



CH-V502TR

4K UHD+ HDMI over IP Transceiver with USB Extension



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.
- Please completely disconnect the power when the unit is not in use to avoid wasting electricity.

VERSION HISTORY

REV.	DATE	SUMMARY OF CHANGE
RDV1	2019/05/27	Preliminary release



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1. INTRODUCTION

This HDMI over IP Transceiver with USB Extension is designed for high-quality, IP routable, AV extension with minimum latency. Every transceiver can be configured to function as either a transmitter or a receiver, enhancing the flexibility of any installation. By using a sophisticated ultra-light compression scheme (lossless for most content) it's a great solution for extending 4K HDMI audio/video streams and data. Advanced HDMI content such as HDR (High Dynamic Range), 10-bit color and multi-channel HD Bitstream audio can be extended in Bypass mode.

The use of high quality 10 Gigabit Ethernet ports and Cat.6A or better cable allows for point-to-point transmission of the video signal up to 100m. Multiple control and data signals may also be transmitted along with the audio and video, including IR, RS-232, USB 2.0, and Ethernet.

When combined with the optional IP Master Controller or control software, the functionality of the transceiver expands exponentially. Multiple transceivers may be combined with one or more 10 Gigabit Ethernet switches and the units can be used together to form a distributed video matrix, a multi-viewer system, or a video wall system adding to their flexibility in large event installations. The integrated USB hub of each transceiver can be configured to be in USB Host or Device Mode and can function as a simple point to point KVM extension, freely routed between any two endpoints, or it can be configured into a special "Simultaneous" mode, allowing up to 7 Host Mode transceivers to extend their USB ports to a single Device Mode transceiver. This type of USB KVM routing flexibility enables a wide range of multi-user, control room, or on-demand installation scenarios.

The unit may be powered directly by PoE when connected via Cat.6A to a 10 Gigabit Ethernet switch that provides PoE (802.3at) allowing for great flexibility in installation location. The built-in EDID and HDCP management functionality enables the unit to fit into every situation. Basic configuration of the unit can be achieved via front panel buttons with an OSD (On-Screen Display). Advanced control requires the optional IP Master Controller, or control software, and a LAN connection.

2. APPLICATIONS

- Video, Audio, LAN, IR, and USB extension
- Hotel or convention center display
- Multi-monitor broadcast
- Distributed video matrix system
- Distributed video wall system
- Remote KVM system control

3. PACKAGE CONTENTS

- 1× 4K UHD+ HDMI over IP Transceiver
- 1× 12V/3A DC Power Adapter
- 1× Power Cord
- 2× D-Sub to Terminal Block Cables (1 male, 1 female)
- 1× Operation Manual

4. SYSTEM REQUIREMENTS

- HDMI source equipment such as a media player, video game console, PC, or set-top box
- HDMI receiving equipment such as an HDTV, monitor, or audio amplifier
- Analog audio receiving equipment such as headphones, an audio amplifier or powered speakers
- A 10 Gigabit Ethernet network switch with jumbo frame and IGMP snooping support is required for distributed video systems (Optional, required for multi-transmitter/receiver systems)
- IP Master Controller or PC control software to configure distributed matrix, video wall or multi-view systems (Optional)

