

# Panasonic

BUSINESS

**AW-UE100W** [White Model]  
**AW-UE100K** [Black Model]  
4K Integrated Camera



4K 60p/50p NDI®&SRT supported PTZ Camera with a compact body and a wide range of features



Worldwide Olympic Partner



Worldwide Paralympic Partner



Official camera supplier of the Olympic and Paralympic Games

# High-quality 4K PTZ Camera compatible with a variety of video transmission systems to support next-generation video production

This 4K Integrated Camera is compatible with various IP transmission protocols, including NDI®\*1, SRT\*2, and Freed\*3, achieving flexible video production with high-quality 4K 60p/50p\*4 video. 12G-SDI output is also supported in addition to 3G-SDI and HDMI, allowing the appropriate output to be selected for use in a wide range of situations, from live streaming of events to studio production.



## High-Quality 4K 60p/50p\*4 Shooting

3840 x 2160 4K output and 59.94p/50p\*4 shooting achieve extremely smooth video, even in live sports and other environments containing rapid movement.

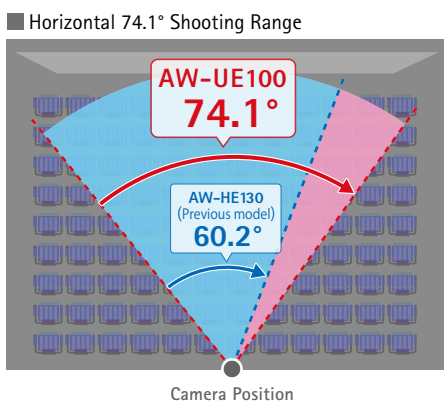
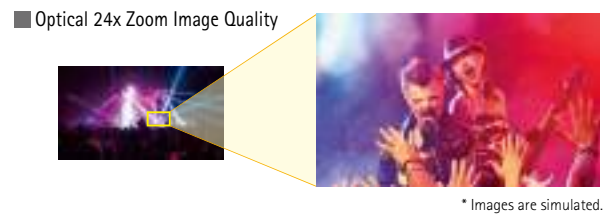
Output format	
<b>4K</b> (12G-SDI output/HDMI output)	2160/59.94p, 2160/50p, 2160/29.97p*5, 2160/25p*5, 2160/24p*5, 2160/23.98p*5
<b>HD</b> (3G-SDI output/HDMI output)	1080/59.94p, 1080/50p, 1080/29.97p*5, 1080/29.97PsF*6, 1080/25p*5, 1080/25PsF*6, 1080/23.98p*7, 1080/24p*5, 1080/23.98p*5, 1080/23.98PsF*6, 1080/59.94i, 1080/50i
	720/59.94p, 720/50p

## 1/2.5-type MOS sensor

The camera is equipped with a newly-developed 1/2.5-type 4K MOS sensor and achieves high-resolution video.

## Shooting with 24x optical zoom and a 74.1° horizontal angle of view

In addition to 24x optical zoom, the inclusion of i.Zoom enables super resolution zooming of up to 36x in HD Mode and 28x in 4K mode while maintaining high resolution. The 1.4x and 2x digital extender zoom also allows distant subjects to be captured clearly, while the 74.1° horizontal angle of view enables a wide area to be shot from a limited installation space.



## Newly-developed high-precision Direct Drive motor

The inclusion of a Direct Drive motor for the rotating section improves operability, responsiveness and quietness during pan/tilt operations.

### operability

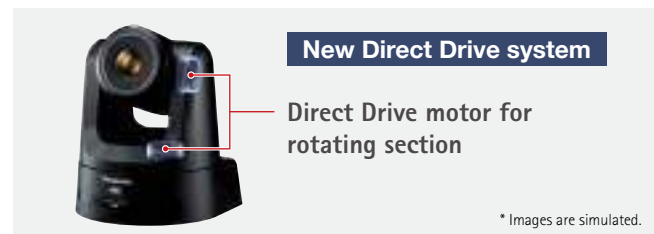
A wide range of speeds are supported, from slow movement of 0.08° per second to ultra-high speeds of 180° per second (Fast2 Mode).

### responsiveness

Excellent responsiveness allows for accurate camera work, ensuring that the target area is captured.

### quietness

A noise level of NC30 or less is ensured, enabling shooting in situations such as Concert hall and Studio where quietness is required.



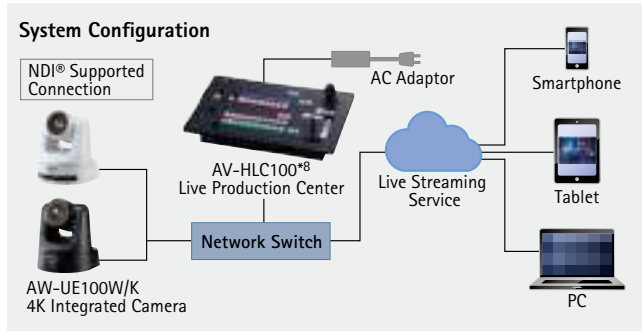
## Electronic Image Stabilization (EIS) for roll direction

Electronic Image Stabilization (EIS) for the roll direction has been added in addition to Optical Image Stabilization (OIS). Stable images with reduced blurring can be shot even in locations where special equipment such as a rail system or camera arms are used.



## High image quality and low latency with high bandwidth NDI® support

High bandwidth NDI® and high efficiency low bandwidth NDI®|HX, which encode and transmit high-quality video in real time, are included. High bandwidth NDI® transmits 4K video at a maximum of 250 Mbps and full HD video at a maximum of 125 Mbps, enabling high-quality, low-latency live video transmission.



## SRT\*2 support for stable video transmission over public lines



SRT, a next-generation video transmission protocol with strong security suitable for unstable network environments, is supported.

## Secure

Strong security is ensured by encrypting video data before transmission.

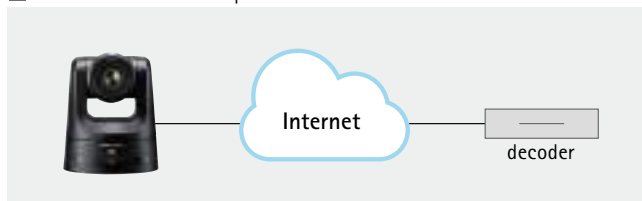
## Reliable

The packet loss recovery function automatically detects and retransmits packets lost during transmission, ensuring smooth, stable video transmission.

## Transport

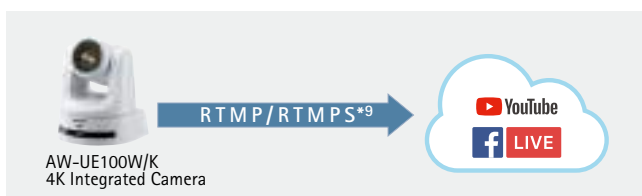
The flexible and adaptable buffer management system enables stable video transmission even in network environments with unstable bit rates. Long-distance video transmission over public lines is supported.

### Video transmission over public lines



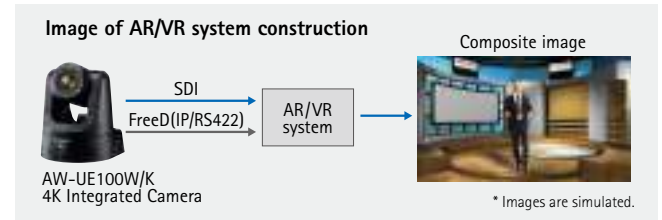
## Direct Broadcast via RTMP/RTMPS\*9

RTMP/RTMPS\*9 is supported to enable direct upload of video to live-streaming services such as YouTube Live and Facebook Live. This means a live stream can be broadcast directly from the camera.



## FreeD\*3 Support for Construction of AR/VR\*10 Systems

Integration with AR/VR systems is available via FreeD-compliant command output. Camera tracking information (pan/tilt/zoom/focus/iris) is output according to a synchronizing signal to facilitate configuration of virtual systems without an encoder.



## Cropping (+ Zoom) function

A cropped portion of the video can be created simultaneously during output of the full 4K video. Up to three crop areas can be specified, with easy operation using the AW-RP150GJ Remote Camera Controller and the web browser screen. The inclusion of cropping zoom also allows up to 5x zoom of cropped images.



\* Images are simulated.

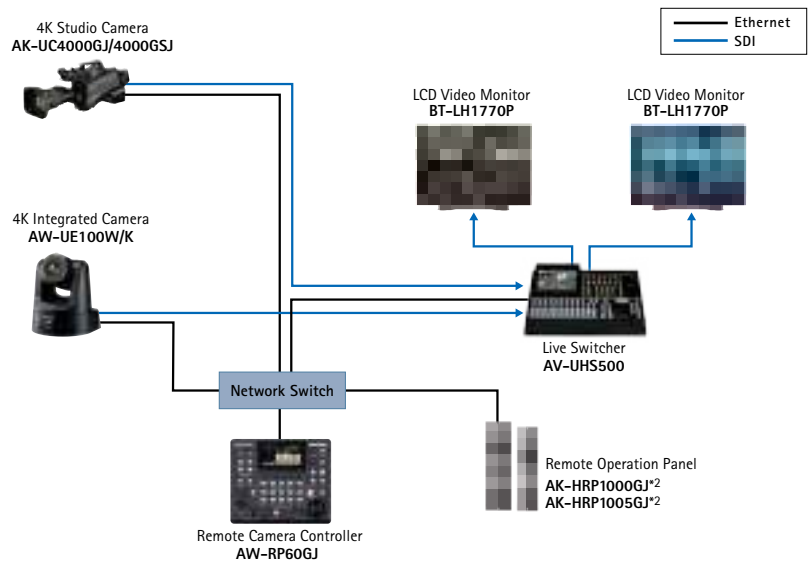
\*1: NDI® is a new live video production workflow support protocol for IP use developed by NewTek in the United States. In this instance, NDI® is used to indicate high bandwidth NDI®. \*2: SRT: Secure Reliable Transport. \*3: FreeD: Widely used protocol for transmitting camera tracking information, mainly in virtual studio systems. \*4: Actual output format is UHD (3840 x 2160) 59.94p/50p. \*5: Native output. \*6: Cannot be output from HDMI. \*7: It denotes "1080/23.98p over 59.94i". \*8: Only available during full HD operation. AV-HLC100 does not support 4K output. \*9: RTMP: Real-Time Messaging Protocol. RTMPS: Real-Time Messaging Protocol Secure. \*10: AR: Augmented Reality. VR: Virtual Reality. \*11: Picture quality is lower with the cropping zoom.

## Application Examples

### Application 01: 4K Studio

#### Studio shooting of smooth, high-quality 4K 60p/50p\*1 images

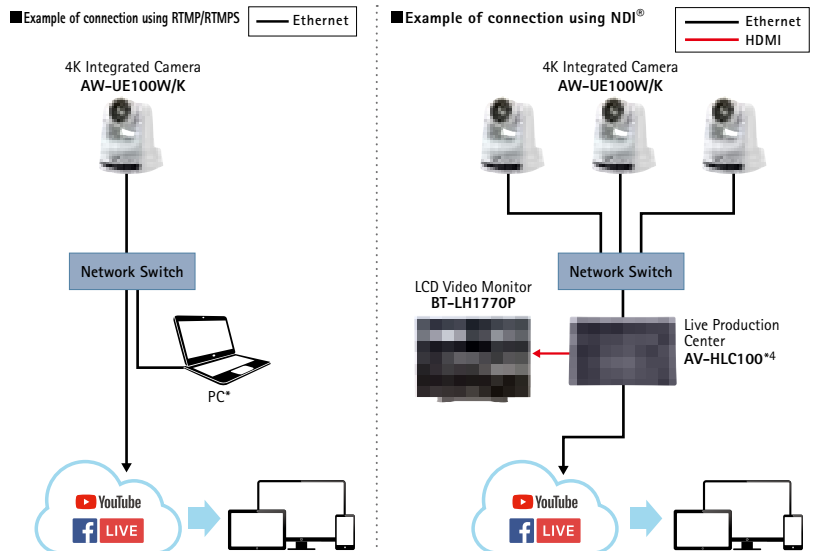
The AW-UE100W/K is capable of 4K 60p/50p\*1 output for high-quality remote shooting in studio operations where high image quality is required. A large tally lamp has been equipped to make on-air cameras easily identifiable, even from far away.



### Application 02: Live Streaming

#### Select the optimal streaming workflow for each situation with RTMP/RTMPS and NDI®\*3 support

When working with a single camera, video can be uploaded directly from AW-UE100W/K to live distribution services with RTMP/RTMPS. When multiple cameras are used, they can be connected to the AV-HLC100\*2\*4 Live Production Center with NDI®\*3. Multiple AW-UE100W/K can be controlled from the AV-HLC100\*2\*4 for high-quality, low-latency live distribution.

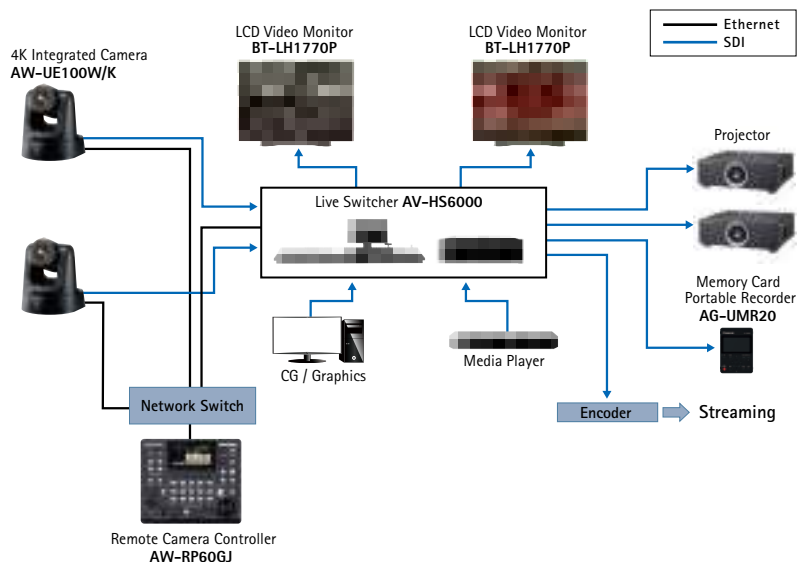


\*A computer is required for server connection settings.

### Application 03: Halls

#### High-magnification zoom and wide-angle shooting ensure targets are captured clearly in large venues

The large 1/2.5-type MOS sensor enables high-sensitivity shooting with little noise in halls and other dark locations. The optical 24x zoom further ensures that even far-away targets shot in large venues are captured clearly. 74.1° horizontal wide-angle shooting allows incredible flexibility in shooting location while still being able to capture the entire shot.



\*1: Actual output format is UHD (3840 x 2160) 59.94p/50p.

\*2: Use may require a software version update.

\*3: NDI® is a new live video production workflow support protocol for IP use developed by NewTek in the United States. In this instance, NDI® is used to indicate high bandwidth NDI®.

\*4: Only available during full HD operation. AV-HLC100 does not support 4K output.

## Optional Products

### PC Software for Remote Camera Support

#### Supporting Lecture Capture with Auto Tracking function

##### Auto Tracking Software Key

Stand-Alone and Web App Versions

**AW-SF100**\*1

Server Version

**AW-SF200**\*1

2 Additional Licenses (for AW-SF200)

**AW-SF202**\*1

3 Additional Licenses (for AW-SF200)

**AW-SF203**\*1

A 30-day Free Trial is Available

- High-performance auto tracking using highly-specialized facial recognition and deep learning technology allows the camera to follow lecturers in any direction.
- The AW-UE100W/K cropping function allows a single camera to crop and track up to three people.
- Operation with IP connection enables installation/control of cameras in remote classroom.
- AW-SF100 allows a single PTZ camera to be controlled on either a stand-alone or web application version. AW-SF200 operates on a server.
- The web application version enables camera control from a tablet, smartphone, desktop PC, etc.
- AW-SF200 enables simultaneous auto tracking and centralized control of multiple cameras.\*2



AW-SF200 Main View

\*1: Use may require a software version update.

\*2: Up to four cameras per server can be controlled simultaneously.

\* Depending on the shooting environment, the system may not be able to detect or track the target correctly. Please use this software in an environment where the adjustment work can be performed by the operator to deal with errors in detection and auto tracking. \* There is a 30-day free trial available for the Auto Tracking Software. Please read carefully the precautions for this software and check if it works correctly in your operating environment before you purchase "Auto Tracking Software Activation Key". For further information, please see "Download/Software Download" on the Panasonic website <<https://pro-av.panasonic.net/>>.

• The face recognition function is based upon the face recognition software developed by PUX Corporation.

#### Control multiple PTZ Cameras from PC

##### PTZ Control Center Free software

- Video can be checked during centralized management of multiple cameras.
- Camera control enabled via GUI for image quality adjustment, pan, tilt, zoom, etc. Touch panel operations are supported.
- Clicking the preset button attached to thumbnails enables simple recall of presets.
- Pan, tilt, zoom and other operations can also be controlled using game controllers made by other companies.



Main screen

#### Software that converts PTZ camera on your network into Super Web cam

##### PTZ Virtual USB Driver Free software

- Remote cameras on the network can be used as USB cameras for simple execution of web meetings with high image quality.
- Camera controls such as image quality adjustment and pan/tilt/zoom can be operated from the GUI.
- Up to five cameras can be registered.
- Automatic detection of connected cameras and network settings enabled.

\* For further information on the optional software, please see "Download/Software Download" on the Panasonic website <<https://pro-av.panasonic.net/>>.

### Optional Products

As of August, 2020

#### Remote Camera Controller AW-RP150GJ\*3

• A separate AC adaptor or PoE+ HUB is required for power supply.



#### Remote Camera Controller AW-RP60\*3

• A separate AC adaptor or PoE HUB is required for power supply.



#### Live Switcher AV-UHS500



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IT/IP Platform  
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[https://pro-av.panasonic.net/en/products/it\\_ip\\_platform/](https://pro-av.panasonic.net/en/products/it_ip_platform/)

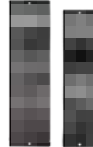
#### Live Production Center AV-HLC100\*3



#### Remote Operation Panel (ROP)

AK-HRP1000GJ\*3\*4  
AK-HRP1005GJ\*3\*4\*5  
AK-HRP1015GJ\*3\*6

• A separate PoE HUB is required for power supply.



#### Wireless remote control AW-RM50G

(\*AA\*, \*R6\* or \*LR6\* battery x2 are not included.)



\*3: Use may require a software version update.

\*4: Support planned for the future.

\*5: Limited Stock

\*6: Scheduled for release in the fourth quarter of CY2020. Not available in some areas.

# Specifications

## <GENERAL>

Power Requirements:	12 V DC (10.8 V to 13.2 V) (Supplied AC adaptor) 42 V to 57 V DC (PoE++ power supply)
PoE++:	IEEE802.3bt standard: DC 42 V to 57 V (Camera Input) (Software authentication (LLDP) is supported)
Current Consumption:	3.0 A (Supplied AC adaptor) 1.0 A (PoE++ power supply)
Ambient Operating Temperature:	0 °C to 40 °C (32 °F to 104 °F)
Ambient Operating Humidity:	20 % to 90 % (no condensation)
Storage Temperature:	-20 °C to 50 °C (-4 °F to 122 °F)
Mass:	Approx. 2.2 kg (4.84 lb) (excluding cable cover, mount bracket) Approx. 2.3 kg (5.06 lb) (including cable cover, excluding mount bracket)
Dimensions (W x H x D):	169.2 mm x 204.6 mm x 170.6 mm (6-21/32 inches x 8-1/16 inches x 6-23/32 inches) (excluding protrusions, cable cover, mount bracket)
Finish:	AW-UE100WP/AW-UE100WPC/AW-UE100WE/AW-UE100WED: Pearl white AW-UE100KP/AW-UE100KPC/AW-UE100KE/AW-UE100KED: Black
Controller Supported:	AW-RP150GJ, AW-RP60GJ

## <Camera Unit>

Imaging Sensors:	1/2.5-type 4K MOS x 1										
Lens:	Motorized Optical 24x zoom, F1.8 to F4.0 [f=4.12 mm (5/32 inches) to 98.9 mm (3-29/32 inches); 35 mm (1-3/8 inches) equivalent; 25.0 mm (31/32 inches) to 600.0 mm (23-5/8 inches)]										
Zoom:	<ul style="list-style-type: none"> <li>Optical zoom: 24x</li> <li>i.Zoom: UHD 28x, FHD 36x</li> <li>Digital extender zoom: 1.4x, 2x</li> </ul>										
Conversion Lens:	Not supported										
Angle of View Range:	Horizontal angle of view: 74.1°(wide) to 3.3°(tele) Vertical angle of view: 46.0°(wide) to 1.9°(tele) Diagonal angle of view: 81.8°(wide) to 3.8°(tele)										
Optical Filter:	Through, 1/4, 1/16, 1/64, IR through (IR through is used as "Night mode")										
Focus:	Switching between auto and manual										
Focus Distance:	Entire zooming range: 1200 mm (3.9 ft) Wide end: 100 mm (0.33 ft)										
Color Separation Optical System:	1MOS										
Standard Sensitivity:	F4/2000 lx (When [Shooting Mode] is [Normal]) F5.6/2000 lx (When [Shooting Mode] is [High Sens.])										
Minimum Illumination:	3 lx (conditions: F1.8, 59.94p, 50 IRE, 42 dB, without accumulation)										
S/N:	60dB(typ) (When [Shooting Mode] is [Normal])										
Horizontal Resolution:	1500 TV lines Typ (Center area)										
Gain Selection:	Auto, 0 dB to 36 dB* • Super Gain function installed: 37 dB to 42 dB										
Frame Mix*2:	Auto, 0 dB, 6 dB, 12 dB, 18 dB, 24 dB										
Electronic Shutter Speed:	<table border="1"> <tr> <td>59.94p/59.94i</td> <td>1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000</td> </tr> <tr> <td>29.97p</td> <td>1/30, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000</td> </tr> <tr> <td>23.98p/24p</td> <td>1/24, 1/48, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000</td> </tr> <tr> <td>50p/50i</td> <td>1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000</td> </tr> <tr> <td>25p</td> <td>1/25, 1/50, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000</td> </tr> </table>	59.94p/59.94i	1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000	29.97p	1/30, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000	23.98p/24p	1/24, 1/48, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000	50p/50i	1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000	25p	1/25, 1/50, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000
59.94p/59.94i	1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000										
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23.98p/24p	1/24, 1/48, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000										
50p/50i	1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000										
25p	1/25, 1/50, 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000										
Synchro Scan:	<table border="1"> <tr> <td>59.94p/59.94i</td> <td>60.00 Hz to 7200 Hz</td> </tr> <tr> <td>29.97p</td> <td>30.00 Hz to 7200 Hz</td> </tr> <tr> <td>23.98p/24p</td> <td>24.00 Hz to 7200 Hz</td> </tr> <tr> <td>50p/50i</td> <td>50.00 Hz to 7200 Hz</td> </tr> <tr> <td>25p</td> <td>25.00 Hz to 7200 Hz</td> </tr> </table>	59.94p/59.94i	60.00 Hz to 7200 Hz	29.97p	30.00 Hz to 7200 Hz	23.98p/24p	24.00 Hz to 7200 Hz	50p/50i	50.00 Hz to 7200 Hz	25p	25.00 Hz to 7200 Hz
59.94p/59.94i	60.00 Hz to 7200 Hz										
29.97p	30.00 Hz to 7200 Hz										
23.98p/24p	24.00 Hz to 7200 Hz										
50p/50i	50.00 Hz to 7200 Hz										
25p	25.00 Hz to 7200 Hz										
Gamma:	HD/FILMLIKE1/FILMLIKE2/FILMLIKE3										
White Balance:	ATW, 3200K, 5600K AWB: AWB-A/AWB-B VAR (selectable between 2000K and 15000K by designating a value)										
Chroma Amount Variability:	OFF, -99 % to 99 %										
Scene File:	Scene1, Scene2, Scene3, Scene4										
Output Format:	<table border="1"> <tr> <td>SDI Output 4K</td> <td>2160/59.94p, 2160/50p, 2160/29.97p*, 2160/25p*, 2160/24p*, 2160/23.98p*</td> </tr> <tr> <td>SDI Output HD</td> <td>1080/59.94p, 1080/50p, 1080/29.97p*, 1080/29.97PsF, 1080/25p*, 1080/25PsF, 1080/23.98p*, 1080/24p*, 1080/23.98p*, 1080/23.98PsF, 1080/59.94i, 1080/50i, 720/59.94p, 720/50p</td> </tr> </table>	SDI Output 4K	2160/59.94p, 2160/50p, 2160/29.97p*, 2160/25p*, 2160/24p*, 2160/23.98p*	SDI Output HD	1080/59.94p, 1080/50p, 1080/29.97p*, 1080/29.97PsF, 1080/25p*, 1080/25PsF, 1080/23.98p*, 1080/24p*, 1080/23.98p*, 1080/23.98PsF, 1080/59.94i, 1080/50i, 720/59.94p, 720/50p						
SDI Output 4K	2160/59.94p, 2160/50p, 2160/29.97p*, 2160/25p*, 2160/24p*, 2160/23.98p*										
SDI Output HD	1080/59.94p, 1080/50p, 1080/29.97p*, 1080/29.97PsF, 1080/25p*, 1080/25PsF, 1080/23.98p*, 1080/24p*, 1080/23.98p*, 1080/23.98PsF, 1080/59.94i, 1080/50i, 720/59.94p, 720/50p										

Output Format:	HDMI Output 2160/59.94p, 2160/50p, 2160/29.97p*, 2160/25p*, 2160/24p*, 2160/23.98p*
	HDMI Output HD 1080/59.94p, 1080/50p, 1080/29.97p*, 1080/25p*, 1080/23.98p*, 1080/24p*, 1080/23.98p*, 1080/59.94i, 1080/50i, 720/59.94p, 720/50p

## <Synchronization System>

Internal/External synchronization (BBS/Tri-level sync)

## <INPUT>

Input Connector:	DC IN 12 V
G/L IN	BBS (Black Burst Sync), tri-level sync supported 75 Ω terminal (BNCx1)
AUDIO IN	<p>MIC/LINE input Compatible (SDI/HDMI/IP) AAC compatible (compatible with IP only) ø 3.5 mm stereo mini jack Input impedance: Approx. 10 kΩ (unbalanced)</p> <ul style="list-style-type: none"> <li>During MIC input Input level: -40 dBV (0 dB=1 V/Pa, 1 kHz) Plug-in power compatible, supply voltage: 2.5 V ± 0.5 V</li> <li>During LINE input Input level: -10 dBV</li> <li>Input volume variable range: -36 dB to 12 dB (3 dB step)</li> <li>Embedded audio output level: -12 dBFS</li> <li>Sampling frequency: 48 kHz</li> <li>Quantization bit rate: 24bit (SDI, HDMI), 16bit (IP)</li> </ul>

## <OUTPUT>

Video Output:	HDMI HDMI 2.0 connector 4:2:2/10bit • HDCP is not supported. • Viera Link is not supported.
	12G-SDI OUT SMPTE 2082-1/SMPTE292 standard/75 Ω (BNC x 1)
	3G-SDI OUT SMPTE292/75 Ω (BNC x 1) • Level-A/Level-B supported

## <INPUT/OUTPUT>

Input / Output Connector:	LAN RJ-45 LAN terminal for IP control and video transmission PoE++ power terminal (IEEE802.3bt compliant)
	RS-422 CONTROL IN RS-422A (RJ-45)

## <Pan-tilt Head Unit>

Camera/Pan-tilt Head Control:	IP connecting cable • When connecting through a PoE++ hub LAN cable*5 (category 5e or above, straight cable), max. 100 m (328 ft) • When a PoE++ hub is not used LAN cable*5 (category 5e or above, straight cable), max. 100 m (328 ft)  AW protocol connecting cable LAN cable*5 (category 5e or above, straight cable), max. 1000 m (3280 ft)
Installation Method:	Stand-alone (Desktop) or suspended (Hanging)*8
Pan/tilt Operation Speed:	Speed range: 0.08°/s to 60°/s (Normal mode) • 3 speed modes installed Normal: 60°/s, Fast1: 90°/s*, Fast2: 180°/s*
Panning Range:	±175°
Tilting range:	-30° to 210°**
Quietness:	NC30 or less

## <Supported operating systems and web browsers>\*9

Supported operating systems and web browsers:	Windows	Microsoft® Windows® 10 Windows® Internet Explorer® 11 (64bit/32bit) Microsoft Edge Google Chrome
	Mac	macOS 10.13/Safari 13 macOS 10.14/Safari 13 macOS 10.15/Safari 13 macOS 10.15/Google Chrome
	iPhone / iPad	iOS Safari iPadOS
	Android	Android OS Google Chrome

## <IP Streaming>

Image Streaming Mode:	JPEG(MJPEG), H.264, H.265, NDI®/HX, High Bandwidth NDI®
Image Resolution:	3840x2160, 1920x1080, 1280x720, 640x360, 320x180
Image Transmission setting (JPEG):	Frame Rate: Maximum 30 fps Image quality (Fine / Normal)

Image Transmission Setting (H.264):	<ul style="list-style-type: none"> <li>Transmission Type: Unicast port (AUTO) Unicast port (MANUAL) Multicast port</li> <li>Transmission Priority Constant bit rate Frame rate Best effort</li> <li>Frame Rate [60Hz] 5fps/15fps/30fps/60fps (UHD: 30fps, 60fps) [50Hz] 5fps/12.5fps/25fps/50fps (UHD: 25fps, 50fps)</li> <li>Max Bit Rate 512kbps/768kbps/1024kbps/1536kbps/2048kbps/3072kbps/4096kbps/ 6144kbps/8192kbps/10240kbps/12288kbps/14336kbps/16384kbps/ 20480kbps/24576kbps/32768kbps/40960kbps/51200kbps/76800kbps</li> </ul>
	<ul style="list-style-type: none"> <li>Transmission Type: Unicast port (AUTO) Unicast port (MANUAL) Multicast port</li> </ul>

Image Transmission Setting (H.265):	<ul style="list-style-type: none"> <li>Transmission Type: Unicast port (AUTO) Unicast port (MANUAL) Multicast port</li> <li>Frame Rate [60Hz]30fps [50Hz]25fps</li> <li>Max Bit Rate 8192kbps/12288kbps/25600kbps/51200kbps/76800kbps</li> </ul>
	<ul style="list-style-type: none"> <li>Transmission Type: Unicast port (AUTO) Unicast port (MANUAL) Multicast port</li> </ul>

Audio Compression Type:	AAC-LC, 48 kHz / 16 bit / 2ch
Supported Protocol:	<ul style="list-style-type: none"> <li>IPv6: TCP/IP, UDP/IP, HTTP, HTTPS, DNS, NTP, DHCPv6, RTP, MLD, ICMP, ARP, RTMP, SRT</li> <li>IPv4: TCP/IP, UDP/IP, HTTP, HTTPS, RTSP, RTP, RTP/RTCP, DHCP, DNS, DDNS, NTP, IGMP, ICMP, ARP, RTMP, RTSP, SRT</li> </ul>

**<Other Function>**

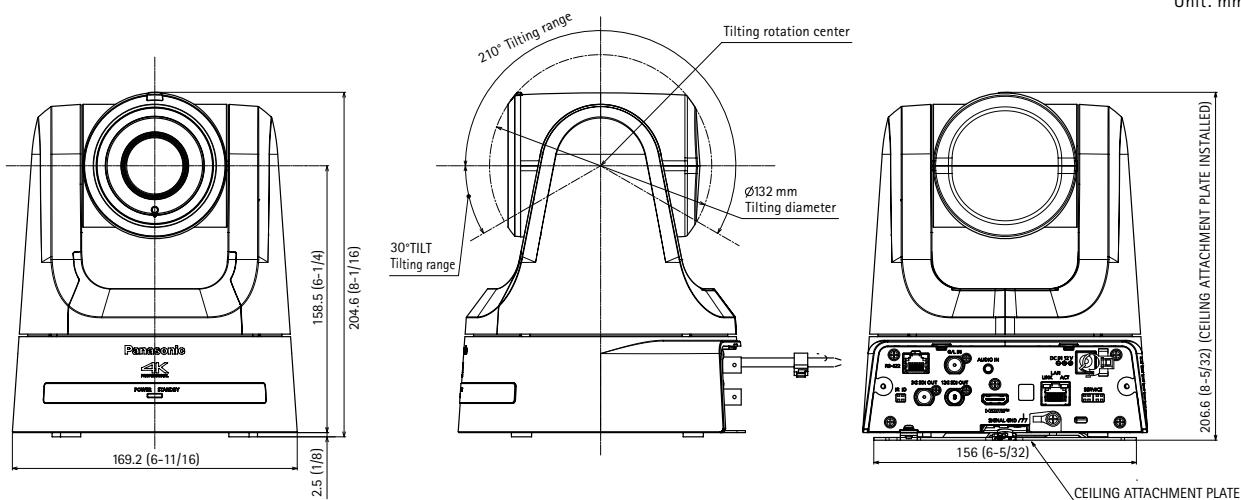
NDI® support:	<ul style="list-style-type: none"> <li>NDI®   HX : Included as standard</li> <li>High Bandwidth NDI®: Included as standard</li> </ul>
Tally LED display color:	red / green

\*1: 1 dB steps. \*2: This cannot be configured when the format is 2160/29.97p, 2160/23.98p, 2160/24p, 2160/25p, 1080/29.97p, 1080/23.98p(59.94i), 1080/29.97PsF, 1080/23.98PsF, 1080/25p, 1080/25PsF. \*3: Native output. \*4: OVER 59.94i output (your monitor may recognize the signal as 59.94i). \*5: Use of an STP (shielded twisted pair) cable is recommended. \*6: To ensure safety, the unit must be secured using the mount bracket supplied. \*7: Note that the operating noise may be loud in high speed. If the operating noise is disturbing, use the Normal mode. \*8: Depending on the pan or tilt position, the camera may be reflected in the image. \*9: Supported OS indicated are for browsers current as of August 2020. See "Service and Support / PASS" on the Panasonic website (<https://pro-av.panasonic.net/en/>) for the latest information on browser support. \*10: It denotes "1080/23.98p over 59.94p"

**Dimensions**

As of August, 2020

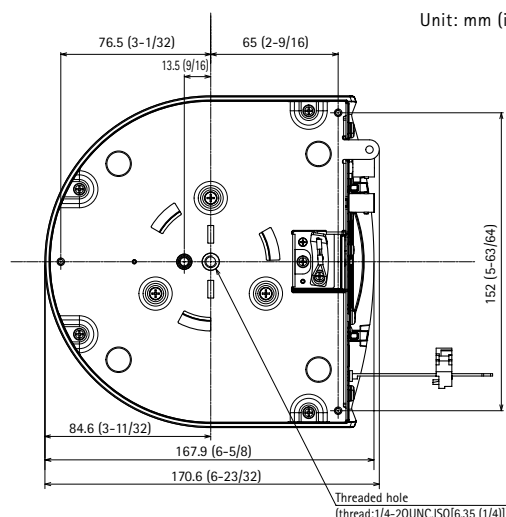
Unit: mm (inches)



**Rear View**

**Bottom View**

Unit: mm (inches)



## Compatible Third-Party Equipment

### NewTek, Inc.

TriCaster TC1 2RU  
**TC1**  
Operation-verified in June, 2020



TriCaster Mini 4K  
**TCM4KUHD**  
Operation-verified in June, 2020



### Explorer Inc.

SRT compatible  
H.265/HEVC 4K/2K decoder  
**EHU-3410D**  
Operation-verified in June, 2020



### Haivision

SRT Set Top Box  
**Haivision Play Set-Top Box 4000**  
Operation-verified in June, 2020



### GeoVision

PoE Adapter  
**GV-PA901**  
Operation-verified in Mar. 2017



PoE++

### NETGEAR, Inc.

NETGEAR 10-PORT GIGABIT  
ETHERNET ULTRAGO POE++  
SMART MANAGED PRO  
DESKTOP SWITCH  
**GS110TUP\*1**

Operation-verified in Mar. 2020



PoE++

NETGEAR 10-PORT GIGABIT  
ULTRAGO POE++ SMART  
MANAGED PRO  
RACKMOUNT SWITCH  
**GS710TUP\*1**

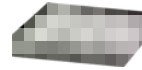
Operation-verified in Mar. 2020



PoE++

### Allied Telesis

Gigabit Layer3 PoE++ Switch  
**AT-x320-10GH\*1**  
Operation-verified in Mar. 2020



PoE++

•Power supply not included.  
AT-PWR300 is required.

### PLANET Technology Corp.

Layer 3 8-Port 10/100/1000T 802.3bt  
PoE + 2-Port 10/100/1000T + 2-Port  
10G SFP+ Managed Switch  
**GS-5220-8UP2T2X**

Operation-verified in Oct. 2018



PoE++

\*1: LLDP authentication is planned for future support.

## Third-Party Inquiries

- <NewTek, Inc.> <https://www.ndi.tv/> MAIL: [ndi@newtek.com](mailto:ndi@newtek.com) TEL: +1 210-370-8000
- <Explorer Inc.> MAIL: [sales@explorer-inc.co.jp](mailto:sales@explorer-inc.co.jp) TEL: +81(138)47-7604
- <Haivision> <https://www.haivision.com/contact/>
- <GeoVision Inc.> MAIL: [sales@geovision.com.tw](mailto:sales@geovision.com.tw) TEL: +886-2-8797-8376
- <NETGEAR, Inc.> <http://www.netgear.com/home/contact-us/>
- <Allied Telesis> (North America) <http://alliedtelesis.com/contact>  
(Asia/Pacific) [customer\\_info@alliedtelesis.com](mailto:customer_info@alliedtelesis.com)  
(EMEA) [Customer\\_info@alliedtelesis.com](mailto:Customer_info@alliedtelesis.com)  
(Central South America) [Customer\\_info@alliedtelesis.com](mailto:Customer_info@alliedtelesis.com)
- <PLANET Technology Corp.> <https://www.planet.com.tw/en> MAIL: [sales@planet.com.tw](mailto:sales@planet.com.tw)

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\* Specifications are subject to change without notice.

# Panasonic®

Panasonic Corporation  
Connected Solutions Company

2-15 Matsuba-cho, Kadoma, Osaka 571-8503 Japan



For more information, please visit Panasonic web site  
<https://pro-av.panasonic.net/en/qr/>



Factories of AVC Networks Company have received ISO14001:2004-the Environmental Management System certification. (Except for 3rd party's peripherals.)



Broadcast and  
Professional  
AV Website



Contact Information



Facebook



Mobile App



# 2020 PRO PTZ CAMERA LINEUP

	COMPACT ePTZ	ENTRY-LEVEL	HD w/HDMI	HD w/SDI	HD PROFESSIONAL	4K PROFESSIONAL	4K NDI PERFORMANCE	4K PERFORMANCE	ALL WEATHER
	STANDARD	STANDARD	STANDARD		STANDARD	STANDARD	<b>PERFORMANCE</b>	<b>PERFORMANCE</b>	OUTDOOR
MODEL	AW-UE4	AW-HE38H	AW-HE40H	AW-HE40S	AW-HE42	AW-UE70	AW-UE100	AW-UE150	AW-HR140
NDI / NDIHX Models	-	AW-HN38H	AW-HN40H	Upgrade Available	Upgrade Available	AW-UN70	Integrated	Upgrade Available	-
Camera Body Color	Black (K) or White (W)	Black (K) or White (W)	Black (K) or White (W)		Black (K) or White (W)	Black (K) or White (W)	Black (K) or White (W)	Black (K) or White (W)	Silver
<b>GENERAL</b>									
Sensor	1/2.5" MOS	1/2.3" MOS	1/2.3" MOS		1/2.3" MOS	1/2.3" MOS	1/2.5" MOS	1" MOS	1/2.86" 3MOS
Optical Zoom	-	22x	30x		20x	20x	24x	20x	20x
i.Zoom	-	30x	40x		30x	-	28x (UHD) / 36x (HD)	32x	-
Digital Zoom	4x	16x	16x		12x	12x	10x	10x	10x
FOV (Horizontal)	111°	61.6° (W) - 2.9° (T)	61.6° (W) - 2.10° (T)		65.1° (W) - 3.26° (T)	65.1° (W) - 3.26° (T)	74.1° (W) - 3.3° (T)	75.1° (W) - 4.0° (T)	60.2° (W) - 3.3° (T)
FOV (Vertical)	75°	37.0° (W) - 1.6° (T)	37.0° (W) - 1.18° (T)		39.5° (W) - 1.83° (T)	39.5° (W) - 1.83° (T)	46° (W) - 1.9° (T)	46.7° (W) - 2.3° (T)	36.2° (W) - 1.9° (T)
FOV (Diagonal)	120°	68.7° (W) - 3.3° (T)	68.7° (W) - 2.42° (T)		72.4° (W) - 3.74° (T)	72.4° (W) - 3.74° (T)	81.8° - 3.8° (T)	82.8° (W) - 4.6° (T)	67.4° (W) - 3.8° (T)
Focus	Auto / Manual	Auto / Manual	Auto / Manual		Auto / Manual	Auto / Manual	Auto / Manual	Auto / Manual	Auto / Manual
Horizontal Resolution	1400 Lines	1000 Lines	1000 Lines		1000 Lines	1300 Lines (UHD)	1400 Lines	1600 Lines	1000 Lines
Minimum Illumination	4 lx	0.35 lx	0.35 lx		0.35 lx	0.35 lx	3 lx (at F1.8, 59.94p, 50IRE, +42dB)	2 lx	2 lx
Gain	0 dB - 42dB	0 dB - 48dB	0 dB - 48 dB		0 dB - 48 dB	0 dB - 48 dB	0dB - 36dB (Super Gain +37dB +42dB)	0 dB - 36 dB	0 dB - 42 dB
Control	IP / IR	Serial / IP / IR	Serial / IP / IR		Serial / IP / IR	Serial / IP / IR	Serial / IP / IR	Serial / IP / IR	Serial / IP
Power	PoE or USB <sup>1</sup>	PoE+ or AC	PoE+ or AC		PoE+ or AC	PoE+ or AC	PoE++ or AC	PoE++ or XLR <sup>3</sup>	PoE++ or XLR <sup>3</sup>
PoE Wattage	Up to 15W	Up to 30W	Up to 30W		Up to 30W	Up to 30W	Up to 57W	Up to 100W	Up to 60W
Power Consumption	1 A (USB / DC 5V) 0.2 A (PoE)	1.2 A (AC) 0.4 A (PoE+)	1.2 A (AC) 0.4 A (PoE+)		1.3 A (AC) 0.5 A (PoE+)	1.3 A (AC) 0.5 A (PoE+)	3.0A (DC) 1.0A (PoE++)	4.0 A (XLR) 1.2 A (PoE++)	5.5 A (XLR) 2.1 A (PoE++)
Weight	1.10 lbs	3.30 lbs	3.30 lbs		3.30 lbs	3.30 lbs	4.85 lbs	9.24 lbs	19.8 lbs
Installation	Tripod, Wall, Ceiling	Tripod, Wall, Ceiling	Tripod, Wall, Ceiling		Tripod, Wall, Ceiling	Tripod, Wall, Ceiling	Tripod, Wall, Ceiling	Tripod, Wall, Ceiling	Wall, Ceiling
Mount Position	Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop		Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop	Invertible: Ceiling or Desktop
<b>PTZ</b>									
Pan Range	±175° (manual)	±175°	±175°		±175°	±175°	±175°	±175°	±175°
Tilt Range	±25° (manual)	-30 to 90°	-30 to 90°		-30 to 90°	-30 to 90°	-30 to 210°	-30 to 210°	-30 to 210°
Pan / Tilt Speed	-	300°/s (Presel)   90°/s (M)	300°/s (Presel)   90°/s (M)		300°/s (Presel)   90°/s (M)	300°/s (Presel)   90°/s (M)	±175°/30° - +210°	-180°/s	60°/s
Operation Noise	-	NC35 or Less	NC35 or Less		NC35 or Less	NC35 or Less	NC35 or Less	NC35 or Less	NC45 or Less
<b>VIDEO OUTPUT</b>									
LAN	✓	✓	✓	✓	✓	✓	✓	✓	✓
NDI / NDIHX	-	AW-HN38H (NDIHX)	AW-HN40H (NDIHX)	NDIHX (with upgrade)	NDIHX (with upgrade)	AW-UN70 (NDIHX)	4K NDI / HD NDIHX	NDIHX (with upgrade)	-
Optical Fiber	-	-	-	-	-	-	✓	✓	-
12G-SDI	-	-	-	-	✓	✓	-	✓	✓
3G-SDI	-	-	-	-	✓	✓	-	✓	✓
HD-SDI	-	-	-	✓	-	-	-	-	-
HDMI	✓	✓	✓	✓	✓	✓	✓	✓	✓
Composite	-	-	-	-	-	-	-	-	-
USB	✓ (USB-C)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	-	-	-
<b>CONTROL</b>									
Browser (PC/Mac/Mobile) via IP	✓	✓	✓	✓	✓	✓	✓	✓	✓
USB	✓ (USB-C)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	✓ (mini-USB)	-	-	-
VISCA	-	✓	✓	✓	✓	✓	-	-	-
Auto Tracking / Auto Tracking Server	AW-SF100 / AW-SF200	AW-SF100 / AW-SF200	AW-SF100 / AW-SF200		AW-SF100 / AW-SF200	AW-SF100 / AW-SF200	AW-SF100 / AW-SF200	AW-SF100 / AW-SF200	-
Live Stream Studio	AV-HLC100	AV-HLC100	AV-HLC100		AV-HLC100	AV-HLC100	AV-HLC100	AV-HLC100	AV-HLC100
iPad App	-	LiveCTRL App	LiveCTRL App		LiveCTRL App	LiveCTRL App	-	LiveCTRL App	LiveCTRL App
IR Remote Control	AW-RM50	AW-RM50	AW-RM50		AW-RM50	AW-RM50	AW-RM50	AW-RM50	-
Compact Controller	AW-RP60	AW-RP60	AW-RP60		AW-RP60	AW-RP60	AW-RP60	AW-RP60	AW-RP60
Full-Size Controller	-	AW-RP150	AW-RP150		AW-RP150	AW-RP150	AW-RP150	AW-RP150	AW-RP150
Remote Operation Panel (ROP/RCP)	-	AK-HRP200 AK-HRP1000 AK-HRP1015**	AK-HRP200 AK-HRP1000 AK-HRP1015**		AK-HRP1000 AK-HRP1015**	AK-HRP200 AK-HRP1000 AK-HRP1015**	TBD	AK-HRP200 AK-HRP1000 AK-HRP1015**	AK-HRP200 AK-HRP1000 AK-HRP1015**
Live Video Switcher	AV-UHS500	AV-UHS500	AV-UHS500		AV-UHS500	AV-UHS500	AV-UHS500	AV-UHS500	AV-UHS500
Software Controller (Windows)	PTZ Control Center	PTZ Control Center	PTZ Control Center		PTZ Control Center	PTZ Control Center	PTZ Control Center	PTZ Control Center	PTZ Control Center
<b>FEATURES</b>									
IP Live Preview / Output	✓	✓	✓	✓	✓	✓	✓	✓	✓
Image Stabilization	-	Electronic	Electronic		Optical	Optical	Optical	Optical	Optical / D.I.S.S.
Night Mode (for IR)	-	✓	✓		✓	✓	✓	✓	✓
Dynamic Range Stretch (DRS)	✓	✓	✓		✓	✓	✓	✓	✓
Audio Input / Embedding	✓	✓	✓		✓	✓	✓	✓	✓
Color Temperature Adjustment	✓	✓	✓		✓	✓	✓	✓	✓
Presets	Up to 100	Up to 100	Up to 100		Up to 100	Up to 100	Up to 100	Up to 100	Up to 100
microSD Card Recording	-	✓	✓		✓	✓	-	-	-
High Dynamic Range (HDR)	-	✓	✓		-	-	-	✓	-
Direct Streaming Function	✓	-	-		-	-	✓	✓	-
Streaming Protocols	RTSP, RTMP, RTMPS	RTSP	RTSP		RTSP	RTSP	RTSP, RTMP, RTMPS, SRT	RTSP, RTMP, RTMPS	-
Web Protocols	HTTP	HTTP, HTTPS, NTP, UPnP, FTP	HTTP, HTTPS, NTP, UPnP, FTP		HTTP, HTTPS, NTP, UPnP, FTP	HTTP, HTTPS, NTP, UPnP, FTP	HTTP, HTTPS, NTP, UPnP	HTTP, HTTPS, NTP, UPnP	HTTP, HTTPS, NTP, UPnP, SNMP
Direct Drive System	-	-	-		-	-	✓	-	-
Fanless Design	✓	✓	✓		✓	✓	-	-	-
Built-in ND Filters	-	-	-		Auto, 1/4, 1/16, 1/64	Auto, 1/4, 1/16, 1/64	TBD	1/4, 1/16, 1/64	1/8, 1/64, Through
Genlock	-	-	-		✓	✓	✓	✓	✓
Advanced Color Adjustment	-	✓	✓		✓	✓	✓	✓	✓
Digital Noise Reduction (DNR)	✓	✓	✓		✓	✓	✓	✓	✓
Position Tracking for AR/VR	-	-	-		-	-	✓ (FreeD)	✓ (FreeD)	-
HD Cropping in 4K Mode	-	-	-		-	-	✓	✓	-
V-LOG Support	-	-	-		-	-	-	✓	-
High-Wind Resistance	-	-	-		-	-	-	-	✓
Lens Wiper / Haze Reduction	-	-	-		-	-	-	-	✓
Built-in Heater / Defroster	-	-	-		-	-	-	-	✓
Water & Dust Proof	-	-	-		-	-	-	-	✓
<b>OPTIONS &amp; ACCESSORIES</b>									
Portable Recorder	AG-UMR20	AG-UMR20	AG-UMR20		AG-UMR20	AG-UMR20	AG-UMR20	AG-UMR20	AG-UMR20
Wall Mount (Black -K) / (White -W)	FEC-40WMK / FEC-40WMW	FEC-40WMK / FEC-40WMW	FEC-40WMK / FEC-40WMW		FEC-40WMK / FEC-40WMW	FEC-40WMK / FEC-40WMW	FEC-100WMW / FEC-100WMK	FEC-150GMK / FEC-150GMK	FEC-HR140WMRBB
Pole Mount Adapter	-	FEC-PA1	FEC-PA1		FEC-PA1	FEC-PA1	TBD	FEC-PA1	-
Ceiling Mount	Included	Included	Included		Included	Included	Included	Included	Built-in
Weatherproof Outdoor Housing	Cooled	PAN-D2-CD/CDP/CDP	PAN-D2-CD/CDP/CDP		PAN-D2-CD/CDP/CDP	PAN-D2-CD/CDP/CDP	PAN-HD12-CD	PAN-HD12-CD	-
	Heated	-	PAN-D2-HB/HBF		PAN-D2-HB/HBF	PAN-D2-HB/HBF	PAN-HD12-HB	PAN-HD12-HB	-
3 Year Warranty	AG-SVCPREF2Y	AG-SVCPREF2Y	AG-SVCPREF2Y		AG-SVCPREF2Y	AG-SVCPREF2Y	AJ-SVCPREM4Y	AJ-SVCPREM2Y	-
5 Year Warranty + Accident Protection	-	AG-SVCPREM4Y	AG-SVCPREM4Y		AG-SVCPREM4Y	AG-SVCPREM4Y	AJ-SVCPREM4Y	AJ-SVCPREM2Y	-
On-Site Training	AJ-S09TFMCNS	AJ-S09TFMCNS	AJ-S09TFMCNS		AJ-S09TFMCNS	AJ-S09TFMCNS	AJ-S09TFMCNS	AJ-S09TFMCNS	AJ-S09TFMCNS
<b>MSRP (BASE MODEL)</b>	<b>\$1,200</b>	<b>\$2,100</b>	<b>\$2,950</b>	<b>\$3,695</b>	<b>\$4,250</b>	<b>\$5,550</b>	<b>\$8,350</b>	<b>\$11,400</b>	<b>\$17,950</b>
<b>MSRP (NDIHX MODEL)</b>	<b>-</b>	<b>\$2,400</b>	<b>\$3,150</b>	<b>+\$299 Upgrade</b>	<b>+\$299 Upgrade</b>	<b>\$5,850</b>	<b>-</b>	<b>+\$299 Upgrade</b>	<b>-</b>

<sup>1</sup>SFP+ module purchased separately. Please reference brochure for recommended models. <sup>\*\*</sup>AK-HRP1015 firmware upgrade may be required.  
<sup>3</sup>Power supply not included with this model. NDI<sup>®</sup> is a registered trademark of NewTek, Inc. All specifications, availability and pricing are subject to change without notice.

## 2020 PRO PTZ CAMERA CONTROL

### FULL-SIZE CONTROLLER AW-RP150

Control up to 200 PRO PTZ cameras with this full-size camera controller. Quickly setup and access camera presets and complex image controls and easily control your cameras with a top-of-the-line joystick, ensuring smooth camera movements.

- LCD Touchscreen w/Touch Focus Functionality
- Camera Monitoring via HD-SDI
- Industry Approved Ergonomic Design
- 3D Joystick for Single-Handed Operation
- Simplified PTZ Camera Presets & Tracing Memory
- Streamlined Multicamera Deployment
- Power via PoE+ or XLR!



**\$4,700**  
MSRP

### COMPACT CONTROLLER AW-RP60

Control up to 200 PRO PTZ cameras, with this full-featured controller. An LCD screen displays menus & key camera information such as iris, zoom and focus.

**\$2,375**  
MSRP

Power via PoE or XLR!



### NEW UPDATES! WINDOWS SOFTWARE PTZ CONTROL CENTER

Use the free PTZ Control Center software to set-up and control your camera on a Windows laptop or desktop PC. With this software, you can utilize your mouse, your touch-screen, or your choice of compatible joysticks or game controllers for camera control.

- Software application that allows for remote operation of Panasonic Professional PTZ cameras via your PC, allowing for control via a standard keyboard/mouse, touchscreen, or a compatible USB joystick / game controller
- Allows for centralized management of multiple PTZ cameras
- Provides simultaneous control of multiple cameras, allowing adjustment of Focus, Iris, Gain, White Balance, Shutter & ND Filters
- Add up to 9 camera presets with thumbnails



Works on Windows 7, Windows 8.1 & Windows 10

### WEB BROWSER

When your camera is on the network, you can set-up and control it via a web browser on a PC, Mac or mobile device such as an iPhone, iPad or Android device. This is a free, yet powerful option for camera control and setup.



### iPad APP LIVECTRL

Use the LiveCTRL app on an iPad Pro to set-up, control and livestream up to 4 Panasonic PRO PTZ cameras. With this app, you can utilize your tablet to produce your entire show. The app is free to download and allows for full camera preview and control at its most basic tier, allowing controlling, switching and livestreaming of up to 4 cameras via an in-app purchase as you scale your production.



CUSTOM RTMP



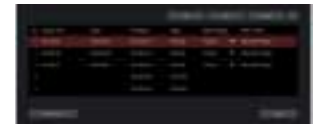
powered by  
Cinemaker™



### DRIVER SOFTWARE PTZ VIRTUAL USB DRIVER

With the free PTZ Virtual USB Driver software, you can convert select Panasonic Professional PTZ cameras on your network into super web cams.

- Allows you to use select Panasonic professional PTZ cameras on your network as USB cameras
- Up to 5 cameras can be registered
- Automatic camera discovery and network settings
- Compatible with all PTZ models as well as the AG-UMR20, AG-UCK20, AG-CX10 and AG-CX350.



Works on Windows 7, Windows 8.1 & Windows 10

### NEW UPDATES! AUTO TRACKING SOFTWARE / SERVER AW-SF100 / AW-SF200

State-of-the-art auto tracking software option for Panasonic PRO PTZ remote cameras. Dramatically simplify your remote camera operation in locations such as classrooms, lecture halls, auditoriums, conference rooms and stage environments. Using a combination of tracking methods, including template matching, facial detection and deep learning, compatible Panasonic PRO PTZ cameras can be automated to keep track of speakers or lecturers without the need for a dedicated camera operator.

