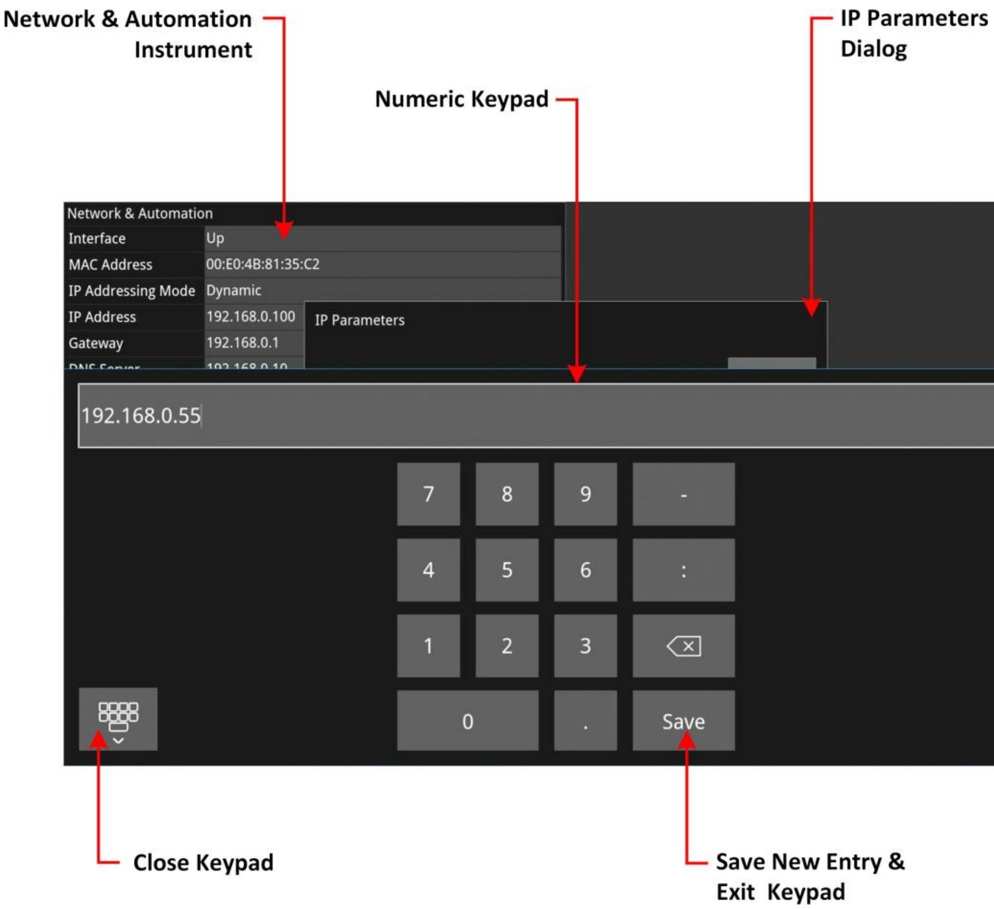


Figure 2-40: Manual Entry of a Static IP Address in the Network & Automation Instrument

To enter an IP address, simply click or tap the numbers on the keypad, then click **Save** to save the address and close the keypad.

Resizing an Instrument Window in an Unlinked Layout

The resize behavior of an instrument changes depending on whether the active layout is locked/unlocked or linked/unlinked.

> **Note:** It is not possible to resize an instrument window in a linked layout.

When **unlocked**, you can double-tap or double-click in any instrument window, or tap the 

softkey in the instrument-specific toolbar, to cycle through a set of standard instrument window sizes.

The size of a window can be either:

- Full screen - only one instrument displayed on the active layout
- 1/4 screen size - up to four instruments displayed at this size on the active layout
- 1/16 screen size - up to 16 instruments displayed at this size on the active layout.

Figure 2-41 shows the different sizes of an instrument in an unlocked layout:

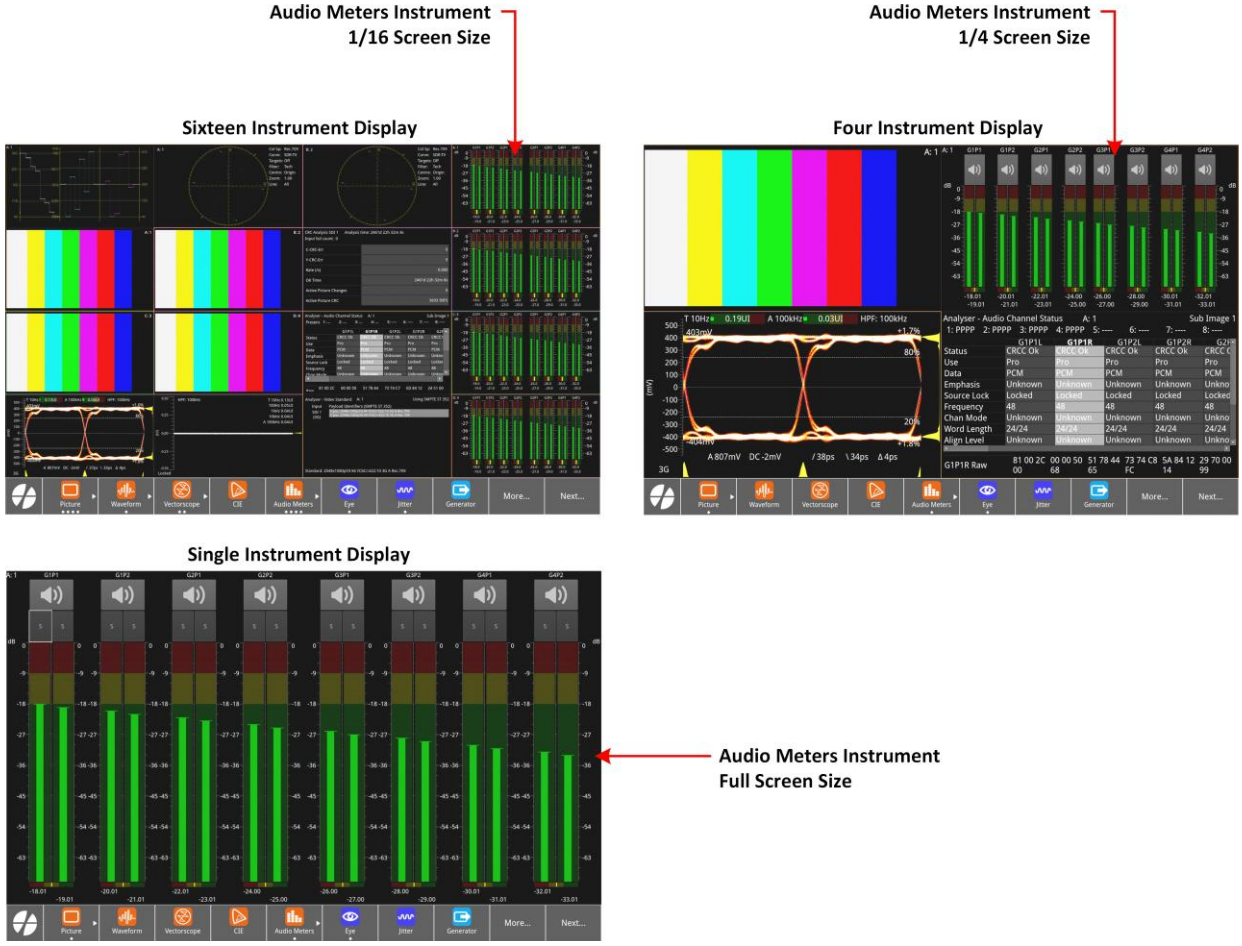


Figure 2-41: Instrument Window Sizing (Unlocked Multi Layout)

When you **lock** a layout, you can zoom an instrument window to full-screen size from its existing size (whether 1/4 or 1/16 screen size) by double-tapping, then revert to its original size with a further double-tap. When at full-size you can page through other instrument windows (also at full-screen size) using the rotary control.

You can also swipe between full-size instrument windows in the active layout. If working remotely on a locked layout with full-size windows, click the left and right arrow keys to display the next or

previous layouts: or

You can add a new layout to left or right extents of the series when the layout is unlocked.

You can also add empty new layouts as placeholders in the Layouts dialog, then add instruments to each as required.

Figure 2-42: Resizing Standard Instruments

Using the Instrument Scroll Bars and Scroll Control Menu

For those Instruments displaying a large amount of data (for example, the Generator - System Patterns tab) vertical and horizontal scroll bars are provided to help navigate the display. A scroll control menu, accessed by a tap and hold or right-clicking the scroll bar, provides further scrolling or paging options.

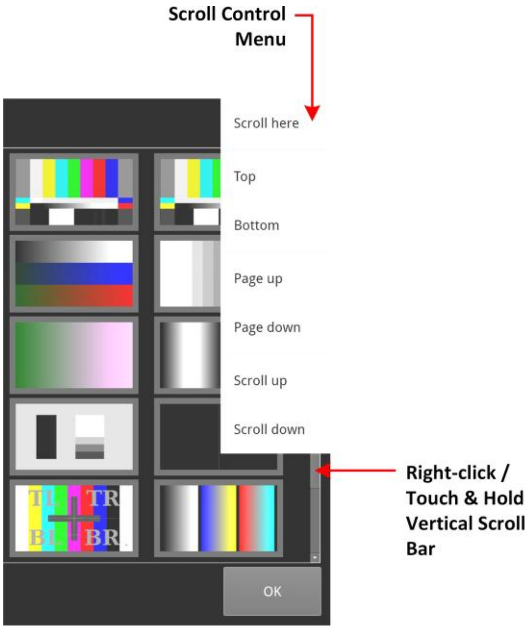
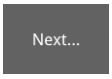
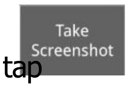


Figure 2-43: Instrument Scroll Bar Control Menu

Taking Screenshots

Use one of the following methods to capture an image of the entire display(s):

- Tap 

 three times in the Favorites Toolbar of the active layout, then tap 

.
- Tap and hold or right-click inside the window of an active instrument to display the Options Menu, then select  from the menu toolbar.
- Connect a USB keyboard to the unit and press **[Shift] + [PrtScn]** to capture the display.

If working remotely using noVNC or the DisplayPort output, you can use either of the first two methods above to take a screenshot.

The image is saved to the SSD as a portable network graphic (**.PNG**) format file. You can retrieve your saved screenshots from the SSD using the USB File Manager or a remote connection method (web browser or SFTP), as required.

For more information on retrieving the file from the unit, see the sections *Managing Files with the USB File Manager* or *Remote Connection to the Unit*.

> **Note:** If your system includes an optional second screen, when you take a screenshot the unit saves two files to the **screenshots** folder and appends **S1** to the screenshot filename from the main unit and **S2** to the screenshot filename from the second screen to differentiate the file. For more information, see *Taking Screenshots on the Second Display*.

Working with Instrument Tabs

Some instruments feature tabs along the top of the window which provide easy access to different functional areas within a single Instrument. The instrument option menus are reserved for auxiliary settings relating to each available tab.

The following figure shows the **Ancillary Status** instrument, which includes tabs to switch between different ANC status views.

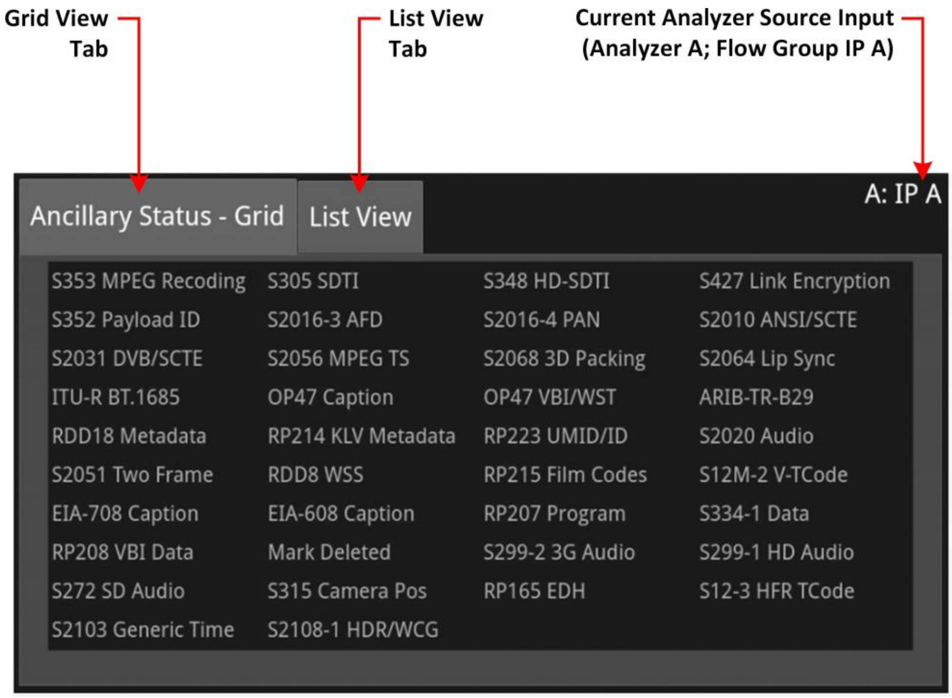


Figure 2-44: Example of Tabs in the Analyzer - Ancillary Status Instrument

Using Instrument Configuration Dialogs

The following instruments provide access to additional configuration dialogs from the options menu, which enable you to select associated parameters quickly and efficiently:

- Network & Automation
- NMOS Configuration
- IP Receive - Flows
- Analyzer - 2110 Format Setup
- Generator (Video and Audio Configuration; Test Pattern selection) (Optional)
- IP Transmit (Optional)
- Analyzer - Video Standard (SDI & 2022-6) (Optional)

The manual **Video Override Parameters** dialog for the **Analyzer - 2110 Format Setup** instrument is shown in *Figure 2-45*.

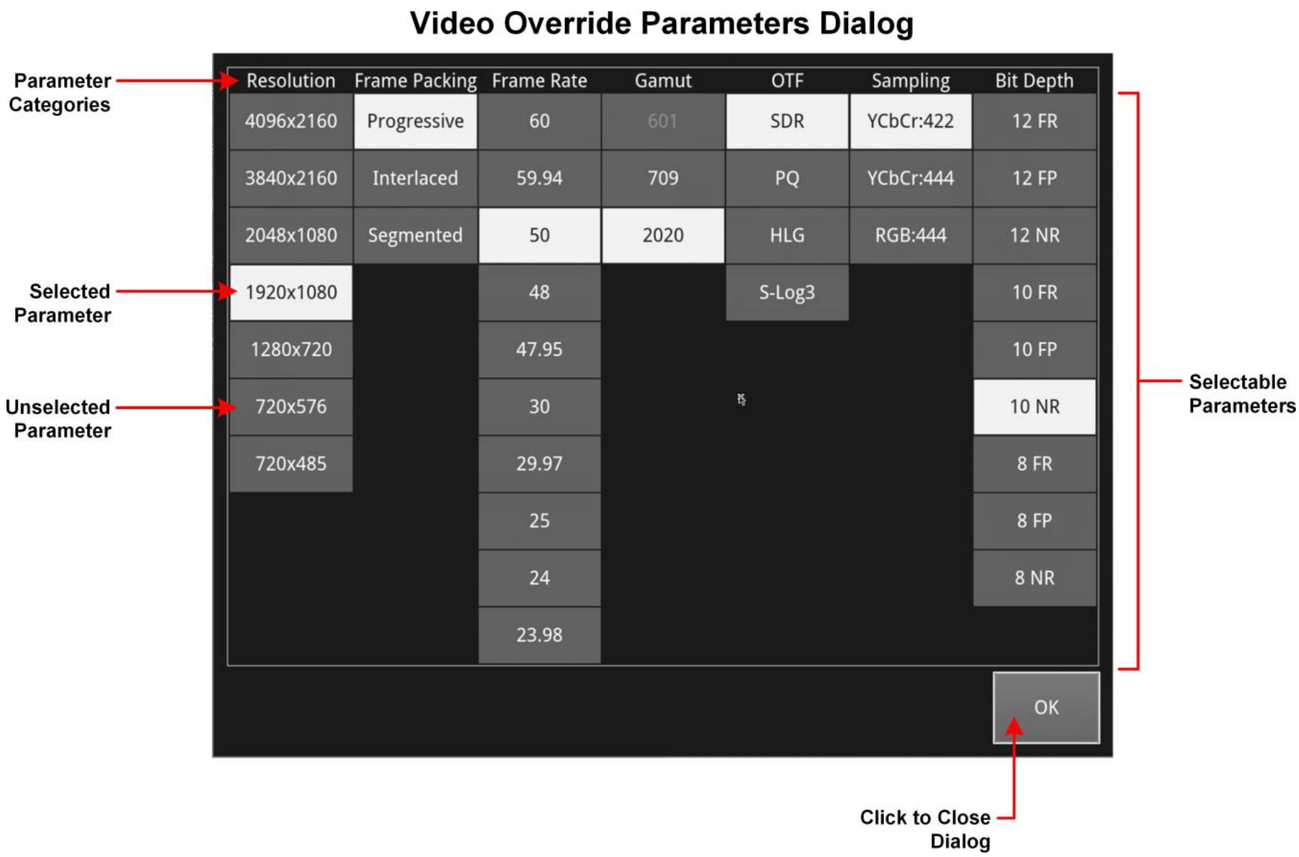


Figure 2-45: Manual Video Override Dialog for ST 2110 IP Video Parameters

When you open a configuration dialog from an instrument's options menu, select the required parameters from the available controls, then click **OK** to close the dialog. Any invalid parameters are grayed-out and unavailable for selection.

Using the Color Picker

Some instruments enable you to select a color from a Color Picker as a configurable display attribute. For example, you can specify the color of the different Analyzer instrument borders in the Display Settings, or choose colors in a custom false color overlay in the Picture instrument, among others.

Select a color as follows:

1. Select the dropdown color selector to open the color picker tool (also referred to as the Hue, Saturation, Value (HSV) tool) shown below.

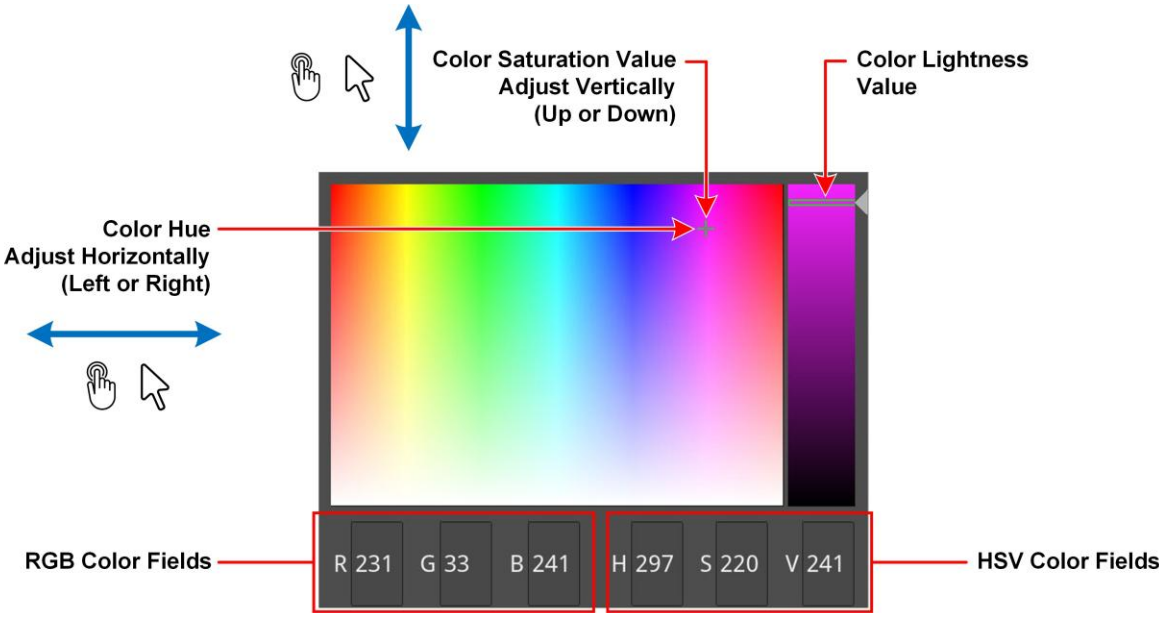


Figure 2-46: Selecting Colors in the Color Picker

2. Enter the RGB or HSV values, if known, into the appropriate color fields along the bottom of the window. Alternatively, pick a color manually as follows:
    a. Click at a point in the left-hand color panel of the color picker to select the hue (hori- zontal) and saturation (vertical) settings of the new color choice.
    b. Click at a point in the right-hand vertical bar to select the color lightness value.
3. Tap or click anywhere outside the dialog to close the color picker.

Working with Layouts

> **Note:** When you save a preset, it includes all configured layouts, including layouts configured on the optional second display, if available.

Overview

The Layouts feature gives you access to multiple screens in which to display instrument windows. By careful planning of your layouts, you can extend the screen area available on your unit, to give the best possible viewing and touch experience. The addition of an optional second display (option **LPX500-EM**) can double the screen area available to you, by providing the same number of independent layouts as available on the main unit.

You can create new layouts in either of two possible analyzer management modes (**Single** or **Multi**) for the standard, dual analyzer unit. A further operational state (**Linked**) is available with the optional quad analyzers, which allows you to switch between Single and Multi modes.

The terms **Single** and **Multi** are used to describe how the analysis instruments use the analyzers and the input assigned to them as follows:

- **Multi analyzer layout mode** where each active analysis instrument can use any analyzer and its assigned inputs. If you switch analyzer for an analysis instrument, other analysis instruments are unaffected. There are no limitations on the choice, positioning, or sizing of instruments.

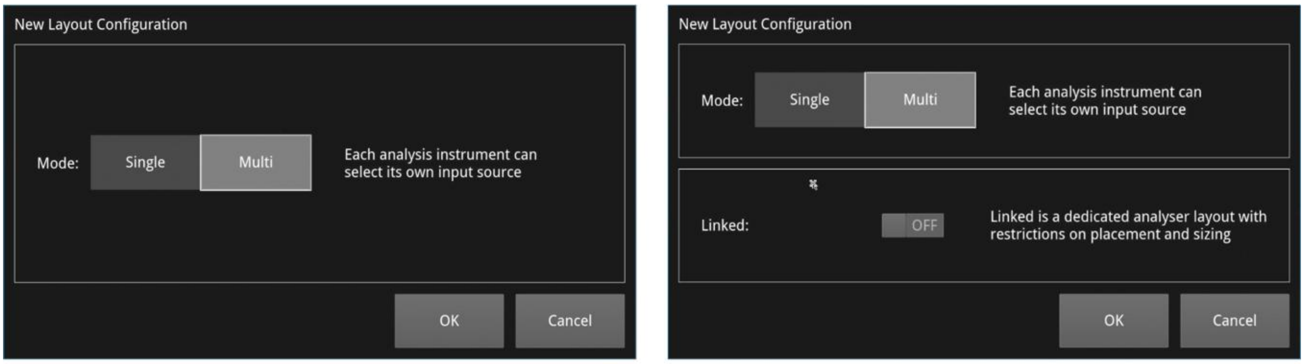
  The first screen you see on starting up the unit is the default layout of type **Multi**, into which you can launch multiple instruments and choose which analysis instruments use which analyzers.
  You can now launch instruments into the active layout or add another layout, of the same or dif- ferent type, to the left or right of the current layout as described in the next section.
- **Single analyzer layout mode** where all open analysis instruments use the input source from the same - **single** - analyzer, at the same time. So for example, all analysis instruments might use the input from **Analyzer A**. You can switch to the input from a different analyzer, for example, **Analyzer B**, but then all open analysis instruments will use the source input from **Analyzer B**. There are no limitations on the choice, positioning, or sizing of instruments when unlinked.
- For units with optional quad analyzers, you can choose a **Linked mode**, to link single and multi layouts, allowing you to switch quickly between both modes. In addition, linked layouts have a dedicated format specifically for analysis instruments, with restrictions on the placement and sizing of the instrument windows. You can launch only the following analysis instruments in a linked layout:
  - Analyzer – 2022-7 Status
  - Analyzer – 2110 Format Setup
  - Analyzer – Ancillary Inspector
  - Analyzer – Ancillary Status
  - Analyzer – Audio Channel Status
  - Analyzer – Audio Meters
  - Analyzer – CIE Chart (requires option: **LPX500-HDR**)

- Analyzer – Picture
- Analyzer – Vectorscope

- Analyzer – RGB Vector (requires option: **LPX500-DIAM**)
- Analyzer – Video Standard (SDI & 2022-6)
- Analyzer – Waveform.

When swiping left or right on the screen of the main unit (or optional second display), when you reach the extreme of your current layouts, the **New Layout Configuration** dialog is displayed, enabling you to add and configure a new layout. For a unit with optional quad analyzers, you will notice that the New Layout Configuration dialog includes an additional switch enabling you to link multi and single layout modes.

Default New Layout Configuration Dialogs



Dual Analyzer Unit **Optional Quad Analyzer Unit**

Figure 2-47: Default New Layout Configuration Dialogs for Dual and Optional Quad Analyzer Units

You can also use the **Layouts** dialog, available from the Settings tab, to manage your layouts, see *Managing Layouts in the Layouts Dialog*.

Launching Instruments on the Default Multi Layout

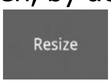
When you launch analysis instruments in a layout you can choose how and from which analyzer the instruments access their source input. Other instrument types are not dependent on the analyzer inputs.

> **Note:** The optional circuitry for the Eye and Jitter instruments (Model **LPX500ISE**) measures the source input only on BNC **SDI In 1**, fitted with a black nut. When available, you can open one Eye or Jitter instrument per layout.

Analysis Instruments open in a specific order in a multi or single layout, starting with Analyzer **A** then **B** for dual analyzer units, followed by Analyzers **C** then **D** for optional quad analyzer units.

In an empty layout, instrument windows are also positioned in order, starting at the top left, then top right, followed by bottom-left then bottom-right. If you close an instrument, leaving a space, the next instrument launched will fill that space.

In an unlinked single or multi layout, instrument windows open, by default, at quarter screen size.

You can resize them by double-tapping or using the softkey 

in the toolbar.

Using Layouts on a Dual Analyzer Unit

Overview

Standard IP Units

With the standard dual analyzer IP-capable unit (Model: **LPX500I**), you can define up to two flow groups (**IP A** and **IP B**), which are assigned automatically to the corresponding analyzers **A** and **B**, respectively.

A single ST 2110 IP flow group can comprise any combination of the following:

- One ST 2110-20 video flow
- Up to four ST 2110-30 or 2110-31 audio flows
- One ST 2110-40 ancillary (ANC)

flow. An ST 2022-6 IP flow group

comprises:

- One ST 2022-6 IP flow

These IP flow groups are assigned automatically to the two analyzers as follows:

- Flow group **IP A** to analyzer **A**, labeled **A: IP A** in analyzer instruments
- Flow group **IP B** to analyzer **B**, labeled **B: IP B** in analyzer instruments.

With a dual analyzer unit, your analysis instruments can use source IP flow groups from either of the two analyzers. You can configure your layouts for optimal analysis.

With the standard dual analyzer unit, you can define the following two types of layout:

- **Multi Layout** where each analysis instrument can select its own analyzer and assigned input
- **Single Layout** where all analysis instruments use the same analyzer and assigned

input. These layout types are described in the following sections.

Optional Combined IP and SDI Units

In addition, with a dual analyzer, optional SDI unit (Models: **LPX500IS** and **LPX500ISE**), you can connect up to four single link, 12K SDI inputs to the physical BNC SDI input connectors on the rear panel of the unit.

With optional source SDI inputs, you can assign them to the two analyzers as follows:

- Any of the four single links to either analyzer **A** or **B**
- Either of two dual links to either analyzer **A** or **B**
- A single quad link to either analyzer **A** or **B**.

With a dual analyzer unit, your analysis instruments can use source SDI inputs from either of the two analyzers. You can configure your layouts for optimal analysis.

With the standard dual analyzer unit, you can define the following two types of layout:

- **Multi Layout** where each analysis instrument can select its own analyzer and assigned input
- **Single Layout** where all analysis instruments use the same analyzer and assigned

input. These layout types are described in the following sections.

Using the Analyzer Identification Labels

The analyzer labels, enabled in the Display Settings dialog, are displayed in the title bar of all analysis instruments to help you identify the analyzer assigned to the source under analysis.

The labels have the following formats:

- **IP Analyzer Labels:** <*Analyzer_letter*>: <*Assigned_IP_Flow_group*>

  For example: **A: IP A**, **B: IP B**
- Optional **SDI Labels:** <*Analyzer_letter*>:

  <*Assigned_SDI_input*> For example: **A: 1**, **A: 2, B: 1**, **B: 2**,

  etc.

Using Multi Layouts with Dual Analyzers

The first layout you will encounter when starting the unit, and the default when adding new layouts, is the type **Multi**.

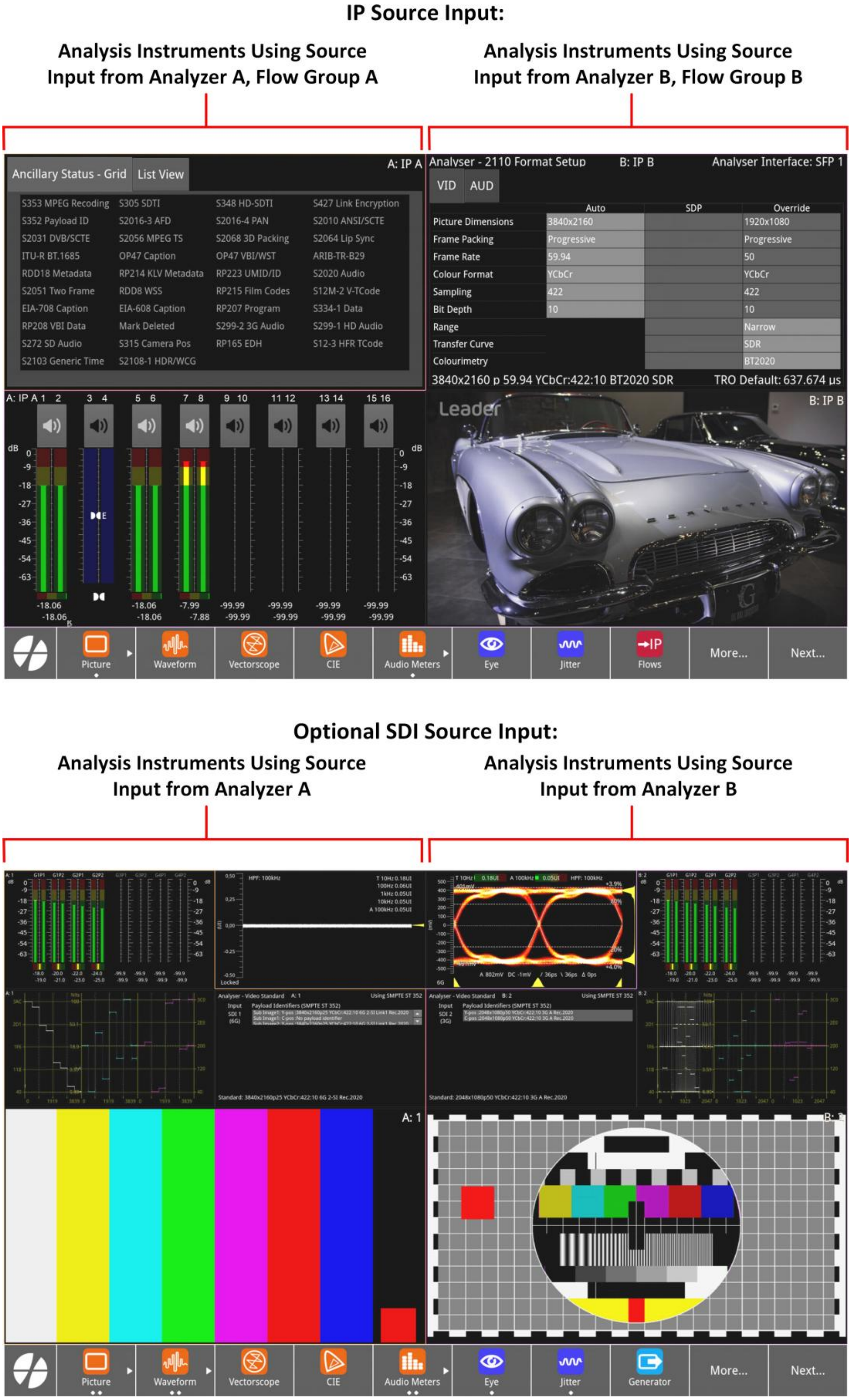
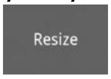


Figure 2-48: Default Multi Layout with Instruments Using Input from Analyzer A or B

With a multi layout, the following conditions apply:

- Launch any type of instrument.
- Each analysis instrument can select its own analyzer and assigned input.
- Position windows at arbitrary locations.
- Lock and unlock the layout.
- Instrument windows can be 1/16, 1/4, or full-screen size. In an unlocked layout you can cycle through each window size using a double-tap or the toolbar softkey 

.

Note: Waveform windows also include two double-height size settings.

- For analysis instruments, you can switch to a source input from a different analyzer either by spotlighting the instrument then using the toolbar softkey 

or using the Analyzer Select dropdown in the instrument's option menu.

Figure 2-49: Switching Analyzer Using the Options Menu Dropdowns for Dual Analyzers

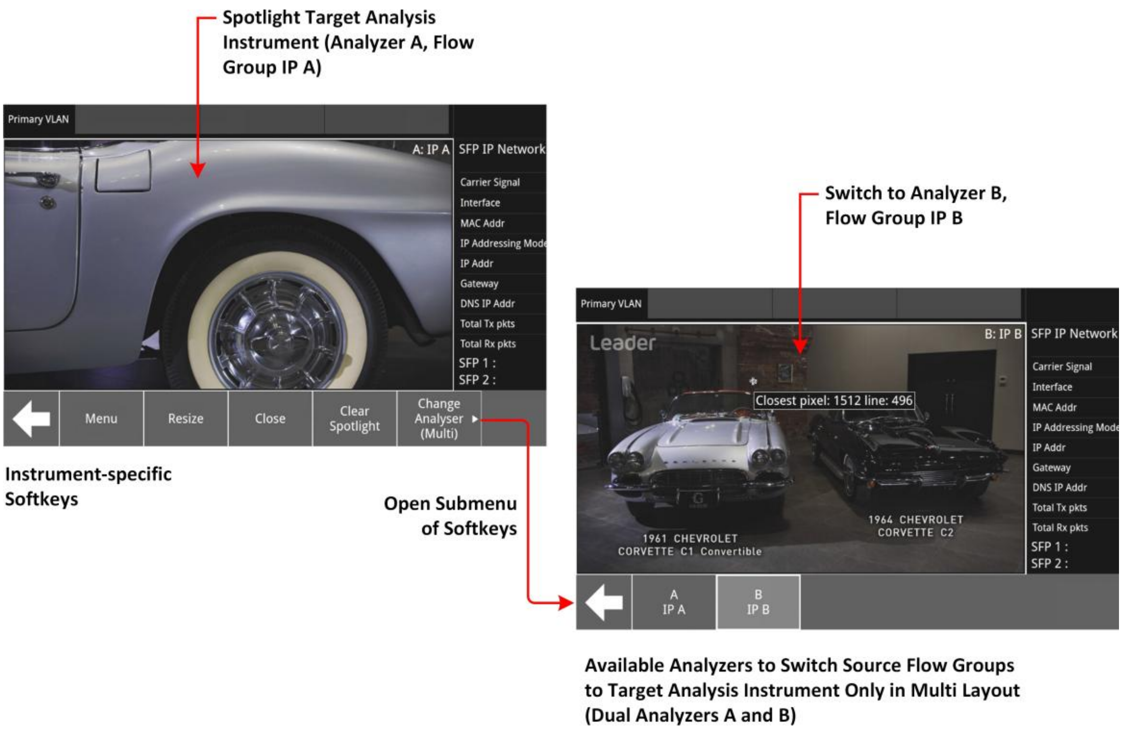


Figure 2-50: Multi Layout with Instruments Using Input from Analyzer A or B (IP Flow Groups)

Once you spotlight an analysis instrument in a multi layout, you can switch to the source input from the other analyzer. For example, in the example above, you can switch from Analyzer **A**, Flow Group **IP A** to Analyzer **B** Flow Group **IP B**.

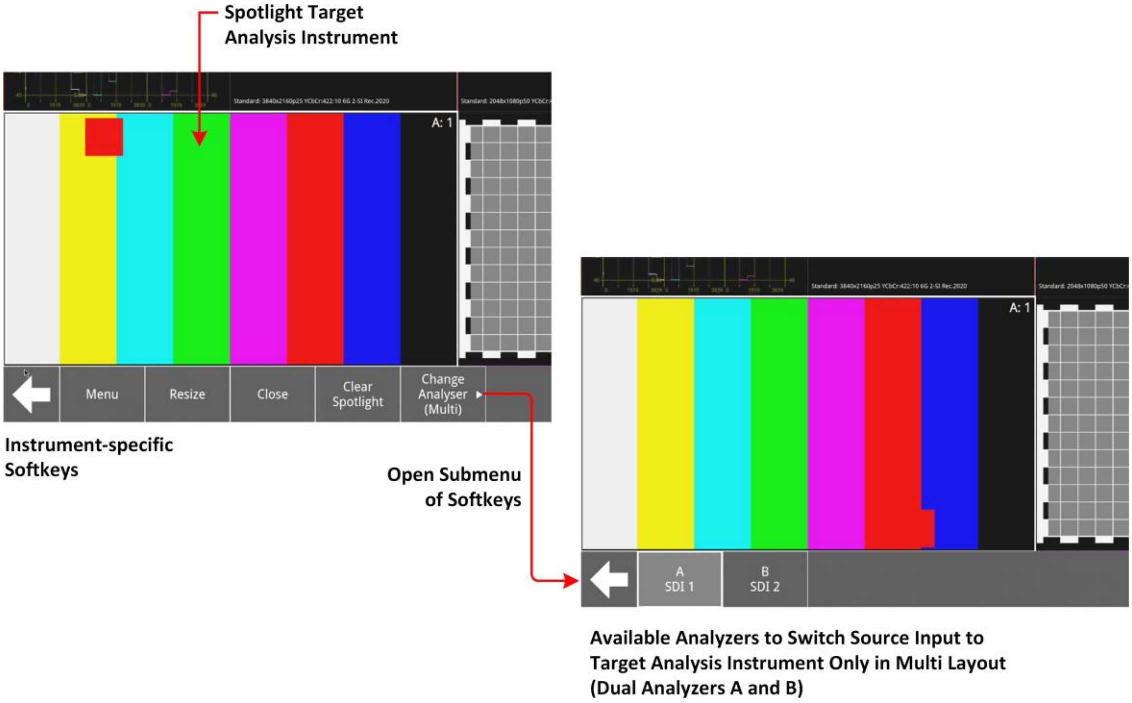


Figure 2-51: Multi Layout with Instruments Using Input from Analyzer A or B (Optional SDI Input)

Once you spotlight an analysis instrument in a multi layout, you can switch to the source input from the other analyzer. For example, in the example above, you can switch from Analyzer **A SDI 1** to Analyzer **B SDI 2**.

This allows you to switch between different source inputs, as required, without changing the screen.

> **Note:** If you switch to a different analyzer and that signal is already being used by an analysis instrument of the same type on the same screen or optional second screen, then you will see the message:
> **Analyzer *n instrument* in use.**

Using Single Layouts with Dual Analyzers

When you add a new layout, as described later in this document, you can choose a **single** layout type, instead of the default multi type.

In a single layout, all analysis instruments use the same analyzer, either analyzer A or B, and its assigned inputs.

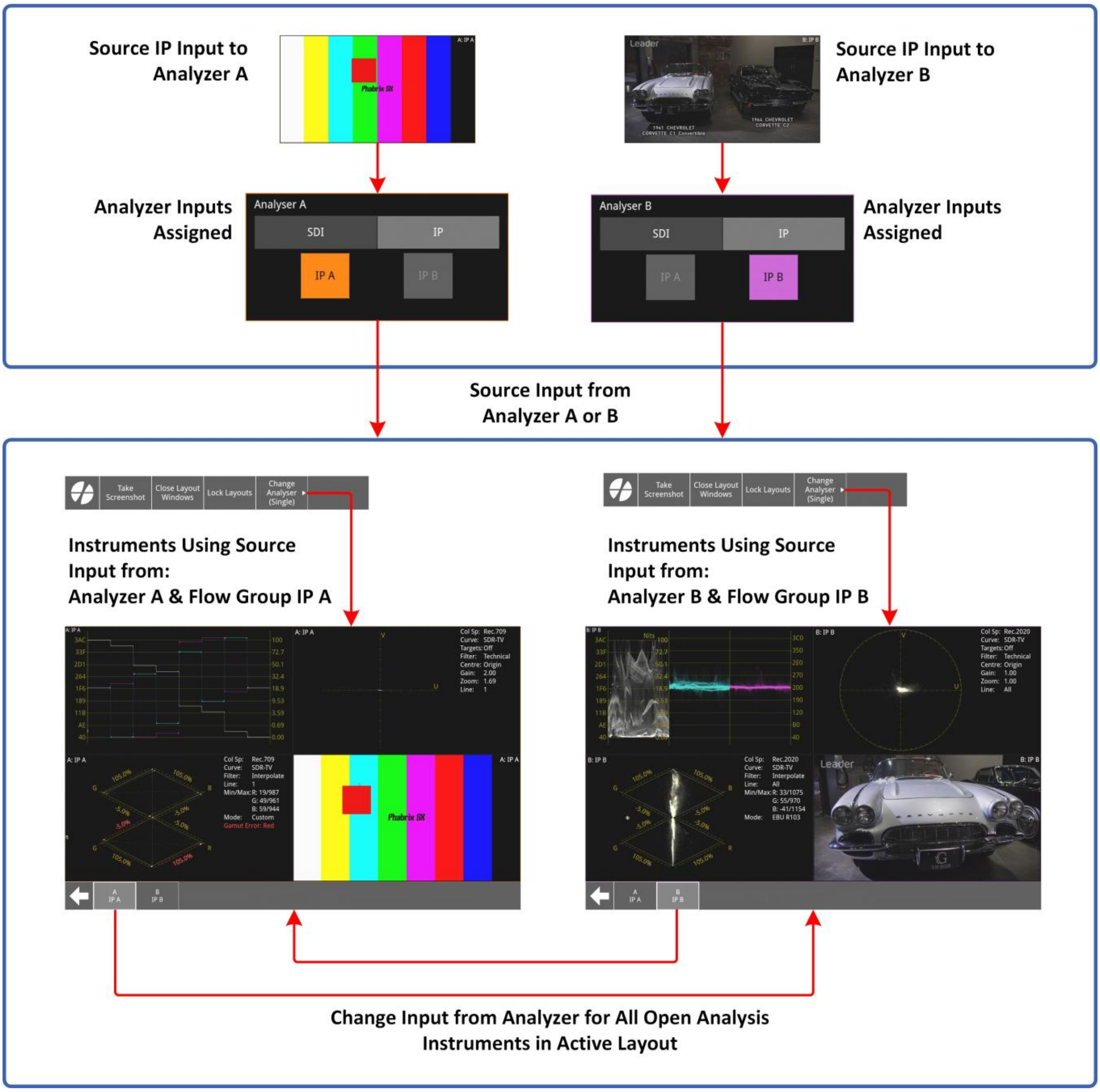


Figure 2-52: Switching Analyzer Input in Single Layout (IP Input)

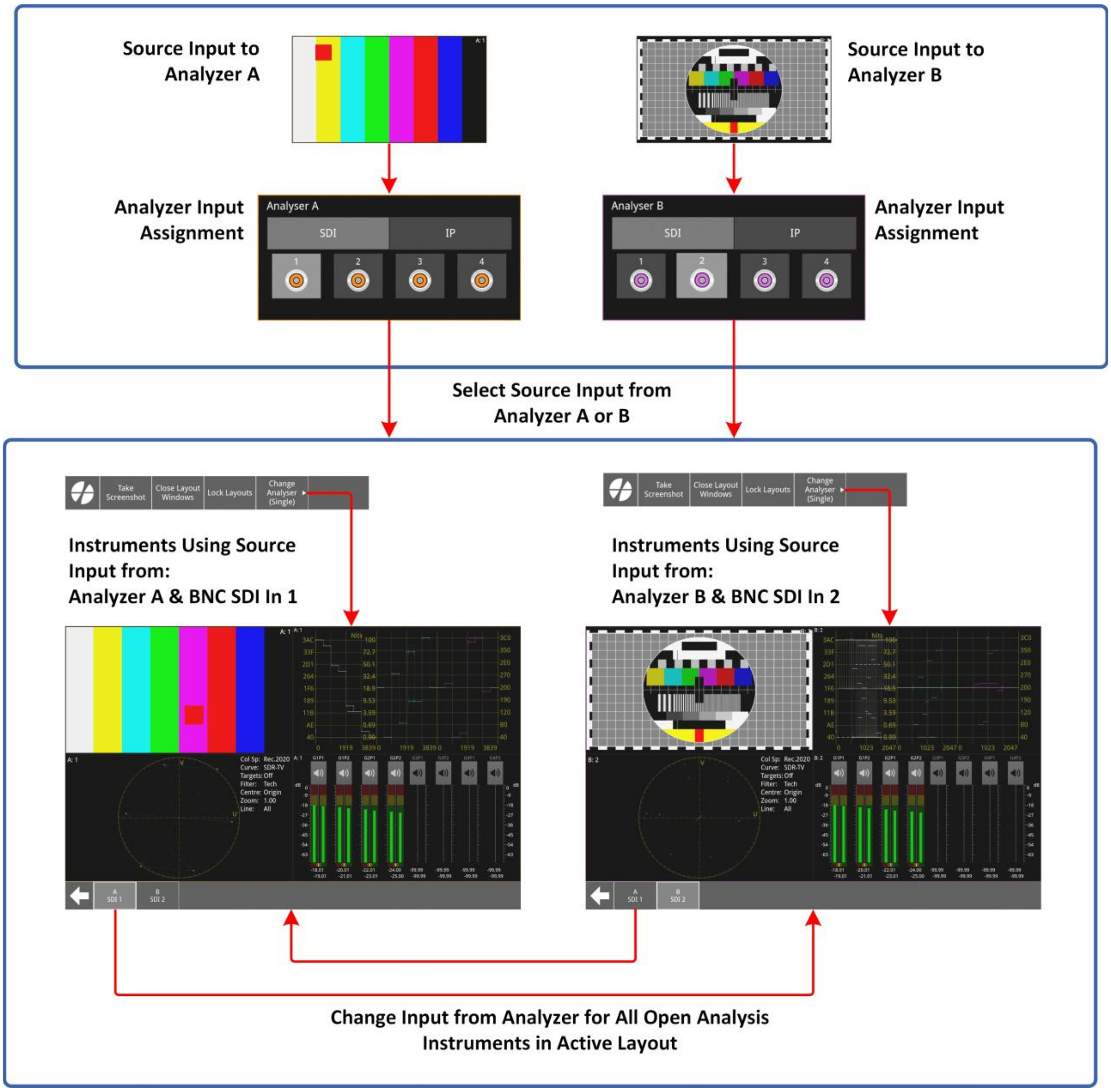


Figure 2-53: Switching Analyzer Input in Single Layout (Optional SDI Input)

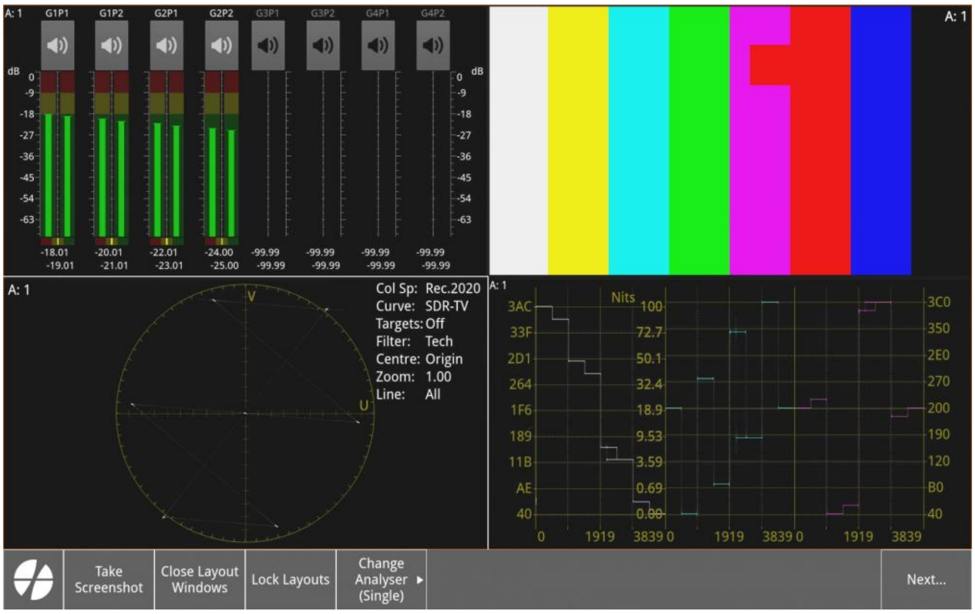


Figure 2-54: Single Layout with All Analysis Instruments Using Analyzer A (Optional SDI Input)

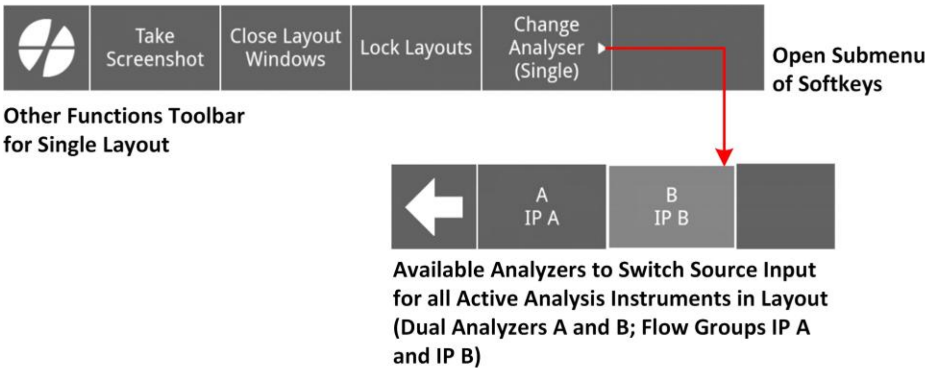


Figure 2-55: Using Toolbar Softkeys to Switch Between Analyzer A or B for All Analysis Instruments (IP Flow Groups)

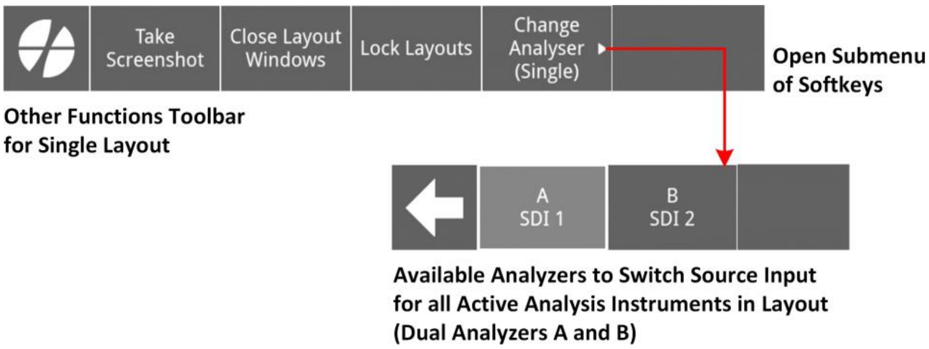


Figure 2-56: Using Toolbar Softkeys to Switch Between Analyzer A or B for All Analysis Instruments (Optional SDI Input)

Using Layouts on an Optional Quad Analyzer Unit

Overview

IP Units with Optional Quad Analyzer License

With an optional quad analyzer IP-capable unit (Model: **LPX500I** with license option **LPX500-QUAD**), you can define up to four flow groups (**IP A**, **IP B**, **IP C** and **IP D**), which are assigned automatically to the corresponding analyzers **A** and **B**, respectively.

A single ST 2110 IP flow group can comprise any combination of the following:

- One ST 2110-20 video flow
- Up to four ST 2110-30 or 2110-31 audio flows
- One ST 2110-40 ancillary (ANC)

flow. An ST 2022-6 IP flow group

comprises:

- One ST 2022-6 IP flow

These IP flow groups are assigned automatically to the four analyzers as follows:

Annotation [TE] Assignment is automatically fixed unlike SDI

- Flow group **IP A** to analyzer **A**, labeled **A: IP A** in analyzer instruments
- Flow group **IP B** to analyzer **B**, labeled **B: IP B** in analyzer instruments
- Flow group **IP C** to analyzer **C**, labeled **C: IP C** in analyzer instruments
- Flow group **IP D** to analyzer **D**, labeled **D: IP D** in analyzer instruments.

Wwith a quad analyzer unit, your analysis instruments can use any of the four analyzers and their assigned inputs.

> **Note:** Linked layout mode is available only for units with four analyzers (software option: **LPX500-QUAD**).

Optional Combined IP and SDI Units

In addition, with a quad analyzer, optional SDI unit (Models: **LPX500IS** and **LPX500ISE** with license option **LPX500-QUAD**), you can connect the same up to four single link, 12K SDI inputs to the physical BNC SDI input connectors on the rear panel of the unit, as with the dual analyzer unit. The main difference, however, is that you can use the four analyzers to analyze four source inputs, simultaneously. Of these source SDI inputs, you can assign these inputs to the four analyzers as follows:

- Any of the four single links to analyzers A, B, C, or D
- A maximum of two dual link (DL) for analysis by any analyzers A, B, C, or D
- A quad link (QL) to either analyzer A, B, C, or D.

With a quad analyzer unit, your analysis instruments can use any of the four analyzers and the source inputs assigned to them. You can configure your layouts for optimal analysis of these inputs as described in the following sections.

Available Layout Types

In addition to the single and multi layouts available with a dual analyzer unit, with the optional quad analyzers you can enable **Linked Layout** mode to **link** layouts so that you can switch quickly between single and multi modes.

With an optional quad analyzer unit, you can define the following different types of layout:

- **Multi Unlinked Layout** where each analysis instrument can select its own input analyzer.
- **Multi Linked Layout**: for analysis instruments only, and where each analysis instrument can select its own input analyzer. The tiling of the instrument windows on the screen can take one of three specific formats: **Tiled**, **Align-H**, or **Align-V**. You can open up to four analysis instru- ments, at 1/16 screen size. When you launch an instrument four copies of the instrument open, with each connected to a different analyzer. This results in four groups of four instruments using source input from all four analyzers. To obtain a more detailed view of one source input, you can switch to single layout at any point using the toolbar softkeys.
- **Single Unlinked Layout** where all analysis instruments use the same input source.
- **Single Linked Layout** for analysis instruments only, and where each analysis instrument uses the same input source. You can open up to four analysis instruments, at 1/4 screen size.
  To obtain an enhanced overview of all source inputs, you can switch to multi layout at any point using the toolbar softkeys.

These layout types are described in the following sections.

Using the Analyzer Identification Labels on a Quad Anlyzer Unit

The analyzer labels, enabled in the Display Settings dialog, are displayed in the title bar of all analysis instruments to help you identify the analyzer assigned to the source under analysis.

The labels have the following formats:

- **IP Analyzer Labels:** *<Analyzer_letter>*: *<Assigned_IP_Flow_group>*

  For example:

  - **A: IP A**
  - **B: IP B**
  - **C: IP C**
  - **D: IP D**
- Optional **SDI Labels:** *<Analyzer_letter>*: *<Assigned_SDI_input>*

  For example:

  - **A: 1**, **A: 2**, **A: 3**, **A: 4**
  - **B: 1**, **B: 2**, **B: 3**, **B: 4**
  - **C: 1**, **C: 2**, **C: 3**, **C: 4**
  - **D: 1**, **D: 2**, **D: 3**, **D: 4**

About the Default Multi Unlinked Layouts with Quad Analyzers

The first layout you will encounter when starting the unit, and the default when adding new layouts, is of type **Multi**, **Unlinked**. In this layout, each instrument can select its own input source from any of the four analyzers. There are no restrictions on the instruments you can launch, or their size and positioning on the screen.

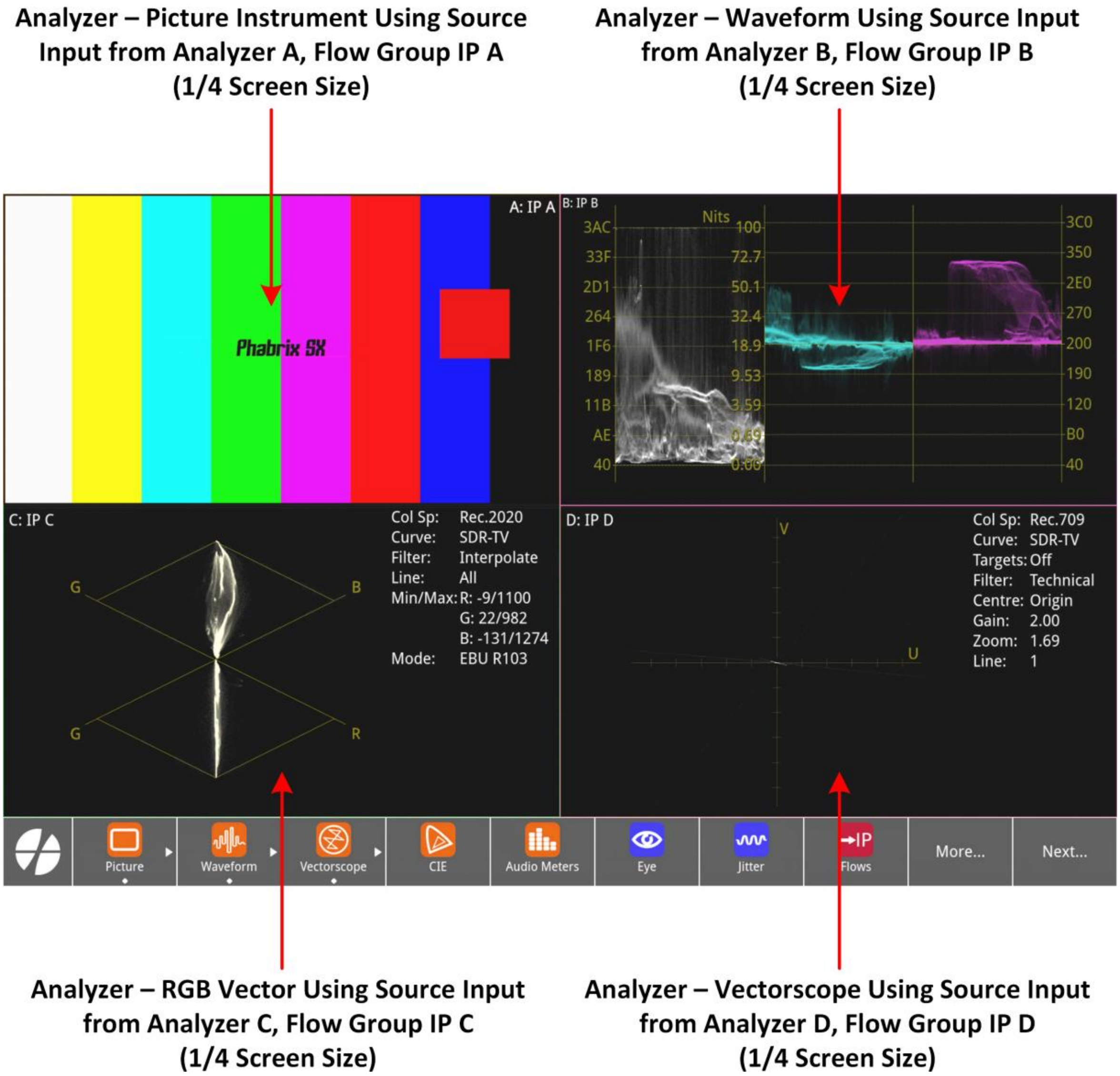


Figure 2-57: Default Multi Unlinked Layout with Instruments Using Analyzers A, B, C and D (IP Input)

> **Note:** If you choose to add a linked layout the linked switch in the new Layout Configuration dialog will be set to ON, by default, for the next layout you add.

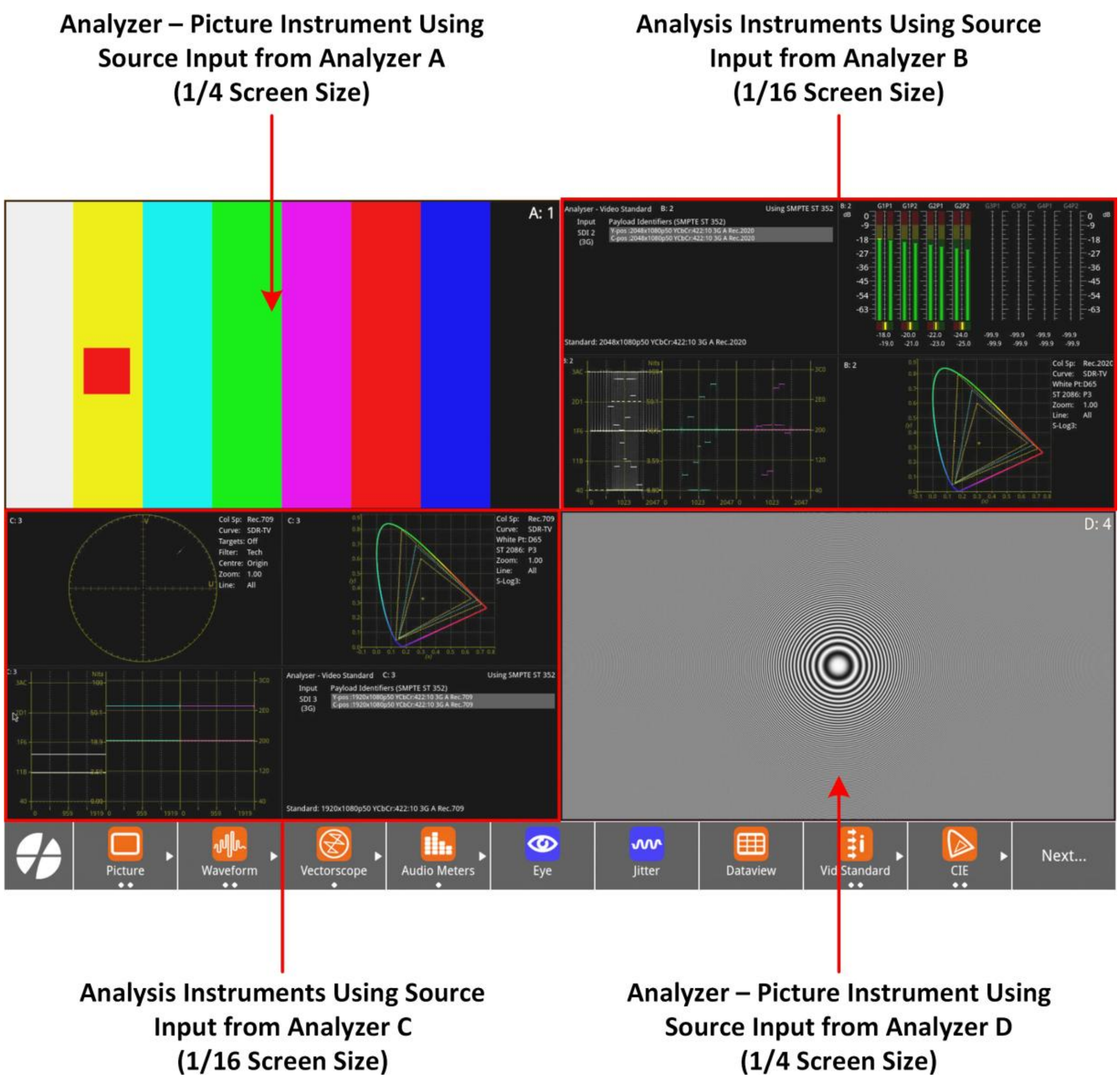


Figure 2-58: Default Multi Unlinked Layout with Instruments Using Analyzers A, B, C and D (SDI Input)

With a multi unlinked layout, the following conditions apply:

- Launch any type of instrument.
- Each analysis instrument can select its own input analyzer.
- Position windows at arbitrary locations.
- Lock and unlock the layout.
- Instrument windows can be 1/16, 1/4, or full-screen size. In an unlocked layout you can cycle through each window size using a double-tap or the toolbar softkey Resize .

> **Note:** Waveform windows also include two double-height size settings.

- For analysis instruments, you can switch to a source input from a different analyzer either by spotlighting the instrument then using the toolbar Change Analyser (Multi) or using the Analyzer softkey

Figure 2-59: Switching Analyzer Using the Options Menu Dropdown for Quad Analyzers

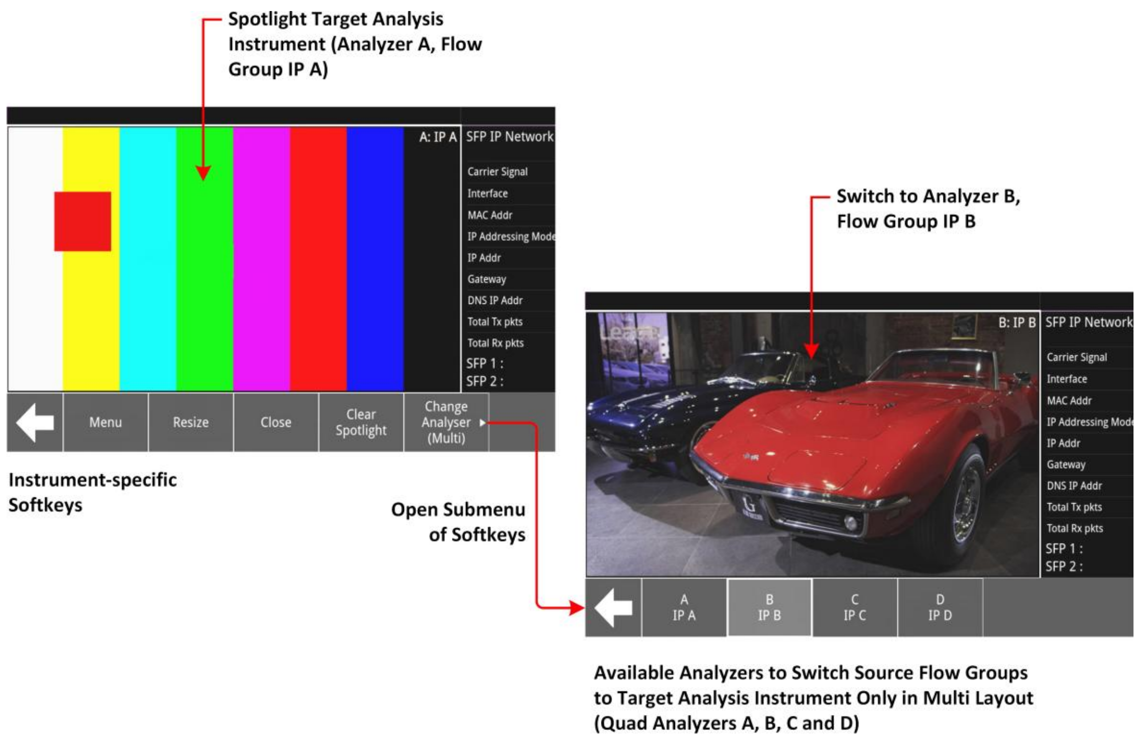


Figure 2-60: Multi Layout with Instruments Using Input from Analyzer A, B, C, or D (IP Input)

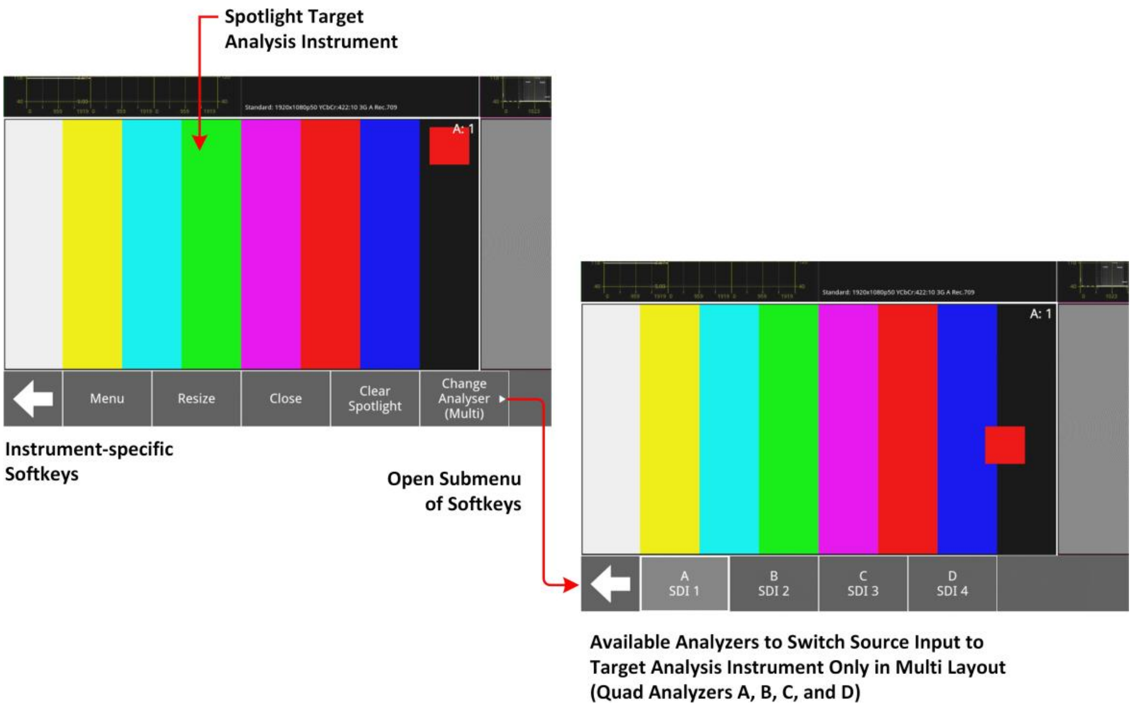


Figure 2-61: Multi Layout with Instruments Using Input from Analyzer A, B, C, or D (SDI Input)

About Single Unlinked Layouts with Quad Analyzers

When you add a new layout, as described later in this guide, you can choose a **single** layout type, instead of the default multi type. In a single layout type, all analysis instruments use the same input source from any of the four analyzers.

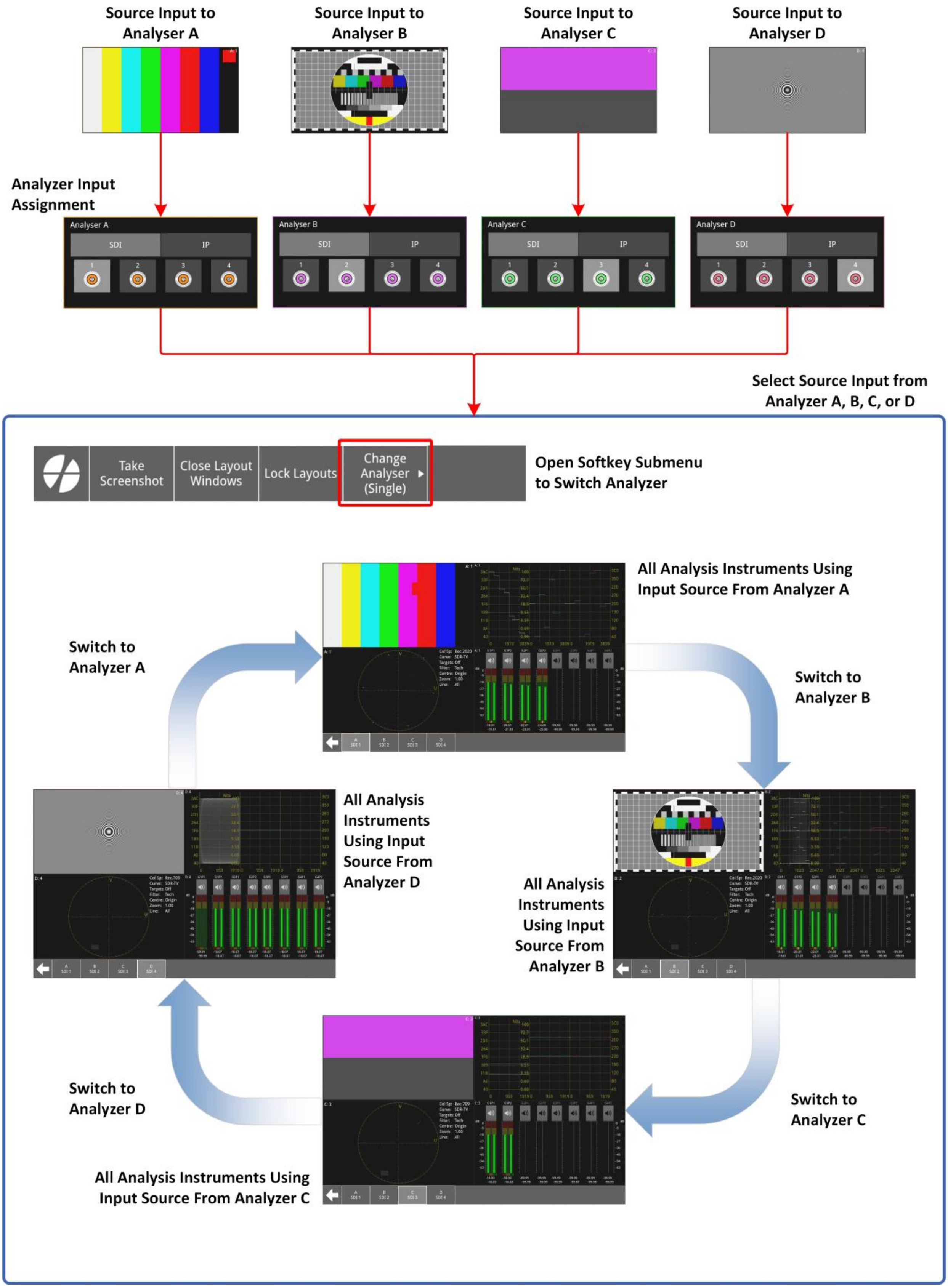


Figure 2-62: Switching Analyzer Input for Single Layout with Optional Quad Analyzers (Optional SDI Input)

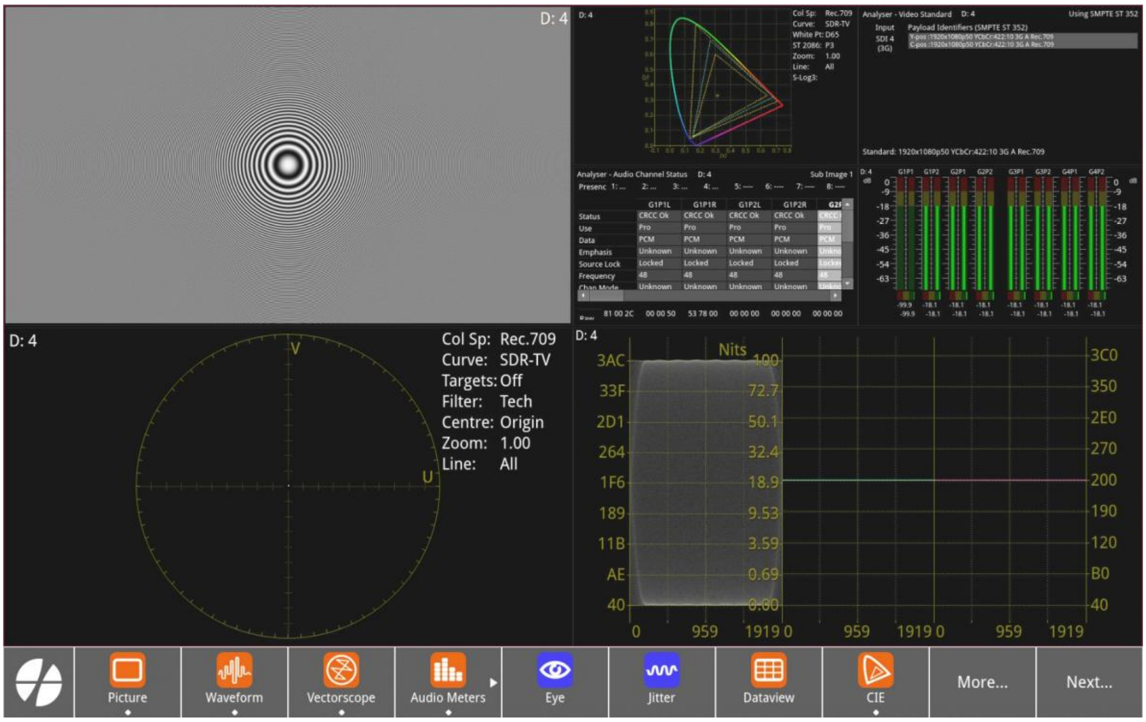


Figure 2-63: Single Unlinked Layout with All Instruments Using Input from Analyzer D (SDI Only)

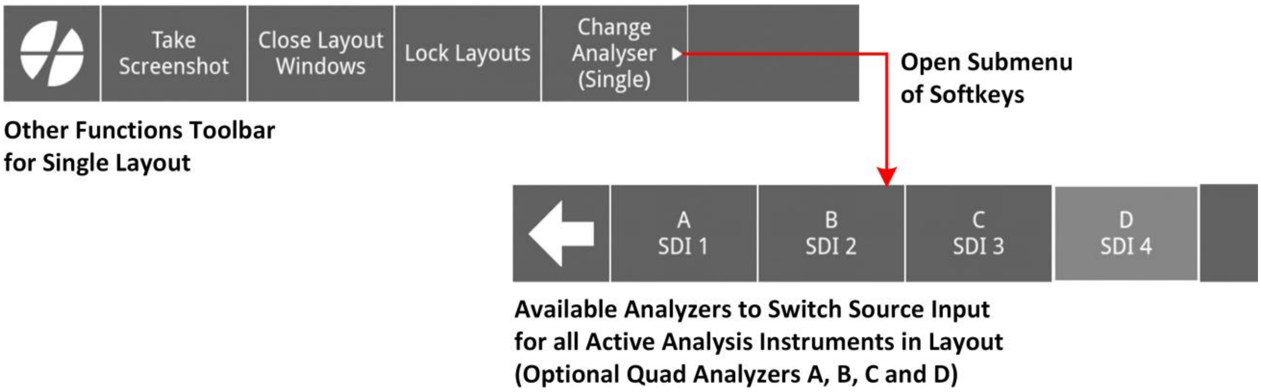


Figure 2-64: Switching All Open Analysis Instruments to Use Input from Analyzer A, B, C or D

About Multi Linked Layouts with Quad Analyzers

A multi linked layout is a specialized overview layout, providing three fixed window tiling formats, enabling you to display four groups of four analysis instruments, with each group accessing the source inputs from one of the four analyzers simultaneously.

You can create a multi linked layout by selecting the mode **Multi** and setting the Linked switch **ON** in the New Layout Configuration dialog.

With a multi linked layout, the following constraints apply:

- You can launch the following analysis instruments:
    - Analyzer - Video Standard
    - Analyzer - Ancillary Inspector
    - Analyzer - Ancillary Status
    - Analyzer - Audio Channel Status
    - Analyzer - Audio Meters
    - Analyzer - CIE Chart (requires software option: **LPX500-HDR**)
    - Analyzer - Picture
    - Analyzer - Vectorscope
    - Analyzer - Waveform
- You can launch only up to four different analysis instruments in each multi linked layout.
- Launching an instrument opens four instances of that instrument, each using input source from a different analyzer.
- Default window tiling format is **Tile** in which instrument windows are arranged in four quad- rants.
- Change the tiling format using the toolbar softkey 

, then choosing **Tile**, **Align-H**, or **Align-V**.
- Lock and unlock the layout.
- Instrument windows are fixed to 1/16 screen size. It is not possible to resize windows in a multi linked layout. If you need a magnified view of an instrument window in a group, switch to Single Linked mode as described in the section *About Single Linked Layouts with*

> **Note:** Some instruments, for example, Audio Meters, have features that are only available when at full screen size. If you need to resize an instrument to full screen, open an instance in a new multi or single unlinked layout.

Quad Analyzers.

- Change the position of windows in a multi linked group using touch or mouse control to drag a window and drop in a new location. Other windows move automatically to fill the gap at the ori- ginal site of the moved window. In addition, the equivalent instrument window in the other three groups moves to reflect the change in the first group. This ensures that all instruments of the same type are in the same relative positions.
- Switch to a single linked layout for a more detailed observation of an instrument by spotlighting the instrument then using the toolbar softkey: 

.

Instrument windows open in a defined order, depending on the selected display tiling option: Tile, Align-H, or Align-V, as follows:

- **Tile:** Launches a 1/16 size window in the top-left corner of each of the quadrants. The next is added to the top-right, then bottom-left and finally bottom-right. It is not possible to resize the windows in a linked layout; they will always be 1/16 size.
- **Align-V**: Starts at left-most column, then moves right, column by column.
- **Align-H**: Starts at the top row, then moves down, row by row.

A feature of the linked display mode (either Single or Multi) is that you can move a window within its quadrant (Tile), row (Align-H), or column (Align-V) and all other windows will move to make space and fill the gap left in the original position of the moved window.

> **Note:** If the layout lock is enabled then the instrument positions cannot be changed.

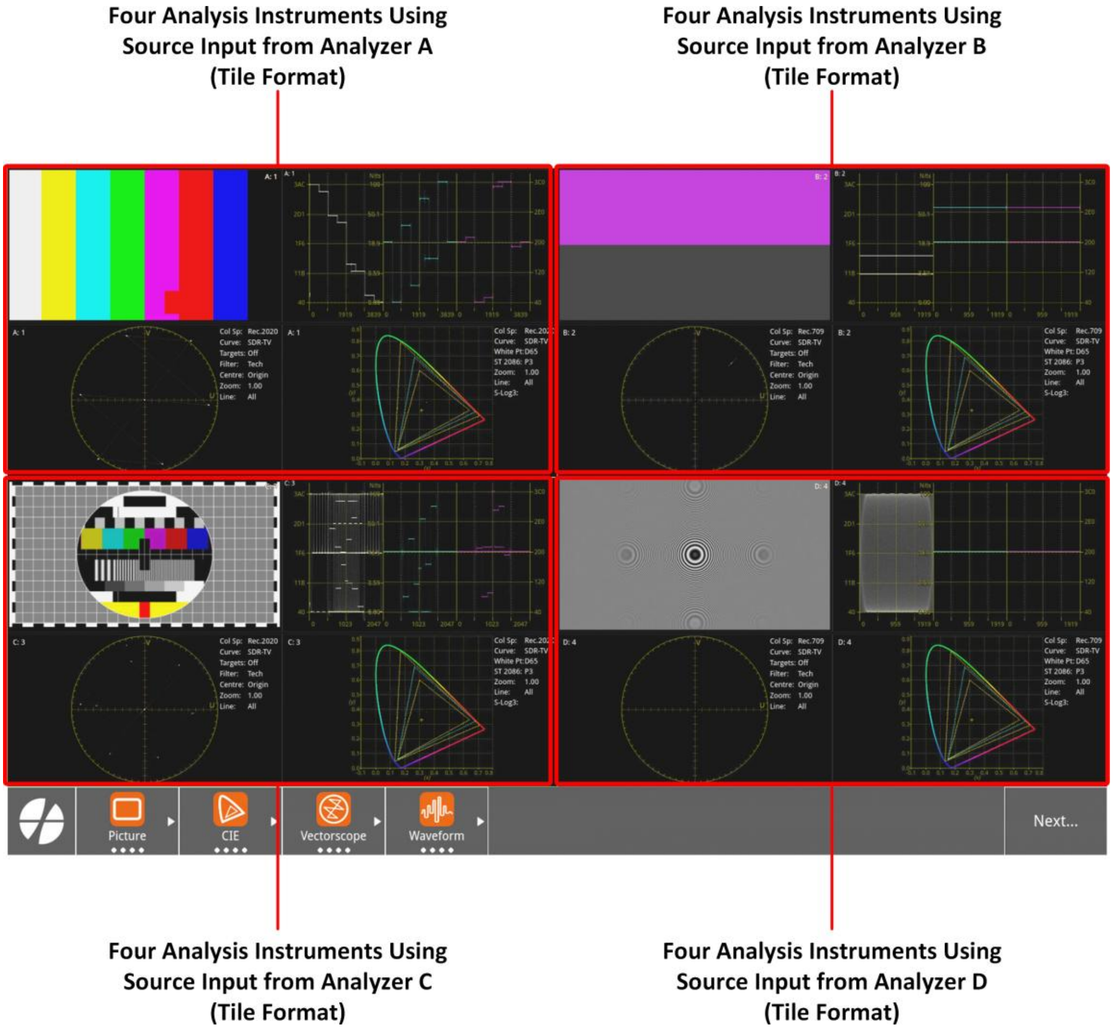


Figure 2-65: Multi Linked Layout with Default Tile Format

When you have opened four analysis instruments in a multi linked layout, no additional instruments can be launched. The instruments tab is grayed-out at this point. If you close an instrument, the Instruments become available for selection again in the Instruments tab.

> **Note:** If the layout lock is enabled then no further instruments can be added.

Switching Between Tiled Views in a Multi Linked Layout

Use the toolbar softkey 

to change the tiling of the active multi linked layout between the three possible formats: tile, align-H, and align-V as shown in the following figure.

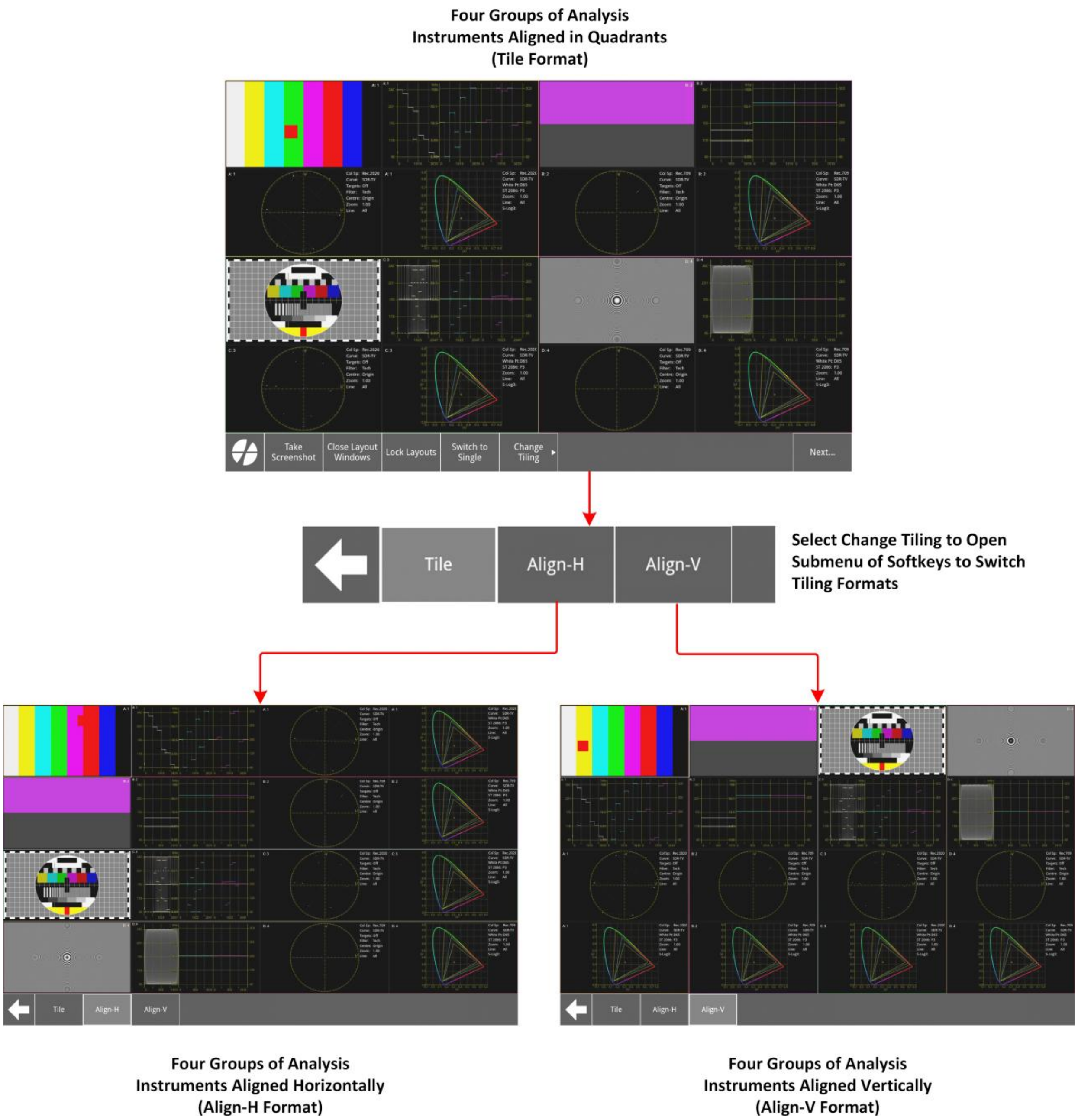


Figure 2-66: Multi Linked Layout - Switching Tiling Formats

Moving Instrument Windows in a Multi Linked Layout

You can move any of the open windows in a multi linked layout when unlocked by touching the target window and dragging to a new position within the same window group. When you release the target window, the neighboring windows move to fill the original gap and prevent overlapping.

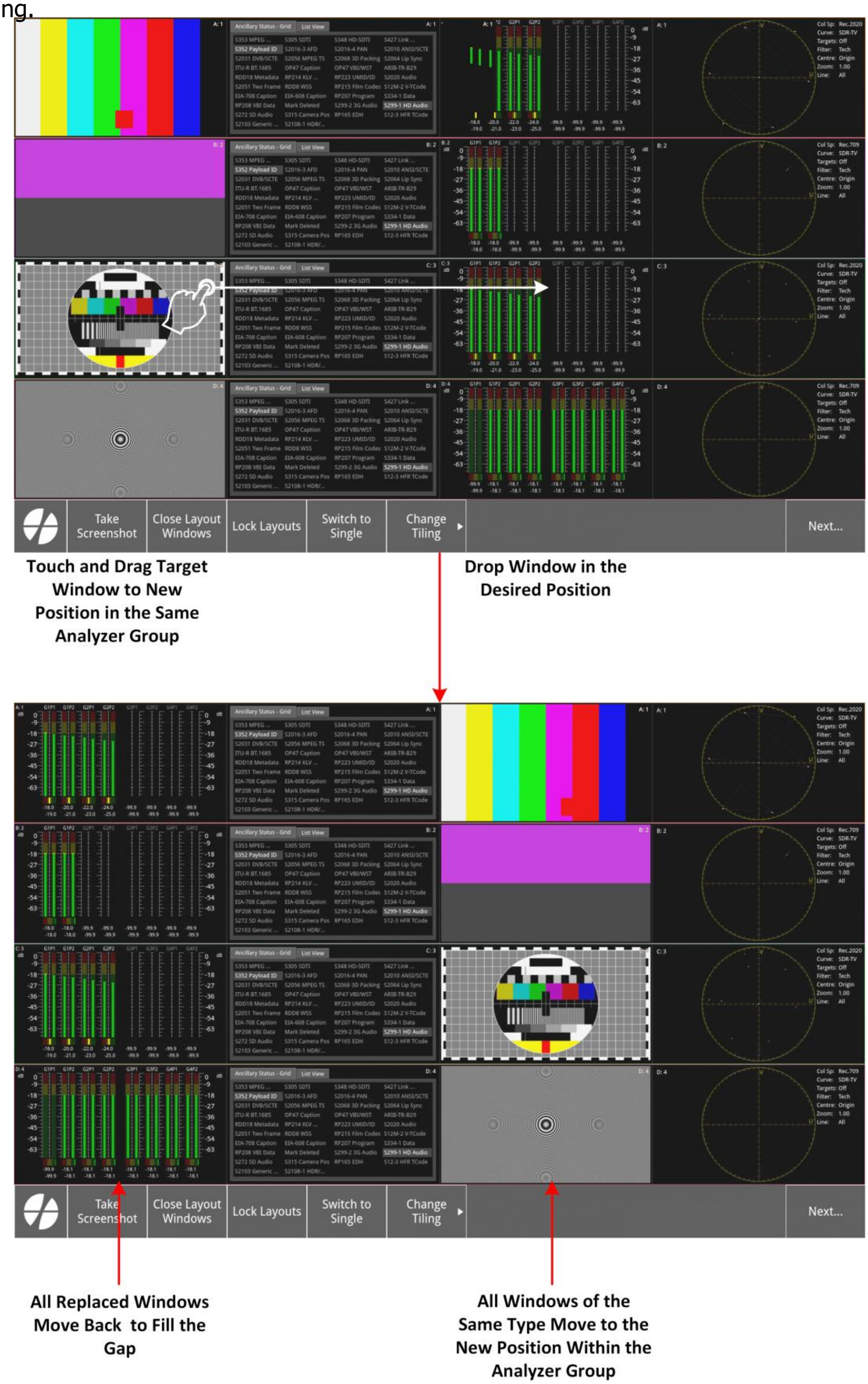


Figure 2-67: Multi Linked Layout - Switching Tiling Formats

About Single Linked Layouts with Quad Analyzers

Annotation [TE] This is about where I got to on my last day. 01/04/25

A single linked layout is similar to a single unlinked layout but its main function is to allow switching from a multi linked layout to display one of the groups of four instruments at 1/4 screen size for more detailed observation.

You can create a single linked layout by selecting the mode **Single** and setting the Linked switch **ON** in the New Layout Configuration dialog.

With a single linked layout, the following constraints apply:

- You can launch only the following analysis instruments:
    - Analyzer - Video Standard
    - Analyzer - Ancillary Inspector
    - Analyzer - Ancillary Status
    - Analyzer - Audio Channel Status
    - Analyzer - Audio Meters
    - Analyzer - CIE Chart (Requires software option: **LPX500-HDR**)
    - Analyzer - Picture
    - Analyzer - Vectorscope
    - Analyzer - Waveform
- You can launch only up to four different analysis instruments in a single linked layout.
- The first group of four instruments launched use source input from Analyzer A. If unconnected, the open instruments display the message: **No input detected.** To use a different source input, use the softkey Change Analyser (Single) to select an input source from a different analyzer.
- Up to four instrument windows are always displayed in tile format at 1/4 screen size.
- Lock and unlock the layout to prevent or allow changes.
- No resizing of instrument windows (1/4 size).
- Change the position of unlocked windows in a single linked group using touch or mouse control to drag a window and drop in a new location. Other windows move automatically to fill the gap at the original site of the moved window.
- Switch to a multi minked layout for a view of the source inputs to all analyzers by spotlighting the instrument then using the toolbar softkey Switch to Multi.

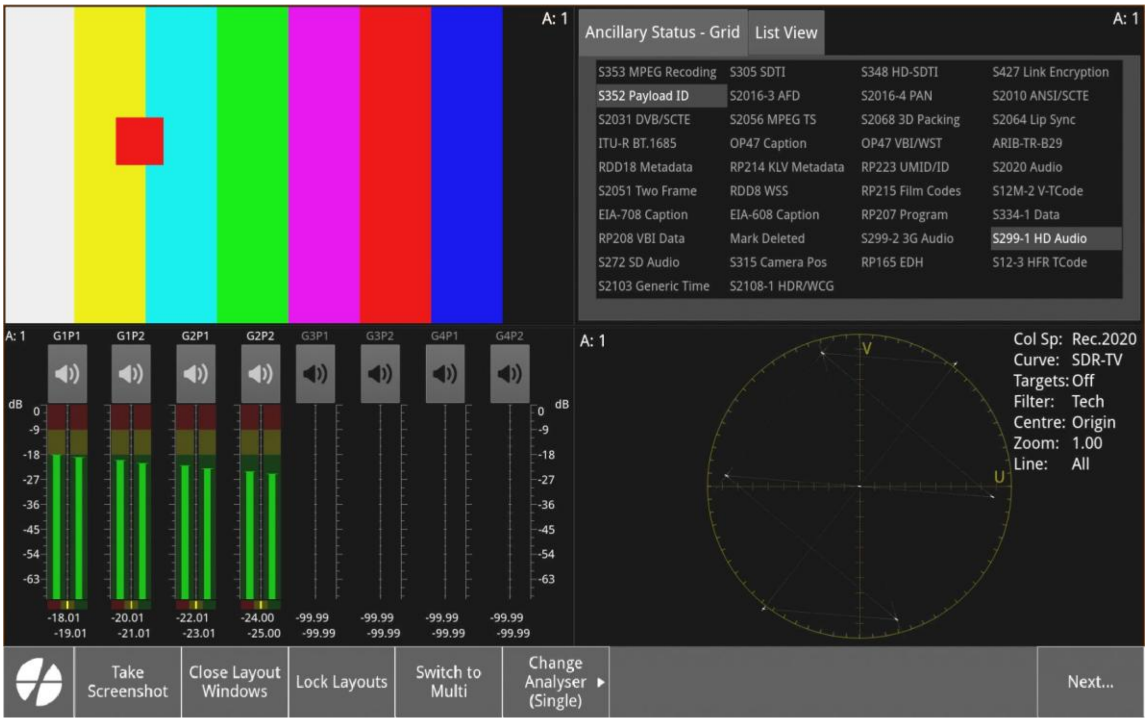


Figure 2-68: Single Linked Layout with All Analysis Instruments Using Input from Analyzer A

When you switch to a single linked layout from a multi linked layout, the unit first displays the four instruments assigned to analyzer **A**. You can then use the softkey 

to display one of the four groups of instruments associated with the selected analyzer. Instrument windows are always displayed in a tiled format of four 1/4 screen instrument windows.

From a single linked layout, you can switch quickly back to a multi linked layout by tapping the softkey 

in the toolbar.

Moving Instrument Windows in a Single Linked Layout

You can move any of the open windows in a single linked layout by touching the target window and dragging it to a new position in the group. When you release the target window, the neighboring windows move to fill the original gap and prevent overlapping.

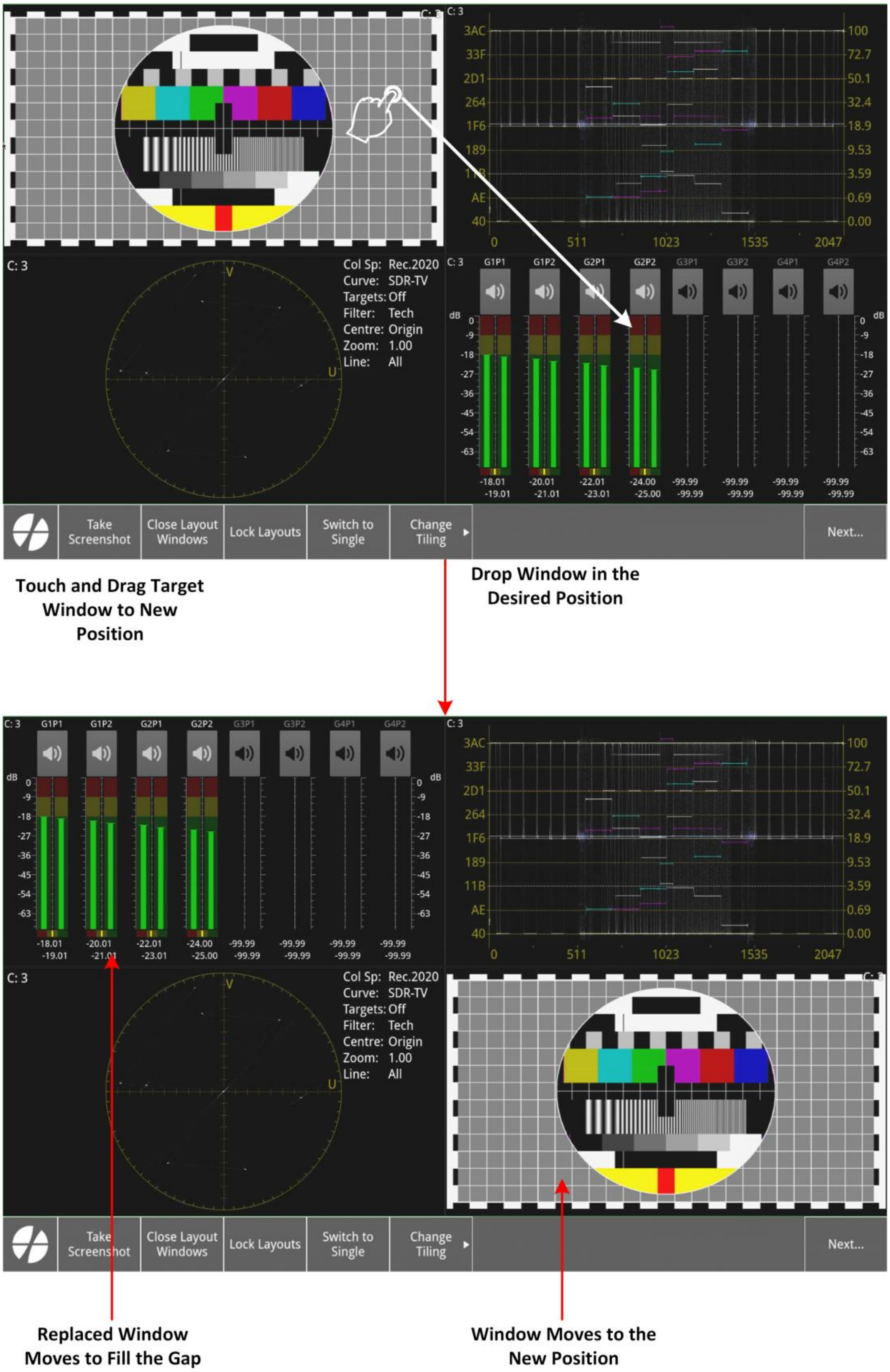


Figure 2-69: Single Linked Layout - Switching Tiling Formats

Navigating Through Layouts

Overview

The LPX500 provides a number of methods you can use to navigate through your layouts. For example, you can choose between using swipe gestures on the touchscreen(s) or the mouse cursor. There is no recommended method, choose whichever method best suits your working style.

When navigating between LPX500 layouts, think of the layouts as a linear series of screens running from left to right. You can add new layouts to the extreme left or extreme right of the existing series of layouts. It is not possible to insert layouts in the middle of the series, however, you can use the **Layouts** dialog to change the order in which layouts are displayed, if desired.

You can configure and save up to **16** screen layouts with associated instruments and settings. On starting the system, you are initially presented with one screen layout, to which you can add up to 15 more layout screens, with up to 16 non-overlapping instruments visible on a single layout. You can open instrument windows on each available layout and navigate between layouts using either touch gestures, the mouse cursor, softkeys in the layouts toolbar, or by switching to a different layout in the Layouts dialog.

You might find that the optimum layout on the touchscreen features up to four quarter screen-size instruments per layout but this depends entirely on your preference. The following graphic shows a configuration of seven layouts, each configured with four instruments.

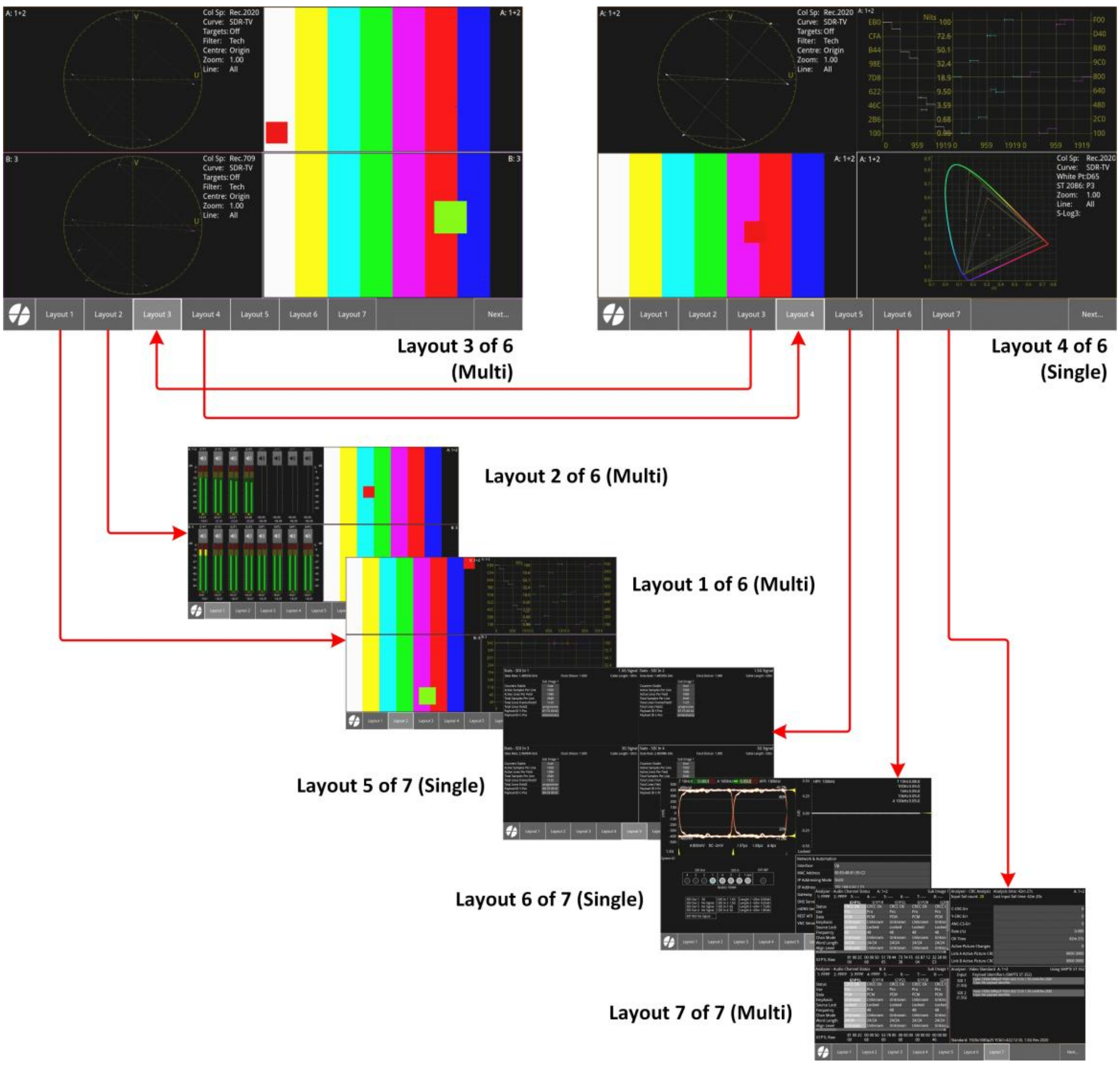


Figure 2-70: Navigation Through Multi and Single Layouts Using Softkeys (Dual

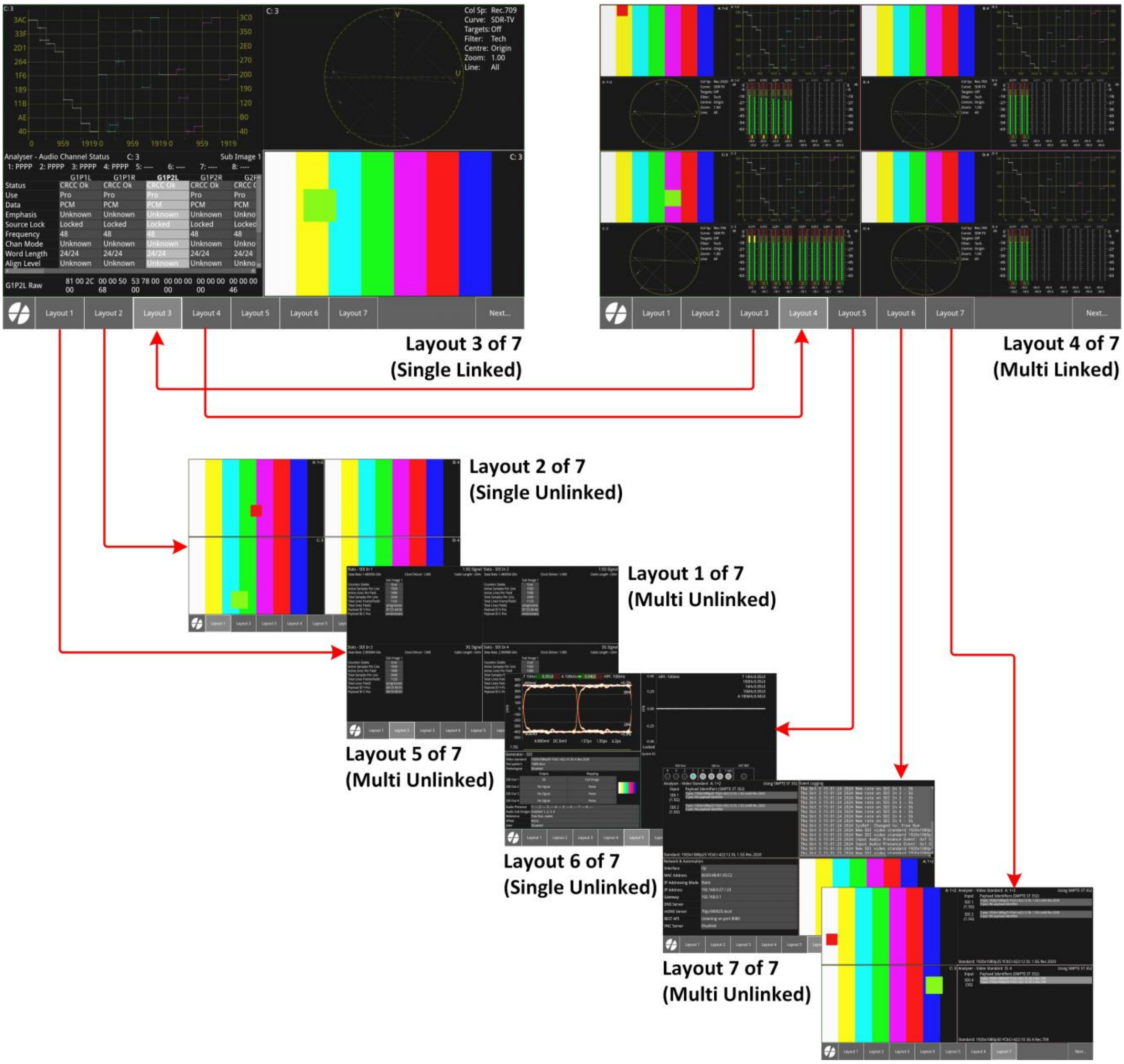


Figure 2-71: Navigation Through Multi, Single and Linked Layouts Using Softkeys (Quad Analyzers)

> **Note:** In this user manual, we refer to the current display as the **Active Layout**.

Each new layout that you add is reflected as a new softkey, displaying the name of the layout, in the layouts toolbar. You can change the displayed order of the softkeys, or change the displayed name in the toolbar, using the Layouts dialog in the Settings tab.

Using Touch Gestures in Layouts

If you have access to the unit, using swipe gestures on the touchscreen of the main unit or optional second display is a quick way to move between layouts. The following graphic shows navigation through a series of three layouts.

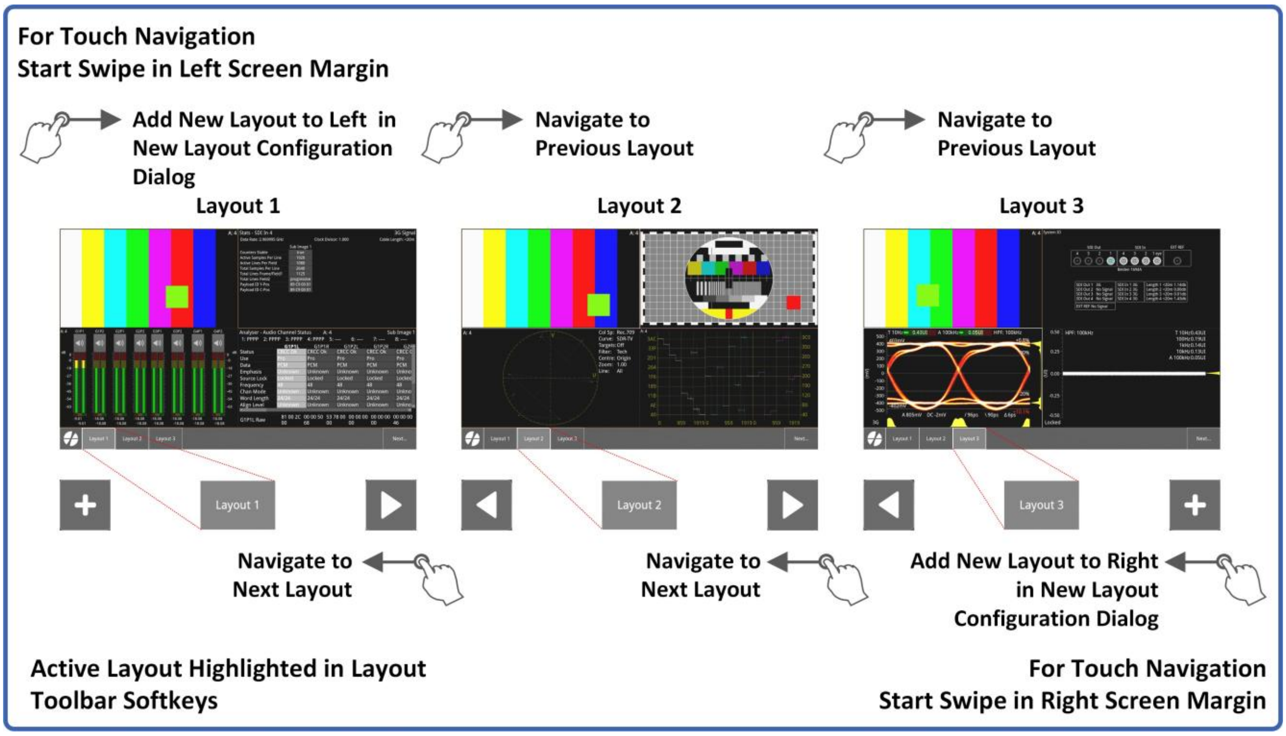


Figure 2-72: Navigating Through Layouts Using Swipe Gestures on the Touchscreen(s)

When using swipe gestures to navigate, you will briefly see one of the following icons displayed in the middle of the left- or right-hand sides of the screen, depending on your position in the series of layouts and whether navigating left or right:

-  Display the **previous** layout to the left.
-  Display the **next** layout to the right.
-  Add a **new** layout to the left or right of the active layout. This is displayed only when you are at the extreme left or right of the current series of layouts. The New Layout Configuration dialog opens enabling you to choose the type of layout required. If you only have a single lay- out (e.g., when starting from factory defaults) you will see this icon at both left and right sides of the screen once you have launched at least one instrument. If your layout is empty, this icon will only be displayed after first launching an instrument in the active layout.

From the initial, default multi layout, you can add additional layouts to the right or left of the active layout.

If you require a new layout, when layouts are unlocked, you can add a new layout to left or right either by swiping on the touchscreen when the Add Layout button () is displayed, or by clicking  on a remote display.

- Swipe right-to-left toward the left-  to add a layout to the right. Alternatively, swipe to-right toward the right-  to add a layout to the

In an unlocked layout, you can touch anywhere inside an instrument window to spotlight it, then drag it to a new position on the screen. In a locked layout the positions of instrument windows are fixed until you unlock the layout.

When swiping in an unlocked layout, make sure that your swipe gesture starts in the swipe zone at the left or right of the screen (shown below) to avoid accidentally moving instrument windows.

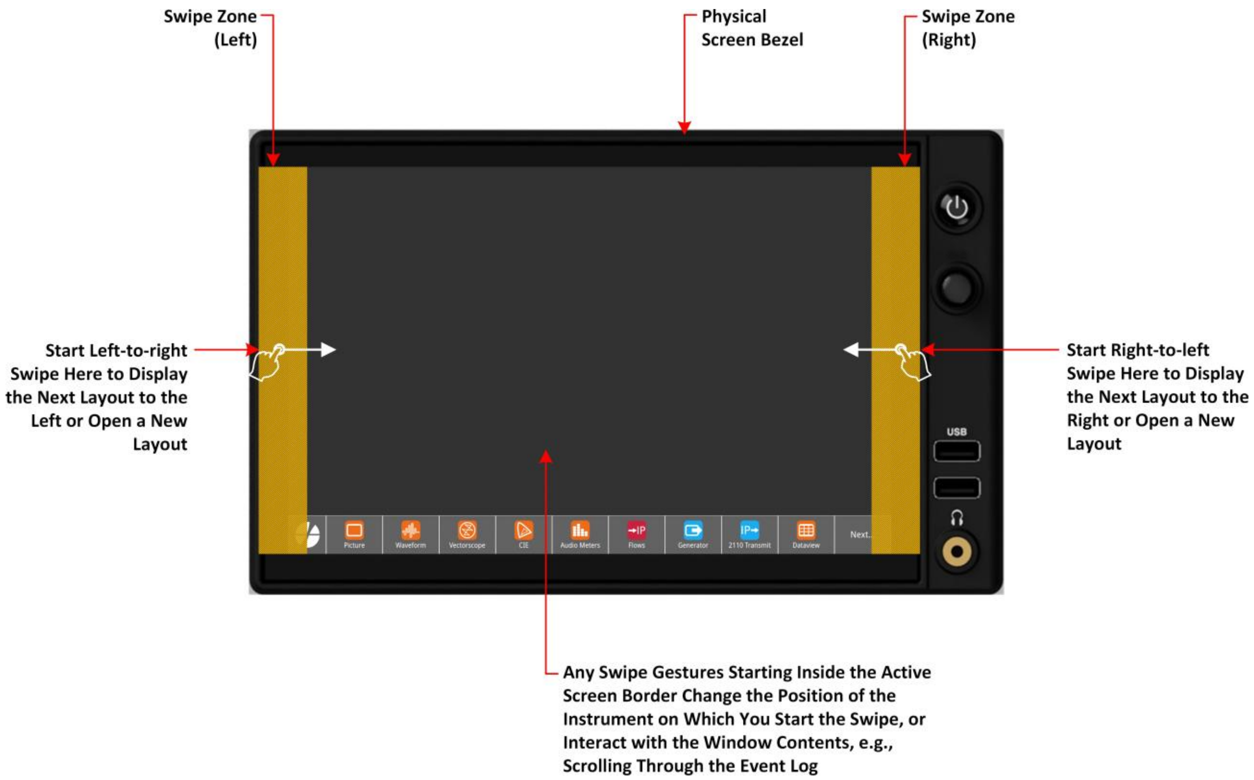


Figure 2-73: Swipe Zones for Using Swipe Gestures to Navigate Layouts

Using Mouse Cursor Control in Layouts

You can use the mouse cursor to navigate layouts on the main unit or optional second screen if you prefer that to touch gestures. If you do not have direct access to either screen (e.g., when working remotely on a DisplayPort screen or over noVNC) then mouse control is the only option to navigate through layouts.

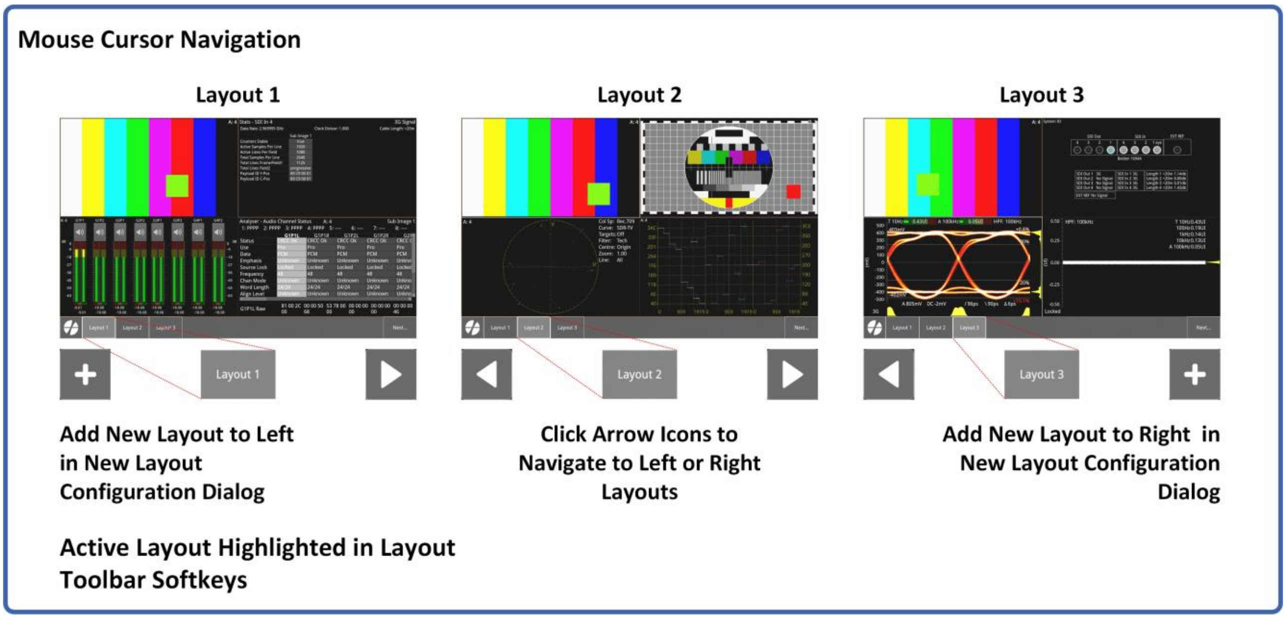


Figure 2-74: Navigating Through Layouts Using the Mouse Cursor

Move your mouse cursor to the center of the left-hand or right-hand edge of the screen and you will see one of the following icons displayed:

- Display the **previous** layout to the left.
- Display the **next** layout to the right.
- Add a **new** layout to the left or right of the current layout. This is displayed only when you are at the extreme left or extreme right of the current series of layouts. This will open the New Layout Configuration dialog enabling you to choose the type of layout required.

From the initial, default multi layout, you can add additional layouts to the right or left of the current layout.

In an unlocked layout, you can also click anywhere inside a window to spotlight it then drag to move it to a new position on the screen. In a locked layout the positions of instrument windows are fixed until you unlock the layout.

If you require a new layout, when unlocked, you can add a new layout to left or right either by swiping on the touchscreen when the Add Layout button ( ) is displayed, or by clicking on a remote display.

- Click the right-hand to add a layout to the right, or click the left-hand to add a layout to the left.

Using the Layouts Toolbar and/or Layouts Dialog

The Layouts toolbar or the Layouts dialog, available in the Settings tab, provide further methods to navigate through your layouts.

The Layouts toolbar may contain up to **16** softkeys if you have configured the maximum number of layouts on your unit.

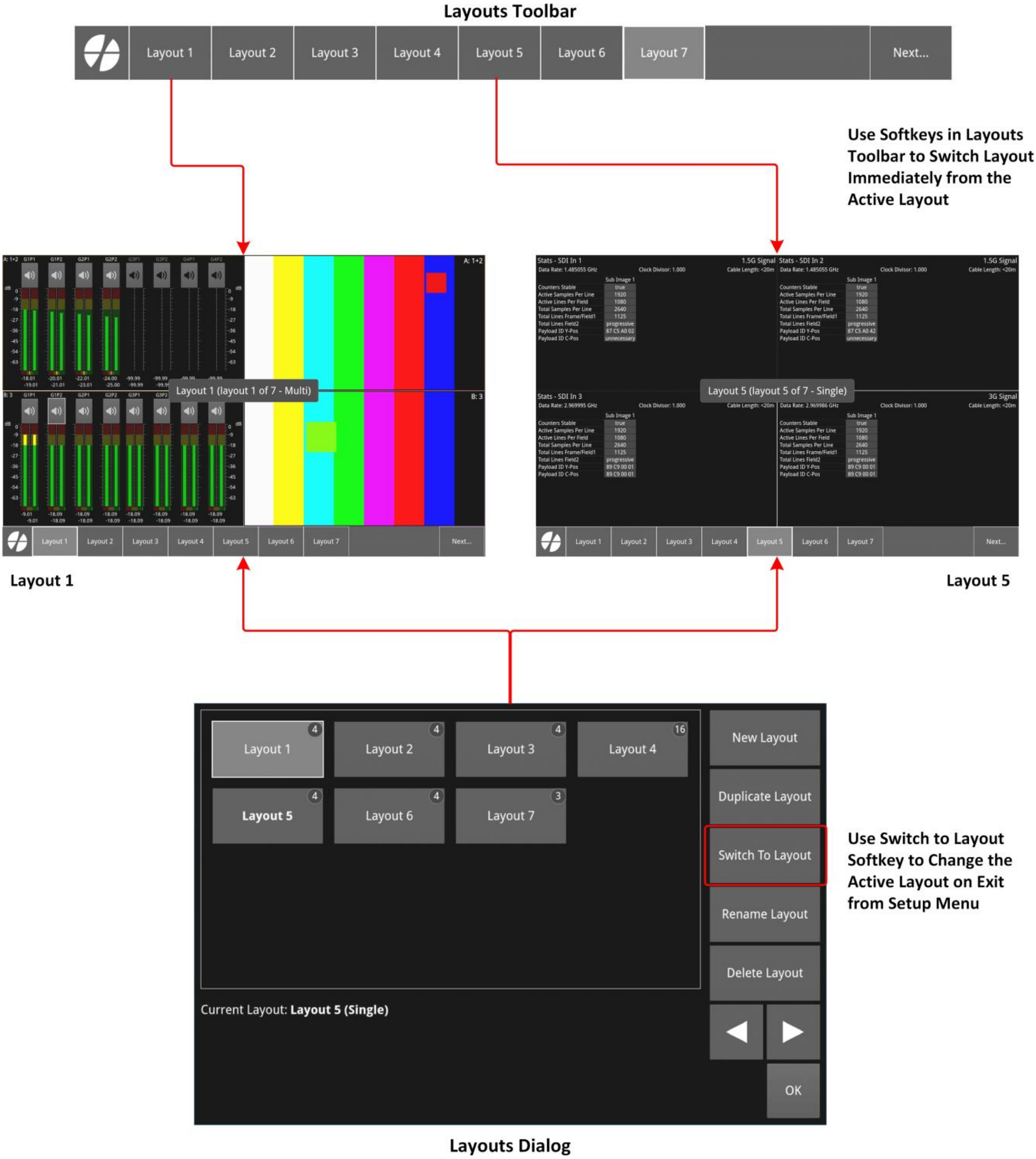
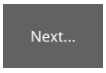
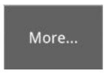


Figure 2-75: Navigating Through Layouts Using the Layouts Dialog or Layouts Toolbar

To navigate through the available layouts on the touchscreen, open the layouts toolbar and tap the desired softkey. On a remote display (DisplayPort or noVNC) move the mouse cursor to the bottom of the screen, navigate to the layouts toolbar, then select the desired softkey.

> **Note:** You can use the layouts dialog and toolbar by touch or the mouse cursor.

To change the active layout using the Layouts toolbar:

1. Tap or click the  softkey until the Layouts toolbar is displayed.
2. Tap or click the softkey representing the layout you want to display.
3. If you have configured more than nine layouts, you may need to tap or click the  softkey to display additional softkeys.

You can manage your layouts, including changing the order of softkeys displayed in the layouts toolbar, using the layouts dialog in the Settings tab. In addition, you can create new layouts or duplicate existing layouts for modification. Once you have added a layout, you can continue to add further empty layouts, as required, until you reach the maximum number of 16.

To open the layouts dialog:

1. Tap or click  to open the Setup menus and open the Settings tab.
2. Tap or click Layouts to open the layouts dialog.

For more information on the layouts dialog, see *Managing Layouts Using the Layouts Dialog*.

Navigating in Unlocked or Locked Layouts

To secure your layout configuration, you can lock it using the  softkey in the toolbar or  in the Setup Menus. This locks the position and size of all instruments in all configured layouts.

When locked, you can navigate between available layouts but certain actions are prevented such as opening the Layouts dialog in the Settings tab, adding instruments, closing instruments, adding new layouts, etc. Furthermore, you can resize an instrument to full-screen size and, using the rotary control, swipe or click to switch between all instruments in the layout, which will be shown at full- screen size. Navigating using swipe or click to the next or previous layout is prohibited when the layout contains more than one full-screen instrument with the layout lock enabled. You can, however, still use the Layouts toolbar to navigate to another layout, if necessary. See the section *Locking and Unlocking Layouts*. You can unlock the layout at any time.

Layout Identification Messages

When you navigate to a different layout screen, the unit briefly displays the layout name, mode, and its position relative to other layouts, as a tooltip in the center of the screen, for example:

To identify the mode of your active layout, tap the softkey representing the active layout (the highlighted softkey with bold font) and the unit displays the identification message in the center of the screen.

