Matrox Radient eV

Installation and Hardware Reference

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Contents

Chapter 1

Introduction

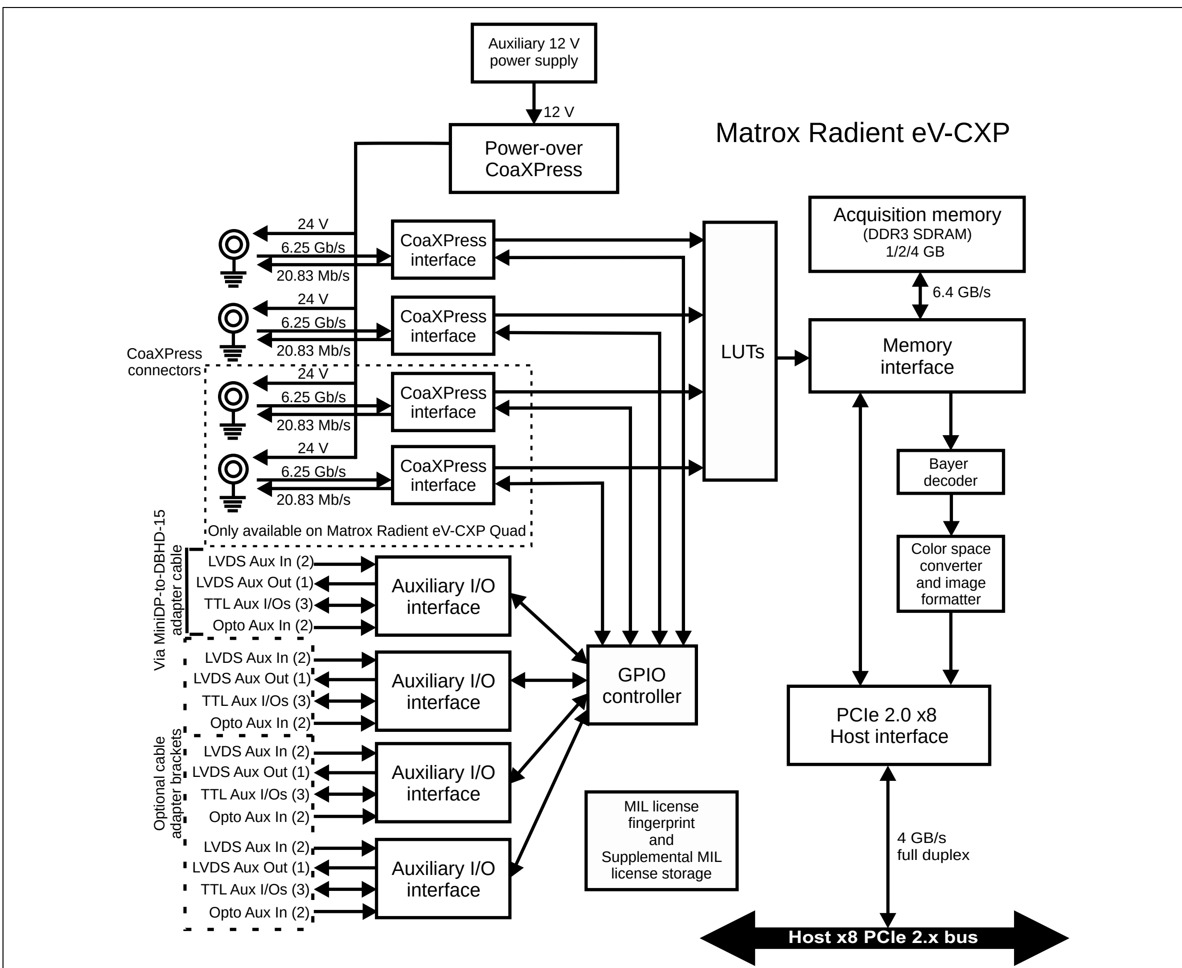
This chapter briefly describes the features of the Matrox Radient eV boards, as well as the software that can be used with the boards.

Matrox Radient eV boards

The Matrox Radient eV family consists of three members: Matrox Radient eV-CXP, Matrox Radient eV-CLHS, and Matrox Radient eV-CL.

Acquisition with Matrox Radient eV-CXP

Matrox Radient eV-CXP is a high-performance PCIe frame grabber that supports image capture from high-resolution, high-speed video sources that use the CoaXPress (CXP) communication standard. There are two versions of Matrox Radient eV-CXP available: Matrox Radient eV-CXP Dual and Matrox Radient eV-CXP Quad.



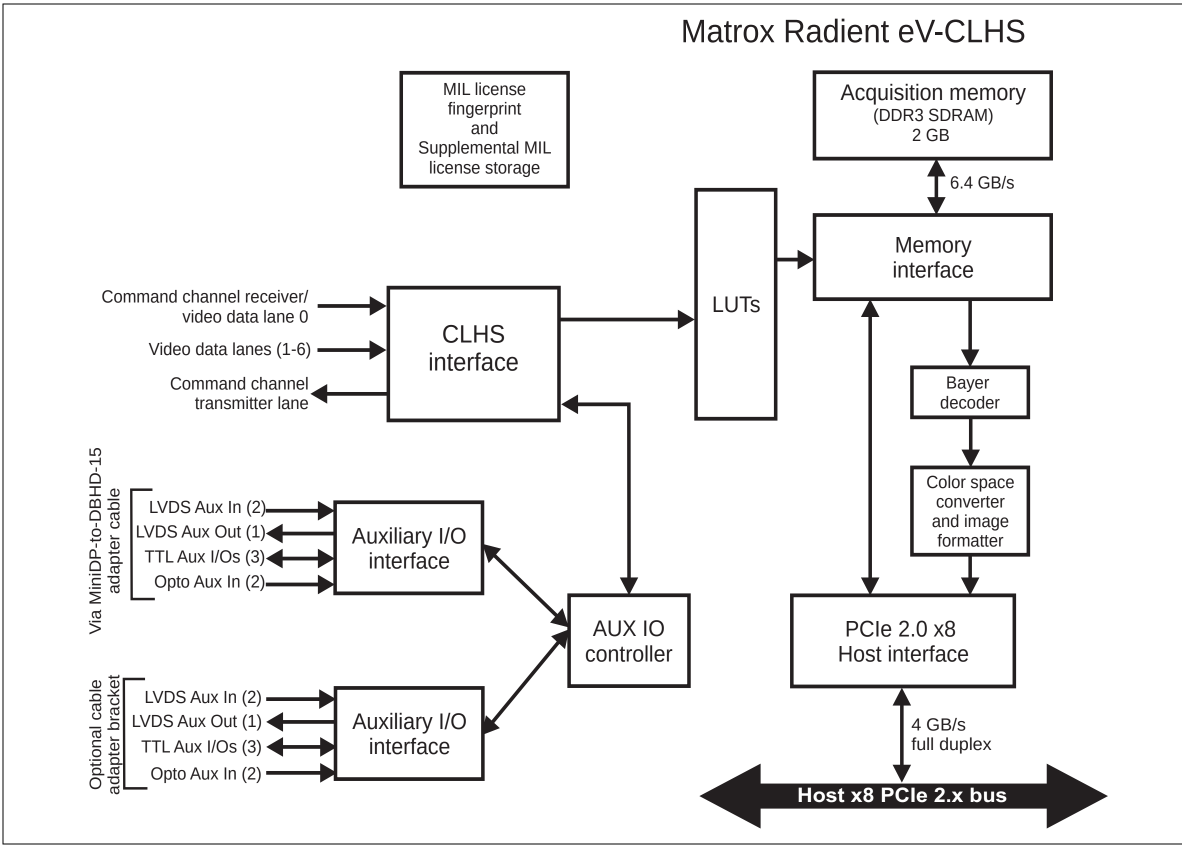
Matrox Radient eV-CXP Dual supports up to two simultaneous CoaXPress links to standard CoaXPress video sources. Matrox Radient eV-CXP Quad supports up to four simultaneous CoaXPress links to standard CoaXPress video sources. A CoaXPress link contains all the connections and components to capture from one video source. For Matrox Radient eV-CXP Dual, one link can use 1 to 2 CoaXPress connections and for Matrox Radient eV-CXP Quad, one link can use 1 to 4 CoaXPress connections; each connection uses one of the independent acquisition paths on Matrox Radient eV-CXP.

The frame grabber can receive image data at a maximum speed of 6.25 Gbits/sec per connection (depending on the cable length). Using multiple connections to implement a link (link aggregation), you can increase the speed of the link to a maximum of 12.5 Gbits/sec for Matrox Radient eV-CXP Dual or 25 Gbits/sec for Matrox Radient eV-CXP Quad.

Matrox Radient eV-CXP provides up to 13 W of power per CoaXPress connection to any device that supports power-over-CoaXPress (PoCXP).

Acquisition with Matrox Radient eV-CLHS

Matrox Radient eV-CLHS is a high-performance PCIe frame grabber that supports image capture from a high-resolution, high-speed video source that uses the Camera Link HS (CLHS) communication standard.



Matrox Radient eV-CLHS supports a single CLHS link to a video source that transmits data at 3.125 Gbits/sec per video data lane between the video source and frame grabber. A CLHS link contains all the connections and components to capture from one video source.

Matrox Radient eV-CLHS has a CLHS capability designator of C2, 7M1. This means it uses a CX4 cable (with thumbscrews) connection between the video source and frame grabber, with up to 7 data lanes and 1 command channel. It uses the M-protocol (multi-camera, multi-lane protocol based on 8b/10b encoding) to decode the data received from the video source.

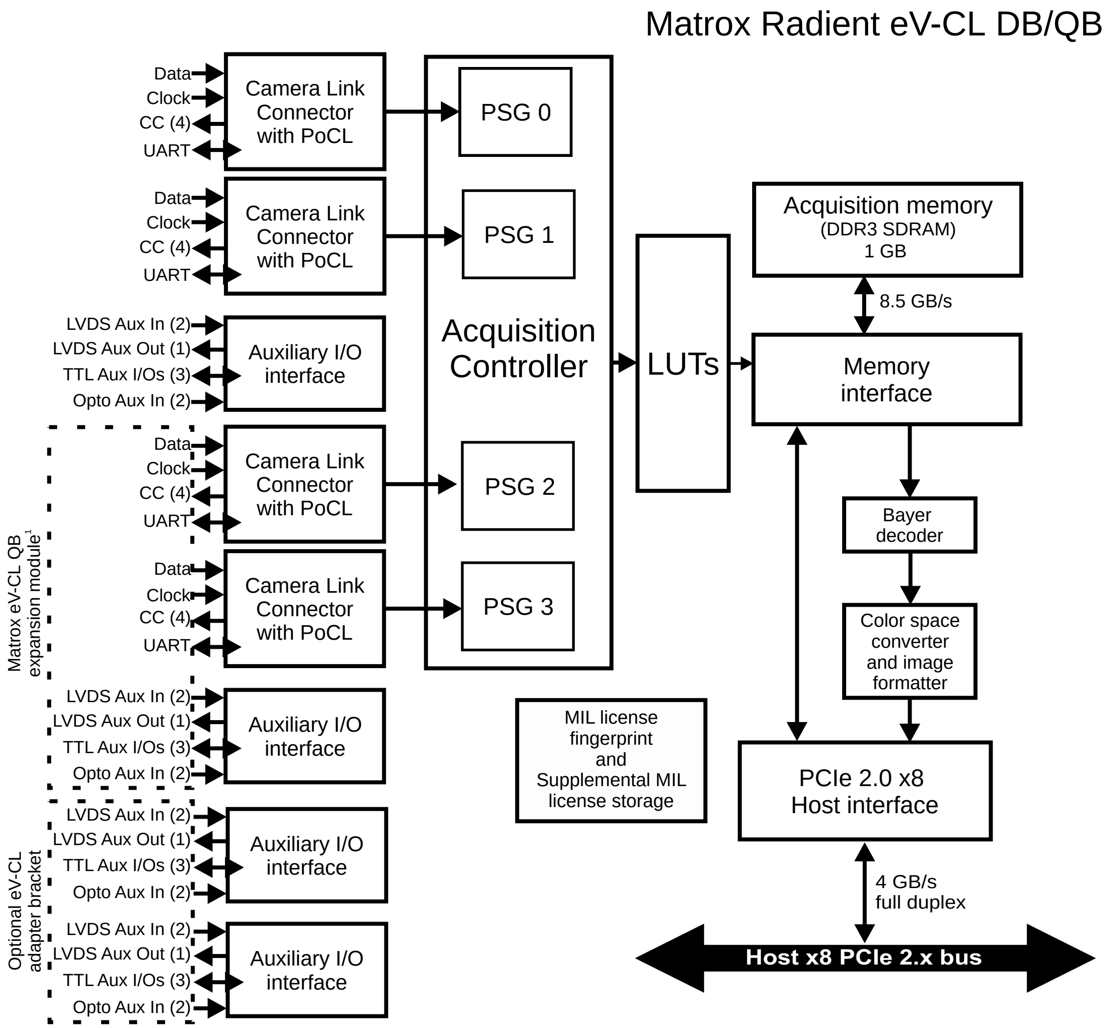
Acquisition with Matrox Radient eV-CL

Matrox Radient eV-CL is a high-performance PCIe frame grabber that acquires images from Camera Link video sources.

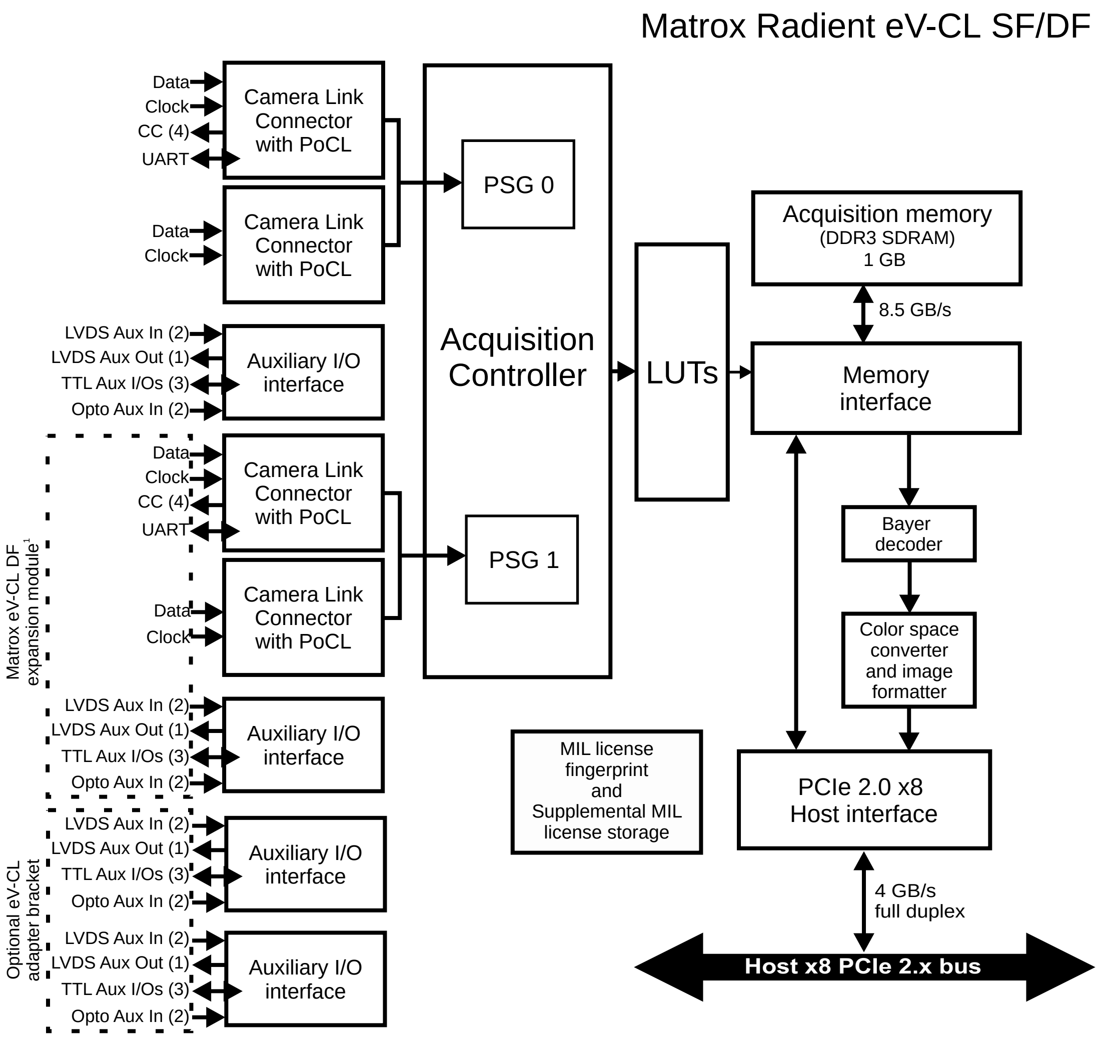
There are four versions of Matrox Radient eV-CL: Radient eV-CL SF, Radient eV-CL DF, Radient eV-CL DB, and Radient eV-CL QB. Matrox Radient eV-CL DB and QB support acquisition from Camera Link video sources in Base configuration; eV-CL DB supports simultaneous acquisition from two of these video sources and eV-CL QB supports four simultaneously. Matrox Radient eV-CL SF and DF support acquisition from Camera Link video sources in Medium, Full, or 80-bit configuration; eV-CL SF supports acquisition from one of these video sources and eV-CL DF supports two simultaneously.

Matrox Radient eV-CL supports power-over Camera Link (PoCL) compliant video sources and Camera Link frequencies of 20 MHz to 85 MHz.

This manual refers to all Matrox Radient eV-CL boards as Matrox Radient eV-CL. When necessary, this manual distinguishes between the boards using their full names.



[1]Note that, without the expansion module, this is a flow diagram of Matrox Radient eV-CL DB. With the expansion module, this is a flow diagram of Matrox Radient eV-CL QB. eV-CL DB is not upgradable to eV-CL QB; the eV-CL DB does not have the required connector for the eV-CL QB module.



[1]Note that, without the expansion module, this is a flow diagram of Matrox Radient eV-CL SF. With the expansion module, this is a flow diagram of Matrox Radient eV-CL DF. eV-CL SF is not upgradable to eV-CL DF; the eV-CL SF does not have the required connector for the eV-CL DF module.

General acquisition features

Matrox Radient eV supports frame and line-scan, monochrome and color video sources. The color video sources can be RGB video sources or video sources with a Bayer color filter. Matrox Radient eV can decode Bayer color-encoded images and perform color space conversions while transferring the image to the Host.

Acquisition memory

Matrox Radient eV-CXP is equipped with 1, 2, or 4 Gbytes of DDR3 SDRAM acquisition memory. Matrox Radient eV-CLHS is equipped with 2 Gbytes of DDR3 SDRAM acquisition memory. Matrox Radient eV-CL is equipped with 1 Gbytes of DDR3 SDRAM acquisition memory. This memory is accessed through the memory interface, and is used to store acquired images. The memory interface has multiple input ports, and it has a data transfer rate of 6.4 Gbytes/sec for Matrox Radient eV-CXP and Matrox Radient eV-CLHS and 8.5 Gbytes/sec for Matrox Radient eV-CL.

Additional functionality

In addition to the core video capture capabilities, Matrox Radient eV incorporates a variety of features to simplify overall system integration. These features include:

- **Color space converter and image formatter.** This can convert data as it is being transferred to the Host. It can convert 8- or 16-bit monochrome or 24- or 48-bit packed BGR data to monochrome, packed BGR, packed BGRa, planar RGB, or YUV (YUYV) format. In addition, it can flip or subsample data sent to the Host.

- **Bayer decoder.** This can convert Bayer-encoded data to RGB. The following Bayer patterns are supported: GRBG, GBRG, BGGR, and RGGB.

- **Auxiliary, multi-purpose signals.** These are non-video signals that can support one or more functionalities (for example, trigger input or timer output), depending on the auxiliary signal.

- **Integrated rotary decoders.** These can decode quadrature input received from a rotary encoder.

Data transfer

Your Matrox Radient eV can send data to the Host at a maximum theoretical transfer rate of 4.0 Gbytes/sec. Optimum conditions for high speed transfer include using the board in a PCIe 2.x slot with 8 active lanes, using a 256-byte payload. DMA write performance is chipset and computer dependent, and is slightly affected by the image size and alignment in Host memory (frame start address and line pitch).

To measure the effective available bandwidth of the PCIe slot in your computer with your Matrox Radient eV board, Matrox provides the RadientCXP Bench, RadientCLHS Bench, or Radient eV-CL Bench tool. These tools are integrated in the MILConfig utility, which is shipped with software that supports Matrox Radient eV products (for example, MIL).

Documentation conventions

This manual refers to all Matrox Radient eV boards as Matrox Radient eV. When necessary, this manual distinguishes between the boards using their full names. Also note that, when the term Host is used in this manual, it refers to the host computer.

Software

To operate your Matrox Radient eV, you can use one or more Matrox Imaging software products that supports the board. These are the Matrox Imaging Library (MIL) and its derivatives (for example, MIL-Lite and Matrox Intellicam). All Matrox software is supported under Windows; MIL is also supported under Linux when using Matrox Radient eV. Consult your software manual for supported versions of these operating systems.

MIL

MIL is a high-level programming library with an extensive set of optimized functions for image capture, processing, analysis, transfer, compression, display, and archiving. Image processing operations include point-to-point, statistical, spatial filtering, morphological, geometric transformation, and FFT operations. Analysis operations support calibration, are performed with sub-pixel accuracy, and include pattern recognition (normalized grayscale correlation and Geometric Model Finder), blob analysis, edge extraction and analysis, measurement, image registration, metrology, character recognition (template-based and feature-based), code recognition and verification (1D, 2D and composite code types), bead (continuous strips of material) inspection, 3D reconstruction, and color analysis.

MIL applications are easily ported to new Matrox hardware platforms and can be designed to take advantage of multi-processing and multi-threading environments.

MIL-Lite

MIL-Lite is a subset of MIL. It includes all the MIL functions for image acquisition, transfer, display control, and archiving. It also allows you to perform processing operations that are typically useful to pre-process grabbed images.

Matrox Intellicam

Matrox Intellicam is an interactive Windows program that allows for fast video source interfacing and provides interactive access to all the acquisition features of your Matrox board. Matrox Intellicam also has the ability to create custom digitizer configuration format (DCF) files, which MIL and its derivatives use to interface with specific non-standard video sources. Matrox Intellicam is included with all Matrox Imaging software products.

Essentials to get started

To begin using your Matrox Radient eV, you must have a computer with the following:

- An available conventional x8 (or x16) PCIe 1.x or 2.x slot[*]. Note that a PCIe 2.x slot will ensure the fastest possible transfer of data to the Host.
- Processor with an Intel 32-bit or 64-bit architecture, or equivalent.
- A relatively up-to-date PCIe chipset. A chipset that supports the PCIe 2.x standard is preferable. The list of platforms that are known to be compatible with Matrox Radient eV is available on the Matrox website, under the board's PC compatibility list.
- MIL or one of its derivatives. This software should be installed after you install your board.

Matrox does not guarantee compatibility with all computers that have the above specifications. Please consult with your local Matrox Imaging representative, local Matrox Imaging sales office, the Matrox web site, or the Matrox Imaging Customer Support Group at headquarters before using a specific computer.

Consult your software package for other computer requirements (for example, operating system and memory requirements).

*. Note that you can also install Matrox Radient eV in a x4 PCIe slot that has a mechanical x8 connector; however, the maximum transfer rate between Matrox Radient eV and the Host is reduced by 50%.

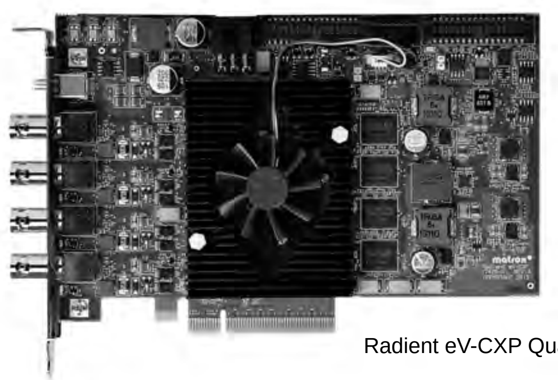
Inspecting the Matrox Radient eV package

You should check the contents of your Matrox Radient eV package when you first open it. If something is missing or damaged, contact your Matrox representative.

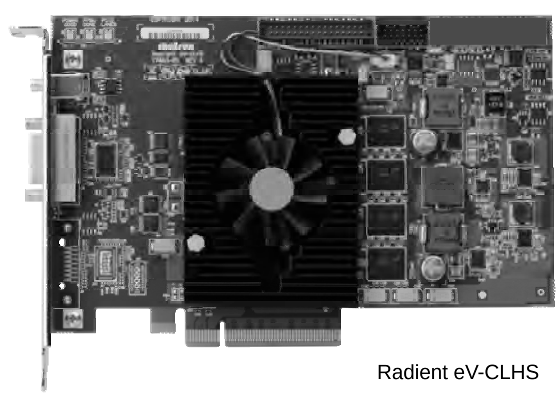
Standard items

You should receive the following items:

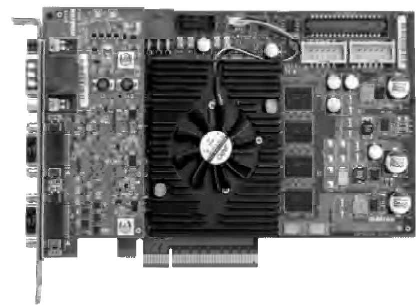
- The Matrox Radient eV board.



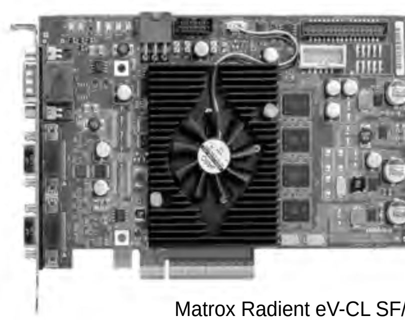
Radient eV-CXP Quad



Radient eV-CLHS



Matrox Radient eV-CL DF/QB



Matrox Radient eV-CL SF/DB

- For Matrox Radient eV-CXP or eV-CLHS, a MiniDP-to-DBHD-15 adapter cable. The cable has a Mini DisplayPort (MiniDP) connector at one end, and a DBHD-15 connector at the other end.

Available separately

You might have also ordered one or more of the following:

- A DBHD-15 cable adapter bracket, equipped with two DBHD-15 auxiliary I/O connectors.

