WOLF's Modular Expansion Cards (MXC):

Combine MXC modules to make extremely powerful video capture, display and encoding solutions on VPX, CompactPCI, VME, COMExpress designs and OEM products.

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THE EMBEDDED WORLD

High-fidelity video capture, processing, encoding, and display requirements have taken the military and aerospace embedded world by storm. Embedded graphics have never been in higher demand. As the number of camera inputs, camera processing, displays and data rates increase, embedded systems are challenged to keep pace.

Take an airplane cockpit for example: It may need to drive three or more video displays, each showing different information derived, and possibly combined, from many different sources. A tank, having no windows, may require multiple internal displays sourced from multiple external cameras, with minimal latency. Meanwhile, a control room might have six tiled screens on a wall that could be combined into a single large image or present up to six separate images.

The display information from each of those examples may be derived from raw video data, frame grabbers or cameras and may require combining graphics and images from multiple video streams. The displays and cameras may be connected using SDI, DisplayPort, HDMI, DVI, LVDS, STANAG 3350 or analog RGBHV interfaces.

SDI signals require speeds of up to 6 Gbps, outpacing the capabilities of most existing XMC or PMC mezzanines.

Input pre and post processing can be just as diverse with real-time low latency object recognition and image enhancement using GPGPU parallel processing, video encoding with MPEG-2, MPEG-4/H.264/AVC, H.265/HEVC, and AES encryption.

Video often requires additional OpenGL overlays, transformation, metadata injection, and a GUI for the operator. Different systems employ these functions in a multitude of combinations and most of them have severe size, weight, performance, latency and power limitations.

Table 1 highlights the advantages of the MXC form factor as compared to existing XMC, MXM and PMC mezzanine form factors.

Format	Video I/O	Pins	PCIe Lanes	Max Freq. (GHz/s)	Rugged	Dimensions (mm)	Cards per Carrier	
							3U	6U
MXC	I/O	500	16	10	Yes	85×70	2	4
MXM 3.1	Output	285	16	8	No	90×108.4 (†)	1	2
XMC	I/O	< 100	8	3.125/5	Yes	149×74	1	2
PMC	I/O	< 100	1 (PCI)	< 1	Yes	149×74	1	2

Table 1: MXC exceeds all characteristics of existing standards.

(†) measurement includes envelope of MXM Type-B module and required MXM mating connector.

THE MXC FORM FACTOR

The size of MXC is critical; small enough to fit two modules on a single 3U carrier. No other mezzanine card can accomplish this, and the advantage doubles again with four modules on a 6U platform. The envelope size for MXC is equal to the board outline, due to the interface connector used.

The connector is a highly rugged, high-bandwidth 500-pin Samtec SEARAY™ connector, rated for 10GHz. The staggering number of pins allows for a level of dedicated capability unparalleled in the embedded world, and the 85Ω 10GHz rated pins leaves

plenty of room for today's *and* tomorrow's high-speed data transfer rates.

Banks of pre-defined signals are reserved for digital and analog video input and output interfaces such as SDI (up to 6G-SDI), DisplayPort, HDMI, DVI/TMDS, LVDS, Camera Link™, RGBHV, STANAG-3350, RS-343, RS-170, and Gigabit Ethernet. Together, as many as eleven video inputs can be mixed and overlaid on up to fifteen different video outputs.

MXC is designed with high-speed video data transmissions in mind, and each module can communicate using up to 16 lanes of PCIExpress Gen3, giving you the bandwidth you need for multiple high-definition raw or encoded video streams. This data plane is crucial for high-speed communication between MXC Modules with minimal system performance impact.

When you combine multiple MXC cards on 3U or 6U carriers, a 48- or 96-channel PCIe switch enables 16 dedicated PCIe lanes for each MXC module, enabling direct DMA bus communication between MXC modules and the VPX backplane. This makes it possible to create an extreme-performance, high-speed system solution, capable of moving up to 252 Gbps of data (see *Figure 2*).