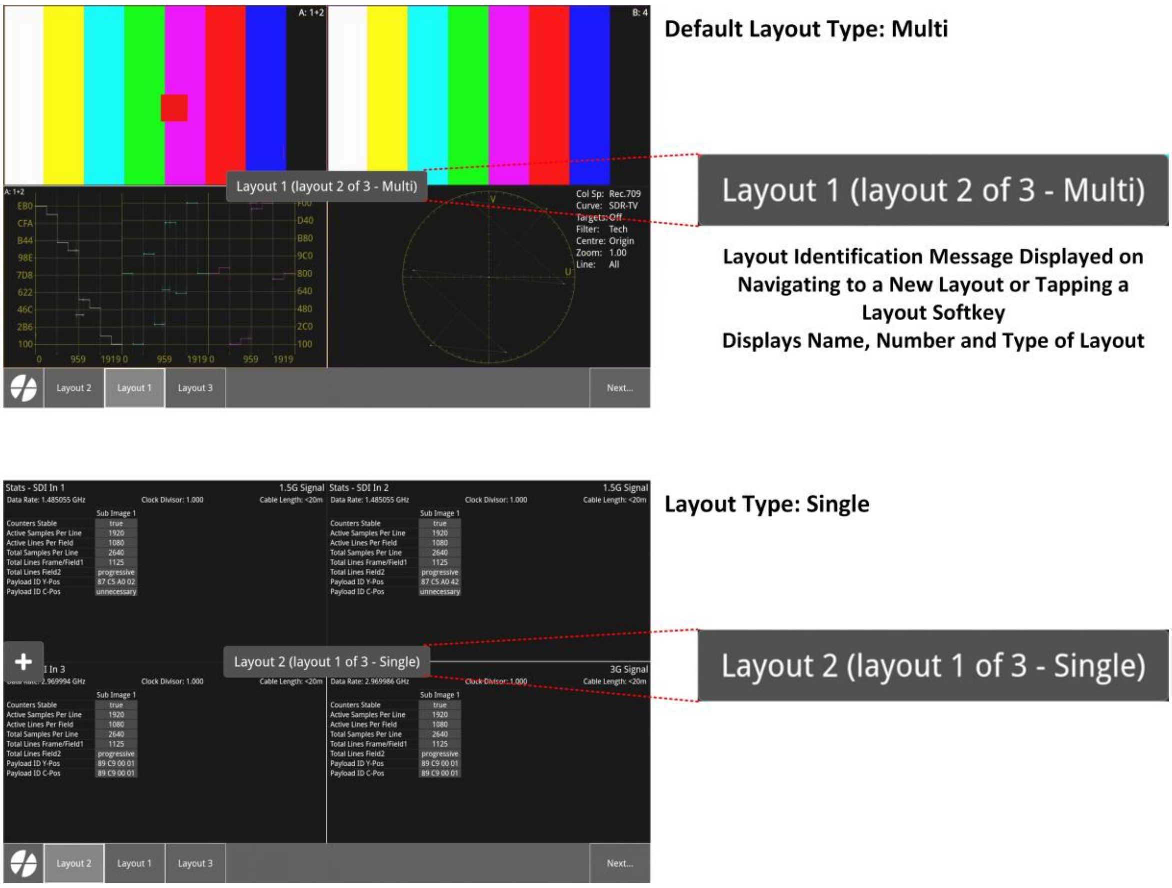


Figure 2-76: Messages Identifying the Current Active Layout (Dual Analyzers)

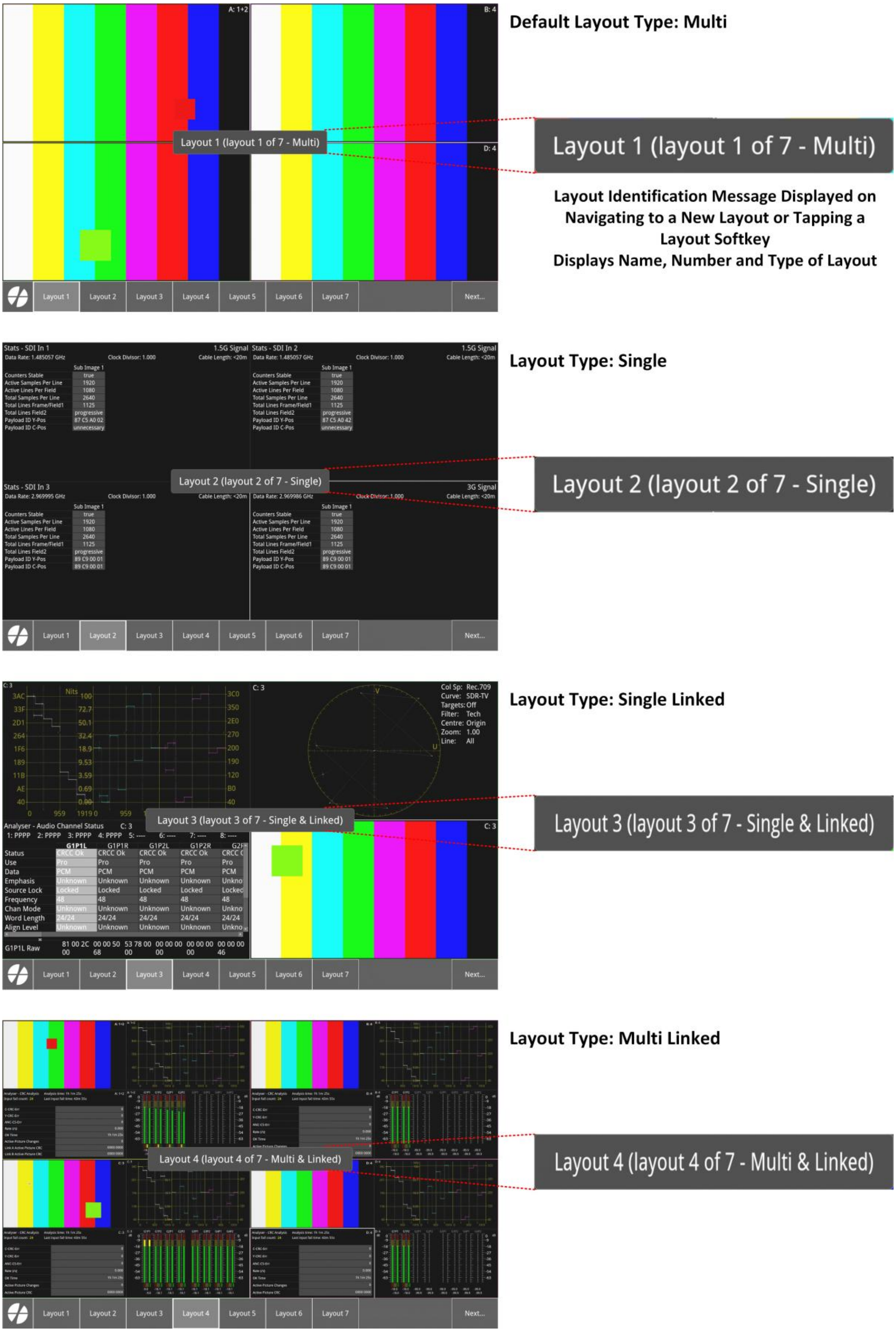


Figure 2-77: Messages Identifying the Current Active Layout (QuadAnalyzers)

You can open the same instrument in different layouts; however, the instrument settings are the same in all layouts and the only active instance of the instrument is that in the currently selected, active layout.

> **Note:** A Preset may contain up to **16** layouts or, if the optional second screen is included, **32** layouts (16 per screen). When you load a preset you will also load the layouts associated with that preset.

If you have already configured the maximum number of layouts, then to add another layout, either delete an old or unused layout, or adapt the configuration of an existing layout.

Locking and Unlocking Layouts

When satisfied with the configuration and instruments available in your layout, you can lock the layout to prevent accidental changes using either the softkey Lock Layouts in the toolbar or the lock icon at the top-left of the screen in the Setup menus.

> **Note:** This action locks ***all*** layouts, including any on the optional second screen, not only the active layout.

An **unlocked** layout:

- Appends any newly added instruments to the favorites toolbar of the active layout, even if not included in your favorites list, for ease of identification (e.g., when hidden behind another instru- ment.)
- Matches the favorites toolbar to the instruments in the active layout when switching between layouts (including instruments already in the favorites list.)

  > **Note:** If you apply default settings, the unit removes only those instruments from the favorites toolbar that are not included in your favorites list.

- Allows you to move instrument windows.
- Allows you to add new layouts of any mode.
- Allows you to delete or rename layouts.
- Allows you to access the **Layouts** dialog to manage layouts.
- Allows you to add new instruments to a layout or remove

instruments. A **locked** layout:

- Allows you to navigate through all existing layouts.
- Prevents accidental changes to instrument window positions when swiping the touchscreen to navigate between layouts.
- Configures the favorites toolbar to show only the instruments in the active layout when switch- ing between layouts (excluding instruments in the favorites list unless used in the

  > **Note:** If you apply Default Settings to a unit with a locked layout, the unit removes any instrument shortcuts that were not originally included in the Instrument Favorites toolbar

  layout).

  > **Note:** When you apply Restore Default Settings, the unit returns to an unlocked layout state.

- Allows you to toggle the size of an instrument window between its current size and full-screen size and back with no intermediate sizes (excluding linked layouts on optional quad analyzer units.)
- Enables you to scroll left or right through full-screen size instruments either by turning rotary control to the left or right, swiping left or right, or tapping / ◀ or ▶.
- Prevents you from closing open instruments until you unlock the

- Prevents users from adding new instruments until unlocked.
- Prevents users from adding new layouts until unlocked.
- Prevents access to the Layouts dialog until unlocked.

To lock or unlock the layout, toggle either the Lock / Unlock Layouts softkeys in the toolbar or the padlock icon in the Setup menus:

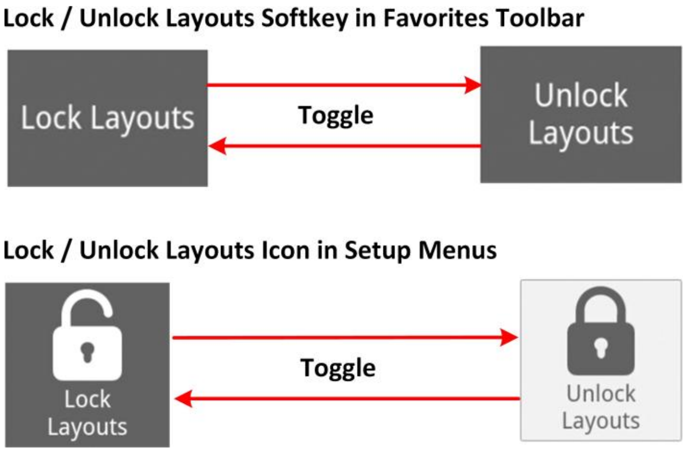


Figure 2-78: Toggling the Lock / Unlock Layouts Softkey and Icon

To add a new layout, first unlock the layout using one of the available methods.

When you lock a layout, the Layouts dialog launcher in the Settings tab is grayed-out and no longer available:

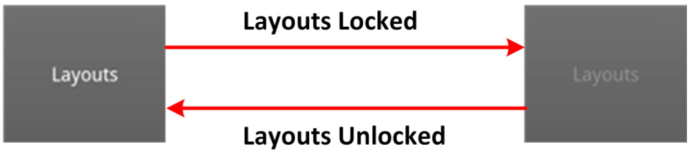


Figure 2-79: Accessing the Layouts Dialog when Layouts Locked or Unlocked

Managing Layouts Using the Layouts Dialog

Overview

As previously described, layouts enable you set up a series of screen layouts to the left or right of your initial screen.

Instead of adding a new layout by swiping to the extreme left or right of your operational layouts to add a new layout, you can add empty layouts in the **Layouts** dialog from the Settings tab.

To access the **Layouts** dialog, tap or click  to display the Setup menus, open the **Settings** tab and select **Layouts**.

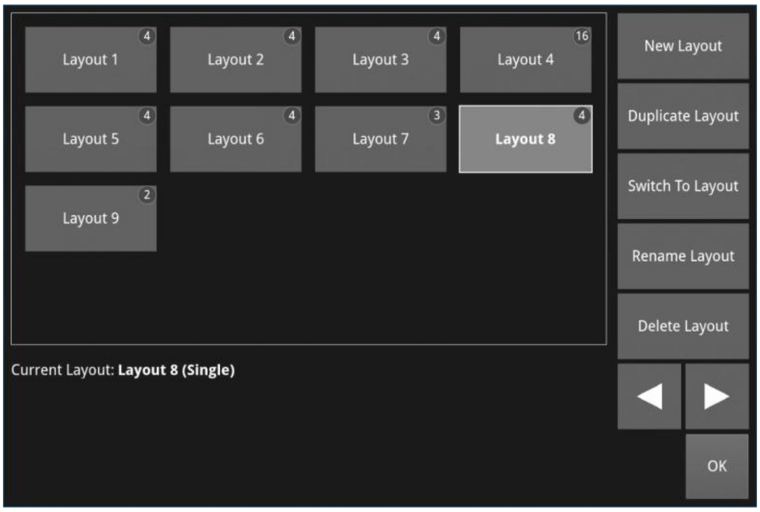
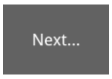


Figure 2-80: Adding a New Layout From the Layouts Dialog

You can create multiple new layouts, as required, using the New Layout softkey or by copying an existing layout using Duplicate Layout. This enables you to build a library of up to 16 bespoke layouts per screen (with the optional second screen) tailored to your specific operational tasks. The unit displays each new layout in both the Layouts toolbar and the Layouts dialog.

To access the **Layouts** toolbar from the active layout, tap or click 

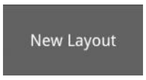
until the Layouts toolbar is displayed.

Figure 2-81: Accessing Layouts from the Layouts Toolbar

Note: If you have created more than nine layouts, you may need to tap or click 

to click

Standard Dual Analyzer Units

Create a new layout by tapping:  in the Layouts dialog.

The **New Layout Configuration** dialog opens, where you can choose the type of layout required.

Adding Multi Layout Type (Default) **Adding Single Layout Type**

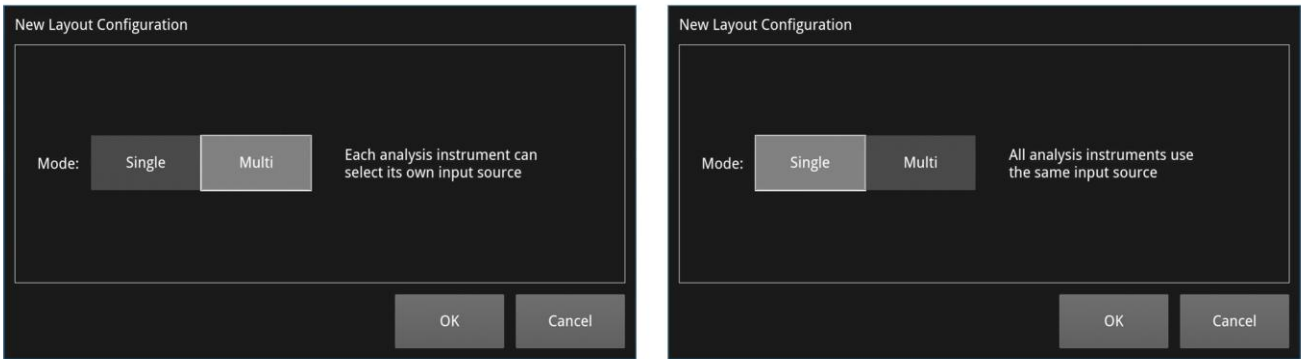


Figure 2-82: Adding a New Layout Using the New Layout Configuration Dialog

At this point you need to choose between **Single** or **Multi** layout modes, depending on how you want to set up your analysis instruments and how to display the layouts with the source inputs associated with the analyzers.

After validating the selection, the unit adds a layout to the next available position of the dialog. The new layout initially contains no instruments. You will notice that this action also adds a softkey to the Layouts toolbar with the same label. You can now use the dialog controls to change the name of the layout, or its position in the series. You can add as many layouts as you need, up to the maximum of **16**, and then populate them with instruments when needed.

You can also add a new layout by swiping left or clicking  or  on the first layout or right on the last active layout as shown in the following figure.

> **Note:** Swiping away from a newly created empty layout, using the method above, removes the empty layout from the list. Layouts can only be added in Layout unlocked mode. When you have created fewer than 16 layouts you can create more layouts.

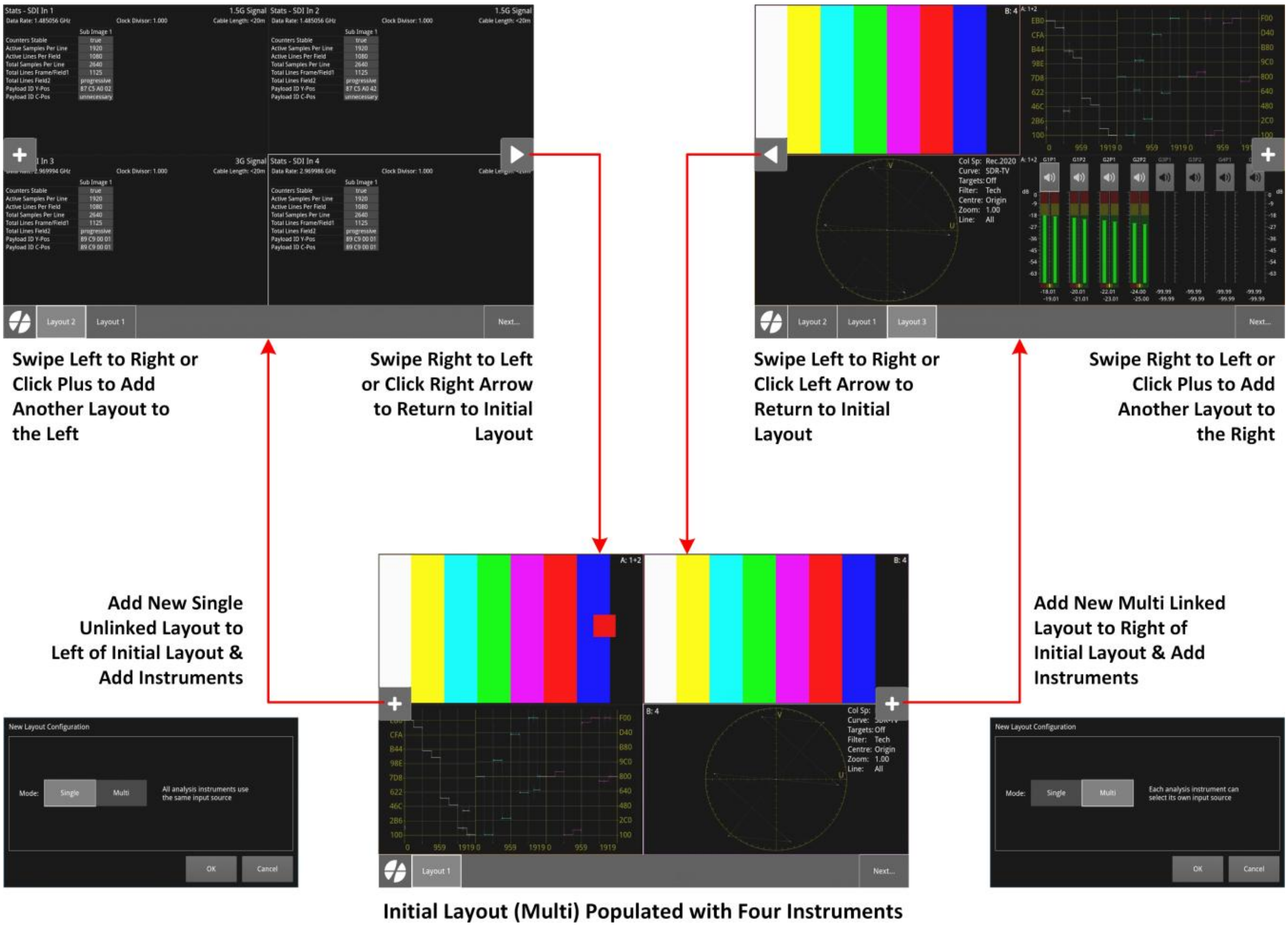
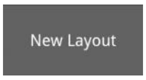


Figure 2-83: Adding New Layouts from the First Default Layout (Dual Analyzers)

Units with Optional Quad Analyzers

Create a new layout by tapping: 

in the Layouts dialog.

The **New Layout Configuration** dialog opens, where you can choose the type of layout required.

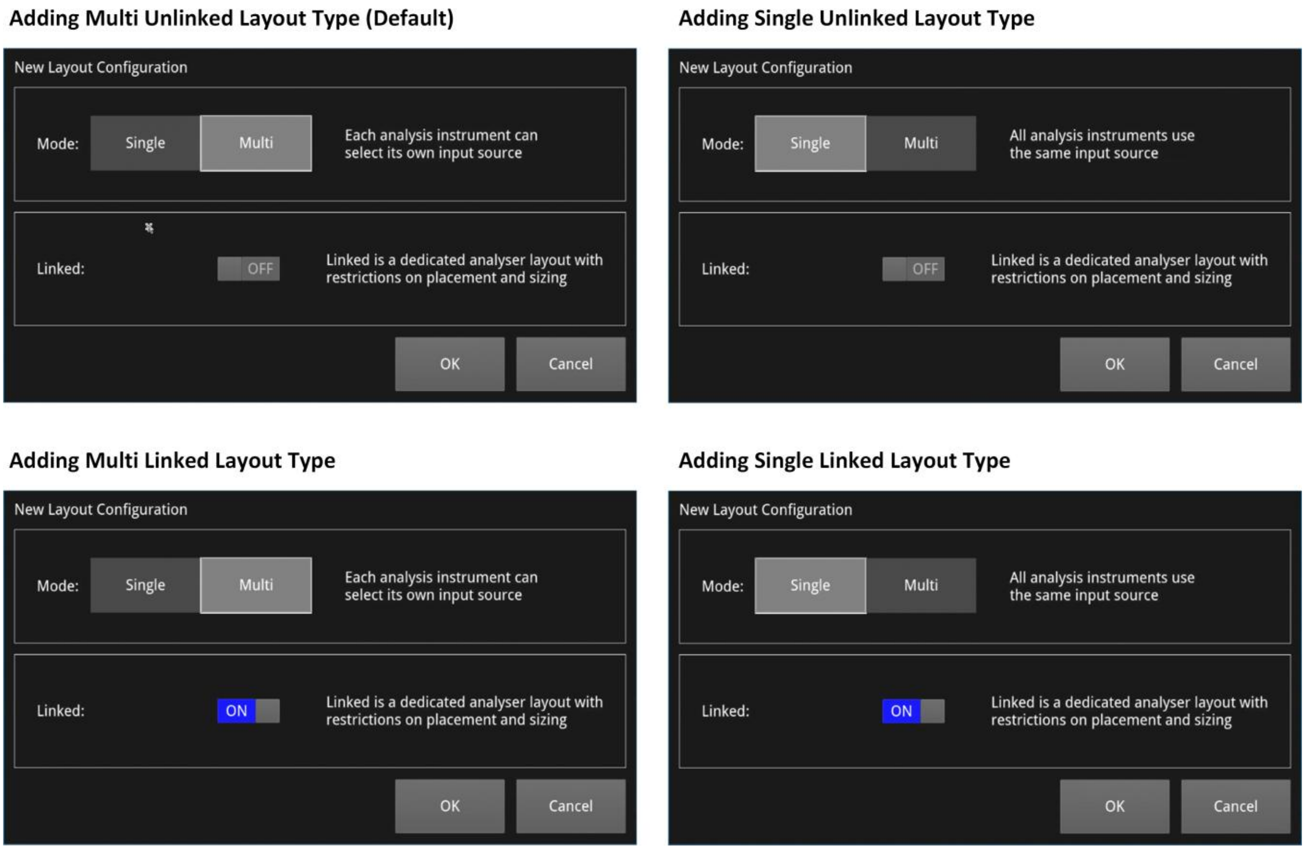


Figure 2-84: Adding a New Layout Using the New Layout Configuration Dialog (Quad Analyzers)

At this point, depending on how you want your analysis instruments to be set-up, and layouts to be displayed, using the source inputs associated with the analyzers, you need to choose:

- Between **Multi** (default) or **Single** layout mode
- Whether to **Link** single and multi modes. Layouts on a quad analyzer unit are unlinked by default but linking enables quick switching between multi and single modes.

After validating the selection, the unit adds a layout to the next available position of the dialog. The new layout initially contains no instruments. You will notice that this action also adds a softkey to the Layouts toolbar with the same label. You can now use the dialog controls to change the name of the layout, or its position in the series. You can add as many layouts as you need, up to the maximum of **16**, and then populate them with instruments when needed.

You can also add a new layout by swiping left or clicking  or  on the first layout or right on the last active layout as shown in the following figure.

> **Note:** Swiping away from a newly created empty layout, using the method above, removes the empty layout from the list. Layouts can only be added in Layout unlocked mode. When you have created fewer than 16 layouts you can create more layouts.

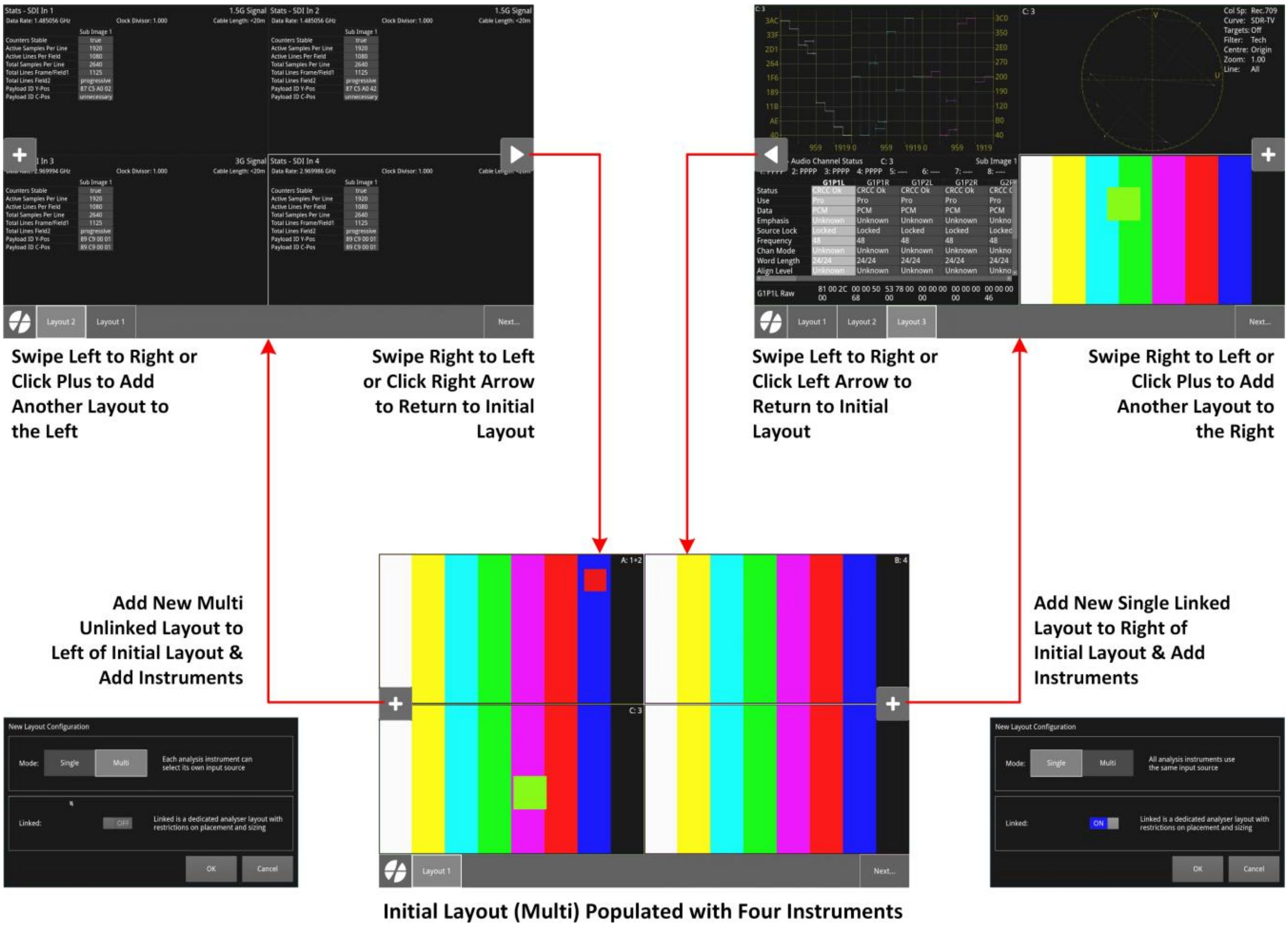


Figure 2-85: Adding New Layouts from the Initial Default Layout (Quad Analyzers)

Working with the Layouts Dialog

To access the **Layouts** dialog, tap or click to display the Setup menus, open the **Settings** tab and select **Layouts**.

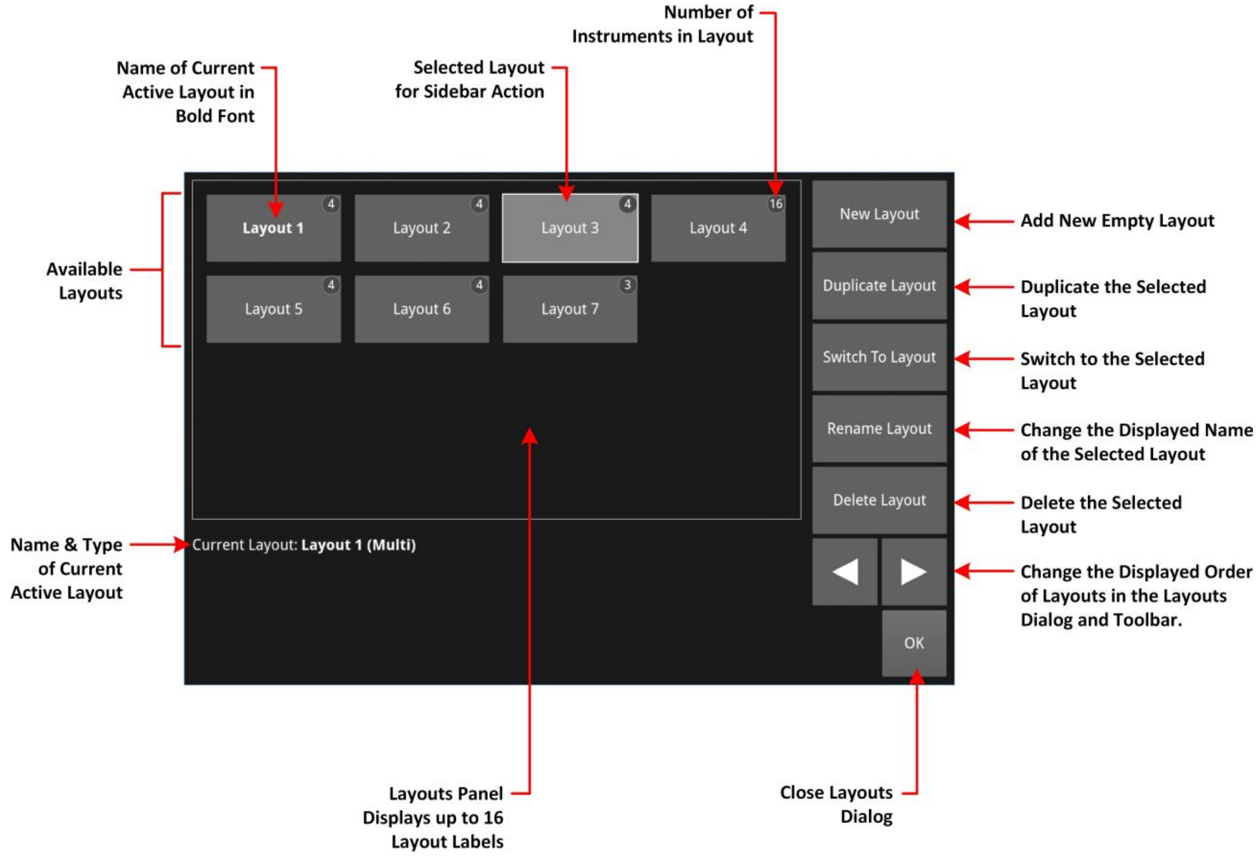


Figure 2-86: Layouts Dialog and Controls

The Layouts dialog provides an overview of all currently defined layouts. The name of the current active layout is displayed in a bold font on the layout label and also below the layouts panel.

You can use the Layouts dialog to manage the softkey labels displayed in the layouts toolbar. The number displayed in the top-right corner of each layout label represents the number of instruments currently defined in that layout. When you add a new layout in the Layouts dialog, you will see **0** (zero) displayed in the layout label, indicating a layout without any instruments.

Using the layout controls at the right-hand side of the panel, you can do the following:

- Create a new empty layout.
- Duplicate an existing layout for later modification.
- Switch to the selected layout. You will see the name of the selected layout displayed in the lower section of the dialog and when you return to the operational view, this layout will be act- ive. Whenever you switch to the Setup menu, you will see the name of the active layout dis- played in the top-left of the screen below the Lock / Unlock Layouts icon.
- Rename a layout label; the changed name is displayed in the Layouts dialog, at the top left of the Setup menu, and in the corresponding softkey of the Layouts toolbar.
- Delete a layout that is no longer required.

> **Note:** This action cannot be reversed.

- Change the displayed order of a layout in the Layouts dialog and toolbar using the left and right arrow keys: ◀ ▶.

After adding the maximum number of layouts (**16**) the dialog controls are grayed-out and can no longer be used to add or duplicate a layout.

If you load a preset from the presets dialog, then the layouts in the dialog are those that were defined when you saved the preset, including those defined for the optional second display, if available.

> **Note:** The controls at the right-hand side of the layouts panel become active once you select a layout label in the layouts panel. The **New Layout** control is active until you configure the maximum number of layouts (16).

Adding a New Layout

Add a new layout placeholder to the set displayed in the layouts panel and toolbar.

From the layouts dialog in the Settings tab, select New Layout.

This opens the New Layout Configuration dialog where you can define the type of layout required. The unit places a label in both the layouts panel and the layouts toolbar.

You can now select the new layout then use Switch To Layout to make the empty layout screen active, into which you can launch various combinations of instruments according to the type of layout you have chosen.

By default, this action adds the new layout label to the last position in the Layouts panel and toolbar and automatically labels each layout sequentially as **Layout 1**, **Layout 2**, **Layout 3**, etc.

If necessary, use Rename Layout to change the layout name.

Duplicating an Existing Layout

A quick way to define a new layout is to duplicate an existing layout and then change the open instruments in that layout.

From the **Layouts** dialog available in the **Settings** tab of the Setup menus, select one of the existing layouts to duplicate then tap or click: Duplicate Layout.

When you duplicate a layout, the unit adds the new layout label next to the one being duplicated and appends ***-n*** to the text of the label, where ***n*** is an incremented number, starting with **2**.

Switching to a Different Layout

When working with layouts in the layouts dialog, you can tap or click Switch To Layout to switch the current active layout immediately in the operating view to the selected layout. You will see the string below the layouts panel change to show the name of the selected layout and the label of the layout displayed in bold font. The layout name displayed in the top-left of the Setup menu also changes.

After switching layout, you can duplicate, rename or re-position the layout in the layouts dialog. Press

OK to close the dialog, then you can add instruments to the layout or edit the layout in the operating view.

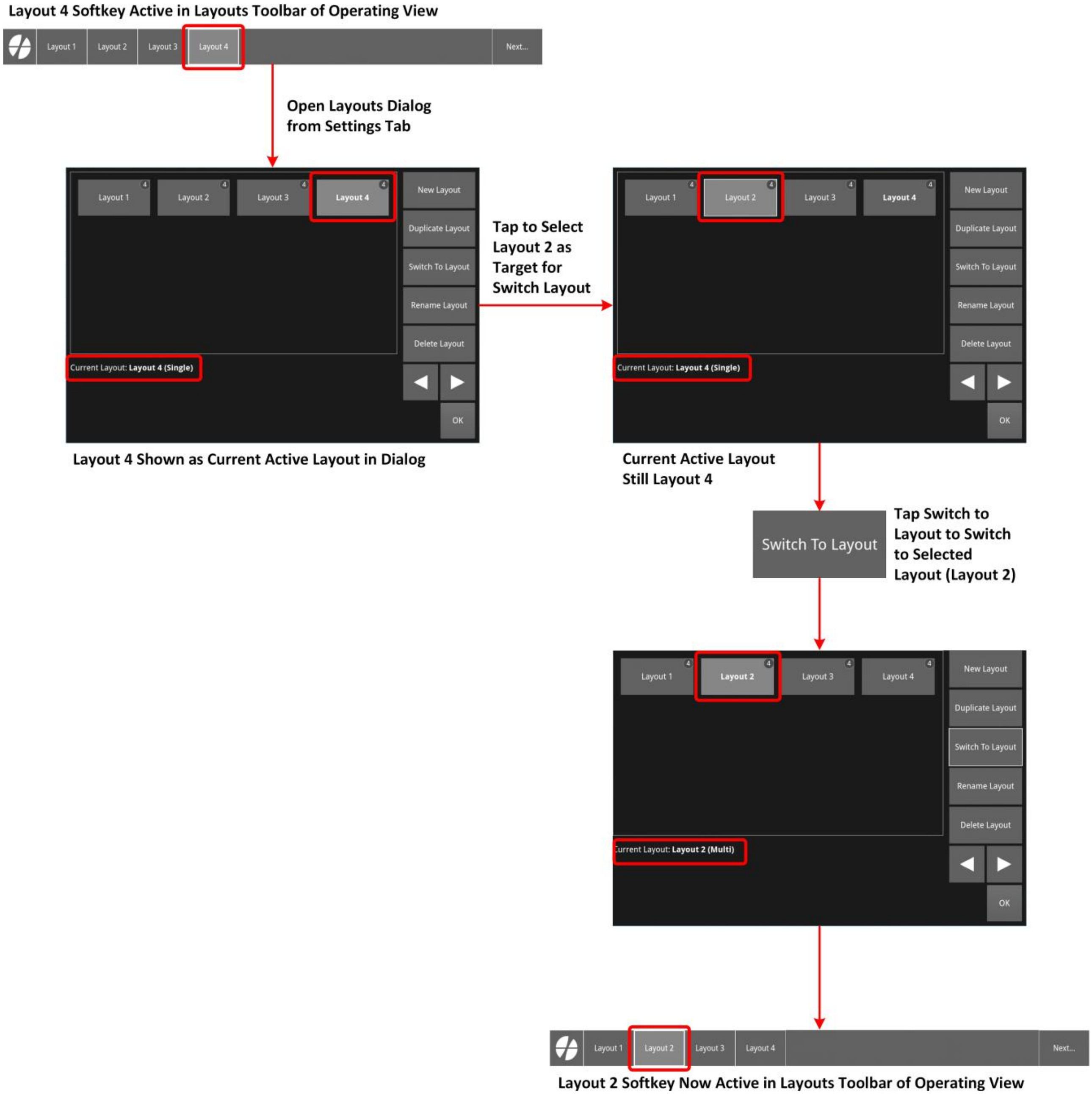


Figure 2-87: Switching Active Layout from the Layouts Dialog

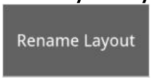
Renaming a Layout

> **Note:** You can use either the on-screen keyboard, a noVNC connection, or a USB keyboard connected to one of the USB ports of the unit to edit the name of an existing layout. The on- screen keyboard is displayed when enabled in the Display Settings.

To rename a layout:

- Tap or click to display the Setup menus, open the **Settings** tab then select **Layouts** to open the layouts dialog.

- Select the layout you would like to rename from those available in the layouts panel.

  Select 

and enter the new name in the text field using either the on-screen or a USB key- board. Tap or click **OK** in the New name dialog to save your changes.

  The existing layout settings are saved under the new name.

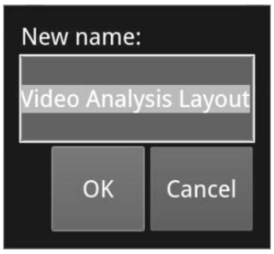
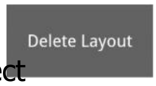


Figure 2-88: Rename Layout Dialog

Deleting a Layout

To delete a Layout:

- Tap or click  to display the Setup menus, open the **Settings** tab then select **Layouts** to open the layouts dialog.

- Select the layout you would like to delete. Select 

and then select **Delete** in the con- firmation dialog. If you decide not to delete the layout, select **Cancel**. Tap or click **OK** to close the layouts dialog.

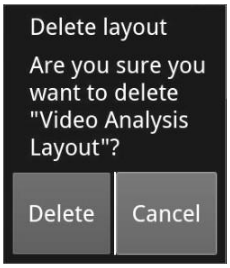


Figure 2-89: Delete Layout Confirmation Dialog

> **Note:** Deleting a layout cannot be undone.

Reordering a Layout in the Toolbar and Layouts Dialog

To change the displayed order of layouts and of the layout softkeys in the layouts toolbar:

- Tap or click to display the Setup menus, open the **Settings** tab then select **Layouts** to open the layouts dialog. Use the softkeys to change the position of the selected layout label to the left or right in the layouts panel.

  The order you choose is reflected both in the softkeys of the layouts toolbar and in the displayed order of layouts when swiping through the layout series.

Closing Layout Windows

The Close Layout Windows softkey in the toolbar closes **all** open instruments in the active layout, leaving an empty screen. Any instruments running in other layout screens remain

> **Note:** This operation is not reversible so you will either need to open new instruments for the active layout, or reload the preset including that layout (if previously saved.) The Close Layout Windows softkey is available only when the layout is unlocked.

open.

Managing Multiple Analyzers

Overview

The standard LPX500 unit is equipped with two analyzers enabling the analysis instruments of the standard unit to analyze two, single link SDI inputs simultaneously. Software option **LPX500-QUAD**, extends the unit to four analyzers, enabling analysis of four, single link SDI inputs simultaneously.

The unit supports the input of the following SDI standards:

- SD, HD, 3G, 6G, 12G.

The SDI source inputs are connected to the four, physical BNC SDI input connectors on the rear panel (**SDI In 1** through **SDI In 4**).

For both dual and quad analyzer systems you can connect any of the following SDI source inputs to the rear panel SDI connectors:

- Four single SDI inputs (each up to 12G): SDI In 1, 2, 3, or 4
- Two dual input links: SDI In 1 and 2, or SDI In 3 and 4
- One quad input link: SDI In 1, 2, 3, and 4.

You can assign a combination of the SDI inputs to the unit's analyzers within the limitations of the licensed configuration of your unit.

Once connected to the unit, you can decide which of the inputs you want to analyze by assigning the source inputs to the analyzers using the **Analyzer Input Assignment** dialog from the Settings tab.

Figure 2-90: Analyzer Input Assignment Launcher in the Settings Tab

Assigning Source SDI Inputs to Analyzers

To enable your analysis instruments to evaluate the SDI source inputs, you need to assign each of up to four physical inputs to the SDI In BNC connectors on the rear panel to the two (or optionally four) analyzers.

To do so, launch the Analyzer Input Assignment dialog from the Settings tab as shown below. In a standard dual analyzer unit, the two analyzers are referred to as:

- **Analyzer A** and
- **Analyzer B**

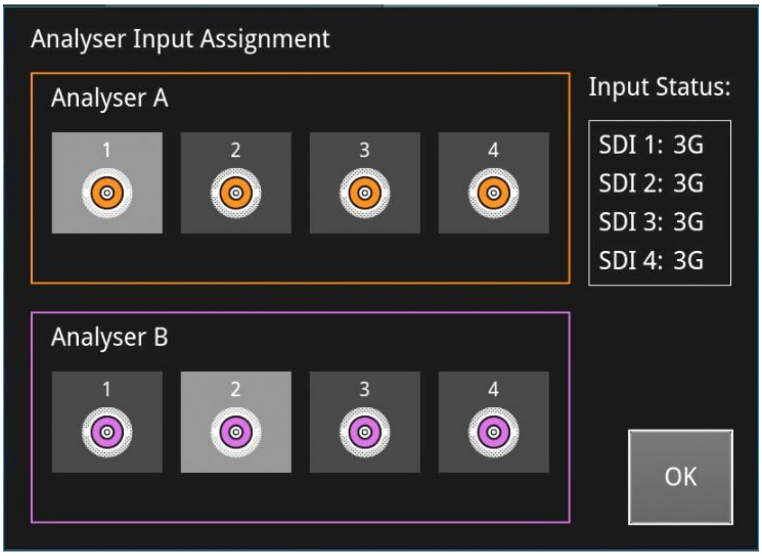


Figure 2-91: Analyzer Input Assignment Dialog Standard Dual Analyzer Unit

In an optional quad analyzer unit, the four analyzers are referred to as:

- **Analyzer A**
- **Analyzer B**
- **Analyzer C** and
- **Analyzer D**

Figure 2-92: Analyzer Input Assignment Dialog Optional Quad Analyzer Unit

Each analyzer block in the input assignment dialog displays four *connector icons* representing the SDI input BNC connectors on the rear panel. When there is a signal on a particular input you will see that the middle ring of the connector icon displays the same color assigned to that analyzer in the Display Settings and also used for the border of the analysis instrument windows used by that analyzer.

To assign an SDI input to an analyzer, tap or click the connector icon corresponding to the physical connector on the rear panel. When assigned, the connector icon takes on a light-gray background which changes back to dark-gray when unassigned.

Table 2-5 : Connector Status Changes in the Analyzer Input Assignment Dialog

Connector Icon	SDI Input Status
	Valid SDI input connected to SDI In 1; not assigned in the input assignment dialog.
	Valid SDI input connected to SDI In 1 and assigned (selected) in the input assignment dialog.
	No (or invalid) input to SDI In 1 and unassigned.
	No (or invalid) input to SDI In 1 but assigned (selected) in the input assignment dialog. You will see the following warning message displayed: **Signal not present on all selected links**

The following figures for dual and optional quad analyzer units show how the physical BNC connectors relate to the analyzer input assignment dialog.

Note: A multi-linked layout does not allow analysis of multi-link (DL and QL) signals. With this type of layout the unit treats each signal on the SDI In connectors as a single-link signal.

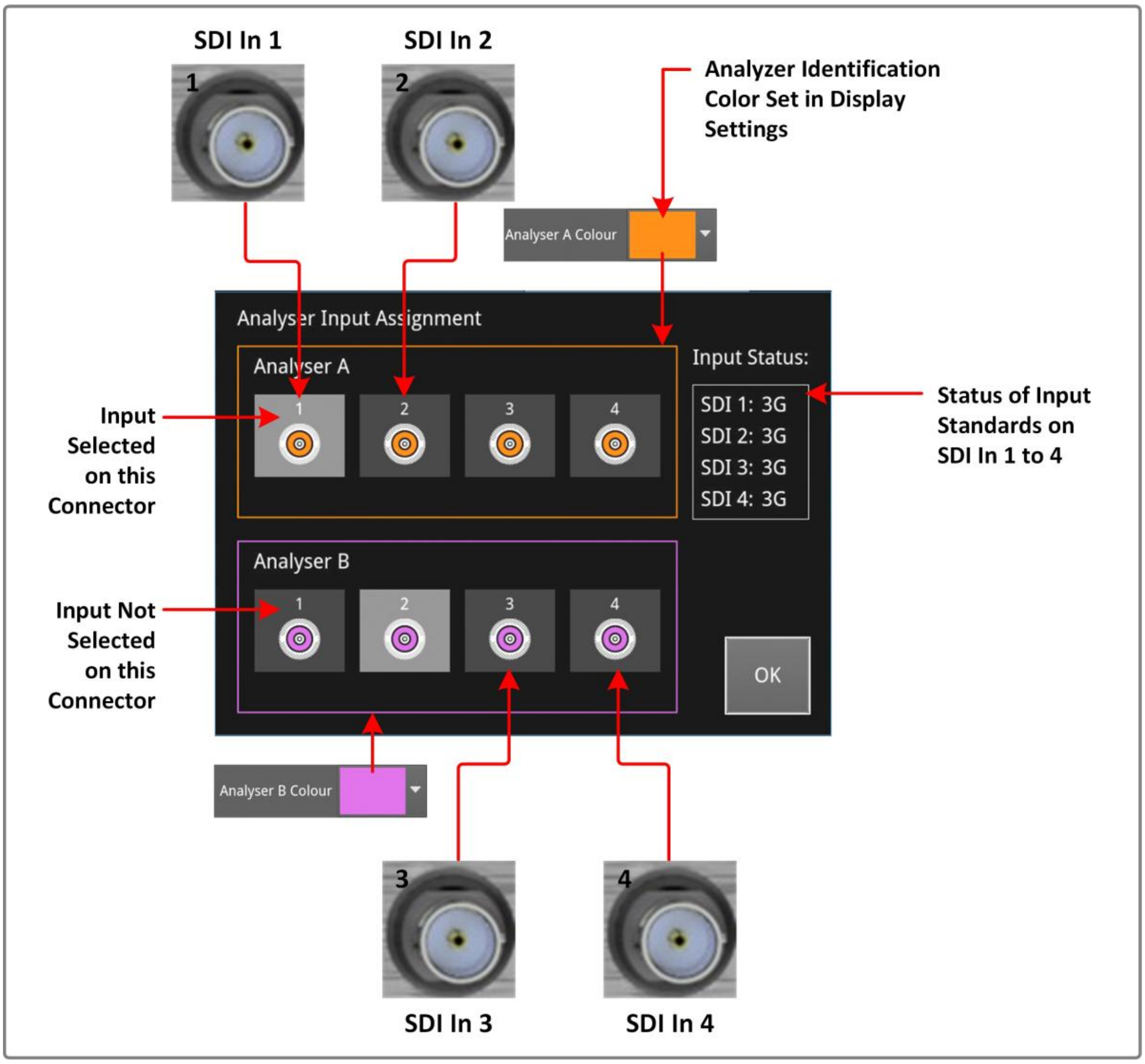


Figure 2-93: Analyzer Input Assignment Dialog Standard Dual Analyzer Unit

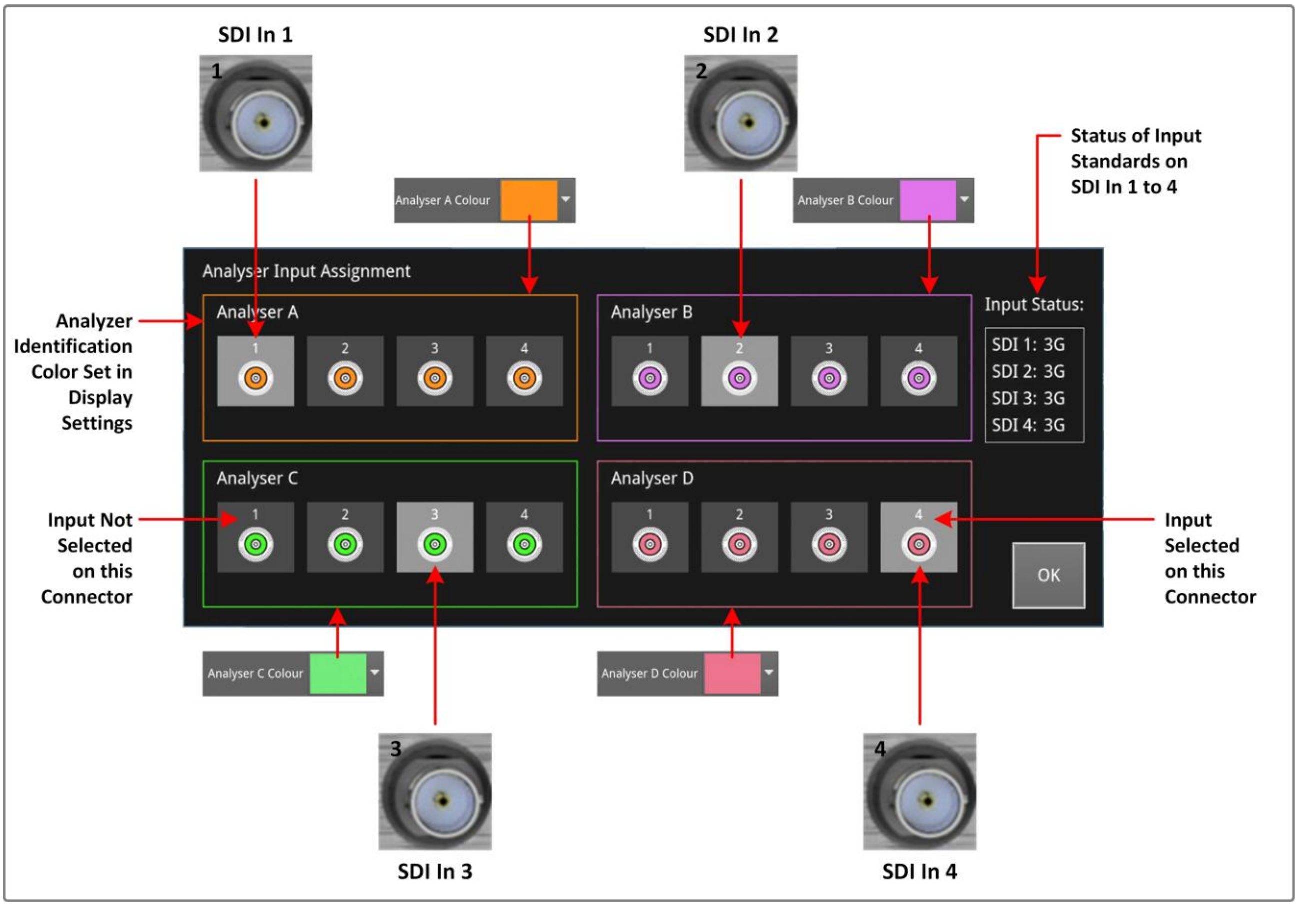
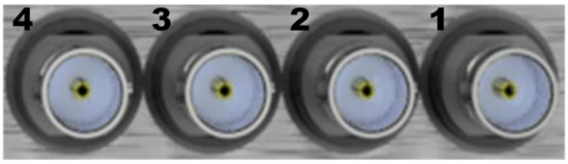


Figure 2-94: Analyzer Input Assignment Dialog Optional Quad Analyzer Unit

When you configure Instruments in your layouts, depending on the type of layout, you can configure the analyzer assignment using various different methods after setting up the analyzer source input assignment, see the section *Working with Layouts* .This is also shown in the following figures *Figure 2-93* and *Figure 2-95*

> **Note:** The Analyzer Input Assignment is a system setting and as such all analyzer instruments in all layouts are affected by any changes you make to the source input assignment. The source input assignment is implemented immediately on selecting the BNC connector icon.

Physical BNC Input Connectors on Rear Panel

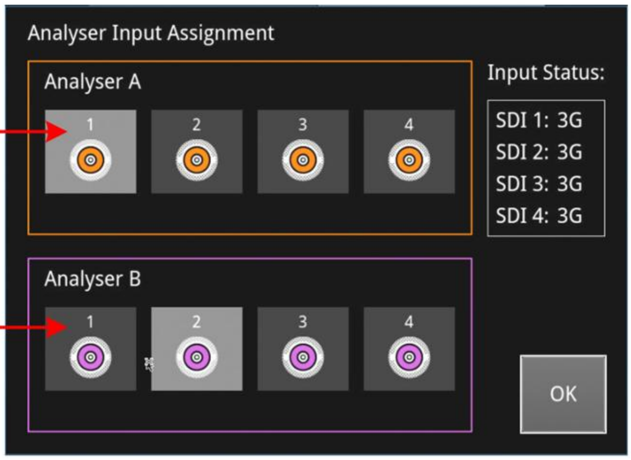


Up to Four SDI Inputs
(4 x Single, 2 x Dual, or 1 x Quad)

Launch Analyzer Input Assignment from Settings Tab

Selected

Unselected

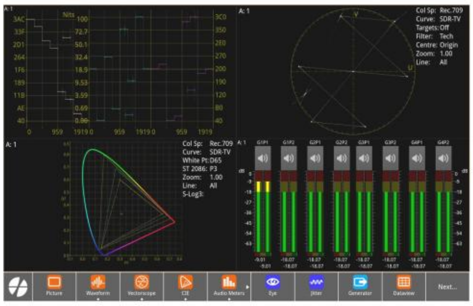


Use to Select Which Physical SDI Inputs are Assigned to Analyzers A and B
In this Example:
SDI In 1 is Assigned to Analyzer A,
SDI In 2 is Assigned to Analyzer B,
SDI In 3 and SDI In 4 have Active SDI Inputs but are Unassigned

Define Layout(s)

Available Layout Types

Single Layout



All Analyzer Instruments Use the Same Analyzer Input Source

Multi Layout

Each Analyzer Instrument Can Select Source Input from Either Analyzer

Note: No Linked Layouts Available with Dual Analyzers

Figure 2-95: Assigning Source Inputs to Analyzers (Standard Dual Analyzers)

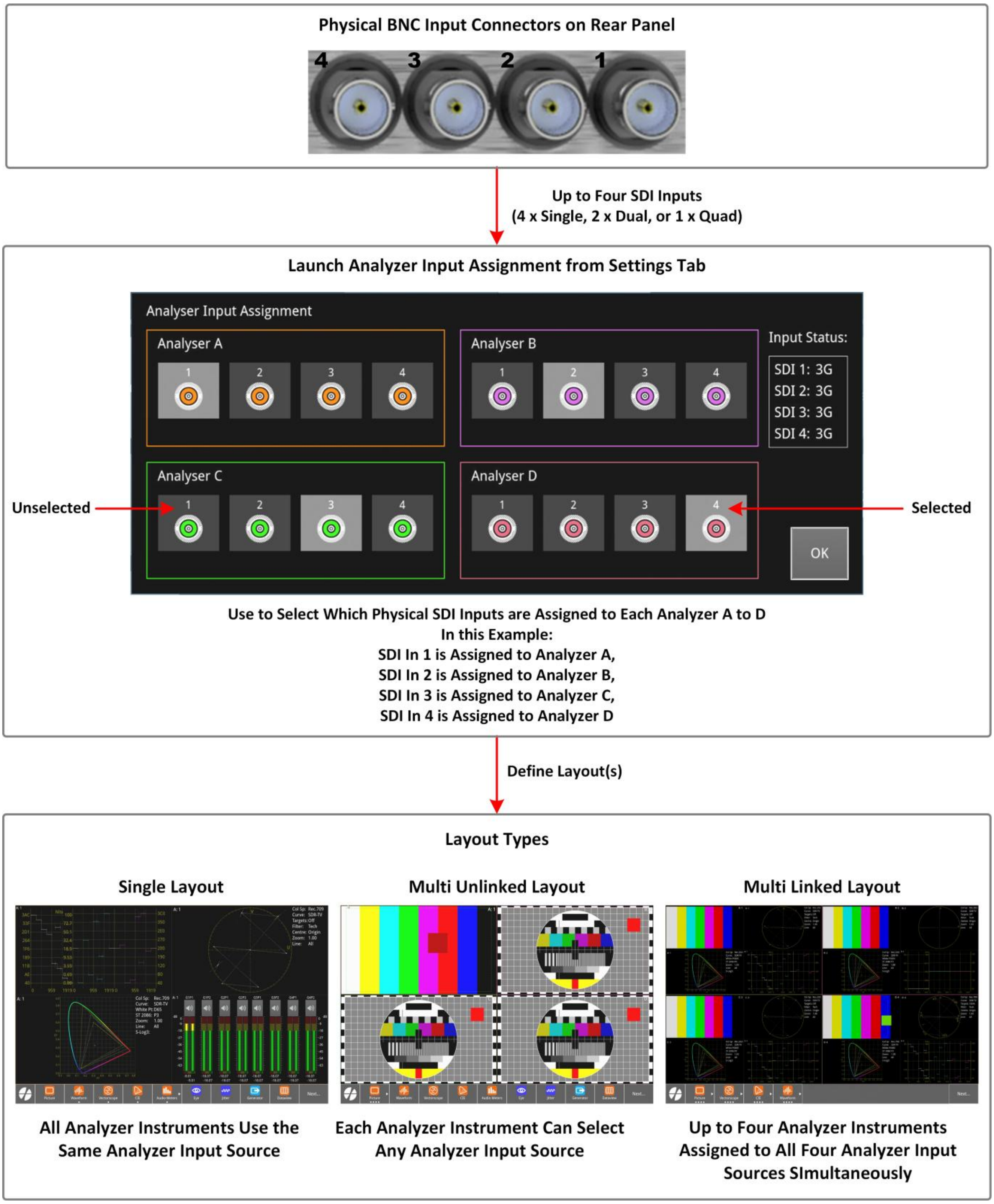


Figure 2-96: Assigning Source Inputs to Analyzers (Optional Quad Analyzers)

Using Single Link SDI Source Inputs

With a standard dual analyzer unit, you can connect four single link SDI signals to the BNC connectors **SDI In 1 to 4** on the rear panel.

When assigning SDI signals to the analyzers, however, you can assign only two of the source inputs to the analyzers for simultaneous analysis. Each single link SDI source input can be assigned to any analyzer, giving multiple combinations including:

- A: 3 and B: 4;
- A: 1 and B: 3;
- A: 2 and B: 4;
- A: 4 and B: 1, etc.

For example, you might assign the signal on SDI In 1 to Analyzer A and the signal on SDI In 2 to Analyzer B as follows:

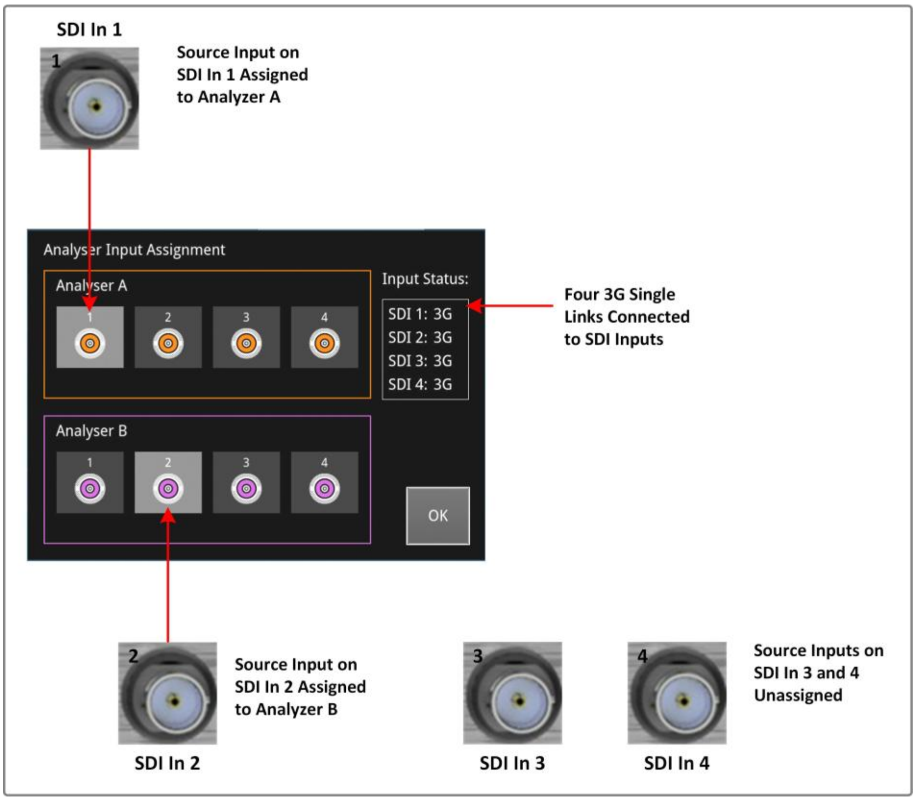


Figure 2-97: Assigning Single Link Source Inputs to Analyzers (Standard Dual Analyzers)

With an optional quad analyzer unit, you can connect four single-link SDI signals to the BNC connectors **SDI In 1 to 4** on the rear panel.

When assigning SDI source inputs to the analyzers you can assign all four source inputs to each analyzer for simultaneous analysis. Each single link SDI source input can be assigned to any analyzer, giving multiple combinations including:

- A: 3, B: 3, C: 3, and D: 3;
- A: 2, B: 2, C: 1, and D: 1;
- A: 1, B: 1, C: 1, and D: 1;
- A: 4, B: 4, C: 3, and D: 3; etc.

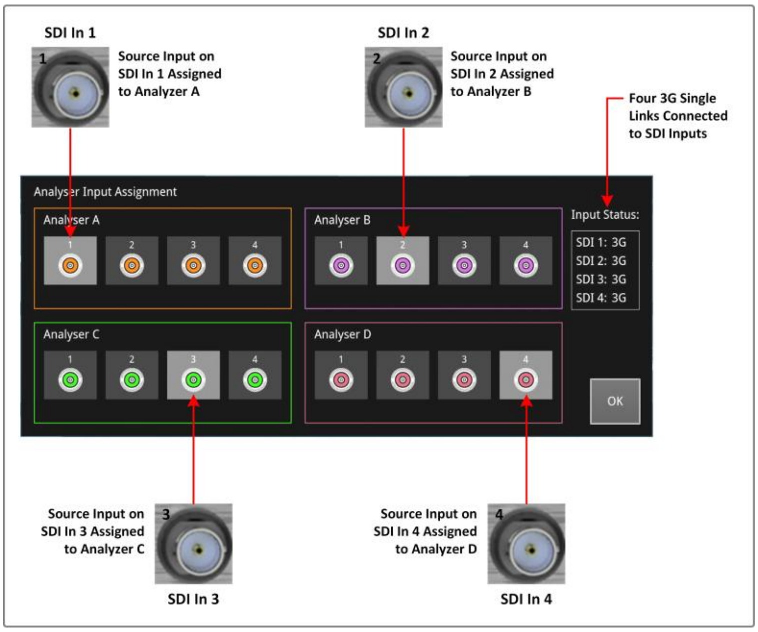


Figure 2-98: Assigning Single Link Source Inputs to Analyzers (Optional Quad Analyzers)

Using Dual Link SDI Source Inputs

With a standard dual analyzer unit, you can connect two dual link SDI signals to the **SDI In 1 to 4** BNC connectors on the rear panel.

To enable the unit to identify the dual link source input, always connect the dual link pairs as follows:

- **SDI In 1 and SDI In 2** or
- **SDI In 3 and SDI In 4**

Similarly, in the analyzer input assignment dialog, assign the pairs for an analyzer as **1 + 2** or **3 + 4** only. If you try other combinations with a dual link input, you will receive an **Invalid Selection** error message.

When assigning SDI source inputs to the analyzers, however, you can assign only two of the source inputs for simultaneous analysis. For example, you might assign the dual link source inputs on SDI In 1 and SDI In 2 both to Analyzer A as follows:

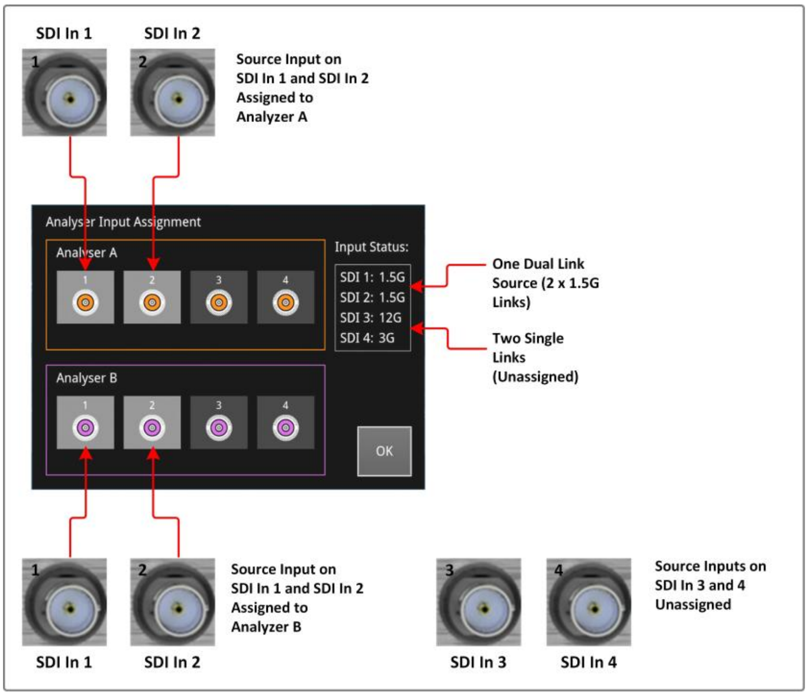


Figure 2-99: Assigning Dual Link Source Inputs to Analyzers (Standard Dual Analyzers)

If you also assign the SDI In 1 and 2 inputs to Analyzer B, as shown above, then you can compare the same dual link video in two picture windows, alongside each other.

You can assign a dual link source input to analyzers in the following combinations:

- Analyzer A: 1+2 or Analyzer A: 3+4
- Analyzer B: 1+2 or Analyzer B: 3+4
- Analyzer A: 1+2 and Analyzer B: 3+4
- Analyzer A: 3+4 and Analyzer B: 1+2
- Analyzer A: 1+2 and Analyzer B: 1+2
- Analyzer A: 3+4 and Analyzer B: 3+4

In a similar way, with optional quad analyzers, you can assign two dual link source inputs to analyzers in the following combinations:

- Analyzer A, B, C, or D only
- Analyzers A, B, C, and D: 1+2

- Analyzers A, B, C, and D: 3+4
- Analyzers A: 1+2, B: 3+4, C: 1+2, D: 3+4
- Analyzers A: 3+4, B: 1+2, C: 3+4, D: 1+2
- Analyzers A: 1+2, B: 3+4, C: 1+2, D: 3+4
- Analyzers A: 3+4, B: 3+4, C: 1+2, D: 1+2
- Analyzers A: 1+2, B: 1+2, C: 3+4, D: 3+4

Using Quad Link SDI Source Inputs

With a standard dual analyzer unit, you can connect one quad link SDI signal to the **SDI In 1 to 4** BNC connectors on the rear panel.

To enable the unit to identify the quad link source input, always connect as follows:

- **SDI In 1, SDI In 2**, **SDI In 3**, and **SDI In 4**

Similarly, in the analyzer input assignment dialog, assign the quad link to an analyzer as **1, 2**, **3** and **4**. If you try other combinations with a quad link input, you will receive an **Invalid Selection** error message.

When assigning SDI source inputs to the analyzers, however, you can assign the quad source inputs either to one or both analyzers for simultaneous analysis, as follows:

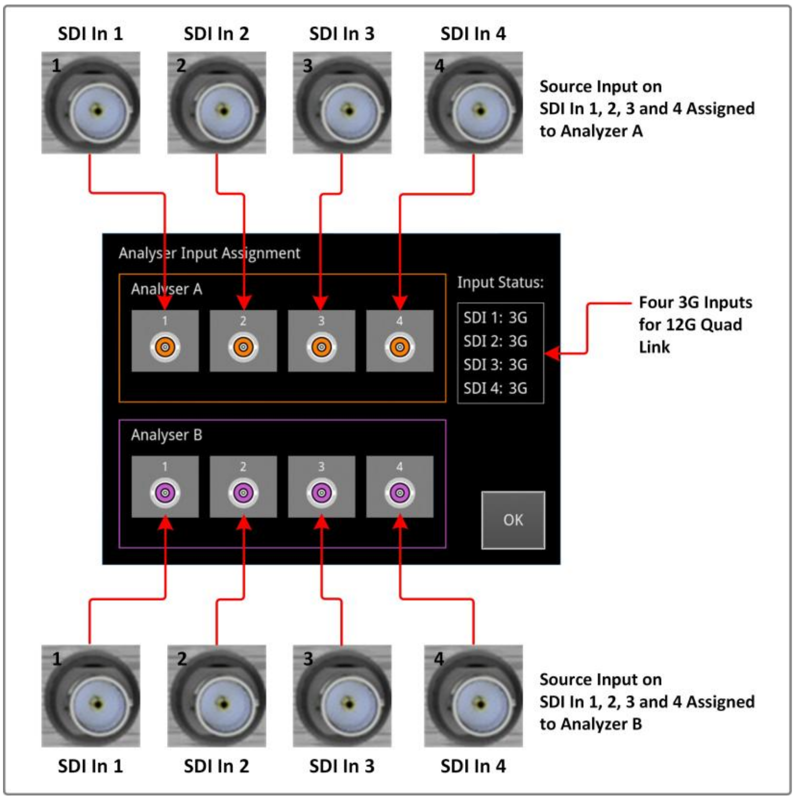


Figure 2-100: Assigning Quad Link Source Inputs to Analyzers (Standard Dual Analyzers)

If you also assign the SDI In 1, 2, 3 and 4 inputs to Analyzer B: 1-4, as shown above, then you can compare the same quad link video in two picture windows, alongside each other.

To summarize, you can assign a quad link source input to analyzers as follows:

- Assign to **Analyzer A** only (**A: 1-4**)
- Assign to **Analyzer B** only (**B: 1-4**)
- Assign to both **Analyzers A** and **B** (**A: 1-4** and **B: 1-4**) for side-by side comparison.

In a similar way, with optional quad analyzers, you can assign a single quad link source input to analyzers as follows:

- Assign to **Analyzer A** only (**A: 1-4**)
- Assign to **Analyzer B** only (**B: 1-4**)
- Assign to **Analyzer C** only (**C: 1-4**)
- Assign to **Analyzer D** only (**D: 1-4**)
- Assign to all **Analyzers A**, **B**, **C**, and **D** (**A: 1-4**, **B: 1-4**, **C: 1-4**, **D: 1-4**) for side-by side comparison.

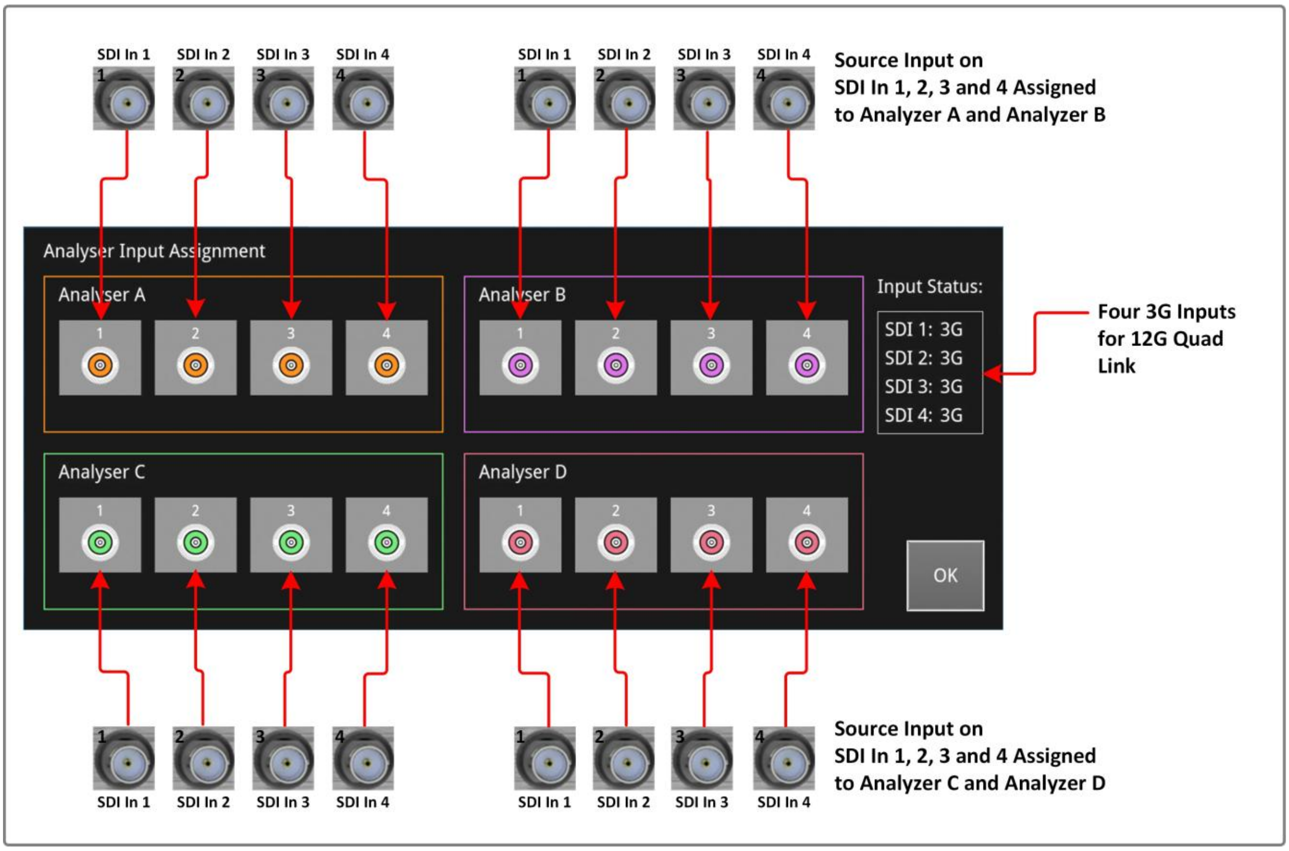


Figure 2-101: Assigning Quad Link Source Inputs to Analyzers (Optional Quad Analyzers)

Working with the Optional Second Display

Overview

When your system includes the optional second display (option **LPX500-EM**) it acts as a display independent from the main unit. You can open instruments, save presets, define and save layouts and perform most tasks on the second display in the same way you would on the main unit.

The main unit, however, provides the memory storage and processing for the whole system so that items you define or generate on the second display (for example, screenshots, presets, layouts, etc.) are saved to the main unit. Consequently, some features like the File Manager are available only on the main unit, which also includes the USB ports for the insertion of USB memory sticks.

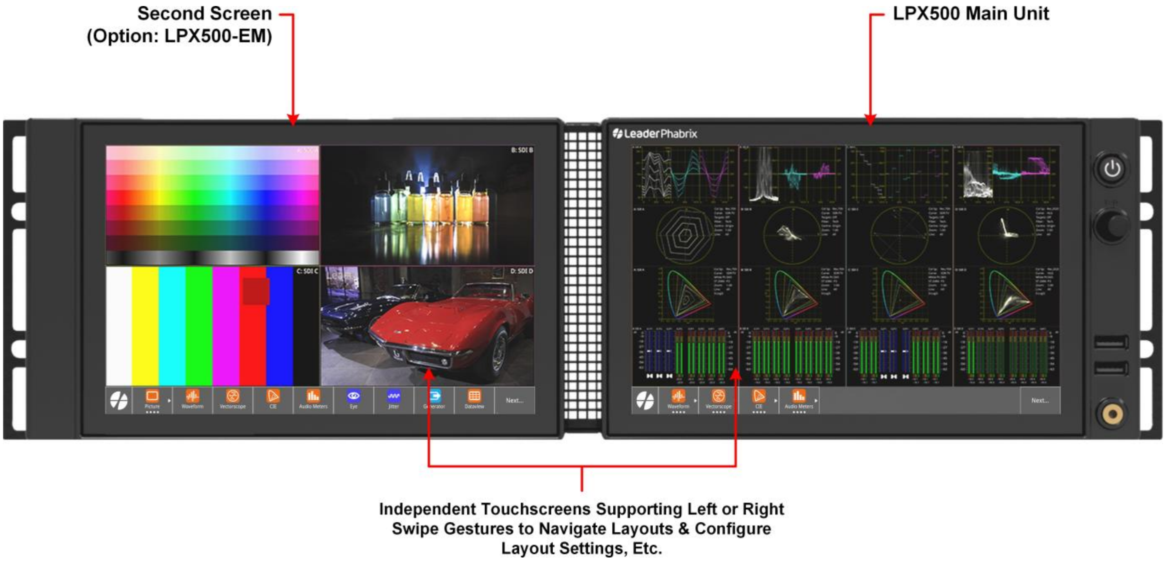


Figure 2-102: LPX500 with Optional Second Screen Connected (Shown in the Rack Mount)

Presets apply to both the main unit and the optional second display, if available. If you save a preset when the second display is connected and active, the saved preset includes configuration settings for both the main unit and second screen. Consequently, the same Presets toolbar is displayed on both the main unit and the second screen. This situation is different for the Layouts toolbar. This means that you see the same Presets toolbar on both the main unit and second display. Layouts, however, are specific to the main unit or second display so you will have different Layout toolbars on both displays. It is important to note that, as layouts are included when you save presets, different layout toolbars will be displayed when you load a preset.

Connecting and Disconnecting the Second Display

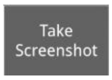
The optional second display connects to the main unit by way of the dedicated USB type C v3.1 high- speed cable, supplied with the display. This ensures that the second display can draw its power from the main unit. Always locate the second display to the left-hand side of the main unit, when viewed from the front.

If you are planning to disconnect the second display and use only the main unit, always save a named preset of your current configuration before disconnecting. This will allow you to restore the windows you had open on the second screen when you return to using both together again. After disconnecting, reboot the main unit so that it can work in single display mode.

> **Note:** If you update the dual display preset while in single screen display mode the second display layout and preset information will be deleted.

When you reconnect the second display, reboot the main unit to initiate the dual display mode. Once rebooted, you can reload your preset to restore the screen layouts and instruments from before the disconnection.

Taking Screenshots on the Second Display

Tap the 

softkey on either the main unit or second display to take screenshots of both screens, simultaneously. The unit automatically saves two screenshot files to the **../screenshots** (default) folder on the main unit that you can retrieve using the File Manager.

To differentiate the screenshots, the unit appends a suffix **S1** or **S2** to the filename as follows:

- Main unit screenshot: **yyyy-mm-ddT**<*timestamp*>**S1.png**
- Second display screenshot: **yyyy-mm-ddT**<*timestamp*>**S2.png**

> **Note:** The file manager is available only from the Settings tab of the main unit.

Remote Connection to the Second Display Using noVNC

With the optional second screen installed, you can choose which noVNC client you connect to when making a remote connection to the unit by appending the suffix **_1** to the **noVNC** address in the browser address bar. For details, see: *Connecting to the Unit Using noVNC from a Web Browser.*

Managing Presets

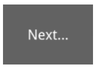
> **Note:** Presets from the Qx Series are not recognized on the LPX500.

Overview

The system periodically saves its current configuration to memory so that when you restart the unit, the last used configuration is automatically restored. In addition, whenever you work with the LPX500, you can save your current layouts and settings as a named **Preset**, at any time, for ease-of- use and convenience. If you decide to start a different task, you can launch a preset rather than opening and adjusting individual layouts and/or instruments.

You can save multiple presets as required, giving you a library of screen layouts and configurations tailored to specific operational tasks. The unit saves each preset to both the **Presets Toolbar** (*Figure 2-103*) and to the **Presets Dialog** in the Settings tab (*Figure 2-104*).

> **Note:** If you use the file manager utility to upload presets from another LPX500 unit, make sure that you reboot the unit after uploading the presets. This ensures that the presets are registered on the new LPX500 unit. Once the presets are registered, you can rename them as described later in this section.

To access the Presets toolbar, tap 

from the active layout.

Figure 2-103: Available Presets in the Presets Toolbar

To access the **Presets** dialog, tap or click  to display the Setup menus, open the **Settings** tab and select **Presets**.

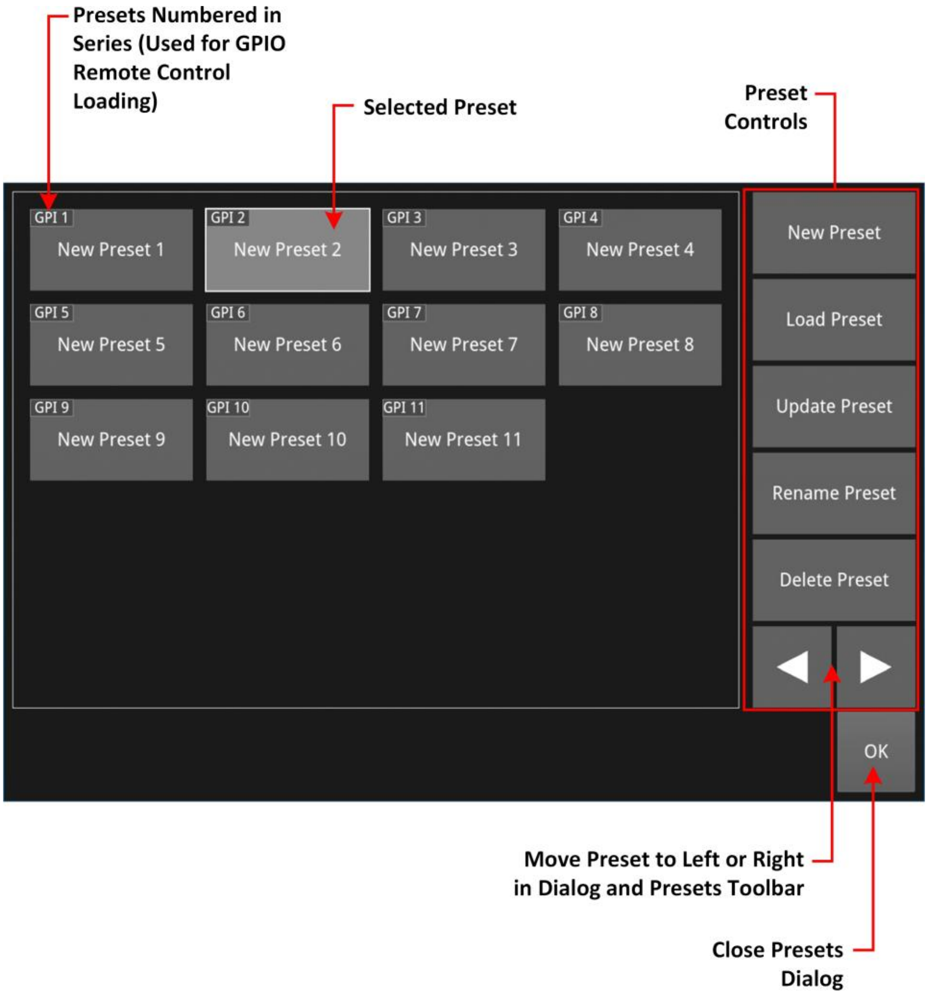


Figure 2-104: Presets Dialog and Controls

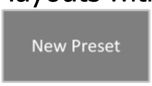
You can use the presets dialog to manage the presets displayed in the presets toolbar. The preset controls at the right-hand side of the panel enable you to do the following:

- Create a new preset.
- Load an existing preset.
- Update a preset with current instrument layout and/or settings.
- Rename a preset.
- Delete a preset that is no longer required.
- Change the displayed position of a preset in the presets toolbar (and dialog) using the left and right arrow keys.

Tap or click **OK** to close the presets dialog.

Adding a Preset

Add a preset to the current set displayed in the presets panel and the presets toolbar using the **Presets** dialog available in the **Settings** tab of the Setup menu.

Once you have organized the layouts with your required instruments configured as required, open the presets panel and select 

.

This adds the new preset to the last position in both the presets panel and presets toolbar. Each preset is automatically labeled sequentially as **New Preset**, **New Preset 1**, **New Preset 2**, etc. If necessary, use the **Rename Preset** control to change the assigned name.

A preset includes the following features:

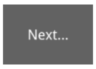
- All defined layouts with their associated instruments.
- All user-defined instrument settings.
- All user-defined system settings, for example, display brightness.

To save other presets, organize the display layouts as required, and repeat as above. Tap or click **OK** to close the presets dialog.

Loading a Preset

Loading a preset from your available list is a quick way to launch a suite of instruments, preconfigured for your intended task, simultaneously.

To load an existing preset, either:

- Tap 

in the toolbar until you reach the presets toolbar, then select a preset from those available, or

> **Note:** If you have saved more than nine presets, you may need to 
>
> to display tap

- Tap or click  to display the Setup menus, select **Presets** then select a preset from the full list available in the presets panel. You may need to scroll up or down the available list, depending on the number of existing presets. Tap or click **OK** to close the Presets dialog.

Updating a Preset

Instead of creating a new Preset each time, if you are satisfied with any changes you have made to layouts and/or settings, you can choose to update a preset.

To update an existing preset:

- Tap or click  to display the Setup menus, select **Presets** then select the preset you would like to update from the full list available in the Presets panel. You may need to scroll up or down the list.
- Select 

and confirm that you are happy to overwrite the selected preset.

  Any layout and instrument setting changes are saved to the same preset name and the previous settings are overwritten. Tap or click **OK** to close the presets dialog.

Figure 2-105: Confirm Existing Preset can be Overwritten and Updated

Renaming a Preset

> **Note:** You can use either the on-screen keyboard, or a USB keyboard connected to one of the USB ports of the unit, to edit the name of an existing preset.

To rename a preset:

- Tap or click  to display the Setup menus, select **Presets** then select the preset you would like to rename from the full list available in the presets panel. You may need to scroll up or down the list. Select Rename Preset and enter the new name in the text field using either the on- screen or a USB keyboard. Tap or click **OK** in the new name dialog to save your changes. Tap or click **OK** to close the presets dialog.

  This changes the displayed name of the preset.

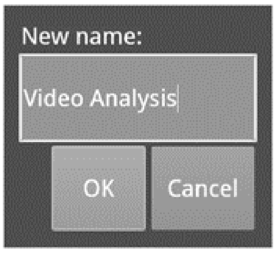


Figure 2-106: Rename Preset Dialog

Deleting a Preset

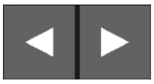
To delete a preset:

- Tap or click  to display the Setup menus, select **Presets** then select the preset you would like to delete from the list available in the presets panel. Select Delete Preset and then select **Delete** in the delete preset dialog to confirm the deletion. If you decide not to delete the pre- set, select **Cancel**. Tap or click **OK** to close the presets dialog.

Figure 2-107: Delete Preset Confirmation Dialog

Reordering a Preset in the Toolbar and Presets Dialog

To change the displayed order of presets in the Presets toolbar and Presets panel:

- Tap or click  to display the Setup menus, select **Presets** then select a preset you would like to move in the list available in the Presets panel. You may need to scroll up or down the list. Use the softkeys  to change the displayed position of the selected preset to the left or right in the presets panel.

The order you choose is also reflected in the softkeys of the presets toolbar.

Loading Presets Using the REST API or External Remote Control

You can use the REST API or an external remote control interfacing with the 15 pin D-type GPIO connector on the rear panel of the unit to load presests.

To do so, you need to know of the GPIO number of the desired preset in the presets dialog. In addition, you need to enable the REST API in the **Network & Automation** instrument.

For more information on the remote control loading of presets, see *Remote Control of Preset Loading*.

Customizing the Instrument Favorites Toolbar

> **Note:** When the optional second screen is available, the same favorite shortcuts are applied to the instrument favorites toolbar on both screens. You can change the shortcuts configuration on either screen but it is recommended only to configure the toolbar from one screen at a time.
> Opening and closing the shortcut configuration dialog on both screen at the same time can cause undesired effects

You can customize the nine instrument softkeys available in the Instrument Favorites Toolbar using the **Favorite Shortcut Configuration** dialog in the Settings tab of the Setup menus.

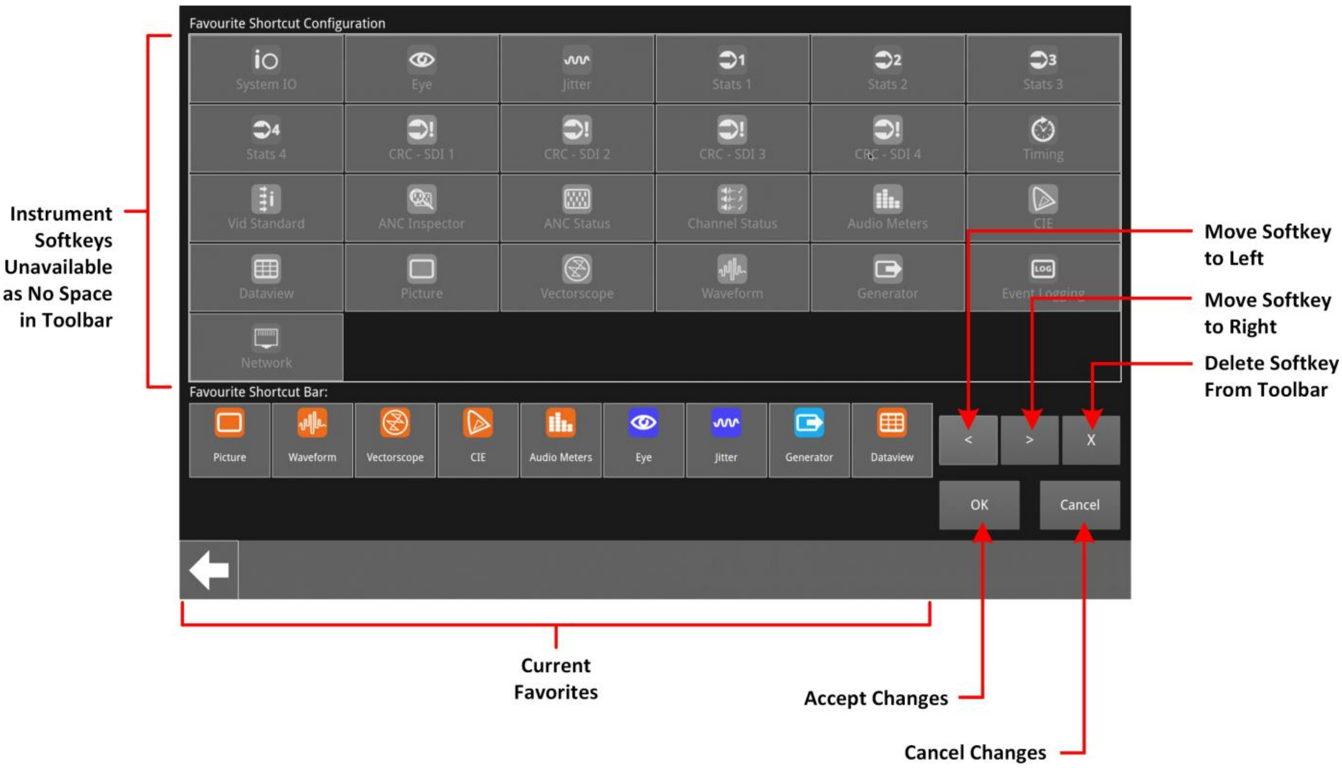
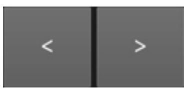


Figure 2-108: Favorite Shortcut Configuration Dialog

Change the instrument softkeys displayed in the Favorites Toolbar as follows:

1. Delete any unwanted softkeys from the toolbar by

   Selecting an unwanted softkey in the current favorites list then tap or click .
   You will see the available instrument icons in the library are now displayed in color, see *Figure 2-109*.
2. Tap or click a replacement softkey to add to the toolbar from the available library of softkeys.
3. Adjust the position of the softkey in the toolbar using: 
4. Tap or click **OK** to accept your changes to the toolbar.

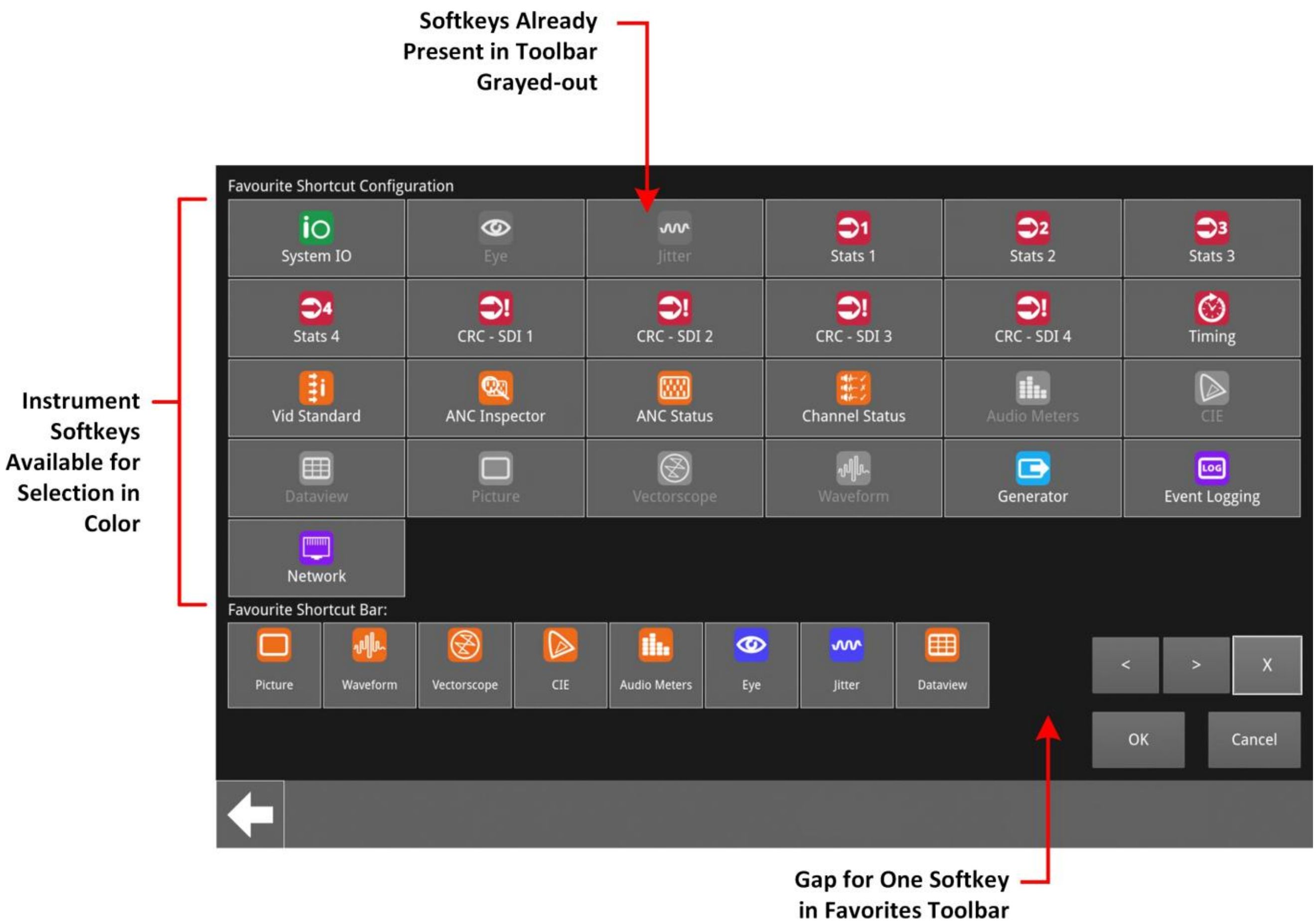


Figure 2-109: Favorite Shortcut Configuration Dialog

Instrument Icon Quick Reference

The icons shown below each represent a different Instrument (some optional) and are displayed in the Instrument Bar when the corresponding Instrument is active.

System Instruments:

Event Logging	Network & Automation

Video Standard Analyzer Instruments:

Analyzer - CIE Chart	Analyzer - Data View
Analyzer - Picture	Analyzer - Vectorscope
Analyzer - Waveform	Analyzer - Video Standard
Analyzer - Ancillary Inspector	Analyzer - Ancillary Status
Analyzer - Audio Channel Status Meters	Analyzer - Audio
	Analyzer - RGB Vector
Analyzer - Audio Meters	Analyzer - 2110 Format Setup
Analyzer - 2022-7 Status	Analyzer - 2110-21 Status
Analyzer - Loudness Monitor	Analyzer - Dolby Metadata

Physical Analyzer Instruments:

Eye - SDI in 1	Jitter SDI in 1

Generator Instruments:

Generator	2022-6 Transmit (SFP 2 or QSFP 4) 2110 Transmit (SFP 1/2 or 1+2) or 2110 Transmit (QSFP 3/4 or 3+4)

Raw Data Instruments:

SFP E - Network Stats	SFP F - Network
Stats	System IO
SFP 1 (or QSFP 3) - Info	SFP 2(or QSFP 4) - Info
PTP Info	

Datastream Analyzer Instruments:

Stats - SDI in 1	Stats - SDI in 2

Stats - SDI in 3

Video Timing &
System Reference

Video Timing &
System Reference

IP Receive - Interpacket Timing

NMOS Status and Configuration

NMOS Receivers - SDP

NMOS Sender - SDP

Stats - SDI in 4

IP Receive - Flows

CRC Analysis SDI In 1 to 4

Stats - 2022-6 Receive

NMOS Receivers - IS05

NMOS Sender -IS05

3

Configuring and Checking the Unit

This chapter describes how to set-up some fundamental parameters and check that the unit is working correctly; it includes the following sections:

Network and Automation

Overview

The **Network & Automation** instrument provides all the network information and facilities you need to connect the unit to a network and then interact remotely with the unit over the network.

Once the unit is powered on and an RJ45 Ethernet connector inserted in the management port, you can access the unit remotely and get its date and time from an NTP server. You can choose either dynamic or static IP addressing for the management Ethernet port.

You can control the unit from a remote location using a number of methods, including:

- Virtual Network Computing (VNC)
- REST API (for remote control).

Network & Automation	
Interface	Up
MAC Address	00:E0:4B:81:35:C2
IP Addressing Mode	Dynamic
IP Address	10.50.102.36
Gateway	10.50.100.1
DNS Server	10.50.100.2
mDNS Server	lpx-000025.local
REST API	Listening on port 8080
VNC Server	Disabled

Figure 3-1: Network & Automation Instrument

Using Virtual Network Computing (noVNC or VNC) for Remote Access

The virtual network computing or VNC facility enables you to connect either to the main unit or the optional second screen from a remote location and provides you with direct screen control of the unit(s).

When you enable the **VNC Server** parameter in the options menu, the unit allows remote access to the noVNC clients, from a standard web browser. In addition, you can also connect remotely using a suitable, locally-installed VNC client viewer (for example, VNC® Connect, etc.)

For more information on establishing a remote connection to the unit using noVNC or from a VNC client , see the section *Using Virtual Network Computing (VNC)*.

Instrument Menu Options

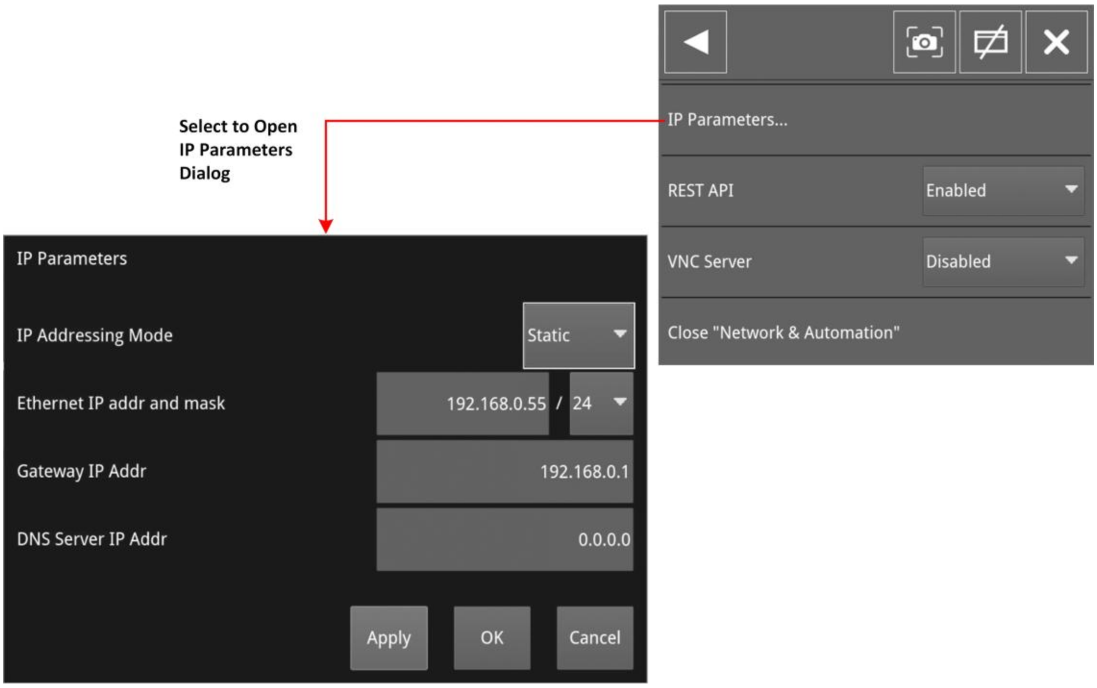


Figure 3-2: Network & Automation Instrument Menu Options

The following table lists the configurable parameters in the Network & Automation instrument options menu:

Table 3-1 : Network & Automation Menu Options

Item	Options	Description
IP Parameters		
IP Addressing Mode	Dynamic Static	For remote access to the unit, you can assign the IP address of the unit either dynamically, on a DHCP enabled network, or specify a static IP address manually. When assigned dynamically, the following IP address fields are automatically populated and cannot be edited.
Ethernet IP addr and mask	Enter static IP address and mask (range: 8 to 31) as required.	Only active when static IP addressing is selected. Use the dropdown list to select the Mask. The unit uses CIDR nota- tion; with a default value of **/24**. Use either a USB key- board or the on-screen numeric keypad to enter the address .
Gateway IP Addr	Enter the IP address of the Gate-	Only active when static IP addressing is selected. Use

Item	Options	Description
	way as required.	either a USB keyboard or the numeric keypad to enter the address.
DNS Server IP Addr	Enter the IP address of the DNS Server.	Only active when static IP addressing is selected. Use either a USB keyboard or the on-screen numeric keypad to enter the address. After entering all required static IP parameters, click **Ok** to save. **Note:** A gateway address is required, even if on a network without a default gateway. Use a dummy gateway address if this is the case.
Remote Connection Parameters		
REST API	Enabled Disabled (Default)	When enabled the REST API allows the use of the unit's web server and the remote loading of presets. It is recommended to use the IP Address (or mDNS Hostname if your client's host supports it) as the recipient of the request, and the REST API Port is the port towards which requests need to be directed. Use a suitable software program or script to access and control the unit e.g. cURL or PostMan. To load presets using remote control, you will need to enable either Bit or Binary mode in the **System IO** options menu, see *Remote Control Loading of Presets*.
VNC Server	Enabled Disabled (Default)	When enabled allows remote connection to the main unit or optional second screen from either: • A standard web browser using integrated noVNC to connect to the noVNC client on the unit, or • A locally installed VNC client viewer (for example, VNC® Connect). The VNC Server field of the Network & Automation window shows the number of current VNC connections to the unit. Once a connection is made, or ended, this number is automatically updated. For more information on using VNC to connect remotely to the unit, see the section *Using Virtual Network Computing (VNC)*. **Note:** When the optional second screen is connected, the number of connections displayed is the total number of VNC connections open on the main unit and second screen.

Note: The mDNS Hostname has the following case-sensitive syntax:

lpx-*<serial number>*.local. For example: **lpx-123456.local**

Using the Numeric Keypad to Enter Static IP Details

If you select the static IP addressing mode in the IP Parameters dialog, tap or click in any of the IP address fields to display the on-screen numeric keypad as shown in *Figure 3-3*.

> **Note:** The on-screen numeric keypad is available only if the on-screen keyboard is enabled in the Display Settings dialog (this is the default setting.) Otherwise, you can use a USB keyboard connected to the unit or the keyboard of your remote connection.

Enter an address using the keypad as follows:

1. Use the backspace to remove digits to be replaced or highlight a section to overwrite.

   As you delete digits, the remainder of the address will change color to yellow indicating that the address is not valid.

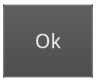
2. Enter the new address using the number keys and period key as required.

   When you enter a full IP address, the font color changes back to white indicating that the address is valid.

3. Tap or click 

 to save the new address and close the numeric keypad. To quit the numeric keypad without saving, tap or click .

4. If you need to change the subnet mask, select the appropriate value from the dropdown box.

5. When satisfied with all IP addressing parameters, tap or click 

 to save and exit the dia- log.

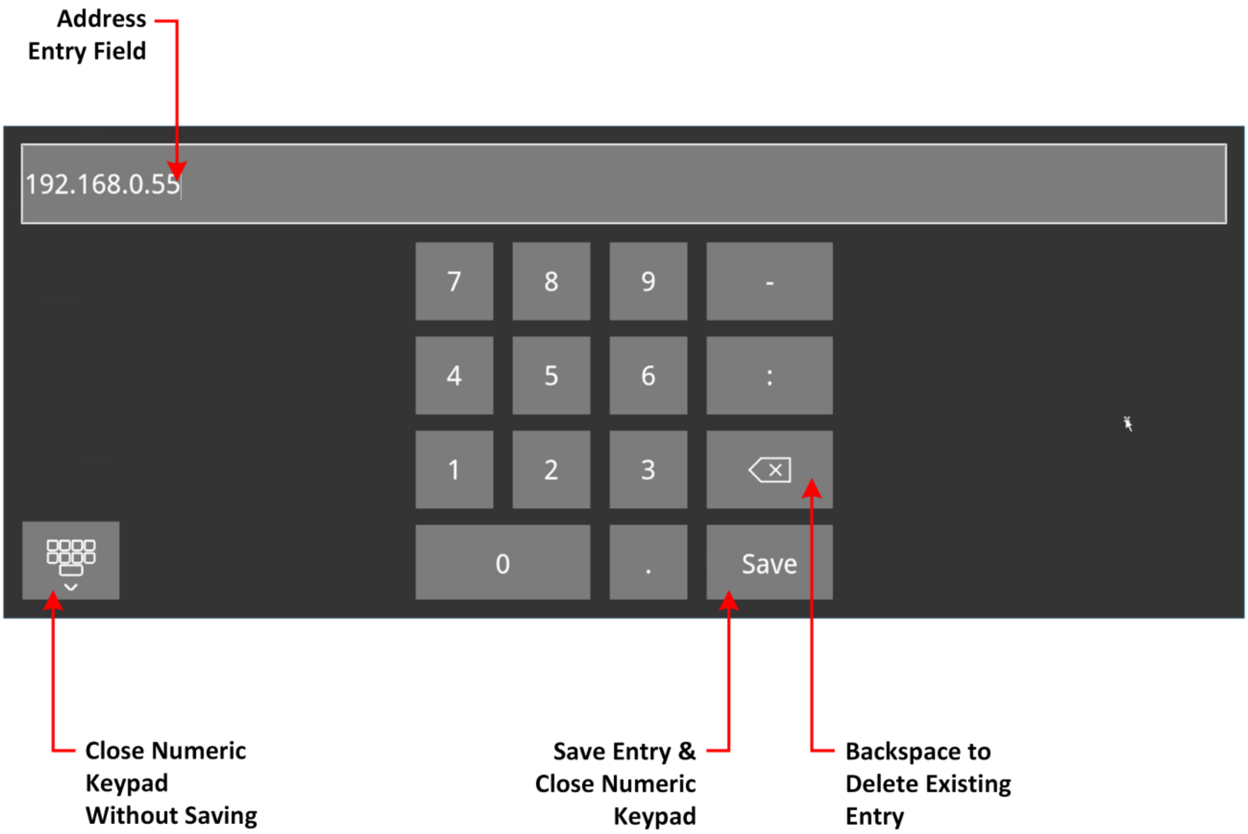


Figure 3-3: Numeric Keypad to Enter Static IP Addresses

Setting the Time, Date and NTP Server

The unit displays the system date and time in the top-right corner of the screen in the Setup menus.

Figure 3-4: Time and Date Display in Setup Menus

You can configure the unit to use a date and time transmitted by a target Network Time Protocol (NTP) server or set the time and date manually in the **Time and Date** dialog.

Configure the date and time as follows:

1. Tap or click  to open the Setup Menus.
2. Tap or click the time/date display in the top-right corner of the screen. This opens the Time and Date dialog:

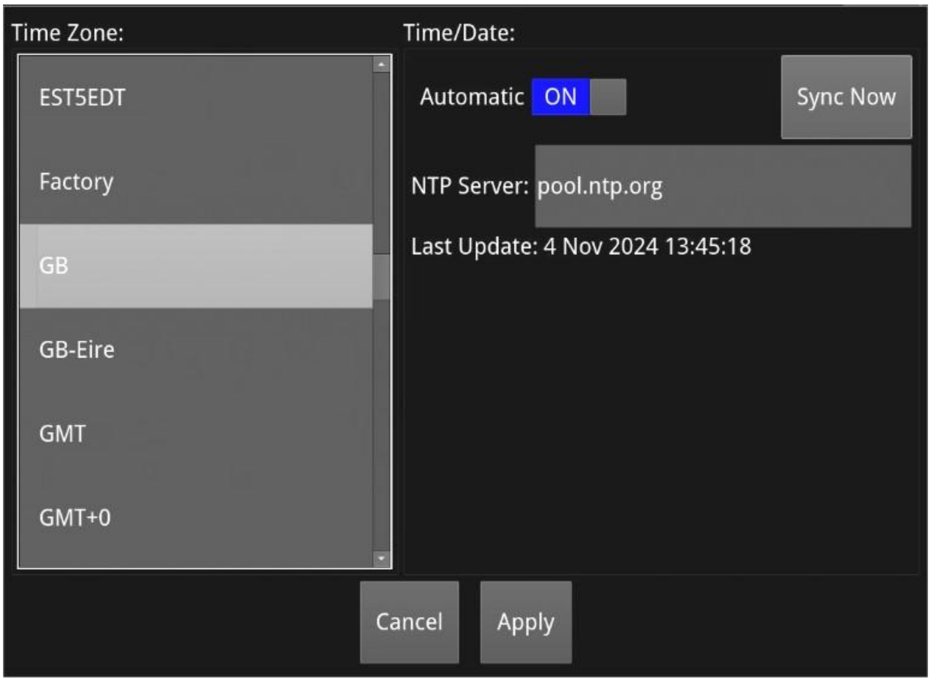


Figure 3-5: Time and Date Dialog

3. To use the automatic time and date from an NTP server:

   a. Set the **Automatic** toggle switch to ON.

   b. Enter the address of the NTP server using the on-screen keyboard or a USB keyboard. For example: **pool.ntp.org**

   c. Select your local time zone from the **Time Zone** list box.

   d. Click **Sync Now** to synchronize to the selected time zone.

   e. Click **Apply** to save your changes and quit the dialog. To discard your changes, click **Cancel**.

3. To set a time and date for the unit manually:

   a. Set the **Automatic** toggle switch to OFF. This displays the manual date and time fields.

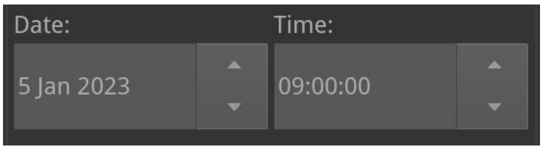


Figure 3-6: Manual Date and Time Fields

   b. Adjust the date by clicking the target field and either enter a new date using the key- board or adjust the day using the up/down arrow buttons at the right of the field.

   c. Adjust the time by double-tapping or -clicking the target hours, minutes, or seconds to select, then increase or decrease the setting using the up/down arrow buttons at the right of the field.

   d. Click **Apply** to save your changes and quit the dialog. To discard your changes, click **Cancel**

Table 3-2 : NTP Traffic Generation

Automatic Toggle Switch Setting	Action	Result
OFF	None	Unit stops synchronizing with NTP servers. No NTP traffic generated.
OFF	Tap or click **Sync Now**	Force one-time synchronization with NTP server. **Note:** Generates NTP traffic for the single sync and then no longer.
ON	Tap or click **Apply**	Unit automatically synchronizes with the NTP server and continues to do so, generating NTP traffic. Closes Time Setting dialog. Unit displays UTC time according to the selected timezone.

Note: If the optional second screen is connected, you can adjust the clock settings only from the Setup menu on the main unit.

Setting-up the Display

Modifying the Display Settings

The unit's Display Settings in the Settings tab enable you to set the following:

- Output frame rate, and brightness of the user interface and display backlighting.
- Use of the onscreen keyboard and the displayed units for all temperature measurements.
- Popup function bar for remote access to the unit over DisplayPort or using the SDI monitor out- put (SDI MON connector). For local touchscreen access and noVNC remote access it is recom- mended to disable this feature to prevent the popup of the toolbar.
- Presence of color-coded Analyzer instrument window frames.
- Colors of the analyzer instrument window frames assigned to each of the two (or optionally four) Analyzers, when window frames are enabled. The colors are also used in the Analyzer Input Assignment dialog.
- Color of the generator instrument window frames, when window frames are enabled, and in the System IO instrument to show active generator output.

Configure the touchscreen(s) and any external display to which the unit is connected as follows:

> **Note:** Changes to the Display Settings apply to both screens simultaneously, if the second optional display is included, irrespective of the display from which the dialog is launched.

1. Tap or click to open the Setup Menus and select the **Settings** tab. This displays the dialog to adjust the display settings.

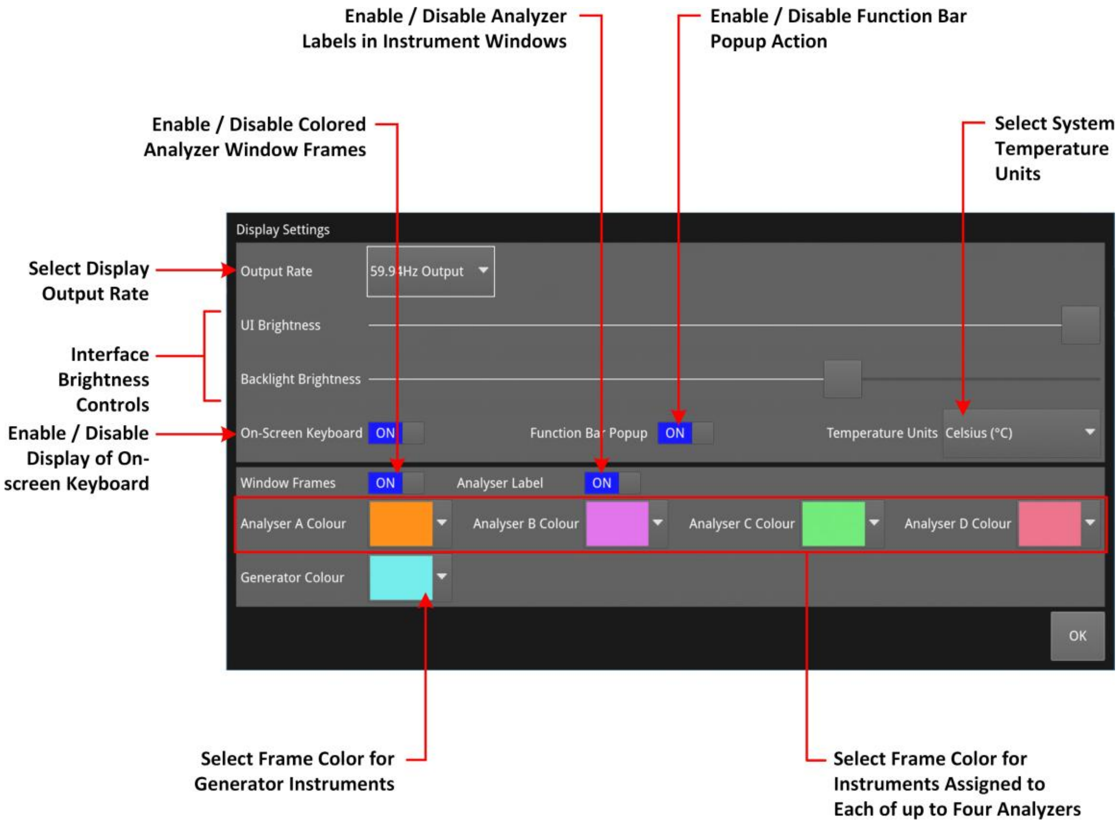


Figure 3-7: Display Options in the Settings Tab

2. Select the desired frame rate from the **Output Rate** dropdown list:
   - 47.98 Hz
   - 48 Hz
   - 50 Hz
   - 59.94 Hz
   - 60 Hz
3. Drag the **UI Brightness** slider left or right to decrease or increase the brightness of the user interface to a comfortable level. This affects both the touchscreen(s) and any connected external display.

   You can also adjust the brightness in increments, or to maximum / minimum values, using the following softkeys:

   UI Brightness slider softkeys:

   Backlight Brightness slider softkeys:

> **Note:** When using the Screenshot function to capture the display, it is recommended to set the brightness to the maximum setting to increase the clarity of the saved image.

4. Drag the **Backlight Brightness** slider left or right to decrease or increase the brightness of the touchscreen backlighting. This affects only the touchscreen display(s).
5. Choose whether to use the **Onscreen Keyboard** for text and numeric entry in instrument dialog fields. The onscreen keyboard is enabled by default. If you choose to disable the onscreen key- board you will need to have a USB keyboard connected to one of the USB ports on the unit. Alternatively, you can also use the keyboard connected to a PC from which you have initiated a remote connection to a unit using noVNC.
6. Choose whether to prevent the toolbar popping-up from the lower section of the screen when using the touchscreen locally or noVNC to access the unit remotely. If using DisplayPort or the SDI Monitor output for remote viewing of the user interface, you will need to enable this feature so that the function bar becomes available for use with the mouse.
7. Choose whether to display system temperature measurements in units of degrees Celsius (**°C**) or Fahrenheit (**°F**) from the **Temperature Units** dropdown. The selected units are used in all instruments where a temperature measurement is displayed.
8. Choose whether to display a border around the instruments by switching on or off the **Window Frames** toggle switch. When disabled, you switch off all border color differentiation between analyzer instruments.
9. Choose whether to display an **Analyzer Label** to identify the assigned analyzer in the top-left or -right of the analyzer instrument window.
10. When the **Window Frames** toggle switch is 
, you can change the border of analyzer instruments as described in the section *Using the Color*

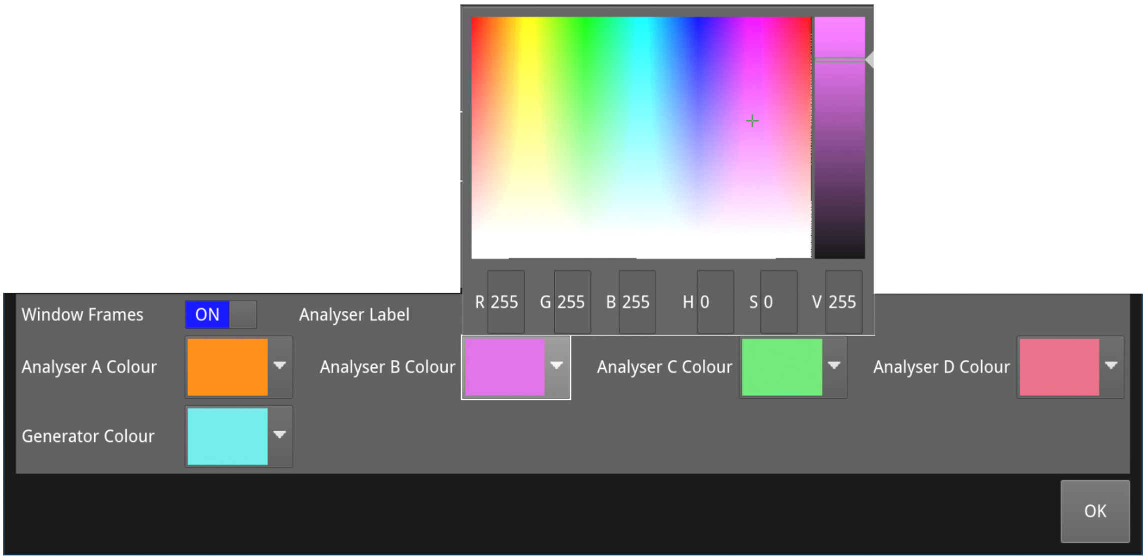


Figure 3-8: Selecting a Color for Analysis Instruments Assigned to Analyzer B in the HSV Window

> **Note:** The borders and icons of System Instruments are always colored light gray.

11. Selected colors are applied immediately. Click anywhere outside the HSV window to close the dialog.
12. Click **OK** to close the Display Settings dialog.
13. Tap or click  to exit the Setup Menus and return to the active layout.

Checking the Unit

Overview

Your unit should now be powered on, with the correct date and time displayed in the Setup Menus and at least a basic layout displayed, including any of your modifications. At this point you should confirm that the unit is healthy and running correctly, as expected, by checking the following:

- System Health
- Licensing and ordered licensed options
- Software and firmware versions.

These items are described in the following sections.

Checking the System Health

You can check the current health status of the unit in the **System Health** dialog as follows:

1. Tap or click to open the Setup Menus and select the **Settings** tab.
2. Tap or click: **System Health**.
   This opens the System Health dialog displaying the current health of the unit's hardware, includ- ing: CPU and FPGA temperature in degrees Celsius or Fahrenheit, and the revolutionary speed of the cooling fans.

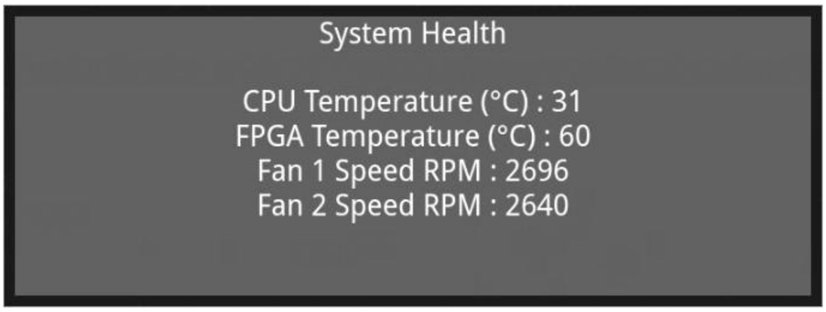


Figure 3-9: System Health Information

Table 3-3 : System Health Recommended Thresholds

Item	Safe Range	Description
CPU Temperature	From 0° to 60°C (32° to 140°F)	Unit will issue a high temperature warning at 60°C (140°F) and switch off at 85°C (185°F)
FPGA Temperature	From 0° to 60°C (32° to 140°F)	Unit will issue a high temperature warning at 60°C (140°F) and switch off at 85°C (185°F)

Cooling Fans	1500 to 8000 rpm	Speed of fans varies with the temperature of the FPGA. Two cooling fans are located in the rear of the unit and operate at 25% of the maximum capability of the fans.

Checking the Unit Licenses

It is important at this point to confirm that your unit has been shipped with the software options and corresponding licenses documented in your original order.

Check the licensing details and other system information in the **About** dialog as follows:

1. Tap or click to open the Setup Menus and select the **Settings** tab.
2. Tap or click: **About**.
   This opens the About dialog, displaying license and version information. Use the scroll bar to display the complete list. Information includes:
   - Software version and build
   - Unit serial number
   - License details
   - Build ID
   - FPGA and CPU ID and versions
   - Calibration details.
3. Tap or click anywhere outside the About window to close the dialog.

Figure 3-10: Serial Number and License Information

Restarting the Unit

If at any time you want to restart the unit, you can do so from the **Settings** tab of the Setup Menus without powering-down the unit.

Restart the unit as follows:

1. Tap or click  to open the Setup Menus and select the **Settings** tab.

Figure 3-11: Restart Device Launcher in Settings Tab

2. Tap or click **Restart Device**.
   This opens a Restart confirmation dialog:

Figure 3-12: Restart Confirmation Dialog

3. Click **OK** to confirm the restart or **Cancel** to quit without restarting.
   When you confirm the restart, the unit immediately enters boot mode and displays its status using the LED behind the On switch.

Restoring Factory Default Settings

If you make configuration changes to the unit which you would rather discard, you can restore the unit to the factory default settings at any time.

Restore the factory defaults as follows:

1. Tap or click  to open the Setup Menus and select the **Settings** tab.
2. Tap or click: **Restore Default Settings**.
   This opens a confirmation dialog, prompting you to confirm your choice before the factory defaults are restored.

> **Note:** It is recommended first to copy all your saved Presets to a USB memory stick as a backup, using the File Manager, before restoring the factory defaults.

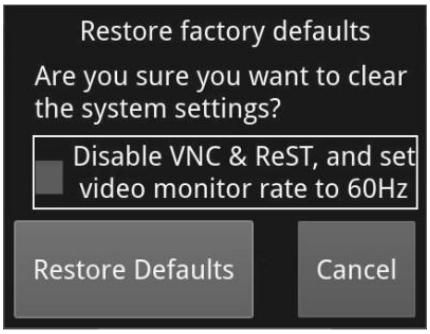


Figure 3-13: Confirmation Dialog to Restore Factory Default Settings

3. If you want to restore VNC, ReST and video monitor rates to factory defaults (disabled, disabled and 60 Hz respectively) select the checkbox. Otherwise, leave the checkbox unchecked.
4. Tap or click: **Restore Defaults** to confirm or **Cancel** to quit.

Resetting the SFP Configuration Database

By default, the unit's SFP Configuration Database contains configuration details for the approved, factory supplied SFPs.

> **Note:** If you have previously modified the SFP Configuration Database manually to include SFPs that were not approved, be sure to copy your current list from the unit *before* you reset the database values. By doing so, after reset, you can then add your user-defined SFPs to the database again if they are not automatically recognized by the unit. Contact Support for details on SFP configuration procedures.

Update the SFP Configuration Database with the latest standard list of PHABRIX approved SFPs for the current software release as follows:

1. Tap or click  to open the Setup Menus and select the **Settings** tab.
2. Tap or click: **Reset SFP Config Database**.
   This opens a confirmation dialog, prompting you to confirm the reset.
3. Select **Reset** in the confirmation dialog.
   You are warned that the database will revert to the factory defaults. Any user-defined SFP entries in the database will be deleted. To quit the reset process, select **Cancel**.

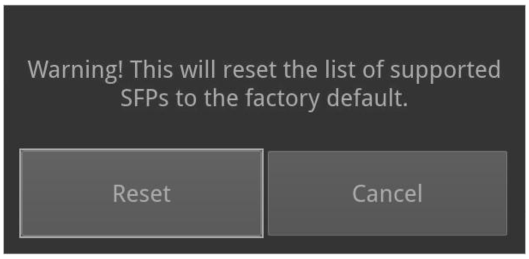


Figure 3-14: Resetting the SFP List to Factory Defaults

> **Note:** If you have not previously modified the database, but have unsupported SFPs that you wish to use after reset, contact Support for information on how these might be added to the SFP database.

Upgrading the Unit

Upgrading the System Software and Firmware

New software releases will be made available regularly as the product is developed.

Software downloads are approximately 300 MB in size and can be found in the Support area of the LeaderPhabrix website currently located at:

https://leaderphabrix.com/contact-support/leaderphabrix-product-software/

1. Complete and submit the access request form.
2. Click the generated link to download the latest software.
3. Download the **.pug** file for the selected software release.

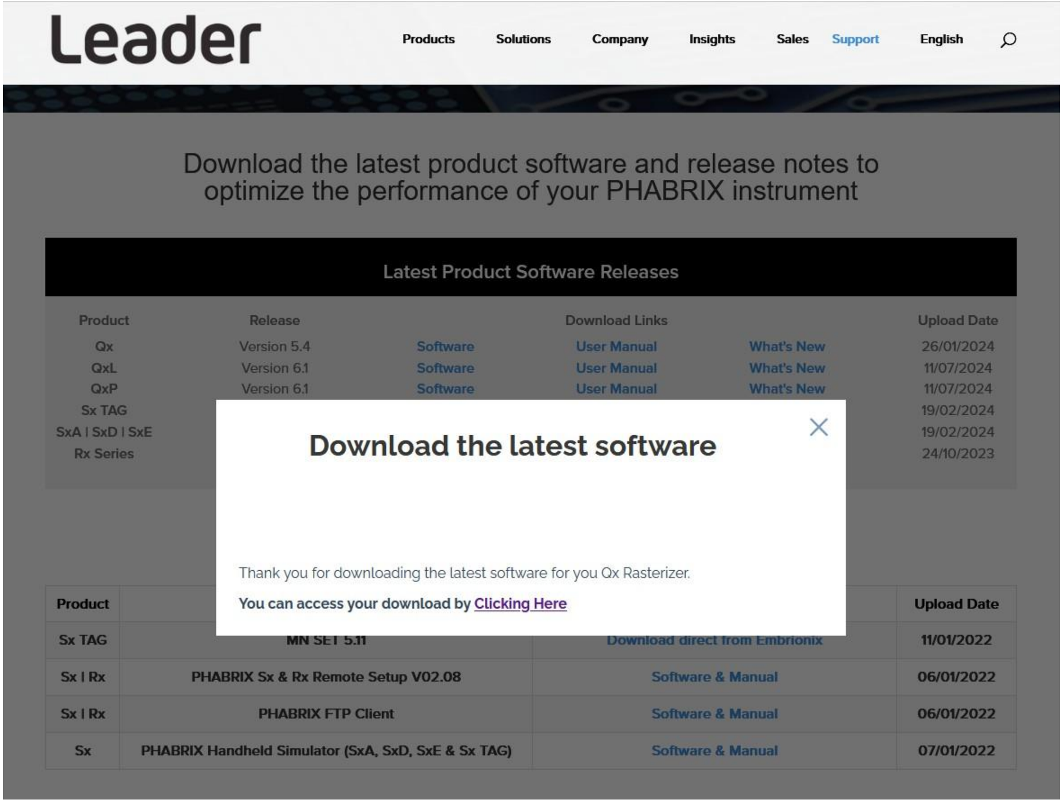


Figure 3-15: Downloading the Software Bundle from the Software Downloads Page

4. Upgrade the software on the unit using one of the following methods described below.

Upgrading the Software from a USB Stick

Upgrade the software using a USB memory stick as follows:

1. Copy the downloaded **.pug** file to the root directory of a FAT32 or exFAT formatted USB stick.
2. Make sure that the unit is switched OFF before upgrading.
3. Insert the USB stick into a USB port on either the front or rear panel of the unit.
4. Press the power button to power-up the unit.

