XA-3P

Portable HDMI Pattern Generator, Analyser & Cable Tester (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	26/02/2018	First release

CONTENTS

1. INTRODUCTION

This portable HDMI Signal Generator & Analyser provides a convenient way to test and verify all aspects of an HDMI signal path, including source and sink. This unit complies with the HDMI 2.0a and HDCP 1.4/2.2 standards. The unit's Analyser mode complies with the CEA standard HDR static metadata extensions CEA-861-F and CEA-861.3 for EDID analysis.

The unit is powered by a single rechargeable Lithium-ion battery (not included). Beyond the Lithium-ion battery, the unit may also be powered (and the battery recharged) via the micro USB port. An external power bank can also be used to extend the portable service time. 4K sources can be scaled down to 1080p output in Analyser mode to support a wider range of displays when analysing high-bandwidth sources.

The unit has an integrated OLED display which provides a way to quickly and clearly view the current signal state or the results of signal analysis. This portable handheld design is ideal for both the professional end user and installation engineer alike.

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 (Portable Version)
- 1×USB Mirco-B to USB Type-A Cable
- 1×Operation Manual

4. SYSTEM REQUIREMENTS

HDMI 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.

5. FEATURES

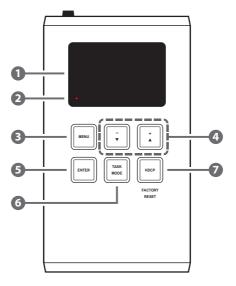/// HDMI input and output with 18Gbps (600MHz) 4K UHD support

/// DVI 1.0 compliant with the use of an HDMI-DVI adaptor

/// HDCP 1.4 and 2.2 compliant

/// Supports HD resolutions up to 4096×2160@60Hz (4:4:4, 8-bit)

/// Source bypass support in Analyser mode

/// 4K sources can be scaled down to 1080p in Analyser mode to support a wider range of displays when analysing a high-bandwidth source

/// HDR bypass and analysis support

/// Source video, audio and timing analysis

/// Analysis and emulation of EDID data

/// HDCP and SCDC monitoring functions

/// HDMI packet analysis

/// Analyser mode complies with the CEA standard HDR static metadata extensions CEA-861-F and CEA-861.3

/// 23 selectable output resolutions available in Test Pattern mode

/// 11 selectable static test patterns in Test Pattern mode

/// HDMI 2.0 cable test function including tests for 5V, CEC and hot-plug detection support

/// Supports LPCM 2.0, 5.1, and 7.1 audio output with adjustable sinewave frequencies for each channel

/// Comprehensive EDID management support with 10 built-in default EDIDs and 10 user EDIDs copied from sink devices

/// Powered by a single Lithium-ion battery (not included) or use of an external USB power bank can provide extended operation time

/// OLED display with rapid updates of current status information

/// Supports optional Windows control software

/// Supports USB firmware update

/// Portable palm-sized design with easy to use front-panel controls

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6. OPERATION CONTROLS AND FUNCTIONS

6.1 Front Panel

1 OLED: This screen's layout changes depending on the unit's operational mode and selected function. The status lines at the top shows the unit's current operational mode (Analyser, Pattern, or Cable Test), USB port mode (power or control), power status, and mode-specific detection details. Information below the status lines consists of either the unit's menu or signal analysis data.

A **Analyser Mode:** The status line will display the 5V, TMDS clock, and sync detection state of the connected source. (1 = detected, 0 = not detected.)

```
Analyser  P1 ▮▮▮
5V. 0  Clk. 0  Syn. 0
◀ Main Menu ▶
Input Setup
Monitor Source
Monitor HDCP
Monitor SCDC
```

B **Pattern Mode:** The status line will display the RxSense and Hot-plug detection state of the connected display. (1 = detected, 0 = not detected.)

```
Pattern  P1 ▮▮▮
RSense. 0 HPD. 0
◀ Main Menu ▶
Output Setup
Monitor Sink
Monitor HDCP
Monitor SCDC
```

C **Cable Test Mode:** The status line will display a cable connection graphic.

```
Cable T.  P1 ▮▮▮
IN ▶――――◀OUT
◀ Main Menu ▶
Run Test
Cable Setup
Setup
Information
```

2 **BATTERY CHARGING LED:** The battery charging LED will illuminate red when a USB power source is connected and actively charging the battery.

3 **MENU:** Press to back out from menu items and return to the main OLED menu screen.

