HDCP2.2

4KHDR

XA-4

Advanced HDMI Pattern Generator & Analyser (4K, HDCP2.2, HDMI2.0)

OPERATION MANUAL

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SAFETY PRECAUTIONS

Please read all instructions before attempting to unpack, install or operate this equipment and before connecting the power supply.

Please keep the following in mind as you unpack and install this equipment:

- Always follow basic safety precautions to reduce the risk of fire, electrical shock and injury to persons.
- To prevent fire or shock hazard, do not expose the unit to rain, moisture or install this product near water.
- Never spill liquid of any kind on or into this product.
- Never push an object of any kind into this product through any openings or empty slots in the unit, as you may damage parts inside the unit.
- Do not attach the power supply cabling to building surfaces.
- Use only the supplied power supply unit (PSU). Do not use the PSU if it is damaged.
- Do not allow anything to rest on the power cabling or allow any weight to be placed upon it or any person walk on it.
- To protect the unit from overheating, do not block any vents or openings in the unit housing that provide ventilation and allow for sufficient space for air to circulate around the unit.

REVISION HISTORY

VERSION NO.	DATE	SUMMARY OF CHANGE
v1.00	28/02/2018	Final release

CONTENTS

UPDATE CONTENTS

1. INTRODUCTION

This HDMI Signal Generator & Analyser is an advanced and handy tool for generating, testing and verifying the signal path within your 18Gbps HDMI ecosystem. With 90 built-in resolutions, 58 test patterns and over a dozen types of A/V analysis functions, this unit provides an enormous range of testing options. HDMI data packet, EDID and HDCP analysis is supported along with EDID upload and emulation. Additionally the Status and Control Data Channel (SCDC) can be monitored, allowing HDMI 18Gbps signal detection and analysis. Up to 8 channels of LPCM audio test tones can be generated with a wide range of frequencies.

This unit also supports the ability to upload up to 2 user-generated graphic files which can be used as additional test patterns. The use of multi-function and multi-colour backlit buttons allows for easy operation of the unit's wide variety of functions and a clear OLED display provides a way to quickly view the current signal status information. In addition to the front panel buttons, the unit can also be controlled via RS-232, Telnet, and IR providing a complete range of control options.

2. APPLICATIONS

- Installer/Integrator multi-function test tool
- HDMI source and sink testing
- UHD system/SCDC error identification
- Third-party equipment setup
- Source and sink EDID reading, writing and saving
- HDCP compliance verification
- Production testing
- R&D design and testing

3. PACKAGE CONTENTS

- 1×HDMI Signal Generator & Analyser (Bench Version)
- 1×5V/2.6A DC Power Adapter
- 1×DC to USB Type-A Power Cable
- 1×Remote Control (CR-174)

- 1×Operation Manual

4. SYSTEM REQUIREMENTS

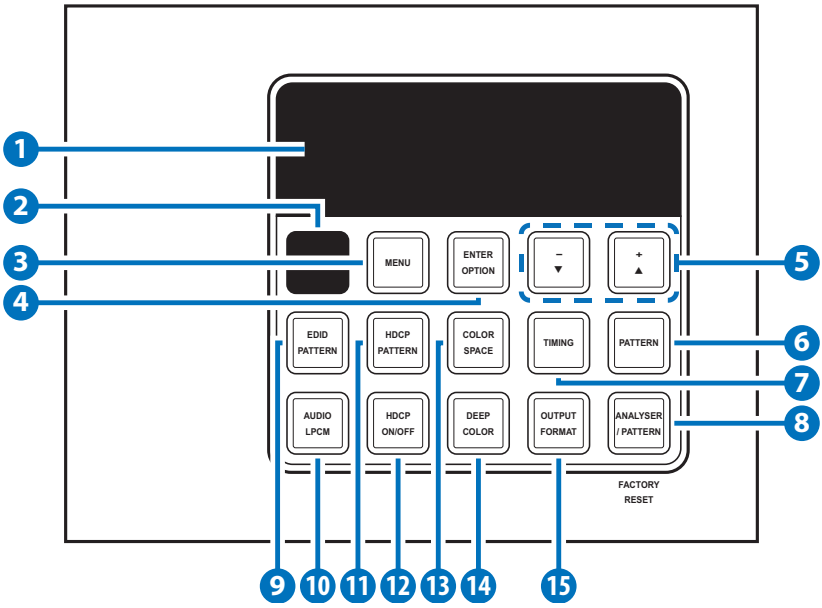
- HDMI/VGA receiving equipment such as an HDTV, monitor or audio amplifier and/or HDMI source equipment such as a media player, video game console or set-top box.
- Analogue audio source equipment such as a PC or media player and/or analogue audio receiving equipment such as headphones, an audio amplifier or powered speakers.
- RS-232 or Ethernet control device such as PC/Laptop. (Optional)
- USB enabled device for uploading user test patterns.

5. FEATURES

- HDMI 2.0 (up to 4K@60Hz 4:4:4) and DVI 1.0 compliant
- HDCP 1.4 and 2.2 compliant
- Analysis of source and sink data paths up to 18Gbps HDMI signals
- Analysis of HDMI data packets
- Analysis and control of HDCP v1.4 and v2.2
- Analysis and emulation of EDID data, including SCDC
- Analysis of input audio signals
- HDR bypass and analysis support
- Generate HDMI timings up to 18Gbps (4096×2160@60Hz 4:4:4, 8-bit)
- Generate HDMI and VGA signal outputs
- 2 custom user test pattern resolutions: 640×480 & 1920×1080
- External stereo audio input and output
- Generation of LPCM sinewave audio on up to 8 channels
- Front-panel, RS-232, Telnet, and IR remote controls
- OLED display with rapid updates of current status information
- Detailed OSD for settings and informational displays
- Supports USB firmware and pattern update
- Small and portable unit

6. OPERATION CONTROLS AND FUNCTIONS

6.1 Front Panel



1 **OLED:** Displays the current signal analysis information or test pattern mode selection details including input and/or output resolution timing. The screen layout changes depending on the unit's mode.

A **Analyser Mode (ANALYSER/PATTERN button is RED):** In Analyser mode, if there is no live video source detected on the input port, the OLED will display any voltage, TMDS or sync that might be present.

Once a live video signal is detected, the unit will display that signal's current timing, format, HDCP version, AV Mute status, colour space, colour depth and audio format.

B **Pattern Mode (ANALYSER/PATTERN button is BLUE):** In Pattern mode, when the output isn't connected to a sink, the unit will display the current output timing, RxSense, and Hot-plug detection status.

Once an active sink has been connected, the lower portion of the display will change to indicate the current test pattern number and name.

2 **IR WINDOW:** Accepts IR signals from the included IR remote for control of this unit only.

3 **MENU:** Press to enter the OSD menu, or to back out from menu items.

4 **ENTER/OPTION:** Press to confirm a selection or to go deeper into a menu item. When the selected function has optional selections, the associated button's LED will illuminate along with the +/▲ & –/▼ buttons.

5 **+/▲ & –/▼:** Press to move up and down or adjust selections within menus. These buttons will illuminate when the selected function has values that can be adjusted up or down.

6 **PATTERN:** Within Pattern mode, press to enable selection of the test pattern used. The +/▲ & –/▼ buttons will illuminate and are used to select the new pattern. The new test pattern will automatically become active after selecting it and pausing for 2 seconds. Additional variations (if available) are selected by pressing the PATTERN button additional times. Within Analyser mode, press to turn on/off a "title-safe/action-safe" overlay.

7 **TIMING:** Press to enable selection of the output timing and resolution used. The +/▲ & –/▼ buttons will illuminate and are used to select the new timing. The currently selected timing will be shown on the

OLED display. The new timing will automatically become active after selecting it and pausing for 2 seconds.

Force Bypass: In Analyser mode, press and hold this button for 2 seconds to force the output to use Bypass mode.

Note: In Analyser mode, please select the "Bypass" timing if you do not wish for your source's output signal to be scaled by the unit before being sent to the display. The TIMING button's LED will blink Red when the timing is set to Bypass.

8. **ANALYSER/PATTERN:** Press to switch the unit between Analyser Mode (LED=Red) and Pattern Mode (LED=Blue).

   Force Hot-Plug: When in Analyser Mode, press and hold the button for 2 seconds to force an RX hot-plug.

   AV Mute: When in Pattern Mode, press and hold the button for 2 seconds to turn on/off the AVMute bit within the output's GCP (General Control Packet).

   Factory Reset: Press and hold this button while powering the unit on to perform a factory reset of the unit.

9. **EDID PATTERN:** Press to enable selection of the EDID to use on the HDMI input port. The +/▲ & –/▼ buttons will illuminate and are used to select the new EDID. The currently selected EDID will be shown on the OLED display. The new EDID will automatically become active after selecting it and pausing for 5 seconds.

10. **AUDIO LPCM:** Within Analyser mode, press to select which digital audio source pair (0–3) is routed to the primary stereo channel (LPCM 2.0 and headphone output) for monitoring. The LED colour indicates the selection (Off=SD0, Red=SD1, Blue=SD2, Purple=SD3). Within Pattern mode, press to switch between LPCM 2.0 (LED=Red), 5.1 (LED=Blue) and 7.1 (LED=Purple) channel test tone output formats.

    Volume Control: Press and hold this button for 2 seconds to allow adjustment of the output volume by using the up and down arrow buttons.

11. **HDCP PATTERN:** Press to enable/disable the OSD display of the detected HDCP version support and handshaking information between the sink and source. In Analyser mode the unit is the RX, in Pattern mode the unit is the TX. In Pattern mode, if HDCP handshaking fails, an error message "HDCP OUT FAIL" will be displayed on the OSD.

12 **HDCP ON/OFF:** Press to switch between supported HDCP versions or to disable HDCP. Within Analyser mode, OFF (LED=Off), HDCP 1.4 (LED=Red), and HDCP 1.4+2.2 (LED=Blue) modes are available for the input port. Within Pattern mode, OFF, HDCP 1.4, and HDCP 2.2 modes are available for the output port.