Cooling is a serious concern, with four high-performance modules in a tightly confined space. MXC's superior design takes great strides to reduce the overall thermal solution. A smaller physical size, combined with heat dissipating components placed on top-side only provide an easily accessible space to attach the form-molded conduction or air-cooled heatplate and provide the ability to expand if a larger cooling envelope is required.

MXC modules only require 3.3V and/or 5V power to operate; the lower voltages provide more efficient power regulation, reducing extraneous heat and lowering overall power requirements.

All of this leads to one inescapable conclusion: MXC is a rugged, modular, high-performance video-centric architecture. The 500-pin SEARAY™ connector is low-force and reliable, as is the removable heat plate that allows for a simple thermal integration to OEM hardware.

Designed to MIL-STD-810 and IPC Class 3 standards, MXC modules will stand up to the harsh operating environments of -40 to 85°C with high humidity, severe shock, and vibration.

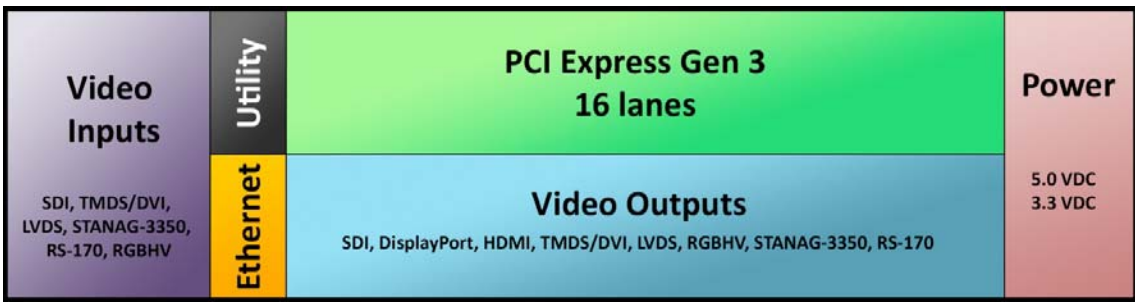

Figure 1. The MXC signal map has a wide array of dedicated pins to support many new and legacy video standards