4 **+/▲ & −/▼:** Press to move up and down or adjust selections within menus.

5 **ENTER:** Press to confirm a selection or to go deeper into a menu item.

Note: In Analyser and Pattern modes, press and hold this button for 2 seconds to turn audio On or Off.

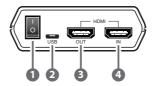**6** **TASK MODE:** Press to switch the unit between Analyser Mode, Pattern Mode, and Cable Test Mode.

Note: In Analyser mode, press and hold this button for 2 seconds to toggle the input's hot plug trigger. In Pattern mode, press and hold this button for 2 seconds to enable or disable the output's AV Mute function.

7 **HDCP:** Press to switch between supported HDCP versions (1.4, 2.2) or to disable HDCP. In Analyser mode, this changes the HDCP versions supported by the input port. In Pattern mode, this changes the HDCP required by the output port.

Note: The button's outline will light up according to the HDCP state and current version supported. Red = HDCP 1.4, blue = HDCP 2.2, off = HDCP disabled, flashing = HDCP authentication failure.

Factory Reset: Pressing and holding the HDCP button during power on will reset the unit to its factory default settings.

6.2 Top Panel

1 **POWER:** Flip this switch to turn the unit ON or OFF.

2 **USB:** Multi-function port for power/battery charging, firmware update or RS-232 command control.

Note: USB operation modes are changed within the OLED Setup menu.

3 **HDMI OUT:** Connect to an HDMI TV, monitor or amplifier for digital video and audio output.

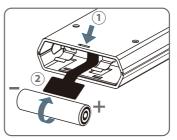**4** **HDMI IN:** Connect to HDMI source equipment such as a media player, game console or set-top box.

6.3 Battery Compartment

While this unit may be powered directly via the USB port, it is more typically powered by a rechargeable Lithium-ion battery (not included) which is concealed within the bottom of the unit.

A **Opening the Compartment:** Use a small flathead screwdriver to gently, but firmly, press down into the slot ① behind the base panel and the bottom cover will pop out.

B **Removing the Battery:** If a battery is already installed, a Mylar tab ② will be visible beneath the battery. Pull on the Mylar tab to pop the battery out of its holding brackets.

C **Inserting the Battery:** Turn the unit so that it is face down and align the battery so that the positive terminal of the battery (marked with a +) is aligned with the positive (+) marking on the right-hand side on the back of the battery compartment. Extend the Mylar tab out of the battery compartment, then place the battery on top of the extended tab and slide the battery into the unit until it snaps into the holding brackets as shown in the illustration.

D **Closing the Compartment:** After the battery has been properly inserted, place the battery compartment cover back into the bottom of the unit by first fitting the 2 small tabs on the cover into the 2 slots in the case and then gently snapping the cover into place.

E **Charging the Battery:** Connect a USB charger (5V/2.1A minimum) to the USB port to charge the unit's battery until it is full. The typical charging time, from empty to full, is approximately 3 hours while the unit's power is off. Average operation time from a fully charged battery is roughly 4 hours, but might be less depending on specific usage and battery quality.

Note: A battery is not included in the standard package, however the Panasonic NCR18650B (3.6V/3350mAh) Lithium-ion rechargeable battery is recommended.

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6.4 OLED Display

Power Saving Mode

The OLED display will automatically switch off after the set number of minutes. All other functions of the unit will continue normally while the display is turned off and the HDCP button will slowly flash red to indicate it is in power saving mode. To turn the OLED display back on, press any key. This power saving feature is only available while the unit is not receiving power via USB.

USB Port Function

🔋	Battery charge mode.
🔧	RS-232 control mode.
⚙	Firmware update mode.

Power Status

🔌	External power only. No battery present.
🔋	External power. Battery at max charge.
⚡	External power. Battery charging.
▮▮▮▮	Battery power with ~100% charge.
▮▮▮	Battery power with ~75% charge.
▮▮	Battery power with ~50% charge.
▮	Battery power with under 25% charge. Icon flashes to indicate recharge needed.
▯	Battery power is critically low. Auto shutdown.