- MIL or MIL-Lite. Matrox Intellicam is included with both of these software packages.

❖ For Matrox Radient eV-CXP, if needed, you can purchase high-quality, 75 Ω coaxial cables from the video source manufacturer, Belden Inc., or other third parties. For Matrox Radient eV-CLHS, if needed, you can purchase CX4 connector cables with thumbscrews from the video source manufacturer, Meritec Inc., or other third parties. For Matrox Radient eV-CL, if needed, you can purchase a 26-pin high-density male mini Camera Link or PoCL-compliant Camera Link cable (HDR or SDR) from the video source manufacturer, Components Express inc., 3M Interconnect Solutions for Factory Automation, Intercon 1, or other third parties.

Handling components

The electronic circuits in your computer and the circuits on your Matrox Radient eV are sensitive to static electricity and surges. Improper handling can seriously damage the circuits. Be sure to drain static electricity from your body by touching a metal fixture (or ground) before you touch any electronic component. In addition, do not let your clothing come in contact with the circuit boards or components.

Warning Before you add or remove devices from your computer, always **turn off** the power to your computer and all peripherals.

Installation

The installation procedure consists of the following steps:

1. Complete the hardware installation procedure described in *Chapter 2: Hardware installation*.

2. Complete the software installation procedure described in the documentation accompanying your software package.

More information For information on using multiple Matrox Radient eV boards, refer to *Chapter 3: Using multiple Matrox Radient eV boards*.

For in-depth hardware information, refer to *Chapter 4: Matrox Radient eV hardware reference*; whereas for a summary of this information, as well as environmental and electrical specifications, and connector pinout descriptions, see *Appendix B: Technical information*.

This manual occasionally makes reference to a MIL-Lite function. However, anything that can be accomplished with MIL-Lite can also be accomplished with MIL.

Need help?

If you experience problems during installation or while using this product, refer to the support page on the Matrox Imaging web site: www.matrox.com/imaging/support. This page provides answers to frequently asked questions, as well as offers registered customers additional ways of obtaining support.

If your question is not addressed and you are currently registered with the MIL maintenance program, you can contact technical support. To do so, you should first complete and submit the online Technical Support Request Form, accessible from the above-mentioned page. Once the information is submitted, a Matrox support agent will contact you shortly thereafter by email or phone, depending on the problem.

Chapter

2

Hardware installation

This chapter explains how to install your Matrox Radient eV board in your computer.

Installing your Matrox Radient eV board

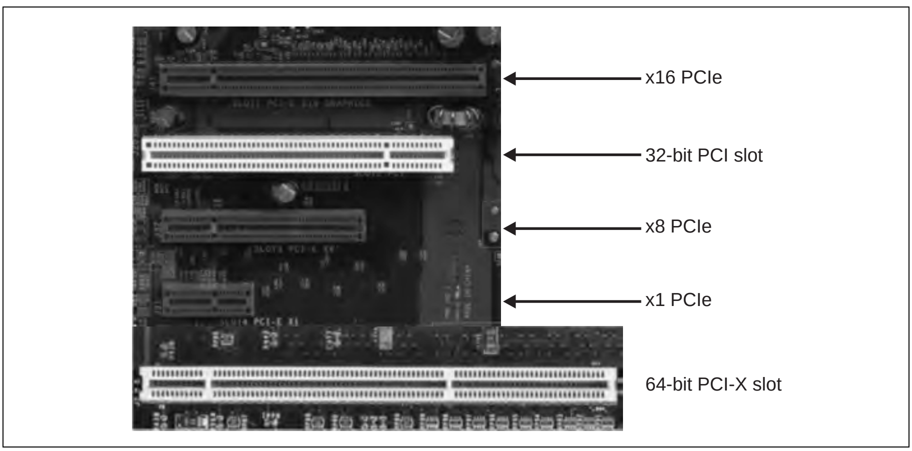
Before you install your Matrox Radient eV board, some precautionary measures must be taken. Turn off the power to your computer and its peripherals, and drain static electricity from your body (by touching a metal part of the computer chassis).

Important ❖ Note that your board should be installed before you install your software.

Proceed with the following steps to install your board:

1. Remove the cover from your computer; refer to your computer's documentation for instructions.

2. Check that you have an empty x8 (or x16) PCIe 1.x or 2.x slot in which to install your Matrox Radient eV*. Note that a PCIe 2.x slot will ensure the fastest possible transfer of data to the Host.

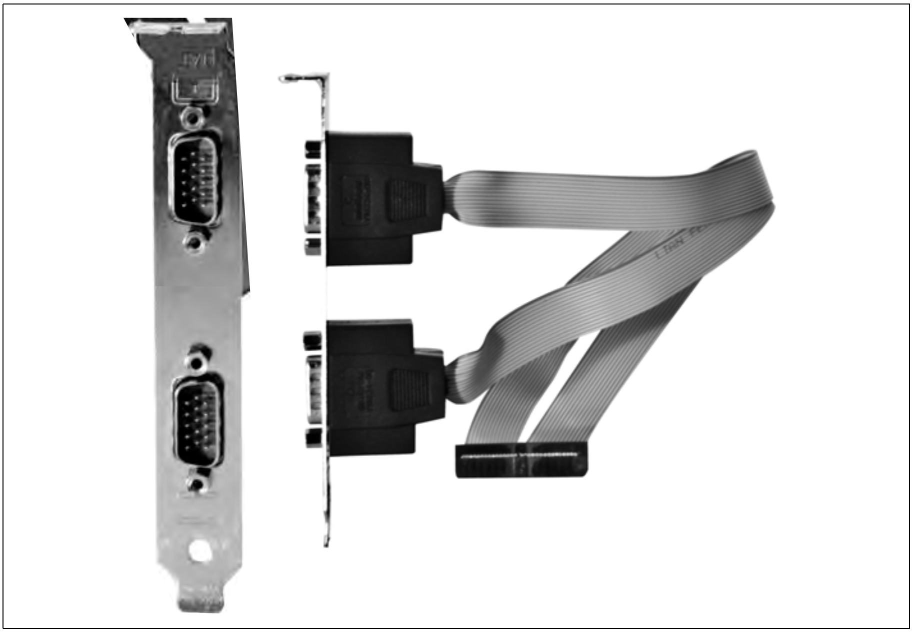


*. Note that you can also install Matrox Radient eV in a x4 PCIe slot that has a mechanical x8 connector; however, the maximum transfer rate between Matrox Radient eV-CXP and the Host is reduced by 50%.

Matrox Radient eV might drop frames if the PCIe slot does not have at least 8 active lanes (for example, if the board is connected to a x8 PCIe slot that has only four active lanes*). Verify with your motherboard manufacturer to find out whether your motherboard works efficiently with a x8 PCIe board, such as Matrox Radient eV.

If you need to install the DBHD-15 cable adapter brackets, you will need an additional slot for each cable adapter bracket. These slots need not be adjacent to the Matrox Radient eV board. In addition, the cable adapter brackets do not plug into a slot's connector; they attach only to the back of the computer's chassis.

❖ Note that the external auxiliary I/O connectors on the cable adapter brackets are panel mount connectors. If you don't want to occupy an entire slot for each additional bracket, you can punch out two holes in the computer chassis, and then screw the connectors in the holes.

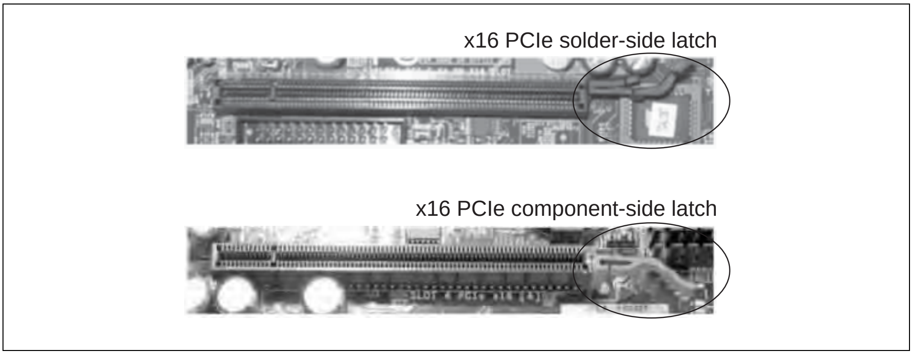


*. After installing the board, you can verify in software the number of PCIe lanes that are currently active, using the MIL-Lite function MsysInquire() with M_PCIE_NUMER_OF_LANES.

3. If there is a metal plate at the back of the selected slots, remove it. Keep the screw from the top of the plate to anchor your board and cable adapter brackets once they are installed.

4. Position your Matrox Radient eV board in the selected PCIe slot. Align the connectors of your board with the opening at the back of the slot, and move the board until the connectors pass through the opening.

Important When installing your Matrox Radient eV board in a x16 PCIe slot, special care must be taken to avoid damaging the board. Some x16 PCIe slots have a connector with a retainer. You should avoid touching the latch of this retainer with the board. Alternatively, you can remove the latch from the retainer.



5. Once the input connectors are in the opening of the chassis, press the board firmly but carefully straight down into the connector of the slot.

6. Anchor the board using the screw that you removed in step 3.

7. If using Matrox Radient eV-CXP, connect the PCIe power cable from your computer's 12 V power supply to the PCIe auxiliary power connector.

❖ You only need to connect the auxiliary power if you are using PoCXP-compliant video sources with Matrox Radient eV-CXP.

8. If required, install the cable adapter brackets, as described in the section *Installing the cable adapter brackets*, later in this chapter.

9. Attach your video sources, as described in the section *Connecting video sources to Matrox Radient eV-CXP*, *Connecting a video source to Matrox Radient eV-CLHS*, or *Connecting video sources to Matrox Radient eV-CL*, later in this chapter.

10. Turn on your computer.

❖ When you boot your computer under Windows, Windows' Plug-and-Play system will detect a new Multimedia Video Device and you will be asked to assign it a driver. At this point, you should click on **Cancel**.

Under Windows and Linux, the driver will be installed during the installation of Matrox Radient eV software.

11. Disable active state power management (ASPM) for PCIe devices, to maximize the performance of Matrox Radient eV. In the BIOS, disable all ASPM (or equivalent) settings (typically accessible from the **Power management** sub-menu of the **Advanced Configurations** menu). In addition, if the operating system has an **ASPM for PCIe devices** option, disable this option as well. For example, under Microsoft Windows 7, open the **Power Options** dialog box from the Windows Control Panel. For the currently selected power plan, click on **Change Plan Settings** and then click on **Change Advanced Power Settings**. In the presented dialog, expand **PCI Express**, and then expand **Link State Power Management** and set it to **Off**.

12. Under Microsoft Windows, set the power plan option to high performance to maximize the performance of Matrox Radient eV and minimize the possibility of dropped frames. For example, under Microsoft Windows 7, open the **Power Options** dialog box from the Windows Control Panel and set the power plan option to **High Performance**.

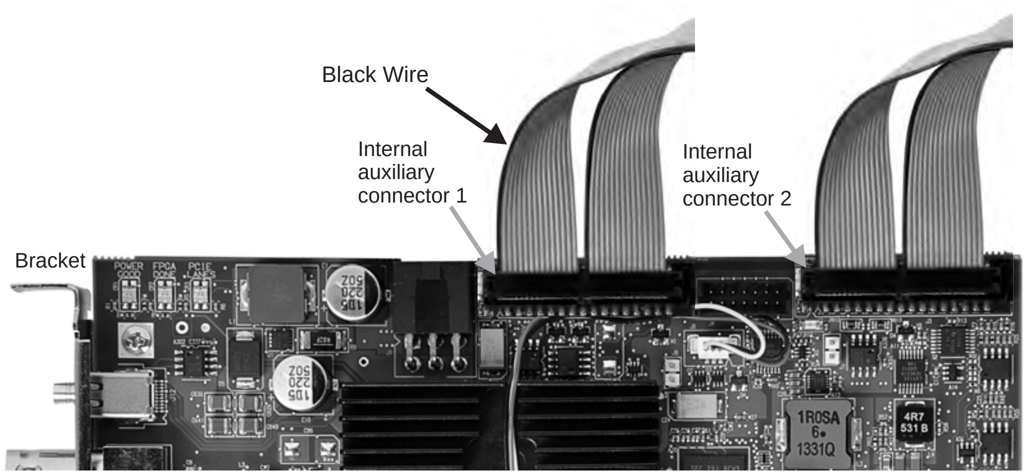
Installing the cable adapter brackets

To install the cable adapter brackets, proceed with the following steps:

1. Make sure that your Matrox Radient eV board is fastened to the computer chassis.

2. Attach the cable adapter bracket to the internal auxiliary I/O connectors on the Matrox Radient eV board. When attaching the flat ribbon cables of the adapter brackets, position each cable so that the black wire is on the same side as the bracket of the Matrox Radient eV board. Matrox Radient eV-CXP has two internal 32-pin auxiliary I/O connectors. Matrox Radient eV-CLHS has one internal 32-pin auxiliary I/O connector. Matrox Radient eV-CL has one internal 32-pin auxiliary I/O connector and two internal 10-pin auxiliary I/O connectors.

   Note that the two cable adapter brackets for Matrox Radient eV-CXP are physically identical. For naming purposes, the cable adapter bracket that you connect to internal auxiliary I/O connector 1 is the primary cable adapter bracket. The secondary cable adapter bracket is the cable adapter bracket that you connect to internal auxiliary I/O connector 2.



3. Slide the bracket of the cable adapter bracket into the opening at the back of the selected slot.

4. Anchor the bracket to the chassis using the screw that you removed in the previous section.

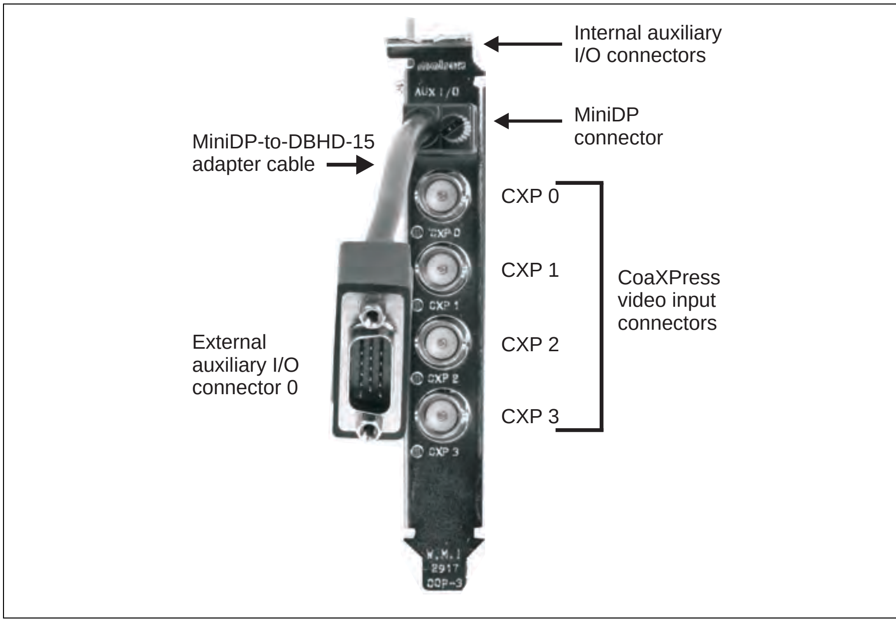
   Note that the external auxiliary I/O connectors on the cable adapter brackets are panel mount connectors. If you don't want to occupy an entire slot for each additional bracket, you can punch out two holes in the computer chassis, and then screw the connectors in the holes.

Connecting video sources to Matrox Radient eV-CXP

The Matrox Radient eV-CXP board has the following connectors on its bracket:

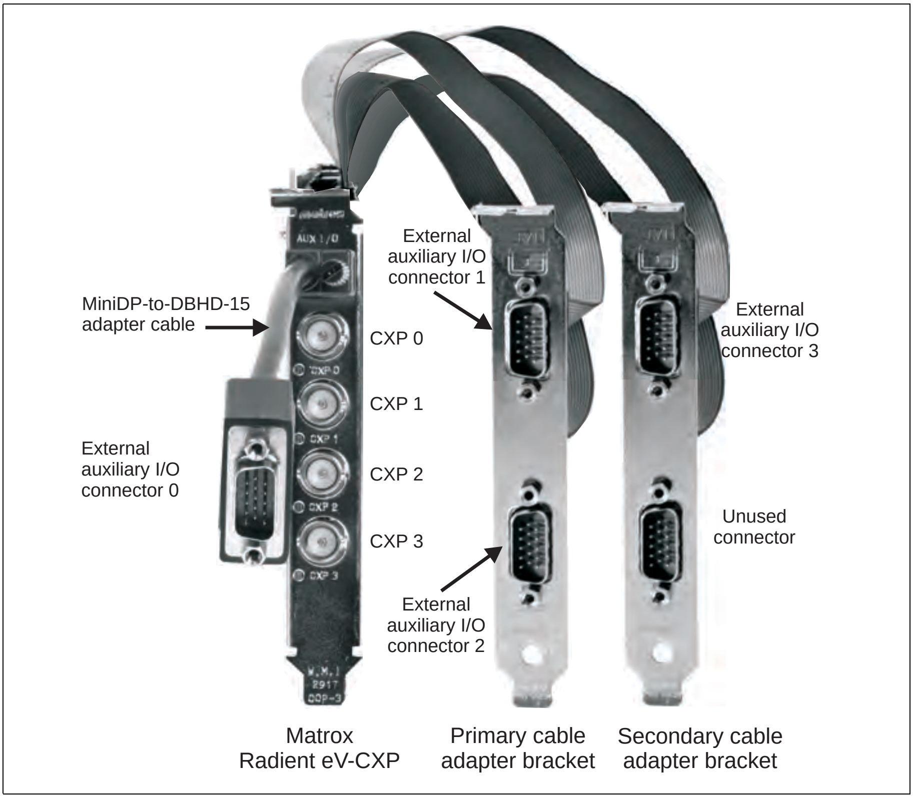
- **Two or four CoaXPress video input connectors (BNC).** Used to receive video streams from the CoaXPress video sources. These connectors are also used to transmit and receive CoaXPress trigger signals, as well as control and acknowledgment messages. The Matrox Radient eV-CXP Dual has two connectors; whereas, the Matrox Radient eV-CXP Quad has four connectors.

- **Mini DisplayPort (MiniDP) connector.** Used to connect the MiniDP-to-DBHD-15 adapter cable. The DBHD-15 connector on the adapter cable is called external auxiliary I/O connector 0. This connector is used to transmit and receive auxiliary signals.



To access the signals of the internal auxiliary I/O connectors, you can install up to two cable adapter brackets. They each have two connectors that are named based on the internal auxiliary I/O connector to which their cable adapter bracket is attached.

- **External auxiliary I/O connectors 1, 2, and 3 (panel mount DBHD-15).** Each used to transmit and receive auxiliary signals.

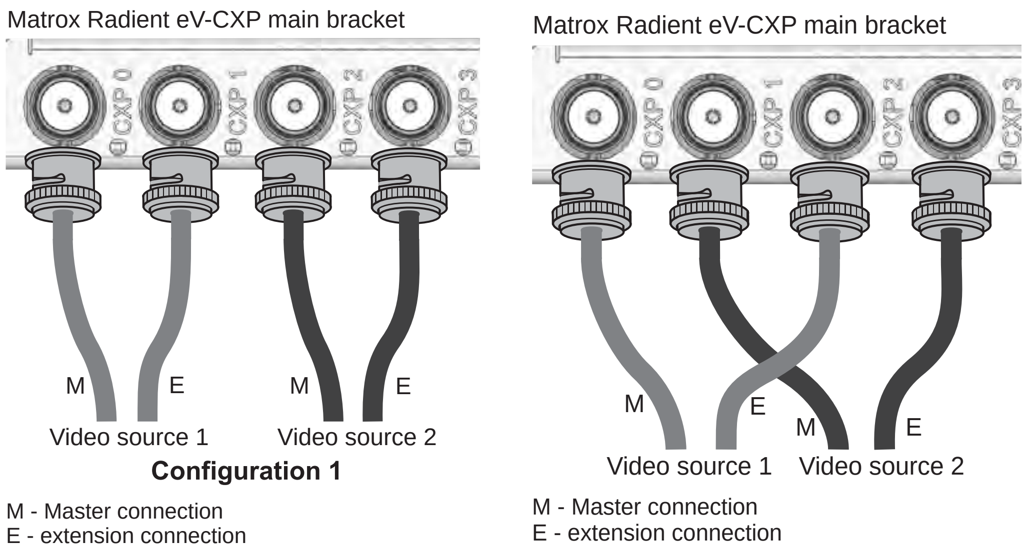


Note that the primary cable adapter bracket is the bracket that you attach to internal auxiliary I/O connector 1, and the secondary cable adapter bracket is the bracket that you attach to internal auxiliary I/O connector 2.

Connecting to CoaXPress video input connectors

When attaching video sources to your Matrox Radient eV-CXP, you must use 75 Ω, coaxial cables with standard BNC connectors. For the best performance, it is recommended that you use high-quality cables, such as Belden 1694A cables.

Note that a video source with multiple cables will have one cable denoted as the master connection (for example, with an arrow marked on the cable) and the others as extension connections. Keep track of the video input connector to which you attach the master connection because you will need this information when using MIL-Lite (**MdigAlloc**() with **M_DEVn**) to identify the video source.



Matrox Radient eV-CXP communicates with the video sources to identify which video source is connected to which input connectors.

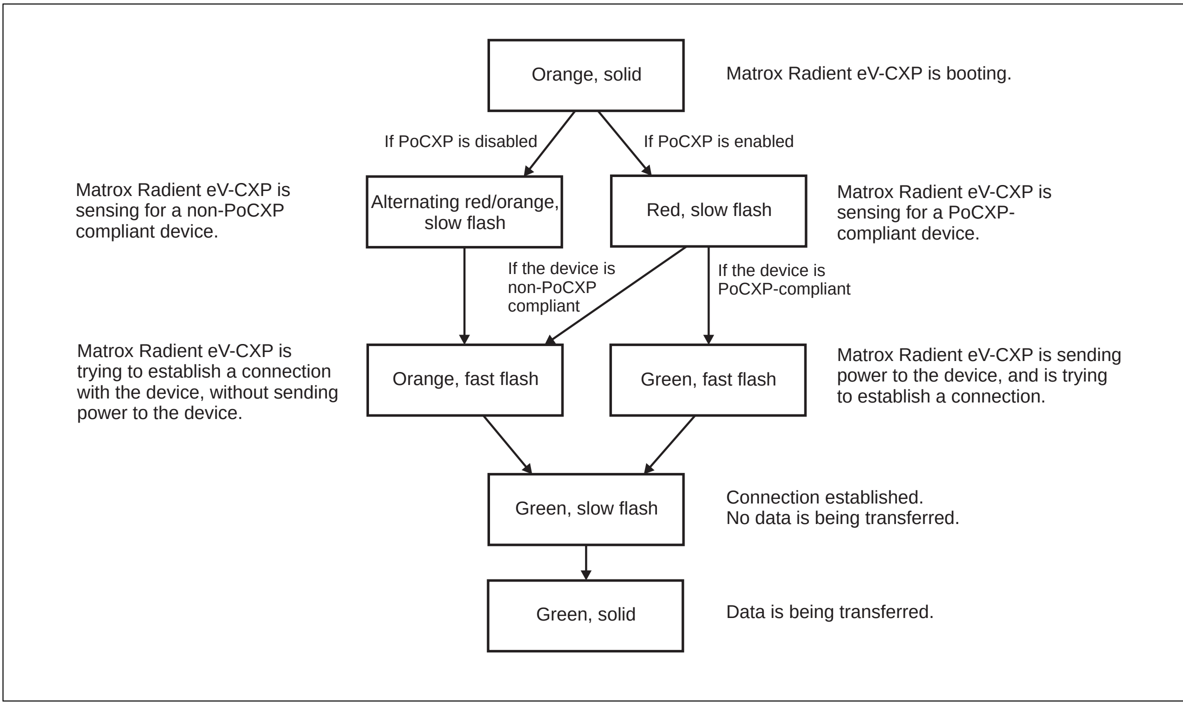
❖ Note that if you are using more than one coaxial cable to connect to the same video source, the cables you choose must be of the same type and length.

The length of cable that you choose will affect the maximum data transmission rate. In general, for lengths greater than 40 m, the longer your cables, the lower the maximum possible bit rate. For example, using high-quality, 100 m cables, the maximum possible bit rate is 3.125 Gbits/sec. Another factor that affects the bit rate is the quality of the cables that you choose.

CoaXPress LEDs

The four CoaXPress LEDs on the main bracket identify the state and activity of connected devices.

The typical sequence of LED states is as follows:



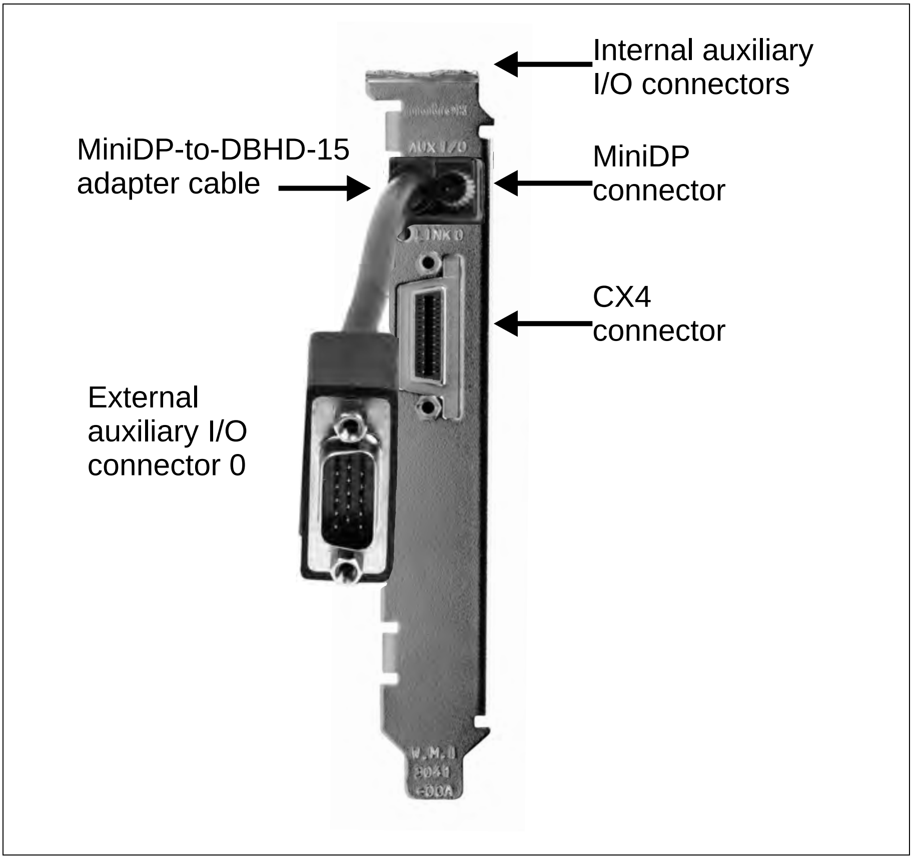
Important

If the sequence of LED states on your Matrox Radient eV is different from this sequence, there could be a problem with your device or with data transfer. Refer to the *CoaXPress LEDs* section in *Appendix B: Technical information* for the complete list of possible LED states.