The fans will run-up to full speed during the upgrade process. Please wait approximately three minutes as the unit upgrades. It will automatically display the active layout when complete. Use the File Manager to eject the USB stick on completion.

> **Note:** The software upgrade progress will also start automatically, after 30 seconds, if a USB stick containing the ***.pug** file, is inserted into a USB port on the unit while it is running.

Remote Upgrade Using SFTP

You can upgrade the software on your unit(s) from a remote location using a standard SFTP client (e.g., FileZilla, etc.) as follows:

1. Complete and submit the access request form.
2. Click the link to download the **.pug** file for the desired software release, see above.
3. Log on remotely to a unit to be upgraded using SFTP, enter:
   sftp user@ *<LPX_IP_Address>*. or
   sftp user@ *<LPX_Hostname>*
   For more information, see the section *Using Secure FTP (SFTP)*.
4. Enter the password for the leader user: **leader**
   You should see the message **Connected to user@** *<LPX_IP_Address>* or **Connected to user@** *<LPX_Hostname>*
5. Use the SFTP **put** command to upload the upgrade **.pug** file to the upgrade directory of the unit: **/transfer/upgrade**.
   You should see the percentage completion and time remaining for the transfer displayed at the right of the terminal window.

```
C:\Users\technical.author\Downloads>sftp user@lpx-000025
Leader 70PJ [X86] Yocto 4.0.15 (kirkstone) lpx-000025
user@lpx-000025's password:
Connected to lpx-000025.
sftp> ls
transfer
sftp> cd transfer
sftp> cd upgrade
sftp> ls
sftp> put LPX-1596229956-7.0.0-prod.pug
Uploading LPX-1596229956-7.0.0-prod.pug to /transfer/upgrade/LPX-1596229956-7.0.0-prod.pug
LPX-1596229956-7.0.0-prod.pug                                            100%  312MB 100.1MB/s   00:03
sftp> |
```

Figure 3-16: Uploading the Upgrade File Remotely to the Unit

6. On completion of the transfer the unit automatically detects the presence of the upgrade file and starts its upgrade cycle.

Upgrading the Software Options

You can order and install licenses for optional software toolkits at any time after purchasing your unit. You will receive an email from LeaderPhabrix with an encrypted license file attachment:

encrypted_license_file.enc.

Install the license(s) for an optional toolset or toolsets as follows:

1. Make sure that the unit is powered on.
2. Download the email attachment and copy it to a FAT32 or exFAT formatted USB memory stick.
3. Insert the USB memory stick into any of the USB ports on the front or rear of the unit.
   The unit detects the software package and displays a dialog box listing the licenses currently installed alongside the new licenses available with the option upgrade.

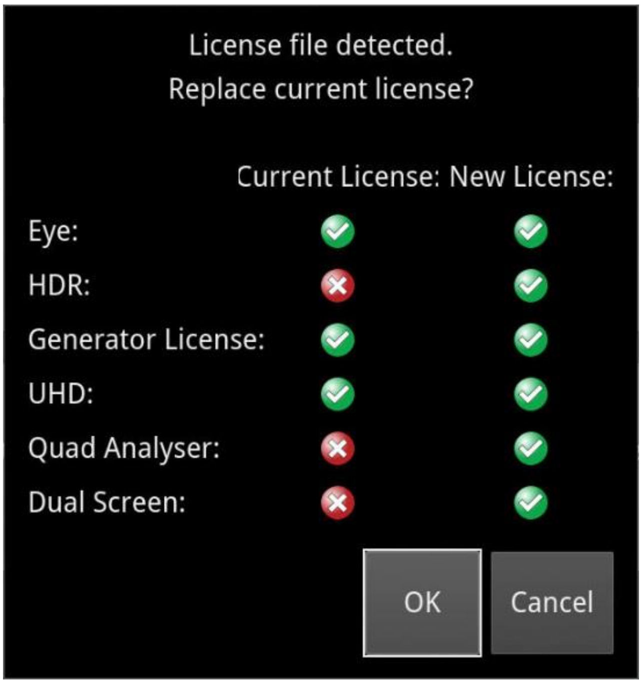


Figure 3-17: Confirmation Dialog for Software Option Upgrade

4. Make sure that the new lecense(s) you have purchased are listed in the **New License** column with a green check mark then click **OK** to update the license(s).
   After updating the license(s), the unit opens a further dialog box requesting you to restart the unit to apply your changes and activate the new option(s).

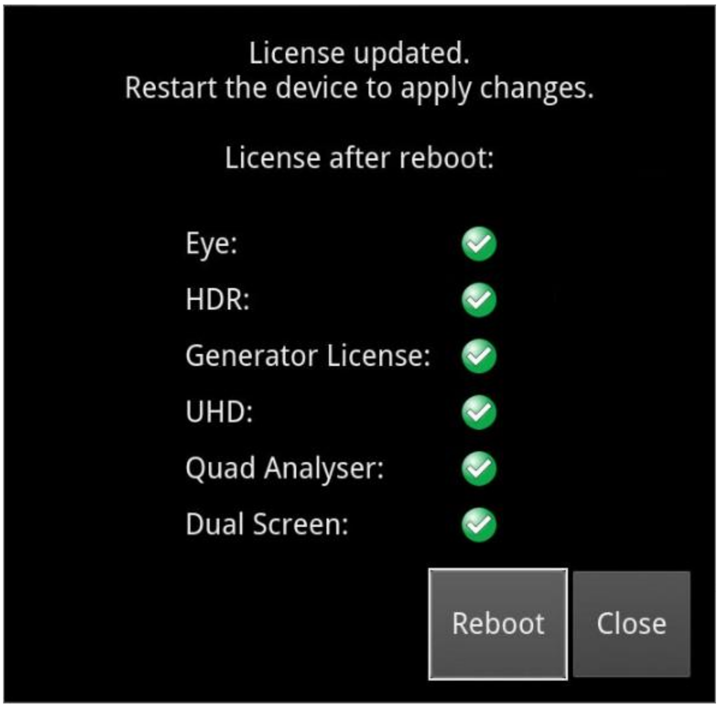


Figure 3-18: Requesting a Reboot to Activate the New Option(s)

5. Confirm that all expected licenses have been updated, then click **Reboot**.
   The unit reboots and the upgraded options will be available for use. Tap or click **Cancel** to close the license dialog.
6. Open the **About** dialog from the **Settings** tab of the Setup Menus and confirm that your new license(s) are available.

Managing Files with the USB File Manager

Overview

To transfer and manage your files, the unit provides a File Manager which enables you to download files from the unit to a FAT32 or exFAT formatted USB memory stick or to upload files from USB to the unit. To display the USB File Manager, either insert a USB memory stick into one of the USB connectors on the front or rear panels of the unit or launch from the Settings tab. When displayed, the File Manager window is divided into two panels – the left-hand panel displays files and folders available on the unit and the right-hand panel displays files and folders on the USB stick. You can either select files and then choose a copy option from the menu or drag selected files and drop them into the desired target window.

> **Note:** The unit supports a single inserted USB memory stick at any one time. If a second stick is inserted, it will not be recognized until the first USB stick is removed.

With the USB File Manager you can:

- Select files on either device
- Copy selected files in two directions (from unit to USB or USB to unit)
- Drag and drop selected files between the unit and USB device
- Rename files on the USB stick
- Create folders on the USB stick
- Delete files from the unit or USB stick.

You can upload or download the following file types to or from the unit:

- Test patterns
- Screenshots
- Presets
- Logfiles
- Test pattern image files (TIFF file format.)

Available space on both the unit and USB stick is displayed at the bottom of each of the File Manager panels.

> **Note:** When using the File Manager over a remote connection (for example, when using noVNC) you will need physical access to the unit both to insert the USB and to remove it after ejecting

Opening the File Manager

> **Note:** You can launch the File Manager only from the Settings tab of the main unit. The File Manager launcher is grayed-out in the Settings tab of the optional second screen.

To open the File Manager:

- Insert a USB memory stick into one of the USB ports on the front or rear panel of the unit.

  This automatically opens the File Manager window on the main unit's display:

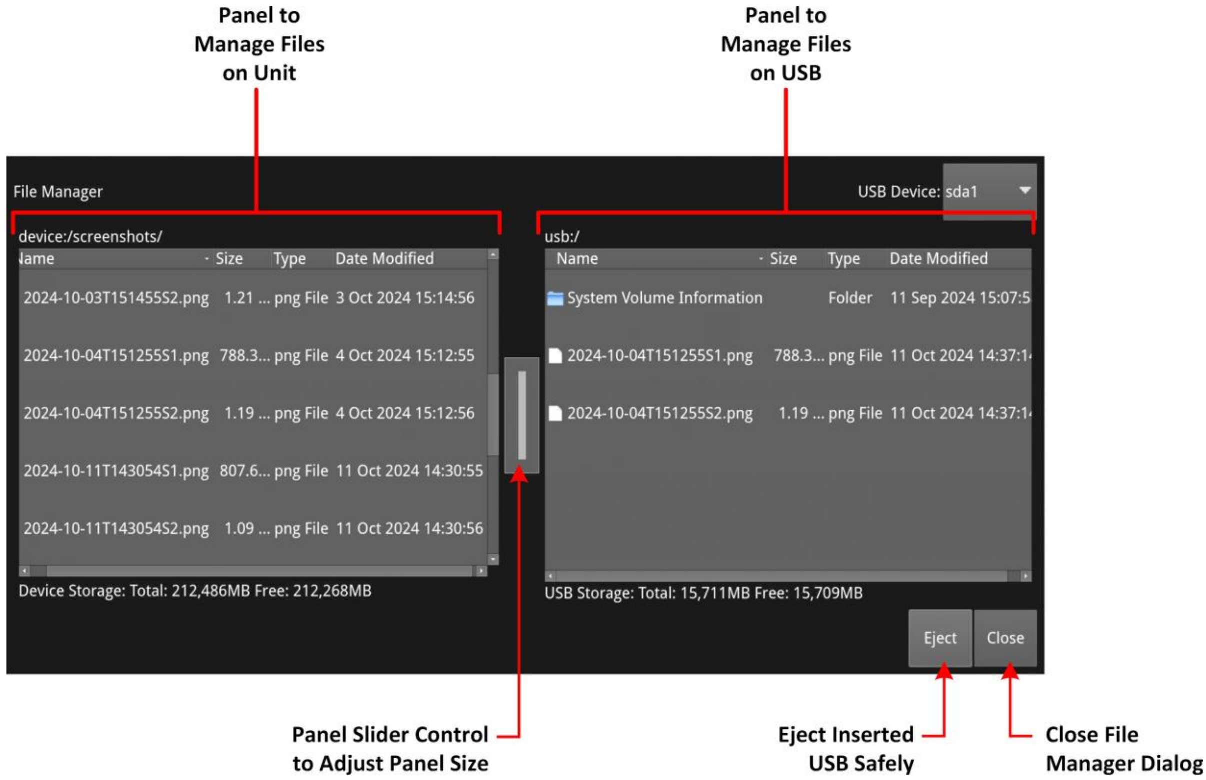


Figure 3-19: File Manager Window

Alternatively, you can launch the File Manager from the **Settings** tab of the Setup Menus as follows:

1. Tap or click  to open the Setup Menus and select the **Settings** tab.
2. Tap or click **File Manager** to display the File Manger window.

Copying Files from the Unit to USB

Copy files from the unit as follows:

1. Insert a USB stick into one of the USB ports and wait for the File Manager to open.
2. Double-tap or double-click the folder icon containing the files to copy.
3. Tap or click to select the files to copy in the left-hand panel.
   You can also tap and hold or right-click then choose **Select All Device Files** from the File Man- ager menu.

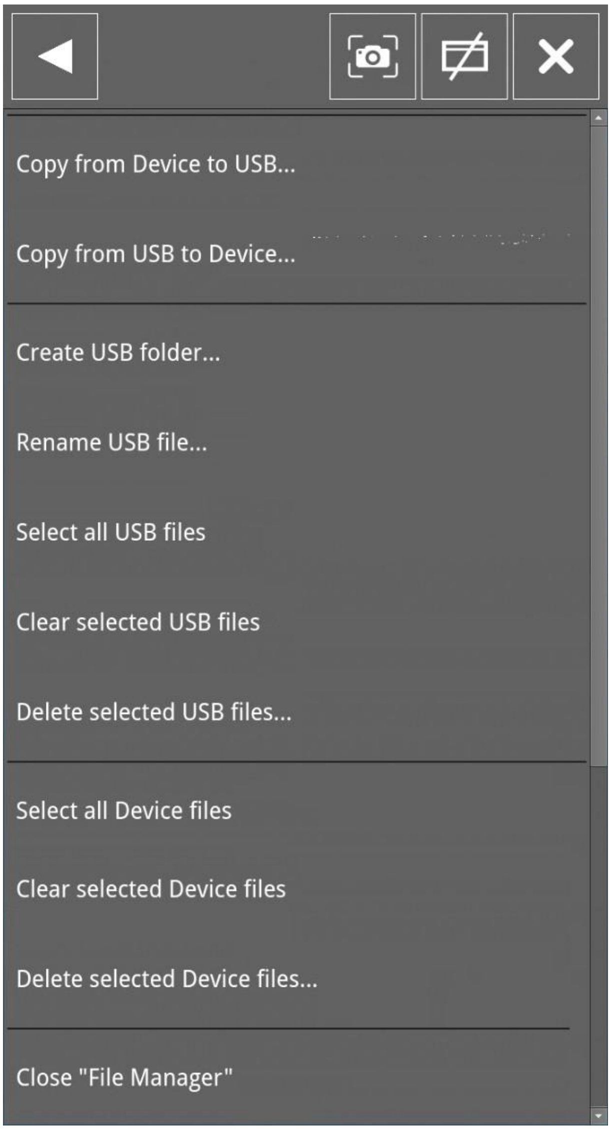


Figure 3-20: File Manager Menu

To deselect a file, simply tap or click it again. You can also choose **Clear Selected Device Files** from the File Manager menu to deselect multiple files.

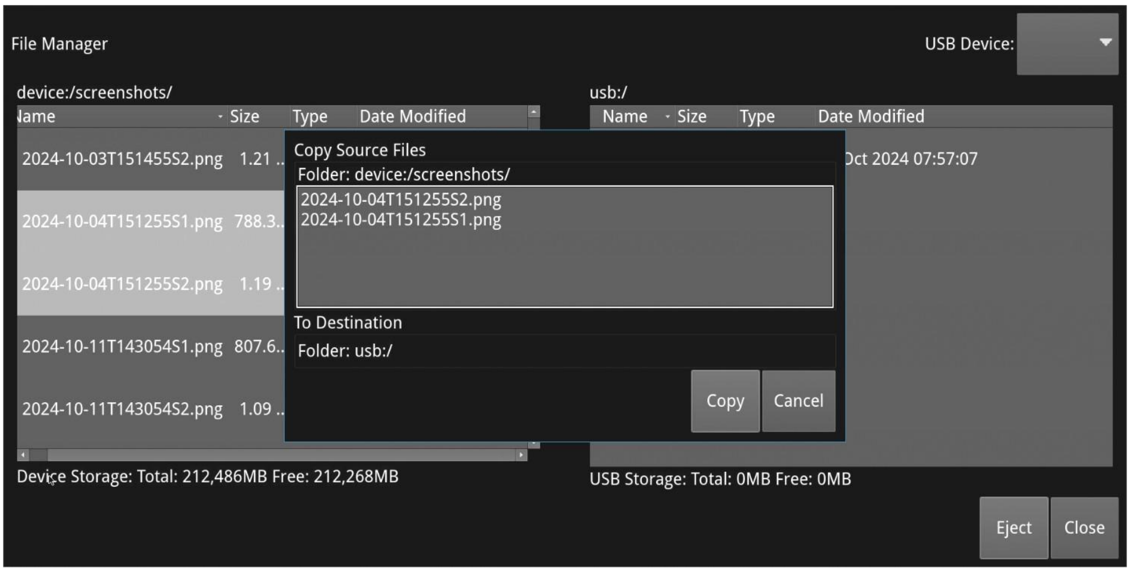


Figure 3-21: Copying Selected Files from the Unit to a Connected USB Stick

4. Tap and hold or right-click anywhere in the File Manager window to display the menu and select **Copy from Device to USB**   This opens the Copy Source Files dialog.
5. Check that the selected files and destination are correct, then tap or click **Copy** to confirm.

Uploading Files from USB to the Unit

Upload files to the unit as follows:

1. Insert a USB stick into one of the USB ports and wait for the File Manager window to open.
2. Select the files you want to upload in the right-hand panel, or choose **Select all USB files** from the menu.
3. Select the target folder on the unit, in the left-hand panel.
4. Tap and hold or right-click anywhere in the File Manager window to display the menu and select **Copy from USB to Device** This opens the Copy Source Files dialog.
5. Check that the selected files and destination folder are correct then tap or click **Copy** to con- firm.

> **Note:** If uploading presets from another unit, always reboot the unit to register the presets on completion of the upload.

Deleting Files from the Unit

Delete files on the unit as follows:

1. Launch the File Manager from the **Settings** tab of the Setup Menus.
2. Select the files you want to remove in the left-hand panel, or choose **Select all Device files** from the menu.
3. Tap and hold or right-click anywhere in the File Manager window to display the menu and select **Delete selected Device files** This opens the Delete Files dialog.
4. Check that you have selected the correct files then click **Delete** to confirm.

> **Note:** When you delete a file using the File Manger the action cannot be undone. Take care to delete only files you know are no longer required.

Event Logging on the Unit

Overview

Event logging on the unit enables you to view the logs in the **Event Logging** Instrument window. The unit allocates 500 lines for logging detail before overwriting log data. It will also recall the log data last captured if the unit is restarted.

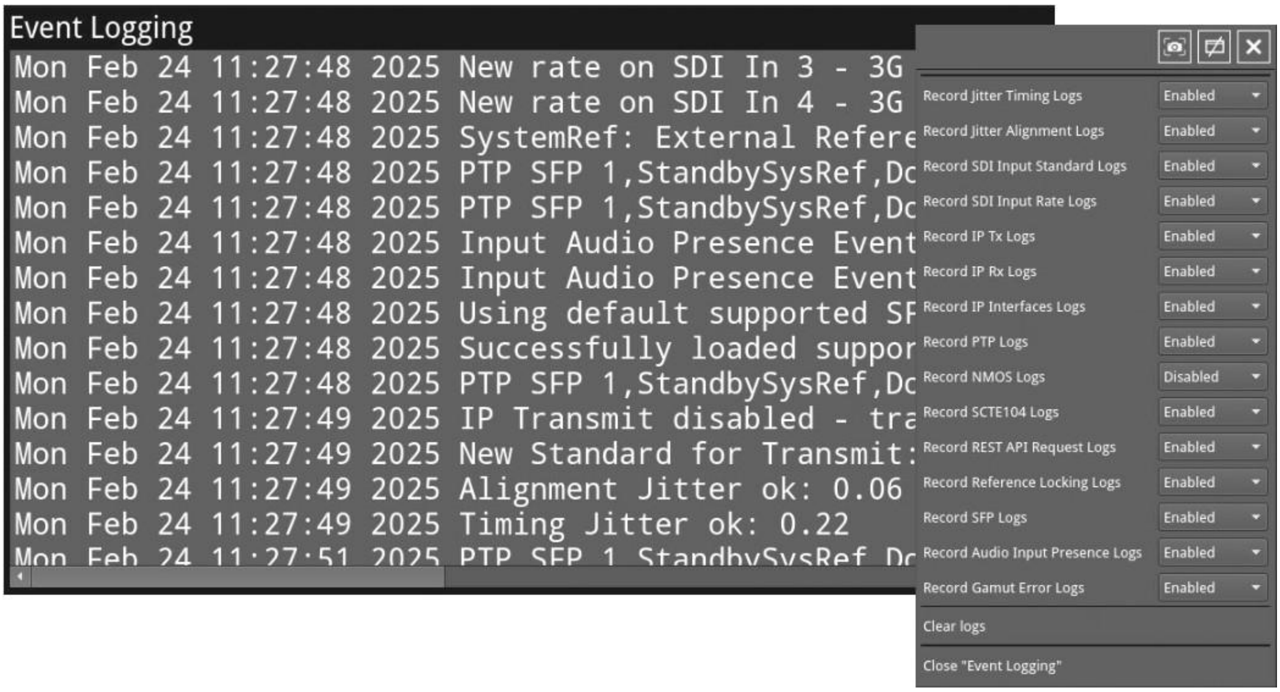
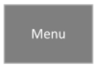


Figure 3-22: SDI Event Logging with Options Menu Showing All Event Logs Enabled

Available Event Logging Options

To enable event logging options, either tap and hold inside the Event Logging border, tap 

or right-click the mouse in the instrument window to enable or disable the following event logs in the Options menu:

- Record Jitter Timing Logs
- Record Jitter Alignment Logs
- Record SDI Input Standard Logs
- Record SDI Input Rate Logs
- Record IP Tx Logs
- Record IP Rx Logs
- Record IP Interfaces Logs
- Record PTP Logs (ST 2110 IP input only)
- Record NMOS Logs (ST 2110 IP input only)
- Record SCTE104 Logs
- Record REST API Request Logs

- Record Reference Locking Logs
- Record SFP Logs
- Record Audio Input Presence Logs
- Record Gamut Error Logs

Select the **Clear logs** control to clear the contents of the currently active logs.

Remote Connection to the Unit

Overview

Various methods are provided to enable you to establish a remote connection to your unit and optional second screen, depending on your requirements, for example you could establish a remote connection using one of the following methods:

- Integrated noVNC or other standard VNC client
- SFTP
- Web browser.

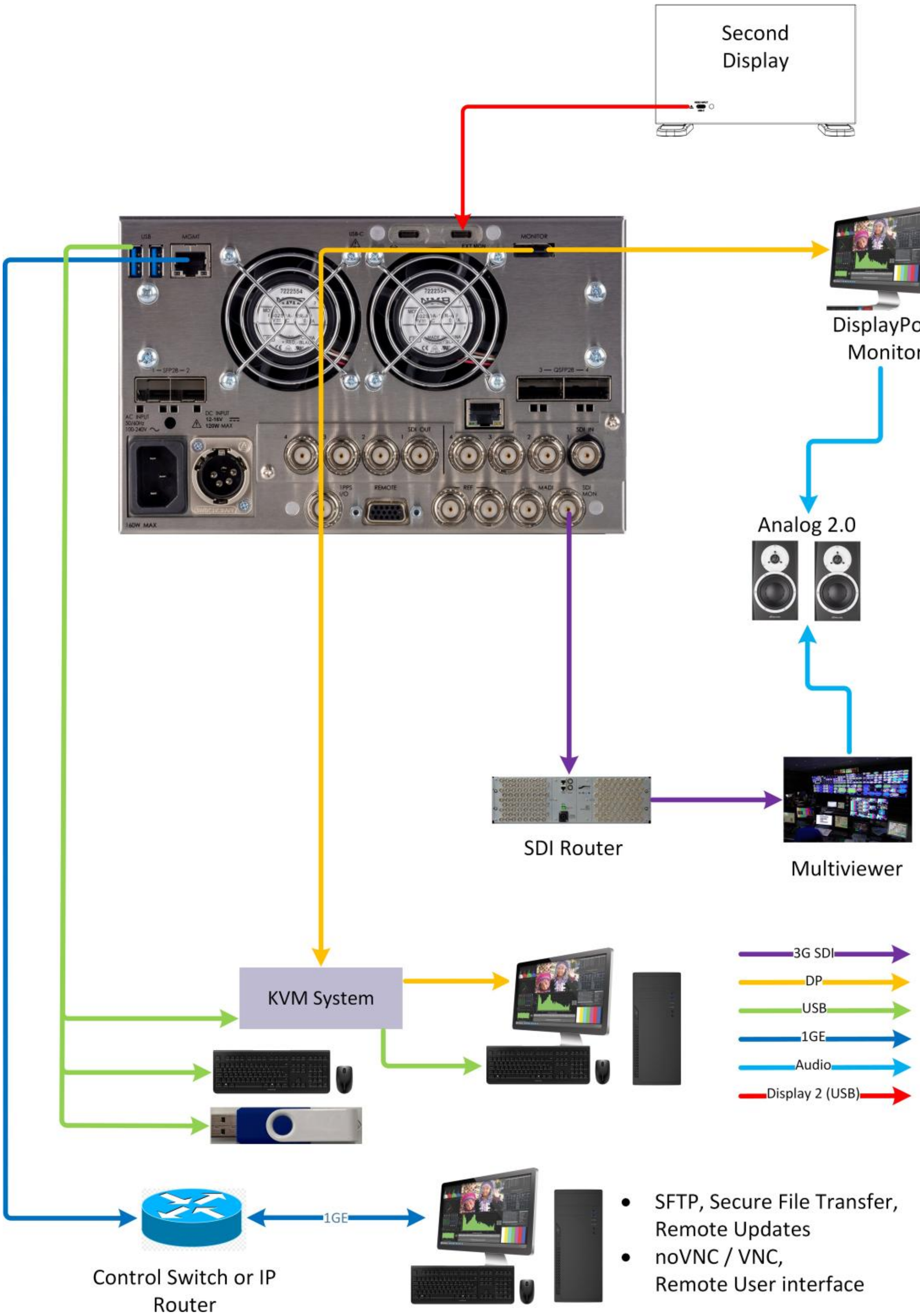


Figure 3-23: Remote Connectivity Overview

Available Functionality

Remote Operational Control:

- **noVNC:** View the screen and control the user interface from a remote location from a standard web browser using noVNC.
- **VNC:** View the screen and control the user interface from a remote location using a suitable VNC client installed on your PC.
- **REST API**: Remote control loading of presets.

Remote File Management:

- **SFTP:** Upgrade the unit from a remote location. Retrieve log, preset, and screenshot files. Delete preset or screenshot files. Add saved presets from a different unit. Add, retrieve, and delete user-created test pattern files.
- **Web Browser:** View and retrieve, Log, Preset, Screenshot, and User Test Pattern files. Altern- atively, use the USB File Manager function to transfer files.

> **Note:** In the setup directions that follow, **192.168.0.70** and **lpx-000480** are used as examples only. Be sure to use the IP Address, hostname or mDNS hostname specific to your unit.

Using Virtual Network Computing (VNC)

The virtual network computing or VNC facility enables you to connect from a remote location and provides you with direct screen control of the unit.

When you enable the **VNC Server** parameter in the **Network & Automation** instrument, the unit allows remote access from either:

- A standard web browser using noVNC to connect to the noVNC client on the unit, or
- A locally installed VNC client viewer (for example, VNC® Connect).

For more information on establishing a remote VNC connection to the unit, see the section *Network and Automation*.

Enabling VNC on the Unit

From the **Network & Automation** Instrument, enable the options menu parameter **VNC Server**.

When enabled, the VNC Server field displays the number of current VNC connections to the unit. Once a connection is made or ended, this number is automatically updated.

> **Note:** If the optional second screen is connected, the number of connections displayed is the total number of main unit and second screen VNC connections.

Connecting to the Unit Using noVNC from a Web Browser

The following are the minimum versions of web browsers supported for use with noVNC:

- Chrome 64
- Firefox 79
- Safari 13.4
- Edge 79

Note: The Opera web browser is not supported for use with this unit.

Once the **VNC Server** is enabled on the unit, you can access the unit using noVNC from a standard web browser on your local PC as follows:

1. If necessary, launch the **Network & Automation** instrument to obtain the host name or IP address of the target remote unit.
2. Enter either of the following URLs into a new browser tab to access the noVNC client **main unit**: **http://<*Unit_Serial_Number*>/novnc_0** or **http://<*IP_Address*>/novnc_0**

   For example: **http://lpx-000480/novnc_0** or **http://192.168.1.72/novnc_0**

3. Enter either of the following URLs into a new browser tab to access the noVNC client on the optional **second screen**:

   http://<*Unit_Serial_Number*>/novnc_1 or **http://<*IP_Address*>/novnc_1**

   For example: **http://lpx-000480/novnc_1** or **http://192.168.1.72/novnc_1**

4. Click **Connect** in the noVNC title screen.

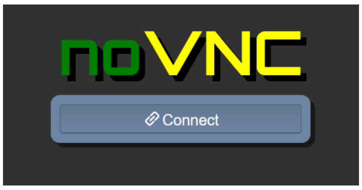


Figure 3-24: noVNC Connect Button

5. For the default username **user**, enter the unit's password: **leader**
6. Switch the display to **full-screen mode** using the noVNC side menu.

   This will ensure that you can access the Favorites Toolbar to manage the user interface when working remotely on the unit. You can also set the noVNC Scaling Mode to Local Scaling. In addition, you can choose to enable the function bar popup in the Display Settings.

Note: You may need to reconnect to the unit after a reboot.

Using a Generic VNC Client to Connect Remotely to the Unit

Make a remote connection to the main unit, or optional second screen, using a locally installed VNC Client viewer, as follows:

1. From the Instruments tab of the Setup menus, open the Instrument **Network & Automation** then tap and hold to open the options menu.
2. For the option **VNC Server** select **Enabled**.
   This enables the VNC server on the unit. The Network & Automation instrument displays the total number of current VNC server connections.
3. Install a VNC client viewer of your choice (for example, VNC® Connect) on the remote PC and launch the viewer.
4. Initiate a connection to the unit by entering the IP address or hostname of the unit displayed in the **Network & Automation** instrument.
5. When required, enter the password: **leader** for the default username **user**.

   A view of the desktop will open on your computer screen. You can now control the unit or optional second screen with your local mouse and keyboard. You should see that the total- number of current VNC server connections displayed in the Network & Automation instrument has increased.

To connect to the optional second screen using a generic VNC client, set the port to **:1** or **5901**.

> **Note:** Remote monitoring of the audio output from the unit is not available over VNC.

Using SFTP

You can use a standard SFTP client (e.g., FileZilla, etc.) to perform the following tasks on the unit:

- Upgrade the software from a remote location, see *Upgrading the Unit*.
- Retrieve event logs, presets, screenshots and user-defined test pattern files
- Delete presets, screenshots and user-defined test pattern files
- Upload presets from another unit and user-defined test patterns.

Connecting to the Unit Using SFTP

Run your chosen SFTP client application on the computer from which you will connect to the unit.

Enter the unit's host address using the specific IP address of your unit or its hostname, in one of the following formats:

- **sftp://192.168.0.70**
- **sftp://lpx-000094.local**

In addition, enter the following details:

- Username: **user**
- Password: **leader**
- Port: **22**

Once connected, open the transfer directory to access the following folders on the unit:

- **common licenses**
- **log** - for the Event

- **presets**
- **screenshots**
- **testPatterns**
- **upgrade**
- **userTestPatterns**

You can download files from any of these folders or delete files from the userTestPatterns, upgrade, and presets folders. In addition, you can add or upload files to the presets, upgrade and userTestPatterns folders.

Using a Web Browser

You can use a standard web browser to view and retrieve Event Log, Screenshot, Preset, and User Test Pattern files.

Connecting to the Unit Using a Web Browser

In the web browser of your choice on your computer, enter the IP address of your unit or serial number, in either of the following formats:

- **http://192.168.0.70** or
- **http://lpx-<***Serial_Number***>**

For example:

- **http://lpx-000028**

Once connected, you can access any of the following folders:

- userTestPatterns
- presets
- logs
- screenshots
- usbDrives

When connected, you should see a similar display to the following (depending on your choice of browser):

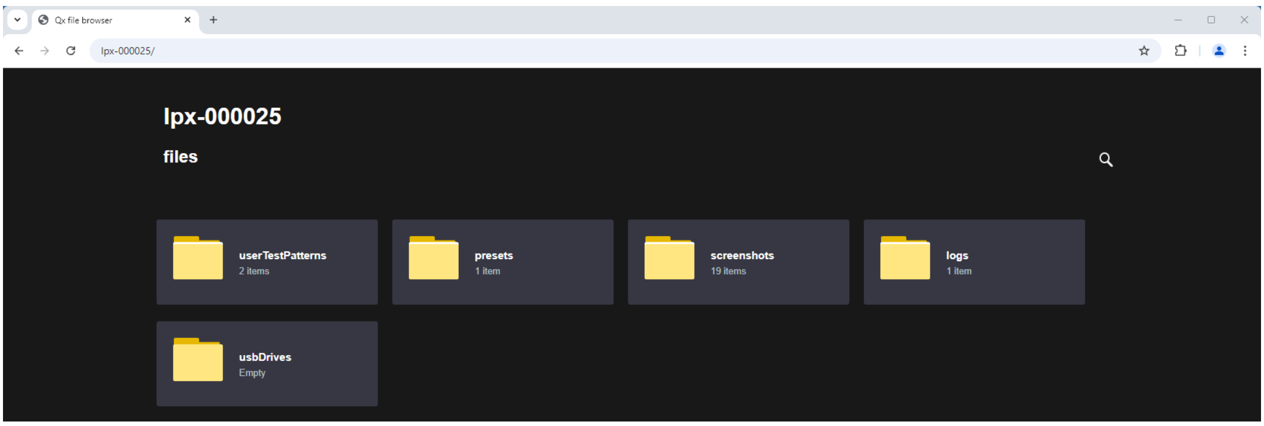


Figure 3-25: Web Browser Access to the Unit's Folders

View and save files to your computer as required.

> **Note:** Files cannot be deleted using the web browser.

Remote Control Loading of Presets

You can use the 15-pin D-type remote control connector (labeled **REMOTE** on the rear panel) to load presets using the GPIO interface.

Two methods are available to load presets using remote control:

- **Bit mode:** Each of the pins 2 to 9 of the REMOTE GPIO connector corresponds to a bit in the preset series. Use pin 2 to pin 9 to load presets **1 to 8**.
- **Binary mode:** Set pin 2 as the least significant bit (LSB) to pin 7 as the most significant bit (MSB) and use binary code to load presets **1 to 60**.

Select the desired method from the options menu of the **System IO** instrument:

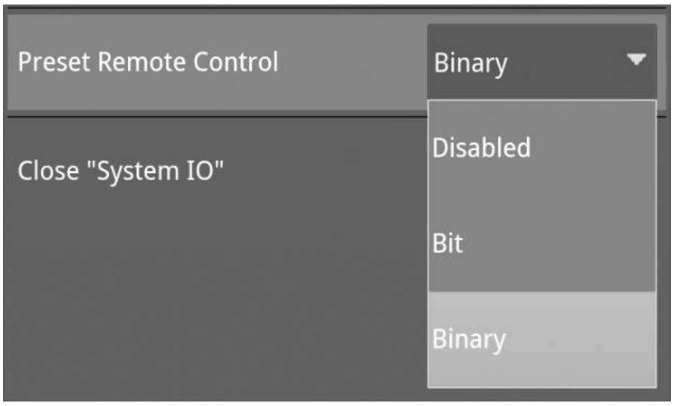


Figure 3-26: Selecting the Preset Remote Control Method in System IO Options Menu

> **Note:** Only the first 63 presets can be triggered via GPIO.

Control Timing

The input connectors respond to active-low signals. Do not apply negative voltages or voltages that exceed +5 V. The active-low signal must be stable for at least 350 ms. Following an active-low signal, wait at least 1 second before applying the next signal.

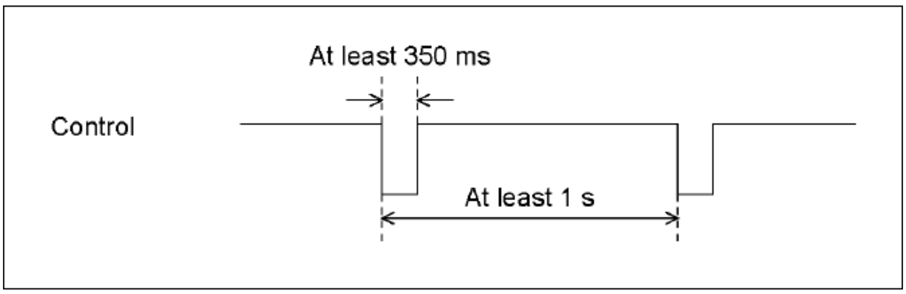


Figure 3-27: Control Timing 1

After making a setting, it may take about 3 seconds for the operation to finish. If you configure subsequent settings before the initial operation finishes, only the last setting will take effect. All settings in between will be discarded. (In the following figure, Control 2 will be discarded.

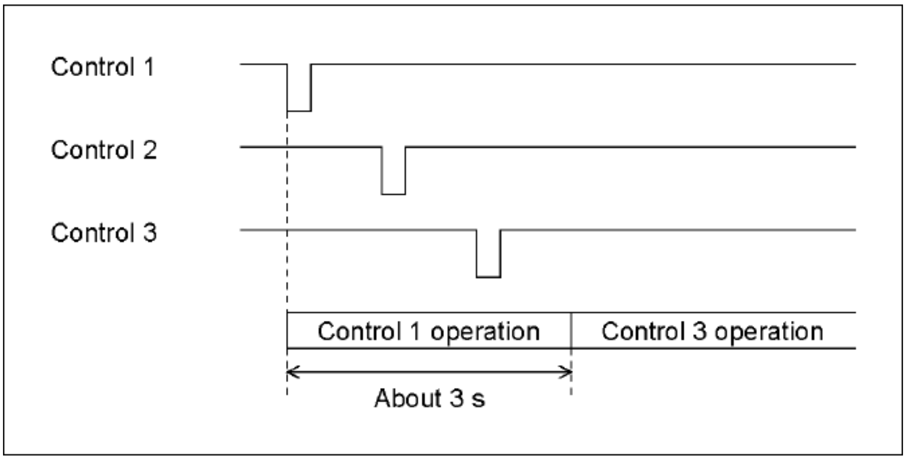


Figure 3-28: Control Timing 2

4

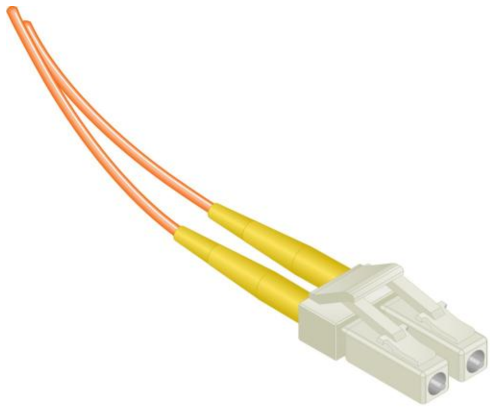
IP Setup and Configuration

This chapter describes the System Instruments used to setup and configure the unit for ST 2110 or ST 2022-6 IP flows to the analyzer(s) and includes the following sections:

IP Connectors and Modules

Overview

All IP connections to the unit are made using SFP+, SFP28, or QSFP28 transceiver modules as shown below.



LC-LC Type Optical Fiber (Multimode) Connector

10 Gbit/s MSA SFP+ / 25 Gbit/s MSA SFP28 Optical Transceiver Module in Cage on Rear Panel

100 Gbit/s MSA QSFP28 Optical Transceiver Module in Cage on Rear Panel

Figure 4-1: Optical Fiber Connector and 10 Gbit/s SFP+, 25 Gbit/s SFP28 and 100 Gbit/s QSFP28 Optical Transceiver Modules

IP Input and Output (ST 2022-6)

The following graphic shows a schematic view of ST 2022-6 IP inputs (and outputs) to and from the Analyzer and Generator circuitry, using SFP28 (or optional QSFP28) interface modules.

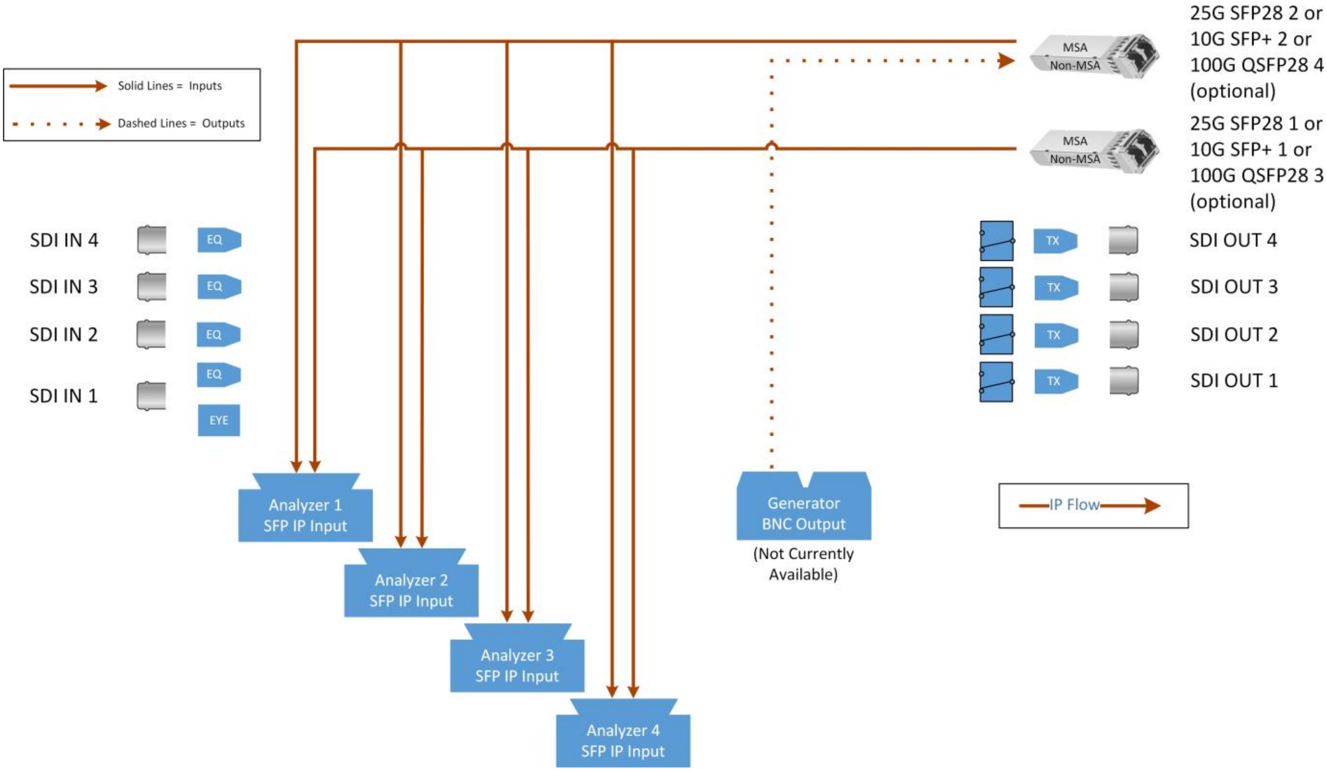


Figure 4-2: IP Input/Output Modules to Analyzer / Generator Circuitry (ST 2022-6 IP Input)

Where:

- **EQ** = SDI Cable Equalizer (Not Used with IP)
- **Tx** = Signal Transmitter
- **EYE** = Eye Processing Circuitry (SDI Only) (Factory-fitted option)
- **MSA** = Multi-source Agreement

IP Input and Output (ST 2110)

The following graphic shows a schematic view of ST 2110 IP inputs (and outputs) to and from the Analyzer and Generator circuitry, using SFP28 (or optional QSFP28) interface modules.

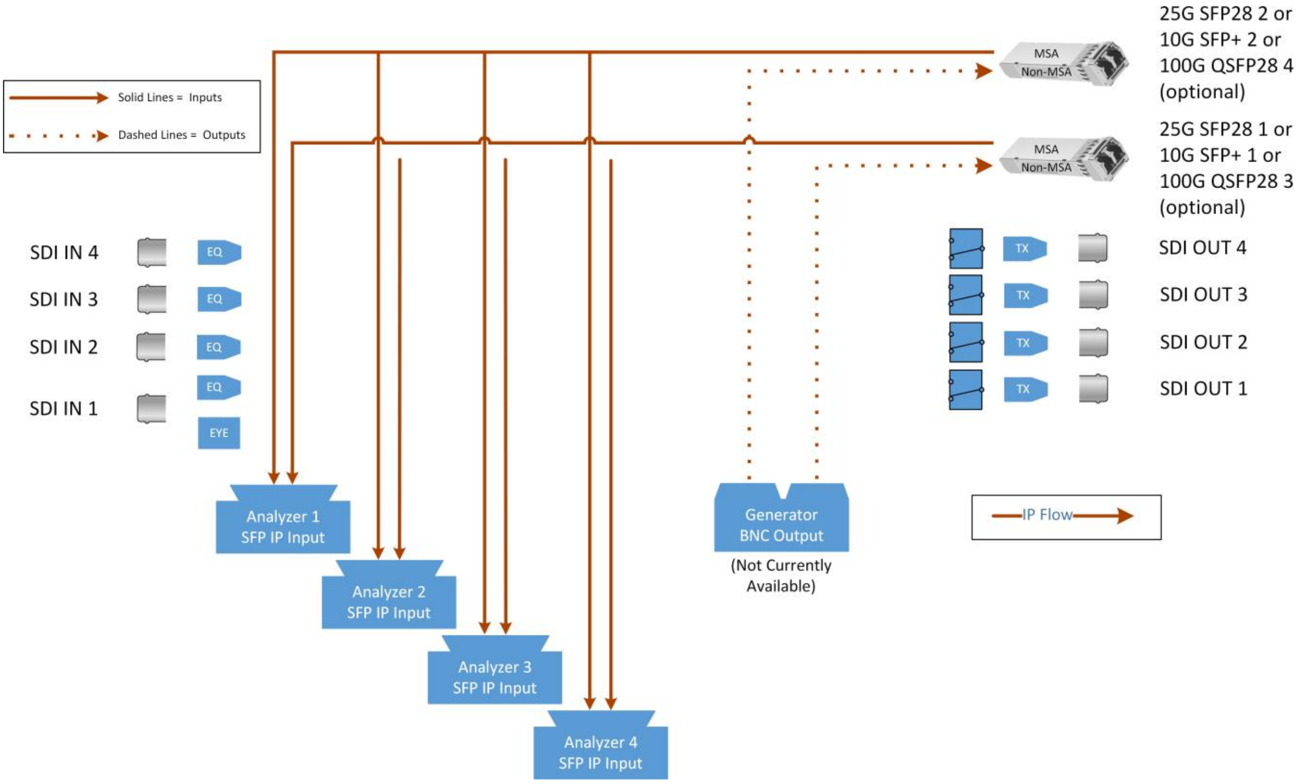


Figure 4-3: IP Input/Output Modules to Analyzer / Generator Circuitry (ST 2110)

Where:

- **EQ** = SDI Cable Equalizer (Not Used with IP)
- **Tx** = Signal Transmitter
- **EYE** = Eye Processing Circuitry (SDI Only) (Factory-fitted option)
- **MSA** = Multi-source Agreement

IP Interfaces to the Unit

Overview

The four analyzers of the standard unit support SMPTE standards ST 2110 and ST 2022-6, payloads of 270M, 1.5G, 3G, 6G, 12G, for SD or HD, using the following optical transceiver modules:

- 10G SFP+ (Standard unit: **LPX500I**)
- 25G SFP28 (Requires option: **LPX500-IP-25G**)
- 100G QSFP28 (Requires option: **LPX500-IP-100G**)

The option **LPX500-IP-25G** enables a higher speed and bandwidth interface using 25G SFP28 optical transceiver modules and the option **LPX500-IP-100G** can increase connection speeds and bandwidth further using 100G (4 x 25G channels) QSFP28 optical transceiver modules.

In addition, a packet interval profile generator **2022-6 Transmit (SFP 2/4)** is available .

For ST 2110 analyzer inputs, you can simultaneously analyze ST 2110-20 (video), 2110-30 (PCM) and 2110-31 (AES transport) audio, and 2110-40 ANC media flows. The unit also supports ST 2022-7 Seamless Protection Switching (SPS) for both ST 2022-6 and ST 2110 IP inputs. Furthermore, hardware-based time-stamping locked to PTP ensures accurate, real-time, deterministic timing of media flows through the support of ST 2059 Precision Time Protocol (PTP) on **SFP 1**.

IP connections to the unit using the rear panel 10G SFP+ or 25G SFP28 optical transceiver module(s) **SFP 1** and **SFP 2**; or 100G QSFP28 optical transceiver module(s) **QSFP 3** and **QSFP 4** are as follows:

- ST 2110 input (Rx) on **SFP 1** (or **QSFP 3**) and/or **SFP 2** (or **QSFP 4**) with ST 2059 Precision Time Protocol (PTP) on **SFP 1** (or **QSFP 3**).
- ST 2110 input (Rx) with ST 2022-7 SPS on both **SFP 1** (or **QSFP 3**) and **SFP 2** (or **QSFP 4**) and ST 2059 Precision Time Protocol (PTP) on both **SFP 1** and **SFP 2**.
- ST 2110 output (Tx) on **SFP 1** (or **QSFP 3**) and/or **SFP 2** (or **QSFP 4**).
- ST 2022-6 input (Rx) on **SFP 1** (or **QSFP 3**) and/or **SFP 2** (or **QSFP 4**).
- ST 2022-6 output (Tx) on **SFP 2** (or **QSFP 4**).

With factory-supplied 10G SFP+s (**PHSFP-10GE-SR**), 25G SFP28s (**PHSFP-25GE-SR**), or 100G QSFP28s (**PHSFP-100GE-SR**), you must use LC-to-LC optical, multimode duplex fiber cables for IP connections to the SFP / QSFP interfaces; the following cable specifications are approved:

- OM1 (62.5/125)
- OM2 (50/125)
- OM3 (50/125)
- OM4 (50/125)

With factory-supplied 10G SFP+s (**PHSFP-10GE-LR**), 25G SFP28s (**PHSFP-25GE-LR**), or 100G QSFP28s (**PHSFP-100GE-LR**), you must use LC-to-LC optical, single mode duplex fiber cables for IP connections to the SFPs; the following cable specifications are approved:

- OS1 (9/125)
- OS2 (9/125)

ST 2110 Input (Rx) Optical SFP Interfaces (Analyzer - IP Input)

Both **SFP 1** and **SFP 2** (or **QSFP 3** and **QSFP 4**) are available as input (Rx) connections for ST 2110 IP video, audio and ancillary data (ANC) flows at 10G (optionally 25G or 100G). Support for ST 2059 Precision Time Protocol (PTP) is available on **SFP 1**.

You can analyze flows on **SFP 1** or **SFP 2**, or use both interfaces in tandem in a **Seamless Protection Switching (SPS)** configuration where ST 2022-7 functionality provides seamless reconstruction of flows by using the *best* packets presented on either interface.

You can define the video and audio flow parameters in the **Analyzer - 2110 Format Setup** Instrument.

ST 2110 Output (Tx) Optical SFP Interfaces (Generator or Monitor Flows - IP Output)

Both **SFP 1** and **SFP 2** (optionally **QSFP 3** or **QSFP 4**) are available as output (Tx) connections for ST 2110 IP video, audio and ancillary data (ANC) flows at 10G (or optionally 25G / 100G) over IP.

You can transmit Generator or Monitor flows on **SFP 1** or **SFP 2** (optionally **QSFP 3** or **QSFP 4**).

You can define the video, audio and ancillary flow parameters in the **2110 Transmit** Instrument. For more information, see the section *2110 Transmit (ST 2110 IP Output)*.

ST 2022-6 Input (Rx) Optical SFP Interface (Analyzer - IP Input)

Both **SFP 1** and **SFP 2** (optionally **QSFP 3** and **QSFP 4**) are available as input (Rx) connections for ST 2022-6 input flows at 10G (optionally 25G or 100G).

You can analyze flows on **SFP 1** or **SFP 2** (or **QSFP 3** or **QSFP 4**), or use both interfaces **SFP 1+2** (**QSFP 3+4**) in tandem in a **Seamless Protection Switching (SPS)** configuration where ST 2022-7 functionality provides seamless reconstruction by using packets from either flow to compensate for possible packet loss or corruption.

You can use the **Analyzer - Video Standard (SDI & 2022-6)** instrument to override the parameters of the received ST 2022-6 flow, if necessary. For example, if the video rendering shows that the ST 352 payload data is wrong or inaccurate, you can use your knowledge of the correct parameters to override those that are incorrect. If you do not know the correct parameters but the video rendering is unsatisfactory, you can choose to ignore the ST 352 payload identifiers and allow the unit to estimate the parameter values.

ST 2022-6 Output (Tx) Optical SFP Interface (2022-6 Transmit IP Output)

The Generator transmit (Tx) connection for IP ST 2022-6 video is **SFP 2** or **QSFP 4**. This output provides the ST 2022-6 IP video packet generation at 10G (or optionally 25G / 100G) over IP.

System IO for IP Inputs

Overview

Due to the complexity of the UHDTV standards, PHABRIX has introduced innovative ways to display status information. The **System IO** Instrument provides a quick overview of the signal inputs and outputs connected to the unit. In addition, System IO displays the status of signal interfaces and the external reference.

System IO for IP Inputs

The unit can both receive and transmit either ST 2022-6 or ST 2110 IP flows by way of the active SFP28 or optional QSFP28 interface modules, which are represented in the System IO window by color-coded connector icons. For generator output, the color of the SFP connector icon is displayed in cyan, to indicate Tx signals.

> **Note:** You can change the representative color for the Generator output in the *Display Settings* dialog.

An entirely grayed-out connector indicates that a signal is not present. If an SFP or QSFP module is unseated or not present, this is displayed graphically with a black void to indicate a missing interface. To switch between the SFP28 interfaces, and QSFP interfaces, select the required interface from the QSFPs or SFPs dropdown in the System IO options menu.

The tables display SFP type and presence information, together with external reference standard and status overview.

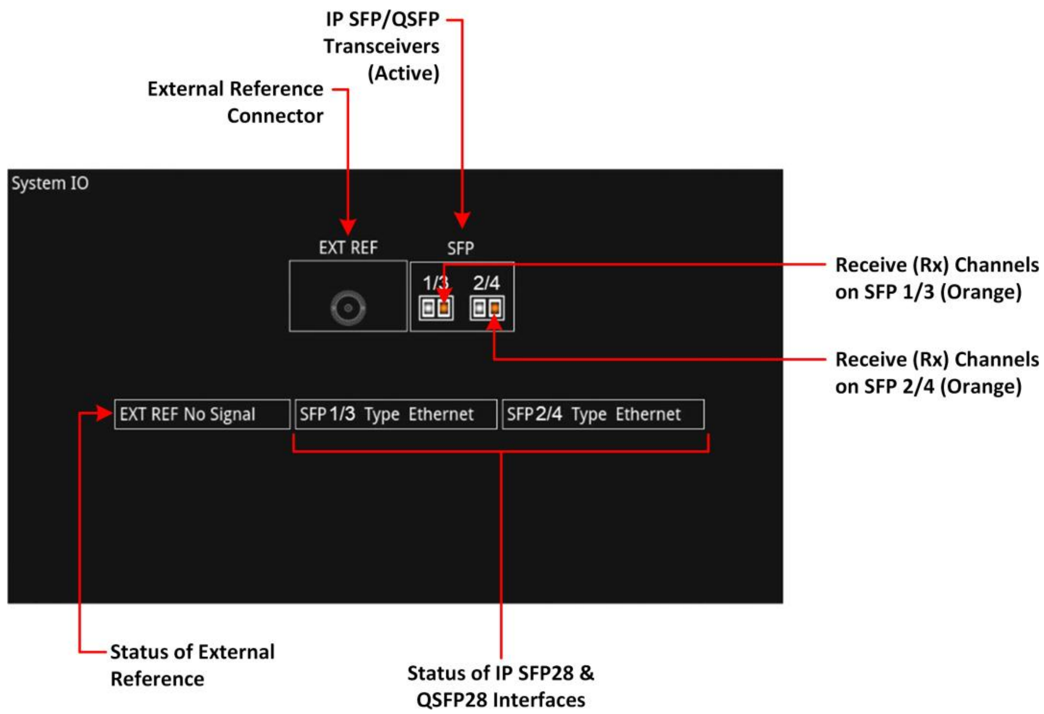


Figure 4-4: System IO Instrument on IP only Unit (Without Fa

Annotation [TE] Update with QSFPs when released. This is a fudge

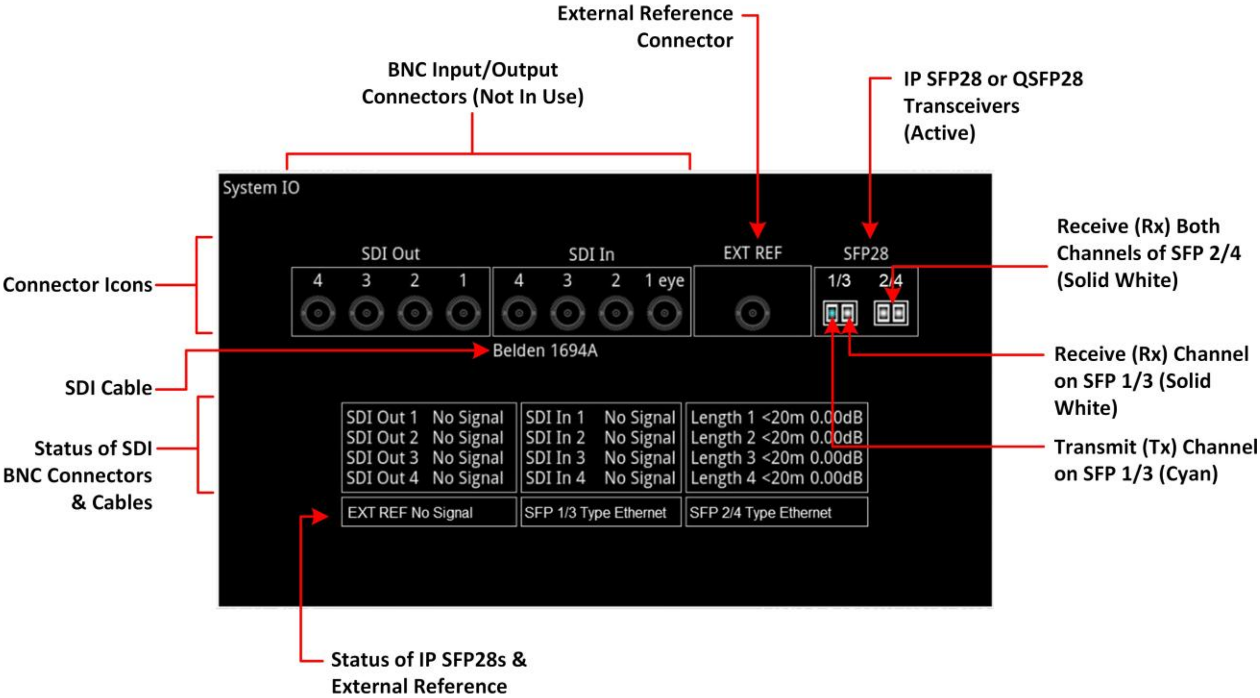


Figure 4-5: System IO Instrument Showing SFP 1/3 (TxRx) and SFP2/4 (Rx) (With Factory-fitted SDI Option)

Instrument Menu Options

The following table lists the configurable parameters in the System IO instrument options menu:

Table 4-1 : System IO Options

Item	Options	Description
BNC Out 1 BNC Out 2 BNC Out 3 BNC Out 4	Off Generator (Default) Loop SDI In 1, 2, 3, or 4 (SD-SDI or HD-SDI)	Choose whether to configure each SDI BNC Out connector (1, 2, 3 or 4) individually, to use either the Loop SDI In 1, 2, 3, or 4 signal, the Generator signal, or to switch off the output.
Cable Type	Belden 8281 Belden 1505 Belden 1694A (Default) Belden 1855A Canare L5CFB Image 1000	Selects the type of SDI cable used to connect the BNC connectors. The selected SDI cable type is shown below the SDI In BNC connector view. **Note:** Cable lengths can only be estimated if the cable is one of these supported types.
Preset Remote Control	Disabled (Default) Bit Binary	Use to enable the loading of presets using remote control by way of the 15-pin GPIO D-type connector on the rear panel. You can choose between Bit mode and Binary mode. See *Remote Control Loading of Presets* for further details.
QSFPs or SFPs	SFPs (Default) QSFPs	Enables you to switch the IP interface(s) between the 10G (or optionally 25G) SFP28s 1 and 2 or 100G QSFPs 3 and 4.

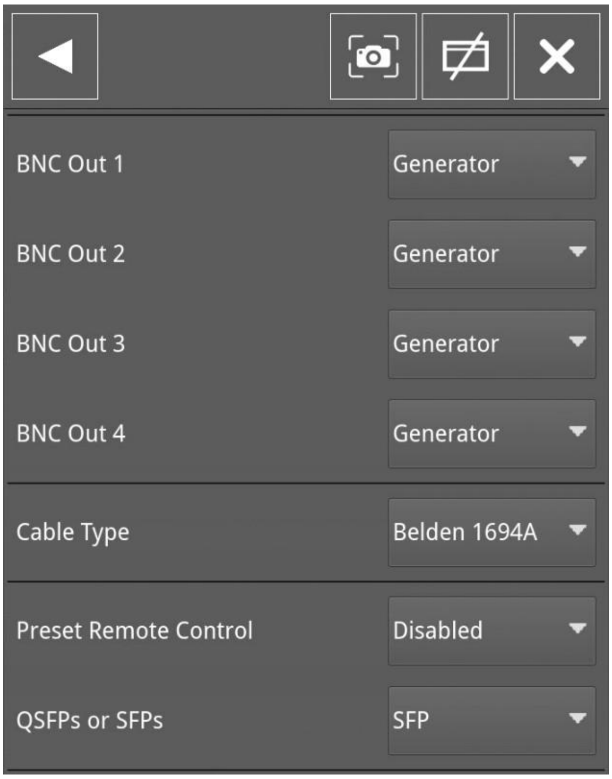


Figure 4-6: System IO Options Menu

SFP IP Network

Overview

The **SFP IP Network** instrument provides an overview of the status of the unit's SFP interfaces used for ST 2022-6 IP packet transmission (**SFP 2** or **QSFP 4**) and reception (**SFP 1** and **2** or **QSFP 3** and **4**), and for ST 2110 IP packet reception or transmission (**SFP 1** and **2**) or **QSFP 3** and **4**). This window displays the following parameters:

- SFP 1/3, and SFP 2/4 presence
- Carrier signal presence
- Interface status
- SFP MAC and IP addresses
- Domain Name System (DNS) Server IP address
- Packet information (Tx and Rx)
- IGMP maximum version status.

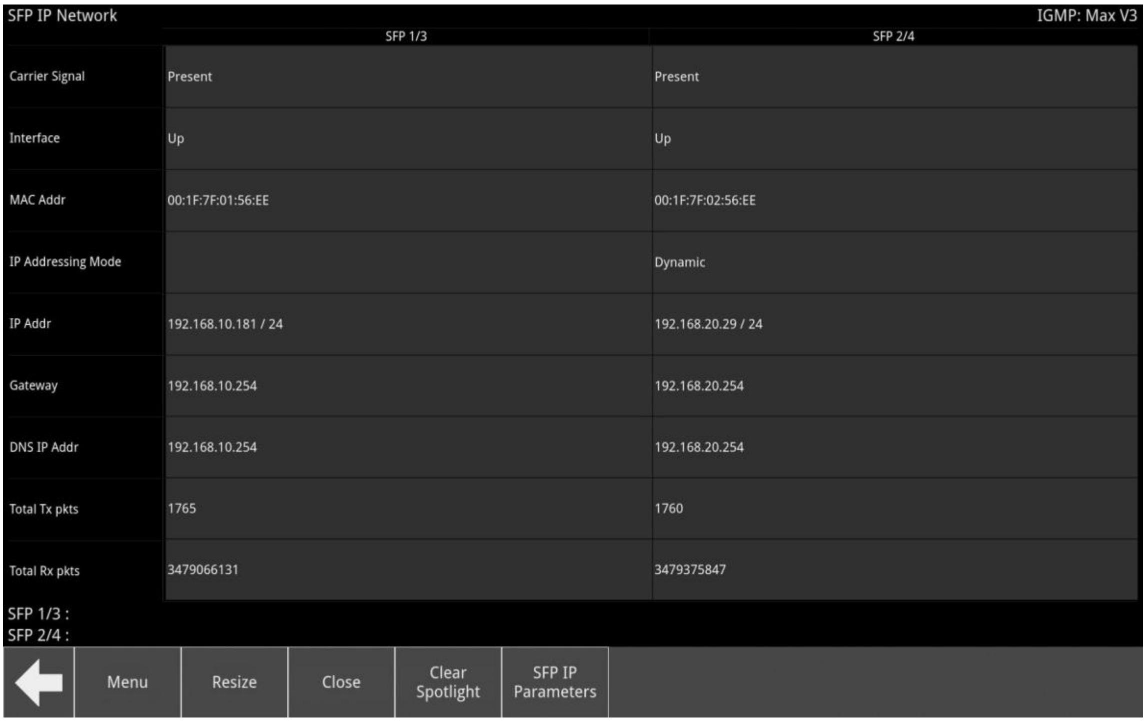


Figure 4-7: SFP IP Network Instrument

> **Note:** If you insert a 25G SFP28 in either the SFP 1 or 2 module cages when the 25G IP license (**LPX500-IP-25G**) is not installed, the instrument title will change color to red. If you hover the cursor over the title the following error message is displayed:
> **Error: IP 25G License: Not Present. Inserted 25G SFPs will not function.**

> **Note:** If you insert a 100G QSFP28 in either the SFP 3 or 4 module cages when the 100G IP license (**LPX500-IP-100G**) is not installed, the instrument title will change color to red. If you

hover the cursor over the title the following error message is displayed:
Error: IP 100G License: Not Present. Inserted 100G SFPs will not function.

In addition, error status information is displayed at the foot of the window.

Instrument Menu Options

Tap and hold or right-click in the instrument window to display a submenu you can use to set the IP address (DHCP or Static) and network/subnet mask of each SFP using a USB keyboard or on-screen keypad.

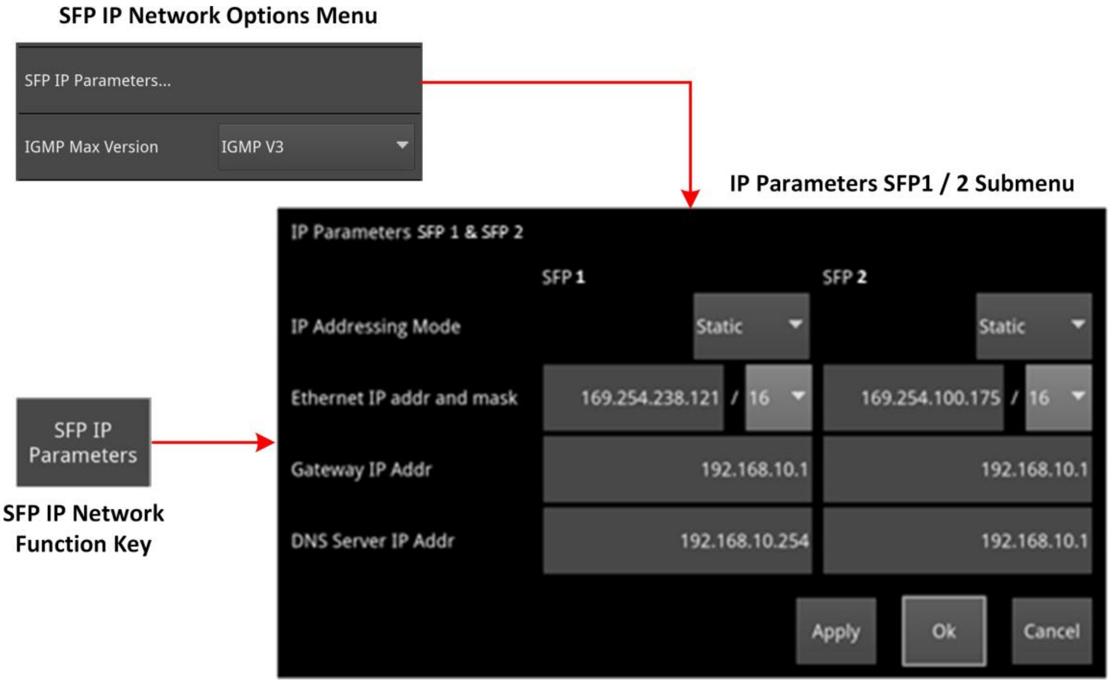


Figure 4-8: SFP IP Network Menu Options and Submenu

The following table lists the configurable parameters in the SFP IP Network instrument options menu and submenu:

Table 4-2 : SFP IP Network Options

Item	Options	Description
SFP IP Parameters (SFP 1/3 & SFP 2/4)		
IP Addressing Mode	Dynamic (Default) Static	Select the method to set the IP address of the SFP, either automatically, using DHCP, or manually, by entering the IP address directly. When set to Dynamic (default), the IP address, mask, gateway and DNS fields are grayed out and these details are assigned automatically. When set to Static, the IP addressing fields are activated, allowing you to enter the IP details manually.
SFP 1 / 2 IP Addr and Mask	Automatically allocated (Dynamic) or Manual Entry (Static)	IP address and mask of the SFP. Mask selection is by way of a dropdown menu; set mask in range 8 to 31. Classless Inter-Domain Routing (CIDR) notation is used with a default value of /24 (i.e., 255.255.255.0)
SFP 1 /2 Gateway IP Addr	Automatically allocated (Dynamic) or Manual	IP address of the SFP Gateway.

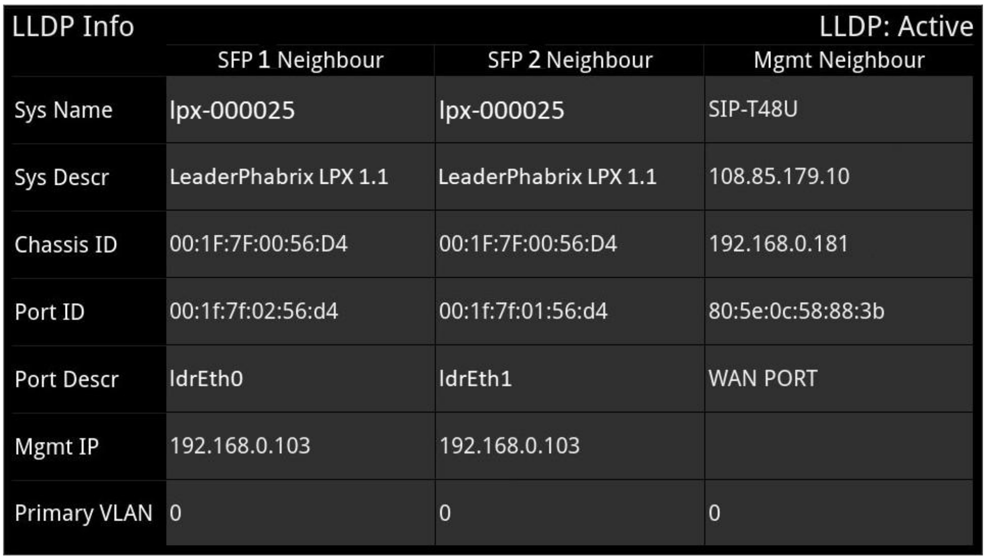
	Entry	

Item	Options	Description
	(Static)	
SFP 1 / 2 DNS IP Addr	Automatically allocated (Dynamic) or Manual Entry (Static)	IP address of the DNS server. Set IP address of DNS Server as required, for example, when manually configuring for use with NMOS.
Apply	Instrument Control	Apply and save the SFP IP parameters when manually allocated.
IGMP Max Version		
IGMP Max Version	IGMP V3 (Default) IGMP V2 IGMP V1	Represents the highest supported version of the Internet Group Management Protocol (IGMP). Currently version 3 is the highest supported version. In the event that the network is running IGMP version 2 or version 1, the unit automatically switches down to the lower version of the protocol. Currently there is no visual display of the version at which the unit is running. You can set the maximum allowed IGMP version using this instrument. Selecting the highest available IGMP Max Version will affect all IGMP requests (including both PTP and Media Flows requested through the **IP Receive - Flows** instrument.)

LLDP Information

Overview

Link Layer Discovery Protocol (LLDP) is a link layer protocol used by network devices to advertise their identity, capabilities and neighbors. The **LLDP Info** Instrument is particularly useful as an in-band method when you need to identify the port and device to which the unit is connected at the other end of a wired Ethernet link on a local area network.


LLDP Info — LLDP: Active

	SFP 1 Neighbour	SFP 2 Neighbour	Mgmt Neighbour
Sys Name	lpx-000025	lpx-000025	SIP-T48U
Sys Descr	LeaderPhabrix LPX 1.1	LeaderPhabrix LPX 1.1	108.85.179.10
Chassis ID	00:1F:7F:00:56:D4	00:1F:7F:00:56:D4	192.168.0.181
Port ID	00:1f:7f:02:56:d4	00:1f:7f:01:56:d4	80:5e:0c:58:88:3b
Port Descr	ldrEth0	ldrEth1	WAN PORT
Mgmt IP	192.168.0.103	192.168.0.103	
Primary VLAN	0	0	0

Figure 4-9: LLDP Info Instrument

When you enable LLDP send and receive, the unit searches for neighboring LLDP-enabled devices connected to SFP 1, 2 (or optionally QSFP 3, 4) and the Management Port. The unit reports the following data items:

- System Name
- System Description
- Chassis ID
- Port ID
- Port Description
- Management IP Address
- Primary VLAN ID.

When disabled, no LLDB information is reported.

The unit can provide the following information over LLDP:

Table 4-3 : LLDP Information Provided

Item	Unit Reports
System Name:	Serial number
System Description:	Unit Hostname and Software Version Number
Chassis ID and subtype:	Unit Management MAC address
Port ID and subtype:	Unit Management MAC address
Port Description:	• Eth0 (Management) • ldrEth0 (SFP 1, 3) • ldrEth1 (SFP 2, 4)
Management IP Addresses:	Management IP address

Instrument Menu Options

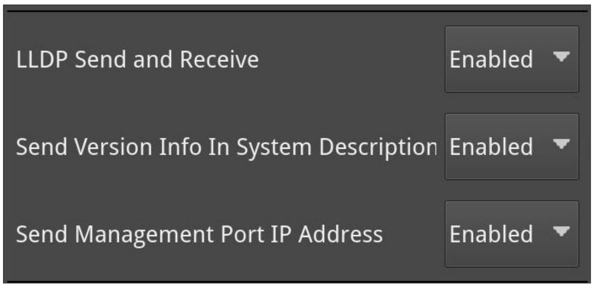


Figure 4-10: LLDP Info Menu Options

The following table lists the configurable parameters in the LLDP Info instrument options menu:

Table 4-4 : LLDP Info Menu Options

Item	Options	Description
LLDP Send and Receive	Enabled Disabled (Default)	When disabled, restricts some of the information that is communicated over LLDP, for example, when con- sidering the IT security of your system. You can enable these parameters to allow routine maintenance.
Send Version Info in Sys- tem Description	Enabled (Default) Disabled	Displayed only when LLDP Send and Receive is enabled. When disabled, the system description will indicate only **LeaderPhabrix LPX** and will not advertise the software version number.
Send Management Port IP Address	Enabled (Default) Disabled	Displayed only when LLDP Send and Receive is enabled. When disabled, the unit will not advertise its management IP address.

SFP (1, 2) / (3, 4) - Info

Overview

The **SFP - Info** windows provide at-a-glance physical status information on each SFP (or optional QSFP) interface module. Information includes identification, connector, line code (encoding), and vendor details to check compatibility for use with the unit. More detailed status information for the SFP, such as temperature and voltage is also displayed.

SFP E - Info

Temperature: 39.8 °C Voltage: 3.27 V
Rx Power: 1.25 mW Tx Power: 1.10 mW

Vendor	Gigalight	Bit Rate (MBd)	25750
Part No	GSS-MPO250-SRC	Optical Wavelength (nm)	850
Vendor OUI	00-00-00	SFF 8472 Compliance	SFF 8472 Rev 12.3
Revision	1A	Temp High Warning (°C):	80.0
Serial No	M2204110950	Temp Low Warning (°C):	-10.0
Identifier	SFP/SFP+/SFP28 and later	Temp High Alarm (°C):	85.0
Ext Identifier	GBIC/SFP function via two-wire only	Temp Low Alarm (°C):	-15.0
Connector Type	LC	Voltage High Warning(V)	3.47
Encoding	NRZ	Voltage Low Warning (V)	3.14
10G Ethernet	10G Base-SR	Voltage High Alarm (V)	3.50
Extended Compliance	100GBASE-SR4/25GBASE-SR	Voltage Low Alarm (V)	3.10
Fibre Channel Link Length	Short Distance (S)	Tx Power High Warning (mW):	2.00
Fibre Channel Technology	Shortwave laser, linear Rx (SA)	Tx Power Low Warning (mW):	0.32
Rate Identifier	Unspecified	Tx Power High Alarm (mW):	2.51
Supported Link Length Smf (km)	0	Tx Power Low Alarm (mW):	0.25
Supported Link Length Smf (m)	0	Rx Power High Warning (mW):	2.00
Supported Link Length OM1 (m)	0	Rx Power Low Warning (mW):	0.10
Supported Link Length OM2 (m)	0	Rx Power High Alarm (mW):	2.51
Supported Link Length OM3 (m)	70	Rx Power Low Alarm (mW):	0.08
Supported Link Length OM4 / Copper (10m / m)	10		

Figure 4-11: SFP (A, B) / (E, F) - Info Instrument (Full Screen Size)

> **Note:** If you insert a 25G SFP in either the SFP 1 or 2 module cages when the 25G IP license (**LPX500-IP-25G**) is not installed, the Instrument title will change color to red. If you hover the cursor over the title the following error message is displayed:
> **IP 25G License not present, please use a 10G ethernet SFP.**

Instrument Menu Options

The following table lists the configurable parameters in the (A, B) / (E, F) - Info instrument submenu:

Table 4-5 : SFP (1, 2) / (3, 4) - Info Instrument Menu Options

Item	Options	Description
Power Units	mW (Default) dBm	Units displayed for SFP Rx/Tx optical power.

NMOS Status Overview & Configuration (ST 2110 IP Input)

Overview

The AMWA NMOS toolset supports **IS-04 Discovery and Registration** (versions 1.0, 1.1, 1.2 and 1.3) and **IS-05 Device Connection Management** (versions 1.0 and 1.1). Support is also provided for the discovery of PTP Domain Number by way of **IS-09 System Discovery**. The unit supports discovery over both multicast DNS (mDNS) and unicast DNS-SD as described in the JT-NM requirements (*JT-NM TR1001-1:2018*) as well as manual entry of the NMOS Registry address.

The **NMOS** Instrument displays status information about the unit when acting as an NMOS receiver or sender, providing the following:

- NMOS Node current status (Enabled or Disabled)
- DNS Search Domain (Local or Domain name)
- Operating mode (Registered or Peer to Peer)
- Registration Discovery (Manual or Automatic (DNS-SD))
- Registration URL
- Receiver Mode (NMOS interface type, dual or single)
- Sender Mode (NMOS interface type, dual or single)
- Configure with IS-09 (Enable or disable remote discovery of PTP domain

number). For details, see the *NMOS Options Menu*.

NMOS	
NMOS Node	Enabled
DNS Search Domain	Local
Operating mode	Peer To Peer
Registration Discovery	Auto (DNS-SD)
Registration URL	
Receiver mode	Single interface
Sender mode	Single interface
Configure with IS-09	Disabled

Figure 4-12: NMOS Instrument - Status Overview (ST 2110 IP Input)

For additional NMOS instruments in the group, see:

- *NMOS Receivers - SDP (ST 2110 IP Input)*
- *NMOS Receivers - IS05 (ST 2110 IP Input)*
- *NMOS Senders - SDP (ST 2110 IP Input)*

- NMOS Senders - IS05 (ST 2110 IP Input).

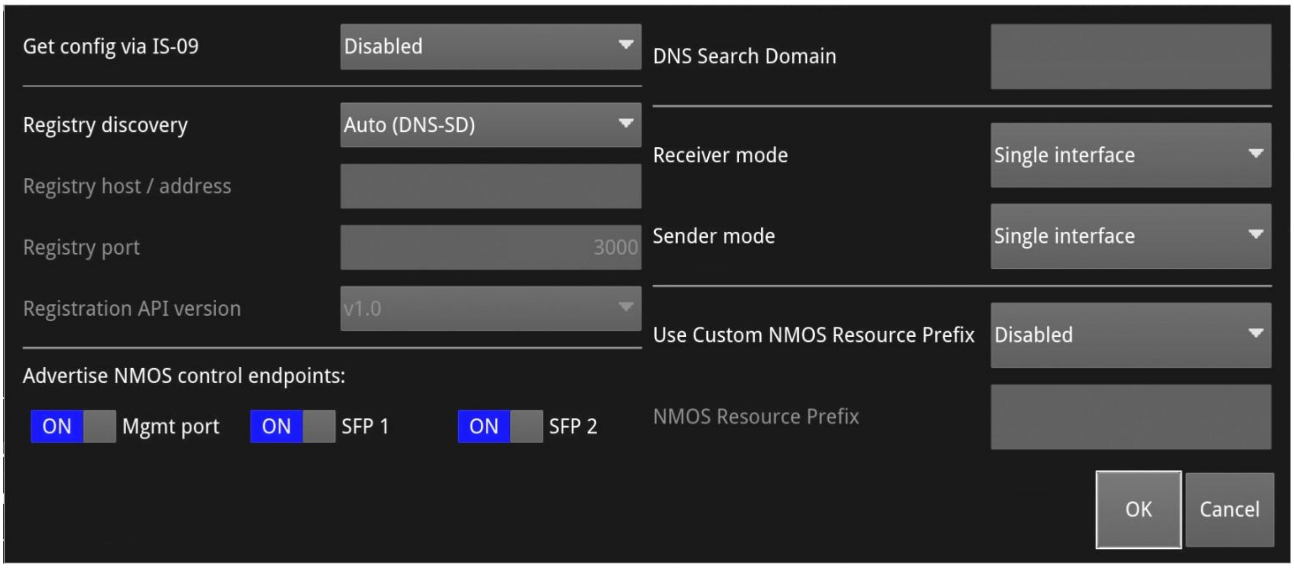


Figure 4-13: NMOS Generic Configuration Dialog (ST 2110 IP Inputs)

As a component of an NMOS-enabled environment, the unit can register its presence with the NMOS Registry as either a pair of single interface nodes, or as a dual interface node, for all ST 2110 flow types.

Use the configuration dialog of the NMOS Instrument to enable or disable the unit as an NMOS node and, when enabled, set the NMOS communication parameters of the node. This configuration is used by the following, additional instruments in the NMOS Group:

- NMOS Receiver - SDP
- NMOS Receiver - IS05
- NMOS Sender - SDP
- NMOS Sender - IS05.

An overview of the components comprising the NMOS Group is shown in *Figure 4-14*. For more information on each of these NMOS instruments, see the corresponding section.

Once registered as a receiver or sender node, you can use an NMOS Controller to manage the active connections with the unit.

The choice of single/dual interface for the NMOS receiver or sender node is independent of the choice of ST 2022-7 SFP 1, SFP 2, or Seamless SFP 1+2 mode selection.

> **Note:** In the event that the unit is unable to locate the NMOS Registry, it will revert to NMOS Peer to Peer mode and display **Peer to Peer** in place of the NMOS Registry IP address and port number.

Any changes to connectivity made by the NMOS Controller are dynamically reflected in the corresponding NMOS Instrument.

To troubleshoot your NMOS environment, you can enable the recording of NMOS Logs in the *Event Logging* instrument.

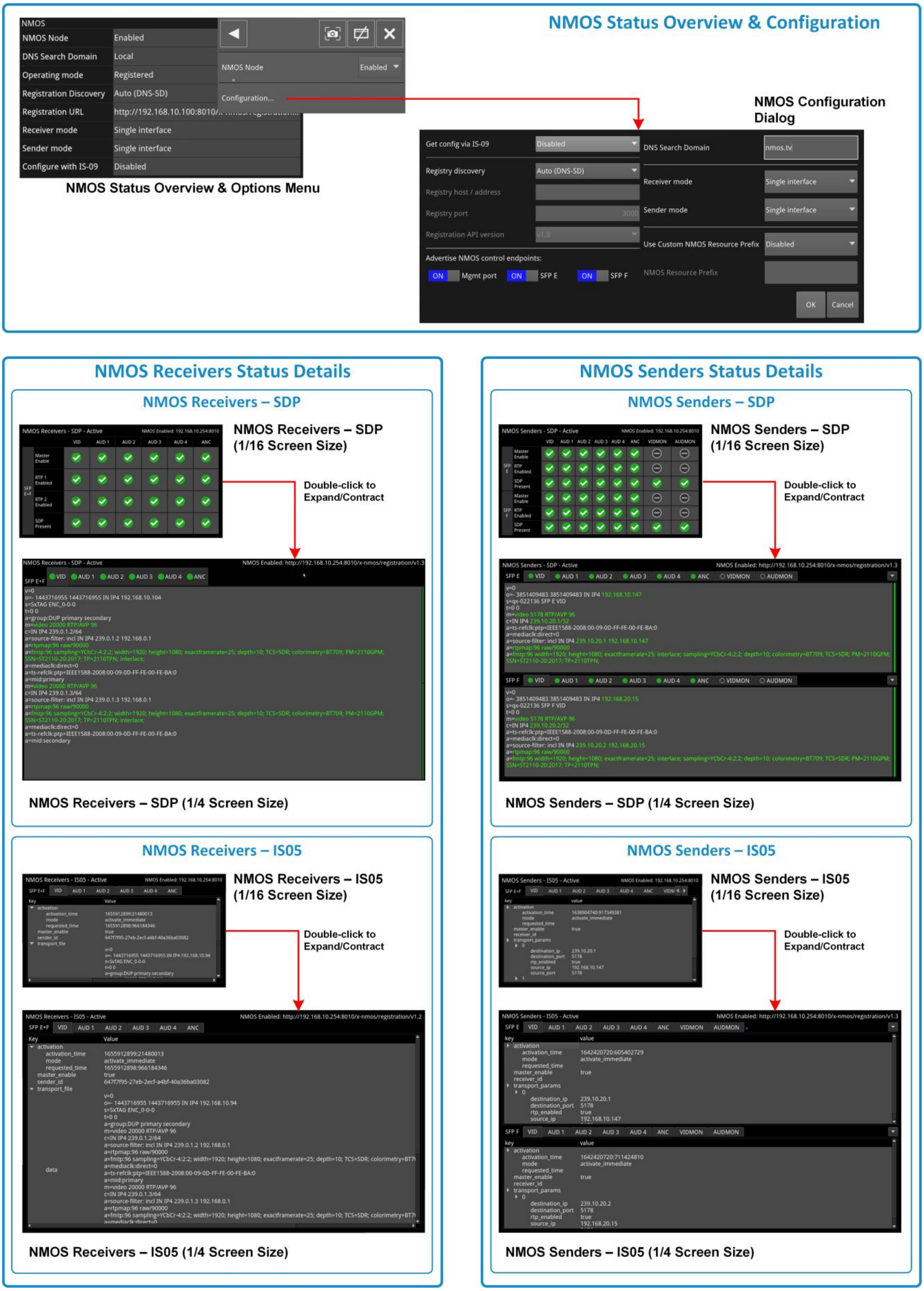


Figure 4-14: An Overview of the NMOS Group of Instruments (ST 2110 IP Input)

Toggle Switches to Advertise NMOS Control Endpoints

The **Advertise NMOS control endpoints** toggle switches in the NMOS configuration dialog enable you to prevent network interfaces from being advertised in specific sections of the Node API resources, for details see the section: *Using the Advertise NMOS Control Endpoints Toggle Switches*. This allows you to define how NMOS controllers connect to the unit by advertising the network addresses on which the unit listens for IS-04 and IS-05 requests.

For example, if an NMOS controller is connected only to the same network as the management port on the unit and cannot see the two networks to which the media interfaces on SFP 1 and SFP 2 are connected, you can disable NMOS control endpoint adverts on SFP 1 and SFP 2 using the toggle switches. If adverts from these endpoints are not disabled, the NMOS controller may try to make requests to unreachable networks.

> **Note:** These controls have no effect on the availability of Sender, Receiver, Flow or Source resources with respect to the media interfaces nor do they affect which interfaces listen for NMOS requests. Even if an interface is prevented from advertising itself the interface continues to listen. Furthermore these controls have no effect on multicast or unicast DNS-SD service discovery.

Instrument Menu Options

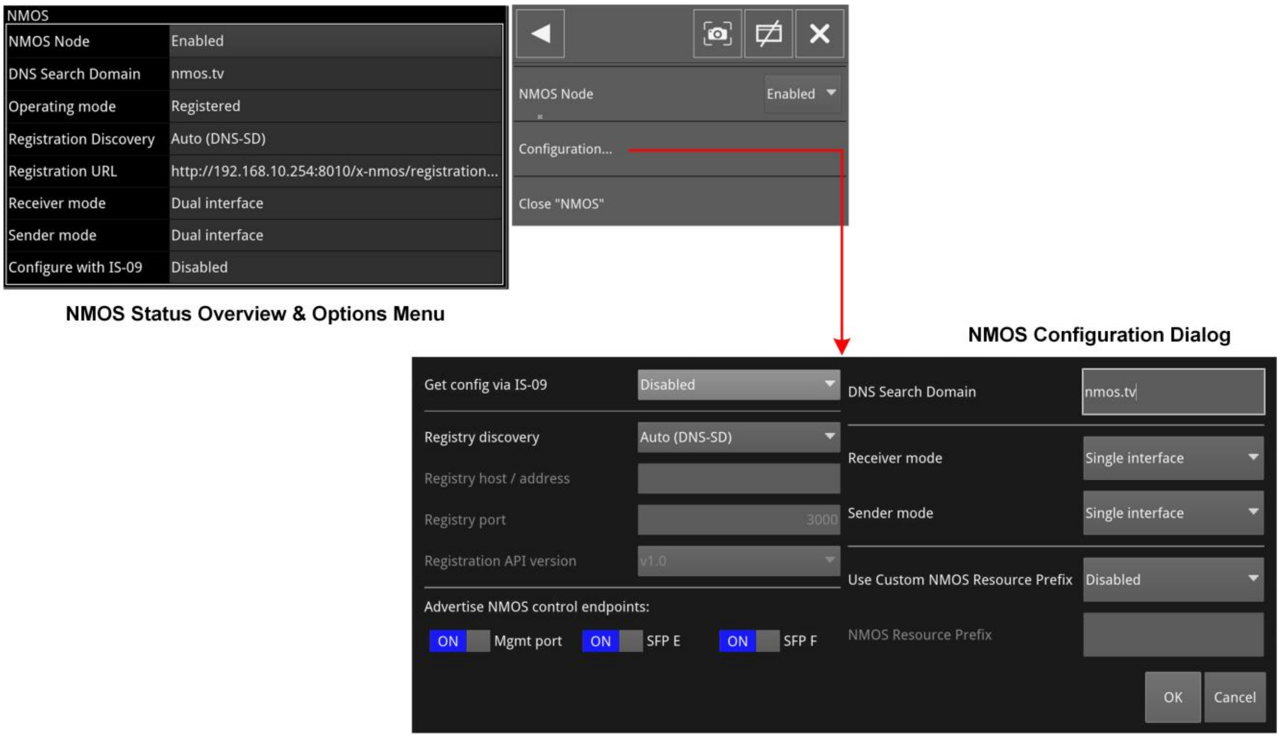


Figure 4-15: NMOS Instrument Options and Configuration Menu (ST 2110 IP Input)

The following table lists the configurable parameters in the NMOS instrument options menu:

Table 4-6 : NMOS Menu Options

Item	Options	Description

NMOS Node	Enabled Disabled (Default)	When enabled, allows the unit to act as an NMOS **Node**, and announce itself as a receiver or sender to the NMOS Registry. **Note:** If the interface changes (for example, it might be

Item	Options	Description
		disconnected or taken down) the NMOS Node must be disabled and then re-enabled to re-establish the connection.
Configuration....	N/A	Opens the Configuration dialog, see parameter details below.
Configuration Dialog Parameters		
Get config via IS-09	Enabled Disabled (Default)	Use NMOS IS-09 to obtain common global system parameters. When enabled, the unit will obtain the PTP domain from the IS-09 system source and apply to both SFP interfaces, if available.
DNS Search Domain	Blank (default) or free text entry field.	When left blank or set to the reserved mDNS domain (**local.**) the unit issues multicast DNS-SD (mDNS) requests. If you manually specify a domain different from **local.** using an external USB keyboard, you instruct the unit to use unicast DNS-SD requests.
Receiver mode	Dual interface Single Interface	This option enables you to select whether the unit registers itself as either an NMOS single or dual receiv- ing interface. When single, each interface is displayed as a single entity in the NMOS Controller. When dual, the interfaces are displayed as a pair in the NMOS Controller. When prompted, confirm your change.
Sender mode	Dual interface Single Interface	This option enables you to select whether the unit registers itself as either an NMOS single or dual send-ing interface. When single, each interface is displayed as a single entity in the NMOS Controller. When dual, the interfaces are displayed as a pair in the NMOS Controller. When prompted, confirm your change.
Registry discovery	Auto (DNS-SD) (Default) Manual	Use either default, automated mDNS/DNS Service Dis- covery as defined by the DNS Search Domain entry to Identify the NMOS Registry, or enter the Registry details manually.
Registry host / address	Blank (default) or free text entry field.	Active only when **Registry discovery** set to Manual. Use the number pad to specify the IP address of the NMOS Registry.
Registry port	3000 (Default)	Active only when **Registry discovery** set to Manual. Use the number pad to specify the port number of the NMOS Registry.

Registration API version	v1.0 (Default) v1.1 v1. 2 v1. 3	Active only when **Registry discovery** set to Manual. Controls which version of the IS-04 API the NMOS node uses. **Note:** All API Versions will be displayed.
Use Custom NMOS Resource Prefix	Enabled Disabled (Default)	By default the NMOS Node Label is set to the unit's serial number e.g., **qx-123456**. This is then used as part of the NMOS resource label e.g., **qx-123456 SFP E VID 1**. When enabled, this control enables you to enter a different NMOS node label, if required, e.g., **MCR QxP**

Item	Options	Description
NMOS Resource Prefix	Blank (default) or free text entry field.	Active only when **Use Custom NMOS Resource Prefix** enabled. Use a USB keyboard to enter a custom prefix NMOS device label for the NMOS resource name.
Advertise NMOS control endpoints		
Management Port (Mgmt Port)	ON (default) OFF	These toggle switches enable you to define how NMOS controllers connect to the unit by advertising the network addresses on which the unit listens for IS- 04 and IS-05 requests. When switched ON, this setting makes the management port visible to the NMOS controller so that it can be used as the interface for NMOS requests from the unit. Switch OFF to prevent the management port from advertising its network address. For example, in the event that the management port is installed in a different network from the SFPs.
SFP 1	ON (default) OFF	When switched ON, this setting makes SFP 1 visible to the NMOS controller so that it can be used as the interface for NMOS requests from the unit. Switch OFF to prevent SFP 1 from advertising its network address.
SFP 2	ON (default) OFF	When switched ON, this setting makes SFP 2 visible to the NMOS controller so that it can be used as the interface for NMOS requests from the unit. Switch OFF to prevent SFP 2 from advertising its network address.

Note: If you are not using DHCP and are configuring the system by specifying the DNS Server manually, it is recommended do so in the **SFP IP Network** instrument, see *SFP IP Network*.

NMOS Receivers - SDP (ST 2110 IP Input)

Overview

The **NMOS Receivers - SDP** instrument displays either a summary status overview (1/16 or 1/4 screen size) or details of the current NMOS SDP file, defining the sender connectivity of the node (full screen size).

The NMOS Receivers - SDP instrument toggles between displaying the statuses of the Master Enable, RTP Enables and SDP record, displaying the content of the active or staged Session Description Protocol (SDP) records.

Use this instrument to review the SDP file content or to save SDP files for offline analysis.

NMOS Receivers - SDP

As a component of an NMOS-enabled environment, the unit can register its presence with the NMOS Registry, for all flow types, as either a pair of single nodes, or as a dual receiver node.

This Instrument will display either one or two SDP records, depending on the configuration of the NMOS Receiver. If configured for an NMOS dual interface, SFP E and SFP F interfaces are treated as a pair and only one SDP record is displayed. When configured for NMOS single interfaces, then SFP E and SFP F are treated individually and the unit displays separate SDP records for each interface. For more information, see *IETF RFC 4566 SDP: Session Description Protocol* and SMPTE ST 2110-20, -30,
-31 and -40.

At 1/16 and 1/4 screen size, you can switch the display between either a summary overview, showing the state of the Master and RTP Enables and the presence of a valid SDP record for each flow, or the details of the SDP file. The display adapts to show either one, two or four audio flows, depending on the number of flows configured in the *IP Receive - Flows* instrument.

In the summary overview, the unit displays the following information about the connection:

- **Master Enable:** Shows the status of either the active or staged NMOS Master Enable.
- **RTP Enabled:** (Single interface) Shows the status of either the Active or Staged NMOS RTP enable for each interface.
- **RTP 1 / RTP 2 Enabled:** (Dual interface) Shows the status of either the active or staged NMOS RTP Enable for each interface.
- **SDP Present:** Shows whether a validated SDP record is present.

At 1/16 and 1/4 screen size, switch between active and staged views, or the display of Summary or SDP details using the options menu. The unit defaults to displaying the Summary view of the SDP details.

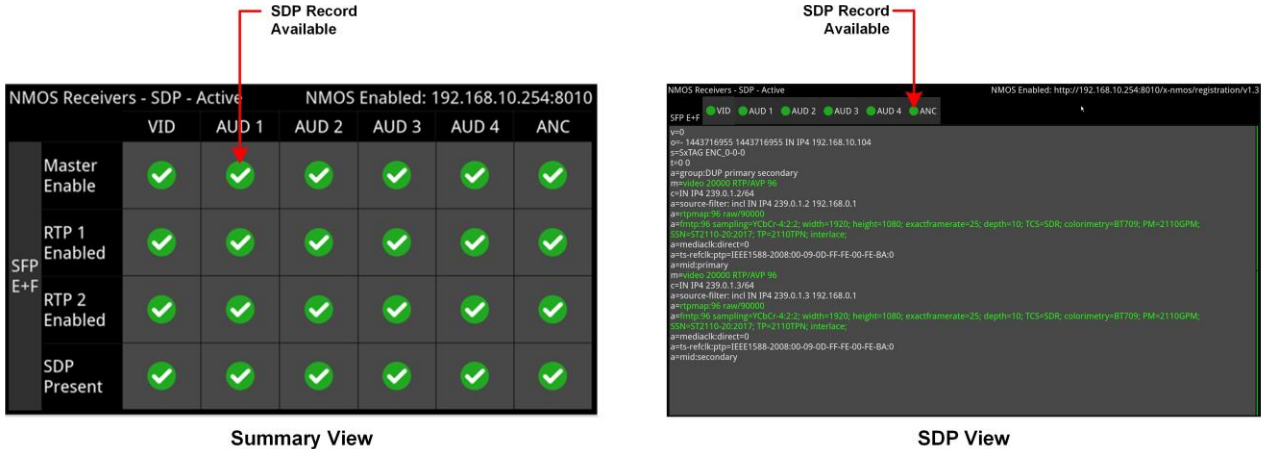


Figure 4-16: NMOS Receivers - SDP Instrument (Dual Interface) (ST 2110 IP Input)

At full screen size, the instrument displays the full details of the SDP record.

You can switch between the active and staged data from the options menu and the unit displays the current selection (Active or Staged) in the instrument's title bar or as Summary or SDP details in the options menu.

Once registered, you can use an NMOS Controller to manage the active connections with the unit. Use the tabs above the SDP panel(s) to monitor the active video, audio and ancillary SDP records, or to inspect the staged SDP files.

> **Note:** The unit listens for NMOS communications on UDP Port 3000.

The choice of single/dual NMOS node is independent of the choice of 2022-7 SFP E, SFP F, or Seamless SFP E+F mode selection.

> **Note:** In the event that the unit is unable to locate the NMOS Registry, it will revert to NMOS Peer to Peer mode and display **Peer to Peer** in place of the NMOS Registry IP address and port number in the title bar.

Any changes to connectivity made by the NMOS Controller are dynamically reflected in the NMOS Receivers - SDP Instrument.

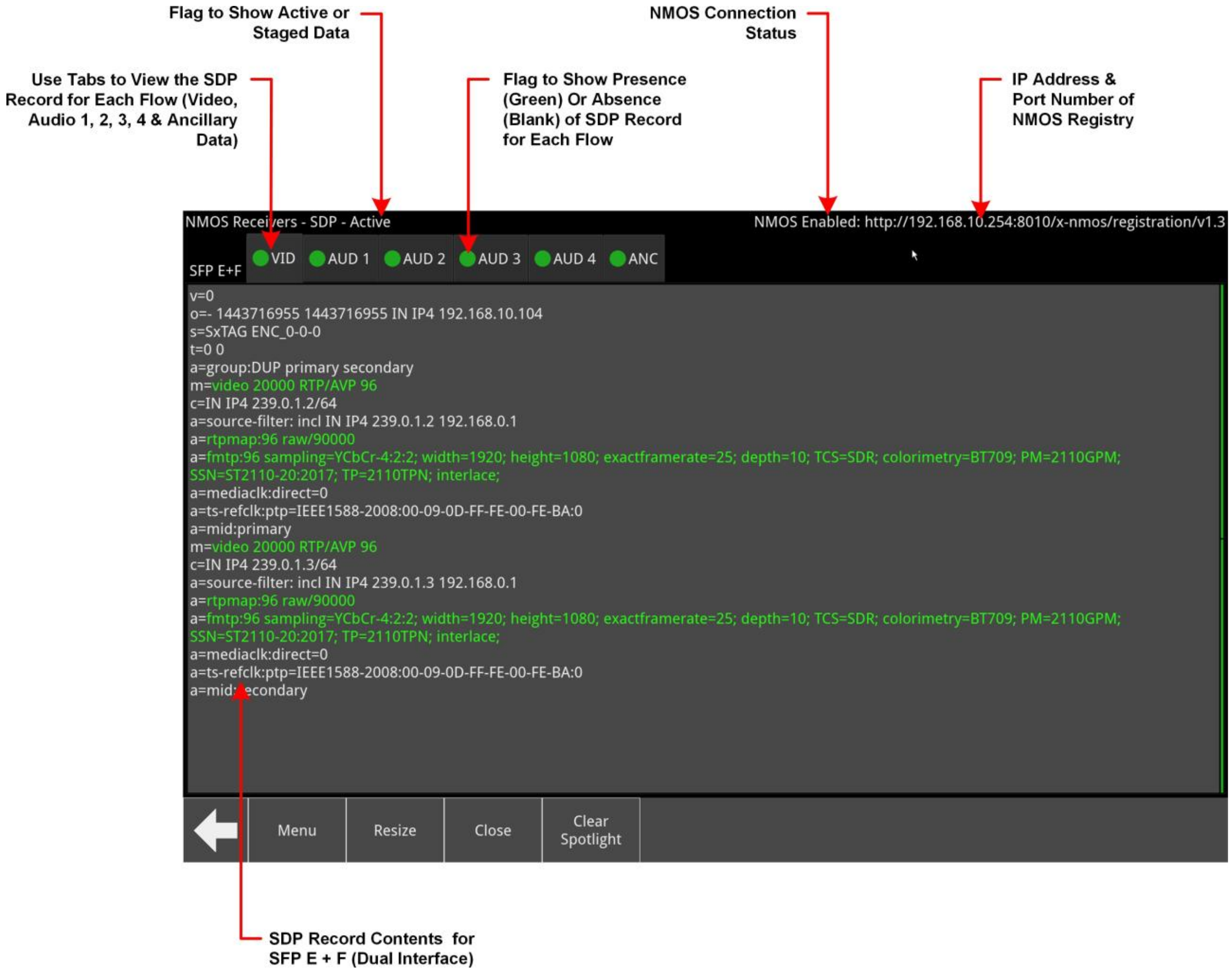


Figure 4-17: NMOS Receivers - SDP Instrument Views (Dual Interface, Full Screen Size) (ST 2110 IP Input)

Saving SDP Records to Disk

You can save the active SDP records to disk as follows:

1. Open the Options menu and select Save Active SDPs. The unit saves all active SDP records to a zip file.
2. Access the SDP records from the following folder: From the File Manager:
   qx:/log/sdp
   Using SFTP:
   /transfer/log/sdp

Instrument Menu Options

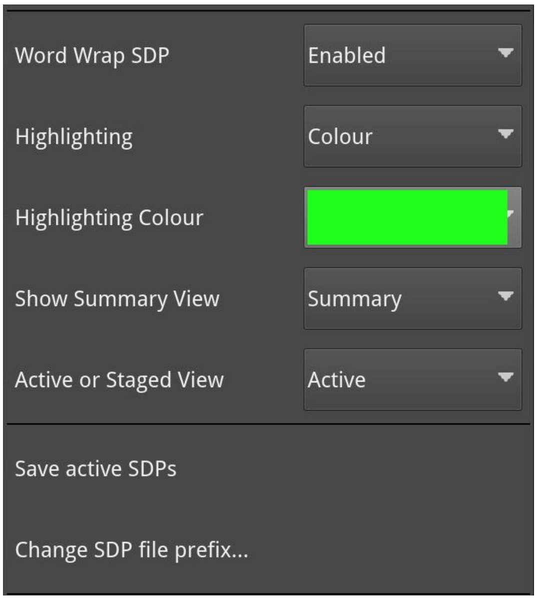


Figure 4-18: NMOS Receivers - SDP Instrument Menu Options

The following table lists the configurable parameters in the NMOS Receivers - SDP instrument options menu:

Table 4-7 : NMOS Receivers - SDP Menu Options

Item	Options	Description
Word Wrap SDP	Enabled (Default) Disabled	When enabled, uses word wrap to display the full SDP text descriptions in the available width of the display win- dow. When disabled, you will need to use the horizontal scroll bar(s) to read long SDP descriptions.
Highlighting	None (Default) Monochrome Color	Select Color to open the color palette from which you can select the most appropriate color in which to highlight those SDP data parameters most pertinent to the unit's setup, for example, the source and destination IP addresses, video and audio setup parameters, etc. Select Monochrome to highlight in gray those SDP data parameters, most pertinent to the unit's setup. You can save the highlighting option and any selected color in the presets.
Highlighting Color	Select from color palette.	Choose a highlight color from the color palette in which to display SDP data parameters.
Show Summary View	Summary (Default) 1/16 and 1/4 screen size SDP	Switch between the overview summary and the SDP detail. This option is available at 1/16 and 1/4 screen size.
Active or Staged View	Active (Default) Staged	This option enables you to switch between the active SDP file and the staged file.
Save Active SDPs	N/A Active Control	Save the active, validated SDP file to the unit's storage. The instrument saves files with a **.sdp** extension.
Change SDP file pre- fix...	**ActiveReceiverSdp** (Default) Or enter an alternative filename using a connected	Change the default file prefix if saving multiple SDP files to prevent overwriting of the last saved file.

	USB keyboard.	

NMOS Receivers - IS05 (ST 2110 IP Input)

Overview

AMWA IS-05 Device Connection Management specifies how to allow a device in an NMOS-compatible system to connect to other devices.

The **NMOS Receivers - IS05** instrument displays a convenient view of the IS-05 parameters as seen by the NMOS node for each flow.

NMOS Receivers - IS05

The NMOS Receivers - IS05 instrument provides additional detail about the NMOS connection to supplement the information in the Session Description Protocol (SDP) record. This instrument displays the current NMOS IS-05 parameters, defining the receiver connectivity of the node. The instrument presents the IS-05 data in either a tree format (shown below), with expandable or collapsible sections, or as a raw text string. You can switch between the active and staged data from the options menu and the unit displays the current selection (Active or Staged) in the instrument's title bar. The display adapts to show tabs for either one, two or four audio flows, depending on the number of flows configured in the *IP Receive - Flows* instrument.

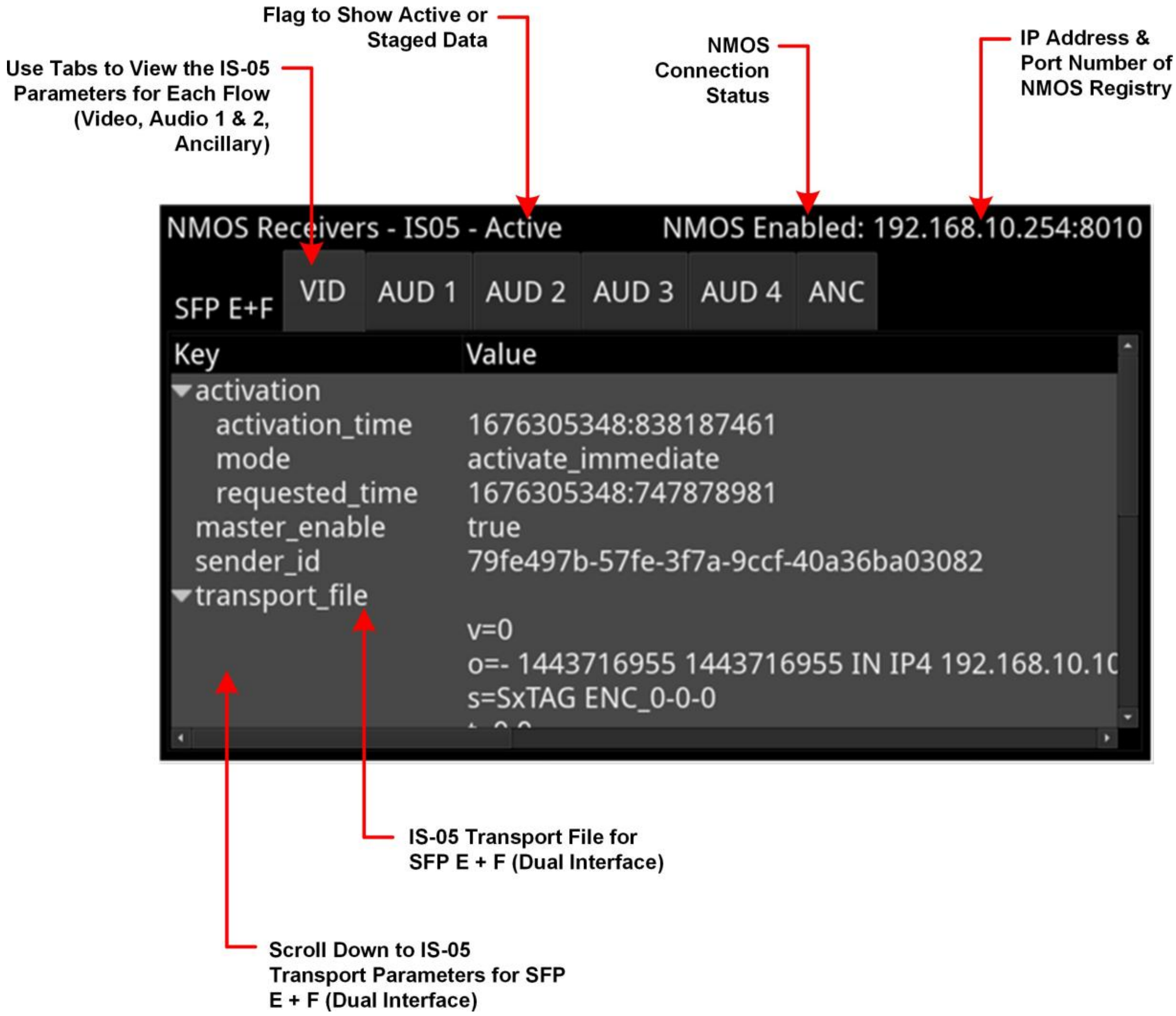


Figure 4-19: NMOS Receivers - IS05 Instrument (Dual Interface) (ST 2110 IP Input)

The NMOS Receivers - IS05 instrument displays either one or two sets of IS-05 parameters, depending on how the NMOS Receiver is configured. If the unit is configured for an NMOS dual interface, SFP E and SFP F interfaces are treated as a pair, and only one IS-05 parameter set is displayed. If the unit is configured for NMOS single interfaces, then SFP E and SFP F are treated individually and the unit displays separate IS-05 parameter sets for each interface.

Each interface (either single or dual) provides tabs to switch between the possible flows (VID, AUD 1 to AUD 4 (configurable) and ANC) enabling you to view the IS-05 parameters for each flow. You can choose to display the instrument in 1/16 screen size or, for improved viewing of data, at 1/4 screen size.

For more information on the **NMOS Receivers - SDP** instrument, see *NMOS Receivers - SDP (IP 2110 Mode)*.

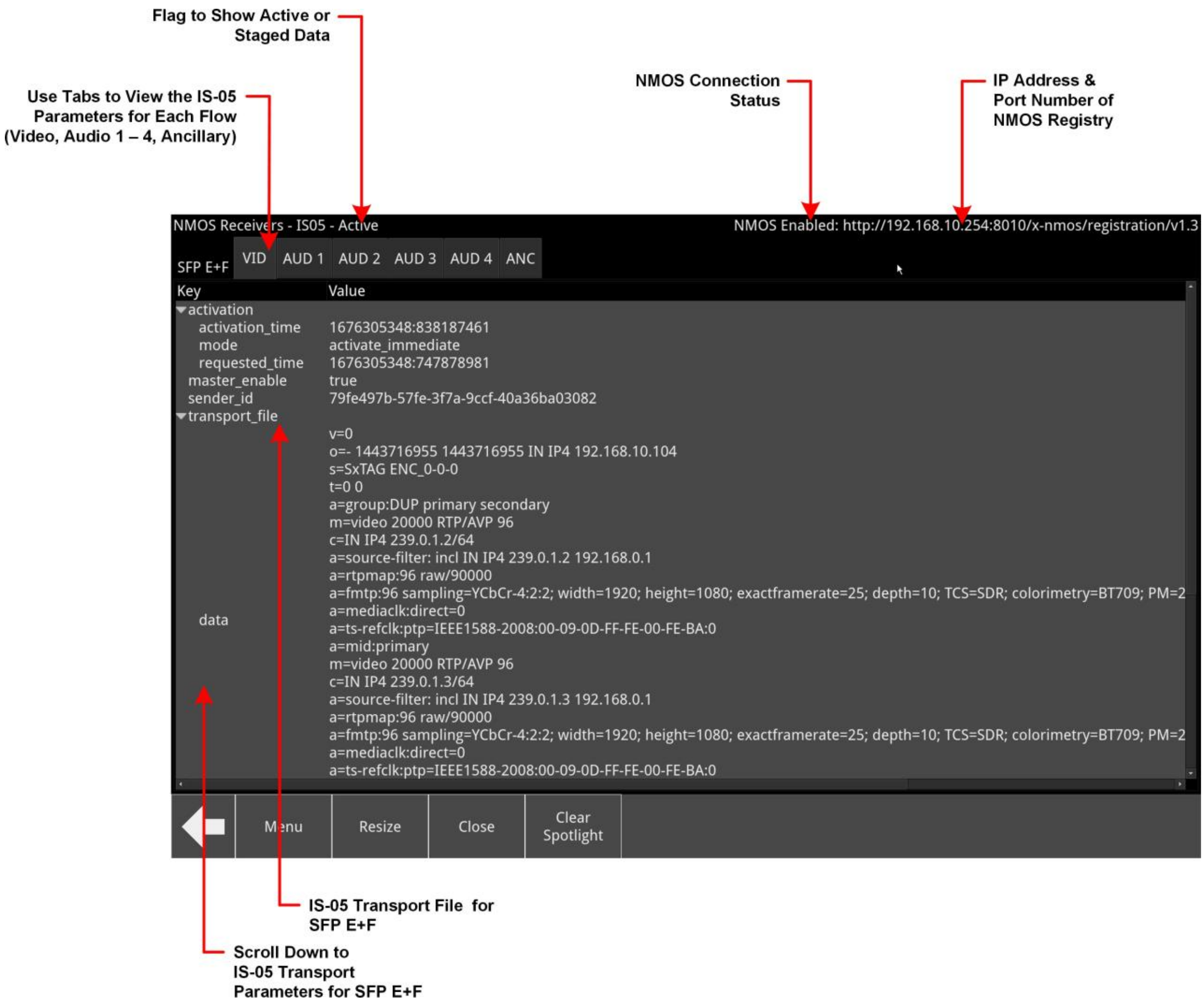


Figure 4-20: NMOS Receivers - IS05 Instrument - Expanded to Full Screen Size (Dual Interface) (ST 2110 IP Input)

Instrument Menu Options

Figure 4-21: NMOS Receivers - IS05 Instrument Menu Options

The following table lists the configurable parameters in the NMOS Receivers - IS05 instrument options menu:

Table 4-8 : NMOS Receivers - IS05 Menu Options

Item	Options	Description
Word Wrap JSON	Enabled (Default) Disabled	When enabled, wraps the raw text string containing the IS-05 parameters to the displayed screen width.
Show Tree View	Tree (Default) Raw	When enabled, displays the NMOS IS-05 parameters in an interactive tree format.
Active or Staged View	Active (Default) Staged	This option enables you to switch between the active and the staged IS-05 parameters.

NMOS Senders - SDP (ST 2110 IP Inputs)

Overview

The **NMOS Senders - SDP** Instrument displays the content of the active Session Description Protocol (SDP). Use this instrument to review the SDP file content or save active SDP records for offline analysis. The NMOS sender is activated automatically when the 2110 Generator is available.

NMOS Senders - SDP

As a component of an NMOS-enabled environment, the unit can register its presence, for all flow types, as either a pair of single nodes, or as a dual sender node,.

This Instrument will display either one or two SDP records, depending on the configuration of the NMOS Sender. If configured for an NMOS dual interface, SFP E and SFP F interfaces are treated as a pair and only one SDP record is displayed. When configured for NMOS single interfaces, then SFP E and SFP F are treated individually and the unit displays separate SDP records for each interface. For more information, see *IETF RFC 4566 SDP: Session Description Protocol* and SMPTE ST 2110-20, -30,
-31 and -40.

The NMOS Senders - SDP instrument displays either a summary status overview (1/16 and 1/4 size) or details of the current NMOS SDP file, defining the sender connectivity of the node (full screen size).

At 1/16 and 1/4 screen size, you can switch the display between either a summary overview, showing the active SDP connections for each flow, or the details of the SDP record. In the summary overview, the unit displays the following information about the connection:

- **Master Enable:** Shows the status of the active NMOS Master Enable.
- **RTP Enabled:** (Single interface) Shows the status of the active NMOS RTP enable for each inter- face.
- **RTP 1 / RTP 2 Enabled:** (Dual interface) Shows the status of the active NMOS RTP Enable for each interface.
- **SDP Present:** Shows whether an SDP record is present.

Switch between the display of Summary or SDP in 1/16 or 1/4 screen size, using the options menu.

> **Note:** As the Sender SDP record is created dynamically when the flow is activated (Active view), a Staged Sender SDP record does not exist.
>
> An NMOS Receiver, however, may have both Active and Staged SDP records.

Figure 4-22: NMOS Senders - SDP Instrument (Single Interface) (ST 2110 IP Inputs)

At full screen size, the instrument displays the complete details of the active SDP record.

Once registered, you can use an NMOS Controller to manage the active connections with the unit. Use the tabs above the SDP panel(s) to monitor the active video, audio, ancillary, VIDMON and AUDMON SDP records.

> **Note:** The unit listens for NMOS communications on UDP Port 3000.

The choice of single/dual NMOS node is independent of the choice of 2022-7 SFP E, SFP F, or Seamless SFP E+F mode selection.

> **Note:** In the event that the unit is unable to locate the NMOS Registry, it will revert to NMOS Peer to Peer mode and display **Peer to Peer** in place of the NMOS Registry IP address and port number in the title bar.

Any changes to connectivity made by the NMOS Controller are dynamically reflected in the NMOS Senders - SDP instrument.

Figure 4-23: NMOS Senders - SDP Instrument View (Dual Interface,) (ST 2110 IP Inputs)

Saving SDP Records to Disk

You can save the active SDP records to disk as follows:

1. Open the Options menu and select Save Active SDPs. The unit saves all active SDP records to a zip file.
2. Access the SDP records from the following folder: From the File Manager:
   qx:/log/sdp
   Using SFTP:
   /transfer/log/sdp

Instrument Menu Options

Figure 4-24: NMOS Senders - SDP Instrument Menu Options

The following table lists the configurable parameters in the NMOS Senders - SDP instrument options menu:

Table 4-9 : NMOS Senders - SDP Menu Options

Item	Options	Description
Word Wrap SDP	Enabled (Default) Disabled	When enabled, uses word wrap to display the full SDP text descriptions in the available width of the display win- dow. When disabled, you will need to use the horizontal scroll bar(s) to read long SDP descriptions.
Highlighting	None (Default) Monochrome Color	Select Color to open the color palette from which you can select the most appropriate color in which to highlight those SDP data parameters, most pertinent to the unit's setup, for example, the source and destination IP addresses, video and audio setup parameters, etc. Select Monochrome to highlight in gray those SDP data parameters, most pertinent to the unit's setup. You can save the highlighting option and any selected color in the presets.
Highlighting Color	Select from color palette.	Choose a highlight color from the color palette in which to display SDP data parameters.
Show Summary View	Summary (Default) SDP	Switch between the overview summary and the SDP detail. This option is available only at 1/16 screen size.

Save Active SDPs	N/A Active Control	Save active SDP records to the unit's storage. The instrument saves files with a **.sdp** extension.

Item	Options	Description
Change SDP file pre- fix...	**ActiveSenderSdp** (Default) Or enter an alternative filename using the onscreen keyboard or a connected USB keyboard.	Change the default file prefix if saving multiple SDP records to prevent overwriting of the last saved file.

NMOS Senders - IS05 (ST 2110 IP Inputs)

Overview

AMWA IS-05 Device Connection Management specifies how to allow a Device in an NMOS compatible system to connect to other Devices.

The **NMOS Senders - IS05** instrument displays a convenient view of the IS-05 parameters as seen by the Qx NMOS node for each flow.

NMOS Senders - IS05

The NMOS Senders - IS05 instrument provides additional detail about the NMOS connection to supplement the information in the Session Description Protocol (SDP) record. This instrument displays the current NMOS IS-05 parameters, defining the sender connectivity of the node. The instrument presents the IS-05 data in either a tree format (shown below), with expandable or collapsible sections, or as a raw text string. You can switch between the active and staged data from the options menu and the unit displays the current selection (Active or Staged) in the instrument's title bar.

Figure 4-25: NMOS Senders - IS05 Instrument (Dual Interface, 1/16 Screen Size) (ST 2110 IP Inputs)

The NMOS Senders - IS05 instrument displays either one or two sets of IS-05 parameters, depending on how the NMOS Sender is configured. If the unit is configured for an NMOS dual interface, SFP E and SFP F interfaces are treated as a pair, and only one IS-05 parameter set is displayed. If the unit is configured for NMOS single interfaces, then SFP E and SFP F are treated individually and the unit displays separate IS-05 parameter sets for each interface.

Each interface (either single or dual) provides tabs to switch between the possible flows (VID, AUD1 to AUD4, ANC, VIDMON and AUDMON) enabling you to view the IS-05 data for each flow. You can choose to display the instrument in 1/16 screen size or, for improved viewing of data, at 1/4 screen size.

For more information on the **NMOS Senders - SDP** instrument, see *NMOS Senders - SDP (IP 2110 Mode)*.

Figure 4-26: NMOS Senders - IS05 Instrument - Expanded to 1/4 Screen Size (Single Interface) (ST 2110 IP Inputs)

Instrument Menu Options

Figure 4-27: NMOS Senders - IS05 Instrument Menu Options

The following table lists the configurable parameters in the NMOS Senders - IS05 instrument options menu:

Table 4-10 : NMOS Senders - IS05 Menu Options

Item	Options	Description
Word Wrap JSON	Enabled (Default) Disabled	When enabled, wraps the raw text string containing the IS-05 parameters to the displayed screen width.
Show Tree View	Tree (Default) Raw	When enabled, displays the NMOS IS-05 parameters in an interactive tree format.

Active or Staged View	Active (Default) Staged	This option enables you to switch between the active and the staged IS-05 parameters.

PTP Info
(ST 2110 IP Input)

Overview

The unit supports SMPTE protocol ST 2059 Precision Time Protocol for the synchronization of media across an IP network. You can receive a single active PTP reference feed into any of the SFP interfaces, as the system reference.

The **PTP Info** instrument enables you to display PTP status information and to configure the PTP reference signal.

You can select the system reference in the **Video Timing & System Reference** Instrument. Use the **System Reference** dropdown list to select either PTP SFP ***n*** or Free Run.

The selection of IGMP Max Version in the **SFP IP Network** instrument affects all IGMP requests, including PTP and Media Flows requested in the **IP Receive - Flows** Instrument.

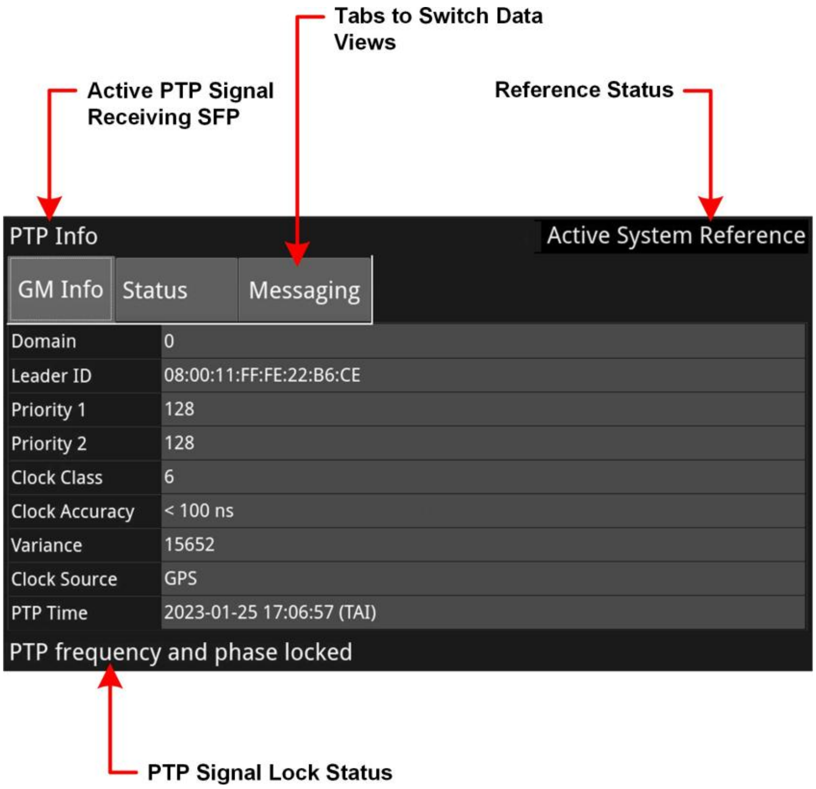


Figure 4-28: PTP Info Instrument (ST 2110 IP Input)

The PTP Info instrument features include:

- Control of the PTP Grandmaster (GM) domain and communication mode (Multicast (Mult- icast/Multicast) or SMPTE Mixed without negotiation (Multicast/Unicast)
- Indication of PTP lock status
- GM information including Master ID and Best Master Clock Algorithm (BMCA) parameters
- Indication of estimated frequency and phase lock offset
- Indication of one-step or two-step sync traffic.

The PTP information at the bottom of the window indicates the state of the PTP lock, which you can interpret using the information in the following table:

Table 4-11 : PTP Information Status Messages

PTP Info Status Message	PTP Info Status Color	PTP Lock State
PTP Not Locked	Red	??
Listening	Red	The PTP Follower is listening on the selected domain number, but has not acquired a PTP Leader or PTP Delay Request information.
Frequency locked	Yellow	The PTP Follower has acquired a PTP Leader and has achieved frequency lock. The Estimated Phase offset is greater than 2 µs.
Frequency and phase locked	White	The PTP Follower is frequency locked and the estimated phase offset is less than 2 µs.
In holdover	Yellow	The PTP Follower had acquired lock, but has now lost the PTP Leader and is in frequency holdover.
Recovered from holdover	Yellow	The PTP Follower has recovered from a holdover condition where the GM was lost but subsequently re-acquired.

The **Clear Warnings** button in the Instrument submenu enables you to remove any yellow warning messages that may be displayed following changes to the PTP lock.

The **PTP Info** Instrument provides detailed information about the PTP reference signal in the following three tabs:

- **GM Info:** Provides information about the PTP Grandmaster clock to which the system is locked.
- **Status:** Provides information about the configuration, operating mode and status of the unit with respect to the PTP reference signal, together with an indication of the quality of the lock to PTP.
- **Messaging:** Provides information about the timing and number of Announce and Sync PTP messages received from the Grandmaster.

The content of each tab in the PTP Info instrument is described in the following sections:

GM Info Tab

The **GM Info** tab reports the following data elements relating to the PTP clock signal received from the Grandmaster:

Table 4-12 : Grandmaster Information (GM Info) Tab

Data Element	Description
Domain	The domain number of the current synchronization domain, in the range 0 (default) to 127.
Leader ID	Identity attribute of the Grandmaster clock.
Priority 1	The Priority 1 attribute of the Grandmaster clock in the range 0 to 255 with the lower value having the highest priority.
Priority 2	The Priority 2 attribute of the Grandmaster clock in the range 0 to 255 with the lower value having the highest priority.
Clock Class	The traceability of the time or frequency distributed by the clock, provided as a numerical value identifying the clock state.

Clock Accuracy	Indicates the expected accuracy of the clock.

Data Element	Description
	For example: < 250 ns
Variance	Provides an indication of the quality of the Grandmaster Clock.
Clock Source	The source of time used by the Grandmaster clock, for example, GPS.
PTP Time	Actual PTP time received from the Grandmaster to which the unit is aligned. For example: 2020-09-16 11:00:00 (TAI) (*Temps Atomique International*)

Status Tab

The **Status** tab reports the following data elements relating to the current PTP status of the unit:

Table 4-13 : Status Data Tab

Data Element	Description
Communication Mode	Current setting of the unit. For more information, or to change the setting, see the sec- tion *Instrument Menu Options*.
Delay Req Interval	Current setting of the unit. For more information, or to change the setting, see the sec- tion *Instrument Menu Options*.
AnnounceTimeout	Current setting of the unit. For more information, or to change the setting, see the sec- tion *Instrument Menu Options.*
Latency Offset	Current setting of the unit. For more information, or to change the setting, see the sec- tion *Instrument Menu Options*.
Local PTP State	Current status of the unit with respect to the PTP signal, for example, Listening.
Appl Freq Adjustmnt	The Applied Frequency Adjustment is the adjustment, in parts per billion, made to the unit's clock to make it frequency-locked to the clock of the Grandmaster, that is, both clocks are at the same frequency but not necessarily at the same phase. This value is calculated in software.
Appl Freq Adj Delta	The Applied Frequency Adjustment Delta is the change (delta) to the Applied Fre- quency Adjustment in the last second. When in lock, this will typically be 0 or 1 part per billion. This value is calculated in software.
Offset from Leader	The estimated phase offset between the Grandmaster clock and the local follower clock, for example, – 200 ns.
Steps Removed	The number of IP hops between the Grandmaster and the local follower clock. If the unit were connected directly to the GM, the value would be 1.