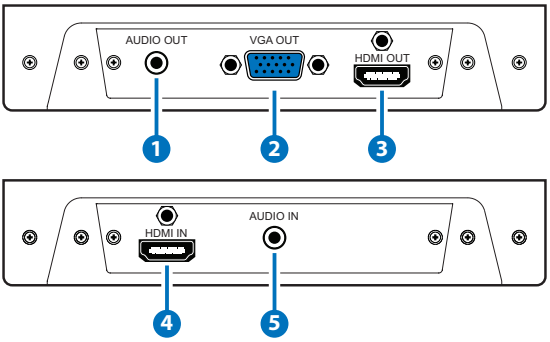
13 **COLOR SPACE:** Press repeatedly to switch between the available colour space formats. The button's LED is coloured to indicate the current colour space: Red=RGB, Blue=YCbCr 4:4:4, Purple=YCbCr 4:2:0, Off=YCbCr 4:2:2.

14 **DEEP COLOR:** Press repeatedly to switch between the available output colour bit depth options. The button's LED is coloured to indicate the current bit depth: Off=8-bit, Red=10-bit, Blue=12-bit.

15 **OUTPUT FORMAT:** Press to switch between DVI (LED=Blue) and HDMI (LED=Red) output formats.

Disable Output: Press and hold the button for 2 seconds to disable/enable video output completely. The button's LED will turn off when output is disabled.

6.2 Top and Bottom Panels



1 **AUDIO OUT:** Connect to powered speakers or an amplifier for stereo analogue audio output with a 3.5mm phone jack cable.

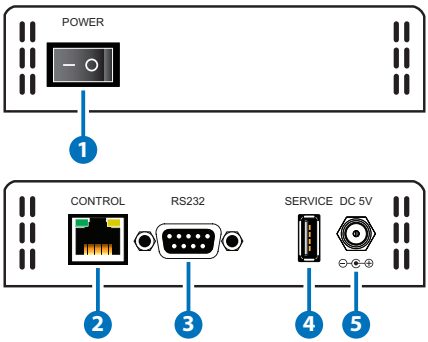
2 **VGA OUT:** Connect to a VGA (RGBHV) monitor or display for analogue video output.

3 **HDMI OUT:** Connect to HDMI TVs, monitors or amplifiers for digital video and audio output.

4 **HDMI IN:** Connect to HDMI source equipment such as a media player, game console or set-top box.

5 **AUDIO IN:** Connect to the stereo analogue output of a device such as a CD player or PC.

6.3 Left and Right Panels



1 **POWER:** Flip this switch to turn the unit ON or OFF after connecting an appropriate power source.

2 **CONTROL:** Connect directly, or through a network switch, to your PC/laptop to control the unit via Telnet.

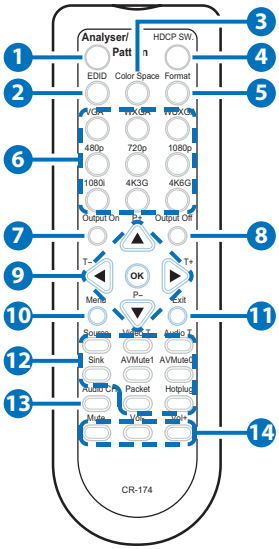
3 **RS-232:** Connect directly to your PC/laptop to send RS-232 commands to control the unit.

4 **SERVICE:** This slot is used for firmware updates and uploading customer designed test pattern files.

Note: The patterns are restricted to 640×480 and 1920×1080. Both must be 24-bit RGB bitmap files

5 **DC 5V:** Plug the 5V DC power supply into the unit and connect it to an AC wall outlet for power or use the DC to USB adapter cable to connect to a portable USB power bank (2.1A minimum) for power.

6.4 Remote Control



1. **Analyser/Pattern:** Press to switch between Analyser Mode and Pattern Mode.
2. **EDID:** Press repeatedly to switch between the available EDIDs for the HDMI input.
3. **Color Space:** Press repeatedly to switch between the available colour space formats (RGB, YCbCr 4:4:4, YCbCr 4:2:2 & YCbCr 4:2:0).
4. **HDCP SW.:** Press to switch between supported HDCP versions or to disable HDCP.
5. **Format:** Press to switch between DVI and HDMI output formats.
6. **VGA~4K6G:** Press to directly select the output resolution.
7. **Output On:** Press to enable video output.
8. **Output Off:** Press to disable video output.
9. **T– & T+:** Press ◄/► to select a new output resolution timing. Within the OSD menu, press to adjust selections.

   P+ & P–: Press ▲/▼ to change the current test pattern. Within the OSD menu, press to move up and down.

   OK: After selecting a pattern, press and hold for 2 seconds to switch to alternate variations of the pattern. Within the OSD menu, press to confirm selections.
10. **Menu:** Press to enter the OSD menu.
11. **Exit:** Press to exit the OSD or cancel the selection.
12. *For use in Analyser Mode only:*

    Source: Press to display source signal information on the OSD.

    Video T: Press to display video analysis details on the OSD.

    Audio T: Press to display audio analysis details on the OSD.

Packet: Press to display the HDMI input's packet analysis info.

Hotplug: Press to force an RX hot-plug event on the input port.

For use in Pattern Mode only:

Sink: Press to display HDMI output detection/information on the OSD.

AV Mute1: Press to turn on the AVMute bit within the output's GCP.

AV Mute0: Press to turn off the AVMute bit within the output's GCP.

13 **Audio CH:** Within Analyser mode, press to select which digital audio source pair (0–3) is routed to the primary stereo channel for monitoring. Within Pattern mode, press to switch between LPCM 2.0, 5.1 & 7.1 channel test tone output formats.

14 **Mute/Vol+/Vol–:** Press the Mute button to mute both digital and analogue audio outputs. Press the Vol+/Vol– buttons to increase/ decrease the volume.

6.5 OSD Menu

6.5.1 Analyser Mode

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Source Monitor	[Analytic Data]	
Video Timing	[Analytic Data]	
Audio Timing	[Analytic Data]	
Packet	Monitor	[Analytic Data]
	GCP	
	AVI	
	AIF	
	SPD	
	VSIF H14b	
	DRMI (HDR)	
EDID Analyser	HDMI Sink	[Analytic Data]
	VGA Sink	
	RX EDID	
	Default & Copied EDID	[D1 ~ 10] Default EDIDs
		[C1 ~ 10] Copied EDIDs
EDID Emulator	RX EDID Select	Copy HDMI Sink
		[D1] DVI
		[D2] VGA
		[D3] 8B 2D 2CH LPCM PC
		[D4] 8B 2D 2CH LPCM HD
		[D5] 12B 2D 8CH Bits 720p
		[D6] 12B 3D 8CH Bits HD
		[D7] 12B 2D 8CH Bits 4K6G
		[D8] 12B 2D 8CH HBR 4K3G
		[D9] 12B 2D 8CH HBR 4K420
		[D10] 12B 2D 8CH HBR 4K6G
		[C1 ~ 10] Copy 01 ~ 10

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
EDID Emulator	Copy HDMI Sink EDID	Copy HDMI sink EDID to [C1 ~ 10]
	Copy VGA Sink EDID	Copy VGA sink EDID to [C1 ~ 10]
	Rename Copied Sink EDID	Rename EDID [C1 ~ 10]
	Burn EDID to HDMI Sink	Burn EDID [D1 ~ 10] & [C1 ~ 10] to unlocked HDMI sink EDID
	Burn EDID to VGA Sink	Burn EDID [D1 ~ 10] & [C1 ~ 10] to unlocked VGA sink EDID
HDCP Input Monitor	[Analytic Data]	
SCDC Input Monitor		
RX Port Controls	Hot Plug Preset	Low
		High
		Toggle
	Hot Plug Toggle Time	50ms ~ 500ms **(100ms)**
	Hot Plug Run	
	RX Sense*PoR	**On**
		Off
	DDC*PoR	**On**
		Off
	V.Freq/1.001 Detection	**On**
		Off
	PC Clock Tolerance	1/1000 ~ 10/1000 **(6/1000)**
	HDCP Port On/Off*PoR	**On**
		Off
	HDCP Port Version	v1.4
		v1.4+v2.2
	HDCP REAUTH_REQ Toggle	
	HDCP Counter Reset	

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
RX Port Controls	SCDC Port *PoR	**On**
		Off
	SCDC CED Ch Auto Clear	On
		Off
	! *Auto clear while source reads CED.*	
Output Resolution	See "Test Timing List" below **(T66 1080p60)**	
OSD Settings	H Position	0% ~ 100% **(10%)**
	V Position	0% ~ 100% **(10%)**
	Transparency	0 ~ 7 **(4)**
	A Mode Colour (Analyser mode only)	**Red**
		Blue
		Black
	P Mode Colour (Pattern mode only)	Red
		Blue
		Black
	Font Type	**Narrow**
		Wide
Ethernet	IP Mode	**DHCP**
		Static
	IP Address	X.X.X.X **(192.168.1.50)**
	Subnet Mask	X.X.X.X **(255.255.255.0)**
	Gateway	X.X.X.X **(192.168.1.254)**
Setup	Firmware Update	**No**/Yes
	Image 640×480 Update	**No**/Yes
	Image 1920×1080 Update	**No**/Yes
	[Letter H] Option 2	Small
		Medium
	3D Source Image Bypass	**No**/Yes

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Setup	Information Refresh	1 Sec ~ 2 Sec **(2 Sec)**
		Manual
	IR Controller Address	0 ~ 3 **(0)**
	Copied EDID Reset	**No**/Yes
	Ethernet Reset	**No**/Yes
	Factory Reset	**No**/Yes
Information	[Unit Version Details]	

Factory Default

- Items in **Bold** are the factory default settings.

Power-On Reset

- Settings marked with ***PoR** are reset to the default when the unit is powered off and back on.

Source HDR Ability

- Parse the HDR Static Metadata data block in the sink's EDID.
- Output 4K60 (4:2:0, 10/12-bit), or 4K30 (4:4:4, 10/12-bit).
- Output DRMI (Dynamic Range & Mastering InfoFrame).

Sink HDR Ability

- Build an RX EDID that includes the HDR Static Metadata data block.
- Receive 4K60 (4:2:0, 10/12-bit), or 4K30 (4:4:4, 10/12-bit) signals.
- Receive DRMI and decode the HDR contents.