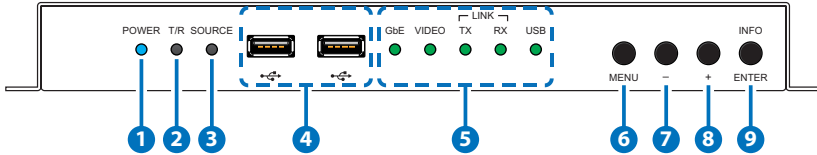


5. FEATURES

- HDMI 2.0 and DVI 1.0 compatible
- HDCP 2.2 and HDCP 1.x compliant
- Configurable as either a transmitter or a receiver
- 1 HDMI input
- 1 HDMI output (Functions as local monitor output in Transmitter Mode)
- 1 analog stereo audio jack (Functions as an input in Transmitter Mode or an output in Receiver Mode)
- 2 USB 2.0 (Type A) ports and 1 USB 2.0 (Mini B) port
- Ultra-light compression, lossless for most content
- Extension up to 100m in Point-to-Point mode (with Cat.6A cable)
- Supports independent breakaway A/V matrix switching with minimum latency, video wall generation, and multi-view compositing (requires optional IP Master Controller/control software)
- Supports pass-through of 10/12-bit HDR sources (Point-to-Point and Bypass modes only)
- Supports pass-through of audio formats including LPCM (up to 8 channels), Bitstream and HD Bitstream from HDMI sources
- Analog stereo audio extension, insertion and extraction (insertion and extraction requires optional IP Master Controller/control software)
- Bi-directional IR, RS-232, USB 2.0, and Ethernet extension
- Supports a special Simultaneous Mode for USB extension allowing a host connected to a single transceiver to connect to up to 7 transceivers with USB devices connected (mass storage devices are not supported in this mode)
- Unit can be powered directly by PoE when connected to a 10 Gigabit Ethernet (10GbE) switch that provides PoE (802.3at)
- Basic configuration via front panel buttons with an On-Screen Display (OSD)
- Supports the use of an external control center (IP Master Controller) or control software to provide expanded functionality (Contact your authorized dealer for more information)

6. OPERATION CONTROLS AND FUNCTIONS

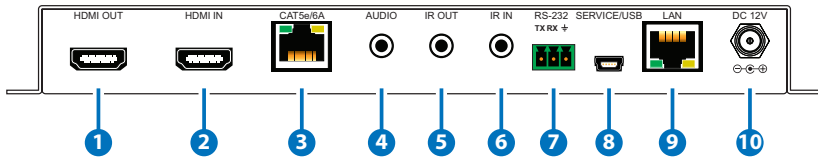
6.1 Front Panel



- 1 POWER LED:** This LED will illuminate to indicate the unit is on and receiving power.
- 2 T/R LED:** This LED indicates if the unit is in Transmitter (Green LED) or Receiver (Amber LED) mode.
- 3 SOURCE LED:** This LED will illuminate when the local HDMI input is live and selected.
- 4 USB 2.0 (Type A) Ports:** Connect directly to standard USB devices such as a mouse, keyboard or flash drive to extend their USB functionality to the currently active/routed USB Device Mode transceiver.
- 5 STATUS LED BLOCK**
 - A GbE LED:** This LED will illuminate and blink to indicate a live and active connection on the gigabit Ethernet port.
 - B VIDEO LED:** This LED will illuminate when a video signal is live on the 10GbE streaming port. When no video is active the LED will remain off, even if the streaming connection is valid.
 - C TX & RX LINK LEDs:** These LEDs will illuminate and blink to indicate data transmission and reception activity across the 10GbE streaming connection.
 - D USB LED:** This LED will illuminate when the unit's USB ports have successfully paired with the USB ports on another unit. This LED will blink if the unit's USB ports are not currently paired and in stand-by mode.
- 6 MENU BUTTON:** Press to enter the OSD menu, or to back out from menu items.
- 7 - (MINUS) BUTTON:** Press to move up or adjust selections within OSD menus. When not in a menu, press to manually toggle between inputs (Receiver Mode only).

- 8 **+ (Plus) BUTTON:** Press to move up or adjust selections within OSD menus. When not in a menu, press to manually toggle between inputs.
- 9 **ENTER/INFO BUTTON:** When inside an OSD menu, press to confirm a selection or to go deeper into a menu item. When not in a menu, press to activate the Information OSD.

6.2 Rear Panel



- 1 **HDMI OUT PORT:** Connect to an HDMI TV, monitor or amplifier for digital video and audio output.
- 2 **HDMI IN PORT:** Connect to HDMI source equipment such as a media player, game console or set-top box.
- 3 **CAT5e/6A PORT:** Connect directly to a compatible transmitter/receiver for Point-to-Point extension, or to a 10 Gigabit Ethernet switch for distributed matrixing (requires IP Master Controller or control software), with a single Cat.5e/6/7 cable for extension of all data signals.

Note: If the connected network switch supports the IEEE 802.3at-2009 PoE (Power over Ethernet) standard, this unit can optionally be powered directly via this Ethernet port.

- 4 **AUDIO PORT:**
 - A **Transmitter Mode:** Connect to the stereo analog output of a device such as a CD player or PC.
 - B **Receiver Mode:** Connect to powered speakers or an amplifier for stereo analog audio output.

Note: The signal is passed directly from the audio port on the transmitter to the audio port on the receiver in Point-to-Point configurations.

- 5 **IR OUT PORT:** Connect to an IR Blaster to broadcast IR signals from a connected transmitter/receiver to devices within direct line-of-

sight of the IR Blaster.

Note: Currently, only 38KHz IR signal extension is supported.

