

DisplayPort 1.4 MST Hub

Features

- DisplayPort® (DP) ver.1.4a compliant receiver
 - ▶ Link rate 1.62 / 2.74 / 5.4 / 8.1Gbps
 - ▶ 1, 2, or 4 lanes configuration
 - ▶ MST up to 6 streams (compressed /uncompressed)
 - ▶ AUX CH 1 Mbps
 - ▶ HPD_OUT
 - ▶ Adaptive receiver equalization
 - ▶ TPS4 EQ Phase LT support
 - ▶ Scrambling of main link data
 - ▶ De-spreading of link frequency
 - ▶ Video Stream Handling
 - RGB/ YCC 444/422/420 pixel format up to 16 bpc
 - Up to 1080 Mpix/sec dual pixel path
 - ▶ DPCD
 - DPCD data structure revision 1.4
 - SST Split SDP capability
 - VSC_EXT_SDP for VESA & CTA
 - Protocol converter capability & control
 - Virtual DP Peer Device capability & control
 - CEC tunneling over AUX
 - ▶ Chainable SDP packets (2KB or more metadata per stream)
 - ▶ Adaptive Sync SDP
 - ▶ PPS SDPAudio stream handling
 - Non-HBR Compressed Formats
 - 2/8 ch layouts
 - Up to 192kHz sample rates
 - Dolby Digital, Digital+, Atmos
 - ▶ HBR Audio Formats
 - 8 ch layout
 - Up to 1536kHz sample rates
 - Dolby TrueHD, Atmos, DTS Master
 - LPCM Formats
 - 2/8/16/32 Ch
 - Up to 192kHz sample rates
 - 3D LPCM, speaker allocation & mapping
 - ▶ OneBit DSD Formats
 - 2/8 ch
 - Single & Double Rate
 - 12288 kHz sample rates
 - ▶ DST DSD Formats
 - Single/Double rate
 - Up to 22579.2kHz
 - ▶ Audio InfoFrame/ ACP/ ISRC/ Audio Metadata DI packets
- Triple DP1.4a / HDMI2.0b (DP++) transmitters
 - ▶ DP mode
 - Lane count, Link rate conversion
 - Link rate 1.62 / 2.74 / 5.4 / 8.1Gbps
 - 1, 2, or 4 lanes configuration
 - MST up to 6 streams
 - AUX CH 1 Mbps
 - 3.3V HPD_IN
 - ▶ HDMI mode
 - TX1 & TX3: VML AC coupled HDMI
 - TX2: CML DC-coupled HDMI
 - No External Level shifters needed
 - 600 MHz maximum TMDS character clock
 - TMDS character-clock divide_by_4 mode
 - HPD_IN (5V Tolerant)
 - DDC CH (5V Tolerant)
- HDMI 2.1 Features
 - ▶ Through 6GHz TMDS Mode
 - ▶ Supports 4k120Hz,4:2:0, 8bpc with Adaptive Sync to VRR conversion
 - ▶ Dynamic HDR Metadata through Extended Metadata Packet
 - ▶ Supports VRR, FVA, QMS, QFT, ALLM
 - ▶ Scrambler for DP/HDMI output
 - ▶ Programmable signal amplitude and edge rate control
 - ▶ Programmable pre-emphasis control
 - ▶ Pixel format RGB / YCC 444/422/420
 - ▶ Deep color up to 16 bits per color
 - ▶ 3D video timings
 - ▶ CEC support – snooping, tunneling
 - ▶ SCDC read request handling
 - ▶ Metadata handling
 - ▶ Conversion to DVI output
 - ▶ Link power management

Features (continued)

