CPHD-V4

4K UHD+ HDMI Signal Generator & Analyzer

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 (DD/MM/YY)	SUMMARY OF CHANGE
RDV1	30/07/15	Preliminary release
RDV2	03/08/16	Draft manual
RDV3	07/09/16	Updated texts and images
RDV4	01/08/17	Updated sections 6.7 & 6.9

CONTENTS

1. INTRODUCTION

The HDMI Signal Generator & Analyzer is an advanced and handy tool for generating, testing and verifying the signal path within your 18Gbps HDMI ecosystem. With 87 built-in resolutions, 56 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-color 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 & Analyzer
- 1×Remote Control (CR-174)
- 1×DC to USB Type-A Power Cable
- 1×5V/2.6A Power Adaptor
- 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.
- Analog audio source equipment such as a PC or media player and/or analog 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.

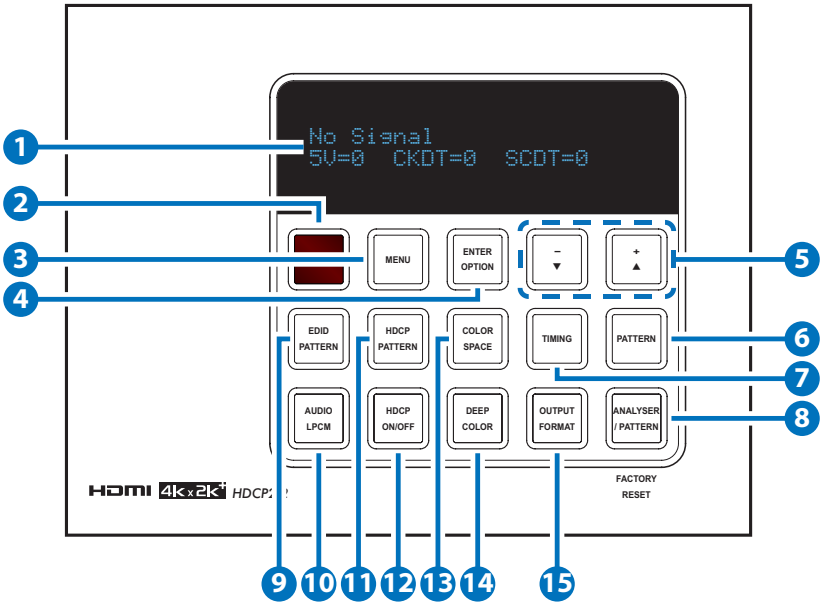
5. FEATURES

- 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
- VGA output supports 350p, 480p, 576p, 720p, 1080i, 1080p, 640×480, 800×600, 1024×768, 1280×1024, 1366×768, 1400×1050, 1440×900, 1600×900 (RB), 1600×1200, 1680×1050, 1920×1200 (RB), 2048×1080p
- HDMI output supports 350p, 480p, 576p, 720p, 1080i, 1080p, 640×480, 800×600, 1024×768, 1280×1024, 1366×768, 1400×1050, 1440×900, 1600×900 (RB), 1600×1200, 1680×1050, 1920×1200 (RB), 3G4K, 6G4K
- 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

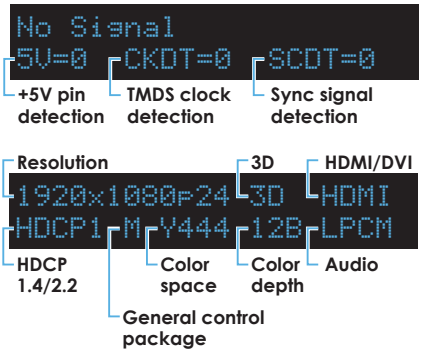
6. OPERATION CONTROLS AND FUNCTIONS

6.1 Front Panel

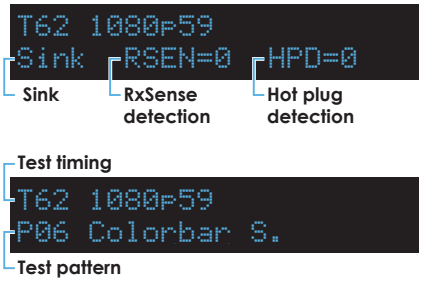


1 OLED Screen: Displays the current signal analysis information or test pattern mode selection details including input and/or output resolution timing. The screen layout changes depending on the unit's mode.

Analyzer Mode (ANALYZER/PATTERN button is RED): In Analyzer 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, color space, color depth and audio format.



Pattern Mode (ANALYZER/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 Analyzer 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.

Note: In Analyzer 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 **ANALYZER/PATTERN:** Press to switch the unit between Analyzer Mode (LED=Red) and Pattern Mode (LED=Blue). When in Analyzer Mode, press and hold the button for 2 seconds to force an RX hot-plug. 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 Analyzer 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 color 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. Press and hold this button for 2 seconds to allow adjustment of the output volume.

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 Analyzer 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.