Unit HDR Capabilities & Limitations

- Support HDR bypass & analysis in Analyser mode.
- HDR EDID must be copied from an connected sink to the RX EDID through the EDID Emulator menu in Analyser mode.
- EDID Analyser & DRMI Packet Monitor for HDR analysis in Analyser mode.
- Output emulated HDR metadata to test sink HDR detection in Pattern mode.

- No support for test patterns with HDR content in Pattern mode.

EDID Analyser Limitation

- The EDID Analyser does not support 4-block analysis.

EDID Settings

- The unit has 10 built-in EDIDs and 10 custom EDID slots.
- Within the OSD menu's "EDID Emulator" section, the EDID from the currently connected sink, a built-in EDID, or a custom EDID may be selected for use as the unit's EDID.
- Programming a custom EDID through the RS-232 connection is supported.

IR Settings

- The IR remote uses one out of 4 available address channels for control of the test pattern generator, allowing up to 4 to be located in the same area while being controlled by different remotes.
- Select "IR Controller Address" within the "Setup" section of the OSD's main menu.
- Assign an address number (from 0 to 3) that matches the setting on the remote that is to be used with the unit. The default factory setting is 0.
- The IR remote's address can be set using the two DIP switches located on the back of the remote, inside the battery cover. The default factory setting is 0 (off, off).

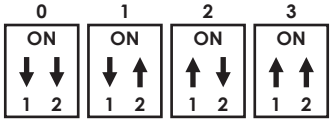


Image File Format

- Uploadable image file format: 640×480/1920×1080 (RGB, 24-bit, bitmap).

6.5.2 Pattern Mode

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Sink Monitor	[Analytic Data]	
Pattern	See "Test Pattern List" below **(P16 Colourbar S.)**	
Audio Output	Source*PoR	HDMI In
		Analogue In
		Int. Sinewave
	Volume	0 ~ 80 **(70)**
	Analogue Out CH	**SD0 L/R**
		SD1 L/R
		SD2 L/R
		SD3 L/R
	Sampling Rate	**48 kHz**
		96 kHz
		192 kHz
	Word Length	16 Bits
		20 Bits
		24 Bits
	Channels	2CH
		5.1CH
		7.1CH
	SD0-L ~ SD3-L Freq.	Mute
		200Hz ~ 1600Hz **(1000Hz)**
	SD0-R ~ SD3-R Freq.	Mute
		200Hz ~ 1600Hz **(1000Hz)**
EDID Analyser	Same as Analyser Mode	[Analytic Data]
EDID Emulator		
HDCP Output Monitor		

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
HDR Output Emulator	HDR Out On/Off	On
		Off
HDR Output Emulator	Settings	1 ~ 3 **(1)**
	Value Unit	Hex
		nit (cd/m*m)
	Tx AVI Colorimetry	No Data
		ITU601
		ITU709
		xvYCC601
		xvYCC709
		sYCC601
		Adobe Y601
		Adobe RGB
		BT.2020 (1)
		BT.2020 (2)
	EOTF	[0] SDR Luminance Range
		[1] HDR Luminance Range
		[2] SMPTE ST 2084.2
		[3] Future EOTF
	Metadata Descriptor	**Static Metadata Type 1**
		Reserved
	Display primaries x0 ~ 2	0.0000 ~ 1.3100 **(0.0000)**
	Display primaries y0 ~ 2	0.0000 ~ 1.3100 **(0.0000)**
	White point x	0.0000 ~ 1.3100 **(0.0000)**
	White point y	0.0000 ~ 1.3100 **(0.0000)**
	Max disp mastering lumi	0 ~ 65500 **(0)**
	Min disp mastering lumi	0.0000 ~ 6.5500 **(0.0000)**
	Max Content Light Level	0 ~ 65500 **(0)**
	Max Frame-average L-L	0 ~ 65500 **(0)**

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
HDR Output Emulator (Cont.)	Tx AVI Colour Space	[Analytic Data]
	Sink EDID supports HDR	
SCDC Output Monitor	[Analytic Data]	
TX Port Controls	+5V Out On/Off	**Follow TMDS**
		Always On
	HDCP Output On/Off[#PoR]	On
		Off
	HDCP Output Version	**v1.4**
		v2.2
	HDCP AKE_Send_Stored_km()	On
		Off
	HDCP Counter Reset	
	SCDC CED Counter Read	**On**
		Off
	TX doesn't read sink CH0 ~ 3 Error-Counter.	
	SCDC CED Always Read	**On**
		Off
	TX ignores sink CED_Update flag.	
	SCDC CED Ch Auto Clear	On
		Off
	While sink CED_ Update flag=1, TX auto clears its CH0 ~ 3 Error-Counter and reads a new counter from the sink.	
Output Resolution	See "Test Timing List" below **(T66 1080p60)**	
OSD Settings	H Position	0% ~ 100% **(10%)**
	V Position	0% ~ 100% **(10%)**
	Transparency (Solid ~ Transparent)	0 ~ 7 **(4)**

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
	A Mode Colour (Analyser mode only)	**Red**
		Blue
		Black
OSD Settings	P Mode Colour (Pattern mode only)	Red
		Blue
		Black
Ethernet	IP Mode	**DHCP**
		Static
	IP Address	X.X.X.X **(192.168.1.50)**
	Subnet Mask	X.X.X.X **(255.255.255.0)**
	Gateway	X.X.X.X **(192.168.1.254)**
Setup	Firmware Update	**No**/Yes
	Image 640×480 Update	**No**/Yes
	Image 1920×1080 Update	**No**/Yes
	[Letter H] Option 2	Small
		Medium
	3D Source Image Bypass	**No**/Yes
	Information Refresh	1 Sec ~ 2 Sec **(2 Sec)**
		Manual
	IR Controller Address	0 ~ 3 **(0)**
	Copied EDID Reset	**No**/Yes
	Ethernet Reset	**No**/Yes
	Factory Reset	**No**/Yes
Information	[Unit Version Details]	

Factory Default: Items in **Bold** are the factory default settings.

Power-On Reset: Settings marked with *PoR are reset to the default when the unit is powered off and back on.

HDR Output Emulator Limitations: This function simulates HDR info frame (DRMI) and AVI colourimetry (BT.2020, etc.) output. It does not generate HDR/ colourimetry video content.

6.5.3 Test Timings

1. Selectable Output Resolutions

Test Timing List	Hz	ID
640×350p	85	**T01**
640×480p	59	**T02**
	72	**T03**
	75	**T04**
	85	**T05**
720×400p	70	**T06**
	85	**T07**
800×600p	56	**T08**
	60	**T09**
	72	**T10**
	75	**T11**
	85	**T12**
848×480p	60	**T13**
1024×768p	60	**T14**
	70	**T15**
	75	**T16**
	85	**T17**
1152×864p	75	**T18**
1280×768p	60 (RB)	**T19**
	60	**T20**
	75	**T21**
	85	**T22**
1280×800p	60 (RB)	**T23**
	60	**T24**
	75	**T25**
	85	**T26**
1280×960p	60	**T27**

Test Timing List	Hz	ID
1280×1024p	60	**T29**
	75	**T30**
	85	**T31**
1360×768p	60	**T32**
1366×768p	60 (RB)	**T33**
	60	**T34**
1400×1050p	60 (RB)	**T35**
	60	**T36**
	75	**T37**
1440×900p	60 (RB)	**T38**
	60	**T39**
	75	**T40**
	85	**T41**
1600×900p	60 (RB)	**T42**
1600×1200p	60	**T43**
1680×1050p	60 (RB)	**T44**
	60	**T45**
1920×1200p	60 (RB)	**T46**
480i	59	**T47**
	60	**T48**
480p	59	**T49**
	60	**T50**
576i	50	**T51**
576p	50	**T52**
720p	50	**T53**
	59	**T54**
	60	**T55**

Test Timing List	Hz	ID
	85	**T28**
1080i	59	**T57**
	60	**T58**
1080p	23	**T59**
	24	**T60**
	25	**T61**
	29	**T62**
	30	**T63**
	50	**T64**
	59	**T65**
	60	**T66**
2048×1080p	23	**T67**
	24	**T68**
	25	**T69**
	29	**T70**
	30	**T71**
	50	**T72**
	59	**T73**
	60	**T74**

Test Timing List	Hz	ID
1080i	50	**T56**
3840×2160p	23	**T75**
	24	**T76**
	25	**T77**
	29	**T78**
	30	**T79**
	50	**T80**
	59	**T81**
	60	**T82**
4096×2160p	23	**T83**
	24	**T84**
	25	**T85**
	29	**T86**
	30	**T87**
	50	**T88**
	59	**T89**
	60	**T90**
Auto→Native		**T91**
Bypass		**T92**

Note: RB = Reduced Blanking.

Auto mode (T91) will default to 1080p60 if no supported resolution is detected from the connected sink.

Bypass (T92) is only available in Analyser mode.

2. Standard Input/Output Resolution Support

Total Resolutions

- This unit supports a total of 90 output resolutions.
- Input resolutions are valid for Analyser Mode only.

VGA Output Limitations

- Only supports RGBHV (YUV, RGBS, and RGsB are not supported).
- In Analyser mode the VGA output is disabled.
- In Pattern mode the VGA output has limited resolution support.
- OSD Menu display is not supported.

PC Resolution	Vertical Frequency (Hz)	Input	Output		
		HDMI	HDMI	DVI	VGA
640×350p	85	✓	✓	✓	✓
640×480p	59, 72, 75, 85	✓	✓	✓	✓
720×400p	70, 85	✓	✓	✓	✓
800×600p	56, 60, 72, 75, 85	✓	✓	✓	✓
848×480p	60	✓	✓	✓	✓
1024×768p	60, 70, 75, 85	✓	✓	✓	✓
1152×864p	75	✓	✓	✓	✓
1280×768p	60 (RB), 60, 75, 85	✓	✓	✓	✓
1280×800p	60 (RB), 60, 75, 85	✓	✓	✓	✓
1280×960p	60, 85	✓	✓	✓	✓
1280×1024p	60, 75, 85	✓	✓	✓	✓
1360×768p	60	✓	✓	✓	✓
1366×768p	60 (RB), 60	✓	✓	✓	✓
1400×1050p	60 (RB), 60, 75	✓	✓	✓	✓
1440×900p	60 (RB), 60, 75, 85	✓	✓	✓	✓
1600×900p	60 (RB)	✓	✓	✓	✓
1600×1200p	60	✓	✓	✓	✓
1680×1050p	60 (RB), 60	✓	✓	✓	✓

PC Resolution	Vertical Frequency (Hz)	Input	Output		
		HDMI	HDMI	DVI	VGA
1920×1200p	60 (RB)	✓	✓	✓	✓

Note: RB = Reduced Blanking.