- 6 IR IN PORT:** Connect to an IR Extender to receive IR control signals and extend them to devices connected to a connected transmitter/receiver. Ensure that the remote being used is within direct line-of-sight of the IR Extender.

Note: Currently, only 38KHz IR signal extension is supported.

- 7 RS-232 TERMINAL BLOCK:** Connect directly to a PC, laptop or serial controllable device with a 3-pin adapter cable to extend the RS-232 signal between a transmitter and receiver.

- 8 SERVICE/USB 2.0 (Mini B) Port:** Connect directly to a standard USB host such as a PC or laptop to extend their USB functionality to all currently connected/routed USB devices.

Note: This port is only active when "USB Control Mode" is set to "Device". In a Point-to-Point extension configuration, only one transceiver should be set as a USB Device at a time.

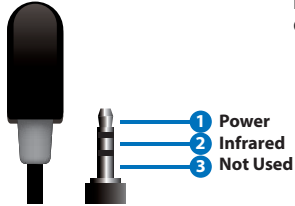
- 9 LAN PORT:** Connect to an Ethernet supporting device or to your local network as appropriate to extend the network between the transmitter and receiver.

- 10 DC 12V PORT:** Plug the 12V DC power adapter into this port and connect it to an AC wall outlet for power.

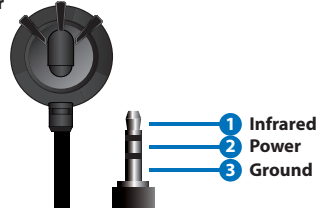
Note: Optional, not required if the unit is powered via PoE.

6.3 IR Cable Pinouts

IR Blaster Cable

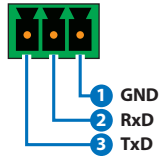


IR Extender Cable



6.4 RS-232 Bypass Pinout

3-pin Terminal Block



Serial Port Default Settings	
Baud Rate	57600
Data Bits	8
Parity Bits	None
Stop Bits	1
Flow Control	None

6.5 OSD Menu

All functions of this unit can be controlled by using the OSD (On Screen Display) which is activated by pressing the MENU button on the front of the unit. Use the + (PLUS), - (MINUS), and ENTER buttons to navigate the OSD menu. Press the MENU button to back out from any menu item and then press it again to close the menu.

MAIN MENU
OSD
EDID
HDCP
Device Setting
Information
Factory Setting

The individual functions of the OSD will be introduced in the following section. Items marked in **BOLD** are the factory default settings.

OSD	
2ND LEVEL	3RD LEVEL
Display Information	ON
	Off
Information Timeout	Off
	10~40 Sec [10 Sec]
Menu Timeout	Off
	10~40 Sec [10 Sec]
Menu H Position	0~100 [10] (Tx Mode)
	0~100 [90] (Rx Mode)
Menu V Position	0~100 [10] (Tx Mode)
	0~100 [90] (Rx Mode)

- 1) Display Information:** Enable or disable the Information OSD.
- 2) Information Timeout:** Set the display timeout for the Information OSD.

- 3) **Menu Timeout:** Set the display timeout for the OSD Menu.
- 4) **Menu H Position:** Set the horizontal position of the OSD Menu.
Note: Independent values are saved for Transmitter and Receiver modes.
- 5) **Menu V Position:** Set the display timeout for the OSD Menu.
Note: Independent values are saved for Transmitter and Receiver modes.

EDID	
2ND LEVEL	3RD LEVEL
HDMI EDID	INTERNAL 1 FHD (2Ch)
	Internal 2 FHD (MCh)
	Internal 3 UHD (2Ch)
	Internal 4 UHD (MCh)
	Internal 5 UHD+ (2Ch)
	Internal 6 UHD+ (MCh)
	External A
	External B (Transmitter Mode only)
	User 1
	User 2

- 1) **HDMI EDID:** Select the EDID to send to the HDMI input. This unit provides the following 6 internal EDIDs:

FHD (2Ch)	1920×1080p@60Hz (170MHz) 8-bit color, LPCM 2.0	LPCM 2.0
FHD (MCh)	1920×1080p@60Hz (170MHz) 8-bit color	LPCM 7.1 & Bitstream
UHD (2Ch)	3840×2160p@30Hz (300MHz) 12-bit Deep Color	LPCM 2.0
UHD (MCh)	3840×2160p@30Hz (300MHz) 12-bit Deep Color	LPCM 7.1 & Bitstream

UHD+ (2Ch)	3840×2160p@60Hz (600MHz) 12-bit Deep Color	LPCM 2.0
UHD+ (MCh)	3840×2160p@60Hz (600MHz) 12-bit Deep Color	LPCM 7.1 & Bitstream

Note: In some rare cases it is possible for custom or external EDIDs to cause compatibility issues with certain sources. If this happens, it is recommended to switch to one of the 6 internal EDIDs for maximum compatibility.

