



## DATA SHEET

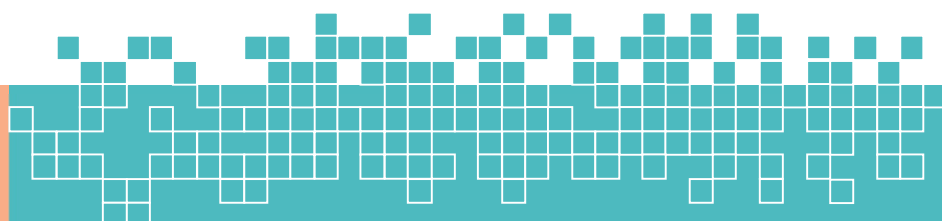


### **DisplayPort™ 1.4 to HDMI™ 2.1 Active Adapter R3 / B014E8ZC7E**

Connect to an HDMI Ultra HD display with High Dynamic Range from a DisplayPort-supported computer using the DisplayPort Active Adapter!

#### Overview

Designed specifically for those who enjoy high-level computing, graphics, and gaming. HDMI 2.1 up to 48Gbps allows even smooth 8K video playback, especially when combined with a 60Hz frame rate and HDR creating lifelike colors and movements giving users the ultimate visual experience. Converts DisplayPort video signal at up to 8K 7680×4320@60Hz with DSC or 4K 4096×2160@120Hz with DSC including 1440p at 240Hz.



## SPECIFICATIONS:

### **DisplayPort™ 1.4 to HDMI™ 2.1 Active Adapter R3 - B014E8ZC7E**

UPTab Active Adapter is a DisplayPort 2.0 to HDMI 2.1 Protocol Converter that receives both video and audio streams from DisplayPort link and converts to TMDS/FRL output. The DP receiver supports up to 8.1Gbps link rate over 4 lanes. The HDMI output port can support TMDS and FRL transmitter. The TMDS transmitter is compliant with HDMI 2.1 specification for the data rate up to 6Gbps and the FRL transmitter is compliant with HDMI 2.1 specification with the data rate up to 12Gbps. UPTab Active Adapter is capable of processing compressed or uncompressed video input. FEC decoding and encoding is employed for the reliable reception and transmission of DSC 1.1/1.2a compressed stream. UPTab Active Adapter supports HDCP 1.4 and HDCP 2.3 repeater for downstream sink with an embedded key. UPTab Active Adapter supports static and dynamic HDR metadata transport. UPTab Active Adapter integrates an on-chip microcontroller with an external SPI ROM.

#### **DisplayPort 2.0 Receiver**

- Compliant with DisplayPort Specification Version 2.0 for RBR, HBR, HBR2 and HBR3
  - DisplayPort 1, 2, and 4 lanes
  - Support SSC up to 0.5% down spread
  - DPCD supports DP v2.0 data structure
  - HDCP 2.3 and HDCP 1.3
- VESA Display Stream Compression Standard (DSC) v1.1/1.2a Bitstream Handling and FEC policy, DSC decoder and pass-through mode
- Supports DP source detection via AUX channel
- DP input port support lane swapping and polarity swapping
- Supports Horizontal Blanking Expansion (HBE)
- Supports Adaptive Sync Video
- Supports CEC-Tunneling-over-AUX

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### HDMI 2.1 Transmitter

- Compliant with HDMI Specification Version 2.1
  - TMDS data rate up to 6Gbps
  - FRL data rate up to 12Gbps
  - SCDC (Status and Control Data Channel)
  - HDCP 2.3 and HDCP 1.4
- Supports DSC pass-through mode
- TMDS and FRL modes with scrambling for EMI/RFI reduction
- Supports FRL FFE
- Supports static and dynamic HDR
- Supports up to 8 channels of 16-/20-/24-bit audio up to 192kHz sample frequency
- Supports IEC 60958 L-PCM, IEC 61937 compressed audio and 32-ch L-PCM 3D audio.
- Supports Variable Refresh Rate (VRR), Quick Media Switch (QMS), Auto Low Latency Mode (ALLM) and Dynamic Auto Lipsync (DALSL)
- Supports DVI output format

### General

- Supports multiple color formats:
  - DP: RGB 6/8/10/12 bits per component (bpc); YCbCr4:4:4/ YCbCr4:2:2 /YCbCr4:2:0 8/10/12 bpc
  - HDMI: RGB 8/10/12 bpc; YCbCr4:4:4, YCbCr4:2:2 and YCbCr4:2:0 8/10/12 bpc
- Supports color space conversion
- Contents protection HDCP repeaters with on-chip keys
- Supports DP HDCP 2.3 to HDMI HDCP 1.4 conversion
- On-chip MPU with Secure Boot
- Low power consumption
- External 25MHz  $\pm$ 50ppm crystal
- External 3.3V SPI Flash speed up to 54MHz
- 0°C to 70°C Ambient Operating Temperature Range

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## DISPLAYPORT™ RECEIVER

The DisplayPort Receiver interface is compliant with the VESA DisplayPort Standard, Version 2.0. UPTab Active Adapter (B014E8ZC7E) DPCD supports DP v2.0 data structure.