- AW-SF100 (stand-alone software) / AW-SF200 (server)
- Deep Learning, Motion Detection & Facial Recognition used for high-precision auto tracking with minimum tracking error

Works on Windows 7, Windows 8.1 & Windows 10



### REMOTE OPERATION PANEL AK-HRP200 / AK-HRP1000

Ideal for multi-camera shoots that incorporate Professional PTZ and non-PTZ cameras, these advanced remote control panels allow for accelerated fine-tuning of camera color and shading.



### NEW! ROBOTIC DOLLIES, TELESCOPIC COLUMNS & CEILING/FLOOR TRACKS TECNOPOINT TUNING

The first robotic system with tracks to be fully integrated with Panasonic PRO PTZ cameras. The direct system integration allows for full control of the dolly, column and the camera from a single controller.



### AV-HLC100 STREAMSTUDIO

NDI™

Not just a controller, but a full-fledged all-in-one control, production & live streaming system, the AV-HLC100 Stream Studio allows a mixed input of HDMI, SDI and NDI/HX PTZ camera sources (up to 8) for a complete live streaming solution.

- PTZ camera controller, audio mixer, titler, media player, and 1ME live streaming switcher
- Intuitive 3D joystick with pan, tilt, and zoom control
- Stream directly to Youtube Live, Facebook Live, TWITCH, Vimeo, custom RTMP destinations & more





NDI | HX

## Laia Broadcaster 4K Bullet

La Laia Broadcaster 4K Bullet será tu mejor amigo para cualquier solución de producción AV. Gracias a su Sensor Panasonic 1/2,7" y a su lente 4K f4.3mm-129mm, F1.8-F2.8 y su balance de blancos automático conseguirás una imagen nítida para cualquier producción audiovisual.

Laia Broadcaster 4K Bullet es la cámara compacta perfecta para cualquier entorno de producción: salones, auditoriums, estudios... con la mejor calidad de imagen en 4K e incluye el protocolo de comunicación NDI®|HX.

4K

Resolución 4K



Con protocolo de comunicación NDI®|HX



Control Remoto -RS232 y RS 485-



Lente Gran Angular 82°



3G-SDI, Ethernet



EL MEJOR AMIGO PARA CUALQUIER SOLUCIÓN DE PRODUCCIÓN AV, PROPORCIONANDO LA MEJOR CALIDAD DE IMAGEN DE VIDEO Y STREAMING PROFESIONAL

### GARANTÍA PROFESIONAL

3 años de garantía "Prime support" 24 hrs reemplazo avanzado

#### CARACTERÍSTICAS

<b>Sistema de video</b>	4K@60fps, 4K@50fps, 4K@25fps, 1080P@60fps, 1080P@59.94fps, 1080P@50fps, 1080I@60fps, 1080I@59.94fps, 1080I@50fp, 1080P@30fps, 1080P@29.97fps, 1080P@25fps, 720P@60fps, 720P@59.94fps, 720P@50fps, 720P@25fps
<b>Sensor</b>	1/2,5", CMOS, Max Effective Pixel: 8.1 M
<b>Modo de escaneo</b>	Progresivo
<b>Lente</b>	f = 3.5mm FOV 84°
<b>Iluminación mínima</b>	0.5 Lux @ (F1.8, AGC ON)
<b>Disparador</b>	1/30s ~ 1/10000s
<b>Balance de blancos</b>	Auto, Indoor, Outdoor, Una pulsación, Manual.
<b>Compensación de luz de fondo</b>	Soportado
<b>Reducción digital de ruido</b>	2D&3D Reducción digital de ruido
<b>Ángulo de visión</b>	Horizontal 82.6de eco acústico. Reducción automática de ruido. SSP, De-Reverberación, DRC
<b>Modo de autotracking</b>	Opcional. Modo Profesor/Alumno. Require Follower
<b>PIP</b>	Soportado
<b>Compresión de video</b>	H.265, H.264, MJPEG
<b>Video Bit rate</b>	128-20480 Kbps
<b>Doble Stream de video</b>	Soportado: 4K y Full HD
<b>Compresión de audio</b>	AAC
<b>PoE y PoC</b>	Soportado
<b>Protocolo soportado</b>	NDI® HX

#### INTERFAZ DE ENTRADA SALIDA

<b>Salida de video</b>	1 x SDI, BNC. Soporta PoC hasta 1080 30fps
<b>Red</b>	1xRJ45: 10M/100M/1000M PoE.
<b>Otros interfaces</b>	Audio entrada. Phoenix 3 Pin 1xRS485: 2pin Phoenix Port, Max Distance: 1200m, Protocol: VISCA/Pelco-D/Pelco-P
<b>Conector de alimentación</b>	JEITA (DC IN 12V)

#### ESPECIFICACIONES GENÉRICAS

<b>Voltaje de entrada</b>	DC 12V / PoE (802.3af) / PoC
<b>Consumo</b>	1.5A
<b>Temperatura de funcionamiento</b>	-10°C ~ 40°C
<b>Temperatura de almacenamiento</b>	-40°C ~ 60°C
<b>Peso del paquete</b>	0.5Kg

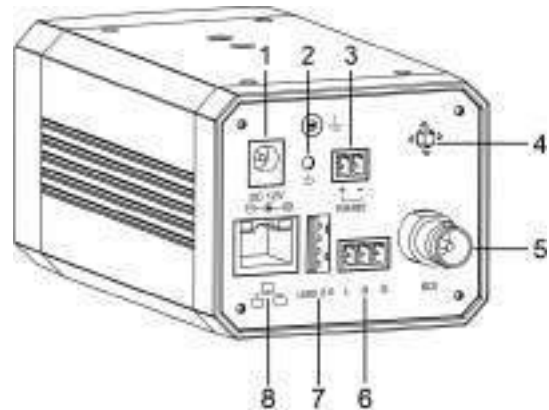
Oficinas centrales:  
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S.S. de los Reyes 28703  
Madrid- España

Servicio post-venta:  
C/Brújula, 4 Pol. Ind. PISA  
41927 Mairena del Aljarafe  
Sevilla - España

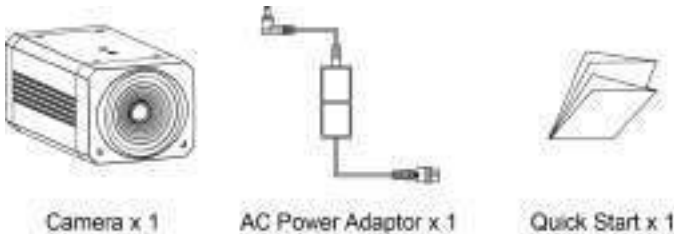


FAMILIA BROADCASTER - PRODUCCIÓN

## 1 Appearance and Interface



## 2 Packing List



No.	Name	No.	Name
1	DC 12V Interface	5	SDI Interface
2	Power Indicator	6	LINE IN Interface
3	RS485 Interface	7	USB 2.0 Interface (optional)
4	Menu Button	8	Network Interface

tracking host. Teacher tracking mode and student tracking mode are optional.

### AF Lens

Full custom auto focus without distortion lens, wide angle field of view up to 46°/84°/120°, small lens, wide vision. At the same time it supports EPTZ.

### Low Light

The application of 2D and 3D noise reduction algorithm greatly reduces the image noise. Even under the condition of ultra-low illumination, it still keeps the picture clean and clear, and the SNR of image is as high as 55dB.

### PoE

Support PoE power supply, and control, power supply, video and audio can be completed with only one network cable.

### Local Storage (optional)

Local storage, local recording of U disk can be realized without NVR.

## 3 Safety Precautions

### Electrical Safety

The installation and use of this product must strictly comply with local electrical safety standards.

### Transport Carefully

Prevent heavy damage, severe vibration or damage caused by immersion.

### Power Polarity

This product uses DC+12V power, please pay attention to the power polarity.



### Careful Installation

This product should be placed on the smooth desktop. Do not tilt mounting the product. Do not use strong force to damage the camera.

### Do not unauthorized disassemble

This product has no parts which can be repaired by the user. The damage caused by the user's own disassembly is not covered by warranty.



Notice

- Electromagnetic fields at specific frequencies may affect the image of the machine.
- Do not hot-plug the power supply during the use of the IP Camera.

## 4 Product Features

### 4K Ultra High Definition

Support 4K ultra high definition, ultra high definition with ultra high resolution, the maximum can provide 4K@30fps/25fps image output, while down compatible with 1080p, 720p and other resolutions.

### Intelligent Teaching Tracking (optional)

Built-in leading image recognition and tracking algorithm, you can achieve smooth and natural tracking without any auxiliary positioning camera or

## 5 Product Specifications

Name	HD Color Box Camera
<b>Camera</b>	
Sensor	1/2.5", CMOS, Effective Pixel: 8.51M
Scanning Mode	Progressive
Lens Mount	M12
Lens 1 (teacher)	Focus: f=7.35mm, FOV: 46°
Lens 2 (student)	Focus: f=3.5mm, FOV: 84°
Lens 3	Focus: f=2.8mm, FOV: 120°
Auto Focus	Support (120° Lens not support)
Minimal Illumination	0.05Lux @ (F1.8, AGC ON)
Shutter	1/30s ~ 1/10000s
White Balance	Auto, Indoor, Outdoor, One Push, Manual, VAR
Digital Noise Reduction	2D, 3D digital noise reduction
Backlight Compensation	Support

EPTZ	Support
Digital Zoom	8x
PoE	Support
Auto Tracking Function	Teacher mode/Student mode (optional)
<b>Network Features</b>	
Encode Protocol	H.264/H.265/MJPEG
Video Stream	First/Second/Third/Four Stream
First Stream Resolution	1920x1080, 1280x720, 1024x576, 960x540, 640x480, 640x360
Second Stream Resolution	3840x2160, 1920x1080, 1280x720, 1024x576, 720x576 (50Hz support), 720x480 (60Hz support), 720x408, 640x360, 480x270, 320x240, 320x180
Third/Four Stream Resolution	1024x576, 960x540, 720x576 (50Hz support), 720x480 (60Hz support), 720x408, 640x360, 480x270, 320x240, 320x180
Video Bit Rate	32Kbps ~ 102400Kbps
Bit Rate Control	Variable Rate, Fixed Rate
Frame Rate	50Hz: 1fps ~ 25fps, 60Hz: 1fps ~ 30fps
Audio Compression	AAC
Audio Bit Rate	48Kbps, 64Kbps, 96Kbps, 128Kbps
Protocols	TCP/IP, HTTP, RTSP, RTMP, ONVIF, DHCP etc.
<b>Input/Output Interface</b>	
Network Interface	1 x RJ45: 10/100/1000M Ethernet Interface (Support PoE)
Audio Interface	1 x Line In: 3pin (Phoenix Interface)
Control Interface	1 x RS485: 2pin, Max Distance: 1200m, Protocol: VISCA/Pelco-D/Pelco-P
Power Interface	DC 12V
USB Interface	1 x USB 2.0: Type A, female (optional)
<b>Physical Parameter</b>	
Input Voltage	DC 12V / PoE (IEEE802.3af)
Current Consumption	0.5A
Operating Temperature	-10°C ~ 40°C
Storage Temperature	-40°C ~ 60°C
Power Consumption	6W
Size	72mm x 60mm x 130mm (without bracket)
Net Weight	0.5Kg
MTBF	> 30000h

## 6 Troubleshooting

### Image

- The monitor shows no image
  - 1) Check that the camera power supply is connected, the voltage is normal, and the power indicator light is always on.
  - 2) Turn off the power switch to check whether the camera is self-testing.
  - 3) Check the cable of video platform and TV whether correct connection.
- Sometimes without the image
 

Check the cable of video platform and TV whether correct connection.

  - Image have jitter when the camera lens at max multiple.
    - 1) Check whether the camera installed position be stabled.
    - 2) Check whether have vibrating machinery or object near the camera.

- There is no image in IE Browser
 

Please visit VLC website (<http://www.videolan.org/vlc>) download and install VLC media player, after it be installed, IP Camera will display normal image.
- Unable to access IP Camera through IE browser
  - 1) Test whether the PC to access the network can work properly, first of all, the network fault caused by the PC virus can be eliminated, until the PC and IP Camera can communicate with each other Ping.
  - 2) Disconnect the network, connect IP Camera and PC separately, and reset the IP address of PC.
  - 3) Check IP address, subnet mask, and gateway settings for IP Camera.
  - 4) Check whether the MAC address is conflicts.
  - 5) Check whether the Web port is occupied by another device.
- Forget IP address or website login password.
 

Please remember the camera default IP address: **192.168.100.88**; default user name: **admin**; default password: **admin**.

### Control

- Series port can not control
  - 1) Check whether the camera protocol, address such is the same.
  - 2) Check whether the control line is connected well.

## 7 Toxic and Harmful Substances

Part Name	Toxic or harmful substances or elements					
	(Pb)	(Hg)	(Cd)	(CrVI)	(PBB)	(PBDE)
Metal	x	0	0	0	0	0
Plastic	0	0	0	0	0	0
Glass	x	0	0	0	0	0
Circuit board	x	0	0	0	0	0
Power	x	0	0	0	0	0
Attached	x	0	0	0	0	0

This form is compiled in accordance with SJ/T 11364.

O: Indicates that the content of the hazardous substance in all homogenized materials of the component is subject to the limit specified in GB/T 26572.

x: Said the hazardous substance in at least one of the components homogenized material content in excess of the GB/T 26572 limit requirements, and there are no mature alternatives.

## 8 Warranty Card

If failure caused by non-human causes occurs within one year from the date of purchase of the machine, you may enjoy the warranty service of the product. Any of the following circumstances is not covered by the warranty:

- Without disassemble, modification such as fault causes.
- Use of an environment does not conform to requirements of the product.
- Irresistible factors, such as fire, earthquake, lightning strike, etc.
- Warranty card does not match the product number or it is altered.

User Name	
User Address/Post Code	
Contact Number	
Product Model	
Product Series	
Purchasing Date	
Invoice No.	
Sales Department	

User save, lost or not compensated

Sales Department: [support@laiatech.com](mailto:support@laiatech.com)

USB  Español(<https://liatech.com/accesorios/>)  
 Cameras (<https://liatech.com/en/family-cute/>)  
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Videoconference(<https://liatech.com/en/family-myteam/>)  
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Production(<https://liatech.com/en/family-broadcaster/>)  
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Audio (<https://liatech.com/en/family-tpod/>)  
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(<https://www.liatech.com/>)



Liatech

# Accessories

## Our camera mounts

With the Laia camera mounts you can place your video conference camera in a fixed way

Mount

### Ceiling bracket

With our ceiling mount to fix your video conference camera. Get professional quality support with which you can forget about daily installations. Our mounts are compatible with:

- **Cute Range\***(<https://liatech.com/en/family-cute/>)
- **MyTeam Range**(<https://liatech.com/en/family-myteam/>)
- **Broadcaster Range**(<https://liatech.com/en/family-broadcaster/>)

\* Except Laia Cute PC Pro and Laia Cute Lite.



# Wall bracket

Supporte

USB  
Cameras  
▼

(<https://laiatech.com/en/family-cute/>)

With our wall mount to fix your video conference camera. Get professional quality support with which you can forget about daily installations. Our mounts are compatible with:

➤ **Cute Range\***(<https://laiatech.com/en/family-cute/>)

➤ **MyTeam Range**(<https://laiatech.com/en/family-myteam/>)

➤ **Broadcaster Range**(<https://laiatech.com/en/family-broadcaster/>)▼

Production(<https://laiatech.com/en/family-broadcaster/>)

\* Except Laia Cute PC Pro and Laia Cute Lite and Laia Cute 4K AI 2021

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Audio (<https://laiatech.com/en/family-tpod/>)  
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Support(<https://laiatech.com/en/support/>)



## Compatible with all video conferencing services on the market



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Laia community (<https://laiatech.com/en/blog-community-laia/>)

Discover everything that surrounds the world of professional video calling. Join our user community.

Our blog  
(<https://laiatech.com/en/blog-community-laiatech/>)

USB Cameras  
(<https://laiatech.com/en/family-cute/>)



Videoconference  
(<https://laiatech.com/en/family-myteam/>)

(<https://laiatech.com/support/>)

Support and maintenance (<https://laiatech.com/support/>)

Find everything you need for your Laia equipment and about us: manuals, user guide, frequently asked questions... (<https://www.laiatech.com/>)



Production  
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Audio  
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Support, manuals and much more  
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Education  
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Prime Support warranty (<https://laiatech.com/warranty-laiatech/>)

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Laiatech

## Professional audio and video solutions

Contact us

Support and documentation  
(<https://laiatech.com/en/support/>)

### Our solutions

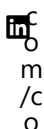
- › CUTE range(<https://laiatech.com/en/family-cute/>)
- › MYTEAM range(<https://laiatech.com/en/family-myteam/>)
- › BROADCASTER range(<https://laiatech.com/en/family-broadcaster/>)
- › T-POD range(<https://laiatech.com/en/family-t-pod/>)

### Other solutions

- › Thermal camera | Laia Cute Thermal(<https://laiatech.com/en/product-cute-thermal/>)
- › Thermal camera | Laia Broadcaster Thermal(<https://laiatech.com/en/product-broadcaster-thermal/>)
- › Education pack(<https://laiatech.com/en/hybrid-education/>)

### About us

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- › Social network(<https://www.linkedin.com/company/laiatech/>)
- › Soporte y mantenimiento(<https://laiatech.com/en/support/>)



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USB  
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Equipped with a GUI menu screen for clear visibility and a joystick for intuitive control.

Compact Remote Camera Controller with PoE\*1 support for single cable connection.



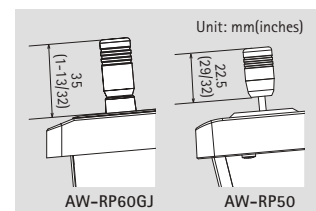
### Equipped with a 3.5-type LCD screen

The AW-RP60GJ is equipped with a 3.5-type LCD screen to deliver a GUI menu where the information you need is provided at a glance for intuitive and quick camera control.



### New Joystick with enhanced operability

The new joystick supports smooth pan and tilt operations and ensures accurate capture of your target image. The grip of joystick is approximately 1.5 times larger than previous model AW-RP50, realizing more stable operation.



### Flexible customization features

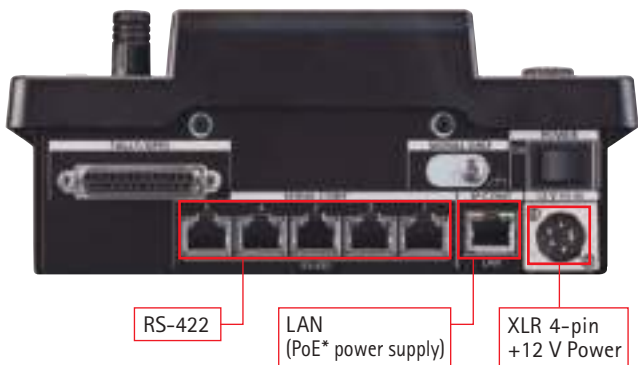
The controller is equipped with four user assignable buttons, to which up to eight functions\*2 of your choice can be assigned. Each preset name can also be customized with a PC tool. These flexible features of the controller make it perfect for use in a wide range of environments, from lectures and corporate seminars to live streaming and broadcasting at amusement facilities.

### PoE\*1 support/Advanced camera adjustment

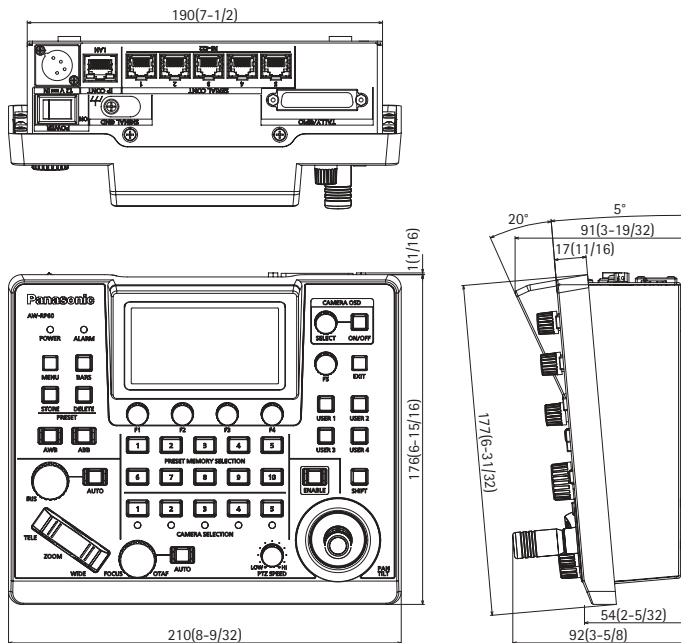
PoE\*1 support enables power supply and camera control to be delivered via a single ethernet cable. In addition to camera control operation, gamma, white balance and other color adjustment functions can be performed, making advanced camera adjustments possible.

\*1: PoE is the abbreviation for Power over Ethernet. \*2: Enable user button 5 through 8 by pressing the shift button.

<Rear View>



<Dimensions>



Unit: mm(inches)

<Specifications>

Power Requirements	12 V DC (10.8 V to 13.2 V)	
PoE*	IEEE802.3af standard: 42 V to 57 V DC (Camera Input)	
Current Consumption	0.9 A (XLR connector input), 0.3 A (PoE power supply)	
Mass	1.5 kg (3.31 lbs)	
Dimensions	W 210 mm x H 92 mm x D 177 mm (8-9/32 inches x 3-5/8 inches x 6-31/32 inches) (excluding protrusions)	
Display	3.5-type liquid crystal (QHD 960 x 540)	
Connection Specifications	No. of Connectable Cameras 200 (IP), 5 (RS422) *Up to 100 for cameras other than the AW-UE150	
	Remote Camera Selection	5 (6 to 200 controlled from the LCD)
	No. of Camera Groups	20 (10 units/group)
	No. of Memory Presets	100

\*PoE is the abbreviation for Power over Ethernet.

- Power supply not included. An AC adaptor or PoE HUB is required.
- Specifications are subject to change without prior notice.

■ Optional Products

AC Adaptor  
AW-PS551

# Panasonic®

Panasonic Corporation  
Connected Solutions Company  
2-15 Matsuba-cho, Kadoma, Osaka 571-8503 Japan



Factories of AVC Networks Company have received ISO14001:2004-the Environmental Management System certification. (Except for 3rd party's peripherals.)



For more information, please visit Panasonic web site  
<https://pro-av.panasonic.net/en/qr/>



Broadcast and Professional AV Website



Contact Information



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Mobile App

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies



- Delivers a unified HD signal distribution solution incorporating both point-to-point wired and IP streaming technologies
  - Provides lossless HD AV signal routing over twisted pair copper wire or fiber
  - Integrates video, audio, networking, and control over one wire or fiber strand
  - Enables high-performance H.264 streaming from any input source up to 1080p or WUXGA
  - Provides a built-in CONTENT LAN port for streaming
  - Affords full matrix switching with ultra high 12.5 Gbps backplane data rate
  - Handles HDMI® devices with Deep Color, 3D, 4K, and high-bitrate 7.1 encoded audio
  - HDBaseT® Certified device — Enables direct connection to other HDBaseT certified equipment
  - HDCP 2.2 compliant via 4K input and output cards
  - Distributes Full HD 1080p, Ultra HD, and 4K signals via DM 8G+® and HDBaseT connectivity
  - Distributes 1080p and WUXGA signals over via DM 8G® Fiber or via DM 8G® SM Fiber
  - Allows streaming of 1080p signals over an IP network with no distance limitations
  - Supports first-generation DM® CAT and DM® Fiber products
  - Configurable with up to eight DM, HDBaseT, and/or HDMI outputs
  - Configurable with up to four streaming outputs
  - Easy output expansion using multiple DM switchers
  - Modular inputs support a complete range of digital, analog, and streaming signal types
  - QuickSwitch HD™ technology manages HDCP keys for fast, reliable switching
  - Auto-Locking® technology achieves rapid switching between disparate sources
  - Performs automatic AV signal format management via EDID
  - Enables device control via CEC
- Allows independent scaling for every display through select output cards and DM receivers
  - Distributes and routes USB HID mouse and keyboard signals
  - Allows full audio and USB breakaway switching
  - Supports analog audio embedding and de-embedding
  - Includes integrated Ethernet switch with Gigabit LAN port
  - Private Network Mode — requires just one IP address for the complete DM system
  - Secure access through full user/group management or Active Directory® credential management integration
  - Hardware level security using 802.1X authentication
  - TLS, SSL, SSH, and SFTP network security protocols
  - Includes a built-in web server
  - 4-space 19 in. (483 mm) rack-mountable

The DM-MD8X8-CPU3-RPS delivers an advanced 4K60 4:4:4 AV signal routing solution to provide the foundation for a complete DigitalMedia™ system. The DM-MD8X8-CPU3-RPS affords ultra fast switching and lossless distribution of HDMI® and other signals to support digital media players, HDTV receivers, computers, cameras, and display devices. The DM-MD8X8-CPU3-RPS is an enhanced version of the [DM-MD8X8-CPU3](#) featuring two built-in redundant power supplies.

The DM-MD8X8-CPU3-RPS is configurable to handle up to AV sources. The outputs are configurable to provide up to eight DM, HDBaseT®, and/or HDMI outputs, or up to four H.264 streaming outputs, in a single chassis.<sup>1</sup> Based on the 3-Series® platform, the DM-MD8X8-CPU3-RPS provides enterprise-grade security.

Integrated Ethernet networking and USB distribution provide a complete connectivity solution combined with built-in Crestron® control<sup>2</sup> for managing the displays and other room devices without any additional wiring. User-friendly operation, setup, and troubleshooting tools are provided through the DM-MD8X8-CPU3-RPS front panel, or via [Crestron Toolbox™](#) software, to allow for easy setup. A web browser interface is also provided.<sup>3</sup>

#### 4K Ultra HD

The DM-MD8X8-CPU3-RPS is designed to meet the extreme bandwidth requirements for handling 4K and Ultra HD video signals. Support for 4K video also ensures support for the latest generation of computers and monitors with native resolutions beyond 1080p and WUXGA.<sup>4</sup>

#### DigitalMedia 8G+® Technology

The DM-MD8X8-CPU3-RPS provides full support for Crestron DigitalMedia 8G+ devices as well as first-generation DM CAT<sup>8,10</sup> and DM Fiber<sup>9,10</sup> products, letting you take advantage of the latest Crestron DigitalMedia 8G+ technology.

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

A DigitalMedia 8G+ system handles high resolution video signals and can simultaneously distribute stereo and multichannel surround sound signals that support high bitrate 7.1 audio formats as well as uncompressed linear PCM. Signals are transported over one CAT type twisted pair cable or one strand of multimode or single-mode fiber.

### HDBaseT® Certified

Using DigitalMedia 8G+® technology, the DM-MD8X8-CPU3-RPS can be connected directly to an HDBaseT compliant device without requiring a DM transmitter or receiver.

### H.264 Streaming

The DM-MD8X8-CPU3-RPS streaming input capability enables IP cameras and other H.264 encoded sources to be distributed via DigitalMedia alongside HDMI and other non-streaming sources. It also allows DM switchers to be bridged together for simplified routing of HD content between buildings and global offices. Large-scale streaming to computers and mobile devices can be facilitated through integration with a streaming media system such as a Wowza® or Kaltura® media system.

### Built-In CONTENT LAN Port

Any streaming input or output may be configured to stream via the CONTENT LAN or LAN port of the DM switcher or via a dedicated CONTENT LAN port of a DMC Series input or output card. Control and content can be combined on a single network or can be isolated onto separate networks.

### Modular Architecture

The DM-MD8X8-CPU3-RPS features a modular architecture with 8 input card slots and 4 dual output card slots. A wide selection of input cards is offered to support a complete range of digital and analog AV signal types as specified in the following specifications table.

### Output Expansion

An HDMI pass-through output is provided on every input card to allow the inputs of up to five DM switchers to be daisy-chained, enabling the configuration of very large distribution systems with many outputs. Using five DM-MD8X8-CPU3-RPS switchers, for example, it is possible to support up to 40 separate outputs.

### QuickSwitch HD™ Technology

Digital media signals are typically encrypted to protect against unauthorized viewing. After authenticating displays or signal processors, a source device must issue a key before delivering an output signal. Crestron QuickSwitch HD technology manages these keys to ensure fast, reliable switching and immunity to blackouts.

### Auto-Locking® Technology

Crestron Auto-Locking technology enables super fast signal switching by instantaneously configuring every device in the signal path as soon as the signal hits the first device. Auto-Locking technology virtually eliminates any noticeable gap while switching.

### EDID Format Management

DigitalMedia technology manages the EDID (Extended Display Identification Data) that devices use to communicate to eliminate conflicts that may arise when one source is routed to multiple displays or audio components. Via Crestron Toolbox software, the format and resolution capabilities of each device can be assessed, allowing the installer to properly configure EDID.

### A Scaler for Every Display

Installing select output cards into the DM-MD8X8-CPU3-RPS or connecting a DM receiver with built-in HD and 4k scalers to the DM-MD8X8-CPU3-RPS allows for high-performance scaling. Independent scalers placed at every display device allow for the routing of multiple sources to many different display devices.<sup>13</sup> The Distributed Scaler Approach ensures an optimal image on every screen and allows a high-res computer source to be viewed on any display in the building.

### Versatile Audio Routing

HDMI is the key to handling 7.1 surround sound formats such as Dolby® TrueHD, Dolby Atmos®, and DTS HD Master Audio™. To share these audio sources with multiple audio zones, the DM-MD8X8-CPU3-RPS allows for the simultaneous distribution of multichannel surround sound and two-channel stereo signals from the same HDMI source.

The digital stereo signal is converted to analog to enable sharing via a Sonnex® Multiroom Audio System or any other audio distribution system. The DM-MD8X8-CPU3-RPS also allows surround sound processors and amplifiers to be located centrally instead of at the display location via optional local HDMI outputs.

### Built-in Ethernet Switch

The DM-MD8X8-CPU3-RPS includes an integrated Ethernet switch with a gigabit LAN port. In addition to transporting digital video and audio, a DigitalMedia system can also extend 100 Ethernet out to each display and source device via select DM receivers and transmitters, providing high-speed connectivity for any room device that requires a LAN connection. Ethernet is also utilized internally by the Crestron control bus to manage the DM devices in the system and provide display control in each room.

### Private Network Mode

To streamline its implementation on a corporate or university LAN, the DM-MD8X8-CPU3-RPS employs Private Network Mode to provide a single-point connection for the complete system. Using Private Network Mode, the

**NOTE:** QuickSwitch HD technology requires the use of a scaling HDMI output, which is available on DigitalMedia™ devices such as the DM-RMC-4KZ-SCALER-C and DMC-4KZ-HDO.

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

DM-MD8X8-CPU3-RPS requires just one IP address for the complete DM network.

#### USB Signal Routing

The DM-MD8X8-CPU3-RPS supports USB HID (Human Interface Device) signal routing so that a USB HID compliant keyboard and/or mouse can provide local control for devices in other locations.<sup>16</sup> USB HID connectivity is provided through select DM receivers, transmitters, and input cards. Connect a USB over Ethernet Extender host module ([USB-EXT-DM-LOCAL<sup>12</sup>](#)) to a host that you would like to communicate with and install a device module ([USB-EXT-DM-REMOTE<sup>12</sup>](#)) at every display location to connect keyboards, gaming controllers, mice, or other devices.

#### CEC Embedded Device Control

Through its connection to the control system, the DM-MD8X8-CPU3-RPS provides a gateway for controlling many devices right through their HDMI or HDBaseT connections, potentially eliminating the need for any dedicated control wires or IR emitters.<sup>13</sup>

#### Web Browser Control

The DM-MD8X8-CPU3-RPS also includes a built-in web server that allows functions such as Ethernet configuration, routing, and firmware upgrades to be performed.<sup>3</sup>

#### Redundant Power Supplies

The DM-MD8X8-CPU3-RPS delivers enhanced reliability through two long-life, redundant power supplies. In the unlikely event of a fault with one of the power supplies (indicated by a flashing red LED), the DM-MD8X8-CPU3-RPS will continue to operate on only one power supply. Individual green LEDs show that the power supplies are functioning without fault. The power supplies can also be remotely monitored via Crestron Fusion® software or any control system touch screen.

*Upgrading an existing DM switcher that has older multi-gang DMCO-series output cards? Use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the new single-gang output card format.*

*Refer to the DigitalMedia Resources Webpage at [www.crestron.com/dmresources/](http://www.crestron.com/dmresources/) for additional design tools and reference documents.*

## Specifications

### Maximum Cable Lengths

Resolution	Cable Type		
	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	Third-Party CAT5e (or higher)
1920x1080 FHD 1080p	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 DCI 2K			
2048x1152 QWXGA			
2560x1080 UWFHD	230 ft (70 m)	165 ft (50 m)	
2560x1080 WQHD			
2560x1600 WQXGA			
3840x2160 4K UHD			
4096x2160 DCI 4K			

Resolution	Cable Type	
	CRESFIBER8G CresFiber® 8G Multimode Fiber	Third-Party OM3 Multimode Fiber
1920x1080 FHD 1080p	1000 ft (300 m) via DM 8G Fiber cards	500 ft (150 m) via DM 8G Fiber cards
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @ 24Hz		

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

Resolution	Cable Type	
	CRESFIBER8G-SM CresFiber 8G Single-Mode Fiber	Third-Party G.652.D (or higher) Single-Mode Fiber
1920x1080 FHD 1080p	7.5 miles (12 km) via DM 8G SM Fiber cards	
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @ 24Hz		

## Video

<b>Switcher</b>	8x8 digital matrix, modular input/output cards, Crestron QuickSwitch HD™ technology
<b>Input Signal Types</b>	Configurable via modular plug-in cards supporting HDMI® (DVI & Dual-Mode DisplayPort compatible <sup>12</sup> ), DVI, 3G-SDI, RGB/VGA, component, S-Video, composite (NTSC & PAL), DM 8G+® & HDBaseT®, DM 8G® Fiber, DM 8G SM Fiber, DM® CAT (legacy), DM Fiber (legacy), & H.264 streaming
<b>Output Signal Types</b>	Configurable via modular plug-in cards supporting HDMI (DVI compatible <sup>15</sup> ), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs)
<b>Backplane Data Rate</b>	12.5 Gbps

**NOTE:** For additional specifications, refer to the DMC Series input and output card spec sheets.

## Audio

<b>Switcher</b>	8x8 digital multichannel audio-follow-video matrix switching, plus independent 8x8 stereo matrix for audio breakaway
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**Input Signal Types** Configurable via modular plug-in cards supporting HDMI (Dual-Mode DisplayPort compatible<sup>12</sup>), 3G-SDI, analog (stereo 2-channel), SPDIF, DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming

**Output Signal Types** Configurable via modular plug-in cards supporting HDMI, analog (stereo 2-channel), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs, and most digital audio input cards also include analog stereo pass-through audio outputs)

**NOTE:** For additional specifications, refer to the DMC Series input and output card spec sheets.

## Communications

<b>Ethernet</b>	100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client, Private Network Mode
<b>USB</b>	USB signal routing via select input cards, transmitters, receivers, and extenders <sup>16</sup> ; USB computer console port for setup
<b>DigitalMedia</b>	DM 8G+, DM 8G Fiber, DM 8G SM Fiber, DM Fiber, DM CAT, HDCP 2.2 <sup>4</sup> , EDID, CEC, PoDM, PoDM+, Ethernet
<b>HDBaseT</b>	HDCP 2.2 <sup>4</sup> , EDID, CEC, RS-232, PoH, Ethernet
<b>HDMI</b>	HDCP 2.2 <sup>4</sup> , EDID, CEC

**NOTE:** Supports management of HDCP and EDID; supports management of CEC between connected HDMI and HDBaseT devices and a control system.<sup>14</sup> For additional specifications, refer to the DMC Series input and output card spec sheets.

## Card Slots

<b>1 - 8</b>	(8) DM switcher input card slots; Each slot accepts (1) DMC-series input card
<b>DM OUTPUTS 1-8</b>	(4) DM switcher output card slots; Each slot accepts (1) DMC-series output card

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

**Connectors**

<b>LAN</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port
<b>CONTENT</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port; Provides a dedicated LAN connection for streaming only, used in lieu of streaming via the LAN port of the switcher or the CONTENT LAN port of a DMC Series input or output card
<b>SERVICE</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port; For factory use only
<b>USB</b>	(1) USB Type A connector, female; USB 2.0 host port for USB flash drive; For save/load of EDID settings and firmware update
<b>100-240V~;3-1.2A 50/60 Hz</b>	(1) IEC 60320 C14 mains power inlet; Mates with included power cord
<b>G</b>	(1) 6-32 screw, chassis ground lug
<b>COMPUTER (front)</b>	(1) USB Type B female; USB computer console port (6 ft cable included)

**Controls & Indicators**

<b>LCD Display</b>	Green LCD dot matrix, 128 x 64 resolution, adjustable LED backlight, displays inputs/outputs by name, video & audio signal information, Ethernet configuration and setup menus
<b>SOFTKEYS</b>	(4) Push buttons for activation of LCD driven functions
<b>HW-R</b>	(1) Recessed push button for hardware reset, reboots the switcher
<b>ROUTE</b>	(1) Push button and red LED, selects ROUTE mode to allow routing changes
<b>VIEW</b>	(1) Push button and red LED, selects VIEW mode for viewing current routes
<b>INFO</b>	(1) Push button and red LED, selects INFO mode for viewing AV and device info
<b>MENU ENTER</b>	(1) Push button, steps menu back one level
<b>AUDIO</b>	(1) Push button & red LED, selects audio routing view
<b>VIDEO</b>	(1) Push button & red LED, selects video routing view
<b>USB</b>	(1) Push button & red LED, selects USB routing view
<b>Quick-Adjust Knob</b>	(1) Continuous turn rotary encoder, adjusts menu parameters

<b>IN1 - 8</b>	(8) Push buttons and red LEDs, each selects the corresponding input for routing
<b>OUT1 - 8</b>	(8) Push buttons and red LEDs, each selects the corresponding output for routing
<b>POWER SUPPLIES, 1-2</b>	(2) Green LEDs, each indicates when the corresponding internal supply is functioning
<b>POWER SUPPLIES, FAULT</b>	(1) Red flashing LED, indicates a fault with either internal supply
<b>LAN (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity
<b>CONTENT (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity
<b>SERVICE (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity

**Power Requirements**

<b>Main Power</b>	3-1.2 A @ 100-240 VAC, 50/60 Hz
<b>Power Consumption</b>	220 W typical
<b>Available PoDM/PoH Power</b>	Refer to the specifications for each DM 8G+ input and output card

**Redundant Power Supplies**

<b>Quantity/Type</b>	(2) switch-mode, internal
<b>Demonstrated MTBF</b>	>1,000,000 hours per power supply @ full load and 25% C ambient conditions
<b>Redundancy</b>	Complete unit continues to operate at full capacity on one or more functioning power supplies

**Environmental**

<b>Temperature</b>	32° to 104° F (0° to 40° C)
<b>Humidity</b>	10% to 90% RH (noncondensing)
<b>Heat Dissipation</b>	750 BTU/hr
<b>Ambient Noise</b>	31.5 to 37 dBA typical; 30 to 30.5 dBA idle



## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

**Enclosure**

<b>Chassis</b>	Metal with black finish, vented sides, fan-cooled
<b>Front Panel</b>	Metal, black finish with polycarbonate label overlay
<b>Mounting</b>	Freestanding or 4 RU 19-in. (483 mm) rack-mountable (adhesive feet and rack ears included)

**Dimensions**

<b>Height</b>	6.97 in. (177 mm) without feet
<b>Width</b>	17.28 in. (439 mm), 19.06 in. (485 mm) with rack ears
<b>Depth</b>	15.71 in. (399 mm) without cards

**Weight**

20.0 lb (9.1 kg) without cards

**Models**

DM-MD8X8-CPU3-RPS

**Available Accessories****DMC-4KZ-C**

DigitalMedia 8G+® 4K60 4:4:4 HDR Input Card for DM® Switchers, HDBaseT® Compatible

**DMC-4KZ-C-DSP**

DigitalMedia 8G+® 4K60 4:4:4 HDR Input Card w/Downmixing for DM® Switchers, HDBaseT® Compatible

**DMC-4KZ-HD**

HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

**DMC-4KZ-HD-DSP**

HDMI® 4K60 4:4:4 HDR Input Card w/Downmixing for DM® Switchers

**DMC-4KZ-CO-HD**

2-Channel DigitalMedia 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

**DMC-4K-CO-HD-HDCP2**

2-Channel HDBaseT® Certified 4K DigitalMedia 8G+® Output Card for DM® Switchers

**DMC-4K-HDO**

2-Channel 4K Scaling HDMI® Output Card for DM® Switchers

**DMC-DVI**

DVI/VGA Input Card for DM® Switchers

**DMC-HDO**

2-Channel HDMI® Output Card for DM® Switchers

**DMC-S**

DigitalMedia 8G™ Fiber Input Card for DM® Switchers

**DMC-S2**

DigitalMedia 8G™ Single-Mode Fiber Input Card for DM® Switchers

**DMC-S2-DSP**

DigitalMedia 8G™ Single-Mode Fiber Input Card w/Downmixing for DM® Switchers

**DMC-S2O-HD**

2-Channel DigitalMedia 8G™ Single-Mode Fiber Output Card for DM® Switchers

**DMC-SDI**

3G-SDI Input Card for DM® Switchers

**DMC-S-DSP**

DigitalMedia 8G™ Fiber Input Card w/Downmixing for DM® Switchers

**DMC-SO-HD**

2-Channel DigitalMedia 8G™ Fiber Output Card for DM® Switchers

**DMC-STR**

Streaming Input Card for DM® Switchers

**DMC-STRO**

Streaming Output Card for DM® Switchers

**DMC-VGA**

VGA/Video Input Card for DM® Switchers

**DMC-VID4**

Quad Video Input Card for DM® Switchers

**DMC-VID-BNC**

BNC Analog Video Input Card for DM® Switchers

**DMC-VID-RCA-A**

RCA Analog Video Input Card w/Analog Audio for DM® Switchers

**DMC-VID-RCA-D**

RCA Analog Video Input Card w/SPDIF Audio for DM® Switchers

**DM-PSU-8-PLUS**

8-Port PoDM+ Power Supply for DM 8G+® I/O Cards

**DM-PSU-16-PLUS**

16-Port PoDM+ Power Supply for DM 8G+® I/O Cards

**DM-PSU-ULTRA-MIDSPAN**

DigitalMedia™ Ultra Midspan PoDM++ Injector

**USB-EXT-DM-LOCAL**

USB over Ethernet Extender with Routing, Host Module

**USB-EXT-DM-REMOTE**

USB over Ethernet Extender with Routing, 4-Port Device Module

**DM-8G-CONN-100**

Connectors for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

**DM-8G-CONN-WG-100**

Connectors with Wire Guide for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CRIMP**

Crimping Tool for DM-8G-CONN

**DM-8G-CRIMP-WG**

Crimping Tool for DM-8G-CONN-WG

**DM-CBL-8G-NP-SP1000**

DigitalMedia 8G™ Cable, non-plenum, 1000 ft spool

**DM-CBL-8G-P-SP1000**

DigitalMedia 8G™ Cable, plenum, 1000 ft spool

**DM-CBL-ULTRA-LSZH-SP1000**

DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen, 1000 ft spool (Available only in Europe)

**DM-CBL-ULTRA-NP-SP1000**

DigitalMedia™ Ultra Cable, Non-Plenum Type CMR, 1000 ft spool

**DM-CBL-ULTRA-PC-10**

DigitalMedia™ Ultra Patch Cable, 10 ft (3 m)

**DM-CBL-ULTRA-P-SP1000**

DigitalMedia™ Ultra Cable, Plenum Type CMP, 1000 ft spool

**DM-CONN-20**

Connectors for DM-CBL DigitalMedia™ Cable & DM-CBL-ULTRA DigitalMedia Ultra Cable, 20-Pack

**DM-CONN-ULTRA-RECP-50**

DigitalMedia™ Ultra Keystone RJ45 Jack, 50-Pack w/Termination Tool

**DM-RPP-K24**

DigitalMedia™ 24-Port Keystone Patch Panel

**CRESFIBER8G-NP-SP1000**

CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, non-plenum, 1000 ft spool

**CRESFIBER8G-P-SP1000**

CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, plenum, 1000 ft spool

**CRESFIBER8G-SM-CONN-LC-12**

Connectors for CresFiber® 8G Single-Mode Fiber Optic Cable, LC, 12-Pack

**CRESFIBER8G-SM-P-SP2KM**

CresFiber® 8G Single-Mode Fiber Optic Cable, plenum, 2 km spool

**CRESFIBER-CONN-SC50UM-12**

Connectors for CresFiber® 8G Multimode Fiber Optic Cable, SC 50µm, 12-Pack

**CRESFIBER-TK**

CresFiber® Termination Kit (AFL Telecommunications®)

## Notes:

- All output types are configured in pairs except for streaming. To configure a complete DM switcher with output and input cards, use the online [DigitalMedia Switcher Configuration Tool](#). Current DM switchers use DMC-series "single-gang" output cards. For older DM switchers with DMCO-series "multi-gang" output cards, use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the new single-gang output card format.
- Control via the DM network requires a Crestron control system, sold separately.
- Configuration of input cards, output cards, and endpoints is not supported.
- 4K60 4:4:4, HDR, Ultra HD, and HDCP 2.2 are currently supported over HDMI, DM 8G+, and HDBaseT using select input and output cards. Refer to the specifications for each input/output card and each connected device for its full capabilities.
- The maximum cable length for DigitalMedia 8G+ or HDBaseT is dependent upon the type of cable, the choice of input/output card, and the resolution of the video signal. Refer to the "Maximum DM 8G Cable Lengths" table for a detailed overview. Crestron legacy cable models [DM-CBL](#) DigitalMedia Cable and [DM-CBL-D](#) DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment.
- The maximum cable length for DigitalMedia 8G™ Fiber is 1000 ft (300 m) using [CRESFIBER8G](#) multimode fiber optic cable, or 500 ft (150 m) using [CRESFIBER](#) (legacy) or third-party OM3 multimode fiber optic cable.
- The maximum cable length for DigitalMedia 8G Single-Mode Fiber is 7.5 miles (12 km) using [CRESFIBER8G-SM](#) or third-party G.652.D (or better) single-mode fiber optic cable.
- The maximum cable length for DigitalMedia CAT is 450 ft (137 m) using [DM-CBL](#) DigitalMedia Cable. Actual cable length depends upon multiple factors. Up to two DM Repeaters (Model [DM-DR](#)) may be required.
- The maximum cable length for DigitalMedia Fiber is 1000 ft (300 m) using [CRESFIBER](#) (legacy), [CRESFIBER8G](#), or third-party OM2/OM3 duplex multimode fiber optic cable.
- Refer to the Crestron [DigitalMedia Design Guide, Doc. #4546](#), for complete system design guidelines. All wire and cables are sold separately.
- Streaming output supports 2-channel stereo audio only. Multichannel surround sound audio sources cannot be streamed unless downmixed to stereo. Stereo downmix capability requires a "DSP" type DM switcher input card, sold separately.
- Any HDMI input can support a DVI or Dual-Mode DisplayPort signal using a suitable adapter or interface cable.
- Item(s) sold separately.
- Control of third-party HDBaseT devices using CEC is only supported via 4K DM 8G+ input and output cards.
- DVI output is supported via an HDMI output port using a suitable adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.
- Manages the routing of USB HID signals between peripheral DM devices and input cards that are equipped with USB HID ports. Also programmable to manage the routing of USB signals between Crestron USB over Ethernet Extender modules ([USB-EXT-DM](#), sold separately). Refer to the USB-EXT-DM spec sheet for more information.

This product may be purchased from select authorized Crestron dealers and distributors. To find a dealer or distributor, please contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/How-To-Buy/Find-a-Representative](http://www.crestron.com/How-To-Buy/Find-a-Representative) or by calling 855-263-8754.

This product is covered under the Crestron standard limited warranty. Refer to [www.crestron.com/warranty](http://www.crestron.com/warranty) for full details.

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies

The specific patents that cover Crestron products are listed online at [patents.crestron.com](http://patents.crestron.com).

Certain Crestron products contain open source software. For specific information, please visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

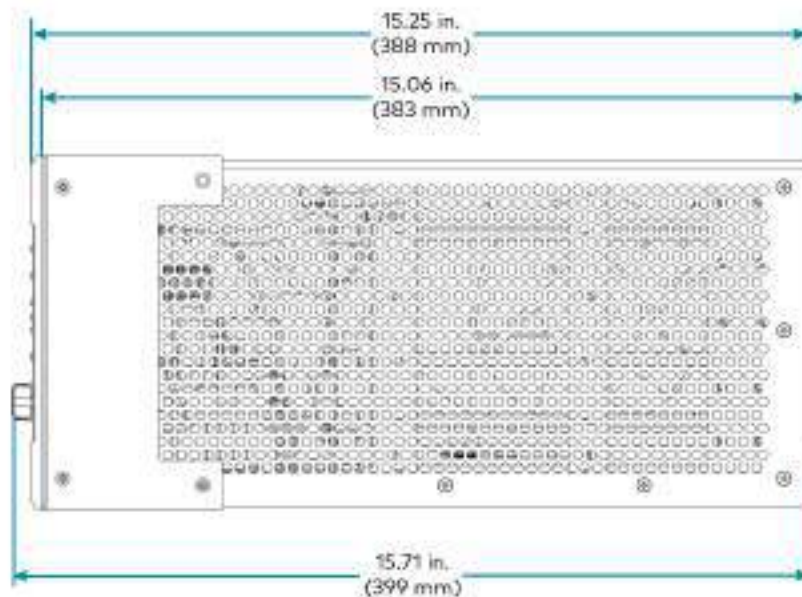
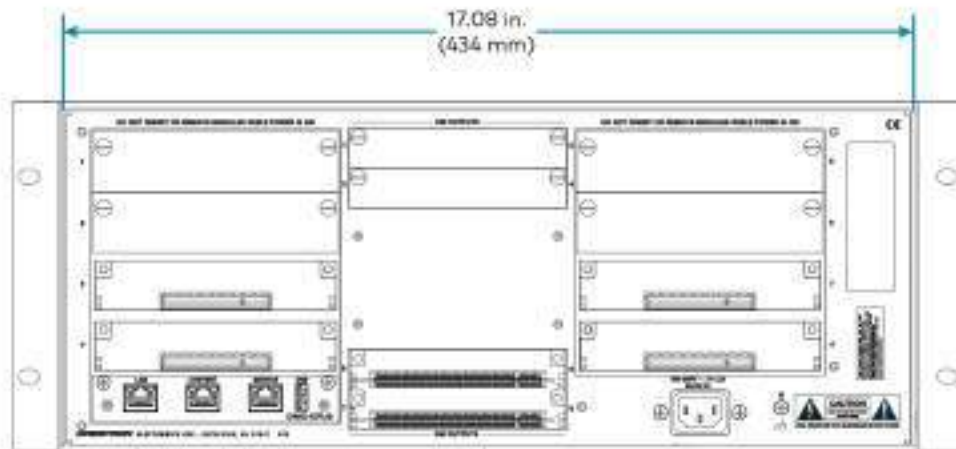
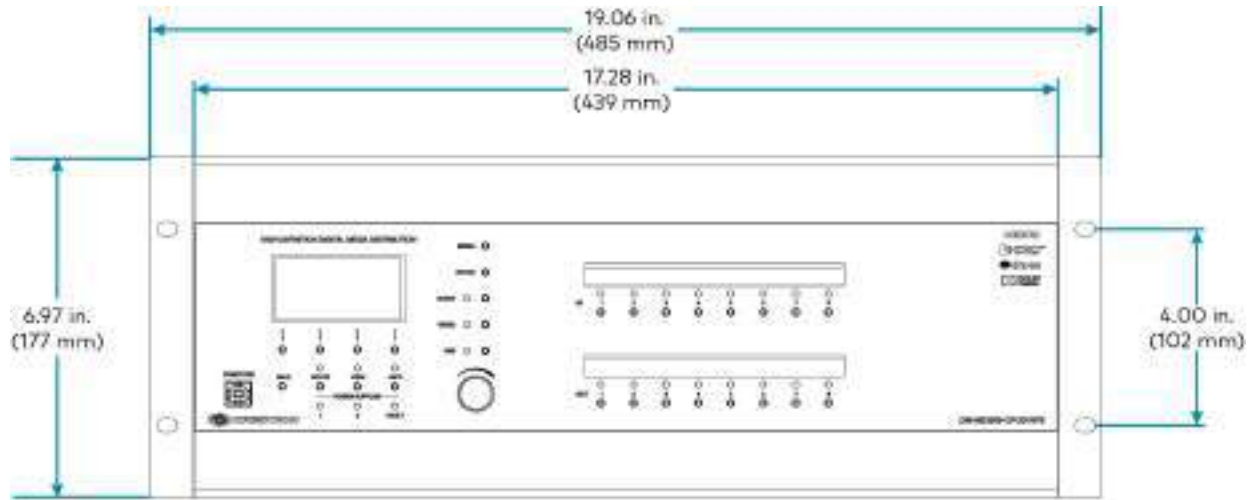
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Rev 11/14/19

## 8x8 DigitalMedia™ Switcher with Redundant Power Supplies



## 16x16 DigitalMedia™ Switcher with Redundant Power Supplies



- Delivers a unified HD signal distribution solution incorporating both point-to-point wired and IP streaming technologies
- Provides lossless HD AV signal routing over twisted pair copper wire or fiber
- Integrates video, audio, networking, and control over one wire or fiber strand
- Enables high-performance H.264 streaming from any input source up to 1080p or WUXGA
- Provides a built-in CONTENT LAN port for streaming
- Affords full matrix switching with ultra high 12.5 Gbps backplane data rate
- Handles HDMI® devices with Deep Color, 3D, 4K, and high-bitrate 7.1 encoded audio
- HDBaseT® Certified device — Enables direct connection to other HDBaseT certified equipment
- HDCP 2.2 compliant via 4K input and output cards
- Distributes Full HD 1080p, Ultra HD, and 4K signals via DM 8G+® and HDBaseT connectivity
- Distributes 1080p and WUXGA signals over via DM 8G® Fiber or via DM 8G® SM Fiber
- Allows streaming of 1080p signals over an IP network with no distance limitations
- Supports first-generation DM® CAT and DM® Fiber products
- Configurable with up to 16 DM, HDBaseT, and/or HDMI outputs
- Configurable with up to 8 streaming outputs
- Easy output expansion using multiple DM switchers
- Modular inputs support a complete range of digital, analog, and streaming signal types

- QuickSwitch HD™ technology manages HDCP keys for fast, reliable switching
- Auto-Locking® technology achieves rapid switching between disparate sources
- Performs automatic AV signal format management via EDID
- Enables device control via CEC
- Allows independent scaling for every display through select output cards and DM receivers
- Distributes and routes USB HID mouse and keyboard signals
- Allows full audio and USB breakaway switching
- Supports analog audio embedding and de-embedding
- Includes integrated Ethernet switch with Gigabit LAN port
- Private Network Mode — requires just one IP address for the complete DM system
- Secure access through full user/group management or Active Directory® credential management integration
- Hardware level security using 802.1X authentication
- TLS, SSL, SSH, and SFTP network security protocols
- Includes a built-in web server
- 7-space 19 in. (483 mm) rack-mountable

The DM-MD16X16-CPU3-RPS delivers an advanced 4K60 4:4:4 AV signal routing solution to provide the foundation for a complete DigitalMedia™ system. The DM-MD16X16-CPU3-RPS affords ultra fast switching and lossless distribution of HDMI® and other signals to support digital media players, HDTV receivers, computers, cameras, and display devices. The DM-MD16X16-CPU3-RPS is an enhanced version of the [DM-MD16X16-CPU3](#) featuring two built-in redundant power supplies.

The DM-MD16X16-CPU3-RPS is configurable to handle up to 16 AV sources. The outputs are configurable to provide up to 16 DM, HDBaseT®, and/or HDMI outputs, or up to 8 H.264 streaming outputs, in a single chassis.<sup>1</sup> Based on the 3-Series® platform, the DM-MD16X16-CPU3-RPS provides enterprise-grade security.