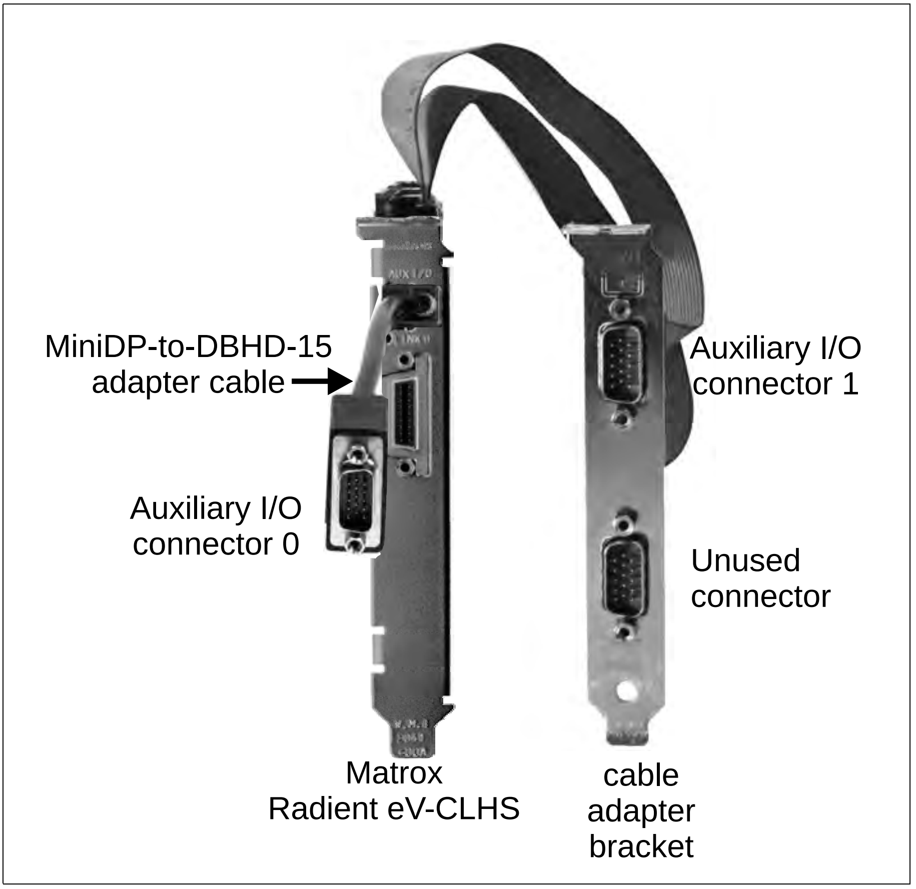
Connecting a video source to Matrox Radient eV-CLHS

The Matrox Radient eV-CLHS board has the following connectors on its bracket:

- **One CX4 video input connector**. Used to receive video data from a CLHS video source. This connector is also used to transmit and receive a Camera Link HS command, pulse (used to generate trigger events), general purpose I/O (GPIO), and acknowledge messages.
- **Mini DisplayPort (MiniDP) connector.** Used to connect the MiniDP-to-DBHD-15 adapter cable. The DBHD-15 connector on the adapter cable is called external auxiliary I/O connector 0. This connector is used to transmit and receive auxiliary signals.



- **External auxiliary I/O connector 1 (panel mount DBHD-15).** Used to transmit and receive auxiliary signals. You must install the cable adapter bracket to access these signals.



A single video source with a CLHS product capability designator of C2, 7M1 can be connected to the CX4 video input connector of the frame grabber using a 10 Gbit Ethernet CX4 cable with thumbscrews. You can purchase such a cable from the video source manufacturer, Meritec Inc., or other third parties. Note that this cable is not available from Matrox.

Connecting video sources to Matrox Radient eV-CL

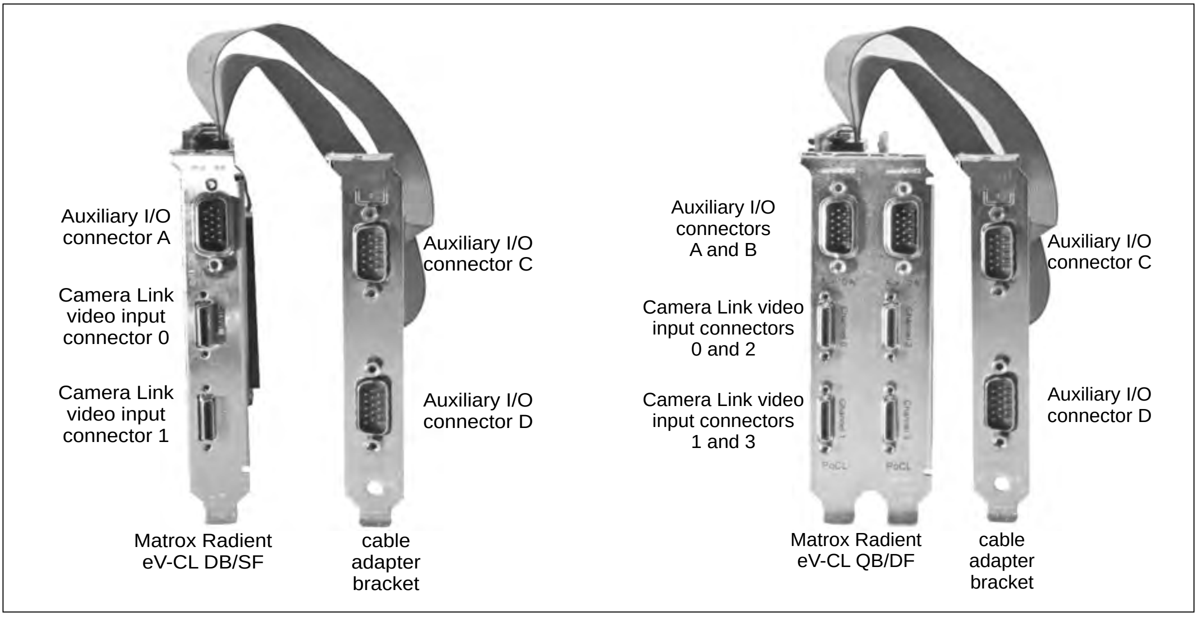
The Matrox Radient eV-CL board has the following connectors on its bracket(s):

- **Two or four Camera Link-compliant video input connectors.** Used to receive video input, timing, and synchronization signals, from the video source. These are also used to transmit/receive communication signals between the video source and the frame grabber through a UART port.

- **External auxiliary I/O connector A or external auxiliary I/O connectors A and B** (**DBHD-15**). Each used to transmit/receive auxiliary signals.

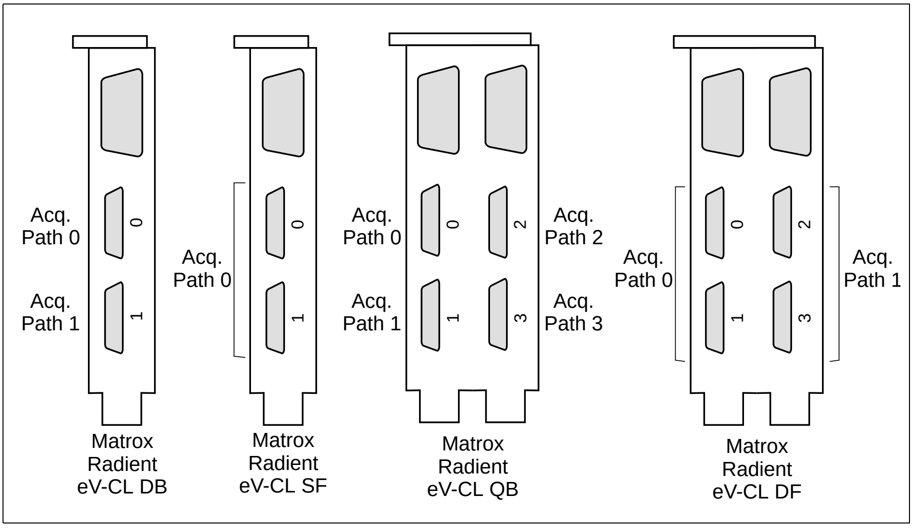
To access the signals of the internal auxiliary I/O connectors, you might have installed a cable adapter bracket. It can have the following connectors:

- **External auxiliary I/O connectors C and D** (**panel mount DBHD-15 or DB-9**). Each used to transmit/receive auxiliary signals.



Attach video sources to Matrox Radient eV-CL as follows:

Matrox Radient eV-CL board	Camera Link connector 0	Camera Link connector 1	Camera Link connector 2	Camera Link connector 3
DB	Video source 0 in Base configuration	Video source 1 in Base configuration	--	--
QB	Video source 0 in Base configuration	Video source 1 in Base configuration	Video source 2 in Base configuration	Video source 3 in Base configuration
SF	Video source 0 in Medium, Full, or 80-bit configuration		--	--
DF	Video source 0 in Medium, Full, or 80-bit configuration		Video source 1 in Medium, Full, or 80-bit configuration	



Warning

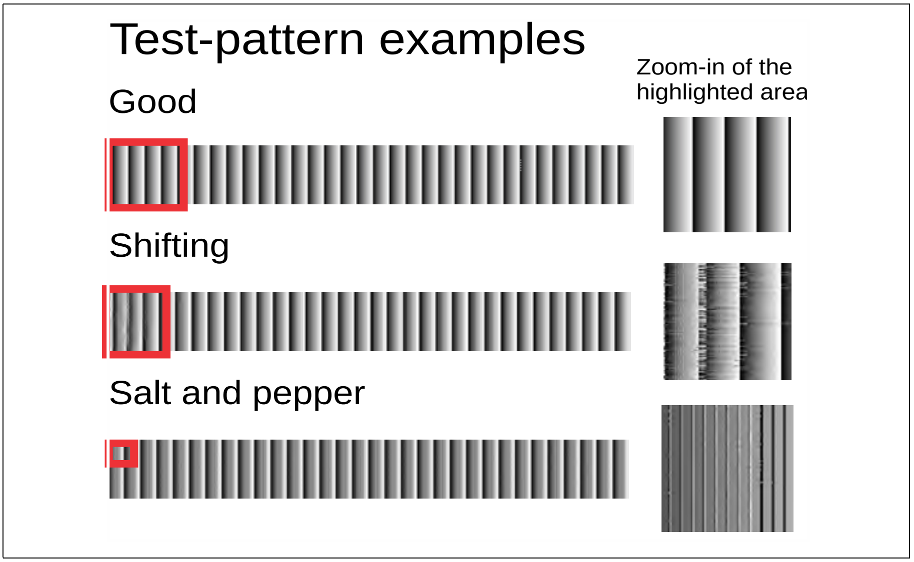
❖ When connecting a video source in Full or 80-bit configuration, ensure that you are connecting its cables to the appropriate connector. Accidentally connecting the cables to the wrong connector can damage the board or your video source. The Camera Link connector's pins 2-5 and pins 15-18 are output pins on the top connector (0 and 2), while they are input pins on the bottom connector (1 and 3).

To connect video sources to the Camera Link connectors, use standard Camera Link cables with a 26-pin high-density male mini Camera Link connector (HDR or SDR) at one end. When connecting to PoCL-compliant video sources, you should use PoCL-compliant Camera Link cables (HDR or SDR). Camera Link cables are not available from Matrox; for possible sources, see the *Connectors on Matrox Radient eV-CL boards* section in *Appendix B: Technical information*.

❖ If using both Camera Link connectors to connect to the same video source (Medium configuration or Full configuration), the cables you choose should be of the same type and length. Note, however, if they are not, Matrox Radient eV-CL will adapt to any delay caused by reasonable differences in length.

Camera Link cables longer than 7 meters

When using Camera Link cables that are longer than 7 meters with Matrox Radient eV-CL and using a pixel clock of 85 MHz, the resulting images from your camera might have either salt and pepper noise or unsynchronized lines (that is, a line is shifted either left or right, and clipped to fit the frame). These errors might be caused by signal degradation due to long cables.



To fix this problem, you must adjust your DCF. To do so:

1. Set your camera to generate images that contain as many different pixel values as possible for every tap (for example, a test pattern containing a horizontal ramp). Refer to your camera's documentation for more information. If your camera does not have a test-pattern mode, select an image similar to a horizontal ramp.

2. Once the test pattern (or sample image) is available, use the **Deseralizer** tool. This tool will adjust values within your DCF to compensate for signal degradation due to the long cables. This tool is available on the **Radient eV-CL** page of the MILConfig utility. Follow all on-screen instructions.

When the process is complete, your camera's DCF is updated. Any MIL application that uses this DCF in the same physical environment should now be able to receive better images (using your camera as a video source).

❖ Note that, if your MILConfig utility does not have the **Deserializer** tool, contact Matrox Technical Support for assistance.

Chapter

3

Using multiple Matrox Radient eV boards

This chapter explains how to use multiple Matrox Radient eV boards.

Installation of multiple boards

You can install and use multiple Matrox Radient eV boards in one computer.

Install each additional Matrox Radient eV board as you installed the first board (refer to *Chapter 2: Hardware installation*). The number of Matrox Radient eV boards that you can install is primarily dependent on the number of physical slots in your computer, and your BIOS; your BIOS establishes how many PCIe devices can be mapped to the PCIe memory space of your computer.

Using MIL-Lite, you have to allocate a MIL system for each board and allocate the resources of each MIL system. For more information, see **MsysAlloc**() with **M_SYSTEM_RADIENTCXP**, **M_SYSTEM_RADIENTCLHS**, or **M_SYSTEM_RADIENTEVCL** in the MIL Reference.

Simultaneous image capture from different boards

In addition to capturing images from multiple video sources with a single Matrox Radient eV board, you can also simultaneously capture images from video sources attached to multiple Matrox Radient eV boards. Note that the number of video sources from which you can simultaneously capture images is limited by the PCIe chipset on your computer.

The use of a high performance PCIe chipset is necessary to sustain PCIe transfers to Host memory. Ideally, a PCIe 2.x chipset should be used. A PCIe 2.x Host bus will optimize the speed of data transmission, and will minimize data loss. The list of platforms that are known to be compatible with Matrox Radient eV is available on the Matrox web site, under the board's compatibility list.

To measure the effective available bandwidth of the PCIe slot in your computer with the Matrox Radient eV board, you can use the RadientCXP Bench, RadientCLHS Bench, or Radient eV-CL Bench tool integrated in the MILConfig utility. As a reference point, capturing from a 2K x 2K, 8-bit, 60 frames/sec video source will require a minimum bandwidth of 240 Mbytes/sec, plus an additional bandwidth margin of approximately 20%, for a bandwidth of 288 Mbytes/sec.

Chapter

4

Matrox Radient eV hardware reference

This chapter explains the architecture, features, and modes of the Matrox Radient eV hardware.

Matrox Radient eV hardware reference

This chapter provides information on the Matrox Radient eV hardware. It covers the architecture, features, and modes of the board's acquisition section. In addition, the chapter covers the Matrox Radient eV hardware related to the formatting and transfer of data. A summary of the features of Matrox Radient eV, as well as pin assignments for the various connectors, can be found in *Appendix B: Technical information*.

Acquisition path

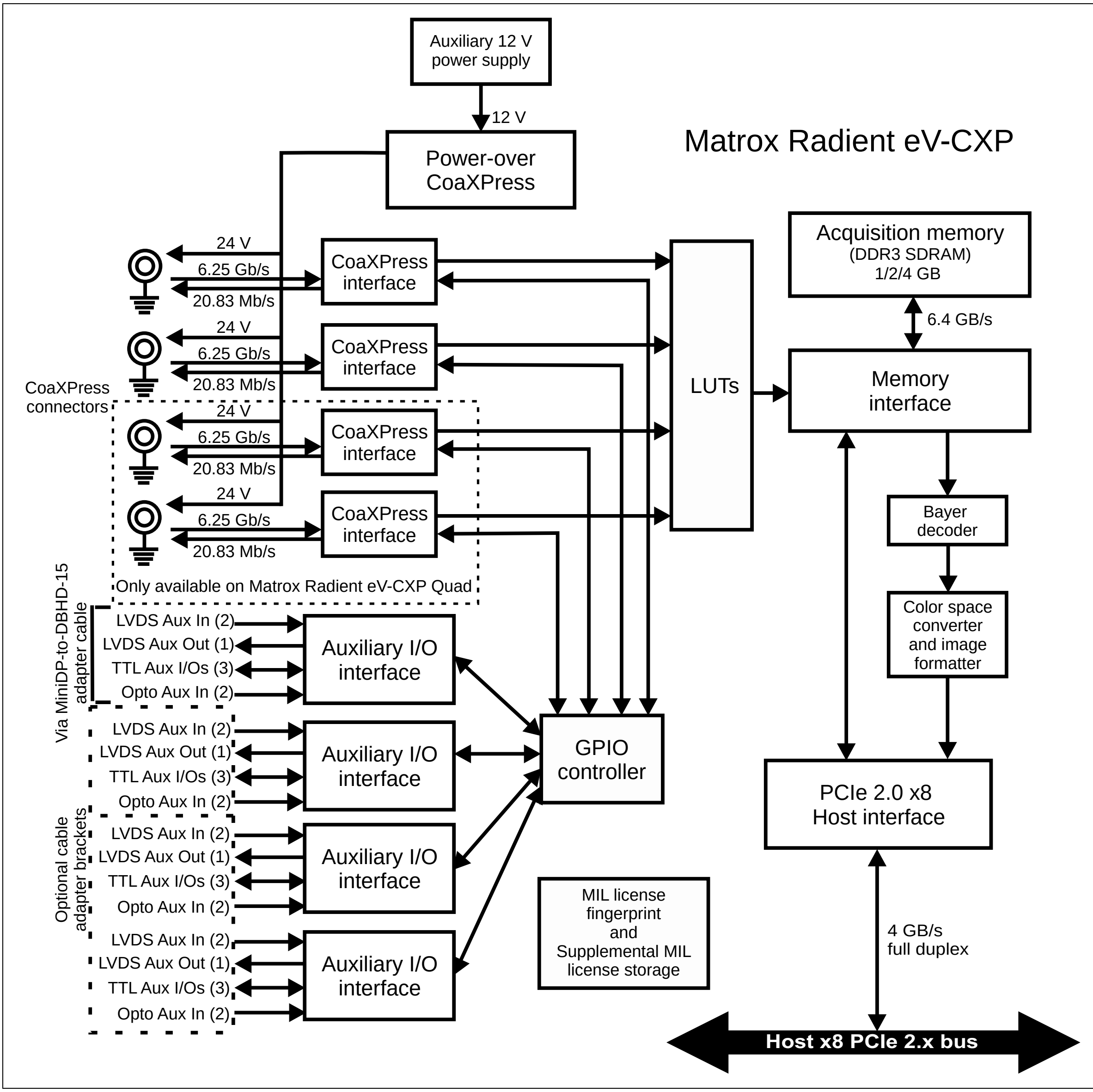
This manual uses the term acquisition path to refer to a path that has the capability to, for example, capture a component or stream of the video input signal. The term *independent acquisition path* is used to refer to an acquisition path that can, if required, acquire data from a video source independently from another such path on the same frame grabber. On Matrox Radient eV-CXP, each CoaXPress connection in a CoaXPress link uses a different acquisition path. On Matrox Radient eV-CLHS, there is only one acquisition path.

Digitizer

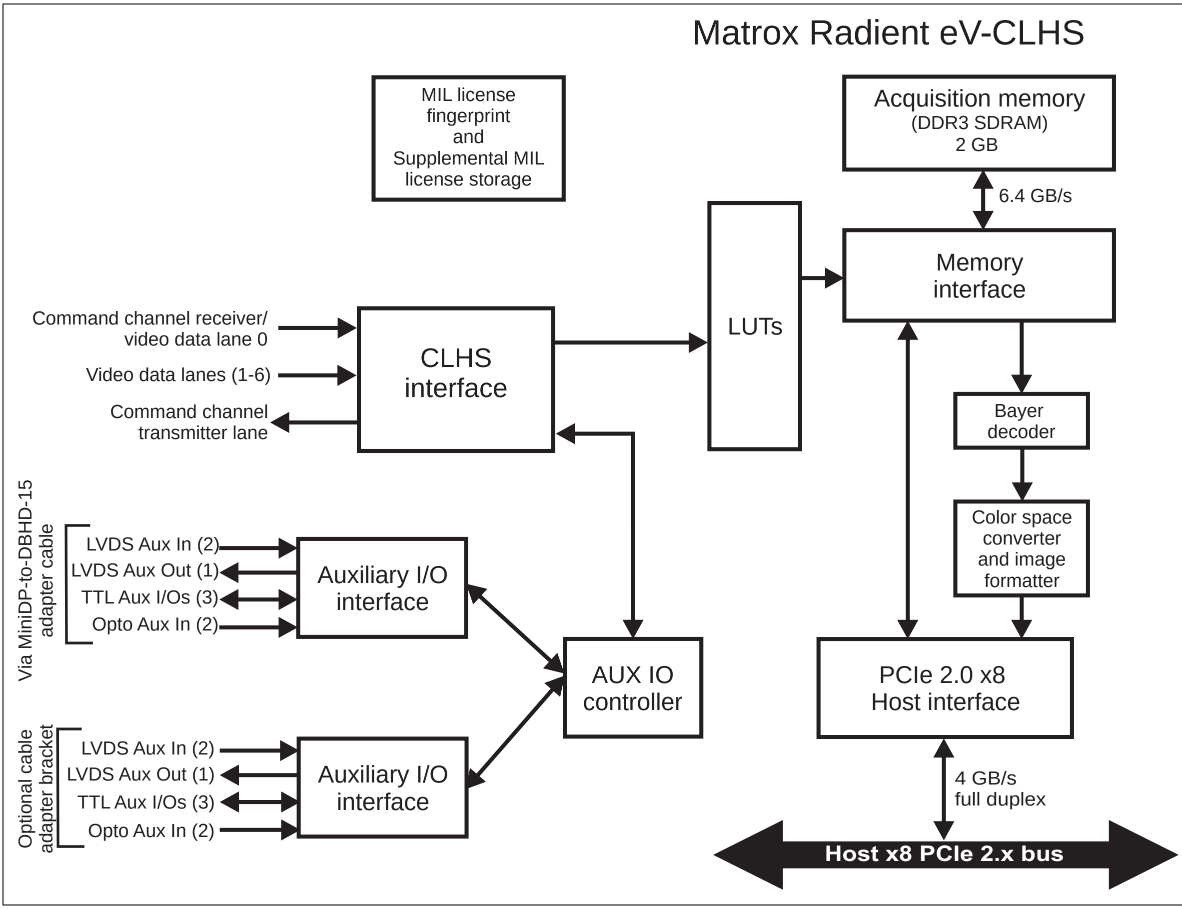
MIL-Lite uses the concept of a MIL digitizer to represent the acquisition path(s) with which to grab from one input source (one CoaXPress link on Matrox Radient eV-CXP) of the specified type. When several MIL digitizers are allocated, their device number along with their DCF identify if they represent the same path(s) (but perhaps for a different input format) or independent path(s) for simultaneous acquisition.

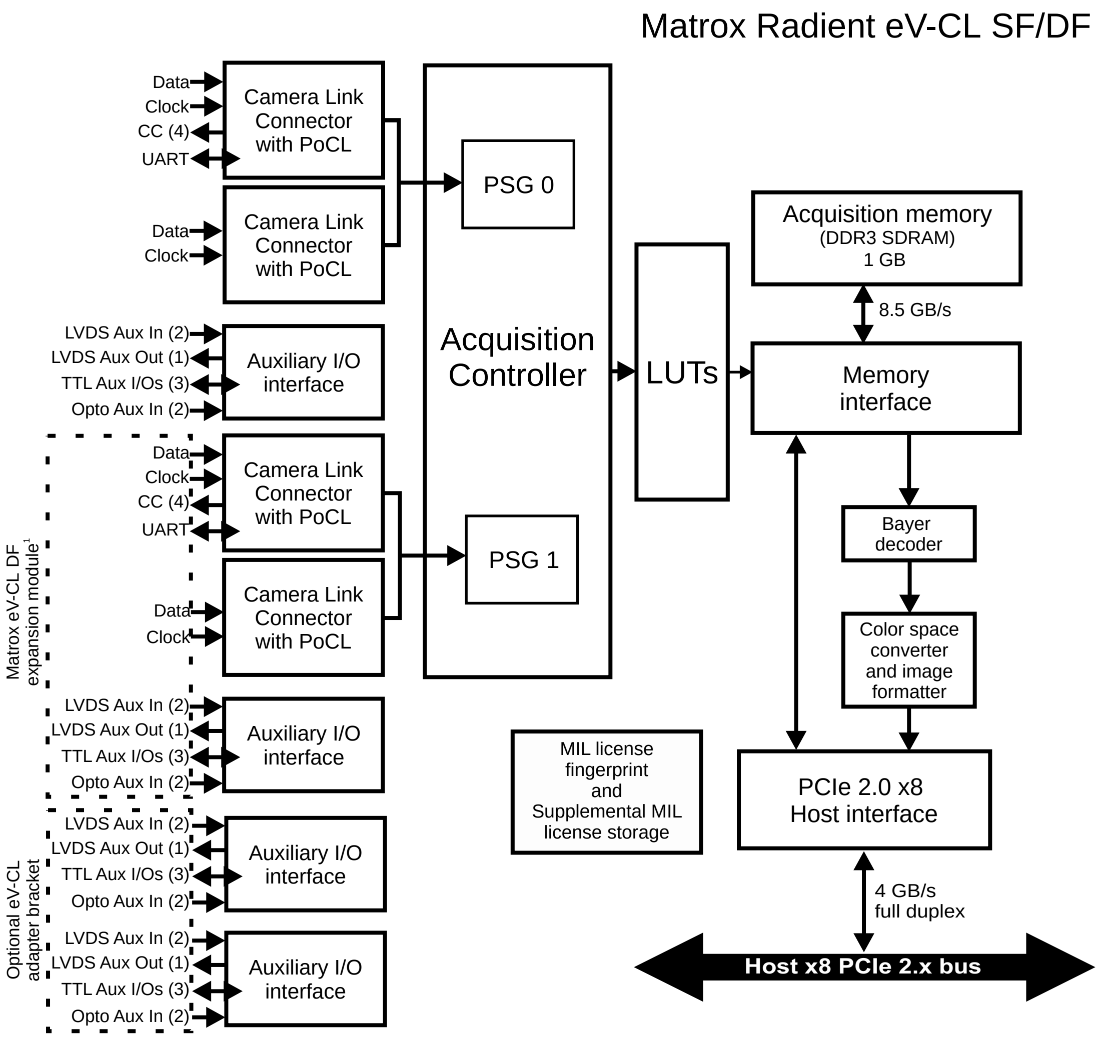
Digitizer configuration format

To program the acquisition section, allocate a MIL digitizer using **MdigAlloc**() with an appropriate DCF (supplied or created) and digitizer device number. If you find a DCF file that is suitable for your video source, but you need to adjust some of the more common settings, you can do so directly, without adjusting the file, using the appropriate MIL-Lite function. For more specialized adjustments, use the Matrox Intellicam program to adjust the DCF file.