TV Resolution	Vertical Frequency (Hz)	Input	Output		
		HDMI	HDMI	DVI	VGA
480i	59, 60	✓	✓	✓	
480p	59, 60	✓	✓	✓	✓
576i	50	✓	✓	✓	
576p	50	✓	✓	✓	✓
720p	50, 59, 60	✓	✓	✓	✓
1080i	50, 59, 60	✓	✓	✓	
1080p	23, 24, 25, 29, 30	✓	✓	✓	
	50, 59, 60	✓	✓	✓	✓
2048×1080p	23, 24, 25, 29, 30	✓	✓	✓	
	50, 59, 60	✓	✓	✓	
3840×2160p	23, 24, 25, 29, 30	✓	✓		
	50, 59, 60	✓	✓		
4096×2160p	23, 24, 25, 29, 30	✓	✓		
	50, 59, 60	✓	✓		

6.5.4 Test Patterns

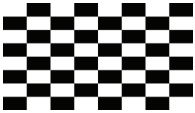
Test Pattern Name	Variations	ID
Border		**P01**
Checkerboard	3	**P02**
Circle 1		**P03**
Circle 4		**P04**
Black		**P05**
Blue		**P06**
Cyan		**P07**
Green		**P08**
Magenta		**P09**
Red		**P10**
White		**P11**
Yellow		**P12**
Colorbar Delay		**P13**
Colorbar-H		**P14**
Colorbar Motion	2	**P15**
Colorbar S.		**P16**
Colorbar Split		**P17**
Colorbar-V	3	**P18**
Cross Hatch 8	2	**P19**
Cross Hatch 16	2	**P20**
Cross Hatch 32	2	**P21**
Diagonal 1		**P22**
Diagonal 2		**P23**
Dot		**P24**
General	3	**P25**
General 2	3	**P26**
Grayscale 8	3	**P27**
Grayscale 16	3	**P28**
Grayscale 32	3	**P29**

Test Pattern Name	Variations	ID
Grayscale 64	3	**P30**
Grayscale 256	4	**P31**
Grayscale 256RGB		**P32**
Grayscale Adjust	256	**P33**
Grayscale H		**P34**
Grid		**P35**
Image	2	**P36**
Letter H	2	**P37**
Line On/Off-H		**P38**
Line On/Off-V	2	**P39**
Line On/Off-V 4K		**P40**
Motion-H	4	**P41**
Motion-V	4	**P42**
Multiburst	3	**P43**
Needles		**P44**
Overscan		**P45**
PLUGE	2	**P46**
Process 4:4:4		**P47**
Square H8	2	**P48**
Square H16	2	**P49**
Square H32	2	**P50**
Text	4	**P51**
Window Blue	4	**P52**
Window Cyan	4	**P53**
Window Green	4	**P54**
Window Magenta	4	**P55**
Window Red	4	**P56**
Window White	4	**P57**
Window Yellow	4	**P58**

1. Border

The **Border** pattern presents 4 equal-sized squares dividing the screen into 4 quadrants, forming a central white cross, with red, green, blue and white inner squares. Ideal for testing screen boundary, alignment and pincushion issues. All lines should be straight, and edge transitions should be sharp.

2. Checkerboard (3 variations)



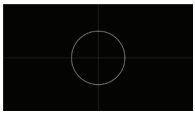
8×8

24×24

48×48

The **Checkerboard** pattern displays a repeating black and white checkerboard image. This is ideal for checking the alignment and corner convergence of TVs or monitors. Bandwidth can be checked by observing the vertical transitions. Transitions from black to white should be sharp. There are 3 variations: 8×8, 24×24 and 48×48.

3. Circle 1



The **Circle 1** pattern provides a single white circle in the middle with a white cross and a white outer border line. This pattern is designed for quickly confirming that the geometry of the scene is correct and that the full source is being displayed, edge to edge.

4. Circle 4


The **Circle 4** pattern provides 4 smaller white circles in each of the 4 corners of the screen. This pattern can help confirm that the display is maintaining correct geometry at the edges of the screen.

5. Black	6. Blue	7. Cyan	8. Green

9. Magenta	10. Red	11. White	12. Yellow

These patterns are full screen purity tests offering eight different full field patterns: **Black**, **Blue**, **Cyan**, **Green**, **Magenta**, **Red**, **White**, **Yellow**. The colour patterns should display an even distribution of brightness and consistent colour tone across the screen. The 100% white pattern should display evenly across the screen and not cause the display's overall brightness to lower, or for the image to become instable. The black pattern will give a good idea of the display's true minimum brightness capability and is helpful for setting the viewing room lighting levels.

13. Colourbar Delay

The **Colourbar Delay** pattern provides a sequence of standard 100% colour bars with a full set of smaller colour squares within each bar. This test is primarily to detect if any of the colour components of the video signal are delayed/skewed relative to each other. Pay close attention to the left and right sides of the squares and look for a colour shift. This is a common problem when using extreme-length analogue extension products, or very long analogue cables.

14. Colourbar-H

The **Colourbar-H** pattern is a standard (white, yellow, cyan, green, magenta, red, blue, black) 100% colour bar pattern using horizontal bars.

15. Colourbar Motion (2 variations)

Slow/Fast Motion

The **Colourbar Motion** pattern is a standard (white, yellow, cyan, green, magenta, red, blue, black) 100% colour bar pattern using vertical bars with a grey bar moving horizontally across it. There are 2 variations: slow and fast motion of the grey bar.

16. Colourbar S.

The **Colourbar S.** pattern is a standard SMPTE colour bar pattern which is used for rapid verification of signal colour accuracy and for display setup using the Blue-Only option on your display, if it has one.

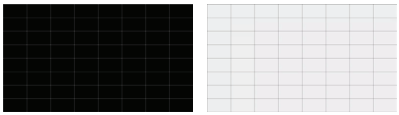
17. Colourbar Split

The **Colourbar Split** pattern is a vertical colour bar pattern with the colour bars split in the middle by large black and white sections. All colours (white, yellow, cyan, green, magenta, red, blue) are at 100% brightness.

18. Colourbar-V (3 variations)

The **Colourbar-V** pattern comes in 3 variations. The first is a standard (white, yellow, cyan, green, magenta, red, blue, black) 100% colour bar pattern using vertical bars. The 2nd variation has all bars at 75% brightness. The 3rd variation is split with the top half being at 100% and the lower half being at 75% brightness.

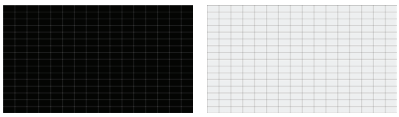
19. Cross Hatch 8 (2 variations)



Normal Inverse

The **Cross Hatch 8** pattern is a full field black & white pattern of crossing vertical and horizontal lines dividing the screen into 8 sections in each direction. This pattern is primarily used to check for colour convergence and pincushion issues in projectors. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

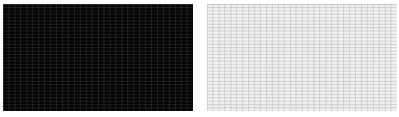
20. Cross Hatch 16 (2 variations)



Normal Inverse

The **Cross Hatch 16** pattern is a full field black & white pattern of crossing vertical and horizontal lines dividing the screen into 16 sections in each direction. This pattern is primarily used to check for colour convergence and pincushion issues in projectors. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

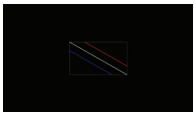
21. Cross Hatch 32 (2 variations)



Normal Inverse

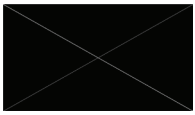
The **Cross Hatch 32** pattern is a full field black & white pattern of crossing vertical and horizontal lines dividing the screen into 32 sections in each direction. This pattern is primarily used to check for colour convergence and pincushion issues in projectors. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

22. Diagonal 1



The **Diagonal 1** pattern is a set of 3 diagonal coloured lines (red, white and blue) within a white square in the middle of the screen. This pattern is used to check for distortion and alignment issues in the center of the screen.

23. Diagonal 2

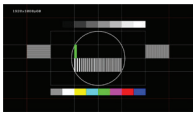


The **Diagonal 2** pattern is 2 diagonal lines that travel from the corners to the exact center of the display. This can be used to check for alignment and geometry issues, particularly with projectors. The outer border of the screen also has a white outline to verify that the full image is being displayed.

24. Dot

The **Dot** pattern is a full field black & white pattern with a repeating pattern of single-pixel (resolutions below 4K) or 4-pixel (at 4K) white dots surrounded by single pixels of black. This pattern is ideal for testing the signal path/display for bandwidth issues, interference, cross-talk or scaling issues.

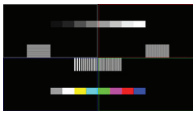
25. General (3 variations)



Stop/Slow/Fast Motion

The **General** pattern is an all-purpose, multi-pattern test to visually check for multiple issues simultaneously. It includes colour bars, 8-step greyscale, vertical and horizontal multi-burst, cross hatch, circle and an optional motion pattern. There are 3 variations: No motion, slow motion and fast motion.

26. General 2 (3 variations)



Stop/Slow/Fast Motion

The **General 2** pattern is a simplified all-purpose, multi-pattern test to visually check for multiple issues simultaneously. It includes colour bars, 8-step greyscale, vertical and horizontal multi-burst, multi-colour center/edge alignment lines, and an optional block motion pattern. There are 3 variations: No motion block, slow motion and fast motion.