Integrated Ethernet networking and USB distribution provide a complete connectivity solution combined with built-in Crestron® control<sup>2</sup> for managing the displays and other room devices without any additional wiring. User-friendly operation, setup, and troubleshooting tools are provided through the DM-MD16X16-CPU3-RPS front panel, or via [Crestron Toolbox™](#) software, to allow for easy setup. A web browser interface is also provided.<sup>3</sup>

#### 4K Ultra HD

The DM-MD16X16-CPU3-RPS is designed to meet the extreme bandwidth requirements for handling 4K and Ultra HD video signals. Support for 4K video also ensures support for the latest generation of computers and monitors with native resolutions beyond 1080p and WUXGA.<sup>4</sup>

## 16x16 DigitalMedia™ Switcher with Redundant Power Supplies

### DigitalMedia 8G+® Technology

The DM-MD16X16-CPU3-RPS provides full support for Crestron DigitalMedia 8G+ devices as well as first-generation DM CAT<sup>8,10</sup> and DM Fiber<sup>9,10</sup> products, letting you take advantage of the latest Crestron DigitalMedia 8G+ technology.

A DigitalMedia 8G+ system handles high resolution video signals and can simultaneously distribute stereo and multichannel surround sound signals that support high bitrate 7.1 audio formats as well as uncompressed linear PCM. Signals are transported over one CAT type twisted pair cable or one strand of multimode or single-mode fiber.

### HDBaseT® Certified

Using DigitalMedia 8G+® technology, the DM-MD16X16-CPU3-RPS can be connected directly to an HDBaseT compliant device without requiring a DM transmitter or receiver.

### H.264 Streaming

The DM-MD16X16-CPU3-RPS streaming input capability enables IP cameras and other H.264 encoded sources to be distributed via DigitalMedia alongside HDMI and other non-streaming sources. It also allows DM switchers to be bridged together for simplified routing of HD content between buildings and global offices. Large-scale streaming to computers and mobile devices can be facilitated through integration with a streaming media system such as a Wowza® or Kaltura® media system.

### Built-In CONTENT LAN Port

Any streaming input or output may be configured to stream via the CONTENT LAN or LAN port of the DM switcher or via a dedicated CONTENT LAN port of a DMC Series input or output card. Control and content can be combined on a single network or can be isolated onto separate networks.

### Modular Architecture

The DM-MD16X16-CPU3-RPS features a modular architecture with 16 input card slots and 8 dual output card slots. A wide selection of input cards is offered to support a complete range of digital and analog AV signal types as specified in the following specifications table.

### Output Expansion

An HDMI pass-through output is provided on every input card to allow the inputs of up to five DM switchers to be daisy-chained, enabling the configuration of very large distribution systems with many outputs. Using five DM-MD16X16-CPU3-RPS switchers, for example, it is possible to support up to 80 separate outputs.

### QuickSwitch HD™ Technology

Digital media signals are typically encrypted to protect against unauthorized viewing. After authenticating displays or signal processors, a source device must issue a key before delivering an output signal. Crestron QuickSwitch HD technology

manages these keys to ensure fast, reliable switching and immunity to blackouts.

**NOTE:** QuickSwitch HD technology requires the use of a scaling HDMI output, which is available on DigitalMedia™ devices such as the DM-RMC-4KZ-SCALER-C and DMC-4KZ-HDO.

### Auto-Locking® Technology

Crestron Auto-Locking technology enables super fast signal switching by instantaneously configuring every device in the signal path as soon as the signal hits the first device. Auto-Locking technology virtually eliminates any noticeable gap while switching.

### EDID Format Management

DigitalMedia technology manages the EDID (Extended Display Identification Data) that devices use to communicate to eliminate conflicts that may arise when one source is routed to multiple displays or audio components. Via Crestron Toolbox software, the format and resolution capabilities of each device can be assessed, allowing the installer to properly configure EDID.

### A Scaler for Every Display

Installing select output cards into the DM-MD16X16-CPU3-RPS or connecting a DM receiver with built-in HD and 4k scalers to the DM-MD16X16-CPU3-RPS allows for high-performance scaling. Independent scalers placed at every display device allow for the routing of multiple sources to many different display devices.<sup>13</sup> The Distributed Scaler Approach ensures an optimal image on every screen and allows a high-res computer source to be viewed on any display in the building.

### Versatile Audio Routing

HDMI is the key to handling 7.1 surround sound formats such as Dolby® TrueHD, Dolby Atmos®, and DTS HD Master Audio™. To share these audio sources with multiple audio zones, the DM-MD16X16-CPU3-RPS allows for the simultaneous distribution of multichannel surround sound and two-channel stereo signals from the same HDMI source.

The digital stereo signal is converted to analog to enable sharing via a Sonnex® Multiroom Audio System or any other audio distribution system. The DM-MD16X16-CPU3-RPS also allows surround sound processors and amplifiers to be located centrally instead of at the display location via optional local HDMI outputs.

### Built-in Ethernet Switch

The DM-MD16X16-CPU3-RPS includes an integrated Ethernet switch with a gigabit LAN port. In addition to transporting digital video and audio, a DigitalMedia system can also extend a 100 Mbps Ethernet link to each display and source device via select DM receivers and transmitters, providing high-speed connectivity for any room device that requires a LAN connection. Ethernet is also utilized internally by the Crestron

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control bus to manage the DM devices in the system and provide display control in each room.

### Private Network Mode

To streamline its implementation on a corporate or university LAN, the DM-MD16X16-CPU3-RPS employs Private Network Mode to provide a single-point connection for the complete system. Using Private Network Mode, the DM-MD16X16-CPU3-RPS requires just one IP address for the complete DM network.

### USB Signal Routing

The DM-MD16X16-CPU3-RPS supports USB HID (Human Interface Device) signal routing so that a USB HID compliant keyboard and/or mouse can provide local control for devices in other locations.<sup>16</sup> USB HID connectivity is provided through select DM receivers, transmitters, and input cards. Connect a USB over Ethernet Extender host module ([USB-EXT-DM-LOCAL<sup>12</sup>](#)) to a host that you would like to communicate with and install a device module ([USB-EXT-DM-REMOTE<sup>12</sup>](#)) at every display location to connect keyboards, gaming controllers, mice, or other devices.

### CEC Embedded Device Control

Through its connection to the control system, the DM-MD16X16-CPU3-RPS provides a gateway for controlling many devices right through their HDMI or HDBaseT connections, potentially eliminating the need for any dedicated control wires or IR emitters.<sup>13</sup>

### Web Browser Control

The DM-MD16X16-CPU3-RPS also includes a built-in web server that allows functions such as Ethernet configuration, routing, and firmware upgrades to be performed.<sup>3</sup>

### Redundant Power Supplies

The DM-MD16X16-CPU3-RPS delivers enhanced reliability through two long-life, redundant power supplies. In the unlikely event of a fault with one of the power supplies (indicated by a flashing red LED), the DM-MD16X16-CPU3-RPS will continue to operate on only one power supply. Individual green LEDs show that the power supplies are functioning without fault. The power supplies can also be remotely monitored via Crestron Fusion® software or any control system touch screen.

*Upgrading an existing DM switcher that has older multi-gang DMCO-series output cards? Use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the new single-gang output card format.*

*Refer to the DigitalMedia Resources Webpage at [www.crestron.com/dmresources/](http://www.crestron.com/dmresources/) for additional design tools and reference documents.*

## Specifications

### Maximum Cable Lengths

Resolution	Cable Type		
	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	Third-Party CAT5e (or higher)
1920x1080 FHD 1080p	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 DCI 2K			
2048x1152 QWXGA			
2560x1080 UWFHD	230 ft (70 m)	165 ft (50 m)	165 ft (50 m)
2560x1080 WQHD			
2560x1600 WQXGA			
3840x2160 4K UHD			
4096x2160 DCI 4K			

Resolution	Cable Type	
	CRESFIBER8G CresFiber® 8G Multimode Fiber	Third-Party OM3 Multimode Fiber
1920x1080 FHD 1080p	1000 ft (300 m) via DM 8G Fiber cards	500 ft (150 m) via DM 8G Fiber cards
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @ 24Hz		

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Resolution	Cable Type	
	CRESFIBER8G-SM CresFiber 8G Single-Mode Fiber	Third-Party G.652.D (or higher) Single-Mode Fiber
1920x1080 FHD 1080p	7.5 miles (12 km) via DM 8G SM Fiber cards	
1920x1200 WUXGA		
1600x1200 UXGA		
2048x1080 2K DCI @ 24Hz		

### Video

<b>Switcher</b>	16x16 digital matrix, modular input/output cards, Crestron QuickSwitch HD™ technology
<b>Input Signal Types</b>	Configurable via modular plug-in cards supporting HDMI® (DVI & Dual-Mode DisplayPort compatible <sup>12</sup> ), DVI, 3G-SDI, RGB/VGA, component, S-Video, composite (NTSC & PAL), DM 8G+® & HDBaseT®, DM 8G® Fiber, DM 8G SM Fiber, DM® CAT (legacy), DM Fiber (legacy), & H.264 streaming
<b>Output Signal Types</b>	Configurable via modular plug-in cards supporting HDMI (DVI compatible <sup>15</sup> ), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs)
<b>Backplane Data Rate</b>	12.5 Gbps

**NOTE:** For additional specifications, refer to the DMC Series input and output card spec sheets.

### Audio

<b>Switcher</b>	16x16 digital multichannel audio-follow-video matrix switching, plus independent 16x16 stereo matrix for audio breakaway
<b>Input Signal Types</b>	Configurable via modular plug-in cards supporting HDMI (Dual-Mode DisplayPort compatible <sup>12</sup> ), 3G-SDI, analog (stereo 2-channel), SPDIF, DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber (legacy), & H.264 streaming
<b>Output Signal Types</b>	Configurable via modular plug-in cards supporting HDMI, analog (stereo 2-channel), DM 8G+ & HDBaseT, DM 8G Fiber, DM 8G SM Fiber, DM CAT (legacy), DM Fiber

(legacy), & H.264 streaming (All input cards also include HDMI pass-through outputs, and most digital audio input cards also include analog stereo pass-through audio outputs)

**NOTE:** For additional specifications, refer to the DMC Series input and output card spec sheets.

### Communications

<b>Ethernet</b>	100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client, Private Network Mode
<b>USB</b>	USB signal routing via select input cards, transmitters, receivers, and extenders <sup>16</sup> ; USB computer console port for setup
<b>DigitalMedia</b>	DM 8G+, DM 8G Fiber, DM 8G SM Fiber, DM Fiber, DM CAT, HDCP 2.2 <sup>4</sup> , EDID, CEC, PoDM, PoDM+, Ethernet
<b>HDBaseT</b>	HDCP 2.2 <sup>4</sup> , EDID, CEC, RS-232, PoH, Ethernet
<b>HDMI</b>	HDCP 2.2 <sup>4</sup> , EDID, CEC

**NOTE:** Supports management of HDCP and EDID; supports management of CEC between connected HDMI and HDBaseT devices and a control system.<sup>14</sup> For additional specifications, refer to the DMC Series input and output card spec sheets.

### Card Slots

<b>1 - 16</b>	(16) DM switcher input card slots; Each slot accepts (1) DMC-series input card
<b>DM OUTPUTS 1-16</b>	(8) DM switcher output card slots; Each slot accepts (1) DMC-series output card

### Connectors

<b>LAN</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port
<b>CONTENT</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port; Provides a dedicated LAN connection for streaming only, used in lieu of streaming via the LAN port of the switcher or the CONTENT LAN port of a DMC Series input or output card
<b>SERVICE</b>	(1) 8-pin RJ45 female; 100Base-TX/1000Base-T Ethernet port; For factory use only



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<b>USB</b>	(1) USB Type A connector, female; USB 2.0 host port for USB flash drive; For save/load of EDID settings and firmware update
<b>100-240 V~6-2.5A 50/60 Hz</b>	(1) IEC 60320 C14 mains power inlet; Mates with included power cord
<b>G</b>	(1) 6-32 screw, chassis ground lug
<b>COMPUTER (front)</b>	(1) USB Type B female; USB computer console port (6 ft cable included)

**Controls & Indicators**

<b>LCD Display</b>	Green LCD dot matrix, 128 x 64 resolution, adjustable LED backlight, displays inputs/outputs by name, video & audio signal information, Ethernet configuration and setup menus
<b>SOFTKEYS</b>	(4) Push buttons for activation of LCD driven functions
<b>HW-R</b>	(1) Recessed push button for hardware reset, reboots the switcher
<b>ROUTE</b>	(1) Push button and red LED, selects ROUTE mode to allow routing changes
<b>VIEW</b>	(1) Push button and red LED, selects VIEW mode for viewing current routes
<b>INFO</b>	(1) Push button and red LED, selects INFO mode for viewing AV and device info
<b>MENU</b>	(1) Push button, steps menu back one level
<b>ENTER</b>	(1) Push button, executes highlighted menu or value
<b>AUDIO</b>	(1) Push button & red LED, selects audio routing view
<b>VIDEO</b>	(1) Push button & red LED, selects video routing view
<b>USB</b>	(1) Push button & red LED, selects USB routing view
<b>Quick-Adjust Knob</b>	(1) Continuous turn rotary encoder, adjusts menu parameters
<b>IN 1 - 16</b>	(16) Push buttons and red LEDs, each button selects the corresponding input for routing
<b>OUT 1 - 16</b>	(16) Push buttons and red LEDs, each button selects the corresponding output for routing
<b>POWER SUPPLIES, 1-2</b>	(2) Green LEDs, each indicates when the corresponding internal supply is functioning

<b>POWER SUPPLIES, FAULT</b>	(1) Red flashing LED, indicates a fault with either internal supply
<b>LAN (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity
<b>CONTENT (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity
<b>SERVICE (rear)</b>	(2) LEDs; Left LED, green indicates 100Base-TX link is established, amber indicates 1000Base-T link is established; Right LED, flashing amber indicates Ethernet activity

**Power Requirements**

<b>Main Power</b>	6-2.5 A @ 100-240 VAC, 50/60 Hz
<b>Power Consumption</b>	440 W typical
<b>Available PoDM/PoH Power</b>	Refer to the specifications for each DM 8G+ input and output card

**Redundant Power Supplies**

<b>Quantity/Type</b>	(2) switch-mode, internal
<b>Demonstrated MTBF</b>	>1,000,000 hours per power supply @ full load and 25° C ambient conditions
<b>Redundancy</b>	Complete unit continues to operate at full capacity on one or more functioning power supplies

**Environmental**

<b>Temperature</b>	32° to 104° F (0° to 40° C)
<b>Humidity</b>	10% to 90% RH (noncondensing)
<b>Heat Dissipation</b>	1500 BTU/hr
<b>Ambient Noise</b>	31.5 to 36 dBA typical; 29 to 30 dBA idle

**Enclosure**

<b>Chassis</b>	Metal with black finish, vented sides, fan-cooled
<b>Front Panel</b>	Metal, black finish with polycarbonate label overlay

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**Mounting** Freestanding or 7 RU 19 in. (483 mm) rack-mountable (adhesive feet and rack ears included)

**Dimensions**

**Height** 12.22 in. (311 mm) without feet  
**Width** 17.28 in. (439 mm), 19.06 in. (485 mm) with rack ears  
**Depth** 15.65 in. (398 mm) without cards

**Weight**

28.4 lb (12.9 kg) without cards

**Models**

DM-MD16X16-CPU3-RPS

**Available Accessories****DMC-4KZ-C**

DigitalMedia 8G+® 4K60 4:4:4 HDR Input Card for DM® Switchers, HDBaseT® Compatible

**DMC-4KZ-C-DSP**

DigitalMedia 8G+® 4K60 4:4:4 HDR Input Card w/Downmixing for DM® Switchers, HDBaseT® Compatible

**DMC-4KZ-HD**

HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

**DMC-4KZ-HD-DSP**

HDMI® 4K60 4:4:4 HDR Input Card w/Downmixing for DM® Switchers

**DMC-4KZ-CO-HD**

2-Channel DigitalMedia 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

**DMC-4K-CO-HD-HDCP2**

2-Channel HDBaseT® Certified 4K DigitalMedia 8G+® Output Card for DM® Switchers

**DMC-4K-HDO**

2-Channel 4K Scaling HDMI® Output Card for DM® Switchers

**DMC-DVI**

DVI/VGA Input Card for DM® Switchers

**DMC-HDO**

2-Channel HDMI® Output Card for DM® Switchers

**DMC-S**

DigitalMedia 8G™ Fiber Input Card for DM® Switchers

**DMC-S2**

DigitalMedia 8G™ Single-Mode Fiber Input Card for DM® Switchers

**DMC-S2-DSP**

DigitalMedia 8G™ Single-Mode Fiber Input Card w/Downmixing for DM® Switchers

**DMC-S2O-HD**

2-Channel DigitalMedia 8G™ Single-Mode Fiber Output Card for DM® Switchers

**DMC-SDI**

3G-SDI Input Card for DM® Switchers

**DMC-S-DSP**

DigitalMedia 8G™ Fiber Input Card w/Downmixing for DM® Switchers

**DMC-SO-HD**

2-Channel DigitalMedia 8G™ Fiber Output Card for DM® Switchers

**DMC-STR**

Streaming Input Card for DM® Switchers

**DMC-STRO**

Streaming Output Card for DM® Switchers

**DMC-VGA**

VGA/Video Input Card for DM® Switchers

**DMC-VID4**

Quad Video Input Card for DM® Switchers

**DMC-VID-BNC**

BNC Analog Video Input Card for DM® Switchers

**DMC-VID-RCA-A**

RCA Analog Video Input Card w/Analog Audio for DM® Switchers

**DMC-VID-RCA-D**

RCA Analog Video Input Card w/SPDIF Audio for DM® Switchers

**DM-PSU-8-PLUS**

8-Port PoDM+ Power Supply for DM 8G+® I/O Cards

**DM-PSU-16-PLUS**

16-Port PoDM+ Power Supply for DM 8G+® I/O Cards

**DM-PSU-ULTRA-MIDSPAN**

DigitalMedia™ Ultra Midspan PoDM++ Injector

**USB-EXT-DM-LOCAL**

USB over Ethernet Extender with Routing, Host Module

**USB-EXT-DM-REMOTE**

USB over Ethernet Extender with Routing, 4-Port Device Module

**DM-8G-CONN-100**

Connectors for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CONN-WG-100**

Connectors with Wire Guide for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CRIMP**

Crimping Tool for DM-8G-CONN

## 16x16 DigitalMedia™ Switcher with Redundant Power Supplies

### DM-8G-CRIMP-WG

Crimping Tool for DM-8G-CONN-WG

### DM-CBL-8G-NP-SP1000

DigitalMedia 8G™ Cable, non-plenum, 1000 ft spool

### DM-CBL-8G-P-SP1000

DigitalMedia 8G™ Cable, plenum, 1000 ft spool

### DM-CBL-ULTRA-LSZH-SP1000

DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen, 1000 ft spool (Available only in Europe)

### DM-CBL-ULTRA-NP-SP1000

DigitalMedia™ Ultra Cable, Non-Plenum Type CMR, 1000 ft spool

### DM-CBL-ULTRA-PC-10

DigitalMedia™ Ultra Patch Cable, 10 ft (3 m)

### DM-CBL-ULTRA-P-SP1000

DigitalMedia™ Ultra Cable, Plenum Type CMP, 1000 ft spool

### DM-CONN-20

Connectors for DM-CBL DigitalMedia™ Cable & DM-CBL-ULTRA DigitalMedia Ultra Cable, 20-Pack

### DM-CONN-ULTRA-RECP-50

DigitalMedia™ Ultra Keystone RJ45 Jack, 50-Pack w/Termination Tool

### DM-RPP-K24

DigitalMedia™ 24-Port Keystone Patch Panel

### CRESFIBER8G-NP-SP1000

CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, non-plenum, 1000 ft spool

### CRESFIBER8G-P-SP1000

CresFiber® 8G Multimode Fiber Optic Cable, 50/125 x4 breakout, plenum, 1000 ft spool

### CRESFIBER8G-SM-CONN-LC-12

Connectors for CresFiber® 8G Single-Mode Fiber Optic Cable, LC, 12-Pack

### CRESFIBER8G-SM-P-SP2KM

CresFiber® 8G Single-Mode Fiber Optic Cable, plenum, 2 km spool

### CRESFIBER-CONN-SC50UM-12

Connectors for CresFiber® 8G Multimode Fiber Optic Cable, SC 50µm, 12-Pack

### CRESFIBER-TK

CresFiber® Termination Kit (AFL Telecommunications®)

#### Notes:

1. All output types are configured in pairs except for streaming (a single streaming output occupies the space of two outputs of any other type). To configure a complete DM switcher with output and input cards, use the online [DigitalMedia Switcher Configuration Tool](#). Current DM switchers use DMC-series "single-gang" output cards. For older DM switchers with DMCO-series "multi-gang" output cards, use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the new single-gang output card format.
2. Control via the DM network requires a Crestron control system, sold separately.
3. Configuration of input cards, output cards, and endpoints is not supported.
4. 4K60 4:4:4, HDR, Ultra HD, and HDCP 2.2 are currently supported over HDMI, DM 8G+, and HDBaseT using select input and output cards. Refer to the specifications for each input/output card and each connected device for its full capabilities.
5. The maximum cable length for DigitalMedia 8G+ or HDBaseT is dependent upon the type of cable, the choice of input/output card, and the resolution of the video signal. Refer to the "Maximum DM 8G Cable Lengths" table for a detailed overview. Crestron legacy cable models [DM-CBL](#) DigitalMedia Cable and [DM-CBL-D](#) DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment.
6. The maximum cable length for DigitalMedia 8G™ Fiber is 1000 ft (300 m) using [CRESFIBER8G](#) multimode fiber optic cable, or 500 ft (150 m) using [CRESFIBER](#) (legacy) or third-party OM3 multimode fiber optic cable.
7. The maximum cable length for DigitalMedia 8G Single-Mode Fiber is 7.5 miles (12 km) using [CRESFIBER8G-SM](#) or third-party G.652.D (or better) single-mode fiber optic cable.
8. The maximum cable length for DigitalMedia CAT is 450 ft (137 m) using [DM-CBL](#) DigitalMedia Cable. Actual cable length depends upon multiple factors. Up to two DM Repeaters (Model [DM-DR](#)) may be required.
9. The maximum cable length for DigitalMedia Fiber is 1000 ft (300 m) using [CRESFIBER](#) (legacy), [CRESFIBER8G](#), or third-party OM2/OM3 duplex multimode fiber optic cable.
10. Refer to the Crestron [DigitalMedia Design Guide, Doc. #4546](#), for complete system design guidelines. All wire and cables are sold separately.
11. Streaming output supports 2-channel stereo audio only. Multichannel surround sound audio sources cannot be streamed unless downmixed to stereo. Stereo downmix capability requires a "DSP" type DM switcher input card, sold separately.
12. Any HDMI input can support a DVI or Dual-Mode DisplayPort signal using a suitable adapter or interface cable.
13. Item(s) sold separately.
14. Control of third-party HDBaseT devices using CEC is only supported via 4K DM 8G+ input and output cards.
15. DVI output is supported via an HDMI output port using a suitable adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.
16. Manages the routing of USB HID signals between peripheral DM devices and input cards that are equipped with USB HID ports. Also programmable to manage the routing of USB signals between Crestron USB over Ethernet Extender modules ([USB-EXT-DM](#), sold separately). Refer to the USB-EXT-DM spec sheet for more information.

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This product may be purchased from select authorized Crestron dealers and distributors. To find a dealer or distributor, please contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/How-To-Buy/Find-a-Representative](http://www.crestron.com/How-To-Buy/Find-a-Representative) or by calling 855-263-8754.

This product is covered under the Crestron standard limited warranty. Refer to [www.crestron.com/warranty](http://www.crestron.com/warranty) for full details.

The specific patents that cover Crestron products are listed online at [patents.crestron.com](http://patents.crestron.com).

Certain Crestron products contain open source software. For specific information, please visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

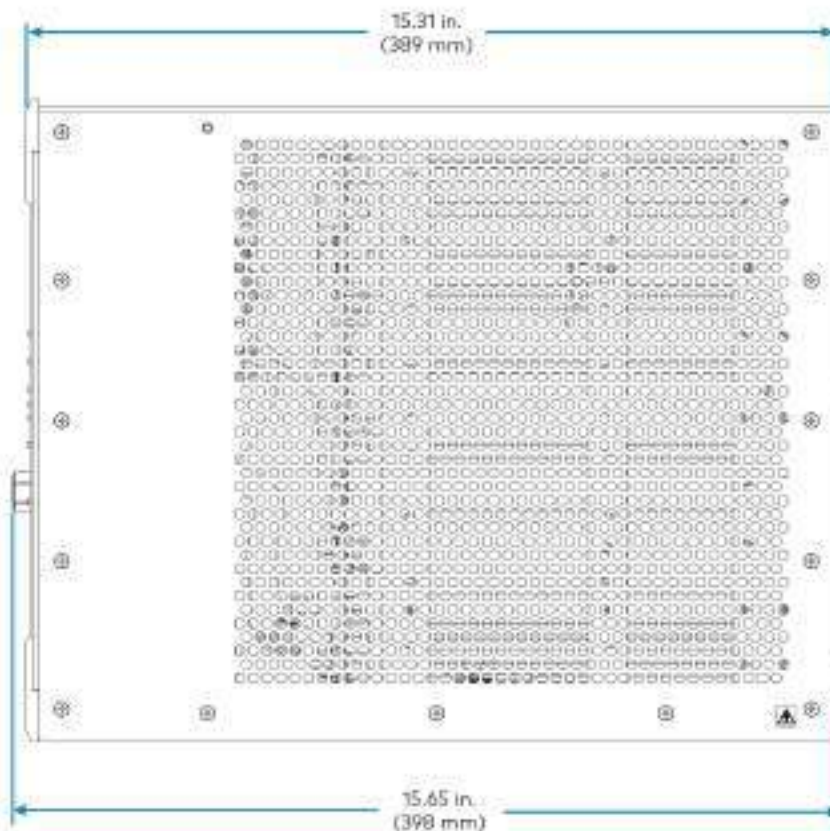
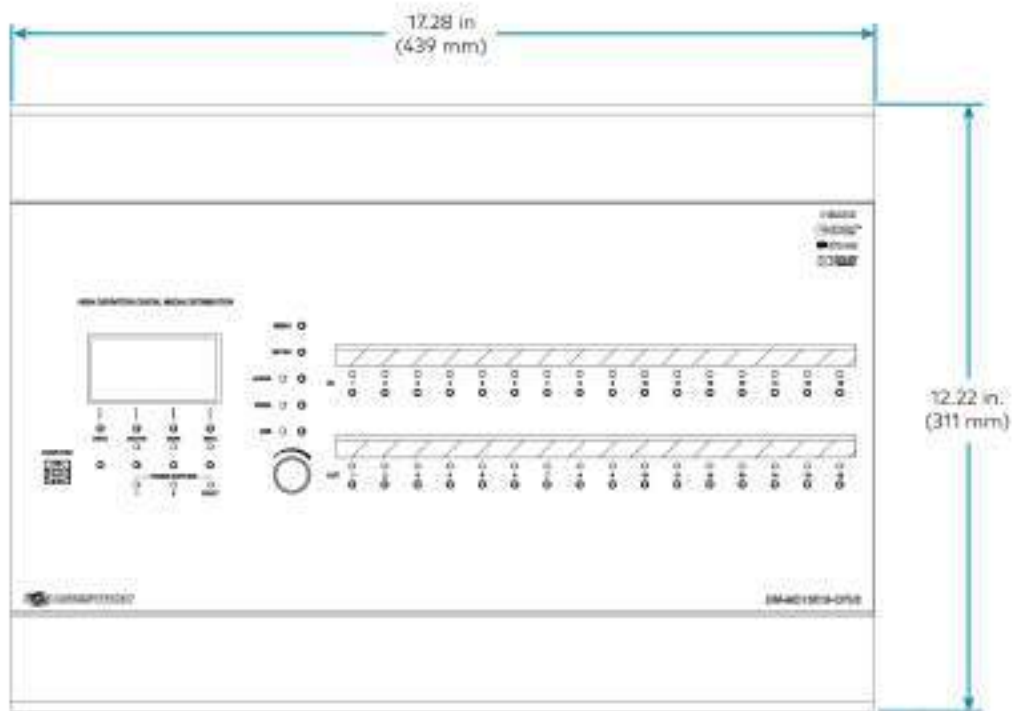
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## 16x16 DigitalMedia™ Switcher with Redundant Power Supplies



## 16x16 DigitalMedia™ Switcher with Redundant Power Supplies



NOTE: Shown without input and output cards installed. All input and output cards sold separately.

## HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

- > Modular input card for a DM-MD8X8, DM-MD16X16, or DM-MD32X32 switcher
- > Provides a single 4K HDMI® input<sup>[2]</sup>
- > Handles UHD and 4K video resolutions up to 4K60 4:4:4<sup>[2]</sup>
- > Handles HDR (High Dynamic Range) video (HDR10)<sup>[2]</sup>
- > Handles 3D video and Deep Color
- > Handles Dolby® TrueHD, Dolby Atmos®, DTS HD®, DTS:X®, and uncompressed 7.1 linear PCM audio
- > HDCP 2.2 compliant
- > Includes an HDMI output for pass-through of the input signal<sup>[2]</sup>
- > Includes a stereo analog line-level audio output with volume control<sup>[3]</sup>
- > Allows de-embedding of stereo 2-channel audio signals
- > Enables device control via CEC
- > Enables USB HID signal extension for a local computer
- > Compatible with Crestron USB over Ethernet Extenders<sup>[4]</sup>
- > Occupies a single DM® switcher input card slot
- > Provides an HDMI problem solving solution using the optional DMCI card interface<sup>[5]</sup>



The **DMC-4KZ-HD** is an input card designed for use with any card-based Crestron® DigitalMedia™ Switcher. It provides one HDMI® input, with complementary HDMI pass-through and analog audio outputs. A USB HID port is also provided. The HDMI input handles Full HD 1080p, Ultra HD, 2K, and 4K video signals with support for HDCP 2.2, HDR10, Deep Color, 3D, and high-bitrate 7.1 audio. The HDMI input can also handle DVI and Dual-Mode DisplayPort signals using an appropriate adapter or interface cable.<sup>[1,2]</sup>

*NOTE: Refer to model **DMC-4KZ-HD-DSP** for use with surround sound sources.*

#### 4K60 4:4:4 & HDR Support

Crestron DigitalMedia (DM) was the world's first AV signal distribution solution to deliver end-to-end 4K signal management for large-scale commercial and residential applications. DM "4KZ" cards and endpoints enable new and existing DM systems to handle full 4K60 4:4:4 video signals, as well as HDR video signals (HDR10), without having to replace any wiring or switchers. Any Crestron DM system that supports 4K can be upgraded to handle 4K60 4:4:4 and HDR by simply installing DM 4KZ based cards, transmitters, and receivers. The DMC-4KZ-HD is designed to replace an existing **DMC-4K-HD** or **DMC-4K-HD-HDCP2** input card without requiring any extra configuration or programming.<sup>[2]</sup>

DM 4KZ technology employs VESA® Display Stream Compression (DSC) to enhance the capabilities of DigitalMedia to handle the extreme bandwidth requirement of resolutions beyond 4K30 4:4:4 and 4K60 4:2:0. DSC is a lightweight, line-based 2:1 compression standard that delivers visually lossless performance for 4K60 4:4:4 and HDR signals. DSC is applied only to 4K60 4:4:4 and HDR input signals. All other signals are transported uncompressed.

#### HDMI® Pass-Through

Every DM switcher input card includes an HDMI output port, which can be used to pass the input signal through to a local audio processor or video monitor, or to feed a second DM switcher for output expansion purposes.<sup>[2]</sup>

#### Audio De-embedding

The DMC-4KZ-HD includes an unbalanced analog audio output, allowing stereo audio signals to be extracted from the digital input and fed to a multiroom audio distribution system. The output volume is adjustable via a control system using a keypad, touch screen, handheld remote, or mobile device.<sup>[3]</sup>

*NOTE: For applications requiring the simultaneous distribution of multichannel surround sound and 2-channel stereo audio signals, use model **DMC-4KZ-HD-DSP**.*

#### USB Signal Extension

Built-in USB HID signal routing allows a connected computer (or other USB HID-compliant host) to be controlled by a mouse and/or keyboard located at a presentation lectern, conference table, or some other remote location. Additional USB devices of virtually any type can be supported using Crestron USB over Ethernet Extender Modules (**USB-EXT-DM-LOCAL** and **USB-EXT-DM-REMOTE**).<sup>[4]</sup>

#### CEC Embedded Device Control

For controlling third-party AV devices, DigitalMedia offers an alternative to conventional IR, RS-232, and Ethernet by harnessing the CEC (Consumer Electronics Control) signal embedded in HDMI. Through its connection to a Crestron control system (via the DM switcher), the DMC-4KZ-HD provides a gateway for controlling the connected source device right through the HDMI connection, potentially eliminating the need for any dedicated control wires or IR emitters.

# DMC-4KZ-HD HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

## Standalone HDMI Problem Solver

In addition to its use as an input card for DM switchers, the DMC-4KZ-HD may also be used with the DMCI DigitalMedia Card Interface<sup>[5]</sup> to provide a handy problem-solving tool with many useful functions. It can be used to extract an analog audio signal from an HDMI stream, to provide a gateway for CEC device control, and to extend a USB HID mouse/keyboard signal over Ethernet. It can also be used to detect a device's video and audio information, manage its EDID, and assess its HDCP capabilities.

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the online [DigitalMedia Switcher Configuration Tool](#).

Please refer to the DigitalMedia webpage at <https://www.crestron.com/digitalmedia> for additional design tools and reference documents.

## SPECIFICATIONS

### Video

**Input Signal Types:** HDMI w/HDR10, Deep Color, 3D, & 4K60 4:4:4 support<sup>[2]</sup> (DVI & Dual-Mode DisplayPort compatible<sup>[1]</sup>)

**Output Signal Types:** HDMI w/HDR10, Deep Color, 3D, & 4K60 4:4:4 support<sup>[2]</sup> (DVI compatible<sup>[1]</sup>)

**Copy Protection:** HDCP 2.2

**Maximum Resolutions:**

Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
Progressive	4096x2160 DCI 4K & 3840x2160 4K UHD	24 Hz	4:4:4	36 bit
		30 Hz	4:4:4	36 bit
		60 Hz	4:2:2	36 bit
		60 Hz	4:4:4	24 bit
	2560x1600 WQXGA	60 Hz	4:4:4	36 bit
	1920x1080 HD1080p	60 Hz	4:4:4	36 bit
Interlaced	1920x1080 HD1080i	30 Hz	4:4:4	36 bit

*NOTE: Common resolutions are shown; other custom resolutions are supported at pixel clock rates up to 600 MHz*

### Audio

**Input Signal Types:** HDMI (Dual-Mode DisplayPort compatible<sup>[1]</sup>)

**Output Signal Types:** HDMI (multichannel pass-through from input), analog stereo (2-channel pass-through from input<sup>[3]</sup>)

**Digital Formats:** Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels

**Analog Format:** Stereo 2-channel

**Digital-To-Analog Conversion:** 24-bit 48 kHz

**Analog Performance:** Frequency Response: 20 Hz to 20 kHz  $\pm$ 0.5 dB;  
S/N Ratio: >95 dB, 20 Hz to 20 kHz A-weighted;  
THD+N: <0.005% @ 1 kHz;  
Stereo Separation: >90 dB

**Analog Volume Adjustment:** -80 to 0 dB

### Communications

**USB:** Supports signal extension of USB HID class devices, expandable to support virtually any USB 1.1 or 2.0 device using Crestron USB-EXT-DM Series USB over Ethernet Extenders<sup>[4]</sup>

**HDMI:** HDCP 2.2, EDID, CEC

*NOTE: Supports management of HDCP and EDID; supports management of CEC between the connected HDMI devices and a control system*

### Connectors

**HDMI OUT:** (1) HDMI Type A connector, female;  
HDMI digital video/audio output<sup>[2]</sup>;  
(DVI compatible<sup>[1]</sup>)

**HDMI IN:** (1) HDMI Type A connector, female;  
HDMI digital video/audio input<sup>[2]</sup>;  
(DVI and Dual-Mode DisplayPort compatible<sup>[1]</sup>)

**USB HID:** (1) USB Type B connector, female;  
USB device port for connection to the USB host interface of a computer or other USB HID-compliant host

**AUDIO OUT:** (2) RCA connectors, female;  
Unbalanced stereo line-level audio output<sup>[3]</sup>;  
Output Impedance: 100 Ohms nominal;  
Maximum Output Level: 2 Vrms

### Construction

Plug-in card, occupies (1) DM switcher input card slot, includes metal faceplate w/black finish

### Weight

8.0 oz (227 g)



# DMC-4KZ-HD HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

## MODELS & ACCESSORIES

### Available Models

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**DMC-4KZ-HD:** HDMI® 4K60 4:4:4 HDR Input Card for DM® Switchers

### Available Accessories

---

**CBL Series:** Crestron® Certified Interface Cables

**USB-EXT-DM-LOCAL:** USB over Ethernet Extender with Routing, Host Module

**USB-EXT-DM-REMOTE:** USB over Ethernet Extender with Routing, 4-Port Device Module

**DMCI:** DigitalMedia™ Card Interface

#### Notes:

1. HDMI requires an appropriate adapter or interface cable to accommodate a DVI or Dual-Mode DisplayPort signal. [CBL-HD-DVI](#) interface cables are available separately.
2. 4K60 4:4:4 performance and HDR support require the use of HDMI cables and couplers with a minimum TMDS bandwidth of 18 Gbps. If 4K60 4:2:0 or 4K30 4:4:4 performance is acceptable, cables and couplers with a minimum bandwidth of 10.2 Gbps may be used. Please be aware that bandwidth loss is cumulative, so performance may be reduced when inserting multiple cables and couplers inline.
3. The analog stereo audio output is only active when the input source is outputting a 2-channel stereo signal. For applications using a multichannel surround sound source, use model [DMC-4KZ-HD-DSP](#) which provides simultaneous surround sound and stereo downmix output signals.
4. USB over Ethernet Extender Modules are sold separately. Refer to the [USB-EXT-DM-LOCAL](#) and [USB-EXT-DM-REMOTE](#) spec sheets for more information.
5. Item(s) sold separately.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at <https://www.crestron.com/How-To-Buy/Find-a-Representative> or by calling 855-263-8754.

The specific patents that cover this and other Crestron products are listed online at <https://www.crestron.com/legal/patents>.

Certain Crestron products contain open source software. For specific information, visit <https://www.crestron.com/opensource>.

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## 3G-SDI Input Card for DM<sup>®</sup> Switchers

- > Modular input card for a DM-MD8X8, DM-MD16X16, or DM-MD32X32 switcher
- > Provides a single SDI input with SDI loop-through
- > Accommodates SD-SDI, HD-SDI, and 3G-SDI video sources
- > Handles video resolutions up to Full HD 1080p
- > Handles 24-bit stereo audio signals<sup>[1]</sup>
- > Includes an HDMI<sup>®</sup> output for pass-through of the input signal
- > Includes a stereo analog line-level audio output with volume control
- > Allows extraction of stereo audio signals
- > Occupies a single DM<sup>®</sup> switcher input card slot
- > Provides an SDI to HDMI convertor using the optional DMCI card interface<sup>[3]</sup>

The DMC-SDI is an input card designed for use with any card-based Crestron<sup>®</sup> DigitalMedia™ Switcher. It provides one SDI input, with complementary SDI loop-through, HDMI<sup>®</sup> pass-through, and analog audio outputs. The SDI input supports SD-SDI, HD-SDI and 3G-SDI formats, handling high-definition video signals up to 1080p60 and 2 channels of 24-bit digital audio<sup>[1]</sup> through a single coaxial cable.

### 3G-SDI

Support for 3G-SDI enables DigitalMedia to accommodate signals from many high-end professional cameras, broadcast switchers, and other AV equipment. An SDI loop-through output is included for connection to a local monitor or other SDI device.

### HDMI<sup>®</sup> Pass-Through

Every DM<sup>®</sup> switcher input card includes an HDMI output port, which can be used to pass the video and audio input signals through to a local audio processor or video monitor, or to feed a second DM switcher for output expansion purposes.

### Audio Extracting

The DMC-SDI also includes an unbalanced analog audio output, allowing stereo audio signals to be extracted from the digital input and fed to a sound system or multiroom audio distribution system. The output volume is adjustable via a control system using a keypad, touch screen, handheld remote, or mobile device.<sup>[1]</sup>

### Standalone SDI to HDMI Converter

In addition to its use as an input card for DM switchers, the DMC-SDI may also be used with the DMCI DigitalMedia Card Interface<sup>[2]</sup> to create a very handy problem-solving tool. It can be used to convert SDI video and audio to HDMI, or to extract an analog audio signal from an SDI source.

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the online [DigitalMedia Switcher Configuration Tool](#).

Please refer to the DigitalMedia Resources Webpage at <http://www.crestron.com/dmresources/> for additional design tools and reference documents.



## SPECIFICATIONS

### Video

**Input Signal Types:** SDI

**Output Signal Types:** SDI (loop-through); HDMI<sup>®</sup> (DVI compatible<sup>[2]</sup>)

**SDI Formats:** SD-SDI (SMPTE 259M), HD-SDI (SMPTE 292M), 3G-SDI (SMPTE 424M)

**Resolutions:** SMPTE 425M (3G-SDI) 4:2:2 Colorspace: 1920x1080@50Hz (1080p50), 1920x1080@60Hz (1080p60);

SMPTE 425M (3G-SDI) 4:4:4 Colorspace: 1280x720@50Hz (720p50), 1280x720@60Hz (720p60), 1920x1080@24Hz (1080p24), 1920x1080@25Hz (1080p25), 1920x1080@30Hz (1080p30), 1920x1080@50Hz (1080i50 or 1080sF25), 1920x1080@60Hz (1080i60 or 1080sF30);

SMPTE 260M (HD-SDI): 1920x1035@60Hz (1035i60);

SMPTE 295M (HD-SDI): 1920x1080@50Hz (1080i50);

SMPTE 274M (HD-SDI): 1920x1080@24Hz (1080p24), 1920x1080@25Hz (1080p25), 1920x1080@30Hz (1080p30), 1920x1080@50Hz (1080i50 or 1080sF25), 1920x1080@60Hz (1080i60 or 1080sF30);

SMPTE 296M (HD-SDI): 1280x720@50Hz (720p50), 1280x720@60Hz (720p60);

SMPTE 259M-C (SD-SDI): 720x480@59.94 (NTSC), 720x576@50i (PAL)

### Audio

**Input Signal Types:** SDI

**Output Signal Types:** SDI (loop-through), HDMI (2-channel pass-through from input), analog stereo (2-channel pass-through from input)

**Digital Formats:** 2 channel PCM<sup>[1]</sup>

**Analog Formats:** Stereo 2-channel

**Digital-To-Analog Conversion:** 24-bit 48 kHz

**Analog Performance:** Frequency Response: 20 Hz to 20 kHz ±0.5 dB;  
S/N Ratio: >95 dB, 20 Hz to 20 kHz A-weighted;

THD+N: <0.005% @ 1 kHz;

Stereo Separation: >90 dB

**Analog Volume Adjustment:** -80 to 0 dB

# DMC-SDI 3G-SDI Input Card for DM<sup>®</sup> Switchers

## Communications

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**HDMI:** CEC

*NOTE: Supports management of CEC between the connected HDMI device and a control system*

## Connectors

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**HDMI OUT:** (1) 19-pin Type A HDMI female;  
HDMI digital video/audio output;  
Also supports DVI <sup>[3]</sup>

**SDI IN:** (1) BNC female;  
SDI video input;  
Input Impedance: 75 Ohms nominal with loop-through disabled

**SDI OUT:** (1) BNC female;  
SDI video/audio loop-through output

**AUDIO OUT:** (2) RCA female;  
Unbalanced stereo line-level audio output;  
Maximum Output Level: 2 Vrms;  
Output Impedance: 100 ohms nominal

## Construction

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Plug-in card, occupies (1) DM switcher input card slot, includes metal faceplate w/black finish

## Weight

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8.0 oz (227 g)

## MODELS & ACCESSORIES

### Available Models

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**DMC-SDI:** 3G-SDI Input Card for DM<sup>®</sup> Switchers

### Available Accessories

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**CBL Series:** Crestron<sup>®</sup> Certified Interface Cables

**DMCI:** DigitalMedia™ Card Interface

### Notes:

1. Allows selecting any one of the four audio groups on the SDI input stream. Receives only the first 2 channels of the selected group.
2. Item(s) sold separately.
3. HDMI requires an appropriate adapter or interface cable to accommodate a DVI signal. [CBL-HD-DVI](#) interface cables are available separately.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/salesreps](http://www.crestron.com/salesreps) or by calling 800-237-2041.

The specific patents that cover Crestron products are listed online at: [patents.crestron.com](http://patents.crestron.com).

Certain Crestron products contain open source software. For specific information, please visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

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## 2-Channel HDMI® 4K60 4:4:4 HDR Scaling Output Card for DM® Switchers

- Modular output card for card-based DigitalMedia™ switchers
- Handles UHD and 4K video resolutions up to 4K60 4:4:4
- Handles HDR (High Dynamic Range) video (HDR10) and Deep Color
- Provides two independent HDMI® outputs
- Includes a discrete 4K60 4:4:4 scaler for each HDMI output
- Handles Dolby® TrueHD, Dolby Atmos®, DTS-HD®, and uncompressed 7.1 linear PCM audio
- HDCP 2.2 compliant
- Supports video wall configurations of up to 8 x 8
- Provides an analog stereo audio output for each HDMI output
- Audio de-embedding of stereo 2-channel audio signals
- Enables device control via CEC (Consumer Electronics Control)
- Occupies a single DM® switcher output card slot

The DMC-4KZ-HDO is an output card designed for use with card-based Crestron® DigitalMedia™ switchers (for example, the DM-MD8X8-CPU3). The card provides two independent HDMI® outputs with complementary analog stereo audio outputs. The HDMI outputs handle Full HD 1080p, Ultra HD, 2K, and 4K video signals with support for HDCP 2.2, HDR10, Deep Color, and high-bitrate 7.1 audio. Built-in 4K60 4:4:4 scaling enables devices connected to the HDMI outputs to handle any video resolution from NTSC 480i to DCI 4K. DVI signals are also supported using an appropriate adapter or interface cable.<sup>1</sup>

#### 4K60 4:4:4 and HDR Support

The DMC-4KZ-HDO incorporates DM 4KZ technology, which uses VESA® Display Stream Compression (DSC) to handle the extreme bandwidth requirement of resolutions beyond 4K30 4:4:4 and 4K60 4:2:0. DSC is a lightweight, line-based 2:1 compression standard that delivers visually lossless performance for 4K60 4:4:4 and HDR signals.<sup>2</sup> DSC is applied to 4K60 4:4:4 and HDR input signals only. All other signals are transported uncompressed.

An existing 4K DigitalMedia system can be upgraded to handle 4K60 4:4:4 and HDR video with the installation of DM 4KZ cards, transmitters, and receivers. The upgrade can be accomplished without the need to replace wiring or switchers. The DMC-4KZ-HDO can replace a DMC-4K-HDO output card in an existing installation (additional programming may be required).

#### 4K60 4:4:4 Scaler

An independent, high-performance 4K60 4:4:4 scaler is provided for each output to ensure that input sources of any resolution or frame rate can be routed and displayed reliably on virtually any display device without compromising the original input signal.



As part of a DM® switcher with many outputs, any video or computer source can be viewed simultaneously on multiple disparate displays, scaling the signal up or down to match the native resolution of each display.

Interlaced sources are converted to progressive scan using motion-adaptive deinterlacing. Intelligent frame rate conversion enables support for 24p and PAL format sources. Fully automatic operation eliminates any complicated setup by utilizing the EDID (Extended Display Identification Data) to configure each scaler.

#### Video Wall Processing

The DMC-4KZ-HDO provides zoom capability and bezel compensation on each HDMI output to display only a portion of the source image. Multiple DMC-4KZ-HDO cards can be combined to provide processing for a video wall composed of up to 64 individual displays. Video wall configurations up to 8 wide by 8 high are supported using a separate output for each display and one or more DM switchers.

#### Audio De-embedding

Each HDMI output on the DMC-4KZ-HDO is accompanied by a balanced/unbalanced analog audio output, allowing stereo audio signals to be extracted from the digital stream and fed to a sound system.<sup>3</sup> The output volume is adjustable via a control system using a keypad, touch screen, handheld remote, or mobile device.

#### CEC Embedded Device Control

When connected to a control system via a DM switcher, the DMC-4KZ-HDO provides a gateway for controlling display devices through CEC (Consumer Electronics Control) over the HDMI outputs, potentially eliminating the need for dedicated control wires or IR emitters.

**To configure a DM switcher with input cards, output cards, cables, and other peripherals, use the online [DigitalMedia Switcher Configuration Tool](#).**

**Are you upgrading an existing DM switcher that has multi-gang DMCO Series output cards? Use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the single-gang output card format.**

Refer to the DigitalMedia web page at <http://www.crestron.com/digitalmedia> for additional design tools and reference documents.

## 2-Channel HDMI® 4K60 4:4:4 HDR Scaling Output Card for DM® Switchers

## Specifications

## Video

**Scalers:** (2) 4K60 4:4:4 video scalers with motion-adaptive deinterlacer, intelligent frame rate conversion, Deep Color support, HDR10 support, content-adaptive noise reduction, widescreen format selection (zoom, stretch, maintain aspect ratio, or 1:1), and video wall processing up to 8 wide x 8 high using multiple cards

**Output Signal Types:** HDMI with HDR10, Deep Color, and 4K60 4:4:4 support<sup>2</sup>

**Copy Protection:** HDCP 2.2

**Maximum Resolutions:** Common resolutions are shown below. Custom resolutions are supported at pixel clock rates up to 600 MHz.

Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
Progressive	4096x2160 DCI 4K and 3840x2160 4K UHD	24 Hz	4:4:4	36 bit
		30 Hz	4:4:4	36 bit
		60 Hz	4:2:2	36 bit
		60 Hz	4:4:4	24 bit
	2560x1600 WQXGA	60 Hz	4:4:4	36 bit
	1920x1080 HD 1080p	60 Hz	4:4:4	36 bit
Interlaced (input only)	1920x1080 HD 1080i	30 Hz	4:4:4	36 bit

## Audio

**Output Signal Types:** HDMI, analog stereo<sup>3</sup>

**Digital Formats:** Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby® TrueHD, Dolby Atmos®, DTS®, DTS-ES, DTS 96/24, DTS-HD High Res, DTS-HD Master Audio™, LPCM up to 8 channels

**Analog Formats:** Stereo 2 channel<sup>3</sup>

**Digital-to-Analog Conversion:** 24-bit 48 kHz

**Analog Performance:**

**Frequency Response:** 20 Hz to 20 kHz ±0.5 dB

**S/N Ratio:** >95 dB 20 Hz to 20 kHz A-weighted

**THD+N:** <0.005% @ 1 kHz

**Stereo Separation:** >90 dB

**Analog Volume Adjustment:** -80 to 0 dB

## Communications

**HDMI:** HDCP 2.2, EDID, CEC

**NOTE:** Supports management of CEC between the connected HDMI devices and a control system.

## Connectors

**HDMI:** (2) 19-pin Type A connectors, female HDMI digital video/audio outputs (DVI compatible<sup>1</sup>)

**L, R:** (2) 5-pin 3.5 mm detachable terminal blocks  
Balanced/unbalanced stereo line-level audio outputs<sup>3</sup>  
Output Impedance: 200 Ohms balanced, 100 Ohms unbalanced  
Maximum Output Level: 4 Vrms balanced, 2 Vrms unbalanced

## Construction

Plug-in card, occupies (1) DM switcher output card slot, includes metal faceplate with black finish

## Weight

10.7 oz (304 g)

## Available Models

**DMC-4KZ-HDO:** 2-Channel HDMI® 4K60 4:4:4 HDR Scaling Output Card for DM® Switchers

## Available Accessories

**CBL-HD-6:** Crestron® Certified HDMI® Interface Cable, 18 Gbps, 6 ft (1.8 m)

**CBL-HD-DVI-6:** Crestron® Certified HDMI® to DVI Interface Cable, 6 ft (1.8 m)

**CBL-HD-LOCK-8:** Locking High-Speed HDMI® Cable, 10.2 Gbps, 8 ft (2.4 m)

**MP-WP150-W:** Media Presentation Wall Plate - HDMI® with Mini-TRS Stereo Audio, White

**MP-WP152-W:** Media Presentation Wall Plate - HDMI®, White

**MPI-WP150-120:** Media Presentation Wall Plates – International Version - HDMI® with Mini-TRS Stereo Audio, White

## 2-Channel HDMI® 4K60 4:4:4 HDR Scaling Output Card for DM® Switchers

### Notes:

1. DVI is supported via either HDMI output with the use of an appropriate adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.
2. 4K60 4:4:4 performance and HDR support require the use of HDMI cables and couplers with a minimum TMDS bandwidth of 18 Gbps. If 4K60 4:2:0 or 4K30 4:4:4 performance is acceptable, cables and couplers with a minimum bandwidth of 10.2 Gbps can be used. Bandwidth loss is cumulative; therefore, performance may be reduced when inserting multiple cables and couplers inline.
3. The analog stereo audio outputs are active only when the selected input source is transmitting a 2-channel stereo signal. For applications using multichannel surround sound sources, the DM switcher should be equipped with DSP type input cards, which can downmix the surround sound signals to stereo.

This product may be purchased from an authorized Crestron dealer. To find a dealer, contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/How-To-Buy/Find-a-Representative](http://www.crestron.com/How-To-Buy/Find-a-Representative) or by calling 855-263-8754.

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## 2-Channel DigitalMedia 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

- > Modular output card for a DM-MD8X8, DM-MD16X16, or DM-MD32X32 switcher
- > Provides two independent 4K DM 8G+® outputs
- > HDBaseT® compatible — Enables direct connection to other HDBaseT certified equipment
- > Includes a parallel HDMI® port on the first output<sup>[2]</sup>
- > Handles UHD and 4K video resolutions up to 4K60 4:4:4<sup>[2]</sup>
- > Handles HDR (High Dynamic Range) video (HDR10)<sup>[2]</sup>
- > Handles 3D video and Deep Color
- > Handles Dolby® TrueHD, Dolby Atmos®, DTS HD®, DTS:X®, and uncompressed 7.1 linear PCM audio
- > HDCP 2.2 compliant
- > Supports cable lengths up to 330 ft (100 m) for all resolutions up to UHD and 4K using DM® Ultra cable<sup>[1]</sup>
- > Supports cable lengths up to 330 ft (100 m) for 1080p, WUXGA, and 2K using DM 8G® cable or CAT5e<sup>[1]</sup>
- > Supports cable lengths up to 230 ft (70 m) for UHD and 4K using DM 8G cable, or 165 ft (50 m) using CAT5e<sup>[1]</sup>
- > Enables HDMI and HDBaseT device control via CEC
- > Supports PoDM and HDBaseT PoE power sourcing<sup>[3]</sup>
- > Occupies a single DM switcher output card slot

The **DMC-4KZ-CO-HD** is an output card designed for use with any card-based Crestron® **DigitalMedia™** Switcher. It provides two independent DM 8G+® outputs, plus one HDMI® output. The HDMI output carries the same signal as the first DM 8G+ output. Both DM 8G+ outputs are compatible with **HDBaseT®**. Using a single CAT type twisted pair cable, each DM 8G+ output enables connection to a DM 8G+ receiver, the input of another DM® switcher, or an HDBaseT certified display device or receiver.<sup>[1]</sup>

#### 4K60 4:4:4 & HDR Support

Crestron DigitalMedia (DM) was the world's first AV signal distribution solution to deliver end-to-end 4K signal management for large-scale commercial and residential applications. DM "4KZ" cards and endpoints enable new and existing DM systems to handle full 4K60 4:4:4 video signals, as well as HDR video signals (HDR10), without having to replace any wiring or switchers. Any Crestron DM system that supports 4K can be upgraded to handle 4K60 4:4:4 and HDR by simply installing DM 4KZ based cards, transmitters, and receivers. The **DMC-4KZ-CO-HD** is designed to replace an existing **DMC-4K-CO-HD** or **DMC-4K-CO-HD-HDCP2** output card without requiring any extra configuration or programming.<sup>[2]</sup>

DM 4KZ technology employs VESA® Display Stream Compression (DSC) to enhance the capabilities of DigitalMedia to handle the extreme bandwidth requirement of resolutions beyond 4K30 4:4:4 and 4K60 4:2:0. DSC is a lightweight, line-based 2:1 compression standard that delivers visually lossless performance for 4K60 4:4:4 and HDR signals. DSC is applied only to 4K60 4:4:4 and HDR input signals. All other signals are transported uncompressed.