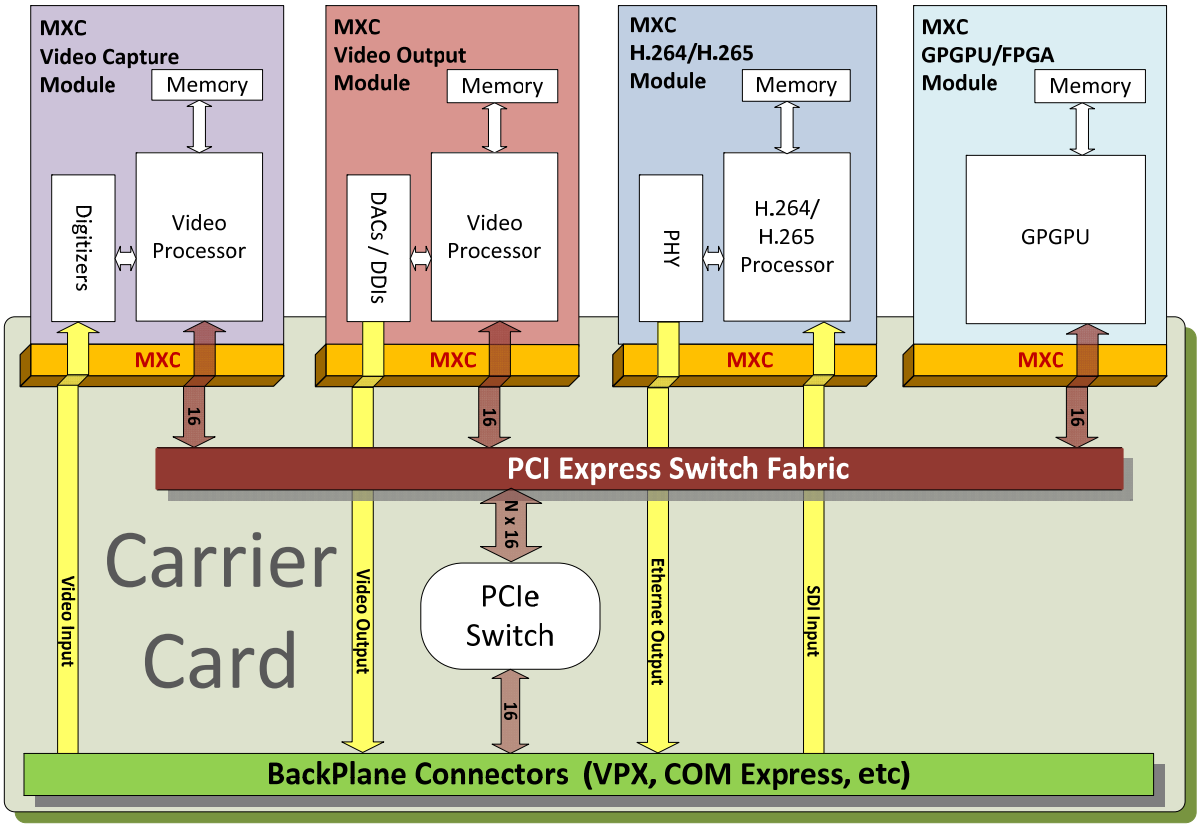

Figure 2: MXC cards intercommunicate over PCI Express, creating an advanced, high speed, video solution.

EXISTING MXC PRODUCTS

The following list highlights some the MXC modules available or in development today:

DISPLAY & GPGPU

- **MXC-E6460-VO**
  Low power video processing card featuring AMD's E6460 GPU with 512MB of GDDR5 memory, up to four independent video outputs, and 192 GFLOPs of GPGPU parallel processing power.
- **MXC-E6760-VO**
  Video processing card featuring an AMD E6760 GPU with 1 GB of GDDR5 memory, up to six independent video outputs, and 567 GFLOPs of GPGPU parallel processing power.
- **MXC-E8xxx-VO**
  Video processing card featuring AMD's next generation embedded GPU with a 60% performance increase over E6760 and same thermal profile.

VIDEO CAPTURE

- **MXC-FG**
  Five channel video capture frame grabber with four NTSC/PAL/SECAM inputs and one RGBHV input.
- **MXC-E6760-MV**
  A combination display and capture card, featuring an AMD E6760 GPU and 1GB of GDDR5 memory. Supports up to six independent video outputs and four NTSC/PAL/SECAM captures.

ENCODING

- **MXC-H.264**
  H.264 Encoder with one 3G-SDI (1080p60) input, or two HD-SDI (1080p30) inputs streamed over Gigabit Ethernet, with optional AES-128 encryption.

FPGA

- **MXC-Kintex7**
  MXC Module based on the Kintex7 Platform with a x16 PCIE interface, memory banks and high speed I/O interface.

MXC fully embraces the modern serial-fabric of Eurocard 3U and 6U form factors with WOLF developed Open VPX and VPX-REDI MXC carrier boards, making it possible for very sophisticated video graphic solutions on a single VPX board.

For those embedded system designers using ultra-small formats, adding MXC mezzanines offers sophisticated high-performance solutions for video capture, encoding, GPGPU parallel processing, video display and encryption.

MXC is the perfect companion to small form factor bus architectures such as COM Express by adding feature-rich video graphics in a turnkey solution, easily incorporated into your designs.

PRODUCT SPOTLIGHT

The ONYX platform by ECRIN Systems mixes Core i7 Intel Multi-core processors with WOLF MXC modules. This has enabled a single rugged, extended temperature, plug & play system, with modular multi-feature video I/O solutions.

Using WOLF MXC modules, ECRIN is able to provide a platform that can be highly customized for multiple OEM applications simply by changing MXC modules.

Current project bids include customized MXCs to add additional STANAG-3350 support and SDI capture and display to GPGPU modules.

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