27. Grayscale 8 (3 variations)

Vert. Bar **Vert. L/R Bar** **Hori. Bar**

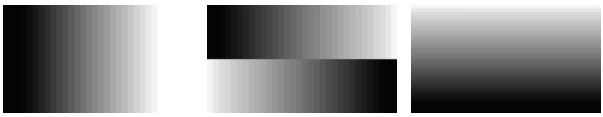
The **Grayscale 8** pattern provides a way to check and adjust the contrast, brightness and grayscale tracking of your display with 8 bars progressing from 0% to 100% brightness in even steps. When testing a display, no colour should be visible in any of the bars, and all bars should be visible and distinct. There are 3 variations: 8 vertical bars, two sets of 8 vertical bars with the lower set reversed, and 8 horizontal bars.

28. Grayscale 16 (3 variations)

Vert. Bar | Vert. L/R Bar | Hori. Bar

The **Grayscale 16** pattern provides a way to check and adjust the contrast, brightness and grayscale tracking of your display with 16 bars progressing from 0% to 100% brightness in even steps. When testing a display, no colour should be visible in any of the bars, and all bars should be visible and distinct. There are 3 variations: 16 vertical bars, two sets of 16 vertical bars with the lower set reversed, and 16 horizontal bars.

29. Grayscale 32 (3 variations)



Vert. Bar | Vert. L/R Bar | Hori. Bar

The **Grayscale 32** pattern provides a way to check and adjust the contrast, brightness and grayscale tracking of your display with 32 bars progressing from 0% to 100% brightness in even steps. When testing a display, no colour should be visible in any of the bars, and all bars should be visible and distinct. There are 3 variations: 32 vertical bars, two sets of 32 vertical bars with the lower set reversed, and 32 horizontal bars.

30. Grayscale 64 (3 variations)

Vert. Bar | Vert. L/R Bar | Hori. Bar

The **Grayscale 64** pattern provides a way to check and adjust the contrast, brightness and grayscale tracking of your display with 64 bars progressing from 0% to 100% brightness in even steps. When testing a display, no colour should be visible in any of the bars, and all bars should be visible and distinct. There are 3 variations: 64 vertical bars, two sets of 64 vertical bars with the lower set reversed, and 64 horizontal bars.

31. Grayscale 256 (4 variations)

Gray | Red | Green | Blue

The **Grayscale 256** pattern provides a way to fine tune the contrast, brightness and grayscale tracking of your display with a full 265 step gradient progressing from 0% to 100% brightness. When testing a display, no colour should be visible at any point across the gradient, and the transition from black to white should appear even and consistent. There are 3 variations: 256 vertical bars, two sets of 256 vertical bars with the lower set reversed, and 265 horizontal bars.

32. Grayscale 256RGB

The **Grayscale 256RGB** pattern provides a way to fine tune the contrast, brightness, grayscale and colour tracking of your display with a four full 265 step gradients (gray, red, green, blue) progressing from 0% to 100% brightness. When testing a display, the transition from dark to light should appear even and consistent across all 4 sections.

33. Grayscale Adjust (256 variations)

Adjustable from 0 to 256

The **Grayscale Adjust** pattern provides a full field of grey with user adjustable brightness levels for testing display gray purity and signal response. The brightness can be freely adjusted from 0 to 255 by pressing the PATTERN button followed by the –/+ buttons. The gray level number will appear in text on screen while it is in adjusting mode.

34. Grayscale H

The **Grayscale H** pattern provides 4 distinct gray fields in an "H" arrangement for testing luminance transition stability. No colour or interference should be visible at the transitions between sections.

35. Grid

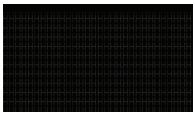
The **Grid** pattern provides a selection of red, green, blue and white boxes with 2×2 grids within and above them to test for pixel on pixel and colour offset issues.

36. Image (2 variations)

The **Image** pattern is a user customizable test pattern that holds two bitmap images. One image is for use with low output resolutions (below 1920×1080) and the other is for high output resolutions (1920×1080 and above). The low resolution image is a 640×480 bitmap (RGB, 24-bit) and the high resolution image is a 1920×1080 bitmap (RGB, 24-bit).

To upload new images into the unit please the new replacement image on a USB thumb drive with the file named "IMG_480.BMP" or "IMG_1080.BMP" as appropriate. Plug the USB thumb drive into the USB port on the unit and navigate to the "Setup" menu. Next, activate the "Image 640×480 Update" or "Image 1920×1080 Update" menu item, as appropriate, to copy the new image to the unit.

37. Letter H (2 variations)



Big/Small H

The **Letter H** pattern is a screen filled with a series of large capital "H" characters moving vertically up the screen. This is a basic test to confirm motion detail. There are 2 variations: Large "H" characters and small "H" characters.

38. Line On/Off-H

The **Line On/Off-H** pattern generates an alternating pattern of single-pixel horizontal white lines. This pattern can be used to analyse the vertical pixel resolution of your display. If the output appears to have mosaic patterns, or appears to be a solid gray field, then it is possible that your display does not fully support the resolution you are currently sending to it.

39. Line On/Off-V (2 variations)

White & Black Lines

Red & Green Lines
(Not supported in 4K)

The **Line On/Off-V** pattern generates an alternating pattern of single-pixel vertical lines. This pattern can be used to analyse the horizontal pixel resolution of your display. If the output appears to have mosaic patterns, or appears to be a solid field (grey, white or black), then it is possible that your display does not fully support the resolution you are currently sending to it. There are 2 variations: alternating white & black lines and alternating red and green lines.

*The red and green variation is not available if the selected output resolution is 4K. This version of the pattern can't display single pixel lines in 4K resolutions, please use the **Line On/Off-V 4K** pattern.*

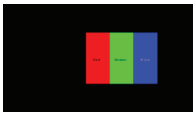
40. Line On/Off-V 4K

White & Black Lines

The **Line On/Off-V 4K** pattern generates an alternating pattern of single-pixel vertical lines. This pattern can be used to analyse the horizontal pixel resolution of your display. If the output appears to have mosaic patterns, or appears to be a solid field (grey, white or black), then it is possible that your display does not fully support the resolution you are currently sending to it.

*This pattern is only available for the following resolutions: 3840×2160@24/25/30Hz & 4096×2160@24Hz, and the colour space will be forced to output as RGB with a colour depth of 8-bit. If a non-supported resolution is selected the pattern will automatically change to **Line On/Off-V**.*

41. Motion-H (4 variations)



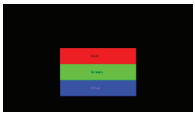
Slow/Fast RGB Block

Slow/Fast String

The **Motion-H** patterns are a collection of horizontal motion tests. These can be used to test your display's pixel on/off response time. There are 4 variations: Slow red/green/blue block, fast red/green/blue, slow moving sample text, fast moving sample text.

The contents of the text can be modified using an RS-232 or telnet command and can be up to 20 characters long.

42. Motion-V (4 variations)



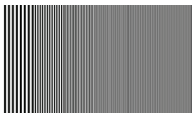
Slow/Fast RGB Block

Slow/Fast String

The **Motion-V** patterns are a collection of vertical motion tests. These can be used to test your display's pixel on/off response time. There are 4 variations: Slow red/green/blue block, fast red/green/blue , slow moving sample text, fast moving sample text.

The contents of the text can be modified using an RS-232 or telnet command and can be up to 20 characters long.

43. Multiburst (3 variations)



Stop Motion

Slow/Fast Motion

The **Multiburst** pattern provides a standard multiburst pattern consisting of vertical white lines that decrease in thickness from left to right allowing the user to analyse the bandwidth and frequency response of the video path and connected display. There are 3 variations: Standard multiburst, multiburst with a slow moving gray block, and multiburst with a fast moving gray block.

44. Needles

The **Needles** pattern is a standard needle pulse test. The top half of the screen is black and the bottom half is white with 2 thin inverse-brightness lines crossing from top to bottom. This pattern allows for analysis of the sharpness, blooming and screen distortion issues that a display might have.

45. Overscan

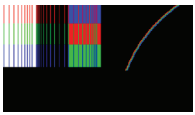
The **Overscan** pattern provides a quick way to determine how much overscan, or clipping, is being caused by a display. It consists of 5 concentric rectangles moving in from the outer edge of the signal. They are positioned at 0%, 2.5%, 5%, 7.5% and 10% of the screen size.

46. PLUGE (2 variations)

Full/Limited RGB Range

The **PLUGE** pattern is used to perform the accurate and consistent brightness and contrast configuration of a display. Typically you will want to adjust the brightness control of the monitor so that the first bar is just barely indistinguishable from the background black while the second bar is still clearly visible. Next you should adjust the contrast so that all four segments of the greyscale box are clearly visible and distinguishable. There are 2 variations: Full RGB range (0–255) and Limited RGB range (16–235).

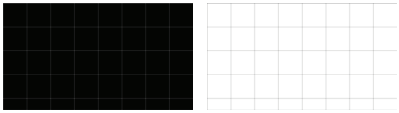
47. Process 4:4:4



The **Process 4:4:4** pattern is designed to help determine if a signal path has been colour sub-sampled to 4:2:2 or 4:2:0 somewhere in the signal path between the Test Generator and the display's panel. If the signal has not been sub-sampled, the multi-coloured curved line will be composed of 3 distinct coloured lines (red, blue and green) with no merging or loss of colour/detail. The red/green/blue/white patterns on the left will also present clean and distinct colour lines without breaks in the vertical

pattern.

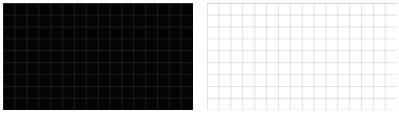
48. Square H8 (2 variations)



Normal Inverse

The **Square H8** pattern is a full field black & white pattern of squares dividing the screen horizontally into 8 sections. This pattern is primarily used to check projector linearity. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

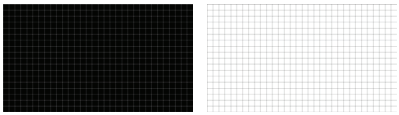
49. Square H16 (2 variations)



Normal Inverse

The **Square H16** pattern is a full field black & white pattern of squares dividing the screen horizontally into 16 sections. This pattern is primarily used to check projector linearity. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

50. Square H32 (2 variations)



Normal Inverse

The **Square H32** pattern is a full field black & white pattern of squares dividing the screen horizontally into 32 sections. This pattern is primarily used to check projector linearity. There are 2 variations: Normal (white lines, black field) and Inverse (black lines, white field).