#### DigitalMedia 8G+®

Engineered for ultra high-bandwidth and ultimate scalability, DigitalMedia 8G+ (DM 8G+) provides a true one-wire lossless transport for moving high-definition video, audio, power, Ethernet, and control signals over twisted pair copper wire. DM 8G+ transports uncompressed Full HD 1080p, WUXGA, and 2K signals over distances up to 330 feet (100 m) using Crestron **DM Ultra Cable**, **Crestron DM 8G® Cable**, or third-party CAT5e. Higher resolution signals up to UHD and 4K are supported over distances up to 330 feet (100 m) using DM Ultra Cable, 230 feet (70 m) using DM 8G Cable, or 165 feet (50 m) using CAT5e.<sup>[1]</sup>

#### HDBaseT® Compatible

Crestron DigitalMedia 8G+ technology is designed using HDBaseT Alliance specifications, ensuring interoperability with other HDBaseT certified products. Either DM 8G+ output can be connected directly to an HDBaseT compliant device without requiring a DM receiver.

#### Bonus HDMI® Output

A single HDMI output is included on the **DMC-4KZ-CO-HD**, which functions in parallel with the first DM 8G+ output. Both outputs may be used simultaneously to split a single switched signal to feed two separate devices.<sup>[2]</sup>

#### CEC Embedded Device Control

For controlling third-party AV devices, DigitalMedia offers an alternative to conventional IR, RS-232, and Ethernet by harnessing the CEC (Consumer Electronics Control) signal embedded in HDMI. Through its connection to a control system (via the DM switcher), the **DMC-4KZ-CO-HD** provides a gateway for controlling display devices right through their HDMI or HDBaseT connections, potentially eliminating the need for any dedicated control wires or IR emitters.

#### Power over DM®

Power over DM (PoDM) technology affords a true one-wire solution by supplying power to each connected device over the same wire that carries video, audio, and data signals. To enable PoDM power sourcing through either DM 8G+ output port (DM OUT), simply connect a compatible PoDM or PoE power source to its companion PoE/PoDM input port (POE IN). Compatible power sources include Crestron models **DM-PSU-8-PLUS**, **DM-PSU-16-PLUS**, **DM-PSU-ULTRA-MIDSPAN**, and **CEN-SWPOE-16**, or any IEEE 802.3af or 802.3at compliant PoE PSE (Power Sourcing Equipment).

# DMC-4KZ-CO-HD 2-Channel DM 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

Support for PoDM+ is enabled using any of the Crestron models listed above, or a third-party 802.3at Type 2 PSE. PoDM++ power sourcing is enabled using the DM-PSU-ULTRA-MIDSPAN only. PoDM may also be used to power HDBaseT PoE powered devices.<sup>[3]</sup>

To configure a DM switcher complete with input and output cards, cables, and other peripherals, please use the online [DigitalMedia Switcher Configuration Tool](#).

Are you upgrading an existing DM switcher that has older “multi-gang” DMCO-series output cards? Use the online [Output Card Additions and Upgrades Tool](#) to update your existing output cards and switcher to the new “single-gang” output card format.

Please refer to the DigitalMedia webpage at <https://www.crestron.com/digitalmedia> for additional design tools and reference documents.

## SPECIFICATIONS

### Video

**Output Signal Types:** DM 8G+ & HDBaseT w/HDR10, Deep Color, 3D, & 4K60 4:4:4 support; HDMI w/HDR10, Deep Color, 3D, & 4K60 4:4:4 support<sup>[2]</sup> (DVI compatible<sup>[4]</sup>)

**Copy Protection:** HDCP 2.2

**Maximum Resolutions:**

Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
Progressive	4096x2160 DCI 4K & 3840x2160 4K UHD	24 Hz	4:4:4	36 bit
		30 Hz	4:4:4	36 bit
		60 Hz	4:2:2	36 bit
		60 Hz	4:4:4	24 bit
	2560x1600 WQXGA	60 Hz	4:4:4	36 bit
	1920x1080 HD1080p	60 Hz	4:4:4	36 bit
Interlaced	1920x1080 HD1080i	30 Hz	4:4:4	36 bit

*NOTE: Common resolutions are shown; other custom resolutions are supported at pixel clock rates up to 600 MHz*

### Audio

**Output Signal Types:** DM 8G+, HDBaseT, HDMI

**Formats:** Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS®, DTS ES, DTS 96/24, DTS HD High Res, DTS-HD Master Audio, DTS:X, LPCM up to 8 channels

### Communications

**DigitalMedia:** DM 8G+, HDCP 2.2, EDID, CEC, PoDM, PoDM+, PoDM++, Ethernet

**HDBaseT:** HDCP 2.2, EDID, CEC, RS-232, PoE, PoE+, Ethernet

**HDMI:** HDCP 2.2, EDID, CEC

*NOTE: Supports management of HDCP and EDID; supports management*

*of CEC between the connected HDMI and HDBaseT devices and a control system*

### Connectors

**DM OUT:** (2) 8-pin RJ45 connectors, female, shielded; Comprises (2) DM 8G+ outputs, HDBaseT compliant; PoDM PSE port (HDBaseT PoE compatible)<sup>[3]</sup>; Each connects to the DM 8G+ input of a DM receiver or other DM device, or to an HDBaseT device, via CAT5e, Crestron [DM-CBL-8G](#), or Crestron [DM-CBL-ULTRA](#) cable<sup>[1]</sup>

**POE IN:** (2) 8-pin RJ45 connectors, female; Comprises (2) PoE/PoDM inputs; Each connects to one port of an IEEE 802.3af or 802.3at compliant PoDM or PoE PSE (Power Sourcing Equipment) to enable PoDM or HDBaseT PoE power sourcing via the corresponding DM OUT port. Compatible with PoE+, PoDM+, and PoDM++. Supports Crestron models [DM-PSU-8-PLUS](#), [DM-PSU-16-PLUS](#), [DM-PSU-ULTRA-MIDSPAN](#), and [CEN-SWPOE-16](#).<sup>[3]</sup>

**HDMI:** (1) HDMI Type A connector, female; HDMI digital video/audio output (DVI compatible<sup>[4]</sup>)<sup>[2]</sup>; Outputs same signal as the first (left) DM OUT port

### Indicators

**DM OUT:** (4) LEDs, green LEDs indicate DM link status, amber LEDs indicate video and HDCP signal presence, for each corresponding DM 8G+ output

### Construction

Plug-in card, occupies (1) DM switcher output card slot, includes metal faceplate w/black finish

### Weight

6.2 oz (176 g)

### Maximum Cable Lengths

Cable Type:	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	CAT5e (or better) <sup>[1]</sup>
<b>Resolution:</b>			
1920x1080 FHD 1080p	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 DCI 2K			
2048x1152 QWXGA			
2560x1080 UWFHD	230 ft (70 m)	165 ft (50 m)	
2560x1440 WQHD			
2560x1600 WQXGA			
3840x2160 4K UHD			
4096x2160 DCI 4K			



# DMC-4KZ-CO-HD 2-Channel DM 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

## MODELS & ACCESSORIES

### Available Models

**DMC-4KZ-CO-HD:** 2-Channel DigitalMedia 8G+® 4K60 4:4:4 HDR Output Card for DM® Switchers

### Available Accessories

**DM-PSU-8-PLUS:** 8-Port PoDM+ Power Supply for DM® Switchers

**DM-PSU-16-PLUS:** 16-Port PoDM+ Power Supply for DM® Switchers

**DM-PSU-ULTRA-MIDSPAN:** DigitalMedia™ Ultra Midspan PoDM++ Injector

**DM-RPP-K24:** DigitalMedia™ 24-Port Keystone Patch Panel

**DM-CONN-ULTRA-RECP Series:** DigitalMedia™ Ultra Keystone RJ45 Jacks

**DM-CBL-ULTRA-PC Series:** DigitalMedia™ Ultra Patch Cables

**DM-CBL-ULTRA-NP Series:** DigitalMedia™ Ultra Cable, Non-Plenum Type CMR

**DM-CBL-ULTRA-P Series:** DigitalMedia™ Ultra Cable, Plenum Type CMP

**DM-CBL-ULTRA-LSZH Series:** DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen

**DM-CONN-20:** Connectors for DM-CBL-ULTRA DigitalMedia Ultra Cable, 20-Pack

**DM-CBL-8G-NP Series:** DigitalMedia 8G™ Cable, non-plenum

**DM-CBL-8G-P Series:** DigitalMedia 8G™ Cable, plenum

**DM-8G-CONN-WG-100:** Connectors with Wire Guide for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CRIMP-WG:** Crimping Tool for DM-8G-CONN-WG

**CBL Series:** Crestron® Certified Interface Cables

### Notes:

1. The maximum cable length for DigitalMedia 8G+ (DM 8G+) or HDBaseT is dependent upon the type of cable and resolution of the video signal. Refer to the “Maximum Cable Lengths” table for a detailed overview. Crestron legacy cable models [DM-CBL](#) DigitalMedia Cable and [DM-CBL-D](#) DigitalMedia D Cable support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are required when bundling multiple cables in a wire run, and are recommended for all applications to safeguard against unpredictable environmental electrical noise which may impact performance at resolutions above 1080p. Refer to the [Crestron DigitalMedia Design Guide, Doc. #4546](#) for complete system design guidelines. DM 8G+ is compatible with HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment. All wire and cables are sold separately.
2. 4K60 4:4:4 performance and HDR support require the use of HDMI cables and couplers with a minimum TMDS bandwidth of 18 Gbps. If 4K60 4:2:0 or 4K30 4:4:4 performance is acceptable, cables and couplers with a minimum bandwidth of 10.2 Gbps may be used. Please be aware that bandwidth loss is cumulative, so performance may be reduced when inserting multiple cables and couplers inline.
3. To enable PoDM or HDBaseT PoE power sourcing via either DM OUT port, the corresponding POE IN port must be connected to a PoDM power supply ([DM-PSU-8-PLUS](#), [DM-PSU-16-PLUS](#), or [DM-PSU-ULTRA-MIDSPAN](#)) or an 802.3af or 802.3at compliant PoE PSE ([CEN-SWPOE-16](#) or third-party). PoDM+ and HDBaseT PoE+ are supported using any of the listed Crestron models, or other 802.3at Type 2 Class 4 compliant PoE+ PSE. PoDM++ power sourcing is supported using the DM-PSU-ULTRA-MIDSPAN only. Refer to the connected DM 8G+ or HDBaseT devices for their PoDM or HDBaseT PoE capabilities and requirements. Any wiring that is connected to a PoDM, PoE, or HDBaseT PoE PSE port is for intra-building use only and should not be connected to a line that runs outside of the building in which the PSE is located.
4. DVI is supported via the HDMI output using a suitable adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at <https://www.crestron.com/How-To-Buy/Find-a-Representative> or by calling 855-263-8754.

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## DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

- DigitalMedia 8G+® receiver, audio extractor, and display controller
- Handles UHD and 4K video resolutions up to 4K60 4:4:4
- Handles HDR (High Dynamic Range) video (HDR10) and Deep Color
- Provides one DM 8G+® input for connection to a DM® switcher or transmitter via a single CAT 5e (or higher) twisted pair cable
- Compatible with the HDBaseT® standard
- Provides one HDMI® input
- Provides one HDMI output with 4K60 4:4:4 scaler
- Enables adjustable overscan or underscan up to 7.5%
- Provides a stereo analog line-level audio output
- Allows de-embedding of stereo 2-channel audio signals
- Handles Dolby® TrueHD, Dolby Atmos®, DTS-HD®, and uncompressed 7.1 linear PCM audio
- HDCP 2.2 compliant
- Supports video wall configurations of up to 8 x 8
- Supports cable lengths up to 330 ft (100 m) for all resolutions up to UHD and 4K using DM Ultra cable
- Supports cable lengths up to 330 ft (100 m) for 1080p, WUXGA, and 2K using DM 8G® cable or CAT5e
- Supports cable lengths up to 230 ft (70 m) for UHD and 4K using DM 8G cable, or 165 ft (50 m) using CAT5e
- Provides a 100 Mbps Ethernet LAN connection
- Enables device control via CEC, IR, RS-232, and Ethernet
- Compatible with Crestron® USB over Ethernet Extenders
- Provides two low-voltage relay control ports
- Powered via the DM connection or optional power pack (sold separately)
- Low-profile surface-mount design

The DM-RMC-4KZ-SCALER-C provides an advanced one-box interface solution for a single display device as part of a complete Crestron® DigitalMedia™ system. Functioning as a DM 8G+® receiver, 4K60 4:4:4 HDR video scaler, and control interface, the DM-RMC-4KZ-SCALER-C provides DM 8G+ and HDMI® inputs, an HDMI output, and an analog audio output.<sup>1,2,3</sup> RS-232, IR, Ethernet, and relay control ports are also provided.

### 4K60 4:4:4 and HDR Support

The DM-RMC-4KZ-SCALER-C incorporates DM 4KZ technology, which uses VESA® Display Stream Compression (DSC) to handle the extreme bandwidth requirement of resolutions beyond 4K30 4:4:4 and 4K60 4:2:0. DSC is a lightweight, line-based 2:1 compression standard that delivers visually lossless performance for 4K60 4:4:4 and HDR signals.<sup>4</sup> DSC is applied only to 4K60 4:4:4 and HDR input signals. All other signals are transported uncompressed.



An existing 4K DigitalMedia system can be upgraded to handle 4K60 4:4:4 and HDR video with the installation of DM 4KZ cards, transmitters, and receivers. The upgrade can be accomplished without the need to replace wiring or switchers. The DM-RMC-4KZ-SCALER-C can replace a DM-RMC-4K-SCALER-C in an existing installation (additional programming may be required).

### DM 8G+ Technology

Engineered for ultra high-bandwidth and ultimate scalability, Crestron® DM 8G+ technology transports high-definition video, audio, power, Ethernet, and control signals over twisted pair copper wire. Uncompressed Full HD 1080p, WUXGA, and 2K signals are supported at distances up to 330 feet (100 m) using Crestron [DM® Ultra Cable](#), Crestron [DM 8G® Cable](#), or third-party CAT5e (or higher). Higher resolution signals up to UHD and 4K are supported at distances up to 330 feet (100 m) using DM Ultra Cable, 230 feet (70 m) using DM 8G Cable, or 165 feet (50 m) using third-party CAT5e (or higher).<sup>5</sup>

### Compatible with the HDBaseT Standard

DM 8G+ technology is designed using HDBaseT Alliance specifications, ensuring interoperability with other HDBaseT® certified products. Via the DM 8G+ input, the DM-RMC-4KZ-SCALER-C can be connected directly to an HDBaseT compliant source without requiring a DM transmitter.

### Multimedia Display Interface

The DM-RMC-4KZ-SCALER-C provides simple switching between a DM input and an HDMI input. An input can be selected manually by using the INPUT SELECT push button on the device, programmatically through a control system, or automatically by connecting a source to an input.

A single HDMI output port is provided for connection to a display device. The HDMI output can also handle DVI signals using an appropriate adapter or interface cable.<sup>2</sup>

A single CAT5e (or higher) cable connects the DM-RMC-4KZ-SCALER-C to a DM switcher or transmitter or to an HDBaseT source, transporting video, audio, control, networking, and power signals through one simple RJ-45 connection. Multiple DM-RMC-4KZ-SCALER-C devices can be installed to handle each display in a multiroom distribution system—all fed from a central DM switcher. Alternatively, a single DM-RMC-4KZ-SCALER-C can be fed straight from a DM 8G+ or HDBaseT transmitter, providing a simple solution for extending a computer or AV signal to a single display.

## DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

### 4K60 4:4:4 Scaler

The HDMI output of the DM-RMC-4KZ-SCALER-C feeds the decoded signal to the local display device. The built-in scaler ensures an optimal image, scaling the encoded source resolution up or down to match the native resolution of the display device.

Interlaced sources are converted to progressive scan using motion-adaptive deinterlacing. Intelligent frame rate conversion enables support for 24p and PAL format sources. Fully automatic operation eliminates any complicated setup by using the EDID (Extended Display Identification Data) of the display to configure the scaler.

### Video Wall Processing

The DM-RMC-4KZ-SCALER-C provides zoom capability and bezel compensation on the HDMI output to display only a portion of the source image. Multiple DM-RMC-4KZ-SCALER-C devices can be combined to configure a video wall composed of up to 64 individual displays. Configurations of up to 8 wide by 8 high are supported, requiring a separate DM-RMC-4KZ-SCALER-C for each display and one or more DM switchers with sufficient DM 8G+ outputs.

### Audio De-embedding

The DM-RMC-4KZ-SCALER-C is equipped with a balanced/unbalanced analog audio output, allowing stereo audio signals to be extracted from the digital stream and fed to a local amplifier, sound bar, or a pair of powered speakers.<sup>3</sup> The output volume is adjustable via a control system using a keypad, touch screen, handheld remote, or mobile device.

### LAN Connectivity

In addition to high-definition AV and control, a DigitalMedia system integrates high-speed Ethernet networking for a total signal distribution solution. The DM-RMC-4KZ-SCALER-C includes a 100 Mbps Ethernet port, which can be used to provide a convenient LAN connection for a local network device.

### Embedded Device Control

The DM-RMC-4KZ-SCALER-C includes built-in RS-232, IR, and Ethernet control ports to enable programmable control of the connected display device via a control system. When connected to a control system, the DM-RMC-4KZ-SCALER-C also provides a gateway for controlling the display device through CEC (Consumer Electronics Control) over the HDMI output, potentially eliminating the need for dedicated control wires or IR emitters. The DM-RMC-4KZ-SCALER-C also supports CEC over the HDBaseT connection, enabling control of an HDBaseT source connected to the DM 8G+ input.

Two low-voltage relay ports are also included on the DM-RMC-4KZ-SCALER-C for control of a projection screen or lift.

### USB Signal Extension (Optional)

A DigitalMedia system allows for the routing of USB signals alongside video and audio. USB signal extension is enabled on the DM-RMC-4KZ-SCALER-C by adding a [USB-EXT-DM](#) USB over Ethernet Extender Module.<sup>6</sup>

### Low-Profile Installation

The DM-RMC-4KZ-SCALER-C mounts conveniently to a wall, ceiling, or other flat surface. The device fits easily behind a flat panel display or above a ceiling-mounted projector. The unit can be powered by PoDM+, HDBaseT PoE+, or the optional [PW-2412WU](#) wall mount power pack (sold separately).<sup>7,8</sup>

All connectors and LED indicators are positioned on the sides, ensuring optimal access and visibility for a clean, serviceable installation. An array of indicators is provided for easy setup and troubleshooting.

Refer to the *DigitalMedia Resources* web page at <http://www.crestron.com/dmresources/> for additional design tools and reference documents.

### Specifications

#### Maximum Cable Lengths

Resolution	Cable Type		
	DM-CBL-ULTRA DM® Ultra Cable	DM-CBL-8G DM 8G® Cable	Third-Party CAT5e (or Higher) <sup>5</sup>
1920x1080 FHD 1080p	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920x1200 WUXGA			
1600x1200 UXGA			
2048x1080 DCI 2K			
2048x1152 QWXGA			
2560x1080 UWFHD		230 ft (70 m)	165 ft (50 m)
2560x1440 WQHD			
2560x1600 WQXGA			
3840x2160 4K UHD			
4096x2160 DCI 4K			

#### Video

**Scaler:** 4K60 4:4:4 video scaler with motion-adaptive deinterlacer, intelligent frame rate conversion, Deep Color support, HDR10 support, content-adaptive noise reduction, widescreen format selection (zoom, stretch, maintain aspect ratio, or 1:1), video wall processing up to 8 wide x 8 high<sup>9</sup>

**Input Signal Types:** DM 8G+, HDBaseT, and HDMI with HDR10, Deep Color, and 4K60 4:4:4 support<sup>1</sup>

**Output Signal Types:** HDMI with HDR10, Deep Color, and 4K60 4:4:4 support<sup>2</sup>

**Copy Protection:** HDCP 2.2

**Maximum Scaler Input, Pass-Through, and Output Resolutions:** Common resolutions are shown in the following table. Custom resolutions are supported at pixel clock rates up to 600 MHz.

Scan Type	Resolution	Frame Rate	Color Sampling	Color Depth
Progressive	4096x2160 DCI 4K and 3840x2160 4K UHD	24 Hz	4:4:4	36 bit
		30 Hz	4:4:4	36 bit
		60 Hz	4:2:2	36 bit
		60 Hz	4:4:4	24 bit
	2560x1600 WQXGA	60 Hz	4:4:4	36 bit
Interlaced (input only)	1920x1080 HD 1080i	60 Hz	4:4:4	36 bit
		30 Hz	4:4:4	36 bit

#### Audio

**Input Signal Types:** DM 8G+, HDBaseT, HDMI

**Output Signal Types:** HDMI, analog stereo<sup>3</sup>

**Digital Formats:** Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby® TrueHD, Dolby Atmos®, DTS®, DTS-ES, DTS 96/24, DTS-HD High Res, DTS-HD Master Audio™, LPCM up to 8 channels

**Analog Formats:** Stereo 2 channel<sup>3</sup>

**Digital-to-Analog Conversion:** 24-bit 48 kHz

**Analog Performance:**

**Frequency Response:** 20 Hz to 20 kHz ±0.5 dB

**S/N Ratio:** >95 dB 20 Hz to 20 kHz A-weighted

**THD+N:** <0.005% @ 1 kHz

**Stereo Separation:** >90 dB

**Analog Volume Adjustment:** -80 to 0 dB

#### Communications

**Ethernet:** 100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, DHCP

**RS-232:** 2-way device control and monitoring up to 115.2k baud with hardware and software handshaking (via control system)

**IR/Serial:** 1-way device control via infrared up to 1.1 MHz or serial TTL/RS-232 (0-5 volts) up to 19.2k baud (via control system)

**DigitalMedia:** DM 8G+, HDCP 2.2, EDID, CEC, PoDM+, Ethernet

**HDBaseT:** HDCP 2.2, EDID, CEC, PoE+, Ethernet

**HDMI:** HDCP 2.2, EDID, CEC

**NOTE:** Supports management of HDCP and EDID. Also supports management of CEC between the connected HDMI and/or HDBaseT device(s) and a control system.

## DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

### Connectors

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**COM:** (1) 5-pin 3.5 mm detachable terminal block  
Bidirectional RS-232 port  
Up to 115.2k baud, hardware and software handshaking support

**IR 1-2:** (1) 4-pin 3.5 mm detachable terminal block  
Comprises (2) IR/Serial ports  
IR output up to 1.1 MHz  
1-way serial TTL/RS-232 (0-5 Volts) up to 19200 baud

**AUDIO OUT L, R:** (1) 5-pin 3.5 mm detachable terminal block  
Balanced/unbalanced stereo line-level audio output<sup>3</sup>  
Output Impedance: 200 Ohms balanced, 100 Ohms unbalanced  
Maximum Output Level: 4 Vrms balanced, 2 Vrms unbalanced

**RELAY 1-2:** (1) 4-pin 3.5 mm detachable terminal block  
Comprises (2) normally open, isolated relays  
Rated 1 Amp, 30 Volts AC/DC  
MOV arc suppression across contacts

**Ground:** (1) 6-32 screw  
Chassis ground lug

**24 V 1.25A MAX:** (1) 2.1 x 5.5 mm DC power connector  
24 Volt DC power input  
PW-2412WU power pack sold separately

**DM IN:** (1) 8-pin RJ-45 female, shielded  
DM 8G+ input, HDBaseT standard compliant  
PoDM+ PD (Powered Device) port (HDBaseT PoE+ compatible)<sup>7,8</sup>  
Connects to the DM 8G+ output of a DM switcher, transmitter, or other DM device or to an HDBaseT device via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable<sup>5</sup>

**HDMI IN:** (1) 19-pin Type A connector, female  
HDMI digital video/audio input (DVI and Dual-Mode DisplayPort™ compatible<sup>1</sup>)

**HDMI OUT:** (1) 19-pin Type A connector, female  
HDMI digital video/audio output (DVI compatible<sup>2</sup>)

**LAN:** (1) 8-pin RJ-45 female, shielded  
100Base-TX Ethernet port

### Controls and Indicators

---

**RESET:** (1) Recessed push button, for hardware reset

**SETUP:** (1) Red LED and (1) recessed push button, for Ethernet setup

**LAN:** (2) LEDs, green indicates Ethernet link is established, flashing amber indicates Ethernet activity

**HDMI OUT:** (1) Green LED, indicates video signal is detected at the HDMI output

**HDMI IN:** (1) LED, solid green indicates video signal is detected at the HDMI IN port and is the active input source, flashing green indicates video signal is detected at the HDMI IN port but is not the active input source

**INPUT SELECT:** (1) Push button for manual input selection

**DM IN:** (1) LED, solid green indicates video signal is detected at the DM IN port and is the active input source, flashing green indicates video signal is detected at the DM IN port but is not the active input source

**DM IN (RJ-45):** (2) LEDs, green indicates DM or HDBaseT link is established; solid amber indicates HDCP video is detected at the input, flashing amber indicates non-HDCP video is detected at the input

**24 VDC:** (1) Green LED, indicates operating power supplied via PoDM+, HDBaseT PoE+, or local power pack

### Power

---

**Power over DM:** IEEE 802.3at Type 2 Class 4 (25.5 W) compliant PoDM+ PD (Powered Device), capable of being powered by PoDM+ PSE (Power Sourcing Equipment)<sup>7</sup>

**Power over HDBaseT:** IEEE 802.3at Type 2 Class 4 (25.5 W) compliant HDBaseT PoE+ PD (Powered Device), capable of being powered by HDBaseT PoE+ PSE (Power Sourcing Equipment)<sup>8</sup>

**Power Pack (Optional):** Input: 100-240 Volts AC, 50/60 Hz  
Output: 1.25 Amps @ 24 Volts DC  
Model: PW-2412WU (sold separately)

**Power Consumption:** 18.2 Watts

### Environmental

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**Temperature:** 32° to 104° F (0° to 40° C)

**Humidity:** 10% to 90% RH (non-condensing)

**Heat Dissipation:** 62.1 BTU/hr

### Enclosure

---

**Chassis:** Metal, black finish, with (2) integral mounting flanges, vented top and sides

**Mounting:** Freestanding, surface mount, or attachment to a single rack rail

### Dimensions

---

**Height:** 9.18 in. (233 mm)

**Width:** 5.35 in. (136 mm)

**Depth:** 1.33 in. (34 mm)

### Weight

---

1.25 lb (567 g)

## DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

### Models and Accessories

#### Available Models

**DM-RMC-4KZ-SCALER-C:** DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

#### Available Accessories

**PW-2412WU:** Wall-Mount Power Pack, 24 VDC, 1.25 A, 2.1 mm, Universal

**DM-PSU-ULTRA-MIDSPAN:** DigitalMedia™ Ultra Midspan PoDM++ Injector

**DM-CBL-ULTRA-LSZH-SP1000:** DigitalMedia™ Ultra Cable, Low Smoke Zero Halogen, 1000 ft Spool (Available only in Europe)

**DM-CBL-ULTRA-NP-SP1000:** DigitalMedia™ Ultra Cable, Non-Plenum Type CMR, 1000 ft Spool

**DM-CBL-ULTRA-P-SP1000:** DigitalMedia™ Ultra Cable, Plenum Type CMP, 1000 ft Spool

**DM-CBL-ULTRA-PC-10:** DigitalMedia™ Ultra Patch Cable, 10 ft (3 m)

**DM-CBL-8G-NP-SP1000:** DigitalMedia 8G™ Cable, Non-Plenum, 1000 ft Spool

**DM-CBL-8G-P-SP1000:** DigitalMedia 8G™ Cable, Plenum, 1000 ft Spool

**DM-CONN-20:** Connectors for DM-CBL DigitalMedia™ Cable and DM-CBL-ULTRA DigitalMedia Ultra Cable, 20-Pack

**DM-CONN-ULTRA-RECP-50:** DigitalMedia™ Ultra Keystone RJ-45 Jack, 50-Pack with Termination Tool

**DM-8G-CONN-100:** Connectors for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CONN-WG-100:** Connectors with Wire Guide for DM-CBL-8G DigitalMedia 8G™ Cable, 100-Pack

**DM-8G-CRIMP:** Crimping Tool for DM-8G-CONN

**DM-8G-CRIMP-WG:** Crimping Tool for DM-8G-CONN-WG

**CBL-HD-6:** Crestron® Certified HDMI® Interface Cable, 18 Gbps, 6 ft (1.8 m)

**CBL-HD-DVI-6:** Crestron® Certified HDMI® to DVI Interface Cable, 6 ft (1.8 m)

**CBL-HD-LOCK-8:** Locking High-Speed HDMI® Cable, 10.2 Gbps, 8 ft (2.4 m)

**MP-AMP30:** Media Presentation Audio Amplifier

**MP-AMP40-70V:** Media Presentation Audio Amplifier, 70 Volt

**MP-AMP40-100V:** Media Presentation Audio Amplifier, 100 Volt

**MP-WP140-W:** Media Presentation Wall Plate - DVI-I with Mini-TRS Stereo Audio, White

**MP-WP150-W:** Media Presentation Wall Plate - HDMI® with Mini-TRS Stereo Audio, White

**MP-WP152-W:** Media Presentation Wall Plate - HDMI®, White

**MP-WP181-C-W:** Media Presentation Wall Plate - Crestron DigitalMedia 8G+®, White

**MPI-WP150-120:** Media Presentation Wall Plates - International Version - HDMI® with Mini-TRS Stereo Audio, White

**MPI-WP181-C-120:** Media Presentation Wall Plate - International Version - Crestron DigitalMedia 8G+®, White

**IRP-2:** IR Emitter Probe with Terminal Block Connector

**USB-EXT-DM-LOCAL:** USB over Ethernet Extender with Routing, Host Module

**USB-EXT-DM-REMOTE:** USB over Ethernet Extender with Routing, 4-Port Device Module

**SAROS SB-200-P-B:** Saros® Soundbar 200, Powered, Black

#### Notes:

1. The HDMI input can accommodate a DVI or Dual-Mode DisplayPort signal using an appropriate adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.
2. The HDMI output can accommodate a DVI signal using an appropriate adapter or interface cable. [CBL-HD-DVI](#) interface cables are available separately.
3. The analog stereo audio output is active only when the DM-RMC-4KZ-SCALER-C is receiving a 2-channel stereo signal. For applications using a multichannel surround sound source, use the [DM-RMC-4K-SCALER-C-DSP](#), which provides a stereo downmix of the multichannel signal.
4. 4K60 4:4:4 performance and HDR support require the use of HDMI cables and couplers with a minimum TMDS bandwidth of 18 Gbps. If 4K60 4:2:0 or 4K30 4:4:4 performance is acceptable, cables and couplers with a minimum bandwidth of 10.2 Gbps can be used. Bandwidth loss is cumulative; therefore, performance may be reduced when inserting multiple cables and couplers inline.
5. The maximum cable length for DigitalMedia 8G+ (DM 8G+) or HDBaseT transmission is dependent upon the type of cable and resolution of the video signal. Refer to the "Maximum Cable Lengths" table for a detailed overview. Crestron legacy cable models DM-CBL and DM-CBL-D support the same resolutions and cable lengths as CAT5e. Shielded cable and connectors are recommended to safeguard against unpredictable environmental electrical noise that may impact performance at resolutions above 1080p. Refer to the Crestron DigitalMedia System Design Guide for additional guidelines. DM 8G+ technology is compatible with the HDBaseT Alliance specifications for connecting to HDBaseT compliant equipment. All wire and cables are sold separately.
6. USB-EXT-DM USB over Ethernet Extender Modules are sold separately. Refer to the [USB-EXT-DM-LOCAL](#) and [USB-EXT-DM-REMOTE](#) specification sheets for more information.
7. In order for the DM-RMC-4KZ-SCALER-C to receive PoDM+ (Power over DigitalMedia+), the device must connect to a DM switcher or other equipment that has a PoDM+ PSE port. Wiring that connects to a PoDM+ PSE port is for intrabuilding use only.
8. In order for the DM-RMC-4KZ-SCALER-C to receive HDBaseT PoE+, the device must connect to equipment that has an HDBaseT PoE+ PSE port. Wiring that connects to an HDBaseT PoE+ PSE port is for intrabuilding use only.

## DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler

9. Video wall processing requires a separate DM-RMC-4KZ-SCALER-C for each display.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at <https://www.crestron.com/How-To-Buy/Find-a-Representative> or by calling 855-263-8754.

The specific patents that cover Crestron products are listed online at [www.crestron.com/legal/patents](http://www.crestron.com/legal/patents).

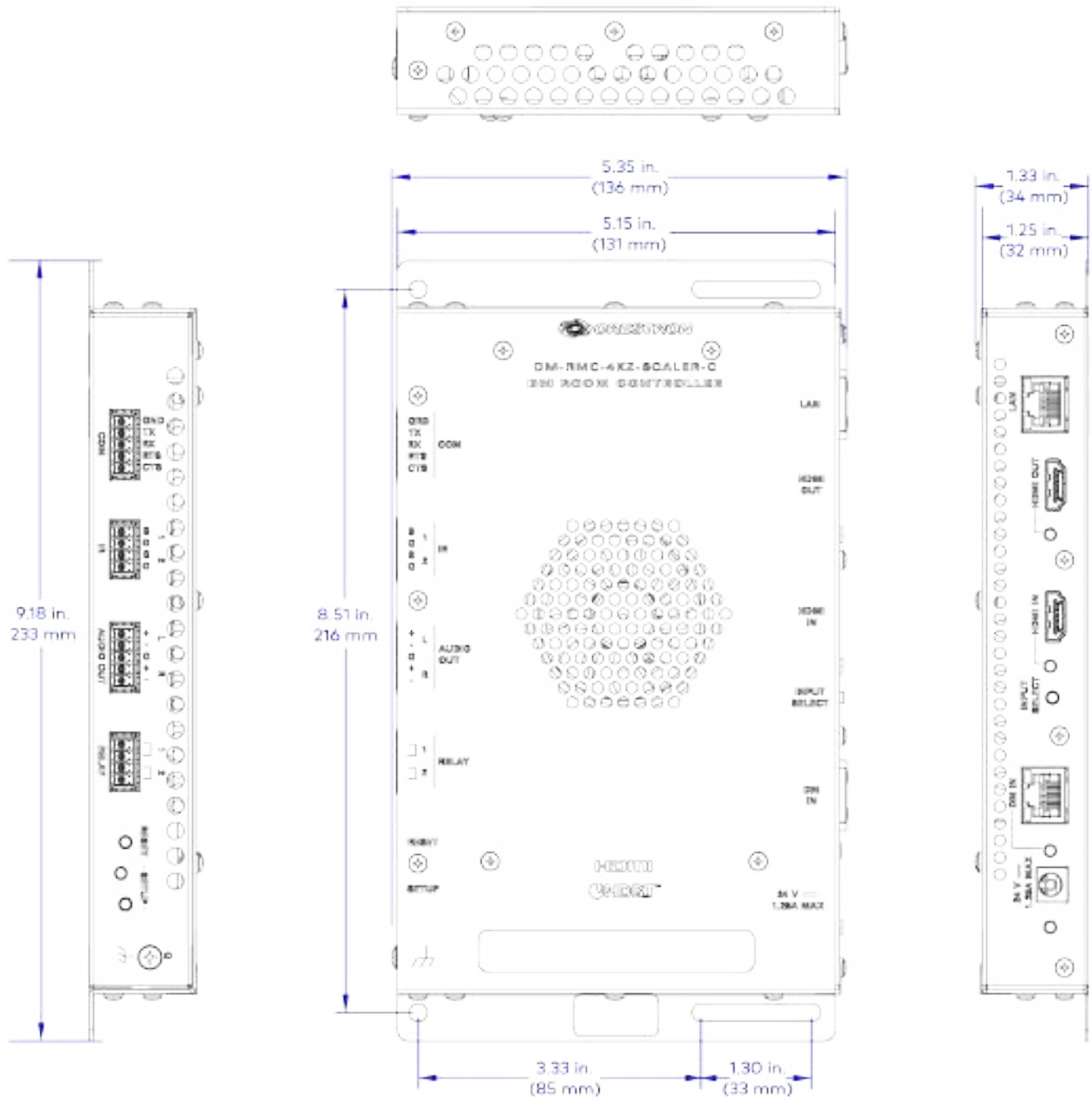
Certain Crestron products contain open source software. For specific information, visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

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DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler





## 3-Series Control System®

- > Enterprise-class control system
- > 3-Series® Control Engine — substantially faster and more powerful than other control systems
- > Exclusive modular programming architecture
- > Onboard 512MB RAM & 4GB Flash memory
- > Expandable storage up to 1TB
- > Rear panel memory card slot
- > High-speed USB 2.0 host port
- > Industry-standard Ethernet and Cresnet® wired communications
- > XPanel with Smart Graphics® computer and web based control
- > iPhone®, iPad®, and Android® control app support
- > Crestron Fusion® Cloud Enterprise Management Service support
- > SNMP remote management support
- > One RS-232/422/485 COM port with hardware and software handshaking
- > Two RS-232 COM ports with software handshaking only
- > Eight IR/serial, eight relay, and eight Versiport I/O ports
- > Programmable event scheduling with astronomical time clock
- > Native BACnet™/IP support<sup>(1)</sup>
- > Installer setup via Crestron Toolbox™ software or web browser
- > C#, symbol based, and drag-and-drop programming environments
- > Full Unicode (multi-language) support
- > Increased network throughput and security
- > Secure access through full user/group management or Active Directory integration
- > Hardware level security using 802.1X authentication
- > JITC certified model available for use in secure network environments
- > TLS, SSL, SSH, and SFTP network security protocols
- > FIPS 140-2 compliant encryption
- > IIS v.6.0 Web Server
- > IPv6 ready
- > Front panel USB computer console port
- > 1-space rack-mountable



### 3-Series® Control Systems

Today's commercial buildings and custom homes comprise more technology than ever before, and all these systems need to be networked, managed, and controlled in fundamentally new ways. The IP based 3-Series platform is engineered from the ground up to deliver a network-grade server appliance capable of faithfully handling everything from boardroom AV and home theater control to total building management.

3-Series embodies a distinctively robust, dynamic, and secure platform to elevate your system designs to higher levels of performance and reliability. Compared to other control systems, Crestron 3-Series provides a pronounced increase in processing power and speed with more memory, rock solid networking and IP control, and a unique modular programming architecture.

### Modular Programming Architecture

Designed for enhanced scalability, the CP3 affords high-speed, real-time multi-tasking to seamlessly run multiple programs simultaneously. This exclusive modular programming architecture lets programmers independently develop and run device-specific programs for AV, lighting, shades, HVAC, security, etc., allowing for the optimization of each program, and allowing changes to be made to one program without affecting the whole. Even as your system grows, processing resources can easily be shifted from one 3-Series processor to another without rewriting any code. The end benefit is dramatically simplified upgradability with minimal downtime, whether implementing changes on site or remotely via the network.

### Robust Ethernet & IP Control

IP technology is the heart of 3-Series, so it should be no surprise that its networking abilities are second to none. High-speed Ethernet connectivity enables integration with IP-controllable devices and allows the CP3 to be part of a larger managed control network. Whether residing on a sensitive corporate LAN, a home network, or accessing the Internet through a cable modem, the CP3 provides secure, reliable interconnectivity with IP-enabled touch screens, computers, mobile devices, video displays, media servers, security systems, lighting, HVAC, and other equipment — whether on premises or across the globe.

The Crestron® CP3 is an enterprise-class control system for residential, commercial, and government applications. Featuring the 3-Series® control engine, the CP3 forms the core of any modern networked home or commercial building, managing and integrating all the disparate technologies throughout your facility to make life easier, greener, more productive, and more enjoyable.

# CP3 3-Series Control System®



CP3 – Rear View

## Control Apps & XPanel

Years ago, Crestron pioneered the world's first IP-based control system unleashing vast new possibilities for controlling, monitoring, and managing integrated systems over a LAN, WAN, and the Internet. Today, Crestron offers more ways than ever to control your world the way you want. Using a computer, smartphone, or tablet device, Crestron lets you control anything in your home or workplace from anywhere in the world.

Native to every 3-Series control system, Crestron [XPanel](#) technology transforms any laptop or desktop computer into a virtual Crestron touch screen. Crestron [control apps](#) deliver the Crestron touch screen experience to iPhone®, iPad®, and Android® devices, letting you safely monitor and control your entire residence or commercial facility using the one device that goes with you everywhere.

## Crestron Fusion® Cloud

[Crestron Fusion Cloud](#) provides an integrated platform for creating truly smart buildings that save energy, enhance worker productivity, and prolong the life-span of valuable equipment. As part of a complete managed network in a corporate enterprise, college campus, convention center, or any other facility, the CP3 works integrally with Crestron Fusion Cloud to enable remote scheduling, monitoring, and control of rooms and technology from a central help desk. It also enables organizations to reduce energy consumption by tracking real-time usage and automating control of lighting, shades, and HVAC.



## SNMP Support

Built-in SNMP support enables integration with third-party IT management software, allowing network administrators to manage and control Crestron systems on the network in an IT-friendly format.

## Cresnet®

Cresnet provides a dependable network wiring solution for Crestron keypads, lighting controls, shade motors, thermostats, occupancy sensors, and other devices that don't require the higher speed of Ethernet. The Cresnet bus offers easy wiring and configuration, carrying bidirectional communication and 24VDC power to each device over a simple 4-conductor cable. To assist with troubleshooting, the CP3 includes our patent-pending Network Analyzer which continuously monitors the integrity of the Cresnet network for wiring faults, marginal performance, and other errors.

## Onboard Control Ports

In addition to Ethernet, the CP3 includes three bidirectional COM ports and eight IR ports to interface directly with all of your centralized AV sources, video displays, and other devices. Eight programmable relay ports are included for controlling projection screens, lifts, power controllers, and other contact-closure actuated equipment. Eight "Versiport" I/O ports

enable the integration of power sensors, motion detectors, door switches, alarms, or anything else that provides a dry contact closure, low-voltage logic, or 0-10 Volt DC signal.

## BACnet™/IP

Native support for the [BACnet/IP](#) communication protocol provides a direct interface to third-party building management systems over Ethernet, simplifying integration with HVAC, security, fire & life safety, voice & data, lighting, shades, and other systems. Using BACnet/IP, each system runs independently with the ability to communicate together on one platform for a truly smart building.<sup>[1]</sup>



## Government Version

Crestron is committed to developing solutions for critical secure network environments. A government version of the CP3, model CP3-GV, is available preconfigured for deployment on a multi-level secured network. It has been specially developed and tested with specific government firmware. The CP3-GV has been assessed by JITC using IA requirements from the Department of Defense, and the results have been documented in a DIACAP scorecard. For additional information, see [Crestron True Blue Online Help Answer ID 5361](#).

## SPECIFICATIONS

### Control Engine

Crestron 3-Series; real-time, preemptive multi-threaded/multitasking kernel; Transaction-Safe Extended FAT file system; supports up to 10 simultaneously running programs

### Memory

SDRAM: 512 MB

Flash: 4 GB

Memory Card: Supports SD and SDHC cards up to 32 GB

External Storage: Supports USB mass storage devices up to 1 TB

### Communications

**Ethernet:** 10/100 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, BACnet/IP<sup>[1]</sup>, IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client

**Cresnet:** Cresnet master mode

**USB:** Supports USB mass storage class devices via rear panel USB 2.0 host ports, supports computer console via front panel USB 2.0 device port

# CP3 3-Series Control System®

**RS-232/422/485:** For 2-way device control and monitoring, all ports support RS-232 up to 115.2k baud with software handshaking, one port also supports RS-422 or RS-485 and hardware handshaking

**IR/Serial:** Supports 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud

## Connectors & Card Slots

---

**RELAY OUTPUT 1 – 8:** (2) 8-pin 3.5 mm detachable terminal blocks; Comprises (8) normally open, isolated relays; Rated 1 Amp, 30 Volts AC/DC; MOV arc suppression across contacts

**I/O 1 – 8:** (1) 9-pin 3.5 mm detachable terminal block; Comprises (8) “Versiport” digital input/output or analog input ports (referenced to GND);

Digital Input: Rated for 0-24 Volts DC, input impedance 20k Ohms, logic threshold >3.125V low/0 and <1.875V high/1;

Digital Output: 250 mA sink from maximum 24 Volts DC, catch diodes for use with “real world” loads;

Analog Input: Rated for 0-10 Volts DC, protected to 24 Volts DC maximum, input impedance 21k Ohms with pull-up resistor disabled;

Programmable 5 Volts, 2k Ohms pull-up resistor per pin

**IR - SERIAL OUTPUT 1 – 8:** (2) 8-pin 3.5 mm detachable terminal blocks; Comprises (8) IR/Serial output ports;

IR output up to 1.2 MHz;

1-way serial TTL/RS-232 (0-5 Volts) up to 115.2k baud

**COM 1:** (1) 5-pin 3.5 mm detachable terminal block;

Bidirectional RS-232/422/485 port;

Up to 115.2k baud; hardware and software handshaking support

**COM 2 – 3:** (2) 3-pin 3.5 mm detachable terminal blocks;

Bidirectional RS-232 ports;

Up to 115.2k baud; software handshaking support

**MEMORY:** (1) SD memory card slot;

Accepts one SD or SDHC card up to 32 GB for memory expansion

**USB:** (1) USB Type A female;

USB 2.0 port for storage devices

**LAN:** (1) 8-pin RJ45 jack;

10Base-T/100Base-TX Ethernet port

**NET:** (1) 4-pin 3.5 mm detachable terminal block;

Cresnet master port;

Outputs power to Cresnet devices if a power pack is connected to the 24VDC power input jack;

Receives Cresnet network power if no power pack is connected to the 24VDC power input jack;

See “Power” section for additional specifications

**24VDC 2.0A:** (1) 2.1 x 5.5 mm DC power connector;

24 Volt DC power input, PW-2420RU power pack included;

Passes through to NET port to power Cresnet devices;

See “Power” section for additional specifications

**G:** (1) 6-32 screw;

Chassis ground lug

**COMPUTER (front):** (1) USB Type B female;

USB 2.0 computer console port (cable sold separately);

For setup only

## Controls & Indicators

---

**PWR:** (1) Green LED, indicates operating power supplied from power pack or Cresnet network

**NET:** (1) Amber LED, indicates communication with the Cresnet system

**MSG:** (1) Red LED, indicates control system has generated an error message

**HW-R:** (1) Recessed pushbutton for hardware reset

**SW-R:** (1) Recessed pushbutton for software reset

**LAN (rear):** (2) LEDs, green LED indicates Ethernet link status, amber LED indicates Ethernet activity

## Power

---

**Power Pack:** 2.0 Amps @ 24 Volts DC;

100-240 Volts AC, 50/60 Hz power pack, model PW-2420RU included

**Available Cresnet Power:** 24 Watts (1 Amp @ 24 Volts DC) when using power pack

**Cresnet Power Usage:** 15 Watts (0.625 Amp @ 24 Volts DC) when using Cresnet network power

## Environmental

---

**Temperature:** 41° to 113° F (5° to 45° C)

**Humidity:** 10% to 90% RH (non-condensing)

**Heat Dissipation:** 50 BTU/hr

## Enclosure

---

**Chassis:** Metal, black finish

**Faceplate:** Extruded metal, black finish, polycarbonate label overlay

**Mounting:** Freestanding or 1 RU 19-inch rack-mountable (adhesive feet and rack ears included)

## Dimensions

---

**Height:** 1.70 in (44 mm) without feet

**Width:** 17.28 in (439 mm), 19.00 in (483 mm) with rack ears

**Depth:** 6.56 in (167 mm)

## Weight

---

3.12 lb (1.42 kg)

# CP3 3-Series Control System®

## MODELS & ACCESSORIES

### Available Models

CP3: 3-Series Control System®

CP3-GV: 3-Series Control System® - Government Version

### Included Accessories

PW-2420RU: Power Pack, Desktop, 24VDC, 2A (50 Watts), Regulated, US/International (Qty. 1 included)

### Available Accessories

C2N-HBLOCK: Multi-type Cresnet Distribution Block

CNTBLOCK: Cresnet Distribution Block

CNSP-XX: Custom Serial Interface Cable

IRP2: IR Emitter Probe w/Terminal Block Connector

Crestron® App: Control App for Apple® iOS® & Android®

XPanel: Crestron Control® for Computers

myCrestron: Dynamic DNS Service for Crestron Systems

Crestron Fusion®: Enterprise Management Platform

3-Series® BACnet™/IP Support: 3-Series Native BACnet/IP Interface

License

CSP-LIR-USB: IR Learner

Notes:

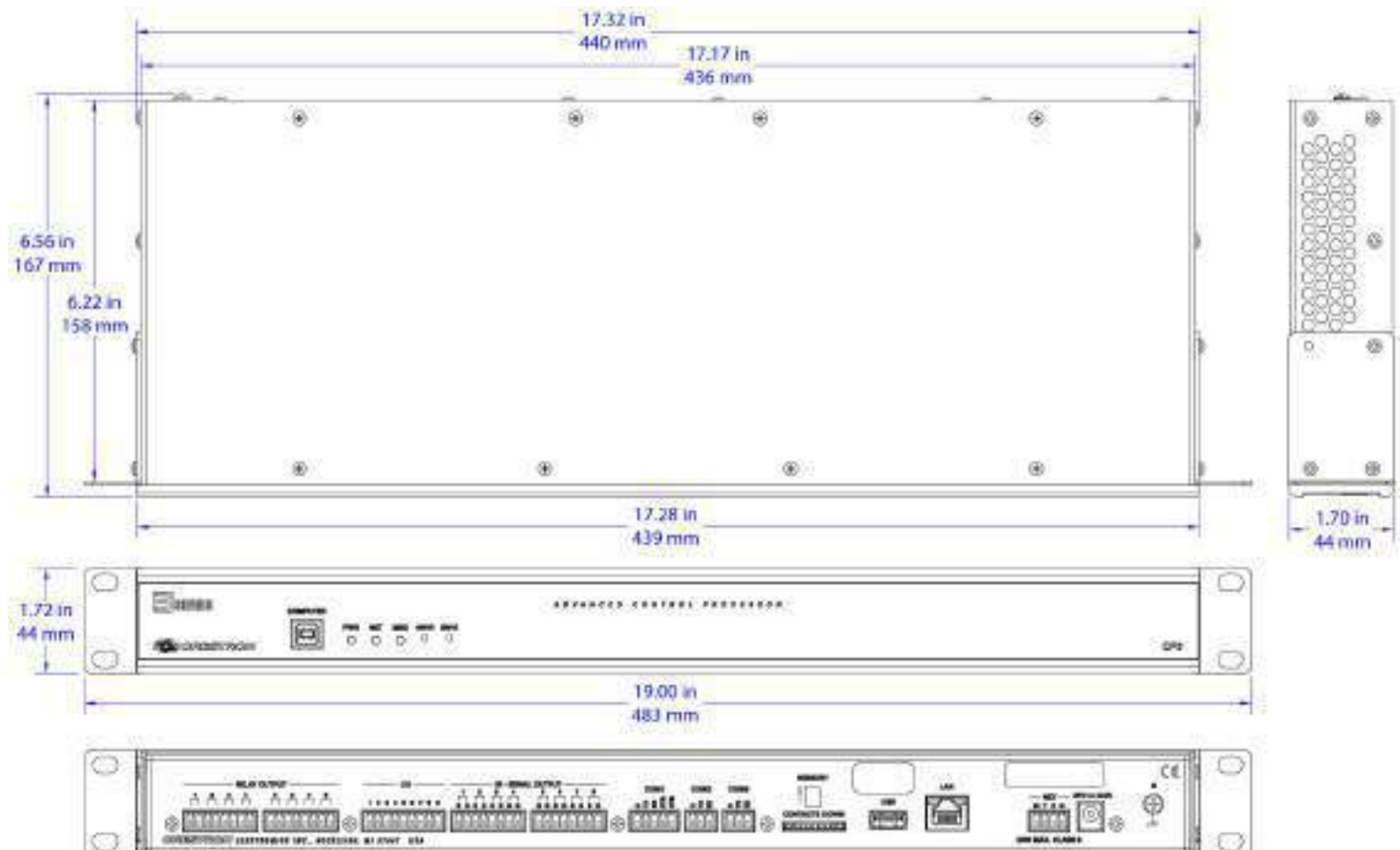
1. License required. The CP3 supports a maximum of 1000 BACnet objects when dedicated for BACnet use only. Actual capabilities are contingent upon the overall program size and complexity.

This product may be purchased from an authorized Crestron dealer. To find a dealer, please contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/salesreps](http://www.crestron.com/salesreps) or by calling 800-237-2041.

The specific patents that cover Crestron products are listed online at: [patents.crestron.com](http://patents.crestron.com).

Certain Crestron products contain open source software. For specific information, please visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

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## Crestron Control® for Computers



- Enables virtual Crestron® touch screen control on a computer
- Compatible with Windows® and macOS® platforms
- Runs as a desktop application or in a Web browser
- Supports Smart Graphics™
- Can be programmed just like a Crestron touch screen or mobile app
- Can be generated instantly from an existing touch screen or mobile project
- Communicates directly over IP with a Crestron control system
- No special servers are required

**NOTE:** Starting 12/31/2020, Flash® technology will reach its end of life, and XPanel will no longer be supported by web browsers. Refer to the [XPanel Conversion Tool](#) to convert an existing web-based XPanel project to a desktop-based XPanel project.

### Transform any computer into a virtual Crestron® touch screen with XPanel.

Crestron XPanel lets you control your home, office or classroom using a laptop or desktop computer running Windows® or macOS®. It can be installed and run as a desktop application. Use XPanel as a low-cost control solution for a small classroom AV system, to monitor your home from the office, as an interactive kiosk in a lobby or museum exhibit, or to enable centralized control of lighting and climate control in an office building or conference center.

### Supports Smart Graphics™

XPanel supports Smart Graphics™<sup>1</sup>, delivering the Crestron touch screen experience to your computer using buttons, sliders, gauges, dynamic text, scrolling lists, and customizable themes. A touch screen project developed using Smart Graphics can be instantly transformed into an XPanel project, dramatically reducing programming time. Touch screen projects

using Smart Graphics can even be launched right on a computer by simply changing the file extension, offering a simple way for programmers to test touch screen projects without an actual touch screen present.

### Supports Control Systems

Crestron control systems support XPanel natively<sup>1</sup> to add remote access to any system. Using XPanel, your computer communicates directly with your 2-Series or 3-Series®<sup>1</sup> control system over Ethernet.

### Control System Compatibility

- XPanel is supported on all Ethernet-enabled Crestron® control systems.
- XPanel with Smart Graphics™ is supported on all 3-Series® control systems.
- XPanel with Smart Graphics is supported on the following 2-Series control systems: AV2, CP2E, DMPS-100-C, DMPS-200-C, DMPS-300-C, DMPS-300-C-AEC, PAC2, PRO2, and RACK2.

**NOTE:** Smart Graphics applications such as Media Player, Weather, and EnergyMonitor require a 3-Series control system.

For additional information about Smart Graphics, refer to the Crestron True Blue Online Help [Answer ID 5188](#).

Note:

1. Refer to Control System Compatibility above.

This product may be purchased from select authorized Crestron dealers and distributors. To find a dealer or distributor, please contact the Crestron sales representative for your area. A list of sales representatives is available online at [www.crestron.com/How-To-Buy/Find-a-Representative](http://www.crestron.com/How-To-Buy/Find-a-Representative) or by calling 855-263-8754.

This product is covered under the Crestron standard limited warranty. Refer to [www.crestron.com/warranty](http://www.crestron.com/warranty) for full details.