6.5 OSD Menu

6.5.1 Analyser Mode

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Input Setup	Hotplug Time	50ms ~ 500ms **(150ms)**
	Hotplug Toggle	
	RxSense*PoR	**On**
		Off
	DDC Bus*PoR	**On**
		Off
	HDCP Port*PoR	v1.4
		v1.4+v2.2
		Off
	HDCP REAUTH-REQ	
	4K to 1080p	On YCbCr Out
		On RGB Out
		Off
	SCDC Port*PoR	**On**
		Off
	PC Tolerance	1 ~ 10 **(6)**
	❗ *Each step is ±1/1000.*	
Monitor Source	Timing	[Analytic Data]
	HDCP	
	Format	
	Colourspace	
	Audio	
	Deep Colour	
	AVI, AIF, HDR, VSI, AVMute, SPD, 3D	
Monitor HDCP (v1.4)	Source HDCP	[Analytic Data]
	Rx HDCP Port	

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ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Monitor HDCP (v1.4)	Aksv	[Analytic Data]
	Bksv	
	Ri Source	
	Ri' Rx	
	Count	
	Day 0 00 : 00 : 00	
Monitor HDCP (v2.2)	Source HDCP	[Analytic Data]
	Rx HDCP Port	
	TxCaps	
	RxCaps	
	Receiver ID	
	rn	
	riv	
Monitor SCDC	Rx SCDC Port	[Analytic Data]
	Sink Version	
	Source Version	
	Scramble Enabled	
	Scramble Status	
	Clock Detect	
	Ch2/1/0 Locked	
	CED Ch0	
	CED Ch1	
	CED Ch2	
	ENTER Reset/Start	
	HF VSDB	
	SCDC Exist	
Video Timing	Timing	[Analytic Data]
	TMDS Clock	
	Pixel Clock	

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ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Video Timing	Data Rate	[Analytic Data]
	Bit Depth, 3D, Y4:2:0, Scramble	
	Total (H/V Total Pixel/Line)	
	Act (H/V Active Pixel/Line)	
	Polarity (H/V Sync. Polarity)	
	Scan	
	HFreq (H Sync. Frequency)	
	VFreq (V Sync. Frequency)	
	Offset1 (H/V Sync. Offset1)	
	Offset2 (H/V Sync. Offset2)	
Audio Timing	ACR, AIF, ASP, HBR	[Analytic Data]
	N	
	CTS	
	ASP PLL Lock	
	ASP audio FIFO	
	ASP Layout	
	ASP Ch No.	
	CHS App. Type	
	CHS Audio Coding	
	CHS Ch No.	
	CHS Source No.	
	CHS Sampling Rate	
	CHS Sampling Size	

ANALYSER MODE		
LEVEL 1	LEVEL 2	LEVEL 3
Packet	GCP 0x03	[Analytic Data]
	AVI 0x82	
	AIF 0x84	
	SPD 0x83	
	VSIF H14b 0x81	
	DRMI (HDR) 0x87	
EDID Analyser	Sink	[Analytic Data]
	Rx EDID	
	[D1] DVI	[Default EDID Details]
	[D2] VGA	
	[D3] 8B LPCM PC	
	[D4] 8B LPCM HD	
	[D5] 12 BS 720p	
	[D6] 12 BS HD 3D	
	[D7] 12 BS 4K6G	
	[D8] 12 HBR 4K3G	
	[D9] 12 HBR 4K420	
	[D10] 12 HBR 4K6G	
	[C1 ~ 10] Copy 01 ~ 10	[Copied EDID Details]
EDID Emulator	Copy Sink	
	[D1] DVI	[Default EDID Details]
	[D2] VGA	
	[D3] 8B LPCM PC	
	[D4] 8B LPCM HD	
	[D5] 12 BS 720p	
	[D6] 12 BS HD 3D	
	[D7] 12 BS 4K6G	
	[D8] 12 HBR 4K3G	
	[D9] 12 HBR 4K420	

ANALYSER MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
EDID Emulator	[D10] 12 HBR 4K6G	[Default EDID Details]
	[C1 ~ 10] Copy 01 ~ 10	[Copied EDID Details]
EDID Copy Sink	[C1 ~ 10] Copy 01 ~ 10	[Copied EDID Details]
EDID Burn Sink	[D1] DVI	[Default EDID Details]
	[D2] VGA	
	[D3] 8B LPCM PC	
	[D4] 8B LPCM HD	
	[D5] 12 BS 720p	
	[D6] 12 BS HD 3D	
	[D7] 12 BS 4K6G	
	[D8] 12 HBR 4K3G	
	[D9] 12 HBR 4K420	
	[D10] 12 HBR 4K6G	
	[C1 ~ 10] Copy 01 ~ 10	[Copied EDID Details]
Setup	USB Port	**Power**
		RS-232
	OLED Contrast	0 ~ 8 **(6)**
	Firmware Update	Yes/**No**
	Power Saving	2min ~ 10min
		Off
	EDID Reset	Yes/**No**
	Factory Restore	Yes/**No**
Information	[Unit Version Details]	

🛈 **Factory Default**

Items in Bold are the factory default settings.

