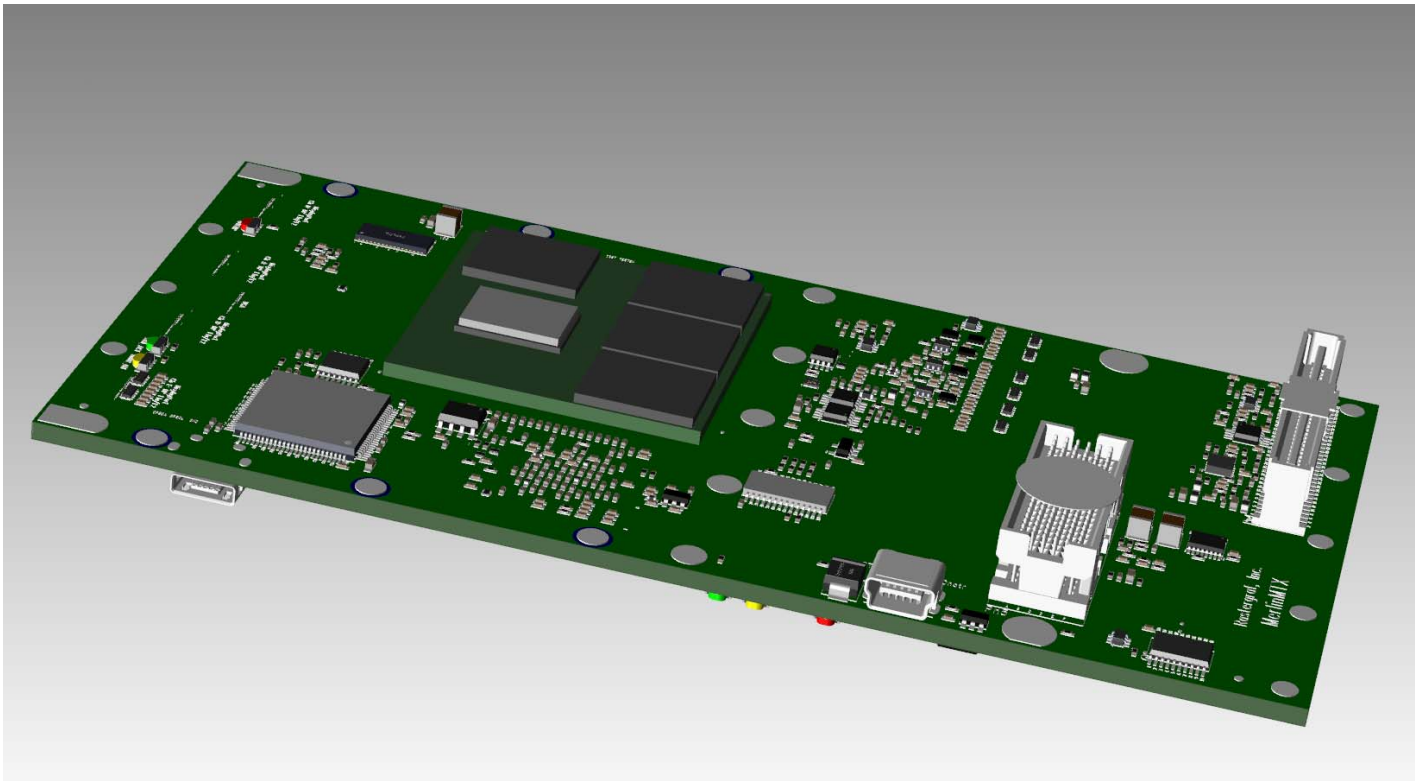
Rastergraf

MerlinMTX

XMC CCPMC Graphics Controller
with
Multichannel NTSC/PAL Video Digitizer

Support for Windows ▪ Linux



Features

- Multi-channel AMD E8860 2D/3D graphics controller
- XMC (x4/x8 PCIe 2.0) host port interface
- Display resolution up to 4096 × 2160 per channel
- On-chip 2GB GDDR5 Graphics Memory
- Hardware support for DirectX 11.1, OpenGL 4.2, and OpenCL 1.2
- Front and/or Rear (Pn4) Connector Access
- On-board ARM CPU provides comprehensive BIST support
- Extensive I^2C/SMbus and JTAG-based diagnostics
- Voltage and thermal sensors monitor board functions
- Versatile display and audio/video input options on Pn4
- Linux and Windows OS and x86 BIOS support
- VITA 20 CCPMC compatible

MerlinMTX Overview

The MerlinMTX fulfills high performance requirements for a complete graphics and video acquisition solution found in VxWorks, Linux, and Windows embedded systems.