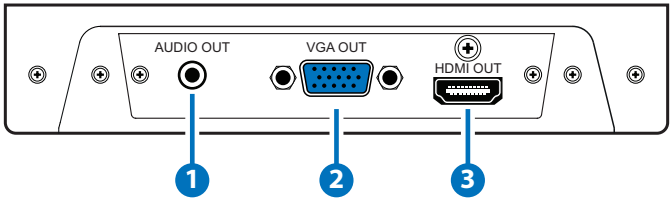
12 **HDCP ON/OFF:** Press to switch between supported HDCP versions or to disable HDCP. Within Analyzer mode, OFF (LED=Off), HDCP 1.4 (LED=Red), and HDCP 1.4+2.2 (LED=Blue) modes are available for the input port. Within Pattern mode, OFF, HDCP 1.4, and HDCP 2.2 modes are available for the output port.

13 **COLOR SPACE:** Press repeatedly to switch between the available color space formats. The button's LED is colored to indicate the current color 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 color bit depth options. The button's LED is colored 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. 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 Panel

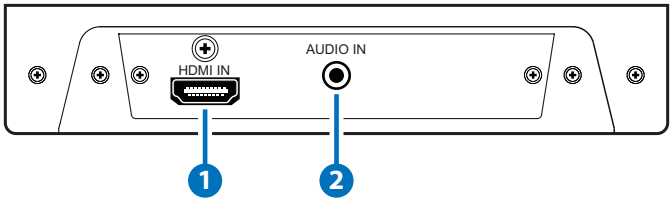


1 **AUDIO OUT:** Connect to powered speakers or an amplifier for stereo analog audio output with a 3.5mm phone jack cable.

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

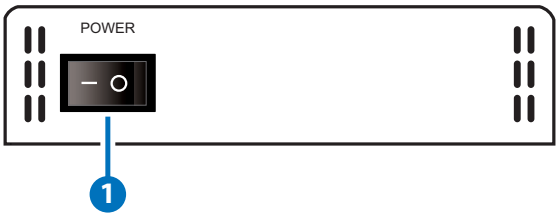
3 **HDMI OUT:** Connect to HDMI TVs, monitors or amplifiers for digital video and audio output.

6.3 Bottom Panel



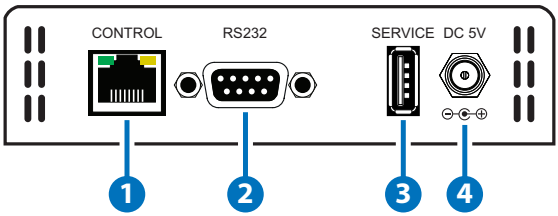
1. **HDMI IN:** Connect to HDMI source equipment such as a media player, game console or set-top box.
2. **AUDIO IN:** Connect to the stereo analog output of a device such as a CD player or PC.

6.4 Left Panel



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

6.5 Right Panel



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

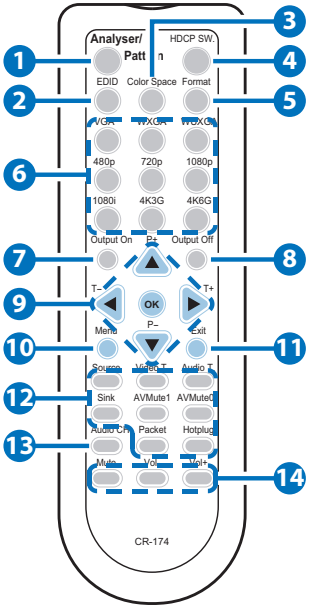
2. **RS-232:** Connect directly to your PC/laptop to send RS-232 commands to control the unit.

3. **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

4. **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.

6.6 Remote Control



1. **Analyzer/Pattern:** Press to switch between Analyzer 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 color space formats (RGB, YCbCr 4:4:4, YCbCr 4:2:2 and 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 **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.

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.

*Note: * for use in Analyzer Mode only;*
*** for use in Pattern Mode only.*

13 **Audio CH:** Within Analyzer 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 and 7.1 channel test tone output formats.

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

6.7 OSD Menu

6.7.1 Analyzer Mode

LEVEL 1	LEVEL 2	LEVEL 3
Source Monitor	Analytic Data	
Video Timing	Analytic Data	
Audio Timing	Analytic Data	
Packet	Monitor	Analytic Data
	GCP	Analytic Data
	AVI	Analytic Data
	AIF	Analytic Data
	SPD	Analytic Data
	VSIF H14b	Analytic Data
	DRMI (HDR)	Analytic Data
EDID Analyzer	HDMI Sink	Analytic Data
	VGA Sink	Analytic Data
	RX EDID	Analytic Data
	Default & Copied EDID	[D1] ~ [D10] Default EDID Settings
		[C1] ~ [C10] Copied EDID Settings
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

LEVEL 1	LEVEL 2	LEVEL 3
EDID Emulator (Cont.)	RX EDID Select	[D8] 12B 2D 8CH HBR 4K3G
		[D9] 12B 2D 8CH HBR 4K420
		[D10] 12B 2D 8CH HBR 4K6G
		[C1] Copy 01
		[C2] Copy 02
		[C3] Copy 03
		[C4] Copy 04
		[C5] Copy 05
		[C6] Copy 06
		[C7] Copy 07
		[C8] Copy 08
		[C9] Copy 09
		[C10] Copy 10
	Copy HDMI Sink EDID	Copy HDMI sink EDID to [C1] ~ [C10]
	Copy VGA Sink EDID	Copy VGA sink EDID to [C1] ~ [C10]
	Rename Copied Sink EDID	Rename EDID [C1] ~ [C10]
	Burn EDID to HDMI Sink	Burn EDID [D1] ~ [D10] & [C1] ~ [C10] to unlocked HDMI sink EDID
	Burn EDID to VGA Sink	Burn EDID [D1] ~ [D10] & [C1] ~ [C10] to unlocked VGA sink EDID
HDCP Input Monitor	Analytic Data	
SCDC Input Monitor	Analytic Data	