### Physical Layer (PHY)

The DisplayPort main link operates data rate up to 8.1Gbps. UPTab Active Adapter (B014E8ZC7E) DP Receiver receives serial data stream, de-serializes and decodes in ANSI 8B/10B format. Subsequently, the receiver unscrambles and de-skews the decoded data. DP RX EQ is programmable.

The DisplayPort AUX channel is a half-duplex, bi-directional channel, which supports bit rate at 1 Mbps. The logical sub-block of AUX channel generates and detects Start/Stop condition, locks to Sync pattern, and encode/decodes of data using Manchester-II coding. The electrical sub-block of AUX channel consists of one differential pair that operates as a half-duplex bi-directional channel. The AUX channel provides Link Configuration, Link maintenance and EDID access.

DisplayPort Hot Plug/Unplug detection is indicated by HPD signal. The pulsed HPD signal is also used as an Interrupt Request (IRQ) by sink device. The low-going pulse width within 0.5ms to 1.0ms is asserted as IRQ\_HPDP from sink device to source device, which shall read link status field of DisplayPort Configuration Data (DPCD) and take proper action.

### Link Layer

DisplayPort receiver Link Layer services reconstruct original video and audio data and timing base through isochronous transport services over main link. It also handles AUX Channel link and device services. The main link supports 4 lanes, 2 lanes and 1 lane at 1.62Gbps/2.7Gbps/5.4Gbps/8.1Gbps data rate. The optimal lane count and data rate shall be negotiated through capability discovery and link training between source and sink devices. The isochronous transport services of Link Layer provide packing/unpacking, stuffing/un-stuffing, framing/un-framing, inter-lane skewing/de-skewing and

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stream clock recovery as well as insertion/extraction of Main Stream Attributes data, and inserting/extracting of secondary-data packet with ECC (Error Control Code) for audio stream and CTA861-G Info Frame packets.

UPTab Active Adapter Revision 3 (B014E8ZC7E) DisplayPort receiver supports RGB444 (6/8/10/12-bit), YCbCr444 (8/10/12-bit), YCbCr422 (8/10/12-bit) and YCbCr420 (8/10/12) video input formats. Audio input supports up to 8 channels of 16-/20-/24-bit Audio up to 192kHz. Audio format supports IEC 60958 L-PCM, IEC 61937 compressed audio, One Bit Audio and DST, 32-ch L-PCM 3D audio.

### **HDMI TRANSMITTER**

The High-Definition Multimedia Interface (HDMI) implemented in UPTab Active Adapter (B014E8ZC7E) is fully compliant with the High-Definition Multimedia Interface Specification, Version 2.1.

Audio and video contents from the decoded DisplayPort audio and video streams are converted to HDMI 2.1 compliant TMDS output or HDMI 2.1 compliant FRL output. The HDMI TMDS output supports up to 6.0Gbps data rate, allowing display up to 4Kx2K at 60Hz refresh rate in 8-bit color and 3D video, up to 1080p at 120Hz. The HDMI 2.1 FRL output supports up to 12Gbps data rate, allowing display resolution up to 10K@50Hz in DSC pass-through mode. UPTab Active Adapter Revision 3 (B014E8ZC7E) HDMI TX requires minimum Horizontal Blanking to be 80 Tri-Bytes. Audio output supports up to 8 channels of 16-/20-/24-bit audio up to 192kHz. Audio format supports IEC 60958 L-PCM, IEC 61937 compressed audio, One Bit Audio and DST, 32-ch LPCM 3D audio. UPTab Active Adapter Revision 3 (B014E8ZC7E) HDMI TX supports scrambling in both TMDS and FRL modes. HDMI TX supports FFE in FRL mode. UPTab Active Adapter Revision 3 (B014E8ZC7E) supports SCDC (Status and Control Data Channel) via DDC bus for exchanging of point-to-point dynamic data between the Source and the Sink. UPTab Active Adapter Revision 3 (B014E8ZC7E) also features monitor hot plug detect (HPD) signal to detect the attachment or presence of a sink device.