PTP Messaging Tab

The **Messaging** tab reports the following data elements relating to the receipt of Announce and Sync messages from the Grandmaster:

Table 4-14 : Messaging Data Tab

Data Element	Description
Announce Message Inter- val	The Grandmaster sends out Announce messages to provide listening nodes with information about the sending clock. The Announce Message Interval is the time between consecutive Announce mes- sages. This value is signaled by the GM and reported by the unit.

Announce Messages Received	The number of Announce messages received from the Grandmaster to which the unit is locked.
Announce Messages	The number of Announce messages sent from the Grandmaster that were not received

Data Element	Description
Missed	by the unit.
Sync Message Interval	The Grandmaster sends out Sync messages, which it uses to calculate the offset from the Master and to make adjustments. This value is signaled by the GM and reported by the unit.
Sync Messages Received	The number of Sync messages received from the Grandmaster to which the unit is locked.
Sync Messages Missed	The number of Sync messages sent from the Grandmaster that were not received by the unit.
Last Sync Message	The state of the two-step flag in the last sync message indicating one-step or two-step. A two-step flag indicates that there is a follow-up message containing the time-stamp, whereas a one-step flag indicates that the time-stamp is included as part of the Sync Message.

Instrument Menu Options

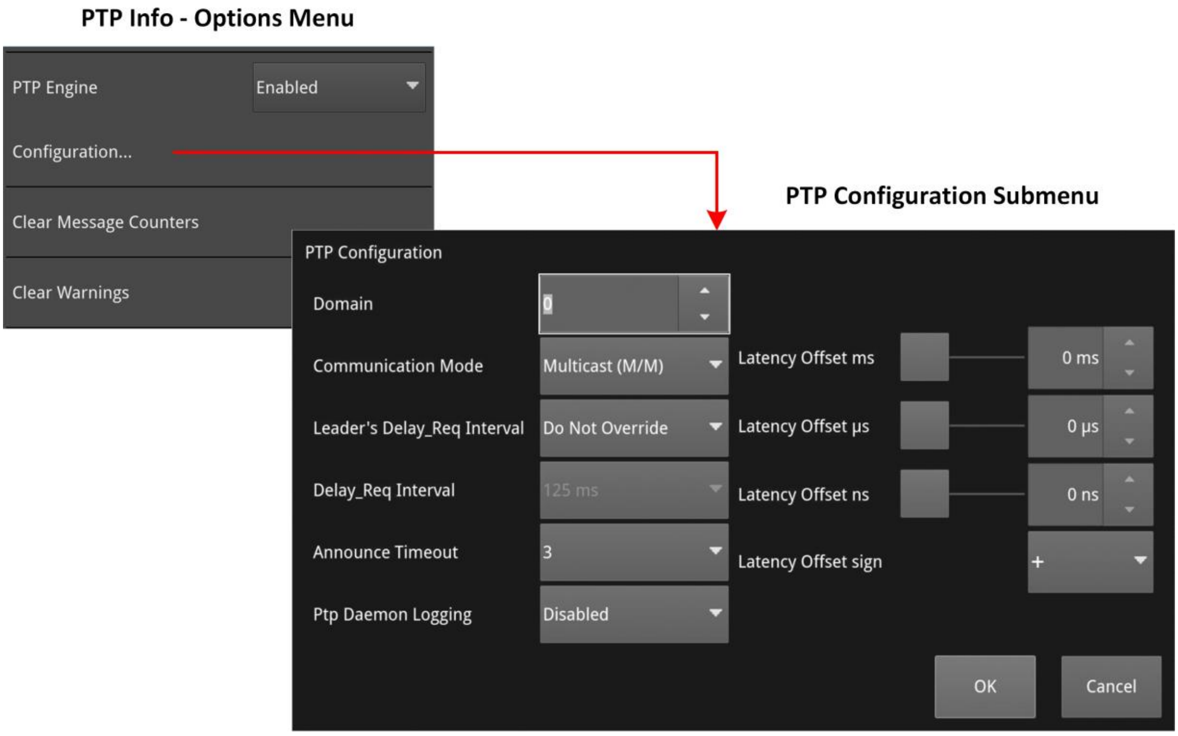


Figure 4-29: PTP Info Instrument Menu and Configuration Dialog

The following table lists the configurable parameters in the PTP Info instrument submenu:

Table 4-15 : PTP Info Menu Options

Item	Options	Description
PTP Main Menu		
PTP Engine	Enabled (Default) Disabled	When disabled, switches off the PTP engine on the corresponding SFP to stop listening to PTP messages on that interface. You can select which SFP to use as the current, active PTP engine using the **System Reference** dropdown in the options menu of the **Video Timing & System Reference** instrument.
Configuration...	System Control	Opens PTP Configuration dialog. See below.
Clear Message Coun- ters	System Control	Resets all message counters to zero, for example, resets the counters Announce Messages Received and Sync Messages Received.
Clear Warnings	System Control	Removes warning messages from the status line at the bottom of the Instrument window.
PTP Configuration Dialog		
Domain	0 (default) to 127	Defines the IP domain in which the PTP GM is located.
Communication Mode	Multicast (Multicast/Multicast) SMPTE Mixed (Multicast/Unicast)	The unit supports two PTP communication modes: • Multicast mode (Multicast Announce and Sync, Multicast Delay Request, Delay Response) • SMPTE Mixed mode without negotiation (Mult- icast Announce and Sync, Unicast Delay Request, Delay Response) In Multicast mode, you can set the unit automatically to adopt the Leader Sync message rate for its multicast Delay Request message rate, by setting the unit's **Leader's Delay_Req interval** option to **Do not override in Muticast mode**. Alternatively, you can set the Delay Request message rate to manual control by setting the unit's **Leader's Delay_Req interval** option to **Override in all modes**. In SMPTE Mixed mode the Delay Request message rate is always under manual control.
Leader's Delay_Req Interval	Do not override in Multicast Mode (Default) Override in all modes	In Multicast Mode, the default Delay_Req interval is set to be the same as the Leader Sync message interval.
Delay_Req Interval	7.8125 ms, 15.625, ms, 31.25 ms, 62.5 ms, 125 ms (Default), 250 ms, 500 ms, 1 s, 2 s, 4 s, 8 s, 16 s, 32 s	Allows you manually to define a Delay Request (Delay_ Req) message interval, that is, the rate at which Delay_ Req messages are sent. When you set the Com- munication mode to SMPTE Mixed or Multicast (MM) and enable Override in all modes, this is the rate at which the unit sends Delay_request messages back to the Grand- master.
AnnounceTimeout	2 - 10 (× Announce Timeout) Default: 3 × Announce Timeout	A Grandmaster transmits a PTP Announce Message to indicate its presence on the network. Accompanying this

Item	Options	Description
		message is the signaled Announce Message Rate and the Announce Timeout Count. A PTP follower, such as this unit, uses this information to confirm that the Master is still present and active. If the unit experiences a set of missing Announce messages greater than the Announce Timeout Count, then it will assume that the PTP Master is missing and will attempt to re-lock. The time for this count to trigger is the **Announce Timeout**. This is a user-defin- able delay that is equal to the selected value multiplied by the Announce Timeout. The delay period allows for a seamless Grandmaster change-over before the unit attempts to re-acquire PTP lock. The default setting is three times the Announce Receipt timeout but you can choose between two to ten times the Announce Receipt timeout interval.
Ptp Daemon Logging	Disabled (Default) Enabled	Customer support feature, disabled by default. Do not enable this option unless specifically requested to do so by PHABRIX Support to assist troubleshooting.
Latency Offset (ms, µs, ns scales)	User Defined	The long term PTP phase alignment of the unit can be affected by network delay asymmetries or, for example, by conversion between a 1 G PTP source and a 25 G net- work. You can adjust this long-term PTP phase offset by comparing the 1 PPS from the unit on the GPI output with the 1 PPS from the PTP Grandmaster on an oscilloscope. You can then adjust the unit's PTP Latency Offset control sliders accordingly to bring the unit's 1 PPS into time align- ment with the 1 PPS of the Grandmaster. The value of the PTP Latency offset is reported in the **Status** tab of the PTP Info instrument.
Latency Offset sign	+ (Default) −	Sets the Latency Offset as an increase (positive (+) value) or decrease (negative (−) value.)
Ok	System Control	Applies any PTP configuration changes after updating the PTP settings.

The Delay Request message rate options are as follows:

Table 4-16 : Options for the Delay Request Message Rate

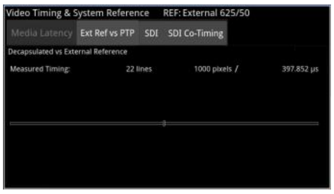
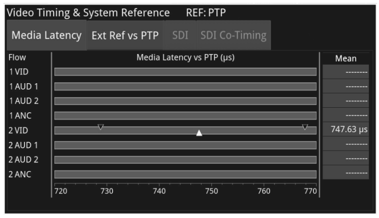
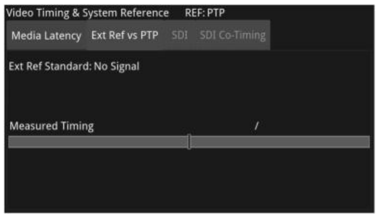
Delay_Req Interval	Delay Request Messages/Second
7.8125 ms	125
15.625 ms	62.5
31.25 ms	31.25
62.5 ms	15.625
125 ms	8
250 ms	4
500 ms	2
1 s	1
2 s	0.5
4 s	0.25
8 s	0.125
16 s	0.0625
32 s	0.03125

Video Timing & System Reference (ST 2110 IP Input)

Overview

The **Video Timing & System Reference** Instrument provides measurements that enable you to assess the timing quality of the input relative to a selected reference. If necessary, you can then set timing offsets against which to measure. The measurements and adjustment tools available depend on whether the inputs are received from ST 2022-6 or ST 2110 IP flows, as summarized in the following table.

Table 4-17 : Overview of IP Video Timing Functions for Different Flow Types

<table>
<tr><th></th><th colspan="2">Analyzer Input</th></tr>
<tr><th></th><th>ST 2022-6 IP Flow</th><th>ST 2110 IP Flows</th></tr>
<tr><td rowspan="2">Standard License</td><td rowspan="2">Decaps vs Sys Ref

</td><td>Media Latency Tab (Mean Data Column)

</td></tr>
<tr><td>Ext Ref vs PTP

</td></tr>
</table>

Timing of ST 2022-6 IP Input: Decapsulated vs System Reference

For ST 2022-6 input, the **Video Timing & System Reference** instrument window compares the timing of the Decapsulated input against a selected System Reference to which the unit is locked. You can select the system reference from either External or Free Run reference signals. The Instrument displays the following resulting measurements in both spatial units (lines and pixels) and time (µs or ns):

- Measured Timing
- Offset to Apply (with External Reference only)
- Offset Timing (with External Reference only).

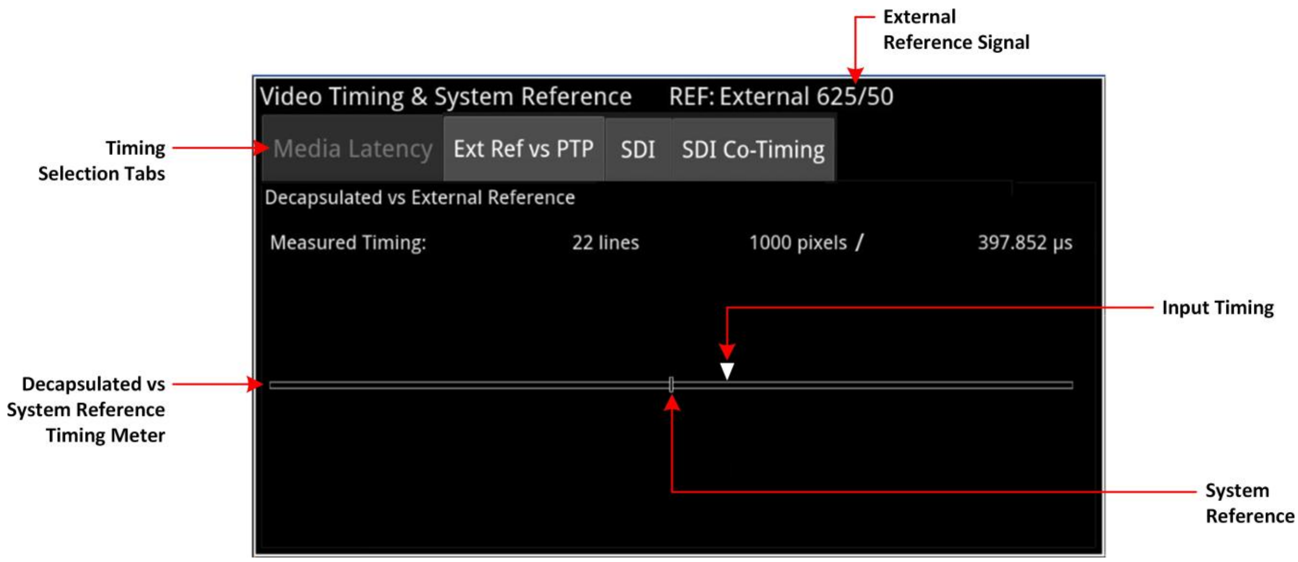


Figure 4-30: Video Timing & System Reference Instrument (ST 2022-6 IP Input)

A timing meter dynamically measures the timing of the input (white triangle) against the System Reference (centrally fixed, black vertical rectangle). In addition to measuring the input against an absolute system reference, you can choose to apply a system reference offset against which to measure. The position of any offset is shown on the timing bar as a black triangle.

Video Timing for ST 2110 IP Input

Overview

For an ST 2110 IP input, the **Video Timing & System Reference** instrument must be stably locked to the same PTP source as the sending device. The **Video Timing & System Reference** window includes the following two tabs, each providing access to different timing data:

- External Reference vs PTP
- Media Latency

External Reference vs PTP Tab

The **Ext Ref vs PTP** tab is a timing tool for use in a hybrid system to compare the external analog reference with the PTP reference. Use the options menu to set the **System Reference** to **PTP** and the PTP lock must be stable with a low PTP Estimated Phase Offset for this measurement to be valid.

The instrument displays the time difference between the external analog reference and PTP both in units of video lines and pixels, and units of time (µs or ms.)

The accuracy of this measurement depends on the long-term PTP phase alignment of the unit, which can be affected by network delay asymmetries or by conversion between a 1G PTP source and a 10G or 25G network.

You can adjust this long-term PTP phase offset by comparing the 1PPS from the unit on the GPIO with the 1PPS from the PTP Grandmaster using an oscilloscope. In addition, you can adjust the unit's PTP Latency Offset controls in the options menu of the **PTP Info** Instrument to bring the 1PPS of the unit into time alignment with the 1PPS of the Grandmaster.

The **Ext Ref vs PTP** tab displays any offset between an external reference signal and the PTP reference. It shows this value in units of time as well as in lines and pixels. If the external reference originates from the same source as PTP then the value displayed should represent the phase offset of the unit. Use this tool to show how well your external reference is locked to PTP. If it is not locked to PTP, you will notice the value drifting.

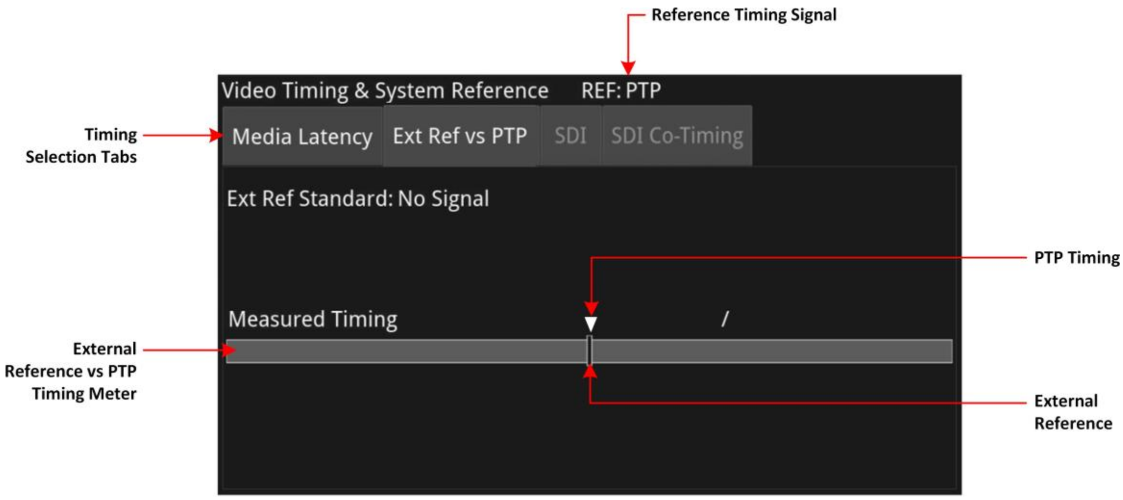


Figure 4-31: Ext Ref vs PTP Tab of the Video Timing & System Reference Instrument (ST 2110 IP Input)

Media Latency Tab

The **Media Latency** tab displays the end-to-end latency of each flow, between the source and the unit, when both are locked to PTP. Any latency represents the time delay between the point at which a packet is created at the source and the point at which it is received. The *latency period* includes the length of time it takes to send the packet and the time taken by the packet to travel across the network. The unit calculates the latency by comparing the timestamp in the RTP packet header with the hardware timestamp at the time of ingest.

This tab provides both a graphical display of latency in the horizontal timing meters and a tabular display of the actual corresponding mean values in the right-hand Mean column. In the scalar view, the white arrows indicate the current latency, offset from PTP, and the black arrows show the historical maximum and minimum values. The actual mean values are shown in the Mean column to the right.

This tab aims to show the relationship between the video, audio and ancillary data flows and consequently, to indicate the amount of buffering required at the receiver to synchronize the flows.

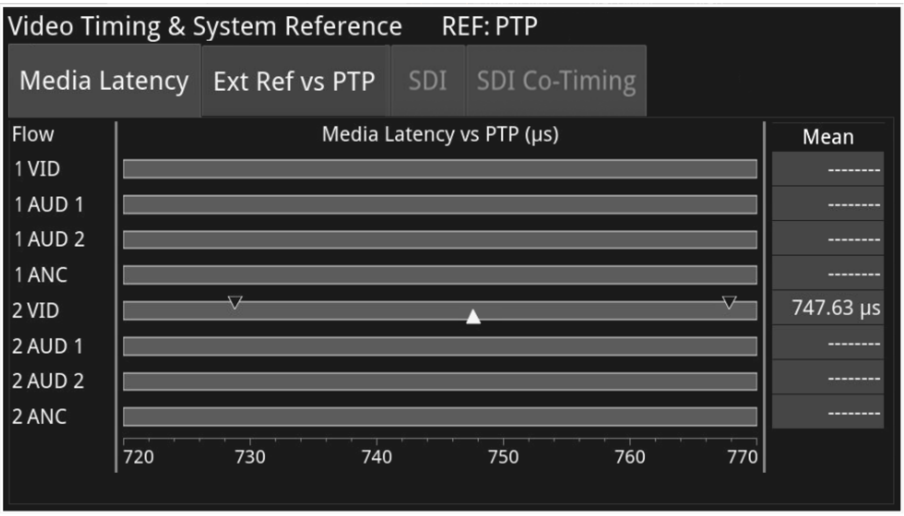


Figure 4-32: Media Latency Tab of the Video Timing & System Reference Instrument (ST 2110 IP Input)

The **Media Latency** measure is the difference between the arrival time of a packet and the RTP timestamp of that packet, averaged over 1 second and is calculated as follows:

Latency = TPA_0 – $RTP_{Timestamp}$ (averaged over 1 second) Where:

- **TPA_0** is the arrival PTP time of a media packet as measured by the unit
- **$RTP_{Timestamp}$** is the timestamp within the received packet created by the source.

For Video and ANC flows, the RTP timestamp is constant for the entire frame, so the latency is only measured when the RTP timestamp changes. This occurs on the first packet of a frame for a progressive flow, or field for an interlaced flow, with the results averaged over 1 second.

For Audio flows, as the RTP timestamp increments with each audio packet the latency is measured for every packet with the results averaged over 1 second.

To see more detail about the media latency, you can zoom in on a specific area of interest by clicking anywhere on a timing meter of interest, which changes the scale to match the values of the specific flow. For example, when zooming into a video flow, the scale changes from milliseconds (ms) to microseconds (µs). Click the meter again to zoom out and return to the overview. You can also switch between overview and zoom for individual flow meters by selecting the specific meter from the instrument submenu. See the Instrument options table below.

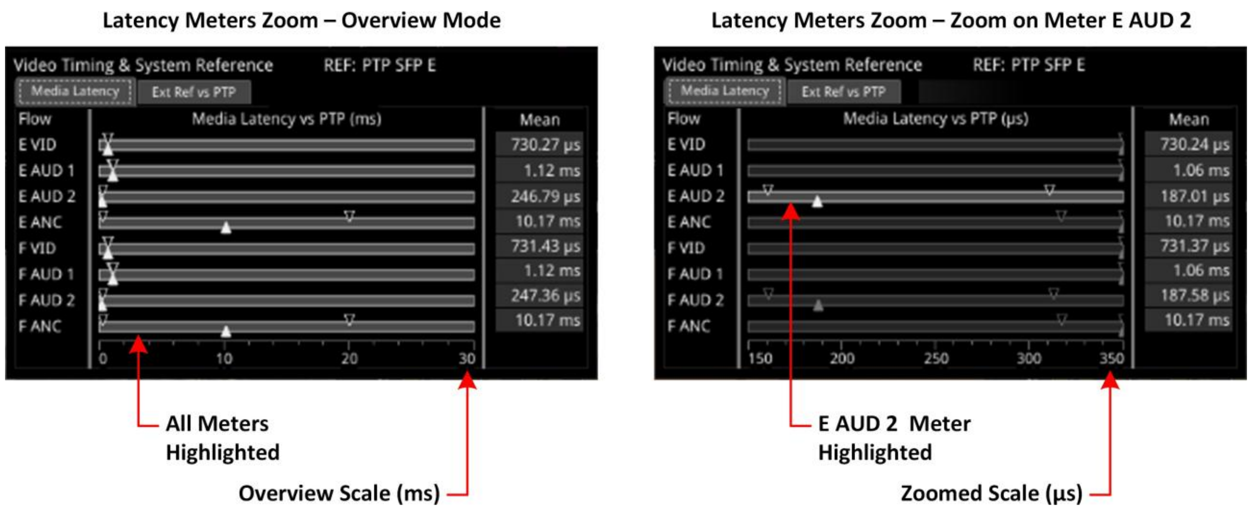


Figure 4-33: Media Latency Tab of the Video Timing & System Reference Instrument (ST 2110 IP Input)

Instrument Menu Options

The following table lists the configurable parameters of the Media Latency tab and are available with a standard core license in the **Video Timing & System Reference** instrument options menu for
ST 2110 IP input:

Table 4-18 : Video Timing & System Reference Menu Options (ST 2110 IP Input)

Item	Options	Description
Ext Ref vs PTP Tab Options		
System Reference	Free Run (Default) Ext Ref SDI (SDI Input Only) PTP	System reference locking controls define the reference to which the unit and any signal it generates is locked. By selecting the default option Free Run, the system locks to the internal oscillator as the timing reference signal. If the system loses the external reference signal for some reason, the system will automatically switch to use the Free Run reference signal. System reference lock status information is displayed in the title bar of the instrument, and any error in the health state of the reference is displayed in red. For ST 2110 IP input, make sure that the system reference is stably locked to the same PTP source as the sending device. System reference lock status information is displayed in the upper-right corner of the instrument, and any error in the health state of the reference is displayed in red.

Ext Ref Termination	Enabled Disabled (Default)	When enabled, adds an internal 75 ohm termination to the reference input to stabilize the system reference signal. **Note:** This termination may be temporarily disrupted during power cycles, Analyzer input changes and upgrades.

Item	Options	Description
Ext Ref Meter Range	+/− 0.1 line +/− 0.5 line (Default) +/− 0.5 frame	Adjusts the displayed range of the external reference tim- ing meter in the upper section of the Instrument to display readings at frame scale, or to zoom in to a fraction of a line.
Input Offset Type	Lines And Pixels Time	Defines whether to apply an offset using spatial (lines/pixels) or temporal (μs, ns) values.
Input Time Offset	0.00, +/− 0.01, etc...	For Time as the offset type, set the timing offset in micro- seconds (μs).
Input Line Offset	0 to +/− (Total number of Lines in the current stand- ard minus one.)	For Lines And Pixels as the offset type, set the course tim- ing offset as a number of lines.
Input Pixel Offset	0 to +/− (Total number of Pixels per Line in the cur- rent standard minus one.)	For Lines And Pixels as the offset type, set the fine timing offset as a number of pixels.
Set Input Offset to current	N/A	Sets the input offset to the same position as the current Decapsulated signal.
Clear Input Offset	N/A	Removes any input offset.
Media Latency Tab Options		
Latency Meters Zoom	Overview (Default), 1 VID, 1 AUD 1, 1 AUD 2, 1 ANC, 2 VID, 2 AUD 1, 2 AUD 2, 2 ANC	Select a specific timing meter to switch between over- view and zoomed-in view.
Anchor time scale start in Overview mode	Zero (0) or less, Any value	Anchor time scale start in Overview mode. Set the start point of the timescale when in Overview.
Clear Min, Max values	System Control	Set the historical minimum and maximum values back to zero.

Note: Monitoring of audio flows **AUD 3** and **AUD 4** is not supported in the current software release.

IP Receive - Flows

Overview

The **IP Receive - Flows** instrument enables you to:

- Instruct the unit to issue join requests in the **Multicast Requests** configuration tab
- Configure the SMPTE protocol type of each received flow in the **Flow Config** configuration tab
- Select IP flows in each of the four flow groups (**IP A**, **IP B**, and optionally **IP C**,and **IP D**) for ana- lysis using the **Flow Groups** dialog
- Specify the matching parameters for NMOS flows in the **NMOS Flow Config** configuration tab (if using NMOS).

On opening the IP Receive - Flows instrument, a Multicast Requests table provides an overview of the current IP flows being received, together with their parameters. The IP flows include those that match multicasts to which the unit has subscribed and include multicast and unicast flows that have been sent to the unit.

When under AMWA NMOS control, the unit automatically issues an IGMP request, categorizes and selects a flow or flows, all under the control of a Session Description Protocol (SDP) transport file.

For ST 2110 flow groups the unit can simultaneously process the following flow types to each of the two (or optionally four) analyzers:

- One ST 2110-20 video
- Any of the following combinations of ST 2110-30 linear PCM or ST 2110-31 AES-3 audio flows to the maximum limits below (at 125 µs packet times):
  - With ST 2110-30 linear PCM, either:
    - One audio flow of up to 64 channels, or
    - Two audio flows of up to 32 channels each, or
    - Four audio flows of up to 16 channels each.
  - With ST 2110-31 AES-3, either:
    - One or two audio flows of up to 60 channels, or
    - Four audio flows of up to 16 channels each.
- One ancillary (ANC) flow.

> **Note:** You can configure the number of audio flows in the IP Receive - Flows options menu.

For ST 2022-6 input to **SFP 1/3** or **SFP 2/4**, you can select a single flow at a time for processing.

> **Note:** Allocation of a media flow type or protocol is independent of the Payload Type ID number, so it is possible to have several different media flow types with the same Payload Type ID.

Detailed information for each flow is provided in the Multicast Requests table as follows:

- SFP Interface (SFP 1 and/or 2) (or optionally SFP 3 and/or 4)
- Channel Allocation (Video, Audio 1, Audio 2, Audio 3, Audio 4, ANC)

- SMPTE Media Protocol (2110-20, -30, -40, 2022-6, etc.)

- Payload Type ID Number (Full screen view only)
- Destination and Source IP Addresses and Port Numbers
- Synchronization Source (SSRC) Identifier
- Mean Flow Bandwidth averaged over 1 second
- Total Packet Counts (Full screen view only)
- Sequence Error Count (Full screen view only).

Both Sequence Payload and CRC errors are displayed in the **Errors** count column.

The overall status of Multicast IGMP requests is displayed above the table, for example: Multicast Requests: 18/18 joins sent. You can control Multicast IGMP join and leave requests using the submenu dialogs, and configure the maximum version of IGMP requests in the SFP IP Network Instrument.

You can manage and configure the flow protocols in the **Flow Config** dialog. In addition, you can quickly configure any incoming flows with unassigned protocols (Other IP) by tapping or clicking the flow, then assigning the flow type and analysis path in the Flow Config dialog.

For both ST 2022-6 and ST 2110 IP input, **IP Receive - Flows** supports the reception of flows on:

- Standard configuration: **SFP 1** or **SFP 2**, as well as ST 2022-7 Seamless Protection Switching (SPS) of pairs of flows on **SFP 1 + 2**, or
- Optional configuration: **(Q)SFP 3** or **(Q)SFP 4**, as well as ST 2022-7 Seamless Protection Switching (SPS) of pairs of flows on **SFP 3 + 4.**

> **Note:** SPS protection of a flow pair is available across **SFP 1 + 2** (or optionally **SFP 3 + 4**), however, SPS protection of a flow pair within a single SFP is not supported.

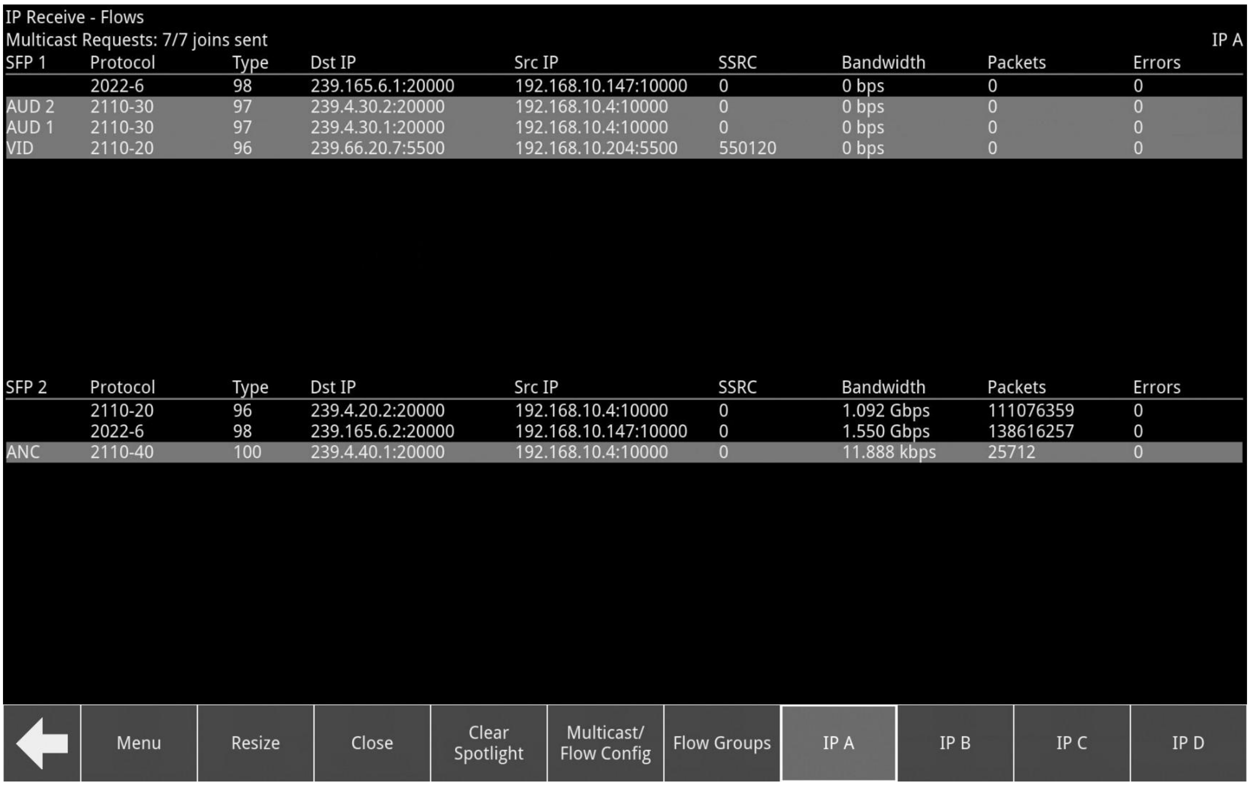
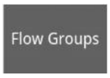


Figure 4-34: IP Receive - Flows Instrument: Multicast Requests Overview

Media flows may have already been presented to the unit either by a unicast sender, a network orchestrator or by the unit being attached to a switch or router mirror port or passive optical tap. In these situations, the details of the media flow are automatically displayed in the Flows window.

If the unit is required to initiate a multicast session by way of an IGMP request then this can be achieved either automatically, using NMOS; or manually, by selecting **Multicast/Flow Config** from the **Flows** options menu. This displays a window with the following selectable tabs:

- **Multicast Requests** see *Multicast Setup (Multicast Requests*
- **Flow Config(uration)** see *Flow Protocol Configuration (Flow Config)*
- **NMOS Flow Config(uration)** see *NMOS Flow Configuration (NMOS Flow Config)*.

In addition, select **Flow Groups...** from the options menu or tapping or clicking the softkey 

in the toolbar to select flows in the Flow Groups dialog:

- **Flow Groups** see *Flow Groups.*

Use the flow group softkeys in the toolbar to highlight the individual flows comprising that flow group:

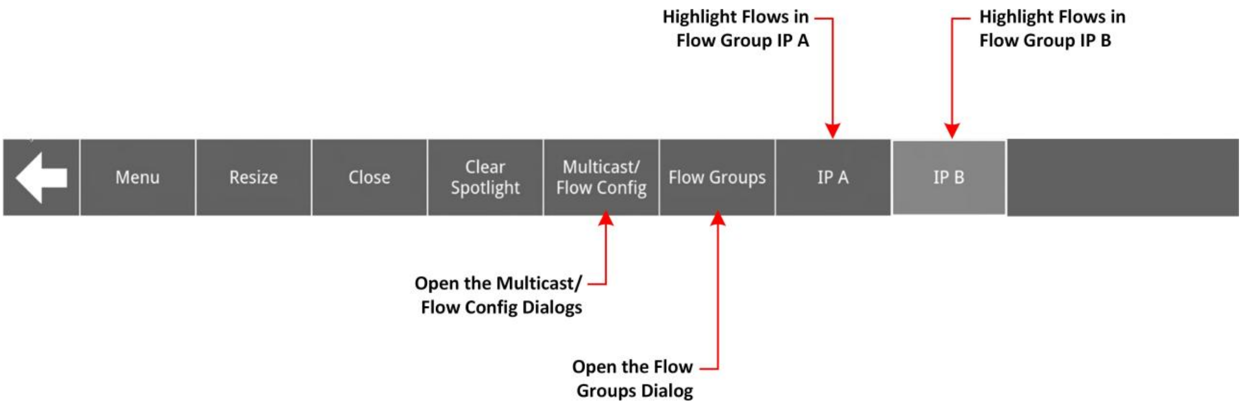


Figure 4-35: IP Receive - Flows Toolbar Softkeys

The unit can access IP flows using either IGMP v1, v2 or v3 multicast requests, with the maximum level of an IGMP request configured in the options menu of the SFP IP Network instrument. The selected maximum IGMP multicast level is applied to all media ports.

Once a multicast group is successfully joined, all flows within it will appear in the **IP Receive - Flows** window. The IP flows, with assigned SMPTE protocols listed in the window, are those currently available in the selected flow group and on the chosen interfaces. You can select flows for analysis in the **Flow Groups** dialog.

> **Note:** If you insert a 25G SFP in either the SFP 1 or 2 interface cages when the 25G IP license (**LPX500-IP-25G**) is not installed, the Instrument title will change color to red. If you hover the cursor over the title the following error message is displayed:
> **Error: IP 25G License: Not Present. Inserted 25G SFPs will not function.**
>
> Similarly, if you install 100G QSFPs in the QSFP 3 or 4 interface cages without the 100G IP license (**LPX500-IP-100G**) you will see an error message displayed.

Instrument Menu Options

The options menu, provides access to further multicast and flow configuration dialogs, together with additional flow parameters and clearing controls.

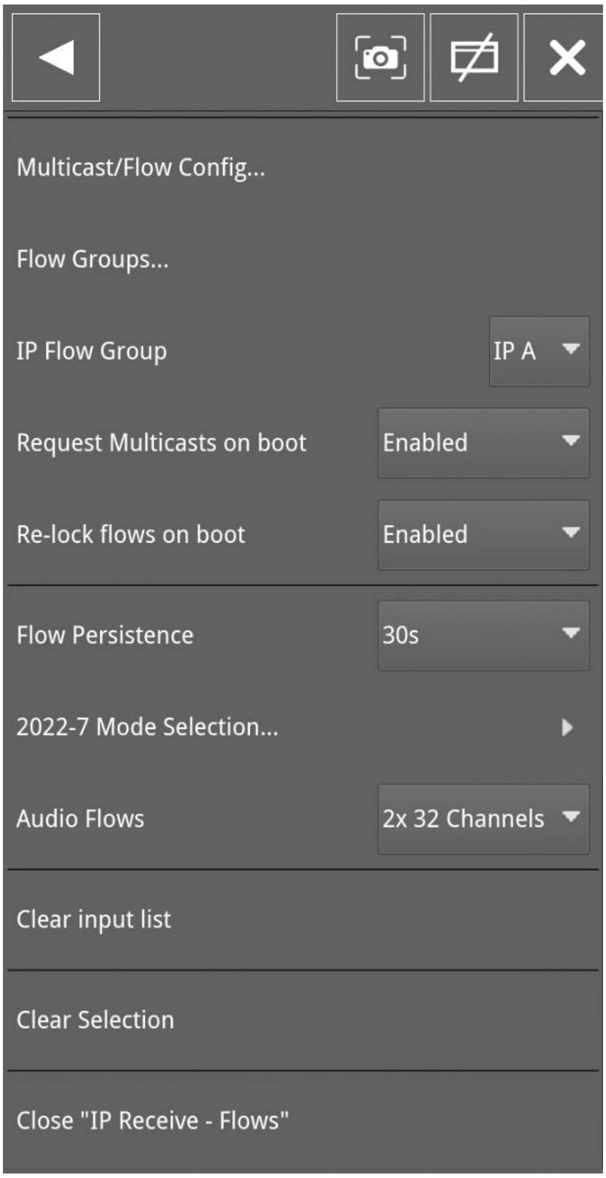


Figure 4-36: IP Receive - Flows Options Menu

The following table lists the configurable parameters in the IP Receive - Flows options menu:

Table 4-19 : IP Receive - Flows Menu Options

Item	Options	Description
Multicast/Flow Config...	System Control	Click to open a new dialog box with tabs for Multicast Requests, Flow Config, Flow Groups and **NMOS Flow Config** as previously described.
Flow Groups...	System Control	Opens the Flow Groups dialog.
IP Flow Group	IP A (Default) IP B IP C (Optional) IP D (Optional)	Switch the active flow group and assigned flows displayed in the IP Receive - Flows window and the IP Flow Group dialog.
Request Multicasts on boot	Enabled (Default) Disabled	When enabled, sets the unit to request to receive Multicast flows auto- matically on reboot.
Re-lock flows on boot	Enabled (Default) Disabled	When enabled, sets the unit to re-lock to the selected flows auto- matically on reboot.
Flow Persistence	1 s 10 s 30 s (Default) 1 min 5 min 10 min Infinite	Sets the amount of time that old, inactive flows remain displayed in the Flows window
2022-7 Mode Selec- tion	SFP 1 SFP 2 Seamless 1+2 Optionally: (Q)SFP 3 (Q)SFP 4 Seamless 3+4	Choose whether you want to analyze flows available on one or both SFP receiver interfaces for ST 2022-6 or ST 2110 IP input. The current interface mode is displayed in the top right-hand corner of the instrument window (Analyzer Interface). For ST 2022-6 IP input, you need select only a single flow (containing video, audio, and ancillary data) in a flow group for analysis. For ST 2110 IP input, you can select up to six flows per flow group (one video, four audio and one ANC) at the same time. When ST 2022-7 seamless protection switching (SPS) is enabled (**Seamless 1+2** or optionally **Seamless 3+4**), the SPS functionality provides seamless reconstruction by using packets from either flow to compensate for possible packet loss or corruption.
Audio Flows	1 x 64 Channels 2 x 32 Channels 4 x 16 Channels (Default)	**Note:** This applies to ST 2110 IP flows only. Set the maximum number of received audio flows and audio channels for each interface. The default setting is four flows per interface at up to 16 channels per

		flow.
Clear input list	System control	Tap or click to clear the displayed list of available flows and the Packet and Sequence Error counters.
Clear Selection	System control	Tap or click to deselect the currently selected flow(s).

Manual Multicast Setup

To access the **Multicast Setup** dialog, select **Multicast/Flow Config...** from the options menu and select the **Multicast Requests** tab if not already open.

You can enter the details of a multicast join request and the desired SFP interface using the controls in the bottom-right corner of the dialog.

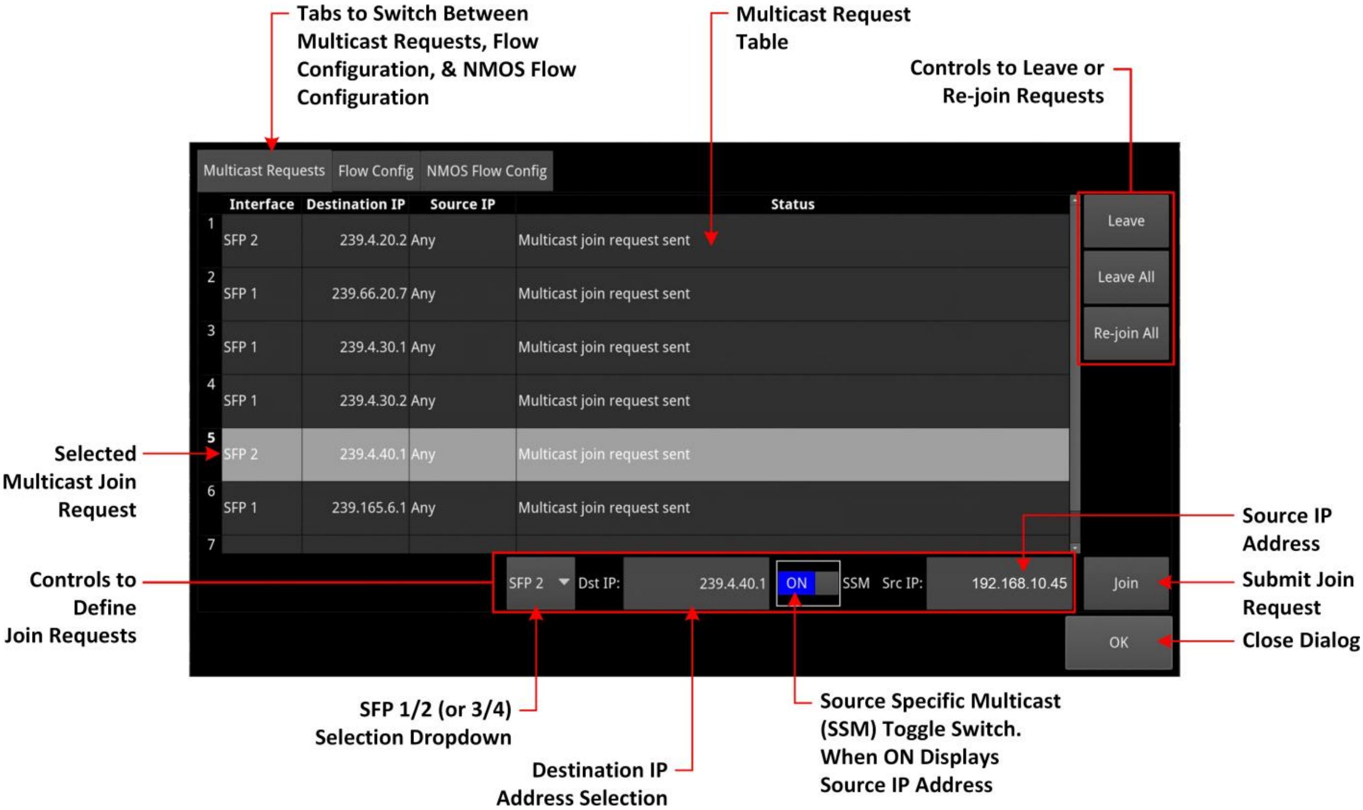


Figure 4-37: IP Receive - Flows: Multicast Requests Tab

Using the Instrument Controls

To create a request, select interface **SFP 1** or **SFP 2** (or optionally **SFP 3** or **SFP 4**) from the dropdown list.

Enter the destination IP address of the multicast group to join in the **Dst IP** field, within the following range, using either a USB keyboard or the onscreen keypad:

- **224.0.0.1** to **239.255.255.255**

You can choose to use **Source Specific Multicast (SSM)**, in conjunction with IGMPv3, to ensure that the unit receives packets originating from the source IP address that you select. To use SSM, set the **SSM** toggle switch to **ON**.

> **Note:** IGMPv1 and IGMPv2 do not support SSM.

To send the multicast join request, tap or click: **Join**.

This join request is added to the table of multicast requests in the tab dialog window, together with the status of the join request.

To join a multicast already listed in the table, but not currently joined, or to resend a join request for a multicast that has already been joined, select it and then tap or click **Join**.

To exit a multicast, select it from the table in the dialog box, then tap or click:

- **Leave**

To exit all multicasts, tap or click:

- **Leave All**

A prompt dialog is displayed, asking you to confirm that you want to leave all multicasts. To request to re-join all multicasts currently listed in the multicast request table, tap or click:

- **Re-join All**

To close the **Multicast Requests** dialog window, tap or click:

- **OK**

To set the unit to request to re-join all multicasts currently listed in the multicast request table automatically on reboot, return to the instrument options menu and set the parameter **Request Multicasts on boot** to **Enabled**.

Flow Protocol Configuration (Flow Config)

Having successfully joined a multicast, or if media traffic has already been routed to the unit, then all the associated flows will be visible in the **Flows** overview table when opening the instrument.

The multi-flow nature of SMPTE ST 2110 means that a labeling procedure is required to identify the various flows and their specific parameters. Before using an incoming ST 2110 IP flow, it is important first to identify the type of SMPTE protocol flow you are dealing with, in order to

> **Note:** If an IGMP join has been initiated under NMOS control, then all flow parameters will be automatically configured using the information in the Session Description Protocol (SDP) transport file.

analyze it correctly.

If a media flow type is not recognized by the unit, then the protocol type is identified as **Other IP**, and automatically appears in the **Unconfigured Flows** table in the **Flow Config** dialog, which maintains the list of flow protocol configurations. Use this dialog to assign the protocol to an unconfigured flow or change the protocol of a flow.

The unit automatically stores all flow configurations and this list builds up over a period of time. Media flows can also be preconfigured, before being requested.

Using the Flow Config Controls

Select **Multicast/Flow Config** from the Instrument options menu, then select the **Flow Config** tab to display the following dialog:

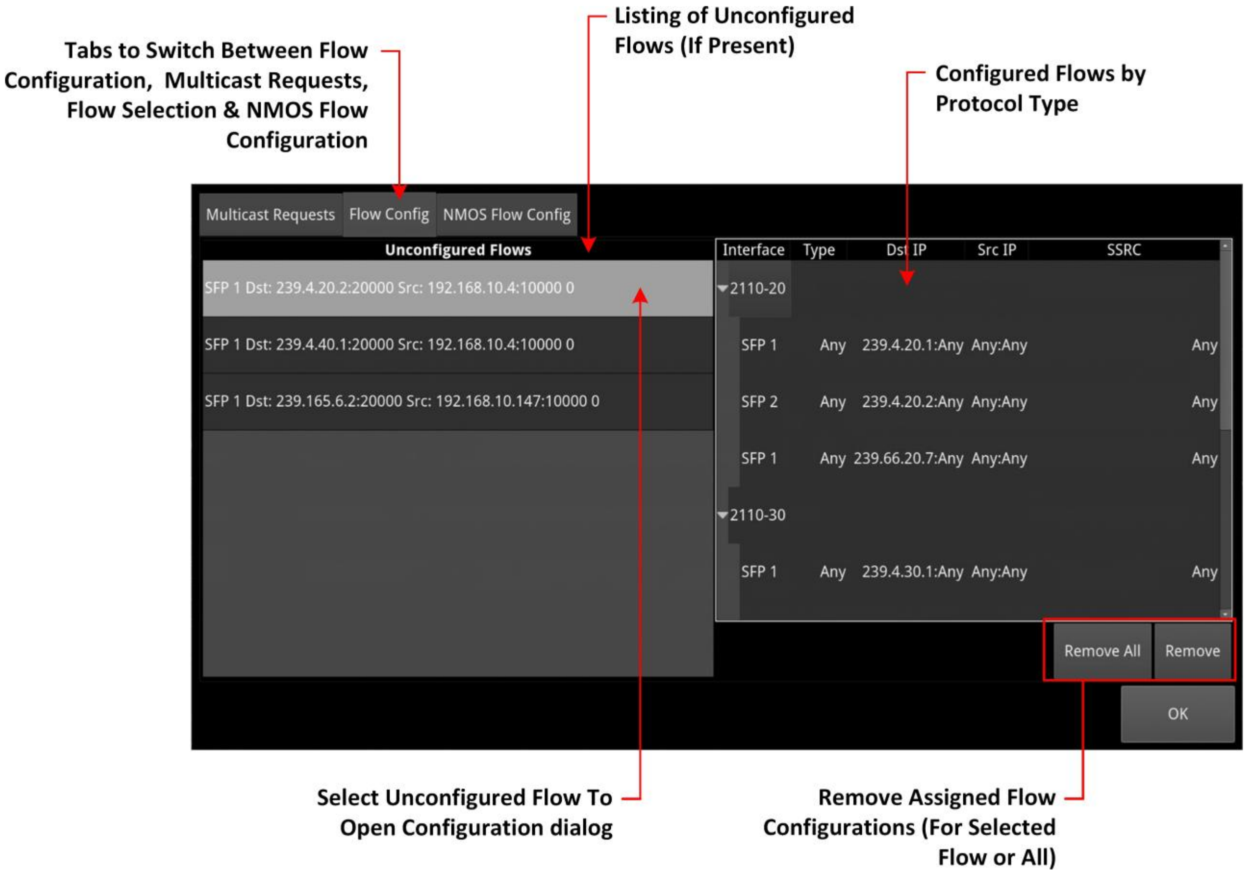


Figure 4-38: IP Receive - Flows: Flow Config Tab

- The left-hand pane displays any unconfigured flows. When you select an unconfigured flow, the unit displays the flow configuration dialog in which you can set the user-controlled para- meters.

- The right-hand pane displays all configured flows listed by protocol type.
- When under automatic NMOS control, the following parameters are set by default:
  - Payload Type
  - Destination IP Address
  - Destination UDP Port Number
  - Source IP Address.

To configure a flow, tap or click to select the flow in the **Unconfigured Flows** pane. Its current parameters populate the fields in the flow configuration dialog.

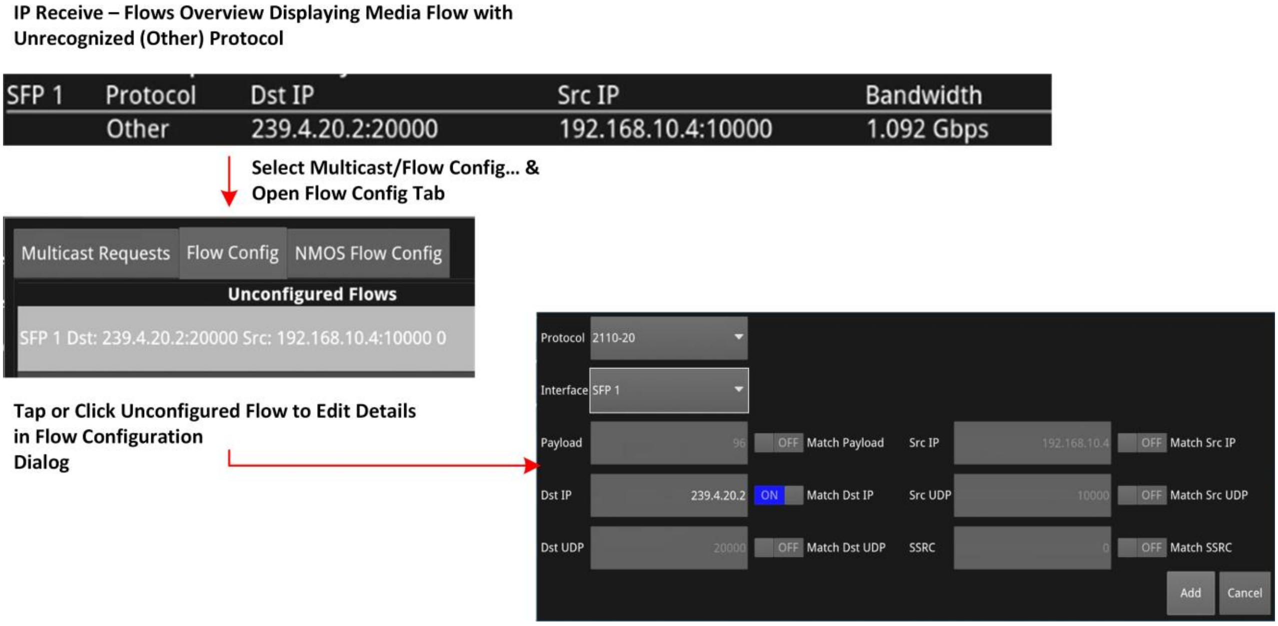


Figure 4-39: IP Receive - Flows: Flow Configuration Dialog for Unconfigured Flows

Using the controls, select options as required:

- **Protocol** options for ST 2110 input:
  - 2110-20 (video)
  - 2110-30 (PCM audio)
  - 2110-31 (AES 3 audio)
  - 2110-40 (ancillary).
- **Protocol** option for ST 2022-6 input:
  - 2022-6.

Where an SSRC ID is included in an available flow, decide whether you want to analyze the flow only when this SSRC is matched.

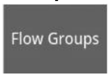
Once you have configured a flow, tap or click **Add** to move it into the right-hand pane of configured flows.

To remove the current configuration assigned to a flow, tap or click **Remove** or tap/click **Remove All** to clear all flow configurations. If you choose **Remove All**, you are prompted to confirm that you want to remove all configured flows. Tap or click **Remove All** to proceed. If the flow is still present on one of the SFP interfaces, it will appear back in the **Unconfigured Flows** window, where it can be modified, if required. On completion, tap or click **OK** to close the **Flow Config** dialog.

Defining Flow Groups

The Flow Groups dialog enables you to select the composition of flow groups for analysis from the flows available in the IP Receive - Flows instrument. You can set-up the following flow groups:

- Flow Group **IP A** for Analyzer **A** (standard)
- Flow Group **IP B** for Analyzer **B** (standard)
- Flow Group **IP C** for Analyzer **C** (optional requires **LPX500-QUAD**)
- Flow Group **IP D** for Analyzer **D** (optional requires **LPX500-QUAD**).

You can open the **Flow Groups** dialog either by selecting **Flow Groups...** from the options menu or by tapping or clicking the softkey  in the toolbar.

The **Flow Groups** dialog displays all available flows, by flow type, being received on **SFP 1/3** and/or **SFP 2/4** depending on whether SFP28s or QSFP28s are in use.

Use this dialog to define the composition of your flow groups for analysis.

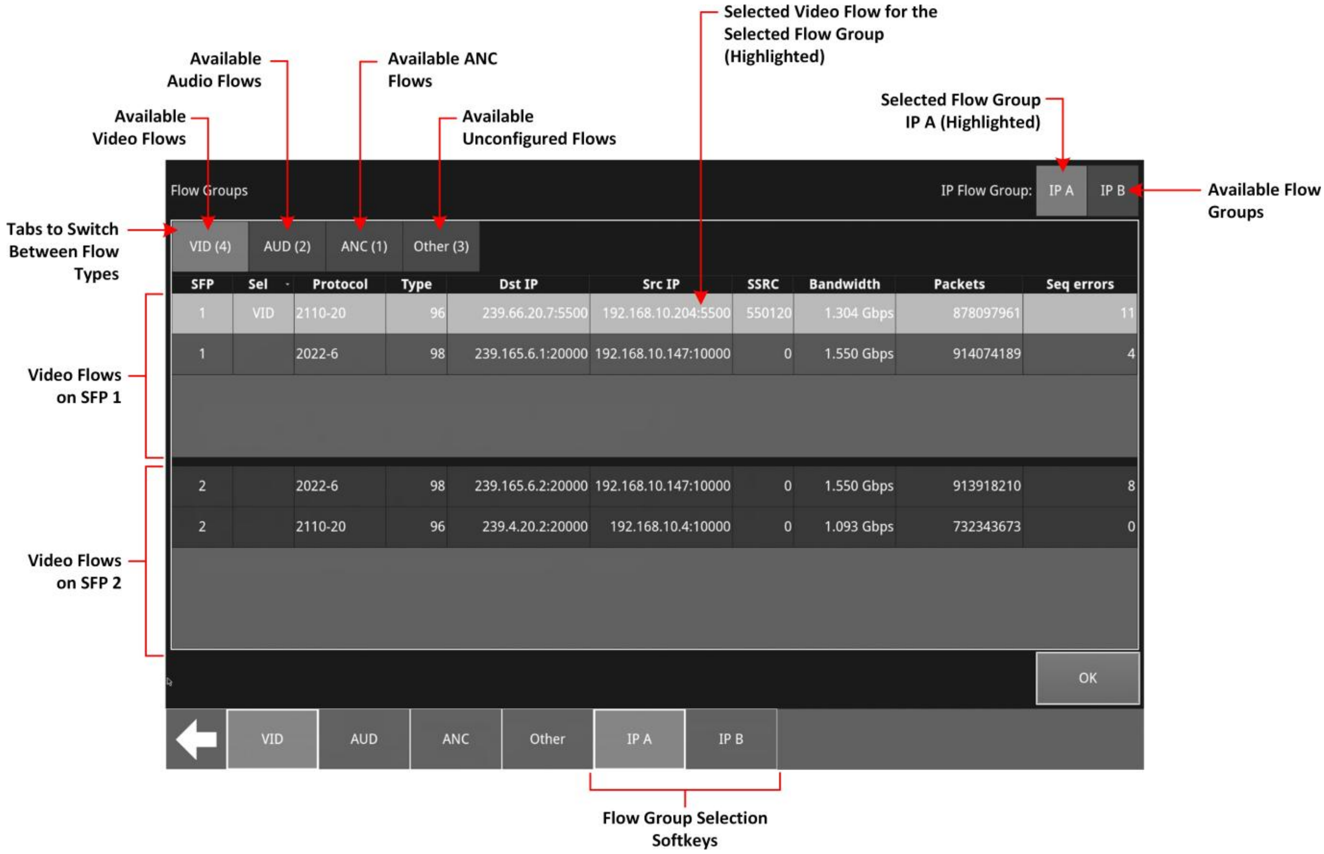


Figure 4-40: IP Receive - Flow Groups Dialog for a Dual Analyzer Unit

Any flows received, for which the media flow type is unknown to the unit, display the protocol type as **Other IP**. If you select a flow showing a protocol of Other IP in the Other tab of the Flow Groups dialog, you can configure that flow in a popup dialog as shown in *Figure 4-41*. At this point, you can specify the correct protocol for the flow, whether the flow is selected or not once configured, and enable/disable match parameters.

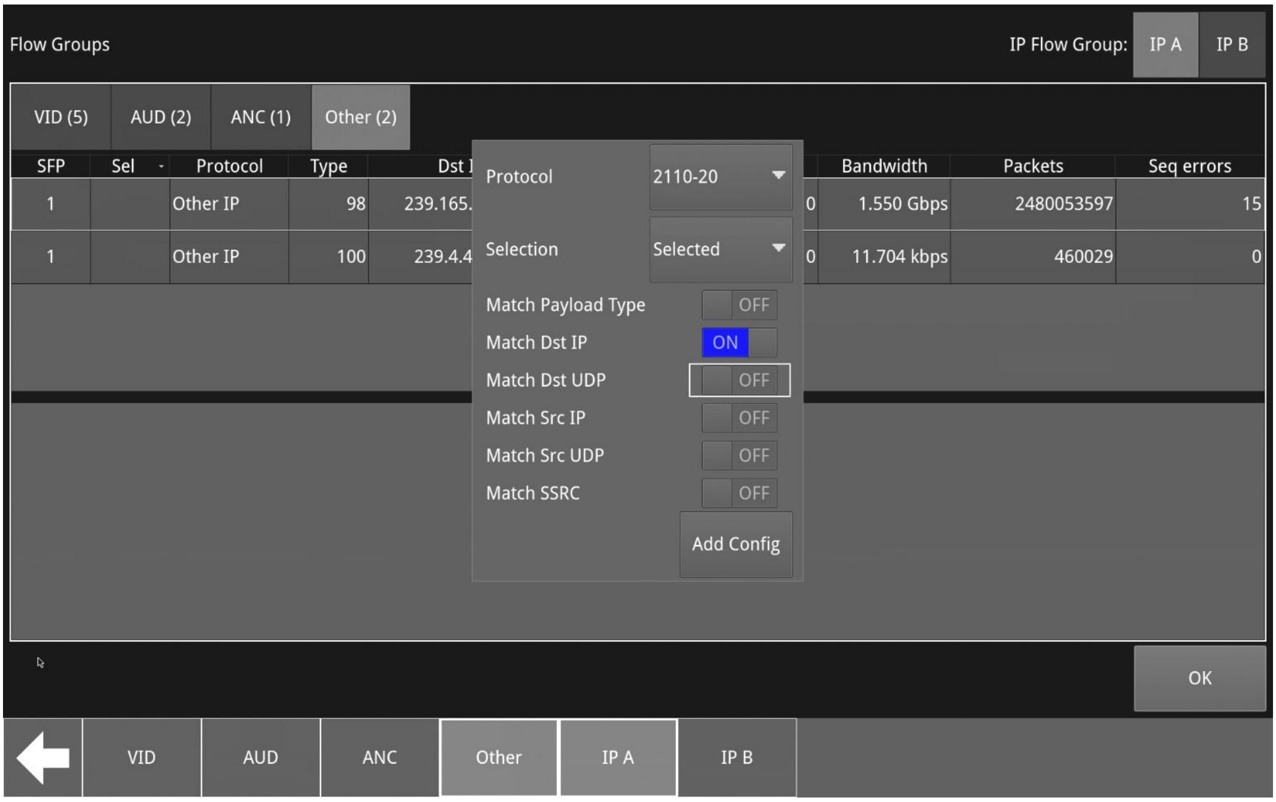


Figure 4-41: Flow Groups Dialog to Configure Other IP Flow

NMOS Flow Configuration (NMOS Flow Config)

When the unit generates an NMOS IS-05 join, the configured flows match against the following iGMP and NMOS parameters by default:

- Payload Type
- Destination IPv4 Address (Dst IP)
- Destination UDP Port Number (Dst UDP)
- Source IPv4 Address (Src IP)

There may be occasions in a typical network environment when these parameters do not match perfectly so the unit provides the ability to adjust the precision of flow matching by manually de-selecting one or more of these parameters. For example, if you deselect **Payload Type**, the flows will match on the remaining three parameters: **Dst IP**, **Dst UDP** and **Src IP**.

If you de-select the Source IPv4 address, the unit will not issue an IGMP source-specific multicast join request as the source IP address can no longer be used.

If you deselect any of the matching parameters, be sure to click **OK** to apply your changes.

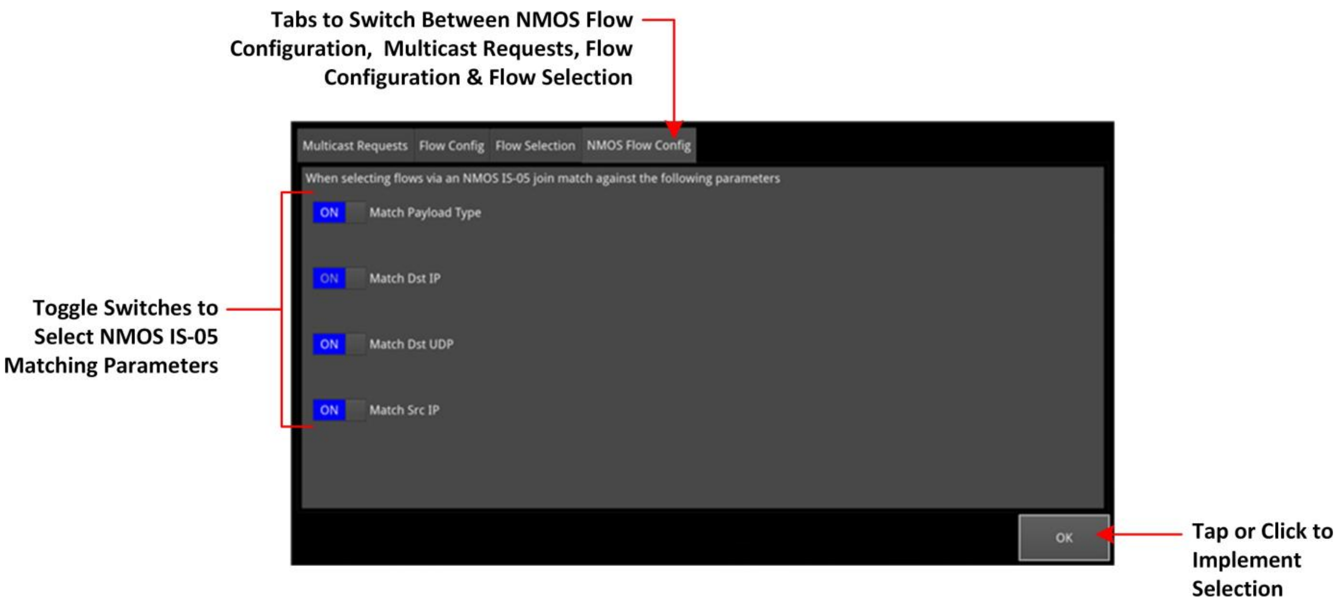


Figure 4-42: IP Receive - Flows: NMOS Flow Config Tab

Analyzer - 2110 Format Setup (ST 2110 IP Input)

Overview

The **Analyzer - 2110 Format Setup** instrument automatically evaluates the received and selected ST 2110-20 video flow and estimates the appropriate video standard for that flow.

Two tabs provide access to the separate Video and Audio parameters, enabling you to define manual override parameters for one video flow and up to four audio flows.

Features include:

- Automatic estimation of video format parameters for ST 2110-20 flows
- Extraction of video format parameters from an SDP record by way of NMOS for ST 2110-20 flows
- User-configurable video format parameters for ST 2110-20 flows.

Video Tab Setup

In the **Video (VID)** tab, the video parameters are displayed in three columns to show their source as follows:

- **Auto:** Lists the video parameters automatically detected from the received flow
- **SDP:** Lists the video parameters extracted from the Session Description Protocol (SDP) record, provided by NMOS, if available. If you use an SDP record to select a flow, then the format para- meters are populated automatically from the SDP transport file.
- **Override:** Lists any manually entered video parameters, which you can use to override the auto-detected or SDP parameters and apply them to the flows selected for analysis, if neces- sary.

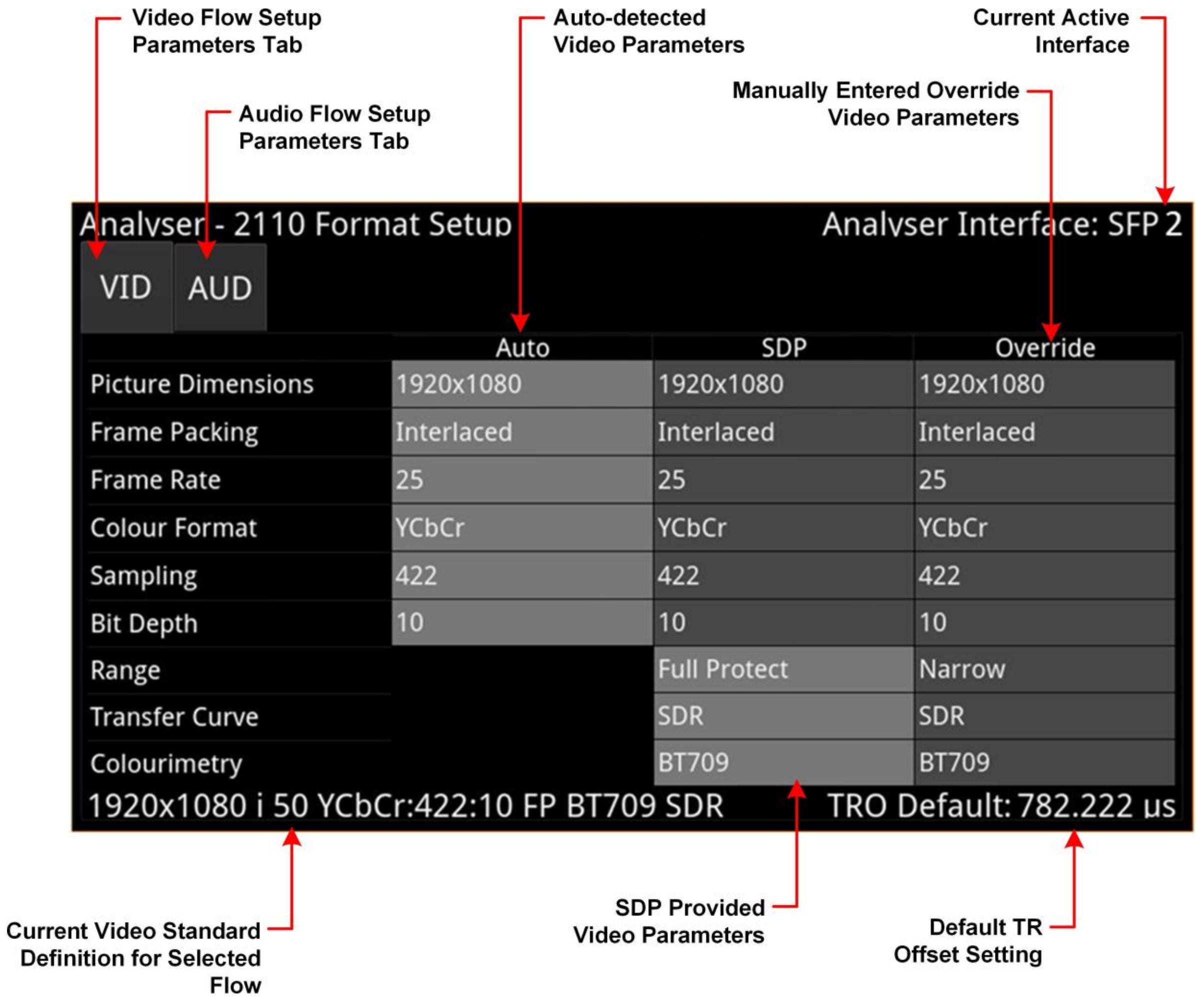


Figure 4-43: Analyzer - 2110 Format Setup Instrument - Video Tab

> **Note:** If the 2110 Format Setup instrument is active but the unit is configured to analyze either an ST 2022-6 IP flow or optional SDI input, you will see the following warning message displayed in the window: **Invalid Input**.
>
> To resolve, make sure that an ST 2110 flow or flow group is assigned to the analyzer.

The Analyzer - 2110 Format Setup Instrument automatically estimates the following parameters for a selected 2110-20 video flow:

- Picture dimensions (height and width)
- Frame packing type (interlaced, progressive, or segmented)
- Frame rate
- Color format
- Sample format
- Bit depth.

All parameters currently in use by the video standard are displayed in a bold white font, with unused parameters grayed-out. If the flow is selected using an SDP, the unit extracts the video parameters from the SDP record and displays them in the SDP column. If an SDP record is not available, the SDP column is grayed-out and no parameters are listed. SDP parameters are currently provided only if you select the flow using an SDP available through NMOS. If you later manually deselect the flow, and then reselect it, the SDP parameters will be lost.

If necessary, you have an option to use the manual override parameters instead of the automatically estimated or SDP parameters. If you do so, the auto-estimated and SDP parameters remain available and displayed but are not used. The default manual override is the same as the current default video standard, for example: **1920x1080 i 50 YCbCr:422 10 FP SDR 709**.

When using Auto-estimation, where a video parameter can be estimated correctly, the auto-estimated parameters take priority over the supplied SDP parameters (if available). When it is not technically possible to auto-estimate a parameter, then either the SDP values (if available) or the manual override settings are adopted instead.

It is not technically possible to estimate the Range, Transfer Curve or the Colorimetry parameters so these are taken either from the SDP file (if available) or the Manual settings (if defined). Furthermore, it is not possible to distinguish automatically between either YCbCr:444 and RGB:444, or YCbCr:422 12 bit and RGB:444 8 bit formats. In these situations the Auto Detector will report **Undetermined** in red font in the corresponding field of the **Auto** column.

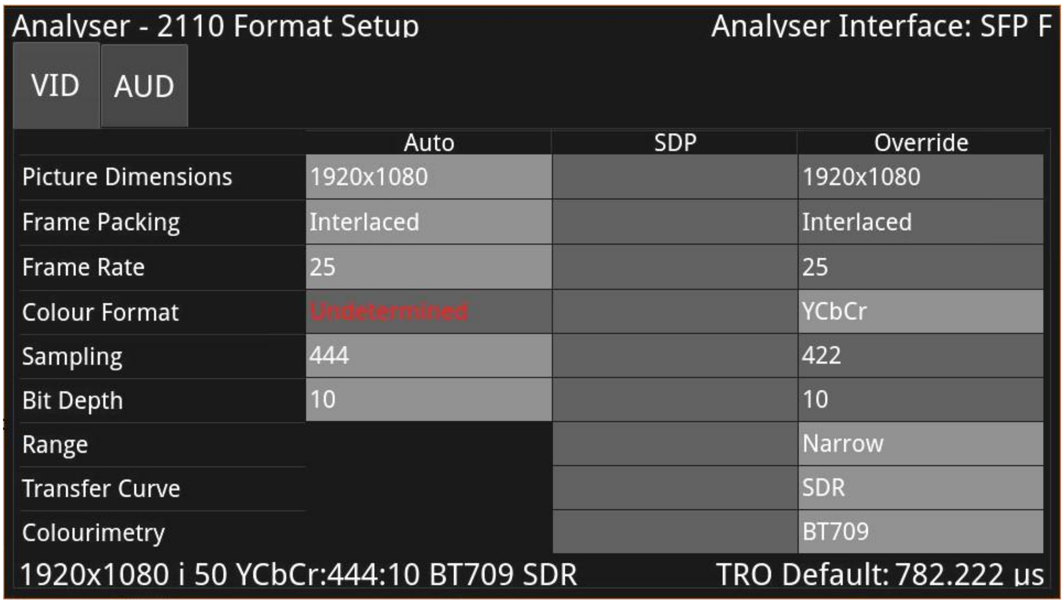


Figure 4-44: Analyzer - 2110 Format Setup Instrument Showing Undetermined Parameter

In the event that a parameter does not match the parameter currently in use, that parameter is displayed in a yellow font to highlight the mismatch.

For example, the following screen shows that the frame packing and frame rate in the SDP column do not match those in the Auto column currently in use, and neither does the range parameter in the SDP file match the incoming standard.

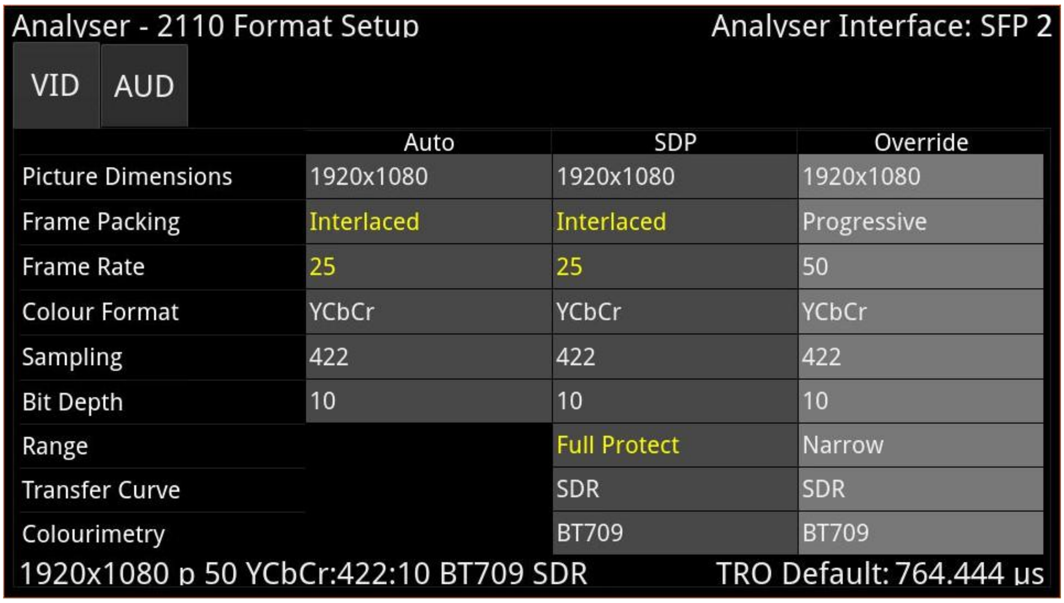


Figure 4-45: Analyzer - 2110 Format Setup Instrument Showing Unmatched SDP Parameters

The 2110 Format Setup Instrument estimates the standard for the 2110-20 video flow on both interfaces SFP 1/2 (or optionally QSFP 3/4), with the video standard used depending on the setting of the current analyzer interface. If the unit is in Seamless 1+2 (or 3+4) mode, then the parameters from SFP 1 are used unless no flow is present or a fault is identified, in which case, the parameters from SFP 2 are used.

Colorimetry Range and Bit Depth Support

The unit supports the detection and analysis of SMPTE Full Range video standards, in addition to SMPTE Narrow Range, when the Range parameter is specified in the SDP Record. Theunit uses the definitions for Narrow, Protected (Full Protect) and Full Range as defined in SMPTE RP 2077 *Full- Range Image Mapping*.

Full, Protected and Narrow ranges for 10 and 12 bit depths are summarized in the following table for ST 2110 IP video flows:

Range Type	IP 2110-20 Code Value Digital Representations		
	8-Bit Range	10-Bit Range	12-Bit Range
Full Range (FR)	255	1023	4095
Full Protected Range (FP)	254	1019	4079
Narrow Range (NR)	235	940	3760
	...	...	...
Narrow Range (NR)	16	64	256
Full Protected Range (FP)	1	4	16
Full Range (FR)	0	0	0

Figure 4-46: Colorimetry Ranges (ST 2110 Flows)

> **Note:** When analyzing a video input standard, the unit does not scale up from Protected Range to Full Range or scale down from Full Range to Protected Range.

If using NMOS and the optional Range parameter in the SDP record is set to **Full** or **Full Protect**, you will see this displayed in the SDP column of the 2110 Format Setup overview. If this parameter is not set, then the incoming video is assumed to be SMPTE Narrow range, by default.

When defining manual video override parameters, you can select either Full Range (**FR**), Full Protected Range (**FP**), or Narrow Range (**NR**) colorimetry for any of the available 8, 10, or 12 bit depths.

The active colorimetery range is displayed in the definition of the current standard for the selected flow at the bottom of the display, for example:

`1920 x 1080 i50 YCbCr:422:10 FR BT709 SDR`

For more information on videocolorimetry range definitions as implemented in the unit, see the section *Video Colorimetry Range Definitions*.

Audio Tab Setup

The 2110 Format Setup Instrument automatically estimates the following parameters for the selected audio flows (AUD1 through AUD4):

- Packet time (ms)
- Channel count.

When using Auto-estimation, where an audio parameter can be estimated correctly, the auto-estimated parameters take priority over the supplied SDP parameters (if available). When it is not technically possible to auto-estimate a parameter, then either the SDP values (if available) or the manual settings are adopted instead.

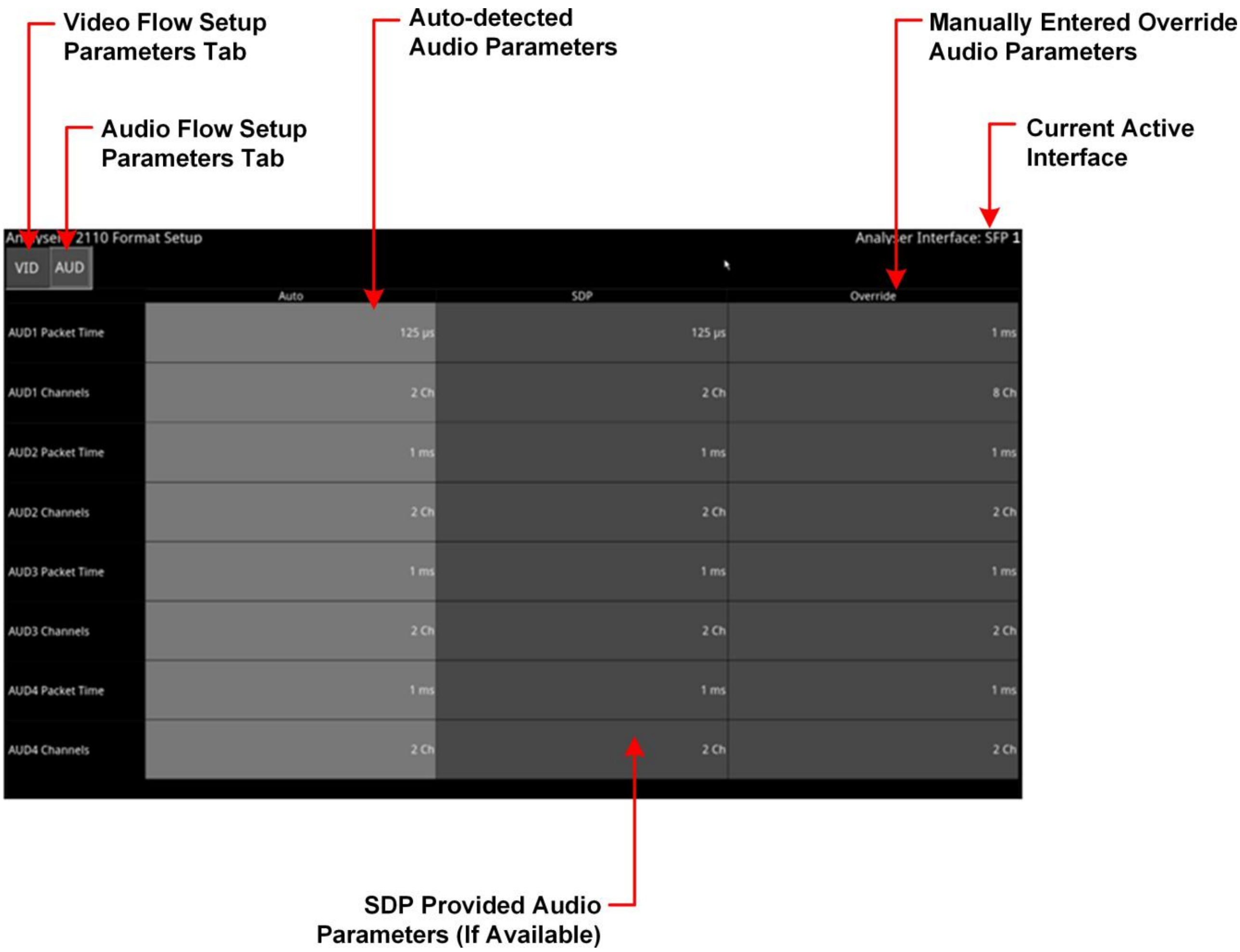


Figure 4-47: Analyzer - 2110 Format Setup Instrument - Audio Tab with Four Audio Flows

Features include:

- User-configurable audio format parameters for ST 2110-30 flows includes packet time and chan- nel count
- Automatic detection of audio format, channel count and packet time.

Instrument Menu Options

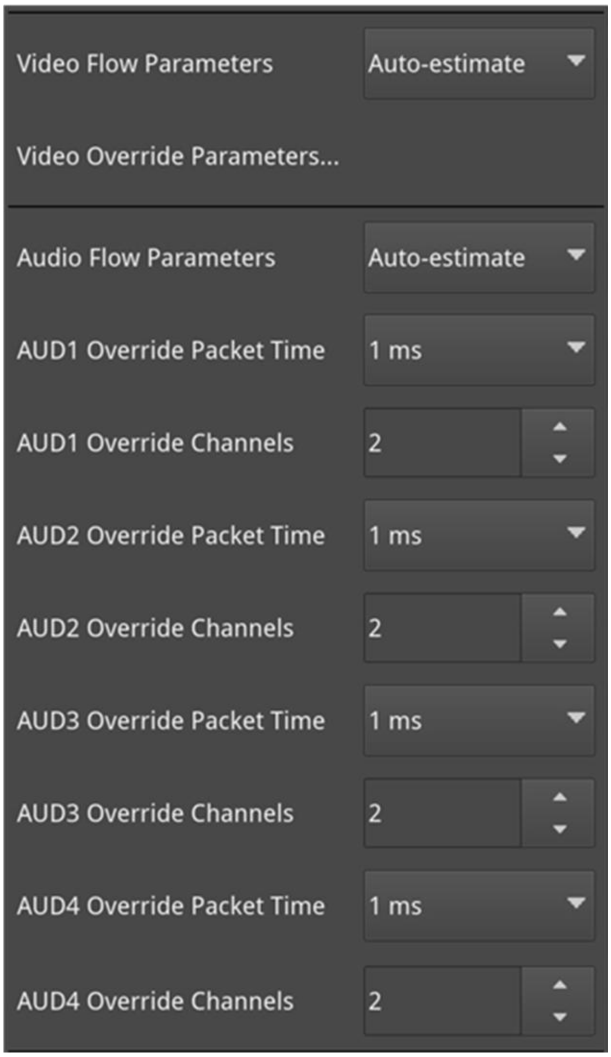


Figure 4-48: Analyzer - 2110 Format Setup Instrument Menu Options with Four Audio Flows

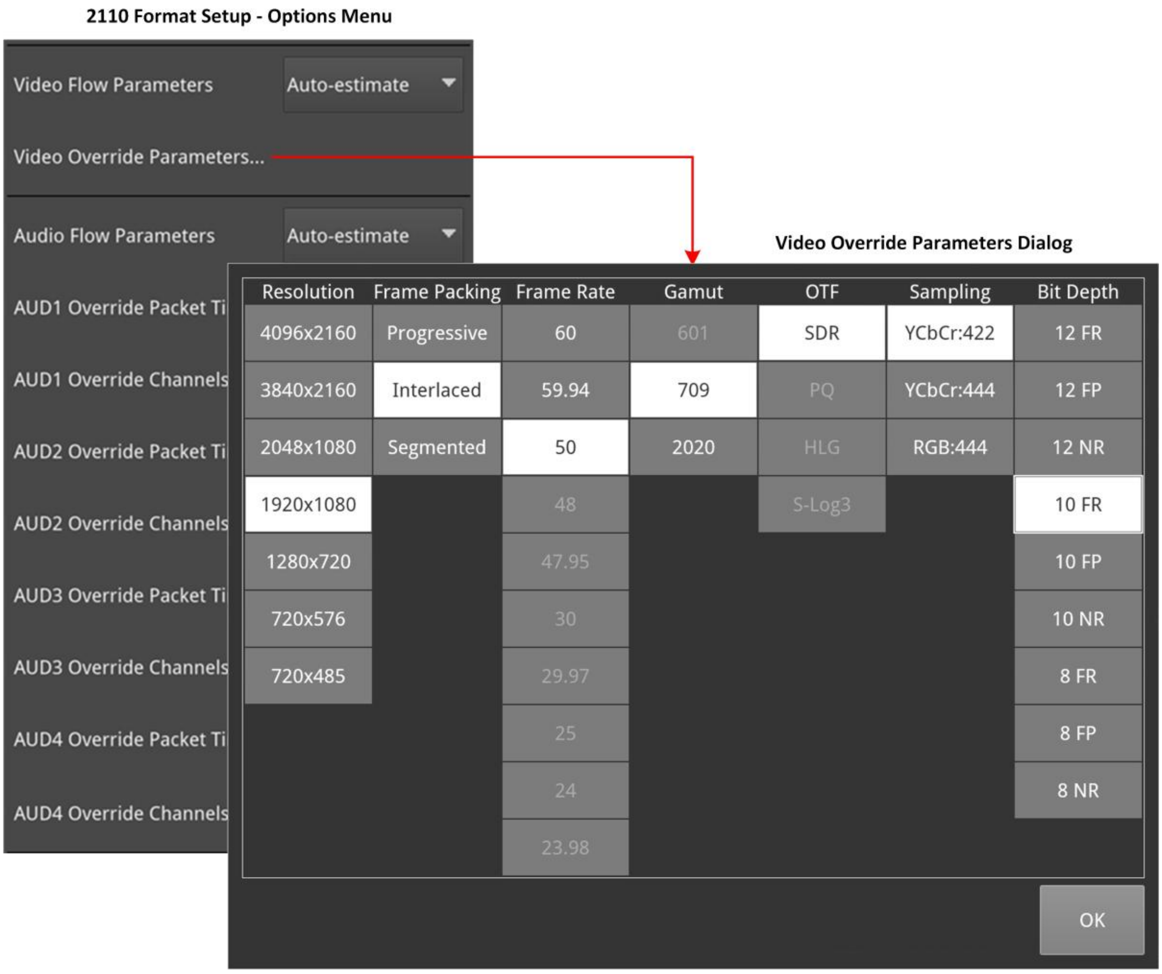


Figure 4-49: 2110 Format Setup - Video Override Parameters Dialog

The following table lists the video and audio format parameter options, available to select for the Override column, in the Analyzer - 2110 Format Setup instrument options menu:

Table 4-20 : Analyzer - 2110 Format Setup Menu Options

Item	Options	Description
Video Flow Parameters		
Video Flow Parameters	Auto-estimate (Default) Override	When set to **Auto-estimate** the unit attempts to determine the incoming IP video standard automatically. When successful, the unit uses these parameters to set up the video. In the event that the unit cannot estimate a video parameter, then it uses the video standard from an SDP file if one is available (currently only by way of NMOS); otherwise it uses the Override parameters. **Note:** The unit cannot currently estimate the parameters **OTF** (transfer curve) and **Gammut** (colorimetry) so always uses the SDP (if available) or Override parameters. When set to **Override** the unit uses the parameters defined in the video override parameters dialog to set-up the video together with the audio override parameters defined in the options menu.
Video Override Para-	System Control	Opens the Video Override Parameters configuration dia-

Item	Options	Description
meters...		log.
Override Video Flow Parameters		
Resolution	1280 x 720 1920 x 1080 2048 x 1080 3840 x 2160 4096 x 2160	Select the appropriate picture dimensions for the flow.
Frame Packing	Interlaced Segmented Progressive	Select the appropriate frame packing method for the flow.
Frame Rate	23.98, 24, 25, 29.97, 30, 47.95, 48, 50, 59.94, 60	Select the appropriate frame rate for the flow.
Gamut	601 709 2020	Select the appropriate colorimetry standard for the flow.
OTF (Optical Transfer Function)	SDR PQ HLG Unspecified	Select the appropriate transfer curve for the flow. **Note:** The option **Unspecified** forces the OTF setting to S-Log3.
Sampling	YCbCr:422 YCbCr:444 RGB:444	Select the appropriate sampling method for the flow.
Bit Depth	8 bit (FR, FP, or NR) 10 bit (FR, FP, or NR) 12 bit (FR, FP, or NR)	Defines the colorimetry bit-depth and range (Full (**FR**), Full Protected (**FP**), or Narrow (**NR**)) of the incoming video standard when using manual override parameters.
Override Audio Flow Parameters		
Audio Flow Parameters	Auto-estimate (Default) Override	If you select the option **Override**, you can manually set the following fields (the maximum number of Channels depends on the Packet Time set):
AUD1 Override Packet Time	1 ms 125 µs	Enabled only when Audio flow parameters option is set to Override.
AUD1 Override Channels	1 to 10 at 1 ms 1 to 80 at 125 µs (2110-30) 1 to 60 at 125 µs (2110-31)	Enabled only when Audio flow parameters option is set to Override.
AUD2 Override Packet Time	1 ms 125 µs	Enabled only when Audio flow parameters option is set to Override.
AUD2 Override Channels	1 to 10 at 1 ms 1 to 80 at 125 µs (2110-30) 1 to 60 at 125 µs (2110-31)	Enabled only when Audio flow parameters option is set to Override.
AUD3 Override Packet Time	1 ms 125 µs	Enabled only when Audio flow parameters option is set to Override.
AUD3 Override Channels	1 to 10 at 1 ms 1 to 80 at 125 µs (2110-30) 1 to 60 at 125 µs (2110-31)	Enabled only when Audio flow parameters option is set to Override.
AUD4 Override Packet Time	1 ms 125 µs	Enabled only when Audio flow parameters option is set to Override.

Item	Options	Description
AUD4 Override Channels	1 to 10 at 1 ms 1 to 80 at 125 µs (2110-30) 1 to 60 at 125 µs (2110-31)	Enabled only when Audio flow parameters option is set to Override.

5

SDI Setup and Configuration

SDI Connections to the Unit

Overview

All SDI inputs and outputs are by way of BNC connectors for the transmission of SDI signals in to and out of the unit as shown below.

Figure 5-1: BNC SDI Input / Output Connectors

SDI Input and Output Schematic (SDI Input / Output)

The following graphic shows a schematic view of SDI inputs and outputs, to and from the Analyzer and Generator circuitry respectively, using BNC connectors.

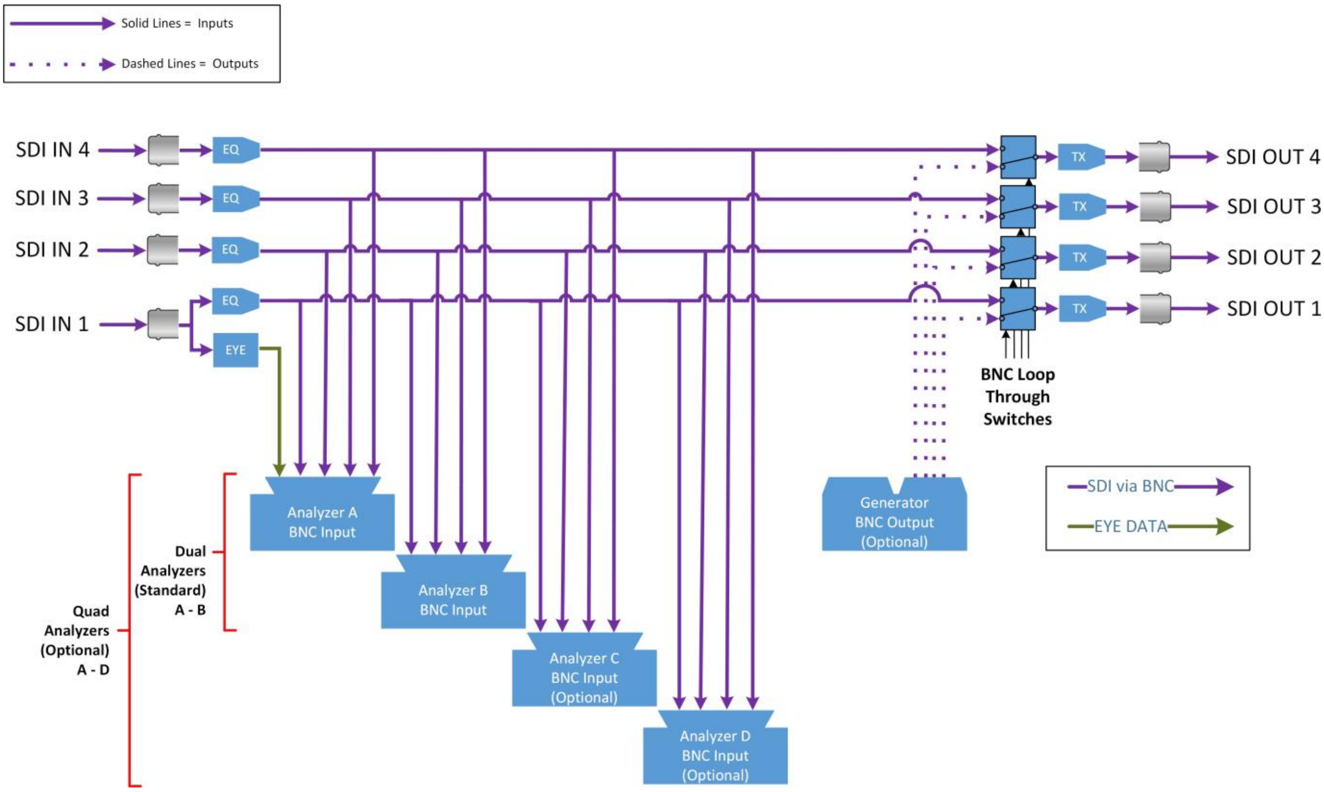


Figure 5-2: SDI Input / Output Connectors to Analyzer / Generator Circuitry

Where:

- **EQ** = SDI Cable Equalizer
- **Tx** = Signal Transmitter
- **EYE** = RTE™ Real-time Eye Processing Circuitry

For SDI Inputs:

- All BNC input connectors **SDI In 1**, **SDI In 2**, **SDI In 3**, and **SDI In 4** support both SD-SDI and HD-SDI input, including 270M, 1.5G, 3G as standard
- All BNC input connectors **SDI In 1**, **SDI In 2**, **SDI In 3**, and **SDI In 4** can optionally support UHD SDI input, including: 6G-SDI and 12G-SDI (requires **LPX500-UHD** license).
- Optional Eye and Jitter analysis is available for the source input connected to **SDI In 1** only.

> **Note:** The SDI BNC Loop feature for HD-SDI inputs is available with SDI connector configuration BNC In / BNC Out only.

For SDI Outputs:

- To generate multi-link signals, when the optional generator is available (**LPX500-GEN**) the cor- responding SDI Out BNC connectors are used.

- To duplicate a generated single-link signal, the option **Generator Output Copy** must be **Enabled** (see *Generator (Video)*) and the desired SDI Out connector must be set to **Generator** (see *System IO*). The Generator Output Copy function is not available for SD-SDI signals.
- To loop-out an active SDI In signal, see *System IO.*

SDI Input / Output Configurations

Depending on your purchased software options, your unit may have two (standard) or four (requires software option: **LPX500-QUAD**) analyzers.

You can choose different combinations of BNCs for input / output, to and from the unit, as follows:

- Single Link Inputs: Use BNCs **SDI IN 1**, **2**, **3**, or **4**
- Dual Link Inputs: Use BNCs **SDI IN 1** and **2**, or **SDI IN 3** and **4**
- Quad Link Inputs: Use BNCs **SDI IN 1**, **2**, **3**, and **4**.

You can assign any of your connected SDI inputs to the dual or quad analyzers using the **Analyzer Input Assignment** dialog in the Settings tab, see *Managing Multiple Analyzers*.

Select the SDI output connector configuration you require in the **System IO** instrument options menu by configuring the **BNC Out** parameters. For more information, see: *System IO*.

SDI Inputs Using BNC Connectors

Note: You need to assign the source SDI input to the desired Analyzer using the **Analyzer Input Assignment** dialog in the Settings tab of the Setup Menus.

The Physical Layer input connection for eye and jitter is the right-most BNC input connector (when viewed from the rear) fitted with a black-colored nut. This provides the multirate eye and jitter connection from 270M SD-SDI to 12G HD-SDI.

Note: The **SDI In 1** BNC is always the source SDI input on which physical layer Eye / Jitter analysis is performed, irrespective of SDI inputs connected to BNCs **SDI In 2** through **4**

The input connectors to the Analyzer have the following capabilities:

- Four 270M SD-SDI to 12G HD-SDI capable, input BNC connectors: **SDI In 1**, **2**, **3**, and **4**.

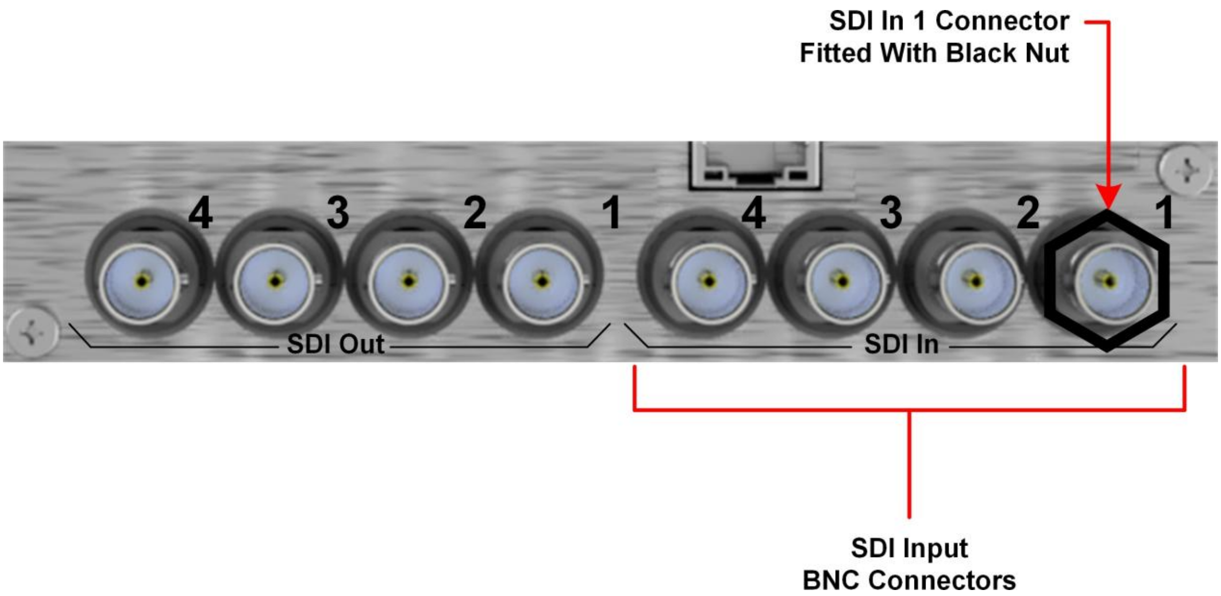


Figure 5-3: Rear Panel SDI Input BNC Connectors

Up to four SD-SDI or HD-SDI inputs can be connected at any one time. The system automatically determines the signal-set to analyze on each BNC input, whether single-, dual-, or quad-link.

For HD-SDI inputs, if the SMPTE ST 352 packets are known to be incorrect then you can select **Ignore** for the parameter **Payload Identifiers** in the **Analyzer - Video Standard** instrument options menu.

SDI BNC In-to-SDI BNC Out signal pass-through is provided by selecting the **Loop SDI In 1**, **2**, **3**, or **4** parameter in the **System IO** or **Generator** instrument options menu, making the SDI input signal(s) available on the corresponding SDI BNC output connector(s).

For a summary of the input and output capabilities with SD-SDI and HD-SDI, see *Table 5-1* in the following section.

SDI Outputs Using BNC Connectors

You can control the output signal independently on each of the four SDI BNC output connectors **SDI Out 1**, **2**, **3**, or **4** using the **System IO** or **Generator** instruments.

SDI Out 1 is present, by default, and carries the first HD-SDI signal in the group, **SDI Out 2** is active for dual- and quad-link HD-SDI standards, and **SDI Out 3** and **SDI Out 4** are active for quad-link HD-
SDI standards.

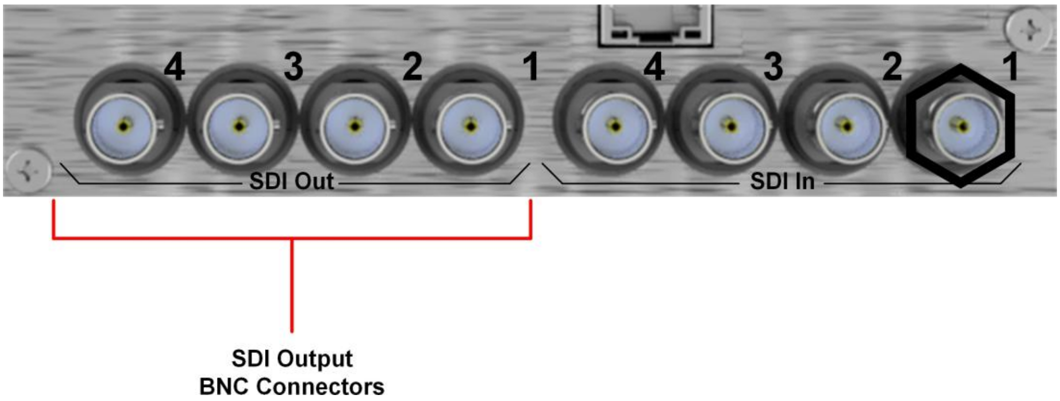


Figure 5-4: Rear Panel SDI Output BNC Connectors

For each of the four output BNC connectors, you can select from the following optional modes either from the options menu of the **System IO** instrument or using the SDI Output Assignment submenu of the **Generator**:

- **Off:** Mutes the selected SDI Out connector.
- **Loop SDI in 1**, **2**, **3**, or **4:** Enables you to repeat the signal presented to the SDI BNC inputs as an output from the SDI BNC Outputs. When selected, there is a direct mapping between the **SDI In** BNC connector and its corresponding **SDI Out** BNC connector, for example, **SDI In 1** loops to **SDI Out 1**, **SDI In 2** loops to **SDI Out 2**, and so on.
- **Generator:** The unit sends the output signal from the Generator to the selected SDI Out con- nectors. For single link signals you can enable the **Generator Copy** mode in the options menu to copy the signal to additional output connectors.

Table 5-1 : Summary of SD- and HD-SDI Capabilities on BNC Input and Output Connectors

BNC Connector	SD-SDI			HD-SDI		
	SD-SDI Input	Generator Copy	Loop Through	HD-SDI Input	Generator Copy	Loop Through
Input Connectors						
SDI In A	**Yes**	N/A	**Yes**	**Yes**	N/A	**Yes**
SDI In B	**Yes**	N/A	**Yes**	**Yes**	N/A	**Yes**
SDI In C	**Yes**	N/A	**Yes**	**Yes**	N/A	**Yes**
SDI In D	**Yes**	N/A	**Yes**	**Yes**	N/A	**Yes**
Output Connectors						
SDI Out A	N/A	N/A	**Yes**	N/A	**Yes**	**Yes**
SDI Out B	N/A	**Yes**	**Yes**	N/A	**Yes**	**Yes**
SDI Out C	N/A	**Yes**	**Yes**	N/A	**Yes**	**Yes**
SDI Out D	N/A	**Yes**	**Yes**	N/A	**Yes**	**Yes**

Where: N/A = Not Applicable

Colorimetry Range Definitions for the LPX Series

The LPX Series supports the analysis of 10 or 12 bit video signals. For each RGB or YCbCr color channel in a 10 bit video signal there are 1024 possible values, from **0 to 1023**. This represents the **Full Range**, abbreviated to **FR** in the **Manual Configuration** dialog of the **Analyzer - Video Standard** instrument. See *Figure 5-5*, adapted from EBU R 103, for a schematic overview.

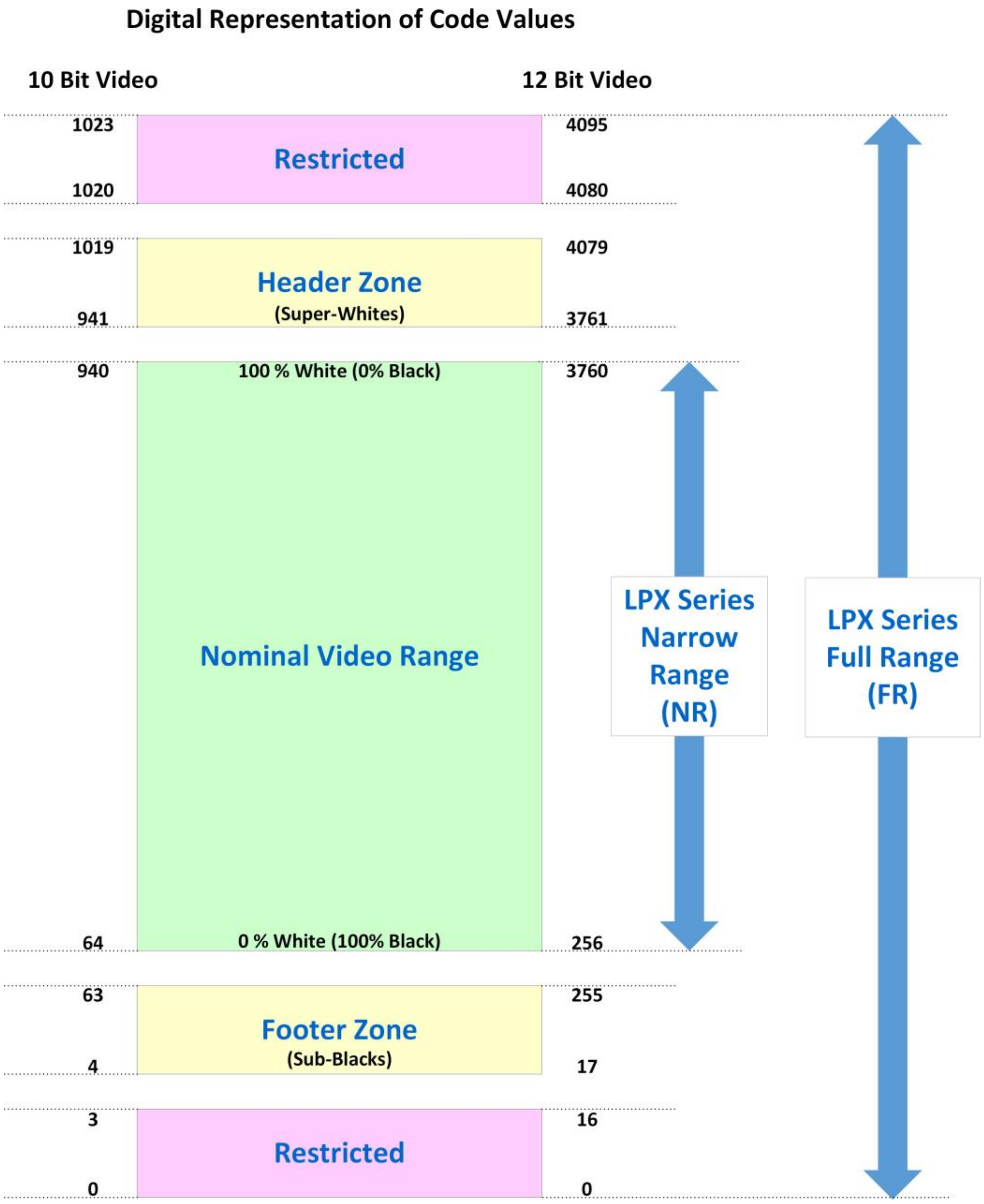


Figure 5-5: Typical Video Code Values and Equivalent LPX Range Definitions (SDI Only)

SMPTE defines the first 4 bits (**0 to 3**) and last 4 bits (**1020 to 1023**) of a 10 bit video signal as reserved for signal processing so these must not contain video data. This leaves the range of available code values for color display as **4 to 1019**. In this range, **4** represents the darkest black of the sub-blacks and **1019** the brightest white of the super-whites at the bottom and top of the color scale, respectively.

The nominal video range for a 10 bit video signal is the code range extending from 100% Black to 100% white, excluding the sub-blacks and super whites. For a 10 bit video signal this range is between code values **64** and **940** and is defined as **Narrow Range** (**NR**) in the LPX Series.

In addition, EBU R 103 defines a header zone between the nominal video range and the restricted bits at the upper extent of the range and a footer zone between the nominal video range and the restricted bits at the lower extent of the range. The header and footer zones, containing the super- whites and sub-blacks respectively, are intended as buffer zones in case color ranges exceed the upper or lower limits of the nominal video range. When converting from YCbCr to RGB formats and *vice versa*, the foot- and headroom provide buffer space if required. The number of code values in the header and footer depends on the bit depth of the video signal.

For a 10 bit video signal there are 1024 possible values in the Full Range (**FR**) from **0** to **1023**. Similarly, for a 12 bit video signal there are **4096** possible values giving the Full Range (**FR**), from **0** to **4095**. In this case, the first and last 15 bits are reserved for signal processing.

To summarize, the following table shows the Fulland Narrow ranges as implemented in the LPX Series for SDI signals:

Range Terminology in LPX Series	10 Bit Code Values	12 Bit Code Values
Full Range (FR)	0 - 1023	0 - 4095
Narrow Range (NR)	64 - 940	256 - 3760

For more detailed information about video signal ranges, see the recommendation EBU R 103 *Video Signal Tolerance in Digital Television Systems*.

System IO (Factory Fitted Option)

Overview

Due to the complexity of the UHDTV standards, LeaderPhabrix has introduced innovative ways to display status information. The **System IO** instrument provides a quick status overview of the signal inputs and outputs connected to the unit. In addition, System IO displays the status of signal interfaces, external reference, cable length and attenuation, and connector details.

System IO also enables you to select the BNC connectors for your SDI outputs using the options menu. In addition, a **Loop** function enables you to pass-through the SDI BNC input signal(s) making them available on the corresponding **SDI BNC** output connector(s).

System IO for SDI Input

The top half of the instrument window shows a graphical view of the rear panel connectors, displaying from left to right: SDI BNC outputs, SDI BNC inputs, and external reference. In addition, the connector icons show the active I/Os at any of the connectors).

With the optional Eye functionality (chassis option **LPX500ISE**) you will see the legend **eye** displayed above the connector representing SDI In 1, showing that physical layer eye and jitter analysis is available for SDI input on **SDI In 1**.

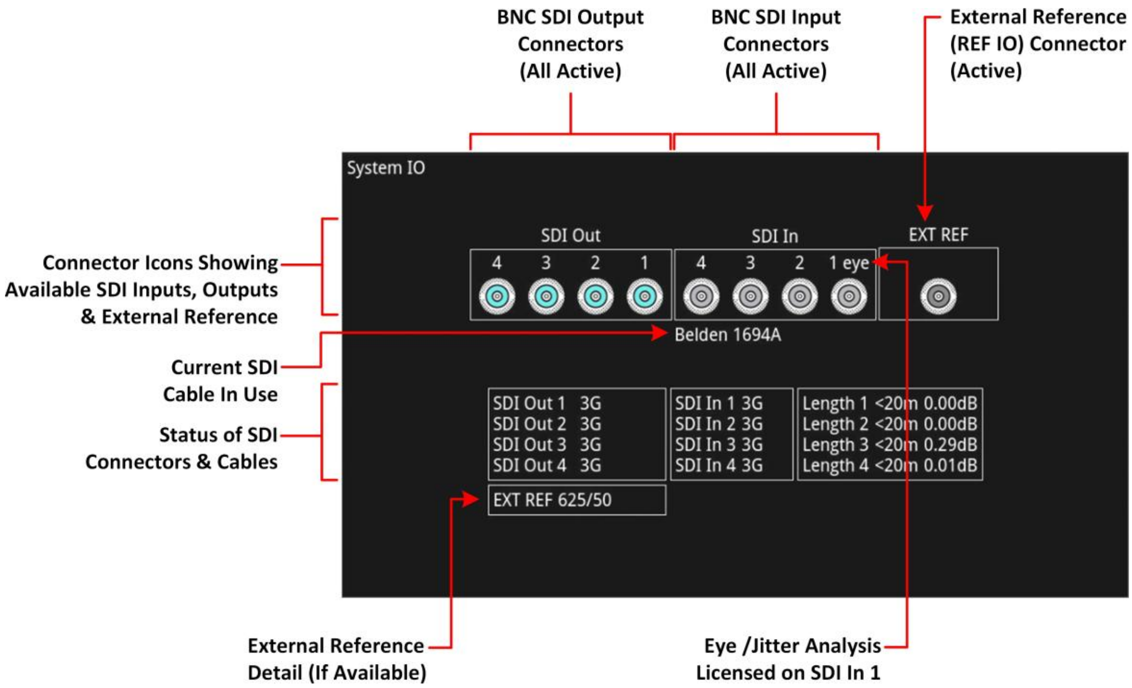
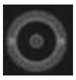


Figure 5-6: System IO Instrument Showing Analyzer Input as SDI Source

Active SDI outputs are indicated by color-coded connectors; with the color assigned by the Generator color scheme selected in the Display Settings, see the section *Modifying the Display Options* .

When successfully receiving SDI inputs on SDI In 1 to 4, the SDI In connector icons display a light-gray middle ring. A connector icon with a black middle ring indicates that a signal is not present, as shown below:

-  Active SDI input (or external reference) to rear panel BNC.
-  No input /output to / from rear panel BNC.
-  Active SDI output from rear panel BNC (requires option **LPX500-GEN**).

Instrument Menu Options

You can configure the SDI signal IO mechanism using the instrument options menu.

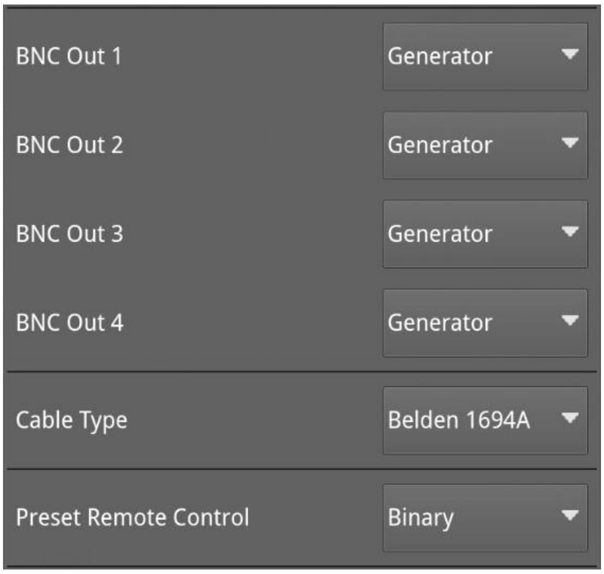


Figure 5-7: System IO Instrument - Menu Options

The following table lists the configurable parameters of the System IO instrument:

Table 5-2 : System IO Menu Options

Item	Options	Description
BNC Out 1 BNC Out 2 BNC Out 3 BNC Out 4	Off Generator (Default) Loop SDI In 1, 2, 3, or 4 (SD-SDI or HD-SDI)	Choose whether to configure each SDI BNC Out connector (1, 2, 3 or 4) individually, to use either the Loop SDI In 1, 2, 3, or 4 signal, the Generator signal, or to switch off the output.
Cable Type	Belden 8281 Belden 1505 Belden 1694A (Default) Belden 1855A Canare L5CFB Image 1000	Selects the type of SDI cable used to connect the BNC connectors. The selected SDI cable type is shown below the SDI In BNC connector view. **Note:** Cable lengths can only be estimated if the cable is one of these supported types.
Preset Remote Control	Disabled (Default) Bit Binary	Use to enable the loading of presets using remote control by way of the 15-pin GPIO D-type connector on the rear panel. You can choose between Bit mode and Binary mode. See *Remote Control Loading of Presets* for further details.

Signals presented to the unit's SDI BNC Inputs can be repeated out on the SDI BNC outputs of the unit, by enabling the **Loop SDI In 1**, **2**, **3**, or **4** options for the appropriate interface connector(s). When this loop feature is activated, there is a one-to-one mapping between the BNC 1, 2, 3, and 4, inputs and outputs respectively.

> **Note:** To use the Loop SDI feature for a single-link input signal you need either a valid SD-SDI or HD-SDI input connected to any of the input BNCs. You can also loop-out a connected dual or quad link signal but you need to ensure that all components of the signal are looped out. If not the receiving unit may be unable to interpret the received signal correctly.

To duplicate output of the generated single-link or dual-link video standard on all unused SDI Out BNCs, enable the option **Generator Copy** in the **Generator** options menu, see the section *Generator Copy and SDI Out Configuration* for more information.

> **Note:** Copying of the Generator output is not applicable to quad-link standards as all outputs are used.

The presence of an external reference and its standard is also displayed graphically with a colored connector. If you set the system to lock to an external reference and achieve a stable lock, then the inner ring of the EXT REF BNC connector icon is highlighted in gray. The following EXT REF BNC colors relate to various external reference statuses:

- Gray (reference connected)
- Red (reference in error)
- Black (no reference connected)

> **Note:** The EXT REF BNC shows the status of an external reference only, which is not necessarily the system reference. Overall system reference is selected in the **Video Timing and System Reference** instrument.

The tables displayed below the connector icons show the input and output status, cable length and attenuation, and external reference standard and status information. You can hover the mouse over the external reference information to display a tooltip containing additional status information, if necessary.

The external reference table displays the following states:

- EXT REF: No Signal, Unstable, 525/59.94, 625/50, etc.

If an external reference is not currently being used as system reference, its field text will display in yellow. When an external reference is the system reference, this table field text is colored white.

Estimated measurements for the maximum cable length (in meters) and attenuation (in decibels) are displayed for each SDI BNC input. The System IO instrument displays the cable lengths as follows:

- SD-SDI input on BNC In 1, 2, 3 or 4: Displays the cable length as **<50m**
- HD-SDI input on BNC In 1, 2, 3 or 4: Displays the cable length as **<20m**.

To measure the length of a connected cable, be sure first to select the correct cable type from the instrument options menu.

Video Timing & System Reference

Overview

The **Video Timing & System Reference** instrument provides the following functional areas:

- An **SDI** tab to measure the timings of source inputs, allowing you to calculate any timing offsets required to synchronize broadcast equipment,
- An **SDI Co-timing** tab to evaluate the co-timing of dual and quad link SDI inputs , enabling you to ensure that the source inputs adhere to the required standards.

This section covers the measurement and adjustment tools available for SDI input to the dual or optional quad analyzers.

Video Timing in the SDI Tab

The SDI tab of the **Video Timing & System Reference** instrument window enables you to measure SDI input timings against a configurable reference signal to which the unit is locked. You can then adjust offset timings to assess and synchronize the output timing of equipment throughout the broadcast chain.

You can set the System Reference to an external reference, SDI, or Free Run.

The instrument displays the following resulting measurements in both spatial units (lines and pixels) and time units (µs or ns):

- Measured Timing
- Offset to Apply (with External Reference and SDI only)
- Offset Timing (with External Reference and SDI only).

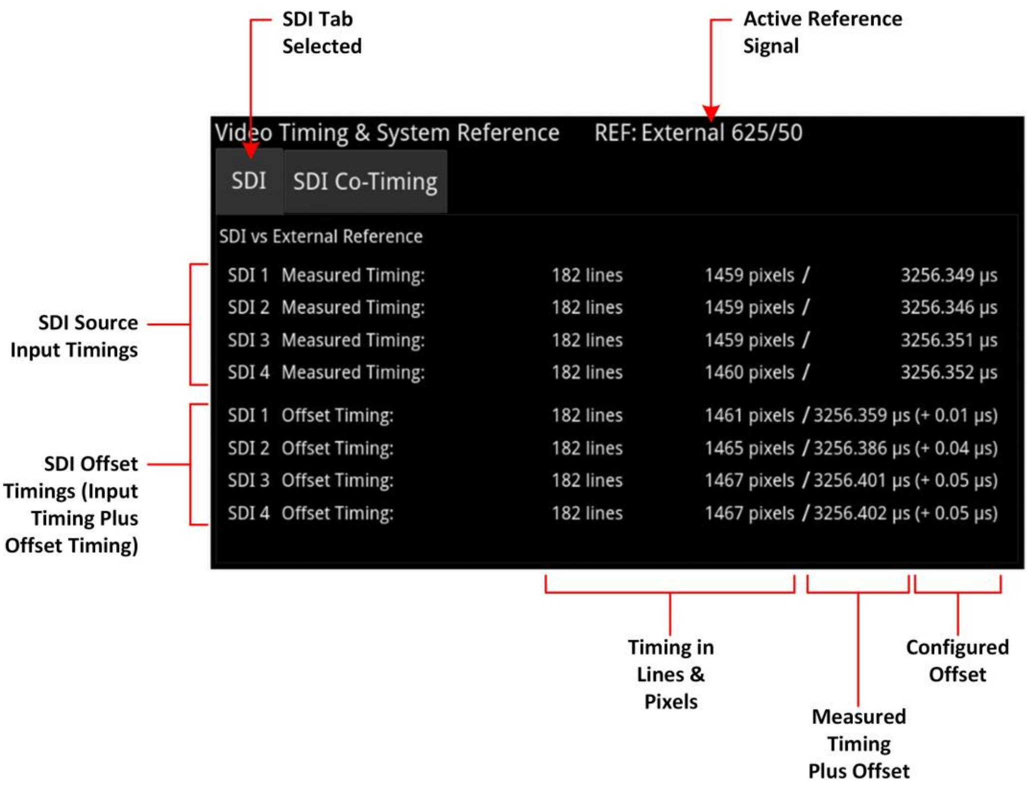


Figure 5-8: Video Timing & System Reference Instrument (SDI Tab)

Video Timing in the SDI Co-Timing Tab

The **SDI Co-Timing** tab displays a graphical view of timing information for each input of either a dual link (SDI In 1 and 2 and/or optionally SDI In 3 and 4) or quad link (SDI In 1, 2, 3 and 4) source input.

Many of the standards associated with UHDTV are a combination of signals to form the image plane, for example, four 3G inputs combined to generate a 12G composite picture. Relative timing tools show whether the dual or quad elements creating the single picture are correctly aligned and comply with the reference. The instrument presents both graphical indicators and numeric values for these critical measurements.

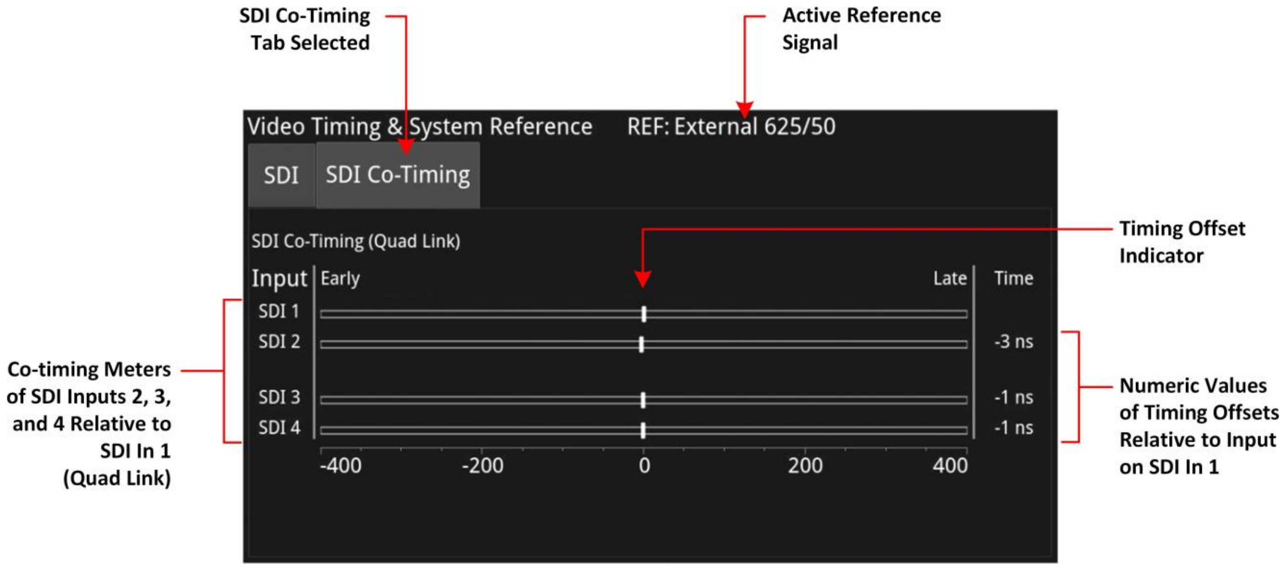


Figure 5-9: Video Timing & System Reference Instrument (SDI Co-Timing Tab)

The horizontal Early / Late timing meters show whether the timing offset on each subsequent input of the quad or dual link is earlier or later than the input signal on SDI In 1. The Instrument displays the actual timing offset values in the Time column to the right of the timing meters. Early timings are shown as negative values and late timings are positive. Any red text indicates a measurement outside the specification.

Instrument Menu Options

The following table lists the configurable parameters of the Video Timing & System Reference instrument submenu:

Table 5-3 : Video Timing & System Reference Menu Options

Item	Options	Description
System Reference	Free Run (Default) External Reference SDI	System reference locking controls define the reference to which the unit, and any signal it generates, is locked. By selecting the default option Free Run, the system locks to its internal oscillator to set its timing reference. If the sys- tem loses the external or SDI reference signal for some reason, the system will automatically switch to use the Free Run reference signal. You can view system reference lock status information by hovering the cursor over the sys- tem reference in the upper-right corner of the instrument. Any error or warning

		conditions concerning the state of the reference are dis-

Item	Options	Description
		played in red or yellow respectively.
SDI 1 Input Time Offset	−999999.0 to 999999.0 µs	Set the timing offset in microseconds (µs).
SDI 2 Input Time Offset	−999999.0 to 999999.0 µs	Set the timing offset in microseconds (µs).
SDI 3 Input Time Offset	−999999.0 to 999999.0 µs	Set the timing offset in microseconds (µs).
SDI 4 Input Time Offset	−999999.0 to 999999.0 µs	Set the timing offset in microseconds (µs).
Set SDI 1 Input Offset to cur- rent	System Control	Sets the input measurement offset to the same position as the current SDI In 1 source input.
Set SDI 2 Input Offset to current	System Control	Sets the input measurement offset to the same position as the current SDI In 2 source input.
Set SDI 3 Input Offset to current	System Control	Sets the input measurement offset to the same position as the current SDI In 3 source input.
Set SDI 4 Input Offset to current	System Control	Sets the input measurement offset to the same position as the current SDI In 4 source input.
Clear Input Offset	System Control	Removes any input measurement offset(s).
Co-Timing Mode	Quad Link (Default) Dual Link	Select whether the SDI Co-Timing tab displays inputs for either a quad link, or one or two dual links , depending on the number of licensed analyzers in your unit.

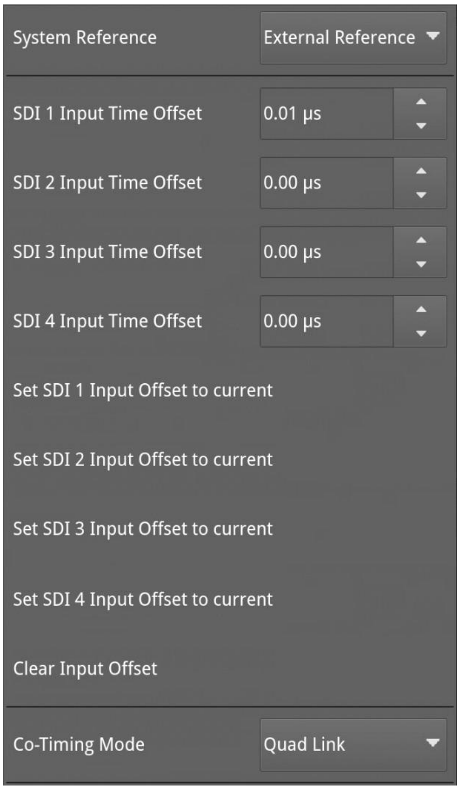


Figure 5-10: Video Timing & System Reference Options Menu

6

Signal Generation Instruments

> **Note:** Requires the **LPX500-GEN** License.