LEVEL 1	LEVEL 2	LEVEL 3
RX Port Controls	Hot Plug Preset	Low
		High
		Toggle
	Hot Plug Toggle Time	50ms ~ 500ms **(100ms)**
	Hot Plug Run	
	RX Sense	**On (PoR)**
		Off
	DDC	**On (PoR)**
		Off
	V.Freq/1.001 Detection	**On**
		Off
	PC Clock Tolerance	1/1000 ~ 10/1000 **(6/1000)**
	HDCP Port On/Off	**On (PoR)**
		Off
	HDCP Port Version	v1.4
		v1.4+v2.2
	HDCP REAUTH_REQ Toggle	
	HDCP Counter Reset	
	SCDC Port	**On (PoR)**
		Off
	SCDC CED Ch Auto Clear	On *Note: Auto clear while source reads CED.*
		Off
Output Resolution	See "Test Timing List" below **(T63 1080p60)**	
OSD Settings	H Position	0% ~ 100% **(10%)**
	V Position	0% ~ 100% **(10%)**
	Transparency	0 ~ 7 **(4)**

LEVEL 1	LEVEL 2	LEVEL 3
OSD Settings (Cont.)	A Mode Color (Analyzer mode only)	**Red**
		Blue
		Gray
	P Mode Color (Pattern mode only)	Red
		Blue
		Gray
	Font Type	**Narrow**
		Wide
Ethernet	IP Mode	**DHCP**
		Static
	IP Address (Static mode only)	X.X.X.X **(192.168.1.50)**
	Subnet Mask (Static mode only)	X.X.X.X **(255.255.255.0)**
	Gateway (Static mode only)	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
		Manual
	IR Controller Address	0 ~ 3 **(0)**
	Copied EDID Reset	**No**/Yes
	Ethernet Reset	**No**/Yes
	Factory Reset	**No**/Yes
Information	Analytic Data	

Notes:

- *Items in **Bold** are factory default settings.*
- *SCDC = Status and Control Data Channel.*
  CED = Character Error Detection.
  PoR = Power on Reset.

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 Analyzer mode.
- HDR EDID must be copied from an connected sink to the RX EDID through the EDID Emulator menu in Analyzer mode.
- EDID Analyzer & DRMI Packet Monitor for HDR analysis in Analyzer 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 Analyzer Limitation

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

EDID Settings

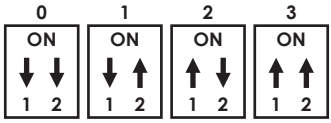
- The unit has 10 built-in EDIDs and 10 custom EDID slots.
- Within the OSD menu's "EDID Emulator" section, the EDID from the currently connected sink, a built-in EDID, or a custom EDID may be selected for use as the unit's EDID.
- Programming a custom EDID through the RS-232 connection is supported.

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).



Power on Reset (PoR)

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

Image File Format

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

6.7.2 Pattern Mode

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

LEVEL 1	LEVEL 2	LEVEL 3
EDID Analyzer	Analytic Data	
EDID Emulator	Analytic Data	
HDCP Output Monitor	Analytic Data	
HDR Output Emulator	HDR Out On/Off	On
		Off
	Settings	**1**
		2
		3
	Value Unit	Hex
		nit (cd/m*m)
	Tx AVI Colorimetry	No Data
		ITU601
		ITU709
		xvYCC601
		xvYCC709
		sYCC601
		AdobeY601
		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	0.0000 ~ 1.3100 **(0.0000)**
	Display primaries y0	0.0000 ~ 1.3100 **(0.0000)**

LEVEL 1	LEVEL 2	LEVEL 3
HDR Output Emulator (Cont.)	Display primaries x1	0.0000 ~ 1.3100 **(0.0000)**
	Display primaries y1	0.0000 ~ 1.3100 **(0.0000)**
	Display primaries x2	0.0000 ~ 1.3100 **(0.0000)**
	Display primaries y2	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)**
	Tx AVI Color Space	Analytic Data
	Sink EDID supports HDR	Analytic Data
SCDC Output Monitor	Analytic Data	
TX Port Controls	+5V Out On/Off	**Follow TMDS**
		Always On
	HDCP Output On/Off	On
		Off (PoR)
	HDCP Output Version	**v1.4**
		v2.2
	HDCP AKE_Send_ Stored_km()	On
		Off
	HDCP Counter Reset	
	SCDC CED Counter Read	**On**
		Off *Note: TX doesn't read sink CH0~3 Error-Counter.*
TX Port Controls (Cont.)	SCDC CED Always Read	**On** *Note: TX ignores sink CED_Update flag.*
		Off