The specific patents that cover Crestron products are listed online at [patents.crestron.com](http://patents.crestron.com).

Certain Crestron products contain open source software. For specific information, please visit [www.crestron.com/opensource](http://www.crestron.com/opensource).

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Rev 11/12/20

# Dual-Channel H.264 Encoder for Broadcast Streaming and Recording

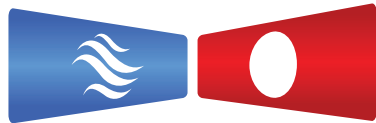


## Matrox® Monarch™ HDX Dual-Channel H.264 Encoder for Broadcast Streaming and Recording.

The Matrox Monarch HDX is a simple and versatile video encoding appliance specifically designed for broadcasters and webcasters who need a flexible solution that is powerful enough to take on today's demanding webcasting and recording workflows. Monarch HDX offers 3G-SDI and HDMI inputs with frame-synchronization to correct any discontinuity at the input, and two independent H.264 encoders that can be assigned to individual tasks. Webcasting to YouTube and Facebook Live is easy for these popular platforms. All that's needed is to setup the device once with these accounts and it's automatically retained for subsequent streams.

## Powerful, high quality H.264 encoding engine

The Monarch HDX can share 30 Mb/s of encoding capacity across the two channels. Each channel benefits from a powerful scaling, de-interlacing, and noise reduction engine to ensure only pristine images are sent to be encoded.



## Simultaneous streaming and recording

The quality of your VOD downloads need never be dictated by the available upload bandwidth. Monarch HDX dual encoders can broadcast a live webstream at one bitrate while simultaneously recording mastering quality H.264 files for immediate availability, such as post event VOD or editing with your NLE of choice.

## Dual-channel streaming

When used as a webcasting encoder, the Monarch HDX generates an H.264-encoded stream compliant with RTSP or RTMP protocols. You can assign each channel separately to deliver what you need, where you need. Each channel can stream up to 10Mb/s, allowing you to simultaneously stream to two destinations or set the device for up to 20Mb/s streaming quality for a single encoding destination.



## Easily webcast to your audience

Monarch HDX can provide live content to CDNs such as YouTube, Facebook Live, and Ustream; media servers such as Adobe Flash and Wowza; or directly to a computer or device found on a LAN. The device is easily configured for YouTube and Facebook accounts with a few short steps. As a certified “Works with Wowza” encoder it allows users to benefit from enhanced integration with the Wowza™ streaming engine via XML files or Wowza tokens. Additionally, Monarch HDX supports XML files generated for use with Flash Live Media Encoder.

## Dual-channel recording

Monarch HDX provides a huge amount of flexibility as an H.264 video recorder. Content is captured as either MOV or MP4 files to ensure that recordings can be played by the viewer’s choice of application. Each recording channel can be stored independently to a local SD card or USB drive, or remotely on a network-mapped drive so that files are immediately available to anyone on the network. Recordings can also be encoded at different bitrates should there be a need to deliver content to devices with varying decode or bandwidth capacities.



## Secure back-up with disaster recovery

By targeting local and remote storage simultaneously, Monarch HDX ensures that no action will be lost should the network go down. Furthermore, it provides users with the ability to create split files while recording; particularly useful when recording for extended periods of time. The user can set a specific file segment length and Monarch HDX will automatically stop recording in one file and start a new file once the elapsed time is reached, without losing a single frame. The split file feature also ensures the majority of content will be preserved if disaster hits such as a power failure. All files created up to that moment will be saved and uncorrupted.

## Matrox file consolidator application

Matrox provides a free Java-based utility that allows users to consolidate a sequence of MP4 or MOV files recorded with the “Split File” feature enabled. The application does not transcode but simply rewraps the video data, accelerating the consolidating process. The resulting file will have the same quality as the original and playback seamlessly, even across the file boundaries.



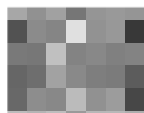
## Selectable HDMI and SDI inputs and simultaneous outputs

Monarch HDX H.264 video recorder can accept signals from HDMI or SDI sources. The input is selected using the web based UI, Matrox Command Center, or directly on the unit itself, allowing for a wide range of connectivity to devices such as cameras, switchers or routers. Additionally, both inputs are complemented by internal frame synchronisers to ensure uninterrupted streaming and recording operations, regardless of the disturbance on the input. The audio is also selectable between the two channels of the embedded video signal or the analog stereo input. Audio may be dynamically muted/unmuted without affecting the video encoding operation.

Regardless of input selection, SDI, HDMI video and embedded and analog audio outputs are live. For SDI workflows, the Monarch HDX recorder has an extremely low pass-through latency with a built-in power-loss relay which, in case of power loss, will route the SDI input directly to the SDI output, ensuring signal path integrity and fail safe design options.



## Closed captioning support



Ideal for broadcasters who require the integration of closed captioning while streaming and/or recording. Monarch HDX retrieves closed captioning data from the SDI VANC or line 21, then embeds the data within the H.264 essence as CEA-608. Caption-enhanced H.264 media can be streamed to video hosting platforms including YouTube Live and Ustream, media servers such as Wowza™, or a variety of content delivery networks (CDNs). MOV/MP4 files recorded with Monarch HDX preserves captions and can be included in VOD or archiving workflows.

## Profiles and presets

Monarch HDX ships with a number of typical streaming and recording presets that define all the encoding parameters including resolution and bitrate. Whether preset or custom parameters are used, they only need to be entered once and saved as a unique profile. A profile not only contains encoding parameters but also destination information detailing where the encoded video is being sent. Multiple profiles can be saved if the device is used in different environments. Each profile can be loaded instantly without having to re-enter data.



## Control from anywhere

Matrox Monarch HDX can be controlled and configured via the Monarch HDX Command Center using any device on the network that supports a standard web browsing application such as a computer, smart phone or tablet. Designed for operator ease-of-use, master controls provide one-click operation to start streaming, recording or both from anywhere within the user interface.

The device also provides convenient controls directly on the unit itself to stop/start recording or streaming, and an additional button to assign the input.

## Matrox Utils application

The Matrox Utils application allows operators to remotely scan and find all Monarch HDX's present on their network. The Utils application will also scan the attached Monarch HDX and notify the operator if the unit is up to date with its installed firmware version and will also update the device automatically to ensure that it has the latest software release installed. The Matrox Utils application can also be used to reboot Monarch HDX devices present on the network.



## H.264 preview stream

Monarch HDX H.264 encoder provides a very useful low bitrate preview stream of the input directly in the Command Center UI. This same preview can be viewed using software players such as VLC or on third-party devices, such as Crestron control panels. This stream is available independently of the two encoder channels allowing you to check your video signal before your webcast goes live.



## Integrate Matrox Monarch HDX into your own application or environment

Broadcasters, network or cloud-based video management platform developers, A/V integrators and value-added resellers can use Monarch HDX Dev Tools, which include automatic configuration tools and the Monarch HDX Control API, to provide a unified, consistent and branded user experience. Individual users need not interact with the Monarch HDX Command Center web UI, which can simplify enterprise-level and centrally administered deployments.



Automatic configuration tools can be used to set all Monarch HDX encoding and destination settings by simply loading a properly formatted configuration file. For example, specialized CDNs and video platform providers who wish to offer a branded plug-and-play user experience can use the automatic configuration tools to give their customers a very simple installation procedure. The customer only needs to insert a USB key containing the customized automatic configuration file, boot the new Monarch HDX and the device will be ready to stream at exactly the right settings. Similarly, IT administrators in broadcast, corporate and education environments with deployments of multiple Monarch HDX units on a network can use the tools to manage all of the units from a single application or portal. This can be done automatically by having each Monarch HDX access a defined webpage for configuration settings at boot up. Alternatively, the task of fetching configuration settings can be triggered manually from the Monarch HDX Command Center.

Monarch HDX Control API is an HTTP-based API that lets system integrators create their own control software to start, to stop, to set streaming bitrates and destinations, and to get the status of a Monarch HDX device. The Monarch HDX Command Center or the automatic configuration tools are used to initially configure devices with complete streaming and recording parameters. Once set up, units can be controlled using the custom application, on-device buttons only or the Command Center.



**ROSS**



## Integrate with Crestron or ROSS DashBoard

The Monarch HDX Control API is an ideal way to integrate Monarch HDX functionality into an existing broadcast facility, classroom, boardroom or other space equipped with a Crestron control system. Broadcasters who use ROSS equipment can take advantage of our ROSS DashBoard network control and monitoring integration. Monarch HDX registered users are invited to download a sample SIMPL module written to run on Crestron 2-Series® and 3-Series® Room Media Controllers or our ROSS DashBoard module for use with ROSS DashBoard Control Systems.

## Robust and practical design

Powerful and robust, Monarch HDX offers simple, one touch stream and record push buttons, input selection, and a locking power connector. Monarch HDX's HDMI or SDI outputs makes it easy to monitor what you are streaming and recording, regardless of signal source. All eight channels of embedded audio can be passed from any input to any output. When embedded audio is selected, all eighth channels are passed from input to output. When Analog audio is selected, it is both looped out as well as embedded in video outputs. Its design allows Monarch HDX to be just as easily located on a desktop as in a rack - up to two units can fit in a single 1RU tray. The storage and button controls are conveniently located on the front of the unit while the power and I/O ports are found at the back. Finally, the Monarch HDX also features a wide input voltage range of 9 to 24 volts. It can be powered using the Matrox supplied power supply or DC sources such as standard field batteries.

## Matrox Monarch HDX connections



- |  |  |   |
|--|--|---|
| <ol style="list-style-type: none"> <li>1. Power LED</li> <li>2. Input Section Button</li> <li>3. Start/Stop Encoder 1</li> <li>4. Start/Stop Encoder 2</li> <li>5. USB 2.0 Ports</li> <li>6. SD Card Slot</li> <li>7. Power Connector</li> </ol> | <ol style="list-style-type: none"> <li>8. Gigabit Ethernet Port</li> <li>9. RS-232 Connector</li> <li>10. HDMI Output Connector (with embedded audio)</li> <li>11. HDMI Input Connector (with embedded audio)</li> <li>12. SDI Output Connector (with embedded audio)</li> </ol> | <ol style="list-style-type: none"> <li>13. SDI Input Connector (with embedded audio)</li> <li>14. Auxiliary Input Connector</li> <li>15. Analog Audio Output (stereo)</li> <li>16. Analog Audio Input (stereo)</li> </ol> |
|--|--|---|

### Contact Matrox

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E-mail: [video.info@matrox.com](mailto:video.info@matrox.com)

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Tel: +44 (0) 1895 827220 • Fax: +44 (0) 1895 827239  
E-mail: [video.info.emea@matrox.com](mailto:video.info.emea@matrox.com)

Matrox is a market leader in the 4K and HD digital video hardware and software fields, offering accelerated H.264 encoding, streaming, AV signal conversion, capture/playout servers, and CGs. Matrox's Emmy award-winning technology powers a range of multi-screen content creation and delivery platforms used by broadcasters, telcos, cable operators, post-production facilities, live event producers, videographers, and AV professionals worldwide. Founded in 1976, Matrox is a privately held company headquartered in Montreal, Canada.

For more information, visit [www.matrox.com/video](http://www.matrox.com/video).

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# Monarch HDX Encoder Appliance

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Monarch HDX Encoder Appliance



## Dual-Channel H.264 Encoder For Broadcast Streaming And Recording

The Matrox Monarch HDX is a simple and versatile video encoding appliance specifically designed for broadcasters and webcasters who need a flexible solution that is powerful enough to take on today's demanding webcasting and recording workflows. Monarch HDX offers 3G-SDI and HDMI inputs with frame-synchronization to correct any discontinuity at the input, and two independent H.264 encoders that can be assigned to individual tasks. Webcasting to YouTube and Facebook Live is easy for these popular platforms. All that's needed is to setup the device once with these accounts and it's automatically retained for subsequent streams.

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Powerful, high quality H.264 encoding engine



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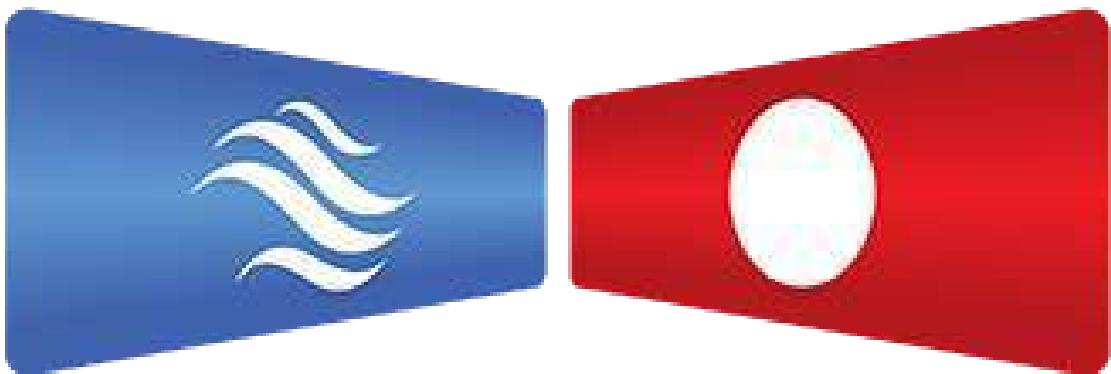
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[View samples \(/en/node/6959/\)](/en/node/6959/)

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[View compatible products \(/en/video/products/encoders-decoders/monarch-series/monarch-hdx-compatible-products\)](/en/video/products/encoders-decoders/monarch-series/monarch-hdx-compatible-products)

## Dual-channel recording



Monarch HDX provides a huge amount of flexibility as an H.264 video recorder. Content is captured as either MOV or MP4 files to ensure that recordings can be played by the viewer's choice of application. Each recording channel can be stored independently to a local SD card or USB drive, or remotely on a network-mapped drive so that files are immediately available to anyone on the network. Recordings can also be encoded at different bitrates should there be a need to deliver content to devices with varying decode or bandwidth capacities.

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# Matrox file consolidator application

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Matrox provides a free Java-based utility that allows users to consolidate a sequence of MP4 or MOV files recorded with the “Split File” feature enabled. The application does not transcode but simply rewraps the video data, accelerating the consolidating process. The resulting file will have the same quality as the original and playback seamlessly, even across the file boundaries.

## Selectable HDMI and SDI inputs and simultaneous outputs



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## Closed captioning support



Ideal for broadcasters who require the integration of closed captioning while streaming and/or recording. Monarch HDX retrieves closed captioning data from the SDI VANC or line 21, then embeds the data within the H.264 essence as CEA-608. Caption-enhanced H.264 media can be streamed to video hosting platforms including YouTube and Ustream, media servers such as Wowza™, or a variety of content delivery networks (CDNs). MOV/MP4 files recorded with Monarch HDX preserves captions and can be included in VOD or archiving workflows.

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## Control from anywhere



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provide one-click operation to start streaming, recording or both from anywhere within the user interface.

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The device also provides convenient controls directly on the unit itself to stop/start recording or streaming, and an additional button to assign the input.

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## Matrox utils application

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The Matrox Utils application allows operators to remotely scan and find all Monarch HDX's present on their network. The Utils application will also scan the attached Monarch HDX and notify the operator if the unit is up to date with its installed firmware version and will also update the device automatically to ensure that it has the latest software release installed. The Matrox Utils application can also be used to reboot Monarch HDX devices present on the network.

## H.264 preview stream



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Integrate Matrox Monarch HDX into your own application or environment



Broadcasters, network or cloud-based video management platform developers, A/V integrators and value-added resellers can use the Monarch HDX Dev Tools, which include automatic configuration tools and the Monarch HDX Control API, to provide a unified, consistent and branded user experience. Individual users need not interact with the Monarch HDX Command Center web UI, which can simplify enterprise-level and centrally administered deployments.

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Automatic configuration tools can be used to set all Monarch HDX encoding and destination settings by simply loading a properly formatted configuration file. For example, specialized CDNs and video platform providers who wish to offer a branded plug-and-play user experience can use the automatic configuration tools to give their customers a very simple installation procedure. The customer only needs to insert a USB key containing the customized automatic configuration file, boot the new Monarch HDX and the device will be ready to stream at exactly the right settings.

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Similarly, IT administrators in broadcast, corporate and education environments with deployments of multiple Monarch HDX units on a network can use the tools to manage all of the units from a single application or portal. This can be done automatically by having each Monarch HDX access a defined webpage for configuration settings at boot up. Alternatively, the task of fetching configuration settings can be triggered manually from the Monarch HDX Command Center.

Monarch HDX Control API is an HTTP-based API that lets system integrators create their own control software to start, to stop, to set streaming bitrates and destinations, and to get the status of a Monarch HDX device. The Monarch HDX Command Center or the automatic configuration tools are used to initially configure devices with complete streaming and recording parameters. Once set up, units can be controlled using the custom application, on-device buttons only or the Command Center.

**[Download the Monarch HDX DEV tools reference guide \(/en/./en/video/apps/documentation?id=3\)](#)**

## Integrate with Crestron or ROSS DashBoard



The Monarch HDX Control API is an ideal way to integrate Monarch HDX functionality into an existing broadcast facility, classroom, boardroom or other space equipped with a Crestron control system. Broadcasters who use ROSS equipment can take advantage of our ROSS DashBoard network control and monitoring integration. Monarch HDX registered users are invited to download a sample SIMPL module written to run on Crestron 2-Series® and 3-Series® Room Media Controllers or our ROSS DashBoard module for use with ROSS DashBoard Control Systems.

[Register now to integrate with Crestron \(/en/video/forms/download/monarch-hdx-module-crestron\)](/en/video/forms/download/monarch-hdx-module-crestron)

[Register now to integrate with ROSS DashBoard \(/en/video/forms/download/monarch-hdx-module-ross\)](/en/video/forms/download/monarch-hdx-module-ross)

## Robust and practical design



Powerful and robust, Monarch HDX offers simple, one touch stream and record push buttons, input selection, and a locking power connector. Monarch HDX's HDMI or SDI outputs makes it easy to monitor what you are streaming and recording, regardless of signal source. All eight channels of embedded audio can be passed from any input to any output. When embedded audio is selected, all eighth channels are passed from input to output. When Analog audio is selected, it is both looped out as well as embedded in video outputs. Its design allows Monarch HDX to be just as easily located on a desktop as in a rack—up to two units can fit in a single 1RU tray. The storage and button controls are conveniently located on the front of the unit

while the power and I/O ports are found at the back. Finally, the Monarch HDX also features a wide input voltage range of 9 to 24 volts. It can be powered using the Matrox supplied power supply or DC sources such as standard field batteries.

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|--|--|---|
| <ul style="list-style-type: none"> <li>1. Power LED</li> <li>2. Input Section Button</li> <li>3. Start/Stop Encoder 1</li> <li>4. Start/Stop Encoder 2</li> <li>5. USB 2.0 Ports</li> <li>6. SD Card Slot</li> <li>7. Power Connector</li> </ul> | <ul style="list-style-type: none"> <li>8. S/PDIF Input Port</li> <li>9. PS-2/232 Connector</li> <li>10. HDMI Output Connector (with embedded audio)</li> <li>11. HDMI Input Connector (with embedded audio)</li> <li>12. SDI Output Connector (with embedded audio)</li> </ul> | <ul style="list-style-type: none"> <li>13. SDI Input Connector (with embedded audio)</li> <li>14. Auxiliary Input Connector</li> <li>15. Analog Audio Output (stereo)</li> <li>16. Analog Audio Input (stereo)</li> </ul> |
|--|--|---|

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## Technical specifications

Product	
Part Number	MHDX/I
Form Factor	Standalone appliance Rack-mountable: 1U, 1/2 rack (horizontal)
Connectivity	
Video Input	HDMI* SDI*  *Video Input Format is Auto-Detected All outputs are active regardless of audio and video input selection.

Overview **HDMI**

Tech Specs Progressive  
• 1920x1080 @

Videos 60/59.94/50/30/29.97/25/24/23.98 fps  
• 1280x720 @ 60/59.94/50 fps

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• 1920x1080i 29.97/25 fps

Support

**SDI**

Progressive  
• 1920x1080 @  
60/59.94/50/30/29.97/25/24/23.98 fps  
• 1280x720 @ 60/59.94/50 fps

Interlaced  
• 1920x1080i @ 29.97/25 fps  
• 720x486i @ 29.97 fps  
• 720x576i @ 25 fps

Compliant with SMPTE 259M/292M/424M (Level A) / 425M

Closed Captioning embedded in VANC of SD or HD SDI signals per SMPTE 334-1 or Captions found in Line 21 of SD signals per EIA-608 are embedded in the essence of H.264 as SEI NAL Units (CEA-608) as per SCTE 128-1 specification.

Video Input Resolutions

Video Output

HDMI  
SDI

Video Output Resolutions

Preview output of video input signal. Preview output is available when source is SDI or HDMI.

0 frame latency passthrough of SDI Input signal. Output is a clean distribution of SDI incoming signal. Hardware bypass relay present in SDI signal path is "closed" on power failure.

When input is an SD-SDI resolution, the HDMI preview output will show video window boxed on an HD output.

Audio Input

Processes the first two channels of audio embedded in HDMI or SDI input signals.

Unbalanced analog stereo input via 1/8" (3.5mm) jack.

Line Level

<p><b>Audio Output</b></p>	<p><u>Overview</u> Passthrough of 8 channel of embedded audio channels in HDMI and SDI signals.</p> <p><u>Tech Specs</u></p> <p><u>Videos</u> Unbalanced analog stereo output via 1/8” (3.5mm) jack—passthrough of input.</p> <p><u>Resources</u></p> <p><u>Related News</u> <u>Line Level</u></p> <p><u>Support</u> Note that all outputs are active regardless of audio and video input selection.</p>
<p><b>Confidence Preview</b></p>	<p>1x SDI</p> <p>1x HDMI</p> <p>Maximum resolution: 1920x1080</p>
<p style="text-align: center;"><b>Performance</b></p>	
<p><b>Color Space and Chroma Sub-Sampling</b></p>	<p>4:2:0 (8-bit)</p>
<p style="text-align: center;"><b>Video and Audio Processing</b></p>	
<p><b>Frame Synchronization</b></p>	<p>The Monarch HDX contains frame synchronization circuitry designed to compensate for disruptions of the input signal. This circuitry is in place for both SDI and HDMI inputs. Streaming and recording operations will proceed cleanly with repeated or dropped frames.</p>
<p><b>Video Scaling</b></p>	<p>High Quality multi-tap 10 bit Down Scaler and De-Interlacer Available for both streaming and recording operations</p>
<p><b>Audio Encoding Format</b></p>	<p>AAC-LC</p>
<p><b>Audio Sampling Frequency</b></p>	<p>32 kHz</p> <p>44.1 kHz</p> <p>48 kHz</p>



<p>Audio Bitrates</p>	<p><a href="#">Overview</a> Range from 32 kbps to 256 kbps  <a href="#">Tech Specs</a> Note that audio codec settings are applied to both encoders.  <a href="#">Videos</a></p>
	<p><a href="#">Resources</a>  <b>Codec</b>  <a href="#">Related News</a></p>
<p>Video Encoding Formats</p>	<p><a href="#">Support</a> H.264/MPEG-4 Part 10 (AVC)</p>
<p>Encoding Profiles</p>	<p>Baseline (BP)  Main (MP)  High (HiP)</p>
<p>Encoder Bitrates Range</p>	<p>Single Encoder - Streaming mode: 20 Mbps  Single Encoder - Recording mode: 30 Mbps  Dual Encoder - Maximum of 10 Mbps for streaming channels  Maximum of 30 Mbps combined for both channels</p>
<p>Encoding Rate Control</p>	<p>Average max/min data rate controls  Deblocking Filter  Selectable frame rates  GOP Size  Variable bitrate support</p>
<p>Encoding Level</p>	<p>Up to 4.2</p>
<p style="text-align: center;"><b>Recording</b></p>	

[Overview](#) 2x USB 2.0\*

[Tech Specs](#) 1x SD card slot\*\*

[Videos](#) Network mapped drive\*\*\*

[Resources](#)

[Related News](#) \*Support for NTFS (3.1) and FAT32 file system. The Monarch HDX will support writing to

[Support](#) USB3 devices at USB2 speeds. Also note, there is a very high variability in the performance capabilities of “thumb” drives (even USB3 versions). Many are optimized for “read” operations while the Monarch HDX requires sustained “write” capabilities. For best results, Matrox recommends using powered USB drives. If small portable media is required, SD cards may be more suitable.

## Recording Locations

\*\* Supports SD and SDHC cards. Only NTFS formatted SDXC cards are supported. (Class 10 highly recommended).

\*\*\* Support for writing to shared folders in computers found on a network using Windows Share protocols (suitable for Windows system) as well as NFS protocols (suitable for Mac and Linux systems).

## Recording Lengths

Maximum file length of 300 minutes—irrespective of storage type used. File splitting feature allows a user to record continuously for long periods by defining file segment sizes. The Monarch appliance will create these sequential file segments over the course of the recording operation without losing a single frame of video. File segment can have a length of 1 to 300 minutes.

## Network

### Network Standard

RJ45 providing 10/100/1000 Base-T Ethernet with Static or DHCP addressing

### IP Addressing

IPv4

DHCP (default) and static IP

<p>Streaming Protocols</p>	<p><a href="#">Overview</a> RTMP, RTSP/RTP  <a href="#">Tech Specs</a> Unicast and Multi Unicast (number of clients may vary from 3 to 10)  <a href="#">Videos</a></p>
<p>Command and Control</p>	<p><a href="#">Resources</a> HTTPS over TCP  <a href="#">Related News</a>  <a href="#">Support</a> UPnP (discovery)</p>
<p><b>Physical</b></p>	
<p>Product Dimensions</p>	<p>5.6 (L) x 8.5 (W) x 1.4 (H) inches  14.2 (L) x 21.6 (W) x 3.6 (H) cm</p>
<p>Unit Weight</p>	<p>1.3 lbs / 0.6 kg</p>
<p>Power Supply Unit</p>	<p>Line voltage: 100-240 V a.c.  Frequency: 50-60 Hz  Input: external AC/DC adapter - IEC320-C14  DIN4 locking power connector</p> <p><b>Power-supply safety:</b>  cULus (Canada/US)  CE (EU)  GS (Germany)  CCC (China)  RCM (Au/Nz)  EAC (Russia / Customs Union)  PSE (Japan)  KCC (Korea)  BIS (India)</p>
<p><b>Hardware &amp; Software</b></p>	
<p>Hardware Included</p>	<p>Matrox Monarch HDX appliance  Matrox Monarch HDX external power supply  IEC-C8 power cords (US, UK and EU)</p>

<p>Accessories (sold separately)</p>	<p><a href="#">Overview</a> Monarch Rack Mount Kit* (MRCH/RACK/KIT)</p> <p><a href="#">Tech Specs</a> Monarch HDX power supply unit**</p> <p><a href="#">Videos</a> (PWR/SUP/MHDX)</p> <p><a href="#">Resources</a> Can fit up to two Monarch HDX units in a 1RU space.</p> <p><a href="#">Related News</a> **Does not include IEC-C8 power cord. These cables must be sourced locally.</p> <p><a href="#">Support</a></p>
<p>Software</p>	<p>Monarch HDX Command Center HTTPS API *</p> <p>*Free download</p>
<p><b>Environmental</b></p>	
<p>Operating Conditions</p>	<p>Temperature: 0 to 45 degrees Celsius</p> <p>Altitude: 650 hPa (3,580 m) to 1,013 hPa (0 m)</p> <p>Humidity: 20% to 80% non-condensing</p>
<p>Storage Conditions</p>	<p>Temperature: -40 to 70 degrees Celsius</p> <p>Altitude: 192 hPa (12,000 m) to 1,020 hPa (-50 m)</p> <p>Humidity: 5% to 95% non-condensing</p>
<p>Power Consumption</p>	<p>Input: 9-24 volts</p> <p>Total Power Consumption: 20-30 watts (42 max)</p>
<p><b>General</b></p>	
<p>Supported Operating Systems (software)</p>	<p>Windows 10 (64 bit)</p>
<p>EMC/EMI Device Class</p>	<p>Class A</p>

EMC/EMI Certifications	<p><a href="#">Overview</a> CE (EU)</p> <p><a href="#">Tech Specs</a> FCC (US)</p> <p><a href="#">Videos</a> ICES-3 (Canada)</p> <p><a href="#">Resources</a></p> <p><a href="#">Related News</a> KC (Korea)</p> <p><a href="#">Support</a> RCM (Aus/NZ)</p>
Environmental Certifications	RoHS Directive 2011/65/EU amended by (EU) 2015/863
Warranty	Two-year limited warranty with free online or telephone support

VIEW LESS

## Videos



[ISE 2020: Matrox Features Maevox & Monarch Series Encoders and Decoders for Web Streaming](#)

<https://www.youtube.com/embed/ZnpK7IV-000?iframe=true&width=640&height=480&rel=0>

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# How to Use Your Monarch HDX

Episode 1

Finding and saving the IP address

[Episode 1: Connecting to your Monarch HDX device on the network](#)

<https://www.youtube.com/embed/gS4xjMWR6Oc?iframe=true&width=640&height=480&rel=0>

[VIEW MORE](#)

## Resources

[Matrox Monarch Rack Mounting Guide](#)

<https://www.matrox.com/en/file/9496/download?token=FjFVaBxz>

[Monarch HDX Workflows](#)

<https://www.matrox.com/en/file/2553/download?token=4hexhH6j>

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## Case studies



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[Matrox Monarch HDX Signs with University of Kentucky Men's Basketball](#)

[\(/en/video/media/case-studies/matrox-monarch-hdx-signs-university-kentucky-mens-basketball\)](/en/video/media/case-studies/matrox-monarch-hdx-signs-university-kentucky-mens-basketball)

Matrox Monarch HDX encoders deliver high-quality, multi-bitrate recording capability for men's basketball games, behind-the-scenes footage, and more.



[\(/en/video/media/case-studies/john-brown-](/en/video/media/case-studies/john-brown-)

[university-goes-matrox-webcast-upcoming-centennial-celebratory\)](#)

[John Brown University Goes with Matrox to Webcast Upcoming Centennial Celebratory](#)

[Events \(/en/video/media/case-studies/john-brown-university-goes-matrox-webcast-upcoming-centennial-celebratory\)](/en/video/media/case-studies/john-brown-university-goes-matrox-webcast-upcoming-centennial-celebratory)

Athletic, cultural, and religious events are simultaneously streamed to multiple destinations for maximum reach.



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[matrox-helps-australian-screen-editors-guild-webcast-inaugural\)](#)

[Making the Cut: Matrox Helps the Australian Screen Editors Guild Webcast Inaugural Edit Royale Even \(/en/video/media/case-studies/making-cut-matrox-helps-australian-screen-editors-guild-webcast-inaugural\)](#)

Monarch HDX Dual-Channel Encoder Enables Professional-Grade, Portable TV Studio to Live Stream Prestigious Video Editing Competition.

SEE ALL [\(/EN/VIDEO/NEWS?FIELD\\_ARTICLE\\_CATEGORY\\_TARGET\\_ID=242\)](/EN/VIDEO/NEWS?FIELD_ARTICLE_CATEGORY_TARGET_ID=242)

## Latest news

[Matrox to Drive AV-over-IT Innovations and Industry Leadership at ISE 2020](#)  
(<https://www.matrox.com/en/video/media/press-releases/matrox-drive-av-over-it-innovations-and-industry-leadership-at-ise-2020>).

ISE show agenda includes best-in-class AV/IT portfolio showcase, new features and products, and presentations on open standards and interoperability.

[Matrox at IBC 2019 – Product Preview](#) (<https://www.matrox.com/en/video/media/press-releases/matrox-ibc-2019-product-preview>).

At IBC 2019, Matrox will showcase its full range of high-performance 4K IP KVM extenders, groundbreaking multi-monitor controllers, award-winning multi-4K encoders, and more.

[Matrox at NAB 2019 – Product Preview](#) (<https://www.matrox.com/en/video/media/press-releases/matrox-nab-2019-product-preview>).

At NAB 2019 (booth SL3811), Matrox® will showcase its full range of award-winning HD and 4K/multi-HD encoders, cutting-edge SMTPE ST 2110 NIC and hardware codec cards, and high-performance 4K IP KVM extenders.

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## ATEM Television Studio Pro 4K



O ATEM Television Studio Pro 4K possui oito entradas 12G-SDI independentes para operar em todos os formatos populares de HD e Ultra HD em até 2160p60. Cada entrada possui ressinchronização e um conversor de padrões de baixa latência completo, o que significa que a entrada se adapta automaticamente ao formato do switcher. Você pode operar até 8 entradas, todas com formatos de vídeo diferentes! O mixer de áudio Fairlight atualizado possui dinâmica, equalizador paramétrico de seis bandas, dois canais mono separados e simulador estéreo com atraso de áudio nas entradas analógicas. O ATEM Television Studio Pro 4K também inclui Chave Croma ATEM Avançada, multivisualização Ultra HD e clipes em movimento no pool de mídia.

**US\$2,995**

### Conexões

#### Total de Entradas de Vídeo

8

#### Total de Saídas

12

#### Total de Saídas Auxiliares

1

#### Taxas SDI

1.5G, 3G, 6G, 12G.

#### Total de Entradas de Áudio

2 x XLR. 1 x microfone.

#### Total de Saídas de Áudio

1 x fone de ouvido.

#### Entradas de Vídeo SDI

8 x HD/UHD de 10 bits alternáveis.  
2 canais de áudio embutido.

#### Entradas de Vídeo HDMI

Nenhuma.

#### Entradas de Sincronização

Tri-Sync ou Black Burst.

#### Ressinchronização das Entradas de Vídeo

Em todas as 8 entradas.

#### Conversores de Taxa de Quadro e Formato

Em todas as 8 entradas.

#### Saídas de Programa SDI

9 x HD/UHD de 10 bits alternáveis.

#### Saídas de Áudio SDI

2 canais embutidos na saída SDI.

#### Total de Multivisualização

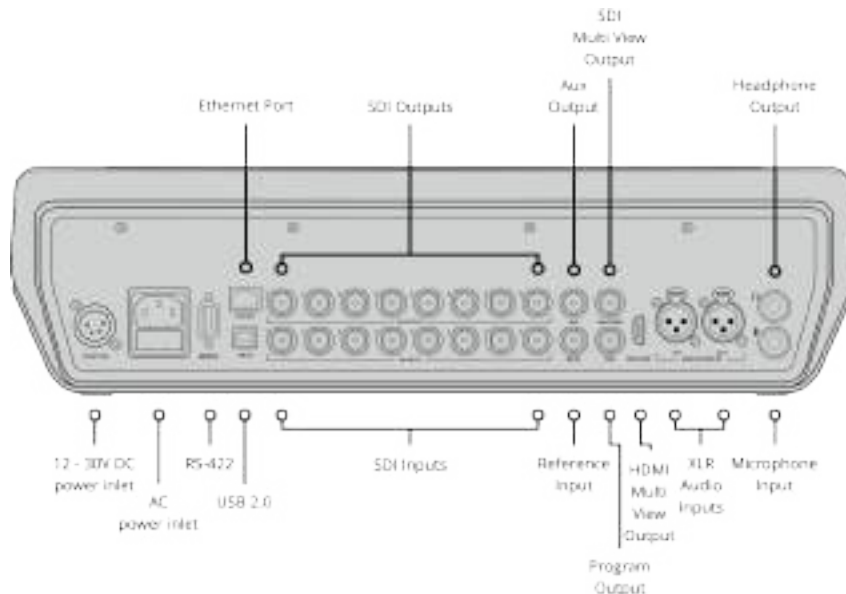
1

#### Saídas para Multivisualização de Vídeo SDI

1

#### Saídas para Multivisualização de Vídeo HDMI

1



## Padrões

### Padrões de Vídeo SD

Nenhum.

### Padrões de Vídeo HD

720p50, 720p59.94  
1080p23.98, 1080p24, 1080p25,  
1080p29.97, 1080p50, 1080p59.94  
1080i50, 1080i59.94

### Padrões de Vídeo Ultra HD

2160p23.98, 2160p24, 2160p25,  
2160p29.97, 2160p50, 2160p59.94

### Conformidade SDI

292M e 424M, 2081, 2082.

### Amostragem de Vídeo

4:2:2 de 10 bits.

### Precisão de Cor

4:2:2 de 10 bits.

### Espaço de Cor

4:2:2 YUV

### Resoluções de Entrada para Computadores

720p50, 720p59.94  
1080p23.98, 1080p24, 1080p25,  
1080p29.97, 1080p30, 1080p50,  
1080p59.94, 1080p60  
1080i50, 1080i59.94, 2160p23.98,  
2160p24, 2160p25, 2160p29.97,  
2160p30, 2160p50,  
2160p59.94, 2160p60.

### Conversão do Espaço de Cor

Nenhuma.

### Atraso de Processamento

6 linhas.

### Mixer de Áudio

12 entradas x mixer de 2 canais.  
Liga/Desliga/Audio-Follow-Video  
selecionáveis por canal, além de  
controle de ganho separado por  
canal.

Medição de nível e pico. Inclui novas  
ferramentas Fairlight de  
melhoramento de áudio:  
Compressor, portão, limitador  
e equalizador paramétrico de seis  
bandas. Linha de atraso  
e sintetizador estéreo somente nas  
entradas XLR.

Controle de ganho do master.  
Controle do nível de saída do fone de  
ouvido com mix separado de  
programa, intercomunicação  
e sidetone.

## Especificidades Do Produto

### Chaveadores Upstream

1 com chave Croma/Linear/Luma.

### Chaveadores Downstream

2

### Chaveadores Croma

1

### Chaveadores Linear/Luma

3

### Suporte à Intercomunicação

Integrado, utiliza fones de ouvido  
aeronáuticos.

### Suporte a Mix Minus

Sim, nas 8 saídas PGM da câmera.

<b>Chaveador de Transição (Vinheta/DVE)</b> Vinheta e DVE.	<b>DVE com Bordas 3D e Sombreamento</b> 1	<b>Sinalização</b> Indicação em vermelho para programa e verde para pré-visualização.
<b>Número Total de Camadas</b> 5	<b>Interface</b> Resolução mínima do monitor de 1366 x 768.	<b>Saída de Sinalização</b> Embutido via SDI. Adicionada via conexão ethernet ao produto Blackmagic Design GPI and Tally Interface. (Não incluído)
<b>Geradores de Padrão</b> 2	<b>Número de Janelas</b> 1 x 10	<b>Rotulagem das Janelas de Fonte</b> Sim.
<b>Geradores de Cor</b> 2	<b>Janelas Roteáveis</b> 8 roteáveis e 2 fixas para programa e pré-visualização.	

## Monitoramento por multivisualização

<b>Monitoramento por Multivisualização</b> 1 x 10 visualizações.	<b>Padrão de Vídeo da Multivisualização</b> HD/Ultra HD.
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## Leitor De Mídia

<b>Leitores de Mídia</b> 2, com memória flash não volátil.	<b>Capacidade de Clipes no Pool de Mídia</b> 2 com preenchimento e chave. Pool compartilhado.	<b>Duração Máxima de Clipes em 1080 HD no Leitor de Mídia</b> 360 quadros.
<b>Capacidade de Imagens Estáticas no Pool de Mídia</b> 20 com preenchimento e chave.	<b>Formato de Arquivos de Clipes no Pool de Mídia</b> Sequência TGA.	<b>Duração Máxima de Clipes em Ultra HD no Leitor de Mídia</b> 90 quadros
<b>Formato de Imagens Estáticas no Pool de Mídia</b> PNG, TGA, BMP, GIF, JPEG e TIFF.	<b>Duração Máxima de Clipes em 720 HD no Leitor de Mídia</b> 1440 quadros.	<b>Formato de Arquivos de Áudio no Pool de Mídia</b> WAV, MP3 e AIFF.
<b>Canais</b> Sinais de preenchimento e chave para cada leitor de mídia.		

## Controle

<b>Painel de Controle</b> Integrado com o controle de câmera. Painel de controle por software incluído. Suporte para painel broadcast opcional.	<b>Compatibilidade com Painel de Controle</b> Inclui ATEM Software Control Panel. Também é compatível com ATEM 1 M/E Broadcast Panel e ATEM 2 M/E Broadcast Panel.	<b>Painel de Controle Incluso</b> ATEM Software Control Panel incluído gratuitamente para Mac 10.12 Sierra, Mac 10.13 High Sierra ou mais recentes e Windows 8.1 de 64 bits ou Windows 10 de 64 bits.
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## Software

### Atualizações de Software

Usando USB diretamente conectado a computadores Mac ou Windows. Inclui ATEM Switcher Utility.

### Configuração

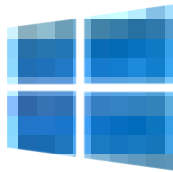
Via ATEM Software Control Panel, com exceção do endereço IP do chassi ATEM que é configurado através do ATEM Switcher Utility conectado ao chassi via USB.

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## Sistemas Operacionais



Mac 10.14 Mojave,  
Mac 10.15 Catalina ou mais recentes.



Windows 8.1 e 10.

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## Requisitos de Energia

### Fonte de Alimentação

1 x 100 - 240 AC interna. 12 DC de 4 pinos.

### Consumo de Energia

70 W

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## Especificações Físicas



## Especificações Ambientais

### Temperatura Operacional:

5° C a 40° C

### Temperatura de Armazenamento:

-20° a 60° C (-4° a 140° F)

### Umidade Relativa:

0% - 90% sem condensação

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## Incluso

ATEM Television Studio Pro 4K

Cartão SD com software e manual

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## Garantia

12 meses de garantia limitada do fabricante.

### **Política de Reparo**

Os detalhes da garantia podem ser encontrados no manual ATEM Switchers Operation Manual na página de suporte em [www.blackmagicdesign.com/pt](http://www.blackmagicdesign.com/pt).

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Blackmagic Design Authorized Reseller

# Micro Converter BiDirectional SDI/HDMI 3G wPSU



Obtenha o menor conversor bidirecional de qualidade broadcast do mundo! Faça a conversão de SDI para HDMI e de HDMI para SDI ao mesmo tempo, inclusive em formatos diferentes. Também oferece suporte a conversão de protocolo de controle de câmera, assim você pode utilizar unidades Blackmagic Pocket Cinema Camera com switchers de produção ao vivo SDI profissionais. Inclui fonte de alimentação de 100 - 240 V AC com adaptadores de tomada internacionais.

**US\$75**

## Conexões

### Entradas de Vídeo SDI

1 x SDI SD, HD ou 3G.

### Saídas de Vídeo SDI

Ajuste automático na entrada de vídeo HDMI.

### Entradas de Vídeo HDMI

Entrada HDMI tipo A.

### Saídas HDMI

Saída HDMI tipo A.

### Suporte Multitaxa

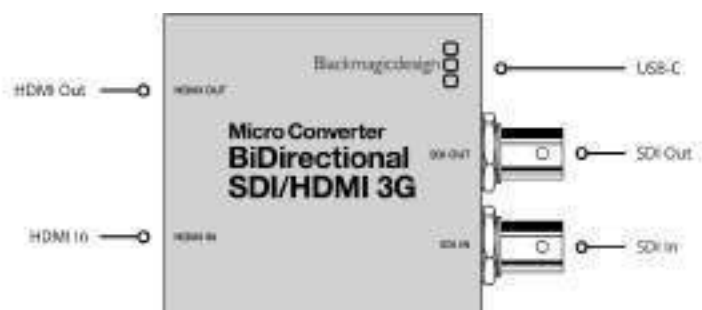
Deteção automática de SD ou HD.

### Atualizações, Configuração e Alimentação

USB Tipo C.

### Reclocking

Sim.



## Padrões

### Padrões de Vídeo SDI

525i59.94 NTSC, 625i50 PAL



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### Padrões de Vídeo HD

720p50, 720p59.94, 720p60  
1080p23.98, 1080p24, 1080p25,  
1080p29.97, 1080p30, 1080p47.95,  
1080p48, 1080p50, 1080p59.94,  
1080p60  
1080PsF25, 1080PsF29.97, 1080PsF30  
1080i50, 1080i59.94, 1080i60  
2Kp23.98 DCI, 2Kp24 DCI, 2Kp25 DCI,  
2Kp29.97 DCI, 2Kp30 DCI,  
2Kp47.95 DCI, 2Kp48 DCI, 2Kp50 DCI,  
2Kp59.94 DCI, 2Kp60 DCI  
2KPsF25 DCI, 2KPsF29.97 DCI,  
2KPsF30 DCI

### Conformidade SDI

SMPTE 259M, SMPTE 292M,  
SMPTE 296M, SMPTE 424M,  
SMPTE 425M

### Taxas de Vídeo SDI

Conexões de vídeo SDI comutáveis automaticamente entre definição padrão e alta definição; nível A e B selecionável pelo usuário por meio do utilitário de configuração.

### Precisão de Cor SDI

4:2:2.

### Espaço de Cor SDI

YUV.

### Comutação Automática SDI

Deteção automática de SDI SD, HD ou 3G.

### Padrões de Vídeo HDMI

525i29.97 NTSC, 625i25 PAL  
720p50, 720p59.94, 720p60  
1080p23.98, 1080p24, 1080p25,  
1080p29.97, 1080p30, 1080p47.95,  
1080p48, 1080p50, 1080p59.94,  
1080p60  
1080i50, 1080i59.94, 1080i60

### Precisão de Cor HDMI

4:2:2.

### Espaço de Cor HDMI

YUV.

---

## Proteção Contra Cópia

A entrada HDMI não é capaz de captar fontes HDMI com proteção contra cópia. Confirme sempre a propriedade de direitos autorais antes da captura ou distribuição de conteúdo.

---

## Camera Control

Conversão bidirecional de sinais suporta controle de câmera e sinalização Blackmagic.

---

## Software

### Controle de Software

Atualização dos programas Mac™ e Windows™ via USB.

### Atualização de Software Interno

Via USB.

---

## Sistemas Operacionais



Mac 10.14 Mojave,  
Mac 10.15 Catalina ou mais recentes.



Windows 10.

---

## Controle de Configuração

Via utilitário de software.

---

---

## Requisitos de Energia

### Fonte de Alimentação

Fonte de alimentação universal de + 5 V incluída com adaptadores de tomada internacionais para a maioria dos países.

### Consumo de Energia

2,5 W.

### Faixa de Voltagem Operacional

4,4 a 5,25 V DC.

---

## Especificações Ambientais

### Temperatura Operacional

0 a 40 °C (32 a 104 °F)

### Temperatura de Armazenamento

-20 a 60 °C (-4 a 140 °F)

### Umidade Relativa

0% - 90% sem condensação.

---

## Especificações Físicas



---

## Incluso

### Micro Converter BiDirectional SDI/HDMI 3G wPSU

Fonte de alimentação universal de + 5 V com adaptadores de tomada internacionais.

---

## Garantia

3 anos de garantia limitada do fabricante.

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NewTek Spark™ (/spark/)

Features (/spark/features/)

Tech Specs (/spark/tech-specs/)

Updates (/downloads/?spark-family)

# Technical Specifications

	Spark Plus IO 4K	Spark Plus IO SDI	Spark Plus 4K
Video Input	1 x HDMI	1 x 3G/HD/SD-SDI	1 x HDMI
Video Output	1 x HDMI	1 x 3G/HD/SD-SDI	NA
Audio Input	3.5mm Mono Mic Level Embedded HDMI	3.5mm Line Level Embedded SDI	3.5mm Line Level Embedded HDMI
Audio Output	3.5mm Line Level Embedded HDMI	3.5mm Line Level Embedded SDI	NA
Encoding/ Decoding	NDI®	NDI®	NDI® encoding only
Network	1 x RJ-45 port Gigabit Ethernet		
Interface	Web-based user interface for configuration and monitoring		
Tally	NDI with built-in tally light		
Formats	2160p: 60, 59.94, 30, 29.97, 25 1080p: 60, 59.94, 50, 30, 29.97, 25 720p: 60, 59.94, 50, 29.97 576p: 50 480p: 60, 59.94	1080p: 60, 59.94, 50, 29.97, 25 1080i: 59.94, 50 720p: 60, 59.94, 50, 29.97, 25	2160p: 60, 59.94, 30, 29.97, 25 1080p: 60, 59.94, 50, 30, 29.97, 25 720p: 60, 59.94, 50, 29.97, 25 576p: 50 (16:9, 4:3) 480p: 60, 59.94 (16:9, 4:3)
SDI	N/A	75 Ohm impedance SMPTE ST-424M, ST-292M	N/A
Power	Power over Ethernet or External power adaptor		External power via USB type-C
Physical	Portable enclosure with threaded screw camera mount 3.94 x 3.15 x .94 in (100 x 80 x 24 mm) .53 lbs (.24 kg)		Portable enclosure with threaded screw camera mount 4.72 x 3.54 x .87 in (120 x 90 x 22 mm) .53 lbs (.24 kg)

Subject to change without notice.

Where to Buy  
NewTek Products

Speak with a Solutions Expert

Get expert advice on a live production workflow around NewTek systems and NDI or let us connect you with one of our local partners, our Solutions Experts are here to

help.



CONNECT (HTTPS://GO.NEWTEK.COM/L/428312/2  
LAST\_FORM\_SUBMISSION\_PAGE=NEWTEK%20SPAR

NewTek has a network of resellers located around the world. All of them are experts in our product and in the video production and streaming industry.

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# NOW CONNECT EVERYTHING



## Spark Plus™ IO

### 4Kp60 & 3G-SDI

### Your workflow, your choice

NewTek Spark Plus™ video converters are the fastest, easiest, and best way to video over IP. Ultra-portable enclosures with resolutions up to UHD 60p, the groundbreaking benefits of NDI®, and a host of tools and capabilities makes NewTek Spark Plus video converters the right choice for all sorts of video applications.

## Customer Stories:

See how content creators are using NewTek Spark, NDI®, and other NewTek products.

---

### How The Cronulla Sharks Use Video To Attract More Fans

“Our crew plugs a Connect Spark device into one of our cameras. And now, it’s a remote camera that can do fan interviews anywhere in the stadium...”

[\(/blog/cronulla-sharks/\)](#)

---

### Add Versatility, Flexibility, Quality to Live Production

“Until you actually use the TriCaster platform, or the NDI platform, and Connect Spark interfaces, you probably won’t realize how much you can do that you always thought was out of reach...”

[\(/blog/victor-borachuk/\)](#)

CHAT WITH  
CUSTOMER SUPPORT <sup>x</sup>

CHAT WITH A SALES  
SPECIALIST <sup>x</sup>

---

### White County Georgia Builds Award-Winning High School Media Program

NewTek Spark (vspark) "Everything we do is NDI-based. All of our cameras run off Connect Spark devices. That signal is plugged in to any jack anywhere within our network of seven schools..."

(/blog/white-county-schools/)

# NEWTEK SPARK™ AVAILABLE NOW

All Models



## Add Spark to your gaming

Plug into the action and get video from games, cameras, and other devices distributed to viewers on-site at events, or watching from the other side of the world, putting them right at the center of the competition.

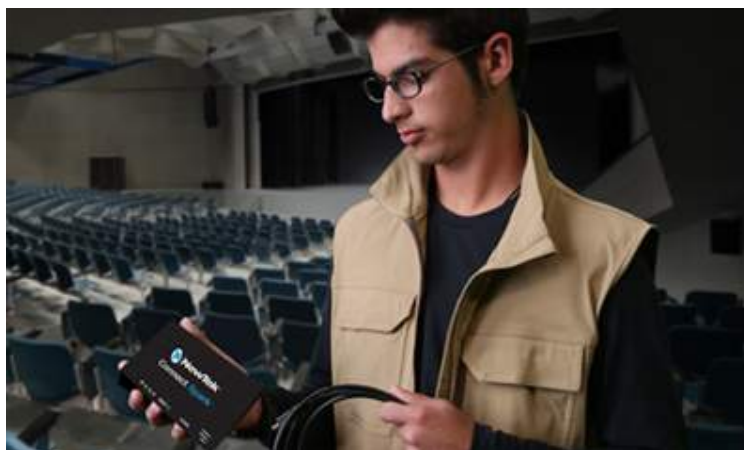


Open Broadcaster Software

streamstar



Wirecast



CHAT WITH CUSTOMER SUPPORT <sup>x</sup>

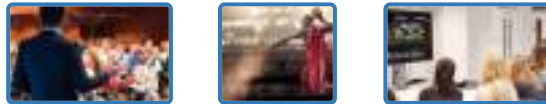
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Easily connect your camera, laptop or webcam to Spark and deliver live video to your meetings, training, conferences, and more through Google Hangouts, GoToMeeting™, Skype™, Skype for Business, WebEx, Zoom, and other communication platforms.



## Add Spark everywhere: your venue, your classroom, your event & more

Whenever, wherever you need to get video signal from here to there, NewTek Spark is the fastest, easiest way to get it done. Just connect your device and like magic it appears on your network and is accessible to show and share.



Portable. Affordable. Efficient.

**There is a NewTek Spark that's perfect for you**

### Spark Plus IO 4K



- Convert video up to UHD 60p and audio from HDMI to NDI®
- Convert video up to UHD 60p and audio from NDI® to HDMI
- Power Over Ethernet
- Tally support via NDI

CHAT WITH  
CUSTOMER SUPPORT <sup>x</sup>

CHAT WITH A SALES  
SPECIALIST <sup>x</sup>



- Convert video up to 3G and audio from SDI to NDI®
- Convert video up to 3G and audio from NDI® to SDI
- Power Over Ethernet
- Tally support via NDI

### Spark Plus 4K



- Convert video up to 2160p
- IP transport via NDI®
- Tally support via NDI
- Portable and Mountable

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Expert

Get expert advice on a live production workflow around NewTek systems and NDI or let us connect you with one of our local partners, our Solutions Experts are here to help.

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CHAT WITH CUSTOMER SUPPORT x

CHAT WITH A SALES SPECIALIST x



EU DECLARATION OF CONFORMITY

Name and Address of the manufacturer: Dell Inc. One Dell Way MS: PS4-30 Round Rock, Texas USA 78682

Name and address of the authorised representative: Dell Products Europe BV Raheen Business Park Limerick, Ireland Email product.compliance@dell.com

This declaration of conformity is issued under the sole responsibility of Dell, Inc.

OBJECT OF THE DECLARATION

Type of Object: Workstation
Regulatory Model: D02T
Regulatory Type: D02T001, D02T002
Trade/Manufacturer name: DELL

The object of the declaration described above is in conformity with the following Directives:

- DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC
DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products

The object of the declaration is in compliance with the following European standards, regulations, and technical references:

SAFETY: EN 60950-1:2006 +A1:2010 +A2:2013 +A11:2009 +A12:2011/IEC 60950-1:2005 ed2 +A1:2009 +A2:2013 EN 62311:2008 EN 62368-1:2014

EMC: EN 55032:2012/CISPR 32:2012 EN 55032:2015/CISPR 32:2015 EN 55024:2010 +A1:2015/CISPR 24:2010 +A1:2015 EN 61000-3-2:2014/IEC 61000-3-2:2014 (Class D) EN 61000-3-3:2013/IEC 61000-3-3:2013 DRAFT EN 301 489-1 V2.2.0 DRAFT EN 301 489-3 V2.1.1

ENERGY: EN 50564:2011/IEC 62301:2011 EN 62623:2013/IEC 62623:2012 Commission Regulation (EU) No. 617/2013

RoHS: EN 50581:2012

RADIO: RFID/NFC (Optional) EN 300 330 V2.1.1

SUPPLEMENTARY INFORMATION: The object of this declaration has been tested and found to comply with the electromagnetic compatibility (EMC) limits for a Class B digital device pursuant to the listed directives, regulations and standards. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or business environment. Optional devices, such as radios, conform to the noted standard when the Dell Inc. provided devices are installed in the product. The equipment was tested in a typical configuration.

Round Rock, Texas, USA

Place of Issue

Maurice Wu

Signed for and on behalf of Dell Inc.