- Video processing
 - ▶ MST to SST conversions or pass-through
 - ▶ SST left-right separation
 - ▶ Color space conversion from RGB to YCC
 - ▶ Colorimetry support: BT2020, BT709, BT601, and Adobe RGB
 - ▶ Color bit depth expansion (10 to 12 bits) 16 bits per color pass through
 - ▶ DP to HDMI Stereoscopic 3D Transport
 - ▶ Frame sequential to stacked top-bottom conversion
 - ▶ Pass through of other 3D formats
 - ▶ Programmable coefficient 3x3 matrix
 - Programmable input offset
 - Programmable output offset
 - Programmable output clipping levels
 - ▶ Chroma down sampling
 - 5-tap H & V FIR filters with programmable coefficients
 - 12 bits per color input width
 - 12 bits per color output width
 - YCbCr444 to YCbCr420 conversion
 - YCbCr444 to YCbCr422 conversion
 - ▶ Pass through for YCbCr444/422/420
 - ▶ Video Horizontal blanking expansion
 - ▶ Pixel stream de-skewing
 - ▶ Adaptive Sync Video
- Max video resolution and color depth on DP output uncompressed
 - 5K3K60Hz, RGB/YCbCr444, 8 bpc
 - 8K4K60Hz, YCbCr420 up to 8 bpc
 - 4K2K120Hz, RGB/YCbCr444, 8 bpc
- Max video resolution and color depth on HDMI TX
 - 4Kp60Hz, RGB/YCbCr444, 8 bpc
 - 4Kp60Hz, YCbCr420, up to 16 bpc
 - 4Kp30Hz, RGB/YCbCr444, up to 16 bpc
- Audio processing
 - ▶ Audio stream forwarding from DP RX to HDMI TX
 - ▶ Conversion to I2S or TDM audio output (8 CH)
 - ▶ Conversion to SPDIF audio output (2CH)
- HDCP support
 - ▶ HDCP1.3 to HDCP1.4 Repeater function
 - ▶ HDCP2.3 to HDCP1.4 Repeater function
 - ▶ HDCP2.3 to HDCP2.3 Repeater function
 - ▶ Read-protected embedded HDCP keys
- Enhanced security
 - ▶ Encrypted on-chip key storage
 - ▶ RSA-2048bit signed application firmware
 - ▶ Secure Boot & In-system Programming
 - ▶ Test, debug ports deactivation
- Metadata handling
 - ▶ HDMI TX DVI/HDMI mode setting (DPCD register)
 - ▶ YCbCr444-420 conversion (DPCD register)
 - ▶ IEC60958 BYTE3 channel status overwrite
 - ▶ CTA861G INFO FRAME generation
 - ▶ CTA861.3 HDR and Mastering InfoFrame
 - ▶ Chainable VSC_EXT SDP packing format
- ARM processor and peripheral controllers
 - ▶ ARM Cortex M3 core
 - ▶ SPI controller
 - ▶ I2C master, slave controller
 - ▶ On-Chip, RAM, ROM, OTP
- Device configuration options
 - ▶ Application FW stored in SPI flash
 - ▶ AUX CH, I2C host interface
- Internal video pattern generator
 - ▶ Configurable through vendor specific DPCD registers
- EMI reduction support
 - ▶ Spread spectrum for DP input, output
 - ▶ Scrambler for DP and HDMI outputs
- Low power operation
 - ▶ 700mW nominal operation
 - ▶ Under 10mW Standby operation
- ESD specification
 - ▶ ESD: ±2kV HBM, 500 V CDM
- Package
 - ▶ 289 LFBGA (12 x 12mm)
 - ▶ Halogen free Halogen free RoHS and Green Compliant
- Power supply voltages
 - ▶ 1.8V Analog and I/O, 0.95V Analog and core

Description

The KTM5000 is an advanced DisplayPort1.4a MST hub, targeted primarily for Mobile Notebook accessory and display applications. This device functions as a multi-stream audio-video splitter and protocol converter with an HDCP1.x/ HDCP2.3 repeater.

The KTM5000 consists of three AC coupled DP/DP++ or DC coupled HDMI/DVI DFPs, each with four high-speed lanes. The Stream Routing Logic in KTM5000 allows flexible routing of incoming DP MST stream converted into any combination of MST or SST streams on any of the DFP video ports with link rate and lane count change option. Also, the SST stream can be replicated on two or more DFP ports. In addition, the DP SST stream can be converted into a HDMI or DVI output (TMDS signal format).