LEVEL 1	LEVEL 2	LEVEL 3
	SCDC CED Ch Auto Clear	On *Note: While sink CED_ Update flag=1, TX auto clears its CH0~3 Error-Counter and reads a new counter from the sink.*
		Off
Output Resolution	See "Test Timing List" below **(T63 1080p60)**	
OSD Settings	H Position	0% ~ 100% **(10%)**
	V Position	0% ~ 100% **(10%)**
	Transparency (Solid~Transparent)	0 ~ 7 **(4)**
	A Mode Color (Analyzer mode only)	**Red**
		Blue
		Gray
	P Mode Color (Pattern mode only)	Red
		Blue
		Gray
Ethernet	IP Mode	**DHCP**
		Static
	IP Address (Static mode only)	X.X.X.X **(192.168.1.50)**
	Subnet Mask (Static mode only)	X.X.X.X **(255.255.255.0)**
	Gateway (Static mode only)	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

LEVEL 1	LEVEL 2	LEVEL 3
	[Letter H] Option 2	Small
		Medium
	3D Source Image Bypass	**No**/Yes
	Information Refresh	1 Sec
		2 Sec
		Manual
	IR Controller Address	0 ~ 3 **(0)**
	Copied EDID Reset	**No**/Yes
	Ethernet Reset	**No**/Yes
	Factory Reset	**No**/Yes
Information	Analytic Data	

Notes:

- *Items in **Bold** are factory default settings.*
- *SCDC = Status and Control Data Channel.*
  CED = Character Error Detection.
  PoR = Power on Reset.

HDR Output Emulator Limitation

- This function simulates HDR info frame (DRMI) and AVI colorimetry (BT.2020, etc.) output. It does not generate HDR/colorimetry video content.

Power on Reset (PoR)

- Settings marked with this are reset to the default when the unit is powered off.

6.7.3 Test Timings

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**
	85	**T28**
1280×1024p	60	**T29**

Test Timing List	Hz	ID
1280×1024p	75	**T30**
	85	**T31**
1360×768p	60	**T32**
1366×768p	60 (RB)	**T33**
	60	**T34**
1400×1050p	60 (RB)	**T35**
	60	**T36**
1440×900p	60 (RB)	**T37**
	60	**T38**
1600×900p	60 (RB)	**T39**
1600×1200p	60	**T40**
1680×1050p	60 (RB)	**T41**
	60	**T42**
1920×1200p	60 (RB)	**T43**
480i	59	**T44**
	60	**T45**
480p	59	**T46**
	60	**T47**
576i	50	**T48**
576p	50	**T49**
720p	50	**T50**
	59	**T51**
	60	**T52**
1080i	50	**T53**
	59	**T54**
	60	**T55**
1080p	23	**T56**
	24	**T57**
	25	**T58**

Test Timing List	Hz	ID
1080p	29	**T59**
	30	**T60**
	50	**T61**
	59	**T62**
	60	**T63**
2048×1080p	23	**T64**
	24	**T65**
	25	**T66**
	29	**T67**
	30	**T68**
	50	**T69**
	59	**T70**
	60	**T71**
3840×2160p	23	**T72**
	24	**T73**
	25	**T74**
	29	**T75**
	30	**T76**
	50	**T77**
	59	**T78**
	60	**T79**
4096×2160p	23	**T80**
	24	**T81**
	25	**T82**
	29	**T83**
	30	**T84**
	50	**T85**
	59	**T86**
	60	**T87**

Test Timing List	Hz	ID
Bypass		**T88**

RB = Reduced Blanking.

Note: T88 Bypass is only available in Analyzer mode.

Input/Ouput PC Resolutions

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	✓	✓	✓	✓
1440×900p	60 (RB), 60	✓	✓	✓	✓
1600×900p	60 (RB)	✓	✓	✓	✓
1600×1200p	60	✓	✓	✓	✓
1680×1050p	60 (RB), 60	✓	✓	✓	✓
1920×1200p	60 (RB)	✓	✓	✓	✓

RB = Reduced Blanking.

Input/Output TV Resolutions

TV Resolution	Vertical Frequency (Hz)	Input	Output		
		HDMI	HDMI	DVI	VGA
480i	59, 60	✓	✓	✓	
480p	59, 60	✓	✓	✓	✓
576i	50	✓	✓	✓	
576p	50	✓	✓	✓	✓

TV Resolution	Vertical Frequency (Hz)	Input	Output		
		HDMI	HDMI	DVI	VGA
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	✓	✓		

Total Resolutions

- This unit supports a total of 87 output resolutions.

VGA Output Limitations

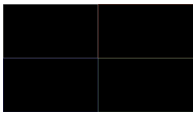
- Only supports RGBHV (YUV, RGBS, and RGsB are not supported).
- In Analyzer mode the VGA output is disabled.
- In Pattern mode the VGA output has limited resolution support.
- OSD Menu display is not supported.