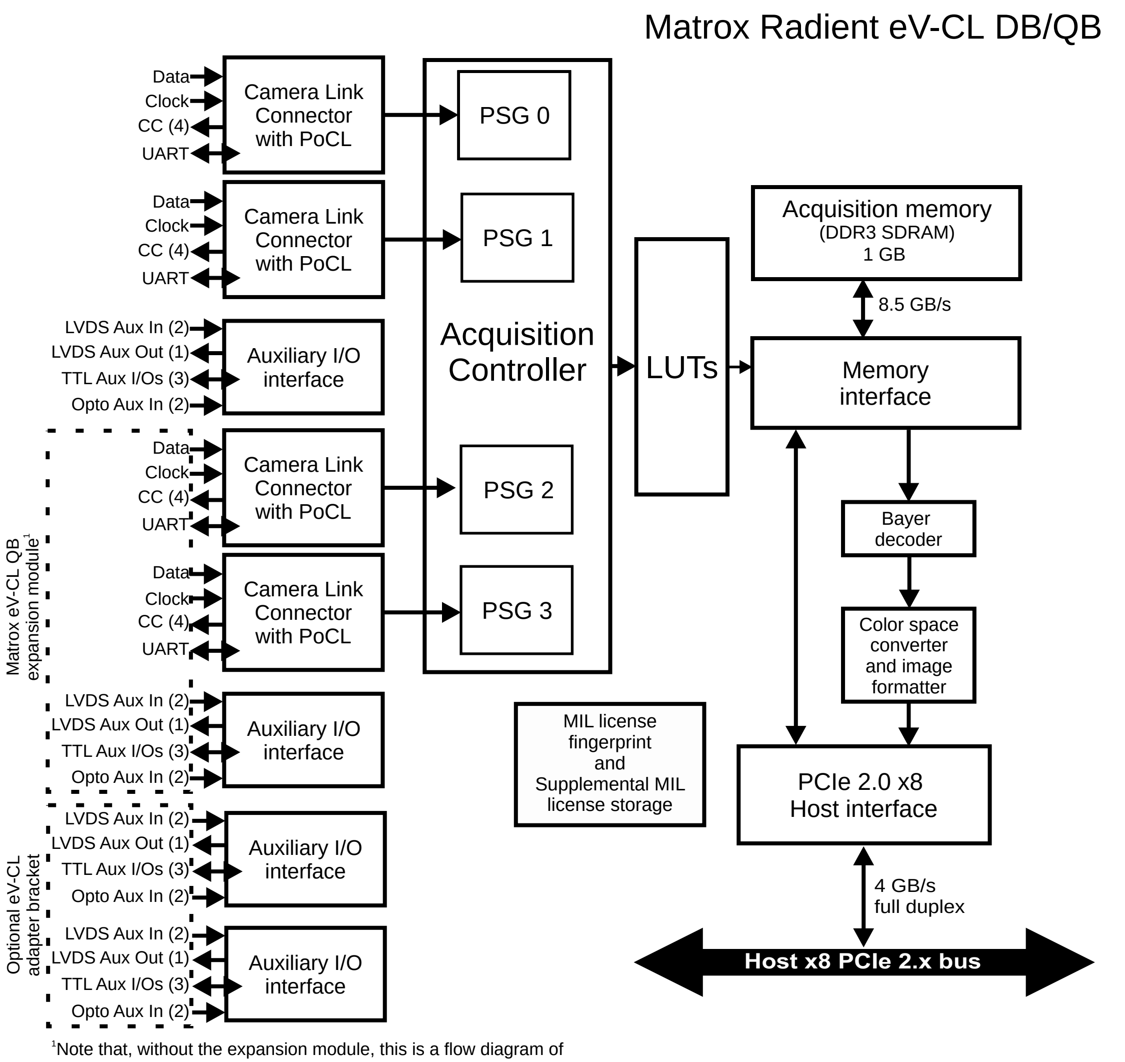


Auxiliary 12 V power supply
12 V
Power-over CoaXPress
Matrox Radient eV-CXP
24 V
6.25 Gb/s
20.83 Mb/s
CoaXPress interface
CoaXPress connectors
Only available on Matrox Radient eV-CXP Quad
LUTs
Acquisition memory (DDR3 SDRAM) 1/2/4 GB
6.4 GB/s
Memory interface
Bayer decoder
Color space converter and image formatter
Via MiniDP-to-DBHD-15 adapter cable
Optional cable adapter brackets
LVDS Aux In (2)
LVDS Aux Out (1)
TTL Aux I/Os (3)
Opto Aux In (2)
Auxiliary I/O interface
GPIO controller
PCIe 2.0 x8 Host interface
MIL license fingerprint and Supplemental MIL license storage
4 GB/s full duplex
Host x8 PCIe 2.x bus


Matrox Radient eV-CLHS
MIL license fingerprint and Supplemental MIL license storage
Acquisition memory (DDR3 SDRAM) 2 GB
6.4 GB/s
LUTs
Memory interface
Command channel receiver/ video data lane 0
Video data lanes (1-6)
Command channel transmitter lane
CLHS interface
Bayer decoder
Color space converter and image formatter
Via MiniDP-to-DBHD-15 adapter cable
LVDS Aux In (2)
LVDS Aux Out (1)
TTL Aux I/Os (3)
Opto Aux In (2)
Auxiliary I/O interface
AUX IO controller
PCIe 2.0 x8 Host interface
Optional cable adapter bracket
LVDS Aux In (2)
LVDS Aux Out (1)
TTL Aux I/Os (3)
Opto Aux In (2)
Auxiliary I/O interface
4 GB/s full duplex
Host x8 PCIe 2.x bus



[1]Note that, without the expansion module, this is a flow diagram of Matrox Radient eV-CL SF. With the expansion module, this is a flow diagram of Matrox Radient eV-CL DF. eV-CL SF is not upgradable to eV-CL DF; the eV-CL SF does not have the required connector for the eV-CL DF module.



[1]Note that, without the expansion module, this is a flow diagram of Matrox Radient eV-CL DB. With the expansion module, this is a flow diagram of Matrox Radient eV-CL QB. eV-CL DB is not upgradable to eV-CL QB; the eV-CL DB does not have the required connector for the eV-CL QB module.

Matrox Radient eV-CXP acquisition

Matrox Radient eV-CXP can capture video from digital video sources compliant with the CoaXPress standard 1.1 specification. Matrox Radient eV-CXP Quad has four independent acquisition paths (CoaXPress connections), whereas Matrox Radient eV-CXP Dual has two independent acquisition paths. When a video source is connected to Matrox Radient eV-CXP, the board communicates with the video source to determine the rate at which data will be transferred. Matrox Radient eV-CXP can provide power-over-CoaXPress to attached video sources.

For each video source connected to the board, Matrox Radient eV-CXP supports a CoaXPress trigger input signal and a CoaXPress trigger output signal, which are used to communicate exclusively with the video source. To communicate with other third-party devices, Matrox Radient eV-CXP provides 32 auxiliary signals. Auxiliary input signals can be rerouted to the CoaXPress trigger output signal and the CoaXPress trigger input signal can be rerouted to auxiliary output signals.

Matrox Radient eV-CXP supports monochrome, RGB color, and Bayer color-encoded acquisition. The board can perform color-conversion, flipping, and image subsampling.

Performance

The performance of each connection between Matrox Radient eV-CXP and the video source is as follows:

	Maximum
Number of pixels / line	64 K
Number of lines / frame	64 K
Downlink bit rate (per connection)	6.25 Gbits/sec
Uplink bit rate (per connection)	0.02 Gbits/sec

The maximum data transmission rate that you can achieve depends on the length of your coaxial cable, the quality of the cable, as well as the type of PCIe slot to which you connect your Matrox Radient eV-CXP.

Effect of cable length

For lengths greater than 40 m, the longer the cables, the lower the maximum possible bit rate. High-quality cables, such as Belden 1694A cables, will allow for the highest possible bit rates. The table below outlines the bit rates that you can expect to achieve at certain lengths, using Belden 1694A cables, as well as the bit rates possible when connecting to a single video source using link aggregation (2, 3, and 4 cables).

Length	Number of connections (cables connected to the video source)	Maximum bit rate (speed)
130 m	1	1.25 Gbits/sec
100 m	1	3.125 Gbits/sec
40 m	1	6.25 Gbits/sec
40 m	2	12.5 Gbits/sec
40 m	3	18.75 Gbits/sec
40 m	4	25.0 Gbits/sec

Effect of the type of PCIe slot

A PCIe 2.x slot supports a higher data transmission rate than a 1.x slot. A by-four (x4) PCIe slot will lower the data rate by half, when compared to a by-eight (x8) PCIe slot of the same base specification (1.x or 2.x). While transferring data to the Host, these factors will reduce the maximum transmission rate as shown in the table.

	Maximum data transmission rate	
	x8 PCIe slot	**x4 PCIe slot (with mechanical x8 connector)**
PCIe base specification 1.x	50%	25%
PCIe base specification 2.x	100%	50%

Power-over-CoaXPress

Matrox Radient eV-CXP supports power-over-CoaXPress (PoCXP) compliant video sources, and non-PoCXP compliant video sources. When Matrox Radient eV-CXP is connected to a proper auxiliary 12 V power supply, the CoaXPress standard is configured to provide up to 13 W per connection, at a nominal voltage of 24 V, to the connected device.

Matrox Radient eV-CXP detects whether the video source is PoCXP-compliant. When connecting to non-PoCXP compliant video sources, Matrox Radient eV-CXP has appropriate circuitry to ensure that no power is transmitted. To manually disable the PoCXP circuitry and ensure that no power is sent to the device, you can use the MIL-Lite function **MdigControl**() with **M_POWER_OVER_CABLE**.

Matrox Radient eV-CXP is also equipped with an overcurrent protection mechanism and a resettable fuse that can sustain a current of 1 A.

Acquisition

Matrox Radient eV-CXP accepts 8-, 10-, 12-, 14- and 16-bit video data. All data is transmitted in packets over a CoaXPress link.

The Matrox Radient eV-CXP CoaXPress interface is responsible for buffering incoming data before it is written to memory, as well as assembling and disassembling packets from the video sources. Video sources can be frame or line-scan video sources.

Lookup tables

Matrox Radient eV-CXP has on-board lookup tables (LUTs) that can be used to precondition input data at acquisition time, before it is stored in memory.

There is one LUT palette available per acquisition path (CoaXPress connection) for 8- and 10-bit monochrome or color data; for color data, all color components map through the same LUT palette. For 12-bit monochrome or color data, all acquisition paths use the same palette; for color data, the same palette is used fo'all color components. For 14- and 16-bit data, a transparent LUT palette is used. The LUTs are programmed using the MIL-Lite function **MdigControl**() with **M_LUT_ID**.

CoaXPress trigger signals and control messages

To communicate exclusively with the video source(s), Matrox Radient eV-CXP supports CoaXPress trigger signals and control messages. Trigger packets, which are sent and received between the video source(s) and the board, are virtually represented as trigger signals. Control messages constitute the basic communication mechanism between the video source(s) and the board.

For each video source connected to the board, Matrox Radient eV-CXP supports a CoaXPress trigger input signal and a CoaXPress trigger output signal. A CoaXPress trigger input signal can be used to start a timer, or to trigger other off-board devices (via the auxiliary output signals). A CoaXPress trigger output signal can be sent from the board to a video source to initiate image acquisition or to optionally control the exposure time.

To send a trigger output signal to the camera, you use the MIL-Lite function **MdigControl**() with **M_IO_SOURCE + M_TL_...**. To set the CoaXPress trigger input signal as the signal used to trigger the grab, use **MdigControl**() with **M_GRAB_TRIGGER_SOURCE** set to **M_TL_...**

For more information on how to use the auxiliary input and output signals, refer to the *Auxiliary signals* section, later in this chapter.

Matrox Radient eV-CLHS acquisition

Matrox Radient eV-CLHS can capture video from a digital video source compliant with the Camera Link HS standard. Matrox Radient eV-CLHS has a CLHS product capability designator of C2, 7M1. This means it uses a CX4 cable (with thumbscrews) connection between video source and frame grabber, with up to 7 data lanes and 1 command channel. Matrox Radient eV-CLHS uses the M-protocol (multi-camera, multi-lane protocol based on 8b/10b encoding) to decode the data received from the video source. A video source connected to Matrox Radient eV-CLHS must use the same connector and protocol as the frame grabber and can have 7 or fewer data lanes. For example, you can use a video source with a CLHS product capability designator of C2, 4M1, but you cannot use a video source with a designator of F1, 1M1 because it does not have the same connector as the frame grabber.

In addition, Matrox Radient eV-CLHS supports using the CLHS message layer to communicate exclusively with the video source. To communicate with other third-party devices, Matrox Radient eV-CLHS provides 16 auxiliary signals.

Matrox Radient eV-CLHS supports monochrome, RGB color, and Bayer color-encoded acquisition. The board can perform color-conversion, flipping, and image subsampling.

Performance

The performance of each connection between Matrox Radient eV-CLHS and the video source is as follows:

	Maximum
Number of pixels / line	64 K
Number of lines / frame	64 K
Bit transfer rate / lane (8b/10b encoded)	3.125 Gbits/sec

Effect of the type of PCIe slot

A PCIe 2.x slot supports a higher data transmission rate than a 1.x slot. A by-four (x4) PCIe slot will lower the data rate by half, when compared to a by-eight (x8) PCIe slot of the same base specification (1.x or 2.x). While transferring data to the Host, these factors will reduce the maximum transmission rate as shown in the table.

	Maximum data transmission rate	
	x8 PCIe slot	**x4 PCIe slot (with mechanical x8 connector)**
PCIe base specification 1.x	50%	25%
PCIe base specification 2.x	100%	50%

Acquisition

Matrox Radient eV-CLHS accepts 8-, 10-, 12-, 14- and 16-bit video data. All data is transmitted in packets over a CLHS link.

The CLHS interface is responsible for decoding CLHS packets from the video source, which includes writing the video data to memory and handling CLHS command and pulse messages. The video source can be a frame or line-scan video source.

Lookup tables

Matrox Radient eV-CLHS has on-board lookup tables (LUTs) that can be used to precondition input data at acquisition time, before it is stored in memory.

There is one LUT palette available for 8- and 10-bit monochrome or color data; for color data, all color components map through the same LUT palette. For 14- and 16-bit data, a transparent LUT palette is used. The LUTs are programmed using the MIL-Lite function **MdigControl**() with **M_LUT_ID**.

CLHS message layer

To communicate between video source and frame grabber, Matrox Radient eV-CLHS uses the CLHS message layer. CLHS messages are delivered using the command channel over the CLHS link. Pulse message packets, which are sent and received between the video source and the board, are virtually represented as trigger signals. Command messages constitute the basic communication mechanism between the video source and the board.

Matrox Radient eV-CL acquisition

Matrox Radient eV-CL can capture video from digital video sources compliant with the Camera Link specification. Matrox Radient eV-CL can provide power over Camera Link to attached video sources.

Matrox Radient eV-CL supports frame and line-scan monochrome and color video sources. The color video sources can be RGB video sources or video sources with a Bayer color filter. Matrox Radient eV-CL can decode Bayer color-encoded images and perform color space conversions while transferring the image to the Host. Besides standard Camera Link video sources, Matrox Radient eV-CL also supports additional types of video sources, including some time-multiplexed video sources.

Matrox Radient eV-CL DB has two independent acquisition paths and Matrox Radient eV-CL QB has four independent acquisition paths operating in Base configuration. Matrox Radient eV-CL SF has one acquisition path and Matrox Radient eV-CL DF has two independent acquisition paths operating in Medium, Full, or 80-bit configuration.

Each acquisition path can grab at Camera Link frequencies of 20 MHz to 85 MHz. Each acquisition path has its own programmable synchronization generator (PSG) and can operate at different acquisition rates.

The acquisition section of Matrox Radient eV-CL supports a comprehensive set of general purpose I/O and serial ports to control cameras and other devices.

Performance

The video timing of each acquisition path is as follows:

	Maximum
Number of pixels / line (including sync and blanking)	64 K
Number of lines / frame (including sync and blanking)	64 K
Pixel clock	85 Mhz
Bandwidth	Dependent on the type of Camera Link configuration used.

The maximum pixel clock frequency is dependent on the length of the cable used. Refer to the *Technical features specific to Matrox Radient eV-CL* subsection of the *Board summary* section in *Appendix B: Technical information*.

Acquisition

A Base-type acquisition path supports up to 24 bits of video data when acquiring from Camera Link-compliant video sources or up to 48 bits when acquiring from non-standard time-multiplexed video sources. Similarly, a Medium-type acquisition path can grab up to 48 bits of video data when acquiring from Camera Link-compliant sources or up to 64 bits when acquiring from non- standard time-multiplexed sources. A Full-type acquisition path supports up to 64 bits of video data when acquiring from Camera Link-compliant video sources. An 80-bit-type acquisition path supports up to 80 bits of video data when acquiring from Camera Link-compliant video sources.

The video sources can be frame or line-scan video sources. Note that the acquisition paths in dual-Base mode are completely independent; therefore, the video sources do not need to be identical when running in these modes.

Supported video sources

The following video sources are supported when running in Base configuration:

	Video sources supported per acquisition path
Camera Link Standard	• One tap 8/10/12/14/16-bit. • Two tap 8/10/12-bit. • One tap 3 x 8-bit (RGB). • Four tap 8-bit with time-multiplexing.
Not Camera Link Standard	• Two tap 14/16-bit with time-multiplexing. • Four tap 10/12-bit with time-multiplexing.

In addition to the above video sources, the following video sources are supported when running in Medium configuration:

	Video sources supported
Camera Link Standard	• Four tap 8/10/12-bit. • One tap 3 x 10/12-bit (RGB).
Not Camera Link Standard	• 8 tap 8-bit with time-multiplexing (using only 2 receivers). • Two tap 14/16-bit. • One tap 3 x 14/16-bit (RGB). • Two tap 3 x 8-bit (RGB) (genlocked).

In addition to the above video sources, the following video sources are supported when running in Full configuration:

	Video sources supported
Camera Link Standard	• Eight tap 8-bit.
Not Camera Link Standard	• Four tap 14-16-bit

In addition to the above video sources, the following video sources are supported when running in 80-bit configuration:

	Video sources supported
Camera Link Standard	• Eight tap 10-bit. • 10 tap 8-bit

Matrox Radient eV-CL supports power over Camera Link (PoCL) and non-PoCL compliant video sources. For compatibility with non-PoCL video sources, Matrox Radient eV-CL features SafePower mode to supply power only after determining whether the connected video source is PoCL compliant. The PoCL protection on-board fuse can sustain a current of 0.4 A.

Demultiplexers to support time-multiplexed video sources

The acquisition paths of the board feature a demultiplexer. Each can deserialize input from time-multiplexed video sources on a clock cycle basis. Time-multiplexed video sources can output larger pixel depths and more taps than are possible with non-time-multiplexed video sources in the same configuration, but with a decrease in overall performance. When enabled, the demultiplexer assumes that two video streams share the same data path and that the streams are interleaved based on the clock cycle. The demultiplexer assumes that on one clock cycle, the data is from one stream and that on the next clock cycle, the data is from another stream. The demultiplexer can only deserialize video inputs that, when combined and, if necessary, expanded, total a maximum depth of 64 bits per acquisition path.

Expansion refers to the automatic addition of padding zeros on the most significant bits (MSB) of 10-, 12-, and 14-bit data to create byte aligned 16-bit data.

Communication

For each acquisition path, two LVDS pairs are used to transmit and receive asynchronous serial communication between the video source and the board. These signals are handled by the Universal Asynchronous Receiver/Transmitters (UARTs).

For each acquisition path, four camera control output signals are also available. These are general-purpose signals that are sent to the video source.

UARTs

Matrox Radient eV-CL offers an LVDS-compatible Matrox serial interface. Each interface is mapped as a COM port so that it can be accessed through the Microsoft Windows API. Each interface is comprised of both a transmit port and a receive port, permitting the interface to work in full-duplex (bidirectional) mode. The interfaces are located on the Camera Link connectors.

Each interface is controlled by a Universal Asynchronous Receiver-Transmitter (UART)[*]. Each UART features independently programmable baud rates, supporting all standard baud rates from 300 baud up to 115200[†] baud.

Acquisition Controller

The acquisition controller is responsible for reconstructing and storing image data in main on-board memory. When writing data to memory, the acquisition controller can perform line and frame reversal; it can flip the image horizontally and/or vertically.

On Matrox Radient eV-CL DB/QB, the acquisition controller can write to four non-sequential memory regions (zones) per acquisition path.

On Matrox Radient eV-CL SF/DF, the acquisition controller can write to ten non-sequential memory regions in Medium, Full, or 80-bit configuration.

Note that the width of each region must be a multiple of the number of taps in that region.

To establish the number of non-sequential memory regions to which your video source must write, refer to the documentation accompanying your video source.

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*. The UART implementation was derived from a design by Daniel Wallner. Please see *Appendix C: Acknowledgments* for copyright information.

†. In addition, the maximum baud rate is highly dependent on the amount of computer resources available.

PSGs

For each acquisition path, the acquisition controller provides a programmable synchronization generator (PSG). Each PSG allows for independent acquisition from one video source, since each PSG is responsible for managing all video timing and synchronization signals.

The PSGs are also responsible for managing the camera control and auxiliary signals supported by the board. These signals are configurable signals that can support one or several functions, one of which is user-defined for Matrox Radient eV-CL; the table in the next subsection identifies the functions to which the camera control and auxiliary signals can be defined. The PSGs are also responsible for implementing the functionality to which these can be defined.

Auxiliary signals

The following sections describe the auxiliary signals for Matrox Radient eV.

Auxiliary signals for Matrox Radient eV-CXP and eV-CLHS

The auxiliary signals of Matrox Radient eV-CXP and eV-CLHS are acquisition path independent and can be used to initiate on-board events (inputs) or can be transmitted to third-party devices (outputs). You can also reroute a CoaXPress trigger input signal, with Matrox Radient eV-CXP, or a trigger input signal (pulse) from the CLHS message layer, with Matrox Radient eV-CLHS, to another device via an auxiliary output signal. Note that, an auxiliary input signal can also be re-routed to a video source via the CoaXPress trigger output signal, for Matrox Radient eV-CXP, or via the CLHS message layer, for Matrox Radient eV-CLHS. An auxiliary input signal cannot be re-routed to an auxiliary output signal.

The following table summarizes the auxiliary functionality that Matrox Radient eV supports using its auxiliary I/O signals. The table also documents the MIL constants to use.

	TTL Aux I/O												OPTO Aux In								LVDS Aux In								LVDS Aux Out			
	Aux I/O Connector												Aux I/O Connector								Aux I/O Connector								Aux I/O Connector			
	0			1			2*			3*			0		1		2*		3*		0		1		2*		3*		0	1	2*	3*
M_AUX_IO*n*†	4	5	6	12	13	14	20	21	22	28	29	30	0	1	8	9	16	17	24	25	2	3	10	11	18	19	26	27	7	15	23	31
Functionality that can be routed or received	AUX(TRIG)_TTL_IO_4	AUX(TRIG)_TTL_IO_5	AUX(TRIG)_TTL_IO_6	AUX(TRIG)_TTL_IO_12	AUX(TRIG)_TTL_IO_13	AUX(TRIG)_TTL_IO_14	AUX(TRIG)_TTL_IO_20	AUX(TRIG)_TTL_IO_21	AUX(TRIG)_TTL_IO_22	AUX(TRIG)_TTL_IO_28	AUX(TRIG)_TTL_IO_29	AUX(TRIG)_TTL_IO_30	AUX(TRIG)_OPTO_IN0	AUX(TRIG)_OPTO_IN1	AUX(TRIG)_OPTO_IN8	AUX(TRIG)_OPTO_IN9	AUX(TRIG)_OPTO_IN16	AUX(TRIG)_OPTO_IN17	AUX(TRIG)_OPTO_IN24	AUX(TRIG)_OPTO_IN25	AUX(TRIG)_LVDS_IN2	AUX(TRIG)_LVDS_IN3	AUX(TRIG)_LVDS_IN10	AUX(TRIG)_LVDS_IN11	AUX(TRIG)_LVDS_IN18	AUX(TRIG)_LVDS_IN19	AUX(TRIG)_LVDS_IN26	AUX(TRIG)_LVDS_IN27	AUX(EXP)_LVDS_OUT7	AUX(EXP)_LVDS_OUT15	AUX(EXP)_LVDS_OUT23	AUX(EXP)_LVDS_OUT31
Timer (M_TIMER*n*†)	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4																	1/2/3/4	1/2/3/4	1/2/3/4	1/2/3/4
Trigger controller affected by input signal	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡				
Bit of quadrature input§ — **Decoder** 0																					0	1										
Decoder 1																							0	1								
Decoder 2																									0	1						
Decoder 3																											0	1				
User output (bit of static-user-output register M_USER_BIT*n*†)	4	5	6	12	13	14	20	21	22	28	29	30																	7	15	23	31

*. Only available on Matrox Radient eV-CXP.

†. MIL constant, where *n* corresponds to the number in the row. The functionalities that can be routed onto these auxiliary signals are shared across all acquisition paths.

‡. Unlike some other Matrox frame grabbers, there is no limit to the number of events that can be triggered simultaneously using the auxiliary input signals, nor is there a restriction on which auxiliary signal can be used to trigger an event.