🛈 **Power-On Reset**

Items marked with *PoR will return to their factory default settings when the power is turned off.

6.5.2 Pattern Mode

PATTERN MODE		
LEVEL 1	LEVEL 2	LEVEL 3
Output Setup	Timing	[T1] 720×480p59
		[T2] 720×576p50
		[T3] 1280×720p25
		[T4] 1280×720p30
		[T5] 1280×720p50
		[T6] 1280×720p60
		[T7] 1920×1080i50
		[T8] 1920×1080i60
		[T9] 1920×1080p24
		[T10] 1920×1080p25
		[T11] 1920×1080p30
		[T12] 1920×1080p50
		[T13] 1920×1080p60
		[T14] 3840×2160p24
		[T15] 3840×2160p25
		[T16] 3840×2160p30
		[T17] 3840×2160p50
		[T18] 3840×2160p60
		[T19] 4096×2160p24
		[T20] 4096×2160p25
		[T21] 4096×2160p30
		[T22] 4096×2160p50
		[T23] 4096×2160p60
	Pattern	[P1] Black
		[P2] Blue
		[P3] Cyan
		[P4] Green
		[P5] Magenta

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Output Setup	Pattern	[P6] Red
		[P7] White
		[P8] Yellow
		[P9] Color Bar
		[P10] Grayscale 256
		[P11] V Line OnOff
	Format	**HDMI**
		DVI
	Colourspace	**RGB**
		YUV444
	ColourRange	**Full**
		Limited
	Audio LPCM***PoR**	2CH
		5.1CH
		7.1CH
	HDCP Out	v1.4
		v2.2
		Off
	HDCP V2.2 AKE_Stored_km()	On
		Off
	AVMute***PoR**	On
		Off
	Output***PoR**	**On**
		Off
	+5V Out	**Follow**
		On
Monitor Sink	HDCP Port/Auth	[Analytic Data]
	EDID	
	SCDC Port	

PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Monitor HDCP (Output HDCP 1.4)	Tx HDCP	[Analytic Data]
	Sink HDCP Port	
	Aksv	
	Bksv	
	Ri Tx	
	Ri' Sink	
	Count	
	Day 0 00:00:00	
Monitor HDCP (Output HDCP 2.2)	Tx HDCP	[Analytic Data]
	Sink HDCP Port	
	TxCaps	
	RxCaps	
	Receiver ID	
	rn	
	riv	
	Stored km	
	Sink REAUTH	
	Count	
	Day 0 00:00:00	
Monitor SCDC	Sink SCDC Port	[Analytic Data]
	Sink Version	
	Source Version	
	Scramble Enable	
	Scramble Status	
	Clock Detect	
	Ch2/1/0 Locked	
	CED Ch0	
	CED Ch1	
	CED Ch2	

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PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Monitor SCDC	ENTER Reset/Start	[Analytic Data]
	HF VSDB	
	SCDC Exist	
Audio Output	Volume	0 ~ 80 **(70)**
	Sample Rate	**48 kHz**
		96 kHz
		192 kHz
	Word Length	16 Bits
		20 Bits
		24 Bits
	Channels*PoR	2
		5.1
		7.1
	SD0-L ~ SD03-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		
EDID Copy Sink		
EDID Burn Sink		
HDR Emulator	HDR Out	On
		Off
	AVI Colourimetry	BT.2020 (1)
		BT.2020 (2)
		No Data
		ITU601
		ITU709
		xvYCC601

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PATTERN MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
HDR Emulator	AVI Colourimetry	xvYCC709
		sYCC601
		Adobe Y601
		Adobe RGB
	EOTF	[0] SDR Lumi Range
		[1] HDR Lumi Range
		[2] SMPTE ST2084.2
		[3] Future EOTF
	Metadata Descr.	**S. Metadata Type 1**
		Reserved
	Max. Content L-L	0 ~ 65500 **(0)**
	Max. FrameAve L-L	0 ~ 65500 **(0)**
	AVI Colour Space	[Analytic Data]
	Sink EDID HDR	
Setup	USB Port	**Power**
		RS-232
	OLED Contrast	0 ~ 8 **(6)**
	Firmware Update	Yes/**No**
	Power Saving	2min ~ 10min
		Off
	EDID Reset	Yes/**No**
	Factory Restore	Yes/**No**
Information	[Unit Version Details]	

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

ⓘ **Power-On Reset**
Items marked with ***PoR** will return to their factory default settings when the power is turned off.