6.7.4 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
Grayscale 8	3	P26
Grayscale 16	3	P27
Grayscale 32	3	P28

Test Pattern Name	Variations	ID
Grayscale 64	3	P29
Grayscale 256	4	P30
Grayscale 256RGB		P31
Grayscale Adjust	256	P32
Grayscale H		P33
Grid		P34
Image	2	P35
Letter H	2	P36
Line On/Off-H		P37
Line On/Off-V	2	P38
Line On/Off-V 4K		P39
Motion-H	4	P40
Motion-V	4	P41
Multiburst	3	P42
Needles		P43
Overscan		P44
Pluge	2	P45
Square H8	2	P46
Square H16	2	P47
Square H32	2	P48
Text	4	P49
Window Blue	4	P50
Window Cyan	4	P51
Window Green	4	P52
Window Magenta	4	P53
Window Red	4	P54
Window White	4	P55
Window Yellow	4	P56

1. Border



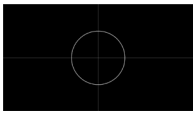
The **Border** pattern presents 4 equal-sized squares dividing the screen into 4 quadrants, forming a central white cross, with red, green, blue and white inner squares. Ideal for testing screen boundary, alignment and pincushion issues. All lines should be straight, and edge transitions should be sharp.

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

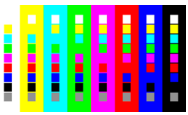
The **Circle 4** pattern provides 4 smaller white circles in each of the 4 corners of the screen. This pattern can help confirm that the display is maintaining correct geometry at the edges of the screen.

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 color patterns should display an even distribution of brightness and consistent color 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. Colorbar Delay



The **Colorbar Delay** pattern provides a sequence of standard 100% color bars with a full set of smaller color squares within each bar. This test is primarily to detect if any of the color 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 color shift. This is a common problem when using extreme-length analog extension products, or very long analog cables.

14. Colorbar-H

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

15. Colorbar Motion (2 variations)

Slow/Fast Motion

The **Colorbar Motion** pattern is a standard (white, yellow, cyan, green, magenta, red, blue, black) 100% color 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. Colorbar S.

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

17. Colorbar Split

The **Colorbar Split** pattern is a vertical color bar pattern with the

color bars split in the middle by large black and white sections. All colors (white, yellow, cyan, green, magenta, red, blue) are at 100% brightness.

18. Colorbar-V (3 variations)

100% 75% 100% & 75%

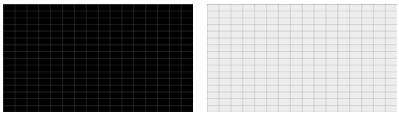
The **Colorbar-V** pattern comes in 3 variations. The first is a standard (white, yellow, cyan, green, magenta, red, blue, black) 100% color bar pattern using vertical bars. The 2nd variation has all bars at 75% brightness. The 3rd variation is split with the top half being at 100% and the lower half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



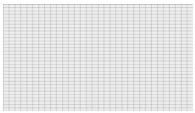
Normal Inverse

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 color 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)

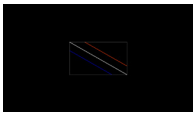
Normal



Inverse

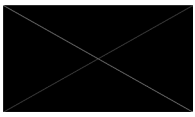
The **Cross Hatch 32** pattern is a full field black & white pattern of crossing vertical and horizontal lines dividing the screen into 32 sections in each direction. This pattern is primarily used to check for color convergence and pincushion issues in projectors. There are 2 variations: Normal (white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

22. Diagonal 1



The **Diagonal 1** pattern is a set of 3 diagonal colored 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

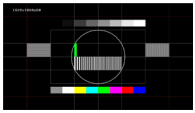


The **Diagonal 2** pattern is 2 diagonal lines that travel from the corners to the exact center of the display. This can be used to check for alignment and geometry issues, particularly with projectors. The outer border of the screen also has a white outline to verify that the full image is being displayed.

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 color bars, 8-step greyscale, vertical and horizontal multi-burst, cross hatch, circle and motion patterns. There are 3 variations: No motion, slow motion and fast motion.

26. Grayscale 8 (3 variations)

Vert. Bar

Vert. L/R Bar

Hori. Bar

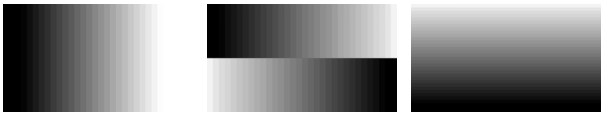
The **Grayscale 8** pattern provides a way to check and adjust the contrast, brightness and grayscale tracking of your display with 8 bars progressing from 0% to 100% brightness in even steps. When testing a display, no color should be visible in any of the bars, and all bars should be visible and distinct.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

27. 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 color 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.

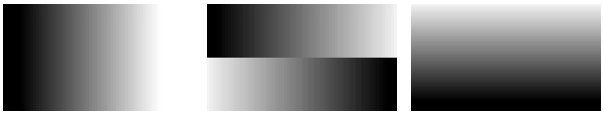
28. Grayscale 32 (3 variations)



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 color 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.

29. 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 color should be visible in any of the bars, and all

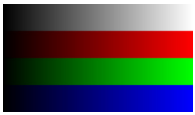
bars should be visible and distinct. There are 3 variations: 64 vertical bars, two sets of 64 vertical bars with the lower set reversed, and 64 horizontal bars.

30. 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 color 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.

31. Grayscale 256RGB



The **Grayscale 256RGB** pattern provides a way to fine tune the contrast, brightness, grayscale and color 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.

32. 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.

33. Grayscale H

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

34. 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 color offset issues.

35. 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).

Note: 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.

36. Letter H (2 variations)

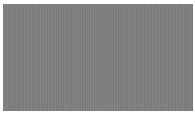
Big/Small H

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.