51. Text (4 variations)

Normal & Small | Inverse & Small | Normal & Big | Inverse & Big

The **Text** pattern is used to check the clarity of text at various sizes and colours. This is primarily a test for projectors. There are 4 variations: Small multi-colour text on a black background, small multi-colour text on a white background, large multi-colour text on a black background, and large multi-colour text on a white background.

52. Window Blue (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

53. Window Cyan (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

54. Window Green (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

55. Window Magenta (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

56. Window Red (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

57. Window White (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

58. Window Yellow (4 variations)

Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

These **Window** patterns are additional screen purity tests offering seven different patterns with different sized windows of each colour on a black field: **Blue**, **Cyan**, **Green**, **Magenta**, **Red**, **White**, **Yellow**. The colour patterns should display an even distribution of brightness and consistent colour tone across the screen. Each pattern has 4 variations: Normal 75% Window, Inverse 75% Window, Normal 50% Window, and Inverse 50% Window.

6.6 RS-232 Protocol

UNIT	
Pin	**Pinout**
1	
2	TxD
3	RxD
4	
5	GND
6	
7	
8	
9	

TERMINAL	
Pin	**Pinout**
1	
2	RxD
3	TxD
4	
5	GND
6	
7	
8	
9	

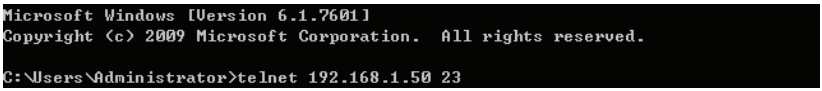
SERIAL PORT SETTINGS	
Baud Rate	115200
Data Bits	8
Parity Bits	None
Stop Bits	1
Flow Control	None

6.7 Telnet Control

Before attempting to use Telnet control, please ensure that both the unit and the PC are connected to the same active networks.

To Access the Command Line Interface (CLI)	
Windows 7	Click **Start**, type "cmd" in the search field, and press **Enter**.
Windows XP	Click **Start** > **Run**, type "cmd", and press **Enter**.
Mac OS X	Click **Go** > **Application**s > **Utilities** > **Terminal**.

Once in the Command Line Interface (CLI) type "**telnet**" followed by the IP address of the unit (and the port number if it is non-standard) and then hit "Enter". This will connect us to the unit we wish to control. Type "**help**" to list the available commands. See below for reference.



Note: The default IP address is 192.168.1.50. If the IP address is changed then the IP address required for Telnet access will also change accordingly.

6.8 RS-232 and Telnet Commands

Before using the commands, please read the following:

Syntax

- All commands MUST start with the "$" character or the command will not be recognized by the unit. Commands must end with a carriage return (0x0D). Use of a line feed (0x0A) is optional. Commands are not case-sensitive.

Parameters

- The characters "[" and ""are placed around descriptions of the variable parameters where additional explanation was needed. Please type the selected parameter without the contents inside the "[" and "]" characters when entering the command.

Responses

- The unit will respond to most commands with a repeat of the original command followed by the specified parameters or requested information except where otherwise noted. If an invalid command is entered the unit will respond with "$err".
- All unit responses end with a carriage return (0x0D) + line feed (0x0A).

Cautions

- Only one command may be processed at a time. Additional commands should not be sent until the response from the previous command has been received.

COMMANDS	
DESCRIPTION	**VARIABLES**
$?↵	
Show full command list.	
$HELP↵	
Show full command list.	
$AUDIO_CH N1↵	
Set the number of internally sourced audio output channels.	Available values for **N1**: 2 [2 Channels (2.0)] 6 [6 Channels (5.1)] 8 [8 Channels (7.1)]
$AUDIO_CH?↵	
Display the current number of audio output channels.	
$AUDIO_FREQ N1,N2↵	
Set the internal audio output frequency of the selected channel (in Hz).	Available Values for **N1**: SD0_L [SD0 Left Channel] SD0_R [SD0 Right Channel] SD1_L [SD1 Left Channel] SD1_R [SD1 Right Channel] SD2_L [SD2 Left Channel] SD2_R [SD2 Right Channel] SD3_L [SD3 Left Channel SD3_R [SD3 Right Channel] **N2** = MUTE, 200, 400, 600, 800, 1000, 1200, 1400, 1600
$AUDIO_FREQ? N1↵	
Display the internal audio output frequency of the selected channel (in Hz).	Available Values for **N1**: SD0_L [SD0 Left Channel] SD0_R [SD0 Right Channel] SD1_L [SD1 Left Channel] SD1_R [SD1 Right Channel] SD2_L [SD2 Left Channel] SD2_R [SD2 Right Channel] SD3_L [SD3 Left Channel] SD3_R [SD3 Right Channel]

COMMANDS	
DESCRIPTION	**VARIABLES**
$AUDIO_MUTE N1↵	
Turn the audio output mute on or off.	**N1** = ON, OFF
$AUDIO_MUTE?↵	
Display the audio output mute state.	
$AUDIO_SOURCE N1↵	
Set the audio output source.	Available values for **N1**: ANA [Analogue Input] HDMI [HDMI Input] INT [Internal]
$AUDIO_SOURCE?↵	
Display the audio output source.	
$AUDIO_SR N1↵	
Set the internal audio output sampling rate (in kHz).	**N1** = 48, 96, 192
$AUDIO_SR?↵	
Display internal audio output sampling rate	
$AUDIO_VOL N1↵	
Set the audio output volume.	**N1** = 0 ~ 80
$AUDIO_VOL?↵	
Display the current audio output volume.	
$BOOT GO↵	
Reboot the unit.	
! *The unit won't respond to any commands during the boot process.*	
$BOOT?↵	
Display the current boot state.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$COLOR_SPACE N1↵	
Set the output colour space.	Available values for **N1**: RGB [RGB 4:4:4] Y444 [YCbCr 4:4:4] Y422 [YCbCr 4:2:2] Y420 [YCbCr 4:2:0]
$COLOR_SPACE?↵	
Display the current output colour space.	
$DEEP_COLOR N1↵	
Set the output colour bit depth.	**N1** = 8, 10, 12
$DEEP_COLOR?↵	
Display the current output colour bit depth.	
$EDID_COPY_SINK N1↵	
Copy the current HDMI sink's EDID to the designated copy slot.	**N1** = C1 ~ C10
If the copy fails "$err" will be displayed.	
$EDID_MANUF? N1↵	
Display the manufacturer name stored in the EDID of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink]
If the EDID fails to be read, "$err_ddc" will be displayed. *If the EDID has invalid content, "$err_bad" will be displayed.*	
$EDID_MODEL? N1↵	
Display the model/monitor name stored in the EDID of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink]
If the EDID fails to be read, "$err_ddc" will be displayed. *If the EDID has invalid content, "$err_bad" will be displayed.*	

COMMANDS	
DESCRIPTION	**VARIABLES**
$EDID_NAME N1,N2↵	
Set the EDID name of the selected copy slot.	**N1** = C1 ~ C10 **N2** = {Name} [20 characters max]
$EDID_NAME? N1↵	
Display the name of the selected EDID slot.	**N1** = D1 ~ D10, C1 ~ C10
$EDID_NATIVE? N1↵	
Display the native resolution value stored in the EDID of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink]
! *First detailed timing from Block 0.* *If the EDID fails to be read, "$err_ddc" will be displayed.* *If the EDID has invalid content, "$err_bad" will be displayed.*	
$EDID_READ N1,N2↵	
Displays the selected data block stored in the EDID of the selected location.	Available values for **N1**: D1 ~ D10 [Default EDID 1 ~ 10] C1 ~ C10 [Copy EDID 1 ~ 10] SINK_H [HDMI Sink] SINK_V [VGA Sink] Available values for **N2**: BLOCK0 [EDID Block 0] BLOCK1 [EDID Block 1] BLOCK2 [EDID Block 2] BLOCK3 [EDID Block 3]
! *This data is output as a bit stream of 128 bytes following the <CR><LF> of the command acknowledgement.* *Each hex data unit is composed of 3 digits. The first 2 digits are the hex value. The 3rd digit is a space (0x20).* *Blocks 2 & 3 are only supported from the HDMI Sink.*	
If the EDID fails to be read, "$err_ddc" will be displayed. *If block 2 or block 3 doesn't exist, "$err_block" will be displayed.*	

COMMANDS	
DESCRIPTION	**VARIABLES**
$EDID_RX N1↵	
Select the EDID to use with the unit's HDMI input (Rx).	Available values for **N1**: D1 ~ D10 [Default EDID 1 ~ 10] C1 ~ C10 [Copy EDID 1 ~ 10] SINK [Currently connected HDMI sink]
$EDID_RX?↵	
Display the current EDID selection for the unit's HDMI input (Rx).	
$EDID_TYPE? N1↵	
Display the EDID type of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink]
! *If the EDID fails to be read, "$err_ddc" will be displayed.* *If the EDID has invalid content, "$err_bad" will be displayed.*	
$EDID_WRITE N1,N2 N3↵	
Directly write an EDID block to the selected EDID location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] Available values for **N2**: BLOCK0 [EDID Block 0] BLOCK1 [EDID Block 1] **N3** = <CR><LF>{128 byte hex data}
! *The data must be sent as a 128 byte hex data bit stream following the <CR><LF> in the N3 part of the command.* *Each hex data unit is composed of 3 digits. The first 2 digits are the hex value. The 3rd digit is a space (0x20).* *If the sum of the 128 byte data isn't 0, "$err_checksum" will be displayed.*	