6.5.3 Cable Test Mode

CABLE TEST MODE		
LEVEL 1	**LEVEL 2**	**LEVEL 3**
Run Test (Enter–Start/Stop)	[Testing Specifications]	[Analytic Data] (PASS or FAIL result)
	+5V	
	Hotplug	
	DDC Bus	
	CEC	
	4K6G A/V	
Cable Setup	Level	**Normal**
		Strict
	Length	**2M**
		3M
		4M
		5M
	Time	**2 minute**
		5 minute
		10 minute
		15 minute
		30 minute
		1 hour
		Infinite
Setup	USB Port	**Power**
		RS-232
	OLED Contrast	0 ~ 8 **(6)**
	Firmware Update	Yes/**No**
	Power Saving	2min ~ 10min
		Off
	EDID Reset	Yes/**No**
	Factory Restore	Yes/**No**
Information	[Unit Version Details]	

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ⓘ **Factory Default**

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

ⓘ **Run Test**

Once the testing begins, the test progress bar and the final PASS or FAIL result shows on the 2nd page. Please press the down button to view this information.

ⓘ **Cable Testing**

The cable testing feature performs tests based on the HDMI 2.0 error rate tolerance specification for 18Gbps signals and is provided as an advisory tool only. It is recommended that each cable under test should be tested at least three times to help eliminate outlier results.

6.5.4 Test Timings

1. Output Resolutions (Pattern Mode)

This unit supports a total of 23 output resolution timings when in Pattern Mode.

Test Timing List	Hz	ID
720×480p	59	**T01**
720×576p	50	**T02**
1280×720p	25	**T03**
	30	**T04**
	50	**T05**
	60	**T06**
1920×1080i	50	**T07**
	60	**T08**
1920×1080p	24	**T09**
	25	**T10**
	30	**T11**
	50	**T12**
	60	**T13**
3840×2160p	24	**T14**
	25	**T15**
	30	**T16**
	50	**T17**
	60	**T18**
4096×2160p	24	**T19**
	25	**T20**
	30	**T21**
	50	**T22**
	60	**T23**

2. Input/Output Resolutions (Analyser Mode)

This unit provides 3 options for how to handle the output of 4K video input sources when in Analyser mode. These choices are selectable from the "Input Setup" menu using the "4K to 1080p" item.

To pass the 4K source without modification set "4K to 1080p" to "Off".

To scale the 4K source down to 1080p and output as YCbCr, set it to "On YCbCr Out".

To scale the 4K source down to 1080p and output as RGB, set it to "On RGB Out".

All other (non-4K) resolutions will be passed without modification regardless of this setting.

🔴 *When 4K sources are scaled down to 1080p they will maintain the same refresh rate. For example, if the source is 4K@24Hz, the scaled timing will be 1080p@24Hz.*

ℹ️ **Input/Output Resolution Support**

PC Resolution	Vertical Frequency (Hz)	Input HDMI	Output HDMI
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	70, 75, 85	✓	✓
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	✓	✓

PC Resolution	Vertical Frequency (Hz)	Input HDMI	Output HDMI
1680×1050p	60 (RB), 60	✓	✓
1920×1200p	60 (RB)	✓	✓

Note: RB = Reduced Blanking.

PC Resolution	Vertical Frequency (Hz)	Input HDMI	Output HDMI
480i	59, 60	✓	✓
480p	59, 60	✓	✓
576i	50	✓	✓
576p	50	✓	✓
720p	25, 29, 30	✓	✓
	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	✓	✓

Note: If a source resolution or timing is not natively supported, the resolution will be displayed on the unit as "Timing?".

6.5.5 Test Patterns

1. Output Video Support (Pattern Mode)

There are a total of 11 test patterns available for output when in Pattern Mode.