37. 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 analyze 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.

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



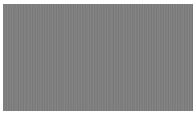
White & Black Lines

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 analyze 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.

*Note: 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.*

39. Line On/Off-V 4K

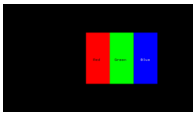


White & Black Lines

The **Line On/Off-V 4K** pattern generates an alternating pattern of single- pixel vertical lines. This pattern can be used to analyze 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.

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

40. Motion-H (4 variations)



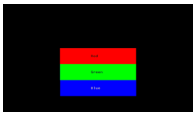
Slow/Fast RGB Block

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.

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

41. Motion-V (4 variations)



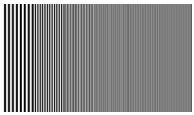
Slow/Fast RGB Block

Slow/Fast String

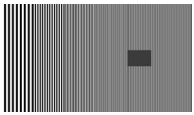
The **Motion-V** patterns are a collection of vertical motion tests. These can be used to test your display's pixel on/off response time. There are 4 variations: Slow red/green/blue block, fast red/green/blue , slow moving sample text, fast moving sample text.

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

42. 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 analyze 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.

43. 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.

44. 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.

45. 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).

46. 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).

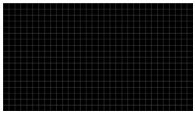
47. Square H16 (2 variations)

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).

48. 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).

49. Text (4 variations)

Normal & Small

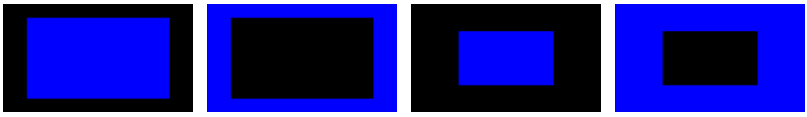
Inverse & Small

Normal & Big

Inverse & Big

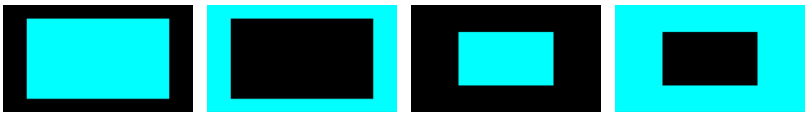
The **Text** pattern is used to check the clarity of text at various sizes and colors. This is primarily a test for projectors. There are 4 variations: Small multi-color text on a black background, small multi-color text on a white background, large multi-color text on a black background, and large multi-color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

50. Window Blue (4 variations)



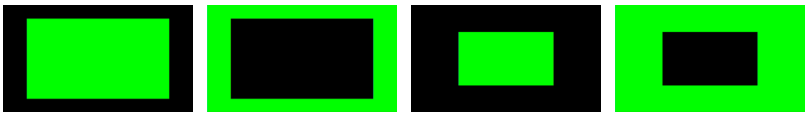
Normal 75% | Inverse 75% | Normal 50% | Inverse 50%

51. Window Cyan (4 variations)



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

52. Window Green (4 variations)



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

53. Window Magenta (4 variations)

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

54. Window Red (4 variations)

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

55. Window White (4 variations)

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

56. 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 color on a black field: **Blue**, **Cyan**, **Green**, **Magenta**, **Red**, **White**, **Yellow**. The color patterns should display an even distribution of brightness and consistent color tone across the screen. Each pattern has 4 variations: Normal 75% Window, Inverse 75% Window, Normal 50% Window, and Inverse 50% Window.

6.8 RS-232 Protocol

UNIT	
Pin	Definition
1	NC
2	TxD
3	RxD
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

▶
◀

REMOTE SYSTEM	
Pin	Definition
1	NC
2	RxD
3	TxD
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

Baud Rates: 115200bps
Data Bits: 8
Parity Bits: None
Stop Bit: 1
Flow Control: None

6.9 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.

COMMAND	DESCRIPTION AND PARAMETERS
$?	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

COMMAND	DESCRIPTION AND PARAMETERS
$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]
$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 [Analog 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. *Note:* • *The unit won't respond to any commands during the boot process.*
$BOOT?	Display the current boot state.

COMMAND	DESCRIPTION AND PARAMETERS
$COLOR_SPACE N1	Set the output color 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 color space.
$DEEP_COLOR N1	Set the output color bit depth. N1 = 8, 10, 12
$DEEP_COLOR?	Display the current output color bit depth.
$EDID_COPY_SINK N1	Copy the current HDMI sink's EDID to the designated copy slot. N1 = C1~C10 *Note:* • *If the copy fails "$err" will be displayed.*
$EDID_MANUF? N1	Display the manufacturer name stored in the EDID of the selected location. Available values for N1: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] *Notes:* • *If the EDID fails to be read, "$err_ddc" will be displayed.* • *If the EDID has invalid content, "$err_bad" will be displayed.*

COMMAND	DESCRIPTION AND PARAMETERS
$EDID_MODEL? N1	Display the model/monitor name stored in the EDID of the selected location. Available values for N1: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] *Notes:* • *If the EDID fails to be read, "$err_ddc" will be displayed.* • *If the EDID has invalid content, "$err_bad" will be displayed.*
$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
$EDID_NATIVE? N1	Display the native resolution value stored in the EDID of the selected location. Available values for N1: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] *Notes:* • *First detailed timing from Block 0.* • *If the EDID fails to be read, "$err_ddc" will be displayed.* • *If the EDID has invalid content, "$err_bad" will be displayed.*

COMMAND	DESCRIPTION AND PARAMETERS
$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] N2 = BLOCK0~BLOCK3 *Notes:* • *This command is not supported over Telnet connections.* • *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.*
$EDID_READ N1,N2 (Cont.)	• *If the EDID fails to be read, "$err_ddc" will be displayed.* • *If block 2 or block 3 doesn't exist, "$err_block" will be displayed.*
$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).