This chapter describes the unit's signal generator Instruments and includes the following sections:

Generator (Video)

Requires Option(s):	LPX500-GEN

Overview

The optional **Generator** instrument enables you to generate the following standards, depending on the configuration of your unit:

- ST 2110 IP output
- ST 2022-6 IP output
- SDI (1.5G, 3G, and optionally 6G and 12G) (Requires models **LPX500IS** or **LPX500ISE**).

> **Note:** To generate UHD and EUHD standards, you also require options **LPX500-UHD** and **LPX500-EUHD** respectively.
>
> The generation of SD-SDI video standards is not currently supported.

The options menu of the Generator provides access to further dialogs to:

- Configure the video standard.
- Select a test pattern for the generated output.
- Configure the audio signals generated.

Each configuration method is different depending on the desired output.

Generating ST 2110 IP Output

When configured to generate **ST 2110 IP** output, the Generator displays a status overview of the current standard being generated, the selected test pattern (name and thumbnail) and information about the reference signal. The selected output type (**IP 2110**) is displayed in the title bar.

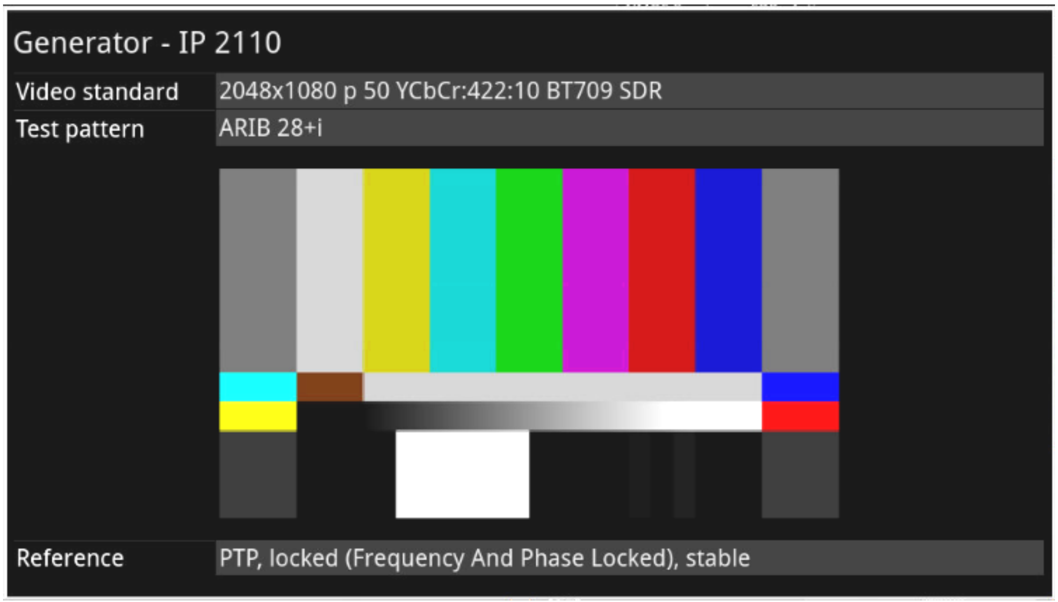
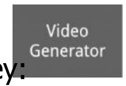


Figure 6-1: Generator Instrument (ST 2110 IP Output)

Configuring the Video Standard

To select a video standard to generate, either:

- Open the options menu (see *Figure 1-4*) and select **Video Generator...** or
- With the spotlight on the Generator, tap the softkey: 

.

This displays a configuration dialog from which you can select the desired parameters for the standard from the following columns:

- Resolution
- Frame Packing
- Frame Rate
- Gamut
- OTF
- Sampling
- Bit Depth and Range.

Selectable parameters are displayed in a bold white font and those that do not apply are grayed-out. If you select an incompatible parameter, the column head is displayed in a **yellow** font indicating that a correction is required. Simply tap or click the desired parameter in each of the columns to define the standard, then tap or click **OK** to activate. and close the dialog

To change the output from the Generator, select the desired standard (SDI, 2022-6, or 2110) from the **Output** box.

Tap and hold or right-click anywhere in the **Generator** window to display the options menu.

Figure 6-2: Generator Video Configuration (ST 2110 IP Output)

You can also select the default test pattern for the standard or open the Test Pattern dialog as described in the section *Generator Test Patterns*.

Video Configuration Parameters (ST 2110 IP Output)

The unit generates video standards for a wide range of resolutions, frame rates, image mappings color gamuts, and transfer curves, depending on the available licenses. You can configure the standard to generate by selecting available parameters from the following:

Table 6-1 : Generator Video Configuration Parameters (ST 2110 IP Output)

Standard Configuration	**Available Parameters**			
Video Standard Configuration Parameters				
Resolution	1280x720 1920x1080	2048x1080 3840x2160,	4096x2160	
Frame Packing	Progressive	Interlaced	Segmented	
Frame Rate	23.98 24 25	29.97 30 47.95	48 50 59.94	60
Gamut	709	2020		
OTF	SDR PQ	HLG S-Log3	S-Log3 SR Live	
Sampling	YCbCr:422	YCbCr:444	RGB:444	
Bit Depth (and Range)	10 NR 12 FP	10 FP 12 FR	10 FR	12 NR

Refer tothe LeaderPhabrix website for the licensing requirements to generate different video standards.

> **Note:** The test pattern may take a few seconds to generate.

Range and Bit Depth Support for Generated Video Standards (ST 2110 IP Output)

From software version 5.4, the unit can generate video standards with either a full range (**FR**), full protected (**FP**) range, or narrow range (**NR**) bit depth for ST 2110 IP output. The Qx Series uses the definitions for Narrow, Full Protected and Full Range as defined in EBU R 103 *Video Signal Tolerance in Digital Television Systems* and SMPTE RP 2077 *Full-Range Image Mapping*.

> **Note:** If you choose to generate a full protected range (FP) standard at 10-or 12-bit depth, pixel data is clipped from the full range standard, rather than scaled, as defined in SMPTE RP 2077

When you choose to generate a full- or full-protected-range video standard, the Generator window displays either **FR** or **FP** respectively, alongside the bit depth label in the Video standard definition, see *Figure 6-3*: If either FR or FP are not displayed, then the generated standard is narrow range.

Figure 6-3: Generator Bit Depth Labels (ST 2110 IP Output)

For more information on video signal range definitions as implemented in the Qx Series, see the section *Video Range Definitions for the Qx Series*.

Generating ST 2022-6 IP Output

When configured to generate **ST 2022-6** IP output, the Generator displays a status overview of the following:

- Details of the current video standard being generated
- Test pattern and description
- Whether pathological insertion is enabled and if so details of the pairs to insert
- Output type and image mapping on **SFP 2** or **QSFP 4**
- Audio signal presence and sub-images
- Reference status.

The selected output type (**IP 2022-6**) is displayed in the title bar.

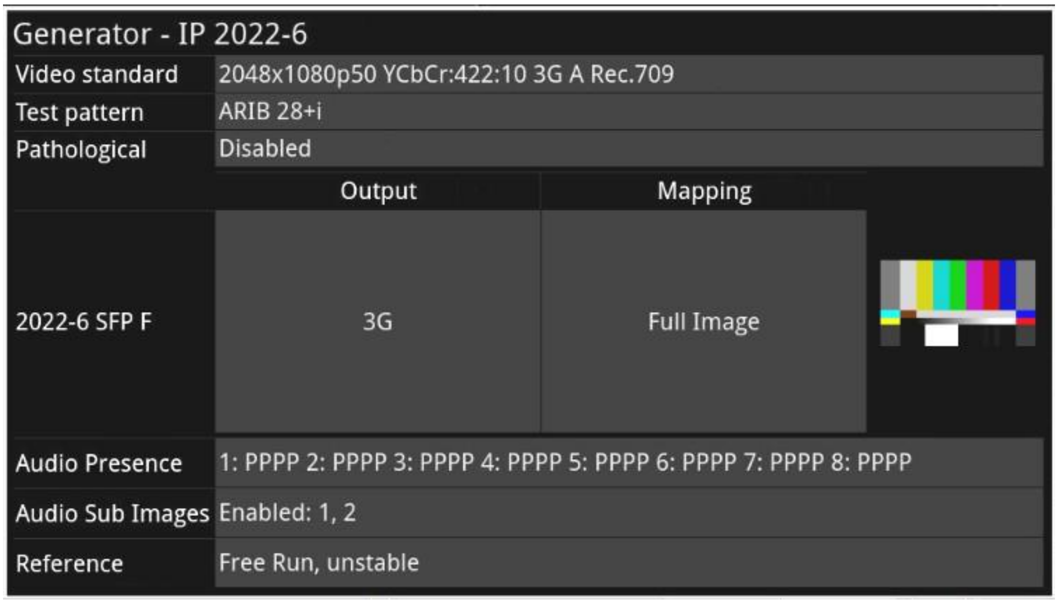
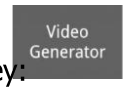


Figure 6-4: Generate - Video Instrument (ST 2022-6 IP Output)

When you generate a pathological overlay in the **Generator**, the unit detects this and Pathological PLL(s) and Eq(s) will then display the number of pathological events generated per second. As one pathological event is created per line, this also indicates the number of lines per second on which pathological conditions occur on the interface. The detection of a pathological condition is available as a GPI output from the unit for use in triggering an external analyzer device.

Configuring the Video Standard

To select a video standard to generate, either:

- Open the options menu (see *Figure 1-4*) and select **Video Generator...** or
- With the spotlight on the Generator, tap the softkey: 

.

This displays a configuration dialog from which you can select the desired parameters for the standard from the following columns:

- Resolution
- Frame Packing
- Frame Rate
- Gamut

- OTF
- Sampling
- Bit Depth and Range.

In addition the **SDI / 2022-6 Config** box in the top-right of the screen enables you to set the SDI output to Level A (single link) or Level B (dual link) as required.

> **Note:** The parameters selected in the Video Configuration dialog must be within the supported range of the standard (ST 2022-6 in this case) before the **2022-6** Output switch becomes active for selection. Otherwise it is grayed-out or inactive.

Selectable parameters are displayed in a bold white font and those that do not apply are grayed-out. If you select an incompatible parameter, the column head is displayed in **yellow** indicating that a correction is required. Simply tap or click the desired parameter in each of the columns to define the standard, then tap or click **OK** to activate and close the dialog.

To change the output from the Generator, select the desired standard (SDI, 2022-6, or 2110) from the **Output** box.

Tap and hold or right-click anywhere in the **Generator** window to display the options menu.

Figure 6-5: Generator Video Configuration (ST 2022-6 IP Output)

You can also select the default test pattern for the standard or open the Test Pattern dialog as described in the section *Generator Test Patterns*.

Video Configuration Parameters (ST 2022-6 IP Output)

The unit generates video standards for a wide range of resolutions, frame rates, image mappings color gamuts, and transfer curves, depending on the available licenses. You can configure the standard to generate by selecting available parameters from the following:

Table 6-2 : Generator Video Configuration Parameters (ST 2022-6 IP Output)

Standard Configuration	Available Parameters			
Video Standard Configuration Parameters				
Resolution	1280x720 1920x1080	2048x1080		
Frame Packing	Progressive	Interlaced	Segmented	
Frame Rate	23.98 24 25	29.97 30 47.95	48 50 59.94	60
Gamut	709	2020		
OTF	SDR PQ	HLG S-Log3	S-Log3 SR Live	
Sampling	YCbCr:422 YCbCr:444	YCbCrA:4224 YCbCrA:4444	RGB:444 RGBA:4444	
Bit Depth (and Range)	10 NR	10 FR	12 NR	12 FR
SDI Output Options				
SDI Output Level	Level A	Level B		

Refer to the LeaderPhabrix website for the licensing requirements to generate the different video standards.

> **Note:** The test pattern may take a few seconds to generate.

Range and Bit Depth Support for Generated Video Standards (ST 2022-6 IP Output)

The unit can generate video standards with either a full range (**FR**) or narrow range (**NR**) bit depth for ST 2022-6 IP output.The unit uses the definitions for Narrow and Full Range as defined in EBU R 103 *Video Signal Tolerance in Digital Television Systems* and SMPTE RP 2077 *Full-Range Image Mapping*.

For a full-range video standard, the Generator window displays **FR** alongside the bit depth label in the Video standard definition, see *Figure 6-3*: If FR is not displayed, then the generated standard is narrow range.

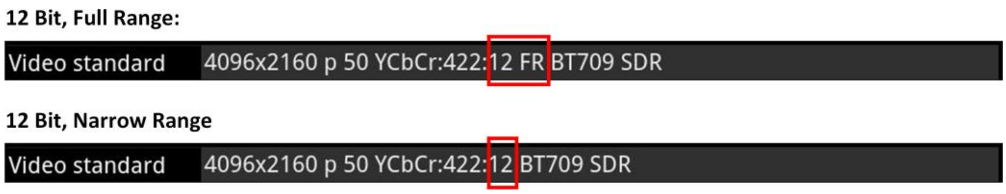


Figure 6-6: Generator Bit Depth Labels (ST 2022-6 IP Output)

For more information on video signal range definitions as implemented in the Qx Series, see the section *Video Range Definitions for the Qx Series*.

Generating SDI Output

> **Note:** The generation of SD-SDI video is not currently supported in this software version.

The Generator displays a status overview of the following when generating SDI output:

- Details of the current video standard being generated
- Description of the selected test pattern
- Status of pathological insertion and, if enabled, details of the pairs inserted
- SDI output and mapping table showing which generate data are sent to which SDI Out output connectors.
- Audio signal presence and sub-images
- Reference status
- Output Offset adjustment.

The output type (**SDI**) is displayed in the title bar.

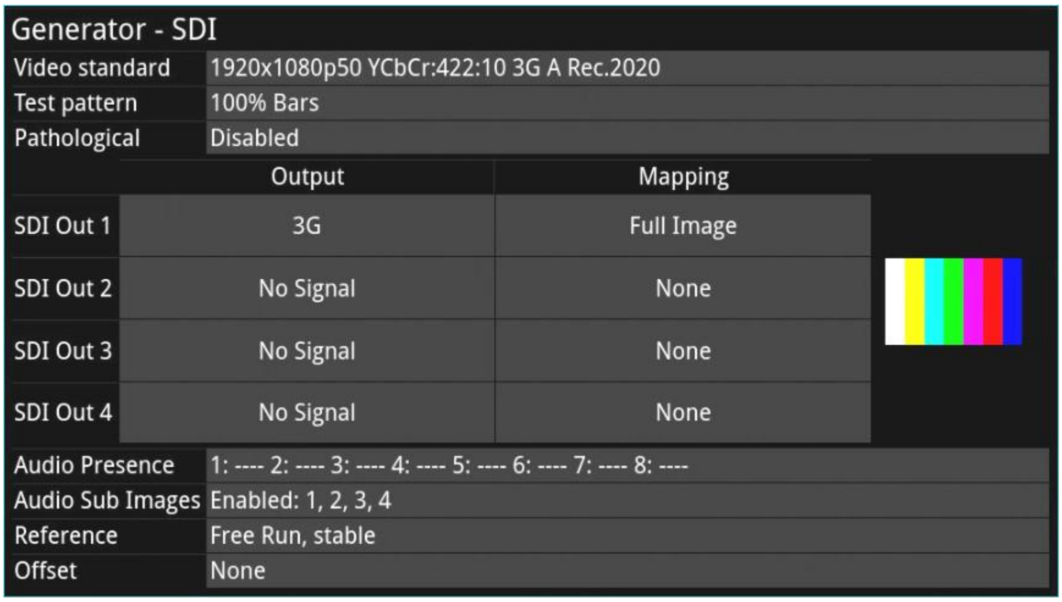
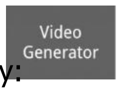


Figure 6-7: Generator - SDI Instrument

Configuring the Video Standard

To specify a video standard to generate, either:

- Open the options menu and select **Video Generator...** or
- With the spotlight on the Generator window, tap the softkey: 
.

This displays a configuration dialog from which you can select the desired parameters for the standard from the following columns:

- Resolution
- Frame Packing
- Frame Rate
- Gamut
- OTF

- Sampling
- Bit Depth and Range.

In addition, the **SDI Config** box in the top-right of the dialog enables you to set the SDI output to Level A or Level B, set either single, dual or quad link and, for UHD 4K, select either 2-SI (Two Sample Interleave) or SQ (Square Division).

Selectable parameters are displayed in a bold white font and those that do not apply are grayed-out. If you select an incompatible parameter, the column header is displayed in **yellow** indicating that a correction is required. Simply tap or click the desired parameter value in each of the columns to define the standard, then tap or click **OK** to close the dialog. You can also choose to use the default test pattern for the standard (**Default (Luma Pixel Ramp)**) or open the Test Pattern dialog to select a different test pattern as described in the section *Generator Test Patterns*.

Figure 6-8: Generator - SDI Video Configuration (Includes Option LPX500-UHD)

> **Note:** The test pattern may take a few seconds to generate when first selected.

Tap and hold or right-click anywhere in the **Generator** window to display the options menu.

Video Configuration Parameters

The unit generates video standards for a wide range of SDI rates, resolutions, frame rates, image mappings, color gamuts, and transfer curves, depending on the available licenses. You can configure the standard to generate by selecting the required parameters from the following:

Table 6-3 : Generator Video Configuration Parameters (Includes Option LPX500-UHD)

Standard Configuration	**Available Parameters**			
Video Standard Configuration Parameters				
Resolution	1280x720 1920x1080	2048x1080 3840x2160 (UHD only)	4096x2160 (UHD only)	
Frame Packing	Progressive	Interlaced	Segmented	
Frame Rate	23.98 24 25	29.97 30 47.95	48 50 59.94	60
Gamut	709	2020		
OTF	SDR PQ	HLG S-Log3	S-Log3 SR Live	
Sampling	YCbCr:422 YCbCr:444	YCbCrA:4224 YCbCrA:4444	RGB:444 RGBA:4444	
Bit Depth (and Range)	10 NR	10 FR	12 NR	12 FR
SDI Output Options				
Link Type	Single Link	Dual Link	Quad Link	
SDI Output Level	Level A	Level B		
Quad Processing Type	2-SI	SQ		

Refer to the LeaderPhabrix website for the licensing requirements to generate different video standards.

Range and Bit Depth Support for Generated Video Standards

The unit can generate video standards with either a full range (**FR**) or narrow range (**NR**) code values for optional SDI output. The unit uses the definitions for Narrow and Full Range as defined in EBU R 103 *Video Signal Tolerance in Digital Television Systems* and SMPTE RP 2077 *Full-Range Image Mapping*.

For a full range video standard, the Generator window displays **FR** alongside the bit depth label in the description of the Video standard, see *Figure 6-3*: If FR is not displayed, then the generated standard is narrow range.

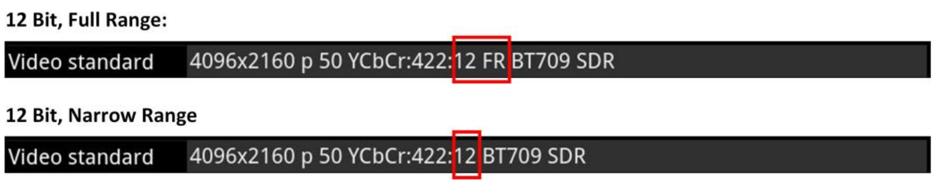


Figure 6-9: Generator Video Standard Descriptions Showing Video Color Range Labels

For more information on video signal range definitions as implemented in the LPX Series, see the section *Video Range Definitions for the LPX Series*.

Generator Test Patterns

To select a test pattern for the standard from the Test Pattern dialog, open the Generator options menu then select either:

- **Test Pattern Config...** or
- **Video Generator Config...** then **Select Test Pattern** or
- With the spotlight on the Generator window, tap the softkey: 

.

The Test Pattern dialog displays all test patterns available for the selected video standard and provides two tabs as follows:

- **System Patterns:** Lists standard test patterns supplied with the unit.
- **User Patterns:** Lists any user-defined test patterns loaded into the folder **/userTestPatterns** by the user.

> **Note:** The test patterns available can vary depending on the video standard selected in the Generator.

Tap or click the required test pattern to select, then tap or click **OK** to close the dialog.

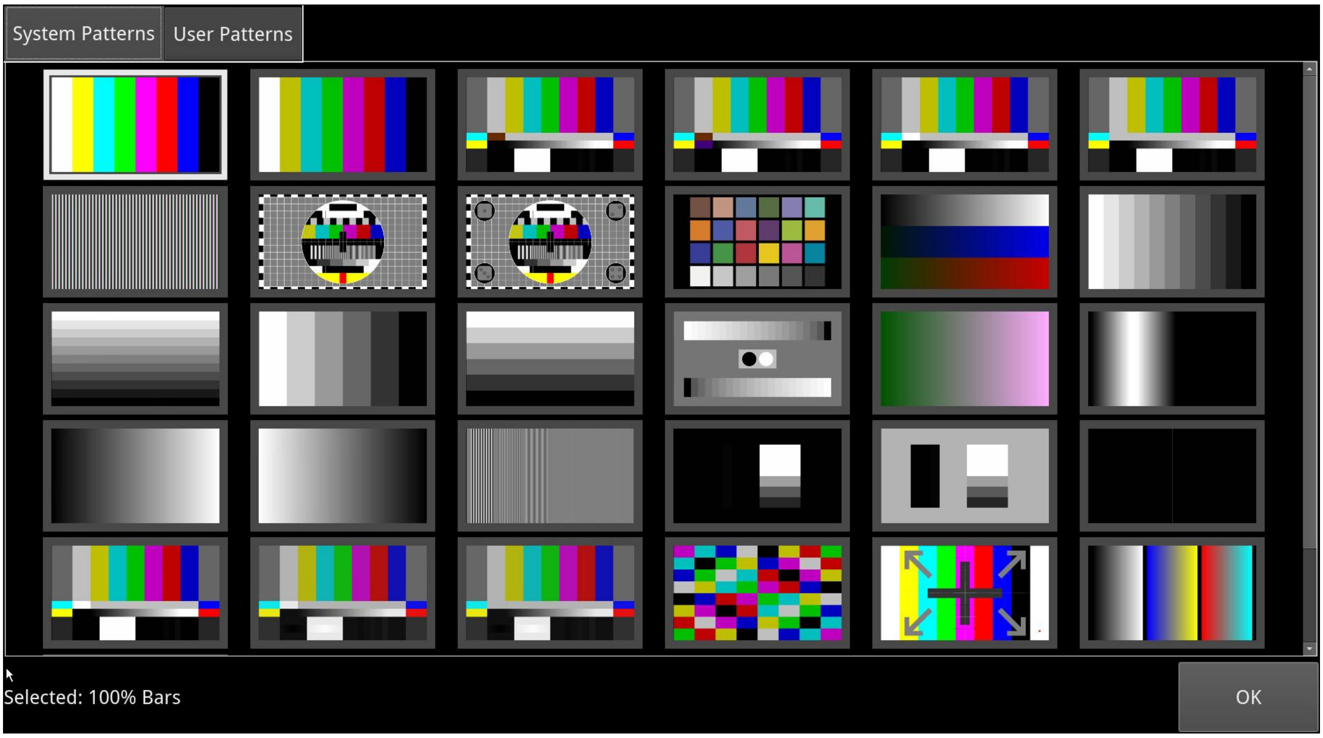


Figure 6-10: Generator - Test Pattern Selection Dialog

The first time you select a test pattern, you may notice a slight delay as the unit generates the test pattern and stores it to the target folder. In particular, you may notice a delay with the larger test patterns: Gray Steps, Vertical Luma Ramp, UHD Quad Align, Circle and Circle 2si Numbers. The next time you load that test pattern the unit loads it directly from the cache with no observable delay.

These test patterns include:

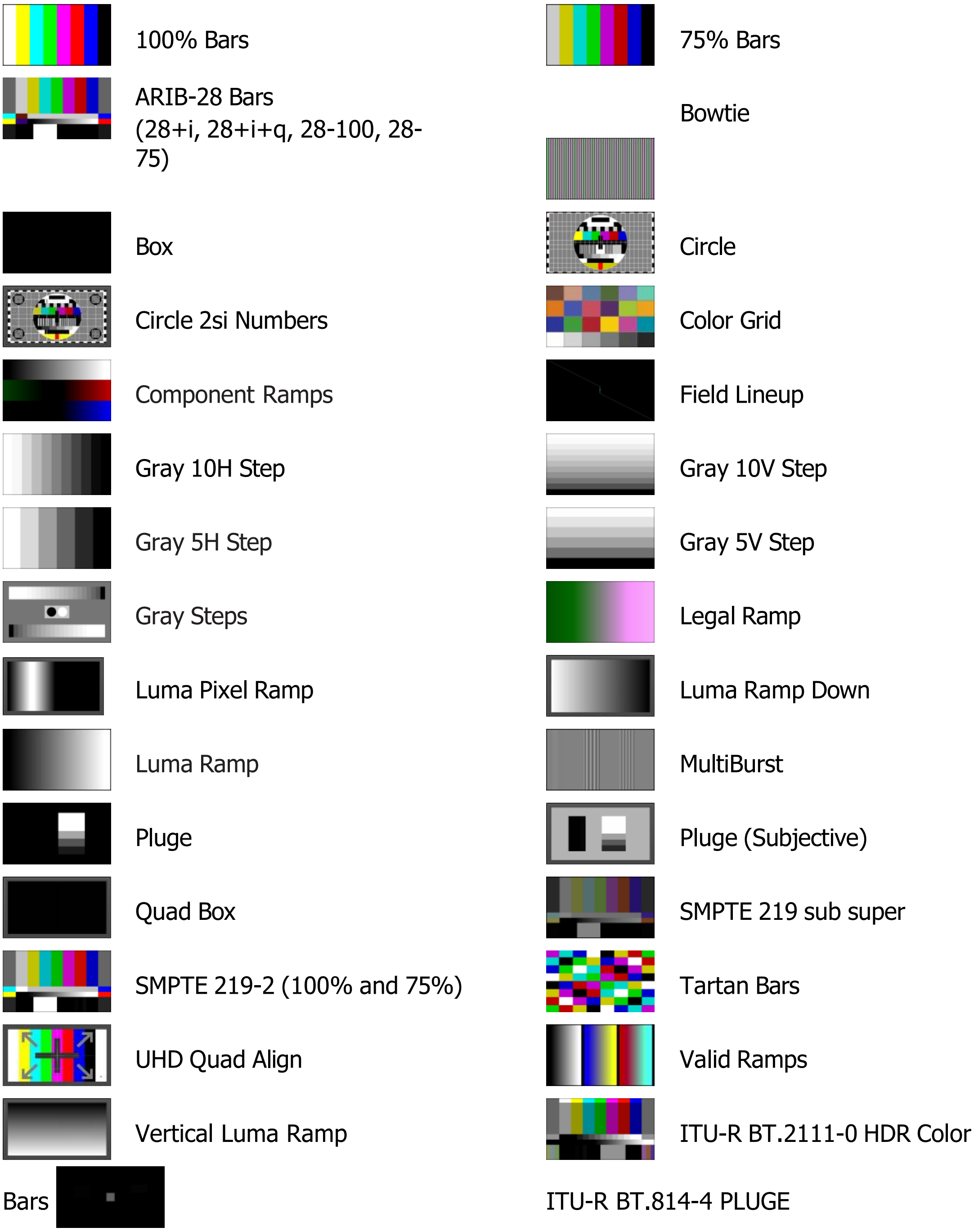


Figure 6-11: Available Test Patterns

HLG, PQ and both S-Log3 and S-Log3 SR Live (HDR Live) test pattern variants are available as part of the **LPX500-HDR** license.

To display a dynamic test pattern, you can choose to overlay a bouncing box on top of any Generator test pattern. To do so, enable the **Bouncing box** in the Generator options menu.

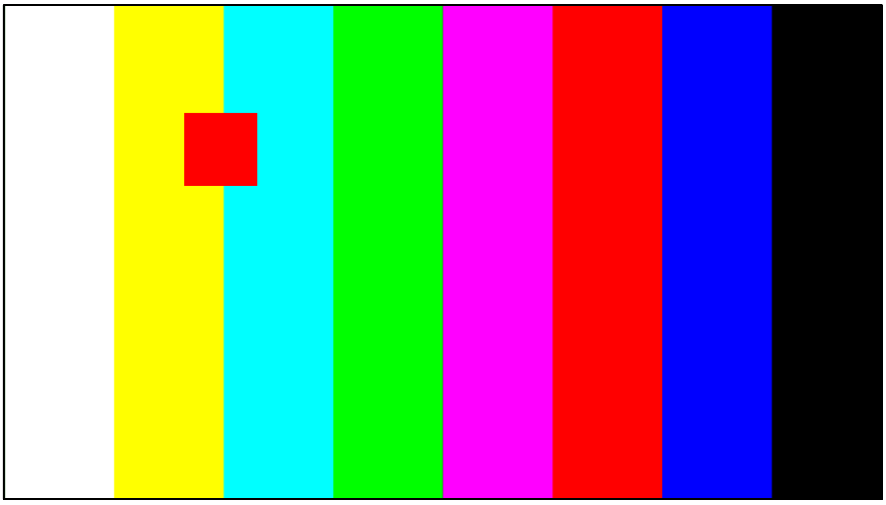


Figure 6-12: Bouncing Box Test Pattern Enabled

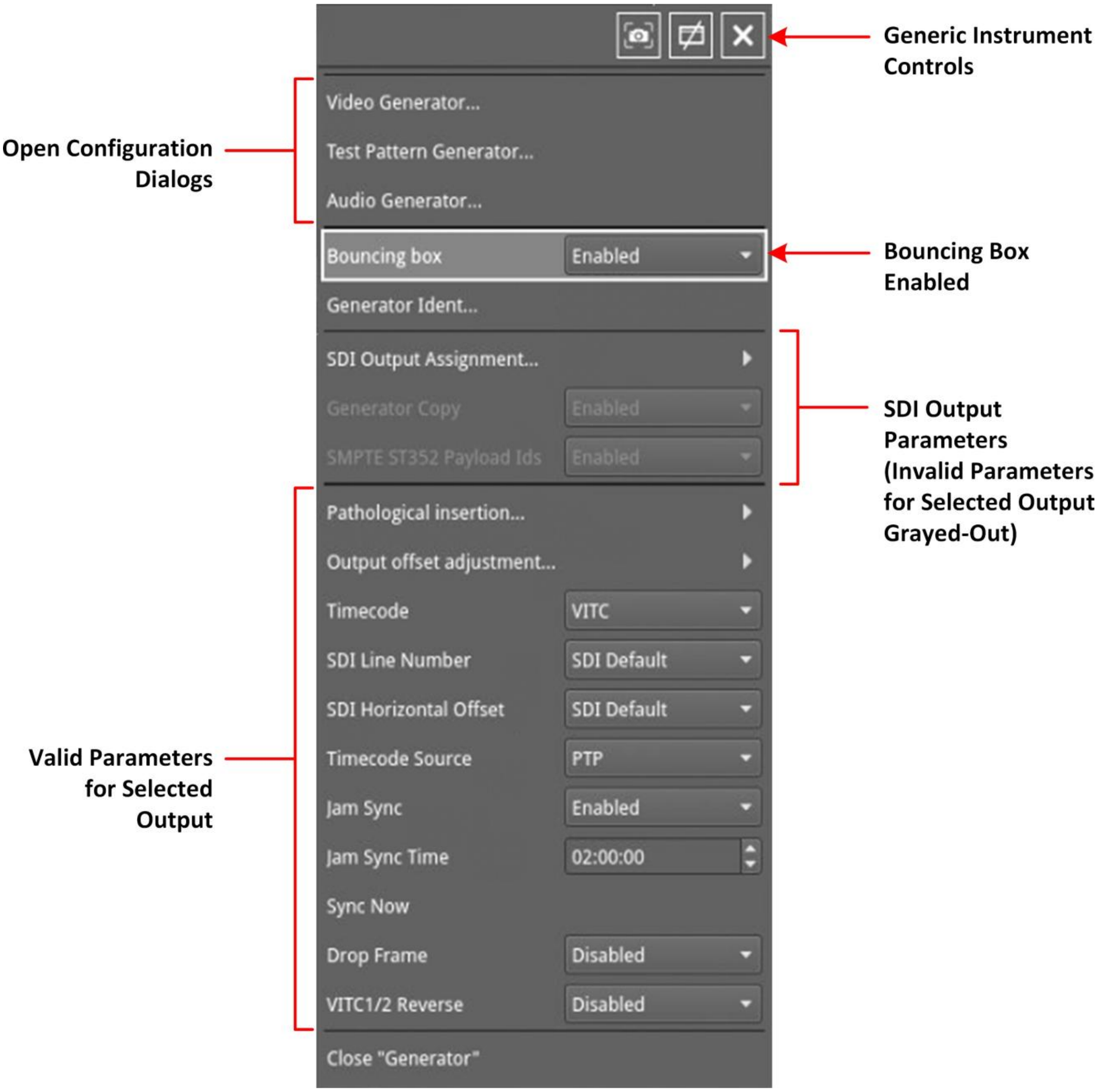


Figure 6-13: Generator - Configuration Options Menu

Including a Generator Text Identifier

You can define a text identifier (or **Ident**) to overlay on the active image of the video standard. An Ident can be useful to identify the source of the generated standard.

You can enter up to four lines of text, with a maximum of 42 characters in each line. In addition, you can select one of nine positions on the Picture instrument window in which to display the Ident, from top-left to bottom right.

To include a text Ident, open the Generator options menu then select **Generator Ident...** to display the Generator Ident dialog.

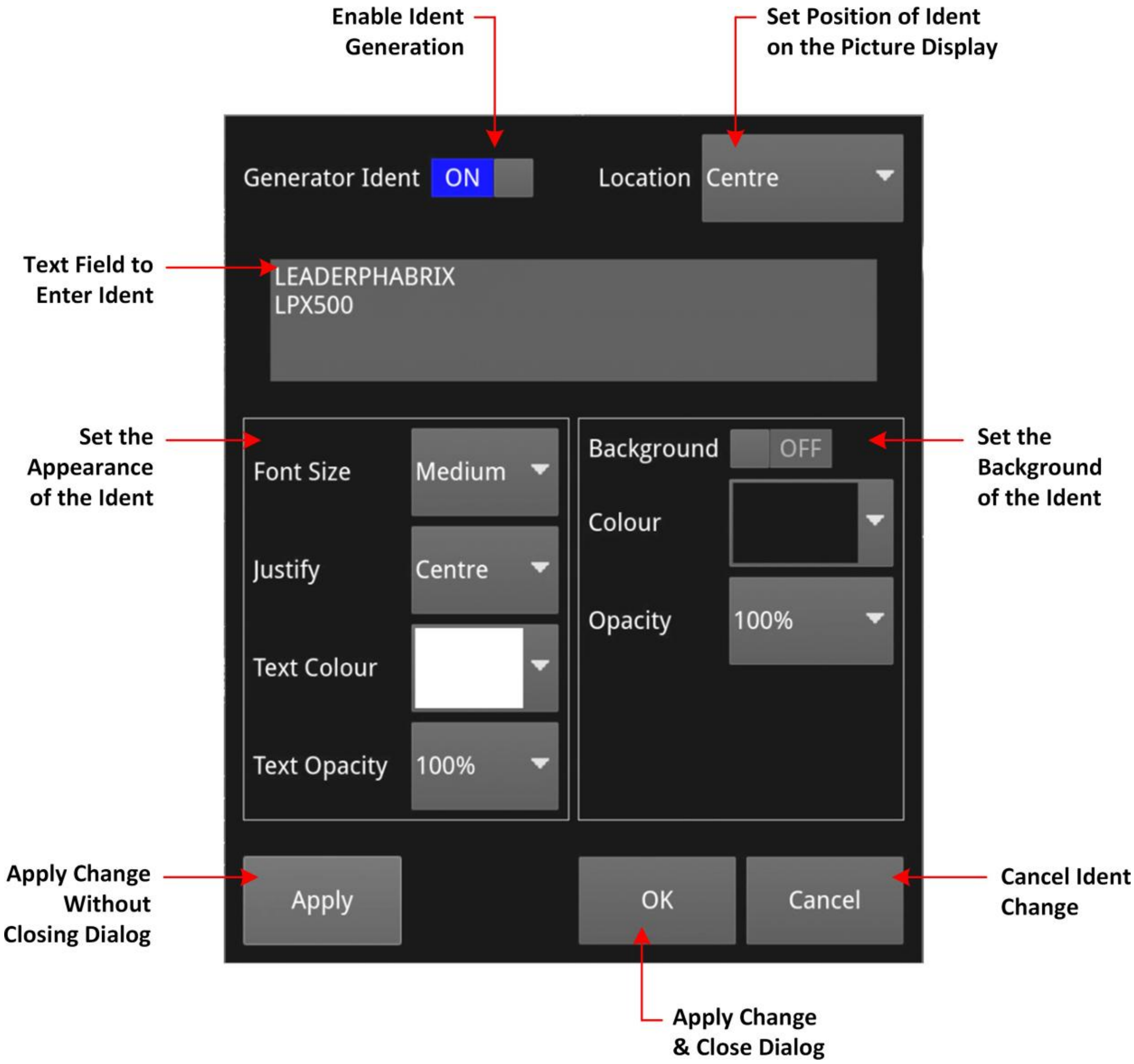


Figure 6-14: Generator - Generator Ident Dialog

Define an Ident as follows:

1. Set the **Generator Ident** toggle switch to **ON** to enable the Ident.
2. Choose where you would like the Ident displayed in the video signal from the **Location** drop- down.You can choose either:
   - Top Left
   - Top
   - Top Right
   - Left

- Center
- Right
- Bottom Left
- Bottom
- Bottom Right

3. Tap or click the cursor in the Ident text entry field.

   If enabled in the Display Options, the onscreen keyboard is displayed. Alternatively, either use a USB keyboard connected to the unit or the keyboard connected to the PC from which you are running a remote noVNC session.

   > **Note:** If using the onscreen keyboard, remember to tap or click **Save** after entering the Ident text to save your changes back to the Generator Ident dialog.

4. Define how you want the ident text to appear in the video picture. You can set the following:
   - **Font Size:** Small, Medium, Large
   - **Justify:** Left, Center, Right
   - **Text Color:** Select from the color picker by tapping or clicking anywhere in the color panel. If you need to refine your selection, use the rotary control on the unit, or the mouse scroll wheel if working remotely, for numeric entry in the

     > **Note:** The selected text (and background) color may change depending on the gamut and transfer function (OTF) selected for the generated video standard.

     RGB HSV fields.
   - **Text Opacity:** 25%, 50%, 75%, 100%

5. Set the background attributes of the Ident. You can set the following:
   - **Background:** On, Off
   - **Background Color:** Select from the color picker using the rotary control on the unit, or the mouse scroll wheel if working remotely, for numeric entry in the RGB HSV fields, if necessary.

     > **Note:** The color lightness value (V) component of the background color is set to zero (black) by default when you select a color in the hue / saturation panel. To change the color of the background from black, select a lightness value in the Value sidebar at the right-hand side of the color picker. You will see the number change from zero in the **Value (V)** field to show the changed background color. For more information see the section *Using the Color Picker*.
   - **Background Opacity:** 25%, 50%, 75%, 100%

6. Click either **Apply** to review your changes while keeping the Generator Ident dialog open, or **OK** to save your changes and close the dialog.

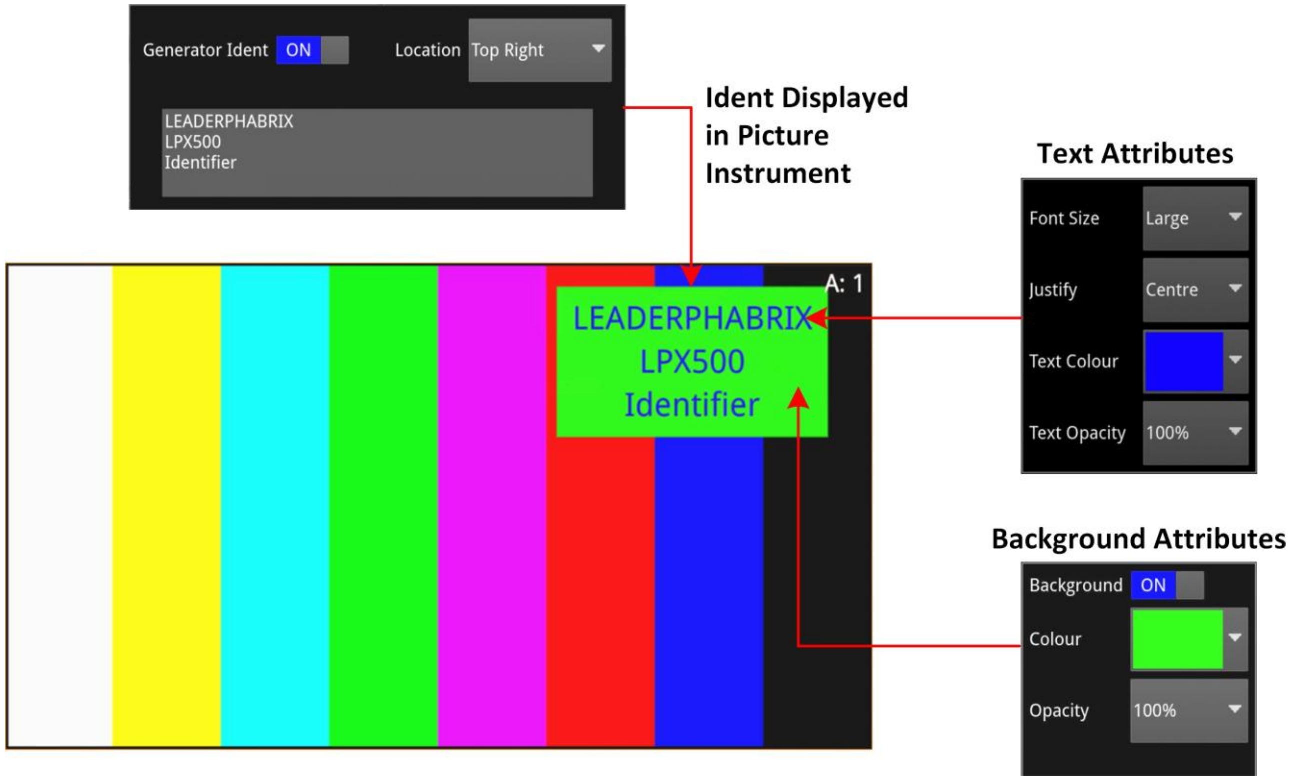


Figure 6-15: Generator Ident Displayed in Picture Instrument

User Test Patterns and Images

You can upload your own, custom test images to the unit if required.

> **Note:** User test files must be in the Tagged Image File Format (**TIFF**) and match the exact parameters (pixel resolution, frame packing, field / frame rate, gamut, sampling, and bit depth) of the video standard you intend to use. If these conditions are not satisfied, the user test pattern will not be displayed in the **User Patterns** tab of the Test pattern selection dialog

The specifications for user test files are detailed below:

Table 6-4 : Required Format of User Test Pattern Images

Format	Type	Extension	Pixel Resolutions	Bit Depth	Pixel Order
TIFF	Native (Files converted to TIFF from other formats are not supported)	.tif	1280 x 720 1920 x 1080 2048 x 1080 3840 x 2160 4096 x 2160	16 per RGB Component, 48 per Pixel	Interleaved

> **Note:** Full range TIFF image files are clipped to full protect range; no scaling is applied.

If you have direct access to the unit, you can upload user test files using the *File Manager*. If you have only remote access to the unit, use SFTP to upload test files as described in the section *Remote Connection to the Unit*.

Upload user test files to the **transfer/userTestPatterns** directory and then restart the unit.

User test images will then be available in the **User Patterns** tab of the Generator **Test pattern selection** dialog as long as the correct standard is selected in the Generator.

Using the Timecode Generator (ST 2110 IP Output)

The Timecode Generator provides a method to generate ATC Timecode in the ANC data-space according to SMPTE ST 12-2. This can then be inserted into the ST 2110-40 generator flow using the configuration dialog of the **2110 Transmit** instrument, see the section *Configuring the Generator ANC Flows*.

You can choose to generate a timecode locked either to PTP or to the local system time. You can also configure the generated timecode to include associated non-integer frame rate drop-frame, and status signaling.

You can enable or disable the timecode in the Generator ANC Flow configuration dialog of the **2110 Transmit** instrument.

Configure the timecode generator parameters using the **Generator** options menu:

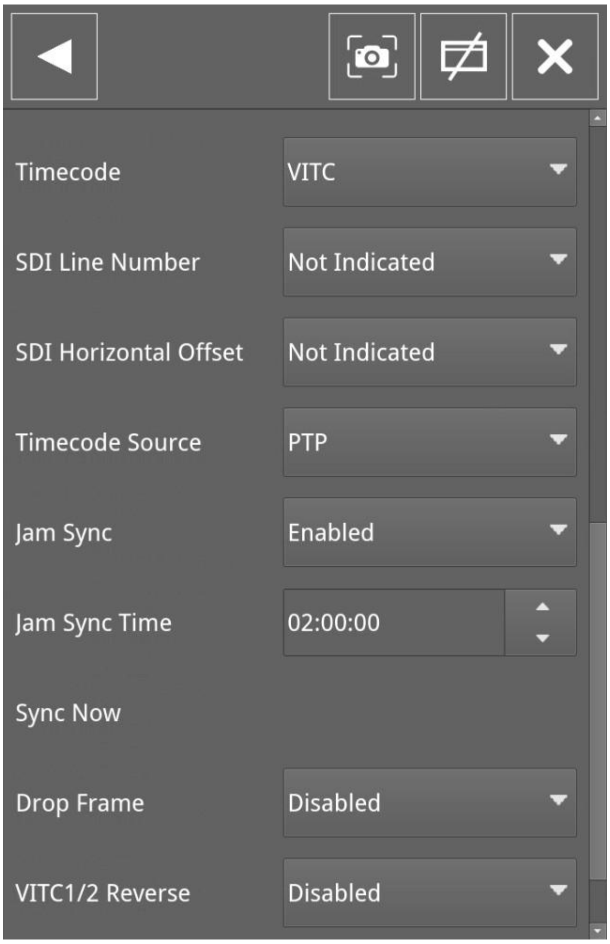


Figure 6-16: ATC Timecode Parameters in the Generator Options Menu (ST 2110 IP Output)

Table 6-5 : Generator - Timecode Generator Menu Options (ST 2110 IP Output)

Item	Options	Description
Timecode Generator Options (ST 2110 IP Output)		
Timecode	LTC VITC	Select either SMPTE Linear timecode (LTC) or SMPTE Vertical Interval Timecode (VITC).
SDI Line	SDI Default	Set the SDI line location of the ancillary packet

Item	Options	Description
Number	Not Indicated	
SDI Horizontal Offset	SDI Default Not Indicated	Set the horizontal offset for the VITC timecode in the ANC data.
Timecode Source	PTP Local Time	When available, select PTP to generate a timecode locked to the PTP signal. Select Local Time to use the local system time with current offsets for local time zone and daylight-saving time.
Jam Sync	Enabled Disabled (Default)	When enabled, automatically forces synchronization of the Time-code Generator at a predefined time.
Jam Sync Time	System Control 00:00:00 to 23:59:59	Time at which the Jam Sync is initiated when the **Jam Sync** option is enabled.
Sync Now	System Control	Use to sync the timecode manually.
Drop Frame	Enabled Disabled (Default)	When enabled, supports drop frame rates of 29.9 and 59.9
VITC 1/2 Reverse	Enabled Disabled (Default)	For progressive frame rates above 30 Hz, enables you to select whether VITC1 is on first field and VITC2 is on the second field or to reverse the setting so that VITC2 is on the first field and VITC1 is on the second field.

The timecode generator is synchronized on the following events:

- On frame rate changes
- When PTP is re-synced
- When the **Jam Sync** option is enabled, once a day at the specified **Jam Sync Time**.
- When you select **Sync Now** to synchronize the timecode generator manually.

Generator SDI Output Assignment

You can configure the SDI signal output to the BNC connectors using the options menu.

To assign the SDI outputs to the selected BNC Out connectors, you can use the **SDI Output Assignment...** submenu from the Generator options menu:

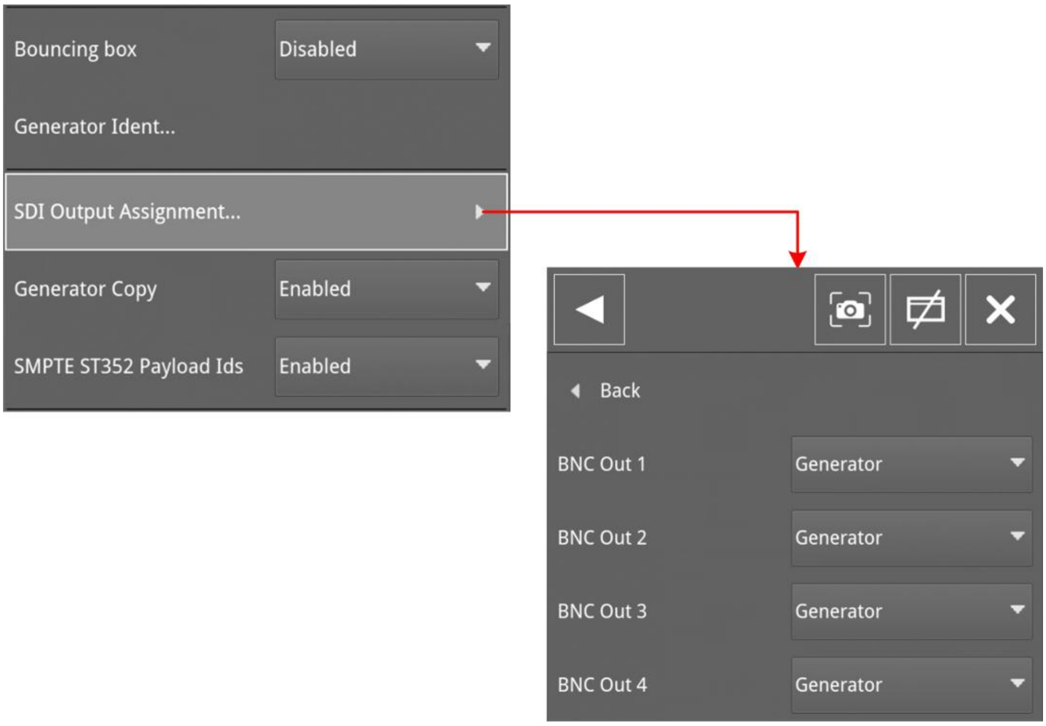


Figure 6-17: Generator - SDI Output Assignment

The following table lists the configurable SDI Output parameters for the Generator instrument:

Table 6-6 : Generator - SDI Output Menu Options

Item	Options	Description
Generator SDI Output Options		
BNC Out 1 BNC Out 2 BNC Out 3 BNC Out 4	Off Generator (Default) Loop SDI In 1, 2, 3, 4	Choose whether to configure each SDI BNC Out connector (1, 2, 3 or 4) to use either the Loop SDI In 1, 2, 3, or 4 signal, the Generator signal or to switch off the output. If necessary, when using the Generator output, you can enable the option **Generator Copy** in the Generator options menu to copy a single or dual link signal to other output BNC connectors.

When configuring the Generator SDI outputs, see also the section *System IO*.

Insertion of ST352 Video Payload IDs for SDI Outputs

The unit includes SMPTE ST352 Payload IDs in the generated standards by default. By looping the SDI Output to the SDI Input and using the analyzer instruments, you can view the SMPTE 352 data in hexadecimal format using the **Analyzer - Dataview** instrument (on Analyzer A). Alternatively select the Identifier **ST352 Payload ID** in the options menu of the **Analyzer - Ancillary Inspector** instrument.

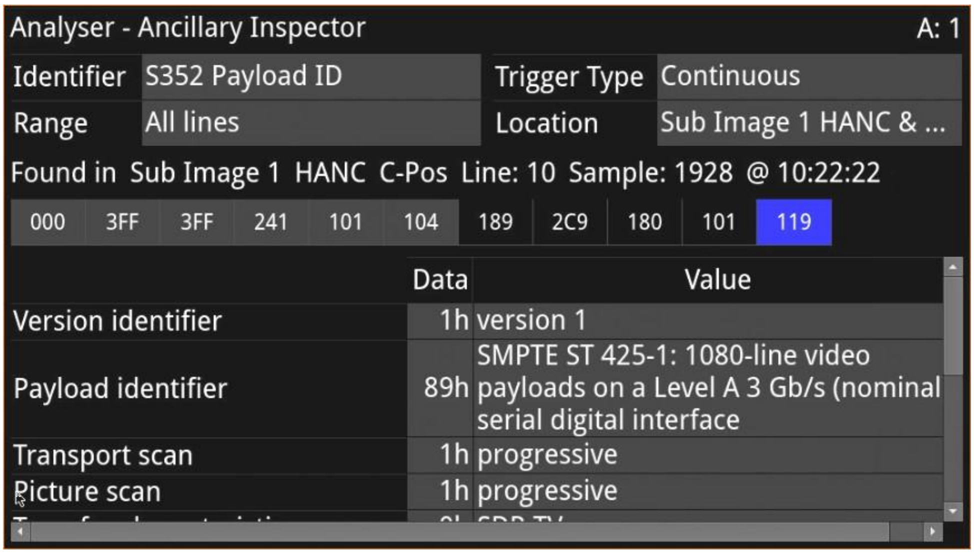


Figure 6-18: Analyzer - Ancillary Inspector Showing SMPTE ST352 Payload IDs

If you need to disable this feature (for example, for test purposes) you can do so by setting the parameter **SMPTE ST352 Payload Ids** in the Generator options menu to **Disabled**. When you select this option, the Generator window displays the selected video standard in yellow and appends the text **ST 352 DISABLED**.

For example:

Output Offset Adjustment (Optional SDI Output)

You can configure the Generator to generate a signal with a fixed offset, relative to the system reference using the **Output offset adjustment...** submenu available from the **Generator** options menu.

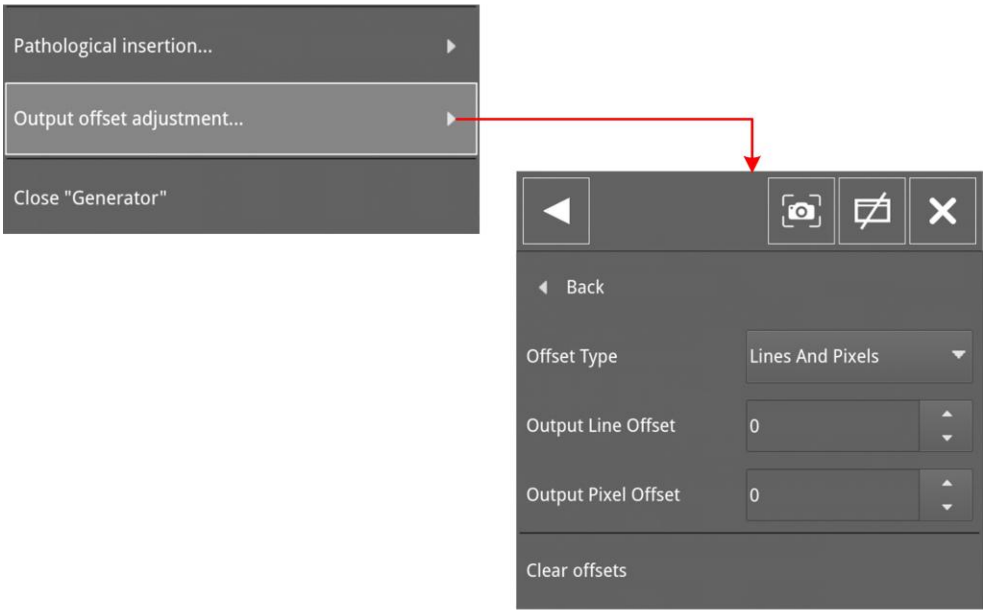


Figure 6-19: Generator - Output Offset Adjustment Submenu

The following table lists the output offset adjustment options available:

Table 6-7 : Generator - Output Offset Adjustment Menu Options

Item	Options	Description
Output Offset Adjustment Options		
Offset Type	Lines And Pixels (Default) Time	Select whether to make offset adjustments using either spatial or temporal values.
Output Line Offset	0 to +/– (Total number of Lines for current standard minus one)	When set to Lines and Pixels, use the combo-box to set the Line offset component as a number of whole lines.
Output Pixel Offset	0 to +/– (Total number of Pixels per Line for current standard minus one)	When set to Lines and Pixels, use the combo-box to set the Pixel offset component as a number of pixels per line.
Output Time Offset	0.00, +/– 0.01, etc...	When set to Time, use the combo-box to set the timing off- set in microseconds.
Clear Offsets	System Control	Select to remove the current Generator offset.

Generator (Audio)
(ST 2022-6 IP & Optional SDI Output)

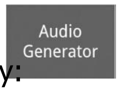
Requires Option(s):	**LPX500-GEN**

Overview

> **Note:** In this section the term *audio* refers to the audio signal embedded in the video. It does not describe standalone audio generation.

You can configure the generation of up to 32 channels of PCM audio in the **Audio Generator...** dialog of the **Generator** options menu.

To configure the generation of an audio signal, either:

- Open the generator options menu and select **Audio Generator...** or
- With the spotlight on the Generator window, tap the softkey: 

.

This opens the audio configuration dialog.

Using the audio generator configuration dialog you can:

- Generate a fixed audio frequency (in Hertz or musical pitch) for **all** audio channels
- Generate a ramped audio frequency (in Hertz or musical pitch), in decreasing steps of 50 Hz (0.05 kHz), for **all** audio channels
- Generate a fixed audio amplitude (in dBFS) for **all** audio channels
- Generate a ramped audio amplitude (in dBFS), in increasing steps of 1 dBFS, for **all** audio chan- nels
- Generate a custom frequency (in Hertz or musical pitch) for either both channels, the left chan- nel only, or right channel only of the **selected channel pair**
- Generate a custom amplitude for either both channels, the left channel only, or right channel only of the **selected channel pair**.

The audio generator configuration dialog is roughly subdivided into four functional areas as shown in *Figure 6-20*. To configure an audio output signal, first select the required audio options in the left-side options panel then select the target groups, channel pairs or single channel using the toggle switch or target channel selector as appropriate. Finally, adjust the frequency and / or amplitude sliders to set the audio output signal as required.

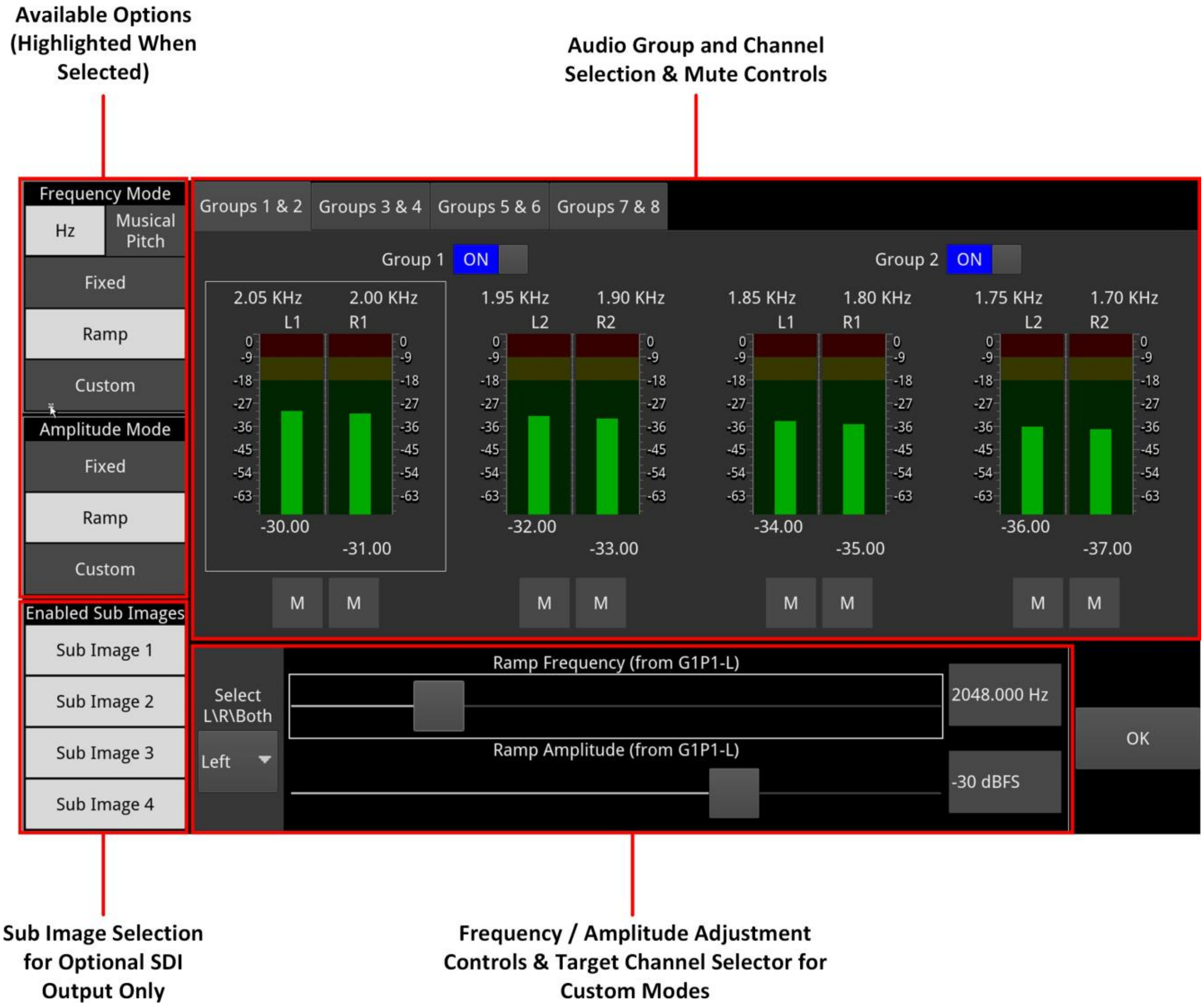


Figure 6-20: Audio Generator Configuration Dialog (ST 2022-6 IP and Optional SDI Output)

Depending on the generated video standard, up to eight audio groups (32 channels) are available. In the Audio Generator Configuration dialog, you can switch audio groups on or off using the **Group *n*** ON/OFF switches. Use the Audio Group tabs to display additional groups.

The options side panel (*Figure 6-21*) enables you to select the desired frequency and / or amplitude modes and, in addition, enable or disable the video sub-image to include the audio signal.

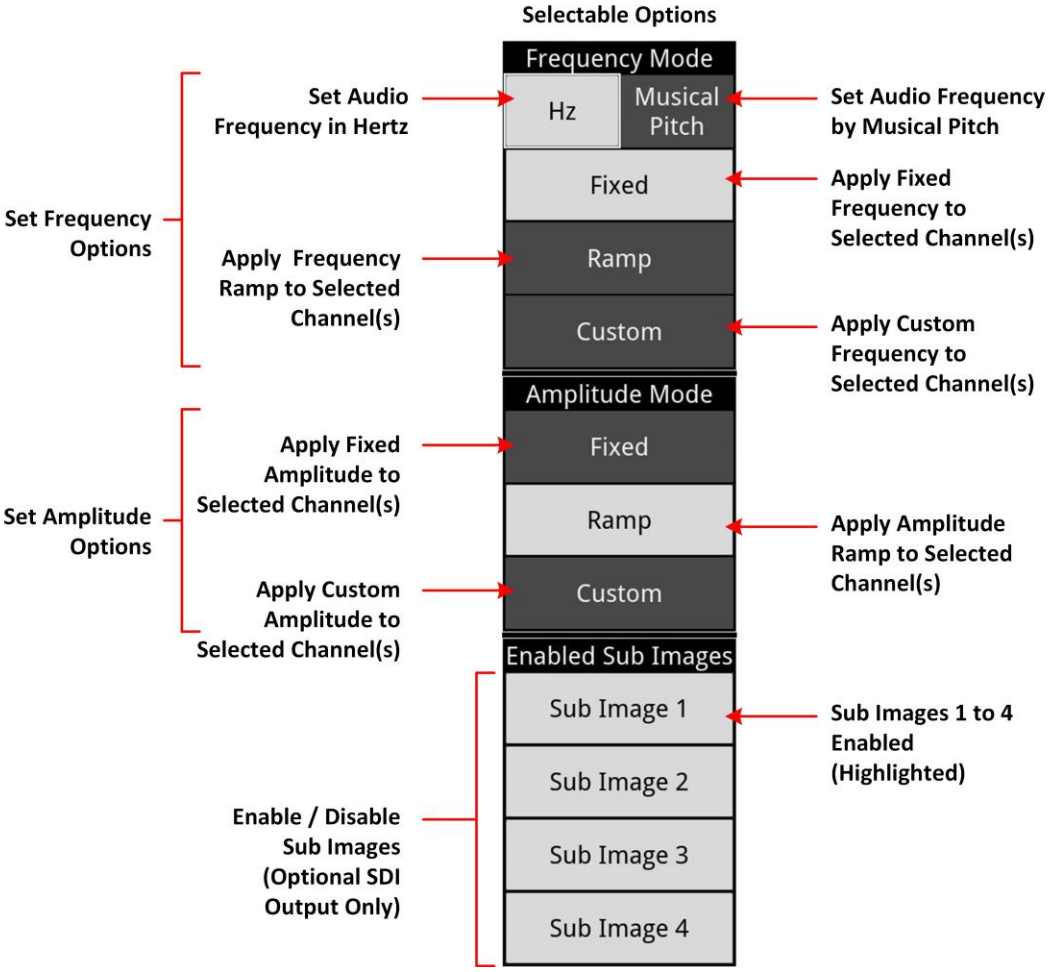


Figure 6-21: Audio Generator Configuration Dialog - Options Panel

After selecting the desired audio options in the side panel, use the audio group and channel selection controls (*Figure 6-22*) to activate or deactivate the target audio groups or to mute channels for the output of the generated audio signal. You can tap or click to select a pair of channels within a group of two pairs of channels as the target for a custom frequency or amplitude setting. A selected pair is shown with a white border.

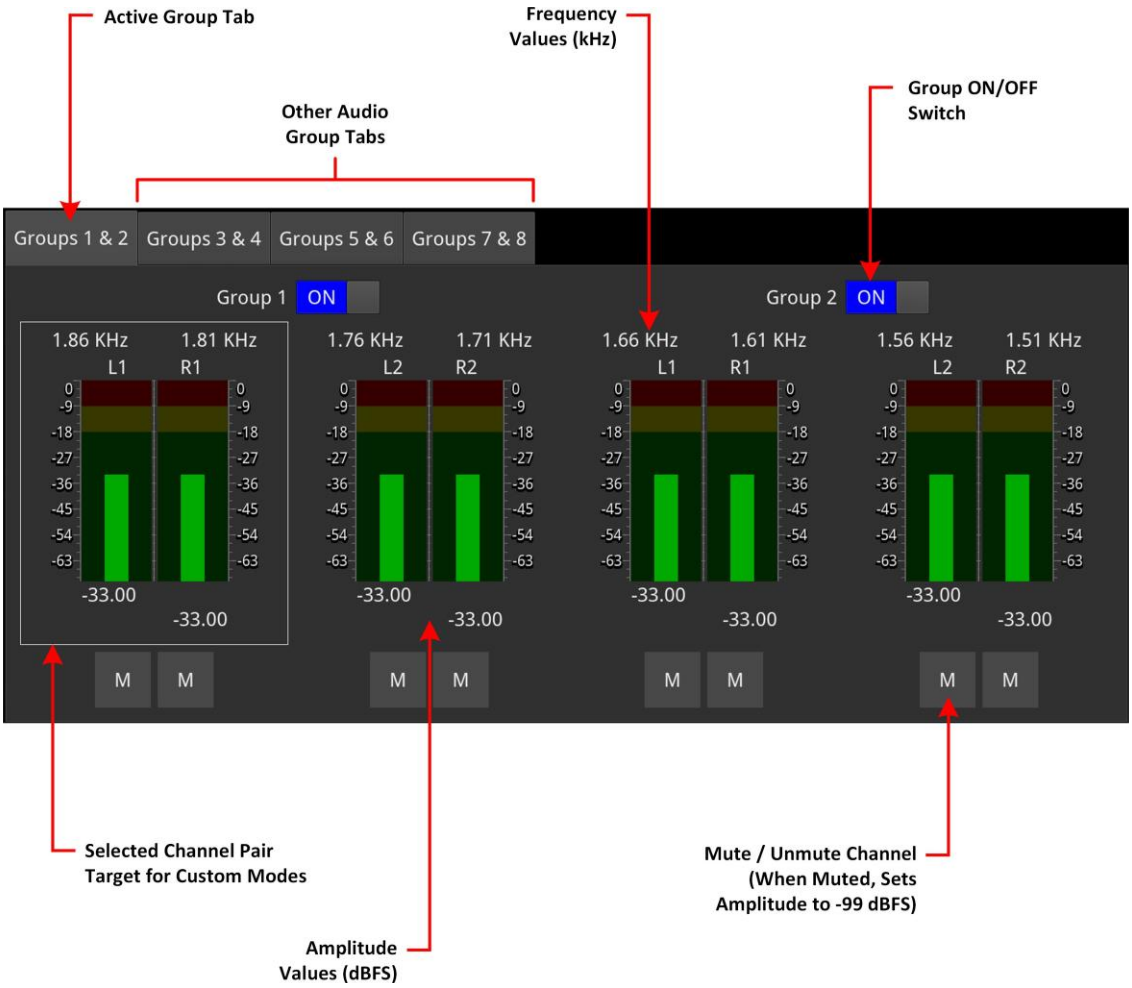


Figure 6-22: Audio Generator Configuration Dialog - Audio Group Selection Panel

You can also use this panel to mute or unmute any of the individual channels.

When setting either a fixed frequency or frequency ramp and/or amplitude for all channels, slide the appropriate control(s) in the adjustment controls panel (*Figure 6-23*) to the left or right as required.

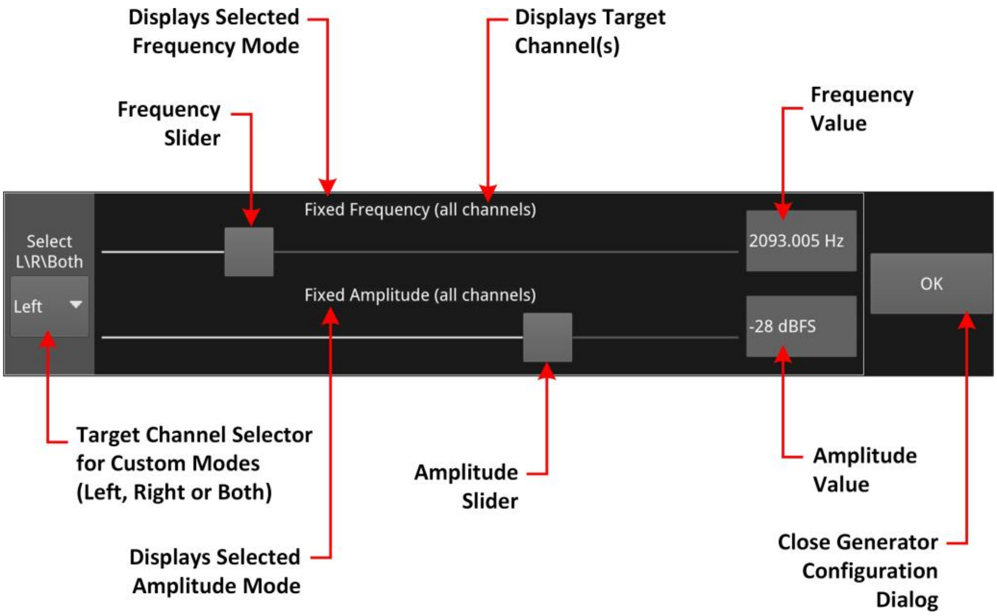


Figure 6-23: Audio Generator Configuration Dialog - Adjustment Controls

When configuring a custom setting for either frequency, and/or amplitude, use the *target channel selector* to define the channels or individual channels to which the custom setting applies. This could be either the selected pair's left channel, right channel, or both channels. You will see the target channel(s) displayed in the label above the appropriate slider.

Audio Generator Configuration Dialog

Using the Audio Configuration dialog, you can configure each channel by frequency and amplitude. In addition, you can set the frequency by musical pitch, at a fixed or custom frequency (in Hz):

Table 6-8 : Audio Generator Parameters (ST 2022-6 IP or Optional SDI Output)

<table>
<tr><th>Audio Feature</th><th colspan="4">Available Parameters</th></tr>
<tr><td>Channel</td><td colspan="4">Group 1 to 8; then for each Group:
• Pair 1 Left
• Pair 1 Right
• Pair 2 Left
• Pair 2 Right</td></tr>
<tr><td rowspan="2">Type and Frequency</td><td colspan="4">Tone
Select Frequency from: 0 to 10,000 Hz (10 kHz)</td></tr>
<tr><td colspan="4">Music Pitch
Select Frequency from:
C 3, C♯/D♭ 3, D 3, D♯/E♭ 3,
E 3, F 3, F♯/G♭ 3, G 3,
G♯/A♭ 3, A 3, A♯/B♭ 3, B 3,
C 4, C♯/D♭ 4, D 4, D♯/E♭ 4,
E 4, F 4, F♯/G♭ 4, G 4,
G♯/A♭ 4, A 4, A♯/B♭ 4, B 4,
C 5, C♯/D♭ 5, D 5, D♯/E♭ 5,
E 5, F 5, F♯/G♭ 5, G 5,
G♯/A♭ 5, A 5, A♯/B♭ 5, B 5,
C 6, C♯/D♭ 6, D 6, D♯/E♭ 6,
E 6, F 6, F♯/G♭ 6, G 6,
G♯/A♭ 6, A 6, A♯/B♭ 6, B 6,
C 7</td></tr>
<tr><td>Amplitude</td><td colspan="4">Adjust amplitude levels in decibels relative to full scale (dBFS), select:
−99 to 0 dBFS</td></tr>
</table>

Generator (Audio) (ST 2110 IP Output)

Requires Option(s):	LPX500-GEN

Overview

You can configure the generation of audio signals in ST 2110 IP mode using the **Audio Generator...** dialog from the **Generator** options menu. The Audio Generator Configuration dialog provides Level C audio operation with:

- Up to 80 channels at 125 µs and ten channels at 1 ms packet time (ST 2110-30) or
- Up to 60 channels at 125 µs and seven channels at 1 ms packet time (ST 2110-31).

Tap and hold or right-click in the Generator instrument to open the options menu, then select **Audio Generator...** to display the audio configuration dialog.

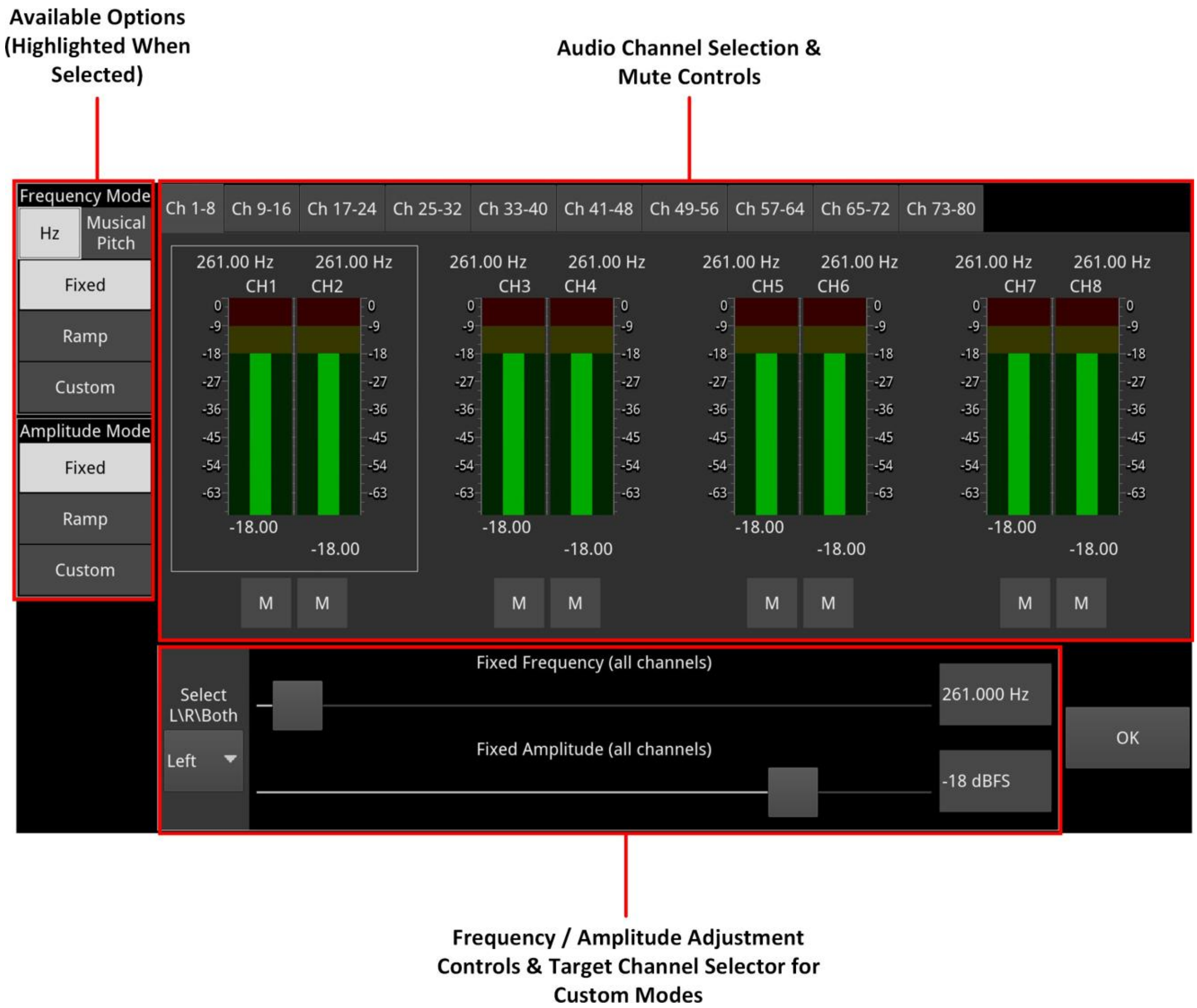


Figure 6-24: Audio Generator Configuration Dialog (ST 2110 IP Output)

Using the Audio Generator Configuration dialog you can:

- Generate a fixed audio frequency (in Hertz or musical pitch) for **all** audio channels
- Generate a ramped audio frequency (in Hertz or musical pitch), in decreasing steps of 50 Hz (0.05 kHz), for **all** audio channels
- Generate a fixed audio amplitude (in dBFS) for **all** audio channels
- Generate a ramped audio amplitude (in dBFS), in increasing steps of 1 dBFS, for **all** audio chan- nels
- Generate a custom frequency (in Hertz or musical pitch) for either both channels, the left chan- nel only, or right channel only of the **selected channel pair**
- Generate a custom amplitude for either both channels, the left channel only, or right channel only of the **selected channel pair**.

The audio generator configuration dialog is roughly subdivided into three functional areas as shown in *Figure 6-24*. To configure an audio output signal, first select the required audio options in the left- side options panel then select the target channel pairs or single channel using the target channel selector as appropriate. Use the tabs to display additional channels. Finally, adjust the frequency and
/ or amplitude sliders to set the audio output signal as required.

The options side panel (*Figure 6-24*) enables you to select the desired frequency and / or amplitude modes and in addition, enable or disable the video sub-image to include the audio signal.

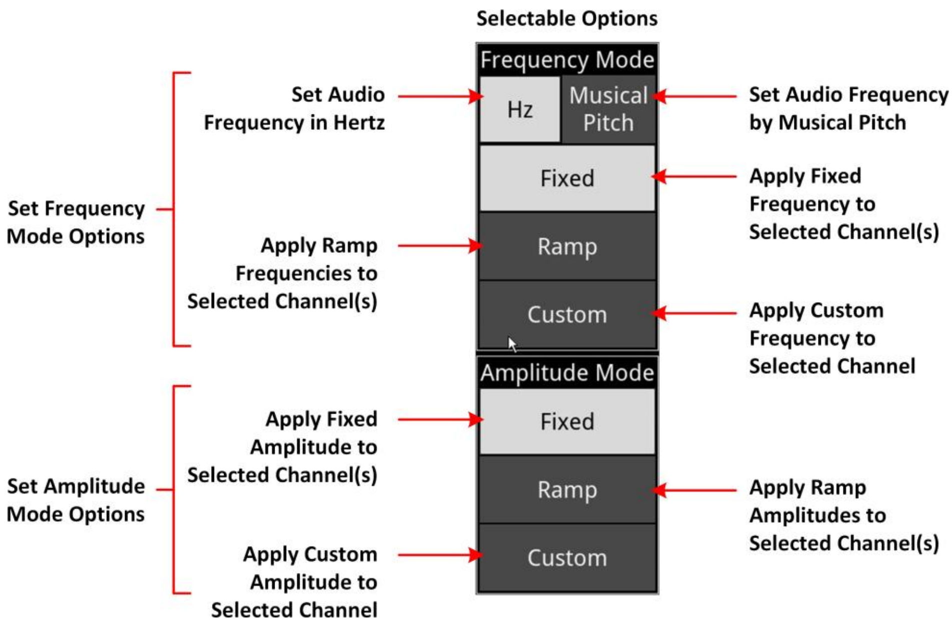


Figure 6-25: Audio Generator Configuration Dialog - Options Panel

After selecting the desired audio options in the side panel, use the audio group and channel selection controls ([Figure 6-26](#)) to activate or deactivate the target audio groups or channels for the output of the generated audio signal. You can tap or click to select a pair of channels within a group of four channels as the target for a custom frequency or amplitude setting. A selected pair is shown with a white border.

Figure 6-26: Audio Generator Configuration Dialog - Audio Channel Selection Panel

You can also use this panel to mute or unmute any of the individual meters.

When setting either a fixed or ramp frequency and / or amplitude for all channels, slide the appropriate control(s) in the adjustment controls panel (*Figure 6-27*) to the left or right as required.

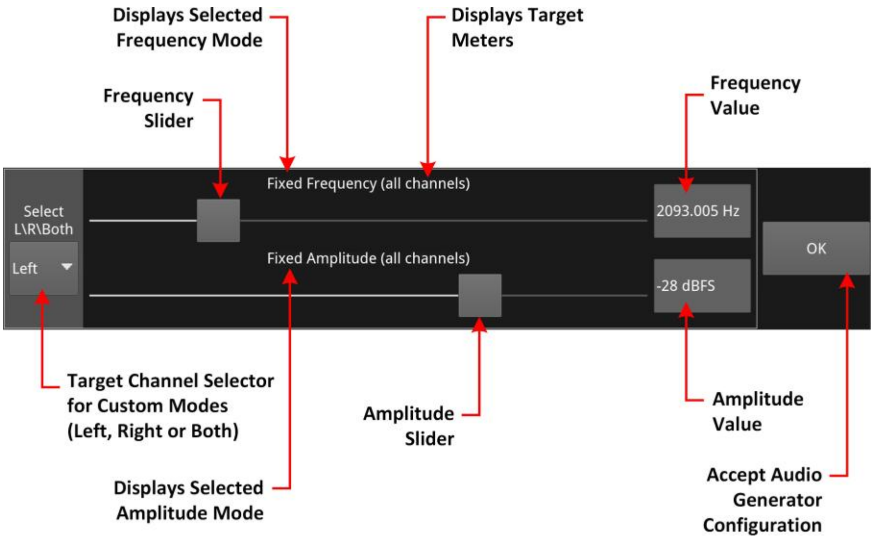


Figure 6-27: Audio Generator Configuration Dialog - Adjustment Controls

When configuring a custom setting for either frequency, and / or amplitude, use the *target channel* selector to define the channels or individual channels to which the custom setting applies. This could be either the selected pair's left channel, right channel, or both channels. You will see the target meter(s) displayed in the label above the appropriate slider.

Audio Generator Configuration Dialog

Using the configuration dropdown menus, you can configure each channel by frequency and amplitude. In addition, you can set the frequency by musical pitch, at a fixed or custom frequency (in Hz):

Table 6-9 : Audio Generator Parameters (ST 2110 IP Output)

Audio Feature	Available Parameters
Channel	• Ch 1 - 8 • Ch 9 - 16 • Ch 17 - 24 • Ch 25 - 32 • Ch 33 - 40 • Ch 41 - 48 • Ch 49 - 56 • Ch 57 - 64 • Ch 65 - 72 • Ch 73 - 80
Type and **Frequency**	Tone Select **Frequency** from: 0 to 10000 Hz
	Music Pitch Select **Frequency** from: C 3, C♯/D♭ 3, D 3, D♯/E♭ 3, E 3, F 3, F♯/G♭ 3, G 3, G♯/A♭ 3, A 3, A♯/B♭ 3, B 3, C 4, C♯/D♭ 4, D 4, D♯/E♭ 4, E 4, F 4, F♯/G♭ 4, G 4, G♯/A♭ 4, A 4, A♯/B♭ 4, B 4, C 5, C♯/D♭ 5, D 5, D♯/E♭ 5, E 5, F 5, F♯/G♭ 5, G 5, G♯/A♭ 5, A 5, A♯/B♭ 5, B 5, C 6, C♯/D♭ 6, D 6, D♯/E♭ 6, E 6, F 6, F♯/G♭ 6, G 6, G♯/A♭ 6, A 6, A♯/B♭ 6, B 6, C 7
Amplitude	Adjust amplitude levels in decibels relative to full scale (dBFS), select: −99 to 0 dBFS

2022-6 Transmit (SFP 2/4) (ST 2022-6 IP Output)

Requires Option(s):	**LPX500-GEN**

Overview

The **2022-6 Transmit (SFP 2/4)** window is used to transmit the currently generated video standard signal as ST 2022-6 standard video packets.

You can use this instrument to simulate IP video network packet jitter introduced under a variety of network conditions by adjusting the transmission distribution profile.

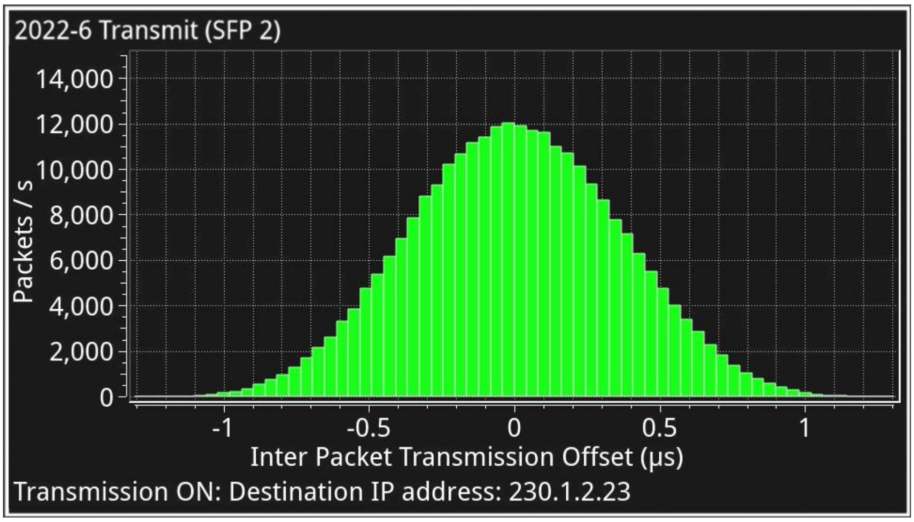


Figure 6-28: 2022-6 Transmit (SFP 2/4)

The histogram shows the interval timing distribution of the generated packets each second - that is, the number of packets being generated each second, against the deviation of each packet interval from the expected interval time. Transmission status information and prompts are also displayed at the bottom of the window. With a mouse connected, if you hover over this status information a tooltip is displayed detailing the Current Transmit Parameters, see the section *Network Settings* for more information.

Instrument Menu Options

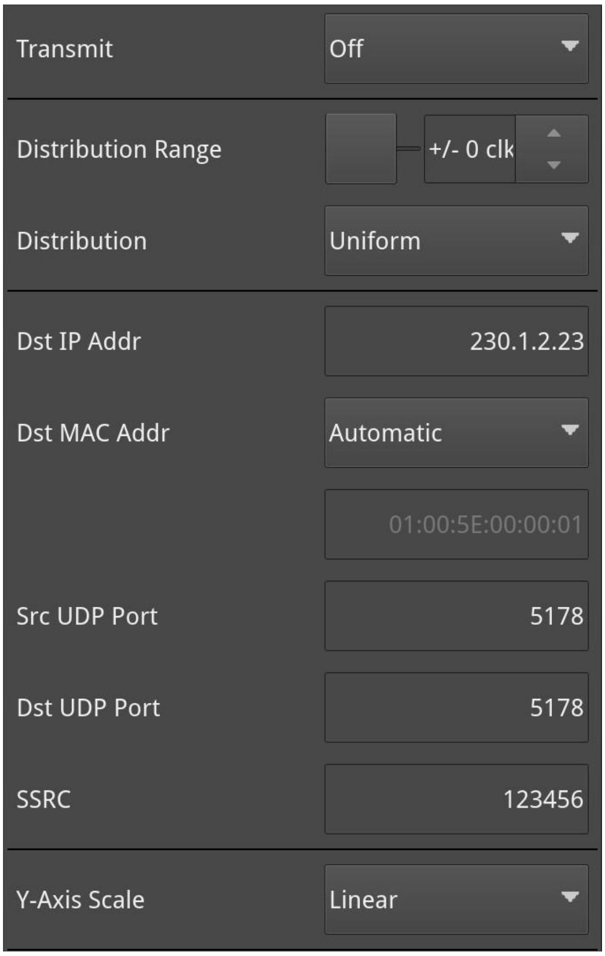


Figure 6-29: 2022-6 Transmit (SFP 2/4) Menu Options

Network Settings

IP, UDP, MAC, and SSRC network settings for packet transmission are set in the submenu, and can be entered using the numeric keypad or a connected USB keyboard when **Transmit** is set to **Off**.

Transmission can be either multicast or unicast. The multicast group destination IP address, or the IP address of the receive device (in the case of unicast) should be set as the destination IP address, as required.

The following table lists the configurable parameters in the 2022-6 Transmit (SFP 2 or optionally QSFP 4) options menu:

Table 6-10 : 2022-6 Transmit (SFP F) Menu Options

Item	Options	Description
Transmit	On Off (Default)	Switch packet transmission for IP 2022-6 output on or off.
Distribution Range	System Control (Slider) +/− 0 (default) to 492 clks for a 1.5G signal or +/− 0 (default) to 204 clks for a 3G signal	Adjust the range of transmission packet intervals. The adjustments are displayed in real-time, in the transmission histogram.
Distribution	Uniform (Default) Gaussian	Select the type of distribution profile plotted in the transmission histogram.

Item	Options	Description
Dst IP Addr	Numeric Entry	Destination IP address for the Tx flow; may be multicast or unicast. The destination MAC address (see below) should be set as required, to **Automatic** for multicast, or **SFP 1** for unicast transmission to the same unit (using ST 2022-6 IP output to transmit from **SFP 2** and ST 2022-6 input to receive on **SFP 1**). For unicast transmission to another device, set to **Manual**, and then enter the MAC address of the receive device (in the case of a direct connection) or the first switching device in the path of the transmitting unit (for an indirect connection to the receive device). Changes to addressing parameters are applied when you switch the Transmit option **On**.
Dst MAC Addr	Automatic (Default) Manual SFP 1	When set to **Automatic**, if the IP address is a multicast address the Destination MAC address is automatically calculated from the IP address. If the IP address is a unicast address, the unit uses ARP (Address Resolution Protocol) for that IP address and automatically learns the MAC address. If the MAC address cannot be found then the flow is not enabled and the unit displays a warning message.
Src UDP Port	Numeric Entry	Set the source UDP port number as required.
Dst UDP Port	Numeric Entry	Set the destination UDP port number as required.
SSRC	Numeric Entry	Set a Synchronization source identifier (SSRC) for Real-time Transport Protocol (RTP) stream subscription, if required.
Y-Axis Scale	Linear (Default) Log10	Plot the number of transmitted packets on the vertical axis using either a linear or logarithmic scale.

Once you have entered all required network settings, switch Transmit **On** to start transmission.

> **Note:** Ensure that you are generating a test signal for transmission in the **Generator** Instrument

2110 Transmit (ST 2110 IP Output)

Requires Option(s):	**LPX500-GEN**

Overview

The **2110 Transmit** Instrument enables you to transmit two different flow types from the unit: either **Generator Flows** or **Monitor Flows**. The **Generator Flows** are the video test patterns from the Video Generator together with any embedded audio tones from the Audio Generator. The **Monitor Flows** are the video and audio signals for the DisplayPort and SDI monitor outputs, or audio being monitored by the Audio Meters instrument; that is, the screen display and any audio feed supplied to an external monitor.

You can configure the currently generated Generator flows and the Monitor flows as IP video flows (2110-20), audio flows (2110-30/-31) or ancillary (ANC) flows (2110-40) for transmission from either SFPs or optionally QSFPs.

The 2110 Transmit instrument supports a full range of test patterns, including: Bars, SMPTE/ARIB Bars, Test Card (Circle), Ramps, Color Grid, Steps PLUGE at all supported frame rates and in SDR or optional HDR formats. The main instrument window (*Figure 6-32*) displays a series of tabs providing access to IP transmission status information for the Generator and Monitor flows as follows:

- 2110 Transmit Flow Overview
  - **Tx:** Displays a summary of the current status of all selected generator / monitor video, audio and ancillary flows being transmitted from the selected SFP or optional
    QSFP interface(s).
- 2110 Transmit Generator Flows
  - **VID:** Displays the current status of the video flow from the Video Generator.
  - **AUD1-2:** Displays the current status of the audio flows AUD1 and AUD2 from the Audio Generator.
  - **AUD3-4:** Displays the current status of the audio flows AUD3 and AUD4 from the Audio Generator.
  - **ANC:** Displays the current status of the ancillary ANC flow from the Video Generator.
- 2110 Transmit Monitor Flows
  - **MON:** Displays the current status of the monitor video and audio

flows. You can configure all Generator and Monitor flows to be transmitted by either:

- SFP 1, SFP 2, or dual-mirrored flows from SFPs 1+2 (2022-7 Seamless Protection Switching mode) or
- Optionally, QSFP 3, QSFP 4, or dual-mirrored flows from QSFPs 3+4 (2022-7 Seamless Pro- tection Switching mode).

The dual-mirrored flows on SFP 1+2 (or QSFP 3+4) are a co-timed, SMPTE ST 2022-7 pair which allows an ST 2022-7 receiver to reconstruct a non-errored flow seamlessly if one of the source flows contains errors. Both Generator and Monitor flows can be transmitted simultaneously providing a maximum of two video flows, five audio flows and one ANC flow from each interface. Tap and hold or right-click in any of the 2110 Transmit status tabs to display the options menu.

Figure 6-30: 2110 Transmit Options

Menu Table 6-11 : 2110 Transmit Menu

Options

Item	Options	Description
Configure Tx Flows...	Instrument Control	Opens the Transmit configuration dialog to select and configure the GENERATOR or MONITOR flows for transmission from the unit.
Clear Packet Counts	Instrument Control	Reset the cumulative packet counts, displayed in the **Packets** column of the **Tx** overview tab, to zero. **Note:** the 2110 Transmit instrument must be in full-screen mode to display this column.

In addition, with the spotlight on the instrument, the instrument softkeys include the following:

Figure 6-31: 2110 Transmit Softkeys

Transmitting GENERATOR Video and Audio Flows

The GENERATOR video flows transmit a test pattern from the Video Generator as a 2110-20 flow using the resolution, color mapping, frame rate and color space parameters set in the Video Generator configuration dialog.

The GENERATOR audio flows transmit generated PCM audio tones as four 2110-30 / -31 flows (AUD1 to AUD4) as defined in the Audio Generator configuration dialog. In the 2110 Transmit instrument, you can configure the Generator Audio flows with Packet Times of 1 ms or 125 µs.

Transmitting the Generator test pattern as a flow provides the following features:

- Video: ST 2110-20 / 2022-7 video flow pair comprising any progressive or interlaced test pat- tern with optional bouncing box.
- Choice of Narrow Gapped or Narrow Linear Packet Read Schedule (PRS)
- General Packing Mode (GPM) (single- or multi-line) or Block Packing Mode (BPM)
- Full range of test patterns (Bars, SMPTE/ARIB Bars, Test Card (Circle), Ramps, Color Grid, Steps PLUGE)
- Full range of Formats: SDR(709), SDR(2020), HDR: PQ, HLG, Slog-3, SR-Live(2020)
- Full range of Progressive Frame Rates: 23.98, 24, 25, 29.97, 30, 47.95, 48, 50, 59.94, 60 Hz.
- Interlaced Frame Rates: 50, 59.94, 60 Hz
- Phase Control of TR_{Offset} with respect to PTP T_{Frame}

Transmitting the Generator audio output as a flow provides the following features:

- Audio: Transmits up to four accompanying 48 kHz sampling, 24-bit, Test Tone/Musical Pitch 2022-7 Audio flow pairs with independent selection of ST 2110-30 or 2110-31 and 1 ms or 125 µs Packet Time for each flow pair.
- Level C Audio Operation with up to 80 channels at 125 µs and ten channels at 1 ms packet time (ST 2110-30); up to 60 channels at 125 µs and seven channels at 1 ms packet time (ST 2110-31).
- Audio generation of Fixed Tone, Fixed Tone Ramp, Musical Pitch Fixed, Musical Pitch Ramp with independent control of Tone/Pitch and Amplitude for each Channel.

Transmitting MONITOR Video and Audio Flows

The MONITOR video flows transmit the graphical user interface as a 2110-20 video flow so the video displays the same picture as is output by way of the HDMI port and has a resolution of 1920 x 1080 progressive YCbCr:422:10bit. The frame rate is set to the same as the HDMI and SDI monitor out and is set using the **Output Rate** dropdown in the Display Settings dialog of the **Settings** menus.

The MONITOR audio flow transmits the monitored audio pair from the *Audio Meters* instrument as a two channel, 2110-30 or 2110-31 flow. This is the same audio as the DisplayPort or SDI monitor output. The audio signal comprising this flow is controlled by selecting the Monitor or Solo buttons in the Audio Meters instrument.

Transmitting the Monitor output as a flow provides the following features:

- Video: ST 2110-20 / 2022-7 video flow pair carrying the unit's display (GUI,DisplayPort output) at 1920x1080 at 47.95, 48,50, 59.94, or 60 Hz Progressive Frame Rates
- Narrow Gapped Packet Read Schedule (PRS)
- Block Packing Mode (BPM) for widest compatibility
- Audio: single monitor 2.0 stereo Audio 48 kHz sampling 24-bit 2022-7 Flow pair with choice of ST 2110-30 or ST 2110-31 and selectable 1 ms or 125 µs Packet Time
- Audio selection follows the selected, Post Volume Fader, 2.0 Stereo or 1.0 Dual Mono audio meter monitored audio.

Reviewing the Tx tab

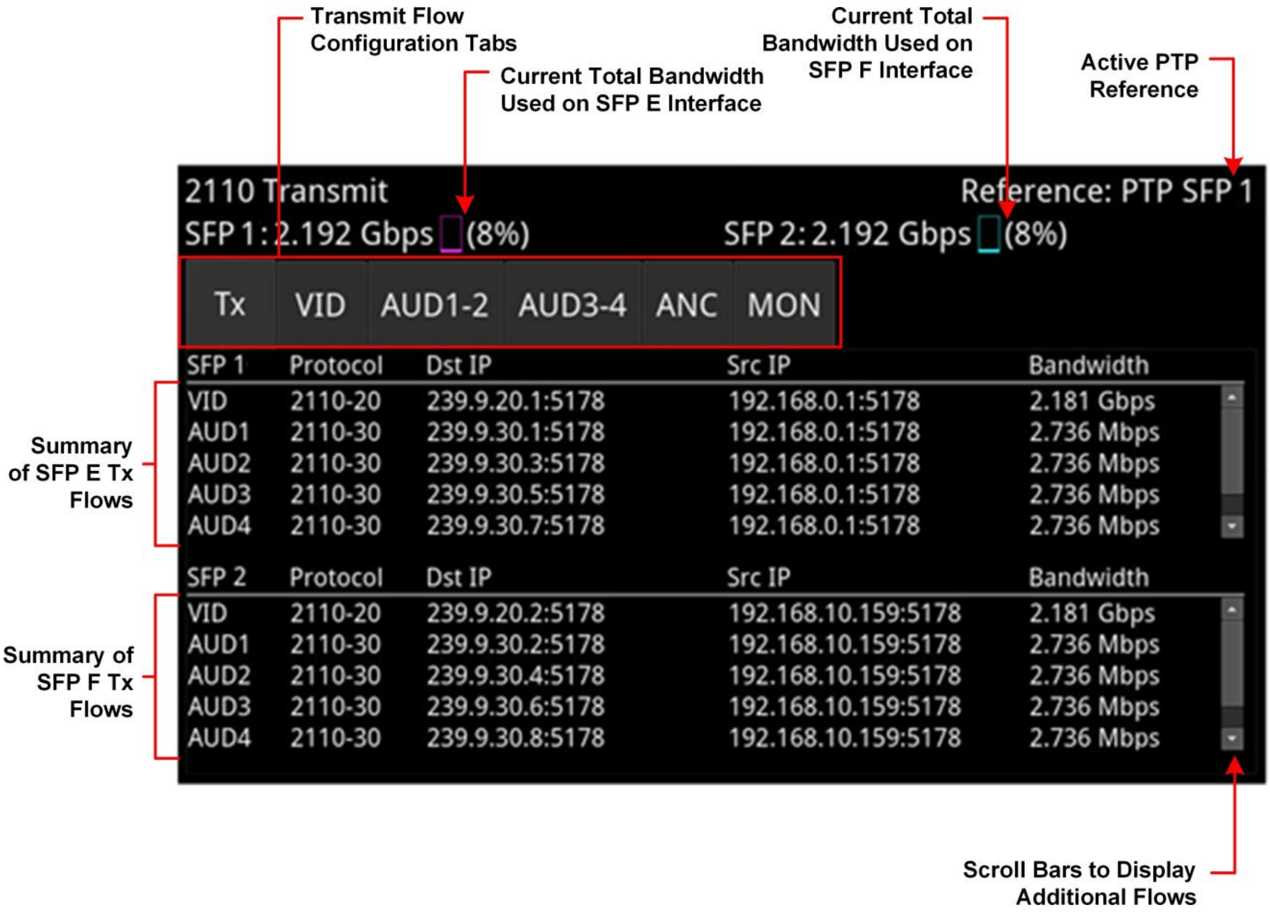


Figure 6-32: 2110 Transmit - Tx Tab

Use this tab as an overview of all flows actively being transmitted from the unit, together with the active PTP reference and an indication of bandwidth used by each interface module.

The **Tx** tab displays current status information about the following flows:

- **VID:** Transmission details of the video flow originating from the Test Pattern Generator (TPG).
- **VID M:** Transmission details of the video flow originating from the unit's Monitor display.
- **AUD1/2/3/4:** Transmission details of the AUD1 to AUD 4 flows from the Audio Generator.
- **AUD M:** Transmission details of the audio flow originating from the unit's Audio Meters instru- ment.
- **ANC:** Transmission details of the ANC flow from the Timecode

Generator. The columns in the overview table of the **Tx** tab are as follows:

- **SFP *n*: / QSFP *n*** The selected SFP /QSFP interface for that flow.
- **Protocol** The active SMPTE 2110 protocol of the flow.
- **Type:** The payload type of the flow (full screen display only).
- **Dst IP:** Destination IP address and UDP port of the flow.
- **Dst MAC:** Destination MAC address (Hex) (full screen display only).
- **Src IP:** Source IP address and UDP port of the flow.
- **SSRC:** Synchronization source identifier used as a unique identifier of the flow source (full screen display only).

- **Bandwidth:** Displays the current bandwidth used by each flow. In addition, the total current bandwidth used by each interface module is displayed in the instrument header.
- **Packets:** Transmitted packet count for each flow (full screen display only).

Tap and hold or right-click anywhere in this window to display the 2110 Transmit options menu. You can change the parameters for any of the active flows by selecting **Configure Tx Flows...** from the options menu. You can also reset the packet count to zero by selecting **Clear Packet Counts** from the options menu.

At the top-right of the screen the reference indicator shows which PTP source is currently active, for example, **Reference: PTP SFP 1**. When displayed in white text, the unit is correctly locked to the PTP engine on SFP 1 or SFP 2.

If displayed as **Free Run** in red , the unit is set to Free Run and a PTP source has not been selected in the **Video Timing & System Reference** instrument. This is an important warning as the 2110 transmit flows are only valid in an ST 2110 system when the unit is locked to PTP.

Reviewing the VID Tab

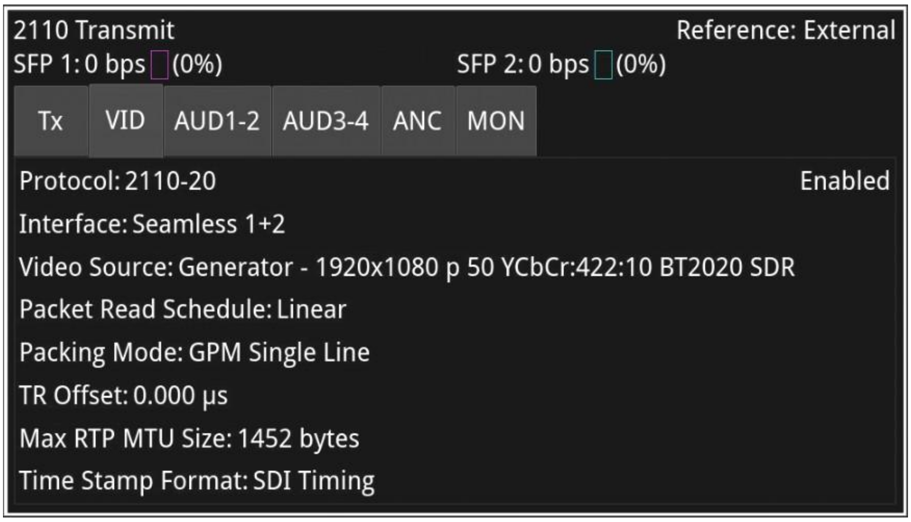


Figure 6-33: 2110 Transmit - VID Status Tab

The **VID** tab displays the active settings for the Video Generator flows, as follows:

- **Protocol:** Displays the active SMPTE 2110 video protocol SMPTE 2110-20.
- **Interface:** Displays the active interface for transmission of the video flow.
- **Video Source:** Identifies the selected video standard from the Video Generator.
- **Packet Read Schedule:** Displays the active packet read schedule for SMPTE 2110-21 - either Gapped or Linear.
- **Packing Mode:** Displays the active packing mode: General Packing Mode (GPM) (single- or multi-line) or Block Packing Mode for the RTP payload being transmitted.
- **TR Offset:** Definition of the egress time of the flow with respect to the local PTP Frame time.
- **Max RTP MTU Size:** Maximum size (maximum transmission unit) of the RTP packet for inform- ation only. The MTU size is defined as the UDP payload size (RTP Header plus RTP Payload. **Note:** The standard UDP size limit of 1460 octets defined in 2110-10 is a combination of the UDP Header + RTP Header + 2120-20 Header + RTP Payload (see SMPTE *ST 2110-10 Section 6.3*).
- **Time Stamp Format:** Either SDI or Egress Timing

You can change settings by selecting **Configure Tx Flows...** from the options menu.

Reviewing the AUD1-2 and AUD3-4 Tabs

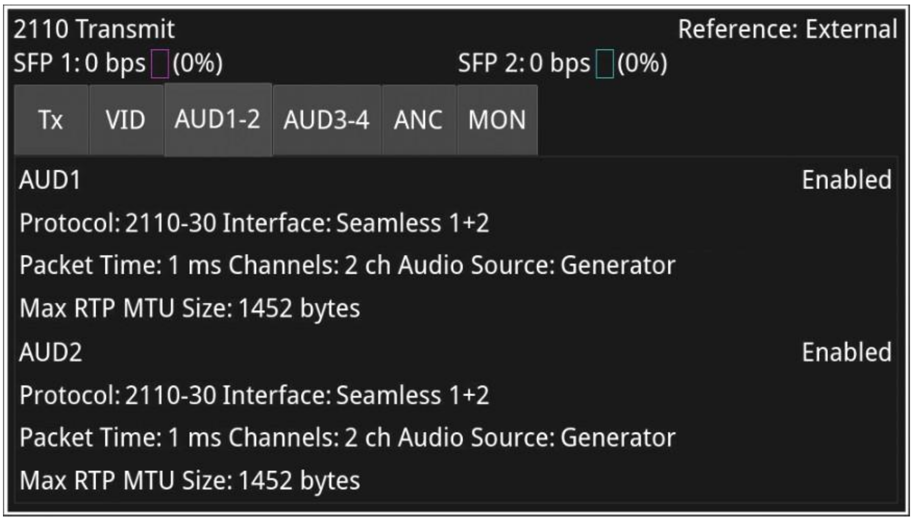


Figure 6-34: 2110 Transmit - AUD1-2 Status Tab

For each of the Generator audio flows, the **AUD1-2** and **AUD3-4** tabs display the active settings for the transmitted Generator audio flows, as follows:

- **Protocol:** Displays the active SMPTE 2110 audio protocol 2110-30 or 2110-31.
- **Packet Time:** Displays the packet time as either 1 ms or 25 μs, depending on the configured protocol and number of channels.
- **Channels:** Displays the number of audio channels being transmitted. Level C Audio operation supports up to 80 channels at 125 μs and 10 channels at 1 ms packet time (ST 2110-30), and up to 60 channels at 125 μs and 7 channels at 1 ms packet time (ST 2110-31).
- **Audio Source:** Displays the source of the audio flows, either Generator or Audio Meter.
- **Max RTP MTU Size:** Maximum size (maximum transmission unit) of the RTP packet for inform- ation only. The MTU size is defined as the UDP payload size (RTP Header plus RTP Payload. **Note:** The standard UDP size limit of 1460 octets defined in 2110-10 is a combination of the UDP Header + RTP Header + 2120-20 Header + RTP Payload (see SMPTE *ST 2110-10 Section 6.3*).

You can change some of these settings by selecting **Configure Tx Flows...** from the options menu.

Reviewing the ANC Tab

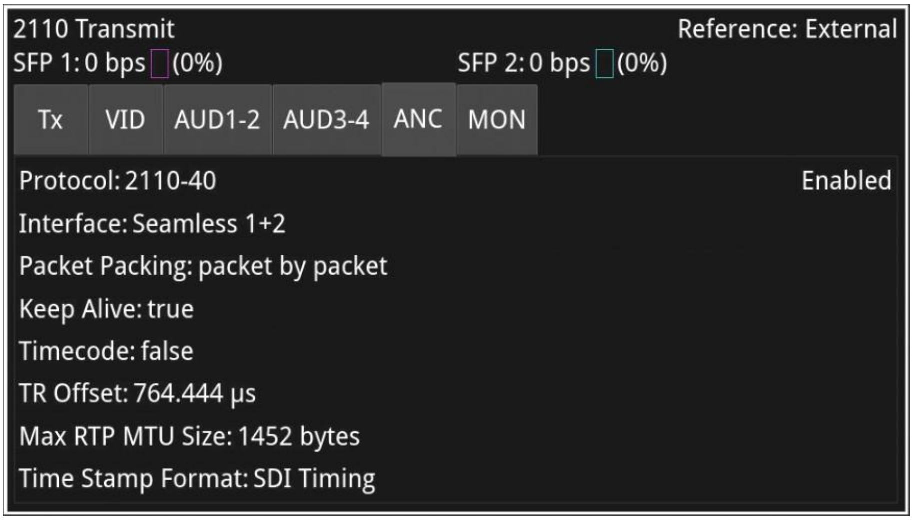


Figure 6-35: 2110 Transmit - ANC Status Tab

The **ANC** tab displays the active settings for the Video Generator flows, as follows:

- **Protocol:** Displays the active SMPTE 2110 ANC protocol SMPTE 2110-40
- **Interface:** Displays the active interface for transmission of the ANC flow.
- **Packet Packing:** Selected packing mode of the ANC flow.
- **Keep Alive:** Select to enable the generation of Keep Alive Packets (true) or disable the gen- eration of Keep Alive Packets (false). **Timecode:** Definition of the timecode parameters from the Timecode Generator
- **TR Offset:** Definition of the egress time of the flow with respect to the local PTP Frame time.
- **Max RTP MTU Size:** Maximum size (maximum transmission unit) of the RTP packet for inform- ation only. The MTU size is defined as the UDP payload size (RTP Header plus RTP Payload. **Note:** The standard UDP size limit of 1460 octets defined in 2110-10 is a combination of the UDP Header + RTP Header + 2120-20 Header + RTP Payload (see SMPTE *ST 2110-10 Section 6.3*).
- **Time Stamp Format:** Either SDI or Egress Timing

You can change some of these settings by selecting **Configure Tx Flows...** from the options menu and expanding the ANC section.

Reviewing the MON Tab

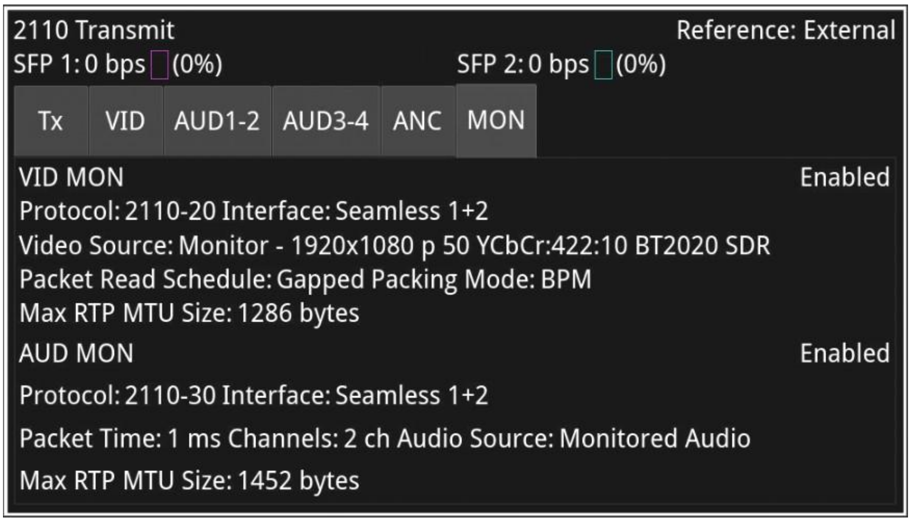


Figure 6-36: 2110 Transmit - MON Status Tab

The **MON** tab displays the active settings for transmission of the Monitor flows, as follows: VID MON Section:

- **Protocol:** Displays the active 2110 video protocol SMPTE 2110-20
- **Interface:** Displays the active interface for output of the video flow.
- **Video Source:** Identifies the selected video monitor, together with resolution, frame rate, color space, etc.
- **Packet Read Schedule:** Displays the active packet read schedule for SMPTE 2110-21 - Gapped only.
- **Max RTP MTU Size:** Maximum size (maximum transmission unit) of the RTP packet for inform- ation only. The MTU size is defined as the UDP payload size (RTP Header plus RTP Payload. **Note:** The standard UDP size limit of 1460 octets defined in 2110-10 is a combination of the UDP Header + RTP Header + 2120-20 Header + RTP Payload (see SMPTE *ST 2110-10 Section 6.3*).

AUD MON Section:

- **Protocol:** Displays the active packet read schedule for SMPTE 2110-21 - Gapped only.
- **Interface:** Displays the active interface for output of the audio flow.
- **Audio Source:** Displays the source of the audio flows as Monitored Audio.
- **Packet Time:** Displays the packet time as either 1 ms or 25 µs, depending on the configured protocol and number of channels.
- **Channels:** Displays the number of SFP channels used for transmission: 2 channels.
- **Max RTP MTU Size:** Maximum size (maximum transmission unit) of the RTP packet for inform- ation only. The MTU size is defined as the UDP payload size (RTP Header plus RTP Payload. **Note:** The standard UDP size limit of 1460 octets defined in 2110-10 is a combination of the UDP Header + RTP Header + 2120-20 Header + RTP Payload (see SMPTE *ST 2110-10 Section 6.3*).

You can change some of these settings by selecting **Configure Tx Flows...** from the options menu.

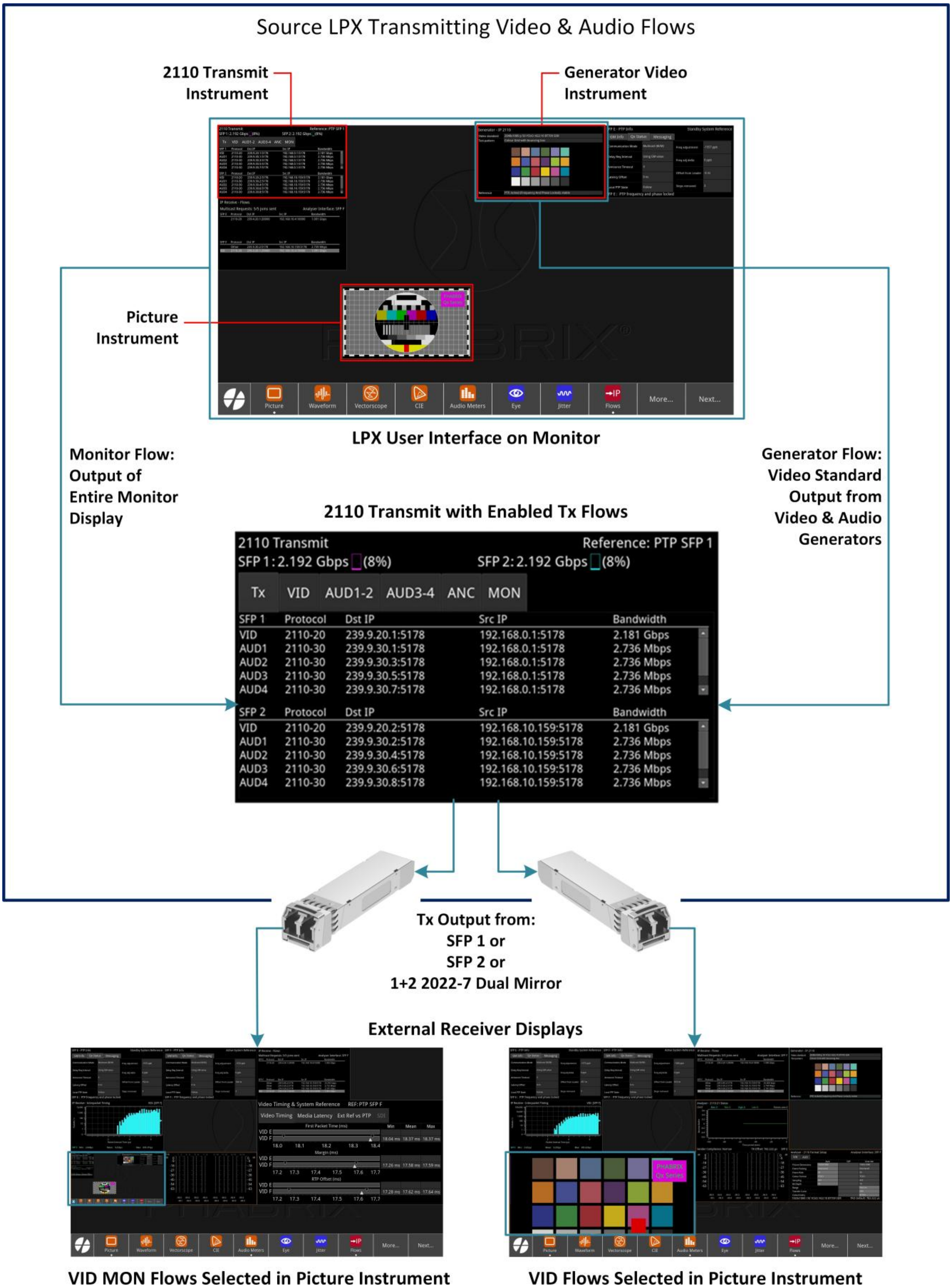


Figure 6-37: Schematic Overview of Transmission of Generator and Monitor Flows by the 2110 Transmit

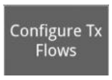
Instrument

Configuring the Generator Flows

The configuration screens are composed of a list of available flows displayed in an expandable list. Select a flow of interest and click the arrow to expand that item, displaying the configurable flow parameters. Each minimized flow provides a single line summary of the current settings for information. In addition, at the right-hand side of each flow is a dropdown list allowing you to enable or disable that particular flow.

> **Note:** The use of unicast broadcast IP addresses for IP transmission is not currently permitted.

To configure the Generator Flows:

1. Either make sure the spotlight is on the instrument then tap  or, from any of the 2110 Transmit status tabs, tap and hold or right-click to open the options menu.
2. Select the option: **Configure Tx Flows...** to open the configuration window.
3. Select the **GENERATOR** tab if not already selected.
   You will see the following screen displayed summarizing all the available flows and their cur- rent activity status.

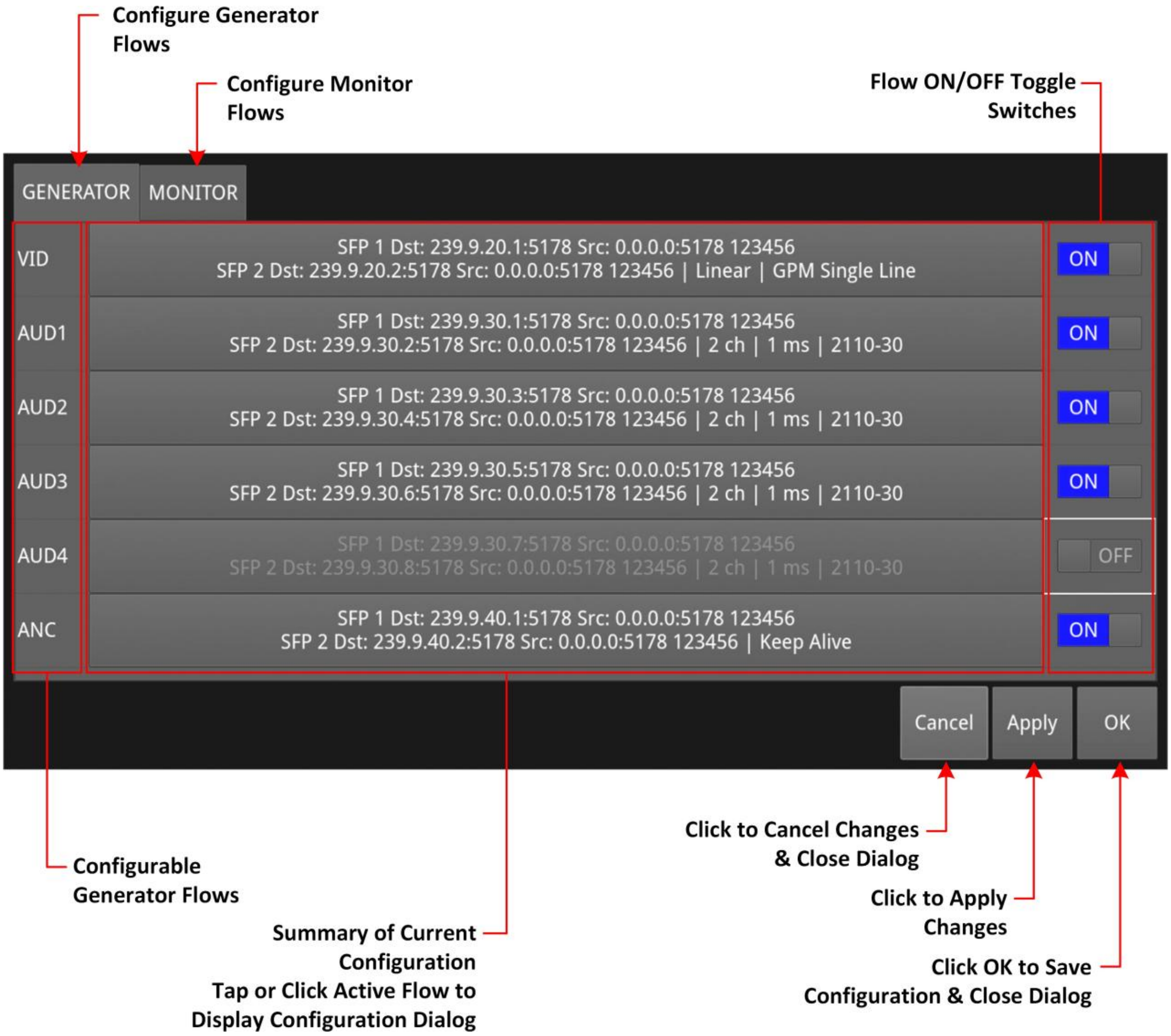


Figure 6-38: 2110 Transmit - GENERATOR Flows Configuration

4. Enable or disable the flows as required using the toggle-switch in the right-hand column.

5. Tap or click the Generator flow you want to configure, from: **VID**, **AUD1, AUD2**, **AUD3**, **AUD4**, **ANC**.
6. Change the flow configurations as required by selecting the options described in the following subsections. Click Ok to close the flow configuration dialog.
7. Make sure that you save your configuration changes. Ether tap or click **Apply** to apply your changes but leave the dialog open or **OK** to accept your changes and close the configuration dialog. To close the dialog box without making any changes, tap or click

> **Note:** When NMOS is enabled the Generator configuration may be under NMOS control. The Generator Configuration dialog is updated with the current state on opening.
>
> If you make a change in the Generator configuration dialog and the Generator configuration is updated using the NMOS API, then the manual configuration will override the NMOS configurations when you tap or click **Apply** or **OK**.

Cancel.

Configuring the Generator Video Flows

When entering a numeric value in the configuration settings, you can use either a USB keyboard connected to the unit or the onscreen numeric keypad.

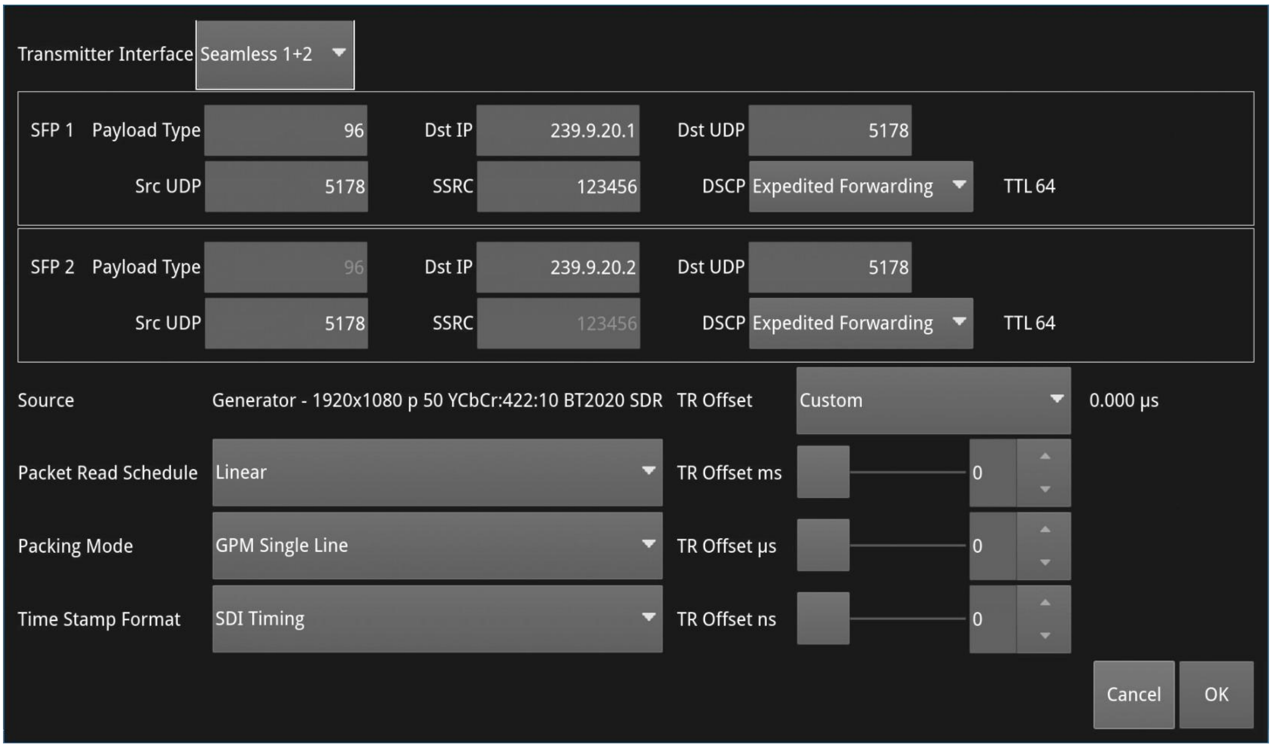


Figure 6-39: 2110 Transmit - Generator Video Flow Configuration

The following table lists the options available when configuring the Generator Video Flows:

Table 6-12 : 2110 Transmit - Generator Video Flow Options

Item	Options	Description

Transmitter Interface	Seamless 1+2 (Default) SFP 1 SFP 2	The active interface for transmitting the Generator video flow. The Seamless 1+2 option provides two identical flows, according to 2022-7, to enable Seamless Protection Switching (SPS) in the receiving device.

Item	Options	Description
SFP 1/2 Payload Type	96 to 127	Defines the Real-time Transport Protocol (RTP) payload type for the video data packet. Default is 96 for 2110-20 Video, 97 for 2110-30/31 Audio, 98 for 2022-6 and 100 for 2110-40.
Dst IP	Numeric Entry	Destination IP address for the Tx flow; may be Multicast or Unicast. If Multicast the MAC address is calculated auto- matically from the IP address. If Unicast, then the unit will ARP the IP address to learn the MAC address auto- matically. If the MAC address cannot be obtained then the flow is not enabled.
Dst UDP	Numeric Entry	Destination UDP port for the Tx flow.
Src UDP	Numeric Entry	Source UDP port for the Tx flow.
SSRC	Numeric Entry	Synchronization source identifier used as a unique identifier of the flow source.
DSCP	Default Forwarding Expedited Forwarding (Default) Voice Admit CS1 to CS5	Differentiated Services Code Point - packet header value used to request priority delivery.
Source	Video Standard selected in Generator Instrument	Test pattern video source details from the **Generator** instrument. Supports the following: Resolution: 1280x720, 1920x1080, 2048x1080. In addition when connected to a 25G network: 3840x2160 and 4096x2160 Color mapping: YCbCr:422:10 Frame Rates: 23.98p, 24p, 25p, 29.97p, 30p, 47.95p, 48p, 50p, 59.94p, 60p, 50i,59.94i, 60i Color Space: SDR-709, SDR-2020, HDR-HLG, HDR-PQ, HDR-Slog3 For example: Generator - 1920x1080 p 50 YCbCr:422:10 BT709 SDR Optional bouncing box also supported.
Packet Read Schedule	Gapped (Default) Linear	Defines the active packet read schedule for SMPTE 2110- 21, select either Gapped or Linear.
Packing Mode	GPM Single-line (Default) GPM Multi-line BPM	Defines the active packing mode either GPM (General Packing Mode) in single- or multi-line mode, or BPM (Block Packing Mode) for the RTP payload being transmitted.
Time Stamp Format	SDI Timing (Default) Egress Timing	Timestamp applied to video frames.