It is intended for use in XMC-hosted systems and can operate in XMC locations with VPWR set to 5V or 12V. The PCB is complies with the VITA 20 CCPMC footprint.

Use in a true conduction-cooled system is supported by Rastergraf's integration partner, Mistral Solutions

The MerlinMTX uses the AMD E8860 GPU, an advanced 3D graphics and multimedia engine with 2GB of high-speed GDDR5 memory. As implemented on the MerlinMTX, the E8860 is linked to the host via an 8-bit PCIe 2.0 interface. An IDT 24T6G2 PCIe 2.0 switch arbitrates between on-board devices and the (PCIe) XMC.

Extensive standards support includes OpenGL 4.2, Open CL 1.2, DirectX 11.1, dual-stream HD as well as H.264, VC-1, and MPEG-2 HD and MPEG-4 DivX and Xvid.

The MerlinMTX Pn4 rear I/O connector supports two NTSC/PAL video inputs (using a Conexant CX25858 digitizer) and two DVI single-link outputs.

An ST Micro STM32F427 32-bit CPU provides Built-In Self Test (BIST) and monitoring of many MerlinMTX functions using I^2C, UART, JTAG, and on-chip A/D converters. Reporting is done via LEDs and USB.

Note that Curtiss-Wright Defense Systems-style thermal gasketing (Fujipoly Sarcon 20GSR-AD) and top and bottom side thermal shunts are required when using the MerlinMTX in a CCPMC application. These items are available from Mistral. See also CW Defense PMC/XMC Module Mounting Instructions, 808335 Version 6.

Table 1 (see next page) includes Special Order MerlinMTX versions that provide some possible combinations of front or PMC Pn4 DisplayPort, PMC Pn4 DVI, and PMC Pn4 video and audio inputs. Of course, the use of front panel access sacrifices complete VITA 20 compatibility.

The MerlinMTX is available with a PIM Rear Transition adapter to ease system integration. The PIM provides access to the 2 DVI channels and the video inputs.

Rastergraf also makes the E8860-based **MerlinPXC**, which supports both PMC and XMC host systems, front and rear DisplayPort channels, rear VGA, MIPI CSI-2 camera input, USB 3.0 support, and includes a PIM Rear Transition adapter to ease system integration.

Embedded Life-Cycle Support

Rastergraf understands the lead-in and life-cycle requirements of the embedded market. Please contact Rastergraf for more information or consult *www.rastergraf.com*.