COMMAND	DESCRIPTION AND PARAMETERS
$EDID_TYPE? N1	Display the EDID type of the selected location. Available values for N1: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] *Notes:* • *If the EDID fails to be read, "$err_ddc" will be displayed.* • *If the EDID has invalid content, "$err_bad" will be displayed.*
$EDID_WRITE N1,N2 N3	Directly write an EDID block to the selected EDID location. Available values for N1: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink] SINK_V [VGA Sink] N2 = BLOCK0~BLOCK1 N3 = <CR><LF>{128 byte hex data} *Notes:* • *The data must be sent as a 128 byte hex data bit stream following the <CR><LF> in the N3 part of the command.* • *Each hex data unit is composed of 3 digits. The first 2 digits are the hex value. The 3rd digit is a space (0x20).* • *If the sum of the 128 byte data isn't 0, "$err_checksum" will be displayed.*
$FACTORY	Execute a factory reset and reboot the unit. *Note:* • *Stored Copy EDIDs and Ethernet settings will not be reset.*
$FWVER?	Display the current firmware version.

COMMAND	DESCRIPTION AND PARAMETERS
$HDCP_IN_SW N1	Enable or disable HDCP support for the unit's HDMI input. N1 = ON, OFF *Note:* • *Affects Analyzer 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 [Supports HDCP v1.4 only] V1.4+V2.2 [Supports HDCP v1.4 & v2.2] *Note:* • *Affects Analyzer 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 *Note:* • *Affects Pattern mode only.*
$HDCP_OUT_SW?	Display the HDMI output's HDCP status. A status of "Talk" means HDCP is currently performing handshaking.
$HDCP_OUT_VER N1	Set the HDCP version to use on the unit's HDMI output. Available values for N1: V1.4 [Output encrypted with HDCP v1.4] V2.2 [Output encrypted with HDCP v2.2] *Note:* • *Affects Pattern mode only.*

COMMAND	DESCRIPTION AND PARAMETERS
$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 [Incremented in 100 unit steps]
$HDR_MCLL?	Display the current maximum HDR content light level.
$HDR_MFALL N1	Set the maximum HDR frame-average light level. N1 = 0~65500 [Incremented in 100 unit steps]
$HDR_MFALL?	Display HDR maximum light level of frame-average
$HDR_SET N1	Select the current HDR setting. N1 = 1~3
$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.

COMMAND	DESCRIPTION AND PARAMETERS
$HDR_TX_COL N1	Set the HDMI output (Tx) AVI Colorimetry mode. Available values for N1: 1 [No Data] 2 [ITU601] 3 [ITU709] 4 [xvYCC601] 5 [xvYCC709] 6 [sYCC601] 7 [AdobeY601] 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 Colorimetry 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.
$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.

COMMAND	DESCRIPTION AND PARAMETERS
$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.
$PATTERN N1	Select the test pattern to output. N1 = 1~56
$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 hot plug 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 [Incremented in 50ms steps]
$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]

COMMAND	DESCRIPTION AND PARAMETERS
$RX_PC_TOL?	Display the PC source clock detection tolerance for the HDMI input (Rx).
$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: 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]

COMMAND	DESCRIPTION AND PARAMETERS
$SOURCE_DETECT? N1	Displays a variety of source detection status and informational values. Available values for N1: 5V [5V detection state] CKDT [TMDS clock detection] 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]

COMMAND	DESCRIPTION AND PARAMETERS	
$SOURCE_DETECT? N1 (Cont.)	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)]
	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]

COMMAND	DESCRIPTION AND PARAMETERS
$SOURCE_DETECT? N1 (Cont.)	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 Analyzer or Pattern Generation. N1 = ANALYSER, PATTERN
$TASK_MODE?	Display the unit's current operation mode.
$TIMING N1	Select the output resolution timing to use. Available values for N1: 1~87 [All available standard output resolutions] 88 [Bypass (Analyzer 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.
$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 will disable all video output]
$TMDS_SW?	Display the current TMDS output status.