HDCP	
2ND LEVEL	3RD LEVEL
HDMI HDCP	Follow In
	FOLLOW OUT
	Disable
	Follow API (Transmitter Mode only)

- 1) **HDMI HDCP:** Set the HDCP behavior of the HDMI input.
- **Follow In:** The input supports up to the HDCP version required by the connected source.
 - **Follow Out:** The input supports up to the HDCP version supported by the connected display.
 - **Disable:** HDCP support is completely disabled.
 - **Follow API:** Uses the HDCP setting defined by the IP Master Controller or control software.

Note: Follow API is not valid in a Point-to-Point configuration.

DEVICE SETTING	
2ND LEVEL	3RD LEVEL
Status	TRANSMITTER
	Receiver
Fan Mode	FOLLOW TEMP
	Always On

DEVICE SETTING	
2ND LEVEL	3RD LEVEL
USB Control Mode	Host
	DEVICE
USB Virtual Hub (USB Device Mode only)	On
	OFF
Input (Receiver Mode only)	Input 1
	INPUT 2
Local Priority (Receiver mode only)	On
	OFF

- 1) **Status:** Set the operational mode of the transceiver. After changing the operation mode, the unit will automatically reboot.
- 2) **Fan Mode:** Set the fan's activation behavior. Selecting "Follow Temp" will result in the fan only turning on if the internal temperature becomes too high.
- 3) **USB Control Mode:** Enable or disable the USB 2.0 (Mini B) port for connection to USB host devices such as a PC or laptop. Selecting Device Mode enables the USB 2.0 (Mini B) port. Selecting Host Mode disables the USB 2.0 (Mini B) port.

Note: The default setting in Transmitter Mode is Device. The default setting in Receiver Mode is Host. In a Point-to-Point extension configuration, only one transceiver should be set as a USB Device at a time.

- 4) **USB Virtual Hub:** Enables or disables the simultaneous connection USB mode which allows the PC/Laptop connected to this unit to be paired with the USB devices on up to 7 "Host Mode" transceivers.

Note: Only available when the USB Control Mode is set to Device.

- 5) **Input:** Select the source to display on the HDMI output. Input 1 is the local HDMI input, Input 2 is the 10GbE streaming video input.

Note: Only available when the unit is in Receiver Mode.

- 6) **Local Priority:** Enable or disable the priority auto switch mode for the HDMI input. When enabled, the unit will automatically switch to the HDMI input if a live signal is present.

Note: Only available when the unit is in Receiver Mode.

INFORMATION	
2ND LEVEL	3RD LEVEL
Resolution	[Show the current status of each item]
Status	
FW Version	
IP	
LAN MAC	
USB MAC	
SN	
Fan Status	

- 1) **Information:** Shows details of the unit's current status including detected input resolution, transceiver mode, firmware version, IP address, MAC address, serial number and fan state.

FACTORY SETTING	
2ND LEVEL	3RD LEVEL
Are you sure?	NO
	Yes

- 1) **Factory Setting:** Selecting YES will reset the unit's settings back to their factory defaults.

Note: The transceiver mode will not be reset.

6.6 Basic AV Extension

6.6.1 Point-to-Point Configuration

The most basic extension configuration available is a point-to-point system with a single unit in Transmitter Mode connected directly to a single unit in Receiver Mode. In this configuration the HDMI input on the Transmitter is transmitted to the connected Receiver without modification to the audio or video format. The analog stereo audio port on the transmitter functions as an input and transfers audio directly to the analog stereo audio port on the receiver for output. The LAN, RS-232 and IR ports form direct connections between transmitter and receiver.