Figure 1: MerlinMTX Parts Locations

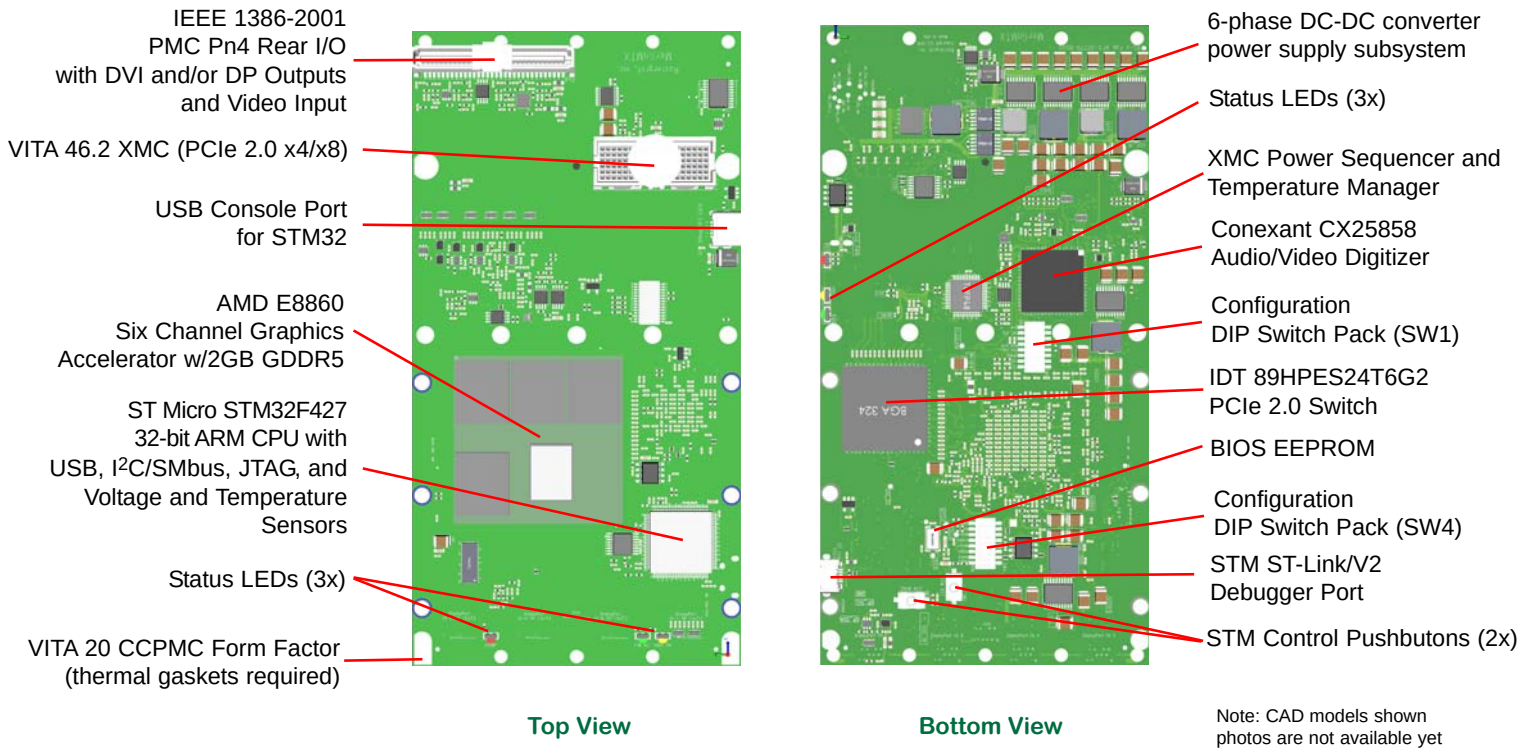
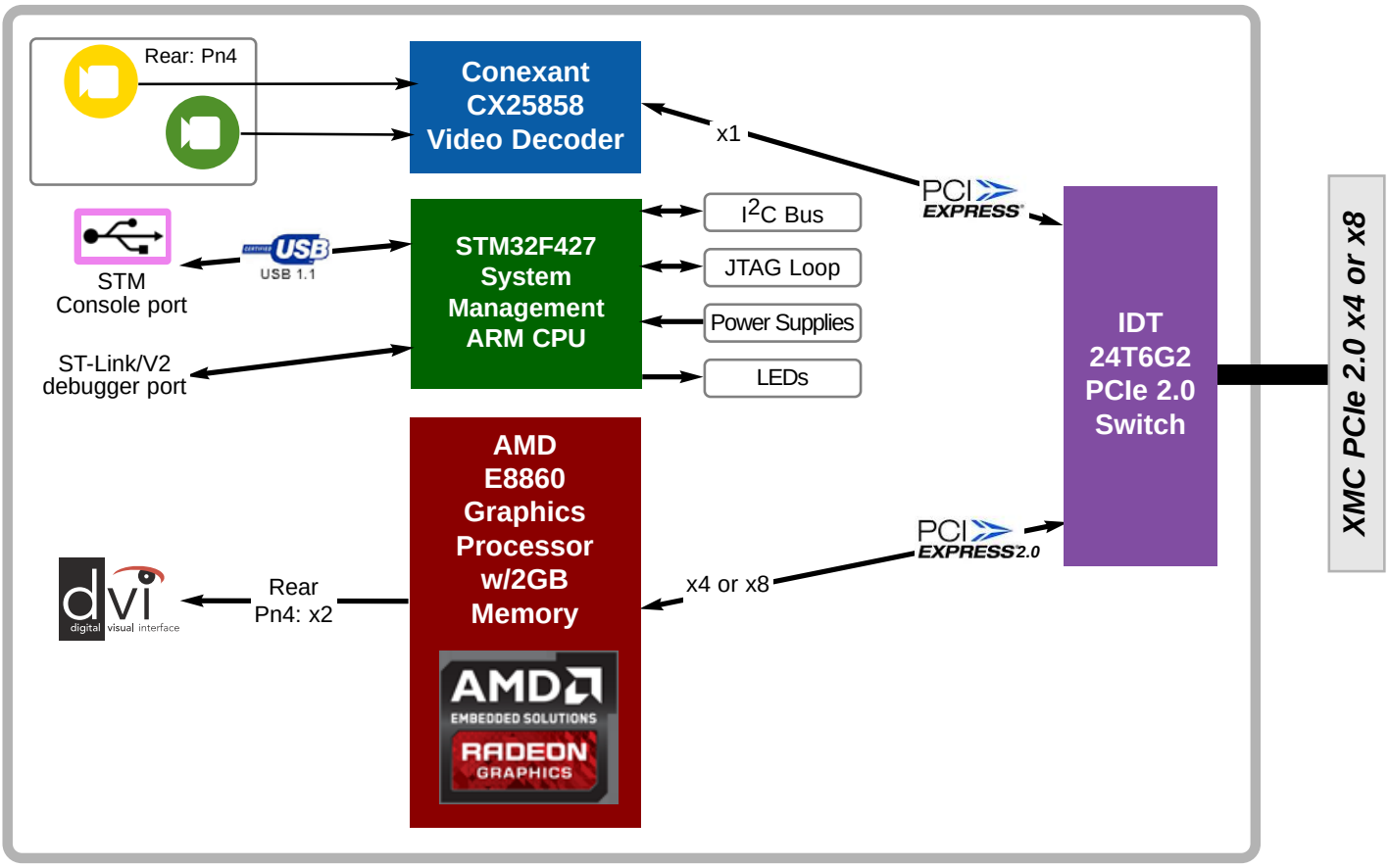