### **HDCP**

HDCP provides a secure audio and video content on DisplayPort receiver and TMDS transmitter interfaces. UPTab Active Adapter Revision 3 (B014E8ZC7E) includes security measures to prevent discovery and nullification of the HDCP keys stored on-chip. UPTab Active Adapter Revision 3

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(B014E8ZC7E) supports HDCP version 1.3/2.3 specification (DP) and HDCP version 1.4/2.3 specification (HDMI). HDCP features are summarized below:

- The DisplayPort receiver performs upstream HDCP 1.3/2.3 function including HDCP authentication and HDCP decryption.
- The HDMI transmitter performs downstream HDCP 1.4/2.3 function including HDCP authentication and HDCP encryption.
- Software will interface with both upstream and downstream HDCP authentication engine to implement the HDCP repeater functions. However, HDCP keys are not accessible for Software.
- HDCP receiver and transmitter Key ROMs integrated

## **HOT PLUG DETECTION (HPD)**

UPTab Active Adapter Revision 3 (B014E8ZC7E) has two hot plug detection signals:

- HDMI\_HPDP: Downstream port hot plug detection input
- DP\_HPDP: Upstream port hot plug detection output

### **HDMI\_HPDP**

HDMI\_HPDP is an input signal. A HIGH on this signal indicates that a sink is connected. It is the hardware that is responsible for detecting the state change on this pin. Firmware will interpret the signal and take actions after the HDMI\_HPDP state change. HDMI\_HPDP state changes are mainly used for the UPTab Active Adapter Revision 3 (B014E8ZC7E) operation and power management.

### **DP\_HPDP**

DP\_HPDP is an output signal. A HIGH on this signal indicates that UPTab Active Adapter Revision 3 (B014E8ZC7E) is ready to take DisplayPort input. Firmware controls this signal according to B014E8ZC7E operation and power state machine.

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## **AUX TO I2C BRIDGE**

AUX to I2C Bridge acts as a bidirectional repeater function from DisplayPort AUX CH interface to HDMI DDC interface. It monitors DisplayPort AUX CH traffic and converts all the I2C-over-AUX CH transactions targeted to the HDMI sink device, into HDMI DDC interface.

The AUX to I2C Bridge provides an interface for UPTab Active Adapter Revision 3 (B014E8ZC7E) firmware to interface to AUX CH directly. This is to provide hardware support for firmware to handle all possible native AUX transactions and I2C-over-AUX transactions, including those targeted to the HDMI sink device.

The AUX to I2C Bridge also provides an interface for B014E8ZC7E to directly access HDMI DDC port. This function will be used when firmware needs to read EDID from downstream device, or to read downstream HDCP port directly.

## **CEC-Tunneling-over-AUX**

CEC-Tunneling-over-AUX is the tunneling of CEC messages using Native AUX transactions across DP AUX CH between a DP Source device and UPTab Active Adapter Revision 3 (B014E8ZC7E). The DP Source device operates as a CEC message consumer and producer, while UPTab Active Adapter Revision 3 (B014E8ZC7E) capable of CEC-Tunneling-over-AUX operation tunnels CEC messages between the DP Source device and CEC bus. UPTab Active Adapter Revision 3 (B014E8ZC7E) HDMI TX supports CEC specification 1.4b and 2.0.

## **DSC Bitstream Transport and FEC Policy**

UPTab Active Adapter Revision 3 (B014E8ZC7E) is a DP Branch device capable of DSC (Display Stream Compression) decompression. Its DSC decoder offers real-time decoding, and supports RGB, YCbCr 4:4:4, YCbCr Simple 4:2:2, YCbCr Native 4:2:2 and YCbCr Native 4:2:0 input formats. UPTab Active Adapter Revision 3 (B014E8ZC7E) DSC Slice Capabilities can support 8, 4, 2 and 1 slice per line. Decoding peak throughput for 4:4:4 and Simple 4:2:2 modes is up to 400MP/s. Decoding peak throughput for Native 4:2:2 and Native 4:2:0 modes is up to 800MP/s. The DP input DSC decoder feature solves the limitation of DP input bandwidth being less than FRL output bandwidth. Forward Error Correction (FEC) is provided to ensure visual glitch-free DSC Bitstream transport.

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UPTab Active Adapter Revision 3 (B014E8ZC7E) also supports DSC pass-through of DP stream from DP RX to HDMI TX. UPTab Active Adapter Revision 3 (B014E8ZC7E) can support 10KP50 (VIC 214) resolution with the DSC pass-through feature.