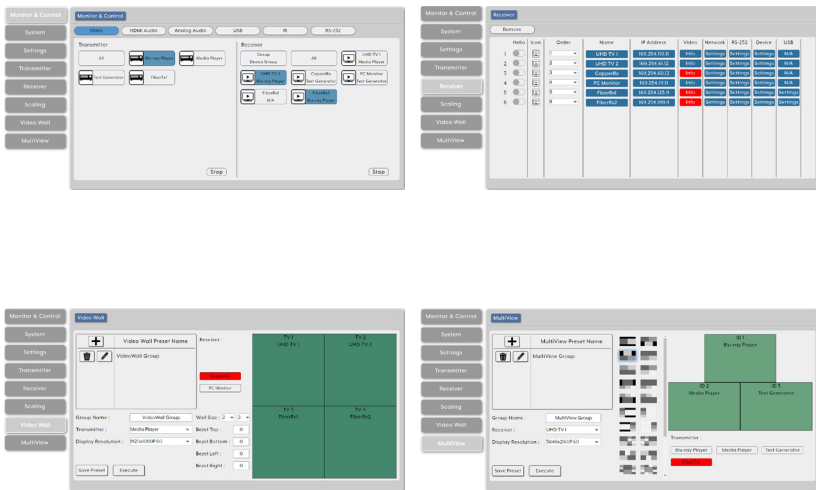
Note: This configuration does not use or require an external control center such as the IP Master Controller to function. No audio insertion/ extraction is performed in this configuration.

6.7 Advanced AV Extension

6.7.1 IP Master Controller

The IP Master Controller is a hardware solution designed to provide a unified and easy method to access and control all of the transmitters and receivers in a system. It provides a user-friendly, and operating system agnostic, web-based interface allowing easy control over all of the most critical functions within a distribution system.

The IP Master Controller hardware is an optional component and is not included with individual transmitter, receiver, or transceiver units. Please contact your authorized dealer for more information.

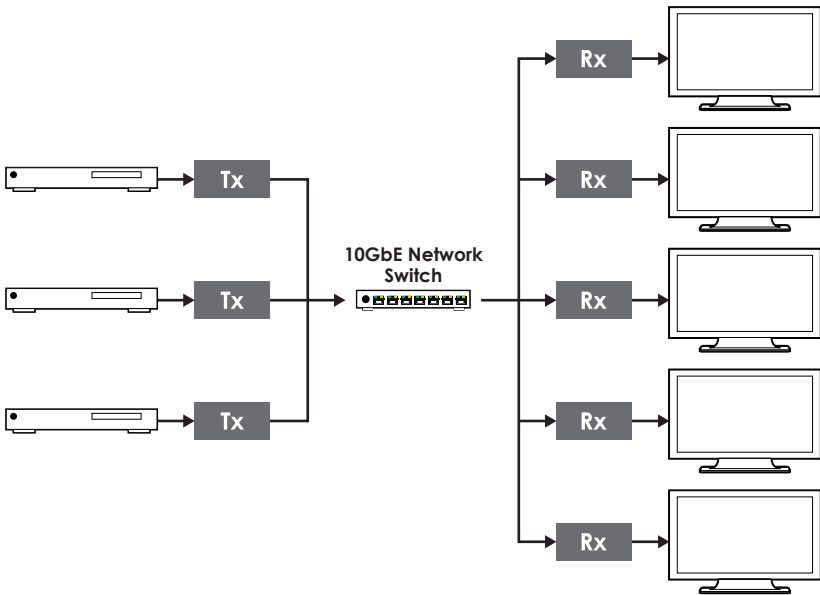


Note: Interface images are for example only and may differ from the delivered product. Full operational documentation can be found within the IP Master Controller's manual.

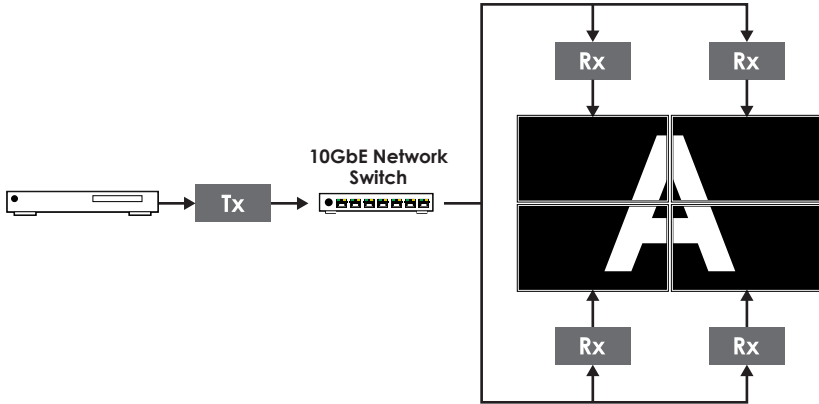
6.7.2 Configuration Examples

When combined with the IP Master Controller, and a 10 Gigabit Ethernet switch, this extension system gains a large number of additional configuration options including: multi-in/multi-out matrix switching with breakaway audio, video wall creation, and a multiview output mode. Audio extraction and embedding is fully controllable. Additionally, control over the configuration of the analog stereo audio port on Transmitter Mode transceivers becomes available, and audio/IR/RS-232 routing can be fully controlled.