Figure 2: MerlinMTX Block Diagram



MerlinMTX Versions

Table 1: Connectivity for the MerlinMTX Models

Merlin Version	Rear I/O DVI Ch D/F	Rear I/O DisplayPort Ch D/C/F	Rear I/O NTSC/PAL In	Rear I/O Audio In	Front Panel DisplayPort Ch E/B/A/D
MerlinMTX	2x DVI PMC Pn4		2x PMC Pn4		
MerlinMTX/1D (special order)		3x DP PMC Pn4			
MerlinMTX/1F (special order)					4x mDP
MerlinMTX/1M (special order)	2x DVI PMC Pn4	1x DP PMC Pn4			
MerlinMTX/2A (special order)	2x DVI PMC Pn4	1x DP PMC Pn4	2x PMC Pn4	2x PMC Pn4	
MerlinMTX/2V (special order)	2x DVI PMC Pn4	1x DP PMC Pn4	4x PMC Pn4		

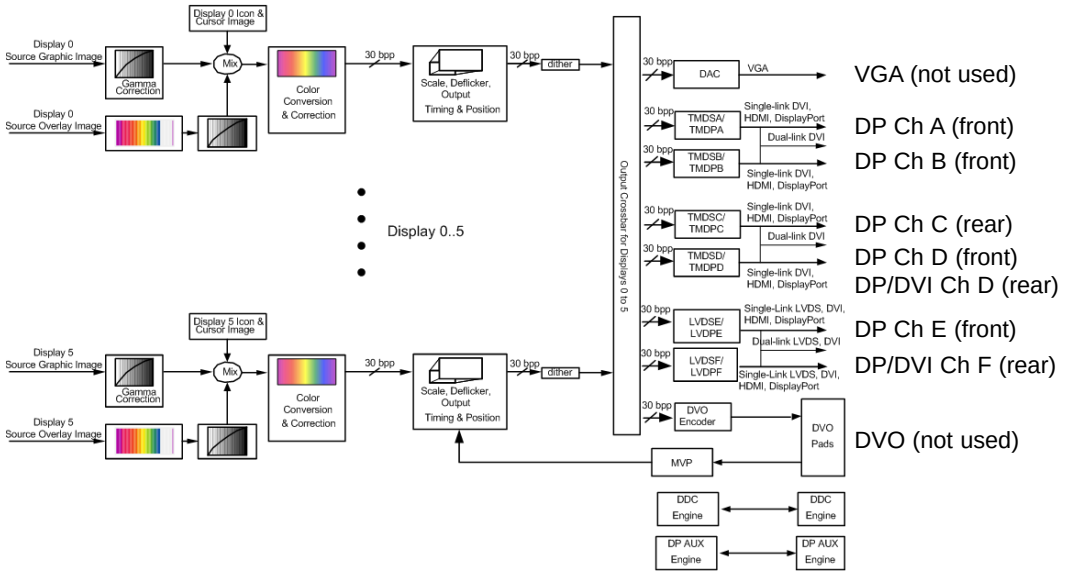
Graphics Display Capabilities

Table 2, below, provides the details about each possible graphics output from the E8860.

Note that regardless of the number of graphics connections on the front and/or rear panels, the E8860 itself allows up to ***6 channels to be active at one time.*** Power drawn on each port should not exceed 50mA (500mA peak).

Optional external in-line dongles can convert the Mini DisplayPort output(s) to NTSC/PAL, DVI, VGA or LVDS. A passive cable can convert the Mini DisplayPort to the larger DisplayPort connector.

Figure 3: E8860 Graphics Output Section



Input Capabilities

Multichannel Digitizer

The ***Conexant CX25858 Video Digitizer*** is PCIe-based and supports simultaneous digitizing multiple NTSC/PAL video and audio inputs. The CX25858 contains high quality video decoders with 10-bit A/ADCs and 5-line comb filtering. Each video input can be independently scaled and includes per-channel programmable motion detection.