COMMANDS	
DESCRIPTION	**VARIABLES**
$FACTORY↵	
Execute a factory reset and reboot the unit.	
! *Stored Copy EDIDs and Ethernet settings will not be reset.*	
$FWVER?↵	
Display the current firmware version.	
$HDCP_IN_SW N1↵	
Enable or disable HDCP support for the unit's HDMI input.	**N1** = ON, OFF
! *Affects Analyser mode only.*	
$HDCP_IN_SW?↵	
Display the current HDCP support setting for the unit's HDMI input.	
$HDCP_IN_VER N1↵	
Set the HDCP version to use on the unit's HDMI input.	Available values for **N1**: V1.4 [HDCP v1.4 only] V1.4+V2.2 [HDCP v1.4 & v2.2]
! *Affects Analyser mode only.*	
$HDCP_IN_VER?↵	
Display the current HDCP version used on the unit's HDMI input.	
$HDCP_OUT_SW N1↵	
Enable or disable HDCP support on the unit's HDMI output.	**N1** = ON, OFF
! *Affects Pattern mode only.*	
$HDCP_OUT_SW?↵	
Display the HDMI output's HDCP status. A status of "Talk" means HDCP is currently performing handshaking.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$HDCP_OUT_VER N1↵	
Set the HDCP version to use on the unit's HDMI output.	Available values for **N1**: V1.4 [HDCP v1.4] V2.2 [HDCP v2.2]
! *Affects Pattern mode only.*	
$HDCP_OUT_VER?↵	
Display the current HDCP version for the output port.	
$HDR_EOTF N1↵	
Set the HDR EOTF (Electro-Optical Transfer Function) mode.	Available values for **N1**: SDR [Traditional Gamma, SDR Luminance Range] HDR [Traditional Gamma, HDR Luminance Range] 2084 [SMPTE ST 2084] RSVD [Reserved for future use]
$HDR_EOTF?↵	
Display the current HDR EOTF mode.	
$HDR_MCLL N1↵	
Set the maximum HDR content light level.	**N1** = 0 ~ 65500 [100 unit increments]
$HDR_MCLL?↵	
Display the current maximum HDR content light level.	
$HDR_MFALL N1↵	
Set the maximum HDR frame-average light level.	**N1** = 0 ~ 65500 [100 unit increments]
$HDR_MFALL?↵	
Display HDR maximum light level of frame-average.	
$HDR_SET N1↵	
Select the current HDR setting.	**N1** = 1 ~ 3

COMMANDS	
DESCRIPTION	**VARIABLES**
$HDR_SET?↵	
Display the current HDR setting.	
$HDR_SW N1↵	
Enable or disable HDR support on the unit's HDMI output.	**N1** = ON, OFF
$HDR_SW?↵	
Display the current HDR support status for the unit's HDMI output.	
$HDR_TX_COL N1↵	
Set the HDMI output (Tx) AVI Colourimetry mode.	Available values for **N1**: 1 [No Data] 2 [ITU601] 3 [ITU709] 4 [xvYCC601] 5 [xvYCC709] 6 [sYCC601] 7 [Adobe Y601] 8 [Adobe RGB] 9 [BT.2020 (1) $Y'_CC'_{BC}C'_{RC}$] 10 [BT.2020 (2) R'G'B' or $Y'C'_BC'_R$]
$HDR_TX_COL?↵	
Display the current HDMI output (Tx) AVI Colourimetry mode.	
$MODEL?↵	
Display the unit's model number.	
$MOTION_TEXT N1↵	
Set the text used for the Motion-H and Motion-V patterns.	**N1** = {Text} [20 characters max]
$MOTION_TEXT?↵	
Display the current text used for the Motion-H and Motion-V patterns.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$NET_GATE?↵	
Display the current Gateway address.	
$NET_IP?↵	
Display the current IP address.	
$NET_IP_MODE N1↵	
Set the IP mode.	Available values for **N1**: DHCP [Automatically get an IP address via DHCP] STATIC [Use the currently defined static Ethernet values]
$NET_IP_MODE?↵	
Display the current IP mode.	
$NET_LINK?↵	
Display the current Ethernet link status.	
$NET_MAC?↵	
Display the unit's MAC address.	
$NET_MASK?↵	
Display the current Netmask address.	
$NET_STATIC_GATE N1↵	
Set the static Gateway address.	**N1** = X.X.X.X [X = 0 ~ 255]
$NET_STATIC_GATE?↵	
Display the static Gateway address.	
$NET_STATIC_IP N1↵	
Set the static IP address.	**N1** = X.X.X.X [X = 0 ~ 255]
$NET_STATIC_IP?↵	
Display the static IP address.	
$NET_STATIC_MASK N1↵	
Set the static Netmask address.	**N1** = X.X.X.X [X = 0 ~ 255]
$NET_STATIC_MASK?↵	
Display the static Netmask address.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$PATTERN N1↵	
Select the test pattern to output.	**N1** = 1 ~ 58
$PATTERN?↵	
Display the current test pattern selection.	
$RX_DDC N1↵	
Enable or disable the DDC bus for the HDMI input (Rx).	**N1** = ON, OFF
$RX_DDC?↵	
Display the DDC bus state for the HDMI input (Rx).	
$RX_HOTPLUG N1↵	
Set hot plug value for the HDMI input (Rx).	Available values for **N1**: OFF [Set hot plug low] ON [Set hot plug high] TOGGLE [Toggle low–high]
$RX_HOTPLUG?↵	
Display the current hot plug state for the HDMI input (Rx).	
$RX_HOTPLUG_T N1↵	
Set the hot plug time (in milliseconds) for the HDMI input (Rx).	**N1** = 50 ~ 500 [50ms increments]
$RX_HOTPLUG_T?↵	
Display the current hot plug time (in milliseconds) for the HDMI input (Rx).	
$RX_PC_TOL N1↵	
Set PC source clock detection tolerance for the HDMI input (Rx).	**N1** = 1 ~ 10 [1/1000 ~ 10/1000]
$RX_PC_TOL?↵	
Display the PC source clock detection tolerance for the HDMI input (Rx).	

COMMANDS	
DESCRIPTION	**VARIABLES**
$RX_SCDC N1↵	
Enable or disable the SCDC port function on the HDMI input (Rx).	**N1** = ON, OFF
$RX_SCDC?↵	
Display the current SCDC port state for the HDMI input (Rx).	
$RX_SENSE N1↵	
Enable or disable the RxSense function for the HDMI input (Rx).	**N1** = ON, OFF
$RX_SENSE?↵	
Display the current RxSense state for the HDMI input (Rx).	
$SINK_DETECT? N1↵	
Displays a variety of sink detection status and informational values.	Available values for **N1**: See below.
HOTPLUG [Sink's hot plug status] RSENSE [Sink's RxSense status] HDCP [Sink's HDCP port status] HDCP_AKSV [Source HDCP AKSV in 2-digit hex (HDCP v1.4)] HDCP_BKSV [Rx HDCP BKSV in 2-digit hex (HDCP v1.4)] HDCP_RXID [Rx Receiver ID in 2-digit hex (HDCP v2.2)] SCDC [SCDC port status] SCDC_SCR_ENABLE [Rx SCDC source scrambling setting] SCDC_SCR_STATUS [SCDC sink scrambling status] SCDC_SINK_VER [SCDC sink version] SCDC_SOURCE_VER [SCDC source version]	

COMMANDS	
DESCRIPTION	**VARIABLES**
$SOURCE_DETECT? N1↵	
Displays a variety of source detection status and informational values.	Available values for **N1**: See below.
5V	[5V detection state]
CKDT	[TMDS clock detection]
DATA_RATE	[Video data rate in Mbps]
TMDS_FORMAT	[Detected TMDS format (DVI or HDMI)]
SCDT	[TMDS sync detection]
HDCP	[Source HDCP status detection]
HDCP_AKSV	[Source AKSV in 2-digit hex (HDCP v1.4)]
HDCP_BKSV	[Rx BKSV in 2-digit hex (HDCP v1.4)]
HDCP_RXID	[HDCP Receiver ID in 2-digit hex (HDCP v2.2)]
HA	[Horizontal active pixels]
HBP	[Horizontal back porch pixels]
HFP	[Horizontal front porch pixels]
HSW	[Horizontal sync width pixels]
HT	[Total horizontal pixels]
HSP	[Horizontal sync polarity]
HVS_OFFSET1	[Horizontal/vertical sync offset1 in dot]
HVS_OFFSET2	[Horizontal/vertical sync offset2 in dot]
PIXEL_CLOCK	[Pixel clock in kHz]
SCAN	[Video scan mode (P = Progressive, I = Interlaced)]
TIMING	[Video timing (See "Source Video Timing List" below)]
TMDS_CLOCK	[TMDS clock in kHz]
VA	[Vertical active lines]
VBP	[Vertical back porch lines]
VFP	[Vertical front porch lines]
VSW	[Vertical sync width lines]
VT	[Total vertical lines]
VSP	[Vertical sync polarity]
ACR	[Audio-Clock-Recovery packet status]
ACR_CTS	[Audio-Clock-Recovery CTS value]
ACR_N	[Audio-Clock-Recovery N value]
ASP	[Audio-Sample packet status]
ASP_CH	[Audio-Sample packet channel number]
ASP_FIFO	[Audio-Sample packet audio FIFO (error or normal)]
ASP_LAYOUT	[Audio-Sample packet layout]
ASP_PLL	[Audio-Sample packet PLL (locked or unlocked)]

COMMANDS	
DESCRIPTION	**VARIABLES**
ASP_PLL	[Audio-Sample packet PLL (locked or unlocked)]
CHS_CODE	[Channel-status audio coding]
CHS_SR	[Channel-status sampling rate in kHz]
CHS_SS	[Channel-status sampling size]
CHS_TYPE	[Channel-status application type (consumer or professional)]
HBR	[High-Bit-Rate packet status]
AIF	[Display packet-AIF data in 2-digit hex]
AVI	[Display packet-AVI data]
DRMI	[Display packet-DMI data]
GCP	[Display packet-GCP data]
SPD	[Display packet-SPD data]
VSI	[Display packet-VSI data]
SCDC_SCR_ENABLE	[Rx SCDC source enable scrambling state]
SCDC_SCR_STATUS	[SCDC sink scrambling status]
SCDC_SINK_VER	[SCDC sink version]
SCDC_SOURCE_VER	[SCDC source version]
$TASK_MODE N1↵	
Set the unit's operation mode to Signal Analyser or Pattern Generation.	Available values for **N1**: ANALYSER [Analyser Mode] PATTERN [Pattern Mode]
$TASK_MODE?↵	
Display the unit's current operation mode.	
$TIMING N1↵	
Select the output resolution timing to use.	Available values for **N1**: 1 ~ 91 [All available standard output resolutions] 92 [Bypass (Analyser mode only)]
$TIMING?↵	
Display the unit's current output resolution timing by timing number.	
$TIMINGX?↵	
Display the unit's current output resolution timing by timing name.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$TMDS_FORMAT N1↵	
Set the TMDS output format.	**N1** = HDMI, DVI
$TMDS_FORMAT?↵	
Display the current TMDS output format.	
$TMDS_SW N1↵	
Enable or disable TMDS output.	**N1** = ON, OFF [Off disables video output]
$TMDS_SW?↵	
Display the current TMDS output status.	
$TX_5V N1↵	
Set the unit's output +5V pin state to follow the TMDS output state or to always be on.	Available values for **N1**: FOLLOW [Only output 5V if there is a live signal] ON [Always output 5V]
$TX_5V?↵	
Display the current output +5V pin setting.	
$UPDATE_FW↵	
Update firmware from USB & reboot the unit.	
$UPDATE_IMG1080↵	
Update the 1920×1080 image from USB & reboot the unit.	
$UPDATE_IMG480↵	
Update the 640×480 image from USB & reboot the unit.	