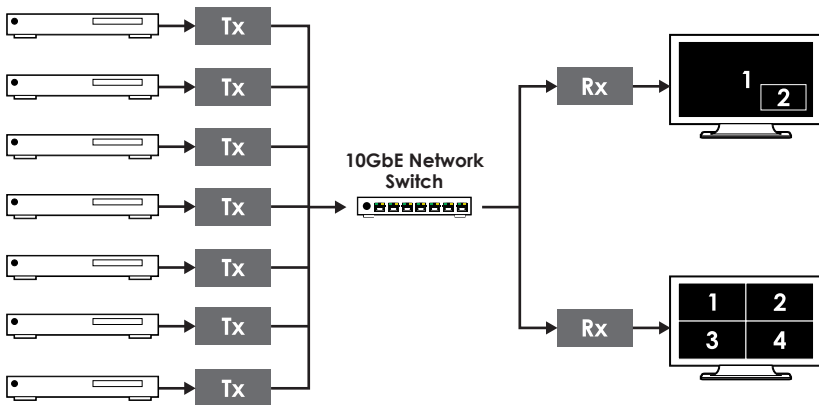
(1) Matrix Configuration



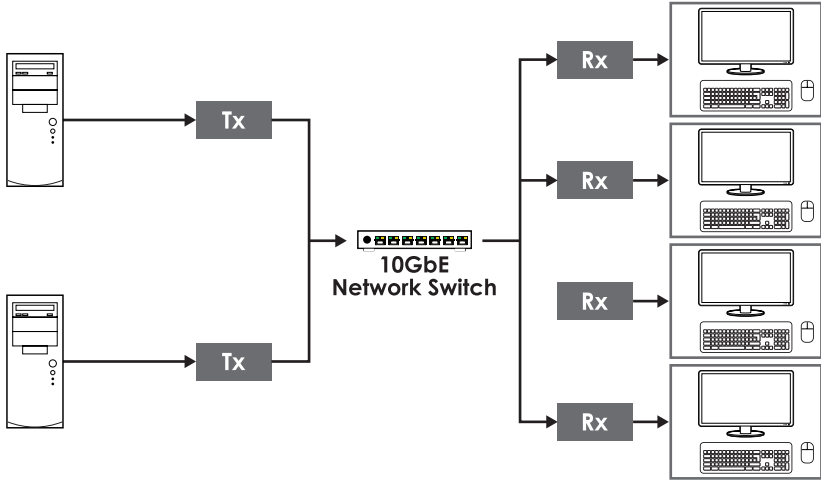
(2) Video Wall Configuration



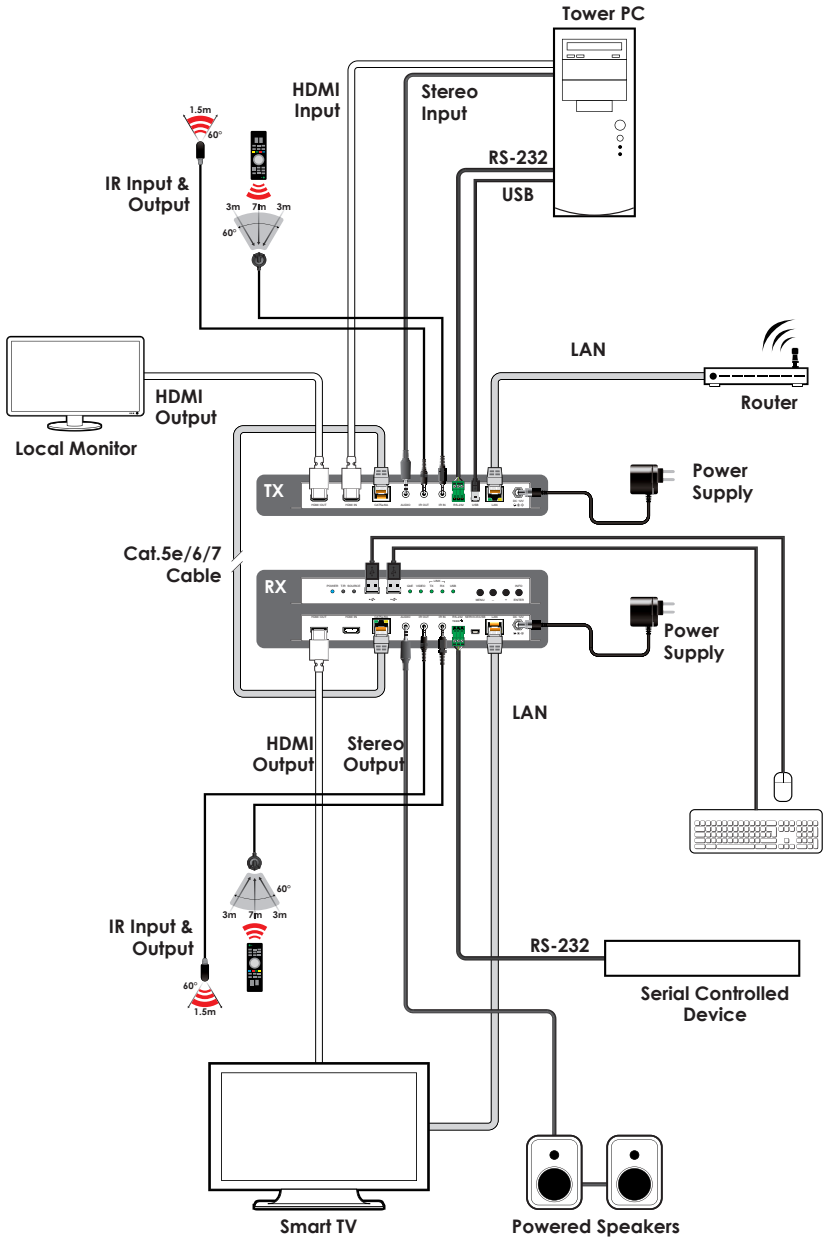
(3) Multiview (PiP/PoP/Quad/etc.) Configuration



(4) KVM Switch Configuration



7. CONNECTION DIAGRAM





8. SPECIFICATIONS

8.1 Technical Specifications

HDMI Bandwidth	18Gbps
Ethernet Bandwidth	10Gbps
Input Port	1×HDMI (Type-A)
Output Port	1×HDMI (Type-A)
Bi-directional Port	1×10GbE LAN (RJ-45)
Pass-through Ports	1×Stereo Audio (3.5mm) 1×RS-232 (3-pin Terminal Block) 1×IR Extender (3.5mm) 1×IR Blaster (3.5mm) 2×USB 2.0 (Type A) 1×USB 2.0 (Mini B)
Pass-through/Control Port	1×LAN (RJ-45)
IR Frequency	38kHz
Baud Rate	57600 (Default), up to 115200bps
Power Supply	12V/3A DC (US/EU standards, CE/FCC/UL certified)
ESD Protection (HBM)	±8kV (Air Discharge) ±4kV (Contact Discharge)