TR Offset	Custom TRO Default (Default)	Defines the egress time of the flow with respect to the local PTP Frame time. The Default value ($TRO_{Default}$) is defined by ST 2110-21 and varies according to the selected Video format and Frame Rate. The **Custom** control allows you to adjust the egress time (and timestamp) with respect to the local PTP frame time from 0 ns up to 15 ms.

Tap or click **Ok** to close the video configuration dialog. Then tap or click **Apply** to apply your configuration changes and continue configuring, or **OK**to save your changes and close the **Configure Tx Flows** window.

Configuring the Generator Audio Flows

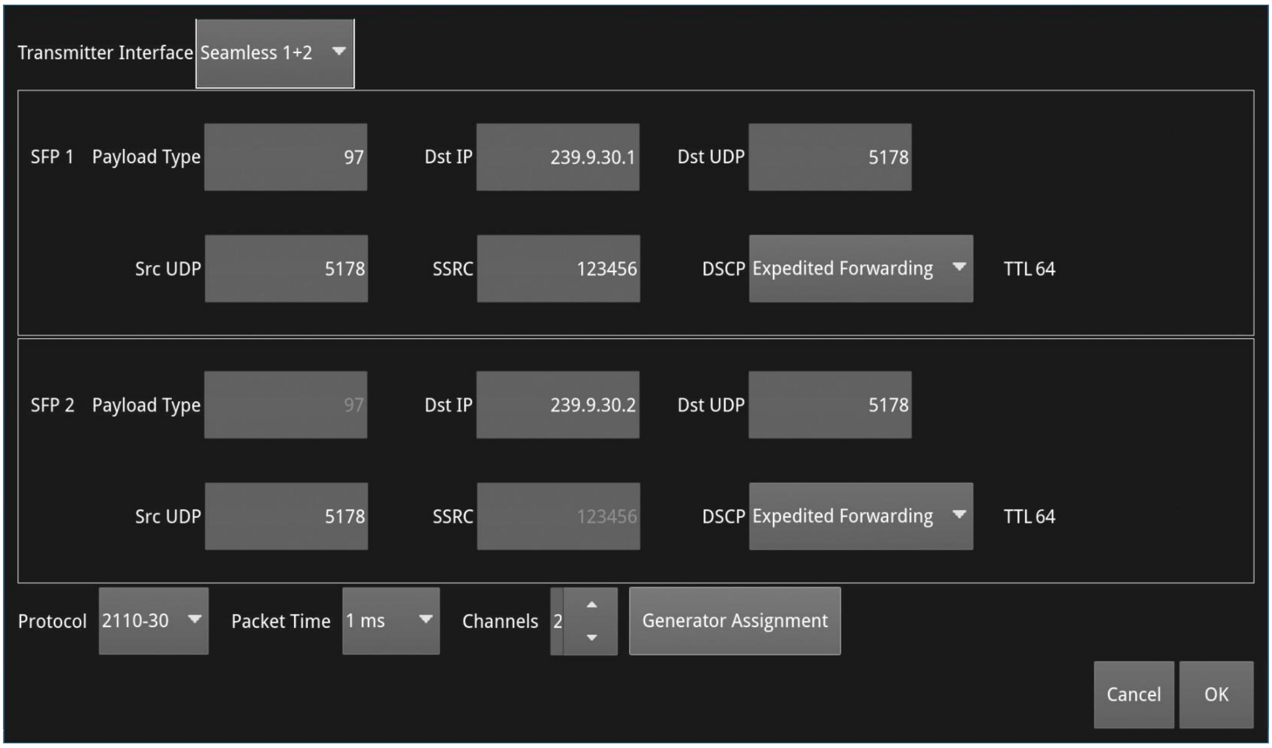


Figure 6-40: 2110 Transmit - GENERATOR Audio 1 Flow Configuration

The following table lists the options available when configuring the Generator Audio Flows:

Table 6-13 : 2110 Transmit - Generator Audio Flow Options

Item	Options	Description
Transmitter Interface	Seamless 1+2 (Default) SFP 1 SFP 2	The active interface for transmitting the Generator audio flow. The Seamless 1+2 option provides two identical flows, according to 2022-7, to enable Seamless Protection Switching (SPS) in the receiving device.
SFP 1/2 Payload Type	96 to 127	Defines the Real-time Transport Protocol (RTP) payload type for the audio data packet. Default is 96 for 2110-20 Video, 97 for 2110-30/31 Audio, 98 for 2022-6 and 100 for 2110-40. Incorrect values are displayed in yellow.
Dst IP	Numeric Entry	Destination IP address for the Tx flow.
Dst UDP	Numeric Entry	Destination UDP port for the Tx flow.
Src UDP	Numeric Entry	Source UDP port for the Tx flow.
SSRC	Numeric Entry	Synchronization source identifier used as a unique identifier of the flow source.
DSCP	Default Forwarding Expedited Forwarding (Default) Voice Admit CS1 to CS5	Differentiated Services Code Point - packet header value used to request priority delivery.
Protocol	2110-30 2110-31	SMPTE protocol selected for the Generator audio flow.

Item	Options	Description
Packet Time	1 ms 25 µs	Defines the packet time as either 1 ms or 25 µs, depending on the configured protocol and number of channels.
Channels	1 - 80 (Depending on selected Protocol and Packet Time)	Select the number of audio channels being transmitted. Level C Audio operation supports the following: **ST 2110-30**: Up to 80 channels at 125 µs and 10 channels at 1 ms packet time **ST 2110-30**: Up to 60 channels at 125 µs and 7 channels at 1 ms packet time.
Generator Assignment	System Control	Tap or click to open a dialog showing an audio channel mapping matrix of all available flow channels and the corresponding Generator channel. Complete the matrix to map the Generator audio channels to the 2110 Transmit flow channels. If necessary, tap or click **Reset Defaults** to restore the default mappings. Tap or click **Ok** to save the audio mapping matrix.

Tap or click **Ok** to close the audio configuration dialog. Then tap or click **Apply** to apply your configuration changes and continue configuring, or **OK**to save your changes and close the **Configure Tx Flows** window.

Configuring the Generator ANC Flows

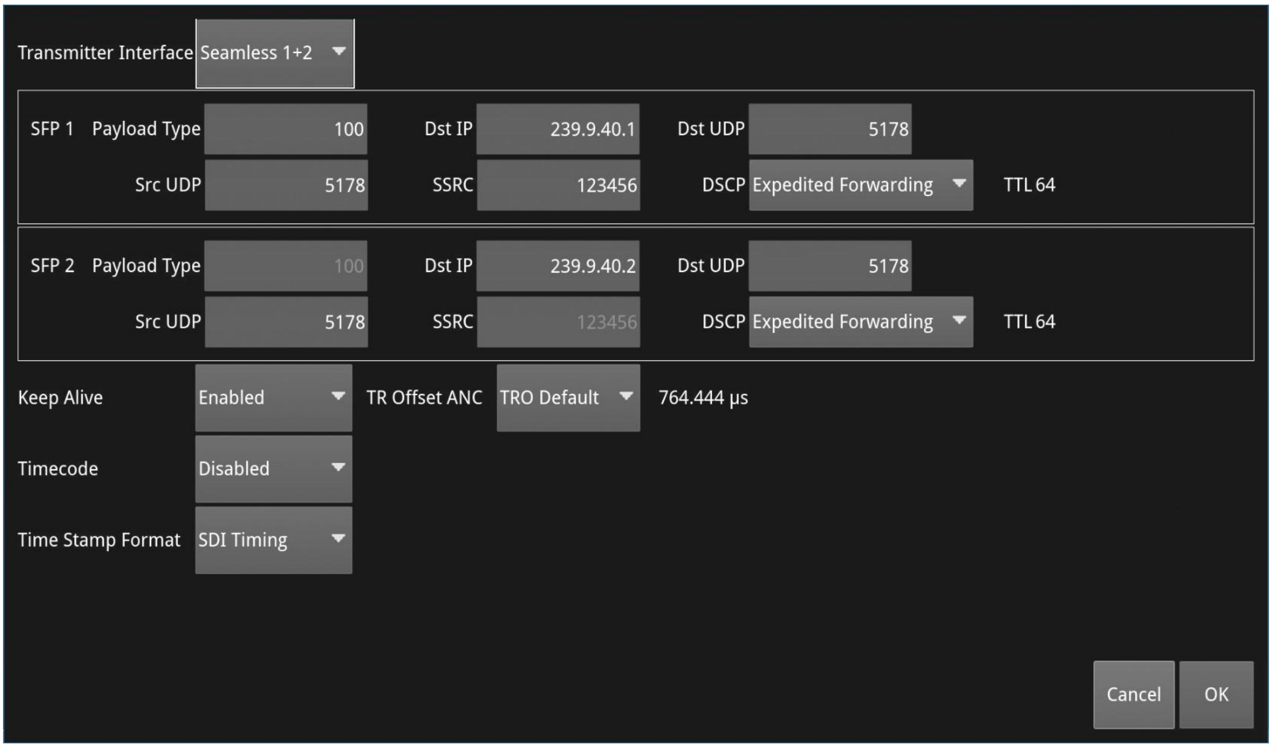


Figure 6-41: 2110 Transmit - GENERATOR ANC Flow Configuration

The following table lists the options available when configuring the Generator ANC Flows:

Table 6-14 : 2110 Transmit - Generator ANC Flow Options

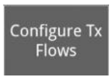
Item	Options	Description
Transmitter Interface	Seamless 1+2 (Default) SFP 1 SFP 2	The active interface for transmitting the Generator ANC flow. The Seamless 1+2 option provides two identical flows, according to 2022-7, to enable Seamless Protection Switching (SPS) in the receiving device.
SFP 1/2 Payload Type	96 to 127	Defines the Real-time Transport Protocol (RTP) payload type for the ANC data packet. Default is 100 for 2110-40.
Dst IP	Numeric Entry	Destination IP address for the Tx flow.
Dst UDP	Numeric Entry	Destination UDP port for the Tx flow.
Src UDP	Numeric Entry	Source UDP port for the Tx flow.
SSRC	Numeric Entry	Synchronization source identifier used as a unique identifier of the flow source.
DSCP	Default Forwarding Expedited Forwarding (Default) Voice Admit CS1 to CS5	Differentiated Services Code Point - packet header value used to request priority delivery.
Keep Alive	Enabled Disabled	Select to enable the generation of Keep Alive Packets (true) or disable the generation of Keep Alive Packets (false)
Timecode	Enabled Disabled	When enabled, uses the timecode from the Timecode Generator.
Time Stamp Format	SDI Timing Egress Timing	Timestamp applied to video frames.
TR Offset ANC	Custom TRO Default (Default)	Defines the egress time of the flow with respect to the local PTP Frame time. The Default value ($TRO_{Default}$) is defined by ST 2110-40. The **Custom** control allows you to adjust the egress time (and timestamp) with respect to the local PTP frame time from 0 ns up to 15 ms.

Tap or click **Ok** to close the ANC configuration dialog. Then tap or click **Apply** to apply your configuration changes and continue configuring, or **OK**to save your changes and close the **Configure Tx Flows** window.

If keep alive packets are present in the flow then the arrival time of the last data packet will be measured. If the video is interlaced there will be a values per field, else values per frame. A mean value for the last 1 second will be measured as well as historical min and max value.

Configuring the Monitor Flows

To configure the Monitor Flows:

1. Either make sure the spotlight is on the instrument then tap 

 or, from any of the 2110 Transmit status tabs, tap and hold or right-click to open the options menu.
2. Select the option: **Configure Tx Flows...**.

3. Select the **MONITOR** tab if not already selected.
   You will see the summary screen displayed listing the available flows and their current activity status.
4. Enable or disable the flows as required using the toggle switch in the right-hand column.
5. Tap or click the flow you want to configure from: **VID M** or **AUD M**.
6. Change the flow configurations as required by selecting the options described below.
7. Make sure you save your configuration changes. Either tap or click **Accept** to accept your changes but leave the dialog open or **OK** to accept your changes and close the configuration dialog. To close the dialog without making any changes, tap or click **Cancel**.

Configuring the Monitor Video and Audio Flows

The Monitor Video and Audio Flows have fewer configurable parameters than the Generator flows as the Video Format 1920 x 1080 422:10 BT 709 SDR and the Frame Rate are imported directly from the Monitor Settings. The Packet Read Schedule and Packing Mode are fixed, by design, for the Monitor Flow and cannot be changed.

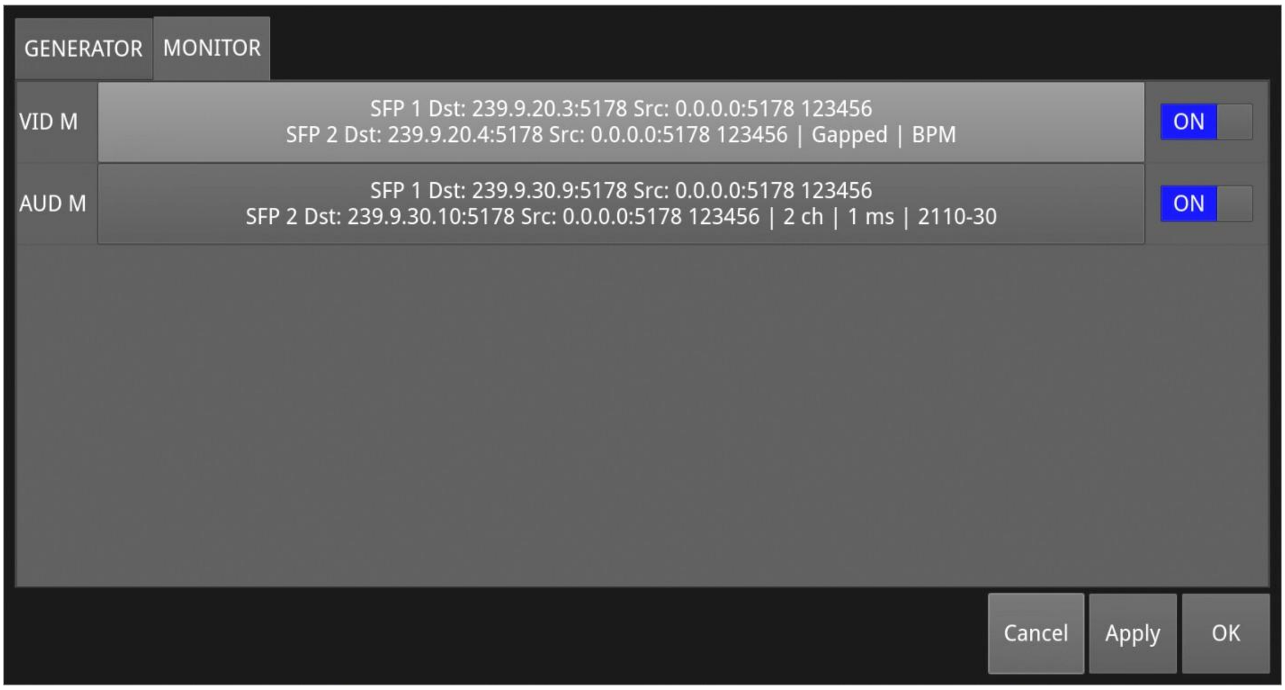


Figure 6-42: 2110 Transmit - MONITOR Video and Audio Flows Configuration

Tap or click either the **VID M** or **AUD M** flow to open the configuration dialog.

The following table lists the options available when configuring the Monitor Video and Audio Flows:

Table 6-15 : 2110 Transmit - Monitor Video and Audio Flow Options

Item	Options	Description
VID M Options		
Transmitter Interface	Seamless 1+2 (Default) SFP 1 SFP 2	The active interface for transmitting the Media video flow. Seamless 1+2 uses SMPTE ST 2022-7 Seamless Pro- tection Switching (SPS).

SFP 1/2 Payload Type	96 to 127	Defines the Real-time Transport Protocol (RTP) payload type for the video data packet. Default is 96 for 2110-20 Video, 97 for 2110-30/31 Audio,

Item	Options	Description
		98 for 2022-6 and 100 for 2110-40.
Dst IP	Numeric Entry	Destination IP address for the Tx flow.
Dst UDP	Numeric Entry	Destination UDP port for the Tx flow.
Src UDP	Numeric Entry	Source UDP port for the Tx flow.
SSRC	Numeric Entry	Synchronization source identifier used as a unique identifier of the flow source.
Source	None	Transmission of the Monitor graphical user interface as a 2110-20 flow. Fixed settings taken directly from the configured monitor. For example: Monitor - 1920x1080 p 50 YCbCr:422:10 BT709 SDR
DSCP	Default Forwarding Expedited Forwarding (Default) Voice Admit CS1 to CS5	Differentiated Services Code Point - packet header value used to request priority delivery.
Packet Read Schedule	None	Defines the active packet read schedule for SMPTE 2110- 21 Gapped only.
Packing Mode	None	Defines the active packing mode BPM (Block Packing Mode) for the RTP payload being transmitted.
AUD MON Options		
Transmitter Interface	Seamless 1+2 (Default) SFP 1 SFP 2	The active interface for transmitting the Media audio flow. Seamless 1+2 uses SMPTE ST 2022-7 Seamless Pro- tection Switching (SPS).
SFP 1/2 Payload Type	96 to 127	Defines the Real-time Transport Protocol (RTP) payload type for the audio data packet. Default is 96 for 2110-20 Video, 97 for 2110-30/31 Audio, 98 for 2022-6 and 100 for 2110-40.
Dst IP	Numeric Entry	Destination IP address for the Tx flow.
Dst UDP	Numeric Entry	Destination UDP port for the Tx flow.
Src UDP	Numeric Entry	Source UDP port for the Tx flow.
SSRC	Numeric Entry	Synchronization source identifier used as a unique identifier of the flow source.
DSCP	Default Forwarding Expedited Forwarding (Default) Voice Admit CS1 to CS5	Differentiated Services Code Point - packet header value used to request priority delivery.
Protocol	2110-30 2110-31	SMPTE protocol selected for the Media audio flow.
Packet Time	1 ms 25 µs	Defines the packet time as either 1 ms or 25 µs, depending on the configured protocol and channels.

Channels	None	The monitored audio pair from the audio meter window is transmitted as a 2 channel ST 2110-30 / -31 flow. This is the same audio as is output via the HDMI or SDI monitor out. Use the **Monitor** or **Solo** buttons in the **Audio Meters** instrument to control the audio signal transmitted in this

Item	Options	Description
		flow. Use the **Monitor** button to select the audio pair below it. Use the **Solo** button to place the single channel into both channels of the flow. The level of this audio is controlled by the main volume controls of the unit. In addition, you also need to un-mute, the main volume control in order to include any audio in the Monitor Audio Flow.

7

Analysis Instruments

This chapter describes the analytical instruments provided with the unit and includes the following sections:

Analyzer - Video Standard (SDI & 2022-6)

Requires Model(s):	LPX500IS or LPX500ISE

Overview

The **Analyzer - Video Standard (SDI & 2022-6)** instrument (for ST 2022-6 IP and optional SDI input) displays, by default, the payload details of the SDI video input being analyzed as described by the SMPTE ST 352 payload ID packets. The instrument then uses this data to identify the appropriate standard corresponding to the video input.

The instrument displays the payloads on the input signals for either:

- ST 2022-6 SFP inputs (SFP 1 / 2 or QSFP 3 /4) or
- SDI BNC inputs (SDI In 1, 2, 3, or 4) (Factory-fitted option).

The entries in the Video Standard overview also identify the current video standard in use, the status of ST 352 usage or any analyzer overrides already set, see *Figure 7-1*.

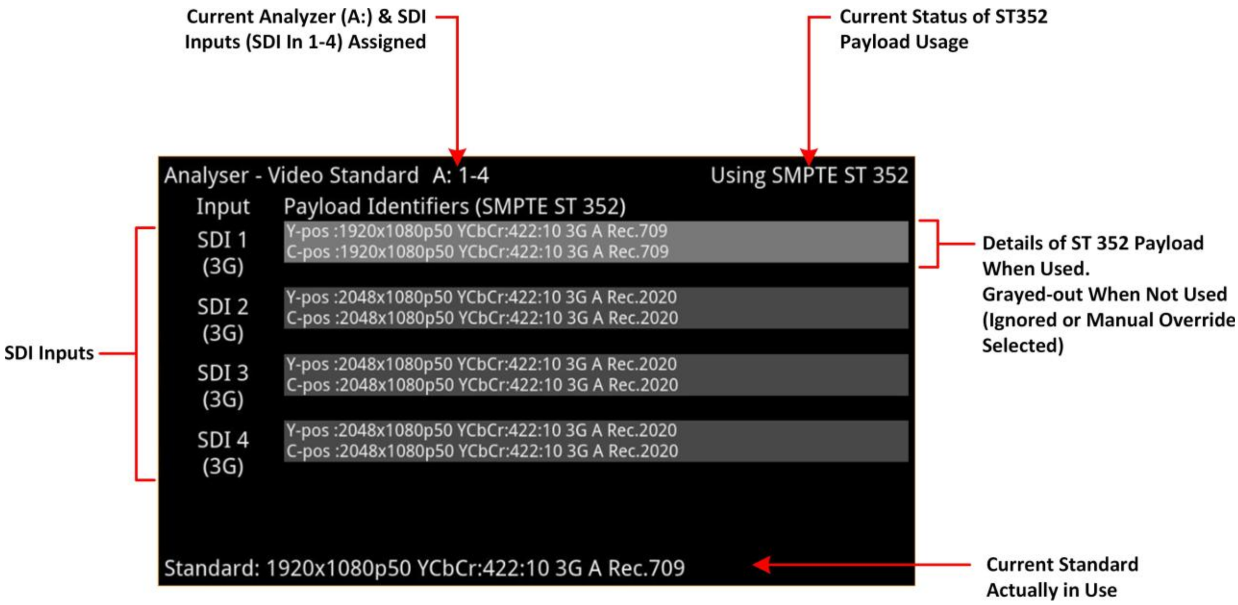


Figure 7-1: Analyzer - Video Standard Instrument (Showing ST2022-6 and Optional SDI Input)

> **Note:** If the Video Standard (SDI & 2022-6) instrument is active but the unit is configured to analyze an ST 2110 IP input, you will see the following warning message displayed in the window: **Invalid Input**.
>
> To resolve, make sure that the input source is **ST 2022-6** or **SDI** as required, with the analyzer input assignment set appropriately.

The input table displays the characteristics of the inputs to the SFP or optional SDI interfaces. For optional SDI, these inputs may be either dual or quad multi link input(s) (or up to four single link inputs). The definition of the current input (standard) being analyzed, if valid, is displayed below the table, at the bottom of the window.

If the instrument detects unstable ST 352 payloads or receives HD or UHD/EUHD video input containing damaged or missing ST 352 packets, then it highlights errors in red and warnings in yellow.

Colorimetry Range and Bit Depth Support

The LPX500 uses the definitions for Narrow, Full Protected, and Full Range as defined in SMPTE RP 2077 *Full-Range Image Mapping*.

Full, Protected and Narrow ranges for 10- and 12-bit depths are summarized in the following table for ST 2022-6 IP and optional SDI input:

Range Type	SDI & IP 2022-6 Code Value Digital Representations	
	10-Bit Range	12-Bit Range
Full Range (FR)	N/A	N/A
Full Protected Range (FP)	1019	4079
Narrow Range (NR)	940	3760
↕	. . .	. . .
Narrow Range (NR)	64	256
Full Protected Range (FP)	4	16
Full Range (FR)	N/A	N/A

Figure 7-2: Colorimetry Ranges (SDI and IP 2022-6)

> **Note:** When analyzing a video input standard, the unit does not scale up from Protected Range to Full Range or scale down from Full Range to Protected Range.

If the incoming ST 352 (VPID) signals SMPTE Full Range, the unit will extract the colorimetry range parameter from the ST 352 payload and display the full range indicator (**FR**), by default, next to the bit depth parameter in the standard definition. If **FR** is not displayed in a standard definition, then the video signal being analyzed is SMPTE Narrow Range.

For example, you might see the detected standard defined as follows for a full range input:

```
1920 x 1080i50 YCbCr-422:10FR 1.5G Rec.2020
```

The active colorimetery range is also displayed in the definition for the standard currently in use at the bottom of the display.

For more information on colorimetry range definitions as implemented, see the section *Colorimetry Range Definitions for the LPX500*.

Manual Override Configuration

You can configure manual overrides for a video standard by selecting **Manual Configuration...** from the options menu of the Video Standard instrument. Use this dialog to configure a standard manually to override the standard automatically detected from the ST 352 payload.

To use the manual override instead of the auto-detected standard, select the option **Manual** from the **Payload Identifiers** dropdown in the options menu.

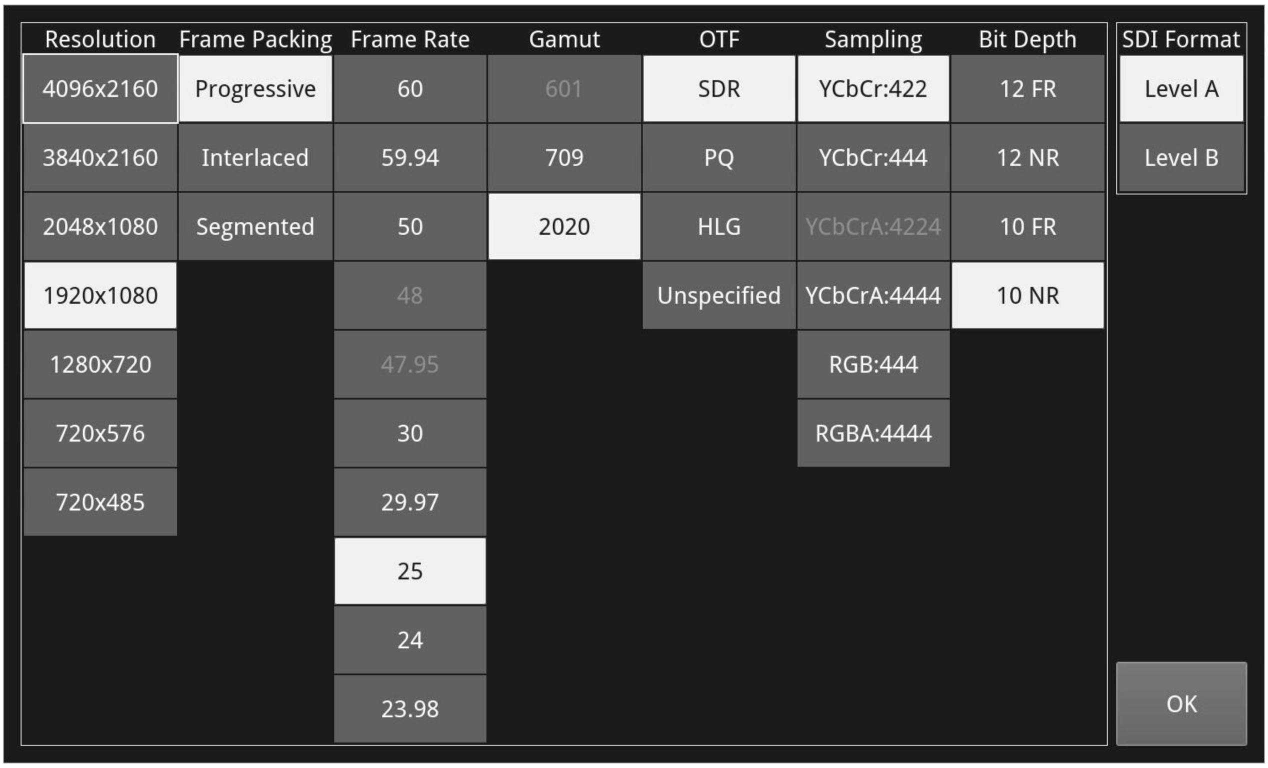


Figure 7-3: Analyzer - Video Standard Instrument - Manual Override Dialog (ST 2022-6 IP Input)

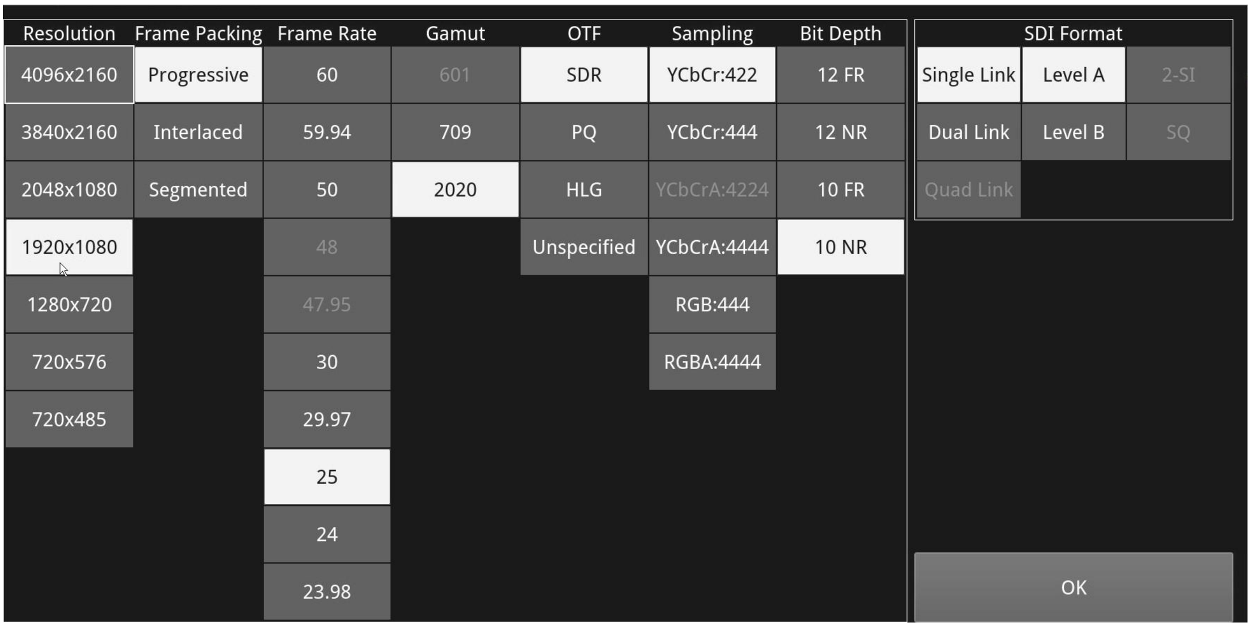


Figure 7-4: Analyzer - Video Standard Instrument - Manual Override Dialog (Optional SDI Input)

For the Manual Configuration override to be a compatible standard, the following criteria must be satisfied:

- The number of physical links are the same or less
- The number of sub-images are the same or less
- The incoming signal (as defined in the **Stats - SDI In 1 to 4** instrument) and the manual con- figuration override standard have the same values for following items:
    - Active Samples per Line
    - Active Lines per Field
    - Total Samples per Line
    - Total lines per Frame/Field1.

Changing the Payload Identification Source

In general, it is recommended to keep the default setting for the **Payload Identifiers** parameter **From S352** so that the unit automatically detects the video standard from the incoming ST 352 payload. In situations where the accuracy of incoming ST 352 packets cannot be relied upon, you can either force the instrument to use your manually-defined standard by selecting the **Manual** option or to ignore both the ST 352 payload *and* manual override by selecting **Ignored**.

Video input with ignored ST 352 packets is indicated in the top-right of the **Analyzer - Video Standard** window, see *Figure 7-5*.

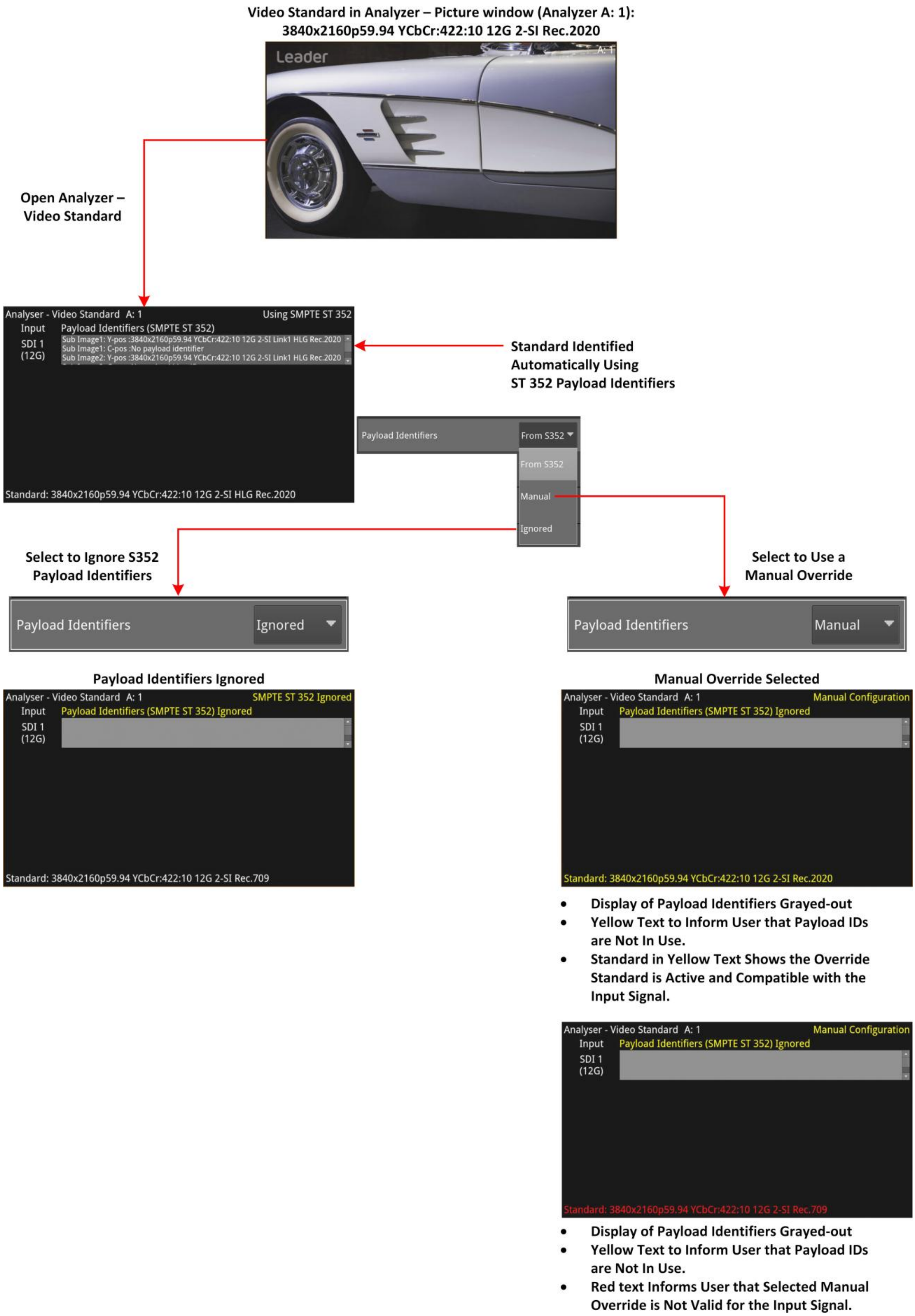


Figure 7-5: Analyzer - Video Standard with Warning and Error Displays (Optional SDI Input)

Instrument Menu Options

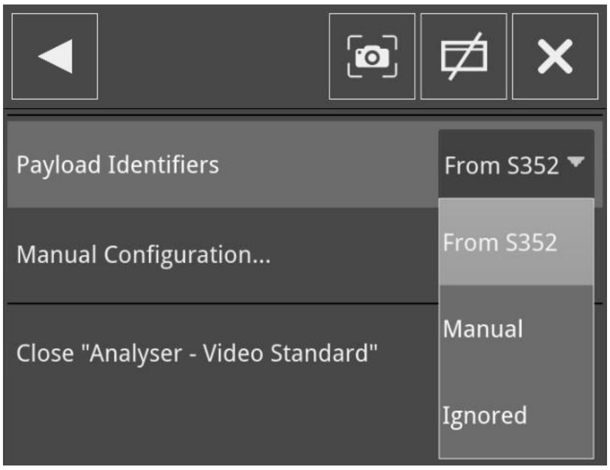


Figure 7-6: Analyzer - Video Standard Instrument - Options Menu

The following table lists the options available to configure the Analyzer - Video Standard instrument:

Table 7-1 : Analyzer - Video Standard Options

Item	Options	Description
Payload Identifiers	From S352 (Default) Manual Ignored	By default, set to **From S352**, the instrument uses the SMPTE ST 352 payload identifiers in the incoming video signal to identify the video standard. Ignore ST 352 data when parameter set to **Ignored**. Instead, the unit uses firmware counters to attempt to identify the standard. As some features cannot be identified using this method (for example, gamut configuration) the Gamut is set to 709 by default. You can choose a manual override configuration using the **Manual Configuration...** dialog. The instrument displays the applied manual configuration in yellow if it matches, or is compatible with, the input signal; otherwise, an error message is displayed in red.
Manual Configuration...	Instrument Control	Opens a manual override dialog enabling you to override the various parameters defining the video standard. If you select a parameter which is incompatible, the text of the column heading containing the incompatible parameter changes color to yellow.

Stats - SDI In 1, 2, 3, 4

Requires Model(s):	LPX500M-IS or LPX500M-ISE

Overview

The **Stats - SDI In 1, 2, 3 and 4** windows provide information to verify the format of the signals being analyzed, and the length of the input cable. A video signal may be comprised of up to four separate SDI links each providing a sub-image.

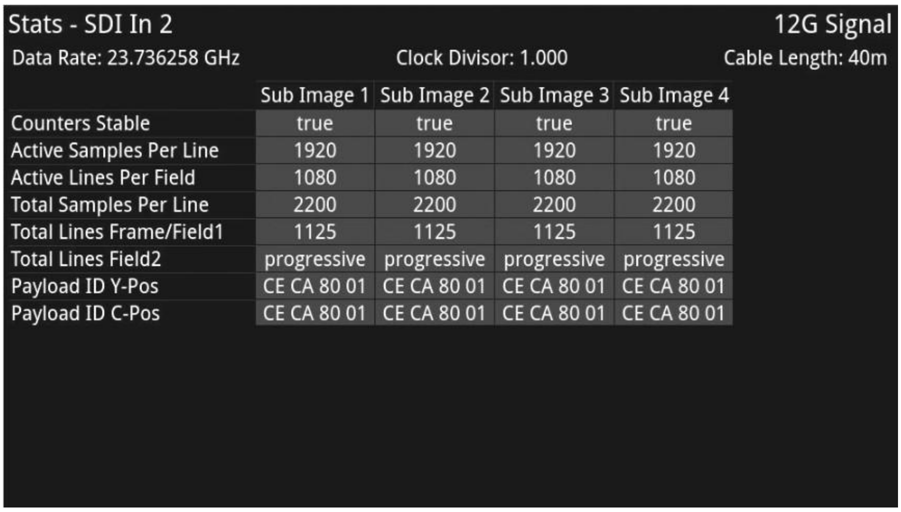


Figure 7-7: Stats - SDI In 2: Displaying Data from Single 12G Input on SDI Input 2

Figure 7-8: Stats - SDI In 1, 2, 3, 4: Displaying Data from Four Inputs (2 x 12G, 1 x 3G and 1 x 1.5G)

Stats - 2022-6 Flow Group 1 - 2 (or 1 - 4) (ST 2022-6 Receive)

Overview

The **Stats - 2022-6 Flow Group 1 - 2(4)** instrument provides information to verify the format of the signal being analyzed when receiving a ST 2022-6 IP input on **SFP 1** or**2** (or optionally **SFP 3** or **4**.)

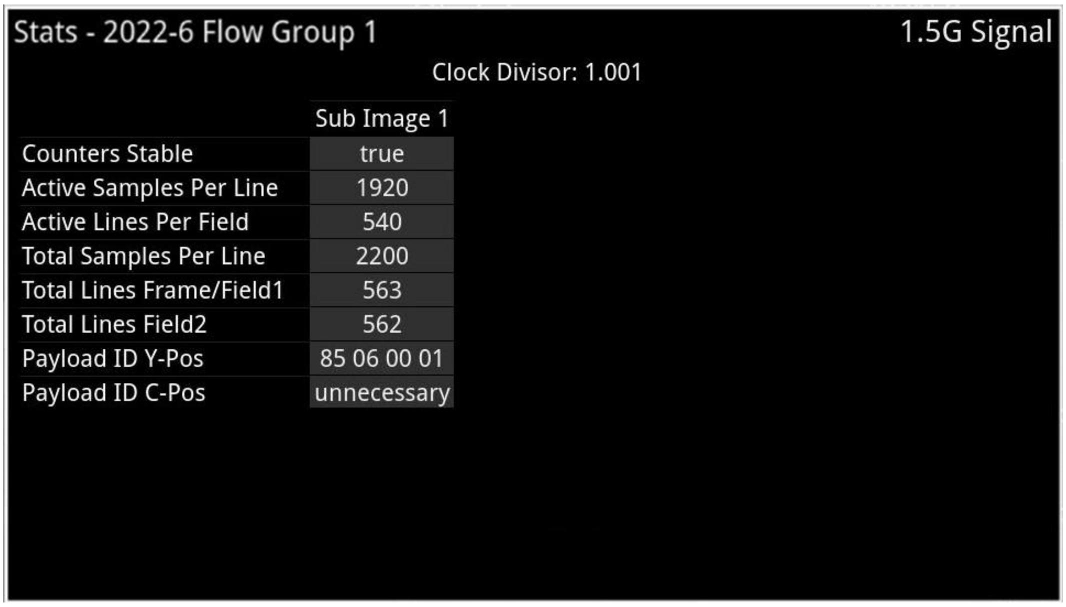


Figure 7-9: Stats - 2022-6 Flow Group Instrument

Note: If the Stats - 2022-6 Flow Group instrument is active but the unit is configured to analyze either an ST 2110 IP or optional SDI input, you will see the following warning message displayed in the window: **Invalid Input**.

To resolve, make sure that the analyzer input is set to **IP** and that the input source is **ST 2022-6**.

CRC Analysis

Overview

The **CRC Analysis SDI 1 to 4** instruments check for CRC (Cyclic Redundancy Check) errors in the received signal on each of the four SDI input connectors. The number of SDI input failures, the last failure time, total analysis time, and error rate are also displayed. Depending on the input required for the standard under test (i.e., quad-, dual-, or single-link signal(s)) the Sub Image columns will display any errors occurring in each of the Sub images. In the larger window size, the Link rows will display any errors occurring per Link for Level B signals.

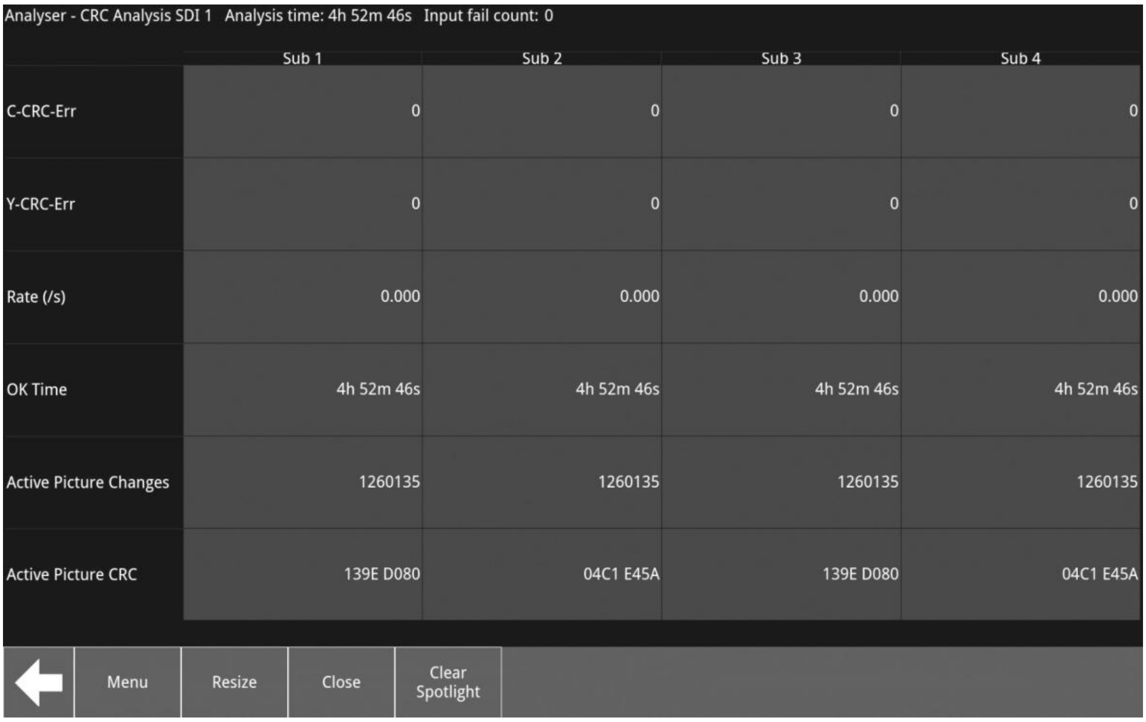


Figure 7-10: Analyzer - CRC Analysis Instrument for SDI In 1

The **OK Time** shows the length of time an image/sub image has been received without error.

The **Active Picture CRC** is created by the receiver for each image or sub-image video frame (dependent on standard) and displayed.

The instrument detects and counts changes in the active picture CRC. This can be used to show that an SDI path is transparent and error free.

The reported CRC error **Rate (/s)** is the number of instances of the addition of the Y- and C-channel CRCs and ANC checksum errors in each second.

- Y- and C-channel CRCs are calculated for each video line in accordance with SMPTE standards

Errors are collected either from the analysis start time, or from the last reset of errors and running time. The reported error rate per second is the total number of errors divided by the total time of analysis.

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - CRC Analysis instrument options menu:

Table 7-2 : Analyzer - CRC Analysis Options

Item	Options	Description
Ignore CRC on switch lines	Disabled (Default) Enabled	When enabled, ignores CRC errors on the switching line.
Reset errors on Input failure	Disabled (Default) Enabled	When enabled, clears the counters on input failure.
Reset errors and running time	System Control	Use this control to reset CRC errors and running time in **all** active CRC analysis instruments.

8

Network Analysis Instruments

This chapter describes Instruments for the analysis of the network quality and includes the following sections:

- Analyzer - 2022-7 Status (IP Input)
- SFP (1, 2) (3, 4) - Network Stats

Analyzer - 2022-7 Status (ST 2022-6 or ST 2110 IP Input)

Overview

Transmitting each media stream across dual, fully-redundant networks or links enables receivers / decoders to use ST 2022-7 Seamless IP Protection Switching (SIPS). This provides perfect error-free transport even in the case of severe packet loss or link outages as long as one good packet arrives within a certain time window on either of the two network links. Depending on the receiver buffer size and desired maximum latency, an individual decoder will be designed to accommodate a specific maximum amount of *skew* between the two flows.

The **Analyzer - 2022-7 Status** instrument provides an indication of the health of each ST 2022-7 flow pair and the time difference (skew) between their incoming packets, depending on the selected receiver classification, as selected in the instrument menu options.

Negative Skew indicates that packets on the **SFP 1** interface have arrived first. Positive Skew indicates that packets on the **SFP 2** interface have arrived first.

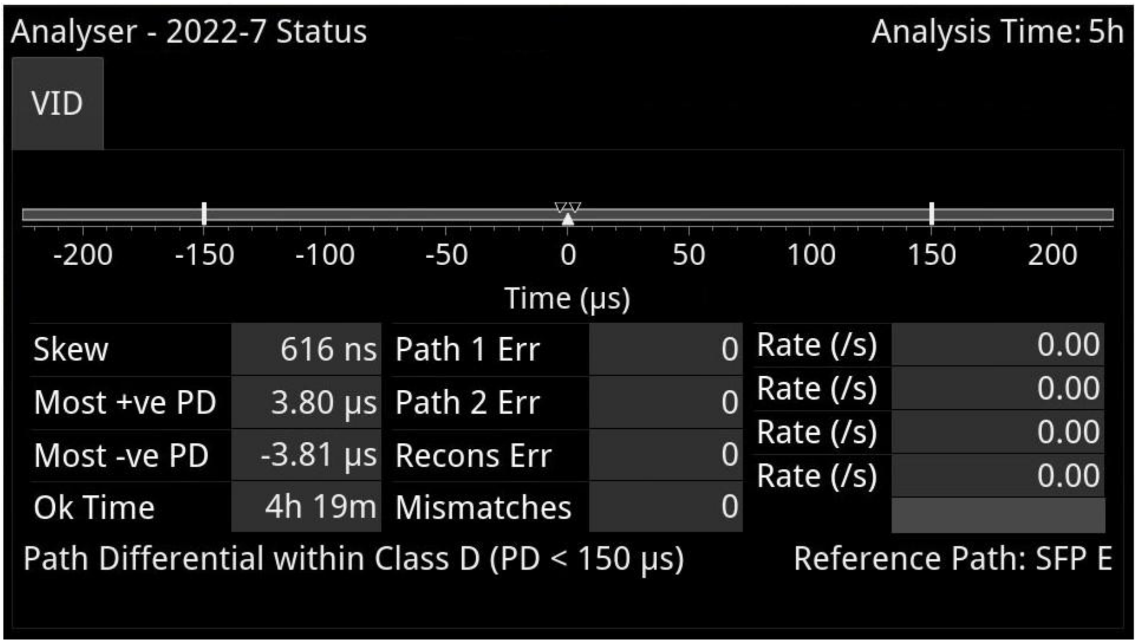


Figure 8-1: Analyzer - 2022-7 Status Instrument (ST 2022-6 IP Flow)

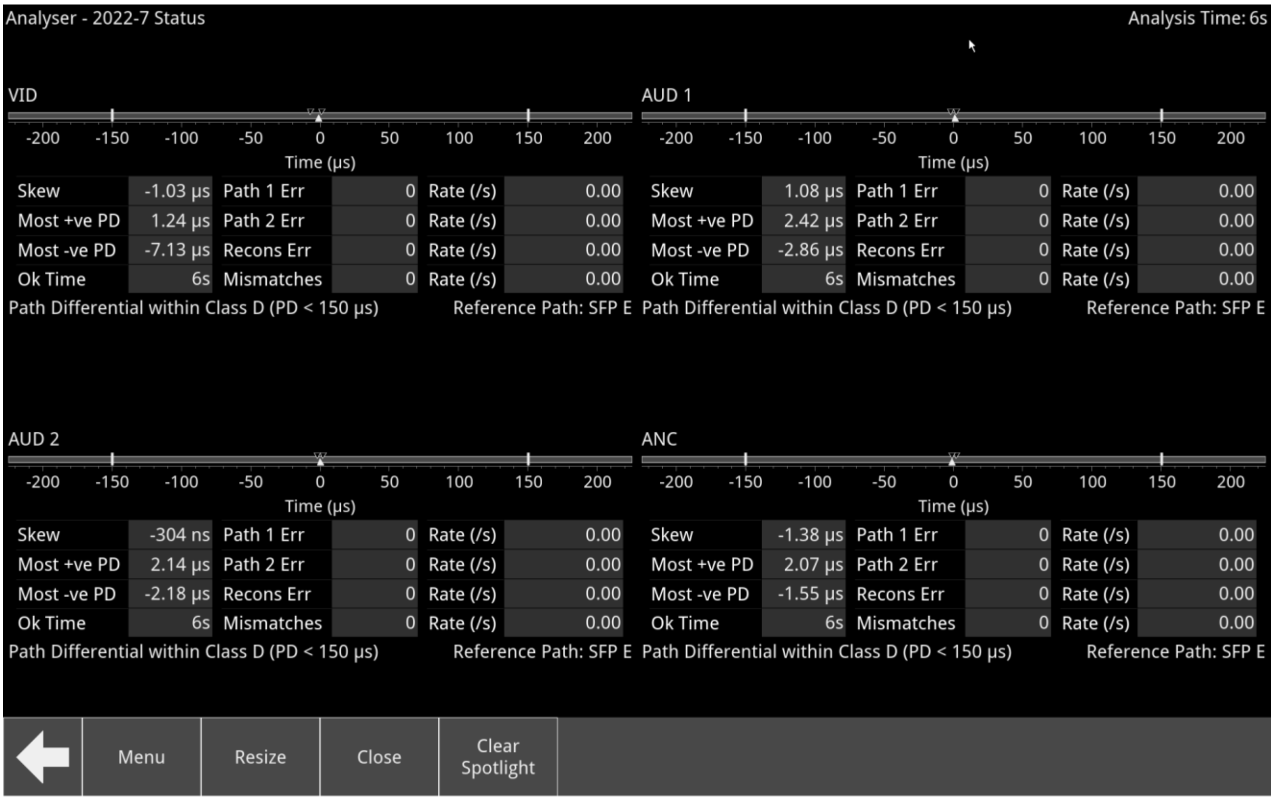


Figure 8-2: Analyzer - 2022-7 Status Instrument (ST 2110 IP Flows)

> **Note:** If the 2022-7 Status instrument is active but the unit is configured to analyze an optional SDI input, you will see the following warning message displayed in the window: **Invalid Input**.
>
> To resolve, make sure that the analyzer input is set to **IP** and that the input source is either **ST 2022-6** or **ST 2110**

For an ST 2110 IP input, double-tap (or double-click) the instrument at 1/4 screen size to display all four flows in full-screen size as shown above. Double-tap or -click again to reduce to 1/16 display size, with a tab to display each flow. Each tab will change color to yellow or red to provide a quick indication of a warning or error condition respectively. One video flow, two audio flows, and a single ancillary flow are available for selection.

> **Note:** Monitoring of audio flows **AUD 3** and **AUD 4** is not supported in the current software release.

Features include:

- Indication of the health of ST 2022-7 seamless protection
- Warning of ST 2022-7 flow-pair mismatch
- Warnings of errors on flows and errors on reconstructed output and error rates per second
- Relative measure of Path Differential (skew) of flows on **SFP 2** (Blue Network) relative to **SFP 1** (Amber Network), with Class A, B, C, D markers.

The error counters in the reporting table, below the timing meter, display the following information:

- **Path 1 Err** and **Path 2 Err** report the number of missing and/or corrupt packets detected on each path. When the unit detects a missing or corrupt packet it increments the counter.
- **Recons Err** is incremented when the instrument detects that a pair of matched packets is miss- ing and/or corrupt. A *matched packet* is the same, corresponding packet, transported on paths 1 and 2.
- **Mismatches** reports the number of pairs of matched packets in which the payload of each is dif- ferent, indicating a potential problem with the flow source rather than the network.

Instrument Menu Options

The following table lists the options available in the Analyzer - 2022-7 Status instrument submenu:

Table 8-1 : Analyzer - 2022-7 Status Options

Item	Options	Description
Receiver Classification	Class A Class B Class C Class D	**Class A**: Low-Skew ≤ 10 ms **Class B**: Moderate-Skew ≤ 50 ms **Class C**: High-Skew ≤ 450 ms for flows under 270 Mb/s and <150 ms for flows ≥ 270 Mb/s **Class D**: Ultra Low-Skew <150 µs
Reset errors and running time	System Control	Resets any errors that have occurred during the running period and sets the running time back to zero.

> **Note:** Set the video frame rate correctly in the **Analyzer - 2110 Format Setup** instrument to ensure accurate video skew measurements.

SFP 1/3 & SFP 2/4 - Network Stats

Overview

The **Network Stats** instrument displays transmission and reception traffic information, detailing the type and number of packets sent and received by the SFP28 or QSFP28 interfaces. CRC errors are identified and packet sequence errors reported. In addition, the instrument displays the network link speed (SFP28s: 10 G or 25 G; QSFP 28s: 100G) and current forward error correction mode in the top- right corner of the window.

> **Note:** When using forward error connection with optional 25G SFPs or 100G QSFPs, you will need to ensure that you have configured the correct FEC type on **both** the IP Switch and the unit.
>
> For 25G SFP28s, the unit supports either IEEE 802.3 Clause 108 by Reed Solomon FEC (RS-CL108) for 25G ports, or no FEC (NO-FEC) without auto-negotiation. The default is to use RS-CL108. The IP switch interface should be configured to use RS-CL108 with FEC auto-negotiation disabled to provide the highest possible level of data integrity on the 25G links.
>
> For 100G QSFP28s, the unit supports either IEEE 802.3 Clause 91 by Reed Solomon FEC (RS-CL91) for 100G ports, or no FEC (NO-FEC) without auto-negotiation. The default is to use RS-CL91. The IP switch interface should be configured to use RS-CL91 with FEC auto-negotiation disabled to provide the highest possible level of data integrity on the 25G links.

SFP 1/3 - Network Stats	Link Speed: 25 Gbps	FEC Mode: RS-CL108
	Rx Cumulative	Tx Cumulative
Packets:	72475016383	818592
Good Packets:	72475016382	818592
Bytes:	98151908658983	73404441
Bad FCS:	0	N/A
Multicast:	72460725184	730929
Unicast:	66160	87613
Broadcast:	14225038	50
VLAN:	0	0

Figure 8-3: SFP 1/3 - Network Stats Instrument

Double-tap or -click the window at 1/4 screen size to expand to full-screen size to display additional packet information.

> **Note:** If you insert a 25G SFP28 in the SFP 1 or 2 module cages without a 25G IP license (**LPX500-IP-25G**) installed, the Instrument title changes color to red. If you hover the cursor over the title the following error message is displayed:
> **Error: IP 25G License: Not Present. Inserted 25G SFPs will not function.**

> **Note:** If you insert a 100G QSFP28 in either the QSFP28 3 or 4 module cages without a 100G IP license (**LPX500-IP-100G**) installed, the Instrument title changes color to red. If you hover the cursor over the title the following error message is displayed:
> **Error: IP 100G License: Not Present. Inserted 100G QSFPs will not function.**

SFP 1/3 - Network Stats		Link Speed: 25 Gbps FEC Mode: RS-CL108
	Rx Cumulative	Tx Cumulative
Packets:	72797576920	822167
Good Packets:	72797576919	822167
Bytes:	98588745133090	73726824
Bad FCS:	0	N/A
Multicast:	72783225498	734089
Unicast:	66588	88026
Broadcast:	14284833	52
VLAN:	0	0
Packets by size (bytes):		
64:	14872307	496601
65 to 127:	8070220	305690
128 to 255:	302982	0
256 to 511:	4785	52
512 to 1023:	8079	19824
1024 to 1518:	72774318547	0
1519 to 1522:	0	0
1523 to 1548:	0	0
1549 to 2047:	0	0
2048 to 4095:	0	0
4096 to 8191:	0	0
8192 to 9215:	0	0

Figure 8-4: SFP 1/3 - Network Stats Instrument (Full Screen Size)

Two counters at the bottom of the expanded Network Stats window display the **FEC Corrected** and **FEC Uncorrected** packet counts. If forward error correction is disabled in the options menu (NO-FEC), then these counters both display: N/A.

Instrument Menu Options

The options menu allows you to enable or disable forward error correction method for the type of SFP/QSFP interface installed in your unit.

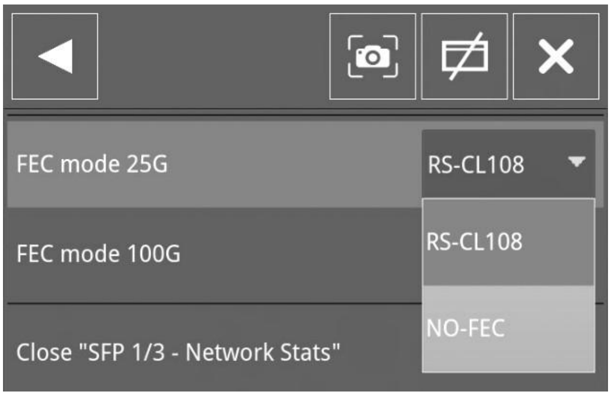


Figure 8-5: SFP 1/3 - Network Stats Instrument Options Menu

The following table lists the configurable parameters in the SFP 1/3 or SFP 2/4 - Network Stats options menu:

Table 8-2 : SFP 1/3 or SFP 2/4 - Network Stats Options

Item	Options	Description
FEC mode 25G	RS-CL108 (Default) NO-FEC	**RS-CL108**: Enable Reed Solomon Forward Error Cor- rection, IEEE 802.3 Clause 108 - the default mode for 25G SFP28s. **NO-FEC**: Disable Forward Error Correction if network equipment does not support Reed Solomon FEC.
FEC mode 100G	RS-CL91 (Default) NO-FEC	**RS-CL91**: Enable Reed Solomon Forward Error Cor- rection, IEEE 802.3 Clause 91 - the default mode for 100G QSFP28s. **NO-FEC**: Disable Forward Error Correction if network equipment does not support Reed Solomon FEC.

Note: Firecode/Base-R forward error correction is not currently supported by the unit.

IP Receive - Interpacket Timing

Overview

A single **IP Receive - Interpacket Timing** window displays the interpacket arrival timings, in each second, for a single flow of the following types:

- **ST 2022-6 IP Input:** You can switch between the flows received on SFP 1, or SFP 2, or both SFP 1+2, by selecting from the options menu of the IP Receive - Flows instrument.
- **ST 2110 IP Input:** You can switch between IP flow types (VID, AUD 1, AUD 2, and ANC) by select- ing from the dropdown list in the instrument options menu. In addition, you can switch between the flows received on SFP 1, or SFP 2, or both SFP 1+2, by selecting from the options menu of the IP Receive - Flows instrument.

The instrument provides analysis of the IP media flow packet reception, and gives a real-time indication as to the health of the received media flow.

The histogram displays the distribution of all packet arrival intervals, for the selected flow, within a given second, together with the mean, minimum, and maximum packet intervals for this period.
Outlier times, significantly longer than the expected mean, may indicate significant delays in packet propagation, or may be indicative of a gapped linear video sender. A high occurrence of such long intervals is characteristic of high jitter in a network.

Features of the Interpacket Timing window include:

- Stream health reporting using a histogram to visualize the distribution of interpacket arrival times (with dynamic auto-scaling provided).
- Packet counts (log or linear scales) mapped against arrival times (µs).
- Easy diagnosis of congestion with maximum, mean and minimum interpacket arrival times.
- Zoom capability (and linear Y-axis scale) for closer inspection of narrow distribution regions.
- Touch controls to center, select range, and reset range as follows:
    - Single tap to center on the mouse position without zooming. This can be used to pan left and right through the histogram.
    - Touch and drag to zoom in on the highlighted range. The selected area has a faint green highlight.
    - Open the options menu and tap the **Reset Scale** control, available when Scaling is set to Manual. This reverts the scale to a range where it shows all the data based on the cur- rent Min and Max values.
- Mouse controls (when working remotely) to center, select range, and reset range as follows:
    - Single left-click to center on the mouse position without zooming. This can be used to pan left and right through the histogram.
    - Click and drag to zoom in on the highlighted range. The selected area has a faint green highlight.
    - Single click of the middle mouse button to reset the scale. This reverts the scale to a range where it shows all the data based on the current Min and Max values. You can also reset the scale by selecting the **Reset Scale** control in the instrument options menu, available when Scaling is set to Manual..

Interpacket Timing with ST 2022-6 IP Input

With ST 2022-6 IP input you can select a single video flow for analysis in the Interpacket Timing instrument. The interpacket timing window displays the arrival time of packets, sampled over one second, where a packet contains video, audio and ancillary data.

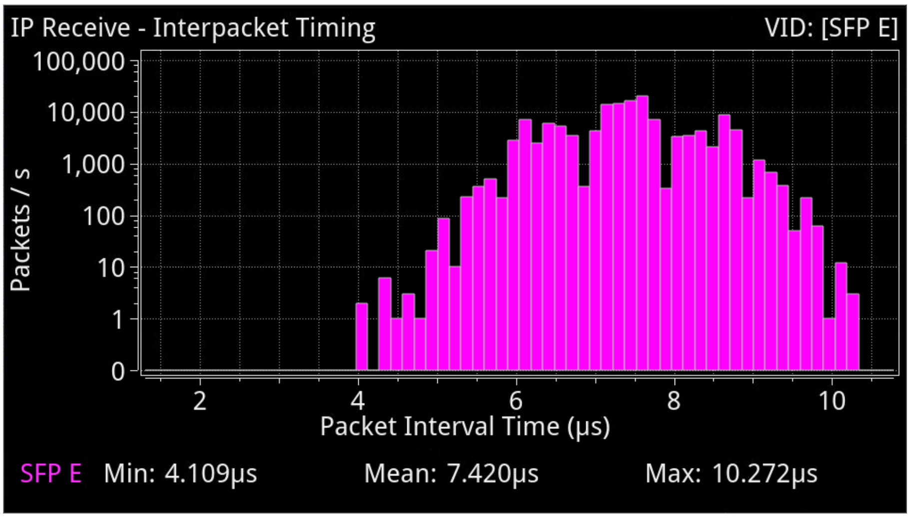


Figure 8-6: IP Receive - Interpacket Timing Instrument (ST 2022-6 IP Input)

When SFP 1 and 2 histograms are displayed together, as shown in the following screen, the unit uses SMPTE ST 2022-7 Seamless Protection Switching (SPS) to reconstruct error free ST 2022-6 packets from the flows on both SFP 1 and SFP 2.

- SFP 1 histograms are pink
- SFP 2 histograms are cyan
- SFP 1 + 2 overlaid histograms are purple where they overlap.

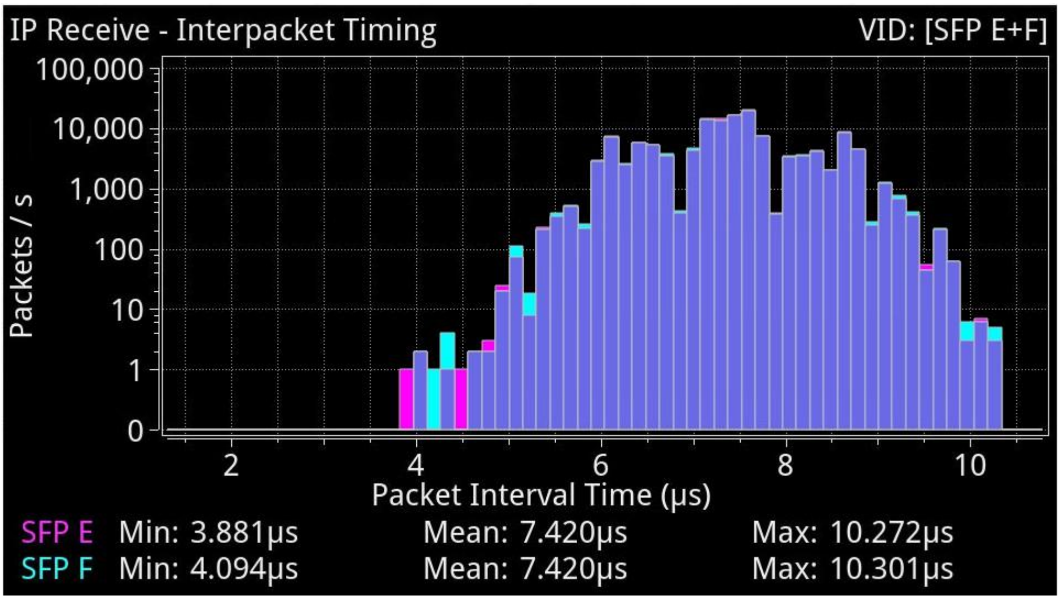


Figure 8-7: IP Receive - Interpacket Timing Using SMPTE ST 2022-7 SPS on Both SFP 1 and 2

Note: The control for selecting SFP 1, SFP 2 or SFP 1 + 2 (Seamless 1 +2) is available from the dropdown menu of the parameter **2022-7 Mode Selection** in the **IP Receive – Flows** instrument options menu.

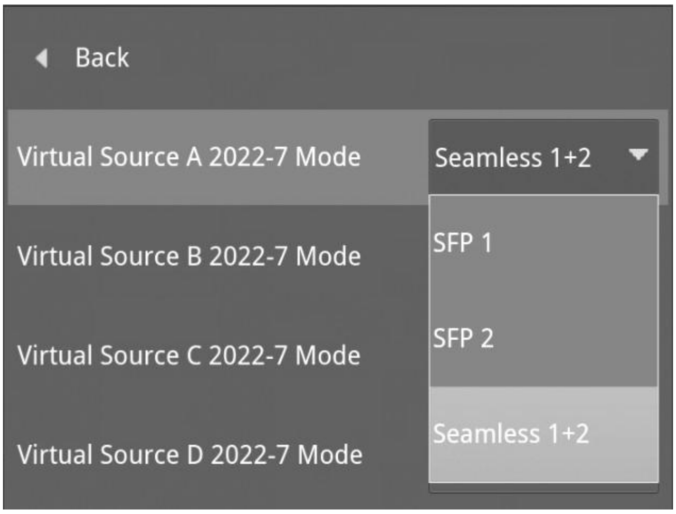


Figure 8-8: SMPTE ST 2022-7 Mode Selection of Seamless 1+2 in IP Receive - Flows

- Select **Seamless 1+2** for **2022-7 Mode Selection** to make a single flow, reconstructed from the flows selected on both SFP interfaces, available for analysis.
- Select **SFP 1** to make only SFP 1 flows available for analysis.
- Select **SFP 2** to make only SFP 2flows available for analysis.

For more information, see the section *IP Receive - Flows* (IP Input). Instrument Menu Options (ST 2022-6 IP Input)

The menu options available for ST 2022-6 IP Input are as follows:

Table 8-3 : IP Receive - Interpacket Timing Menu Options (ST 2022-6 IP Input)

Item	Options	Description
IP Flow Group	IP A (Default) IP B IP C (Optional) IP D (Optional)	Select the flow group for analysis. To be completed
Flow	VID: [SFP 1] VID: [SFP 2] VID: [SFP 1+2]	Available options depend on the setting of the **2022-7 Mode Selection** parameter in the IP Receive - Flows options menu. This is the only flow required for ST 2022-6 IP input, where the packets contain all video, audio and ancillary data.
Y-Axis Scale	Log10 (Default) Linear	Select whether to plot the number of received packets on the vertical (Y) axis using either a logarithmic or linear scale.
Scaling	Auto (Default) Manual	Select how to control the histogram plot scaling. When using the zoom features, the Scaling setting will default to Manual mode. When Manual scaling is selected, you can reset by clicking the **Reset Scale** option, which becomes available.

Interpacket Timing with ST 2110 IP Input

With ST 2110 IP input, one video flow, two audio flows, and a single ancillary flow are available for selection.

> **Note:** Monitoring of audio flows **AUD 3** and **AUD 4** is not supported in the current software release.

The Interpacket Arrival Time window can be switched to display the interpacket timing histograms of the flows on either SFP 1, SFP 2 or SFP 1 + 2 with the two sets of histograms overlaid on top of each other. The following screen shows the interpacket timing for the flows on SFP 1.

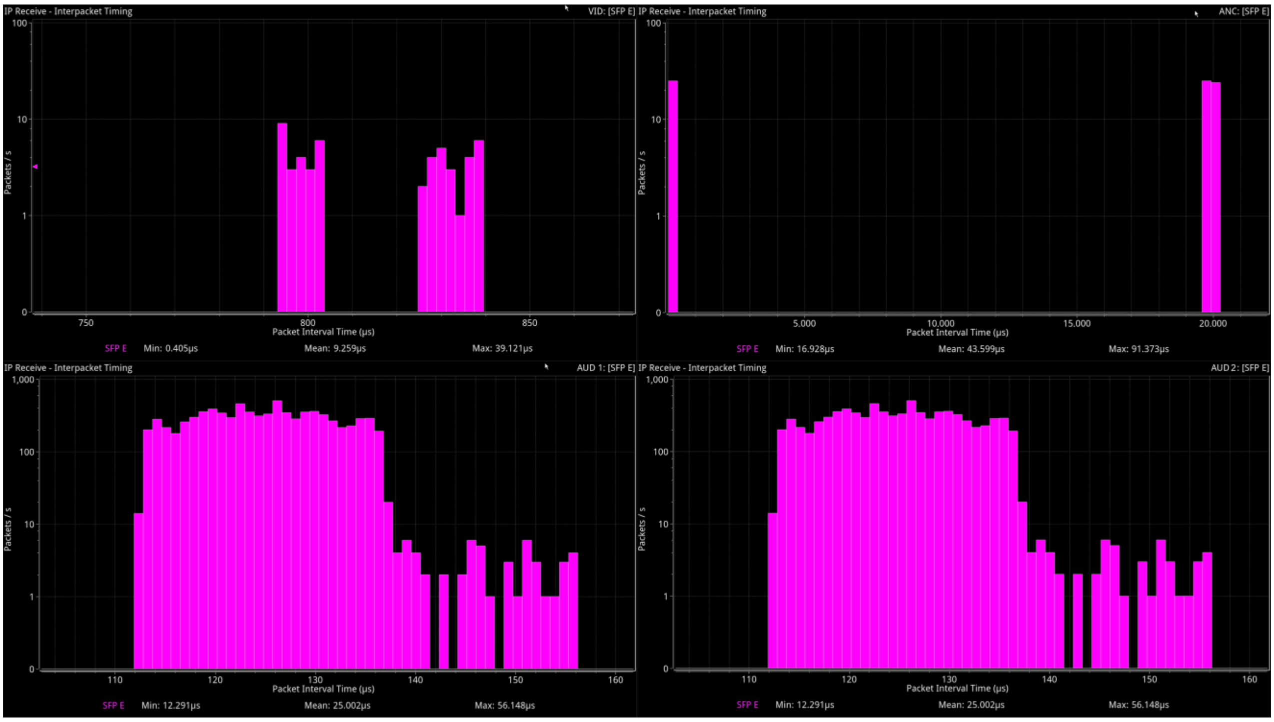


Figure 8-9: IP Receive - Interpacket Timing for ST 2110 IP Input

When SFP 1 and 2 histograms are displayed together, as shown in the following screen, the unit uses SMPTE ST 2022-7 Seamless Protection Switching (SPS) to reconstruct error-free Video, Audio and ANC from the flows on both SFP 1 and SFP 2.

- SFP 1 histograms are pink
- SFP 2 histograms are cyan
- SFP 1 + 2 overlaid histograms are colored purple where they overlap.

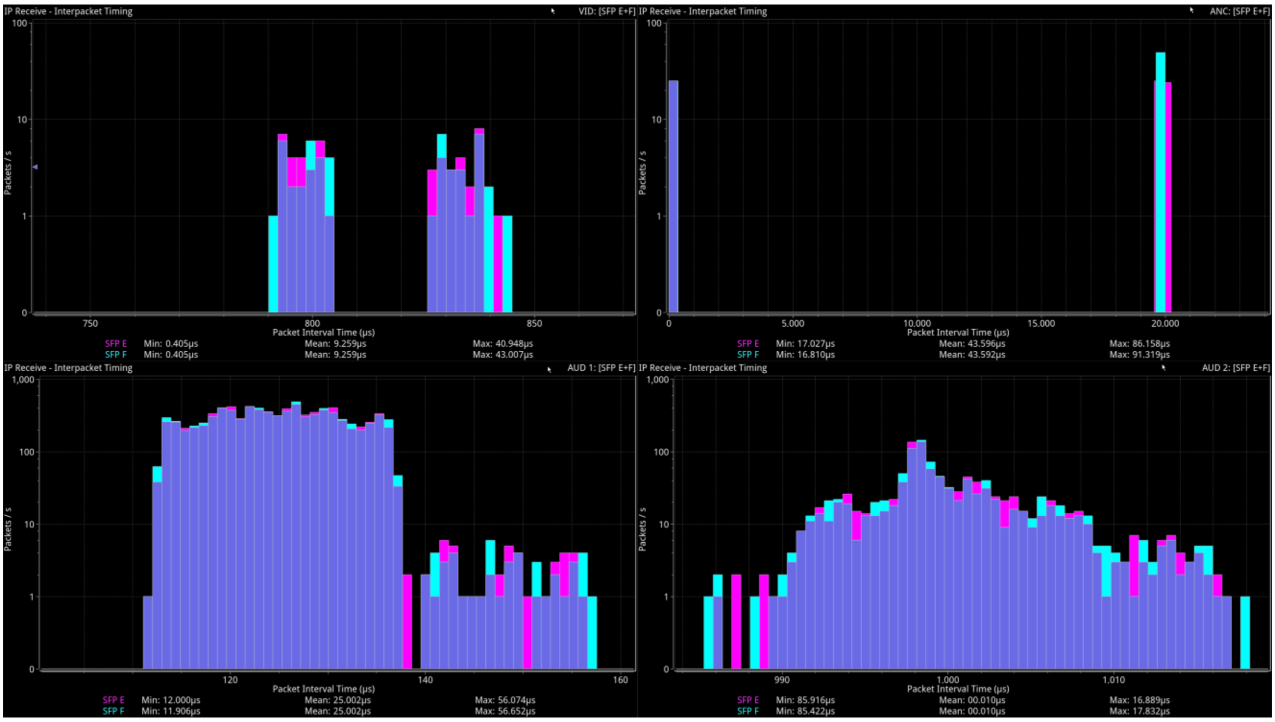


Figure 8-10: IP Receive - Interpacket Timing Using SMPTE ST 2022-7 SPS on Both SFP E and F

> **Note:** The control for selecting SFP 1, SFP 2 or SFP 1 + 2 (Seamless 1 + 2) is available from the dropdown menu of the parameter **2022-7 Mode Selection** in the **IP Receive – Flows** instrument options menu.

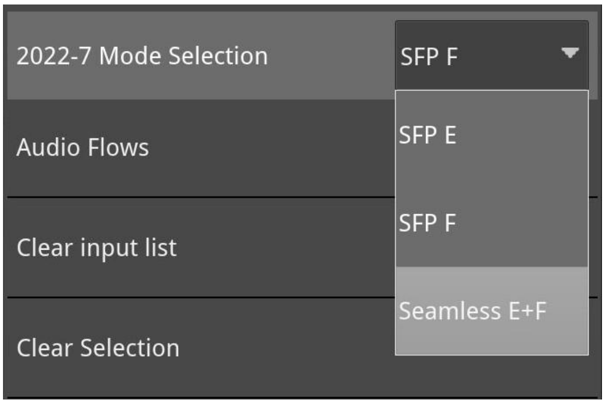


Figure 8-11: SMPTE ST 2022-7 Mode Selection of Seamless 1+2 in IP Receive - Flows

- Select **Seamless 1+2** for **2022-7 Mode Selection** to make a single flow, reconstructed from the flows selected on both SFP interfaces, available for analysis
- Select **SFP 1** to make only SFP 1 flows available for analysis
- Select **SFP 2** to make only SFP 2 flows available for analysis.

For more information, see the section *IP Receive - Flows* (IP Inputs). Instrument Menu Options (ST 2110 IP Input)

The following shows the options available in the instrument options menu:

Figure 8-12: IP Receive - Interpacket Timing Menu Options

The menu options available for ST 2110 IP input are as follows:

Table 8-4 : IP Receive - Interpacket Timing Menu Options (ST 2110 IP Input)

Item	Options	Description
Flow Group	IP A (Default) IP B IP C (Optional) IP D (Optional)	Select the flow group for analysis. To be completed
Flow	VID: [SFP 1], AUD 1: [SFP 1], AUD 2: [SFP 1], ANC: [SFP 1]	Select a flow to display in the active window. **Note:** Available flows are dependent on the option selec- ted in **2022-7 Mode Selection** of the **IP Receive – Flows** Instrument.
Y-Axis Scale	Log10 (Default) Linear	Select whether to plot the number of received packets on the vertical (Y) axis using either a logarithmic or linear scale.
Scaling	Auto (Default) Manual	Select how to control the histogram plot scaling. When using the zoom features, the Scaling setting will default to Manual mode. When Manual scaling is selected, you can reset by clicking the **Reset Scale** control, which becomes available.

9

Content Analysis Instruments

This chapter describes the Instruments used to analyze the quality of the video signal and includes the following sections:

- Analyzer - Picture
- Analyzer - Waveform
- Analyzer - Vectorscope
- Analyzer - RGB Vector Display

> **Note:** For the optional Analyzer - CIE Chart, see *Analyzer - CIE Chart* in the Chapter *HDR Analysis Instruments*.

Analyzer - Picture

Overview

The **Picture** window shows the video input currently being analyzed by the unit. Double-tap or -click anywhere in the window to resize it between:

- One sixteenth (1/16) of the screen
- One quarter (1/4) of the screen
- Full screen.

Some features of the Picture instrument are dynamically linked to the Dataview and Waveform analyzer instruments to enable more precise, real-time analysis of the picture.

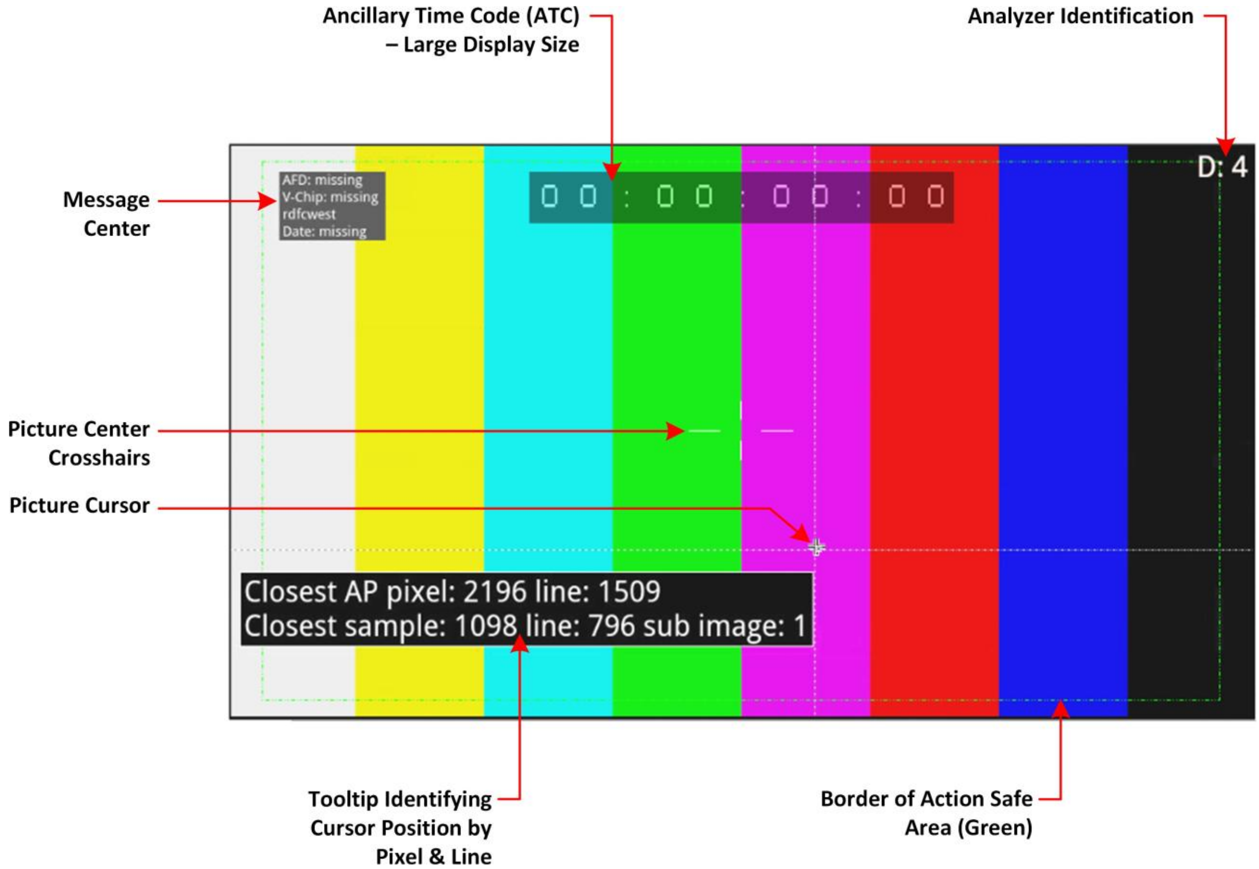


Figure 9-1: Components of the Analyzer - Picture Instrument

In addition to displaying the video picture, you can configure the Picture instrument to overlay various data elements, extracted from the ancillary data in the signal, for quality control purposes, including:

- Closed Captions
- Ancillary Time Code (ATC)
- Picture Cursor and Position Tooltip
- Picture Safe Area
- Picture Center Crosshairs
- Message Center displaying V-chip, AFD, Input Name, ST309 Date, and SCTE104 data

(depend- ing on configuration)

- HDR False Color Overlay and Grayscale Mode (HDR Mode Only). See the section *HDR Heat- map (False Color Overlay)* for more information.

Picture Aspect Ratios

The Picture window features set scaling functionality so that you can view the signal's full picture. These scaling functions enable the source video input to fill the standard 1920 x 1080 (16:9) Picture window with the maximum possible image size.

To scale an image to fit the window correctly, the unit will automatically insert borders either at the top and bottom sides of the window - referred to as **Letter-boxing** - or at the left and right sides of the window - referred to as **Pillar-boxing**, see *Figure 9-2*.

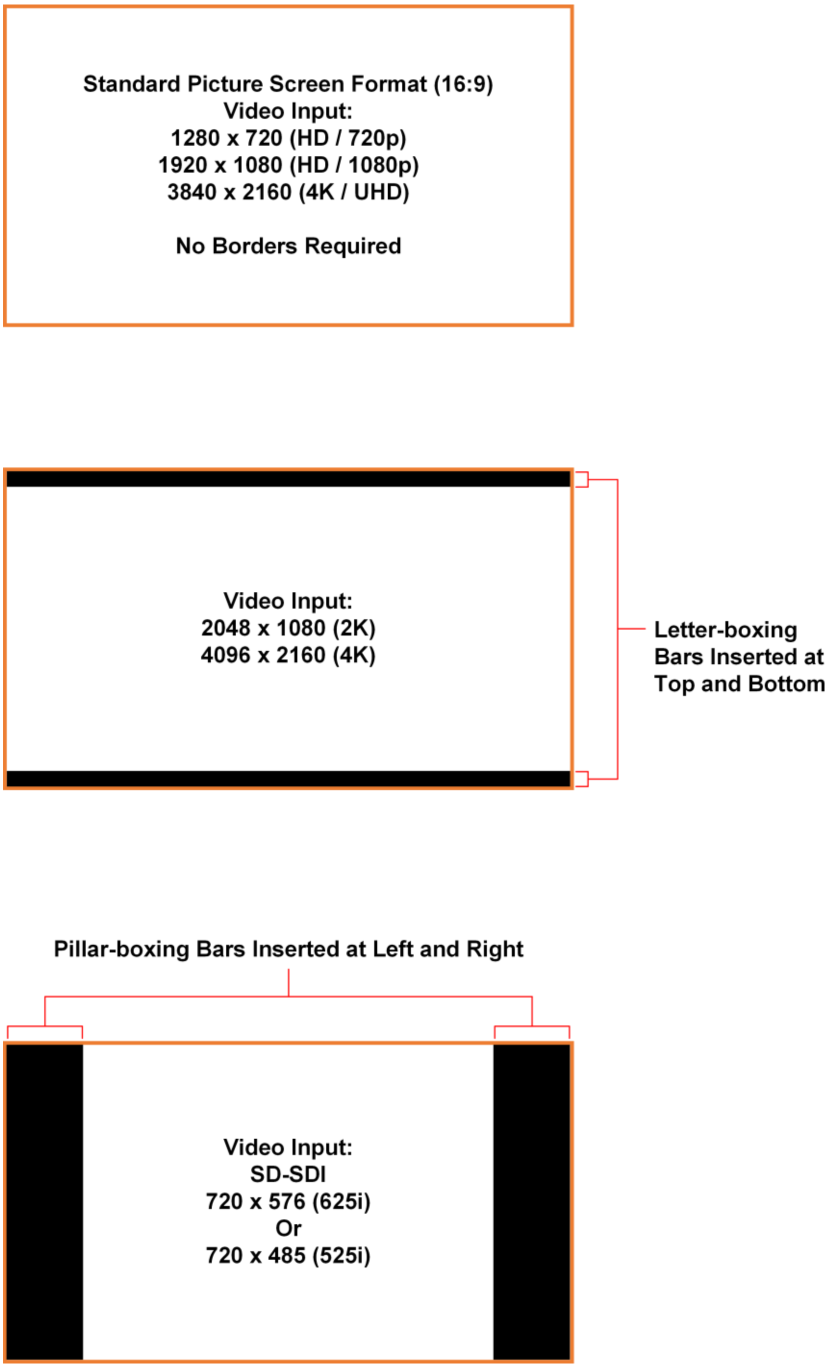


Figure 9-2: Letter-boxing and Pillar-boxing in Picture Instrument

The following table shows where pillar-boxing and letter-boxing borders are displayed:

Table 9-1 : Picture Framing by Screen Resolution

Screen Resolution	Type of Picture Framing Required
SD-SDI 525i: 720 x 485	Scaled to a 4:3 aspect ratio. Pillar-box borders added to left and right sides
SD-SDI 625i: 720 x 576	Scaled to a 4:3 aspect ratio. Pillar-box borders added to left and right sides
1280 x 720	Scales to fit 16:9 aspect ratio of Picture window. No additional borders required.
1920 x 1080	Scales to fit 16:9 aspect ratio of Picture window. No additional borders required.
2048 x 1080	Scaled to a 16:9 aspect ratio. Letter-box borders added to top and bottom sides
3840 x 2160	Scales to fit 16:9 aspect ratio of Picture window. No additional borders required.
4096 x 2160	Scaled to a 16:9 aspect ratio. Letter-box borders added to top and bottom sides

Instrument Menu Options

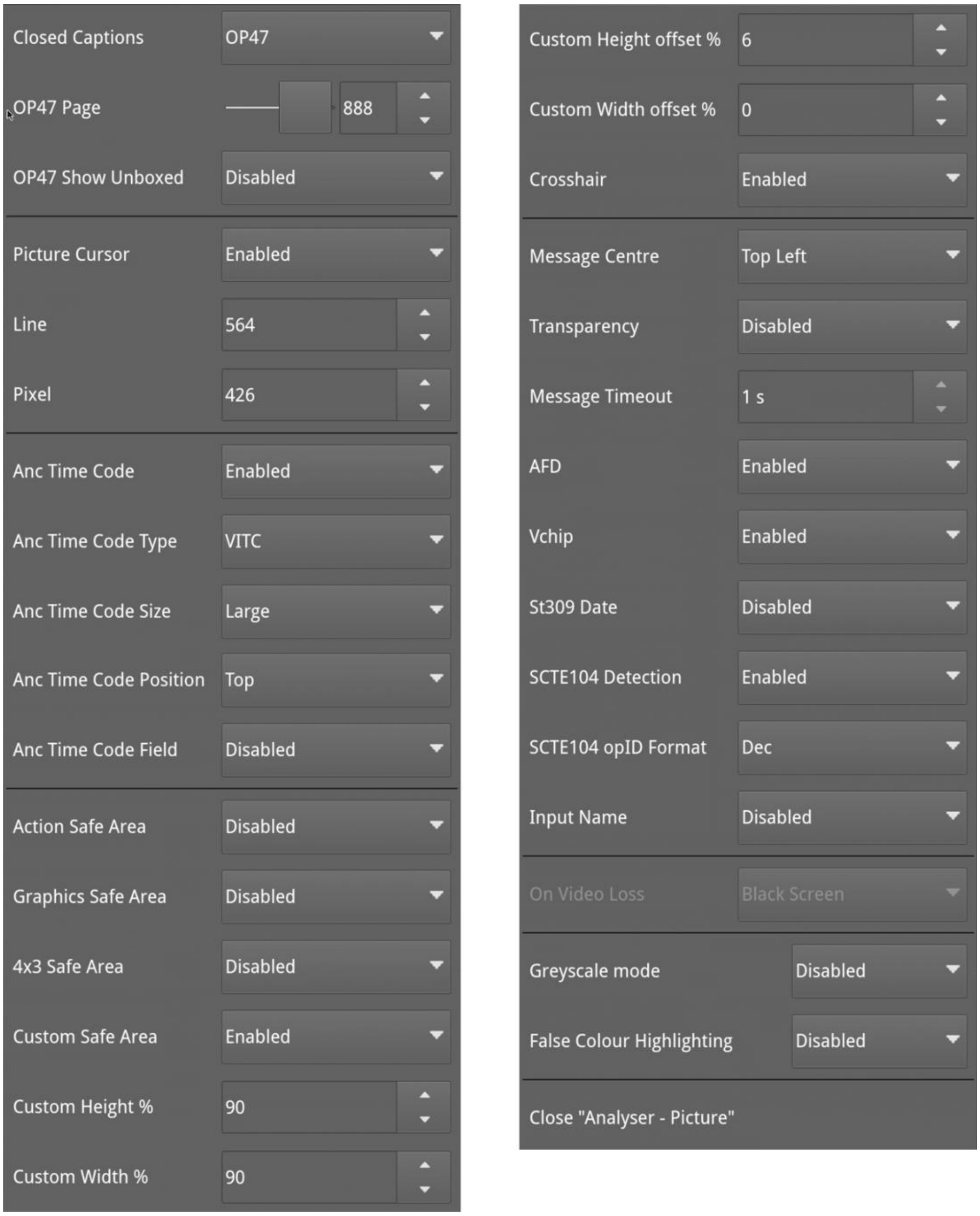


Figure 9-3: Analyzer - Picture Instrument Options Menu (Including Option LPX500-HDR)

The following table lists the standard options available in the Analyzer - Picture Instrument submenu:

Table 9-2 : Menu Options for the Analyzer - Picture Instrument

Item	Options	Description
Closed Captions	Disabled (Default)	Disables the detection of close captions in the ancillary data. When enabled, by selecting one of the following closed caption options, the unit can detect closed captions carried in the ancil- lary data.
	OP47	Enables the detection of OP47 standard closed captions in the ancillary data. This displays an additional menu entry: **OP47 Page**.
	OP47 Page	Select the desired OP47 page containing the relevant closed captions, using the slider or scrolling through page numbers in the range: 100 to 8ff.
	OP47 Show Unboxed	Select to display outside-of-box subtitles (closed captions) outside the permitted area for closed captions. When enabled, this menu item is displayed in yellow font to alert you that the subtitles are being displayed outside the usual display area. If you hover the cursor over this option, when enabled, you will see the following warning displayed: "**Warning: OP47 unboxed captions are being shown, these characters should not be displayed by decoders when bit C6 (subtitle) is set.**" This option is disabled by default.
	608	Enables the detection of CEA 608 standard closed captions in the ancillary data. This displays an additional menu entry enabling you to select the desired target field to contain the CEA 608 format closed captions. **Note:** 608 closed captions are not supported for SD-SDI, use the option **608 in 708** if you need to process 608 closed captions for analog TV.
	608 in 708	Select to display 608 in 708 standard closed captions in the pic- ture window for high definition (HD) video. This displays an addi- tional menu entry enabling you to select the field from which to read the closed captions.
	608 Field	Select the desired field for the 608 captions, from either **Field 1** or **Field 2**.
Picture Cursor	Disabled (Default) Enabled	When enabled, this feature is dynamically linked to both the Waveform and Dataview analysis instruments so that meas- urements from the selected picture position can be taken from these tools at the same time. Allows you to select a specific line and pixel in the picture. When you specify the line and pixel numbers, the unit positions a visible crosshair at that position. You can change the location of the crosshair by tapping or click- ing a different position in the Picture window. **Line**: Line one to maximum number of active lines for the cur- rent standard. **Pixel**: Pixel zero to maximum number of active pixels for the cur- rent standard minus one.
Ancillary Time Code (ATC) Display		

Item	Options	Description
Ancillary Time Code	Disabled (Default) Enabled	When enabled, displays the ATC panel in the picture window.
Ancillary Time Code Type	VITC (Default) LTC	When ATC is enabled, choose whether to display the vertical interval time code (VITC) or the linear time code (LTC) .
Ancillary Time Code Size	Small Medium Large Auto	Increases or decreases the displayed size of the ATC panel in the window. The Auto option adjusts the size of the time code panel automatically, depending on the displayed size of the instrument window.
Ancillary Time Code Position	Botto m Middle Top	Adjusts the displayed position of the ATC panel on the vertical center-line of the window.
Ancillary Time Code Field	Disabled (Default) Enabled	Activates an optional final digit, in the furthest-right position of the time code, to display a field identification flag for either 25 Hz or 24/30 Hz.
Safe Area Generation		
Action Safe Area	Disabled (Default) Enabled	When enabled, displays a 16:9 safe area border for actions as a green, dashed border.
Graphics Safe Area	Disabled (Default) Enabled	When enabled, displays a 16:9 safe area for graphics as a red, dashed border.
4x3 Safe Area	Disabled (Default) Enabled	When enabled, displays a 4:3 safe area as a cyan, dotted bor- der.
Custom Safe Area	Disabled (Default) Enabled	When enabled, displays a user-defined, custom safe area as a white, dashed border.
Custom Height %	Enter percentage	Specifies the custom safe area height as a percentage of the picture window height, by adjusting the top and bottom margins of the safe area.
Custom Width %	Enter percentage	Specifies the custom safe area width as a percentage of the full picture window width, by adjusting the left and right margins of the custom safe area.
Custom Height Offset %	Enter percentage	The offset refers to an adjustable, vertical offset of the center of the custom safe area from the origin of the picture window (location of the crosshair, when enabled). Initially, the center of the custom safe area is located at the origin of the picture window. The custom height offset % is calculated as a percentage of the distance between the crosshair origin and the top or bottom border of the picture window. The offset can be positive (moves the custom safe area down) or negative (moves the custom safe area up).

Custom Width Offset %	Enter percentage	The offset refers to an adjustable, horizontal offset of the center of the custom safe area from the origin of the picture window (location of the crosshair, when enabled). Initially, the center of the custom safe area is located at the origin of the picture window. The custom width offset % is calculated as a percentage of the distance between the crosshair origin and the left or right border of the picture window.

Item	Options	Description
		The offset can be positive (moves the custom safe area right) or negative (moves the custom safe area left).
Crosshair	Disabled (Default) Enabled	When enabled, displays a crosshair to indicate the center (origin) of the displayed image in the picture window.
Message Center Display		
Message Center	Top Left Top Right Bottom Left Bottom Right	Defines the position of the Message Center panel in the picture window. The message center displays messages decapsulated from the ancillary data packets and includes ST309 Date, SCTE 104, AFD and V-Chip, etc.
Transparency	Disabled (Default) Enabled	When enabled, applies a transparent background to the message center in the picture window.
Message Timeout (secs)	1 to 10 seconds	Defines the length of time in seconds dynamic SCTE104 messages are displayed in the message center. SCTE104 messages are removed from the message center after the timeout period.
AFD	Disabled (Default) Enabled	Activates the display of AFD markers in the message center of the picture window.
Vchip	Disabled (Default) Enabled	Activates the display of V-chip markers in the message center of the picture window.
ST309 Date	Disabled (Default) Enabled	Activates the display of the date in the message center using ST 309 date format: **dd mmm yyyyy**.
SCTE104 Detection	Disabled (Default) Enabled	Activates the detection of SCTE104 packets in the ancillary data and displays the message OpID, indicating the message type, in the selected hex or decimal format.
SCTE 104 OpID Format	Decimal (Default) Hexadecimal	Defines whether to display the OpID of the SCTE104 message type in decimal or hex format.
Input Name	Disabled (Default) Enabled	Displays the configured source input name of the video, for example, the ID of the originating camera.
Input Name Configuration...	Opens Input Name Configuration dialog	Use the Input Name Configuration dialog to enter a source input name manually or to extract a name from the ancillary data.
On Video Loss (ST 2110 Only)	Black Screen (Default) Freeze Last Screen	Choose what should be displayed in the picture window if the unit loses the video signal.

Closed Captions

Closed captions (or subtitles in Europe) are the text-based, encoded information included in the ancillary data of the video signal, which can optionally be displayed by the viewer. The unit can detect closed captions carried in the ancillary data and display them, when enabled, in the Analyzer - Picture Instrument for monitoring purposes.

The following closed caption formats are supported:

- **OP-47** (or SMPTE RDD-08): European and Australian standard for closed captions/subtitles on HD TV. Supports the following languages: Czech, English, Finnish, French, German, Hungarian, Italian, Portuguese, Slovakian, Spanish and Swedish
- **608** and **608 in 708**: CEA-608 (or EIA-608) is a legacy US standard for closed captions. CEA- 708 is the current US standard for closed captions on HD TV and is backward compatible with

CEA-608. CEA-708 acts as a wrapper for embedded CEA-608 closed captions, enabling the unit to extract 608-standard closed captions from 708-standard ancillary data. Supports the fol- lowing languages: Danish, English, Finnish ,French, German, Italian, Portuguese, Spanish and Swedish.

Note: Legacy 608 (Line 21) closed captions are not supported for SD-SDI. Select the closed caption option **608 in 708** if you need to process analog TV 608 closed captions for SD-SDI video.

When configuring the Analyzer - Picture instrument to display closed captions, use the Ancillary Status and/or Ancillary Inspector instruments to establish which closed caption system is present in the video signal. The Ancillary Status display will indicate the presence of CEA-608, CEA-708 or OP- 47 data packets in the vertical ancillary area of the SDI signal. You can then select the corresponding closed caption option from the Analyzer - Picture menu.

To display closed captions in the Picture view, enable one of the **Closed Captions** options from the Analyzer - Picture menu and select the desired target page (OP47) or field (608 and 608-in-708) for the appropriate standard.

When enabled, closed caption text is displayed in the Picture area as defined by the format of the selected closed caption standard.

Figure 9-4: Closed Captions in the Picture Instrument

The CEA-708 closed caption system (used in the USA and Canada for HD video embeds information in the VANC area of the HD-SDI video framework and uses data identifier (DID) 0x61 (Hex) for the Caption Distribution Packet (CDP). Typically this supports up to 6 different closed caption streams (or services).

The OP-47 closed caption system (used in Europe and Australia for HD SDI) embeds closed caption text in the VANC area of the HD-SDI video signal using DID 0x43 (Hex). This system supports closed caption pages in the range 0x100 to 0x8FF (Hex).

Comparing Multiple Picture Instruments

The LPX500 enables you to open an instance of the **Analyzer - Picture** Instrument for each active analyzer. With the standard dual analyzer unit, you can have two Picture windows open simultaneously. With an optional quad analyzer unit, you can open four Picture windows simultaneously.

To compare different features of the source input side-by-side, you can assign the same input to both (dual units) or all analyzers (quad units). For example, when positioned together, you might use the

multiple Picture windows to monitor closed captions in different languages, or to compare different screen safe areas, or even false color highlighting (HDR only).

Open two Analyzer - Picture instruments in a **multi unlinked** layout as follows:

1. Tap or click  to open the first **Analyzer - Picture** Instrument from the **Instruments** tab of the Setup menus.
2. Open the **Instruments** tab again and select a second **Analyzer - Picture** instrument.
3. Open the **Settings** tab of the Setup menus again and launch the **Analyzer Input Assignment** dialog.
4. With the input for analysis connected to one of the SDI In BNCs on the rear panel, assign that input for comparison to two analyzers.

You can now apply different elements to the Picture windows using the options menus, including:

- Ancillary Time Code
- Picture Cursor
- Closed Caption Standard
- OP-47 page
- All optional HDR functions, see the section *HDR Heat-map (False Color Overlay)*.
- Picture Safe Areas and Image Center Crosshairs
- Activation of Picture Cursor
- Field for 608 or 608-in-708 closed captions
- All Message Center features.

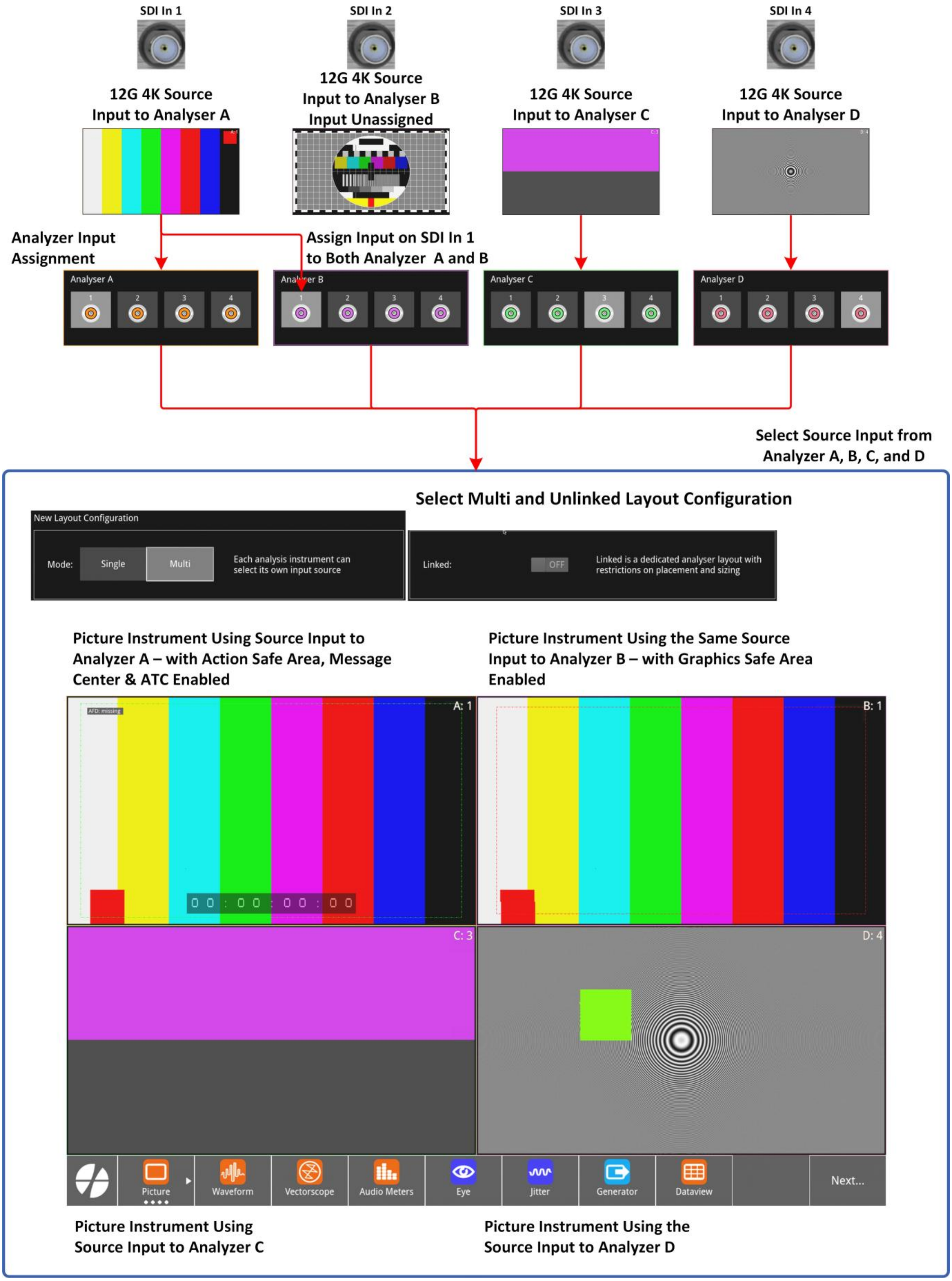


Figure 9-5: Comparison of SDI In 1 Source Input to Analyzers A and B Simultaneously (Optional Quad Analyzers)

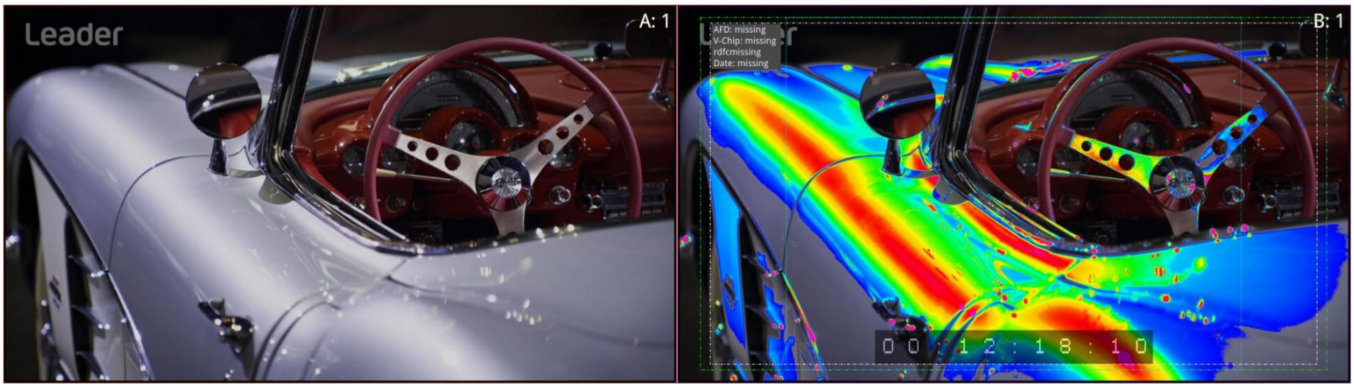


Figure 9-6: Comparison of Picture Features SDI In 1 Source Input to Analyzers A and B

Monitoring Closed Captions in Multiple Picture Instrument Windows

If required, you can open up to four Analyzer - Picture instruments (one for each analyzer) to have up to four Picture windows open at the same time. You can use this feature to monitor closed captions in a different language alongside the original language.

Select different language closed captions in dual Picture windows as follows:

1. In the both Picture windows, select either of the closed caption standards: 608 or 608-in-708.
2. In the first Picture window, set the option **608 Field** to **Field 1**.
3. In the next Picture window, set the option **608 Field** to **Field 2**.
   The unit will now source the closed captions from the two different fields.

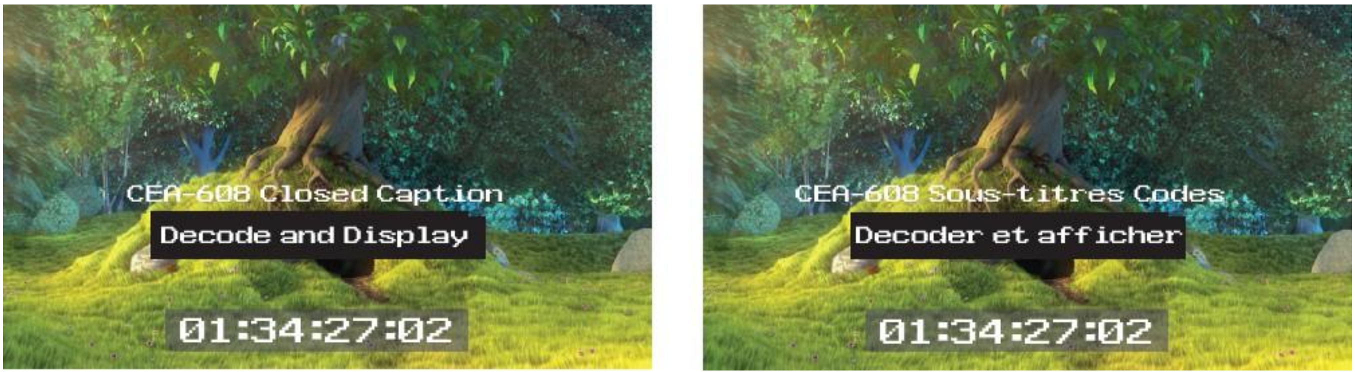


Figure 9-7: Two Analyzer - Picture Instruments Showing Closed Caption Panel

Picture Cursor

The Picture Cursor consists of two intersecting horizontal and vertical dashed lines. With the option **Picture Cursor** enabled, either tap or click anywhere inside the window boundary to position the intersection of the cursor. Alternatively, and more precisely, you can specify the exact position using the Line and Pixel options in the menu. The **Line** value adjusts the vertical position of the picture cursor and the **Pixel** value adjusts the horizontal position.

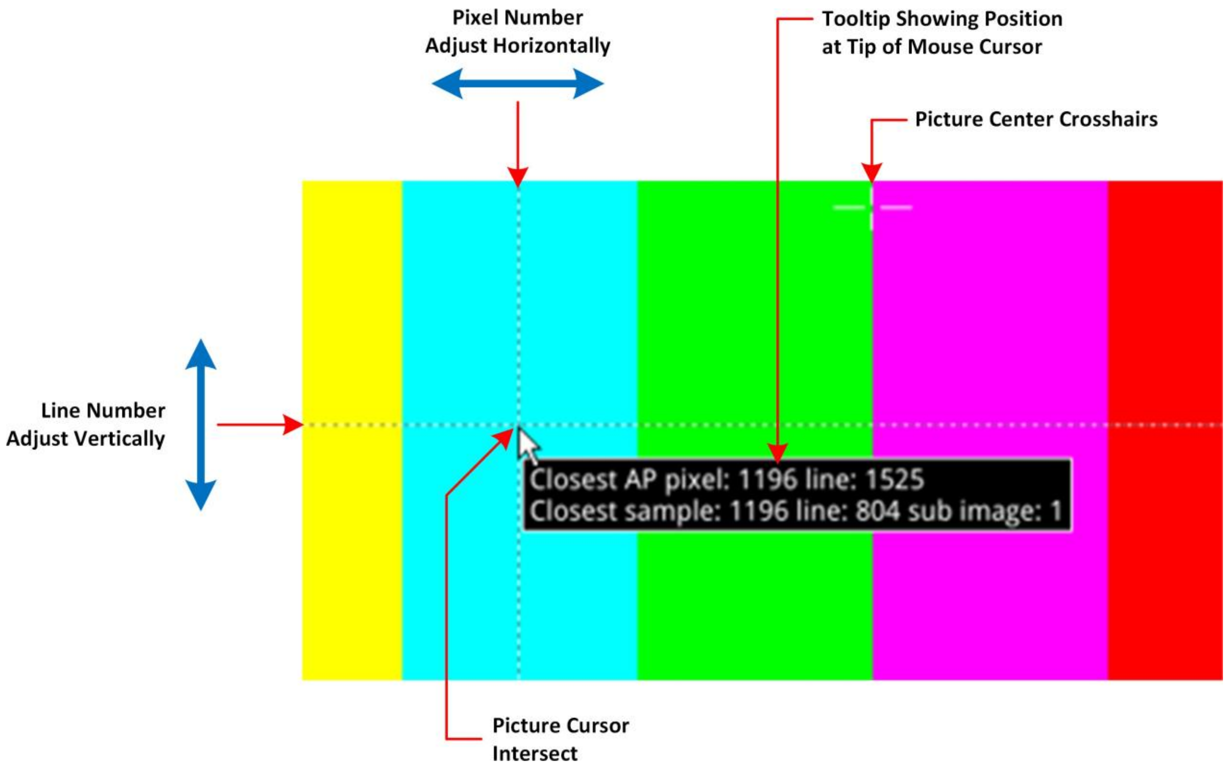


Figure 9-8: Using the Picture Cursor

If you hover the mouse cursor over the position of the picture cursor, the unit displays a tooltip showing the actual mouse cursor position in the picture by line and pixel. This feature is dynamically linked to both the Waveform and Dataview instruments so that measurements from the selected picture position can be taken from these tools at the same time.

Using the Picture Safe Areas

The **Analyzer - Picture** instrument features picture safe areas designed according to the EBU Recommendation R95 "*Safe Areas for 16:9 Television Production*". Picture safe areas define the part of the picture that can be viewed without compromise on a TV or movie screen.

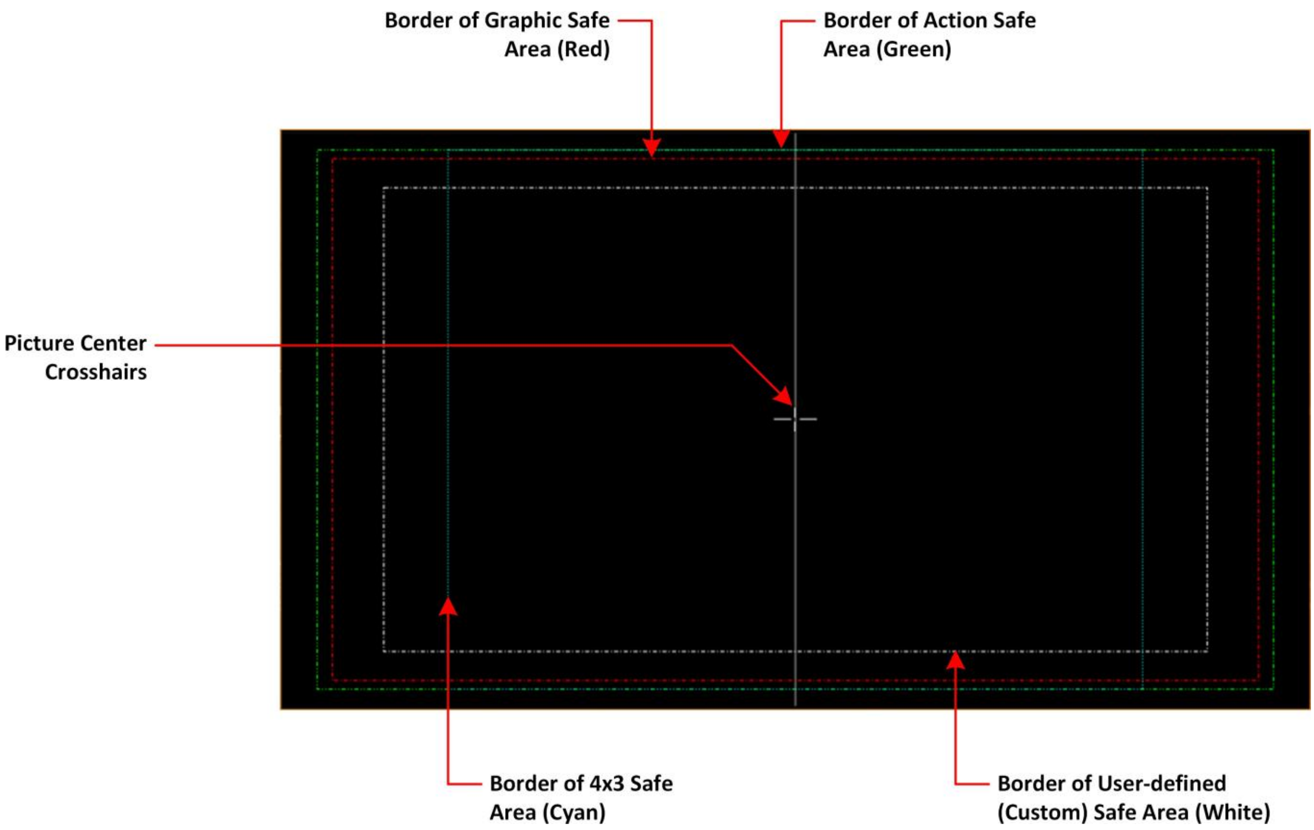


Figure 9-9: Picture Safe Areas Showing Border Colors

The Analyzer - Picture instrument can generate three predefined, independent safe areas for the following:

- **Graphics (16:9):** Smallest of the safe areas; ensures that all essential graphics are protected inside this area. The border of the Graphics safe area is 5% in from all edges of the picture .
- **Action (16:9):** Larger than the Graphics safe area; ensures that all essential program content is protected inside this area. The border of the Action safe area is 3.5% in from all edges of the picture.
- **4x3:** Shows the safe area for HD video to be viewed on domestic TVs still using a 4:3 aspect ratio.

The Picture instrument also includes a facility to generate a user-defined, custom safe area, which enables you to set the height and width of the safe area as a percentage of the picture height and width. In addition, you can also define vertical or horizontal offsets for the custom safe area as a percentage relative to the distance between the side margins (left or right, and top or bottom) and the picture center so that a 100% vertical offset is the distance between the top or bottom of the window and the center of the window.

When enabled, you can display vertical and horizontal crosshairs to mark the center-point of the picture.

The unit currently supports HD 16:9 formats, providing safe areas for 16:9 HD, 3G and UHD picture formats.

By using side-by-side picture windows, where the same source input is assigned to two analyzers, you can compare different picture safe areas. For example, you might compare the safe area of an HD service with a simulation of either a second language HD service or an SD (4:3 or 16:9) version of the service.

For more information, see the EBU Recommendation R95 "*Safe Areas for 16:9 Television Production.*"

Displaying the Picture Safe Areas

Activate a safe picture area in either of the Picture windows as follows:

1. Tap and hold or right-click in the Picture window to open the options menu.
2. To display one of the standard safe areas, select **Enabled** from the corresponding dropdown list. You can differentiate the safe areas by the color of their border, for example:
   - Action Safe Area - Green dashed-line border
   - Graphics Safe Area - Red dashed-line border
   - 4x3 Safe Area - Cyan dashed-line border
   - Custom Safe Area - White dashed-line border
3. To display a custom safe area, set the **Custom Safe Area** to **Enabled**.
   This displays additional fields in which to define the custom safe area, using either:
   - A percentage of the full picture window height or width relative to the top / bottom or left / right borders, or
   - A percentage offset of the custom safe area center from the origin of the picture window.

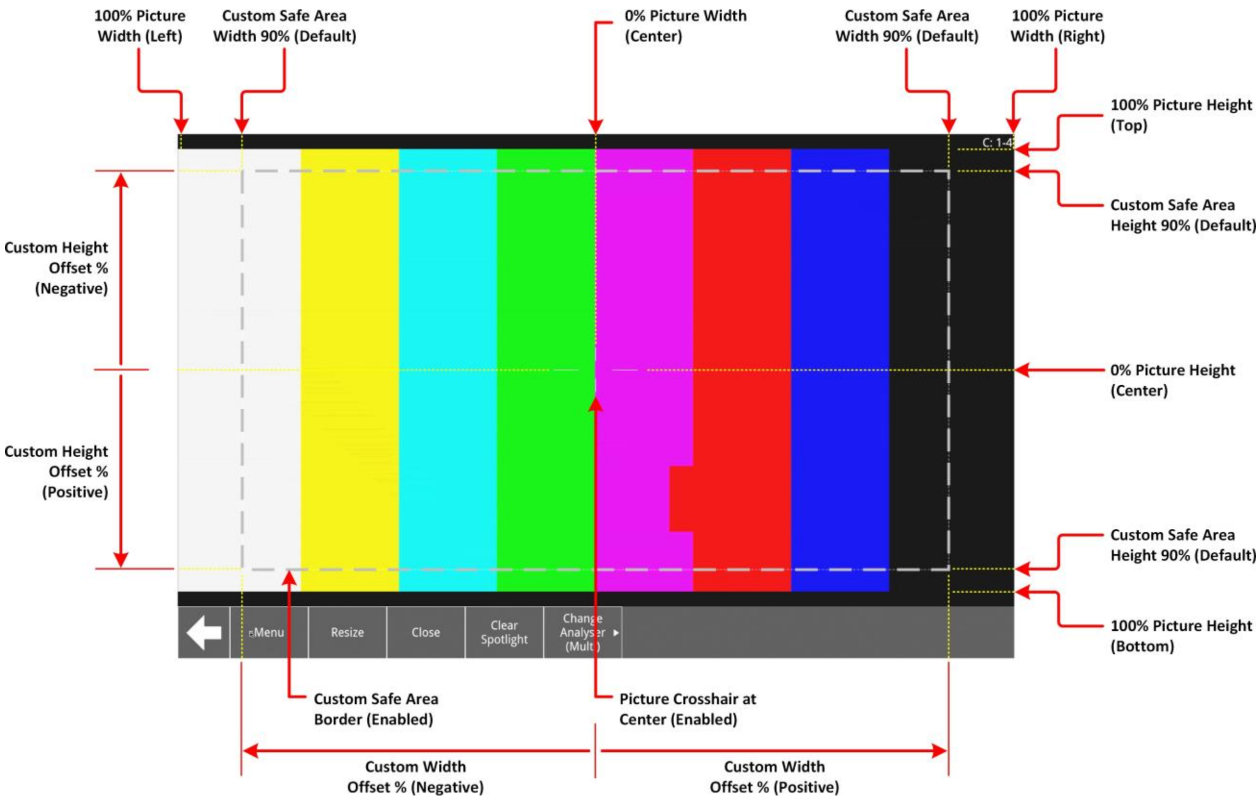


Figure 9-10: Picture - Defining the Custom Safe Area

Using the Picture Message Center

> **Note:** For SD-SDI video input, the unit supports ancillary data as long as it is provided in ANC data packets according to SMPTE ST 291.

The **Message Center** is a designated area of the Analyzer - Picture instrument intended to alert you to the receipt of certain messages transported as packages in the ancillary data stream. The Message Center enables quality control of the source video material, both before and during transmission. On identifying one of the target message types, the Message Center decapsulates the message and displays an appropriate marker, text or ID to reference the message. You can configure the Message Center to display the following:

- **AFD Marker:** The Active Format Description is a set of codes used to identify the aspect ratio of the video signal and the protected areas of the picture.
- **V-chip Marker:** Identifies a parental guidance rating, used primarily in the US and Canada, to categorize age-sensitive material in a TV program. The V-chip hardware in the receiving tele- vision can be configured by the viewer to block certain categories of V-chip ratings as desired.
- **ST309 Date:** The date in ST 309 format: **dd mmm yyyyy**
- **SCTE104 OpID:** The industry standard for including specific program signals and markers in the video signal at various time points, for example, program parts, commercial breaks, etc.
- **Input Name:** The defined source input name of the video stream

V-chip data is included with closed caption data of type CEA-608 or CEA-608-in-708. V-chip data is not currently available with closed captions of type OP-47. If 608 or 608-in-708 closed captions are enabled but unavailable and you then enable the V-chip marker, you will see that the V-chip label in the Picture submenu is displayed in yellow as a warning. Furthermore, if OP-47 closed captions are enabled, together with the V-chip marker, the V-chip label in the Picture submenu is displayed in yellow.

> **Note:** For SD-SDI source video, V-chip data included with legacy 608 (Line 21) closed captions is not supported. Select the closed caption option 608 in 708 if you need to use V-chip for SD-SDI video.

The Message Center separates messages into either *static* or *dynamic* message types. When enabled, static messages are always displayed in the Message Center and indicate the Analyzer source input and the presence of a V-chip or Active Format Description (AFD) code in the ancillary data (when enabled).

> **Note:** For SD-SDI source video, the unit supports AFD data as long as it is provided in ANC data packets according to SMPTE ST 2016-1 and ST 2016-3. Wide Screen signaling (WSS) and Video Index (VI) signaling (SMPTE RP 186) are not supported for SD-SDI.

Dynamic messages, however, are displayed for a configurable timeout period (in seconds) after which they are removed from the Message Center. The unit manages the OpIDs of SCTE104 packages, detected in the ancillary data, as dynamic messages. Each consecutive SCTE104 packet received by the unit replaces the previous displayed OpID.

For ease of viewing, you can choose the specific quadrant of the Analyzer - Picture window in which to display the Message Center from:

- Top-left quadrant
- Top-right quadrant
- Bottom-left quadrant
- Bottom-right quadrant.

> **Note:** The Message Center is displayed only when you enable at least one of the message types (AFD, V-chip, ST309 Date, Analyzer Source, SCTE104 or Input Name) in the submenu.

The layout of the Message Center adapts so that it always displays the static messages closest to the picture edge, depending on the selected screen quadrant in which it is located. This ensures that the V-chip, Analyzer Source, and AFD codes are always displayed in the same position in the window.

Dynamic SCTE104 OpID codes are appended either above or below the static messages, again depending on the quadrant in which the Message Center is located.

You can hover the mouse cursor over a SCTE104 OpID in the Message Center to display a tooltip containing the actual text of the message.

> **Note:** When enabled, V-chip, AFD ST309 Date, Analyzer Source, and SCTE104 OpID data packets will also appear in the **Analyzer - Ancillary Status** instrument and you can view the corresponding packet contents in the **Analyzer - Ancillary Inspector** instrument.

SCTE104 Packet Detection

SCTE104 is the broadcast industry standard for including specific program signals and markers in the video signal, for example, program parts, commercial breaks, etc.

When this option is enabled, the Analyzer - Picture window displays a list of SCTE104 messages in the Message Center, with the most recent displayed at the top of the list. On receipt, the OpID code of each SCTE104 message is displayed for at least two seconds, depending on the configured timeout period.

The unit displays the following information for each SCTE104 message received:

- SCTE104 operation ID (OpID) - identifies the SCTE104 message type.
- Message type as screen tip by hovering the mouse cursor over the OpID.

You can choose to display the message OpID in either hexadecimal or decimal format.

If you are interested in SCTE104 messages, it is recommended to enable SCTE104 messages in the Event Logging instrument so that the full message type is saved to the logfile.

Input Name Dialog

The unit provides a facility to enter identification strings for input sources, for example, cameras, etc. to identify the source of the input stream. The Input Name is displayed in the Message Center for 5 seconds, with this 5 second timeout being reset each time the unit receives an Input Name ancillary packet. If the unit receives no further Input Name ancillary packets after 5 seconds, then it reports the Input Name as **Missing** in the Message Center.

You can choose either to enter the input name manually, or configure the Data Identifier (DID) and Secondary Data Identifier (SDID) value of the input name in the ancillary data of the input stream.

The Input Name is an ancillary data packet with the following message structure:

Ancillary Data Flag			DID	SDID	DC	Data	CS
0x000	0x3ff	0x3ff	0x53	0x49	nn	up to 12 ASCII chars	

Figure 9-11: Input Name Message Structure

In addition, you can define a prefix to be applied to the source input name, for example: **Input ID:**. Enter a source Input Name as follows:

1. Tap and hold or right-click in the Picture window to open the menu.
2. Select **Enabled** from the **Input Name** dropdown.
   This displays the **Input Name Configuration...** control.
3. Tap or click **Input Name Configuration...** to open the Input Name Configuration dialog.
4. Using the onscreen or USB keyboard, configure an input name as follows:
   a. If you require a standard prefix for your input names, enter the prefix text string into the **Prefix** field, for example Source ID:.
   b. To enter an input name manually, tap or click **User Entered** and enter the name using up to a maximum of 12 characters.
   c. To extract an input name automatically from the ancillary data in the input feed, tap or click **Ancillary Data** and select the target DID and SDID. You can specify the DID/SDID using either decimal (default) or hex notation.
5. Tap or click **OK** to save the input name.

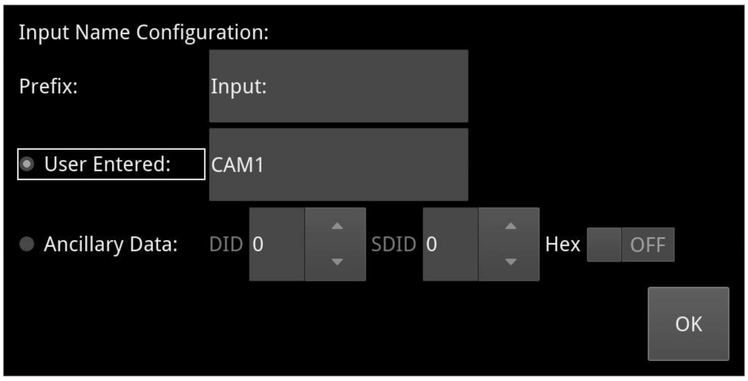


Figure 9-12: Input Name Configuration Dialog

Displaying the Ancillary Time Code

Time and control code information, used to identify video frames, is carried as the payload of packets located in the ancillary data space of the video signal. When you enable the ATC option in the Analyzer - Picture options menu, the ancillary time code is displayed in a panel overlayed across the Picture window.