Test Pattern Name	Variations	ID
Black		P01
Blue		P02
Cyan		P03
Green		P04
Magenta		P05
Red		P06
White		P07
Yellow		P08
Colour Bar		P09
Grayscale 256		P10
Line On/Off-V		P11

1. Black	2. Blue	3. Cyan	4. Green

5. Magenta	6. Red	7. White	8. 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.

9. Colour Bar

The **Colour Bar** pattern is a series of repeating vertical coloured bars (white, yellow, cyan, green, magenta, red, blue, black).

⚠ *This pattern is not available when the output colour range is set to "Limited".*

10. Grayscale 256

Gray

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.

⚠ *This pattern is not available when the resolution is below 1080i, the colour space is set to YUV 4:4:4, or the colour range is set to "Limited".*

11. Line On/Off-V

White & Black Lines

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.

⚠ *When outputting 4K@50/60Hz the pattern will consist of double, rather than single, pixel lines.*

This pattern is not available when the colour space is set to YUV 4:4:4, or the colour range is set to "Limited".

2. Output Audio Support (Pattern Mode)

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

6.6 RS-232 Protocol

When the unit is set to RS-232 mode in the System menu and connected to a PC via a USB cable, the following COM port settings should be used for direct control.

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

6.7 RS-232 Commands

Before using the commands, please read the following:

ℹ 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.

ℹ 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).

ℹ 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.

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COMMANDS	
DESCRIPTION	**VARIABLES**
$?↵	
Show full command list.	
$HELP↵	
Show full command list.	
$4K_TO_1080P N1↵	
Set the 4K downscaling mode.	Available values for **N1**: OFF　　　　　　[No downscaling] ON_RGB　　　　[1080p, RGB colour] ON_YUV　　　　[1080p, YUV colour]
$4K_TO_1080P?↵	
Display the current 4K downscaling mode.	
$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

COMMANDS	
DESCRIPTION	**VARIABLES**
$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_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**
$CABLE_LEVEL N1↵	
Set the cable test level.	**N1** = NORMAL, STRICT
$CABLE_LEVEL?↵	
Display the cable test level.	
$CABLE_RESULT?↵	
Display the cable test result.	
$CABLE_RUN N1↵	
Start or stop the cable testing process.	**N1** = START, STOP
$CABLE_RUN?↵	
Display the cable test status.	
$CABLE_TIME N1↵	
Set the testing time for the cable test.	Available values for **N1**: 1 [2 Minutes] 2 [5 Minutes] 3 [10 Minutes] 4 [15 Minutes] 5 [30 Minutes] 6 [1 Hour] 7 [Infinite]
$CABLE_TIME?↵	
Display the currently set testing time.	
$COLOR_SPACE N1↵	
Set the output colour space.	Available values for **N1**: RGB [RGB 4:4:4] Y444 [YCbCr 4:4:4]
$COLOR_SPACE?↵	
Display the current output colour space.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$EDID_COPY_SINK N1 ↵	
Copy the current HDMI sink's EDID to the designated copy slot.	**N1** = C1 ~ C10
⚠️ *If the copy fails "$err" will be displayed.*	
$EDID_MANUF? N1 ↵	
Display the manufacturer name stored in the EDID of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink]
⚠️ *If the EDID fails to be read, "$err_ddc" will be displayed.* *If the EDID has invalid content, "$err_bad" will be displayed.*	
$EDID_MODEL? N1 ↵	
Display the model/monitor name stored in the EDID of the selected location.	Available values for **N1**: RX [HDMI Input (Rx) Port] SINK_H [HDMI Sink]
⚠️ *If the EDID fails to be read, "$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

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COMMANDS	
DESCRIPTION	**VARIABLES**

$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] |

🔴 *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] |
| | 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.

$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   [Current HDMI sink] |

$EDID_RX?↵

| Display the current EDID selection for the unit's HDMI input (Rx). | |

COMMANDS

DESCRIPTION	VARIABLES
$EDID_TYPE? N1↵	
Display the EDID type of the selected location.	Available values for **N1**: RX [HDMI Input(Rx) Port] SINK_H [HDMI Sink]

> ⛔ *If the EDID fails to be read, "$err_ddc" will be displayed.*
>
> *If the EDID has invalid content, "$err_bad" will be displayed.*

DESCRIPTION	VARIABLES
$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] 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.*

DESCRIPTION	VARIABLES
$FACTORY↵	
Execute a factory reset and reboot the unit.	

> ⛔ *Stored Copy EDIDs and Ethernet settings will not be reset.*

DESCRIPTION	VARIABLES
$FWVER?↵	
Display the current firmware version.	