August 7, 2017

Date of Issue

Maurice Wu

Full Printed Name

CDD02T001-1

Dell Document Control Tracking Number

Senior Manager , Dell Global Product Compliance and Environmental Affairs

Position/Title

1 Regulatory Type uniquely identifies the product, radio, apparatus and EEE which is the object of this DoC.



EU DECLARATION OF CONFORMITY

Name and Address of the manufacturer:

Dell Inc.
One Dell Way
MS: PS4-30
Round Rock, Texas USA 78682

Name and address of the authorised representative:

Dell Products Europe BV
Raheen Business Park
Limerick, Ireland
Email product.compliance@dell.com

This declaration of conformity is issued under the sole responsibility of Dell, Inc.

OBJECT OF THE DECLARATION

Type of Object: WORKSTATION
Regulatory Model: D02T
Regulatory Type: D02T001, D02T002
Trade/Manufacturer name: DELL

The object of the declaration described above is in conformity with the following Directives:

- DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC
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The object of the declaration is in compliance with the following European standards, regulations, and technical references:

SAFETY: EN 60950-1:2006 +A1:2010 +A2:2013 +A11:2009 +A12:2011
EN 62368-1:2014

EMC: EN 55032:2012
EN 55032:2015
EN 55024:2010 +A1:2015
EN 61000-3-2:2014 (Class D)
EN 61000-3-3:2013
DRAFT EN 301 489-1 V2.2.0
DRAFT EN 301 489-17 V3.2.0

ENERGY: EN 50564:2011
EN 62623:2013
Commission Regulation (EU) No. 617/2013

RoHS: EN 50581:2012

RADIO: WLAN/Bluetooth
EN 300 328 V2.1.1
EN 301 893 V2.1.1
EN 300 440 V2.1.1
RFID/NFC (Optional)
EN 300 330 V2.1.1

SUPPLEMENTARY INFORMATION: The object of this declaration has been tested and found to comply with the electromagnetic compatibility (EMC) limits for a Class B digital device pursuant to the listed directives, regulations and standards. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or business environment. Optional devices, such as radios, conform to the noted standard when the Dell Inc. provided devices are installed in the product. The equipment was tested in a typical configuration.

Round Rock, Texas, USA

Place of Issue

Feb 1, 2019

Date of Issue

CDD02T001-3

Dell Document Control Tracking Number

Maurice Wu
Signed for and on behalf of Dell Inc.

Wu, Maurice

Full Printed Name

Sr. Manager, Dell Global Product Compliance and Environmental Affairs

Position/Title

1 Regulatory Type uniquely identifies the product, radio, apparatus and EEE which is the object of this DoC.

<b>ARK   Comparar produtos Intel®</b>	
14/12/2020 15:38	
<b>Processador Intel® Xeon® W-22225 (8,25M de cache, 4,10 GHz)</b>	
<b>Essenciais</b>	
Coleção de produtos	Processador Intel® Xeon® W
Codinome	Produtos com denominação anterior Cascade Lake
Segmento vertical	Workstation
Número do processador	W-2225
Status	Launched
Data de introdução	Q4'19
Litografia	14 nm
Preço recomendado para o cliente	\$444.00
<b>Especificações da CPU</b>	
Número de núcleos	4
Nº de threads	8
Frequência baseada em processador	4.10 GHz
Frequência turbo max	4.60 GHz
Cache	8.25 MB
Velocidade do barramento	8 GT/s
Nº de links de QPI	0
Nº de links de UPI	0
TDP	105 W
<b>Informações complementares</b>	
Opções integradas disponíveis	Não
Ficha técnica	Ver agora
Descrição resumida do produto	Ver agora
URL de informações adicionais	Ver agora
<b>Especificações de memória</b>	
Tamanho máximo de memória (de acordo com o tipo de memória)	1 TB
Tipos de memória	DDR4 2933
Nº máximo de canais de memória	4
Largura de banda máxima da memória	93.85 GB/s
Extensões de endereços físicos	46-bit
Compatibilidade com memória ECC ‡	Sim
<b>Opções de expansão</b>	
Escalabilidade	1S Only
Revisão de PCI Express	3.0
Configurações PCI Express ‡	x4, x8, x16
Nº máximo de linhas PCI Express	48
<b>Especificações de encapsulamento</b>	
Soquetes suportados	FCLGA2066
Configuração máxima da CPU	1
TCASE	61°C
Tamanho do pacote	45mm x 52.5mm
<b>Tecnologias avançadas</b>	

Intel® Deep Learning Boost (Intel® DL Boost)	Sim
Compatível com Intel® Optane™ Memory ‡	Não
Tecnologia Intel® Speed Shift	Sim
Tecnologia Intel® Turbo Boost Max 3.0 ‡	Não
Tecnologia Intel® Turbo Boost ‡	2.0
Elegibilidade da plataforma Intel® vPro™ ‡	Sim
Tecnologia Hyper-Threading Intel® ‡	Sim
Tecnologia de virtualização Intel® (VT-x) ‡	Sim
Tecnologia de virtualização Intel® para E/S dirigida (VT-d) ‡	Sim
Intel® VT-x com Tabelas de páginas estendidas (EPT) ‡	Sim
Intel® TSX-NI	Sim
Intel® 64 ‡	Sim
Conjunto de instruções	64-bit
Extensões do conjunto de instruções	Intel® SSE4.2, Intel® AVX, Intel® AVX2, Intel® AVX-512
Nº de unidades de FMA de AVX-512	2
Estados ociosos	Sim
Tecnologia Enhanced Intel SpeedStep®	Sim
Comutação baseada na demanda Intel®	Sim
Tecnologias de monitoramento térmico	Sim
Acesso de Memória Flexível Intel®	Não
Tecnologia de proteção da identidade Intel® Identity ‡	Sim
Intel® Volume Management Device (VMD - Dispositivo de Gerenciamento de Volume)	Sim
<b>Segurança e confiabilidade</b>	
Novas instruções Intel® AES	Sim
Chave Segura	Sim
Intel® Software Guard Extensions (Intel®SGX)	Não
Intel® Memory Protection Extensions (Intel® MPX)	Sim
Intel® OS Guard	Sim
Intel® Trusted Execution Technology ‡	Sim
Bit de desativação de execução ‡	Sim
Intel® Boot Guard	Sim

# CPU Benchmarks

Over 1,000,000 CPUs Benchmarked

## Intel Xeon W-2225 @ 4.10GHz




Price and performance details for the Intel Xeon W-2225 @ 4.10GHz can be found below. This is made using thousands of [PerformanceTest](#) benchmark results and is updated daily.

- The first graph shows the relative performance of the CPU compared to the 10 other common (single) CPUs in terms of PassMark CPU Mark.
- The 2nd graph shows the value for money, in terms of the CPUMark per dollar.
- The pricing history data shows the price for a single Processor. For multiple Processors, multiply the price shown by the number of CPUs.

<p><a href="#">Home</a> <b>CPUS</b></p> <hr/> <p> <b>High End</b></p> <p>High Mid Range</p> <p>Low Mid Range</p> <p>Low End</p> <hr/> <p> <b>Best Value (On Market)</b></p> <p>Best Value XY Scatter</p> <p>Best Value (All time)</p> <hr/> <p> <b>New Desktop</b></p> <p>New Laptop</p> <hr/> <p> <b>Single Thread</b></p> <p>Systems with Multiple CPUs</p> <p>Overclocked</p> <p>Power Performance</p> <p>CPU Mark by Socket Type</p> <p>Cross-Platform CPU Performance</p> <hr/> <p> <b>CPU Mega List</b></p> <p>Search Model</p> <hr/> <p> <b>Compare</b> <sup>0</sup></p>	<p><b>Intel Xeon W-2225 @ 4.10GHz</b></p> <table border="1"> <tr> <td><b>Class:</b> Server</td> <td><b>Socket:</b> FCLGA2066</td> </tr> <tr> <td><b>Clockspeed:</b> 4.1 GHz</td> <td><b>Turbo Speed:</b> 4.6 GHz</td> </tr> <tr> <td><b>Cores:</b> 4</td> <td><b>Typical TDP:</b> 105 W</td> </tr> <tr> <td colspan="2"><b>Threads</b> : 8</td> </tr> </table> <p><b>Other names:</b> Intel(R) Xeon(R) W-2225 CPU @ 4.10GHz</p> <p><b>CPU First Seen on Charts:</b> Q1 2020</p> <p><b>CPUmark/\$Price:</b> 27.35</p> <p><b>Overall Rank:</b> 323</p> <p><b>Last Price Change:</b> <a href="#">\$444.00 USD</a> (2019-10-01)</p>	<b>Class:</b> Server	<b>Socket:</b> FCLGA2066	<b>Clockspeed:</b> 4.1 GHz	<b>Turbo Speed:</b> 4.6 GHz	<b>Cores:</b> 4	<b>Typical TDP:</b> 105 W	<b>Threads</b> : 8		<p><b>Average CPU Mark</b></p> <div style="text-align: center;"> <p><b>12145</b></p> </div> <p>Single Thread Rating: 2748                  Cross-Platform Rating: 19,389                  Samples: 11*                  *<a href="#">Margin for error:</a> <b>Medium</b></p> <p style="text-align: center;">+ COMPARE</p> <p style="text-align: center;"><b>PerformanceTest V9</b>                  CPU Mark: 27,047 Thread: 2,630</p>
<b>Class:</b> Server	<b>Socket:</b> FCLGA2066									
<b>Clockspeed:</b> 4.1 GHz	<b>Turbo Speed:</b> 4.6 GHz									
<b>Cores:</b> 4	<b>Typical TDP:</b> 105 W									
<b>Threads</b> : 8										

**Search for Intel Xeon W-2225 @ 4.10GHz**

**from the Featured Merchants below:**

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## UNMATCHED POWER. UNMATCHED CREATIVE FREEDOM. NVIDIA® QUADRO® P1000

### Full Professional Performance and Features in a Small Form Factor.

The Quadro P1000 combines a 640 CUDA core Pascal GPU, 4 GB GDDR5 on-board memory and advanced display technologies in a low-profile form factor to deliver amazing graphics performance for demanding professional applications. Support for four 4K displays (4096x2160 @ 60Hz) with HDR color gives you an expansive visual workspace to see your ideas come to life in stunning detail.

Quadro cards are certified with a broad range of sophisticated professional applications, tested by leading workstation manufacturers, and backed by a global team of support specialists. This gives you the peace of mind to focus on doing your best work. Whether you're developing revolutionary products or telling spectacularly vivid visual stories, Quadro gives you the performance to do it brilliantly.

#### FEATURES

- > Four DisplayPort 1.4 Connectors<sup>1</sup>
- > DisplayPort with Audio
- > NVIDIA nView® Desktop Management Software
- > HDCP 2.2 Support
- > NVIDIA Mosaic<sup>2</sup>
- > NVIDIA Iray and MentalRay Support

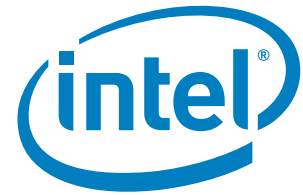


#### SPECIFICATIONS

GPU Memory	<b>4 GB GDDR5</b>
Memory Interface	<b>128-bit</b>
Memory Bandwidth	<b>Up to 82 GB/s</b>
NVIDIA CUDA® Cores	<b>640</b>
System Interface	<b>PCI Express 3.0 x16</b>
Max Power Consumption	<b>47 W</b>
Thermal Solution	<b>Active</b>
Form Factor	<b>2.713" H x 5.7" L, Single Slot, Low Profile</b>
Display Connectors	<b>4x mDP 1.4</b>
Max Simultaneous Displays	<b>4 direct, 4 DP 1.4 Multi-Stream</b>
Display Resolution	<b>4x 4096x2160 @ 60Hz 4x 5120x2880 @ 60Hz</b>
Graphics APIs	<b>Shader Model 5.1, OpenGL 4.5<sup>3</sup>, DirectX 12.0<sup>4</sup>, Vulkan 1.0<sup>3</sup></b>
Compute APIs	<b>CUDA, DirectCompute, OpenCL™</b>

<sup>1</sup> VGA/DVI/HDMI support via adapter/connector/bracket | <sup>2</sup> Windows 7, 8, 8.1 and Linux | <sup>3</sup> Product is based on a published Khronos Specification, and is expected to pass the Khronos Conformance Testing Process when available. Current conformance status can be found at [www.khronos.org/conformance](http://www.khronos.org/conformance) | <sup>4</sup> GPU supports DX 12.0 API, Hardware Feature Level 12\_1

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# Intel® Ethernet Controller I210 Datasheet

## Networking Division (ND)

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### Features:

- Small package: 9 x 9 mm
- PCIe v2.1 (2.5 GT/s) x1, with Switching Voltage Regulator (iSVR)
- Integrated Non-Volatile Memory (iNVM)
- Three single port SKUs: SerDes, Copper, Copper IT
- Value Part (Intel® Ethernet Controller I211)
- Platform Power Efficiency
  - IEEE 802.3az Energy Efficient Ethernet (EEE)
  - Proxy: ECMA-393 and Windows\* logo for proxy offload
- Advanced Features:
  - 0 to 70 °C commercial temperature or -40 to 85 °C industrial temperature
  - Audio-video bridging
    - IEEE 1588/802.1AS precision time synchronization
    - IEEE 802.1Qav traffic shaper (with software extensions)
  - Jumbo frames
  - Interrupt moderation, VLAN support, IP checksum offload
  - PCIe OBFF (Optimized Buffer Flush/Fill) for improved system power management
  - Four transmit and four receive queues
  - RSS and MSI-X to lower CPU utilization in multi-core systems
  - Advanced cable diagnostics, auto MDI-X
  - ECC - error correcting memory in packet buffers
  - Four Software Definable Pins (SDPs)
- Manageability:
  - NC-SI for greater bandwidth pass through
  - SMBus low-speed serial bus to pass network traffic
  - Flexible firmware architecture with secure Flash update
  - MCTP over SMBus/PCIe
  - OS2BMC/CEM (optionally enabled via external Flash)
  - PXE and iSCSI boot

October 2020  
Revision Number: 3.6  
Order No. 333016-010





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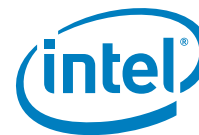
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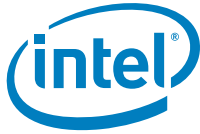
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## Revision History

Rev	Date	Notes
3.6	October 2020	Updated Section 8.0 (Programming Interface). Updated the note below Figure 12-27 (Peak Temperature).
3.5	August 2019	Updated Section 11.3.1 (Power Supply Specification).
3.4	February 2019	Updated Section 11.8.1 (new validated Flash parts).
3.3	June 2018	Updated Section 7.2.2.2.3 [LaunchTime (25)].
3.2	January 2018	Updated Table 2-1 (Pull-Up/Pull-Down Resistors). Added section 3.3.2.4 (iNVM Structure Version Information). Updated section 5.5.6 (Timing Guarantees). Updated section 6.8.2 (Port Identification LED Blinking; Word 0x04). Updated section 11.8.1 (Flash Parts).
3.1	June 2017	Revised Section: <ul style="list-style-type: none"> <li>3.4.3 (iNVM Programming Flows).</li> </ul>
3.0	March 2017	Revised Sections: <ul style="list-style-type: none"> <li>3.7.8.5.7 (Internal PHY Power-Down State).</li> <li>11.6.2.7 (MDIO AC Specification).</li> <li>12.4 (Oscillator Support).</li> <li>12.11 (XOR Testing).</li> </ul>
2.9	January 2016	<ul style="list-style-type: none"> <li>Revised Table 2-1 (changed JTAG_CLK to show a pull down resistor instead of a pull up).</li> <li>Updated intra-document cross references.</li> <li>Revised the description of Section 7.8.3.3.3 (Synchronized Output Clock on SDP Pins).</li> <li>Revised Section 8.15.13 (TimeSync Auxiliary Control Register - TSAUXC (0xB640; RW), bit 4 and bit 7 description).</li> </ul>
2.8	September 2015	<ul style="list-style-type: none"> <li>Revised Section 6.8.7.2 (added image build information).</li> <li>Updated Table 11-11 (<math>t_{DS}</math> and <math>t_{DH}</math> descriptions).</li> <li>Updated Table 11-15 (<math>C_{load}</math> value).</li> <li>Updated Figure 12.12 (changed pull-up value from 1.9 to 1.5).</li> <li>Updated Section 12.5.4 (Diff to CMR value).</li> <li>Added Section 12.5.6.5 (Maximum Trace Lengths Based on Trace Geometry).</li> <li>Fixed cross references in Section 12.6.</li> </ul>
2.7	February 2015	<ul style="list-style-type: none"> <li>Removed all references to IEEE Std 1149.6-2003, IEEE Standard for Boundary-Scan Testing of Advanced Digital Networks, IEEE, 2003.</li> <li>Updated section 8.27.3.37 (Misc Test - Page 6, Register 26).</li> <li>Removed sections 8.27.3.38 through 8.27.3.43.</li> <li>Updated section 12-4 (Oscillator Support).</li> <li>Added section 12.5.5 (Designing the I210 as a 10/100 Mb/s Only Device).</li> <li>Updated section 12.5.6.4 (Differential Pair Trace Routing for 10/100/1000 Designs).</li> </ul>
2.6	June 2014	<ul style="list-style-type: none"> <li>Revised section 11.8.1 (replaced W25Q16DWSSIG with W25Q16DVSSIG).</li> </ul>
2.5	February 2014	<ul style="list-style-type: none"> <li>Replaced figure 2-2.</li> <li>Revised section 3.4 (iNVM).</li> <li>Revised section 3.4.2 (iNVM Structures).</li> <li>Revised section 3.7.8.5.5.1 (Internal PHY Back-to-Back SPD).</li> <li>Revised table 8-6 (Register Summary; PQMPRC[0 - 3]).</li> <li>Revised table 11-11 (Flash I/F Timing Parameters).</li> <li>Revised table 11-17 (Specification for External Clock Oscillator).</li> </ul>



2.4	July 2013	<ul style="list-style-type: none"> <li>Updated revision history.</li> </ul>
Rev	Date	Notes
2.3	June 2013	<ul style="list-style-type: none"> <li>Revised section 1.3.1 (Audio/Video Bridging Support).</li> <li>Revised section 6.7.1.2 (Common Firmware Parameters 1 - Offset 0x1; bit 15).</li> <li>Revised section 7.1.2.10 (Receive-Side Scaling (RSS)).</li> <li>Revised section 7.8.3.1 (Capture Timestamp Mechanism).</li> <li>Revised section 8.21.18 (Flexible Host Filter Table Registers - FHFT (0x9000 + 4*n [n=0...255]; RW); updated note.</li> <li>Revised section 8.27.3.23 (MAC Specific Control Register 1 - Page 2, Register 16; bits 9:8).</li> <li>Revised table 10-37 (Decision Filter Values).</li> </ul>
2.2	April 2013	<ul style="list-style-type: none"> <li>Updated title page (Platform Power Efficiency description).</li> <li>Revised VPD Area Update Flow description (section 3.3.9.3.2).</li> <li>Revised iNVM description (section 3.4).</li> <li>Added line loopback information (section 3.7.6.6).</li> <li>Revised Acquiring Ownership Over a Shared Resource description (section 4.6.1).</li> <li>Revised Releasing Ownership Over a Shared Resource description (section 4.6.2).</li> <li>Revised Dr Disable Mode description (section 5.2.4.1).</li> <li>Revised Device Rev ID (section 6.2.19).</li> <li>Revised Common Firmware Parameters 1 - Offset 0x1 (section 6.7.1.2).</li> <li>Updated Compatibility (Word 0x03) bit 11 description (section 6.8.1).</li> <li>Updated Setup Options PCIe Function 0 (Word 0x30) bit 5 description (section 6.8.6.1).</li> <li>Added PXE VLAN Flash settings (Sections 6.8.6.5 through 6.8.6.9).</li> <li>Updated Software Semaphore - SWSM (0x5B50; R/W)</li> <li>Removed Firmware Status Register (0x8F0C) entry from Table 8-6.</li> <li>Revised note (changed . . . has both F and L flags off to on (section 10.5.7.1).</li> <li>Revised Specification for XTAL1 (In); table 11.16.</li> <li>Revised Third-Party Magnetics Manufacturers table (section 12.5.3).</li> <li>Added Power Delivery Solutions (section 12.7.1).</li> </ul>
2.1	November 2012	<ul style="list-style-type: none"> <li>Revised table 11.1 - Absolute Maximum Ratings</li> <li>Revised section 12.5.3 - Third-Party Magnetics Manufacturers.</li> <li>Revised table 12.16 - Absolute Maximum Case Temperature.</li> <li>Revised table 12.17 - Thermal Simulation Results for Various Environmental Conditions.</li> </ul>
2.0	November 2012	<p>The following sections were revised:</p> <ul style="list-style-type: none"> <li>1.0 Introduction.</li> <li>3.0 Interconnects.</li> <li>6.0 Flash Map.</li> <li>7.0 Inline Functions.</li> <li>8.0 Programming Interface.</li> <li>9.0 PCIe Programming Interface.</li> <li>11.0 Electrical/Mechanical Specification.</li> <li>12.0 Design Considerations.</li> <li>14.0 Diagnostics</li> <li>Added new section 13.0 - Thermal Considerations.</li> </ul>
1.9	October 2012	<ul style="list-style-type: none"> <li>Initial Release (Intel Public).</li> </ul>



## 1.0 Introduction

The Intel® Ethernet Controller I210 (I210) is a single port, compact, low power component that supports GbE designs. The I210 offers a fully-integrated GbE Media Access Control (MAC), Physical Layer (PHY) port and a SGMII/SerDes port that can be connected to an external PHY. The I210 supports PCI Express\* [PCIe v2.1 (2.5GT/s)].

The I210 enables 1000BASE-T implementations using an integrated PHY. It can be used for server system configurations such as rack mounted or pedestal servers, in an add-on NIC or LAN on Motherboard (LOM) design. Another possible system configuration is for blade servers as a LOM or mezzanine card. It can also be used in embedded applications such as switch add-on cards and network appliances.

### 1.1 Scope

This document provides the external architecture (including device operation, pin descriptions, register definitions, etc.) for the I210.

This document is a reference for software device driver developers, board designers, test engineers, and others who may need specific technical or programming information.

### 1.2 Terminology and Acronyms

**Table 1-1. Glossary**

Definition	Meaning
1000BASE-BX	1000BASE-BX is the PICMG 3.1 electrical specification for transmitting 1 Gb/s Ethernet or 1 Gb/s fibre channel encoded data over the backplane.
1000BASE-KX	1000BASE-KX is the IEEE802.3ap electrical specification for transmitting 1 Gb/s Ethernet over the backplane.
1000BASE-CX	1000BASE-X over specialty shielded 150 $\Omega$ balanced copper jumper cable assemblies as specified in IEEE 802.3 Clause 39.
1000BASE-T	1000BASE-T is the specification for 1 Gb/s Ethernet over category 5e twisted pair cables as defined in IEEE 802.3 clause 40.
AEN	Asynchronous Event Notification
b/w	Bandwidth.
BIOS	Basic Input/Output System.
BMC	Baseboard Management Controller - often used interchangeably with Manageability Controller (MC).
BT	Bit Time.
CRC	Cyclic redundancy check
DCA	Direct Cache Access.
DDOFF	Dynamic Device Off



**Table 1-1. Glossary (Continued)**

Definition	Meaning
DFT	Design for Testability.
DQ	Descriptor Queue.
DMTF	Distributed Management Task Force standard body.
DW	Double word (4 bytes).
EEE	Energy Efficient Ethernet - IEEE802.3az standard
EEPROM	Electrically Erasable Programmable Memory. A non-volatile memory located on the LAN controller that is directly accessible from the host.
EOP	End of Packet.
FC	Flow Control.
FCS	Frame Check Sequence.
Firmware (FW)	Embedded code on the LAN controller that is responsible for the implementation of the NC-SI protocol and pass through functionality.
Host Interface	RAM on the LAN controller that is shared between the firmware and the host. RAM is used to pass commands from the host to firmware and responses from the firmware to the host.
HPC	High - Performance Computing.
IPC	Inter Processor Communication.
IPG	Inter Packet Gap.
IPMI	Intelligent Platform Management Interface specification
LAN (auxiliary Power-Up)	The event of connecting the LAN controller to a power source (occurs even before system power-up).
LLDP	Link Layer Discovery Protocol defined in IEEE802.1AB used by IEEE802.3az (EEE) for system wake time negotiation.
LOM	LAN on Motherboard.
LPI	Low Power Idle - Low power state of Ethernet link as defined in IEEE802.3az.
LSO	Large Send Offload.
LTR	Latency Tolerance Reporting (PCIe protocol)
iSVR	Integrated Switching Voltage Regulator
MAC	Media Access Control.
MC	Management Controller
MCTP	DMTF Management Component Transport Protocol (MCTP) specification. A transport protocol to allow communication between a management controller and controlled device over various transports.
MDIO	Management Data Input/Output Interface over MDC/MDIO lines.
MIFS/MIPG	Minimum Inter Frame Spacing/Minimum Inter Packet Gap.
MMW	Maximum Memory Window.
MSS	Maximum Segment Size. Largest amount of data, in a packet (without headers) that can be transmitted. Specified in Bytes.
MPS	Maximum Payload Size in PCIe specification.
MTU	Maximum Transmit Unit. Largest packet size (headers and data) that can be transmitted. Specified in Bytes.
NC	Network Controller.
NC-SI	Network Controller Sideband Interface DMTF Specification
NIC	Network Interface Controller.
OBFF	Optimized Buffer Flush/Fill (PCIe protocol).
TPH	TLP Process Hints (PCIe protocol).
PCS	Physical Coding Sub layer.



Table 1-1. Glossary (Continued)

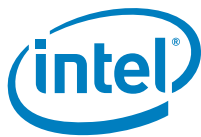
Definition	Meaning
PHY	Physical Layer Device.
PMA	Physical Medium Attachment.
PMD	Physical Medium Dependent.
SA	Source Address.
SDP	Software Defined Pins.
SerDes	Serializer/deserializer. A transceiver that converts parallel data to serial data and vice-versa.
SFD	Start Frame Delimiter.
SGMII	Serialized Gigabit Media Independent Interface.
SMBus	System Management Bus. A bus that carries various manageability components, including the LAN controller, BIOS, sensors and remote-control devices.
SVR	Switching Voltage Regulator
TCO	Total Cost of Ownership (TCO) System Management.
TLP	Transaction Layer Packet in the PCI Express specification.
TSO	Transmit Segmentation offload - A mode in which a large TCP/UDP I/O is handled to the device and the device segments it to L2 packets according to the requested MSS.
VLAN	Virtual LAN
VPD	Vital Product Data (PCI protocol).

## 1.2.1 External Specification and Documents

The I210 implements features from the following specifications.

### 1.2.1.1 Network Interface Documents

1. IEEE standard 802.3, 2006 Edition (Ethernet). Incorporates various IEEE Standards previously published separately. Institute of Electrical and Electronic Engineers (IEEE).
2. IEEE standard 1149.1, 2001 Edition (JTAG). Institute of Electrical and Electronics Engineers (IEEE)
3. IEEE standard 802.1Q for VLAN
4. PICMG3.1 Ethernet/Fibre Channel Over PICMG 3.0 Draft Specification, January 14, 2003, Version D1.0
5. Serial-GMII Specification, Cisco Systems document ENG-46158, Revision 1.7
6. INF-8074i Specification for SFP (Small Form factor Pluggable) Transceiver (<ftp://ftp.seagate.com/sff>)
7. IEEE Std 802.3ap-2007
8. IEEE 1588™ Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems, November 8 2002
9. IEEE 802.1AS Timing and Synchronization for Time- Sensitive Applications in Bridged Local Area Networks Draft 2.0, February 22, 2008
10. IEEE 802.1BF Ethernet Support for the IEEE P802.1AS Time Synchronization Protocol Task Force
11. IEEE 802.3az Energy Efficient Ethernet Draft 1.4, May 2009
12. 802.1BA - Audio Video Bridging (AVB) Systems
13. 802.1Qav - Forwarding and Queuing Enhancements for Time-Sensitive Streams



### 1.2.1.2 Host Interface Documents

1. PCI-Express 2.1 Base specification
2. PCI Specification, version 3.0
3. PCI Bus Power Management Interface Specification, Rev. 1.2, March 2004
4. Advanced Configuration and Power Interface Specification, Rev 2.0b, October 2002

### 1.2.1.3 Networking Protocol Documents

1. IPv4 specification (RFC 791)
2. IPv6 specification (RFC 2460)
3. TCP/UDP specification (RFC 793/768)
4. SCTP specification (RFC 2960)
5. ARP specification (RFC 826)
6. Neighbor Discovery for IPv6 (RFC 2461)
7. EUI-64 specification, <http://standards.ieee.org/regauth/oui/tutorials/EUI64.html>.

### 1.2.1.4 Manageability Documents

1. DMTF Network Controller Sideband Interface (NC-SI) Specification rev 1.0.0, May 2009
2. Management Component Transport Protocol (MCTP) Base Specification, rev 1.1.0, 4/22/2010 which specifies the Management Component Transport Protocol (MCTP)
3. Management Component Transport Protocol (MCTP) SMBus/I2C Transport Binding Specification, rev 1.0.0, 7/28/2009 which describes the binding of MCTP over SMBus.
4. Management Component Transport Protocol (MCTP) PCIe VDM Transport Binding Specification, rev 1.0.1, 12/11/2009 which describes the binding of MCTP over PCI Express.
5. Management Component Transport Protocol (MCTP) IDs and Codes, rev 1.1.0, 11/3/2009 which describes constants used by MCTP specs.
6. Document: [dmtf.org/sites/default/files/standards/documents/DSP0236\\_1.1.0.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0236_1.1.0.pdf)
7. NC-SI Over MCTP Specification, draft 0.4.3c, 8/2008 which describe the encapsulation of NC-SI packets in MCTP.
8. System Management Bus (SMBus) Specification, SBS Implementers Forum, Ver. 2.0, August 2000

### 1.2.1.5 Proxy Documents

1. proxZZy™ for sleeping hosts, February 2010 (ECMA-393)
2. mDNS Offload - Draft 1.0, May 2010

## 1.3 Product Overview

The I210 supports a SerDes or SGMII port for a MAC-to-MAC blade server connection or a MAC-to-external PHY connections. Alternatively, the internal 1000BASE-T PHYs can be used to implement a single port NIC or LOM design.

The I210 targets server system configurations such as rack mounted or pedestal servers, where the I210 can be used as add-on NIC or LOM design. Another system configuration is blade servers, where it can be used on Mezzanine card or LOM. The I210 can also be used in embedded applications such as switch add-on cards and network appliances.



### 1.3.1 Audio/Video Bridging Support

The I210 supports IEEE 802.1 Audio Video Bridging (AVB) specifications. The draft AVB standards are designed to work over widely-used IEEE 802 layer 2 networks. These new standards provide networking features for tightly controlled media stream synchronization, buffering and reservation. The IEEE 802.1AVB task group is working on an interoperability standards for systems based on the AVB document set. This provides a complete list of parameters to plug into the various standards that are needed to build an AVB system. A simple grid of features versus market has been created as a first cut to describe four proposed interoperability profiles. Those profiles include Consumer Electronics, Professional A/V, Industrial, and Automotive. Use of AVB enables higher layer protocols and applications to realize professional-quality A/V even if there are various lower-layer network links in the path between endpoint devices.

The I210 implements 4 receive queues and 4 transmit queues, where up to two queues are dedicated for stream reservation or priority, and up to three queues for strict priority. In Qav mode, the MAC flow control is disabled. Note that Qav mode is supported only in 100 Mb/s and 1000 Mb/s. Furthermore, Qav is supported only in full-duplex mode with no option for Jumbo packets transmission.

## 1.4 External Interface

### 1.4.1 PCIe Interface

The PCIe v2.1 (2.5GT/s) Interface is used by the I210 as a host interface. The interface only supports the PCIe v2.1 (2.5GT/s) rate and is configured to x1. The maximum aggregated raw bandwidth for a typical PCIe v2.1 (2.5GT/s) configuration is 4 Gb/s in each direction. Refer to [Section 2.3.1](#) for a full pin description. The timing characteristics of this interface are defined in the PCI Express Card Electromechanical Specification rev 2.0 and in the PCIe v2.1 (2.5GT/s) specification.

### 1.4.2 Network Interfaces

Three independent interfaces are used to connect the I210 port to external devices. The following protocols are supported:

- MDI (copper) support for standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX, and 10BASE-T applications (802.3, 802.3u, and 802.3ab)
- SerDes interface to connect over a backplane to another SerDes compliant device or to an optical module. The I210 supports both 1000BASE-BX and 1000BASE-KX (Without IEEE802.3ap backplane auto-negotiation)
- SGMII interface to attach to an external PHY, either on board or via an SFP module. The SGMII interface shares the same pins as the SerDes interface.

Refer to [Section 2.3.6](#) for a full pin description. For additional interface details, refer to [Section 11.6.3](#) and [Section 11.6.4](#).

### 1.4.3 Internal Non-Volatile Memory (iNVM)

The I210 stores product configuration information in an Internal Non-Volatile Memory (iNVM) and in Flash memory. The I210 does not support an external EEPROM. The I210 supports a Flash-less mode where all the setup found normally in Flash memory are either set to their default, configured by software, or stored into memory.





**Note:** When operated in Flash-less mode with an external PHY (such as the I210 SGMII SKU), no link up is made possible after power up before the driver configures the external PHY. It means that in such case, WoL is not supported when the system passes through the following states: G3 --> S5 --> WoL.

#### 1.4.4 Serial Flash Interface

The I210 provides an external SPI serial interface to a Flash for storing product configuration information and a boot ROM device such as the Winbond W25X80-BVSNIG or compatible Flash device. Refer to [Section 11.8.1](#) for a list of validated or compatible Flash devices. The I210 supports serial Flash devices with up to 64 Mb (8 MB) of memory. The size of the Flash used by the I210 can be configured by the Flash itself. Refer to [Section 2.3.2](#) for full pin description and [Section 11.6.2.4](#) for timing characteristics of this interface.

**Note:** Though the I210 supports devices with up to 8 MB of memory, bigger devices can also be used. Accesses to memory beyond the Flash device size results in access wrapping as only the lower address bits are used by the Flash device.

#### 1.4.5 SMBus Interface

SMBus is an optional interface for pass-through and/or configuration traffic between a Manageability Controller (MC) and the I210.

The I210's SMBus interface can be configured to support both slow and fast timing modes (up to 1Mb/s). Refer to [Section 2.3.3](#) for full pin description and [Section 11.6.2.2](#) for timing characteristics of this interface.

#### 1.4.6 NC-SI Interface

NC-SI and SMBus interfaces are optional for pass-through and/or configuration traffic between a MC and the I210. The NC-SI interface meets the DMTF NC-SI Specification, Rev. 1.0.0 as an integrated Network Controller (NC) device.

See [Section 2.3.4](#) for full pin description and [Section 11.6.2.5](#) for timing characteristics of this interface.

#### 1.4.7 MDIO/I<sup>2</sup>C 2-Wire Interfaces

The I210 implements a management Interface to control an optional external PHY. The interface can be either a 2-wire Standard-mode I<sup>2</sup>C interface used to control an SFP module or an MII Management Interface (also known as the Management Data Input/Output or MDIO Interface) for control plane connection between the MAC and PHY devices (master side). This interface provides the MAC and software with the ability to monitor and control the state of the external PHY. The I210 supports the data formats defined in IEEE 802.3 clause 22.

Refer to [Section 2.3.6](#) for a full pin description, [Section 11.6.2.7](#) for MDIO timing characteristics, and [Section 11.6.2.3](#) for I<sup>2</sup>C timing characteristics of this interface.

The I<sup>2</sup>C interface can alternatively be run over the SDP 0 and SDP2 pins. This can be useful when the I210 operates with a copper PHY since the dedicated SFPx\_I2C pins are not available in this mode for the control of other external devices.



### 1.4.8 Software-Definable Pins (SDP) Interface (General-Purpose I/O)

The I210 has four software-defined pins (SDP pins) that can be used for IEEE1588 auxiliary device connections, enable/disable of the device, and for other miscellaneous hardware or software-control purposes. These pins can be individually configurable to act as either standard inputs, General-Purpose Interrupt (GPI) inputs or output pins (refer to [Section 6.2.21](#), [Section 8.2.1](#) and [Section 8.2.3](#)), as well as the default value of all pins configured as outputs. Information on SDP usage can be found in [Section 3.5](#) and [Section 7.8.3.3](#). Refer to [Section 2.3.7](#) for pin description of this interface.

### 1.4.9 LED Interface

The I210 implements three output drivers intended for driving external LED circuits. Each of the three LED outputs can be individually configured to select the particular event, state, or activity, which is indicated on that output. In addition, each LED can be individually configured for output polarity as well as for blinking versus a non-blinking (steady-state) indication.

The configuration for LED outputs is specified via the LEDCTL register. Furthermore, the hardware-default configuration for all LED outputs can be specified via Flash fields (refer to [Section 6.2.18](#) and [Section 6.2.20](#)), thereby supporting LED displays configurable to a particular OEM preference.

Refer to [Section 2.3.6](#) for full pin description of this interface.

Refer to [Section 7.5](#) for more detailed description of LED behavior.

## 1.5 Features

[Table 1-2](#) to [Table 1-9](#) list the I210 and I211 features and compares them to other products.

**Table 1-2. I210 Features**

Feature	I210	I211	I350	82574
Number of ports	1	1	4	1
Serial Flash interface	Y <sup>1</sup>	N	Y	Y
Integrated NVM (iNVM)	Y <sup>2</sup>	Y	N	N
4-wire SPI EEPROM interface	N	N	Y	Y
Configurable LED operation for software or OEM custom-tailoring of LED displays	Y	Y	Y	Y
Protected Flash space for private configuration	Y <sup>1</sup>	N	Y	Y
Device disable capability	Y	Y	Y	Y
Package size (mm x mm)	9x9	9x9	17x17/25x25	9x9
Embedded thermal sensor	N	N	Y	N
Embedded thermal diode	N	N	Y	N
Watchdog timer	Y	Y	Y	Y
Feature	I210	I211	I350	82574
Boundary-Scan IEEE 1149.1	Y	Y	Y	Y
Boundary-Scan IEEE 1149.6	N	N	Y	N
Industrial temp (special SKU)	Y	N	N	Y

1. Not applicable in Flash-less I210 operation.

2. Flash-less I210 operation is supported (with no support for manageability related functionalities). Refer to the note that describes the limitation in [Section 1.4.3](#).

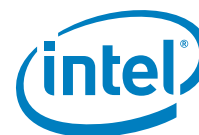


**Table 1-3. Network Features**

Feature	I210	I211	I350	82574
Half duplex at 10/100 Mb/s operation and full duplex operation at all supported speeds	Y	Y	Y	Y
10/100/1000 copper PHY integrated on-chip	1 port	1 port	4 ports	1 port
Jumbo frames supported	Y	Y	Y	Y
Size of jumbo frames supported	9.5 KB	9.5 KB	9.5 KB	9018B
Flow control support: send/receive PAUSE frames and receive FIFO thresholds	Y	Y	Y	Y
Statistics for management and RMON	Y	Y	Y	Y
802.1q VLAN support	Y	Y	Y	Y
802.3az EEE support	Y	Y	Y	N
MDI flip	N	N	Y	N
SerDes interface for external PHY connection or system interconnect	Y	N	4 ports	N
1000BASE-KX interface for blade server backplane connections	Y	N	Y	N
802.3ap Backplane Auto-negotiation	N	N	N	N
SGMII interface for external 1000BASE-T PHY connection	1 port	N	4 ports	N
Fiber/copper auto-sense	N	N	4 ports	N/A
SerDes support of non-auto-negotiation partner	Y	N	Y	N
SerDes signal detect	Y	N	Y	N
External PHY control I/F MDC/MDIO 2-wire I/F	Y	N	Shared or per function	N

**Table 1-4. Host Interface Features**

Feature	I210	I211	I350	82574
PCIe revision	2.1	2.1	2.1 (5 Gb/s or 2.5 Gb/s)	1.1
PCIe physical layer	Gen 1	Gen 1	Gen 2	Gen 1
Bus width	x1	x1	x1, x2, x4	x1
64-bit address support for systems using more than 4 GB of physical memory	Y	Y	Y	Y
Outstanding requests for Tx buffers per port	6	6	24 per port and for all ports	4
Outstanding requests for Tx descriptors per port	1	1	4 per port and for all ports	2
Outstanding requests for Rx descriptors per port	1	1	4 per port and for all ports	2
Credits for posted writes	4	4	4	4
Max payload size supported	512 B	512 B	512 B	512 B
Max request size supported	2 KB	2 KB	2 KB	2 KB
Link layer retry buffer size	3.2 KB	3.2 KB	3.2 KB	2 KB
Vital Product Data (VPD)	Y <sup>1</sup>	N	Y	Y

**Table 1-4. Host Interface Features (Continued)**

Feature	I210	I211	I350	82574
VPD size	1024B <sup>1</sup>	N/A	256B	256B
End to End CRC (ECRC)	Y	Y	Y	N
OBFF (Optimized Buffer Flush/Fill)	Y <sup>2</sup>	N	N	N
Latency Tolerance Reporting (LTR)	Y <sup>2</sup>	N	Y	N
TPH	Y	Y	Y	N
CSR access via Configuration space	Y	Y	Y	N
Access Control Services (ACS)	N	N	Y	N
Audio Video Bridging (AVB) support	Y	N	N	N

1. Not supported in Flash-less I210 operation.
2. Disabled by default via Flash.

**Table 1-5. LAN Functions Features**

Feature	I210	I211	I350	82574
Programmable host memory receive buffers	Y	Y	Y	Y
Descriptor ring management hardware for transmit and receive	Y	Y	Y	Y
ACPI register set and power down functionality supporting D0 and D3 states	Y	Y	Y	Y
Software controlled global reset bit (resets everything except the configuration registers)	Y	Y	Y	Y
Software Definable Pins (SDPs) - per port	4	4	4	N
Four SDP pins can be configured as general purpose interrupts	Y	Y	Y	N
Wake up	Y	Y	Y	Y
Flexible wake-up filters	8	8	8	6
Flexible filters for queue assignment in normal operation	8	8	8	N
IPv6 wake-up filters	Y	Y	Y	Y
Default configuration by the Flash for all LEDs for pre-driver functionality	3 LEDs	3 LEDs	4 LEDs	3 LEDs
LAN function disable capability	Y	Y	Y	Y
Programmable memory transmit buffers	Y	Y	Y	Y
Double VLAN	Y	Y	Y	N
IEEE 1588	Y	Y	Y	Y
Per-packet timestamp	Y	Y	Y	N
Tx rate limiting per queue	Y	N	N	N

**Table 1-6. LAN Performance Features**

Feature	I210	I211	I350	82574
TCP segmentation offload Up to 256 KB	Y	Y	Y	Y
iSCSI TCP segmentation offload (CRC)	N	N	N	N
IPv6 support for IP/TCP and IP/UDP receive checksum offload	Y	Y	Y	Y

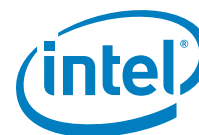


**Table 1-6. LAN Performance Features (Continued)**

Feature	I210	I211	I350	82574
Fragmented UDP checksum offload for packet reassembly	Y	Y	Y	Y
Message Signaled Interrupts (MSI)	Y	Y	Y	Y
Message Signaled Interrupts (MSI-X) number of vectors	5	5	25	5
Packet interrupt coalescing timers (packet timers) and absolute-delay interrupt timers for both transmit and receive operation	Y	Y	Y	Y
Interrupt throttling control to limit maximum interrupt rate and improve CPU utilization	Y	Y	Y	Y
Rx packet split header	Y	Y	Y	Y
Receive Side Scaling (RSS) number of queues per port	Up to 4	Up to 2	Up to 8	Up to 2
Total number of Rx queues per port	4	2	8	2
Total number of TX queues per port	4	2	8	2
RX header replication Low latency interrupt DCA support TCP timer interrupts No snoop Relax ordering	Yes to all	Yes to all	Yes to all	Only No snoop and Relax ordering
TSO interleaving for reduced latency	Y	Y	Y	N
Receive Side Coalescing (RSC)	N	N	N	N
SCTP receive and transmit checksum offload	Y	Y	Y	N
UDP TSO	Y	Y	Y	Y
IPSec offload	N	N	N	N

**Table 1-7. Virtualization Related Features**

Feature	I210	I211	I350	82574
Support for Virtual Machines Device queues (VMDq) per port	N	N	8 pools (single queue)	N
L2 MAC address filters (unicast and multicast)	16	16	32	16
L2 VLAN filters	Per port	Per port	Per pool	Per port
PCI-SIG SR-IOV	N	N	8 VF	N
Multicast/broadcast packet replication	N	N	Y	N
VM to VM packet forwarding (packet loopback)	N	N	Y	N
RSS replication	N	N	N	N
Traffic shaping	N	N	N	N
MAC and VLAN anti-spoofing	N	N	Y	N
Malicious driver detection	N	N	Y	N
Per-pool statistics	Y	Y	Y	N/A
Per-pool off loads	Y	Y	Y	N/A
Per-pool jumbo support	Y	Y	Y	N/A
Mirroring rules	N	N	4	N

**Table 1-7. Virtualization Related Features (Continued)**

Feature	I210	I211	I350	82574
External switch VEPA support	N	N	Y	N
External switch NIV (VNTAG) support	N	N	N	N
Promiscuous modes	VLAN, unicast multicast	VLAN, unicast multicast	VLAN, unicast multicast	unicast multicast

**Table 1-8. Manageability Features**

Feature	I210	I211	I350	82574
Advanced pass-through-compatible management packet transmit/receive support	Y <sup>1</sup>	N	Y	Y
Managed ports on SMBus interface to external MC	1 <sup>1</sup>	N	4	1
Auto-ARP reply over SMBus	Y <sup>1</sup>	N	Y	Y
NC-SI Interface to an external MC	Y <sup>1</sup>	N	Y	Y
Standard DMTF NC-SI protocol support	Y <sup>1</sup>	N	Y	Y
DMTF MCTP protocol over SMBus	Y <sup>1</sup>	N	Y	N
NC-SI hardware arbitration	Y <sup>1</sup>	N	Y	N
DMTF MCTP protocol over PCIe	Y <sup>1</sup>	N	N	N
OS to BMC traffic	Y <sup>1</sup>	N	Y	N
Manageability L2 address filters	2	N	2	1
Manageability VLAN L2 filters	8	N	8	4
Manageability EtherType filters	4	N	4	N
Manageability Flex L4 port filters	8	N	8	4
Manageability Flex TCO filters	1	N	1	2
Manageability L3 address filters (IPv4)	4	N	4	1
Manageability L3 address filters (IPv6)	4	N	4	1
Proxying <sup>2</sup>	1 ARP Offload 2 NS Offloads MLD support mDNS <sup>1</sup>	1 ARP Offload 2 NS Offloads MLD support	1 ARP Offload per PF 2 NS Offloads per PF	N

1. mDNS is not supported in Flash-less I210 operation.

2. In Flash-less I210 operation, proxying support requires a dedicated firmware code be loaded to the device via the host interface (see [Section 3.4.6](#)).

**Table 1-9. Power Management Features**

Feature	I210	I211	I350	82574
Magic packet wake-up enable with unique MAC address	Y	Y	Y	Y
ACPI register set and power down functionality supporting D0 and D3 states	Y	Y	Y	Y
Full wake-up support (APM and ACPI 2.0)	Y	Y	Y	Y
Smart power down at S0 no link and Sx no link	Y	Y	Y	Y



**Table 1-9. Power Management Features**

Feature	I210	I211	I350	82574
LAN disable functionality (equivalent to Static device off functionality in the I210/I211)	Y <sup>1</sup>	Y <sup>1</sup>	Y	Y
PCIe function disable	Y	Y	Y	Y
Dynamic device off	Y <sup>2</sup>	Y <sup>2</sup>	Y	Y
EEE	Y	Y	Y	N
DMA coalescing	Y	N	Y	N
OBFF/PE_WAKE_N	Y <sup>3</sup>	N	N	N

1. Feature not functional if enabled together with dynamic device off.
2. Feature not functional if enabled together with static device off (such as LAN disable).
3. Disabled by default in Flash due to the lack of OBFF enabled platforms at initial release.

## 1.6 I210 and I211 Options

Table 1-10 lists the main differences between features supported by the I210 and I211.

**Table 1-10. I210 9x9 QFN and I211 9x9 QFN Package Feature**

Feature	I210	I211
SerDes/SGMII port	Yes (for SerDes I210 SKU only)	Not supported.
Manageability	Yes	Not supported
Integrated SVR and LVR control	Supported	Supported
82574 pinout compatibility	Footprint compatibility only	Not supported
82583V pinout compatibility	Not supported	Footprint compatibility only

## 1.7 Overview of Changes Compared to the I350

The following section describes the modifications designed in the I210 compared to the I350.

### 1.7.1 Network Interface

#### 1.7.1.1 Energy Efficient Ethernet (IEEE802.3AZ)

The I210 supports negotiation and link transition to a Low Power Idle (LPI) state as defined in the IEEE802.3az (EEE) standard. Energy Efficient Ethernet (EEE) is supported only in the internal copper PHY mode and for the following technologies:

- 1000BASE-T
- 100BASE-TX

EEE enables reduction of the I210 power consumption as a function of link utilization. In addition, the I210 enables overall system power reduction as a function of link utilization by reporting increased latency tolerance values via PCIe LTR messages when link is in the LPI state. For more information, refer to [Section 3.7.7](#).



### 1.7.1.2 OBFF

The I210 support Optimized Buffer Flush Fill (OBFF) for synchronizing platform I/Os and optimizing CPU sleep states. The support is via the PE\_WAKE\_N pin only.

## 1.7.2 Audio and Video Bridging Support

See [Section 1.3.1](#) for details on IEEE 802.1Qav support.

### 1.7.2.1 Tx Timestamp

The I210 supports three types of transmit timestamps:

1. Reporting back of the timestamp in the transmit descriptor.
2. Inserting the timestamp in the packet sent.
3. Recording the timestamp of selected packet in a register (legacy behavior).

Transmit timestamp is described in [Section 7.0](#), Inline Functions.

## 1.7.3 Virtualization

SR-IOV and VMDq is not supported in hardware by the I210. The I210 can still be used in virtualized systems where the VM switching is done in software.

### 1.7.3.1 Number of Exact Match Filters

The number of RAH/RAL registers is 16.

## 1.7.4 Host Interface

### 1.7.4.1 MSI-X Support

The number of MSI-X vectors supported by the I210 changed to 5. For further information, refer to [Section 7.3](#).

### 1.7.4.2 Optimized Buffer Flush/FILL (OBFF)

The I210 supports the PCIe OBFF specification, using the PE\_WAKE\_N signal to enable synchronizing device activity and optimize power management of memory, CPU and RC internal circuitry. By synchronizing PCIe activity of PCIe endpoints, the system can stay in lower power states for a longer duration.

When in buffer fill (DMA coalescing) operating mode, the PCIe link is optionally placed in a L1 power saving state and DMA activity is placed on hold. The I210 moves into buffer flush mode when internal receive buffers pass a pre-determined threshold value, a watchdog timer expires, or the PCIe interface invokes a move out of buffer fill state. Further information can be found in [Section 5.9](#).





## 1.7.5 Manageability

### 1.7.5.1 DMTF MCTP Protocol Over PCIe

The I210 enables reporting and controlling all information exposed in a LOM device via NC-SI using the MCTP protocol over PCIe in addition to SMBus. The MCTP interface over PCIe is used by the MC to control the NIC and for pass through traffic. For more information, refer to [Section 10.7](#).

### 1.7.5.2 Flash Structures

Management related Flash structures were updated. For further information see [Chapter 6.0](#).

### 1.7.5.3 Improved Support of Shared MAC and Shared IP

The I210 supports better filtering in systems when the MAC or the IP is shared with the host. This support is achieved using additional filtering capabilities as described in [Section 10.3.1](#) and can be controlled using a new set of NC-SI OEM commands as the functionality described in [Section 10.6.3.14](#) and [Section 10.3.7](#).

### 1.7.5.4 Simplified SMBus TCO Status and Filter Setting

The TCO status in SMBus received packet was reduced to eight bytes and most of the information was removed in order to keep only the information relevant to the MCs. See [Section 10.5.9.2.1.1](#) for details.

In addition, a generic command is used to set the most common filtering options independently of the actual filters implementation. See [Section 10.5.9.1.7](#) for details.

### 1.7.5.5 Diagnostic Commands

Commands were added to the NC-SI and legacy SMBus to query the identity of the I210 and the firmware versions currently running on the I210. See [Section 10.5.9.2.7](#) and [Section 10.6.3.16.1](#) for details.

## 1.7.6 BOM Cost Reduction

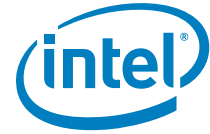
### 1.7.6.1 On-chip 0.9V SVR Control

The I210 includes a fully integrated on-chip Switching Voltage Regulator (SVR) that can be used to generate a 0.9V power supply without the need for a higher cost on-board 0.9V voltage regulator (refer to [Section 3.6](#)).

## 1.8 Device Data Flows

### 1.8.1 Transmit Data Flow

[Table 1-11](#) lists a high level description of all data/control transformation steps needed for sending Ethernet packets to the line.

**Table 1-11. Transmit Data Flow**

Step	Description
1	The host creates a descriptor ring and configures one of the I210's transmit queues with the address location, length, head and tail pointers of the ring (one of 4 available Tx queues).
2	The host is requested by the TCP/IP stack to transmit a packet, it gets the packet data within one or more data buffers.
3	The host initializes descriptor(s) that point to the data buffer(s) and have additional control parameters that describe the needed hardware functionality. The host places that descriptor in the correct location at the appropriate Tx ring.
4	The host updates the appropriate queue tail pointer (TDT)
5	The I210's DMA senses a change of a specific TDT and as a result sends a PCIe request to fetch the descriptor(s) from host memory.
6	The descriptor(s) content is received in a PCIe read completion and is written to the appropriate location in the descriptor queue internal cache.
7	The DMA fetches the next descriptor from the internal cache and processes its content. As a result, the DMA sends PCIe requests to fetch the packet data from system memory.
8	The packet data is received from PCIe completions and passes through the transmit DMA that performs all programmed data manipulations (various CPU off loading tasks as checksum off load, TSO off load, etc.) on the packet data on the fly.
9	While the packet is passing through the DMA, it is stored into the transmit FIFO. After the entire packet is stored in the transmit FIFO, it is forwarded to the transmit switch module.
10	The transmit switch arbitrates between host and management packets and eventually forwards the packet to the MAC.
11	The MAC appends the L2 CRC to the packet and sends the packet to the line using a pre-configured interface.
12	When all the PCIe completions for a given packet are done, the DMA updates the appropriate descriptor(s).
13	After enough descriptors are gathered for write back or the interrupt moderation timer expires, the descriptors are written back to host memory using PCIe posted writes. Alternatively, the head pointer can only be written back.
14	After the interrupt moderation timer expires, an interrupt is generated to notify the host device driver that the specific packet has been read to the I210 and the driver can release the buffers.

## 1.8.2 Receive Data Flow

Table 1-12 lists a high level description of all data/control transformation steps needed for receiving Ethernet packets.

**Table 1-12. Receive Data Flow**

Step	Description
1	The host creates a descriptor ring and configures one of the I210's receive queues with the address location, length, head, and tail pointers of the ring (one of 4 available Rx queues).
2	The host initializes descriptors that point to empty data buffers. The host places these descriptors in the correct location at the appropriate Rx ring.
3	The host updates the appropriate queue tail pointer (RDT).
4	The I210's DMA senses a change of a specific RDT and as a result sends a PCIe request to fetch the descriptors from host memory.
5	The descriptors content is received in a PCIe read completion and is written to the appropriate location in the descriptor queue internal cache.
6	A packet enters the Rx MAC. The Rx MAC checks the CRC of the packet.
7	The MAC forwards the packet to an Rx filter.
8	If the packet matches the pre-programmed criteria of the Rx filtering, it is forwarded to the Rx FIFO. VLAN and CRC are optionally stripped from the packet and L3/L4 checksum are checked and the destination queue is fixed.
9	The receive DMA fetches the next descriptor from the internal cache of the appropriate queue to be used for the next received packet.