The ATC is a 13 character time code with the following format:

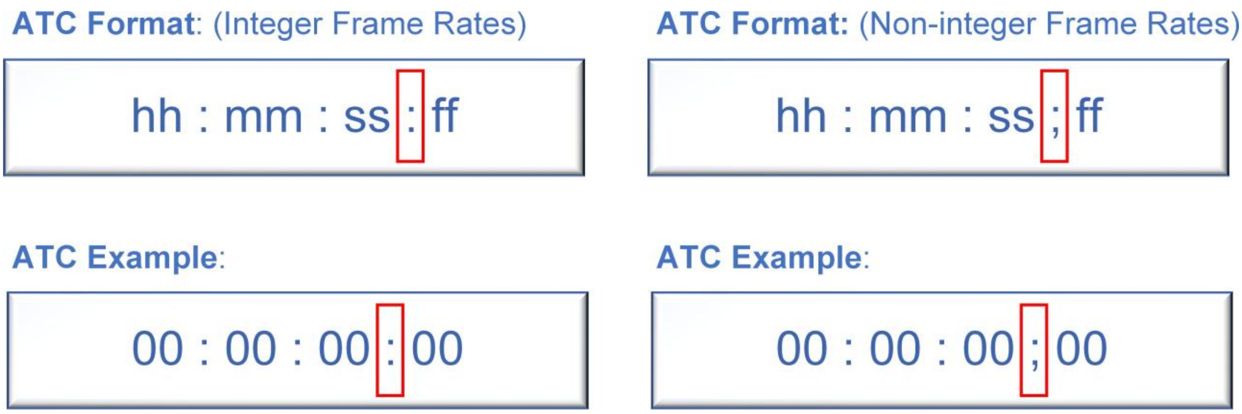


Figure 9-13: Format and Example of the Ancillary Time Code

Where:

- Colon (:) Separator between seconds and frames indicates Integer frame rates
- Semi-colon (;) Separator between seconds and frames indicates drop-frame, non-integer frame rates (for example, 23.9, 29.9, 59.9, etc.)
- hh = hours (24 hour clock)
- mm = minutes
- ss = seconds
- ff = frame number

When enabled, the ATC panel is displayed in the top-center of the window by default and you can adjust both its position down the center line (top, middle or bottom) and the panel size (small, medium, large or automatic size adjustment) for ease of viewing.

The option **Anc Time Code Field** allows you to activate the display of an optional final digit in the time code, after the two digits of the frame number.

When you enable the display of ancillary time code information, the option **Anc Time Code Type**, allows you to choose whether to display the default ancillary time code - vertical interval time code (ATC-VITC) or an ancillary time code - linear time code (ATC-LTC), if available.

On Video Loss (ST 2110 IP Input)

In the event of video loss, you can choose what should be displayed in the Picture instrument, if the video signal is lost, from either of the following options:

- Black Screen
- Freeze Last Frame.

Overview

> **Note:** Some of the features described in this section require the software licenses **LPX500-HDR** and/or **LPX500-UHD** to process high dynamic range (HDR) or ultra high definition (UHD) video, respectively. These are marked in the text as: **HDR Only** or **UHD Only** where appropriate.

The **Waveform** instrument displays the selected input video signal as a waveform in a number of selectable waveform and display modes.

In addition, the Waveform instrument provides numerous analytical tools including:

- Various filters
- Single-line mode link with Vectorscope instrument for Cb/Cr analysis
- Picture cursor control linked to Picture and Dataview instruments
- Full-width display
- Highlight markers (including user-defined markers)
- Configurable horizontal (Y-axis) or vertical (X-axis) measurement cursors
- Zoom and panning functions for waveform inspection.

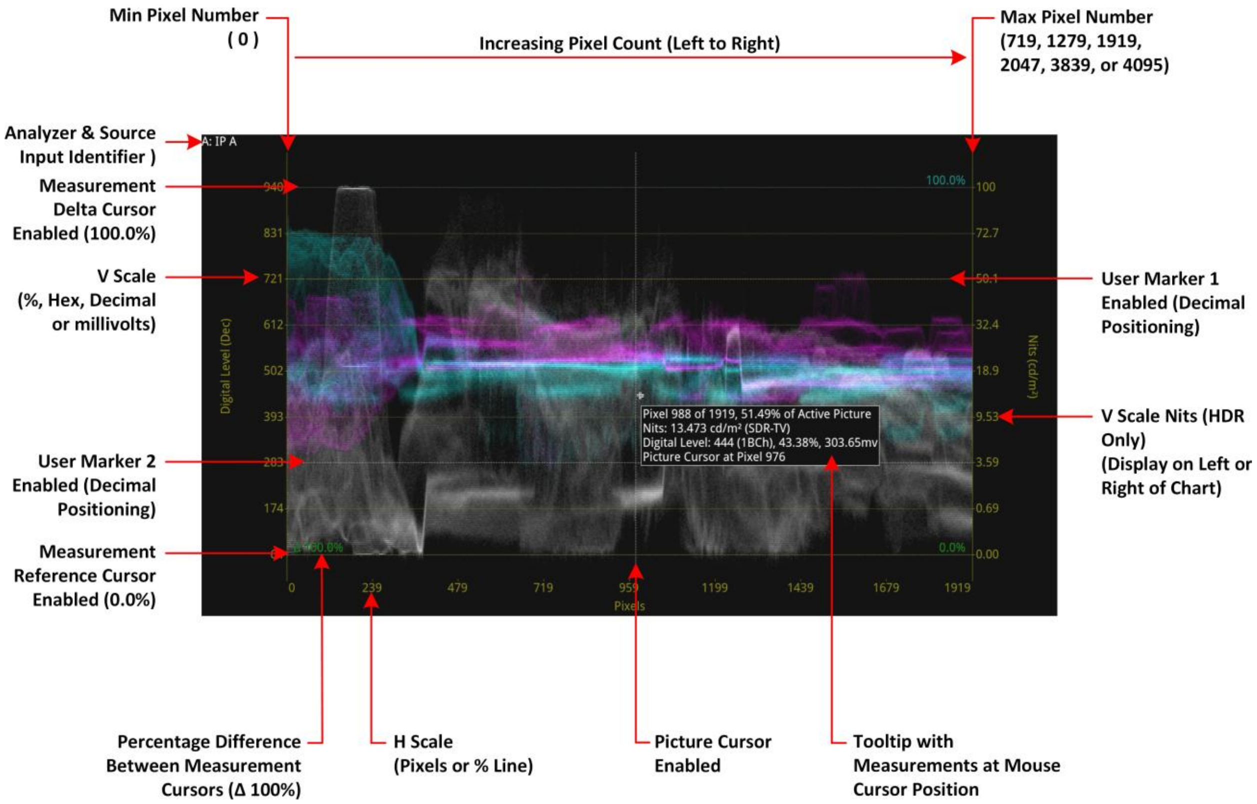


Figure 9-14: Analyzer - Waveform Instrument (Overlay Waveform Mode)

You can use the Waveform instrument in combination with the Picture and Dataview instruments while displaying and adjusting Vectorscope user markers in the Waveform CbCr traces.

When the option **Picture Cursor** is enabled, the cursor is dynamically linked to the cursor in the Picture instrument and to Dataview navigation. Tap or click a position in the Waveform window to update the pixel and active picture line positions selected in the Picture instrument, and the pixel and transport line position selected in Dataview.

If you hover the mouse cursor over any point in the waveform display, you will see a tooltip providing the following information:

- Pixel *x* of the maximum number of active pixels
- Equivalent value in cd/m^2 (Nits) to the Digital Level on the Y axis (HDR Only)
- Digital level in all other available but undisplayed units (decimal, Hex, percentage and mV)
- Pixel position of the Picture cursor
- Horizontal and vertical magnification factors when using the Zoom / Pan functions.

Waveform Window Resizing

The waveform window features two additional, double-height window sizes from other instruments when cycling through the window sizes, as shown below. The double height formats (1/8 and 1/2 screen sizes) allow more detailed inspection of the waveforms.

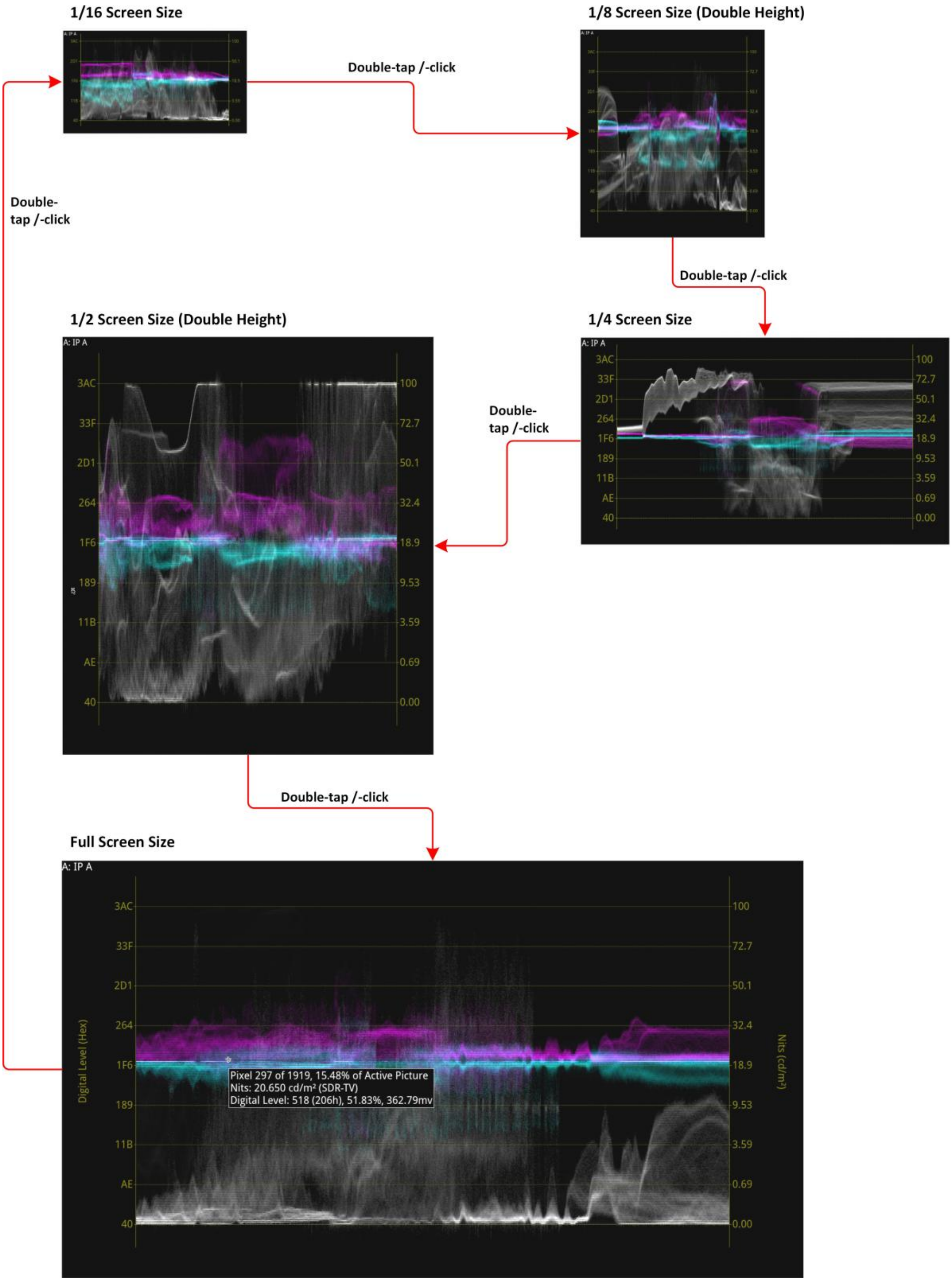


Figure 9-15: Analyzer - Waveform Window Resizing

About the Display Modes

The waveform instrument can display up to four channels for analysis of the video signal color-space components in one of the following selectable display modes:

- **YCbCr**: Luma (Y), Cb, and Cr components
- **YCbCrA**: Luma (Y), Cb, Cr and Alpha (A) components
- **Y**: Individual Luma component
- **Cb**: Individual Cb component
- **Cr**: Individual Cr component
- **RGB**: Red, Green, Blue components
- **GBR**: Green, Blue, Red components
- **YRGB**: Luma, Red, Green, and Blue components
- **YGBR**: Luma, Green Blue, Red components
- **RGBA**: Red, Green Blue, Alpha components
- **Red**: Individual Red component
- **Green**: Individual Green component
- **Blue**: Individual Blue component
- **Alpha**: Individual Alpha component
- **Custom**: Customize the display (see below).

When selected, the Waveform instrument displays the Alpha component of a waveform in white, that is, the same color as the Luma (Y) component and monochrome color mode.

Setting the Vertical and Horizontal Scales

You can choose to display various vertical scales at either the left- or right-hand side of the component display and to set the horizontal scale to pixels, percentage of the video line, or even to hide it.

Figure 9-16 is a schematic representation of the horizontal and vertical scales available for use with the Waveform instrument in Overlay waveform mode with an SDR standard (2048 x 1080 p50 709 SDR YCbCr:422 10bit NR) and at full screen size. The following figure shows the equivalent vertical scales available when analyzing the same standard but at a full range bit depth.

For the Digital Level V scale (Y-axis), you can choose to measure in the following units:

- mV
- Decimal color code values
- Percentage of the color code range
- Hexadecimal color code values.

Similarly you can set the H scale (X-axis) either to the number of pixels or to a percentage of the picture line.

With the HDR license available (**LPX500-HDR**) the Waveform instrument displays a Nits scale on the right-hand side by default but you can choose to switch this to the left-hand side of the display or hide it completely. If you switch to display the Nits scale on the left the Digital Level scale switches to the right-hand side of the Waveforms display.

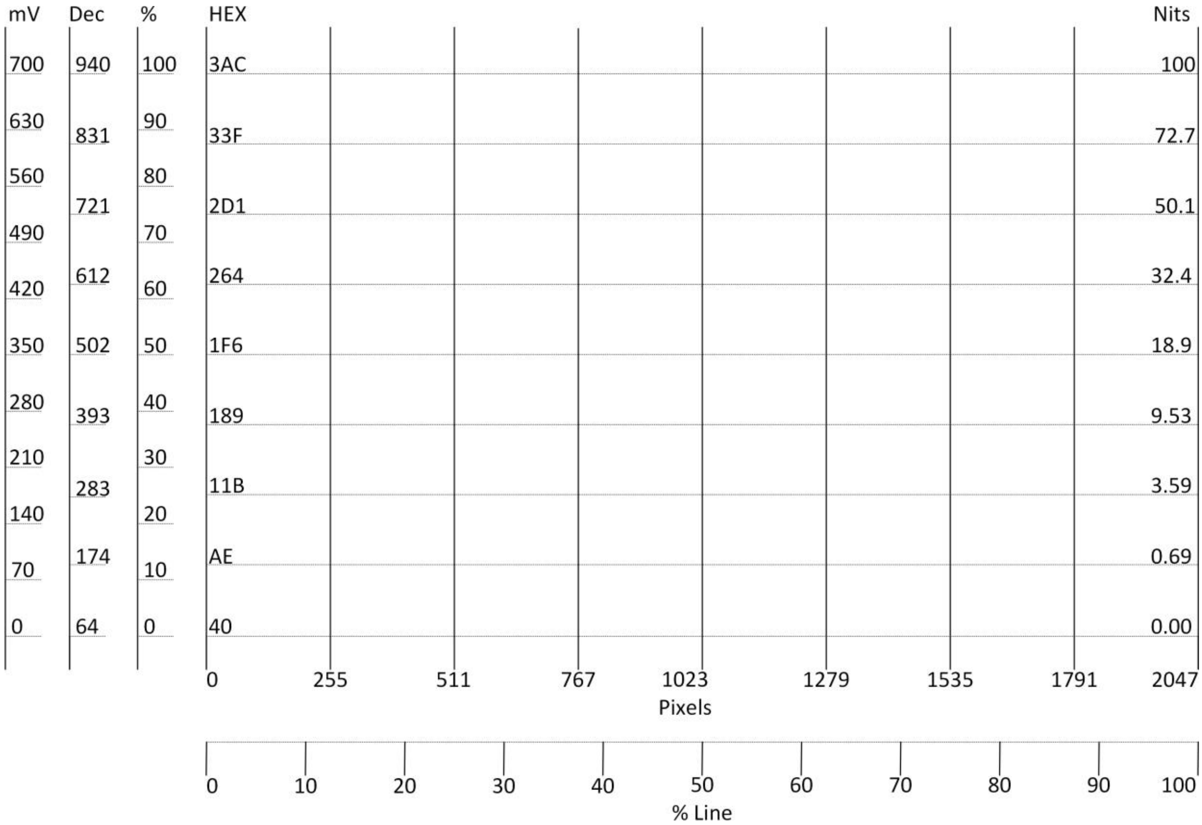


Figure 9-16: Waveform Scales (Overlay Mode; SDR 2048 x 1080; NR, Full Screen Size) (Nits Scale with HDR Only)

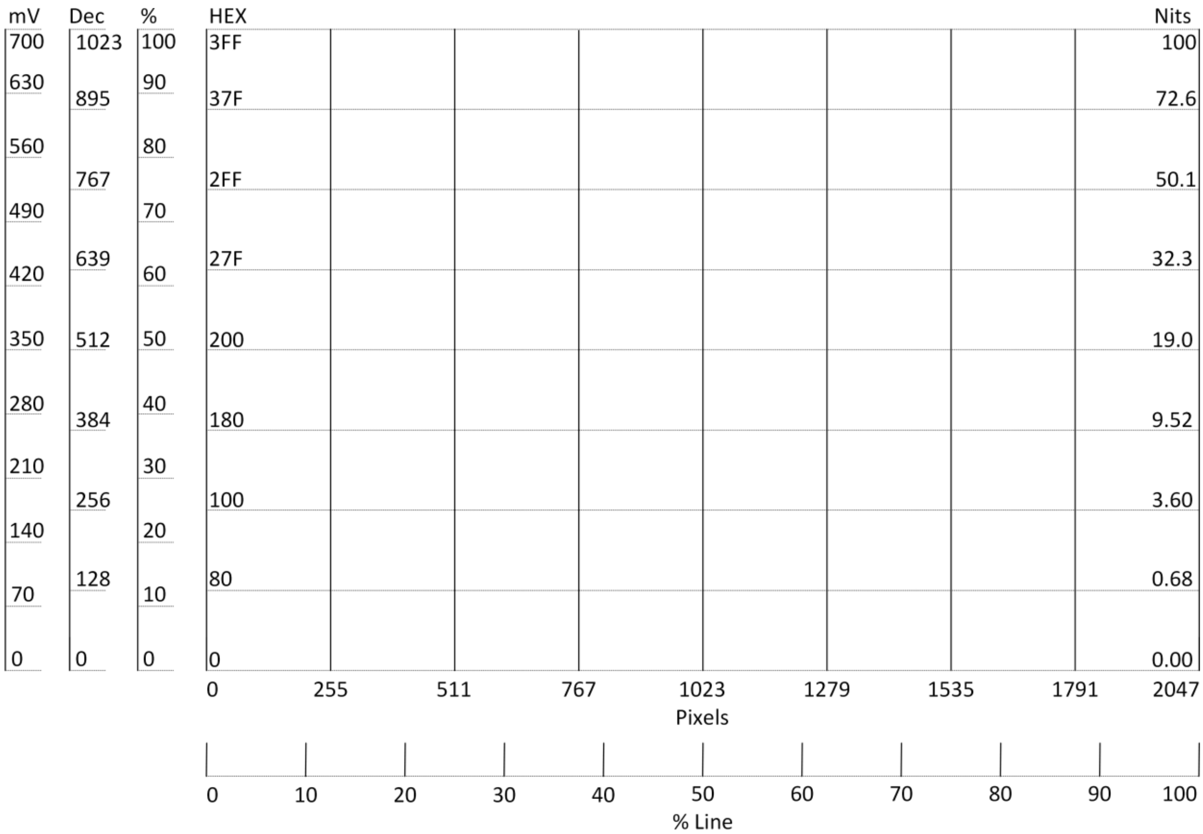


Figure 9-17: Waveform Scales (Overlay Mode; SDR 2048 x 1080; FR; Full Screen Size) (Nits Scale with HDR Only)

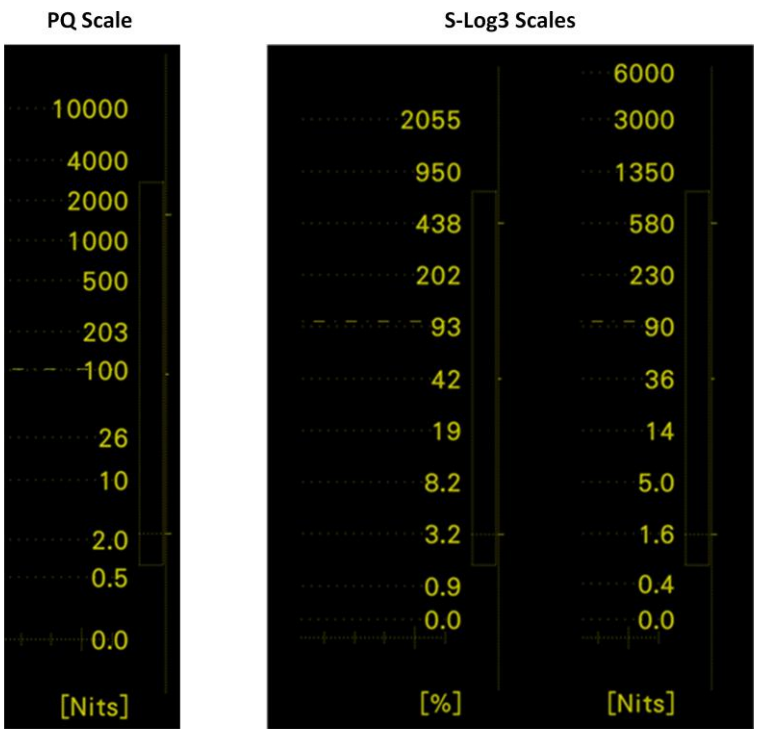


Figure 9-18: Comparison of PQ and S-Log3 Scales for HDR Waveform Analysis (HDR Only)

> **Note:** The Nits scale applies only to the luma (Y) component of the source input (if displayed) up to 100 cd/m^2. A Nits scale is not displayed for either of the Cb or Cr components if these are displayed either together or on their own. (HDR Only.)

The Nits scale is displayed from 0 to 100 cd/m^2 for the SDR transfer curve. For source inputs using the HDR transfer curve, the Nits scale is extended beyond 100 cd/m^2. (HDR Only.)

Using Full-width Screen Mode

A full-width mode is available to display all waveforms in Stacked, Overlay or single-channel Parade waveform modes. The unit displays the selected waveform or waveforms across the full width of the Waveform window. The vertical and horizontal scales are superimposed over the waveforms.

Full-width mode enables you to align the overlay, stacked, or single channel parade waveform with the current video signal displayed in the Picture instrument as shown in *Figure 9-19*.

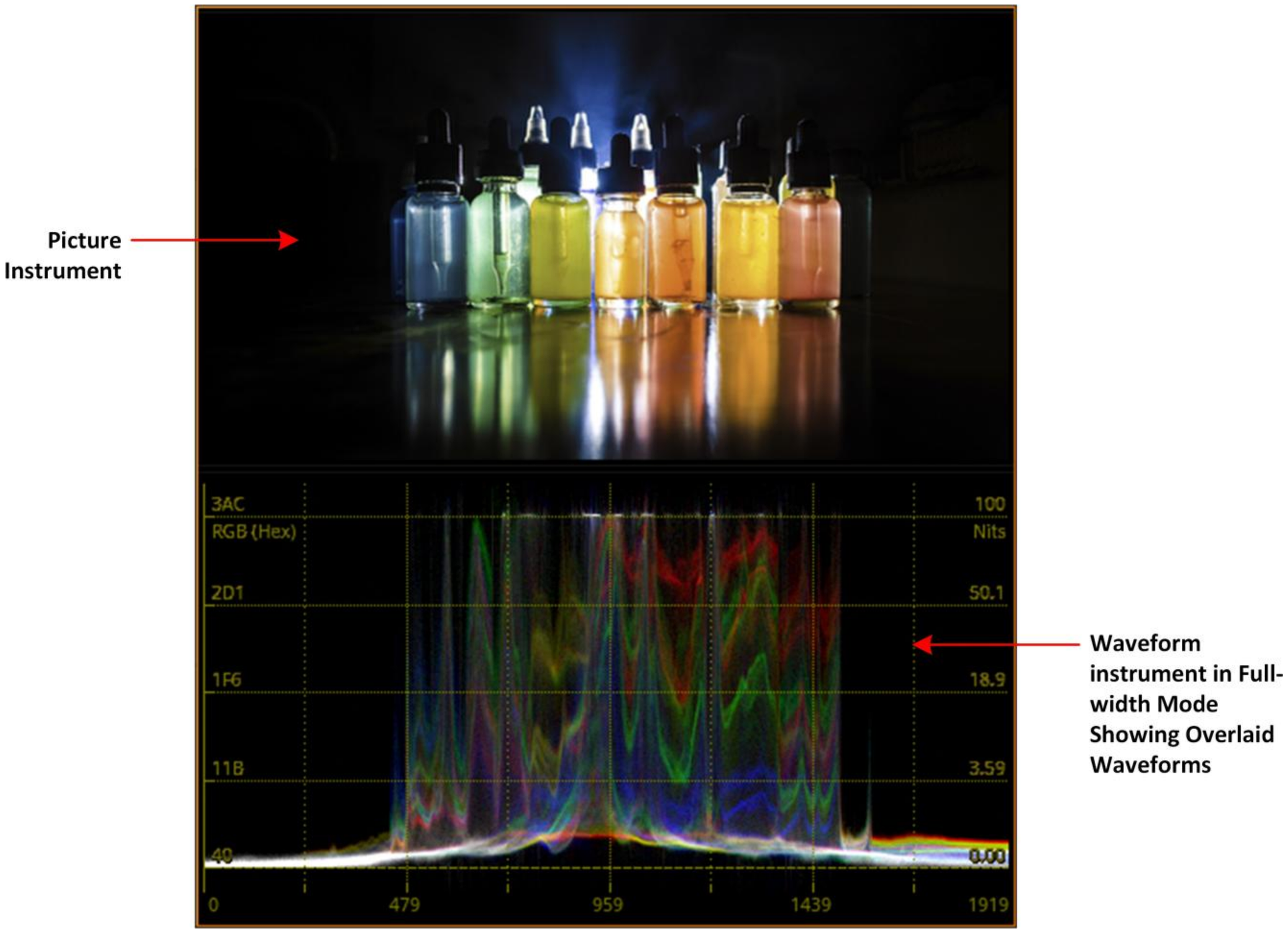


Figure 9-19: Waveform Instrument Matched to Width of Picture Instrument

Using the Custom Display Mode

In addition to using the standard display modes, you can use the Custom Display Mode Configuration option to define your own selection of channels chosen from Y, Cb, Cr, R, G, B and A.

To do so, open the **Custom Display Mode Config...** popup menu from the main options menu. You can define a display mode of up to four channels by selecting a desired luma/chroma component from the **Channel 1** to **Channel 4** dropdown menus. The Channel 2, 3 and 4 dropdown menus become active only once you select a Display Mode for the previous channel.

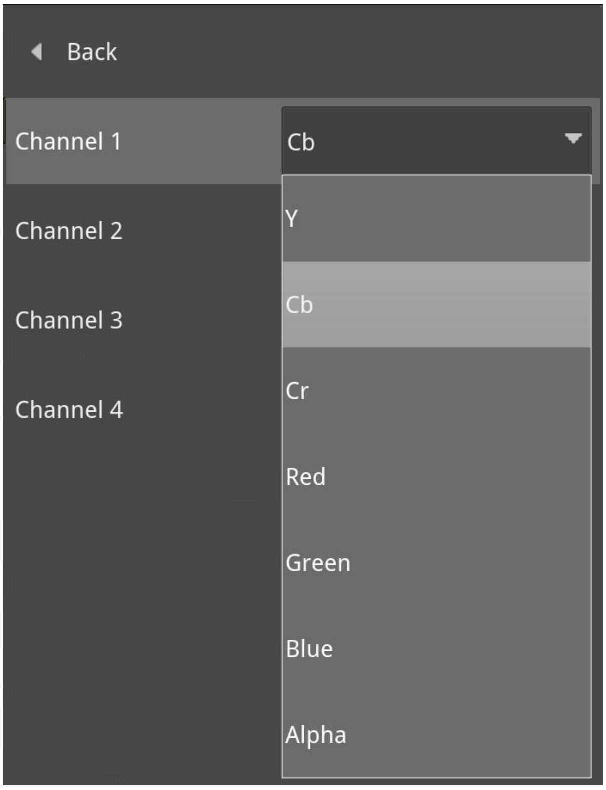


Figure 9-20: Waveform Instrument Custom Display Mode Configuration Menu

To activate your defined custom display mode, select the **Custom** option from **Display Mode** dropdown.

About the Waveform Modes

The following figure shows the source Picture and waveform analysis for each waveform mode in the display modes YCbCr and RGB.

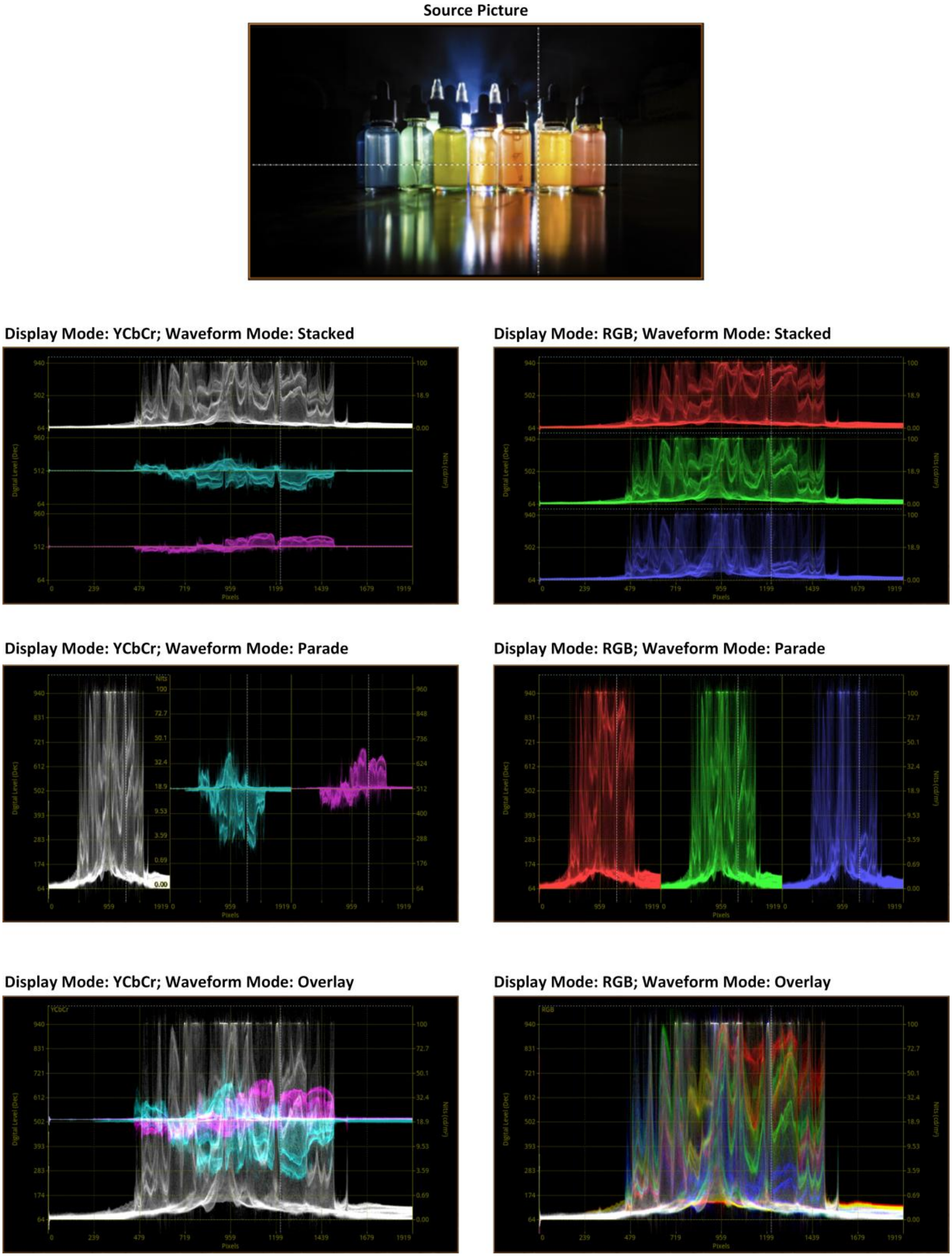


Figure 9-21: Waveform Modes for YCbCr and RGB Display Modes

For the waveform mode **Parade**, you can choose any of the following display modes:

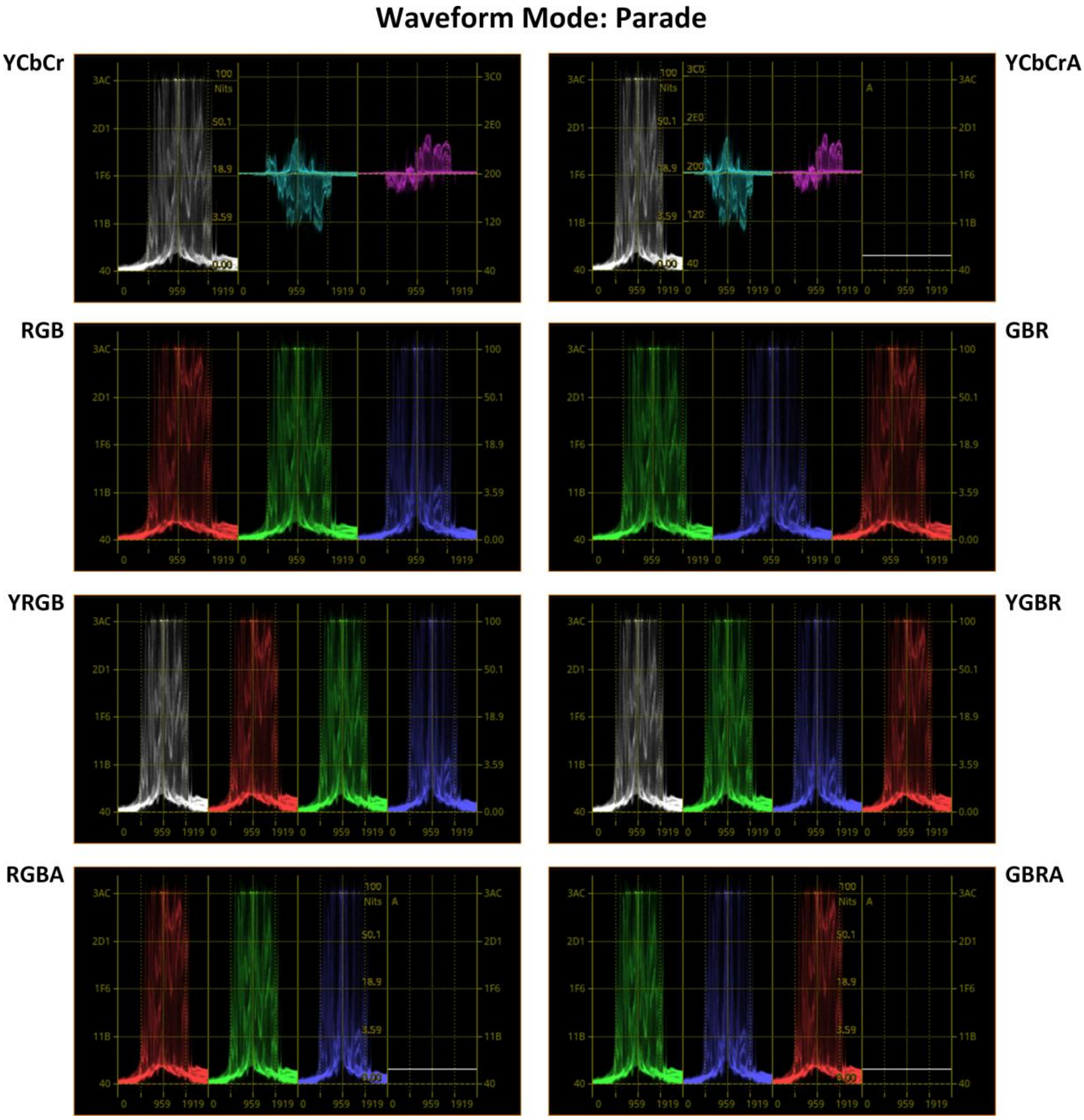


Figure 9-22: Parade Waveform Display Modes (Excludes Single Waveforms)

For the waveform mode **Stacked**, you can choose any of the following display modes:

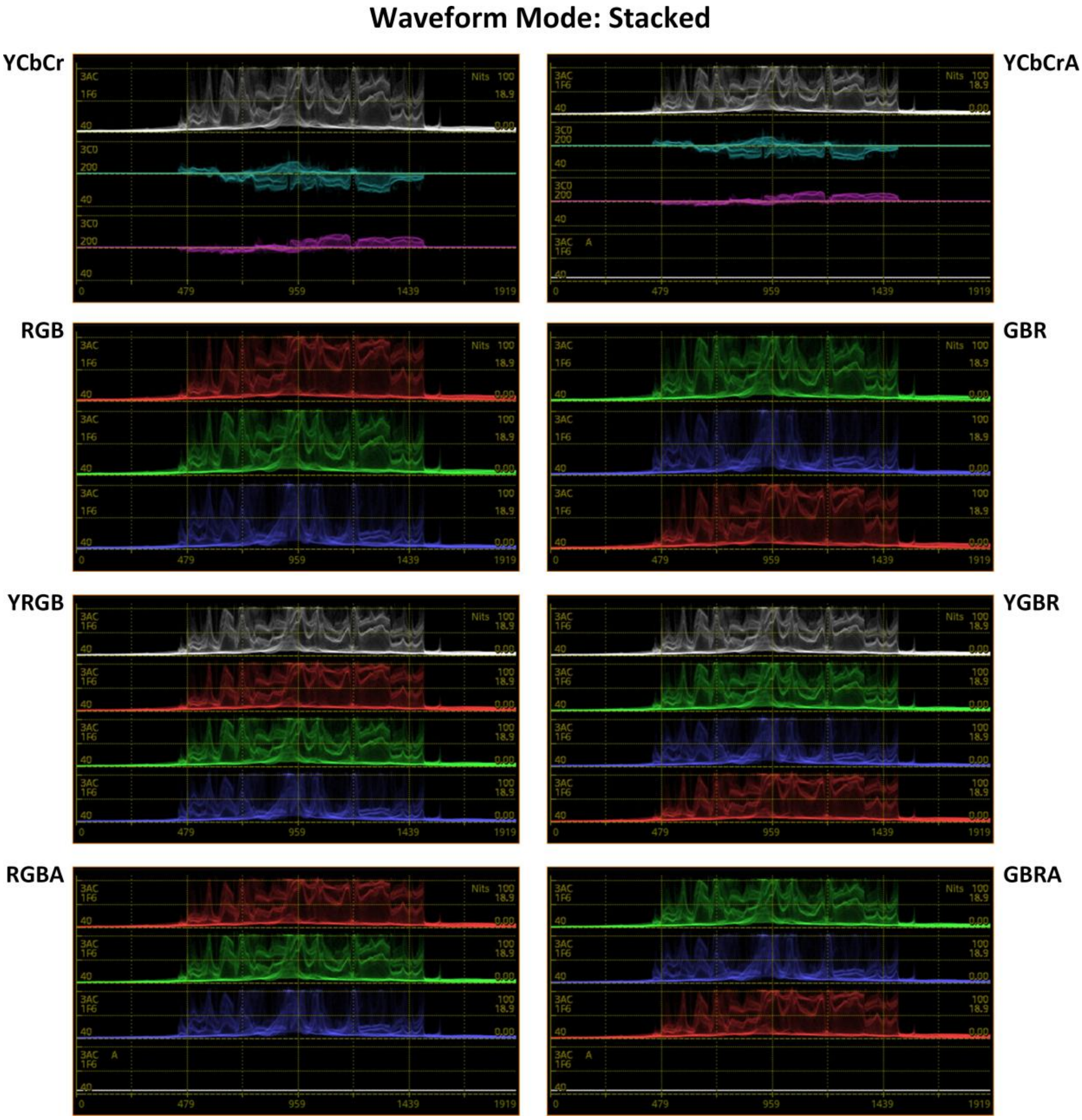


Figure 9-23: Stacked Waveform Display Modes (Excludes Single Waveforms)

The Overlay mode superimposes each waveform on top of the other, the layout of the screen does not change in Overlay mode.

Using the Zoom and Panning Controls

> **Note:** Vertical magnification is not possible when using the stacked waveform mode.

The Waveform instrument provides controls in the options menu that enable you to zoom in/out or pan horizontally/vertically in the displayed waveform. With the options menu open:

- Adjust the **H Magnification** slider control to zoom in/out along the horizontal axis of the wave- form.
- Adjust the **H Position** slider control to pan horizontally to keep the point of interest in view. (This control becomes available when you increase the H Magnification setting above 1.0.)
- Adjust the **V Magnification** slider control to zoom in/out along the vertical axis of the waveform.

- Adjust the **V Position** slider control to pan vertically to keep the point of interest in view. (This control becomes available when you increase the V Magnification setting above 1.0.)

Using Picture and Dataview with the Waveform Instrument

When you enable the Picture Cursor in either the Analyzer - Picture or Analyzer - Waveform instruments (or both), the area of the picture around the cursor is highlighted in the Dataview instrument, as shown in *Figure 9-24* below.

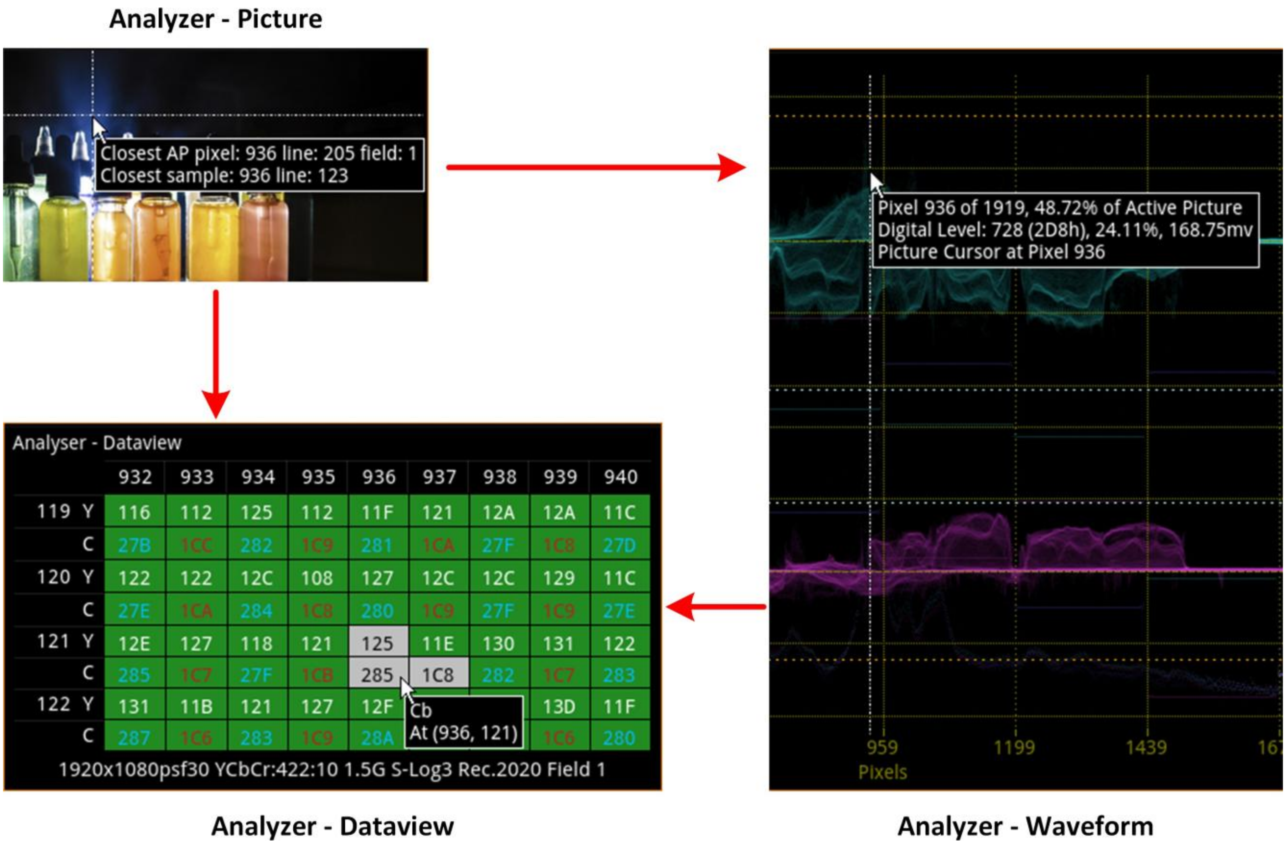
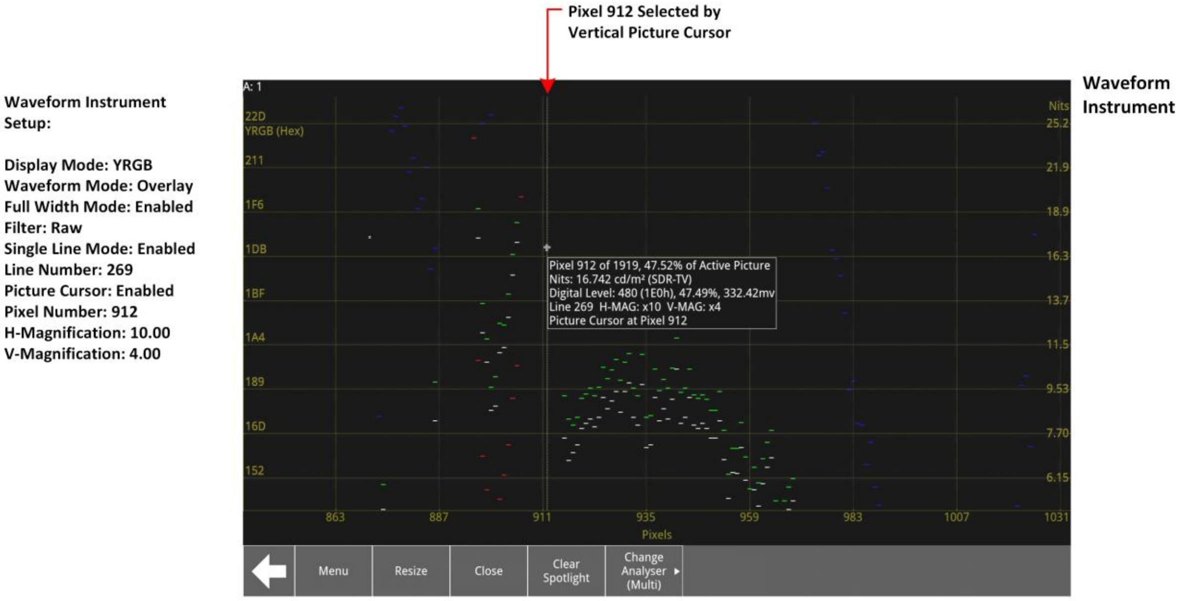


Figure 9-24: Interactive Linking of Picture Cursor in Picture, Waveforms, and Dataview

In addition, you can also use single-line mode without filtering (Raw) to perform detailed technical analysis of a waveform without artifacts generated by filtering, see *Figure 9-25*. For information about the available filters, see the section *Instrument Menu Options*.



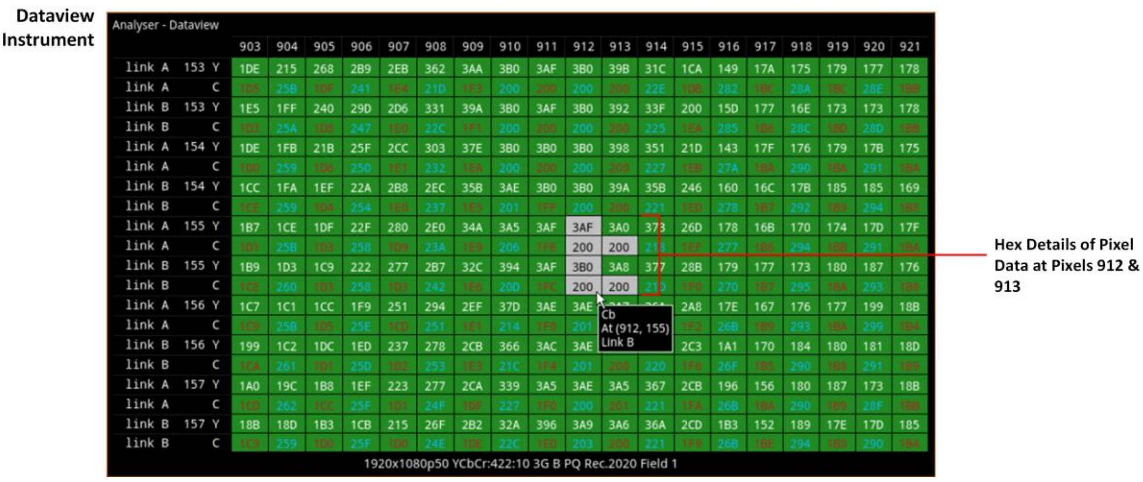


Figure 9-25: Detailed Technical Analysis of Part of Image Using Waveform and Dataview Instruments

Using the Vectorscope with the Waveform Instrument

You can use the Vectorscope and Waveform instruments in combination to analyze the Cb/Cr channels. If you enable single line mode in the vectorscope it is also automatically enabled in the waveform instrument. Similarly, when the Cb and/or Cr channels (stacked and parade waveform modes only) are active, any adjustment of the user markers in the vectorscope is also reflected in the user markers of the waveform instrument.

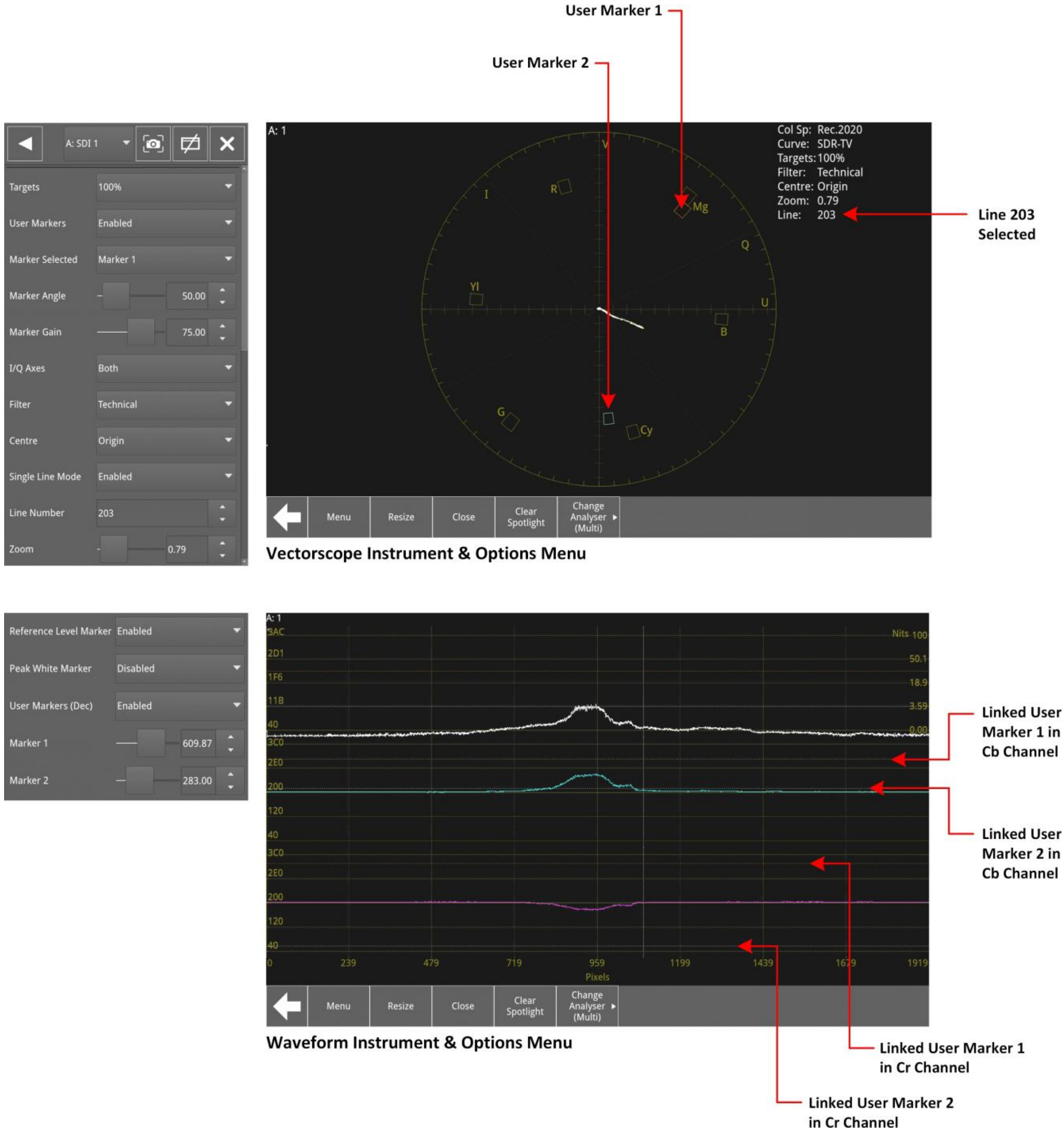


Figure 9-26: Interactive Linking of User Markers in Vectorscope and Waveform Instruments

> **Note:** User markers must be controlled from the vectorscope. User marker changes made in the waveform instrument are not reflected in the vectorscope.

Using the Waveform Measurement Cursors

The unit provides a pair of measurement cursors which you can configure to indicate waveform values against either vertical or horizontal axes. When first enabled, the waveform measurement cursor(s) are displayed as one or two, horizontal dashed lines.

You can choose to display either a single measurement cursor or a pair of cursors. By default, the cursor(s) are aligned horizontally against the current Y axis (referred to as the **Y-axis Cursors**). You can, however, change the orientation of the cursor(s) so that they are aligned vertically to measure against the X axis (referred to as the **X-axis cursors**).

If you choose to display a single cursor, the cursor displays the value at that point; there is no delta value. The single cursor is always referred to as the **Reference** (or REF) cursor and is displayed as a green dashed line.

If you choose to display both measurement cursors, the **Reference** cursor is located at **0%** by default and the **Delta** cursor is displayed as a blue dashed line at **100%** by default.

The value(s) indicated by the cursor(s) are displayed as follows:

- **For Y-axis cursors:** On the cursor, at the right-hand side of the display
- **For X-axis cursors:** Next to the cursor, at the top of the display.

When you enable both cursors, the difference (delta) between the values measured by the Delta and Reference cursors (Delta cursor value minus Reference cursor value) is displayed as follows:

- **For Y-axis cursors:** At the bottom, left-hand side of the display, above the Reference (green) cursor
- **For X-axis cursors:** At the bottom, left-hand side of the display, next to the Reference (green) cursor.

Cursors in a pair can be independent or linked together so that they move as a single unit, with a fixed separation between them. In addition, the cursor(s) display the measured values, in the selected units, and update in real-time if their position changes.

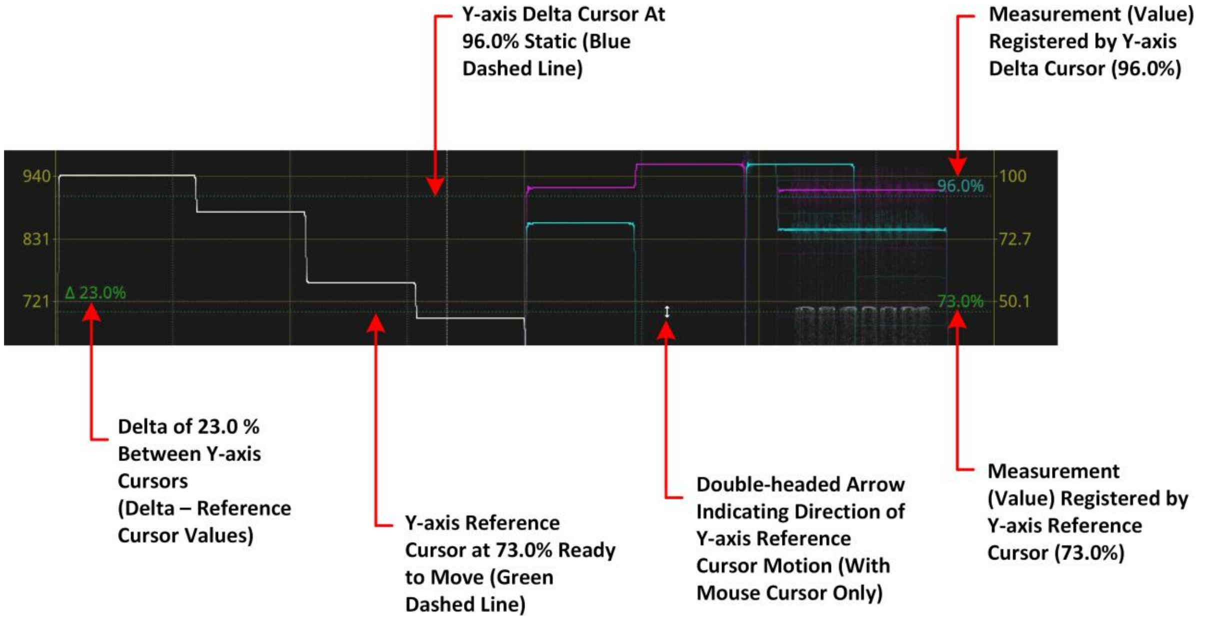


Figure 9-27: Waveform Measurement Y-axis Cursors (Independent Configuration)

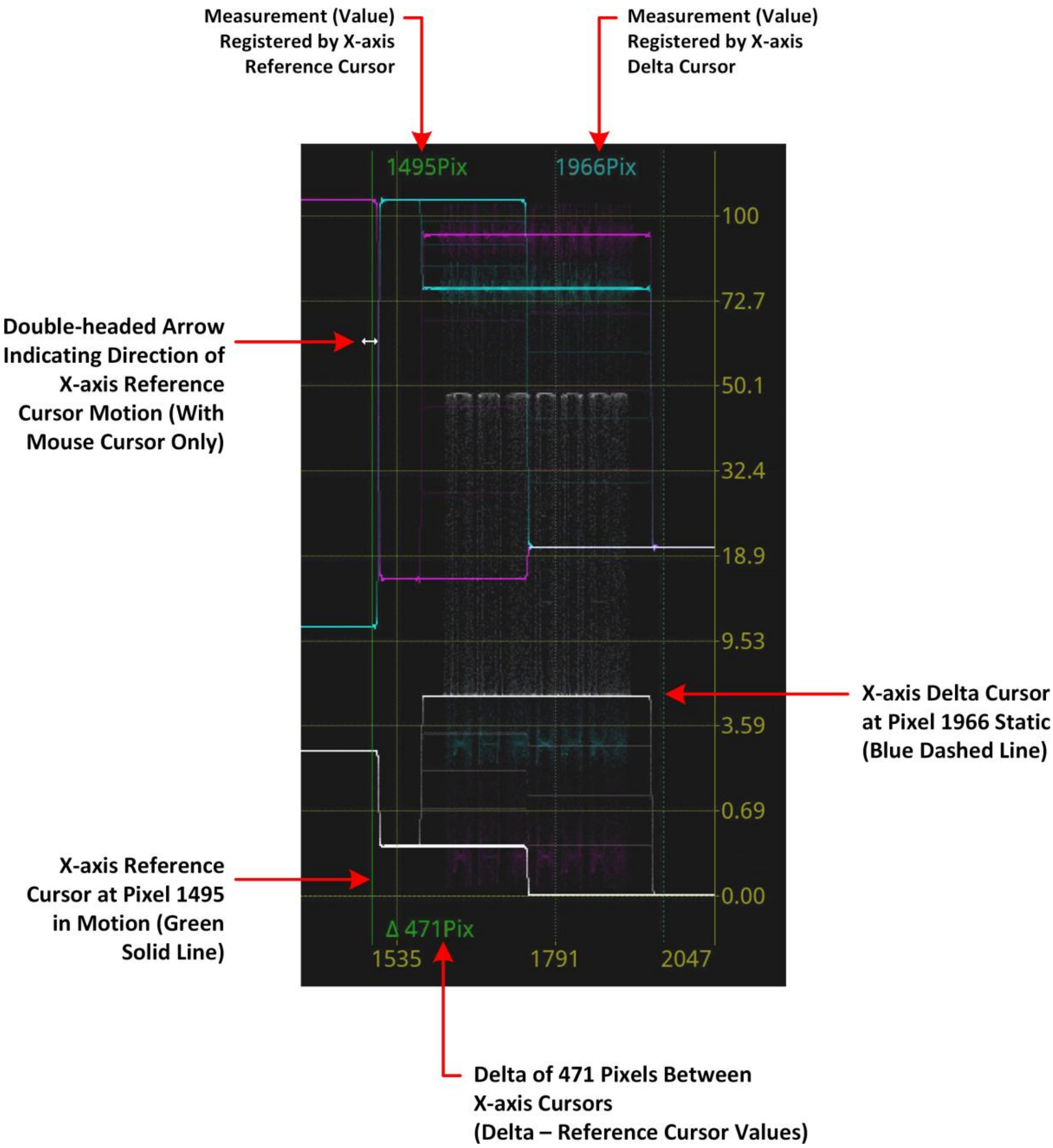


Figure 9-28: Waveform Measurement X-axis Cursors (Independent Configuration)

To position a measurement cursor, use one of the following methods:

- Open the options menu, then adjust the **Ref Cursor Position** slider to move the Reference cursor (recommended).
- Open the options menu, then adjust the **Delta Cursor Position** slider to move the Delta cursor (recommended).
- Tap to select a measurement cursor then turn the rotary control left or right to move the selec- ted cursor(s) down / up (Y-cursors) or left / right (X-cursors), respectively.
- Preferably in a full-screen display, touch a measurement cursor and slide to a new position.
- When using a mouse, select a cursor by moving the mouse pointer over the cursor when you should see the pointer change shape to a double-headed arrow. Click the mouse and the dashed cursor line becomes solid. At this point rotate the mouse wheel or drag the cursor to a new position.

- You can also adjust the positions of the measurement cursors using the instrument softkeys, which become available when one of the cursor control sliders is activated.

Figure 9-29: Waveform Measurement X-axis Cursors

> **Note:** If both cursors are enabled and linked, then both will move together. To move a cursor independently when both are linked, adjust the **Cursor Differential** slider in the options menu. This action moves the Delta cursor while keeping the Reference cursor fixed in position

When in motion, the dashed line of the cursor changes to a solid blue or green line for improved visibility. You will see the measured values on the cursors change in real-time as you adjust the cursor position(s).

You can configure the measurement cursor(s) to measure in different units, as follows:

- **For Y-cursors:** Select units of percent (default), percentage of reference, millivolts, hex value decimal value, or Nits (HDR Only).
- **For X-cursors:** Select units of percent (default), number of pixels, time (µs) or frequency

(kHz). For information about the configurable parameters of the waveform measurement cursors, see the
Measurement Cursor Configuration section of the options table.

Setting a % Reference

Use the **% Reference** cursor scale to measure a position relative to a reference baseline that you set; otherwise, the measurement is relative to the 0 value of the waveform scale.

Setting the % Reference changes the reference value to the current Reference cursor position and the 100% delta cursor value to the current position of the Delta cursor.

> **Note:** Although it is recommended to set a reference when using the % Reference cursor scale, you can use this without setting a reference, however, this is equivalent to using the cursor scale **Percent**.

In the **Measurement Cursor Config...** submenu, first set the Cursor Scale to **Percent Ref**, adjust the position of the Reference cursor to the new baseline, then tap **Set % Ref**. The Reference cursor value is displayed as **0.0%[REF]**. You can now adjust the measurement cursors to measure values within the new range.

On completion, select **Reset % Reference** to set the measurement cursors back to their default positions of 0% and 100%.

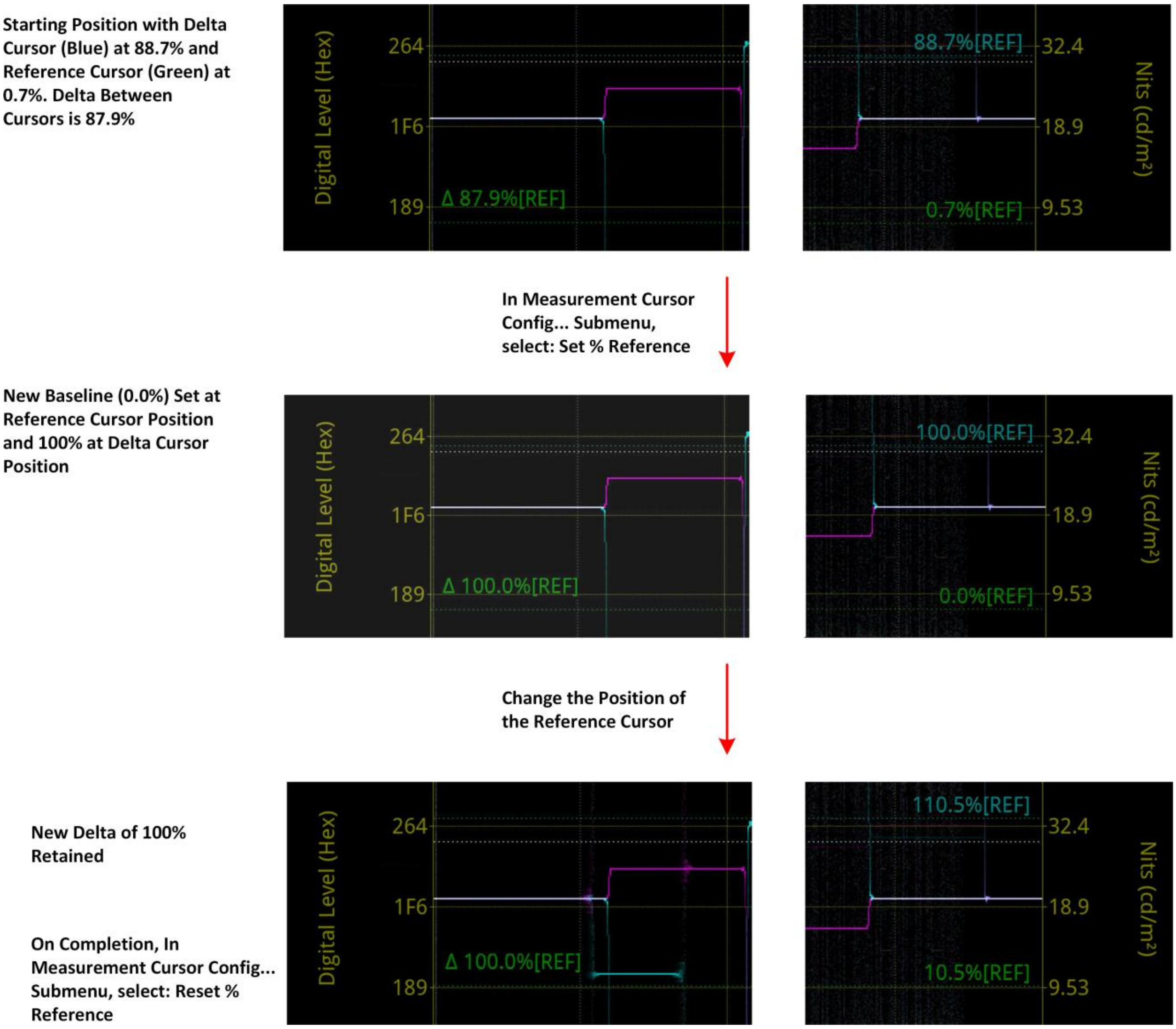


Figure 9-30: Waveform Measurement Cursors - Using Set % Reference

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - Waveform instrument submenu:

Table 9-3 : Analyzer - Waveform Options

Item	Options	Description
Display Mode	YCbCr (Default) YCbCrA Y Cb Cr RGB GBR YRGB YGBR RGBA GBRA Red Green Blue Alpha Custom	Selects the desired display mode in which to display the waveforms. For more information, see *About the Display Modes*.
Custom Display Mode Config...	System Control Opens the Custom Display Mode Channel configurations submenu.	See *Custom Display Mode Configuration* below for submenu parameters. For more information, see *Using the Custom Display Mode*.
Waveform Mode	Parade (Default) Stacked Overlay	**Parade** - displays each individual waveform separately, in horizontal, side-by-side graphs. **Stacked** - displays each individual waveform in vertical stacked graphs. **Note:** vertical magnification is not supported in this waveform mode. **Overlay** - displays each individual waveform on the same graph, superimposed on top of each other.
Full Width Mode	Enabled Disabled (Default) **Note:** In Parade Waveform Mode, you can enable full-width mode for a single channel only.	When you select waveform modes Stacked, Overlay, or any single channel Display Mode (Red, Green, Cb, Cr, etc.) you can enable (or disable) full-width mode.
Scales & Markers Config...	System Control Opens the Scales & Markers configuration submenu.	See *Scales & Markers Configuration* below for submenu parameters.

Filter	Technical (Default) Production Low Pass Raw	Selects the type of filtering applied to the waveform. When you select the Raw option, no filtering is applied and no waveform draw, thus eliminating filtering artifacts. Instead, the values of the pixels in the image are represented as individual points on the graph.

Item	Options	Description
Single Line Mode	Enabled (Default) Disabled	When enabled, allows single line mode analysis of the active picture. When disabled, all lines in the active picture are represented as waveforms, one per line. This is automatically linked to the Vectorscope.
Line Number	System Control One to the total number of active lines in the selected standard.	When single line mode is enabled, selects the line number in the active picture for analysis.
Picture Cursor	Disabled (Default) Enabled	When enabled, dynamically links the picture cursor to the Picture, Dataview, Waveform, Vectorscope and CIE Chart analysis instruments so that measurements from the selected picture position can be taken from these tools at the same time.
Pixel Number	Numeric Field 1 to Maximum Pixel Number	When Picture Cursor enabled, selects a specific pixel num- ber, if required.
Full Range Mode	RP.2077 (Default) SDI Protected	Uses full range, by default, as defined in SMPTE RP 2077 *Full-Range Image Mapping* but can be set to use full pro- tected range, as required. For more information see the section *Video Range Definitions for the LPX Series*.
Measurement Cursors	Off (Default) Single Both	Enables either one (Single) or two (Both) measurement cursors. When displayed initially, the first, Reference cursor is displayed as a green dotted line located at the bottom of the waveform display (0%). If you choose to display both cursors, the second Delta cursor is displayed as a blue dotted line at the top of the waveform display (100%). The default setting is to display horizontal cursors, measuring against the Y axis. You can change the orientation of the measurement cursors in the **Measurement Cursor Config...** submenu.
Measurement Cursor Config...	System Control Opens the Measurement Cursor configuration submenu.	See *Measurement Cursor Configuration* below for sub-menu parameters. For more information see the section *Using the Waveform Measurement Cursors.*
Ref Cursor Position	Slider Control	Available when one or both measurement cursors are enabled. Moves the Reference cursor (green) to adjust the reference level.
Delta Cursor Position	Slider Control	Available when both measurement cursors are enabled and independent. Moves the Delta cursor (blue) to adjust the difference (delta) between the two cursors.

Cursor DIfferential	Slider Control	Available when both measurement cursors are enabled and linked. Moves the Delta cursor (blue) relative to the Reference cursor (green) while keeping the Delta cursor static.

Item	Options	Description
H Magnification	Slider control: 1.00 (Default) to 10.00	Adjusts the horizontal magnification of the waveform using the slider to zoom in to the waveform, providing a better view of a waveform section. Use this control together with the H Position slider to adjust the point of interest in the waveform. When you increase the H magnification above 1.00, the **H Position** control also becomes available to pan horizontally along the waveform while the Options menu is open. **Note:** The Waveform, Vectorscope, and CIE Chart instruments are all linked so that when you adjust the Horizontal Magnification in the Waveform instrument it also adjusts the Horizontal Magnification in the other linked instruments, if they are active.
H Position	Slider control Horizontal Axis	Displayed when the horizontal magnification is greater than 1. Pans along the horizontal axis of the waveform. Enables you to adjust the focus of the waveform within the instrument window, along the horizontal axis, if the position of interest moves out of view when zooming.
V Magnification	Slider control: 1.00 (Default) to 4.00	Adjusts the vertical magnification of the waveform using the slider to zoom in to the waveform, providing a better view of a waveform section. Use this control together with the V Position slider to adjust the point of interest in the waveform. When you increase the V magnification above 1.00, the **V Position** control becomes available to pan vertically through the waveform while the Options menu is open. **Note:** Vertical magnification is not supported in stacked waveform mode.
V Position	Slider control Vertical Axis	Displayed when the vertical magnification is greater than 1. Pans along the vertical axis of the waveform. Enables you to adjust the focus of the waveform within the instrument window, along the vertical axis, if the position of interest moves out of view when zooming.
On Video Loss (ST 2110 Only)	Black Screen (Default) Freeze Last Screen	Choose what should be displayed in the waveform window if the unit loses the video signal.
Brightness	Slider control: 1 to 255 (Default: 255)	Adjusts the brightness of the waveform display.

Gamma	Slider control: 0.2 to 1.00 (Default: 0.5)	Adjusts the gamma component of the waveform display.
Persistence	Slider control: 0 to 511 (Default: 255)	Adjusts the persistence of the waveform display.
Advanced...	System Control	Enables you to adjust the gain on any of the four channels independently. See *Advanced Waveform Controls* below.
Item	**Options**	**Description**
Restore Default Levels	System Control	Resets the Waveform instrument to its default gain levels.
Color Mode	Color (Default) Highlight Green Monochrome	Selects the desired color palette for the waveforms from four different color modes. The Highlight option adds a white highlight to the input component logarithmically proportional to the amount of the displayed color.
S-Log3 Mode (HDR Only)	S-Log3 (Default) SR Live	For HDR video signals, see the section *Advanced HDR Toolset*.. Use when analyzing an S-Log3 or S-Log3 SR Live signal. Set to SR Live to extend the range of the Nits scale.
Custom Display Mode Configuration		
Channel 1	Y Cb (Default) Cr Red Blue Green Alpha	Selects any of the available single Display Modes to display in the Channel 1 position.
Channel 2	None Y Cb Cr (Default) Red Blue Green Alpha	Selects any of the available single Display Modes to display in the Channel 2 position.
Channel 3	None (Default) Y Cb Cr Red Blue Green Alpha	Selects any of the available single Display Modes to display in the Channel 3 position.

Item	Options	Description
Channel 4	Disabled (Default) None Y Cb Cr Red Blue Green Alpha	Enabled only when you select a parameter for Channel 3. Selects any of the available single Display Modes to dis- play in the Channel 4 position.
Scales & Markers Configuration		
V Scale	Percent Hex Value (Default) Decimal Value Millivolts	Selects the units for the vertical (Y-axis) scale in the instru- ment window.
V Scale Nits (HDR Only)	Hidden Right Side (Default) Left Side	Selects the position of the vertical (Y-axis) Nits scale. By default the scale is positioned on the right-hand side of the waveform graph. If the right-most channel is Cr or Cb, the NITS scale is displayed (by default) to the right of the Y channel, if present.
H Scale	Pixels % Line None (Default)	Selects the units for the horizontal (X-axis) scale in the instrument window. To switch off the display of the H Scale, select None.
V Graticules	Disabled (Default) Enabled	When enabled, displays vertical graticules on the wave- form graph. These are disabled by default for enhanced observation of the waveform details.
H Graticules	Disabled Enabled (Default)	When enabled, displays horizontal graticules on the wave- form display. These are enabled by default.
Reference Level Marker (HDR Only)	Disabled Enabled (Default)	When enabled, displays a reference level marker across all waveforms at a fixed value of 203 cd/m^2 (nits), when analyzing an HDR signal. When enabled, the marker is set at 58% for Perceptual Quantizer (PQ) and 75% for Hybrid Log-Gamma (HLG) color ranges, see *Figure 9-32*.
Peak White Marker (HDR Only)	Disabled (Default) 1000 Nits 2000 Nits 4000 Nits 10000 Nits	When enabled, displays a peak white marker across all waveforms in HDR standards at a selectable level in Nits.
User Markers (Dec)	Disabled (Default) Enabled	When enabled, this feature allows you to position user markers anywhere in the waveform display. Provides two sliders for Marker 1 and Marker 2, which you can adjust along the V Scale (Y-axis).
Marker 1 and Marker 2	Slider Controls	When User Markers are enabled, adjust from the minimum to maximum value of the selected V Scale. For example, if set to Hex or Decimal Value, the maximum value will vary with bit depth.
Measurement Cursor Configuration		

Cursor X/Y Select	Y (Default) X	Selects either horizontal Y-axis cursor(s) or vertical X-axis cursor(s) to display along the Y-axis or X-axis, respectively.
Cursor Scale **(For Y-axis Cursor(s))**	Percent (Default)	Selects the required scale for the Y-axis cursor measurements. Displays measurement values as a percentage of the range of chroma/colour values.
	Percent Ref	Displays measurement values as a percentage of the reference value at the point you selected **Set % Reference**, or the default reference (0%) if no user-defined reference is set.
	Millivolts	Displays measurement values in millivolt units
	Hex Value	Displays measurements as hexadecimal values.
	Decimal Value	Displays measurements as decimal values.
	Nits	Displays measurement values in Nits (cd/m^2) (HDR Only)
Cursor Scale **(For X-axis**	Percent (Default)	Selects the required scale for the X-axis cursor

Item	Options	Description
Cursor(s))		measurements. Displays measurement values as a percentage of the waveform width.
	Pixel	Displays measurement values in a number of pixels.
	Time	Displays measurement values in microseconds.
	Frequency (kHz)	Displays measurements in units of kHz.
Cursor Values	Displayed (Default) Hidden	Choose whether to display the values measured at the cur- rent cursor position and the difference between the val- ues when both cursors are active.
Cursor Adjustment	Independent (Default) Linked	When both cursors are active, you can choose whether you want to move each cursor independently of the other or to link both cursors. When linked, both cursors move together as a unit, maintaining a fixed separation between them.
Set % Reference	System control	Sets a new reference range between the current positions of the Reference and Delta cursors, equal to the range 0 to 100%.
Reset % Reference	System control	Returns the measurement range to the default settings. Both cursors also return to their original default positions at top or right (100%) and bottom or left (0%) of the waveform display. Note: This control has no effect if Set % Reference has not been used.
Advanced Waveform Controls		

Channel 1 Gain	Slider control; 0 to 1.9 1.00 (Default)	Adjusts the gain setting for the Channel 1 waveform. The gain setting enables you to adjust the brightness of the trace displayed in Channel 1, changing its brightness independently of the components in the other channels. This functionality is useful when using the Overlay waveform mode, especially in combination with single-line analysis.
Channel 2 Gain	Slider control; 0 to 1.9 1.00 (Default)	Adjusts the gain setting for the Channel 2 waveform. The gain setting enables you to adjust the brightness of the trace displayed in Channel 2, changing its apparent brightness independently of the components in the other channels.
Channel 3 Gain	Slider control; 0 to 1.9 1.00 (Default)	Adjusts the gain setting for the Channel 3 waveform. The gain setting enables you to adjust the brightness of the trace displayed in Channel 3, changing its apparent brightness independently of the components in the other channels.
Channel 4 Gain	Slider control; 0 to 1.9 1.00 (Default)	Adjusts the gain setting for the Channel 4 waveform. The gain setting enables you to adjust the brightness of the trace displayed in Channel 4, changing its apparent brightness independently of the components in the other channels.

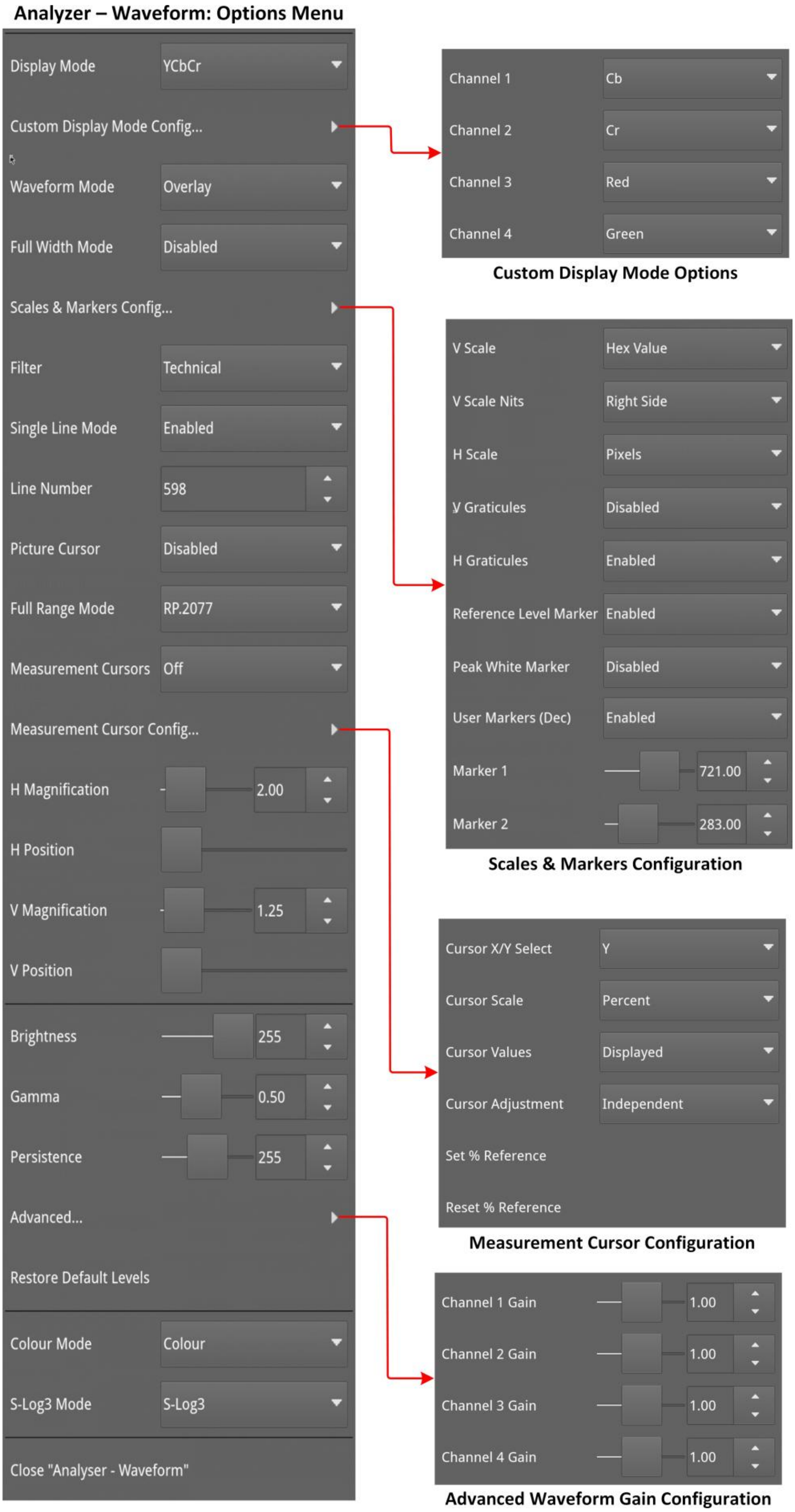


Figure 9-31: Analyzer - Waveform Options Menu and Submenus

Figure 9-32 (below) shows the difference between the **Reference Level Markers** when analyzing HDR PQ 2020 and HDR HLG 2020 signals and the Reference Level Marker is enabled in the **Scales & Markers Config...** submenu.

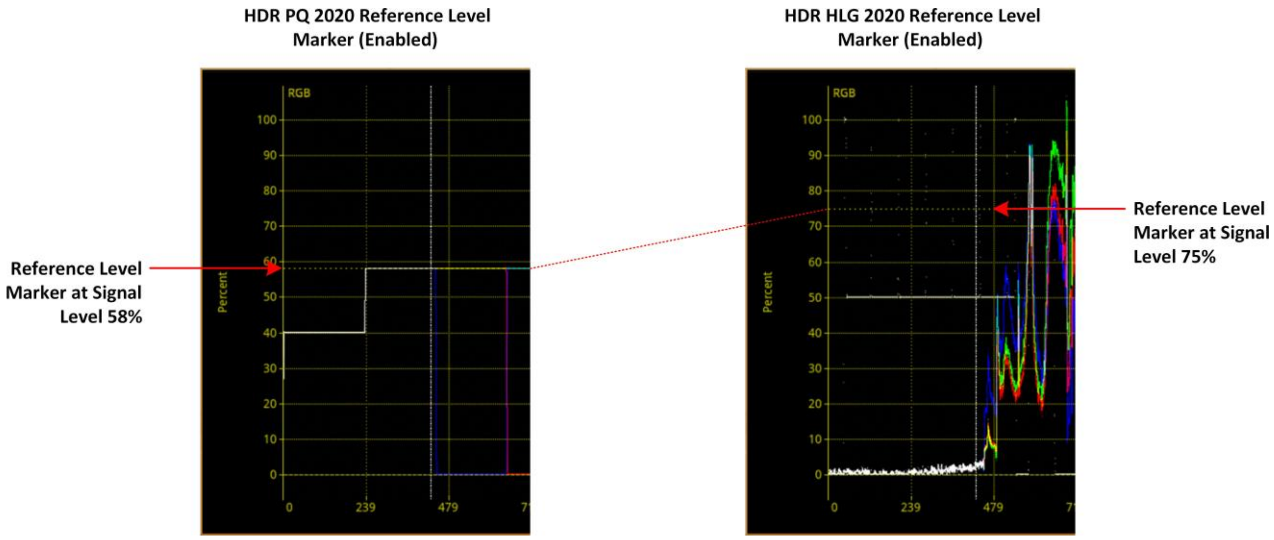


Figure 9-32: Analyzer - Waveform Options Menu - Reference Level Marker (HDR Only)

Analyzer - Vectorscope

Overview

The Vectorscope is part of the video core toolset that provides a polar (X-Y) display of the Cb and Cr Color Difference representations of the image, where the hue of the color is the angular component of the polar display. The Y component of the YCbCr video input to the vectorscope is ignored. The vectorscope presents the amplitude of the color difference as the distance from the origin (black).

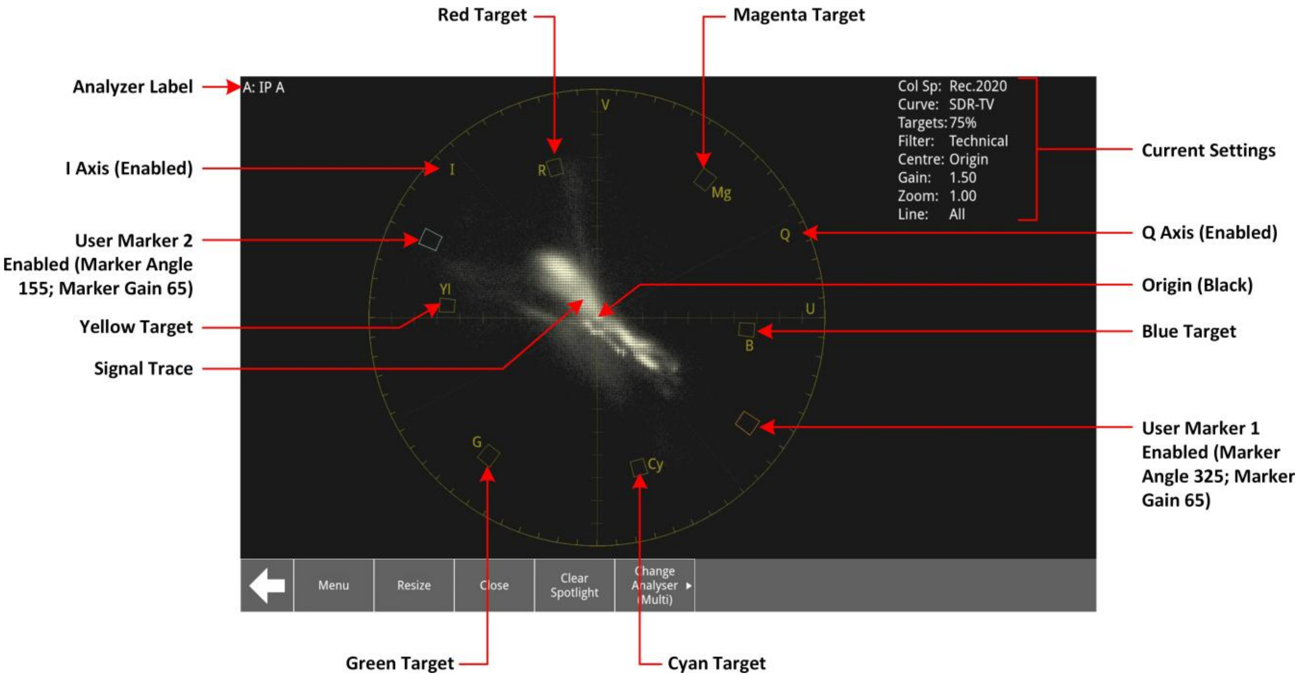


Figure 9-33: Analyzer - Vectorscope Instrument

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - Vectorscope instrument submenu:

Table 9-4 : Analyzer - Vectorscope Options

Item	Options	Description
Targets	Off (Default) 75% 100%	If selected, sets the display graticule scale to match either the 75% or 100% color bar positions. It also leads to the display of markers indicating the positions of pure R, G, B, C, Y and M. When set at 75%, the target represents 75% saturation, and the further from the center of the display, the more saturated that color. At 100%, the target represents 100% saturation.
User Markers (Dec)	Disabled (Default) Enabled	When enabled, places two markers in the vectorscope display. In addition, opens two new sliders for Marker Angle (adjustable in the range 0 and 359.99) and Marker Gain, (adjustable in the range 0 and 100.00).

Marker Selected	Marker 1 (Default)	When User Markers enabled, sets the focus for Marker

Item	Options	Description
	Marker 2	Angle and Marker Gain operations to either Marker 1 or Marker 2. By default, Marker 1 is orange and Marker 2 is cyan. **Note:** Marker 1 and Marker 2 are linked to the User Markers (Dec) in the Waveform instrument.
Marker Angle	Marker 1: 0.00 to 359.99 (Default): 0.00) Marker 2: 0.00 to 359.99 (Default: 90.00)	Adjusts the angle of the cursor from its default starting position around the center of the vectorscope.
Marker Gain	Marker 1: 0.00 to 100.00 (Default: 50.00) Marker 2: 0.00 to 100.00 (Default: 50.00)	Adjusts the Gain on the signal from 0 at the origin to 100 at the outer limit of the vectorscope.
I/Q Axes	Off (Default) I Only Q Only Both	When enabled, displays either the I axis only, the Q axis only, or both IQ axes together. The scale on the axes rep- resents the vertical lines for each color.
Filter	Technical (Default) Production Low Pass Raw	Sets the type of filtering applied. When you select the Raw option, the dots displayed correspond to the pixel values recorded in the stream. There is no filtering applied to these pixels.
Center	Origin (Default) Red Green Blue Magenta Cyan Yellow Marker 1 Marker 2	Selects the origin for the vectorscope display; used as the zoom focus.
Single Line Mode	Disabled (Default) Enabled	When enabled, allows single line mode analysis of the active picture. When disabled, all points in the image are analyzed/represented in the graph.
Line Number	System Control One toTotal number of active lines in the active standard.	When Single Line Mode is enabled, selects the line num- ber in the active picture.
Gain	System Control 1.00 (Default) to 2.00	Use in combination with the zoom control to enhance the detail or color saturation levels of the signal at the zoom location.
Zoom	System Control 0.5 to 4.00 (Default: 1.00)	Zooms-in to, or out of, the selected Center, which can be either the origin, a color target, or either of the user mark- ers. Use the slider control to adjust the zoom.

On Video Loss (ST 2110 Only)	Black Screen (Default) Freeze Last Screen	Choose what should be displayed in the Vectorscope window if the unit loses the video signal.
Brightness	Slider control: 1 to 31 (Default: 8)	Adjusts the brightness of the vectorscope display.

Item	Options	Description
Gamma	Slider control: 1 to 255 (Default: 127)	Adjusts the gamma component of the vectorscope display.
Persistence	Slider control: 1 to 255 (Default: 70)	Adjusts the persistence of the vectorscope display.

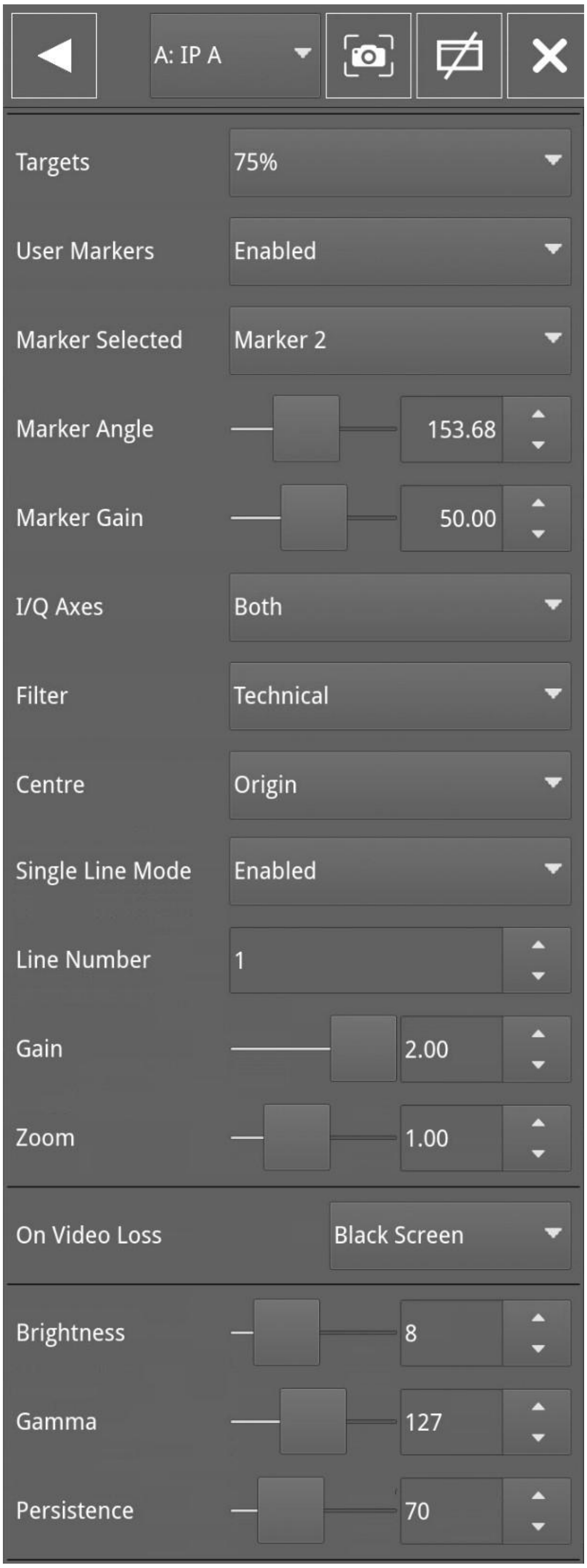


Figure 9-34: Analyzer - Vectorscope Options Menu

Analyzer - RGB Vector Display

Requires Option(s):	LPX500-DIAM

Overview

The optional Analyzer - RGB Vector Display provides an analyzer to monitor deviations outside the gamut of the RGB color space, which can be useful when making camera shading and white balance adjustments in a production environment.

The RGB Vector display includes the following elements:

- An upper diamond shape constructed from the green (G) and blue (B) vectors of the video sig- nal
- A lower diamond shape constructed from the green (G) and red (R) vectors of the video signal
- The current settings of the instrument, with the minimum and maximum values for the RGB components of the signal recorded by the firmware
- Alarm statuses for each RGB component causing a gamut deviation, if enabled.

The axes of the RGB Vector Display represent a green against blue plot in the upper diamond and a green against red plot in the lower diamond, based on the limits of a 100% color bar signal.

> **Note:** A monochrome signal displays a straight line between the two diamond shapes from apex to apex, through the origin.

The direction in which the signal exceeds the diamond borders represents which of the signal components is in gamut error, and whether the upper or lower threshold is exceeded. Blue gamut errors are shown in the upper diamond, red gamut errors in the lower diamond and green gamut errors equally in both upper and lower diamonds.

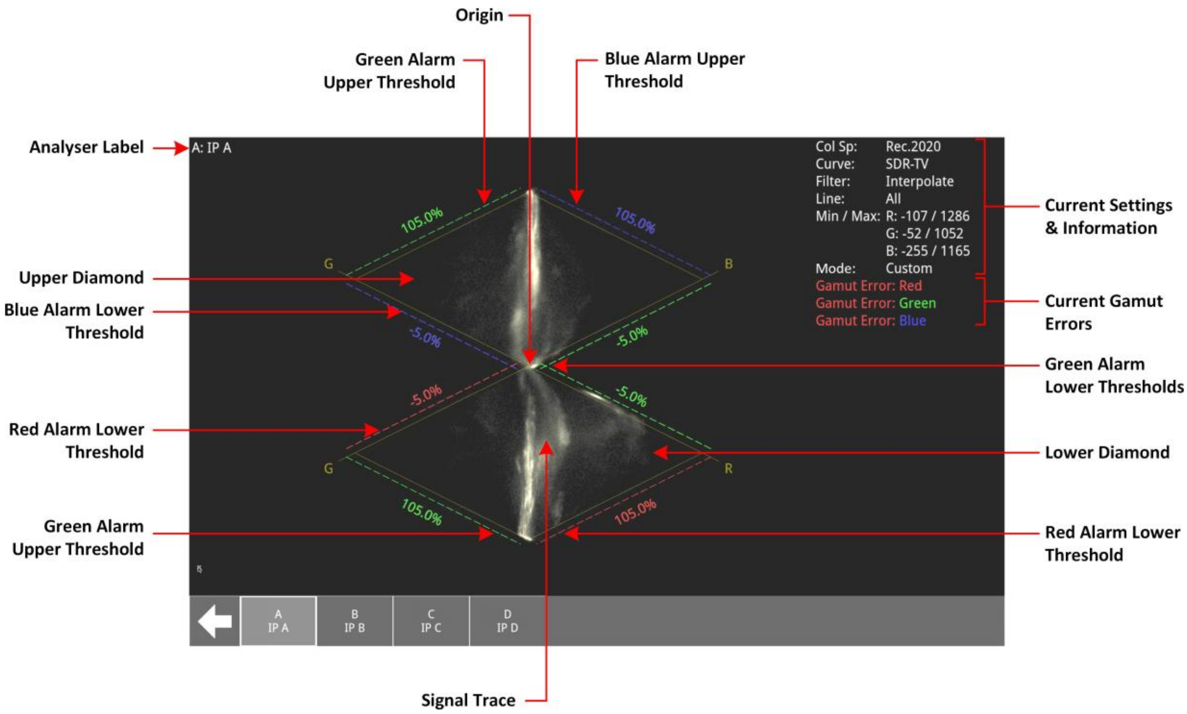


Figure 9-35: Analyzer - RGB Vector Display Instrument (With Custom Gamut Alarm Thresholds Enabled)

You can use the two diamond shapes in the RGB Vector window to set alarm thresholds for monitoring gamut deviations. For a more detailed examination of the origin of the axes, you can choose to separate the two diamond shapes horizontally and vertically using the vector display mode Split. In addition, you can choose to display only the upper or lower diamond shapes to analyze blue or red gamut deviations, respectively.

The origin of the upper and lower diamond shapes, represents the signal black (0 mV) and the apexes represent the signal peak white (700 mV).

You can choose to record gamut deviations by enabling Gamut Error Logs in the Event Logging instrument.

Setting Gamut Thresholds and Alarms

For a signal to be within the gamut of the EBU R103 colorimetry thresholds, all signal vectors must lie within the dashed threshold lines of both the upper Green-Blue and lower Green-Red diamonds. The total area enclosed between the dashed lines and the solid borders of the diamond shapes represents 1% of the complete picture area.

With the Threshold Mode set to EBU R103 and the Alarm Display enabled, the borders of the two diamond shapes represent the gamut alarm thresholds of EBU R103 for a narrow range video standard.

You can also select a custom threshold mode to define different gamut thresholds from those defined in EBU R103.

Gamut alarm thresholds are shown as dashed lines, parallel to the B-G and R-G axes. When a gamut alarm threshold is exceeded, the threshold line corresponding to the deviating color changes to the color causing the gamut deviation. You can choose to set gamut threshold alarms as either a percentage above or below the minimum and/or maximum levels respectively, or as decimal values above or below the thresholds for either a 10 bit-depth or 12 bit-depth signal. In addition, you can set a percentage area of the complete picture that the deviating color can exceed before triggering an alarm.

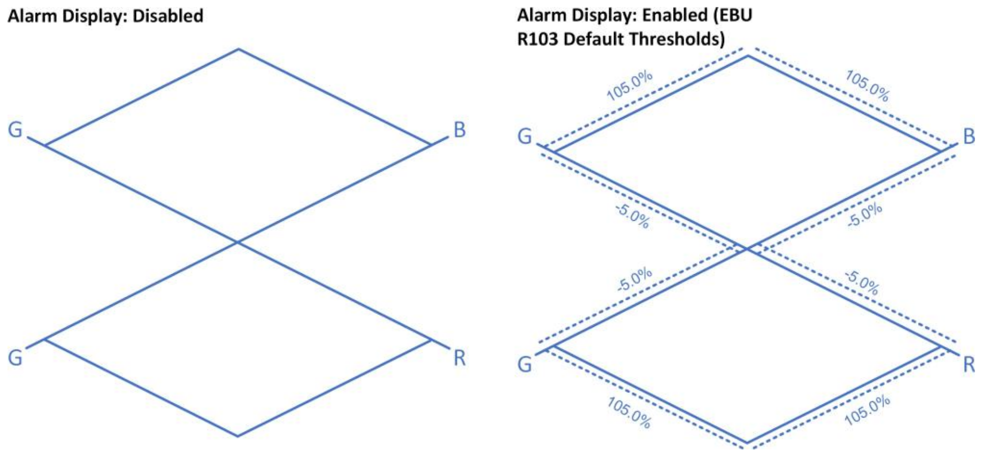


Figure 9-36: Analyzer - RGB Vector Alarm Display Disabled / Enabled

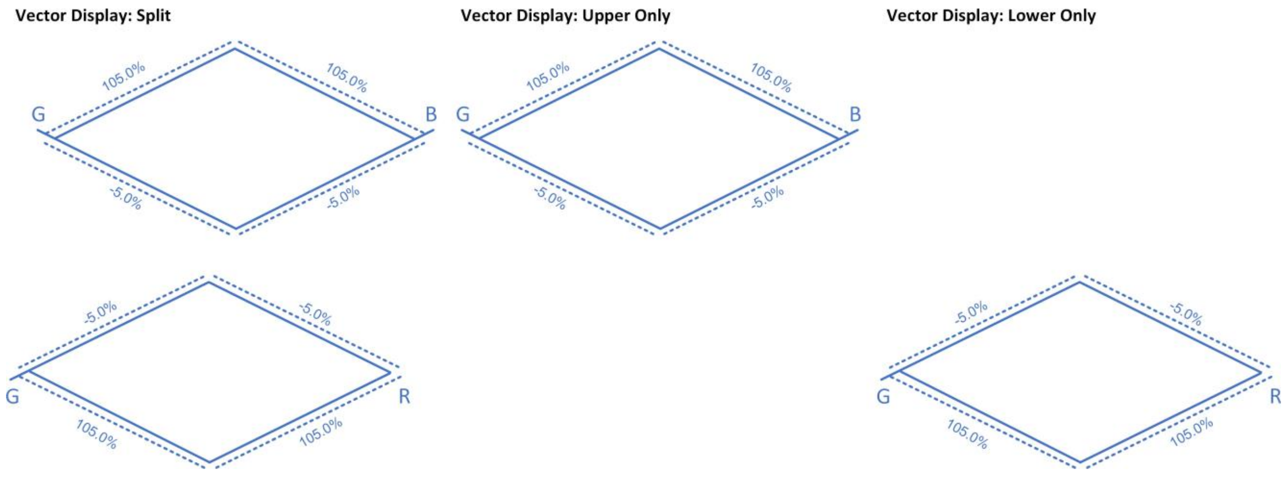


Figure 9-37: Analyzer - RGB Vector Display - Split, Upper, and Lower

> **Note:** The unit filters all out-of-gamut alarms regardless of the filter setting.

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - RGB Vector Display instrument submenu:

Table 9-5 : Analyzer - RGB Vector Display Options

Item	Options	Description
Filter	Interpolate (Default) Raw	Select the type of filtering applied to the signal. When you select the Raw option, no filter is applied.
Vector Display	Default Split Upper Only Lower Only	Use to switch the display to focus on gamut deviations in either the Blue Green diamond (Upper), the Red Green diamond (Lower) or in the black zone between the two diamonds (Split).
Vector Scale	Enabled (Default) Disabled	When enabled, displays the RGB vector axes to form the borders of the upper and lower diamond displays.
Single Line Mode	Disabled (Default) Enabled	When enabled, allows single line mode analysis of the active picture. When disabled, all lines in the active picture are represented.
Line Number	System Control One to the total number of active lines in the selected standard.	When single line mode is enabled, selects the line number in the active picture for analysis.
Reset Levels	System Control	Resets the alarms and minimum/maximum recorded values back to the min/max levels in the current pic- ture.
Gamut Alarms Config...	System Control Opens the Gamut Alarms configuration submenu.	See Gamut Alarms configuration below.
On Video Loss (ST 2110 Only)	Black Screen (Default) Freeze Last Frame	Select what to display in the RGB Vector window if the unit loses the video signal.

Brightness	Slider control: 1 to 31	Adjust the brightness of the RGB vector display.

Item	Options	Description
	(Default: 8)	
Gamma	Slider control: 1 to 255 (Default: 127)	Adjust the gamma component of the RGB vector dis- play.
Persistence	Slider control: 1 to 255 (Default: 70)	Adjust the persistence of the RGB vector display. **Note:** When set to 255, persistence is infinite.
Gamut Alarms Configuration		
Alarm Display	Disabled (Default) Enabled	When enabled, displays the alarm settings on the main display.
Threshold Mode	EBU R103 (Default) Custom	Set the gamut alarm threshold mode to either EBU R103 levels for narrow range, or choose customized alarm thresholds. **Note:** Alarm thresholds are not displayed for full range signals when using threshold mode EBU R103.
Threshold Units	Percent (Default) Decimal	Choose whether to display gamut alarm thresholds as percentage values or absolute decimal values.
Upper Threshold %	Spin control: −7.3% - 109.5% (Default: 105.0)	Displayed when Threshold Units is set to Percent. Sets the upper threshold for gamut deviations.
Lower Threshold %	Spin control: −7.3% - 109.5% (Default: −5.0)	Displayed when Threshold Units is set to Percent. Sets the lower threshold for gamut deviations.
Upper 12-bit Threshold	Spin control: 0 - 4095 (Default: 3760)	Displayed when Threshold Units is set to Decimal. Sets the upper threshold for gamut deviations for a 12 bit-depth signal.
Lower 12-bit Threshold	Spin control: 0 - 4095 (Default: 256)	Displayed when Threshold Units is set to Decimal. Sets the lower threshold for gamut deviations for a 12 bit-depth signal.
Upper 10-bit Threshold	Spin control: 0 to 1023 (Default: 940)	Displayed when Threshold Units is set to Decimal. Sets the upper threshold for gamut deviations for a 10 bit-depth signal.
Lower 10-bit Threshold	Spin control: 0 to 1023 (Default: 64)	Displayed when Threshold Units is set to Decimal. Sets the lower threshold for gamut deviations for a 10 bit-depth signal.
Area%	Spin control: 0.0 to 5.0 (Default: 1.0)	Sets a percentage area of the picture to represent a permitted area of gamut deviation, above which an alarm is raised.

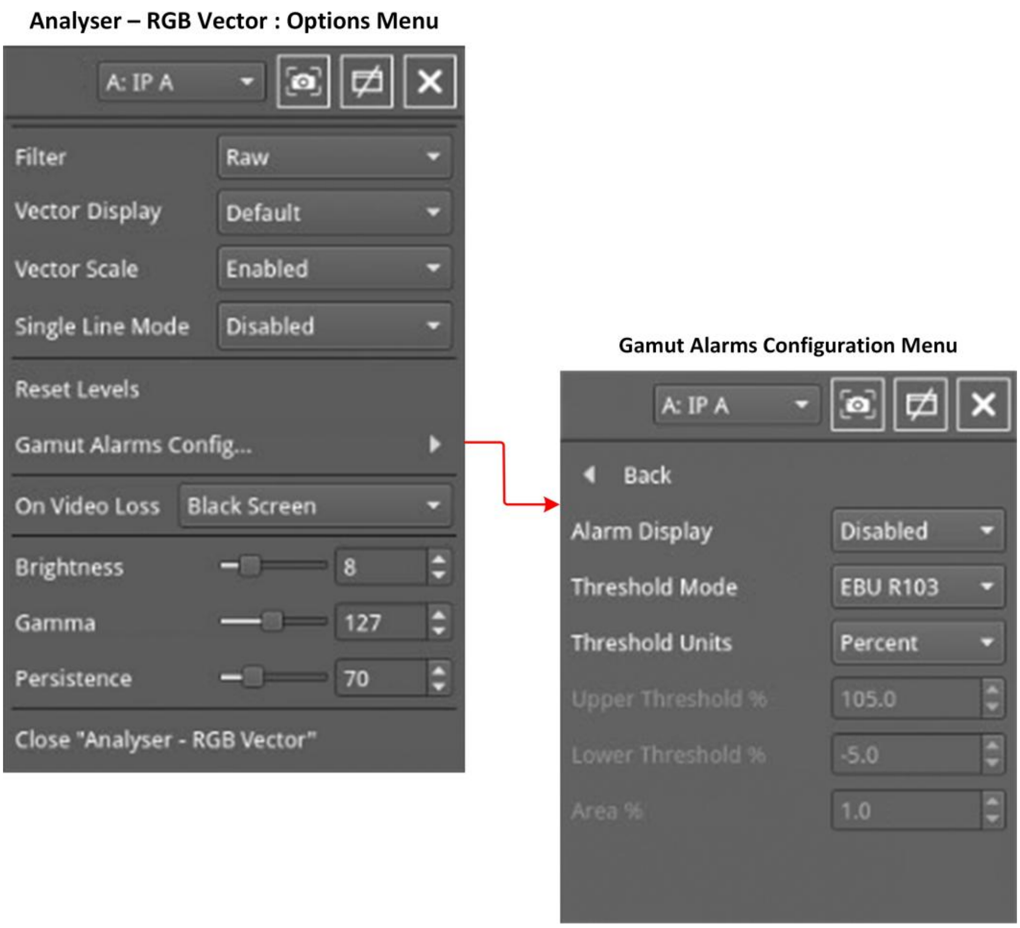


Figure 9-38: Analyzer - RGB Vector Display Options Menu

10

Audio Signal Analysis Instruments

This chapter describes the Audio analytical Instruments and includes the following sections:

Analyzer - Audio Channel Status

Overview

The **Analyzer - Audio Channel Status** Instrument displays detailed information about the available audio channels.

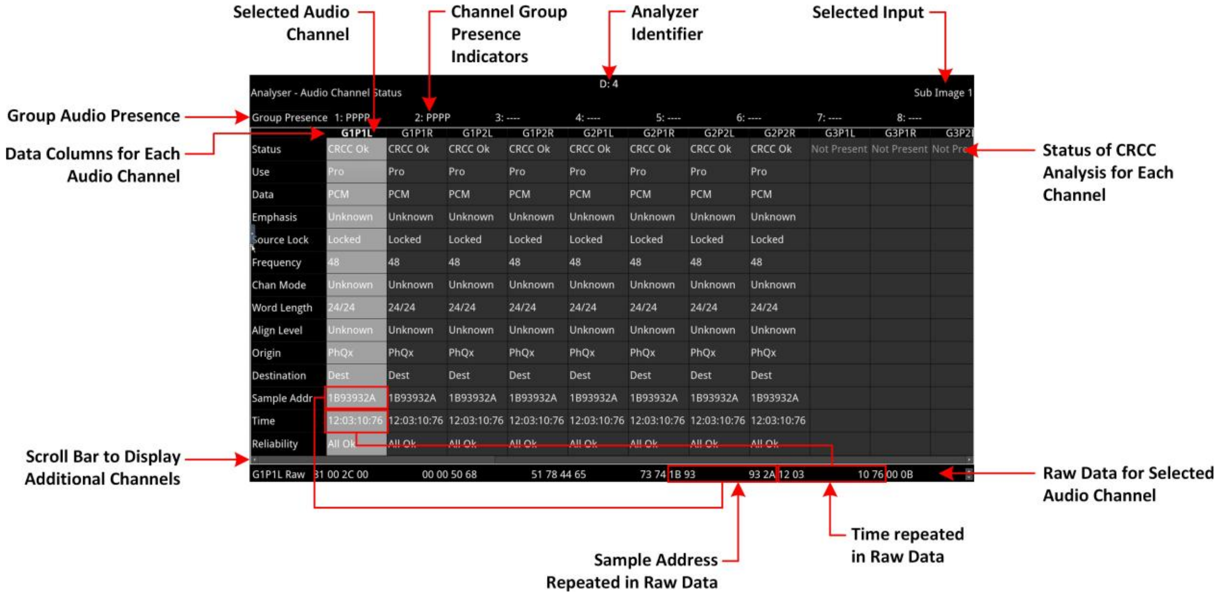


Figure 10-1: Analyzer - Audio Channel Status Instrument (ST 2022-6 and Optional SDI Input)

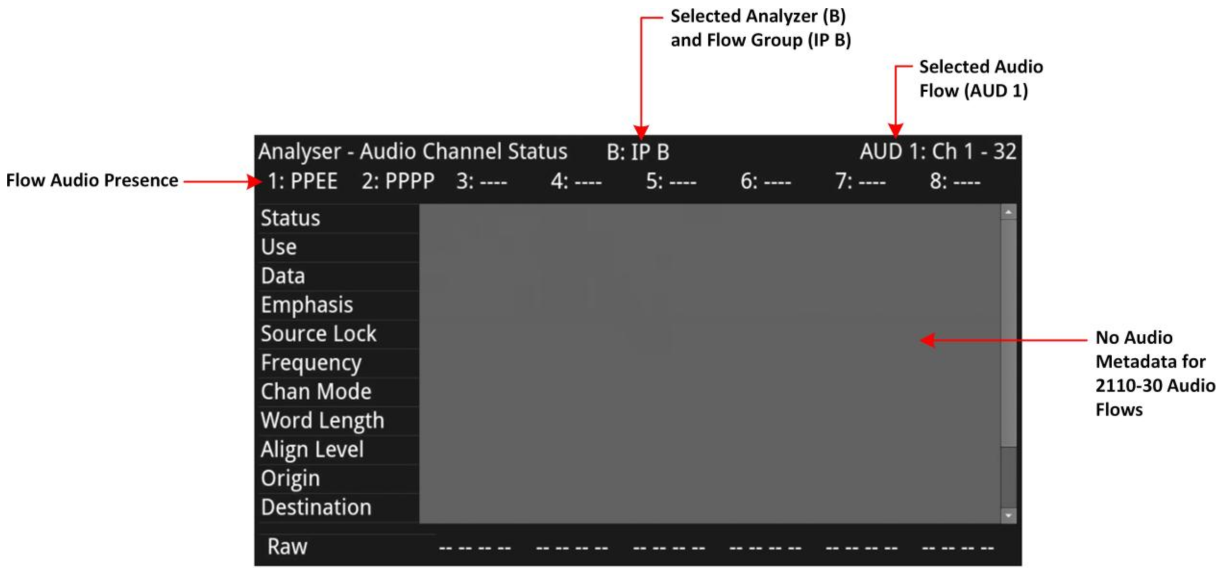


Figure 10-2: Analyzer - Audio Channel Status Instrument (ST 2110-30 IP Flow Group)

The Group Presence is defined in the upper row of the **Analyzer - Audio Channel Status** window. For each channel, one of the following channel presence indicators is displayed:

- **-**: No audio
- **P**: PCM audio present
- **D**: Dolby Digital® packets present
- **+**: Dolby Digital Plus™ packets present
- **E**: Dolby E™ packets present
- **2**: Dolby ED2™ packets present
- **?**: Unspecified data present.

If you hover the mouse cursor over one of the presence indicators, the following tooltip is displayed:

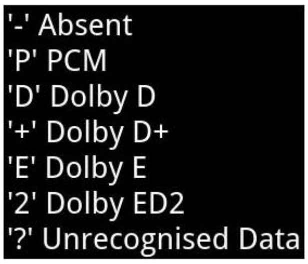


Figure 10-3: Audio Channel Group Presence Tooltip

In addition, the following information is displayed in the main data table for each audio channel:

- **Channel Status:** Result of the cyclical redundancy check checksum (CRCC), for example: CRCC Ok.
  The status table uses the following color-coding to indicate CRCC errors:
  - If the channel status is in error, the text is displayed in a red font
  - If errors have occurred but are no longer present the text is displayed in a yellow font
  - If no errors are present, the text is displayed in a white font.
- **Use:** Intended purpose of the audio signal.
- **Data:** Digital sampling method employed, for example: PCM (pulse-code modulation).
- **Emphasis:** Type of signal pre-emphasis applied to the audio signal.
- **Source lock:** Indicates whether the source is locked to an external time sync, for example: Locked.
- **Frequency:** Audio sampling frequency in kHz, for example: 48.
- **Channel Mode:** Represents the relationship between each audio channel pair.
- **Word Length:** Represents the audio word length, for example: 24/24.
- **Align Level:** Alignment Level element in the audio channel status data.
- **Origin:** Four ASCII characters indicating the channel origin, for example: PhQx
- **Destination:** Four ASCII characters indicating channel destination
- **Sample Address:** A rolling counter that increments with each audio sample
- **Time:** Local time of the encoded audio

- **Reliability:** Contains information about the reliability of the channel status word, for example: All Ok.

Use the horizontal and vertical scroll bars to view the full table of channel columns and audio status parameters.

Raw Data Display

You can click on an audio channel column to select it and display the raw data for that channel in the bottom row of the window.

Each AES3 audio sample, includes the Sample Address and Time occupying eight bytes (14 to 21) with a reliability indication in byte 22 and the cyclical redundancy check checksum (CRCC) in byte 23. With each audio sample, the Sample Address and Time are different for each sample, so bytes 14 to 21 will change, as will the checksum in byte 23.

Instrument Menu Options

The following configurable parameters are available to configure the **Analyzer - Audio Channel Status** Instrument:

Table 10-1 : Analyzer - Audio Channel Status Menu Options

Item	Options	Description
Input Select	Sub Image 1	Sets the target input audio source for analysis. The selec- ted input is displayed in the top-right corner of the instru- ment.
Input Select (ST 2110 IP input)	With one x 64 channel audio flow selected: • AUD 1: Channels 1 - 32 • AUD 1: Channels 33 - 64 With two x 32 channel audio flows selected: • AUD 1 • AUD 2 With four x 16 channel audio flows selected: • AUD 1 • AUD 2 • AUD 3 • AUD 4 **Note:** in ST 2110-31 the number of channels is limited to **1 - 60** for a 125 μs packet time.	For ST 2110 IP input, you can choose the audio flows cur- rently selected in the Analyzer - Audio Meters windows. Audio Channel Status metadata is available only with a flow using **ST 2110-31** (AES 3 transport) or an AES input.

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Overview

The **Analyzer - Audio Meters** instrument displays 16 audio meters together with peak level indicators and indication of audio pair correlation. In addition, the numeric values are displayed in dBFS below each meter.

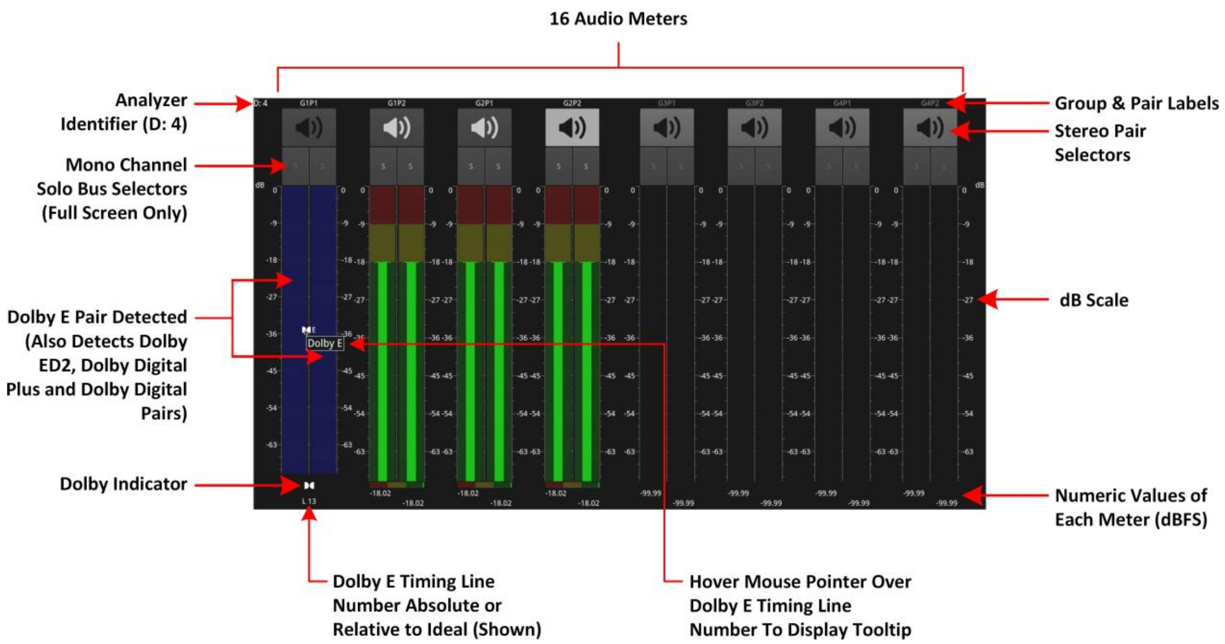

Figure 10-4: Analyzer - Audio Meters Instrument (ST 2022-6 and Optional SDI Input)

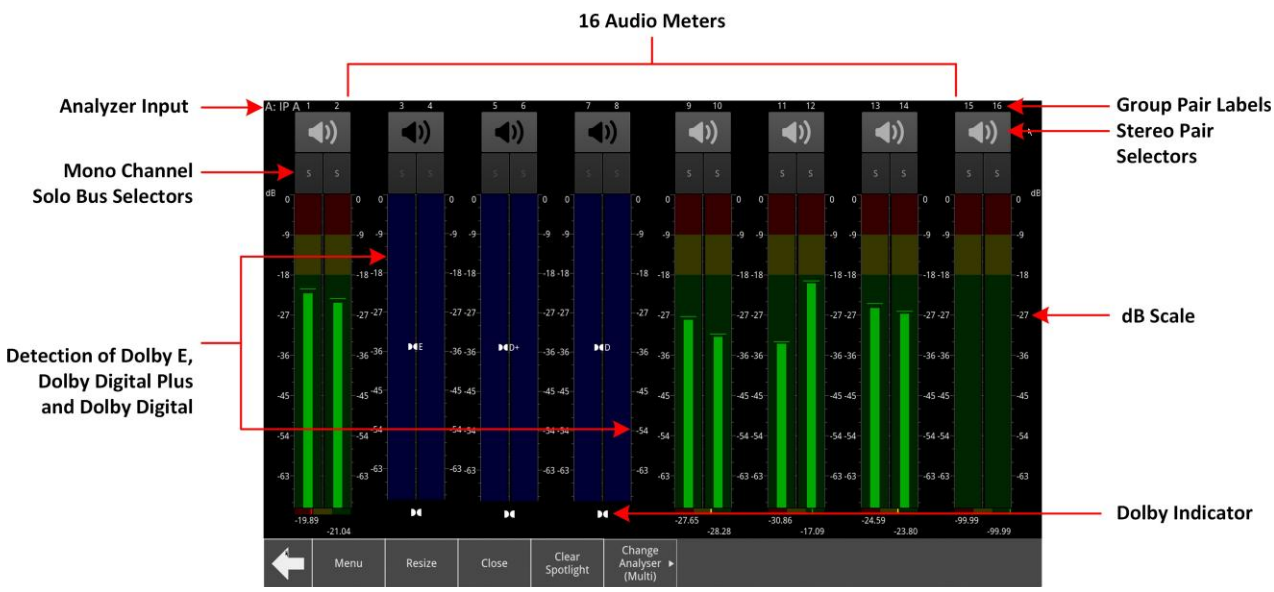

Figure 10-5: Analyzer - Audio Meters Instrument (ST 2110 IP Input)

Dolby E™, Dolby ED2™, Dolby Digital® and Dolby Digital Plus™ streams are automatically detected by the unit, with Dolby® stream presence indicated in blue. For an optional SDI input carrying embedded Dolby E audio, the Dolby E timing line number is also displayed below the meter, either as an absolute value or relative to the Ideal line number specified for that video standard.

The DisplayPort output carries a stereo pair of audio, as do the SDI Mon instrument output and headphone output.

To monitor a stereo pair, select the speaker icon  above the target audio meter. To select a channel, click the corresponding **solo** bus icon (available in **full-screen mode** only) located between the audio meters and the speaker icons.

> **Note:** Before activating audio output, be sure to check the audio settings in the configuration, ensuring that the output is not muted, and the volume is set correctly.

In **unlinked layouts**, you can launch up to two Audio Meters windows for each available analyzer, providing 32 simultaneous channels of audio metering per analyzer. Each window can be assigned to monitor groups 1 to 4 (defined in SMPTE ST 299-1) or groups 5 to 8 (defined in SMPTE ST 299-2) in the Sub-image 1 ANC area as defined in SMPTE ST 2082-10. You can scale the size of each audio window to occupy either 1/16, 1/4 or the full screen area.

In **linked layouts** you can launch only a single Audio Meters window for each analyzer. The window size is also restricted to 1/4 screen size for single linked layouts or 1/16 screen size for multi linked layouts.

> **Note:** When the optional second screen is available, you can display another set of audio meters making it possible to monitor up to 32 audio channels for a single analyzer.

Figure 10-6 provides a comparison of the available audio metering scale options and illustrates the relative scope and alignment levels. For each scale you can select an appropriate ballistic option.

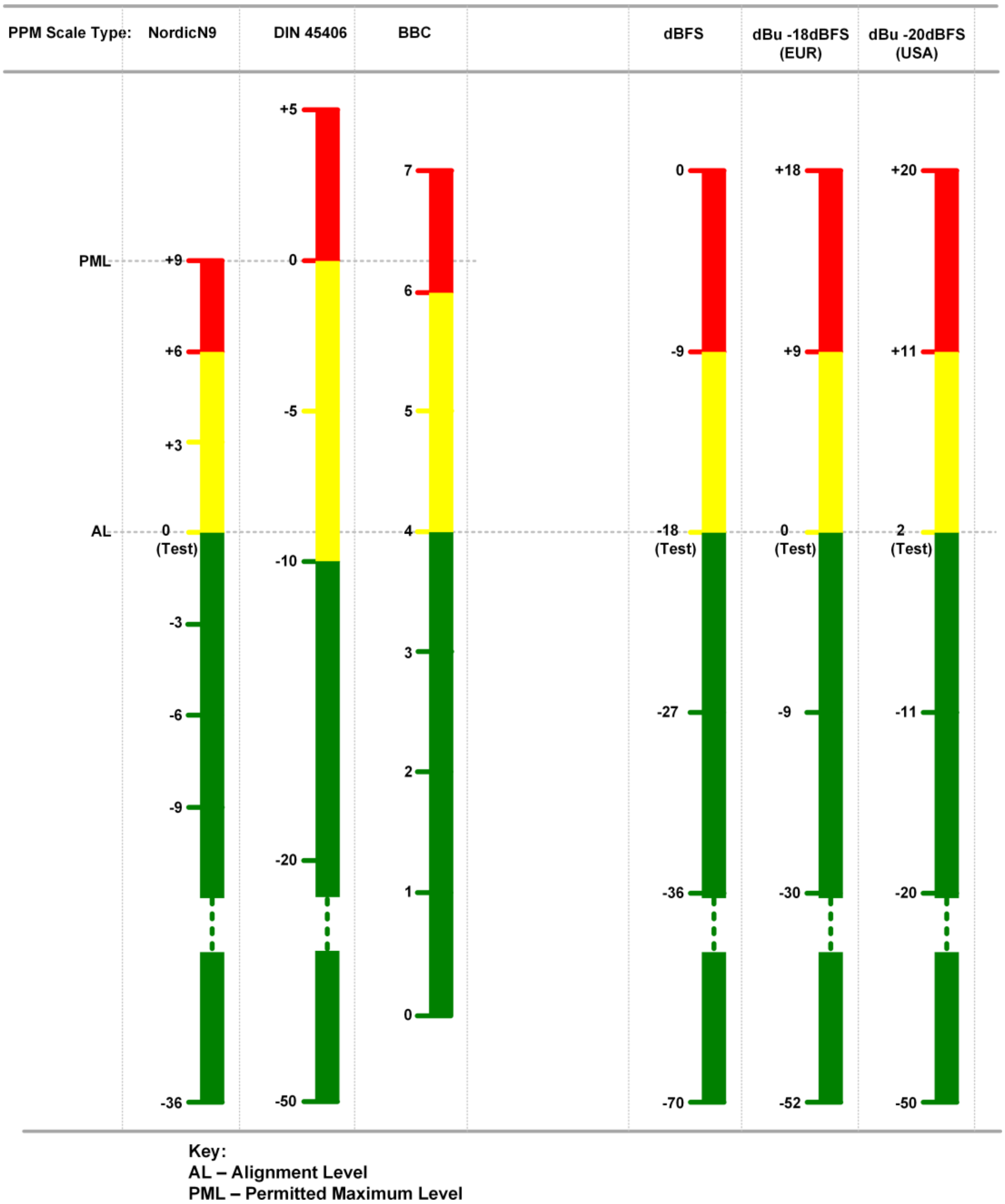

Figure 10-6: Comparison of Audio Metering Scales

Audio Group Metering (ST 2110 IP Input Only)

In the *IP Receive - Flows* instrument (ST 2110 IP input) you can select either of the multiple flows: two audio flows (AUD 1 and AUD 2 providing 2 x 32 channels) or four audio flows (AUD 1 to AUD 4 providing 4 x 16 channels) for **audio group metering**. When you select either 2 x 32 channels or 4 x 16 channels you can set-up audio group metering in the Audio Meters instrument as follows:

- With 2 x 32 channels active, select **AUD 1,2 : Channels 1 -8** from the **Input Select** dropdown.