DESCRIPTION	VARIABLES
$HDCP_IN_SW N1↵	
Enable or disable HDCP support for the unit's HDMI input.	**N1** = ON, OFF

> ⛔ *Affects Analyser mode only.*

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COMMANDS	
DESCRIPTION	**VARIABLES**
$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.*	
$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.	

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COMMANDS	
DESCRIPTION	**VARIABLES**
$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 the current maximum HDR frame-average light level.	
$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.	

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COMMANDS	
DESCRIPTION	**VARIABLES**
$HDR_TX_COL N1↵	
Set the HDMI output (Tx) AVI Colourimetry mode.	Available values for **N1**: 1 [No Data] 2 [ITU 601] 3 [ITU 709] 4 [xvYCC 601] 5 [xvYCC 709] 6 [sYCC 601] 7 [Adobe Y601] 8 [Adobe RGB] 9 [BT.2020 (1) $Y'_C C'_{BC} C'_{RC}$] 10 [BT.2020 (2) $R'G'B'/Y'C'_B C'_R$]
$HDR_TX_COL?↵	
Display the current HDMI output (Tx) AVI Colourimetry mode.	
$MODEL?↵	
Display the unit's model number.	
$PATTERN N1↵	
Select the test pattern to output.	Available values for **N1**: 1 [Black] 2 [Blue] 3 [Cyan] 4 [Green] 5 [Magenta] 6 [Red] 7 [White] 8 [Yellow] 9 [Colour Bar] 10 [Grayscale 256] 11 [V Line On/Off]
$PATTERN?↵	
Display the current test pattern selection.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$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 the 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).	
$RX_SCDC N1↵	
Enable or disable the SCDC port function on the HDMI input (Rx).	**N1** = ON, OFF

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COMMANDS	
DESCRIPTION	**VARIABLES**
$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 HDCP status detection]
HDCP_AKSV	[Sink AKSV in 2-digit hex (HDCP v1.4)]
HDCP_BKSV	[Rx BKSV in 2-digit hex (HDCP v1.4)]
HDCP_RXID	[HDCP Rx ID in 2-digit hex (HDCP v2.2)]
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]

$SOURCE_DETECT? N1↵	
Displays a variety of source detection status and informational values.	Available values for **N1**: See below.

5V	[5V detection state]
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)]
SCDC_SCR_ENABLE	[Rx SCDC source enable scrambling state]
SCDC_SCR_STATUS	[SCDC sink scrambling status]
SCDC_SINK_VER [SCDC sink version]	

COMMANDS

DESCRIPTION	VARIABLES
SCDC_SOURCE_VER	[SCDC source version]
CKDT	[TMDS clock detection]
DATA_RATE	[Video data rate in Mbps]
TMDS_FORMAT	[Detected TMDS format (DVI/HDMI)]
SCDT	[TMDS sync detection]
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 (Ref. "Source Video Timing List")]
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/normal)]
ASP_LAYOUT	[Audio-Sample packet layout]
ASP_PLL	[Audio-Sample packet PLL (locked/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 app type (consumer/professional)]
HBR	[High-Bit-Rate packet status]
AIF	[Display packet-AIF data in 2-digit hex]

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COMMANDS	
DESCRIPTION	**VARIABLES**
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**: CABLE [Cable Test Mode] ANALYSER [Analyser Mode] PATTERN [Pattern Mode]

$TASK_MODE?↵	
Display the unit's current operation mode.	

$TIMER_DAY?↵	
Display the unit's test timer day value.	

$TIMER_HOUR?↵	
Display the unit's test timer hour value.	

$TIMER_MINUTE?↵	
Display the unit's test timer minute value.	

$TIMER_SECOND?↵	
Display the unit's test timer second value.	

COMMANDS	
DESCRIPTION	**VARIABLES**
$TIMING N1 ↵	
Select the output resolution timing to use.	Available values for **N1**:
	1 [720×480p@59]
	2 [720×576p@50]
	3 [1280×720p@25]
	4 [1280×720p@30]
	5 [1280×720p@50]
	6 [1280×720p@60]
	7 [1920×1080i@50]
	8 [1920×1080i@60]
	9 [1920×1080p@24]
	10 [1920×1080p@25]
	11 [1920×1080p@30]
	12 [1920×1080p@50]
	13 [1920×1080p@60]
	14 [3840×2160p@24]
	15 [3840×2160p@25]
	16 [3840×2160p@30]
	17 [3840×2160p@50]
	18 [3840×2160p@60]
	19 [4096×2160p@24]
	20 [4096×2160p@25]
	21 [4096×2160p@30]
	22 [4096×2160p@50]
	23 [4096×2160p@60]
$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 video output format.	**N1** = HDMI, DVI