§. A rotary encoder with quadrature output transmits a two-bit code. The table entries 0 and 1, therefore, denote bit position.

Camera control and auxiliary signals for Matrox Radient eV-CL DB/QB

The following tables summarize the auxiliary functionality that the PSGs support, and the corresponding signals that the PSGs can receive/generate, for Matrox Radient eV-CL DB/QB. The table also documents the MIL constants to use.

		LVDS cam. ctrl Camera Link Connector 0				LVDS cam. ctrl Camera Link Connector 1				LVDS cam. ctrl Camera Link Connector 2*				LVDS cam. ctrl Camera Link Connector 3*			
M_CC_IO*n*	**n**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
for M_DEV*m*†	**m**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
Functionality that can be routed	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**
Timer (M_TIMER*n*†)	0	1/2	1/2	1/2	1/2												
	1					1/2	1/2	1/2	1/2								
	2									1/2	1/2	1/2	1/2				
	3													1/2	1/2	1/2	1/2
User output (bit of Camera Link static-user-output register M_USER_BIT_CC_IO*n*†)	0	0/1	0/1	0/1	0/1												
	1					0/1	0/1	0/1	0/1								
	2									0/1	0/1	0/1	0/1				
	3													0/1	0/1	0/1	0/1

*. Only available on Matrox Radient eV-CL QB

†. MIL constant, where *n* and *m* correspond to the number in the row. M_DEV*m* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

		TTL Aux I/O												OPTO Aux In								LVDS Aux In								LVDS Aux Out			
		Aux I/O Connector												Aux I/O Connector								Aux I/O Connector								Aux I/O Connector			
		A			C			B*			D			A		C		B*		D		A		C		B*		D		A	C	B*	D
M_AUX_IO*n* for M_DEV*m*†	n	8	9	2	8	9	3	8	9	2	8	9	3	6	7	0	1	6	7	0	1	10	11	4	5	10	11	4	5	12	12	13	13
	m	0	0	0/1	1	1	0/1	2	2	2/3	3	3	2/3	0	0	0/1	0/1	2	2	2/3	2/3	0	0	0/1	0/1	2	2	2/3	2/3	0	1	2	3
Functionality that can be routed or received	Acquisition path‡	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_12	TTL_AUX_IO_13	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_28	TTL_AUX_IO_29	TTL_AUX_IO_30	OPTO_AUX_IN0	OPTO_AUX_IN1	OPTO_AUX_IN8	OPTO_AUX_IN9	OPTO_AUX_IN16	OPTO_AUX_IN17	OPTO_AUX_IN24	OPTO_AUX_IN25	LVDS_AUX_IN2	LVDS_AUX_IN3	LVDS_AUX_IN10	LVDS_AUX_IN11	LVDS_AUX_IN18	LVDS_AUX_IN19	LVDS_AUX_IN26	LVDS_AUX_IN27	LVDS_AUX_OUT7	LVDS_AUX_OUT15	LVDS_AUX_OUT23	LVDS_AUX_OUT31
Timer (M_TIMER*n*†)	0		1	2																										1/2			
	1					1	2																								1/2		
	2								1	2																						1/2	
	3											1	2																				1/2
Trigger controller affected by input signal§	0	T0	T1	T2			T3							T0	T1	T2	T3					T0	T1	T2	T3								
	1			T2	T0	T1	T3									T0/ T2	T1/ T3							T0/ T2	T1/ T3								
	2							T0	T1	T2			T3					T0	T1	T2	T3					T0	T1	T2	T3				
	3									T2	T0	T1	T3							T0/ T2	T1/ T3							T0/ T2	T1/ T3				
Timer-clock input	0																						0										
	1																								0								
	2																										0						
	3																												0				
Bit of quadrature input**	0																					0	1										
	1																							0	1								
	2																									0	1						
	3																											0	1				
User output (bit of main static-user-output register M_USER_BIT*n*†)	0	2	3	4			5																							0			
	1			4	2	3	5																								0		
	2							2	3	4			5																			0	
	3									4	2	3	5																				0

*. Matrox Radient eV-CL DB does not have this connector.

†. MIL constant, where *n* and *m* correspond to the number in the row. M_DEV*m* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

‡. Only Matrox Radient eV-CL QB has four acquisition paths. For Matrox Radient eV-CL DB, only information for acquisition path 0 and 1 is applicable.

§. Note that there are only 4 trigger controllers per acquisition path.

**. A rotary encoder with quadrature output transmits a two-bit code. The table entries 0 and 1, therefore, denote bit position.

Type of signal	Acquisition path	LVDS cam. ctrl															
		CL connect. 0				CL connect. 1				CL connect. 2				CL connect. 3			
		CC1	CC2	CC3	CC4	CC1	CC2	CC3	CC4	CC1	CC2	CC3	CC4	CC1	CC2	CC3	CC4
VSYNC output	0	1	1	1	1												
	1					1	1	1	1								
	2									1	1	1	1				
	3													1	1	1	1
HSYNC output	0	1	1	1	1												
	1					1	1	1	1								
	2									1	1	1	1				
	3													1	1	1	1
Clock output	0	1	1	1	1												
	1					1	1	1	1								
	2									1	1	1	1				
	3													1	1	1	1

The following table lists the auxiliary input signals (or auxiliary I/O signals set to input) that can be rerouted onto output signals and the output signals onto which they can be rerouted.

			LVDS cam. ctrl																TTL Aux I/O												LVDS Aux Out			
			Camera Link Connector 0				Camera Link Connector 1				Camera Link Connector 2				Camera Link Connector 3				Aux I/O Connector												Aux I/O Connector			
																			A			C			B*			D			A	C	B*	D
M_AUX_IO*x* or M_CC_IO*y* for M_DEV*z*†		**x**																	8	9	2	8	9	3	8	9	2	8	9	3	12	12	13	13
		y	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4																
		z	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	0	0	0/1	1	1	0/1	2	2	2/3	3	3	2/3	0	1	2	3
Auxiliary input signal (or auxiliary I/O signal set to input)	**M_AUX_IO*x***	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_12	TTL_AUX_IO_13	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_28	TTL_AUX_IO_29	TTL_AUX_IO_30	LVDS_AUX_OUT7	LVDS_AUX_OUT15	LVDS_AUX_OUT23	LVDS_AUX_OUT31
TTL_AUX_IO_4	8	0	•	•	•	•																												
TTL_AUX_IO_5	9	0																																
TTL_AUX_IO_6	2	0/1	•	•	•	•	•	•	•	•																								
TTL_AUX_IO_12	8	1					•	•	•	•																								
TTL_AUX_IO_13	9	1																																
TTL_AUX_IO_14	3	0/1																																
TTL_AUX_IO_20*	8	2									•	•	•	•																				
TTL_AUX_IO_21*	9	2																																
TTL_AUX_IO_22*	2	2/3									•	•	•	•	•	•	•	•																
TTL_AUX_IO_28	8	3													•	•	•	•																
TTL_AUX_IO_29	9	3																																
TTL_AUX_IO_30	3	2/3																																

			LVDS cam. ctrl																TTL Aux I/O												LVDS Aux Out			
			Camera Link Connector 0				Camera Link Connector 1				Camera Link Connector 2				Camera Link Connector 3				Aux I/O Connector												Aux I/O Connector			
																			A			C			B*			D			A	C	B*	D
M_AUX_IOx or M_CC_IOy for M_DEVz†		x																	8	9	2	8	9	3	8	9	2	8	9	3	12	12	13	13
		y	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4																
		z	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	0	0	0/1	1	1	0/1	2	2	2/3	3	3	2/3	0	1	2	3
Auxiliary input signal (or auxiliary I/O signal set to input)	**M_AUX_IOx**	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_12	TTL_AUX_IO_13	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_28	TTL_AUX_IO_29	TTL_AUX_IO_30	LVDS_AUX_OUT7	LVDS_AUX_OUT15	LVDS_AUX_OUT23	LVDS_AUX_OUT31
OPTO_AUX_IN0	6	0																																
OPTO_AUX_IN1	7	0	•	•	•	•																												
OPTO_AUX_IN8	0	0/1					•	•	•	•																								
OPTO_AUX_IN9	1	0/1	•	•	•	•	•	•	•	•																								
OPTO_AUX_IN16	6	2																																
OPTO_AUX_IN17	7	2									•	•	•	•																				
OPTO_AUX_IN24	0	2/3													•	•	•	•																
OPTO_AUX_IN25	1	2/3									•	•	•	•	•	•	•	•																
LVDS_AUX_IN2	10	0	•	•	•	•																												
LVDS_AUX_IN3	11	0																																
LVDS_AUX_IN10	4	0/1					•	•	•	•																								
LVDS_AUX_IN11	5	0/1	•	•	•	•	•	•	•	•																								
LVDS_AUX_IN18‡	10	2									•	•	•	•																				
LVDS_AUX_IN19‡	11	2																																
LVDS_AUX_IN26	4	2/3													•	•	•	•																
LVDS_AUX_IN27	5	2/3									•	•	•	•	•	•	•	•																

*. Matrox Radient eV-CL DB does not have this connector or signal.

†. MIL constant, where *x*, *y*, and *z* correspond to the numbers in the row. M_DEV*z* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

‡. Matrox Radient eV-CL DB does not have this signal.

Camera control and auxiliary signals for Matrox Radient eV-CL SF/DF

The following tables summarize the auxiliary functionality that the PSGs support, and the corresponding signals that the PSGs can receive/generate, for Matrox Radient eV-CL SF/DF. The table also documents the MIL constants to use.

		LVDS cam. ctrl				LVDS cam. ctrl			
		Camera Link Connector 0				Camera Link Connector 2*			
M_CC_IO*n*	**n**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
for M_DEV*m*†	**m**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
Functionality that can be routed	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**
Timer (M_TIMER*n*†)	0	1/2	1/2	1/2	1/2				
	1					1/2	1/2	1/2	1/2
User output (bit of Camera Link static-user-output register M_USER_BIT_CC_IO*n*†)	0	0/1	0/1	0/1	0/1				
	1					0/1	0/1	0/1	0/1

*. Only available on Matrox Radient eV-CL DF.

†. MIL constant, where *n* and *m* correspond to the number in the row. M_DEV*m* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

		TTL Aux I/O								OPTO Aux In								LVDS Aux In								LVDS Aux Out	
		Aux I/O Connector								Aux I/O Connector								Aux I/O Connector								Aux I/O Connector	
		A			C	B*			D	A		C		B*		D		A		C		B*		D		A	B*
M_AUX_IO*n* for M_DEV*m*†	**n**	8	9	2	3	8	9	2	3	6	7	0	1	6	7	0	1	10	11	4	5	10	11	4	5	12	13
	m	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	1
Functionality that can be routed or received	**Acquisition path‡**	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_30	OPTO_AUX_IN0	OPTO_AUX_IN1	OPTO_AUX_IN8	OPTO_AUX_IN9	OPTO_AUX_IN16	OPTO_AUX_IN17	OPTO_AUX_IN24	OPTO_AUX_IN25	LVDS_AUX_IN2	LVDS_AUX_IN3	LVDS_AUX_IN10	LVDS_AUX_IN11	LVDS_AUX_IN18	LVDS_AUX_IN19	LVDS_AUX_IN26	LVDS_AUX_IN27	LVDS_AUX_OUT7	LVDS_AUX_OUT23
Timer (M_TIMER*n*†)	0		1	2																						1/2	
	1						1	2																			1/2
Trigger controller affected by input signal§	0	T0	T1	T2	T3					T0	T1	T2	T3					T0	T1	T2	T3						
	1					T0	T1	T2	T3					T0	T1	T2	T3					T0	T1	T2	T3		
Timer-clock input	0																		0								
	1																						0				
Bit of quadrature input**	0																	0	1								
	1																					0	1				
User output (bit of main static-user-output register M_USER_BIT*n*†)	0	2	3	4	5																					0	
	1					2	3	4	5																		0

*. Matrox Radient eV-CL SF does not have this connector.

†. MIL constant, where *n* and *m* correspond to the number in the row. M_DEV*m* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

‡. Only Matrox Radient eV-CL DF has two acquisition paths. For Matrox Radient eV-CL SF, only information for acquisition path 0 is applicable.

§. Note that there are only 4 trigger controllers per acquisition path.

**. A rotary encoder with quadrature output transmits a two-bit code. The table entries 0 and 1, therefore, denote bit position.

Type of signal	Acquisition path	LVDS cam. ctrl: CL connect. 0: CC1	CC2	CC3	CC4	CL connect. 2: CC1	CC2	CC3	CC4
VSYNC output	0	1	1	1	1				
	1					1	1	1	1
HSYNC output	0	1	1	1	1				
	1					1	1	1	1
Clock output	0	1	1	1	1				
	1					1	1	1	1

The following table lists the auxiliary input signals (or auxiliary I/O signals set to input) that can be rerouted onto output signals and the output signals onto which they can be rerouted.

			LVDS cam. ctrl								**TTL Aux I/O**								**LVDS Aux Out**	
			Camera Link Connector 0				**Camera Link Connector 2**				**Aux I/O Connector**								**Aux I/O Connector**	
												A		**C**		**B***		**D**	**A**	**B***
M_AUX_IO*x* or M_CC_IO*y* for M_DEV*z*†		**x**									8	9	2	3	8	9	2	3	12	13
		y	1	2	3	4	1	2	3	4										
		z	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	1
Auxiliary input signal (or auxiliary I/O signal set to input)	**M_AUX_IOx**	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_30	LVDS_AUX_OUT7	LVDS_AUX_OUT23
TTL_AUX_IO_4	8	0	•	•	•	•														
TTL_AUX_IO_5	9	0																		
TTL_AUX_IO_6	2	0	•	•	•	•														
TTL_AUX_IO_14	3	0																		
TTL_AUX_IO_20*	8	1					•	•	•	•										
TTL_AUX_IO_21*	9	1																		
TTL_AUX_IO_22*	2	1					•	•	•	•										
TTL_AUX_IO_30	3	1																		
OPTO_AUX_IN0	6	0																		
OPTO_AUX_IN1	7	0	•	•	•	•														
OPTO_AUX_IN8	0	0																		
OPTO_AUX_IN9	1	0	•	•	•	•														
OPTO_AUX_IN16	6	1																		
OPTO_AUX_IN17	7	1					•	•	•	•										
OPTO_AUX_IN24	0	1																		
OPTO_AUX_IN25	1	1					•	•	•	•										

			LVDS cam. ctrl								TTL Aux I/O								LVDS Aux Out	
			Camera Link Connector 0				Camera Link Connector 2				Aux I/O Connector								Aux I/O Connector	
											A			C	B*			D	A	B*
M_AUX_IO*x* or M_CC_IO*y* for M_DEV*z*†		**x**									8	9	2	3	8	9	2	3	12	13
		y	1	2	3	4	1	2	3	4										
		z	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	1
Auxiliary input signal (or auxiliary I/O signal set to input)	**M_AUX_IOx**	**Acquisition path**	**CC1**	**CC2**	**CC3**	**CC4**	**CC1**	**CC2**	**CC3**	**CC4**	TTL_AUX_IO_4	TTL_AUX_IO_5	TTL_AUX_IO_6	TTL_AUX_IO_14	TTL_AUX_IO_20	TTL_AUX_IO_21	TTL_AUX_IO_22	TTL_AUX_IO_30	LVDS_AUX_OUT7	LVDS_AUX_OUT23
LVDS_AUX_IN2	10	0	•	•	•	•														
LVDS_AUX_IN3	11	0																		
LVDS_AUX_IN10	4	0																		
LVDS_AUX_IN11	5	0	•	•	•	•														
LVDS_AUX_IN18‡	10	1					•	•	•	•										
LVDS_AUX_IN19‡	11	1																		
LVDS_AUX_IN26	4	1																		
LVDS_AUX_IN27	5	1					•	•	•	•										

*. Matrox Radient eV-CL SF does not have this connector or signal.

†. MIL constant, where *x*, *y*, and *z* correspond to the numbers in the row. M_DEV*z* is the required device number of the digitizer (**MdigAlloc()**) that you must use to access this signal.

‡. Matrox Radient eV-CL SF does not have this signal.

Specifications of the auxiliary signals

Matrox Radient eV has auxiliary signals in the following formats:

Signal Format	Total # of signals											
	eV-CXP		eV-CLHS		eV-CL SF		eV-CL DF		eV-CL DB		eV-CL QB	
	No cable bracket	With cable bracket	No cable bracket	With cable bracket	No cable bracket	With cable bracket	No cable bracket	With cable bracket	No cable bracket	With cable bracket	No cable bracket	With cable bracket
TTL auxiliary input or output signals	3	12	3	6	3	9	6	12	3	9	6	12
Opto-isolated auxiliary input signals	2	8	2	4	2	6	4	8	2	6	4	8
LVDS auxiliary input signals	2	8	2	4	2	6	4	8	2	6	4	8
LVDS auxiliary output signals	1	4	1	2	1	3	2	4	1	3	2	4
LVDS camera control output signals	N/A	N/A	N/A	N/A	4	4	8	8	8	8	16	16
Total number of auxiliary signals	8	32	8	16	12	28	24	40	16	32	32	48

When you route an external signal to an auxiliary signal or vice versa, verify that the external signal meets the electrical specifications of the auxiliary signal.

When an auxiliary input signal is received in TTL format directly, it will be clamped at a maximum of 5.7 V and at a minimum of -0.7 V to protect the input buffer. Typically, the signal should have a maximum of 5 V and a minimum of 0 V. A signal over 2 V is considered high, while anything less than 0.8 V is considered low.

The opto-isolated auxiliary input signals pass through an opto-coupler, a device that protects the board from outside surges and different ground levels, and allows the frame grabber to be totally isolated. The voltage difference across the positive and negative components of the signal must be between 4.71 V and 9.165 V for logic high, and between -5.0 V and 0.8 V for logic low.

You can set the direction of an auxiliary I/O signal using the MIL-Lite function **MdigControl**() with **M_AUX_SIGNAL_MODE**.

You can set up the auxiliary signals in the DCF. Alternatively, for most commonly used functionalities, you can configure the auxiliary signals using the MIL-Lite function **MdigControl**() (for example, with **M_IO...**, **M_GRAB_TRIGGER...**, **M_TIMER...**, or **M_ROTARY_ENCODER...**).

Timers

Matrox Radient eV has four 16-bit timers, which operate on a specified clock source. Timer output signals allow you to control the exposure time and other external events related to the video source (such as a strobe). A timer output signal can be output on any of the auxiliary output signals or auxiliary I/O signals in output mode. A timer output can also be sent to a video source via the CoaXPress trigger output signal on the Matrox Radient eV-CXP or via the CLHS message layer on the Matrox Radient eV-CLHS.

The timers can use one of the following as a clock source:

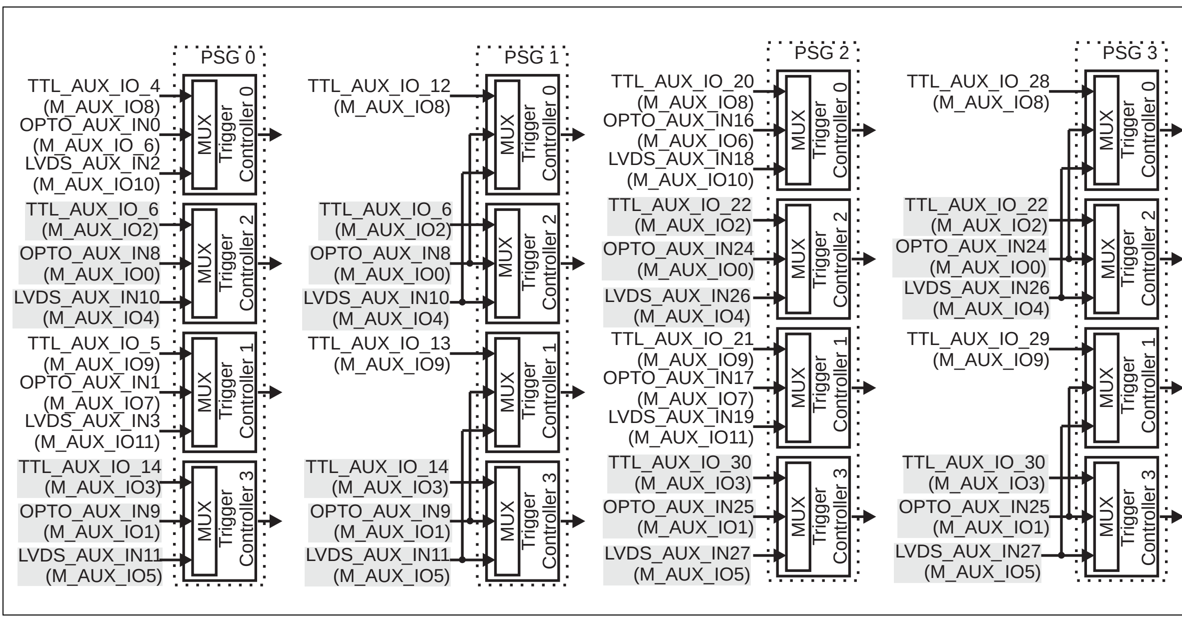
- **A 125 MHz internal clock source.**
- **A clock based on the output of another timer set in continuous mode.**
- **A clock based on the HSYNC or VSYNC signal of your camera.**
- **A clock based on the pixel clock signal of your camera.**

To route a timer output on an auxiliary signal, use the MIL-Lite function **MdigControl**() with **M_IO_SOURCE + M_AUX_IOn** set to **M_TIMERm**. To set up a timer, use **MdigControl**() with **M_TIMER_...**.

Trigger

You can use as a trigger any of the auxiliary input signals (or auxiliary I/O signals in input mode), the CoaXPress trigger input signal on Matrox Radient eV-CXP, or a signal from the CLHS message layer on Matrox Radient eV-CLHS. A trigger signal can be used to initiate image acquisition, or prompt an on-board event.

For Matrox Radient eV-CL, each PSG has 4 trigger controllers. Each trigger controller can trigger the image acquisition, the timers, and/or the synchronization signals of the PSG's acquisition path. Only one auxiliary signal per trigger controller can be programmed as a trigger input signal. The auxiliary signals are restricted to specific trigger controllers.



Timing requirements

When you use an auxiliary input signal as a trigger, the pulse width of the signal must be at least 16 nsec (2 clock periods at 125 MHz).

To enable grabbing upon a trigger, use the MIL-Lite function **MdigControl**() with **M_GRAB_TRIGGER_STATE.** To set the signal used to trigger the grab, use **MdigControl**() with **M_GRAB_TRIGGER_SOURCE.** To start a timer upon a trigger, use **MdigControl**() with **M_TIMER_TRIGGER_SOURCE.**

Rotary decoder

Matrox Radient eV features rotary decoders (quadrature decoders). They are used to decode quadrature input received from a rotary encoder with quadrature output. A rotary encoder is a device that provides information about the position and direction of a rotating shaft (for example, that of a conveyor belt). The encoder outputs a two-bit code (also known as Gray code) on two pairs of LVDS wires for each change in position of the rotating shaft; for a given direction of the rotating shaft, the rotary encoder outputs the code in a precise sequence (either 00 - 01 - 11 - 10 or 00 - 10 - 11 - 01, depending on how the rotary encoder is attached to the rotating shaft). If the rotating shaft changes direction, the rotary encoder transmits the Gray code in the reverse sequence (00 - 10 - 11 - 01 or 00 - 01- 11 - 10, respectively). Matrox Radient eV-CLHS features two rotary decoders, whereas Matrox Radient eV-CXP features four rotary decoders.
Matrox Radient eV-CL has one rotary decoder for each acquisition path.

Upon decoding a Gray code, the rotary decoder increments or decrements its 32-bit internal counter, depending on the direction of movement. You can configure which Gray code sequence represents forward movement and increments the counter; the reverse Gray code sequence will then represent the backward direction and decrement the counter. You can specify the direction of movement occurring when the Gray code sequence is 00 - 01 - 11 - 10, using **MdigControl**() with **M_ROTARY_ENCODER_DIRECTION.**

The rotary decoder supports encoder frequencies of up to 50 MHz. The LVDS receivers of the Matrox Radient eV board support input from -4 V to +5 V.

- ❖ Note that an external source must be used to power the rotary encoder (for example, your computer's 5 V power source).

You can configure the rotary decoder's settings, using the MIL-Lite function **MdigControl**() with **M_ROTARY_ENCODER...**, or by modifying the DCF file with Matrox Intellicam.

User signals

Auxiliary signals can also be used to transmit or receive application-specific user output and/or input.

If you want to start or stop an external event based on some calculation or analysis, you can manually set the state of any auxiliary output signal (or I/O signal set to output) to high or low. To do so, you set the state (on/off) of a bit in a user settable register (static-user-output register). When the bit is on, its associated auxiliary output signal will be high; when it is off, the auxiliary output signal will be low. This bit is referred to as a user-bit. To route the state of a user-bit to an auxiliary output signal, use **MdigControl**() with **M_IO_SOURCE** and **M_USER_BITn**; to set the state of a user-bit, use **MdigControl**() with **M_USER_BIT_STATE**.

Your application can also act upon and interpret the state of an auxiliary input signal (or I/O signal set to input). The state of an auxiliary input signal is not associated with a user-bit; you poll the state of the signal directly. To poll the state of an auxiliary input signal, use **MdigInquire**() with **M_IO_STATUS**. The state of an auxiliary input signal can also generate an interrupt; to do so, use **MdigControl**() with **M_IO_INTERRUPT_STATE** and then use **MdigHookFunction**() with **M_IO_CHANGE** to hook a function to this event (that is, to set up an event handler).

Acquisition memory

Matrox Radient eV-CXP is equipped with 1, 2, or 4 Gbytes of DDR3 SDRAM acquisition memory. Matrox Radient eV-CLHS is equipped with 2 Gbytes of DDR3 SDRAM acquisition memory. Matrox Radient eV-CL is equipped with 1 Gbytes of DDR3 SDRAM acquisition memory. This memory is accessed through the memory interface, and is used to store acquired images. The memory interface transfers data to and from memory at up to 6.4 Gbytes/sec.

Matrox Radient eV has 128 Mbytes of memory mapped onto the PCIe bus. You can use a Host pointer to access this memory, or you can access it directly from another PCIe bus master; this memory is referred to as shared memory. To allocate a buffer in shared memory, use the MIL-Lite function **MbufAlloc...**() with **M_ON_BOARD + M_SHARED**.

Data conversion

The color space converter and image formatter can convert data in the following ways:

- **Subsampling.** Image data can be subsampled.

  The color space converter and image formatter can subsample in the horizontal and vertical directions by integer factors of 1 to 16. The color space converter and image formatter uses nearest-neighbor interpolation.