  This allows you to meter the first eight channels of AUD 1 in the first eight audio meters of the Audio Meters instrument, and the first eight channels of AUD 2 in the next eight audio meters. The remaining channels are unmetered.
- With 4 x 16 channels active, select **AUD 1,2,3,4 : Channels 1 -4** from the **Input Select** drop-down.

  This allows you to meter the first four channels of AUD 1 in the first four audio meters of the Audio Meters instrument, the first four channels of AUD 2 in the next four audio meters, the first four channels of AUD 3 in the next four audio meters and finally the first four channels of AUD 4 in the remaining four audio meters. The remaining channels are unmetered.

To identify the source flow and channels currently being metered, hover the mouse cursor over any of the 16 meters to display a tooltip.

Instrument Menu Options

The following configurable parameters are available to configure the **Analyzer - Audio Meters** Instrument:

Table 10-2 : Analyzer - Audio Meter Menu Options

Item	Options	Description
Input Select **(ST 2022-6 IP and Optional SDI Input)**	Image/Sub Image 1 Group 1-4 Image/Sub Image 1 Group 5-8	Select the source for each pair of audio meters to meter simultaneously up to 32 audio channels in up to two Audio Meter instrument windows.
Input Select **(ST 2110 IP Input)**	With Audio Flows set to **1x 64** Channel: AUD 1: Channels 1 - 16 AUD 1: Channels 17 - 32 AUD 1: Channels 33 - 48 AUD 1: Channels 49 - 64 With Audio Flows set to **2x 32** Channels: AUD 1: Channels 1 - 16 AUD 1: Channels 17 - 32 AUD 2: Channels 1 - 16 AUD 2: Channels 17 - 32 AUD 1,2 Channels 1 - 8 With Audio Flows set to **4x 16** Channels: AUD 1: Channels 1 - 16 AUD 2: Channels 1 - 16 AUD 3: Channels 1 - 16 AUD 4: Channels 1 - 16 AUD1,2,3,4 Channels 1 - 4: (AUD1,2,3,4: 4-4-4-4 AUD1,2,3,4: 2-6-4-4)	Select the audio channels corresponding to the audio flows selected in *IP Receive - Flows*, AUD 1, AUD 2, AUD 3 or AUD 4 for metering in up to two Audio Meter instrument windows. **Note:** For ST 2110-30: One active received flow comprises 1 - 64 channels, whereas two active received flows comprise two times 1 - 32 channels.
Ballistics	PPM Type I PPM Type II Vu VuFr Fast	Set the required peak program meter (PPM) ballistic responsiveness for the audio meters. PPM Type I emulates the performance of IEC 60268-10 Type I PPM style audio meters typically used by German broadcasters. PPM Type II emulates the performance of IEC 60268-10 Type II PPM style audio meters typically used by UK broadcasters. Vu emulates the performance of IEC 60268-17 Type I PPM style audio meters typically used by US and Australian broadcasters. VuFr emulates the performance of ITU-R Rec BS.645 style audio meters typically used by French broadcasters. Fast provides instantaneous attack ballistics.

Item	Options	Description
PPM Scale	dBFS dBu -18dBFS dBu -20dBFS BBC	Set the desired scale for the audio meters according to your standard operating model. The displayed graticule and audio levels change accordingly to reflect the selected scale.
	DIN45406 NordicN9	
Hat hold time	0.00 10.00, infinite	Sets the minimum time that the signal gate is held open in ms.
Monitor Buttons	Enabled (Default) Disabled	Toggle the display of Monitor icons for the audio meters. **Note:** Not displayed at 1/16 screen size.
Solo Buttons	Enabled (Default) Disabled	Toggle the display of Solo icons for each channel of a pair. **Note:** Only available at full screen size.
Dolby E Line Number	Relative to Ideal (Default) Absolute	Select whether to display the Dolby E timing line number relative to the ideal for the selected standard, or as an absolute line number. The line number is shown in red if it is outside the valid range.

Analyzer - Loudness Monitor

Overview

The **Analyzer - Loudness Monitor** instrument enables the metering and monitoring of loudness on the configured audio channels for either a stereo audio pair, or a 5.1 surround sound audio group.

The Loudness Monitor provides the following loudness meters:

- **M**: Momentary loudness meter
- **S**: Short-term loudness meter
- **I**: Integrated loudness meter.

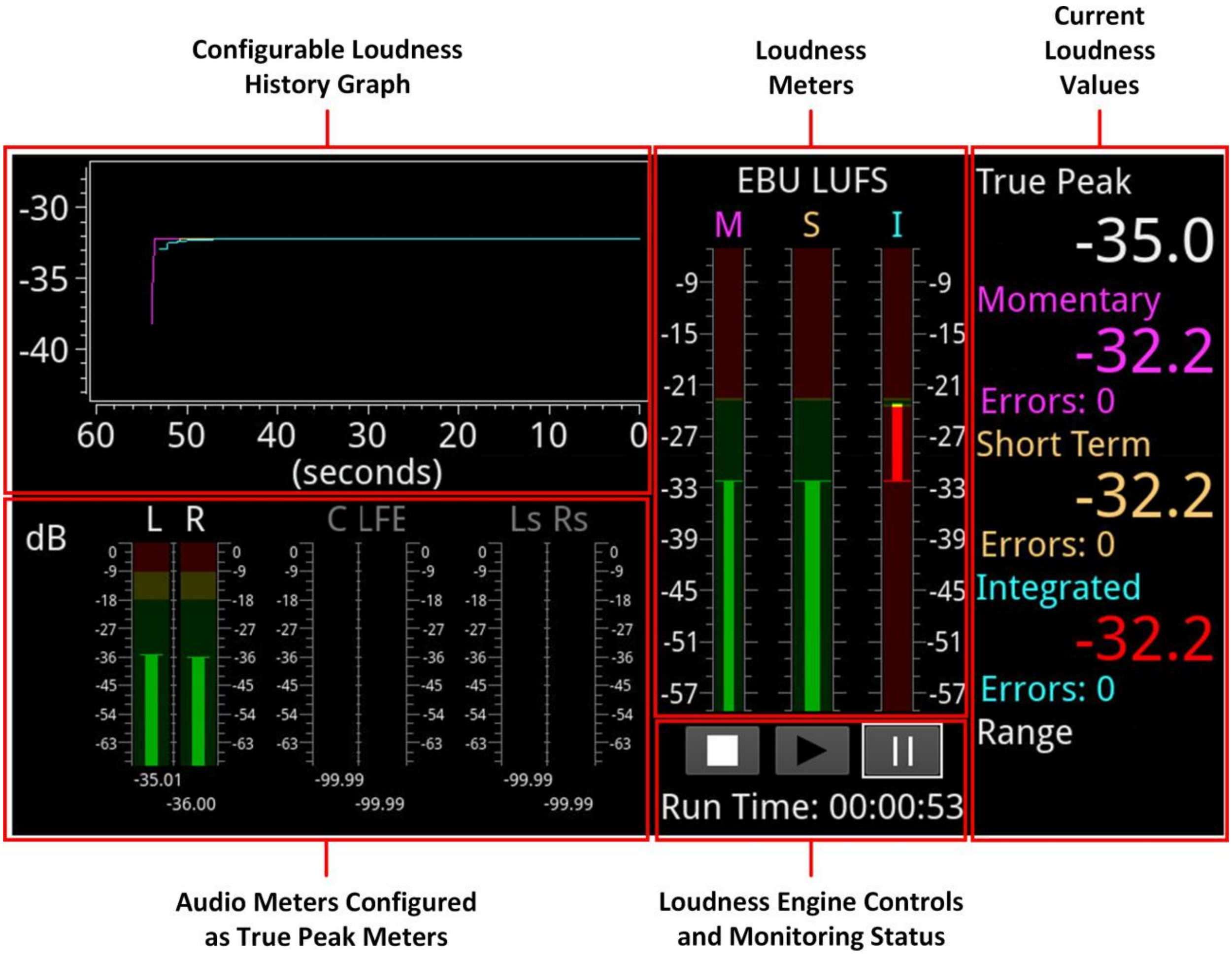

Figure 10-7: Analyzer - Loudness Monitor Instrument

Loudness is measured in accordance with the standards *EBU Recommendation R128* and *ITU-R BS-1770* which define the measurement over different time periods in terms of either:

- EBU Loudness Units Full Scale (**EBU LUFS**)
- EBU Loudness Units (**EBU LU**)
- ITU Loudness K-weighted Full Scale (**ITU LKFS**)
- ITU Loudness Units (**ITU LU**)

The right-hand section of the Loudness window displays the actual loudness values of the assigned audio channels both graphically, in the three loudness meters and numerically, in the current values for Integrated, Momentary and Short Term loudness. This section also displays the True Peak value, together with a value for the Loudness Range.

When below the configured loudness target and tolerance, the momentary, short-term and integrated values are displayed in the same color as their corresponding loudness meter. If the loudness value exceeds the configured tolerance for a particular meter, the corresponding value switches to a red color and an error count is incremented below the value. In addition, if the True Peak value exceeds the configured **True Peak Alarm** threshold, this value also changes color from white to red.

Three media controls below the Loudness Monitors are provided to enable you to start, stop or pause the Loudness Engine and consequently, the loudness monitoring session.

> **Note:** The Loudness Engine controls do not affect the input source/media to the Loudness Monitor.

The left-hand section of the Loudness window displays the Audio Meters acting as inputs to the Loudness Monitor, together with a Loudness History graph, plotting the selected loudness values from the monitoring session in real-time.

For clarity of viewing, you can resize the Loudness Monitor to display the window in either quarter or full-screen size.

The Loudness Options menu allows you to:

- Open the **Audio Assignment** dialog to define the loudness monitoring mode and assign the audio input channels for loudness monitoring and measurement, see the section *Audio Assign- ment for Loudness Monitoring*.
- Define the ballistics and PPM scale type for the conventional audio meters (in the Analyzer - Audio Meters instrument) and the True Peak meters in the Loudness

  > **Note:** The choice of ballistics does not affect the reported true peak values in the true peak meters.

  Monitor.
- Set the loudness standard (EBU or ITU) and units (LU, LUFS or LKFS).
- Configure the Loudness History graph.
- Enable or disable the individual loudness meters (M, S, and I).
- Configure target loudness levels and appropriate tolerances for each loudness meter and, in addition, set an alarm for the True Peak loudness value.
- Reset the True Peak value, the loudness monitoring session, or zero accumulated loudness errors.
- Define the logging duration and lifetime of the loudness logfiles and change the naming of the logfiles.

For details, see the section *Instrument Menu Options.*

Summary Loudness Monitoring Process

When monitoring an audio track or program for loudness, you will need to perform some, or all, of the following steps:

1. Open the **Analyzer - Loudness Monitor** from the Instruments tab of the Setup menus.
2. Open the **Audio Assignment...** dialog form the Loudness options menu. Select the desired audio mode and then assign the appropriate audio inputs, see the section *Audio Assignment for Loudness Monitoring*.
3. Set the ballistics and scale type for the audio and true peak meters.
4. Select the Loudness standard and appropriate scale for the loudness monitors.
5. Enable which of the three possible loudness meters you want to use.
6. Set the graphing period and choose which traces to display in the Loudness History graph.
7. Set the loudness targets and tolerances for the active loudness meters.
8. Set the true peak alarm threshold.
9. Set the desired log duration and lifetime.
10. Tap or click the **Play** button to start the loudness monitoring

session. These tasks are described in more detail in the following subsections.

Audio Assignment for Loudness Monitoring

You can select the audio inputs from the available audio channels to be monitored for loudness by opening the **Audio Assignment...** dialog from the Loudness options menu.

The unit's Audio Meter instruments can provide up to 32 simultaneous audio channels for either ST 2022-6 IP or optional SDI input, or up to 64 audio channels for ST 2110 IP input.

For ST 2022-6 IP or optional SDI input, you can assign any of the 32 channels of the left/right pairs in Groups 1 to 8 to the stereo or 5.1 audio inputs for loudness monitoring.

For ST 2110 IP input, you can assign any of up to 64 input channels to the stereo or 5.1 audio inputs for loudness monitoring.

First select the desired loudness monitoring **Mode** from the dropdown menu:

Table 10-3 : Audio Assignment Modes for Loudness Monitoring

Audio Modes for ST 2022-6 IP or Optional SDI Input:	Audio Modes for ST 2110 IP Input:
SDI Stereo	IP Stereo
SDI	IP

For ST 2110 IP, or optional SDI **Stereo** audio mode, two input audio meters, Left (L) and Right (R) are displayed.

For ST 2110 IP, or optional SDI **5.1** audio mode, all six audio input meters are active as follows:

- **Left** (L)
- **Right** (R)
- **Center** (C)
- **Low frequency effects** (Lfe)

- **Left Surround** (Ls)
- **Right Surround** (Rs).

> **Note:** The Loudness Monitor supports only the following channel order in surround sound mode 5.1: L, R, C, Lfe, Ls, Rs.
> The Audio Assignment dialog then maps the incoming audio to the expected channel order of the Loudness Monitor.

For ST 2022-6 IP or optional SDI input, select the sub-image then the group/pair to use as stereo inputs to the loudness monitor from the dropdown lists. For ST 2110 IP input, select the configured audio flow (AUD 1 to AUD 4) and then assign one of up to 64 available channels (depending on the number of flows) using the selector.

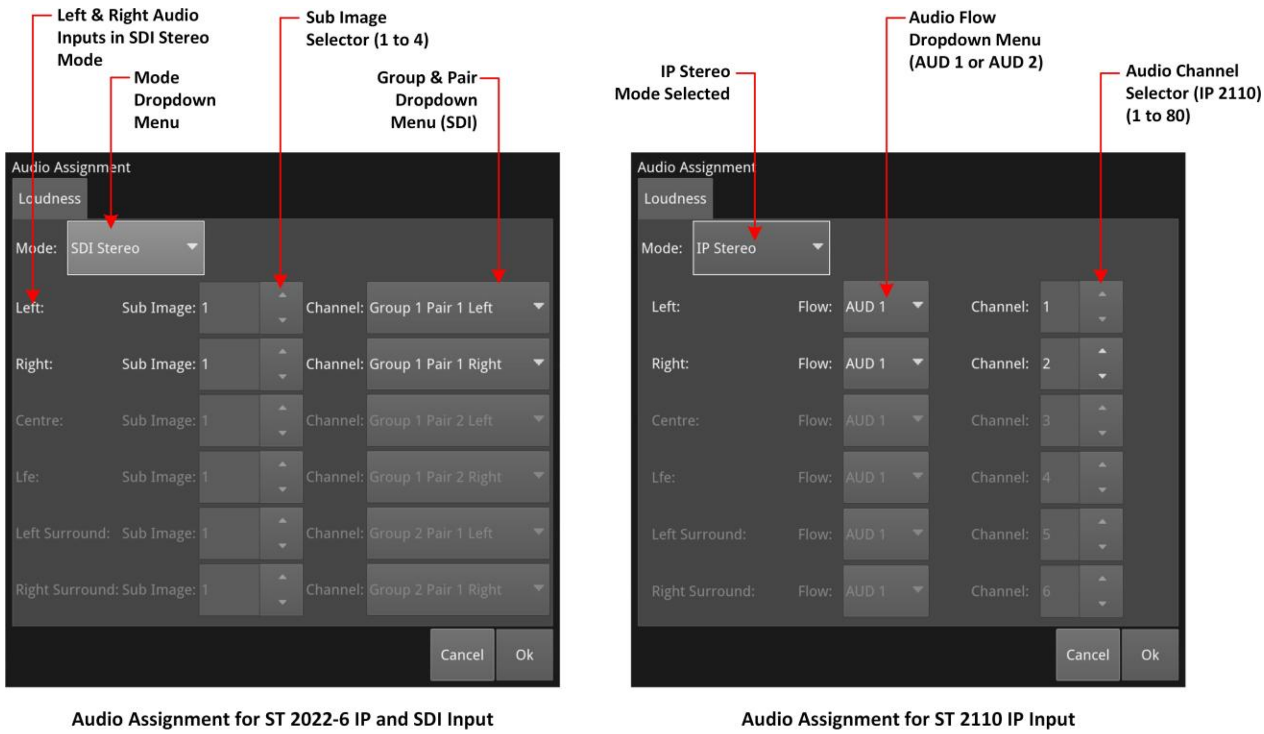

Figure 10-8: Loudness Audio Assignment for ST 2022-6 IP / Optional SDI and ST 2110 IP Input

On completion, tap or click **OK** to save your audio input mapping changes.

Audio Meters for Loudness Inputs

The audio meters displayed in the Loudness Monitor display the active audio levels for the selected mode and assigned audio channels.

In stereo mode, the two selected input channels are active in the Left (L) and Right (R) audio input meters.

In 5.1 surround sound mode, six input channels are active in all six audio input meters: L, R, C, Lfe, Ls and Rs as shown in the following figure.

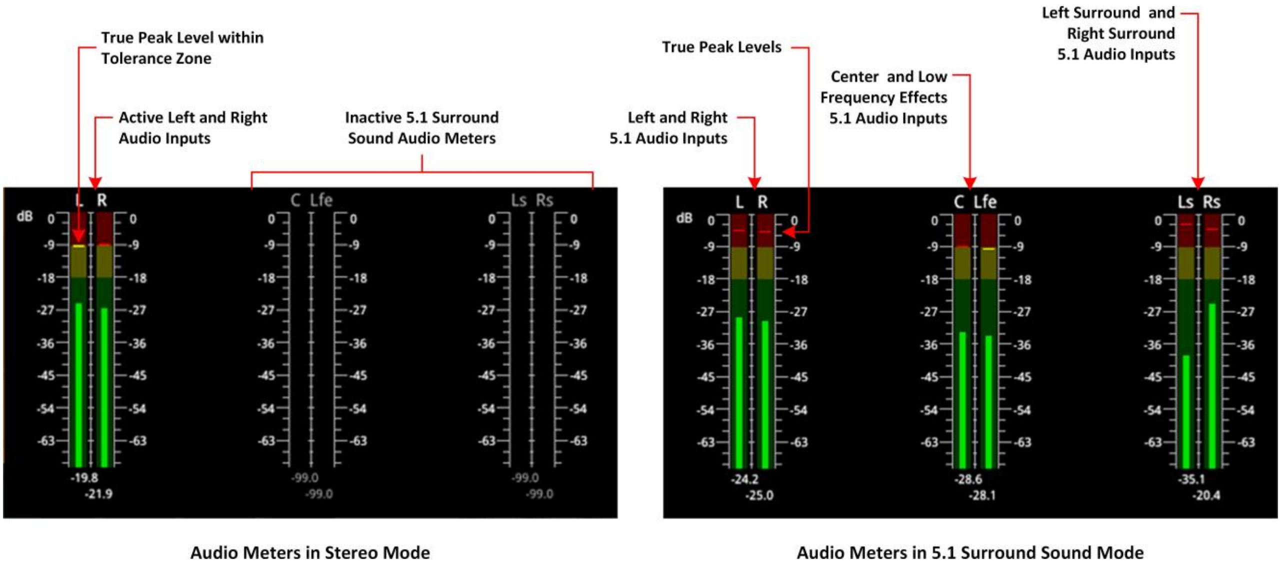

Figure 10-9: Audio Meters for Loudness Inputs in Stereo and 5.1 Surround Sound Modes

The current True Peak levels are also displayed as a horizontal band in each of the active audio meters.

Understanding the Loudness Meters and Values

The Loudness Monitor features three individual loudness meters to measure momentary, short-term and integrated (also known as program loudness) levels across the different time periods defined in the selected standard. You can enable or disable each individual meter using the options menu and set the Loudness standard and scale. The unit updates the loudness meters every 100 ms.

When enabled, the monitors give a visual indication, in real-time, of the current loudness level with the actual value displayed as a numeric in the right-hand column. The loudness value is also plotted in the Loudness History graph to generate a trace of the loudness trend over time.

The **Momentary (M)** Loudness meter measures the loudness of the audio in a **400 ms** period and then updates the Momentary Loudness displays (numeric value, meter and peak).

The **Short-term (S)** Loudness meter measures the maximum level of all short-term loudness values received over a period of **3 s** monitors and then updates the Short-term Loudness displays (numeric value, meter and peak).

The **Integrated (I)** Loudness meter measures the average loudness over the entire length of the monitoring session, audio track or program and then updates the Integrated Loudness displays (numeric value, meter and peak).

> **Note:** If you hover the mouse cursor over the three loudness meters, the unit displays a tooltip showing the Peak Momentary, Short-term and Integrated values.

The underlying Loudness Engine calculates the Momentary, Short-term and Integrated loudness values and the Loudness meters are the visual representation of the underlying algorithm and calculations.

Each Loudness Meter is color-coded for ease of recognition as follows:

- **Momentary Meter**: **Magenta**
- **Short-term Meter**: **Orange**
- **Integrated Meter**: **Cyan**

The colors of the loudness meters are also reflected in both the numeric loudness values and in the plotted traces in the Loudness History graphs.

When a loudness value for one of the loudness meters is in error, the value is displayed in red.

The configurable **Target Zone** of each meter represents the target loudness of the input audio signal and is displayed as the green background in the meter. When the loudness is within the target range, the numeric value is displayed in the same color as the corresponding meter.

The configurable **Tolerance Zone** of each meter represents the tolerance permitted for the loudness of the signal to be outside the target range and is displayed as the yellow background in the meter. If the tolerance is set to zero (0) or a very low value, you may not see a yellow background section on the meter. When the loudness is within the tolerance range, the numeric value is displayed in the same color as the corresponding meter.

The area of the meter outside the target and tolerance levels represents the loudness Error Zone, or excessive loudness, and is displayed as a red background in the meter.

If the loudness is within the error zone of any of the meters, the corresponding loudness value is displayed in red.

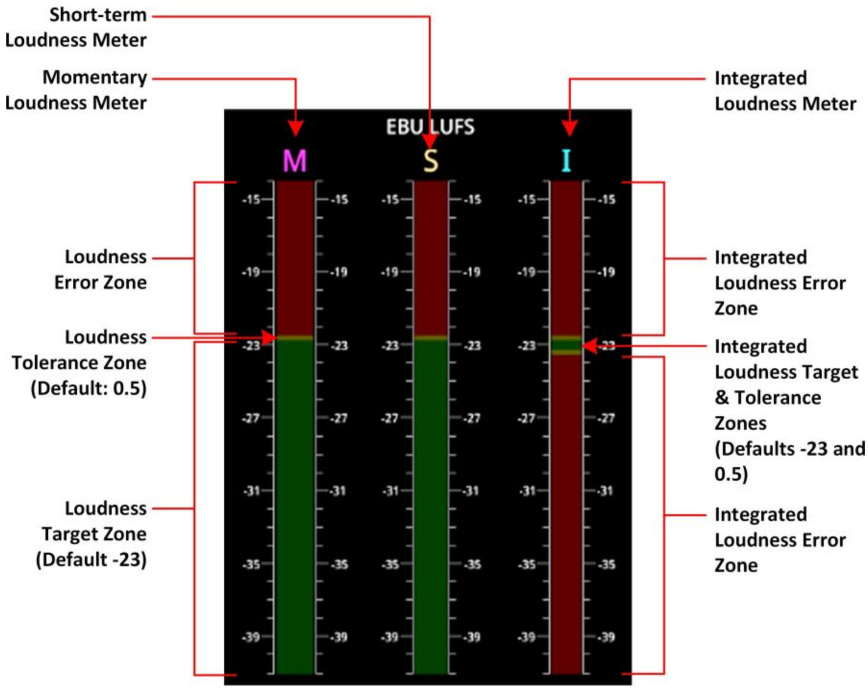

Figure 10-10: EBU LUFS Loudness Meters Showing Default Configuration With No Signal

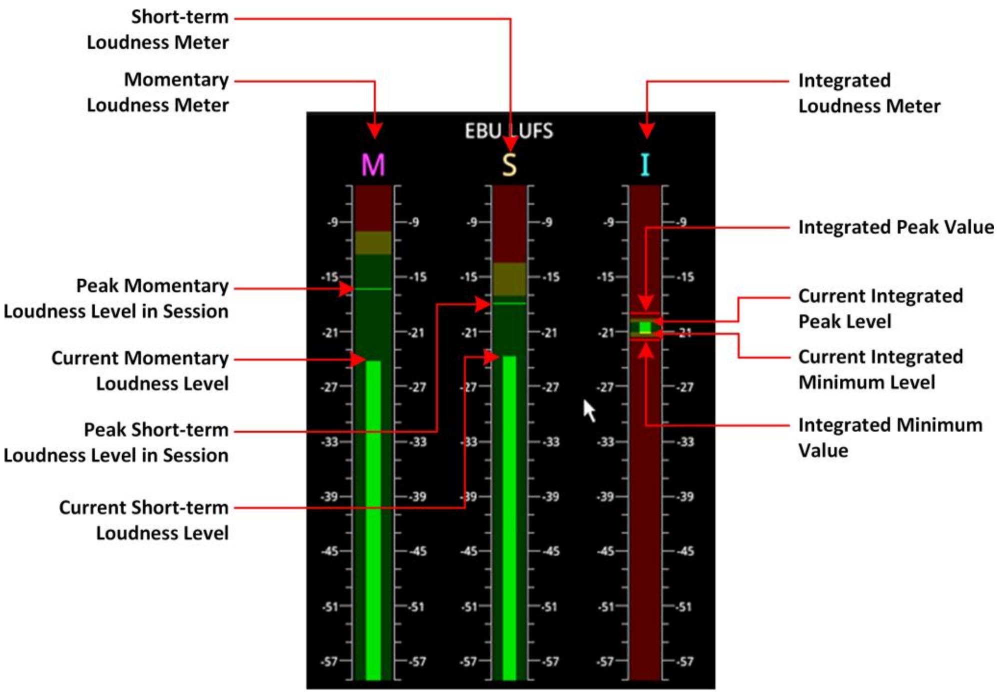

Figure 10-11: Active EBU LUFS Loudness Meters Showing Peak Levels

The unit measures loudness simultaneously, across three different time periods, momentary, short- term and integrated. The current loudness values, displayed to the right of the Loudness meters, are shown in the same color as their corresponding meter, for example, the Momentary Loudness value is magenta, and so on. Only when the value exceeds the configured target and tolerance level does the color of the displayed value change to red to indicate a loudness error condition. Each of the Loudness values is described in the following subsections.

True Peak Value

As specified in the EBU Recommendation EBU-R 128-2020 the True Peak "*level of a programme shall not exceed –1dBTP (dBTruePeak) during production (linear audio).*" The True Peak measurement is calculated from all audio data for each channel and is not affected by the choice of ballistics.

The True Peak value is displayed in white font when below the value of the configurable True Peak Alarm threshold. When the True Peak value exceeds the True Peak Alarm threshold setting, the True Peak value is displayed in red. You can set the True Peak Alarm threshold anywhere in the range from –99.9 to 0 dBFS, with the default set to 0 dBFS.

Figure 10-12: Loudness Values Showing Errors on the Integrated Loudness Value

Momentary Loudness Value and Error Count

The Momentary Loudness value, displayed immediately below the True Peak value, represents the loudness value measured across the shortest timescale of 400 ms. The unit updates the value every 100 ms.

If the Momentary Loudness value is above the configured tolerance level then the unit starts to record an error count and the value changes color to red. The error count represents the number of data samples above the target and tolerance threshold.

Short-term Loudness Value and Error Count

The Short-term Loudness value, represents the loudness value measured across a longer timescale of 3 seconds. The unit updates the value every 100 ms.

If the Short-term Loudness value is above the configured tolerance level then the unit starts to record an error count and the value changes color to red. The error count represents the number of data samples above the target and tolerance threshold.

Integrated Loudness Value and Error Count

The Integrated Loudness value represents the average loudness across the entire session or program. The unit updates the value every one second.

if the Integrated value exceeds the tolerance setting, the error counts are recorded, in the same way as for momentary and short term loudness but, in addition, if the value reaches the target then drops below the tolerance, the unit records ten error counts.

Loudness Range Value

The Loudness Range is defined in the EBU Recommendation EBU-R 128-2020 as "*the distribution of loudness within a programme.*" The unit calculates and updates this value every second.

Using the Loudness Controls

The loudness monitoring controls are designed to appear as standard media controls and work in the same way. Use these controls to start, pause, restart and stop the loudness monitoring session.
Active controls are displayed as a white icon on a gray background and inactive controls are reversed, as shown in the following graphic.

The following loudness monitoring controls are located below the loudness meters to control the progress of loudness monitoring; from left to right:

- **Stop** - stops the current loudness monitoring and logging session
- **Play** - starts the loudness monitoring and logging session
- **Pause** - pauses the current loudness monitoring and logging session.

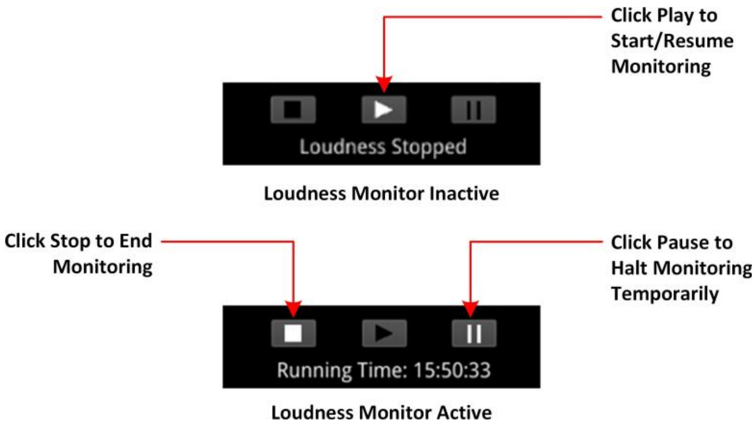

Figure 10-13: Loudness Monitoring Controls

To start a loudness monitoring session, tap or click the **Play** button and to stop the session, tap or click **Stop**. If you want to suspend loudness monitoring temporarily tap or click **Pause**, then either **Play** to resume or **Stop** to end the session.

> **Note:** Selecting **Pause** pauses the current loudness monitoring *and* the logging session. When you tap or click **Play** to resume, the unit continues loudness monitoring using the previous set of audio data and, in addition, restarts the logging session. As a result, the unit re-sets the running- time counter to zero.

You will see the current status of a loudness monitoring session displayed below the controls. If monitoring is in progress, the Loudness Monitor displays the running time of the session, in the format **hh:mm:ss**. If monitoring is paused, or stopped, you will see the messages **Loudness Stopped** or **Loudness Paused**, respectively.

Using the Loudness History Graph

The Loudness History Graph displays a trace of loudness values over a configured time period for each active loudness meter, with the trace displayed in the same color as its associated meter. You can set the displayed graphing period from one minute to a maximum of 10 minutes and the horizontal (x-axis) time scale adjusts accordingly. The vertical (y-axis) scale represents the loudness units for the configured standard, for example, LUFS, LKFS, or LU. The scale values adapt automatically to the loudness values being monitored.

If you position the cursor over any point in the History Graph, the unit displays a tooltip containing the following information:

- Current actual time
- Elapsed time in the loudness monitoring session
- Momentary loudness value at that point (if active)
- Short-term loudness value at that point (if active)
- Integrated loudness value at that point (if active)

If you stop loudness monitoring using the loudness controls and then start another session, the content is cleared from the History Graph.

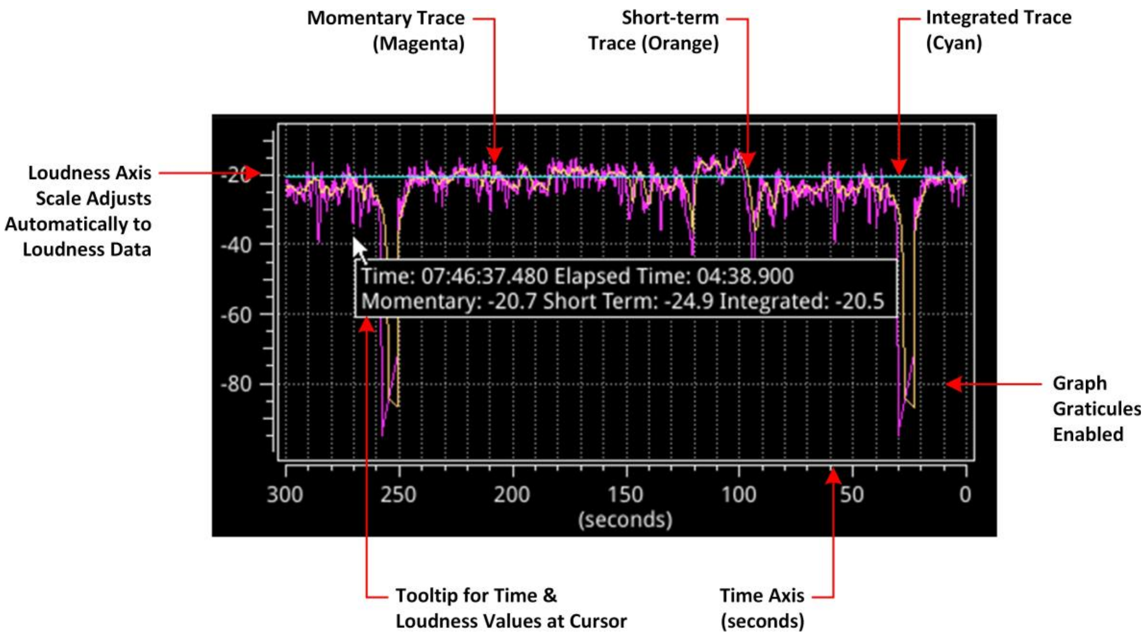

Figure 10-14: Loudness History Graph

Resetting Loudness Values and Errors

The reset controls in the Loudness options menu enable you to reset the following:

- **True Peak Value**: Resets to the current true peak value at the moment of reset.
- **Loudness Monitoring**: Clears the Loudness History Graph and restarts the loudness mon- itoring session to start monitoring again from time zero.
- **Errors**: Zeroes any error counts registered by the Momentary, Short-term or Integrated loud- ness meters.

Managing the Loudness Log Files

The unit automatically starts to record a loudness log when you click **Play** to start the loudness monitoring session.

The unit creates two files for each loudness log as follows:

- A log description text file with a **.txt** extension
- A data file in comma separated value (CSV) format with a **.csv** extension.

Both log files are compressed into a single zip file when the unit saves the logfile to the repository.

The log description text file contains the following content:

- Start Date
- Start Time

- Loudness Mode (LUFS/LKFS/LU)
- List of loudness inputs
- Target and Tolerance configuration
- End Time
- True Peak levels for each loudness input
- Program loudness value
- Highest Momentary Loudness value
- Momentary Error Count
- Highest Short-term Loudness value
- Short-term Error Count
- Highest Integrated Loudness Value
- Integrated Error Count
- Final Loudness Range value.

The data CSV logfile contains the following content:

- Time
- Timecode
- Momentary Loudness value
- Short-term Loudness value
- Integrated Loudness value
- Loudness Range value.

Each time the configured **Log Duration** is reached, or you stop or pause loudness monitoring, the unit saves a Loudness Log to the repository. You can set the Log Duration to a value between five minutes and 24 hours in the Options menu, with a default duration of 30 minutes.

Each loudness logfile is an individual, time-stamped, compressed CSV (comma separated value) zip file, saved in the following folder:

device:/log/loudness

The **Log Lifetime** setting is the period that the unit keeps the loudness logs in its repository. You can set the log lifetime period from one to 30 days in the Options menu. Once the configured log lifetime elapses, the unit will delete the loudness logfile.

Retrieving the Loudness Log Files

Use the File Manager to copy the Loudness logfiles to a USB drive, in the same way as with other files. Open the File Manager from the Settings tab of the Setup menus or insert a USB drive into one of the USB ports.

From the **device:/** folder, open the **log** folder, then the **loudness** folder. You should see all your loudness logfiles listed with a date- and time-stamp, together with a **.zip** extension. Select the desired files, tap and hold or right-click, then select **Copy from Device to USB...** from the menu.

You can also delete selected logfiles, if necessary.

For more information on the File Manager, see the section *Managing Files with the USB File Manager*.

Figure 10-15: Loudness Logfiles Listed in the File Manager

Renaming the Loudness Logfile Base Name

All logfiles are named using the following syntax by default:

loudness_*yyyymmdd_hhmmss*.zip

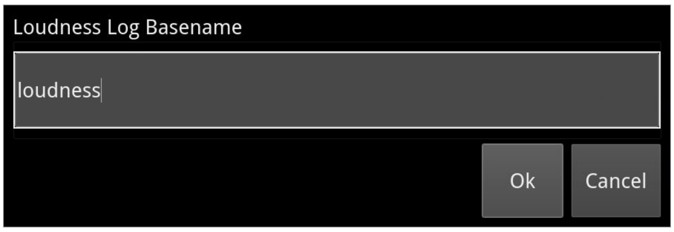

Figure 10-16: Rename Loudness Logfile Base Name

The loudness logs are always date- and time-stamped, however, you can change the default **loudness** base name as required. To do so, select **Rename file...** from the Loudness options menu to display the rename dialog. Enter a new base name in the field, then tap or click **Ok**. The new base name will be used to name all loudness logfiles from that point forward.

When entering a new base name for the logfile, do not use any of the following special characters as they will be automatically removed from the name on saving:

 # < > ` * ' | " $ & , . / : □; = ? @, tab or carriage return

Instrument Menu Options

The following menu parameters are available to configure the **Analyzer - Loudness Monitor** Instrument:

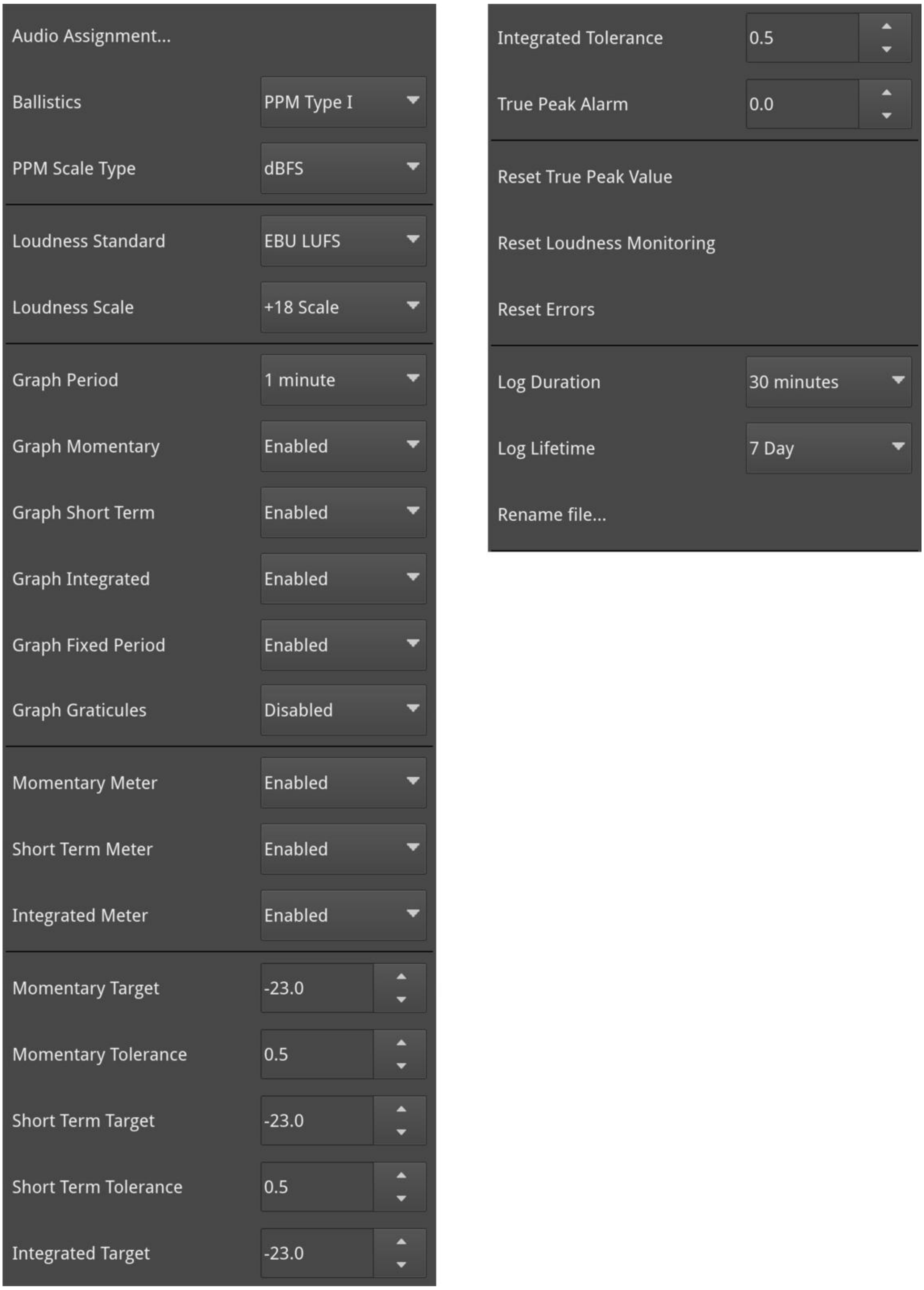

Figure 10-17: Analyzer - Loudness Monitor Menu Options

Table 10-4 : Analyzer - Loudness Monitor Menu Options

Item	Options	Description
Audio Assignment	System Control - opens Audio Assignment dialog	Use this control to open the Audio Assignment dialog to select the audio mode and assign the loudness input channels. For details, see the table *Audio Assignment Modes for Loudness Monitoring*.
Audio Meter Ballistics and Scale Settings		
Ballistics	PPM Type I (Default) PPM Type II Vu VuFr Fast	Set the required peak program meter (PPM) ballistic responsiveness setting for the audio meters. PPM Type I emulates the performance of IEC 60268-10 Type I PPM style audio meters typically used by German broadcasters. PPM Type II emulates the performance of IEC 60268-10 Type II PPM style audio meters typically used by UK broadcasters. Vu emulates the performance of IEC 60268-17 Type I PPM style audio meters typically used by US and Australian broadcasters. VuFr emulates the performance of ITU-R Rec BS.645 style audio meters typically used by French broadcasters. Fast provides instantaneous attack ballistics. **Note:** The Ballistics option is a global setting that applies to all of the unit's audio meters.
PPM Scale Type	dBFS (Default) dBu -18dBFS dBu -20dBFS BBC DIN45406 Nordic N9	Set the desired scale for the loudness audio meters according to your standard operating model. The displayed graticule and audio levels change accordingly to reflect the selected scale. **Note:** The PPM Scale Type applies only to the audio meters in the Loudness Monitor; the Audio Meters instrument has its own Scale Type setting.
Loudness Settings		
Loudness Standard	EBU LUFS (Default) EBU LU ITU LKFS ITU LU	Select the appropriate loudness standard for loudness monitoring of your audio track or program. You can switch between ITU and EBU standards without losing your customized settings.
Loudness Scale	+9 Scale (Default) +18 Scale	The +9 and +18 scales are defined in EBU Tech 3341-2016 and have been adopted by the ITU. The scale ranges are as follows for EBU: +9 Scale: −18.0 LU to +9.0 LU (−41.0 LUFS to −14.0 LUFS) +18 Scale:−36.0 LU to +18.0 LU (−59.0 LUFS to −5.0 LUFS) The scale ranges are as follows for ITU: +9 Scale: −18.0 LU to +9.0 LU (−42.0 LUFS to −15.0 LUFS) +18 Scale: −36.0 LU to +18.0 LU (−60.0 LUFS to −6.0 LUFS) See *Figure 10-18* for a comparison of these scales.

Loudness History Graph Settings		
Graph Period	1 minute (Default)	Define the time period over which the History Graph dis-

Item	Options	Description
	2 minutes 5 minutes 10 minutes	plays loudness data. The horizontal time scale adjusts automatically to the selected period.
Graph Momentary	Enabled (Default) Disabled	When enabled, the unit plots the Momentary loudness trace in the Loudness History Graph. You can switch off the display of the Momentary loudness trace if desired. You can display the Momentary graph even if the Momentary loudness meter is disabled.
Graph Short Term	Enabled (Default) Disabled	When enabled, the unit plots the Short-term loudness trace in the Loudness History Graph. You can switch off the display of the Short-term loudness trace if desired. You can display the Short-term graph even if the Short- term loudness meter is disabled.
Graph Integrated	Enabled (Default) Disabled	When enabled, the unit plots the Integrated loudness trace in the Loudness History Graph. You can switch off the display of the Integrated loudness trace if desired. You can display the Integrated graph even if the Integ- rated loudness meter is disabled.
Graph Fixed Period	Enabled (Default) Disabled	When enabled, the x-axis is set to the static value set in the Graph Period option and does not change dynamically. When disabled, the x-axis scale is dynamic up to a maximum period of 2 minutes (120 seconds), after which it is fixed.
Graph Graticules	Disabled (Default) Enabled	When enabled, displays gridlines in the background of the graph.
Loudness Meter Activity		
Momentary Meter	Enabled (Default) Disabled	When disabled, the Loudness Monitor will not display momentary loudness values or errors, however, the data is still recorded in the loudness log.
Short Term Meter	Enabled (Default) Disabled	When disabled, the Loudness Monitor will not display short-term loudness values or errors, however, the data is still recorded in the loudness log.
Integrated Meter	Enabled (Default) Disabled	When disabled, the Loudness Monitor will not display integrated loudness values or errors , however, the data is still recorded in the loudness log.
Loudness Targets, Tolerances and Alarm		
Momentary Target	Range: – 41 to –14 Default: –23	Set the maximum acceptable Momentary loudness level for the monitored track or program. This represents the green section of the meter and signal.
Momentary Tol- erance	Range: 0.0 to 10.0 Default: 0.5	When set to a value above 0.0, the Momentary tolerance is displayed as the yellow background of the Momentary Loudness meter. When the monitored momentary loudness is within the tolerance, the level color changes to yellow. A tolerance level provides an acceptable buffer to accommodate for measurement errors. If the Momentary tolerance is set to 0.0 then the

Item	Options	Description
		tolerance / target feature is disabled so that the meter background is completely green and no errors are displayed.
Short Term Target	Range: – 41 to –14 Default: –23	Set the maximum acceptable Short-term loudness level for the monitored track or program. This represents the green section of the meter and signal.
Short Term Tol- erance	Range: 0.0 to 10.0 Default: 0.5	When set to a value above 0.0, the Short-term tolerance is displayed as the yellow background of the Short-term Loudness meter. When the monitored short-term loudness is within the tolerance, the level color changes to yellow. A tolerance level provides an acceptable buffer to accommodate for measurement errors. If the Short-term tolerance is set to 0.0 then the tolerance / target feature is disabled so that the meter background is completely green and no errors are displayed.
Integrated Target	Range: – 41 to –14 Default: –23	Set the maximum acceptable Integrated loudness level for the monitored track or program. This represents the green section of the meter and signal.
Integrated Tol- erance	Range: 0.0 to 10.0 Default: 0.5	When set to a value above 0.0, the Integrated tolerance is displayed as the yellow background of the Integrated Loudness meter. When the monitored integrated loudness is within the tolerance, the level color changes to yellow. A tolerance level provides an acceptable buffer to accommodate for measurement errors.
True Peak Alarm	Range: 0 to –99 Default: 0	Set the threshold above which the unit generates errors for the loudness True Peak.
Reset Controls		
Reset True Peak Value	System Control	Resets to the current True Peak value at the moment of reset.
Reset Loudness Monitoring	System Control	Resets both the Loudness History Graph and the loud- ness logs. The loudness monitoring session restarts from time zero.
Reset Errors	System Control	Resets all error counts from the active loudness meters to zero. This control does not reset the loudness logs.
Loudness Log Settings		
Log Duration	5 minutes 15 minutes 30 minutes (Default) 1 hour 2 hours 3 hours 6 hours 12 hours 24 hours	Set the duration of each loudness logfile. When the Log Duration is met during a monitoring session, the unit saves the logfile to the repository with the current date- and time-stamp.

Item	Options	Description
Log Lifetime	1 day 7 days (Default)	Set the retention period for loudness logfiles in the unit's repository. On expiry of the Log Lifetime period, the unit
	14 days 30 days	deletes the logfile to free-up space in the repository.
Rename File...	System Control - Opens file renaming dialog	Use this dialog to change the loudness logfile base-name from **loudness** to a different string.

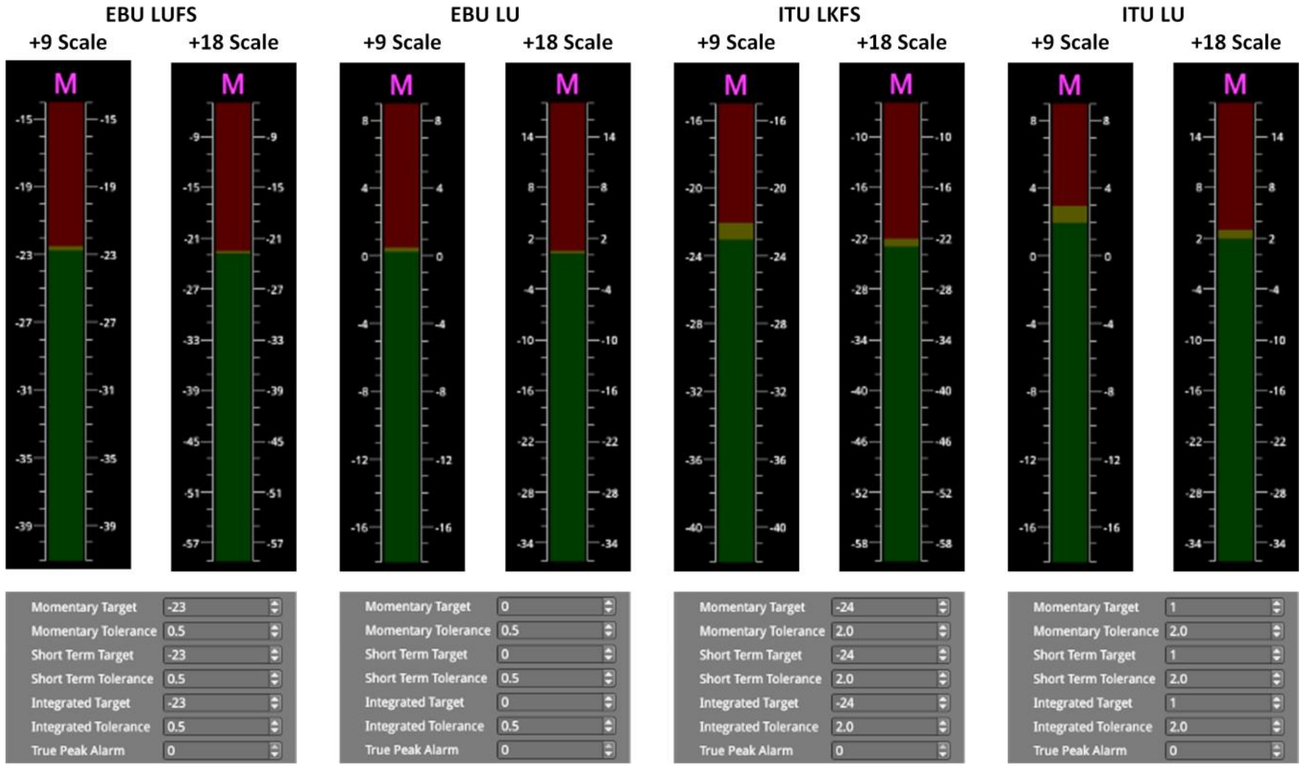

Figure 10-18: Loudness Standard Scales for Momentary Meter & Default Target/Tolerance Settings for All Meters

11

Data Analysis Instruments

This chapter describes the suite of data analysis Instruments and includes the following sections:

- Analyzer - Dataview
- Analyzer - Ancillary Status
- Analyzer - Ancillary Inspector

Analyzer - Dataview

Overview

The **Analyzer - Dataview** instrument displays the raw data present in the SDI input signal.

You can observe the data in hexadecimal, decimal, or binary formats, and each data word has a sample and line coordinate. The instrument displays the entire video frame complete with active video, TRS words, and blanking information. Changing the window size changes the amount of data displayed.

> **Note:** You can use a single instance of the Analyzer - Dataview instrument to analyze data only on the SDI source input assigned to **Analyzer A**. If you open a second instance of the Dataview instrument on the optional second screen, you will see the following warning message displayed: **Analyzer A Dataview in use**

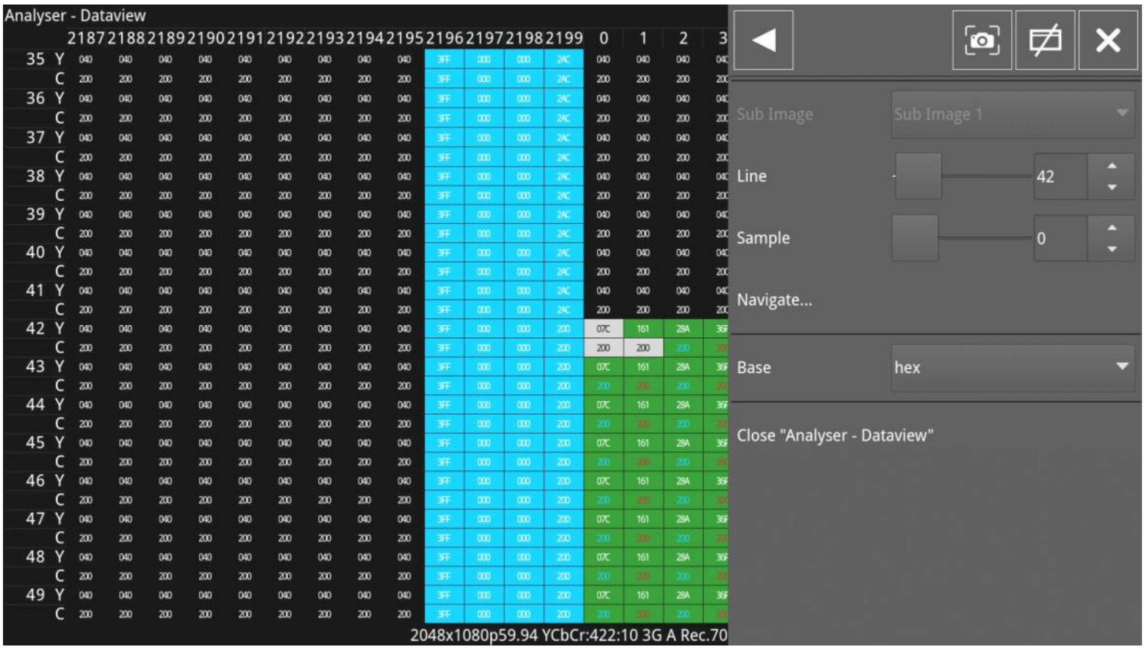

Figure 11-1: Analyzer - Dataview Instrument

Data is presented with a color-coding for both text and background:

- Foreground text color indicates the video sample type, as follows:
  - Y - White
  - Cb - Blue
  - Cr - Red.
- Background color indicates the data type, as follows:
  - Timing reference signal (TRS) words - Blue
  - Blanking - Black
  - Active Picture - Green.

You can quickly navigate the dataview window using the **Line** and **Sample** (pixel) controls in the options menu or using the **Navigate...** keypad, shown below. Both controls are dynamically linked to a Picture Cursor, when enabled, in the Waveform and Picture instruments.

The transport line and sample slider controls enable you to navigate around the dataview grid. In addition, the corresponding active picture line and pixel values are displayed alongside the slider controls.

The Navigation keypad enables you to enter the desired coordinates, and provides buttons for quick navigation to key locations, including:

- First and last samples or lines
- End-of-active-video (EAV) timing reference signal (TRS) word
- Start-of-active-video (SAV) TRS word
- Active Picture: Left, Right, Top and Bottom furthest positions.

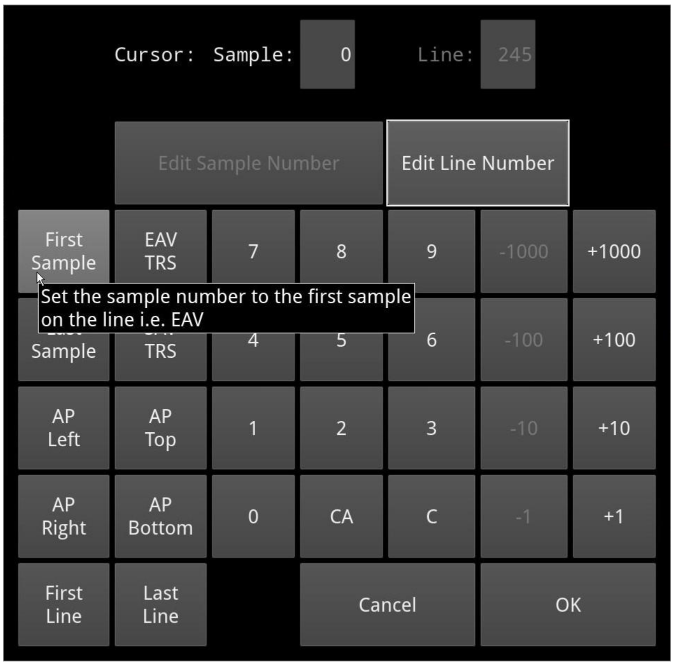

Figure 11-2: Dataview Navigation Keypad

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - Dataview instrument options menu:

Table 11-1 : Analyzer - Dataview Options

Item	Options	Description
Sub Image	Sub Image 1, 2, 3, or 4	Slects the sub image for analysis.
Line	System Control 1 to Total number of active lines in the active picture	Selects the line number in the active picture for analysis.
Sample	System Control 1 to Total number of Pixels in the active picture	Selects the sample of the current line. Allows selection of AP samples and samples in the ANC space.
Navigate...	System Control	Displays the Dataview navigation keypad.

Item	Options	Description
Base	Hex (default) Decimal Binary	Changes the base in which to display the data.

If you hover the mouse cursor over a cell in the grid, the unit displays a tooltip as shown in *Figure 11-3*.

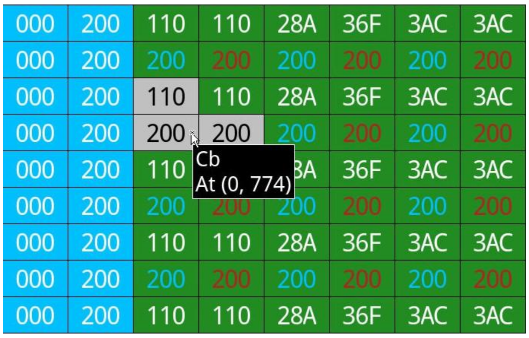

Figure 11-3: Analyzer - Dataview Instrument Showing Mouse Cursor Tooltip

The coordinates displayed in the Dataview tooltip define the sample and line number pair in the frame as **(sample number, line number)**. The tooltip also displays additional information for each cell over which you hold the mouse cursor, whether it is the Y-, Cb, Cr- or Alpha-component, etc. This defines the content of the data cell below the mouse cursor.

The highlighted cells (light-gray background) are the samples that contribute to the definition of a single pixel. You can then pinpoint that specific pixel using the cursor functions of the **Picture** instrument(s). Either tap or click a point in the Picture window or specify the coordinates of the pixel in the options menu of the Picture instrument. Alternatively, specify the **Line** number and **Sample** number using the controls in the Dataview options menu.

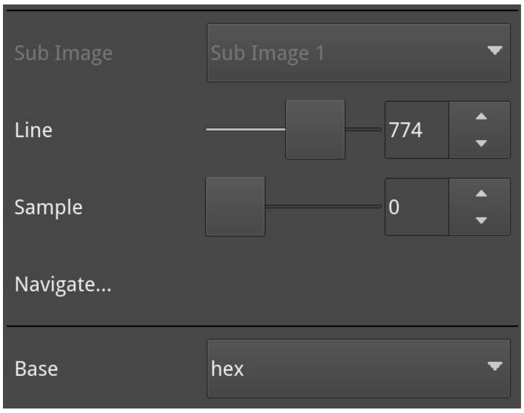

Figure 11-4: Analyzer - Dataview Options Menu

Analyzer - Ancillary Status

Overview

The **Analyzer - Ancillary Status** instrument provides a sophisticated, real-time display to analyze the ancillary data present in the source input. UHDTV has a new set of rules for carrying this data and a clear graphical representation is required to establish compliance.

Color-coded signal conditions for the displayed data provide further health status information as follows:

- White - Indicates ANC packets present and correct
- Red - Indicates ANC packets present but in error
- Yellow - indicates ANC packets present and correct but there has been a previous error.

In addition to the option of a combined view, tabs are provided for separate Grid or List views of the ancillary data.

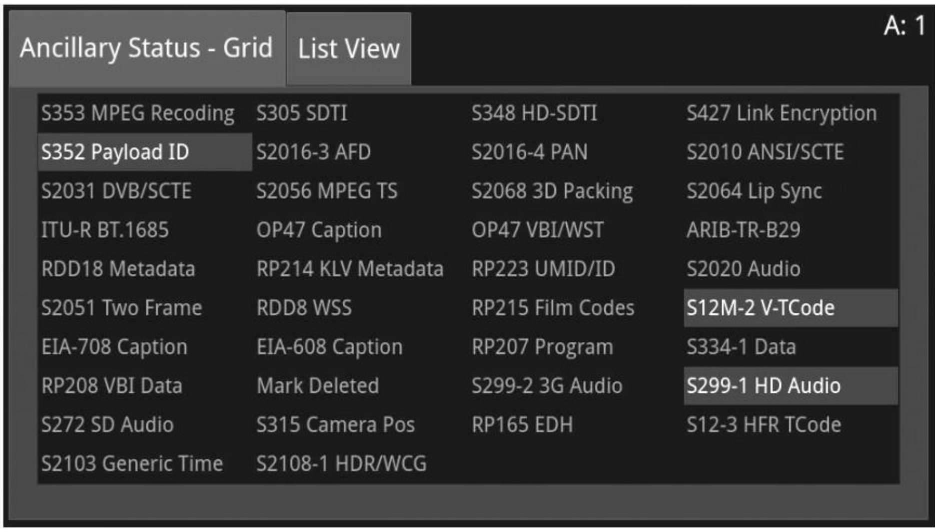

Figure 11-5: Analyzer - Ancillary Status (Grid Tab of Tab View)

The Grid tab provides a high-level overview of the packets present in the ancillary data.

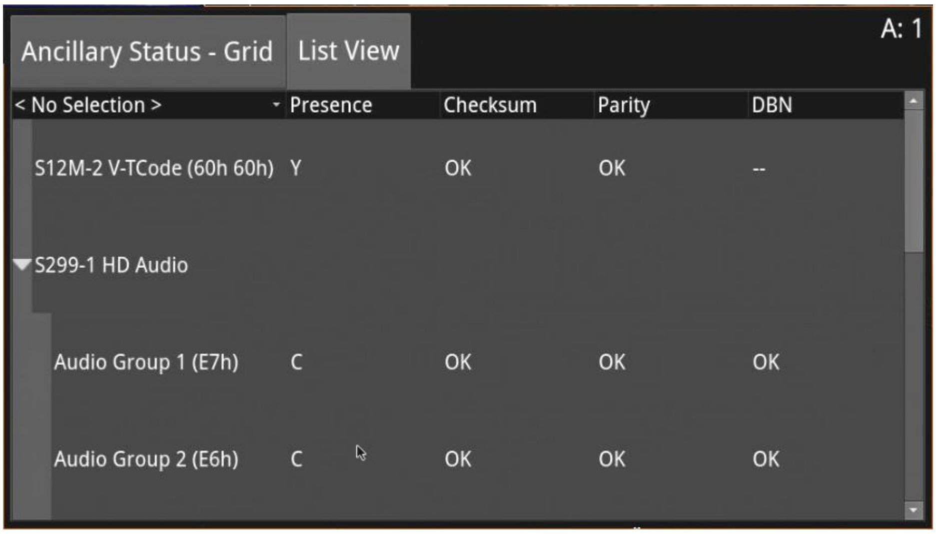

Figure 11-6: Analyzer - Ancillary Status (List View Tab of

In the **List View** tab, you can expand the headings, to allow a granular drill-down of discovered ancillary packets – providing information on presence, checksum, parity, and data block number (DBN). You can select packets in this window, using the **Inspect...** control, for analysis by the **Analyzer – Ancillary Inspector**.

You can also choose to combine the Grid and List Views in a single window by setting the **View** option to **Combined** in the options menu.

In a multi layout, you can launch up to four instances of the Analyzer - ANC Status instrument assigned to your analyzers as required.

Instrument Menu Options

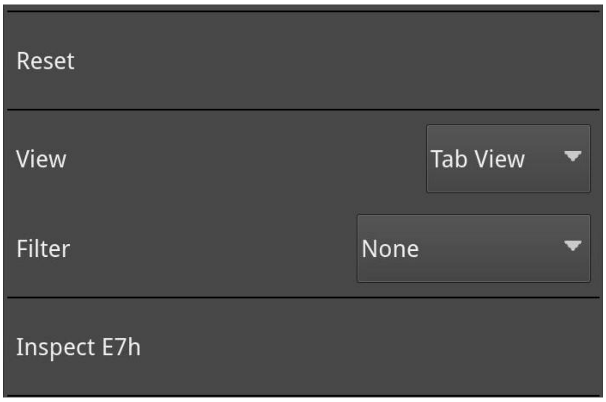

Figure 11-7: Analyzer - Ancillary Status Menu Options

From the **Analyzer - Ancillary Status** instrument submenu, accessible in all views, you can reset the ancillary status analysis, inspect selected packets, filter displayed packets, and set configuration options as follows:

Table 11-2 : Analyzer - Ancillary Status Menu Options

Item	Options	Description
Reset	System Control	Select to reset ancillary status analysis and reset Filter to none (accessible in all views).
View	Tab View Combined	The combined view provides both a high-level overview grid at the top and an expandable list view below, all in a single window.
Filter	None Ancillary Packet Type	Filter the packets listed in the List View tab or set by right- clicking on a packet type in the Grid tab. See the following table for a list of available ancillary data identifiers.
Inspect...	Selected packets in Ancillary Status List View.	**Note:** If a packet type is not selected in the List view, the **Inspect...** option will be grayed-out. Enables you to select a packet from the list and then launch the **Analyzer - Ancillary Inspector** instrument for more detailed analysis of the content of the selected packet(s), see *Table 11-3* for a list of ancillary data IDs. For more information on ANC inspection, see the *Analyzer - Ancillary Inspector*.

		Select **Inspect...** to send the inspection request over to

Item	Options	Description
		the **Analyzer - Ancillary Inspector** Instrument. If the Analyzer - Ancillary Inspector is not currently open, the request opens the instrument. The inspection request is loaded into the **Identifier** field of the Inspector instrument and, depending on the trigger setting, reacts as follows: **None** - the request is loaded, but not acted upon **Single Shot** - the ANC Inspector searches for the packet type and displays the result once a matching packet is detected. (The trigger is then set back to **None**.) **Continuous** - the ANC Inspector continuously searches for the selected packet type and refreshes the displayed results each time it detects a matching packet type.

Table 11-3 : List of Ancillary Status Grid Identifiers

Ancillary Status Grid Identifier	Description
S353 MPEG Recoding	MPEG-2 Recoding Information
S305 SDTI	SDTI transport in active frame space
S348 HD SDTI	HD-SDTI Transport in active frame space
S427 Link Encryption	Link encryption for 1.5 Gb/s Serial Digital Interface
S352 Payload ID	Payload identification, HANC space
S4S2016-3 AFD	AFD and Bar data
S2016-4 PAN	Pan-scan data
S2010 ANSI/SCTE	ANSI/SCTE 104 messages
S2031 DVB/SCTE	DVB/SCTE VBI data
S2056 MPEG TS	MPEG TS packets in VANC
S2068 3D Packing	Stereoscopic 3D frame compatible packing and signaling
S2064 Lip Sync	Lip sync data as specified by ST 2064-1 or ST 2064-2
ITU-RBT.1685	Structure of inter-station control data conveyed by ancillary data packets
OP47 Caption	OP47/RDD8 Subtitling distribution packet (SDP)
OP47 VBI/WST	OP47/RDD8 Transport of VBI and/or WST data in a VANC Multipacket

ARIB-TR-B29	Metadata to monitor errors of audio and video signals on a broadcasting chain
RDD18 Metadata	Acquisition metadata sets for video camera parameters
RP214 KLV Metadata	KLV encoded metadata transport
RP223 UMID/ID	Packing UMID and Program Identification Label data into SMPTE 291M Ancillary Data Packets
S2020 Audio	Compressed audio metadata
S2051 Two Frame	Two frame marker in HANC
RDD8 WSS	Wide-screen signaling data
RP215 Film Codes	Film codes in VANC space

Ancillary Status Grid Identifier	Description
S12M-2 V-TCode	Ancillary time code
EIA-708 Caption	S334-1 EIA 708B Data mapping into VANC space
EIA-608 Caption	S334-1 EIA 608 Data mapping into VANC space
RP207 Program	Program description in VANC space
S334-1 Data	Data broadcast (DTV) in VANC space
RP208 VBI Data	VBI data in VANC space
Mark Deleted	S291 - Packet marked for deletion
S299-2 3G Audio	Audio data in HANC space (3G)
S299-1 HD Audio	Audio data in HANC space (HDTV)
S272 SD Audio	Audio data in HANC space (SDTV)
S315 Camera Pos	Camera position (HANC or VANC space)
RP165 EDH	Error detection and handling (HANC space)
S12-3 HFR TCode	Time code for high frame rate signals
S2103 Generic Time	Generic time label
S2108-1 HDR/WCG	Extended HDR/WCG

For tooltips on each of the Status Grid Identifiers, hover the mouse cursor over the identifier.

Analyzer - Ancillary Inspector

Overview

The **Ancillary (ANC) Inspector** monitors the analyzed signal and displays the contents of selected Ancillary packets in the received data. You can use this instrument in combination with the **Analyzer - Ancillary Status** instrument for more detailed analysis of ancillary data.

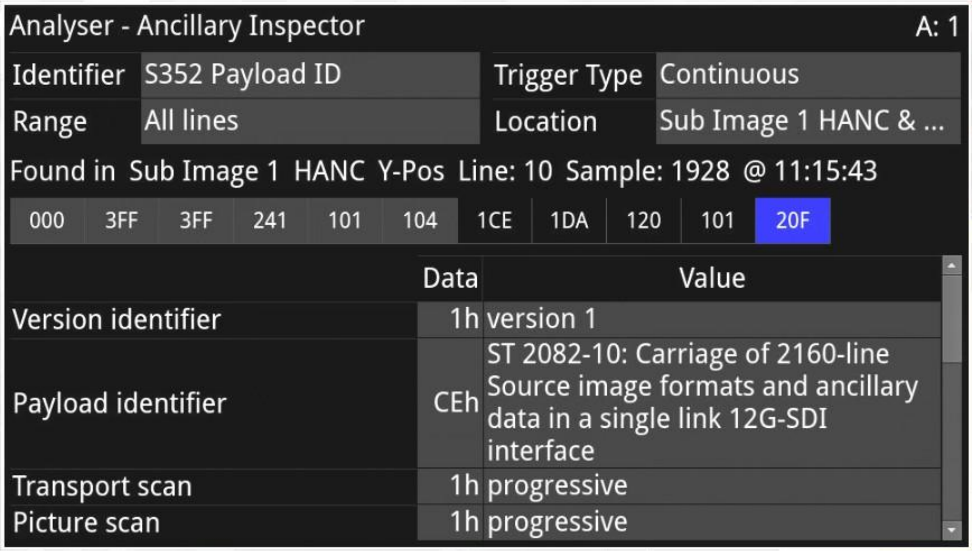

Figure 11-8: Analyzer - ANC Inspector Instrument

> **Note:** The LPX500 provides decapsulation of a packet's data only for the ST 352 Payload ID. For other data packets only the raw data are displayed.

The window displays both the location of the found packet and the time at which it was found.

> **Note:** If the time appears frozen, it means that the signal is no longer recognized by the LPX500. The display remains stuck on the last valid extracted information.

The lower part of the window displays the packet in hexadecimal form including individual header words (gray background), data words (black background), and checksum (blue background). Hover the mouse cursor over each header word to display a description of that word in a tooltip.

In a multi layout, you can launch up to four instances of the Analyzer - ANC Inspector instrument, assigned to your analyzers as required.

Instrument Menu Options

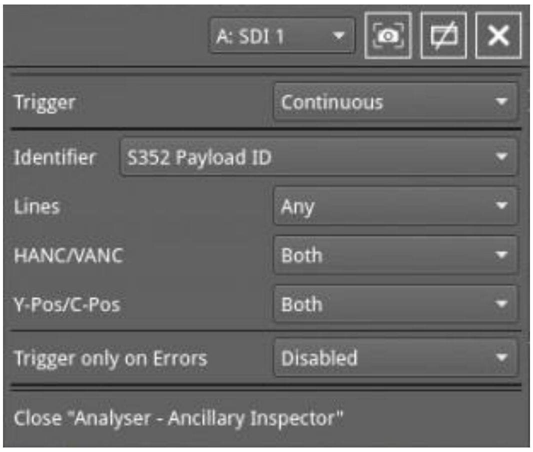

Figure 11-9: Analyzer - Ancillary Inspector Options Menu

The following menu options are available for configuring the **Analyzer - Ancillary Inspector** Instrument:

Table 11-4 : Analyzer - Ancillary Inspector Menu Options

Item	Options	Description
Trigger	None (Default) Single Shot Continuous	Set a trigger so that when ancillary data exactly matching the search parameter(s) are detected, the ANC Inspector triggers and displays the inspection result in the lower part of the window. After detecting a matching packet, when the Trigger is set to **Single Shot**, that single packet is inspected, its content displayed and the trigger state reverts to **None**. The details of the detected error are displayed for inspection. To reset the display, set the Trigger Type back to **Single Shot**. If the Trigger is set to **Continuous**, the inspection of all packets matching the search criteria continues uninterrupted and the display is refreshed in real-time. The details of the last detected error are displayed for inspection. To reset the display, set the Trigger Type back to **Continuous**.
Identifier	None (Default) Ancillary Packet Type	Set the Identifier of the ancillary packet type you want to find. For a list of ancillary data identifiers, see *Table 11-5* Note: The **Custom** identifier enables you to specify a packet type not listed in the standard.
Lines	Any (Default) Inside Range Outside Range	Additional ANC inspection parameter specifying where to look in the ANC space for the data desired.
HANC/VANC	Both (Default) HANC VANC	Additional ANC inspection parameter specifying where to look in the ANC space for the data desired.
Y-Pos/C-Pos	Both (Default) Y- Pos	Additional ANC inspection parameter specifying where to look in the ANC space for the data desired.

	C-Pos	

Item	Options	Description
Trigger only on Errors	Enabled Disabled (Default)	When enabled, opens additional dropdowns to enable any of the following error types.
Checksum Errors	Enabled Disabled (Default)	When enabled, triggers on checksum errors.
DBN Errors	Enabled Disabled (Default)	When enabled, triggers on ancillary data block number (DBN) errors.
Parity Errors	Enabled Disabled (Default)	When enabled, triggers on parity errors in the ANC data.
ANC Gap Errors	Enabled Disabled (Default)	When enabled, triggers on gap errors in the ANC data.

The recognized identifiers or packet types are as follows:

Table 11-5 : List of Available Ancillary Data Identifiers

Any	Custom	S353 MPEG Recoding VANC Space	S353 MPEG Recoding HANC Space	S305 SDTI
S348 HD-SDTI	S427 Link Encryption Message 1	S427 Link Encryption Message 2	S427 Link Encryption Metadata	S352 Payload ID
S2016-3 AFD	S2016-4 PAN	S2010 ANSI/SCTE	S2031 DVB/SCTE	S2056 MPEG TS
S2068 3D Packing	S2064 Lip Sync	S2108-1 HDR/WCG	ITU-R BT.1685	OP47 Caption
OP47 VBI/WST	ARIB-TR-B29	RDD18 Metadata	RP214 KLV Metadata VANC Space	RP214 KLV Metadata HANC Space
RP223 UMID/ID	S2020No Pair Associated	S2020 Audio Channel Pair 1/2	S2020 Audio Channel Pair 3/4	S2020 Audio Channel Pair 5/6
S2020 Audio Channel Pair 7/8	S2020 Audio Channel Pair 9/10	S2020 Audio Channel Pair 11/12	S2020 Audio Channel Pair 13/14	S2020 Audio Channel Pair 15/16
S2051 Two Frame	RDD8 WSS	S12M-2 V-TCode	S2103 Generic Time	EIA-708 Caption
EIA-608 Caption	S12-3 HFR TCode	RP207 Program	S334-1 Data	RP208 VBI Data
Mark Deleted	S299-2 3G Audio Control Group 8	S299-2 3G Audio Control Group 7	S299-2 3G Audio Control Group 6	S299-2 3G Audio Control Group 5
S299-2 3G Audio Audio Group 8	S299-2 3G Audio Audio Group 7	S299-2 3G Audio Audio Group 6	S299-2 3G Audio Audio Group 5	S299-1 HD Audio Control Group 4
S299-1 HD Audio Control Group 3	S299-1 HD Audio Control Group 2	S299-1 HD Audio Control Group 1	S299-1 HD Audio Audio Group 4	S299-1 HD Audio Audio Group 3
S299-1 HD Audio Audio Group 2	S299-1 HD Audio Audio Group 1	S272 SD Audio Control Group 4	S272 SD Audio Control Group 3	S272 SD Audio Control Group 2
S272 SD Audio Control Group 1	S315 Camera Pos	RP165 EDH	S272 SD Audio Group 4 Ext	S272 SD Audio Audio Group 4
S272 SD Audio Group 3 Ext	S272 SD Audio Audio Group 3	S272 SD Audio Group 2 Ext	S272 SD Audio Audio Group 2	S272 SD Audio Group 1 Ext
S272 SD Audio Audio Group 1				

When setting any parameters in ANC Inspector, AND logic applies; so note that *all* active search parameters must be met before ANC Inspector can successfully locate the desired packets.

When searching for data packets it is recommended to keep the search domain as wide as possible to establish that ANC packets can actually be located. Only when the ANC Inspector displays streaming data, should you introduce more specific search parameters.

The ANC Inspector can also be used to report packets containing errors with **Trigger only on Errors** set to **Enabled** and **Identifier** set to **Any**. Where an error is present in a packet, individual data word text will become red in the display indicating the exact position of an error within a packet.

12

12G Physical Layer Analysis

This chapter describes the instruments available with the 12G-SDI Physical Layer Analysis Toolset option and includes the following sections:

Eye - SDI In 1 (Physical Layer Analysis)

Requires Model:	**LPX500M-ISE**

Overview

The optional instrument **Eye - SDI in 1**, available in the **Physical Layer Analysis** toolset, enables you to analyze physical layer compliance measurements from 270 Mbps to 12 Gbps for SDI source input connected to **SDI In 1**. An analog front-end provides a bandwidth of more than 30 GHz (5th harmonic of the 6 GHz fundamental for 12G-SDI.) The GUI uses LeaderPhabrix RealTime Eye (RTE™) to generate a reliable, AC coupled, instantaneous physical layer display with automatic measurements to SMPTE standards.

You can receive accurate measurements within seconds of connecting an SDI input. The unit enables you to measure both rise and fall overshoot at the top and bottom of the waveform. In addition, the unit displays amplitude, rise and fall overshoot delta and DC offset - all compulsory measurements when testing against SMPTE standards. The unit highlights any measurements exceeding the specification in red (for example, an eye amplitude greater than 10 %).

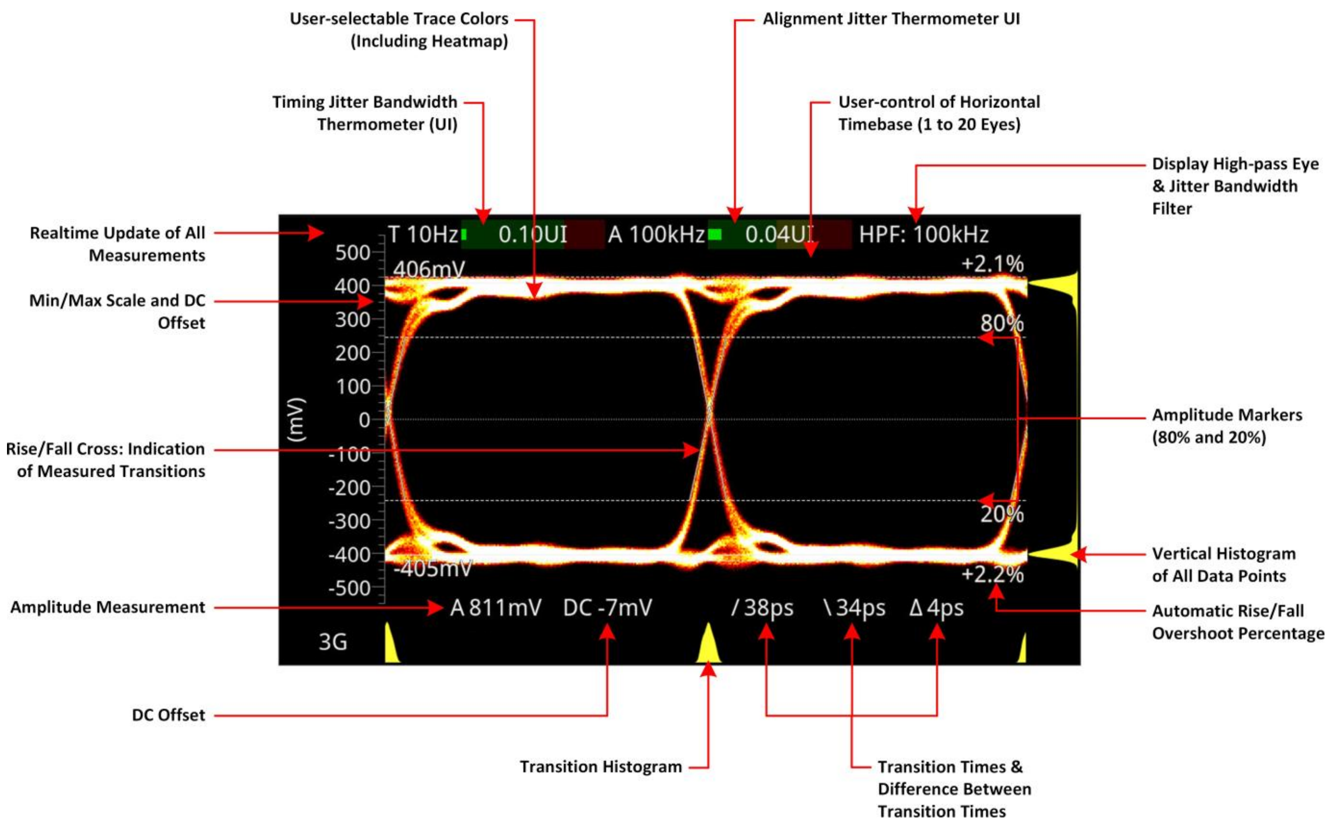

Figure 12-1: Standard SDI Eye Pattern Display (3G) with 100 kHz Jitter Filter

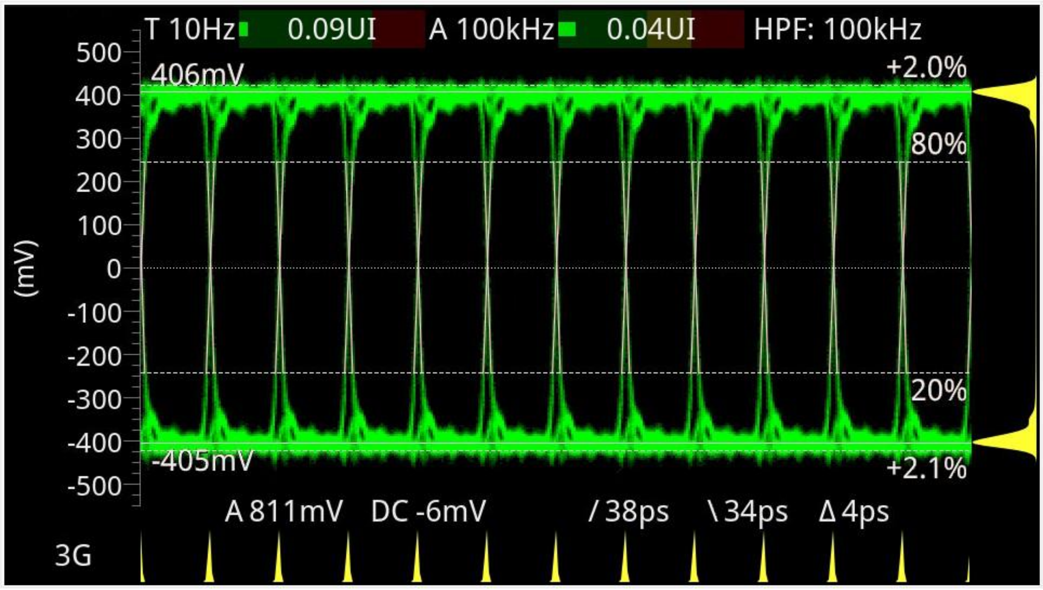

Figure 12-2: 3G-SDI Eye Pattern Set to Display 12 Eyes (Using Green Display Color)

> **Note:** A black nut fitted to the **SDI In 1** BNC identifies the connector with access to the eye and jitter circuitry for physical layer analysis.

The **Eye - SDI In 1** instrument display also provides:

- Timing jitter thermometer color-codedto indicate whether the measured jitter is within the spe- cification of the standard
- Alignment jitter thermometer color-coded according to the analyzed SDI standard
- Positive and negative Eye amplitude values
- On screen indication of 20 % and 80 % levels (dashed lines) for rise and fall time measurements
- Horizontal time histogram of eye crossing point (0 mV threshold)
- Vertical amplitude histogram indicating energy distribution across all samples
- Eye coupled to AC with display of DC offset measurement.

Instrument Menu Options

The following table lists the configurable parameters in the options menu of the Eye - SDI In 1 instrument.

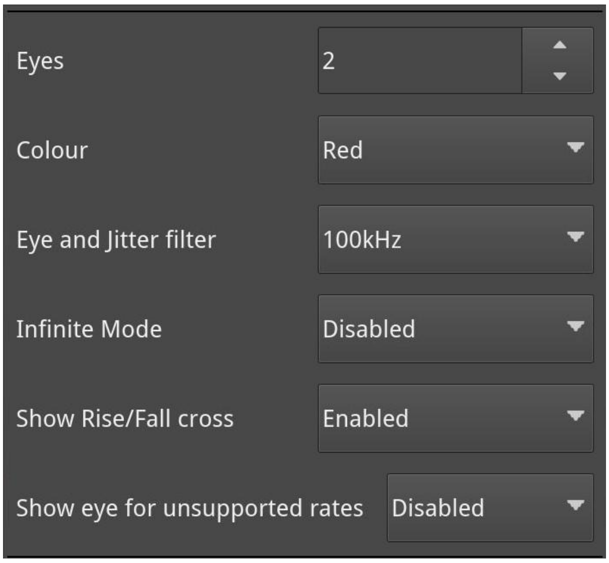

Figure 12-3: Eye - SDI In 1 Menu Options

Table 12-1 : Menu Options for the Eye - SDI In 1 Instrument

Item	Options	Description
Standard Physical Layer Analysis Tools		
Eyes	1 to 20 (Default = 2)	Sets the number of eyes displayed in the instrument win- dow.
Color	Green Heat Red (Default) Ferrara Green-red Blacklight	Sets the color scheme for the eye display.
Eye and Jitter Filter	10 Hz 100 Hz 1 kHz 10 kHz 100 kHz (Default)	Sets the frequency of the high-pass jitter filter. Note: This setting controls the filter applied both to the **Eye - SDI In 1** instrument and the **Jitter - SDI 1** instrument.
Infinite Mode	Disabled (Default) Enabled	When disabled, each Eye data point is displayed only for a fixed period of time. When enabled, infinite mode ensures that no data points are removed from the eye display, so you will probably observe the eye shape thickening and becoming less distinct. This can be useful when attempting to identify anomalies in the signal which appear sporadically over time and might be missed in the standard mode.
Show Rise/Fall Cross	Disabled Enabled (Default)	Toggle the display of the rise/fall crossing point, which gives a visual indication of the rise and fall time meas- urements.
Show eye for unsupported rates	Disabled (Default) Enabled	Toggle the display of eyes for rates currently unsup- ported by the unit. Note: This setting is transient, enabling support of officially unsupported rates. The setting reverts to default following a reboot.

A table showing the SMPTE tolerances for each standard is provided in the section *SMPTE UHDTV:*

SDI Physical Layer Tolerances.

Jitter - SDI In 1 (Physical Layer Analysis)

Requires Model:	LPX500M-ISE

Overview

The **Jitter** instrument is available on the BNC connector labeled **SDI In 1** on the rear panel, and fitted with a black nut.

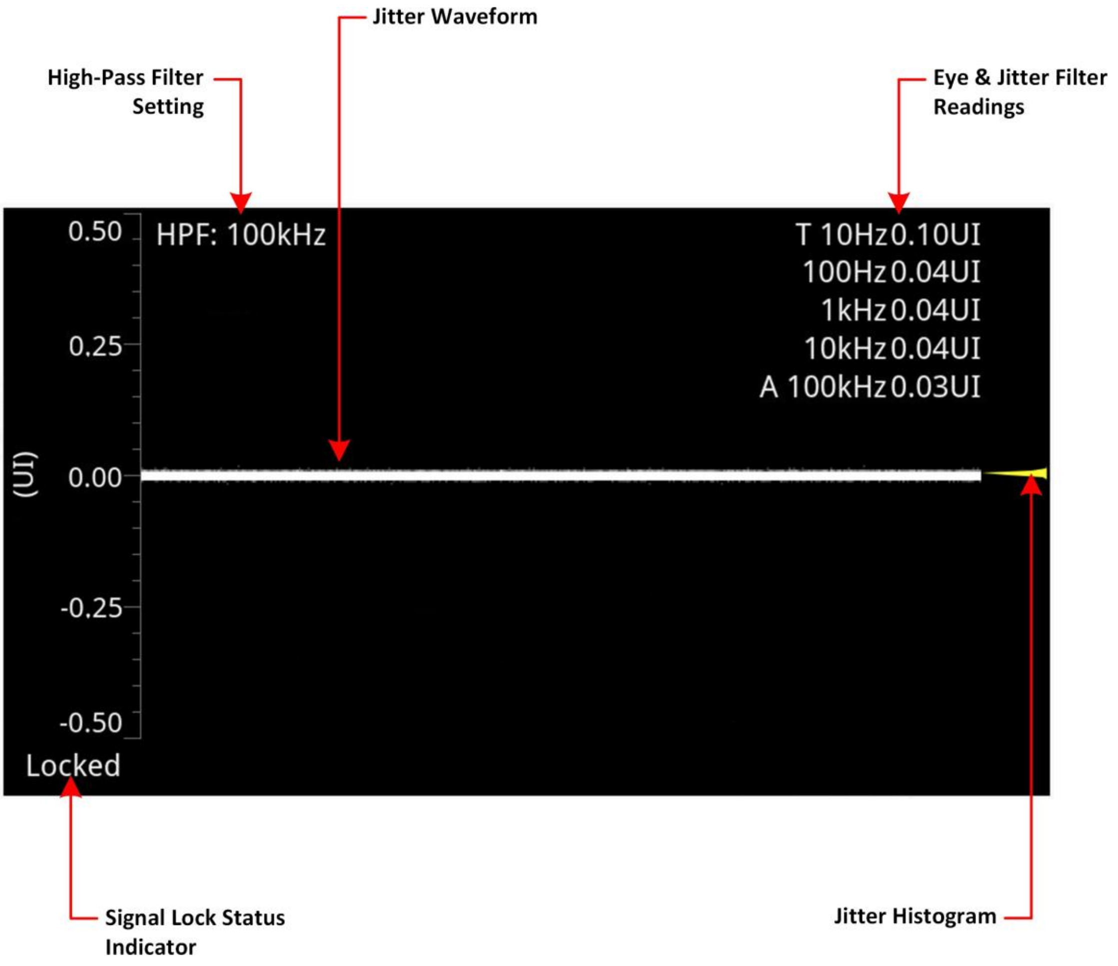

Figure 12-4: Jitter SDI In 1 Instrument

The **Jitter SDI In 1** instrument displays automated measurements to SMPTE standards. A Jitter histogram, displayed at the right of the window in yellow, provides additional information about the distribution of points in the jitter waveform.

Readings for each of the filters are displayed in the top-right corner of the instrument window. Any values displayed in red indicate a reading outside the standard specification for the signal analyzed.

A signal lock status indicator (**Locked / Unlocked**) in the bottom-left corner of the window indicates whether the signal is:

- **Unlocked (grayed-out):** No signal available
- **Unlocked (red font):** The firmware fails to lock to the signal
- **Locked (white font):** Eye pattern is locked, stable and not jittery.

Instrument Menu Options

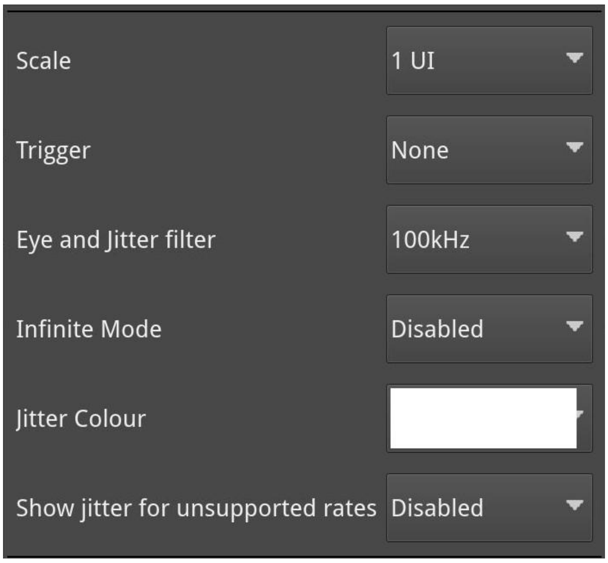

Figure 12-5: Jitter - SDI In 1 Instrument Menu Options

The following table lists the configurable parameters in the Jitter - SDI In 1 instrument options menu:

Table 12-2 : Jitter - SDI In 1 Menu Options

Item	Options	Description
Scale	1 UI (Default) to 128 UI	Adjust the scale of the Y-axis from 1 UI to 128 UI
Trigger	None (Default) Single Line Two Lines Single Field Frame	Select a trigger for jitter measurement. Trigger modes are useful to correlate jitter content to line and frame-rate frequencies.
Eye and Jitter Filter	10 Hz 100 Hz 1 kHz 10 kHz 100 kHz (Default)	This setting controls the high-pass filter applied to both the **Jitter - SDI In 1** instrument and the **Eye - SDI In 1** instrument. If you hover over the HPF field in the top-left of the screen, a tooltip displays the frequency response of the current high-pass filter.
Infinite Mode	Enabled Disabled (Default)	When disabled, jitter data points are displayed only for a fixed period of time and then removed from the display. When enabled, infinite mode ensures that no data points are removed from the display.
Jitter Color	White (Default) Select from the color map.	Color selection is by way of an HSV tool providing two cursors. The left-hand color rectangle allows you to select the hue (horizontal) and saturation (vertical). The right- hand vertical bar selects color intensity.
Show Jitter for Unsupported Rates	Enabled Disabled (Default)	Toggle the display of jitter for rates currently unsupported by the unit. **Note:** This setting is transient, enabling support of offi- cially unsupported rates. The setting reverts to default fol- lowing a reboot.

13

HDR Analysis Instruments

> **Note:** This option requires the Advanced High Dynamic Range (HDR) License: **LPX500-HDR**.

This chapter describes the instruments available with the High Dynamic Range (HDR) Toolset option and includes the following sections:

- Advanced HDR Toolset
- Analyzer - CIE Chart
- HDR Heat-map (False Color Overlay Tools)

Advanced HDR Toolset

Requires Option(s):	LPX500-HDR

Overview

The comprehensive advanced HDR toolset includes a signal generator for HDR test patterns, CIE Chart analyzer, luma false color highlighting (or heat map), a waveform monitor and vectorscope. The HDR toolset supports all the main live production formats for both SDR and HDR.

For Standard Dynamic Range (SDR), the toolset supports:

- BT.709
- BT.2020

For High Dynamic Range (HDR), the toolset supports:

- BT.2100 HLG
- PQ
- Sony S-Log3
- Sony SR Live

The Analyzer - Waveform instrument provides a Nits (Cd/m^2) graticule along with BT.2048 diffuse white markers. The flexible user-controlled HDR heatmap highlights signals beyond SDR with seven simultaneous programmable color overlay bands with presets for HDR and SDR ranges, plus a user- definable preset. The CIE 1931 *x,y* display provides overlays for BT.709, BT.2020 and ST.2086 gamut (P3) to enhance the visualization and analysis of your HDR/WCG content.

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

HDR Test Patterns

In addition to the standard SDR test patterns which are converted to HDR, the Advanced HDR toolset provides an additional two native HDR test patterns. These test patterns are available when you select one of the following HDR WCG (Wide Color Gamut) options from the **Gamut** and **OTF** lists in the **Video Generator Config...** dialog of the **Generator** Instrument:

- 2020 HLG
- 2020 PQ
- 2020 S-Log3
- 2020 S-Log3 SR Live

The available test patterns for a selected video standard are displayed in the **Test Pattern** dialog accessed from the **Video Generator Config...** dialog of the **Generator** instrument. The native HDR test patterns are as follows:

- ITU-R BT.2111-0 HDR Color Bars
- ITU-R BT.814-4 PLUGE – 4 variants

In addition, all other test patterns are converted to HDR when generating an HDR standard/signal, see the section *Generator Test Patterns* for a detailed list. Both S-Log3 and SR Live [S-Log3(HDR Live)] test pattern variants are available.

Transfer Curve and Colorimetry Overrides

HDR content may still contain the SMPTE payload ID for SDR and Rec.709 color space (as standard).

When analyzing HDR and WCG content, therefore, you may want to use the **Analyzer - Video Standard** instrument to apply a manual override configured as follows:

- Transfer Curve Override, select: OTF: SDR, HLG, PQ, or S-Log3
- Colorimetry Override, select: Gamut: 709 or 2020

Analyzer - CIE Chart

Requires Option(s):	LPX500-HDR

Overview

The CIE 1931 *x,y* chart provides a display of signal chromaticity - complete with Rec. 601 525/625, Rec. 709, Rec. 2020, ST 2086 gamut overlays and the Illuminant D65 white point reference.

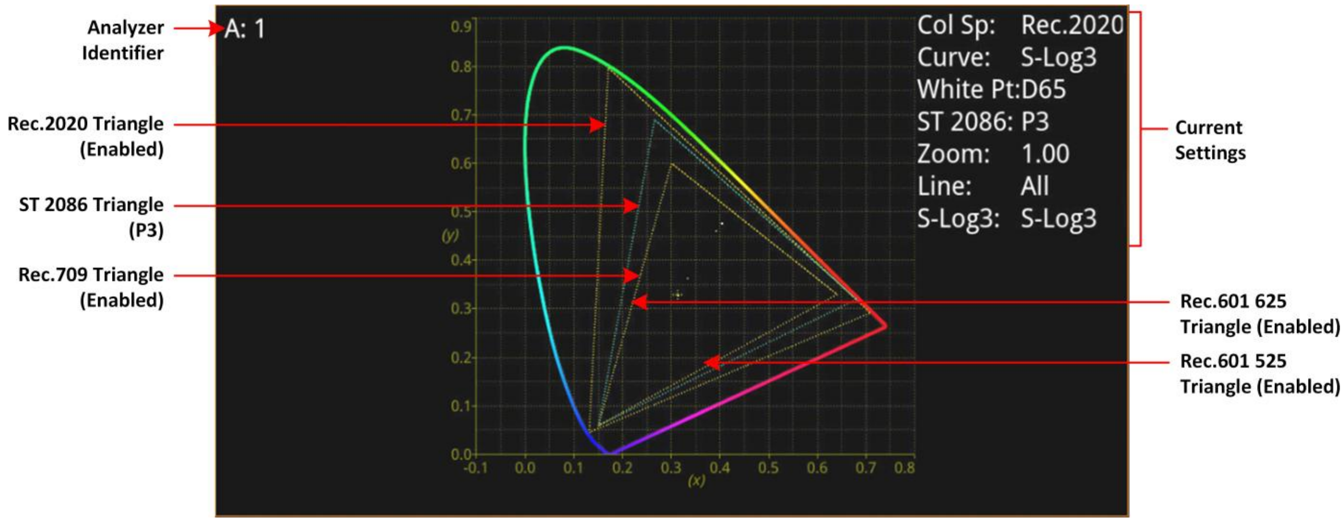

Figure 13-1: Analyzer - CIE Chart Instrument

> **Note:** The legend for S-Log3 is displayed only when analyzing S-Log3 HDR video and reads **S-Log3**, even when set to SR-Live.

Instrument Menu Options

The following table lists the configurable parameters in the Analyzer - CIE Chart instrument submenu:

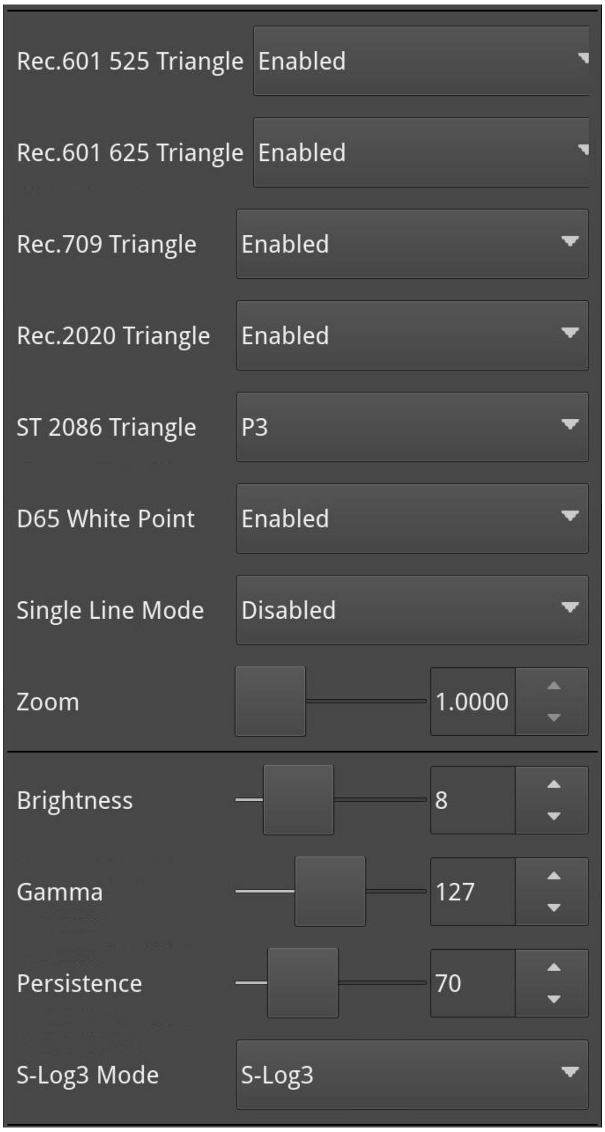

Figure 13-2: Analyzer - CIE Chart Options Menu

Table 13-1 : Analyzer - CIE Chart Options

Item	Options	Description
Rec.601 525 Triangle	Enabled Disabled (Default)	When enabled, displays the triangle for the Rec. 601 color primaries (NTSC 525 line encoding).
Rec.601 625 Triangle	Enabled Disabled (Default)	When enabled, displays the triangle for the Rec. 601 color primaries (PAL 625 line encoding).
Rec.709 Triangle	Enabled (Default) Disabled	When enabled, displays the triangle for the Rec. 709 color primaries.
Rec.2020 Triangle	Enabled (Default) Disabled	When enabled, displays the triangle for the Rec. 2020 color primaries.
ST 2086 Triangle	P3 (Default) Disabled	When enabled, displays the location of the SMPTE ST 2086 Mastering Display Primaries.
D65 White Point	Enabled (Default) Disabled	When enabled, displays cross-hairs for the D65 white point in the CIE Chart.
Single Line Mode	Enabled Disabled (Default)	When enabled, allows single line mode analysis of the active picture. When disabled, all video lines in the active picture are overlaid on top of each other.
Line Number	System Control 1 to Total number of active lines in the video signal.	Selects the line number in the active picture for analysis.
Zoom	Slider control 1.00 (Default) to 4.00	Zooms in/out of the chart for detailed inspection. Use the Zoom slider in combination with the x Position and y Position sliders to pan the chart in the horizontal and vertical directions, respectively.
x Position	Slider control	Pans horizontally across the zoomed-in chart. Use in combination with the Zoom slider to locate a point of interest in the chart.
y Position	Slider control	Pans vertically across the zoomed-in chart. Use in combination with the Zoom slider to locate a point of interest in the chart
Brightness	Slider control 1 to 31 8 (Default)	Adjusts the brightness of the instrument trace.
Gamma	Slider control 1 to 255 127 (Default)	Adjusts the gamma component of the instrument trace.
Persistence	Slider control 1 to 255 70 (Default)	Adjusts the persistence of the instrument trace.
S-Log3 Mode (HDR Only)	S-Log3 (Default) SR Live	Switches the HDR format between S-Log3 and SR Live, if required.

HDR Heat-map (False Color Overlay)

Requires Option(s):	**LPX500-HDR**

A false color overlay can be applied to the image displayed in the **Picture** instrument to highlight luminance ranges in the image that are of particular interest.

The active picture can also be displayed in monochrome using grayscale shades. If enabled at the same time as false color highlighting, all image elements outside of the enabled false color overlay luminance range(s) are displayed in monochrome, leaving the false color highlight elements to stand out more.

Different types of false color overlay may be applied to highlight different types of pixels in the active picture, and the custom mode is provided to enable you to create a bespoke overlay.

The range(s) and colors of a selected false color overlay can be modified by adjusting the seven overlay bands. Up to seven distinct ranges can be simultaneously enabled in a single overlay. If adjusted, the new or modified overlay is designated as the Custom overlay type.

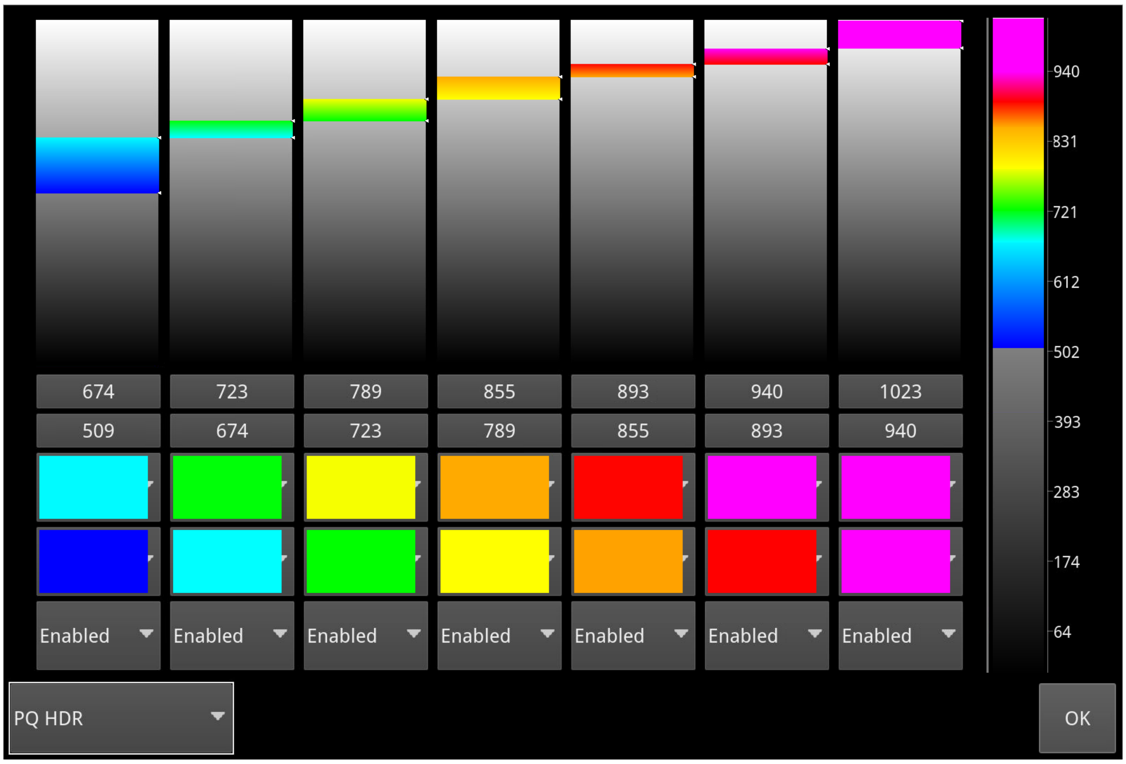

Figure 13-3: Configuring the False Color Overlay (PQ HDR Definition)

When False Color Overlay Scale (decimal level) is enabled, a scale is displayed on the right of the Picture window, overlaid on the active picture (see the following figure). The scale is expressed in Nits or decimal levels.

Figure 13-4: False Color Overlay Scale Applied (Decimal Luminance Scale)

HDR Options in Analyzer - Picture Instrument Menu

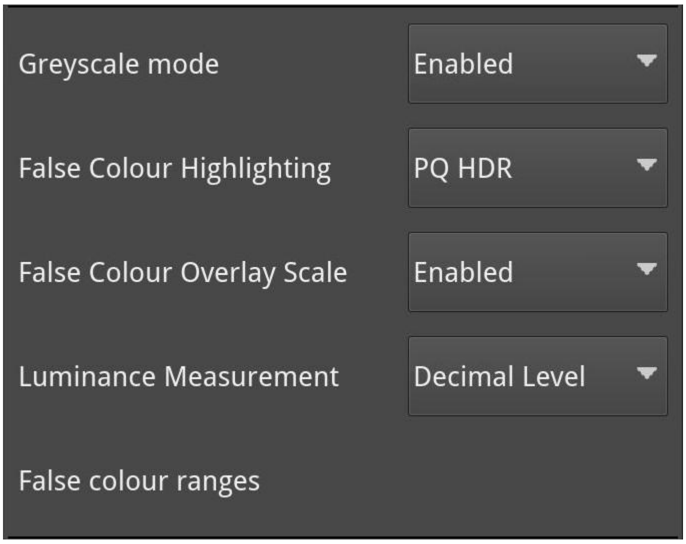

Figure 13-5: HDR Options in Analyzer - Picture Options Menu

The following table lists the options for the Advanced HDR Toolset available in the **Analyzer - Picture** instrument option menu:

Table 13-2 : HDR Menu Options for the Analyzer - Picture Instrument

Item	Options	Description
Grayscale Mode	Disabled (Default) Enabled	When enabled, displays the active picture using a grayscale.
False Color Highlighting	Disabled (Default) PQ HDR SDR All Brands SDR Shadow SDR Skin Tones SDR Highlights Out of Range S-Log3 Out of Range Custom	Select the type of false color overlay required.
False Color Overlay Scale	Disabled (Default) Enabled	When active, displays a scale, showing both numeric and graphic representation of the range(s) for the selected overlay, at the right-hand side of the window.
Luminance Measurement	Decimal Level (Default) PQ Nits	Selects the measurement units used in the false color overlay scale and in the configuration of the false color ranges.
False Color Ranges	Disabled (Default), PQ HDR, SDR All Bands, SDR Shadow, SDR Skin Tones, SDR Highlights, Out of Range, S-Log3 Out of Range, Custom	Opens the false color highlighting dialog. Adjust any of the seven overlay bands to modify the range(s) of colors highlighted by the overlay when applied to the active pic- ture. You can enable up to seven distinct ranges sim- ultaneously in a single overlay. If adjusted, the modified overlay is set as the Custom overlay type.

A

Technical Specifications

This Appendix defines the technical specifications of your unit and includes the following sections:

Technical Specifications

AC Power (Internal PSU)

Connector	IEC, Male
Operating Voltage	100 - 240 VAC ±10%
Frequency	47 - 63 Hz
Current	1.2 A (maximum)
Power Consumption	77 W (typical); 110 W (maximum).

DC Power

Connector	4-pin XLR, Male
Voltage	12 - 16 V DC Input Range Over-voltage protection: +20% (19.2 V) Under-voltage protection: −15% (10.2 V) Reverse-voltage protection: −20 V
Current	12 A (maximum)
Power	85 W (typical), 120 W (maximum).
Connector Pinouts	Connector View from Rear of Unit (male):

NOTE: Pins 1 and 2 are connected internally to Chassis Ground via XLR Shield Pin

- **Pin 1**: 0 V (Ground)
- **Pin 2**: 0 V (Ground)
- **Pin 3**: 12 V (Power)
- **Pin 4**: 12 V (Power)

SDI Analyzer Inputs

Label	SDI IN: 1, 2, 3, 4
Connector	4 x 12G BNC
Input Return Loss	−15 dB (5 MHz to 1.485 GHz), −10 dB (1.485 GHz to 3 GHz), −7 dB (3 GHz to 6 GHz), −4 dB (6 GHz to 12 GHz)
Purpose	SDI inputs supporting SD, HD, 3G, 6G and 12G-SDI standards

SDI Analyzer Outputs

Label	SDI OUT: 1, 2, 3, 4
Connector	4 x 12G BNC

Output Return Loss	−15 dB (5 MHz to 1.485 GHz), −10 dB (1.485 GHz to 3 GHz), −7 dB (3 GHz to 6 GHz), −4 dB (6 GHz to 12 GHz)
Purpose	SDI Outputs supporting SD (looped out), HD, 3G, 6G and 12G-SDI standards

SFP28 Cages

Not supported in this release.

QSFP28 Cages

Not supported in this release.

External Locking Reference

Label	REF IO
Input Signal	Tri-level or Bi-Level (black burst) syncs 23.98, 24, 50, 59.94, 60 Hz
Connector	BNC
Input Impedance	> 10 kohm, software selectable internal 75 ohm
termination Input Return Loss	> 40 dB to 6 MHz (typical)
Maximum Input voltage	± 2 V AC coupled
Specification	Tri-level syncs (SMPTE 274M and SMPTE 296M) 600 mV pk- pk PAL Black Burst (ITU 624-4/SMPTE 318) 1 V pk-pk Composite NTSC (SMPTE 170M) 1 V pk-pk

DisplayPort Instrument Output

Label	MONITOR
Connector	DisplayPort socket
Video Format	1080P47.95 / 1080P48 / 1080P50 / 1080P59.94 / 1080P60, RGB 4:4:4, 8 bit depth Select output frequency in Display Settings.
Audio Format	First stereo pair PCM audio output, 48 kHz, 24 bit
Purpose	Output of user interface to external DisplayPort monitor

SDI Instrument Output

Label	SDI MON
Connector	BNC
Output Impedance	75 ohm
Output Return Loss	−15 dB (5 MHz to 1.485 GHz), −10 dB (1.485 GHz to 3
GHz) Output Level	800 mV pk-pk ± 10 %
Video Format	1080P50 / 1080P59.94 / 1080P60, YCbCr 4:2:2, 10 bit
Audio Format	First stereo pair PCM audio output, 48 kHz, 20 bit
Purpose	3 Gbps SDI copy of user interface

USB 3.x Type A Connectors

USB Version	USB 3.2 (front panel) and USB 3.1 (rear panel)
USB Connector	Type-A socket
Number of USB 3.2 Type A con-mounted	Two, front-

nectors	
Number of USB 3.1 Type A con- nectors	Two, rear-mounted
Purpose	High Speed file transfer to USB storage devices. Keyboard and mouse con- nection.

USB 3.1 Type C Connectors

Label	EXT MON
USB Version	USB 3.1
USB Connector	Type-C connector
Quantity	Two on rear panel **EXT MON** port: Used to connect optional extended monitor. **< - >** port: Internal use only.
Purpose	Data and power link to the optional extended monitor.

USB 3.1 Type C Connector on Optional Extended Monitor

USB Version	USB 3.1
USB Connector	Type-C connector
Quantity	One on rear panel of optional extended monitor. **Video Input** port: Used to connect optional extended monitor to main unit.
Purpose	Data and power link to the optional extended monitor.

Networking

Ethernet	IEEE 802.3 10 / 100 / 1000 BASE-T
Connector	RJ-45
Purpose	SFTP access for software upgrade and upload/download of data files RESTful API for remote loading of presets Web server for file access noVNC for Web browser remote operation VNC server for remote operation NTP for rautomatic clock control.

Rear Panel 15 Pin D-Type Connector

Label REMOTE

Connector 15-way high-density D-type socket

Purpose 8 x GP I/O, 4 x AES I/O, stereo analog audio out and power 12 x inputs, 1 x output (alarm), 2 x Ground
Binary mode uses pins 2 to 7 for remote loading of up to 60 presets
Bit mode uses pins 2 to 9 for remote control loading of up to eight presets.

Format Open drain with 10 kohm pull-up to +3.3 V (can also receive

+5 V) Pinout

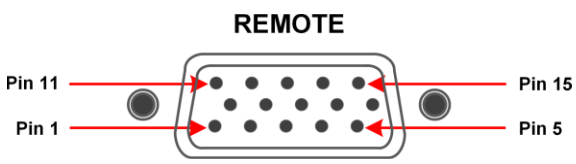

Table A-1 : D15 Remote Control Connector Pinouts

Pin Number	Pin Name	Description
1	OPEN	Open - do not connect
2	/P1	Load preset 1 to 60 (Binary mode) or load preset 1 (Bit mode)
3	/P2	Load preset 1 to 60 (Binary mode) or load preset 2 (Bit mode)
4	/P3	Load preset 1 to 60 (Binary mode) or load preset 3 (Bit mode)
5	/P4	Load preset 1 to 60 (Binary mode) or load preset 4 (Bit mode)
6	/P5	Load preset 1 to 60 (Binary mode) or load preset 5 (Bit mode)
7	/P6	Load preset 1 to 60 (Binary mode) or load preset 6 (Bit mode)
8	/P7	Load preset 7 (Bit mode only)
9	/P8	Loads preset 8 (Bit mode only)
10	/ACH	Not currently used
11	/BCH	Not currently used
12	/CCH	Not currently used
13	/DCH	Not currently used
14	ALARM	Not currently used
15	GND	Ground

Physical Form Factor (LPX500 Main Unit)

Chassis Dimensions (Excluding Display Bezel)	210 (width) x 127.3 (height) x 150 (depth) mm
Chassis Dimensions (Including Display Bezel)	220 (width) x 133 (height) x 153 (depth) mm
Dimensions with Desktop Kit	210 (W) x 195 (H) x 150 (D) mm (Handle and folded feet) 210 (W) x 235 (H) x 150 (D) mm (Handle and extended feet)
Weight	3.7 kg

Physical Form Factor (Optional Extended Monitor)

Chassis Dimensions (Excluding Display Bezel)	210 (width) x 127.3 (height) x 47(depth) mm
Chassis Dimensions (Including Display Bezel)	220 (width) x 133 (height) x 75 (depth) mm
Dimensions with Desktop Kit	210 (W) x 195 (H) x 150 (D) mm (Handle and folded feet) 210 (W) x 235 (H) x 150 (D) mm (Handle and extended feet)
Weight	1.4 kg

B

SMPTE SDTV, HDTV and UHDTV

LeaderPhabrix is committed to developing the toolsets available on the unit, including upgrades to existing instruments and the introduction of new instruments. Please do not hesitate to contact LeaderPhabrix at any time to discuss your requirements for the product or current product timelines.

SDI Physical Layer Tolerances

The unit will automatically measure the SMPTE SDTV, HDTV and UHDTV tolerances listed in the following table:

Table B-1 : SMPTE SDTV, HDTV and UHDTV Tolerances

Data Rate	**0.270 Gbps**	**1.485 Gbps**	**2.97 Gbps**	**5.94 Gbps**	**11.88 Gbps**
Standard	SMPTE ST259	SMPTE ST292-1	SMPTE ST424	SMPTE ST2081-1, 10	SMPTE ST2082-1, 10
Coding	Scrambled NRZI	Scrambled NRZI	Scrambled NRZI	Scrambled NRZI	Scrambled NRZI
Amplitude	800 mV ± 10 %	800 mV ± 10 %	800 mV ± 10 %	800 mV ± 10 %	800 mV ± 10 %
DC Offset	0.0 V ± 0.5 V	0.0 V ± 0.5 V	0.0 V ± 0.5 V	0.0 V ± 0.5 V	0.0 V ± 0.5 V
Rise/Fall Time	< 1500 ps	< 270 ps	< 135 ps	< 80 ps	< 45 ps
Rise/Fall Time Difference	< 500 ps	< 100 ps	< 50 ps	< 35 ps	< 18 ps
Rise/Fall Overshoot	< 10 % of Amplitude	< 10 % of Amplitude	< 10 % of Amplitude	< 10 % of Amplitude	< 10 % of Amplitude
Timing Jitter	< 0.2 UI (10 Hz to 27 MHz)	< 1 UI (10 Hz to 148.5 MHz)	< 2 UI (10 Hz to 297 MHz)	< 4 UI (10 Hz to 594 MHz)	< 8 UI (10 Hz to 1188 MHz)
Alignment Jitter	< 0.2 UI (100 kHz to 27 MHz)	< 0.2 UI (100 kHz to 148.5 MHz)	< 0.3 UI (100 kHz to 297 MHz)	< 0.3 UI (100 kHz to 594 MHz)	< 0.3 UI (100 kHz to 1188 MHz)
75 ohm Coaxial Cable Length (Belden 1694A)	400 m	200 m	200 m	100 m	70 m

The complexity of both analyzing and generating signals for SDTV, HDTV and UHDTV is shown in the above table. SMPTE standards require that the unit's instruments measure critical values within the tolerances set by SMPTE and summarized in the above table.

C

Supported Video Standards

Please contact LeaderPhabrix if you require support for any standards not listed here. The current software version supports the following standards:

HD/2K Supported Formats

The following SDI formats are supported:

Table C-1 : Supported SD/HD/2K Video Standards (SDI Input)

SMPTE Stnds. Link (Content)	Interface	Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	SDI-HDR	SDI-SDR
ST 259 (ST 125)	SD (525i)	720 x 485	4:2:2 (YCbCr)	10	59.94i	-	**A**
ST 259 (ST 125)	SD (625i)	720 x 576	4:2:2 (YCbCr)	10	50i	-	**A**
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	60i, 59.94i, 50i, 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	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○ ●	●
ST 372 (ST 274)	Dual Link HD	1920 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	60i, 59.94i, 50i 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	1920 x 1080	4:4:4 (YCbCr/RGB)	12	60i, 59.94i, 50i 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	1920 x 1080	4:2:2 (YCbCr)	12	60i, 59.94i, 50i 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	2048 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○ ●	●
ST 372 (ST 274)	Dual Link HD	2048 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	2048 x 1080	4:4:4 (YCbCr/RGB)	12	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 372 (ST 274)	Dual Link HD	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	○ ●	●
ST 425-1 (ST 274)	3G Level A (1)	1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○ ●	●
ST 425-1 (ST 2048-2)	3G Level A (1)	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 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●

SMPTE Stnds. Link (Content)	Interface	Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	SDI-HDR	SDI-SDR
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	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
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	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 425-1 (ST 274)	3G Level A (4)	1920 x 1080	4:2:2 (YCbCr)	12	60i, 59.94i, 50i 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
ST 425-1 (ST 2048-2)	3G Level A (4)	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	○ ●	●
ST 425-1 (ST 274)	3G Level B-DL (I)	1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○ ●	●
ST 425-1 (ST 2048-2)	3G Level B-DL (I)	2048 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.95p	○ ●	●
ST 425-1 (ST 274)	3G Level B-DL (II)	1920 x 1080	4:4:4 (YCbCr/RGB) 4:4:4:4 (YCbCrA/RGBA)	10	60i, 59.94i, 50i 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
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)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
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	○ ●	●
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	○ ●	●
ST 425-1 (ST 274)	3G Level B-DL (IV)	1920 x 1080	4:2:2 (YCbCr)	12	60i, 59.94i, 50i 30PsF, 29.97PsF, 25PsF, 24PsF, 23.98PsF 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
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	○ ●	●

Key to table:

- ● - Generator with Option **LPX500-GEN** and Analyzer
- ○ - Optional
- **A** - Analyzer Only
- **-** - Not supported

Table C-2 : Supported SD/HD/2K Video Standards (ST 2110 IP Input)

Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	QxP	
				2110-HDR	2110-SDR
720 x 485	4:2:2 (YCbCr)	10	59.94i	-	○ **A**
720 x 576	4:2:2 (YCbCr)	10	50i	-	○ **A**
1280 x 720	4:2:2 (YCbCr)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
1280 x 720	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.97p	○ ●	●
1280 x 720	4:4:4(YCbCr/RGB)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
1280 x 720	4:4:4(YCbCr/RGB)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
1920 x 1080	4:2:2 (YCbCr)	8	60i, 59.94i, 50i	○ **A**	**A**
1920 x 1080	4:2:2 (YCbCr)	10	60i, 59.94i, 50i	○ ●	●
1920 x 1080	4:2:2(YCbCr)	12	60i, 59.94i, 50i	○ ●	●
1920 x 1080	4:4:4(YCbCr/RGB)	8	60i, 59.94i, 50i	○ **A**	**A**
1920 x 1080	4:4:4(YCbCr/RGB)	10	60i, 59.94i, 50i	○ ●	●
1920 x 1080	4:4:4(YCbCr/RGB)	12	60i, 59.94i, 50i	○ ●	●
1920 x 1080	4:2:2(YCbCr)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
1920 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
1920 x 1080	4:2:2 (YCbCr)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
1920 x 1080	4:4:4(YCbCr/RGB)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
1920 x 1080	4:4:4(YCbCr/RGB)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
1920 x 1080	4:4:4(YCbCr/RGB)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
1920 x 1080	4:2:2 (YCbCr)	8	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
1920 x 1080	4:2:2 (YCbCr)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
1920 x 1080	4:2:2 (YCbCr)	12	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
1920 x 1080	4:4:4(YCbCr/RGB)	8	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
1920 x 1080	4:4:4(YCbCr/RGB)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
1920 x 1080	4:4:4(YCbCr/RGB)	12	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:2:2 (YCbCr)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
2048 x 1080	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
2048 x 1080	4:2:2 (YCbCr)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
2048 x 1080	4:4:4(YCbCr/RGB)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**

Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	QxP	
				2110-HDR	2110-SDR
2048 x 1080	4:4:4(YCbCr/RGB)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
2048 x 1080	4:4:4(YCbCr/RGB)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ ●	●
2048 x 1080	4:2:2 (YCbCr)	8	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:2:2 (YCbCr)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:2:2 (YCbCr)	12	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:4:4(YCbCr/RGB)	8	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:4:4(YCbCr/RGB)	10	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**
2048 x 1080	4:4:4(YCbCr/RGB)	12	30PsF, 29.97PsF, 25PsF, 24PsF, 23.97PsF	○ **A**	**A**

Key to table:

- ● - Generator with Option **PHQXPO-GEN** and Analyzer
- ○ - Optional
- **A** - Analyzer Only
- **-** - Not Supported

4K/UHD Supported Formats

Table C-3 : Supported 4K/UHD SDI Video Standards

SMPTE Stnds. Link (Content)	Interface	Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	SDI-HDR	SDI-SDR
ST 425-3 Annex B.1 (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 B.1 (ST 2048-1)	Quad-link HD-SQ	4096 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○●	○
ST 425-3 Annex B.2 (ST 2036-1)	Dual 3G-B-DS	3840 x 2160	4:2:2 (YCbCr)	10	30p, 29.97p, 25p, 24p, 23.98p	○●	○
ST 425-3 Annex B.2 (ST 2048-1)	Dual 3G-B-DS	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 (1) 2SI	3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○●	○
ST 425-5 (ST 2048-1)	Quad-link 3G-A (1) 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 (2) 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 (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 (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 (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 (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 (1) SQ	3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p	○●	○
ST 425-5 Annex B (ST 2048-1)	Quad-link 3G-A, B (1) 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 (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 (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	○●	○

SMPTE Stnds. Link (Content)	Interface	Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	SDI-HDR	SDI-SDR
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)	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) 4:2:2:4 (YCbCrA)	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	○●	○

Key to table:

- ● - Generator with Option **LPX500-GEN** and Analyzer
- ○ - Optional

Table C-4 : Supported 4K/UHD ST 2110 IP Video Standards (Requires Options: LPX500-UHD and LPX500-EUHD)

Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	2110-HDR	2110-SDR
3840 x 2160	4:2:2 (YCbCr)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
3840 x 2160	4:4:4(YCbCr/RGB)	8	30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
4096 x 2160	4:2:2 (YCbCr)	8	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
4096 x 2160	4:4:4(YCbCr/RGB)	8	30p, 29.97p, 25p, 24p, 23.98p	○ **A**	**A**
3840 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○●	●
3840 x 2160	4:4:4(YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○●	●
4096 x 2160	4:2:2 (YCbCr)	10	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○●	●
4096 x 2160	4:4:4(YCbCr/RGB)	10	30p, 29.97p, 25p, 24p, 23.98p	○●	●

3840 x 2160	4:2:2 (YCbCr)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○●	●

Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	2110-HDR	2110-SDR
3840 x 2160	4:4:4(YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○●	●
4096 x 2160	4:2:2 (YCbCr)	12	60p, 59.94p, 50p, 48p, 47.97p, 30p, 29.97p, 25p, 24p, 23.98p	○●	●
4096 x 2160	4:4:4(YCbCr/RGB)	12	30p, 29.97p, 25p, 24p, 23.98p	○●	●

Key to table:

- ● - Generator with Option **LPX500-GEN** and Analyzer
- ○ - Optional
- **A** - Analyzer Only

Table C-5 : Supported Extended 4K/UHD ST 2110 IP Video Standards (Requires Options: LPX500-UHD and LPX500-EUHD)

Resolution	Sampling Structure	Pixel Depth	Frame / Field Rate	2110-HDR	2110-SDR
UHD Formats					
3840 x 2160	RGB:444	8	47.95p, 48p, 50p, 59.94p, 60p	○ **A**	○ **A**
3840 x 2160	RGB:444	10	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
3840 x 2160	RGB:444	12	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
3840 x 2160	YCbCr:444	8	47.95p, 48p, 50p, 59.94p, 60p	○ **A**	○ **A**
3840 x 2160	YCbCr:444	10	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
3840 x 2160	YCbCr:444	12	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
4K Formats					
4096 x 2160	RGB:444	8	47.95p, 48p, 50p, 59.94p, 60p	○ **A**	○ **A**
4096 x 2160	RGB:444	10	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
4096 x 2160	RGB:444	12	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
4096 x 2160	YCbCr:444	8	47.95p, 48p, 50p, 59.94p, 60p	○ **A**	○ **A**
4096 x 2160	YCbCr:444	10	47.95p, 48p, 50p, 59.94p, 60p	○●	○●
4096 x 2160	YCbCr:444	12	47.95p, 48p, 50p, 59.94p, 60p	○●	○●

Key to table:

- ● - Generator with Option **LPX500-GEN** and Analyzer
- ○ - Optional
- **A** - Analyzer Only

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