**Table 1-12. Receive Data Flow (Continued)**

Step	Description
10	After the entire packet is placed into the Rx FIFO, the receive DMA posts the packet data to the location indicated by the descriptor through the PCIe interface. If the packet size is greater than the buffer size, more descriptors are fetched and their buffers are used for the received packet.
11	When the packet is placed into host memory, the receive DMA updates all the descriptor(s) that were used by packet data.
12	After enough descriptors are gathered for write back or the interrupt moderation timer expires or the packet requires immediate forwarding, the receive DMA writes back the descriptor content along with status bits that indicate the packet information including what off loads were done on that packet.
13	After the interrupt moderation timer completes or an immediate packet is received, the I210 initiates an interrupt to the host to indicate that a new received packet is already in host memory.
14	Host reads the packet data and sends it to the TCP/IP stack for further processing. The host releases the associated buffers and descriptors once they are no longer in use.



## 2.0 Pin Interface

### 2.1 Pin Assignments

The I210 supports a 64-pin, 9 x 9 QFN package with an Exposed Pad\* (e-Pad\*). Note that the e-Pad is ground.

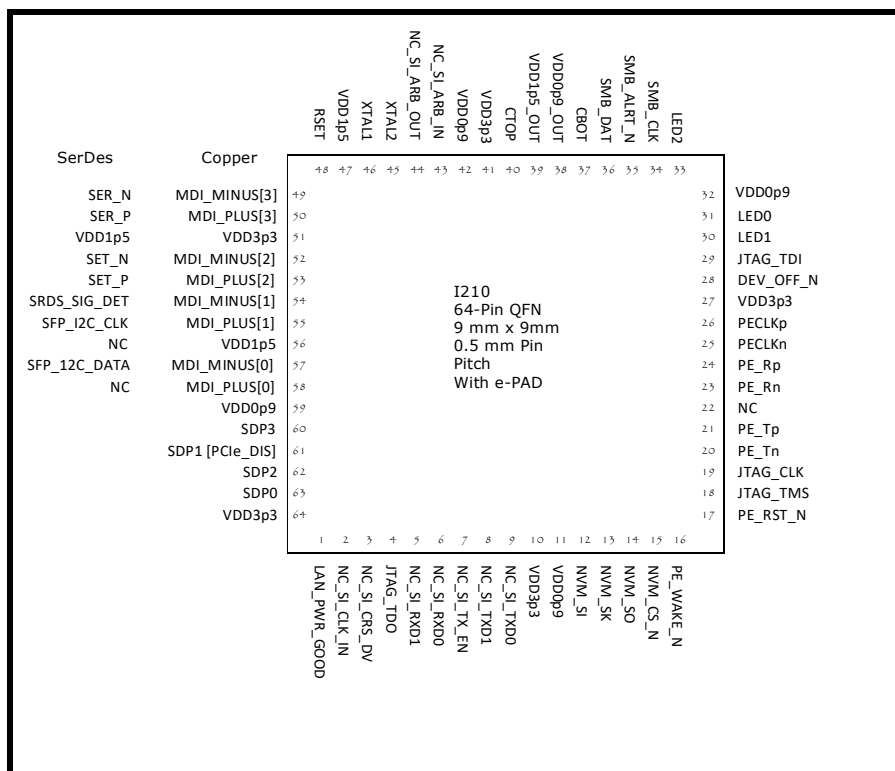


Figure 2-1. I210 64-Pin, 9 x 9 QFN Package With e-Pad



## 2.2 Pull-Up/Pull-Down Resistors

Table 2-1 lists internal and external pull-up/pull-down resistors and their functionality in different device states.

- As stated in the name and function table columns, the internal Pull-Up/Pull-Down (PU/PD) resistor values are 30 KΩ ± 50%.
- Only relevant (digital) pins are listed; analog or bias and power pins have specific considerations listed in Chapter 11.0.

**Note:** Refer to Section 12.0 for a list of board design schematic checklists, layout checklists, and reference design schematics for more details.

The device states are defined as follows:

- Power-up = while 3.3V is stable, yet 1.0V isn't
- Active = normal mode (not power up or disable)
- Disable = device off or dynamic device off – refer to Section 4.3.3

**Table 2-1. Pull-Up/Pull-Down Resistors**

Signal Name	Power Up <sup>1</sup>		Active		Disable <sup>2</sup>		External
	PU	Comments	PU	Comments	PU	Comments	
LAN_PWR_GOOD	N		N		N		Y
PE_WAKE_N	N		N		N		Y
PE_RST_N	N		N		N		PU <sup>3</sup>
NVM_SI	N		N		Y		PD/PU <sup>4</sup>
NVM_SO	Y		Y		Y		N
NVM_SK	Y		N		Y		N
NVM_CS_N	Y		N		Y		N
SMBD	N		N		N		Y
SMBCLK	N		N		N		Y
SMBALRT_N	N		N		N		Y
NCSI_CLK_IN	N	HiZ	N		N		PD
NCSI_CRS_DV	N	HiZ	N		N		PD
NCSI_RXD[1:0]	N	HiZ	N		N		PU
NCSI_TX_EN	N	HiZ	N		N		PD
NCSI_TXD[1:0]	N	HiZ	N		N		PU
NCSI_ARB_OUT	N		N		N	Stable high output	N
NCSI_ARB_IN	N	HiZ	N	<sup>5</sup>	N	<sup>5</sup>	N
SDP0	Y		Y	Until Flash auto-load done	Y	Might keep state by Flash control	N
SDP1	Y		Y	Until Flash auto-load done	Y	Might keep state by Flash control	N
SDP2	Y		Y	Until Flash auto-load done	Y	Might keep state by Flash control	N

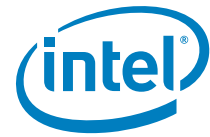


Table 2-1. Pull-Up/Pull-Down Resistors (Continued)

Signal Name	Power Up <sup>1</sup>		Active		Disable <sup>2</sup>		External
	PU	Comments	PU	Comments	PU	Comments	
SDP3	Y		Y	Until Flash auto-load done	Y	Might keep state by Flash control	N
DEV_OFF_N	Y		N		N		PU optional if NC-SI is not used.
SRDS_SIG_DET	Y		N		N		Must be connected on board
SFP_I2C_CLK	Y		Y	Until Flash auto-load done or if <i>I2C disable</i> set in Flash	Y		Y if I2C
SFP_I2C_DATA	Y		Y	Until Flash auto-load done or if <i>I2C disable</i> set in Flash	Y		Y
LED0	Y		N		N	HiZ	
LED1	Y		N		N	HiZ	
LED2	Y		N		N	HiZ	
JTAG_CLK	N		N		N		Y <sup>6</sup>
JTAG_TDI	N		N		N		Y
JTAG_TDO	N		N		N		Y <sup>6</sup>
JTAG_TMS	N		N		N		Y <sup>6</sup>

1. Power up - LAN\_PWR\_GOOD = 0b
2. Refer to Section 5.2.6 for description of disable state.
3. 10 K $\Omega$  to 100 K $\Omega$  pull up can be used.
4. When pulled up, Flash security features are enabled.
5. If NC-SI hardware arbitration is disabled via the *NC-SI ARB Enable* Flash bit (refer to Section 6.2.22), NCSI\_ARB\_IN pin is pulled-up internally.
6. These pins can be pulled up or pulled down (design dependent) when no clock device is connected to it.

## 2.3 Signal Type Definition

In	Input is a standard input-only signal.
Out (O)	Totem pole output is a standard active driver.
T/s	Tri-State is a bi-directional, tri-state input/output pin.
S/t/s	Sustained tri-state is an active low tri-state signal owned and driven by one and only one agent at a time. The agent that drives an s/t/s pin low must drive it high for at least one clock before letting it float. A new agent cannot start driving an s/t/s signal any sooner than one clock after the previous owner tri-states it.
O/d	Open drain enables multiple devices to share as a wire-OR.
A-in	Analog input signals.
A-out	Analog output signals.
B	Input bias.
NCSI_in	NCSI input signal.
NCSI-out	NCSI output signal.



### 2.3.1 PCIe

Table 2-2. PCIe

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
PECLKp PECLKn		26 25	A-in	Input	PCIe Differential Reference Clock In This pin receives a 100 MHz differential clock input. This clock is used as the reference clock for the PCIe Tx/Rx circuitry and by the PCIe core PLL to generate a 125 MHz clock and 250 MHz clock for the PCIe core logic.
PE_Tp PE_Tn		21 20	A-out	Output	PCIe Serial Data Output Serial differential output link in the PCIe interface running at 2.5 Gb/s. This output carries both data and an embedded 2.5 GHz clock that is recovered along with data at the receiving end.
PE_Rp PE_Rn		24 23	A-in	Input	PCIe Serial Data Input Serial differential input link in the PCIe interface running at 2.5 Gb/s. The embedded clock present in this input is recovered along with the data.
PE_WAKE_N		16	T/s	Bi-dir	Wake The I210 drives this signal to zero when it detects a wake-up event and either: <ul style="list-style-type: none"> <li>The PME_en bit in PMCSR is 1b or</li> <li>The APME bit of the Wake Up Control (WUC) register is 1b.</li> </ul> In OBFF mode, OBFF events are signaled using the PE_WAKE_N pin.
PE_RST_N		17	In	Input	Power and Clock Good Indication The PE_RST_N signal indicates that both PCIe power and clock are available.

### 2.3.2 Flash

Table 2-3. Flash

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
NVM_SI		12	T/s	Output	Serial Data Output Connect this lead to the input of the Flash.
NVM_SO		14	T/s	Input	Serial Data Input Connect this lead to the output of the Flash.
NVM_SK		13	T/s	Output	Non-Volatile Memory Serial Clock
NVM_CS_N		15	T/s	Output	Non-Volatile Memory Chip Select Output



### 2.3.3 System Management Bus (SMBus) Interface

**Table 2-4. SMBus Interface**

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
SMB_DATA		36	T/s, o/d	Bi-dir	SMBus Data. Stable during the high period of the clock (unless it is a start or stop condition).
SMB_CLK		34	T/s, o/d	Bi-dir	SMBus Clock. One clock pulse is generated for each data bit transferred.
SMB_ALERT_N		35	T/s, o/d	Output	SMBus Alert. Acts as an interrupt pin of a slave device on the SMBus in pass-through mode.

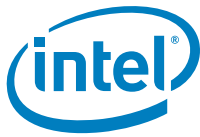
**Note:** If the SMBus is disconnected, an external pull-up should be used for these pins, unless it is guaranteed that manageability is disabled in the I210.

### 2.3.4 NC-SI and Testability

**Table 2-5. NC-SI and Testability**

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
NC_SI_CLK_IN		2	NCSI_in	Input	NC-SI Reference Clock Input. Synchronous clock reference for receive, transmit, and control interface. This signal is a 50 MHz clock +/- 100 ppm.
NC_SI_CRSDV		3	NCSI_out	Output	NC-SI Carrier Sense/Receive Data Valid (CRS/DV).
NC_SI_RXD0		6	NCSI_out	Output	NC-SI Receive Data 0. Data signals to the Manageability Controller (MC).
NC_SI_RXD1		5	NCSI_out	Output	NC-SI Receive Data 1. Data signals to the MC.
NC_SI_TX_EN		7	NCSI_in	Input	NC-SI Transmit Enable.
NC_SI_TXD0		9	NCSI_in	Input	NC-SI Transmit Data 0. Data signals from the MC.
NC_SI_ARB_IN		43	NC-SI-in	Input	NC-SI hardware arbitration token output pin.
NC_SI_ARB_OUT		44	NC-SI-out	Output	NC-SI hardware arbitration token input pin.
NC_SI_TXD1		8	NCSI_in	Input	NC-SI Transmit Data 1. Data signal from the MC.
JTAG_TDI		29	In	Input	JTAG TDI Input.
JTAG_CLK		19	In	Input	JTAG Clock Input.
JTAG_TMS		18	In	Input	JTAG Test Mode Select. This input controls the transitions of the test interface state machine.
JTAG_TDO		4	O/D		JTAG TDO





### 2.3.5 LEDs

Table 2-6 lists the functionality of each LED output pin. The default activity of each LED can be modified in the Flash. The LED functionality is reflected and can be further modified in the configuration registers (LEDCTL).

**Table 2-6. LEDs**

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
LED0		31	Out	Output	Programmable LED number 0.
LED1		30	Out	Output	Programmable LED number 1.
LED2		33	Out	Output	Programmable LED number 2.

### 2.3.6 PHY Pins

**Note:** The I210 has built in termination resistors. As a result, external termination resistors should not be used.

**Table 2-7. PHY Pins**

Symbol	Lead #	Type	Op Mode	Name and Function
MDI_PLUS[0]/NC	58	A	Bi-dir	In BASE-T: Media Dependent Interface[0]: 1000BASE-T: In MDI configuration, MDI[0]+ corresponds to BI_DA+ and in MDI-X configuration MDI[0]+ corresponds to BI_DB+. 100BASE-TX: In MDI configuration, MDI[0]+ is used for the transmit pair and in MDIX configuration MDI[0]+ is used for the receive pair. 10BASE-T: In MDI configuration, MDI[0]+ is used for the transmit pair and in MDI-X configuration MDI[0]+ is used for the receive pair.
MDI_MINUS[0]/SFP_I2C_DATA	57	A	Bi-dir	In BASE-T: Media Dependent Interface[0]: 1000BASE-T: In MDI configuration, MDI[0]- corresponds to BI_DA- and in MDI-X configuration MDI[0]- corresponds to BI_DB-. 100BASE-TX: In MDI configuration, MDI[0]- is used for the transmit pair and in MDIX configuration MDI[0]- is used for the receive pair. 10BASE-T: In MDI configuration, MDI[0]- is used for the transmit pair and in MDI-X configuration MDI[0]- is used for the receive pair. In SerDes: SFP 2 wire interface data – connects to Mod-Def2 pin of SFP (O/D). Can also be used as MDIO pin (T/S).

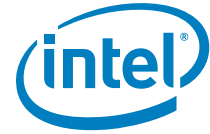
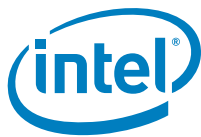


Table 2-7. PHY Pins

Symbol	Lead #	Type	Op Mode	Name and Function
MDI_PLUS[1]/ SFP_I2C_CLK	55	A	Bi-dir	In BASE-T: Media Dependent Interface[1]: 1000BASE-T: In MDI configuration, MDI[1]+ corresponds to BI_DB+ and in MDI-X configuration MDI[1]+ corresponds to BI_DA+. 100BASE-TX: In MDI configuration, MDI[1]+ is used for the receive pair and in MDI-X configuration MDI[1]+ is used for the transmit pair. 10BASE-T: In MDI configuration, MDI[1]+ is used for the receive pair and in MDI-X configuration MDI[1]+ is used for the transmit pair. In SerDes: SFP 2 wire interface clock – connects to Mod-Def1 input of SFP (O/D). Can also be used as MDC pin (Out).
MDI_MINUS[1]/ SRDS_SIG_DET	54	A	Bi-dir	In BASE-T: Media Dependent Interface[1]: 1000BASE-T: In MDI configuration, MDI[1]- corresponds to BI_DB- and in MDI-X configuration MDI[1]- corresponds to BI_DA-. 100BASE-TX: In MDI configuration, MDI[1]- is used for the receive pair and in MDI-X configuration MDI[1]- is used for the transmit pair. 10BASE-T: In MDI configuration, MDI[1]- is used for the receive pair and in MDI-X configuration MDI[1]- is used for the transmit pair. In SerDes: Signal Detect: Indicates that signal (light) is detected from the fiber. High for signal detect, low otherwise. Polarity of Signal Detect pin is controlled by the <i>CTRL.ILOS</i> bit. For non-fiber SerDes applications, link indication is internal, <i>CONNSW.ENRGSRC</i> bit should be 0b and pin should be connected to a pull-up resistor.
MDI_PLUS[2] MDI_MINUS[2]/SET_N MDI_PLUS[3]/SER_P MDI_MINUS[3]/SER_N	53 52 50 49	A	Bi-dir	In BASE-T: Media Dependent Interface[3:2]: 1000BASE-T: In MDI and in MDI-X configuration, MDI[2]+/- corresponds to BI_DC+/- and MDI[3]+/- corresponds to BI_DD+/-. 100BASE-TX: Unused. 10BASE-T: Unused. In SerDes SerDes/SGMII Serial Data input/output: Differential SERDES Receive/Transmit interface. A serial differential input/output pair running at 1.25Gb/s. An embedded clock present in this input is recovered along with the data. This output carries both data and an embedded 1.25 GHz clock that is recovered along with data at the receiving end.
XTAL1 XTAL2	46 45	A-In A-Out	Input/ Output	XTAL In/Out These pins can be driven by an external 25 MHz crystal or driven by an external MOS level 25 MHz oscillator. Used to drive the PHY.
RSET	48	A	Bias	PHY Termination This pin should be connected through a 4.99 K $\Omega$ $\pm$ 1% resistor to ground.



### 2.3.7 Miscellaneous Pins

Table 2-8. Miscellaneous Pins

Symbol	Reserved	Lead #	Type	Op Mode	Name and Function
DEV_OFF_N		28	In	Input	This is a 3.3V input signal. Asserting DEV_OFF_N puts the I210 in device disable mode. Note that this pin is asynchronous. Functionality of this input can be changed by Flash bits settings - see Table 2-11 for more details.
SDP0		63	T/s	Input/Output	Software defined pin 0.
SDP1 [PCIe_DIS]SDP1		61	T/s	Input/Output	Software defined pin 1. See Table 2-11 for PCIe function disable settings.
SDP2		62	T/s	Input/Output	Software defined pin 2.
SDP3		60	T/s	Input/Output	Software defined pin 3.
LAN_PWR_GOOD		1	In	Input	LAN Power Good: A 3.3V input signal. A transition from low to high initializes the device into operation. If the internal Power-on-Reset (POR) circuit is used to trigger device power-up, this signal should be connected to VDDO.
NC		22	Voltage	Input	Optional pin used to connect an external power supply to the PCIe block in order to replace the internal LDO.

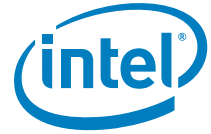
### 2.3.8 Power Supplies and Support Pins

#### 2.3.8.1 Power Support

Table 2-9. Power Support

Symbol	Reserved	Lead #	Type / Voltage	Name and Function
CBOT		37	A-in A-Out	Capacitor bottom connection.
CTOP		40	A-In capacitor A-Out	Capacitor top connection.

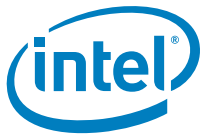
**Note:** These pins must be connected together by a 39 nF capacitor (refer to capacitor part # GRM155R61A393KA01).



### 2.3.8.2 Power Supply

**Table 2-10. Power Supply**

Symbol	Lead #	Type / Voltage	Name and Function
VDD0p9	11, 32, 42, 59	0.9V	0.9V digital power supply.
VDD3p3	10, 27, 41, 51, 64	3.3V	3.3V power supply (for I/O). Pin 51: In BASE-T, 3.3V analog power supply to GPHY; in SerDes, 1.5V analog power supply to SGMII SerDes.
VDD1p5	47, 56	1.5V	Pin 47: 1.5V power supply to the crystal oscillator and bandgap. Pin 56: In BASE-T, 1.5V analog power supply to GPHY; in SerDes, not connected.
VDD0p9_OUT	38	0.9V	0.9V power supply output of the switching cap regulator.
VDD1p5_OUT	39	1.5V	1.5V power supply output of the switching cap regulator.
GND	e-Pad	Ground	The e-Pad metal connection on the bottom of the package. Should be connected to ground.

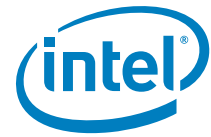


## 2.4 Strapping Options

Table 2-11. Strapping Options

Function	Latch Event	Pad					NVM				PU	Comments
		DEV_OFF_N	SDP3	NVM_SK	NVM_SI	SDP1 [PCIe_DIS]	0x1E.15 Device Off Enable	0x29.10 nvm_aux_pwr_en	0x29.13 nvm_alt_aux_pwr_en	0x29.15 en_pin_pcie_func_dis	Internal PU	
DEV_OFF_N	N/A	0	X	X	X	X	1	X	X	X		Device off mode when the pin is pulled low.
AUX_PWR (option 1)	N/A	1	X	X	X	X	0	1	X	X		AUX power mode when the pin is pulled high.
AUX_PWR (option 2)	N/A	X	1	X	X	X	0	0	1	X		AUX power mode when the pin is pulled high.
SECURITY_EN	LAN_PWR_GOOD	X	X	X	1	X	X	X	X	X	PU (until LPG)	Flash security is disabled when the pin is pulled low.
PCIE_DIS_N	N/A	X	X	X	X	0	X	X	X	1		Active low, valid on Flash load complete. Strap logic that requires a dedicated SDP.

**Note:** nvm\_aux\_pwr\_en and nvm\_alt\_aux\_pwr\_en bits are read as 0b from NVM, AUX\_PWR mode is enabled.



## 2.5 Package

The I210 supports a 64-pin, 9 x 9 QFN package with e-Pad. Figure 2-2 shows the package schematics.

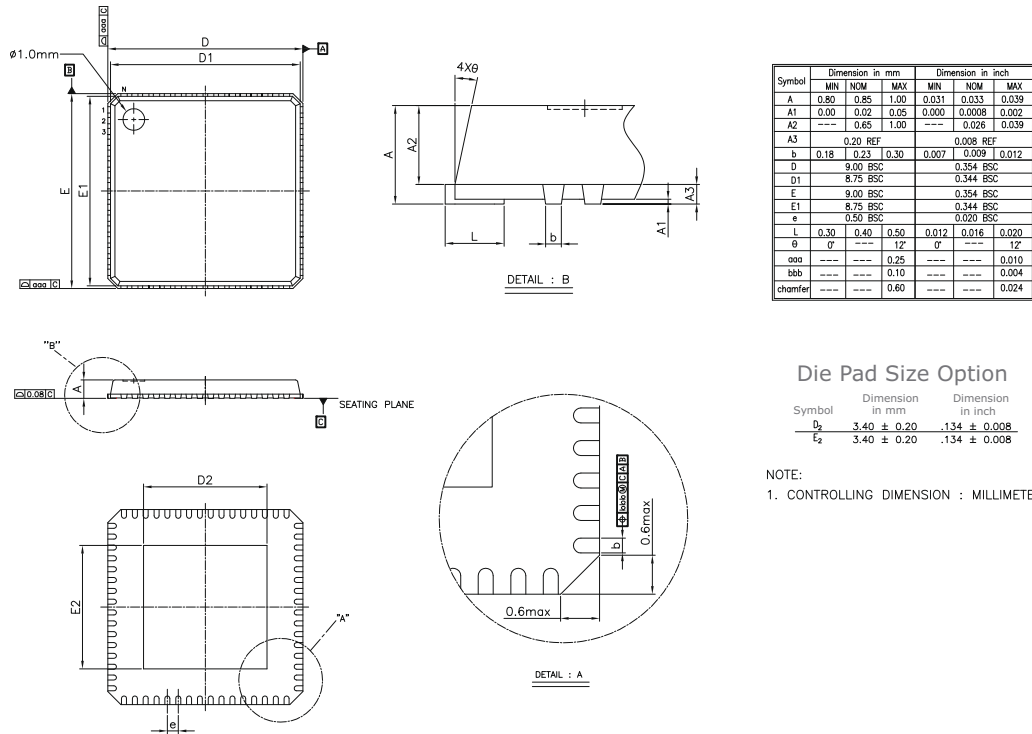
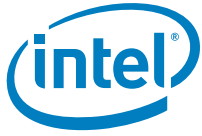
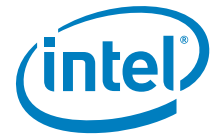


Figure 2-2. I210 QFN 9 x 9 mm Package



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## 3.0 Interconnects

### 3.1 PCIe

#### 3.1.1 PCIe Overview

PCIe is a third generation I/O architecture that enables cost competitive next generation I/O solutions providing industry leading price/performance and features. It is an industry-driven specification.

PCIe defines a basic set of requirements that encases the majority of the targeted application classes. Higher-end applications' requirements, such as enterprise class servers and high-end communication platforms, are encased by a set of advanced extensions that compliment the baseline requirements.

To guarantee headroom for future applications of PCIe, a software-managed mechanism for introducing new, enhanced, capabilities in the platform is provided. [Figure 3-1](#) shows PCIe architecture.

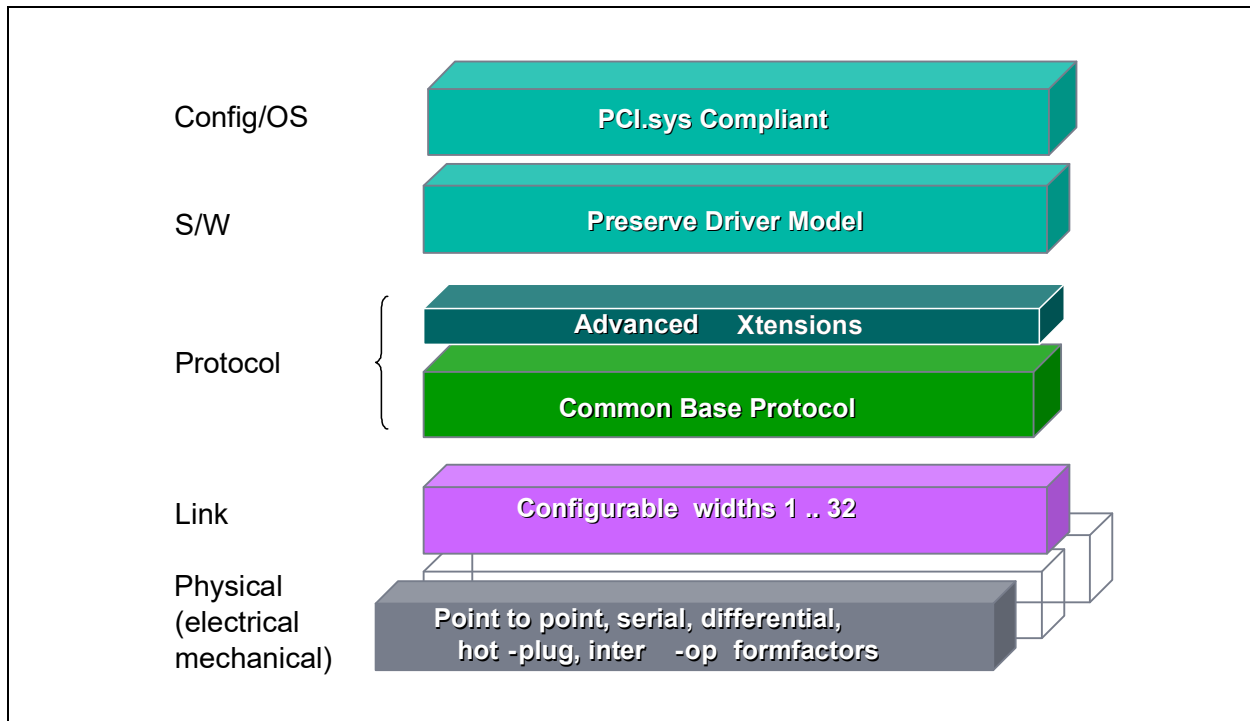
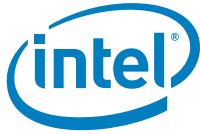


Figure 3-1. PCIe Stack Structure





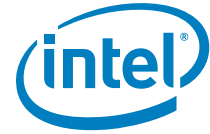
PCIe's physical layer consists of a differential transmit pair and a differential receive pair. Full-duplex data on these two point-to-point connections is self-c such that no dedicated clock signals are required. The bandwidth of this interface increases linearly with frequency.

The packet is the fundamental unit of information exchange and the protocol includes a message space to replace the various side-band signals found on many buses today. This movement of hard-wired signals from the physical layer to messages within the transaction layer enables easy and linear physical layer width expansion for increased bandwidth.

The common base protocol uses split transactions and several mechanisms are included to eliminate wait states and to optimize the reordering of transactions to further improve system performance.

### 3.1.1.1 Architecture, Transaction and Link Layer Properties

- Split transaction, packet-based protocol
- Common flat address space for load/store access (such as PCI addressing model)
  - Memory address space of 32-bits to allow compact packet header (must be used to access addresses below 4 GB)
  - Memory address space of 64-bit using extended packet header
- Transaction layer mechanisms:
  - PCI-X style relaxed ordering
  - Optimizations for no-snoop transactions
- Credit-based flow control
- Packet sizes/formats:
  - Maximum upstream (write) payload size of 512 bytes
  - Maximum downstream (read) payload size of 512 bytes
- Reset/initialization:
  - Frequency/width/profile negotiation performed by hardware
- Data integrity support
  - Using CRC-32 for transaction layer packets
- Link layer retry for recovery following error detection
  - Using CRC-16 for link layer messages
- No retry following error detection
  - 8b/10b encoding with running disparity
- Software configuration mechanism:
  - Uses PCI configuration and bus enumeration model
  - PCIe-specific configuration registers mapped via PCI extended capability mechanism
- Baseline messaging:
  - In-band messaging of formerly side-band legacy signals (such as interrupts, etc.)
  - System-level power management supported via messages
- Power management:
  - Full support for PCI-PM
  - Wake capability from D3cold state
  - Compliant with ACPI, PCI-PM software model



- Active state power management
- Support for PCIe v2.1 (2.5GT/s)
  - Support for completion time out
  - Support for additional registers in the PCIe capability structure.

### **3.1.1.2 Physical Interface Properties**

- Point to point interconnect
  - Full-duplex; no arbitration
- Signaling technology:
  - Low Voltage Differential (LVD)
  - Embedded clock signaling using 8b/10b encoding scheme
- Serial frequency of operation: 2.5 Gb/s.
- Interface width of x1.
- DFT and DFM support for high volume manufacturing

### **3.1.1.3 Advanced Extensions**

PCIe defines a set of optional features to enhance platform capabilities for specific usage modes. The I210 supports the following optional features:

- Extended error reporting - messaging support to communicate multiple types/severity of errors.
- Device serial number.
- Completion timeout control.
- TLP Processing Hints (TPH) - provides hints on a per transaction basis to facilitate optimized processing of transactions that target memory space.
- Latency Tolerance Reporting (LTR) - messaging support to communicate service latency requirements for memory reads and writes to the root complex.

## **3.1.2 General Functionality**

### **3.1.2.1 Native/Legacy**

All the I210 PCI functions are native PCIe functions.

### **3.1.2.2 Transactions**

The I210 does not support requests as target or master.

## **3.1.3 Host Interface**

### **3.1.3.1 Tag IDs**

PCIe device numbers identify logical devices within the physical device (the I210 is a physical device). The I210 implements a single logical device with one PCI function. The device number is captured from the type 0 configuration write transaction.



The PCIe function interfaces with the PCIe unit through one or more clients. A client ID identifies the client and is included in the *Tag* field of the PCIe packet header. Completions always carry the tag value included in the request to enable routing of the completion to the appropriate client.

Tag IDs are allocated differently for read and write. Messages are sent with a tag of 0x0.

### 3.1.3.1.1 TAG ID Allocation for Read Transactions

Table 3-1 lists the Tag ID allocation for read accesses. The tag ID is interpreted by hardware in order to forward the read data to the required device.

Table 3-1. IDs in Read Transactions

Tag ID	Description	Comment
0x0	Data request 0	
0x1	Data request 1	
0x2	Data request 2	
0x3	Data request 3	
0x4	Data request 4	
0x5	Data request 5	
0x6-017	Not used	
0x18	Descriptor Tx	
0x19-0x1B	Not used	
0x1C	Descriptor Rx	
0x1D-0x1F	Not used	

### 3.1.3.1.2 TAG ID Allocation for Write Transactions

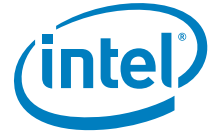
Request tag allocation depends on these system parameters:

- DCA supported/not supported in the system (*DCA\_CTRL.DCA\_DIS* - refer to Section 8.13.4 for details)
- TPH enabled in the system.
- DCA enabled/disabled for each type of traffic (*TXCTL.TX Descriptor DCA EN*, *RXCTL.RX Descriptor DCA EN*, *RXCTL.RX Header DCA EN*, *RXCTL.Rx Payload DCA EN*).
- TPH enabled or disabled for the specific type of traffic carried by the TLP (*TXCTL.TX Descriptor TPH EN*, *RXCTL.RX Descriptor TPH EN*, *RXCTL.RX Header TPH EN*, *RXCTL.Rx Payload TPH EN*).
- System type: Legacy DCA vs. DCA 1.0 (*DCA\_CTRL.DCA\_MODE* - refer to Section 8.13.4 for details).
- CPU ID (*RXCTL.CPUID* or *TXCTL.CPUID*).

See the case studies below for information on different implementations

#### 3.1.3.1.2.1 Case 1 - DCA Disabled in the System

Table 3-2 lists the write requests tags. Unlike read, the values are for debug only, allowing tracing of requests through the system.

**Table 3-2. IDs in Write Transactions (DCA Disabled Mode)**

Tag ID	Description
0x0 - 0x1	Reserved
0x2	Tx descriptors write-back / Tx head write-back
0x3	Reserved
0x4	Rx descriptors write-back
0x5	Reserved
0x6	Write data
0x7 - 0x1D	Reserved
0x1E	MSI and MSI-X
0x1F	Reserved

### 3.1.3.1.2.2 Case 2 - DCA Enabled in the System, but Disabled for the Request

- Legacy DCA platforms - If DCA is disabled for the request, the tags allocation is identical to the case where DCA is disabled in the system. Refer to [Table 3-2](#).
- DCA 1.0 platforms - All write requests have a tag value of 0x00.

**Note:** When in DCA 1.0 mode, messages and MSI/MSI-X write requests are sent with the no-hint tag.

### 3.1.3.1.2.3 Case 3 - DCA Enabled in the System, DCA Enabled for the Request

- Legacy DCA platforms: the request tag is constructed as follows:
  - Bit[0] - DCA Enable
  - Bits[3:1] - The *CPU ID* field taken from the CPUID[2:0] bits of the RXCTL or TXCTL registers
  - Bits[7:4] - Reserved
- DCA 1.0 platforms: the request tag (all 8 bits) is taken from the *CPUID* field of the RXCTL or TXCTL registers

### 3.1.3.1.2.4 Case 4 - TPH Enabled in the System, TPH Enabled for the Request

- The request tag (all 8 bits) is taken from the *CPUID* field of the adequate register or context as listed in [Table 7-61](#).

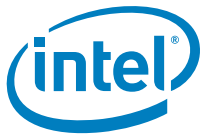
## 3.1.3.2 Completion Timeout Mechanism

In any split transaction protocol, there is a risk associated with the failure of a requester to receive an expected completion. To enable requesters to attempt recovery from this situation in a standard manner, the completion timeout mechanism is defined.

The completion timeout mechanism is activated for each request that requires one or more completions when the request is transmitted. The I210 provides a programmable range for the completion timeout, as well as the ability to disable the completion timeout altogether. The completion timeout is programmed through an extension of the PCIe capability structure (refer to [Section 9.4.6.12](#)).

The I210's reaction in case of a completion timeout is listed in [Table 3-12](#).

The I210 controls the following aspects of completion timeout:



- Disabling or enabling completion timeout.
- Disabling or enabling re-send of a request on completion timeout.
- A programmable range of re-sends on completion timeout, if re-send enabled.
- A programmable range of timeout values.
- Programming the behavior of completion timeout is listed in [Table 3-3](#).

**Table 3-3. Completion Timeout Programming**

Capability	Programming capability
Completion Timeout Enabling	Controlled through <i>PCI Device Control 2</i> configuration register.
Resend Request Enable	Loaded from the Flash into the <i>GCR</i> register.
Number of Re-sends on Timeout	Controlled through <i>GCR</i> register.
Completion Timeout Period	Controlled through <i>PCI Device Control 2</i> configuration register.

Completion Timeout Enable - Programmed through the *PCI Device Control 2* configuration register. The default is: Completion Timeout Enabled.

Resend Request Enable - The *Completion Timeout Resend* Flash bit (loaded to the *Completion\_Timeout\_Resend* bit in the *PCIe Control (GCR)* register enables resending the request (applies only when completion timeout is enabled). The default is to resend a request that timed out.

Number of re-sends on timeout - Programmed through the *Number of resends* field in the *GCR* register. The default value of resends is 3.

### 3.1.3.2.1 Completion Timeout Period

Programmed through the *PCI Device Control 2* configuration register (refer to [Section 9.4.6.12](#)). The I210 supports all ranges defined by *PCIe v2.1 (2.5GT/s)*.

A memory read request for which there are multiple completions are considered completed only when all completions have been received by the requester. If some, but not all, requested data is returned before the completion timeout timer expires, the requestor is permitted to keep or to discard the data that was returned prior to timer expiration.

**Note:** The completion timeout value must be programmed correctly in *PCIe* configuration space (in the *Device Control 2* register); the value must be set above the expected maximum latency for completions in the system in which the I210 is installed. This ensures that the I210 receives the completions for the requests it sends out, avoiding a completion timeout scenario. It is expected that the system BIOS sets this value appropriately for the system.

### 3.1.4 Transaction Layer

The upper layer of the *PCIe* architecture is the transaction layer. The transaction layer connects to the I210 core using an implementation specific protocol. Through this core-to-transaction-layer protocol, the application-specific parts of the I210 interact with the *PCIe* subsystem and transmit and receive requests to or from the remote *PCIe* agent, respectively.



### 3.1.4.1 Transaction Types Accepted by the I210

**Table 3-4. Transaction Types Accepted by the Transaction Layer**

Transaction Type	FC Type	Tx Later Reaction	Hardware Should Keep Data From Original Packet
Configuration Read Request	NPH	CPLH + CPLD	Requester ID, TAG, Attribute
Configuration Write Request	NPH + NPD	CPLH	Requester ID, TAG, Attribute
Memory Read Request	NPH	CPLH + CPLD	Requester ID, TAG, Attribute
Memory Write Request	PH + PD	-	-
I/O Read Request	NPH	CPLH + CPLD	Requester ID, TAG, Attribute
I/O Write Request	NPH + NPD	CPLH	Requester ID, TAG, Attribute
Read Completions	CPLH + CPLD	-	-
Message	PH+ PD <sup>1</sup>	-	-

1. MCTP messages contains a payload.

Flow control types:

- PH - Posted request headers
- PD - Posted request data payload
- NPH - Non-posted request headers
- NPD - Non-posted request data payload
- CPLH - Completion headers
- CPLD - Completion data payload

#### 3.1.4.1.1 Configuration Request Retry Status

PCIe supports devices requiring a lengthy self-initialization sequence to complete before they are able to service configuration requests. This is the case for the I210 where initialization is long due to the Flash read operation following reset.

If the read of the PCIe section in the Flash was not completed and the I210 receives a configuration request, the I210 responds with a configuration request retry completion status to terminate the request. This effectively stalls the configuration request until the subsystem completes a local initialization and is ready to communicate with the host.

#### 3.1.4.1.2 Partial Memory Read and Write Requests

The I210 has limited support of read and write requests when only part of the byte enable bits are set as described later in this section.

Partial writes to the MSI-X table are supported. All other partial writes are ignored and silently dropped.

Zero-length writes have no internal impact (nothing written, no effect such as clear-by-write). The transaction is treated as a successful operation (no error event).

Partial reads with at least one byte enabled are answered as a full read. Any side effect of the full read (such as clear by read) is applicable to partial reads also.

Zero-length reads generate a completion, but the register is not accessed and undefined data is returned.



### 3.1.4.2 Transaction Types Initiated by the I210

**Table 3-5. Transaction Types Initiated by the Transaction Layer**

Transaction type	Payload Size	FC Type	From Client
Configuration Read Request Completion	Dword	CPLH + CPLD	Configuration space
Configuration Write Request Completion	-	CPLH	Configuration space
I/O Read Request Completion	Dword	CPLH + CPLD	CSR
I/O Write Request Completion	-	CPLH	CSR
Read Request Completion	Dword/Qword	CPLH + CPLD	CSR
Memory Read Request	-	NPH	DMA
Memory Write Request	<= MAX_PAYLOAD_SIZE <sup>1</sup>	PH + PD	DMA
Message	64 bytes <sup>2</sup>	PH	INT / PM / Error Unit / LTR

1. MAX\_PAYLOAD\_SIZE supported is loaded from Flash (128 bytes, 256 bytes or 512 bytes). Effective MAX\_PAYLOAD\_SIZE is defined according to configuration space register.
2. MCTP messages contains payload.

#### 3.1.4.2.1 Data Alignment

Requests must never specify an address/length combination that causes a memory space access to cross a 4 KB boundary. The I210 breaks requests into 4 KB-aligned requests (if needed). This does not pose any requirement on software. However, if software allocates a buffer across a 4 KB boundary, hardware issues multiple requests for the buffer. Software should consider limiting buffer sizes and base addresses to comply with a 4 KB boundary in cases where it improves performance.

The general rules for packet alignment are as follows:

1. The length of a single request should not exceed the PCIe limit of MAX\_PAYLOAD\_SIZE for write and MAX\_READ\_REQ for read.
2. The length of a single request does not exceed the I210's internal limitation.
3. A single request should not span across different memory pages as noted by the 4 KB boundary previously mentioned.

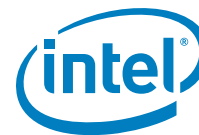
**Note:** The rules apply to all the I210 requests (read/write, snoop and no snoop).

If a request can be sent as a single PCIe packet and still meet rules 1-3, then it is not broken at a cache-line boundary (as defined in the PCIe Cache Line Size configuration word), but rather, sent as a single packet (motivation is that the chipset might break the request along cache-line boundaries, but the I210 should still benefit from better PCIe use). However, if rules 1-3 require that the request is broken into two or more packets, then the request is broken at a cache-line boundary.

#### 3.1.4.2.2 Multiple Tx Data Read Requests (MULR)

The I210 supports 6 pipelined requests for transmit data on the port. In general, the 6 requests might belong to the same packet or to consecutive packets to be transmitted on the LAN port. However, the following restriction applies: all requests for a packet are issued before a request is issued for a consecutive packet.

Read requests can be issued from any of the supported queues, as long as the restriction is met. Pipelined requests might belong to the same queue or to separate queues. However, as previously noted, all requests for a certain packet are issued (from same queue) before a request is issued for a different packet (potentially from a different queue).



The PCIe specification does not ensure that completions for separate requests return in-order. Read completions for concurrent requests are not required to return in the order issued. The I210 handles completions that arrive in any order. Once all completions arrive for a given request, the I210 might issue the next pending read data request.

- The I210 incorporates a re-order buffer to support re-ordering of completions for all requests. Each request/completion can be up to 2 KB long. The maximum size of a read request is defined as the minimum {2 KB, Max\_Read\_Request\_Size}.

In addition to the 6 pipeline requests for transmit data, the I210 can issue up to one read request to fetch transmit descriptors and one read requests to fetch receive descriptors. The requests for transmit data, transmit descriptors, and receive descriptors are independently issued. Each descriptor read request can fetch up to 16 descriptors for reception and 24 descriptors for transmission.

### 3.1.4.3 Messages

#### 3.1.4.3.1 Message Handling by the I210 (as a Receiver)

Message packets are special packets that carry a message code.

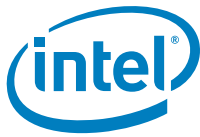
The upstream device transmits special messages to the I210 by using this mechanism.

The transaction layer decodes the message code and responds to the message accordingly.

**Table 3-6. Supported Message in the I210 (as a Receiver)**

Message Code [7:0]	Routing r2r1r0	Message	I210 Response
0x00	011b	Unlock	Silently drop
0x14	100b	PM_Active_State_NAK	Accepted
0x19	011b	PME_Turn_Off	Accepted
0x40 0x41 0x43 0x44 0x45 0x47 0x48	100b	Ignored messages (used to be hot-plug messages)	Silently drop
0x50	100b	Slot power limit support (has one Dword data)	Silently drop
0x7E	000b 010b 011b 100b	Vendor_defined type 0	Drop and handle as an Unsupported Request
0x7F	100b	Vendor_defined type 1	Silently drop
0x7F	000b 010b 011b	Vendor_defined type 1 (see <a href="#">Section 3.1.4.3.3</a> )	Send to MCTP reassembly if Vendor ID = 0x1AB4 (DMTF) and VDM code - 0000b (MCTP). Otherwise, silently drop





### 3.1.4.3.2 Message Handling by I210 (as a Transmitter)

The transaction layer is also responsible for transmitting specific messages to report internal/external events (such as interrupts and PMEs).

**Table 3-7. Supported Message in the I210 (as a Transmitter)**

Message code [7:0]	Routing r2r1r0	Message
0x20	100	Assert INT A
0x21	100	Not used
0x22	100	Not used
0x23	100	Not used
0x24	100	Deassert INT A
0x25	100	Not used
0x26	100	Not used
0x27	100	Not used
0x30	000	ERR_COR
0x31	000	ERR_NONFATAL
0x33	000	ERR_FATAL
0x18	000	PM_PME
0x1B	101	PME_TO_ACK
0x10	100	Latency Tolerance Reporting (LTR)
0x7F	000, 010, 011,	VDM (see Section 3.1.4.3.3)

### 3.1.4.3.3 Vendor Defined Messages (VDM)

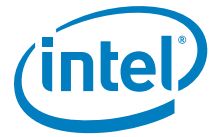
The following vendor defined messages are supported:

- DMTF MCTP

#### 3.1.4.3.3.1 MCTP VDMs

MCTP VDMs are supported as both master and target. The following header fields are involved (see Figure 3-2):

- Fmt - Set to 11b to indicate a 4 Dword header with data
- Type
  - [4:3] set to 10b to indicate a message
  - [2:0] routing r2r1r0 = 000b, 010b or 011b
- Traffic class - Set to 000b
- TLP digest - Set to 0b (no ECRC) unless the ECRC Generation for MCTP in PCIe Control 2 Flash word is set and ECRC generation is enabled.
- Error present - Set to 0b
- Attributes[1:0] - Set to 01b (no snoop)
- Tag field - Indicates this is an MCTP packet and the size of padding to dword alignment added
- Message code = 0x7F (Type 1 VDM)
- Destination ID - captures the target B/D/F for route by ID. Otherwise, reserved
- Vendor ID = 0x1AB4 (DMTF)



+0								+1								+2								+3							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
FMT 011				Type 10r2r1r0				R	TC 000				R	A	t	r	R	T	H	T	E	A	Attr [1:0]	A	T	Length 00_000x_xxxx					
PCI Requester ID																PCI Tag Field						Message Code Vendor Defined = 0111_1111b									
																R	Pad Len		MCTP VDM code - 0000b												
PCI Target ID (For Route by ID messages, otherwise = Reserved)																Vendor ID = 0x1AB4 (DMTF)															

Figure 3-2. MCTP over PCIe VDM Header Format

### 3.1.4.4 Ordering Rules

The I210 meets the PCIe ordering rules (PCI-X rules) by following the PCI simple device model:

- Deadlock avoidance - Master and target accesses are independent. The response to a target access does not depend on the status of a master request to the bus. If master requests are blocked, such as due to no credits, target completions might still proceed (if credits are available).
- Descriptor/data ordering - The I210 does not proceed with some internal actions until respective data writes have ended on the PCIe link:
  - The I210 does not update an internal header pointer until the descriptors that the header pointer relates to are written to the PCIe link.
  - The I210 does not issue a descriptor write until the data that the descriptor relates to is written to the PCIe link.

The I210 might issue the following master read request from each of the following clients:

- One Rx Descriptor Read
- One Tx Descriptor Read
- Tx Data Read (up to 6)

Completing separate read requests are not guaranteed to return in order. Completions for a single read request are guaranteed to return in address order.

#### 3.1.4.4.1 Out of Order Completion Handling

In a split transaction protocol, when using multiple read requests in a multi processor environment, there is a risk that completions arrive from the host memory out of order and interleaved. In this case, the I210 sorts the request completions and transfers them to the Ethernet in the correct order.



### 3.1.4.5 Transaction Definition and Attributes

#### 3.1.4.5.1 Max Payload Size

The I210 policy to determine Max Payload Size (MPS) is as follows:

- Master requests initiated by the I210 (including completions) limits MPS to the value defined for the function issuing the request.
- Target write accesses to the I210 are accepted only with a size of one Dword or two Dwords. Write accesses in the range of (three Dwords, MPS, etc.) are flagged as UR. Write accesses above MPS are flagged as malformed.

#### 3.1.4.5.2 Relaxed Ordering

The I210 takes advantage of the relaxed ordering rules in PCIe. By setting the relaxed ordering bit in the packet header, the I210 enables the system to optimize performance in the following cases:

- Relaxed ordering for descriptor and data reads: When the I210 emits a read transaction, its split completion has no ordering relationship with the writes from the CPUs (same direction). It should be allowed to bypass the writes from the CPUs.
- Relaxed ordering for receiving data writes: When the I210 issues receive DMA data writes, it also enables them to bypass each other in the path to system memory because software does not process this data until their associated descriptor writes complete.
- The I210 cannot relax ordering for descriptor writes, MSI/MSI-X writes or PCIe messages.

Relaxed ordering can be used in conjunction with the no-snoop attribute to enable the memory controller to advance non-snoop writes ahead of earlier snooped writes.

Relaxed ordering is enabled in the I210 by clearing the *RO\_DIS* bit in the CTRL\_EXT register. Actual setting of relaxed ordering is done for LAN traffic by the host through the DCA registers.

#### 3.1.4.5.3 Snoop Not Required

The I210 sets the *Snoop Not Required* attribute bit for master data writes. System logic might provide a separate path into system memory for non-coherent traffic. The non-coherent path to system memory provides higher, more uniform, bandwidth for write requests.

**Note:** The *Snoop Not Required* attribute does not alter transaction ordering. Therefore, to achieve maximum benefit from *Snoop Not Required* transactions, it is advisable to set the relaxed ordering attribute as well (assuming that system logic supports both attributes). In fact, some chipsets require that relaxed ordering is set for no-snoop to take effect.

Global no-snoop support is enabled in the I210 by clearing the *NS\_DIS* bit in the CTRL\_EXT register. Actual setting of no snoop is done for LAN traffic by the host through the DCA registers.

#### 3.1.4.5.4 No Snoop and Relaxed Ordering for LAN Traffic

Software might configure non-snoop and relax order attributes for each queue and each type of transaction by setting the respective bits in the RXCTRL and TXCTRL registers.

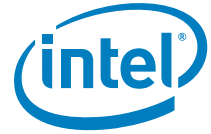


Table 3-8 lists software configuration for the *No-Snoop* and *Relaxed Ordering* bits for LAN traffic when I/OAT 2 is enabled.

**Table 3-8. LAN Traffic Attributes**

Transaction	No-Snoop	Relaxed Ordering	Comments
Rx Descriptor Read	N	Y	
Rx Descriptor Write-Back	N	N	Relaxed ordering must never be used for this traffic.
Rx Data Write	Y	Y	Refer to Note 1 and Section 3.1.4.5.4.1
Rx Replicated Header	N	Y	
Tx Descriptor Read	N	Y	
Tx Descriptor Write-Back	N	Y	
Tx TSO Header Read	N	Y	
Tx Data Read	N	Y	

**Note:**

1. Rx payload no-snoop is also conditioned by the *NSE* bit in the receive descriptor. Refer to Section 3.1.4.5.4.1.

#### 3.1.4.5.4.1 No-Snoop Option for Payload

Under certain conditions, which occur when I/OAT is enabled, software knows that it is safe to transfer (DMA) a new packet into a certain buffer without snooping on the front-side bus. This scenario typically occurs when software is posting a receive buffer to hardware that the CPU has not accessed since the last time it was owned by hardware. This might happen if the data was transferred to an application buffer by the I/OAT DMA engine.

In this case, software should be able to set a bit in the receive descriptor indicating that the I210 should perform a no-snoop DMA transfer when it eventually writes a packet to this buffer.

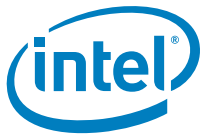
When a non-snoop transaction is activated, the TLP header has a non-snoop attribute in the *Transaction Descriptor* field.

This is triggered by the *NSE* bit in the receive descriptor. Refer to Section 7.1.4.2.

#### 3.1.4.5.5 TLP Processing Hint (TPH)

The *TPH* bit can be set to provide information to the root complex about the cache in which the data should be stored or from which the data should be read as described in Section 7.7.2.

*TPH* is enabled via the *TPH Requester Enable* field in the TPH control register of the configuration space (refer to Section 9.5.3.3). Setting of the *TPH* bit for different type of traffic is listed in Table 7-61.



### 3.1.4.6 Flow Control

#### 3.1.4.6.1 I210 Flow Control Rules

The I210 implements only the default Virtual Channel (VC0). A single set of credits is maintained for VC0.

**Table 3-9. Allocation of FC Credits**

Credit Type	Operations	Number Of Credits
Posted Request Header (PH)	Target Write (one unit) Message (one unit)	Four units
Posted Request Data (PD)	Target Write (Length/16 bytes=1) Message (one unit)	MAX_PAYLOAD_SIZE/16
Non-Posted Request Header (NPH)	Target Read (one unit) Configuration Read (one unit) Configuration Write (one unit)	Four units
Non-Posted Request Data (NPD)	Configuration Write (one unit)	Four units
Completion Header (CPLH)	Read Completion (N/A)	Infinite (accepted immediately)
Completion Data (CPLD)	Read Completion (N/A)	Infinite (accepted immediately)

Rules for FC updates:

- The I210 maintains four credits for NPD at any given time. It increments the credit by one after the credit is consumed and sends an UpdateFC packet as soon as possible. UpdateFC packets are scheduled immediately after a resource is available.
- The I210 provides four credits for PH (such as for four concurrent target writes) and four credits for NPH (such as for four concurrent target reads). UpdateFC packets are scheduled immediately after a resource becomes available.
- The I210 follows the PCIe recommendations for frequency of UpdateFC FCPs.

#### 3.1.4.6.2 Upstream Flow Control Tracking

The I210 issues a master transaction only when the required FC credits are available. Credits are tracked for posted, non-posted, and completions (the later to operate with a switch).

#### 3.1.4.6.3 Flow Control Update Frequency

In any case, UpdateFC packets are scheduled immediately after a resource becomes available.

When the link is in the L0 or L0s link state, Update FCPs for each enabled type of non-infinite FC credit must be scheduled for transmission at least once every 30 μs (-0%/+50%), except when the *Extended Sync* bit of the Control Link register is set, in which case the limit is 120 μs (-0%/+50%).

#### 3.1.4.6.4 Flow Control Timeout Mechanism

The I210 implements the optional FC update timeout mechanism.

The mechanism is activated when the link is in L0 or L0s Link state. It uses a timer with a limit of 200 μs (-0%/+50%), where the timer is reset by the receipt of any Init or Update FCP. Alternately, the timer can be reset by the receipt of any DLLP.



After timer expiration, the mechanism instructs the PHY to re-establish the link (via the LTSSM recovery state).

### 3.1.4.7 Error Forwarding

If a TLP is received with an error-forwarding trailer (poisoned TLP received), the transaction can either be resent or dropped and not delivered to its destination, depending on the *GCR.Completion Timeout resend enable* bit and the *GCR.Number of resends* field. If the re-sends were unsuccessful or if re-send is disabled, the I210 does not initiate any additional master requests for that PCI function until it detects an internal reset or a software reset for the LAN. Software is able to access device registers after such a fault.

System logic is expected to trigger a system-level interrupt to inform the operating system of the problem. The operating system can then stop the process associated with the transaction, re-allocate memory instead of the faulty area, etc.

## 3.1.5 Data Link Layer

### 3.1.5.1 ACK/NAK Scheme

The I210 sends an ACK/NAK immediately in the following cases:

1. NAK needs to be sent
2. ACK for duplicate packet
3. ACK/NAK before low power state entry

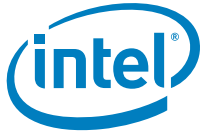
In all other cases, the I210 schedules an ACK transmission according to time-outs specified in the PCIe specification (depends on link speed, link width, and max\_payload\_size).