Dimensions (W×H×D)	215mm×25mm×108mm [Case Only] 215mm×25mm×116.7mm [All Inclusive]
Weight	968g
Chassis Material	Metal (Steel)
Silkscreen 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	24.5W

8.2 Video Specifications

Supported Resolutions (Hz)	Input	Output	Streaming
	HDMI	HDMI	10GbE
720×400p@70/85	✓	✓	✓
640×480p@60/72/75/85	✓	✓	✓
720×480i@60	✓	✓	✓
720×480p@60	✓	✓	✓
720×576i@50	✓	✓	✓
720×576p@50	✓	✓	✓
800×600p@56/60/72/75/85	✓	✓	✓
848×480p@60	✓	✓	✓
1024×768p@60/70/75/85	✓	✓	✓
1152×864p@75	✓	✓	✓
1280×720p@50/60	✓	✓	✓
1280×768p@60/75/85	✓	✓	✓
1280×800p@60/75/85	✓	✓	✓
1280×960p@60/85	✓	✓	✓
1280×1024p@60/75/85	✓	✓	✓
1360×768p@60	✓	✓	✓
1366×768p@60	✓	✓	✓
1400×1050p@60	✓	✓	✓
1440×900p@60/75	✓	✓	✓
1600×900p@60RB	✓	✓	✓
1600×1200p@60	✓	✓	✓
1680×1050p@60	✓	✓	✓
1920×1080i@50/60	✓	✓	✓
1920×1080p@24/25/30	✓	✓	✓
1920×1080p@50/60	✓	✓	✓