COMMAND	DESCRIPTION AND PARAMETERS
$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 outputs 5v if there is a live signal] ON [Always outputs 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**
1440×900p	60 (RB)	**39**
	60	**40**
1600×900p	60 (RB)	**41**
1600×1200p	60	**42**
1680×1050p	60 (RB)	**43**
	60	**44**
1920×1200p	60 (RB)	**45**
480i	59	**46**
	60	**47**
480p	59	**48**
	60	**49**
576i	50	**50**
576p	50	**51**
720p	25	**52**
	29	**53**
	30	**54**
	50	**55**
	59	**56**
	60	**57**
1080i	50	**58**

Resolution	Hz	ID
1080i	59	**59**
	60	**60**
1080p	23	**61**
	24	**62**
	25	**63**
	29	**64**
	30	**65**
	50	**66**
	59	**67**
	60	**68**
2048×1080p	23	**69**
	24	**70**
	25	**71**
	29	**72**
	30	**73**
	50	**74**
	59	**75**
	60	**76**
3840×2160p	23	**77**
	24	**78**
	25	**79**
	29	**80**
	30	**81**
	50	**82**
	59	**83**
	60	**84**
4096×2160p	23	**85**
	24	**86**
	25	**87**
	29	**88**

Resolution	Hz	ID
4096×2160p	30	**89**
	50	**90**
	59	**91**
	60	**92**
Not Supported		**254**

RB = Reduced Blanking.

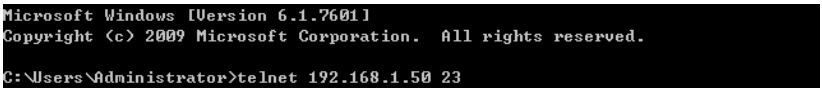
Note: No Signal = No source.

6.10 Telnet Control

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

To access Telnet	
In Windows XP	Click **Start**, type "cmd" in the search field, and press **Enter**.
In Windows 7	Click **Start** > **Run**, type "cmd" in the search field, and press Enter.
In Mac OS X	Click **Go** > **Application**s > **Utilities** > **Terminal**.

Once in the Command Line Interface (CLI), type "telnet" followed by the current IP address of the unit and "23", then hit **Enter**. See below for reference.

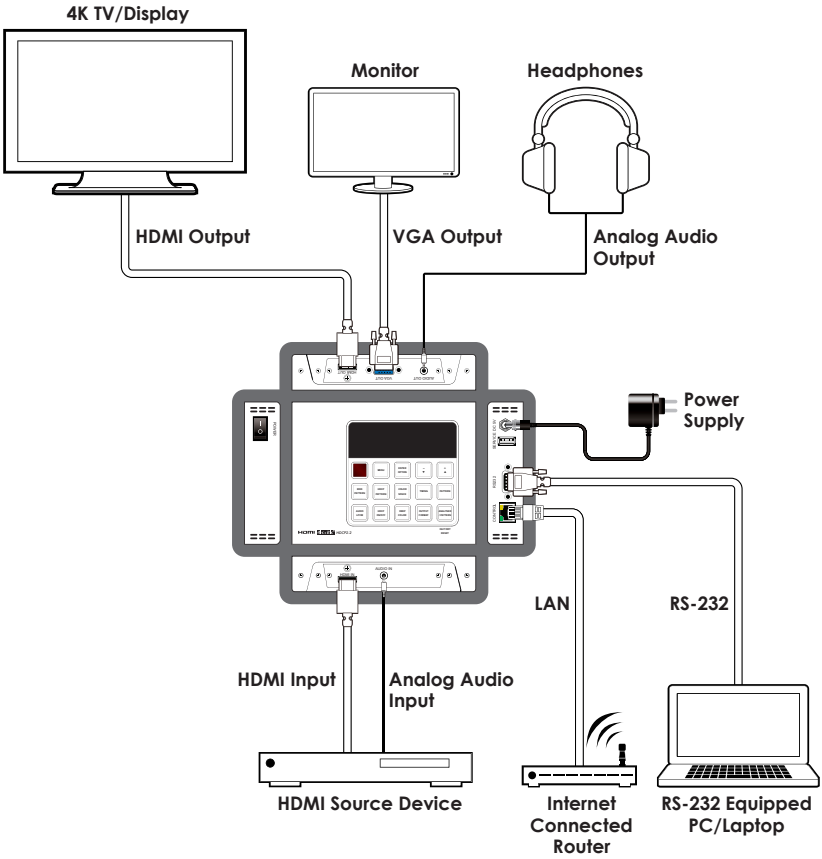


This will connect us to the unit we wish to control. Type "help" to list the available commands.

Notes:

- *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.*
- *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.*

7. CONNECTION DIAGRAM



8. SPECIFICATIONS

8.1 Technical Specifications

Video Bandwidth	600 MHz/18Gbps
Input Ports	1×HDMI 1×3.5mm Stereo
Output Ports	1×HDMI 1×VGA 1×3.5mm Stereo
Control Ports	1×RS-232 (DB-9) 1×IP Control (RJ45)
Power Supply	5V/2.6A DC (US/EU standards, CE/FCC/UL certified) or 2.1A USB Power
ESD Protection	Human body model: ±8 kV (air-gap discharge) ±4 kV (contact discharge)
Dimensions	120mm×30mm×155mm (W×H×D) [Case Only] 125mm×30mm×162mm (W×H×D) [All Inclusive]
Weight	796g
Chassis Material	Metal
Color	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 Color 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 color depth is supported.

* = Specified color 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
Analog 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
CED	Character Error Detection
EDID	Extended Display Identification Data
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDR	High Dynamic Range
IR	Infrared
OLED	Organic Light Emitting Diodes
OSD	On-Screen Display
PoR	Power on Reset
RB	Reduced Blanking
SCDC	Status and Control Data Channel

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