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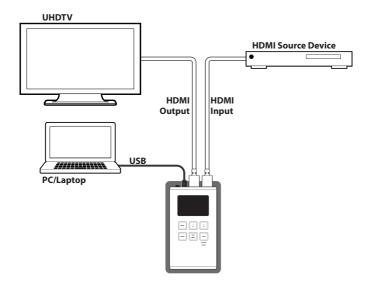
COMMANDS	
DESCRIPTION	**VARIABLES**
$TMDS_FORMAT?↵	
Display the current video output format.	
$TMDS_SW N1↵	
Enable or disable video output.	**N1** = ON, OFF [Off disables video output]
$TMDS_SW?↵	
Display the current video output status.	
$TX_5V N1↵	
Set the unit's output +5V pin state to follow the 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.	

7. CONNECTION DIAGRAM

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8. SPECIFICATIONS

8.1 Technical Specifications

Video Bandwidth	600MHz/18Gbps
Input Port	1×HDMI
Output Port	1×HDMI
Control Interface	1×USB Micro-B
HDMI Cable Length	10m (1080p@60Hz, 12-bit)
	5m (4K@60Hz, 4:4:4, 8-bit)
Power Supply	5V/2.1A USB power or
	Lithium-ion battery (not included)
ESD Protection	Human Body Model:
	±12kV (Air Discharge)
	±8kV (Contact Discharge)
Dimensions	80mm×124mm×26.5mm (W×H×D)
	[Case Only]
	80mm×126mm×26.5mm (W×H×D)
	[All Inclusive]
Weight	260g
Chassis Material	Metal
Silkscreen Color	Silver
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	4.7W

Note: A battery is not included in the standard package, however the Panasonic NCR18650B (3.6V/3350mAh) Lithium-ion rechargeable battery is recommended.

8.2 Operational Notes

Battery

- When the USB port is set to RS-232 mode some power is also provided to the unit via USB, however a properly charged battery is still required to fully operate the unit.
- Many USB hubs do not provide proper 5V power to connected devices. When using a USB hub to connect the unit to a PC, it is strongly recommended to power the unit with a fully charged battery.

Firmware Update

- From the main menu select "Setup"→"Firmware update"→"Yes". The unit will then enter the Firmware Update mode.
- Connect a USB cable between the unit & a PC. After connection, the PC will detect the unit as a USB storage device named "USB UPDATE" and the OLED display will read "Paste FW File...".
- Copy and paste a valid firmware *.BIN file into the USB UPDATE drive.
- After successfully copying the file, the unit will begin the update process. The OLED display will read "Programming..." followed by the HDCP button blinking rapidly. Please do not turn off the power during the programming phase.
- Once the update is complete the unit will automatically reboot.

Factory Reset

- To return the unit to its factory default settings, please press and hold the "HDCP" key while powering the unit on.

PC Control Software

- This unit may also be controlled via a Windows PC software application. For more details, please refer to the separate Control Software for Signal Generator & Analyzer manual.

Cable Testing

- The cable testing feature performs tests based on the HDMI 2.0 error rate tolerance specification for 18Gbps signals and is provided as an advisory tool only. It is recommended that each cable under test should be tested at least three times to help eliminate outlier results.

9. ACRONYMS

ACRONYM	COMPLETE TERM
3D	Three-Dimensional
CEC	Consumer Electronics Control
CED	Character Error Detection
DDC	Display Data Channel
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
EOTF	Electro-Optical Transfer Function
HD	High-Definition
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDR	High Dynamic Range
HDTV	High-Definition Television
Hz	Hertz
kHz	kilohertz
LED	Light-Emitting Diode
LPCM	Linear Pulse-Code Modulation
mAh	milliampere hour
min	minute
ms	millisecond
OLED	Organic Light-Emitting Diode
OSD	On-Screen Display
PC	Personal Computer
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

ACRONYM	COMPLETE TERM
TMDS	Transition-Minimised Differential Signaling
UHD	Ultra-High-Definition
UHDTV	Ultra-High-Definition Television
USB	Universal Serial Bus
VGA	Video Graphics Array