This function is available only on the PMC Pn4 rear I/O connector. See Table 1 for the available video and audio combinations.

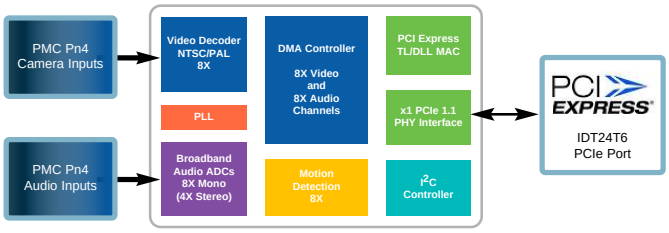


Table 2: MerlinMTX Video Input Sources

Video Mode	Capture Controller	Example Camera	Typical Resolution	Capture Rate (typ)	Capture Mode	Front/Rear Accessibility	Notes
NTSC and/or PAL	CX25858		640x480 NTSC 768x576 PAL	30 NTSC 25 PAL	16-bit YUV	rear	

Hardware Notes

Since the E8860 and CX25858 can run simultaneously, you MUST have at a x4 PCIe host to attain optimal performance.

Software Notes

Please see Software Support (page 8) for information about CX25858 support.

PIM Adapter

A “Personality Interface Module” (PIM) is available that is VITA 36d0_1 compatible. It enables the MerlinMTX rear I/O functions to be accessed either via the PMC Pn4 connector and can be used with VME, cPCI, and OpenVPX PIM Carriers.

An alternate version includes a VME P2-style connector to enable the PIM to be used with Rastergraf and Technobox PMC and XMC carriers.

To help ensure that the PIM will work reliably, the MerlinMTX PMC Pn4 rear I/O connector differential pairs are carefully length-matched and follow pin assignments according to VITA 46.9 for P32d. For best results, be sure to use a CPU or carrier that is VITA 46.9.

Figure 5: PIM Block Diagram

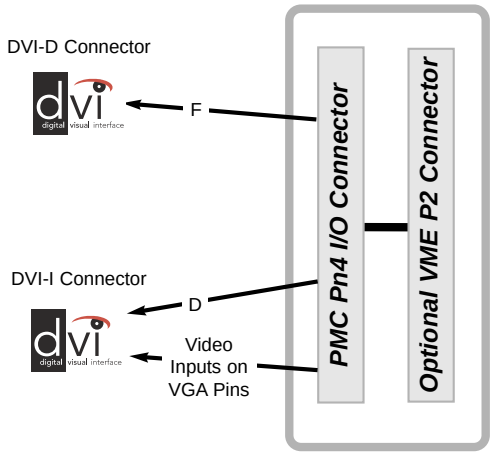
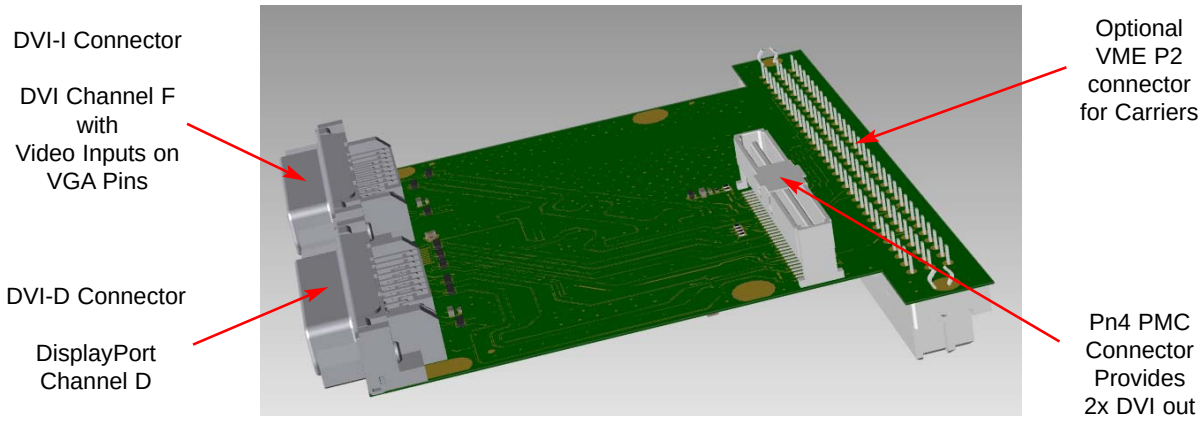


Figure 6: PIM Connectors



Software Support

Software support for the MerlinMTX includes Windows XP/7/8/10 drivers and an x.org accelerated X Server with OpenGL and Xv video input extensions

Table 4: Software Support Matrix (consult factory for current availability)

				DirectX		Multi-Head	OpenGL	x86 BIOS	USB
Windows XP/7/8/10				✓		✓	✓	✓	✓
Linux x86/PowerPC		✓	✓		✓	✓	✓	✓	✓

Systems Management

There are a number of subsystems on the MerlinMTX that are required to enable its correct and reliable operation. The startup of the power systems is set in motion by the leading edge of the system reset pulse. All host power must be stable at that time in order to ensure the proper operation of the board.