  You can use any of the following MIL-Lite functions to subsample image data:

  - **MdigControl**() with **M_GRAB_SCALE_X/Y,** using a factor of less than 1.
  - **MimResize**() with ScaleFactorX and ScaleFactorY set to a value less than 1.
  - **MbufTransfer**() with **M_COPY + M_SCALE**, setting the destination buffer size smaller than the original image.

  Note that Matrox Radient eV does not support cropping in hardware. However, you can have image data cropped during transfer to Host using **MdigControl**() with **M_SOURCE_SIZE_X/Y** and **M_SOURCE_OFFSET_X/Y.**

- **Flipping.** Images can be flipped horizontally or vertically, using the MIL-Lite function **MdigControl**() with **M_GRAB_DIRECTION_X/Y** or when calling **MimFlip**() from on-board buffer to Host.

- **Color space conversion.** The color space converter and image formatter formats an image based on its type and the bit-depth and color format of the destination buffer. You can set the bit depth and color format of the destination buffer when you allocate it using the MIL-Lite function **MbufAlloc...**(). The format of the source image is established in the DCF.

Image data can be converted as follows:

Input format	Output format							
	8-bit monochrome	**16-bit monochrome**	**24-bit packed BGR**	**32-bit packed BGRa**	**48-bit packed BGR**	**16-bit YUV (YUYV)**	**24-bit RGB planar**	**48-bit RGB planar**
8-bit monochrome	yes		yes	yes		yes	yes	
16-bit monochrome	yes	yes	yes	yes	yes	yes	yes	yes
24-bit packed BGR	yes		yes	yes		yes	yes	
48-bit packed BGR	yes	yes	yes	yes	yes	yes	yes	yes

The equations for the YUV16 conversion are described in the following table. The value of *depth* is either 8 or 16 when converting BGR24 or BGR48 data, respectively. Note that while performing BGR48-to-YUV color space conversion, the operations are carried out on 16-bit data; then, each resulting YUV component is bit-shifted right by 8 bits (>> (*depth* - 8) where the value of *depth* is 16).

Color space conversion	Equations
BGR-to-YUV	• $Y = (0.114B + 0.587G + 0.299R) >> (depth - 8)$ • $U = (0.500B - 0.331G - 0.169R + 2^{(depth-1)}) >> (depth - 8)$ • $V = (-0.081B - 0.419G + 0.500R + 2^{(depth-1)}) >> (depth - 8)$

Host interface

The Matrox Radient eV PCIe 2.0 Host interface is capable of high-speed DMA transfers to Host memory, or other memory mapped onto the PCIe bus. The DMA write engine of the Host interface is capable of performing the transfers without the help of the Host CPU.

Matrox Radient eV uses PCIe 2.0 technology to communicate with the Host. Under optimum conditions, Matrox Radient eV can send data to the Host at a peak transfer rate of up to 4 Gbytes/sec. Optimum conditions include using the board in a PCIe 2.x slot with 8 active lanes, using a 256-byte payload.

DMA write performance is chipset and computer dependent, and is slightly affected by the image size and alignment in Host memory.

The Matrox Radient eV Host interface has four DMA write contexts, which act independently, simulating four DMA write engines running in parallel. The presence of multiple DMA contexts does not change the maximum bandwidth, but can help reduce latency.

Appendix A: Glossary

This appendix defines some of the specialized terms used in the Matrox Radient eV documentation.

Glossary

- **Acquisition path.**

  A path that has the components to, for example, digitize or capture a video input signal. Some video sources require multiple acquisition paths.

- **ASPM.**

  Active State Power Management. A hardware PCIe mechanism that autonomously controls power consumption of the PCIe connectors in a computer. The actual power consumed by a PCIe device depends on the PCIe traffic and on the power-saving level to which the PCIe slot is configured. The power-saving level of the PCIe slot is initialized by the operating system.

- **Auxiliary I/O.**

  Auxiliary input/output. Non-video digital signals that can support one or more functionalities depending on the auxiliary signal (for example, trigger input or timer output).

- **Bandwidth.**

  A term describing the capacity to transfer data. Greater bandwidth is needed to sustain a higher transfer rate. Greater bandwidth can be achieved, for example, by using a wider bus or by increasing the clock frequency at which an interface or a processing core operates (for example, increasing the DDR3 SDRAM clock frequency).

- **BNC connector.**

  Bayonet Neill-Concelman connector. A common connector used for 75 Ω coaxial cables. Its fastener uses L-shaped slots to ensure that the coaxial cable is secured to the Matrox Radient eV-CXP board.

- **Camera Link.**

  A serial communication protocol standard designed for computer vision applications based on the National Semiconductor interface Channel-link. It was designed for the purpose of standardizing scientific and industrial video products including cameras, cables and frame grabbers.

- **Camera Link HS.**

  A standard designed to address the needs of modern machine vision systems by defining the communication between a camera and a frame grabber. It provides low latency, low jitter, real-time signals for communicating video data and configuration data between the video source and frame grabber.

- **CLHS product capability designator.**

  A naming convention for CLHS-compliant products, designed to help users quickly identify a CLHS-compliant product‘s capabilities and determine its compatibility to other CLHS-compliant products.

- **CLHS.**

  See *Camera Link HS*.

- **CoaXPress.**

  An asymmetric high-speed communication standard used primarily for video and image data transfer. CoaXPress supports the transmission of video data, control signals, triggers, and power all on the same coaxial line. For each connection, CoaXPress supports downlink data rates of up to 6.25 Gbits/sec (1.25, 2.5, 3.125, 5.0, and 6.25 Gbits/s) and an uplink data rate of 0.02 Gbits/s (20.83 Mbits/sec).

- **Contiguous memory.**

  A block of memory occupying a single, unbroken series of addresses.

- **CXP.**

  See *CoaXPress*.

- **DCF.**

  Digitizer configuration format. A format that defines how the video source and the frame grabber are configured. The video source and the frame grabber are set to the specified camera mode, which defines the format of transferred data. The DCF can also configure the triggers, timers, and rotary decoders.

  DCF files have a *.dcf* extension.

- **DDR3 SDRAM.**

  Double-data-rate type 3 synchronous dynamic random-access memory. A type of general purpose consumer RAM. DDR3 SDRAM allows for data transfer at very high speeds, which is important for I/O-bound functions. This type of memory is inexpensive, high density, and very efficient as long as the data is accessed contiguously.

- **Digitizer configuration format.**

  See *DCF.*

- **Dynamic range.**

  The range of values present in a buffer. An unsigned 8-bit buffer, for example, has an allowable range of 0 to 255; its dynamic range can be any range within these values.

- **Exposure time.**

  Refers to the period during which the image sensor of a video source is exposed to light. As the length of this period increases, so does the image brightness.

- **Frame.**

  A single image grabbed from a video source.

- **Grab.**

  To acquire an image from a video source.

- **Latency.**

  The time from when a command is sent to when its operation is started.

- **LVDS.**

  Low-voltage differential signaling. LVDS offers a general-purpose, high bandwidth interface standard for serial and parallel data interfaces that require increased bandwidth at high speed, with low noise and power consumption.

- **PCIe.**

  Peripheral Component Interconnect Express. The standard used for the computer bus that acts as an interface between hardware devices, such as Matrox Radient eV-CXP, and your computer.

- **Payload.**

  The amount of data transmitted to the PCIe bus within each data packet. Common payload sizes are 128, 256, 512, 1024, 2048, and 4096 bytes.

- **PoCXP.**

  Power-over-CoaXPress. Power-over-CoaXPress is the term for power transmitted to a video source over a coaxial cable using the CoaXPress standard. Power can be provided to a video source, at up to 13 W per cable, at a nominal voltage of 24 V.

- **Real-time processing.**

  The processing of an image at the same speed or faster than the speed at which images are grabbed. Real-time processing ensures that no frames are missed.

  Also known as *live processing*.

- **Rotary encoder.**

  A device used to convert the angular position of a shaft or axle to an analog or digital code.

- **Timer output.**

  The signal generated by one of the programmable timers of the frame grabber. The timer output can be used to control external hardware. For example, it can be fed to the video source to control its exposure time or can be used to fire a strobe light.

Appendix B: Technical information

This appendix contains information that might be useful when installing your Matrox Radient eV board.

Board summary

Global information

- Operating system: See your software manual for supported versions of Microsoft Windows and Linux.

- Minimum computer requirements:

  - x8 (or x16) PCIe 1.x or 2.x slot*.

  - Processor with an Intel 32-bit or 64-bit architecture, or equivalent.

  - A relatively up-to-date PCIe chipset. A chipset that supports the PCIe 2.x standard is preferable. The list of platforms that are known to be compatible with Matrox Radient eV is available on the Matrox website, under the board's PC compatibility list.

  - A proper power supply. Refer to the *Electrical specifications* section.

Matrox does not guarantee compatibility with all computers that have the above specifications. Please consult with your local Matrox Imaging representative, local Matrox Imaging sales office, the Matrox web site, or the Matrox Imaging Customer Support Group at headquarters before using a specific computer.

*. Note that you can also install Matrox Radient eV in a x4 PCIe slot that has a mechanical x8 connector; however, the maximum transfer rate between Matrox Radient eV and the Host is reduced by 50%.

Technical features common to all Matrox Radient eV boards

- Has a x8 PCIe 2.0 Host interface.
- Supports frame and line-scan video sources. The minimum and maximum number of pixels per line are 33 and 65535, respectively.
- Supports video sources with a Bayer color filter. Bayer-encoded data (GRBG, GBRG, BGGR, or RGGB) is converted to RGB.
- Can convert 8- or 16-bit monochrome or 24- or 48-bit packed BGR data to monochrome, packed or planar BGR, packed BGRa, or YUV (YUYV) format.
- Can perform horizontal or vertical flipping.
- Can subsample image data by integer subsampling factors of 1 to 16.
- Supports external 5 V rotary encoders with quadrature output.

Technical features specific to Matrox Radient eV-CXP

- Supports two or four independent CoaXPress connections (Matrox Radient eV-CXP Dual has two CoaXPress connections with up to two independent acquisition paths and Matrox Radient eV-CXP Quad has four CoaXPress connections with up to four independent acquisition paths). Image data can be transmitted at up to 6.25 Gbits/sec when using a single coaxial cable (1.25, 2.5, 3.125, 5.0, or 6.25 Gbits/s), and up to 25 Gbits/sec when using four cables.
- Provides power-over-CoaXPress (PoCXP) (up to 13 W per connection) to any PoCXP-compliant device. The board is equipped with an overcurrent protection mechanism and a resettable fuse. The fuse can sustain a current of 1 A.
- Supports coaxial cable lengths of up to 40 m running at 6.25 Gbits/sec.
- The auxiliary input signals (or auxiliary I/O signals set to input) can be re-routed onto the CoaXPress trigger output signal.
- Has 1, 2, or 4 Gbytes of DDR3 SDRAM. Total memory bandwidth of up to 6.4 Gbytes/sec.

- Has a CoaXPress LED for each CoaXPress input connector, to identify the status and activity of connected devices. Matrox Radient eV-CXP Dual has two CoaXPress LEDs and Matrox Radient eV-CXP Quad has four CoaXPress LEDs.

- Has three board status LEDs to indicate the status of each of the following: power, FPGA/firmware configuration, and PCIe (Host) slot.

- Has 16 (for Matrox Radient eV-CXP Dual) or 32 (for Matrox Radient eV-CXP Quad) auxiliary signals (with the cable adapter brackets installed) that are path independent. Each auxiliary I/O connector provides the following number of signals:

  - Three TTL auxiliary I/O signals (trigger input or user input signals, or timer output, re-routing of the CoaXPress trigger input, or user output signals).

  - One LVDS auxiliary output signal (timer output, re-routing of the CoaXPress trigger input, or user output signals).

  - Two LVDS auxiliary input signals (trigger input, quadrature input, or user input signals).

  - Two opto-isolated auxiliary input signals (trigger input signals).

Technical features specific to Matrox Radient eV-CLHS

- Has a CLHS product capability designator of C2,7M1.
- Supports a single CLHS video source with the same connector and protocol type and 7 or fewer lanes.
- Provides a CLHS link status LED, to identify the status of the link between video source and frame grabber.
- Has 2 Gbytes of DDR3 SDRAM. Total memory bandwidth of up to 6.4 Gbytes/sec.
- Has up to 16 auxiliary signals (with the cable adapter bracket installed). Each auxiliary I/O connector provides the following number of signals:
    - Three TTL auxiliary I/O signals (trigger or user input signals, or timer output, re-routing to the CLHS message layer or user output signals).
    - One LVDS auxiliary output signal (timer output, re-routing to the CLHS message layer, or user output signals).
    - Two LVDS auxiliary input signals (trigger input, quadrature input, or user input signals).
    - Two opto-isolated auxiliary input signals (trigger input signals).

Technical features specific to Matrox Radient eV-CL

- Has a PoCL LED for each input connector, to identify whether the connector is receiving power. Matrox Radient eV-CL DB and QB have four PoCL LEDs, while Matrox Radient eV-CL SB and DF have two.

- Has three board status LEDs to indicate the status of each of the following: power, firmware configuration, and PCIe (Host) slot.

- Matrox Radient eV-CL DB has two independent acquisition paths;
  Matrox Radient eV-CL QB has four independent acquisition paths. Each acquisition path supports a video source in the Camera Link Base configuration.

- Matrox Radient eV-CL SF has a single acquisition path;
  Matrox Radient eV-CL DF has two acquisition paths. Each acquisition path supports a video source in the Camera Link Medium, Full, or 80-bit configuration.

- Can provide power over Camera Link (PoCL) with SafePower. The PoCL protection on-board fuse can sustain a current of 0.4 A.

- Has four camera control signals (re-routing of specific auxiliary input signals, HSYNC output, VSYNC output, clock output, timer output, or user output) per acquisition path[*].

- Supports extended Camera Link cables, for a cable length of up to 15 m at 85 MHz.

- Has up to 32 auxiliary signals that can be path independent or path dependent, depending on the functionality[†] selected[*]. When path dependent, there are:

  - Three TTL auxiliary I/O signals (trigger input or user input, or timer output or user output) per acquisition path.

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*. See the *Camera control and auxiliary signals for Matrox Radient eV-CL DB/QB* and *Camera control and auxiliary signals for Matrox Radient eV-CL SF/DF* sections in *Chapter 4: Matrox Radient eV hardware reference* chapter for supported functionality.

†. For example, for Matrox Radient eV-CL DB and eV-CL QB, TTL_AUX_IO_14 can be used as a trigger input when grabbing from acquisition path 0 or 1; however, you can only route timer 2 of acquisition path 1 to this signal.

- One LVDS auxiliary output signal (timer output or user output) per acquisition path.

- Two LVDS auxiliary input signals (trigger input, timer-clock input, quadrature input, or user input) per acquisition path.

- Two opto-isolated auxiliary input signals (trigger input or user input) per acquisition path.

Electrical specifications

The following table describes the operating voltage and current for the different members of the Matrox Radient eV family.

Operating voltage and current for Matrox Radient eV	
Matrox Radient eV-CXP	Typical: 3.3 V, 425 mA: 1.4 W Typical 12.0 V, 1.2 A: 14.4 W Max. PoCXP 18.5 - 24.0 V, 700 mA: 17 W* (Current drawn from the PCIe auxiliary power connector. Power is not dissipated by the board; it is only used by the video source). Total dissipated by the board: 1.4 W + 14.4 W =15.8 W (typical) Total dissipated by board and PoCXP video sources = 15.8 W + (4 * 17 W) = 83.8 W (typical)
Matrox Radient eV-CLHS	Typical: 3.3 V, 425 mA: 1.4 W Typical 12.0 V, 1.2 A: 14.4 W Total dissipated by the board: 1.4 W + 14.4 W =15.8 W (typical)
Matrox Radient eV-CL	Typical: 3.3 V, 1.4 A: 4.62 W Typical 12.0 V, 1.0 A: 12 W Max. PoCL 12.0 V, 1.6 A: 19.2 W† (Current directly drawn from the slot. Power is not dissipated by the board; it is only used by the camera). Total dissipated by the board: 4.62 W + 12 W =16.62 W (typical) Total dissipated by board and PoCL video sources = 16.62 W + 19.2 W = 35.82 W (typical)

*. The PoCXP protection fuse on Matrox Radient eV-CXP can sustain a current of 1 A.

†. The PoCL protection fuse on Matrox Radient eV-CL can sustain a current of 0.4 A.

The following table describes the specifications for the auxiliary I/O signals on Matrox Radient eV.

I/O Specifications		
	Input signals in LVDS format	100 Ohm differential termination. Input current: -10 µA (min) to +10 µA (max). Common-mode: -4 V (min) to +5 V (max). Differential threshold: low of -50 mV (min); high of +50 mV (max).
	Output signals in LVDS format	No parallel termination. Output current: -10 µA to 10 µA. Output voltage: high (V_{oh}) 1.6 V (max), 1.33 V (typ); low (V_{ol}) 0.9 V (min), 1.02 V (typ) Differential output voltage (with load of 100 Ohm): 250 mV (min) to 450 mV (max). Offset voltage (common-mode): 1.125 V (min) to 1.375 V (max). Propagation delay: 2.8 ns (max).
	Input signals in TTL format	No series termination. Pulled up to 3.3 V with 4.716 K Ohm. Clamped to -0.7 V to +5.7 V. Input current: 5 µA (max). Input voltage: low of 0.8 V (max); high of 2.0 V (min).
	Output signals in TTL format	27 Ohm series termination. High-level output current: -32 mA (max). Low-level output current: +64 mA (max). Output voltage: low of 0.55 V (max); high of 2.0 V (min).
	Opto-coupled input signals*	511 Ohm series termination (connected on the anode inputs of the opto-coupler device). Input current: low: 250 µA (max); high: 5 mA (min (thresholded)) to 15 mA (max) (6.3 to 10 mA recommended). Input voltage: low (V_{il}) of 0.8 V (max); high (V_{ih}) of 4.71 V (min) to 9.165 V (max). Input forward voltage (at 25 degrees C): 1.3 V (min), 1.8 V (max). Propagation delay (at 25 degrees C): 100 ns (max).

*. The Matrox Radient eV opto-couplers are manufactured by Agilent or Avago Technologies (P/N HCPL-0631).

Dimensions and environmental specifications

- Dimensions of all Matrox Radient eV boards except Matrox Radient eV-CL DF/QB: 16.76 L x 11.12 H x 1.871 W cm (6.6" x 4.376" x 0.737") from bottom edge of goldfinger to top edge of board. These values respect the dimensions of a PCIe half-length board.

- Dimensions of Matrox Radient eV-CL DF/QB: 16.76 L x 11.12 H x 3.903 W cm (6.6" x 4.376" x 1.537") from bottom edge of goldfinger to top edge of board.

- Ventilation: 200 LFM between boards.

- Minimum/maximum ambient operating temperature: 0°C to 55°C (32°F to 131°F).

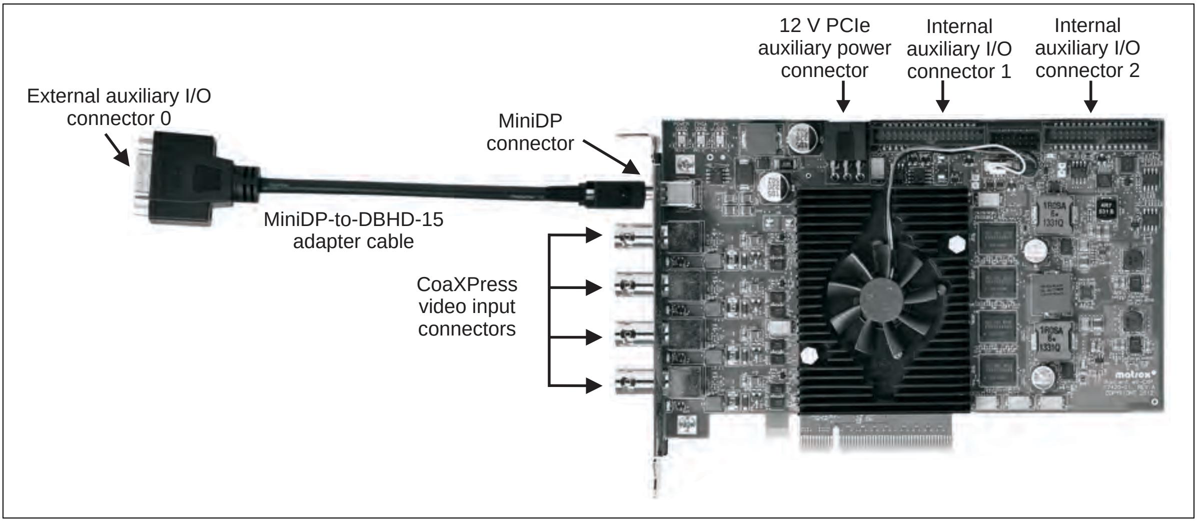
- Minimum/maximum storage temperature: -40°C to 75°C (-40°F to 167°F).

- Operating relative humidity: up to 95% relative humidity (non-condensing).

- Storage humidity: up to 95% relative humidity (non-condensing).

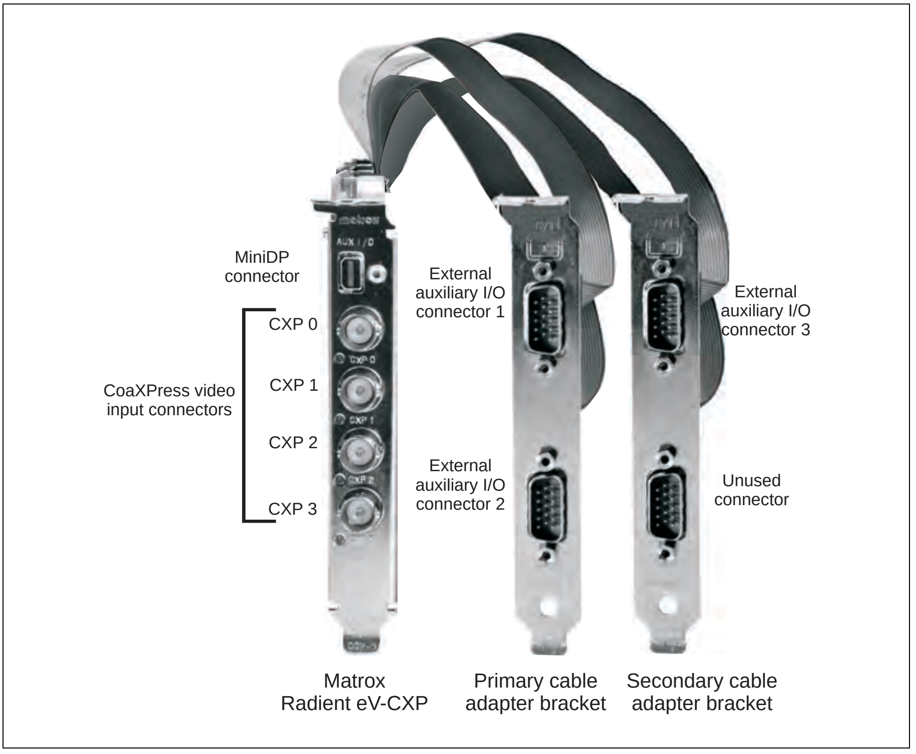
Connectors on the Matrox Radient eV-CXP board

On the Matrox Radient eV-CXP board, there are several interface connectors. On the bracket of the main board, there are two or four CoaXPress video input connectors and one Mini DisplayPort (MiniDP) connector. In addition, close to the top edge of the main board, there are two internal auxiliary I/O connectors and a 12 V PCIe auxiliary power connector.



The MiniDP-to-DBHD-15 adapter cable connects to the MiniDP connector on the main bracket. The DBHD-15 connector at the end of this cable is called external auxiliary I/O connector 0.

The optional cable adapter brackets provide three additional external auxiliary I/O connectors. The primary cable adapter bracket (the bracket attached to internal auxiliary I/O connector 1) has auxiliary I/O connectors 1 and 2. The secondary cable adapter bracket (the bracket attached to internal auxiliary I/O connector 2) has auxiliary I/O connector 3 and an unused connector.



CoaXPress video input connectors

The four CoaXPress (CXP) video input connectors are standard 75 Ω BNC connectors. They are used to receive video input streams and send and receive CoaXPress trigger signals, as well as control and acknowledgement messages.

To interface with these connectors, use standard 75 Ω coaxial cables with BNC connectors. You can purchase high-quality, 75 Ω coaxial cables from your video source manufacturer, Belden Inc., or other third parties. Note that these cables are not available from Matrox.

When using more than one CoaXPress cable to connect to the same video source, you must choose cables of the same type and length, to ensure that the cables have the same propagation delay.

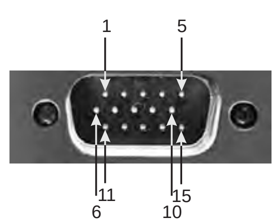
Video sources can be connected to the CoaXPress video input connectors in any order. Matrox Radient eV-CXP communicates with the video source(s) to identify which video source is connected to which connector(s).

External auxiliary I/O connectors

The external auxiliary I/O connectors on the MiniDP-to-DBHD-15 adapter cable and the cable adapter brackets are high-density D-subminiature 15-pin (DBHD-15[*]) male connectors. The external auxiliary I/O connectors are used to transmit and receive auxiliary signals.

❖ The auxiliary I/O connectors on Matrox Radient eV-CXP are not compatible with display devices. Connecting one of the DBHD-15 connectors to a VGA monitor or any other display device might damage both the device and the Matrox Radient eV-CXP board.

The auxiliary signals are path independent; regardless of the acquisition path that is being used to grab images, any of the auxiliary signals can be used. For more information, see the *Auxiliary signals* section in *Chapter 4: Matrox Radient eV hardware reference* chapter for supported functionality.



*. Sometimes referred to as DB-15, but more accurately known as DE-15.

The pinout for auxiliary I/O connector 0 is as follows. Auxiliary I/O connectors 1, 2, and 3 have the same pinout as auxiliary I/O connector 0, except you must add 8, 16, or 24, respectively, to the number at the end of their hardware signal name and MIL constant. For example, AUX(TRIG)_TTL_IO_4 on connector 0 would be AUX(TRIG)_TTL_IO_12 on connector 1.