The receiver in KTM5000 supports all DP standard data rates up to HBR3 (8.1 Gbps/lane) . The dual mode (DP++) transmitters support DP standard data rates up to 8.1 Gbps/lane and TMDS data rates up to 6.0 Gbps/lane. The side-band channel uses 1.0 Mbps Manchester-coded AUX signaling for DP and DDC signaling up to 100kbps for the HDMI interface.

KTM5000 is capable of processing up to six DP audio-video streams. These streams can be part of one single large video timing or six independent video timings from a single source with corresponding independent multi-channel audio. The highest video timing per stream and the number of streams transported is limited by the DP1.4a and HDMI2.0 link bandwidth. KTM5000 supports both RGB 444 and YCC444/422/420 video pixel encoding formats with a color depth up to 16 bpc (bits per component or 48 bits per pixel). It has a pixel processing unit capable of video pixel encoding format conversion from RGB444 to YCC444 with bit depth expansion and down scaling from YCC444 to YCC422/420. Pixel format conversion along with horizontal blanking expansion improves interoperability and smooth rendering of CVT video timings from a mobile PC on a consumer displays such as TVs and projectors which supports only CEA timings.

KTM5000 processes High Dynamic Range (HDR) video content specified in BT601, BT709, BT2020, BT2100 , Adobe RGB colorimetry format with the proper metadata conversion from DP to HDMI. It also offers secure reception and transmission of high bandwidth digital audio and video content with HDCP1.x or HDCP2.3 content protection. As a branch device KTM5000 functions as a HDCP1.x and HDCP2.3 repeater between the DP source and DP or HDMI sink.

KTM5000 uses an external 25 MHz reference clock for its operation. The reference clock can be generated from a 25MHz crystal or from an external source. It has a 300MHz ARM Cortex M3 CPU with on-chip memories for code and data storage. The peripheral subsystem includes SPI, UART (debug only), and I2C master, slave interfaces. An internal Power-On Reset (POR) circuit senses the voltage on the reset input and provides the chip reset during system power-up. The KTM5000 uses an external 16 Mbit SPI flash memory for storing the RSA-2048 signed application firmware with fail-safe recovery. At boot up, the CPU goes through a secure boot process authenticating the application code image stored in the SPI flash. It supports both standard mode and quad mode SPI operation. Firmware update for the SPI flash is done securely through the DP AUX_CH or I2C host interface (Secure In-System-Programming).

Table 1. Part Number

Features	KTM5000
Input	DP (4 Lanes)
Outputs	3x DP++ (DP or HDMI)
USB De-mux & Re-timer	No
HDCP2.2	Yes
HDR, Pixel Processor	Yes
DSC & FEC	No
Package	LFBGA 12x12mm / 0.65mm pitch

Applications

The target applications of the KTM5000 are:

- Mobile PC docking stations
- Dongles
- MST video hubs
- AR / VR devices
- High end displays such as digital signage
- Daisy-chain monitors

Docking Station Application

In a mobile docking station topology, the KTM5000 is part of a larger system which might have a system controller such as TCPC, USB hub, etc. The docking station can be a traditional dock with a custom connector or a travel dock with a DP cable. The KTM5000 is an ideal device for a docking station in which the downstream video ports can be configured as DP1.4a or HDMI2.0 depending on the requirements.