#### Pixel processing

UPTab Active Adapter Revision 3 (B014E8ZC7E) is capable of receiving RGB, YCbCr 4:4:4, YCbCr 4:2:2 and YCbCr 4:2:0 color format input, and it supports the chroma down-sampling listed below:

- ☑ YCbCr 4:4:4 to YCbCr 4:2:0
- ☑ YCbCr 4:4:4 to YCbCr 4:2:2
- ☑ YCbCr 4:2:2 to YCbCr 4:2:0

UPTab Active Adapter Revision 3 (B014E8ZC7E) supports RGB to YCbCr 4:4:4 or YCbCr 4:4:4 to RGB Color Space Conversion. UPTab Active Adapter Revision 3 (B014E8ZC7E) also supports RGB, YCbCr 4:4:4/4:2:2/4:2:0 pass through mode.

#### EDID

EDID Relay: EDID can be relayed from DDC bus in HDMI transmitter interface to AUX channel of upstream DP source without any modification. UPTab Active Adapter Revision 3 (B014E8ZC7E) may either perform an autonomous EDID read before programming the SINK\_COUNT field in the SINK\_COUNT (DPCD address 00200h) to a value greater than 0, or snoop an EDID read performed by the DP TX. Snooping EDID is the UPTab Active Adapter Revision 3 (B014E8ZC7E) default function.

#### GENERIC I/O INTERFACES

There are 15 dedicated General Purpose Input/Output pins (GPIO0~GPIO14) in UPTab Active Adapter Revision 3 (B014E8ZC7E). GPIO max speed is up to 10MHz. All GPIOs have internal 200kΩ pullup resistor or 140kΩ pulldown resistor which is configured by register. Voltage levels of GPIOs are set to VDDIO which is 1.2V or 3.3V.



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## CONTROL I2C SLAVE

Control I2C slave is the programming interface for external device to access internal registers, including DPCD registers. This bus is used to configure, control and debug UPTab Active Adapter Revision 3 (B014E8ZC7E) internal functions. I2C slave speed supports up to 1MHz. Standby State UPTab Active Adapter Revision 3 (B014E8ZC7E) can be transferred to Standby state by DPCD00600h SET\_POWER register. UPTab Active Adapter Revision 3 (B014E8ZC7E) can be waken up from Standby state even on HPD, I2C or AUX channels, it will signal to DP source that it has exited Standby state by generating IRQ\_HPDP.

Product Appearance				
Category	Detailed Description			
Zinc Alloy Housing	L58.65*W21.35*H10.55mm			
Cable Length	150±10mm			
OD	6.0mm			
Feature				
Category	Detailed Description			
Sourcing System	Sourcing	Resolution	HDR / HDCP	Remarks
Windows/ChromeOS AMD/NVIDIA/Intel Graphic card	DisplayPort 1.4 with DSC1.21	7680x4320 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		7680x4320 @ 30Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:2:0
		5120x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 120Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 30Hz	HDCP1.4	10 bits YCbCr 4:4:4
		2560x1440 @ 60Hz	HDCP1.4	10 bits YCbCr 4:4:4
Windows/ChromeOS AMD/NVIDIA/Intel Graphic card	DisplayPort 1.4 with DSC1.1 (Such as Intel Tiger lake, Alder lake GPU)	7680x4320 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		7680x4320 @ 30Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:2:0
		5120x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 120Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 30Hz	HDCP1.4	10 bits YCbCr 4:4:4
		2560x1440 @ 60Hz	HDCP1.4	10 bits YCbCr 4:4:4
Windows/ChromeOS AMD/NVIDIA/Intel Graphic card	DisplayPort 1.4	7680x4320 @ 30Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:2:0
		5120x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 120Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 30Hz	HDCP1.4	10 bits YCbCr 4:4:4
		2560x1440 @ 60Hz	HDCP1.4	10 bits YCbCr 4:4:4
Windows/ChromeOS AMD/NVIDIA/Intel Graphic card	DisplayPort 1.2	3840x2160 @ 60Hz	HDR10 / HDCP2.2	10 bits(HDR) YCbCr 4:4:4
		3840x2160 @ 30Hz	HDCP1.4	10 bits YCbCr 4:4:4
		2560x1440 @ 60Hz	HDCP1.4	10 bits YCbCr 4:4:4
Certificates				
CE, FCC, ROHS, REACH				
Compatible devices				
Category	Detailed Description			
Compatible system	ChromeOS,Windows7,Windows8,Windows10			
DP host / 8K /4K Monitor	8K video requires a desktop computer with an Nvidia RTX 2060/2070/2080 or an AMD Radeon RX 6000 Series GPU. Laptops with 11th generation Intel Tiger Lake CPUs and Intel Iris Xe graphics, such as the Intel Evo certified laptops also support 8K (installation of the latest Intel graphics driver may be required).			