Supported Resolutions (Hz)	Input	Output	Streaming
	HDMI	HDMI	10GbE
1920×1200p@60RB	✓	✓	✓
2560×1440p@60RB	✓	✓	✓
2560×1600p@60RB	✓	✓	✓
2048×1080p@24/25/30	✓	✓	✓
2048×1080p@50/60	✓	✓	✓
3840×2160p@24/25/30	✓	✓	✓
3840×2160p@50/60 (4:2:0)	✓	✓	✓
3840×2160p@24, HDR10	✓	✓	✓
3840×2160p@50/60 (4:2:0), HDR10	✓	✓	✓
3840×2160p@50/60	✓	✓	✓
4096×2160p@24/25/30	✓	✓	✓
4096×2160p@50/60 (4:2:0)	✓	✓	✓
4096×2160p@24, HDR10	✓	✓	✓
4096×2160p@50/60 (4:2:0), HDR10	✓	✓	✓
4096×2160p@50/60	✓	✓	✓

8.3 Audio Specifications

8.3.1 Digital Audio

HDMI Input/Output	
LPCM	
Max Channels	8 Channels
Sampling Rate (kHz)	32, 44.1, 48
Bitstream	
Supported Formats	Standard & High-Definition

8.3.2 Analog Audio

Analog Input	
Max Audio Level	1Vrms
Impedance	10k Ω
Type	Unbalanced

Analog Output	
Max Audio Level	1Vrms
THD+N	< -80dB@0dBFS 1kHz (A-wt)
SNR	> 80dB@0dBFS
Frequency Response	< ± 1 dB@20Hz~20kHz
Crosstalk	< -80dB@10kHz
Impedance	470 Ω
Type	Unbalanced

8.4 Cable Specifications

Cable Length	1080p		4K30	4K60
	8-bit	12-bit	(4:4:4) 8-bit	(4:4:4) 8-bit
High Speed HDMI Cable				
HDMI Input	15m	10m	5m	3m
HDMI Output	15m	10m	5m	3m
Ethernet Cable				
Cat.5e/6	100m		70m	
Cat.6A/7	100m		100m	

- **1080p (FHD Video)**
 - Up to 1080p@60Hz, 12-bit color
 - Data rates lower than 5.3Gbps or below 225MHz TMDS clock
- **4K30 (UHD Video)**
 - 4K@24/25/30Hz & 4K@50/60Hz (4:2:0), 8-bit color
 - Data rates higher than 5.3Gbps or above 225MHz TMDS clock but below 10.2Gbps
- **4K60 (UHD+ Video)**
 - 4K@50/60Hz (4:4:4, 8-bit)
 - 4K@50/60Hz (4:2:0, 10-bit HDR)
 - Data rates higher than 10.2Gbps

9. ACRONYMS

ACRONYM	COMPLETE TERM
10GbE	10 Gigabit Ethernet
ADC	Analog-to-Digital Converter
AV	Audio/Video
Cat.5e	Enhanced Category 5 cable
Cat.6	Category 6 cable
Cat.6A	Augmented Category 6 cable
Cat.7	Category 7 cable
DAC	Digital-to-Analog Converter
DHCP	Dynamic Host Configuration Protocol
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
GbE	Gigabit Ethernet
HD	High-Definition
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDR	High Dynamic Range
HDTV	High-Definition Television
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IR	Infrared
KVM	Keyboard/Video/Mouse
LAN	Local Area Network
LED	Light-Emitting Diode
LPCM	Linear Pulse-Code Modulation
MAC	Media Access Control
OSD	On-Screen Display

ACRONYM	COMPLETE TERM
PC	Personal Computer
SDVoE	Software Defined Video over Ethernet
SNR	Signal-to-Noise Ratio
TCP	Transmission Control Protocol
THD+N	Total Harmonic Distortion plus Noise
UHD	Ultra-High-Definition (10.2Gbps)
UHD+	Ultra-High-Definition Plus (18Gbps)
UHDTV	Ultra-High-Definition Television
USB	Universal Serial Bus
VGA	Video Graphics Array
VLAN	Virtual LAN
VoIP	Video over IP
WUXGA (RB)	Widescreen Ultra Extended Graphics Array (Reduced Blanking)
XGA	Extended Graphics Array
XGA	Extended Graphics Array



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