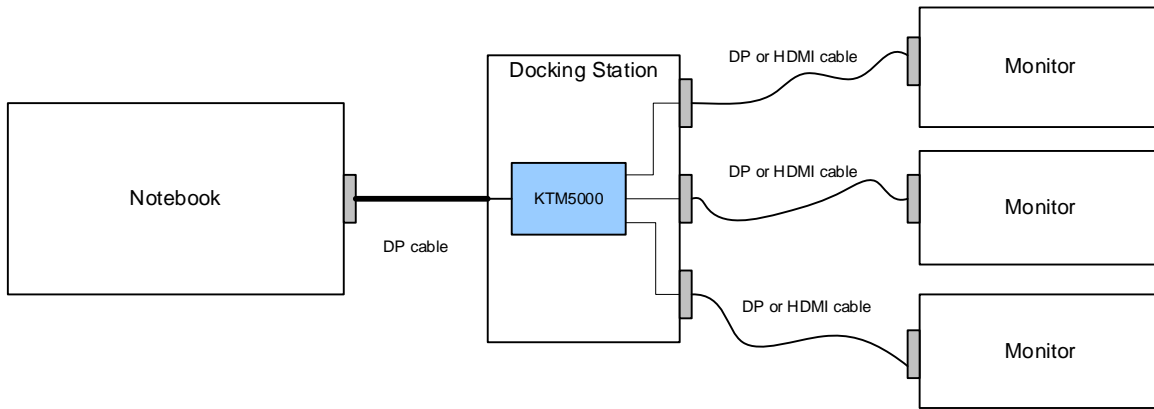


Figure 1. KTM5000 Docking Station Use Case

Daisy-Chain Monitor / Signage Application

A daisy-chain monitor or signage featuring a DP MST hub device with two or more video outputs. KTM5000 is an ideal fit for such applications where it can receive multiple video streams simultaneously. It then routes one of the video stream to the internal SoC and the remaining streams to the downstream units. In this use case, KTM5000 can support two 4K60Hz displays

For a Large Format Display Application, such as a 5x5 video wall configuration, KTM5000 can support 25 or more daisy chained displays.

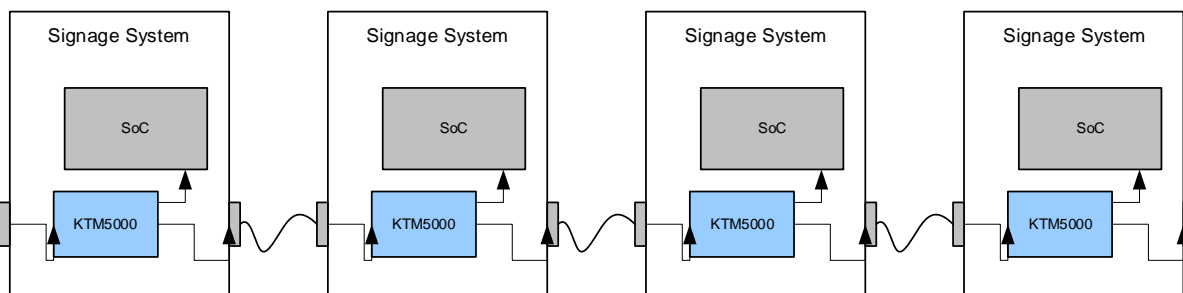


Figure 2. KTM5000 Digital Signage Use Case

AR/VR Application

The current AR/VR head mount displays use a video splitter device for routing the video from the graphics source to the dual OLED panels. Future designs are targeting higher video resolutions, refresh rates, and low latency. The KTM5000 is suitable for such designs; it can deliver up to 2x 2560x2160 @120 Hz. Additionally, the KTM5000 can generate a global frame synchronization signal for synchronizing the video with the sensor inputs. Also it can deliver up to 8CH compressed or LPCM audio through the I2S or TDM format to audio codec for the best quality audio experience.