Pin	Hardware signal name	MIL constant for auxiliary signal	Description
1	AUX(TRIG)_TTL_IO_4	M_AUX_IO4	TTL auxiliary signal 4 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT4).
2	AUX(TRIG)_TTL_IO_5	M_AUX_IO5	TTL auxiliary signal 5 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT5).
3	AUX(TRIG)_TTL_IO_6	M_AUX_IO6	TTL auxiliary signal 6 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT6).
4+,5-	AUX(TRIG)_LVDS_IN2	M_AUX_IO2	LVDS auxiliary signal 2 (input), which supports: trigger input, user input, or quadrature input bit 0.
6+,8-	AUX(TRIG)_LVDS_IN3	M_AUX_IO3	LVDS auxiliary signal 3 (input), which supports: trigger input, user input, or quadrature input bit 1.
7	GND	N/A	Ground.
10	GND	N/A	Ground.
12+,11-	AUX(TRIG)_OPTO_IN1	M_AUX_IO1	Opto-isolated auxiliary signal 1 (input), which supports: trigger input or user input.
13+,14-	AUX(EXP)_LVDS_OUT7	M_AUX_IO7	LVDS auxiliary signal 7 (output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4) or user output (M_USER_BIT7).
15+,9-	AUX(TRIG)_OPTO_IN0	M_AUX_IO0	Opto-isolated auxiliary signal 0 (input), which supports: trigger input or user input.

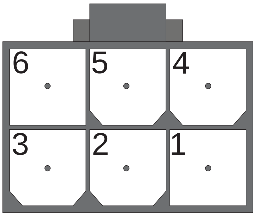
To build your own cable, you can purchase the following parts:

	Mating information
Manufacturer:	NorComp, Inc.
Connector:	180-015-203L001
Backshell:	970-015-010-011

These parts can be purchased from third parties such as Digi-Key Corporation (www.digikey.com).

PCIe auxiliary power connector

The PCIe auxiliary power connector on Matrox Radient eV-CXP is a standard 6-pin, 12 V connector. When this connector is connected to the 12 V power supply of your computer, Matrox Radient eV-CXP can provide power-over-CoaXPress to the devices connected to the CoaXPress input connectors, at up to 13 W per connection.



The pinout for the PCIe auxiliary power connector is as follows:

Pin	Description
1	+12 V
2	+12 V
3	+12 V
4	Ground.
5	Sense.
6	Ground.

LEDs on Matrox Radient eV-CXP

Matrox Radient eV-CXP has LEDs to display the status of the CoaXPress connections, the on-board power, the board configuration, the PCIe (Host) slot, and the firmware.

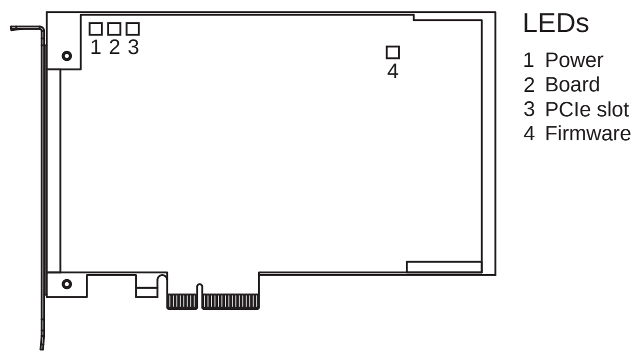
CoaXPress LEDs

Matrox Radient eV-CXP has two or four CoaXPress LEDs on the main bracket. Each LED corresponds to a CoaXPress video input connector, indicates the status of the device attached to that connector, and indicates communication between the device and Matrox Radient eV-CXP. The LEDs can help identify whether the device is sending data, and whether Matrox Radient eV-CXP is transmitting power to the device.

LED color and state	Description
Off	Matrox Radient eV-CXP is not receiving power.
Red, slow flash	Matrox Radient eV-CXP is sensing for a PoCXP-compliant device.
Red, 500 ms flash	An error occurred during data transfer.
Red, fast flash	A CoaXPress system error occurred on the Matrox Radient eV-CXP board. This type of error can prevent Matrox Radient eV-CXP from receiving data. For example, an error will occur if PoCXP is enabled, but the auxiliary 12 V power connector is not connected to a power source.
Red, solid	Overcurrent was detected in the PoCXP circuitry, possibly because of a failure in the connected device or damage to the cable. Matrox Radient eV-CXP stopped sending power to the device to avoid damaging the device or the board.
Alternating red/orange, slow flash	One of the following is occurring: • Matrox Radient eV-CXP is sensing for a non-PoCXP compliant device. PoCXP is disabled. • The device is incompatible. PoCXP is disabled.
Alternating red/green, slow flash	The device is incompatible; PoCXP is enabled.
Orange, slow flash	Matrox Radient eV-CXP is waiting for an event (for example, a trigger).
Green, slow flash	The device is compatible and Matrox Radient eV-CXP has established a connection with the device. No data is being transferred.
Orange, fast flash	Matrox Radient eV-CXP detected a non-PoCXP compliant device. Matrox Radient eV-CXP is trying to establish a connection with the device, without sending power to the device. This state occurs when initially connecting your device.
Green, fast flash	Matrox Radient eV-CXP detected a PoCXP-compliant device. Matrox Radient eV-CXP is sending power to the device, and is trying to establish a connection. This state occurs when initially connecting your device.
Green, solid	Matrox Radient eV-CXP has established a connection with the device and data is being transferred. The LED blinks synchronously with data.
Orange, solid	Matrox Radient eV-CXP is booting, or the PoCXP circuitry is not ready.

Board status LEDs

Matrox Radient eV-CXP has four board status LEDs to indicate the status of each of the following: power, the board configuration, the PCIe (Host) slot, and the firmware.

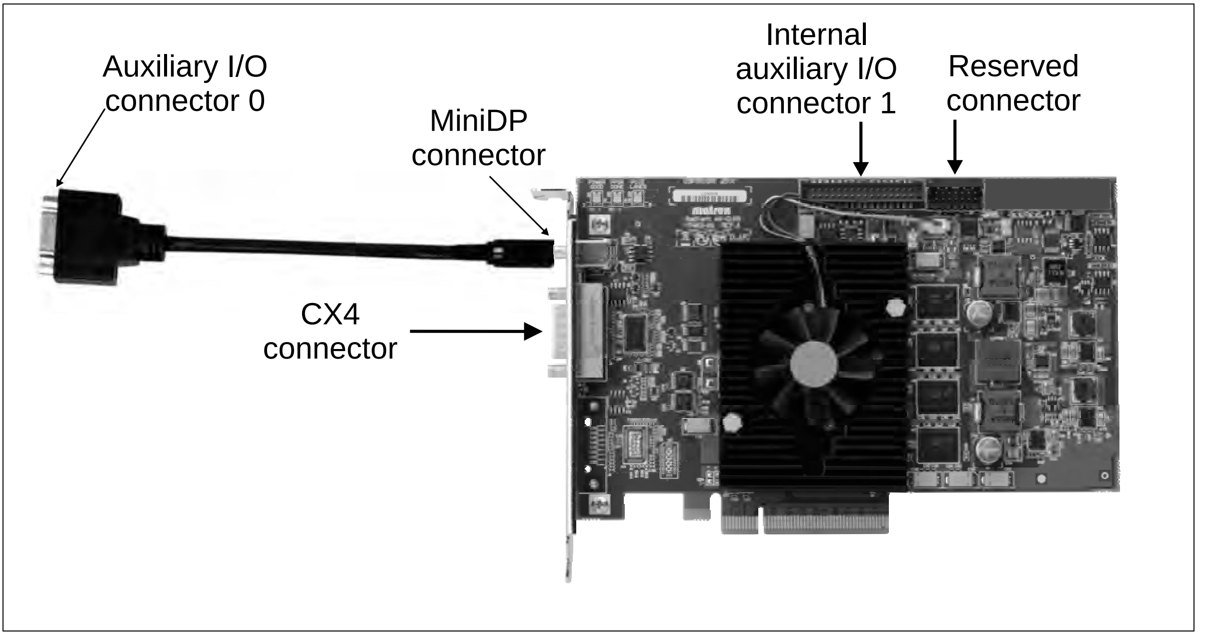


The table below outlines the possible colors for each LED, and their definitions.

LED type	LED color and state	Description
1. Power	Off/Red	One or more of the on-board voltage regulators did not start. If your computer is on and this LED state occurs, there is an issue with the voltage regulators on your Matrox Radient eV-CXP. Contact Matrox technical support.
	Green	All of the on-board voltage regulators are working properly.
2. Board	Red	The board is not configured.
	Green	The board is configured.
3. PCIe slot	Off	The type of slot cannot be established. The PCIe link is down.
	Blinking red	Slot is PCIe 1.x, x1
	Blinking orange	Slot is PCIe 1.x, x4
	Blinking green	Slot is PCIe 1.x, x8
	Solid red	Slot is PCIe 2.x, x1
	Solid orange	Slot is PCIe 2.x, x4
	Solid green	Slot is PCIe 2.x, x8
4. Firmware status	Off	The firmware is OK.
	On	The firmware is corrupted. Fall-back firmware is being used.

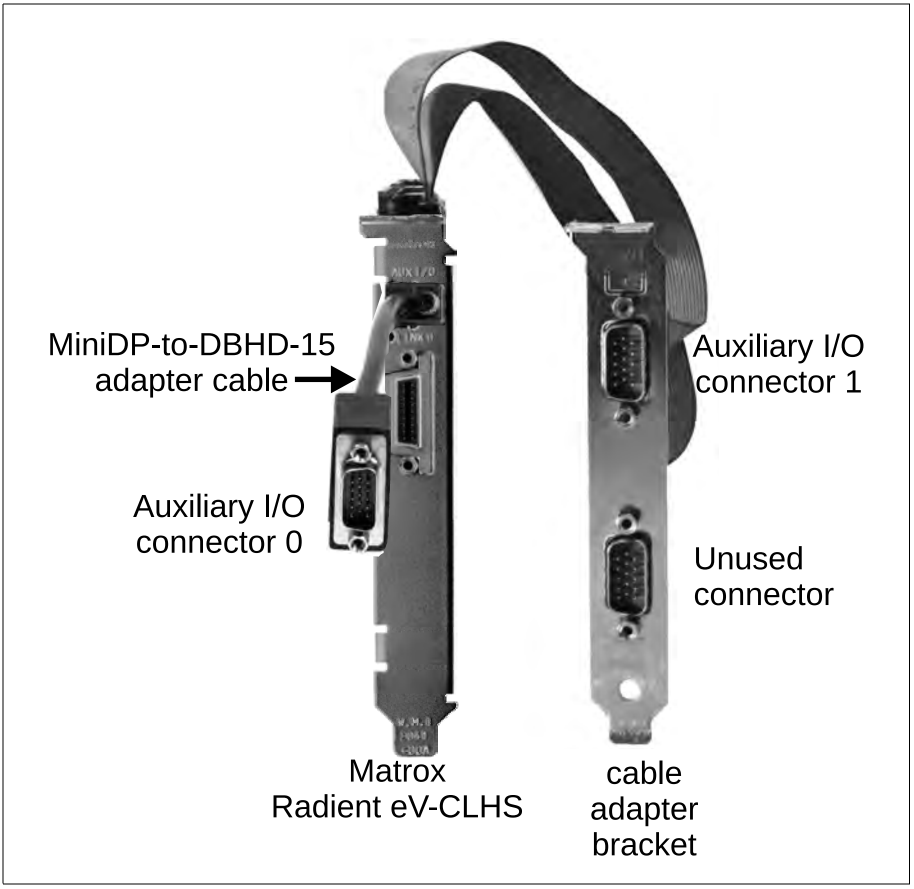
Connectors on Matrox Radient eV-CLHS

On the Matrox Radient eV-CLHS board, there are several interface connectors. On the bracket of the main board, there is one CX4 video input connector and one Mini DisplayPort (MiniDP) connector. In addition, close to the top edge of the main board, there is an internal auxiliary I/O connector.



The MiniDP-to-DBHD-15 adapter cable connects to the MiniDP connector on the main bracket. The DBHD-15 connector at the end of this cable is called external auxiliary I/O connector 0.

The optional cable adapter bracket provides an additional external auxiliary I/O connector and an unused connector.



CX4 video input connector

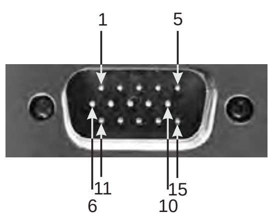
The CX4 video input connector is used to receive video input and send and receive CLHS messages. To interface with this connector, use a standard CX4 cable with a thumbscrew type junction shell. You can purchase CX4 connector cables with thumbscrews from the video source manufacturer, Meritec Inc., or other third parties. Matrox Radient eV-CLHS uses the CLHS C2 standard for the CX4 video input connector (that is, the cable mirrors the connections about its center so that outputs on the video source are inputs on the frame grabber).

External auxiliary I/O connectors

The external auxiliary I/O connectors on the MiniDP-to-DBHD-15 adapter cable and the cable adapter brackets are high-density D-subminiature 15-pin (DBHD-15*) male connectors. The external auxiliary I/O connectors are used to transmit and receive auxiliary signals.

❖ The auxiliary I/O connectors on Matrox Radient eV-CLHS are not compatible with display devices. Connecting one of the DBHD-15 connectors to a VGA monitor or any other display device might damage both the device and the Matrox Radient eV-CLHS board.

For more information, see the *Auxiliary signals* section in *Chapter 4: Matrox Radient eV hardware reference* chapter for supported functionality.



The pinout for auxiliary I/O connector 0 is as follows. Auxiliary I/O connector 1 has the same pinout as auxiliary I/O connector 0, except you must add 8 to the number at the end of their hardware signal name and MIL constant. For example, AUX(TRIG)_TTL_IO_4 on auxiliary I/O connector 0 is AUX(TRIG)_TTL_IO_12 on auxiliary I/O connector 1.

*. Sometimes referred to as DB-15, but more accurately known as DE-15.

Pin	Hardware signal name	MIL constant for auxiliary signal	Description
1	AUX(TRIG)_TTL_IO_4	M_AUX_IO4	TTL auxiliary signal 4 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT4).
2	AUX(TRIG)_TTL_IO_5	M_AUX_IO5	TTL auxiliary signal 5 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT5).
3	AUX(TRIG)_TTL_IO_6	M_AUX_IO6	TTL auxiliary signal 6 (input/output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4), trigger input, user input, or user output (M_USER_BIT6).
4+,5-	AUX(TRIG)_LVDS_IN2	M_AUX_IO2	LVDS auxiliary signal 2 (input), which supports: trigger input, user input, or quadrature input bit 0.
6+,8-	AUX(TRIG)_LVDS_IN3	M_AUX_IO3	LVDS auxiliary signal 3 (input), which supports: trigger input, user input, or quadrature input bit 1.
7	GND	N/A	Ground.
10	GND	N/A	Ground.
12+,11-	AUX(TRIG)_OPTO_IN1	M_AUX_IO1	Opto-isolated auxiliary signal 1 (input), which supports: trigger input or user input.
13+,14-	AUX(EXP)_LVDS_OUT7	M_AUX_IO7	LVDS auxiliary signal 7 (output), which supports: timer output (M_TIMER1/M_TIMER2/M_TIMER3/M_TIMER4) or user output (M_USER_BIT7).
15+,9-	AUX(TRIG)_OPTO_IN0	M_AUX_IO0	Opto-isolated auxiliary signal 0 (input), which supports: trigger input or user input.

To build your own cable, you can purchase the following parts:

	Mating information
Manufacturer:	NorComp, Inc.
Connector:	180-015-203L001
Backshell:	970-015-010-011

These parts can be purchased from third parties such as Digi-Key Corporation (www.digikey.com).

LED on Matrox Radient eV-CLHS

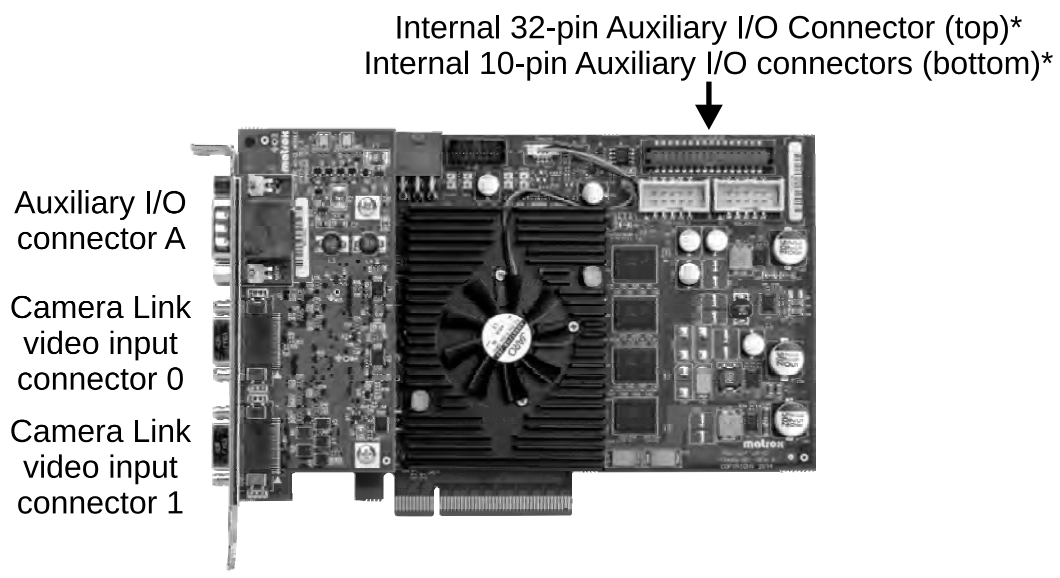
Matrox Radient eV-CLHS provides a link status LED, visible through a hole on the bracket, that provides an indicator for the status of the link between the video source and frame grabber.

The following table lists LED states that the frame grabber can indicate and their descriptions:

LED State	Description
Off	The frame grabber is not powered and/or waiting for software.
Constant Orange	The video source is holding the frame grabber in reset mode, preventing any communication.
Blinking Orange (Medium Speed)	The video source and frame grabber have established communication and determined that they cannot operate together.
Blinking Green (Medium Speed)	The connection between video source and frame grabber has not been established or has been recently broken.
Constant Green	The link between the video source and frame grabber has been properly established and data transfer can take place.

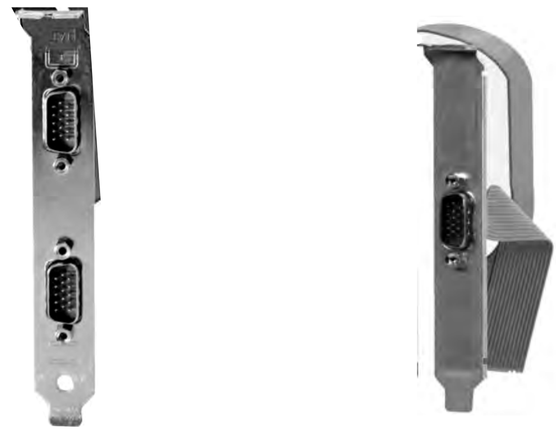
Connectors on Matrox Radient eV-CL boards

On the Matrox Radient eV-CL boards, there are several interface connectors. On the bracket of Matrox Radient eV-CL DB and eV-CL SF, there are two Camera Link video input connectors and an auxiliary I/O connector. On the double bracket of Matrox Radient eV-CL QB and eV-CL DF, there are two pairs of Camera Link video input connectors and two auxiliary I/O connectors. In addition, close to the top edge of the main board, there is an internal auxiliary I/O connector.



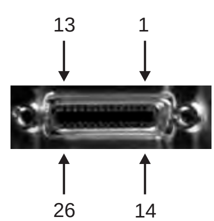
*Use the 32-pin auxiliary I/O connector to connect to the DBHD-15 cable adapter bracket; Use the 10-pin auxiliary I/O connectors to connect to the DB-9 cable adapter bracket.

On the Matrox Radient eV-CL cable adapter brackets, there are either two DBHD-15 auxiliary I/O connectors or one DB-9 auxiliary I/O connector; these allow you to access the signals of the internal auxiliary I/O connector from outside the computer enclosure.



Camera Link video input connectors

The Camera Link video input connectors are 26-pin high-density female mini Camera Link connectors. They are used to receive video input, timing, and synchronization signals and transmit/receive communication signals between the video source and the frame grabber.



The number of Camera Link video input connectors and their pinout depends on the version of Matrox Radient eV-CL and the configuration. The pinout of these connectors follows the Camera Link standard.

Matrox Radient eV-CL DB and eV-CL QB

On Matrox Radient eV-CL DB, there are two Camera Link connectors; whereas on Matrox Radient eV-CL QB, there are four Camera Link connectors. Each Camera Link connector on Matrox Radient eV-CL DB and eV-CL QB supports one video source in Base configuration, and has the same pinout; this pinout is listed in the following table.

Pin	Hardware signal name	MIL constant for auxiliary signal	Description
1	Inner shield		Ground (inner shield), or +12V to camera in PoCL mode.
3+,16-	CC3	M_CC_IO3	Camera control output 3 for acquisition path n, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEVn), user output (M_USER_BIT_CC_IO0/M_USER_BIT_CC_IO1 on M_DEVn), VSYNC, HSYNC, clock output, or rerouting of specific auxiliary input signals*.
5+,18-	CC1	M_CC_IO1	Camera control output 1 for acquisition path n, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEVn), user output (M_USER_BIT_CC_IO0/M_USER_BIT_CC_IO1 on M_DEVn), VSYNC, HSYNC, clock output, or rerouting of specific auxiliary input signals†.
6+,19-	SerTFG		Serial port to frame grabber (UART).
8+,21-	X3		Video input data X3.
9+,22-	Xclk		Clock input X.
10+,23-	X2		Video input data X2.
11+,24-	X1		Video input data X1.
12+,25-	X0		Video input data X0.
13	Inner shield		Ground.
14	Inner shield		Ground.
15+,2-	CC4	M_CC_IO4	Camera control output 4 for acquisition path n, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEVn), user output (M_USER_BIT_CC_IO0/M_USER_BIT_CC_IO1 on M_DEVn), VSYNC, HSYNC, clock output, or rerouting of specific auxiliary input signals†.
17+,4-	CC2	M_CC_IO2	Camera control output 2 for acquisition path n, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEVn), user output (M_USER_BIT_CC_IO0/M_USER_BIT_CC_IO1 on M_DEVn), VSYNC, HSYNC, clock output, or rerouting of specific auxiliary input signals†.
20+,7-	SerTC		Serial port to video source (UART).
26	Inner shield		Ground (inner shield), or +12V to camera in PoCL mode.

*. See the table in the *Auxiliary signals* section of *Chapter 4: Matrox Radient eV hardware reference* for more information on which auxiliary input signals (or auxiliary I/O signals set to input) can be rerouted onto the camera control output signals. Also note that for Matrox Radient eV-CL DB and eV-CL QB, n should be replaced by the number of the Camera Link connector to which the video source is connected.

Matrox Radient eV-CL SF and eV-CL DF

On Matrox Radient eV-CL SF, there is one pair (0-1) of Camera Link connectors, whereas on Matrox Radient eV-CL DF, there are two pairs (0-1 and 2-3) of Camera Link connectors. To each pair of connectors, you can connect one video source in Medium, Full, or 80-bit configuration. Each of the connector pairs uses a single acquisition path. In MIL, the (0-1) connector pair uses acquisition path 0 (M_DEV0), and the (2-3) connector pair uses acquisition path 1 (M_DEV1). The top Camera Link connector of each pair has the pinout described above (except replace n with the number of the acquisition path for the connector pair), while the bottom Camera Link connector of each pair has the following pinout.

Warning

❖ When connecting a video source in Medium, Full, or 80-bit configuration, ensure that you are connecting its cables to the appropriate connector. Accidentally connecting the cables to the wrong connector can damage the board or your video source. Pins 2-5 and pins 15-18 are output pins on the top connector (0 and 2), while they are input pins on the bottom connector (1 and 3).

Pin	Hardware signal name	Description
1	GND or PWR_OUT	Ground (inner shield), or +12V to camera in PoCL mode.
2+, 15-	Z3	Video input data Z3.*
3+, 16-	Zclk	Clock input Z.*
4+, 17-	Z2	Video input data Z2.*
5+, 18-	Z1	Video input data Z1.*
6+, 19-	Z0	Video input data Z0.*
7	terminated	Unused.*
8+, 21-	Y3	Video input data Y3.
9+, 22-	Yclk	Clock input Y.
10+, 23-	Y2	Video input data Y2.
11+, 24-	Y1	Video input data Y1.
12+, 25-	Y0	Video input data Y0.
13	Inner shield	Ground.
14	Inner shield	Ground.
20	100 Ω	Unused.*
26	GND or PWR_OUT	Ground (inner shield), or +12V to camera in PoCL mode.

*. When the board is set to the Medium configuration, these pins are reserved.

To interface with the above connectors, use a standard Camera Link cable with a 26-pin high-density male mini Camera Link connector (HDR or SDR) at one end. You can purchase such a cable from your video source manufacturer, Components Express inc., 3M Interconnect Solutions for Factory Automation, Intercon 1, or other third parties. Note that this cable is not available from Matrox.

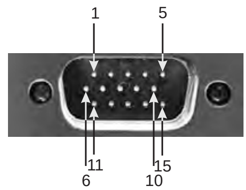
❖ If using both Camera Link connectors to connect to the same video source (Medium configuration or Full configuration), the cables you choose should be of the same type and length. Note, however, if they are not, Matrox Radient eV-CL will adapt to any delay caused by reasonable differences in length.

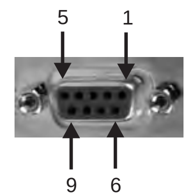
External auxiliary I/O connectors

The external auxiliary I/O connectors on the Matrox Radient eV-CL bracket and the cable adapter bracket are high-density D-subminiature 15-pin (DBHD-15*) male connectors. Alternatively, you can use a cable adapter bracket with a standard D-subminiature 9-pin (DB-9†) female connector for auxiliary I/O connectors B and D. On the cable adapter brackets, the connectors are panel mount connectors. The external auxiliary I/O connectors are used to transmit/receive auxiliary signals.

❖ The auxiliary I/O connectors on Matrox Radient eV-CL are not compatible with display devices. Connecting one of the DBHD-15 connectors on Matrox Radient eV-CL to a VGA monitor or any other display device might damage both the device and the Matrox Radient eV-CL board.

The auxiliary signals can be path independent or path dependent, depending on the functionality selected. For more information, see the *Camera control and auxiliary signals for Matrox Radient eV-CL DB/QB* and *Camera control and auxiliary signals for Matrox Radient eV-CL SF/DF* sections in *Chapter 4: Matrox Radient eV hardware reference* for supported functionality.





*. Sometimes referred to as DB-15, but more accurately known as DE-15.

†. More accurately known as DE-9.