Power Supply Subsystem

By the very definition of a high-performance graphics board, the Merlin is NOT a low-power design. For it to meet its full design specification, the calculated power requirements are:

Voltage Input	Idle	Full Operation
3.3V	0.9A	2A
VPWR=5V	2.45A	6.85A
VPWR=12V	1.1A	3A

Because it can deliver the most power, 5V is the power rail for the 6-phase hex DC-DC converter supply. At the leading edge of system reset, logic detect XMC VPWR at 5V or 12V. When XMC VPWR=12V, a local DC-DC converter is enabled to downconvert it to 5V. There is small efficiency cost to doing this but it simplifies the overall design. An OVP shuts down the entire power section if local 5V exceeds 5.6V.

Temperature Monitoring Subsystem

An LM63 thermal sensor tied to an E8860 substrate diode monitors the E8860 and the area around it. An LM75 sensor monitors the DC-DC converters area. The STM32 also has an internal temperature sensor. If a thermal condition is detected, an LED is lit and, if enabled, the board is shut down. Recovery is done by cycling system power.

Cooling Systems

Copper floods enhance the heat-spreading within the PCB. The 24T6 and E8860 PCIe bus widths (set on-board to x4 or x8) and the E8860 clock and core voltage also affect power dissipation. The BIST subsystem can adjust the GPU parameters when temperatures rise too high. This may be a more effective way to manage heat than adding a heat sink that may congest the air flow through the cardcage. Tests will have to be run in the customer system to determine the impact.

Built-In Self-Test (BIST) Controller

An ST Micro STM32F427 CPU is used to provide Built-In Self-Test (BIST) and real-time monitoring of many MerlinMTX functions using a combination of I^2C, JTAG, and A to D converters (ADC) for voltage measurements. The STM firmware includes support for boot-time register setup, device testing, and even CPLD reprogramming.

Error Reporting

The simplest way that problems are reported is by LEDs:

On the MerlinMTX front panel are:

- Green “V” LED, which is turned on when all on-board supplies are normal;
- Red “Er” LED, which is turned on if a thermal sensor is tripped or some other problem is detected;
- Green “St” LED driven by the STM, slowly cycles on and off.

On Side 2, along the board edge,

- Green, Amber, and Red LEDs driven by [STM OR 24T6 OR CPLD] control bits.

In addition to the LEDs, the STM can communicate with the host system via an external USB port.

System Management Connections

A Mini B USB connector located on the edge of the board enables access to the STM secondary USB port for use with USB peripheral devices.

A Micro AB USB connector is used as for debug but is NOT a USB port. It is used to support programming of the STM control store and to access the STM debug port.

Table 3: MerlinMTX BIST Test Nodes

Access Method	Devices	Testing Method
I^2C	CY22393 Clk, 9DB403 Clk Bfr, 1x CPLD, LM75, LM63 24LC256 EEPROM, ADS1015 4x ADC, 24T6 PCIe Switch, E8860 Graphics	Verify and Initialize Control Registers
JTAG	1x CPLD, 24T6 PCIe Switch, E8860 Graphics	ID and Boundary Test
Voltage	Power Supply: VDD_CORE, VDDCI, VDDR1, VDD_095, VDD_105, VDD_18, ancillary supplies	STM A/D Inputs + ADS1015
Temperature	STM on-chip sensor, LM63 and LM75 Thermal Sensors, E8860 Substrate Diode	poll via I^2C registers

Ruggedization

Rastergraf is not in the militarized business. The intent of the following table is to illustrate how the Rastergraf graphic boards fit into the standard ruggedized classes.

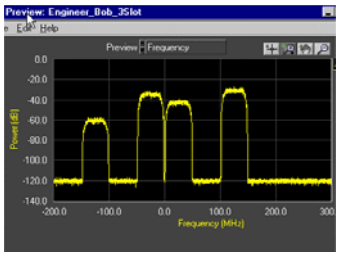
Rastergraf boards use standard distribution grade derated commercial temperature range or industrial temperature range components. No formal component tracking is maintained.