### 3.1.5.2 Supported DLLPs

The following DLLPs are supported by the I210 as a receiver:

**Table 3-10. DLLPs Received by the I210**

DLLP type	Remarks
ACK	
NAK	
PM_Request_ACK	
InitFC1-P	Virtual Channel 0 only
InitFC1-NP	Virtual Channel 0 only
InitFC1-Cpl	Virtual Channel 0 only
InitFC2-P	Virtual Channel 0 only
InitFC2-NP	Virtual Channel 0 only
InitFC2-Cpl	Virtual Channel 0 only
UpdateFC-P	Virtual Channel 0 only
UpdateFC-NP	Virtual Channel 0 only
UpdateFC-Cpl	Virtual Channel 0 only



The following DLLPs are supported by the I210 as a transmitter:

**Table 3-11. DLLPs Initiated by the I210**

DLLP type	Remarks
ACK	
NAK	
PM_Enter_L1	
PM_Enter_L23	
PM_Active_State_Request_L1	
InitFC1-P	Virtual Channel 0 only
InitFC1-NP	Virtual Channel 0 only
InitFC1-Cpl	Virtual Channel 0 only
InitFC2-P	Virtual Channel 0 only
InitFC2-NP	Virtual Channel 0 only
InitFC2-Cpl	Virtual Channel 0 only
UpdateFC-P	Virtual Channel 0 only
UpdateFC-NP	Virtual Channel 0 only

**Note:** UpdateFC-Cpl is not sent because of the infinite FC-Cpl allocation.

### 3.1.5.3 Transmit EDB Nullifying

If re-train is necessary, there is a need to guarantee that no abrupt termination of the Tx packet happens. For this reason, early termination of the transmitted packet is possible. This is done by appending an End Bad Symbol (EDB) to the packet.

## 3.1.6 Physical Layer

### 3.1.6.1 Link Speed

- The I210 supports only 2.5GT/s link speeds.

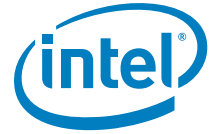
The I210 does not initiate a hardware autonomous speed change and as a result the *Hardware Autonomous Speed Disable* bit in the PCIe Link Control 2 register is hardwired to 0b.

The I210 supports entering compliance mode at the speed indicated in the *Target Link Speed* field in the PCIe Link Control 2 register. Compliance mode functionality is controlled via the *Enter Compliance* bit in the PCIe Link Control 2 register.

### 3.1.6.2 Link Width

The I210 supports a maximum link width of x1.

During link configuration, the platform and the I210 negotiate on a common link width. The link width must be x1.



### 3.1.6.3 Polarity Inversion

If polarity inversion is detected, the receiver must invert the received data.

During the training sequence, the receiver looks at Symbols 6-15 of TS1 and TS2 as the indicator of lane polarity inversion (D+ and D- are swapped). If lane polarity inversion occurs, the TS1 Symbols 6-15 received are D21.5 as opposed to the expected D10.2. Similarly, if lane polarity inversion occurs, Symbols 6-15 of the TS2 ordered set are D26.5 as opposed to the expected D5.2. This provides clear indication of lane polarity inversion.

### 3.1.6.4 L0s Exit latency

The number of FTS sequences (N\_FTS) sent during L1 exit, can be loaded from the Flash.

### 3.1.6.5 Reset

The PCIe PHY can supply a core reset to the I210. The reset can be caused by three sources:

1. Upstream move to hot reset - Inband Mechanism (LTSSM).
2. Recovery failure (LTSSM returns to detect).
3. Upstream component moves to disable.

### 3.1.6.6 Scrambler Disable

The scrambler/de-scrambler functionality in the I210 can be disabled by either one of the two connected devices according to the PCIe specification.

## 3.1.7 Error Events and Error Reporting

### 3.1.7.1 Mechanism in General

PCIe defines two error reporting paradigms: the baseline capability and the Advanced Error Reporting (AER) capability. The baseline error reporting capabilities are required of all PCIe devices and define the minimum error reporting requirements. The AER capability is defined for more robust error reporting and is implemented with a specific PCIe capability structure.

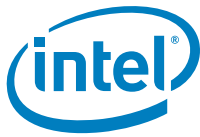
Both mechanisms are supported by the I210.

Also, the *SERR# Enable* and the *Parity Error* bits from the Legacy Command register take part in the error reporting and logging mechanism.

### 3.1.7.2 Error Events

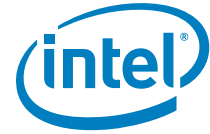
Table 3-12 lists the error events identified by the I210 and the response in terms of logging, reporting, and actions taken. Consult the PCIe specification for the effect on the PCI Status register.





**Table 3-12. Response and Reporting of PCIe Error Events**

Error Name	Error Events	Default Severity	Action
PHY errors			
Receiver error	8b/10b decode errors Packet framing error	Correctable. Send ERR_CORR	TLP to initiate NAK and drop data. DLLP to drop.
Data link errors			
Bad TLP	<ul style="list-style-type: none"> <li>Bad CRC</li> <li>Not legal EDB</li> <li>Wrong sequence number</li> </ul>	Correctable. Send ERR_CORR	TLP to initiate NAK and drop data.
Bad DLLP	<ul style="list-style-type: none"> <li>Bad CRC</li> </ul>	Correctable. Send ERR_CORR	DLLP to drop.
Replay timer timeout	<ul style="list-style-type: none"> <li>REPLAY_TIMER expiration</li> </ul>	Correctable. Send ERR_CORR	Follow LL rules.
REPLAY NUM rollover	<ul style="list-style-type: none"> <li>REPLAY NUM rollover</li> </ul>	Correctable. Send ERR_CORR	Follow LL rules.
Data link layer protocol error	<ul style="list-style-type: none"> <li>Violations of Flow Control Initialization Protocol</li> <li>Reception of NACK/ACK with no corresponding TLP</li> </ul>	Uncorrectable. Send ERR_FATAL	Follow LL rules.
TLP errors			
Poisoned TLP received	<ul style="list-style-type: none"> <li>TLP with error forwarding</li> </ul>	Uncorrectable. ERR_NONFATAL Log header	A poisoned completion is ignored and the request can be retried after timeout. If enabled, the error is reported.
Unsupported Request (UR)	<ul style="list-style-type: none"> <li>Wrong config access</li> <li>MRdLk</li> <li>Configuration request type 1</li> <li>Unsupported vendor Defined type 0 message</li> <li>Not valid MSG code</li> <li>Not supported TLP type</li> <li>Wrong function number</li> <li>Received TLP outside address range</li> </ul>	Uncorrectable. ERR_NONFATAL Log header	Send completion with UR.
Completion timeout	<ul style="list-style-type: none"> <li>Completion timeout timer expired</li> </ul>	Uncorrectable. ERR_NONFATAL	Error is non-fatal (default case): <ul style="list-style-type: none"> <li>Send error message if advisory</li> <li>Retry the request once and send advisory error message on each failure</li> <li>If fails, send uncorrectable error message</li> </ul> Error is defined as fatal: <ul style="list-style-type: none"> <li>Send uncorrectable error message</li> </ul>
Completer abort	<ul style="list-style-type: none"> <li>Received target access with data size &gt; 64-bit</li> </ul>	Uncorrectable. ERR_NONFATAL Log header	Send completion with CA.
Unexpected completion	<ul style="list-style-type: none"> <li>Received completion without a request for it (tag, ID, etc.)</li> </ul>	Uncorrectable. ERR_NONFATAL Log header	Discard TLP.
Receiver overflow	<ul style="list-style-type: none"> <li>Received TLP beyond allocated credits</li> </ul>	Uncorrectable. ERR_FATAL	Receiver behavior is undefined.
Flow control protocol error	<ul style="list-style-type: none"> <li>Minimum initial flow control advertisements</li> <li>Flow control update for infinite credit advertisement</li> </ul>	Uncorrectable. ERR_FATAL	Receiver behavior is undefined. The I210 doesn't report violations of flow control initialization protocol


**Table 3-12. Response and Reporting of PCIe Error Events (Continued)**

Error Name	Error Events	Default Severity	Action
Malformed TLP (MP)	<ul style="list-style-type: none"> <li>Data payload exceed Max_Payload_Size</li> <li>Received TLP data size does not match length field</li> <li>TD field value does not correspond with the observed size</li> <li>Power management messages that doesn't use TC0.</li> <li>Usage of unsupported VC.</li> </ul>	Uncorrectable. ERR_FATAL Log header	Drop the packet and free FC credits.
Completion with unsuccessful completion status		No action (already done by originator of completion).	Free FC credits.
Byte count integrity in completion process.	When byte count isn't compatible with the length field and the actual expected completion length. For example, length field is 10 (in Dword), actual length is 40, but the byte count field that indicates how many bytes are still expected is smaller than 40, which is not reasonable.	No action	The I210 doesn't check for this error and accepts these packets. This might cause a completion timeout condition.

### 3.1.7.3 Error Forwarding (TLP Poisoning)

If a TLP is received with an error-forwarding trailer, the transaction can be re-sent a number of times as programmed in the GCR register. If transaction still fails the packet is dropped and is not delivered to its destination. The I210 then reacts as listed in [Table 3-12](#).

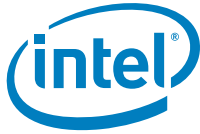
The I210 does not initiate any additional master requests for that PCI function registers until it detects an internal software reset for the LAN port. Software is able to access device registers after such a fault.

System logic is expected to trigger a system-level interrupt to inform the operating system of the problem. Operating systems can then stop the process associated with the transaction, re-allocate memory instead of the faulty area, etc.

### 3.1.7.4 ECRC

The I210 supports End to End CRC (ECRC) as defined in the PCIe specification. The following functionality is provided:

- Inserting an ECRC in all transmitted TLPs:
  - The I210 indicates support for inserting ECRC in the *ECRC Generation Capable* bit of the PCIe configuration registers. This bit is loaded from the ECRC Generation Flash bit.
  - Inserting an ECRC is enabled by the *ECRC Generation Enable* bit of the PCIe configuration registers. For MCTP packets, it is also controlled by the ECRC Generation for MCTP in PCIe Control 2 Flash word.
- ECRC is checked on all incoming TLPs. A packet received with an ECRC error is dropped. Note that for completions, a completion timeout occurs later (if enabled), which would result in re-issuing the request.
  - The I210 indicates support for ECRC checking in the *ECRC Check Capable* bit of the PCIe configuration registers. This bit is loaded from the ECRC Check Flash bit.
  - ECRC checking is enabled by the *ECRC Check Enable* bit of the PCIe configuration registers.
- ECRC errors are reported.



### 3.1.7.5 Partial Read and Write Requests

#### 3.1.7.5.1 Partial Memory Accesses

The I210 has limited support of read/write requests with only part of the byte enable bits set:

- Partial writes with at least one byte enabled should not be used. If used, the results are unexpected, either the byte enable request is honored or the entire Dword is written.
- Zero-length writes has no internal impact (nothing written, no effect such as clear-by-write). The transaction is treated as a successful operation (no error event).
- Partial reads with at least one byte enabled are handled as a full read. Any side effect of the full read (such as clear by read) is also applicable to partial reads.
- Zero-length reads generate a completion, but the register is not accessed and undefined data is returned.

The I210 does not generate an error indication in response to any of the above events.

#### 3.1.7.5.2 Partial I/O Accesses

- Partial access on address
  - A write access is discarded
  - A read access returns 0xFFFF
- Partial access on data, where the address access was correct
  - A write access is discarded
  - A read access performs the read

### 3.1.7.6 Error Pollution

Error pollution can occur if error conditions for a given transaction are not isolated on the error's first occurrence. If the physical layer detects and reports a receiver error, to avoid having this error propagate and cause subsequent errors at upper layers, the same packet is not signaled at the data link or transaction layers.

Similarly, when the data link layer detects an error, subsequent errors that occur for the same packet are not signaled at the transaction layer.

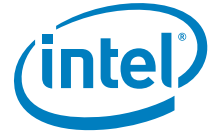
### 3.1.7.7 Completion with Unsuccessful Completion Status

A completion with unsuccessful completion status is dropped and not delivered to its destination. An interrupt is generated to indicate unsuccessful completion.

### 3.1.7.8 Error Reporting Changes

The Rev. 1.1 specification defines two changes to advanced error reporting. A new *Role-Based Error Reporting* bit in the Device Capabilities register is set to 1b to indicate that these changes are supported by the I210. These changes are:

1. Setting the *SERR# Enable* bit in the PCI Command register also enables UR reporting (in the same manner that the *SERR# Enable* bit enables reporting of correctable and uncorrectable errors). In other words, the *SERR# Enable* bit overrides the *UR Error Reporting Enable* bit in the PCIe Device Control register.



2. Changes in the response to some uncorrectable non-fatal errors, detected in non-posted requests to the I210. These are called advisory non-fatal error cases. For each of the errors that follow, the following behavior is defined:
  - a. The *Advisory Non-Fatal Error Status* bit is set in the Correctable Error Status register to indicate the occurrence of the advisory error and the *Advisory Non-Fatal Error Mask* corresponding bit in the Correctable Error Mask register is checked to determine whether to proceed further with logging and signaling.
  - b. If the *Advisory Non-Fatal Error Mask* bit is clear, logging proceeds by setting the corresponding bit in the Uncorrectable Error Status register, based upon the specific uncorrectable error that's being reported as an advisory error. If the corresponding uncorrectable error bit in the Uncorrectable Error Mask register is clear, the First Error Pointer and Header Log registers are updated to log the error, assuming they are not still occupied by a previously unserved error.
  - c. An ERR\_COR message is sent if the *Correctable Error Reporting Enable* bit is set in the Device Control register. An ERROR\_NONFATAL message is not sent for this error.

The following uncorrectable non-fatal errors are considered as advisory non-fatal Errors:

- A completion with an Unsupported Request or Completer Abort (UR/CA) status that signals an uncorrectable error for a non-posted request. If the severity of the UR/CA error is non-fatal, the completer must handle this case as an advisory non-fatal error.
- When the requester of a non-posted request times out while waiting for the associated completion, the requester is permitted to attempt to recover from the error by issuing a separate subsequent request, or to signal the error without attempting recovery. The requester is permitted to attempt recovery zero, one, or multiple (finite) times, but must signal the error (if enabled) with an uncorrectable error message if no further recovery attempts are made. If the severity of the completion timeout is non-fatal and the requester elects to attempt recovery by issuing a new request, the requester must first handle the current error case as an advisory non-fatal error.
- Reception of a poisoned TLP. Refer to [Section 3.1.7.3](#).
- When a receiver receives an unexpected completion and the severity of the unexpected completion error is non-fatal, the receiver must handle this case as an advisory non-fatal error.

### 3.1.7.9 Completion with Unsupported Request (UR) or Completer Abort (CA)

A DMA master transaction ending with an Unsupported Request (UR) completion or a Completer Abort (CA) completion causes all PCIe master transactions to stop, *PICAUSE.ABR* bit is set and an interrupt is generated if the appropriate *Mask* bits are set. To enable PCIe master transactions after receiving an UR or CA completion, software should issue a Device Reset (*CTRL.DEV\_RST*) and re-initialize the function.

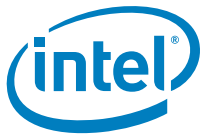
**Note:** Asserting *CTRL.DEV\_RST* flushes any pending transactions on the PCIe and reset's the port.

### 3.1.8 PCIe Power Management

Described in [Section 5.4.1](#) - Power Management.

### 3.1.9 PCIe Programming Interface

Described in [Chapter 9.0](#) - PCIe Programming Interface



## 3.2 Management Interfaces

The I210 contains three possible interfaces to an external MC.

- SMBus
- NC-SI
- MCTP (over PCIe or SMBus)

### 3.2.1 SMBus

SMBus is an optional interface for pass-through and/or configuration traffic between an external MC and the I210. The SMBus channel behavior and the commands used to configure or read status from the I210 are described in [Section 10.5](#).

The I210 also enables reporting and controlling the device using the MCTP protocol over SMBus. The MCTP interface is used by the MC to control the NIC and for pass through traffic. For additional information, refer to [Section 10.7](#).

#### 3.2.1.1 Channel Behavior

The SMBus specification defines a maximum frequency of 100 KHz. However, when acting as a slave, the I210 can receive transaction with a clock running at up to 1 MHz. When acting as a master, it can toggle the clock at 100 KHz, 400 KHz or 1 MHz. The speed used is set by the *SMBus Connection Speed* field in the SMBus Notification Timeout and Flags Flash word ([Section 6.7.3.3](#)).

### 3.2.2 NC-SI

The NC-SI interface in the I210 is a connection to an external MC defined by the DMTF NC-SI protocol. It operates as a single interface with an external MC, where all traffic between the I210 and the MC flows through the interface.

The I210 supports the standard DMTF NC-SI protocol for both pass-through and control traffic as defined in [Section 10.6](#).

#### 3.2.2.1 Electrical Characteristics

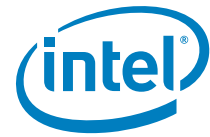
The I210 complies with the electrical characteristics defined in the NC-SI specification.

The I210 NC-SI behavior is configured on power-up in the following manner:

- The *Multi-Drop NC-SI* Flash bit (refer to [Section 6.7.1.3](#)) defines the NC-SI topology (point-to-point or multi-drop; the default is multi-drop).

The I210 dynamically drives its NC-SI output signals (NC-SI\_DV and NC-SI\_RX) as required by the sideband protocol:

- On power-up, the I210 floats the NC-SI outputs.
- If the I210 operates in point-to-point mode, then the I210 starts driving the NC-SI outputs some time following power-up.
- If the I210 operates in a multi-drop mode, the I210 drives the NC-SI outputs as configured by the MC.



### 3.2.2.2 NC-SI Transactions

The NC-SI link supports both pass-through traffic between the MC and the I210 LAN functions, as well as configuration traffic between the MC and the I210 internal units as defined in the NC-SI protocol. Refer to [Section 10.6.2](#) for information.

### 3.2.3 MCTP (over PCIe or SMBus)

The I210 supports MCTP protocol for management. MCTP runs over PCIe or SMBus. The I210 implements NC-SI over MCTP protocol for command and pass through traffic.

## 3.3 Flash

### 3.3.1 General Overview

The I210 uses a Flash device for storing product configuration information. The Flash is divided into four general regions:

- **Hardware Accessed** — Loaded by the the I210 hardware after power-up, PCI reset de-assertion, D3 to D0 transition, or software reset. Different hardware sections in the Flash are loaded at different events. For more details on power-up and reset sequences, see [Section 4.0](#).
- **Secure Firmware Area** — Firmware code and structures used by the firmware for management configuration in its different modes.
- **Unsecure Firmware Area** — Same as above -Firmware code and structures used by the firmware for management configuration in its different modes. This area is used by the software for updating the new firmware code and structures.
- **Software Accessed** — used by software only. The meaning of these words as listed here is a convention for the software only and is ignored by the I210. This region is used by software entities such as LAN drivers, option ROM software and tools, PCIe bus drivers etc. The content of this area is listed here as a convenience for software developers only and is ignored by the I210 hardware.

**Note:** The role played by the secured area and the unsecured area is toggled on every Firmware update. This is referred as the double bank update policy.

The I210 merges the legacy EEPROM and Flash content in a single Flash device. Flash devices require a sector erase instruction in case a cell is modified from 0b to 1b. As a result, in order to update a single byte (or block of data) it is required to erase it first. The I210 supports Flash devices with a sector erase size of 4 KB. Note that many Flash vendors are using the term sector differently. The I210 EAS uses the term Flash sector for a logic section of 4 KB.

The I210 supports Flash devices that are either write-protected by default after power-up or not. The I210 removes the protection by sending the write-protection removal OpCode to the Flash after power up. For the first programming of a blank Flash, it is the host's responsibility to remove the write-protection from the Flash part via bit-banging access. Refer to [Section 11.8](#) for the list of the Flash devices supported by the I210.



The following OpCodes must be supported by the I210 as they are common to all the supported Flash devices:

Name	Opcode	Description
WREN	0x6	Write Enable
RDID	0x9f	Read JEDEC Manufacture ID
WRSR	0x1	Write Status
READ	0x3	Flash Read
RDSR	0x5	Read Flash Status
Sector Erase	0x20	4 KB Sector Erase
Flash Erase	0xc7	Flash Erase
Page Program	0x2	Write to the Flash
Fast Read	0x0b	Read data bytes at higher speed

The other OpCodes to be supported are loaded from the firmware secured area into a set of Flash Opcode registers.

### 3.3.1.1 EEPROM Image Structures

The first valid 4 KB of the Flash is referred herein as the EEPROM Image or as the shadow RAM.

It contains the pointers to all Flash modules, which can be mapped either inside or outside the EEPROM image. Flash words in the EEPROM image that do not belong to any pointed module are referred to as the Flash header.

The Flash mapping is described in [Chapter 6.0](#).

### 3.3.1.2 Flash Detection, NVM Validity Field, and Non-Secure Mode

The I210 supports detection of Flash existence following power-up and detection of a valid Flash image via the *NVM Validity* field in the NVM Validity and Protected Fields Flash word 0x12 (refer to [Section 6.2.8](#)).

The I210 enters non-secure mode (blank Flash programming mode) in the following scenarios:

- No Flash device is detected
- Invalid NVM Validity field read from Flash word 0x12
- The NVM\_SEC\_EN bit is read as 0b from Flash word 0x12
- Device ID field read from firmware image is not the I210's 0x1531 Device ID
- The SECURITY\_ENABLE strap is off

In non-secure mode, all Flash access interfaces from the host to any Flash area or word are enabled in full.

In cases of an invalid NVM Validity field contents, or no Flash detection, auto-load from Flash by hardware or firmware after power-up or reset is not performed.



As a physical recovery method required for manufacturing, the non-secure mode can also be entered by setting a strapping option. Only host access to Flash and shadow RAM is guaranteed when in this mode.

Similarly, as a means to recover from an operational error that might occur during Flash programming, the ROM-based firmware enters the device into non-secure mode if the I210 *Blank Flash Device ID* field content read from the firmware image is not 0x1531, which is used by the tools for specific the I210 SKUs.

Unless specified otherwise, secure mode is assumed throughout this document.

### 3.3.2 Shadow RAM

The I210 maintains the first two 4 KB sectors, Sector 0 and Sector 1, for the hardware configuration content. At least one of these two sectors must be valid at any given time or else the I210 is set by hardware default (iNVM). Following a Power On Reset (POR), the I210 copies the valid lower 4 KB sector of the Flash device into an internal shadow RAM. Any further accesses of the software or firmware to this section of the Flash are directed to the internal shadow RAM. After a software command, modifications made to the shadow RAM content are then copied by the I210 manageability into the other 4 KB sector of the Flash, flipping circularly the valid sector between sector 0 and 1 of Flash.

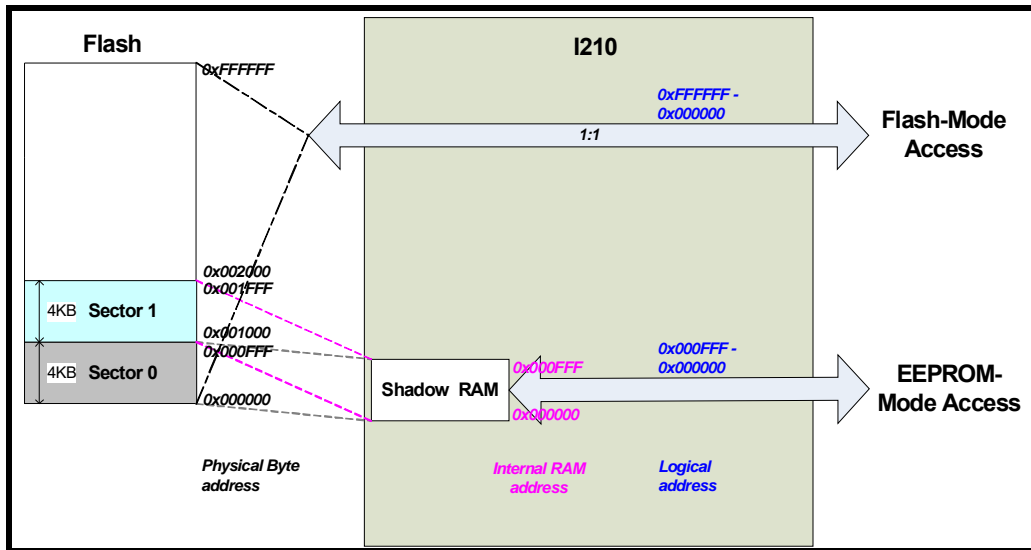
Due to Flash security reasons, hardware does not allow any Flash accesses until the Flash is authenticated and the blocked (protected) sections of the Flash are identified. See more on Flash security in [Section 3.3.10](#).

This mechanism provides the following advantages:

1. A seamless backward compatible read/write interface for software to the first 4 KB of the Flash as if an external EEPROM device was connected. This interface is referred as EEPROM-mode access to the Flash.
2. A way for software to protect image-update procedure from power down events by establishing a double-image policy. It relies on having pointers to all the other Flash modules mapped in the Flash sector which is mirrored in the internal shadow RAM.

[Figure 3.3](#) shows the shadow RAM mapping and interface.





**Figure 3.3. Flash Shadow RAM**

Following a write access by software or firmware to the shadow RAM, the data should finally be updated in the Flash as well. The I210 manageability updates the Flash from the shadow RAM when software requests explicitly to update the Flash by setting the *FLUPD* bit in the EEC register. For saving Flash updates, it is expected that software set the *FLUPD* bit only once it has completed the last write access to the Flash. The I210 manageability then copies the content of the shadow RAM to the non-valid configuration sector and makes it the valid one.

**Notes:** Software should be aware that programming the Flash might require a long latency due to the Flash update sequence handled by manageability. The sector erase command by itself can last hundreds of milliseconds. Software must poll the *FLUDONE* bit in the EEC register to check whether or not the Flash programming completed.

Each time the Flash content is not valid (blank configuration sectors or wrong NVM Validity field contents in both sector 0 and 1) EEPROM access mode is turned off. Software should rather use one of the three flash access means described in [Section 3.3.3](#).

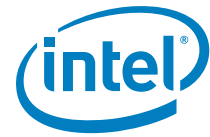
### 3.3.2.1 Protected Areas and Words

The I210 provides a mechanism to define selected areas (two areas) in the shadow RAM that cannot be written by the host; however, the protected areas can be read by the host. They can be write accessed only by the manageability subsystem. The two protected areas are defined via the following registers:

1. The first protected area is a segment defined by words 0x2D and 0x2C that define the start and the end of this read-only area. They are used to load the *1st Start Address* and the *1st End Address* fields in *EEBLKBASE* and *EEBLKEND* registers, respectively.
2. The second protected area is located at the end of the 4 KB shadow RAM. Its size from the shadow RAM's end is defined in Flash word 0x12. It is used to load the *2nd Start Address* field in *EEBLKBASE* register.

For security reasons, the following Flash modules must be mapped into one of the protected areas:

- SW Reset CSR Auto Configuration Pointer (LAN Base Address + Offset 0x17) - [Section 6.3](#)
- PCIe Reset CSR Auto Configuration Pointer (LAN Base Address + Offset 0x23) - [Section 6.4](#)
- CSR Auto Configuration Power-Up Pointer (Offset 0x27) - [Section 6.5](#)



Besides these configurable protected areas, some fixed Flash words in the Flash header are also write-protected from host (RO for host, RW for manageability). It concerns mainly pointers to Flash modules and other Flash words that are critical for the host to device connectivity over PCIe.

Refer to the right-most column in [Table 6-1](#) for the list of protected words.

Any host attempt to write a protected area or word is silently discarded.

Besides protected areas and words mapped in the shadow RAM, the Secure Firmware Area (pointed by Flash word 0x10) is always write protected from host. The size of this area is defined in the `size` field in the module itself.

### 3.3.3 Flash Clients and Interfaces

There are several clients that can access the Flash to different address ranges via different access modes, methods, and interfaces. The various clients to the Flash are software tools (BIOS, etc.), drivers, MC (via firmware), and VPD software.

[Table 3-13](#) lists the different accesses to the Flash.

**Table 3-13. Clients and Access Types to the Flash**

Client	Flash Access Method	Flash Access Mode	Logical Byte Address Range	Flash Access Interface (CSRs or Other)
VPD Software	Parallel (32-bits)	EEPROM	0x000000 - 0x0003FF	VPD Address and Data registers (PCI_E config space), via shadow RAM logic. Any write access is pushed by the I210 into the Flash as soon as possible. VPD module must be located in the first valid Flash sector.
Software	Parallel (16-bits)	EEPROM	0x000000 - 0x000FFF	EERD, EEWR, via shadow RAM logic.
	Parallel (32-bits)	Flash	0x000000 - 0x001FFF	Memory mapped via BARs. Write access to this range is not allowed when in Secure mode. The transaction is completed but not executed.
		Flash	0x002000 - 0xFFFFF	Memory mapped via BARs.
	Parallel (32-bits)	Flash	0x000000 - 0x001FFF	FLSW* register set - Software/Flash burst control. Write access to this range is not allowed when in Secure mode. The transaction is completed with FLSWCTL.CMDV bit cleared and not executed.
		Flash	0x002000 - 0xFFFFF	FLSW* register set - Software/Flash burst control
Software	Bit-banging (1-bit)	Flash	0x000000 - 0xFFFFF	FLA. Access allowed to Software only when in the non-secure mode.

**Note:** Firmware saves words like SMBus Slave Addresses or Signature, which are saved into the Flash at the firmware’s initiative. Software attempts to write access protected areas or words are silently discarded (access completed but not executed).



### 3.3.3.1 Memory Mapped Host Interface

The Flash device can be mapped into memory and/or I/O address space of the PF through the use of Base Address Registers (BARs).

Clearing the *FLBAR\_Size* and *CSR\_Size* fields in PCIe Control 2 Flash word (Word 0x28) to 0b, disables Flash mapping to PCI space via the Flash Base Address register.

Setting the *LAN Boot Disable* bit in the Initialization Control 3 Flash word, disables Flash mapping to the PCI space via the Expansion ROM Base Address register

Using the legacy Flash transactions, the Flash is read from, or written to (under Flash security rules), by The I210 each time the host CPU performs a read or a write operation to a memory location that is within the Flash address mapping or upon boot via accesses in the space indicated by the Expansion ROM Base Address register. Accesses to the Flash are based on a direct decode of CPU accesses to a memory window defined in either:

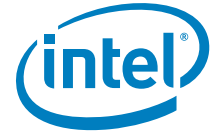
- Memory CSR + Flash Base Address Register (PCIe Control Register at offset 0x10). Refer to [Section 9.3.11](#). Memory BAR accesses are mapped to the Flash, starting from word address 0x0, and up to the exposed BAR size - never beyond it.
- The Expansion ROM Base Address Register (PCIe Control Register at offset 0x30). Refer to [Section 9.3.15](#). Expansion-ROM BAR accesses are mapped to the Flash, starting from the fixed word address 0x1000. For example, just after the first 8 KB used for the shadow RAM banks.
  - a. For *BAR\_SIZE* = 0.5 MB, read accesses to the last 8 KB of the Expansion-ROM BAR returns unpredictable data. Refer to [Figure 3-4](#).
  - b. For *BAR\_SIZE* >= 1 MB, read accesses beyond (1 MB - 8 KB) of the Expansion-ROM BAR returns unpredictable data. Refer to [Figure 3-5](#).

For accesses through any of the two BARs, the following occurs:

- If the Flash part is larger than the exposed BAR size (for saving operating system address space), accesses to the upper Flash addresses are not possible through the BAR.
- If the Flash part is smaller than the exposed BAR size (further to a wrong Flash setting or because of the 128 KB added for CSRs), accesses are (naturally) wrapped around when attempting to access upper addresses.

The I210 is responsible to map accesses via the Expansion ROM BAR to the physical Flash. The offset in the Flash of the Expansion ROM module is fixed and starts at word address 0x001000.

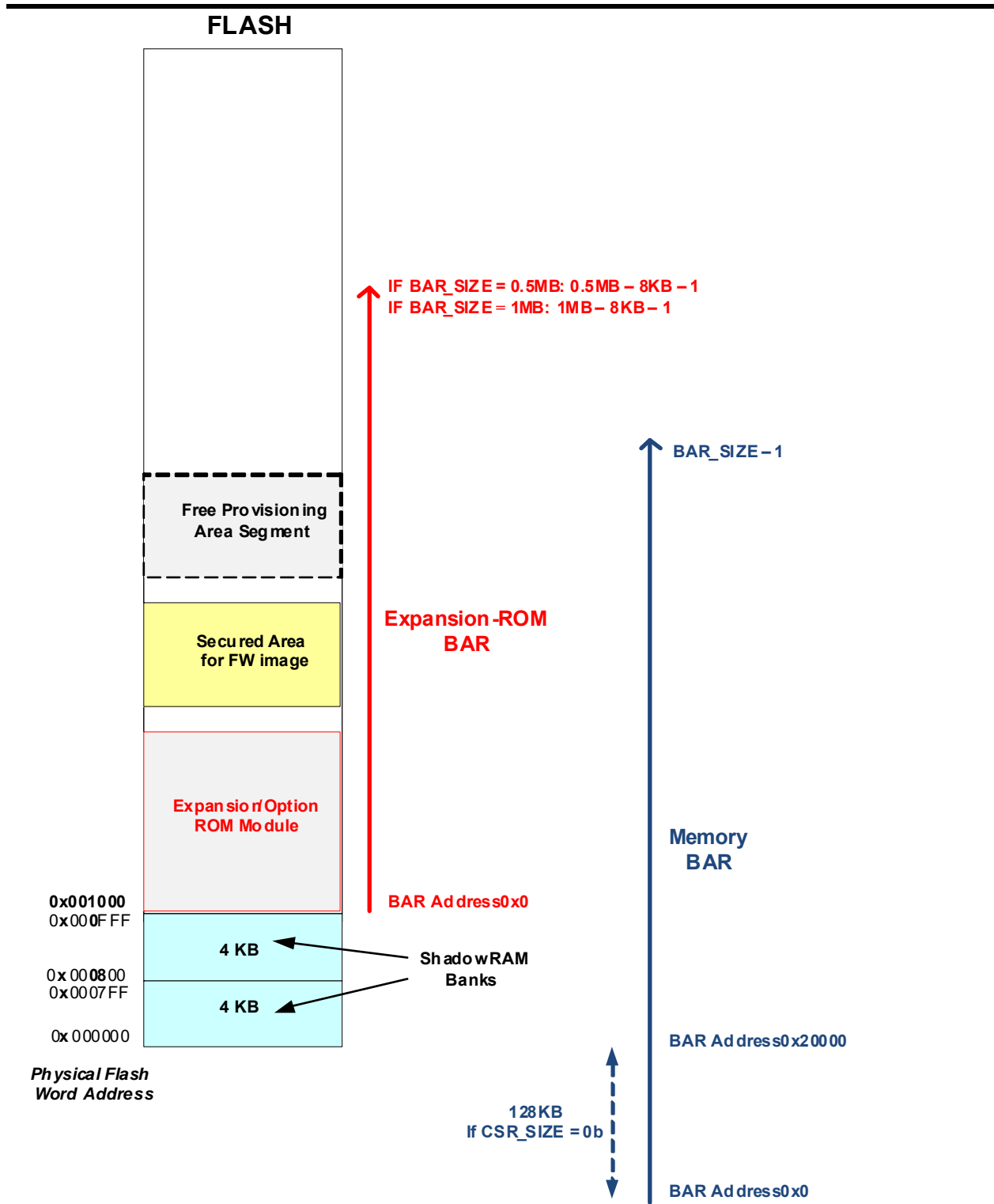
- If there is no valid Flash Validity field in the two first 4 KB sectors, then Expansion ROM BAR is disabled.
- When present, the Expansion-ROM module must be mapped starting from word address 0x1000. For example, just after the first 8 KB of the Flash.
- When no Expansion-ROM module is present, the Flash area starting from word address 0x1000 can be used for other modules mapped outside of the shadow RAM (such as the firmware image).



The I210 controls accesses to the Flash when it decodes a valid access. Attempts to out-of-range write access the PCIe Expansion/Option ROM module (beyond the provisioned 512 KB) is silently ignored, while read access might return any value. The same is done for out-of-range accesses to the host memory BAR.

- Notes:** The I210 supports four byte writes to the Flash. Byte Enable (BE) pins can be set in a consecutive way (starting from 0) for writing less than four bytes.
- Flash read accesses are assembled by the I210 each time the access is greater than a byte-wide access.
- Flash read access times is in the order of 2  $\mu$ s (depending on Flash specification). The device continues to issue retry accesses during this time.
- Flash write access times can be in the order of 2  $\mu$ s to 200  $\mu$ s (depending on Flash specification). Following a write access to the Flash, software should avoid initiating any read or write access to the device until the Flash write access completes.

While in the non-secure mode, Flash BAR access while FLA.FL\_REQ is asserted (and granted) is forbidden. It can lead to a PCIe hang as a bit-banging access requires several PCIe accesses. [Figure 3-4](#) and [Figure 3-5](#) show the BARs mapping schemes according to the size of the BAR vs. the Flash memory sizes supported.



**Figure 3-4. Flash Part Size is Larger Than BAR Size**

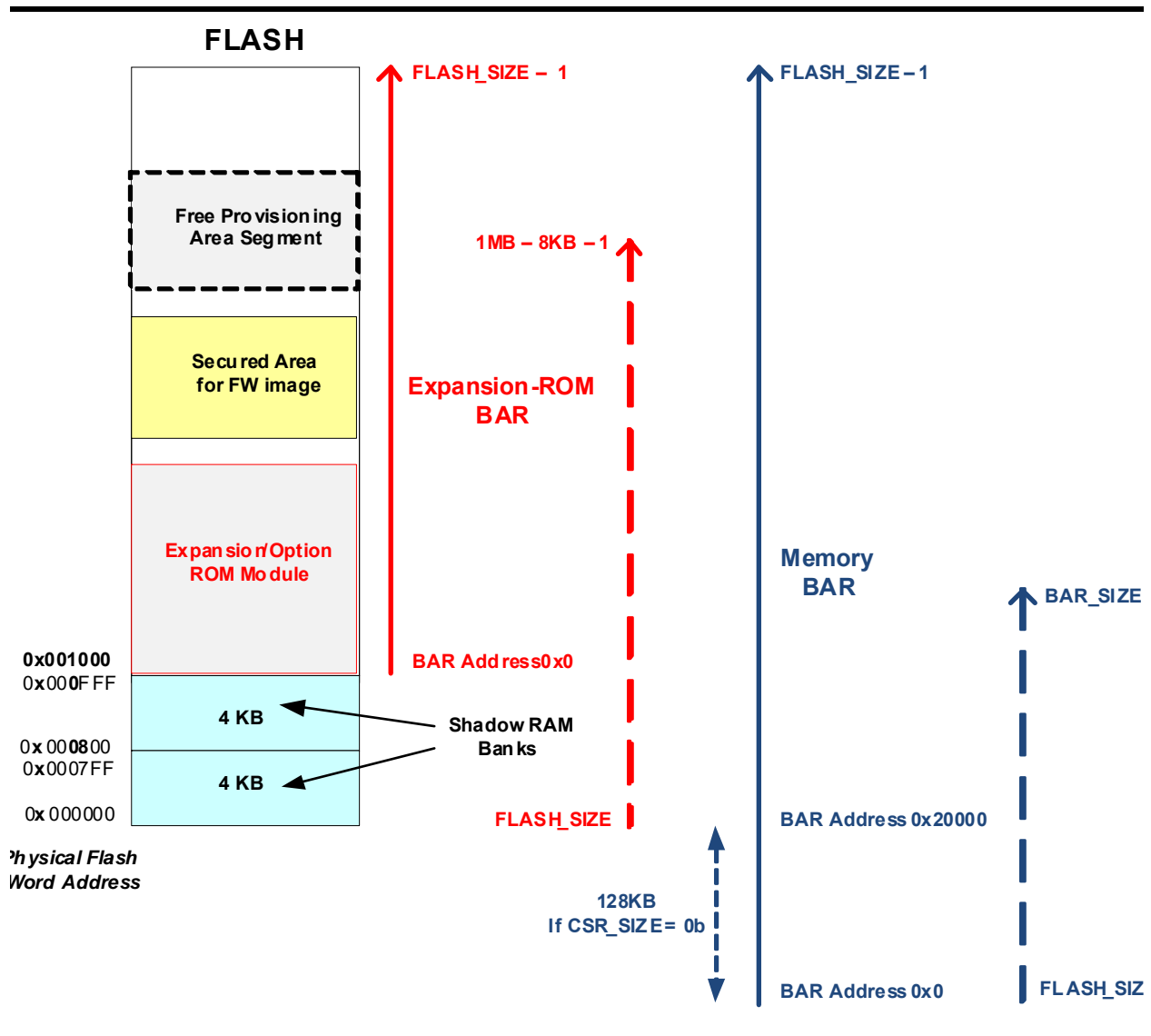


Figure 3-5. Flash Part Size is Smaller Than BAR Size

### 3.3.3.2 Management Controller (MC) Interface

The MC can issue NC-SI commands that require read/write access to some Flash and/or shadow RAM words.

### 3.3.4 Flash Access Contention

The I210 firmware is constantly running from the Flash. Any read or write access to the Flash made by software must be preceded by acquiring ownership over the Flash semaphore (refer to Section 4.6.1). This is also useful to avoid the timeout of the PCIe transaction made to a memory mapped Flash address while the Flash is currently busy with a long sector erase operation.



Two software entities cannot use the semaphore mechanism: BIOS and VPD software.

- Since VPD software accesses only the VPD module, which is located in the first valid sector of the Flash, VPD accesses are always performed against the shadow RAM first. In this case, firmware must take/release ownership over the Flash before dumping the VPD changes into the Flash, as if it was the originator of the Flash access. Shadow RAM dump sequence is described in [Section 3.3.2](#).
- No contention can occur between BIOS and any other software entity (VPD included) as it accesses the Flash while the operating system is down.
- Contention between BIOS and firmware can however happen if a system reboot occurs while the MC is accessing the Flash.
  - If a system reboot is caused by a user pressing the Standby button, it is required to route the wake-up signal from the Standby button to the MC and not to the chipset. The MC issues a system reboot signal to the chipset only after the Flash write access completes. Firmware is responsible to poll whether the Flash write has completed before sending the response to the MC NC-SI command.
  - If a system reboot is issued by a local user on the host, there is no technical way to avoid Flash access contention between BIOS and the MC.

**Caution:** It is the user’s responsibility when accessing the Flash remotely via the MC to make sure another user is not currently initiating a local host reboot there.

**Notes:**

The MAC auto-load from the Flash device itself occurs only after power-up and before host or firmware can attempt to access the Flash. The host must wait until PCIe reset is de-asserted (after ~1 sec, which is enough time for the MAC auto-load to complete).

Software and firmware should avoid holding Flash ownership (via the dedicated semaphore bit) for more than 2 seconds.

Software erase command can be suspended by firmware until it handles its current tasks and/or it loads its cache.

### 3.3.4.1 Arbitration Between Flash Clients

The following lists the relative priority by which the hardware must serve the different Flash clients, whether the access is performed against the internal shadow RAM or into the Flash device:

1. **Hardware auto-load** - no semaphore taking.  
Pointer to an hardware module must first be invalidated (set to 0xFFFF) by the host/MC before modifying the module by a sequence of related changes. A sequence of related changes is a sequence of Flash writes that if interrupted in the middle would leave the hardware module with non-consistent contents. There is still a risk of inconsistent Flash header words being loaded by hardware if the auto-load process occurs in the middle of a write sequence performed over the Flash header. This risk exists in all previous 1 GbE controllers.
2. **Hardware cache read** for the firmware - no semaphore taking.  
This access is served by hardware with a 10:1 ratio relatively to the accesses that follow. The tens of cache read accesses (8-byte Flash read each) that might be performed before a memory mapped Flash access is served (see Steps 4 and 6) should not cause a timeout of the PCIe transaction.



Cache reads can be delayed by the maximum time duration (300 ms) of a previous erase command, which was issued by firmware to hardware. Before issuing any sector erase command to hardware, firmware must complete all its pending tasks and must load from Flash the code pieces required to manage while the Flash is busy for erasing:

- a. For instance, NC-SI commands received are completed with the Package Not Ready status. The MC must retry after 500 ms the commands that were completed with a Package Not Ready status. SMBus transactions are handled in a similar way. Refer to [Section 3.3.4.2](#) for the complete list.
  - b. Offloads performed by firmware waits until the cache read resumes before being handled by firmware. Alternatively, before issuing an Erase command to hardware, firmware initiates some offload tasks that would timeout otherwise.
  - c. Host interface commands can wait for 500 ms before being completed by firmware.
3. Software or firmware read is performed by hardware in a round robin manner between:
    - a. Software reads via BAR or CSRs - Software other than BIOS must take a semaphore (even for reads).
    - b. Firmware reads via CSRs - no semaphore taking. Firmware is also performing the shadow RAM reads required for a VPD read.
  4. Firmware erase/write for VPD and the MC, before performing a shadow RAM dump into the Flash, or for its own needs (such as for replacing factory defaults), firmware must take the semaphore here.
  5. Software erase/write via BAR or CSRs - Software must take a semaphore.
    - a. If the access is performed against the Flash, software must release the semaphore after it has checked the Flash is not busy by the last erase operation performed.
    - b. If the access is performed against the shadow RAM, software must release the semaphore once it has asked firmware to dump the shadow RAM in the Flash by setting the *FLUPD* bit.
  6. Bit-banging access - no semaphore taking.  
 This access is provided to software only when in non-secure mode. Firmware access via the bit-banging interface might lead to a dead lock if the firmware code required to complete the bit-banging is not entirely in the firmware cache before starting the access.

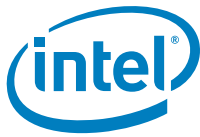
### 3.3.4.2 Firmware Responses When Flash Unavailable

Table 3-14 is organized according to the different events that might occur while the Flash is temporarily not available (like busy with a pervious Flash erase operation). It defines the expected responses for each case, assuming the firmware code, which is responsible to properly handle the event cannot be read from the Flash.

**Table 3-14. Events/Responses When Flash is Unavailable**

Event	Response	Comment
NetProxy packet received	Ignored	Packets or timeouts are processed right after Flash access is recovered.
MCTP packet received	A response with ERROR_NOT_READY (0x04) completion code is returned.	
SMBus read transaction	Not ready command replied	
SMBus write transaction	Byte count word is NACKed	However, the address and the command are acknowledged.





Event	Response	Comment
PCIe to SMBus switching in MCTP mode	Ignored	
SMBus to PCIe switching in MCTP mode	Ignored	
NC-SI packet received	Command completed with Package Not Ready error code.	Command validity checks are not performed. Packets received do not increment the NC-SI statistics counters. <b>Note:</b> The command is answered even if the package was previously unselected.
Any event that requires issuing an AEN	Ignored	All relevant events are processed right after Flash access is recovered.
Command received in the host interface	Ignored	Commands are processed right after Flash access is recovered.
SMBus ARP offload	SMBus ARP offload is performed	New SMBus addresses are written to the Flash right after Flash access is recovered.
VPD write command received	Ignored	The VPD write is processed (and F bit set) right after Flash access is recovered.

### 3.3.5 Flash Read, Write, and Erase Sequences

**Note:** This section describes the low-level Flash procedures handled between software, firmware, and hardware. The high-level Flash flows are built using these procedures, and include the semaphore taking/releasing and other high level tasks. Refer to [Section 3.3.11](#). Each time programming the NVM via CSR accesses, PCIEMISC.DMA Idle Indication bit must be set to 1b.

#### 3.3.5.1 Flash Erase Flow by Software

In this section, software uses FLSW\* registers.

##### Device Erase Flow:

1. Poll the FLSWCTL.DONE bit until it is set.
2. Set FLSWCTL.CMD fields to 0011b.
3. Wait until FLSWCTL.DONE bit is read as 1b and FLSWCTL.FLBUSY bit is read as 0b before releasing the Flash semaphore.

Hardware sets the *DONE* bit without executing the operation if software attempts this command while in Flash secure mode. The *CMDV* field is cleared in such case.

##### Sector Erase Flow:

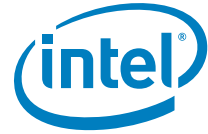
1. Poll the FLSWCTL.DONE bit until it is set.
2. Set FLSWCTL.CMD field to 0010b and set the FLSWCTL.ADDR field to any address that belongs to the Flash 4 KB sector to be erased.
3. Wait until the FLSWCTL.DONE bit is read as 1b and the FLSWCTL.FLBUSY bit is read as 0b before releasing the Flash semaphore.

Hardware sets the *DONE* bit without executing the operation if software attempts to erase a protected sector while in Flash secure mode. The *CMDV* field is cleared in such case.

#### 3.3.5.2 Software Flow to the Bit-banging Interface

This section is relevant to software only while in the non-secure mode.

To directly access the Flash, software should follow these steps:



1. Write a 1b to the *Flash Request* bit (FLA.FL\_REQ).
2. Read the *Flash Grant* bit (FLA.FL\_GNT) until it becomes 1b. It remains 0b as long as there are other accesses to the Flash.
3. Write or read the Flash using the direct access to the 4-wire interface as defined in the FLA register. The exact protocol used depends on the Flash placed on the board and can be found in the appropriate datasheet.
4. Write a 0b to the *Flash Request* bit (FLA.FL\_REQ).
5. Following a write or erase instruction, software should clear the *Request* bit only after it has checked that the cycles were completed by the Flash. This can be checked by reading the *BUSY* bit in the Flash device Status register. Refer to Flash datasheet for the OpCode to be used for reading the Status register.

**Notes:** The bit-banging interface is not expected to be used during normal operation. Software should instead use the EEPROM-mode when accessing the base sector and the Flash-mode for other sectors.

If software must use the bit-banging interface in normal operation, it should adhere to the following rules:

- Gain access first to the Flash using the firmware/software semaphore mechanism.
- Minimize the FLA.FL\_REQ setting for a single byte/word/Dword access or other method that guarantee fast enough release of the FLA.FL\_REQ.

When hardware Flash bit-bang access is aborted due to deadlock avoidance, the *FLA.FLA\_ABORT* bit is set. To clear the block condition and enable further access to the Flash, software should write 1b to the *FLA.FLA\_CLR\_ERR* bit.

### 3.3.5.3 Software Word Program Flow to the EEPROM-Mode Interface

Software must take semaphore ownership before executing these flows.

#### 3.3.5.3.1 Read Interface

Software initiates a read cycle to the Flash via the EEPROM-mode as follows:

1. Software writes the address to be read in the EERD register
2. Software polls the EERD.DONE bit until it is asserted.
3. Software reads the EERD.DATA register field.

Hardware executes the following steps:

1. Eventually clears the *CMDV* bit if the command cannot be currently executed, and goes to step 4.
2. Reads the data from the shadow RAM.
3. Puts the data in *DATA* field of the EERD register.
4. Sets the *DONE* bit in the EERD register.

**Note:** Any word read this way is not loaded into the I210's internal registers. This happens only at a hardware auto-load event.

#### 3.3.5.3.2 Write Interface

Software initiates a write cycle to the Flash via the EEPROM-mode as follows:

1. Poll the *DONE* bit in the EEWR register until it is set.
2. Write the data word and its address in the EEWR register.



As a response, hardware executes the following steps:

1. Eventually clears the *CMDV* bit if the command cannot be currently executed, and goes to step 3.
2. The I210 writes the data to the shadow RAM.
3. The I210 sets the *DONE* bit in the EEWR register.

**Notes:** The VPD area of the Flash can be accessed only via the PCIe VPD capability structure. EEPROM-mode writes are performed into the internal shadow RAM. Software can instruct copying of the internal shadow RAM content into the base sector of the Flash device by setting the EEC.FLUPD bit.

### 3.3.5.4 Flash Program Flow via the Memory Mapped Interface

Software must take semaphore ownership before executing the flow. Software initiates a write cycle via the Flash BAR as follows:

1. Write the data byte to the Flash through the Flash BAR. Use the Byte Enable (BE) pins if less than four bytes has to be written.
2. Poll the FL\_BAR\_BUSY flag in the FLA register until cleared.
3. Repeat the steps 1 and 2 if multiple bytes should be programmed.

As a response, hardware executes the following steps for each write access:

1. Set the FL\_BAR\_BUSY bit in the FLA register.
2. Initiate autonomous write enable instruction.
3. Initiate the program instruction right after the enable instruction.
4. Poll the Flash status until programming completes.
5. Clear the FL\_BAR\_BUSY bit in the FLA register.

**Note:** Software must erase the sector prior to programming it.

### 3.3.5.5 Software Flash Program Flow via the Flash-Mode Interface

Software must take semaphore ownership before executing the flow.

1. Poll the FLSWCTL.DONE bit until it is set. This step is only needed if the flow is executed following a reset event.
2. Write the number of bytes to be written into FLSWCNT.CNT field. The write must not cross a page (256 byte) boundary.
3. Set the *ADDR* field with the byte resolution address in the FLSWCTL register and set the *CMD* field to 0001b.
4. Write the data to the FLSWDATA register.
5. Hardware starts accessing the Flash and begins writing data bits from the FLSWDATA register. If the write is not allowed, the *CMDV* bit is cleared instead.
6. Once hardware completes writing the data to the Flash, the FLSWCTL.DONE register bit is set.
7. Hardware increments FLSWCTL.ADDR field by four (Dword granularity) if byte count left is greater or equal to 4.
8. Software polls the FLSWCTL.DONE bit until it is set.
9. Steps 4 to 8 are repeated several times until the number of bytes programmed in FLSWCNT.CNT field has been written.



10. FLSWCTL.GLDONE bit is set by hardware when the last byte programmed has been written. But software can stop the transaction in the middle as long as it got the *DONE* bit read as 1b. In any case, the *FLBUSY* bit must be read as 0b before releasing the Flash semaphore.

### 3.3.5.6 Software Flash Read Flow via the Flash-Mode Interface

The I210 provides an engine for reading the Flash in a burst mode:

1. Poll the FLSWCTL.DONE bit until it is set. This step is only needed if the flow is executed following a reset event.
2. Set the FLSWCNT.CNT field with the number of bytes to be read from Flash in a burst mode.
3. Set the FLSWCTL.ADDR field with the byte address of the first Dword to be read and set the *CMD* field to 0000b. The FLSWCTL.GLDONE bit is cleared by hardware to indicate a burst read has started.
4. Hardware starts accessing the Flash and clears the FLSWCTL.DONE bit until it writes the read Dword into the FLSWDATA register.
5. Software polls the FLSWCTL.DONE bit until it is set.
6. Software reads the Dword from FLSWDATA register, which is used by hardware to trigger a clear of the FLSWCTL.DONE bit again.
7. Hardware increments FLSWCTL.ADDR field by four (Dword granularity) if byte count left is greater or equal to 4.
8. Steps 5 to 7 are repeated until the number of bytes programmed in FLSWCNT.CNT has been read.
9. Hardware sets the FLSWCTL.GLDONE bit to indicate that all the Flash transactions related to the command issued at step 3 were completed. However, software can stop the transaction in the middle as long as it got the *DONE* bit set.

### 3.3.6 Flash Validity Field

The only way the I210 can tell if a Flash is present and programmed is by trying to read the Flash *Validity* field at Flash word addresses 0x012 and 0x812. If one of the *Validity* fields is read as 01b, a programmed flash is assumed to be present.

### 3.3.7 Flash Deadlock Avoidance

The Flash is a shared resource between the following clients:

1. Hardware auto-read.
2. LAN software accesses.
3. Manageability accesses.
4. Software tools.

All clients can access the Flash using parallel access, on which hardware implements the actual access to the Flash. Hardware schedules these accesses, avoiding starvation of any client.

However, the software and firmware clients can access the Flash using bit-banging. In this case, there is a request/grant mechanism that locks the Flash to the exclusive use of one client. If one client is stuck without releasing the lock, the other clients can no longer access the Flash. To avoid this deadlock, the I210 implements a timeout mechanism, which releases the grant from a client that holds the Flash bit-bang interface (FLA.FL\_SCK bit) for more than 8 seconds. If any client fails to release the Flash interface, hardware clears its grant enabling the other clients to use the interface.

**Note:** The bit-banging interface does not guarantee fairness between the clients, therefore it should be avoided in normal operation as much as possible. When write accesses to the Flash are