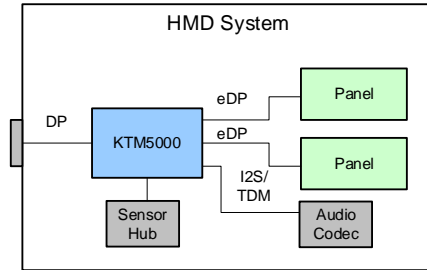
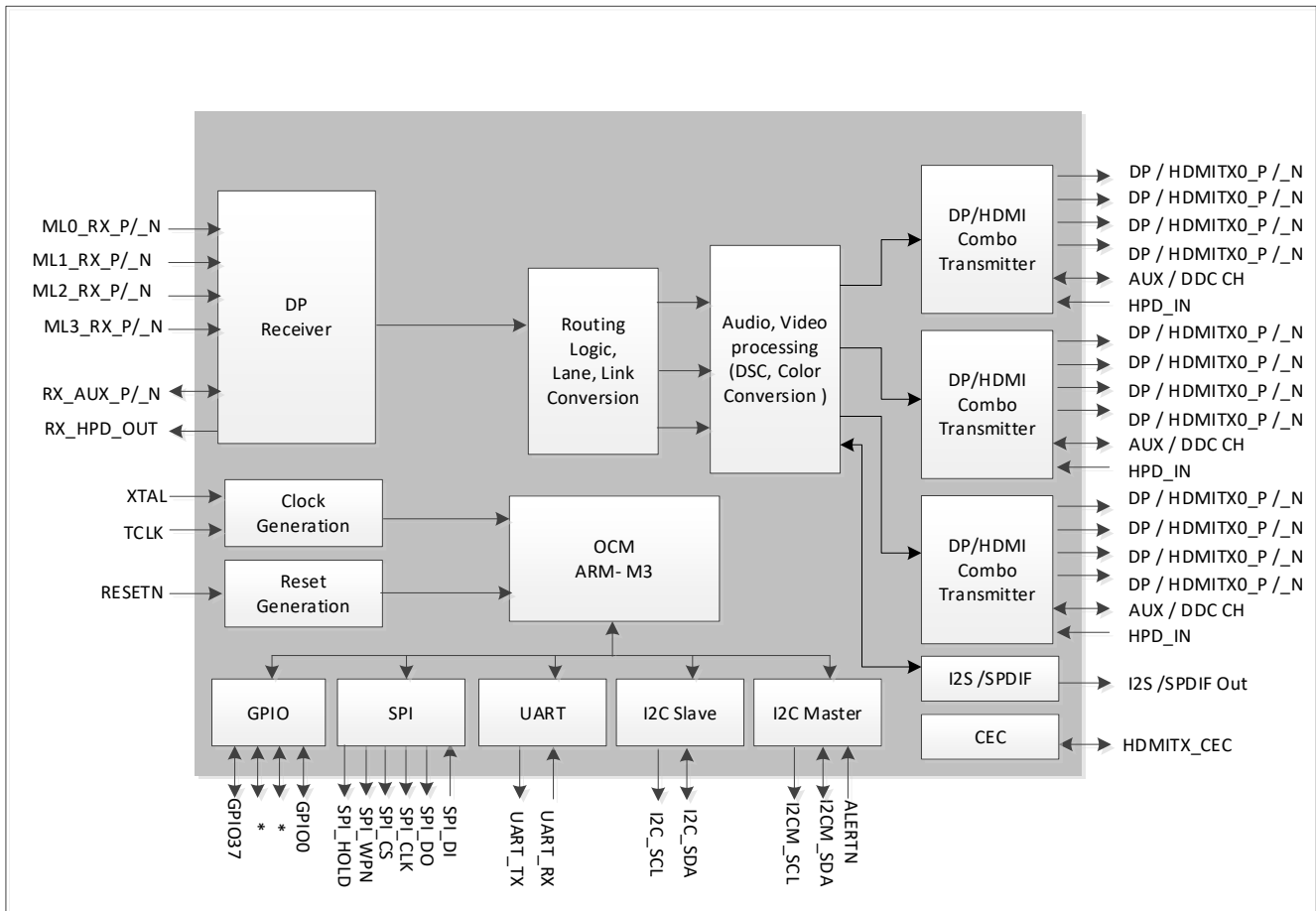


Figure 3. KTM5000 AR/VR Head Mount Display Use Case

Functional Block Diagram



Ordering Information

Part Number	Functional Description	Marking ¹	Operating Temperature	Package	External Package
KTM5000B0	DP 4 Lanes	KTM5000B0	0°C to +70°C	289-LFBGA	TRAYS
KTM5000B0T					Tape and Reel

1. See **Error! Reference source not found.** for trace codes marking details;. ES – Engineering Sample.

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