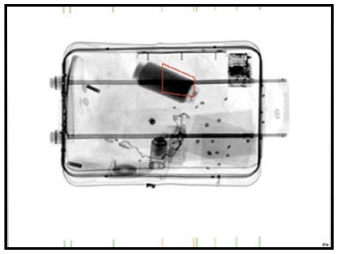
Table 5: Ruggedization Levels

Specification	Air-Cooled Level 0	Air-Cooled Level 50	Air-Cooled Level 100	Conduction-cooled Level 100
Graphics Board(s)	MerlinPXC MerlinMTX AgatePXC TopazPMC	MerlinPXC MerlinMTX AgatePXC TopazPMC	MerlinPXC MerlinMTX AgatePXC TopazPMC	MerlinMTX
Operating Temperature (4, 6)	0°C to 50°C	-20°C to 65°C	-40°C to 71°C	-40°C to 71°C
Storage Temperature	-40°C to 85°C	-40°C to 85°C	-55°C to 125°C	-55°C to 125°C
Humidity Operating	0 to 95% non-condensing	0 to 100% non-condensing	0 to 100% non-condensing	0 to 100% non-condensing
Humidity Storage	0 to 95% condensing	0 to 100% condensing	0 to 100% condensing	0 to 100% condensing
Vibration Sine (1)	2 g peak 15-2 kHz	2 g peak 15-2 kHz	10 g peak 15-2 kHz	10 g peak 15-2 kHz
Vibration Random (2)	0.01 g2/Hz 15-2 kHz	0.02 g2/Hz 15-2 kHz	0.04 g2/Hz 15-2 kHz	0.1 g2/Hz 15-2 kHz
Shock (3)	20 g peak	20 g peak	30 g peak	40 g peak
Conformal Coat (5)	optional	optional	optional	optional
Ordering Option (7)	/CA or /CS	/A5A or /A5S	/A1A or /A1S	/C1A or /C1S

Notes:

1. Sine vibration based on a sine sweep duration of 10 minutes per axis in each of three mutually perpendicular axes. May be displacement limited from 15 to 44 Hz, depending on specific test equipment. **Shock and Vibration values are by design and not tested in production.**
2. Random vibration 60 minutes per axis, in each of three mutually perpendicular axes.
3. Three hits in each axis, both directions, 1/2 sine and saw tooth. Total 36 hits.
4. Standard air-flow is 8 cfm at sea level. Some higher-powered products may require additional airflow. Consult the factory for details.
5. Conformal coating type to be specified by customer. Consult the factory for details..
6. Temperature is measured at the card interior (not at edge) using on-board LM75 temperature monitor.
7. Last letter in ordering option: A for Acrylic Conformal Coating, S for Silicone Conformal Coating





Specifications

Graphics Controller	**AMD Radeon E8860** (AKA Adelaar, Venus Pro MCM, Dev ID 6822, 100-CG2514, 216-0846077) Support for DirectX 11.1, OpenGL 4.2, OpenCL 1.2, and Mantle
Display Memory	2GB GDDR5
Digital Graphics Outputs	Rear I/O (Pn4): Channels C, D, and F. Ch D is shared with the front panel. 2x DVI (D, F) + 1x DisplayPort (C) or 3x DisplayPort (C, D, F). Front Panel: Available only by special order Channels A, B, D, and E. D is shared with PMC Pn4. 4x DisplayPort using Mini DisplayPort connectors.
DisplayPort Monitor Support	Up to 6x DisplayPort 1.2, up to 4Kx2K per display. DP 1.2 also supports multi-display per output.
DVI Monitor Support	Dual DVI up to 1920x1200@24 bpp.
BIOS PROM	64Kb Serial EEPROM stores power-up configuration (BIOS). Custom PowerPlay table controls E8860 clocks and core voltages.
XMC/PCIe Bus Interface	**IDT 89HPES24T6G2** 6 port PCIe 2.0 PCIe switch; each port is x4 PCIe lanes. Ports 0&1: connected to XMC, x4 or x8, PCIe 2.0; (power save option: x4 only) Ports 2&3: connected to E8860, x4 or x8, PCIe 2.0; (power save option: x4 only) Port 4: not connected; Port 5: connected to CX258581, x1, PCIe 1.0;
Video/Audio Digitizer (/2 versions only)	**Conexant CX25858**, up to 4 NTSC/PAL Composite Video In and up to 2 Audio In (see order information), all channels can be active at once. Video capture mode is 4:2:2 or 4:1:1, choice of NTSC or PAL affects all inputs; pairs of audio inputs can be configured for stereo. 2Kb Serial EEPROM stores power-up configuration.
Power Requirements	The VITA 42 specification does not provide useful power limits for XMC board. The effective XMC power dissipation is determined by available cooling and by the host power supply capabilities. That said, due to the limitations on airflow in and around the board, a practical limit is about 30-35 watts. Conduction-cooled power dissipation is highly dependent on the effectiveness of the thermal shunt coupling to the host carrier. In order to achieve full operability, the MerlinMTX/2 requires host power as follows:

Voltage Input	Idle	Full Operation
3.3V	0.5A	2A
VPWR=5V	1.75A	6.85A
VPWR=12V	1.1A	3A

Environment	
Temperature	0°C to +70°C, operating; -55°C to +85°C, storage
Humidity	5% - 95% non-condensing
PMC/XMC Mechanical	IEEE 1386-2001 [*except Side 2 max component height is approx. 3.1 mm instead of 2.1 mm. This is not a significant issue.*]
Dimensions	143.75 mm x 74 mm
Conduction Cooled Factors:	The MerlinMTX follows the ANSI/VITA 20-2001 (R2005) CCPMC specification and includes all primary and secondary thermal interface mounting holes. Note that both PCB sides are copper flooded. While the mounting holes are connected to Chassis Ground, the flooded areas are connected to Local Ground. This requires that that electrically-insulating thermal gaskets (Fujipoly Sarcon 20GSR-AD) be used when mounting the MerlinMTX in a CCPMC application. In addition, top and bottom side thermal shunts must be used to contact, at a minimum, the E8860 (PCB top side) and IDT 24T6 (PCB bottom side) via thermally conductive gap-filler. These items are available from Mistral. See also CW Defense PMC/XMC Module Mounting Instructions, 808335 Version 6.
Maintenance Features	See Page 6

Non-standard Versions

If you have special configuration requirements that do not appear to be covered by the standard versions, please contact the sales department for assistance.

Table 6: MerlinMTX PMC Pn4 Connector Pinout

Pin	Signal Name		Signal Name	Pin
1	GND		PMC_D_DDCDAT	2
3	P4_VIN2		PMC_D_DDCLK	4
5	GND		GND	6
7	n/c		P6_DPF_PWR	8
9	P6_DPF_HPD		n/c	10
11	GND		GND	12
13	PMC_F_TMDSCN		PMC_F_TMDS0N	14
15	PMC_F_TMDSCP		PMC_F_TMDS0P	16
17	GND		GND	18
19	PMC_F_TMDS1N		PMC_F_TMDS2N	20
21	PMC_F_TMDS1P		PMC_F_TMDS2P	22
23	GND		P4_VIN1	24
25	n/c		GND	26
27	n/c		n/c	28
29	GND		GND	30
31	n/c		n/c	32
33	n/c		n/c	34
35	GND		GND	36
37	n/c		n/c	38
39	n/c		n/c	40
41	GND		GND	42
43	n/c		PMC_F_DDCDAT	44
45	n/c		PMC_F_DDCLK	46
47	GND		GND	48
49	n/c		P4_DPD_PWR	50
51	P4_DPD_HPD		n/c	52
53	GND		GND	54
55	PMC_D_TMDSCN		PMC_D_TMDS0N	56
57	PMC_D_TMDSCP		PMC_D_TMDS0P	58
59	GND		GND	60
61	PMC_D_TMDS1N		PMC_D_TMDS2N	62
63	PMC_D_TMDS1P		PMC_D_TMDS2P	64

Note: Differential Pairs are shaded
n/c means user must not connect to pin - it may be active

Ordering Information

Board Configurations

MerlinMTX **Rastergraf P/N AE9-00763-3100**

VITA 20 CCPMC compatible. AMD Radeon E8860 Graphics Accelerator, 2GB GDDR5.
Pn4 (PMC) provides 2x Single-link DVI outputs and 2 NTSC/PAL video inputs. No VGA support.

PIM card for use with compatible RTM is also available. Please contact Rastergraf for more information

Special Order Versions

MerlinMTX/xx **Rastergraf P/N AE9-00763-xxxx**

Please Contact Rastergraf for details about Special Order Versions

Notes: Silicone or acrylic Conformal Coating is available. Please contact factory for more information.
Extended Temperature Testing is available. Please contact factory for more information.

Software

Windows XP/7/8/10 Drivers **Rastergraf P/N ASW-PMMS-0100**

OpenGL and DirectX accelerated display and video input drivers for Windows XP/7/8/10.

Linux X Windows Driver **Rastergraf P/N ASW-PMLN-0300**

x.org-based X-Windows video input and graphics accelerated drivers for x86 or PowerPC Linux.

Contact Us

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