Pinouts for auxiliary I/O connectors of Matrox Radient eV-CL DB and eV-CL QB

The pinout for auxiliary I/O connector A is as follows for Matrox Radient eV-CL DB and eV-CL QB.

Pin on DB-15	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	TTL_AUX_IO_4	M_AUX_IO8	M_DEV0	TTL auxiliary signal (input/output) for acquisition path 0, which supports: user input, user output (M_USER_BIT2 on M_DEV0), trigger input (trigger controller 0 on acq path 0).
2	TTL_AUX_IO_5	M_AUX_IO9	M_DEV0	TTL auxiliary signal (input/output) for acquisition path 0, which supports: timer output (M_TIMER1 on M_DEV0), trigger input (trigger controller 1 on acq path 0), user input, or user output (M_USER_BIT3 on M_DEV0).
3	TTL_AUX_IO_6	M_AUX_IO2	M_DEV0/ M_DEV1	TTL auxiliary signal (input/output), shared between acquisition paths 0 and 1 for trigger input (trigger control 2 on acq path 0; 2 on acq path 1*), user input, user output (M_USER_BIT4 on M_DEV0/M_DEV1), and dedicated to acquisition path 0 for timer output (M_TIMER2 on M_DEV0).
4+,5-	LVDS_AUX_IN2	M_AUX_IO10	M_DEV0	LVDS auxiliary signal (input) for acquisition path 0, which supports: trigger input (trigger controller 0 on acq path 0), user input, or quadrature input bit 0.
6+,8-	LVDS_AUX_IN3	M_AUX_IO11	M_DEV0	LVDS auxiliary signal (input) for acquisition path 0, which supports: user input, trigger input (trigger controller 1 on acq path 0), timer-clock input, or quadrature input bit 1.
7	GND	N/A	N/A	Ground.
10	GND	N/A	N/A	Ground.
12+,11-	OPTO_AUX_IN1	M_AUX_IO7	M_DEV0	Opto-isolated auxiliary signal (input) for acquisition path 0, which supports: user input or trigger input (trigger controller 1 on acq path 0).
13+,14-	LVDS_AUX_OUT7	M_AUX_IO12	M_DEV0	LVDS auxiliary signal (output) for acquisition path 0, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV0) or user output (M_USER_BIT0 on M_DEV0).
15+,9-	OPTO_AUX_IN0	M_AUX_IO6	M_DEV0	Opto-isolated auxiliary signal (input) for acquisition path 0, which supports: user input or trigger input (trigger controller 0 on acq path 0).

*. Trigger controller 2 on acq path 1 is only supported on Matrox Radient eV-CL DB (for hardware signal TTL_AUX_IO_6).

The pinout for auxiliary I/O connector B is as follows for Matrox Radient eV-CL QB.

Pin on DB-15	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	TTL_AUX_IO_20	M_AUX_IO8	M_DEV2	TTL auxiliary signal (input/output) for acquisition path 2, which supports: user input, user output (M_USER_BIT2 on M_DEV2), or trigger input (trigger controller 0 on acq path 2).
2	TTL_AUX_IO_21	M_AUX_IO9	M_DEV2	TTL auxiliary signal (input/output) for acquisition path 2, which supports: timer output (M_TIMER1 on M_DEV2), trigger input (trigger controller 1 on acq path 2), user input, or user output (M_USER_BIT3 on M_DEV2).
3	TTL_AUX_IO_22	M_AUX_IO2	M_DEV2/ M_DEV3	TTL auxiliary signal (input/output), shared between acquisition paths 2 and 3 for trigger input (trigger controller 2 on acq path 2; 2 on acq path 3), user input, user output (M_USER_BIT4 on M_DEV2/M_DEV3), and dedicated to acquisition path 2 for timer output (M_TIMER2 on M_DEV2).
4+,5-	LVDS_AUX_IN18	M_AUX_IO10	M_DEV2	LVDS auxiliary signal (input) for acquisition path 2, which supports: trigger input (trigger controller 0 on acq path 2), user input, or quadrature input bit 0.
6+,8-	LVDS_AUX_IN19	M_AUX_IO11	M_DEV2	LVDS auxiliary signal (input) for acquisition path 2, which supports: user input, trigger input (trigger controller 1 on acq path 2), timer-clock input, or quadrature input bit 1.
7	GND	N/A	N/A	Ground.
10	GND	N/A	N/A	Ground.
12+,11-	OPTO_AUX_IN17	M_AUX_IO7	M_DEV2	Opto-isolated auxiliary signal (input) for acquisition path 2, which supports: user input or trigger input (trigger controller 1 on acq path 2).
13+,14-	LVDS_AUX_OUT23	M_AUX_IO12	M_DEV2	LVDS auxiliary signal (output) for acquisition path 2, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV2) or user output (M_USER_BIT0 on M_DEV2).
15+,9-	OPTO_AUX_IN16	M_AUX_IO6	M_DEV2	Opto-isolated auxiliary signal (input) for acquisition path 2, which supports: user input or trigger input (trigger controller 0 on acq path 2).

The pinout for auxiliary I/O connector C is as follows for Matrox Radient eV-CL DB and eV-CL QB. It can be accessed through either a DB-15 or DB-9 connector using one of the two adapter brackets.

Pin on DB-15	Pin on DB-9	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	1	TTL_AUX_IO_12	M_AUX_IO8	M_DEV1	TTL auxiliary signal (input/output) for acquisition path 1, which supports: user input, user output (M_USER_BIT2 on M_DEV1), or trigger input (trigger controller 0 on acq path 1).
2	-	TTL_AUX_IO_13	M_AUX_IO9	M_DEV1	TTL auxiliary signal (input/output) for acquisition path 1, which supports: timer output (M_TIMER1 on M_DEV1), trigger input (trigger controller 1 on acq path 1), user input, or user output (M_USER_BIT3 on M_DEV1).
3	-	TTL_AUX_IO_14	M_AUX_IO3	M_DEV0/ M_DEV1	TTL auxiliary signal (input/output), shared between acquisition paths 0 and 1 for trigger input (trigger controller 3 on acq path 0; 3 on acq path 1), user input, user output (M_USER_BIT5 on M_DEV0/M_DEV1), and dedicated to acquisition path 1 for timer output (M_TIMER2 on M_DEV1).
4+,5-	8+,3-	LVDS_AUX_IN10	M_AUX_IO4	M_DEV0/ M_DEV1	LVDS auxiliary signal (input), shared between acquisition paths 0 and 1 for trigger input (trigger controller 2 on acq path 0; 2 or 0 on acq path 1) or user input, and dedicated to acquisition path 1 for quadrature input bit 0.
6+,8-	-	LVDS_AUX_IN11	M_AUX_IO5	M_DEV0/ M_DEV1	LVDS auxiliary signal (input), shared between acquisition paths 0 and 1 for trigger input (trigger controller 1 or 3 on acq path 1; 3 on acq path 0) or user input, and dedicated to acquisition path 1 for timer-clock input or quadrature input bit 1.
7	6	GND	N/A	N/A	Ground.
10	-	GND	N/A	N/A	Ground.
12+,11-	4+,5-	OPTO_AUX_IN9	M_AUX_IO1	M_DEV0/ M_DEV1	Opto-isolated auxiliary signal (input), shared between acquisition paths 0 and 1 for trigger input (trigger controller 1 or 3 on acq path 1; 3 on acq path 0) or user input.
13+,14-	-	LVDS_AUX_OUT15	M_AUX_IO12	M_DEV1	LVDS auxiliary signal (output) for acquisition path 1, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV1) or user output (M_USER_BIT0 on M_DEV1).
15+,9-	7+,2-	OPTO_AUX_IN8	M_AUX_IO0	M_DEV0/ M_DEV1	Opto-isolated auxiliary signal (input), shared between acquisition paths 0 and 1 for trigger input (trigger controller 0 or 2 on acq path 1; 2 on acq path 0) or user input.
-	9	NC			Not connected.

The pinout for auxiliary I/O connector D is as follows for Matrox Radient eV-CL QB. It can be accessed through either a DB-15 or DB-9 connector using one of the two adapter brackets.

Pin on DB-15	Pin on DB-9	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	1	TTL_AUX_IO_28	M_AUX_IO8	M_DEV3	TTL auxiliary signal (input/output) for acquisition path 3, which supports: user input, user output (M_USER_BIT2 on M_DEV3), or trigger input (trigger controller 0 on acq path 3).
2	-	TTL_AUX_IO_29	M_AUX_IO9	M_DEV3	TTL auxiliary signal (input/output) for acquisition path 3, which supports: timer output (M_TIMER1 on M_DEV3), trigger input (trigger controller 1 on acq path 3), user input, or user output (M_USER_BIT3 on M_DEV3).
3	-	TTL_AUX_IO_30	M_AUX_IO3	M_DEV2/ M_DEV3	TTL auxiliary signal (input/output), shared between acquisition paths 2 and 3 for trigger input (trigger controller 3 on acq path 2; 3 on acq path 3), user input, user output (M_USER_BIT5 on M_DEV2/M_DEV3), and dedicated to acquisition path 3 for timer output (M_TIMER2 on M_DEV3).
4+,5-	8+,3-	LVDS_AUX_IN26	M_AUX_IO4	M_DEV2/ M_DEV3	LVDS auxiliary signal (input), shared between acquisition paths 2 and 3 for trigger input (trigger controller 0 or 2 on acq path 3; 2 on acq path 2) or user input, and dedicated to acquisition path 3 for quadrature input bit 0.
6+,8-	-	LVDS_AUX_IN27	M_AUX_IO5	M_DEV2/ M_DEV3	LVDS auxiliary signal (input), shared between acquisition paths 2 and 3 for trigger input (trigger controller 1 or 3 on acq path 3; 3 on acq path 2) or user input, and dedicated to acquisition path 3 for timer-clock input or quadrature input bit 1.
7	6	GND	N/A	N/A	Ground.
10	-	GND	N/A	N/A	Ground.
12+,11-	4+,5-	OPTO_AUX_IN25	M_AUX_IO1	M_DEV2/ M_DEV3	Opto-isolated auxiliary signal (input), shared between acquisition paths 2 and 3 for trigger input (trigger controller 1 or 3 on acq path 3; 3 on acq path 2) or user input.
13+,14-	-	LVDS_AUX_OUT31	M_AUX_IO12	M_DEV3	LVDS auxiliary signal (output) for acquisition path 3, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV3) or user output (M_USER_BIT0 on M_DEV3).
15+,9-	7+,2-	OPTO_AUX_IN24	M_AUX_IO0	M_DEV2/ M_DEV3	Opto-isolated auxiliary signal (input), shared between acquisition paths 2 and 3 for trigger input (trigger controller 0 or 2 on acq path 3; 2 on acq path 2) or user input.
	9	NC			Not connected.

Pinouts for auxiliary I/O connectors of Matrox Radient eV-CL SF and eV-CL DF

The pinout for auxiliary I/O connector A is as follows for Matrox Radient eV-CL SF and eV-CL DF.

Pin on DB-15	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	TTL_AUX_IO_4	M_AUX_IO8	M_DEV0	TTL auxiliary signal (input/output) for acquisition path 0, which supports: user input, user output (M_USER_BIT2 on M_DEV0), trigger input (trigger controller 0 on acq path 0).
2	TTL_AUX_IO_5	M_AUX_IO9	M_DEV0	TTL auxiliary signal (input/output) for acquisition path 0, which supports: timer output (M_TIMER1 on M_DEV0), trigger input (trigger controller 1 on acq path 0), user input, or user output (M_USER_BIT3 on M_DEV0).
3	TTL_AUX_IO_6	M_AUX_IO2	M_DEV0	TTL auxiliary signal (input/output), for acquisition paths 0, which supports: trigger input (trigger control 2 on acq path 0), user input, user output (M_USER_BIT4 on M_DEV0), or timer output (M_TIMER2 on M_DEV0).
4+,5-	LVDS_AUX_IN2	M_AUX_IO10	M_DEV0	LVDS auxiliary signal (input) for acquisition path 0, which supports: trigger input (trigger controller 0 on acq path 0), user input, or quadrature input bit 0.
6+,8-	LVDS_AUX_IN3	M_AUX_IO11	M_DEV0	LVDS auxiliary signal (input) for acquisition path 0, which supports: user input, trigger input (trigger controller 1 on acq path 0), timer-clock input, or quadrature input bit 1.
7	GND	N/A	N/A	Ground.
10	GND	N/A	N/A	Ground.
12+,11-	OPTO_AUX_IN1	M_AUX_IO7	M_DEV0	Opto-isolated auxiliary signal (input) for acquisition path 0, which supports: user input or trigger input (trigger controller 1 on acq path 0).
13+,14-	LVDS_AUX_OUT7	M_AUX_IO12	M_DEV0	LVDS auxiliary signal (output) for acquisition path 0, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV0) or user output (M_USER_BIT0 on M_DEV0).
15+,9-	OPTO_AUX_IN0	M_AUX_IO6	M_DEV0	Opto-isolated auxiliary signal (input) for acquisition path 0, which supports: user input or trigger input (trigger controller 0 on acq path 0).

The pinout for auxiliary I/O connector B is as follows for Matrox Radient eV-CL DF.

Pin on DB-15	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	TTL_AUX_IO_20	M_AUX_IO8	M_DEV1	TTL auxiliary signal (input/output) for acquisition path 1, which supports: user input, user output (M_USER_BIT2 on M_DEV1), or trigger input (trigger controller 0 on acq path 1).
2	TTL_AUX_IO_21	M_AUX_IO9	M_DEV1	TTL auxiliary signal (input/output) for acquisition path 1, which supports: timer output (M_TIMER1 on M_DEV1), trigger input (trigger controller 1 on acq path 1), user input, or user output (M_USER_BIT3 on M_DEV1).
3	TTL_AUX_IO_22	M_AUX_IO2	M_DEV1	TTL auxiliary signal (input/output), for acquisition paths 1 which supports trigger input (trigger controller 2 on acq path 1), user input, user output (M_USER_BIT4 on M_DEV1), and timer output (M_TIMER2 on M_DEV1).
4+,5-	LVDS_AUX_IN18	M_AUX_IO10	M_DEV1	LVDS auxiliary signal (input) for acquisition path 1, which supports: trigger input (trigger controller 0 on acq path 1), user input, or quadrature input bit 0.
6+,8-	LVDS_AUX_IN19	M_AUX_IO11	M_DEV1	LVDS auxiliary signal (input) for acquisition path 1, which supports: user input, trigger input (trigger controller 1 on acq path 1), timer-clock input, or quadrature input bit 1.
7	GND	N/A	N/A	Ground.
10	GND	N/A	N/A	Ground.
12+,11-	OPTO_AUX_IN17	M_AUX_IO7	M_DEV1	Opto-isolated auxiliary signal (input) for acquisition path 1, which supports: user input or trigger input (trigger controller 1 on acq path 1).
13+,14-	LVDS_AUX_OUT23	M_AUX_IO12	M_DEV1	LVDS auxiliary signal (output) for acquisition path 1, which supports: timer output (M_TIMER1/M_TIMER2 on M_DEV1) or user output (M_USER_BIT0 on M_DEV1).
15+,9-	OPTO_AUX_IN16	M_AUX_IO6	M_DEV1	Opto-isolated auxiliary signal (input) for acquisition path 1, which supports: user input or trigger input (trigger controller 0 on acq path 1).

The pinout for auxiliary I/O connector C is as follows for Matrox Radient eV-CL SF and eV-CL DF. It can be accessed through either a DB-15 or DB-9 connector using one of the two adapter brackets.

Pin on DB-15	Pin on DB-9	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	1	RESERVED			Reserved. Do not connect.
2	-	RESERVED			Reserved. Do not connect.
3	-	TTL_AUX_IO_14	M_AUX_IO3	M_DEV0	TTL auxiliary signal (input/output), for acquisition path 0, which supports: trigger input (trigger controller 3 on acq path 0), user input, or user output (M_USER_BIT5 on M_DEV0).
4+,5-	8+,3-	LVDS_AUX_IN10	M_AUX_IO4	M_DEV0	LVDS auxiliary signal (input), for acquisition path 0, which supports: trigger input (trigger controller 2 on acq path 0) or user input.
6+,8-	-	LVDS_AUX_IN11	M_AUX_IO5	M_DEV0	LVDS auxiliary signal (input), for acquisition path 0, which supports: trigger input (trigger controller 3 on acq path 0) or user input.
7	6	GND	N/A	N/A	Ground.
10	-	GND	N/A	N/A	Ground.
12+,11-	4+,5-	OPTO_AUX_IN9	M_AUX_IO1	M_DEV0	Opto-isolated auxiliary signal (input), for acquisition path 0,which supports: trigger input (trigger controller 3 on acq path 0) or user input.
13	-	RESERVED			Reserved. Do not connect.
14	7+,2-	RESERVED			Reserved. Do not connect.
15+,9-	-	OPTO_AUX_IN8	M_AUX_IO0	M_DEV0	Opto-isolated auxiliary signal (input), for acquisition path 0, which supports: trigger input (trigger controller 2 on acq path 0) or user input.
-	9	NC			Not connected.

The pinout for auxiliary I/O connector D is as follows for Matrox Radient eV-CL DF. It can be accessed through either a DB-15 or DB-9 connector using one of the two adapter brackets.

Pin on DB-15	Pin on DB-9	Hardware signal name	MIL constant for auxiliary signal	Digitizer device number for auxiliary signal	Description
1	1	RESERVED			Reserved. Do not connect.
2	-	RESERVED			Reserved. Do not connect.
3	-	TTL_AUX_IO_30	M_AUX_IO3	M_DEV1	TTL auxiliary signal (input/output), for acquisition path 1, which supports: trigger input (trigger controller 3 on acq path 1), user input, or user output (M_USER_BIT5 on M_DEV1).
4+,5-	8+,3-	LVDS_AUX_IN26	M_AUX_IO4	M_DEV1	LVDS auxiliary signal (input), for acquisition path 1, which supports: trigger input (trigger controller 2 on acq path 1) or user input.
6+,8-	-	LVDS_AUX_IN27	M_AUX_IO5	M_DEV1	LVDS auxiliary signal (input), for acquisition path 1, which supports: trigger input (trigger controller 3 on acq path 1) or user input.
7	6	GND	N/A	N/A	Ground.
10	-	GND	N/A	N/A	Ground.
12+,11-	4+,5-	OPTO_AUX_IN25	M_AUX_IO1	M_DEV1	Opto-isolated auxiliary signal (input), for acquisition path 1, which supports: trigger input (trigger controller 3 on acq path 1) or user input.
13	-	RESERVED			Reserved. Do not connect.
14	7+,2-	RESERVED			Reserved. Do not connect.
15+,9-	-	OPTO_AUX_IN24	M_AUX_IO0	M_DEV1	Opto-isolated auxiliary signal (input), for acquisition path 1, which supports: trigger input (trigger controller 2 on acq path 1) or user input.
-	9	NC			Not connected.

To build your own cable, you can purchase the following parts:

	Mating information
Manufacturer:	NorComp, Inc.
Connector:	180-015-203L001
Backshell:	970-015-010-011

These parts can be purchased from third parties such as Digi-Key Corporation (www.digikey.com).

LEDs on Matrox Radient eV-CL

Matrox Radient eV-CL has a series of LEDs to display the status of the PoCL connections, the on-board power, the board configuration, the PCIe (Host) slot, and the firmware configuration.

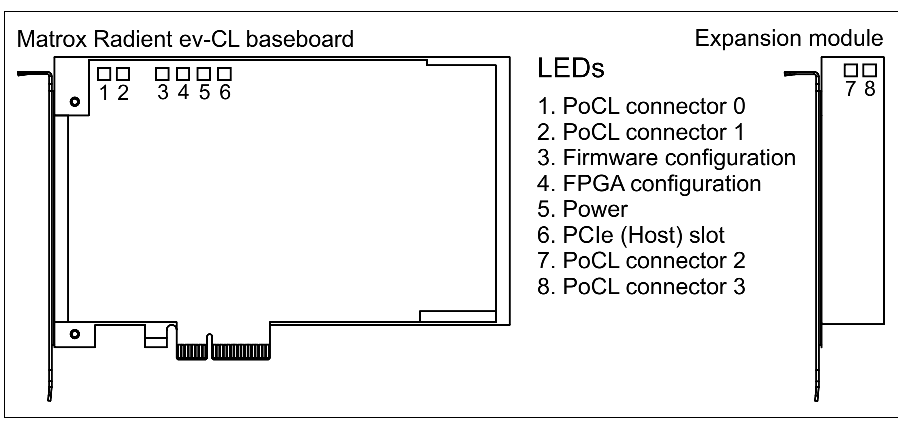
PoCL LEDs

The Matrox Radient eV-CL main board has two PoCL LEDs. In addition, Matrox Radient eV-CL DF and QB have 2 PoCL LEDs on the Matrox Radient eV expansion module. Each LED indicates the status of the PoCL device attached to that connector.

LED color and state	Description
Off	Matrox Radient eV-CL is not providing power to the camera.
Red, solid	Matrox Radient eV-CL is sensing for a PoCL-compliant device.
Green, solid	Matrox Radient eV-CL is providing power to the camera.

Board status LEDs

Matrox Radient eV-CL main board has four additional status LEDs to indicate the status of each of the following: the firmware configuration, the FPGA configuration, the power, and PCIe (Host) slot.



The table below outlines the possible colors for each LED, and their definitions.

LED type	**LED color and state**	**Description**
3. Firmware configuration	Off	The board is configured with the recommended user's firmware.
	Red	The board is configured with the golden firmware (a fall-back configuration).
4. FPGA configuration	Green	The FPGA is configured.
	Red	The FPGA is not configured.
5. Power	Off/Red	One or more of the on-board voltage regulators did not start. If your computer is on and this LED state occurs, there is an issue with the voltage regulators on your Matrox Radient eV-CL. Contact Matrox technical support.
	Green	All of the on-board voltage regulators are working properly.
6. PCIe slot	Off	The type of slot cannot be established. The PCIe link is down.
	Red, solid	Slot is PCIe Gen 1, x8
	Red, blinking	Slot is PCIe Gen 1, x1, x2, or x4
	Orange, solid	Slot is PCIe Gen 2, x8
	Orange, blinking	Slot is PCIe Gen 2, x1, x2, or x4
	Green, solid	Slot is PCIe Gen 3, x8
	Green, blinking	Slot is PCIe Gen 3, x1, x2, or x4

Appendix C: Acknowledgments

This appendix lists the copyright information regarding third-party material used to implement components on the Matrox Radient eV-CL board.

UART copyright information

The following is the copyright notice for the UART design used on the Matrox Radient eV-CL boards.

Appendix D: Listing of Matrox Radient eV boards

This appendix lists the key feature changes to the Matrox Radient eV boards.

Key feature changes

Part number	Version	Description
RAD EV 1G 2C6*	000	First shipping version of Matrox Radient eV-CXP Dual.
	001	Moved CoaXPress connectors. Replaced DBHD-15 connector on main bracket with a Mini DisplayPort (MiniDP) connector. Product ships with MiniDP-to-DBHD-15 adapter cable.
RAD EV 1G 4C6*	000	First shipping version of Matrox Radient eV-CXP Quad.
	001	Moved CoaXPress connectors. Replaced DBHD-15 connector on main bracket with a Mini DisplayPort (MiniDP) connector. Product ships with MiniDP-to-DBHD-15 adapter cable.
RAD EV CS 2G 1C2	000	First shipping version of Matrox Radient eV-CLHS.
RAD EV 1G CLDB	001	First shipping version of Matrox Radient eV-CL DB.
RAD EV 1G CLSF	001	First shipping version of Matrox Radient eV-CL SF.
RAD EV 1G CLQB	001	First shipping version of Matrox Radient eV-CL QB.
RAD EV 1G CLDF	001	First shipping version of Matrox Radient eV-CL DF.

Index

Regulatory Compliance

FCC Compliance Statement

Warning

Changes or modifications to these units not expressly approved by the party responsible for the compliance could void the user's authority to operate this equipment.

The use of shielded cables for connections of these devices to other peripherals is required to meet the regulatory requirements.

Note

These devices comply with Part 15 of FCC Rules. Operation is subject to the following two conditions:

1. These devices may not cause harmful interference, and
2. These devices must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for Class A digital devices, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of these devices in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Industry Canada Compliance Statement

These digital apparatuses do not exceed the Class A limits for radio noise emission from digital apparatuses set out in the Radio Interference Regulations of Industry Canada.

Ces appareils numériques n'émettent pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par Industrie Canada.

EU Notice (European Union)

WARNING: These are class A products. In a domestic environment these products may cause radio interference in which case the user may be required to take adequate measures.

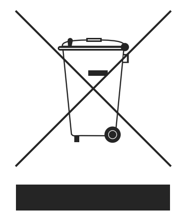
AVERTISSEMENT: Ces appareils sont des produits informatiques de Classe A. Lorsque ces appareils sont utilisent dans un environnement résidentiel, ces produits peuvent entraîner des interférences radioélectriques. Dans ce cas, l'usager peut être prié de prendre des mesures correctives appropriées.

This device complies with EC Directive 89/336/EEC for Class A digital devices. They have been tested and found to comply with EN55022/CISPR22 and EN55024/CISPR24 when installed in a typical class A compliant host system. It is assumed that these devices will also achieve compliance in any Class A compliant system.

Ces unités sont conformes à la Directive communautaire 89/336/EEC pour les unités numériques de Classe A. Les tests effectués one prouvé qu'elles sont conformes aux normes EN55022/CISPR22 et EN55024/CISPR24 lorsqu'elles sont installées dans un système hôte typique de la Classe A. On suppose qu'ils présenteront la même compatibilité dans tout système compatible de la Classe A.

Directive on Waste Electrical and Electronic Equipment (WEEE)

Europe



(English) European user's information – Directive on Waste Electrical and Electronic Equipment (WEEE)

Please refer to the Matrox Web site (**www.matrox.com/environment/weee**) for recycling information.

(Français) Informations aux utilisateurs Européens – Règlementation des déchets d'équipements électriques et électroniques (DEEE)

Se référer au site Web de Matrox (**www.matrox.com/environment/weee**) pour l'information concernant le recyclage.

(Deutsch) Information für europäische Anwender – Europäische Regelungen zu Elektro- und Elektronikaltgeräten (WEEE)

Bitte wenden Sie sich an dem Matrox-Website (**www.matrox.com/environment/weee**) für Recycling Informationen.

(Italiano) Informazioni per gli utenti europei – Direttiva sui rifiuti di apparecchiature elettriche ed elettroniche (RAEE)

Si prega di riferirsi al sito Web Matrox (**www.matrox.com/environment/weee**) per le informazioni di riciclaggio.

Limited warranty

Refer to the warranty statement that came with your product.