Source Video Timing List

Resolution	Hz	ID
640×350p	85	**1**
640×480p	59	**2**
	72	**3**
	75	**4**
	85	**5**
720×400p	70	**6**
	85	**7**
800×600p	56	**8**
	60	**9**
	72	**10**
	75	**11**
	85	**12**
848×480p	60	**13**
1024×768p	60	**14**
	70	**15**
	75	**16**
	85	**17**
1152×864p	70	**18**
	75	**19**
	85	**20**
1280×768p	60 (RB)	**21**
	60	**22**
	75	**23**
	85	**24**
1280×800p	60 (RB)	**25**
	60	**26**
	75	**27**
	85	**28**
1280×960p	60	**29**

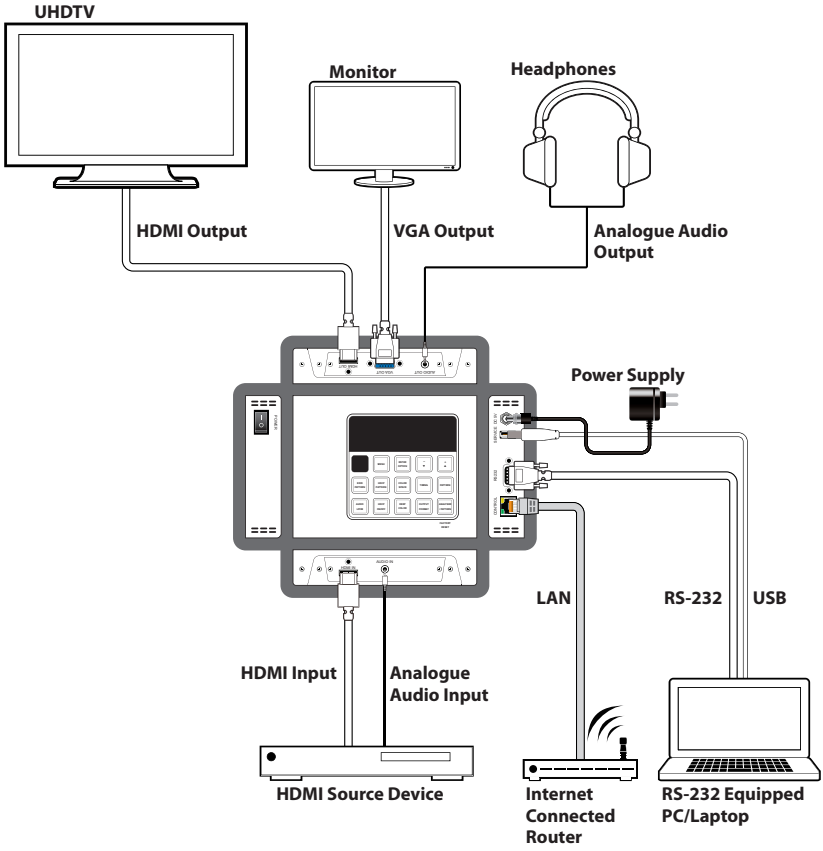
Resolution	Hz	ID
1280×960p	85	**30**
1280×1024p	60	**31**
	75	**32**
	85	**33**
1360×768p	60	**34**
1366×768p	60 (RB)	**35**
	60	**36**
1400×1050p	60 (RB)	**37**
	60	**38**
	75	**39**
1440×900p	60 (RB)	**40**
	60	**41**
	75	**42**
	85	**43**
1600×900p	60 (RB)	**44**
1600×1200p	60	**45**
1680×1050p	60 (RB)	**46**
	60	**47**
1920×1200p	60 (RB)	**48**
480i	59	**49**
	60	**50**
480p	59	**51**
	60	**52**
576i	50	**53**
576p	50	**54**
720p	25	**55**
	29	**56**
	30	57
	50	**58**

Resolution	Hz	ID
720p	59	**59**
	60	**60**
1080i	50	**61**
	59	**62**
	60	**63**
1080p	23	**64**
	24	**65**
	25	**66**
	29	**67**
	30	**68**
	50	**69**
	59	**70**
	60	**71**
2048×1080p	23	**72**
	24	**73**
	25	**74**
	29	**75**
	30	**76**
	50	**77**

Resolution	Hz	ID
2048×1080p	59	**78**
	60	**79**
3840×2160p	23	**80**
	24	**81**
	25	**82**
	29	**83**
	30	**84**
	50	**85**
	59	**86**
	60	**87**
4096×2160p	23	**88**
	24	**89**
	25	**90**
	29	**91**
	30	**92**
	50	**93**
	59	**94**
	60	**95**
Not Support		**254**

Notes: RB = Reduced Blanking. No Signal = No source.

7. CONNECTION DIAGRAM



8. SPECIFICATIONS

8.1 Technical Specifications

Video Bandwidth	600MHz/18Gbps
Input Ports	1×HDMI 1×3.5mm (Stereo)
Output Ports	1×HDMI 1×VGA 1×3.5mm (Stereo)
Control Interfaces	1×RS-232 [9-pin D-sub] 1×IP Control [RJ-45] 1×USB Type-A
HDMI Cable Length	10m (1080p@60Hz, 12-bit) 3m (4K@60Hz, 4:4:4, 8-bit)
Power Supply	5V/2.6A DC (US/EU standards, CE/FCC/UL certified) or 2.1A USB Power
ESD Protection	Human body model: ±8kV (air-gap discharge) ±4kV (contact discharge)
Dimensions	120mm×155mm×30mm (W×H×D) [Case Only] 125mm×162mm×30mm (W×H×D) [All Inclusive]
Weight	796g
Chassis Material	Metal
Silkscreen Colour	Black
Operating Temperature	0˚C~40˚C/32˚F~104˚F
Storage Temperature	–20˚C~60˚C/–4˚F~140˚F
Relative Humidity	20~90% RH (non-condensing)
Power Consumption	8.4W

8.2 Supported Colour Formats

Output Resolution (Hz)	RGB			YCbCr 4:4:4			YCbCr 4:2:2		YCbCr 4:2:0		
	8	10	12	8	10	12	8	12	8	10	12
640×350p@85~ 2048×1080p@60	✓	✓	✓	✓	✓	✓	✓				
3840×2160p@23~30	✓	✓*	✓*	✓	✓*	✓*	✓				
4096×2160p@23~30											
3840×2160p@50~60	✓*			✓*			✓*		✓	✓*	✓*
4096×2160p@50~60											

✓ = Specified colour depth is supported.

* = TMDS scrambling is active.

8.3 Supported Audio Formats

Audio Source	Sampling Rate (kHz)	Channels	Word Length (Bits)	SD0~3 L/R Freq. (Hz)
HDMI Input	Bypass	Bypass	Bypass	Bypass
Analogue Input	48	2.0	16, 20, 24	Bypass
	96	2.0		
	192	2.0		
Internal Sinewave	48	2.0, 5.1, 7.1	16, 20, 24	Mute, 200 ~ 1600
	96	2.0, 5.1, 7.1		
	192	2.0		

48kHz supports a maximum of 2 channels at 2048×1080p@29/30Hz resolution.

96kHz supports a maximum of 2 channels at 480i, 576i, 480p, 576p, 640×480p@59Hz, 720×400p@70Hz, 1280×768p@60Hz (RB), 1366×768p@60Hz (RB), 2048×1080p@29/30/59/60Hz, 4096×2160p@29/30Hz resolutions.

192kHz is NOT supported at 1366×768p@60Hz (RB) or 2048×1080p@29/30Hz resolution.

9. ACRONYMS

ACRONYM	COMPLETE TERM
3D	Three-Dimensional
CEC	Consumer Electronics Control
CED	Character Error Detection
DDC	Display Data Channel
DIP	Dual In-line Package
DHCP	Dynamic Host Configuration Protocol
DRMI	Dynamic Range & Mastering InfoFrame
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
EOTF	Electro-Optical Transfer Function
GCP	General Control Packet
HD	High-Definition
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDR	High Dynamic Range
HDTV	High-Definition Television
Hz	Hertz
IP	Internet Protocol
IR	Infrared
kHz	kilohertz
LED	Light-Emitting Diode
LPCM	Linear Pulse-Code Modulation
MAC	Media Access Control
mAh	milliampere hour
min	minute
ms	millisecond

ACRONYM	COMPLETE TERM
OLED	Organic Light-Emitting Diode
OSD	On-Screen Display
PC	Personal Computer
PLUGE	Picture Line-Up Generation Equipment
PoR	Power-On Reset
RB	Reduced Blanking
SCDC	Status and Control Data Channel
SDR	Standard Dynamic Range
SMPTE	Society of Motion Picture and Television Engineers
TMDS	Transition-Minimized Differential Signaling
UHD	Ultra-High-Definition
UHDTV	Ultra-High-Definition Television
USB	Universal Serial Bus
VGA	Video Graphics Array

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