Zebra GevIQ™

Installation and Technical Reference

ZEBRA

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Introduction

This chapter briefly describes the features of the Zebra GevIQ board, as well as the software that can be used with the board.

Zebra GevIQ board

Zebra GevIQ is a smart network adapter that provides two 10 or 25 GbE interfaces (ports) for connection with 10/25 Gbits/sec GigE Vision-compatible cameras. The board offloads the depacketizing of GigE Vision Streaming protocol (GVSP) packets. Grabbing occurs with next-to-zero CPU usage and zero performance-related packet loss[*]. Zebra GevIQ is a low-profile PCIe 3.0 x8 board that includes two SFP cages for connecting SFP+/SFP28 transceiver modules. The board can also be used as a standard network interface controller (NIC), and supports MIL licensing fingerprint storage.

_____
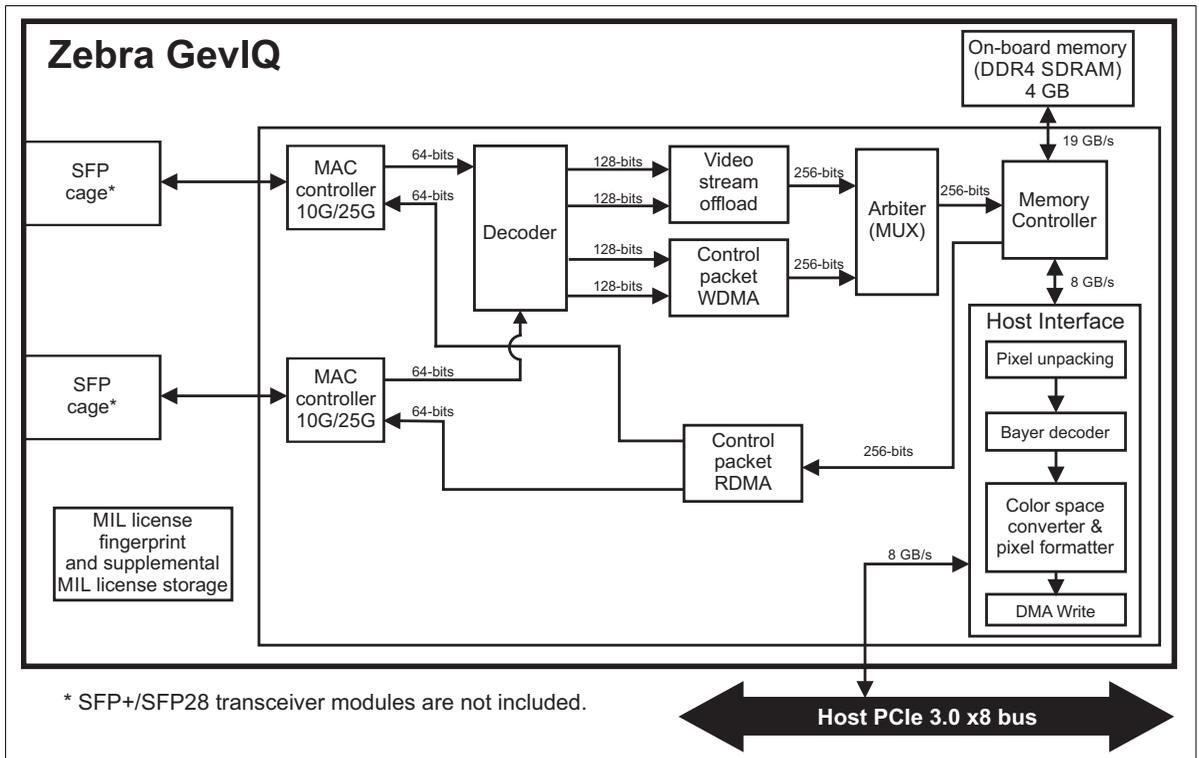
[*].   Excludes packet loss incurred from camera errors, electrical interference, and/or other causes external to Zebra GevIQ.

Acquisition features with Zebra GevIQ

Zebra GevIQ supports up to two GigE Vision cameras connected directly to the Zebra GevIQ board, or up to 32[*] when connected behind a switch, each with an independent acquisition path. Area-scan and line-scan monochrome or color video sources are supported, as long as they are GigE Vision-compliant (including video sources with a Bayer color filter)[†].

Zebra GevIQ can decode Bayer color-encoded images and perform color space conversions while transferring the image to the Host.

GigE Vision streaming protocol packets are offloaded to Zebra GevIQ, where images are reconstructed on-board and then sent to the Host using scatter-gather DMA transfers if the destination buffer is in paged memory. If the destination buffer is non-paged, then standard DMA transfers are used.

Additional functionality

In addition to the core video capture capabilities, Zebra GevIQ incorporates the following features to simplify overall system integration. These features include:

- **Pixel unpacking**. Support for unpacking Mono10p, Mono10packed, Mono12p, Mono12packed, and Mono14p formats to Mono16 format.

- **Color space converter and image formatter**. This can convert data as it is being transferred to the Host from on-board memory or the Bayer color decoder. It can convert 8-bit or 16-bit monochrome, or 24-bit or 48-bit packed BGR data to monochrome, packed BGR, packed BGRa, planar RGB, or YUV (YUYV) format.

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

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[*]. In the initial release of the Zebra GevIQ, there is support for only 8 GigE Vision cameras to be connected behind a switch.

[†]. The Bayer color filter is only supported when grabbing image data and no chunk data is transmitted.

On-board memory

Zebra GevIQ is equipped with 4 Gbytes of DDR4 SDRAM memory. This memory is used to store acquired images, as well as support the transit of transmitted or received Ethernet frames (packets). The memory is accessed through a memory controller that has multiple input/output ports and has a maximum theoretical bandwidth of 19 Gbytes/sec.

Data transfer

Zebra GevIQ can send data to the Host at a maximum theoretical transfer rate of 8 Gbytes/sec using scatter-gather DMA transfers. Optimum conditions for high speed transfer include using the board in a PCIe 3.0 slot with 8 active lanes and using a 256-byte payload. DMA write performance is also 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 Zebra GevIQ board, the Zebra GevIQ Bench utility is provided. This utility is accessible using the MILConfig utility, which is shipped with software that supports Zebra GevIQ (for example, MIL).

Documentation conventions

When the term Host is used in this manual, it refers to the host computer.

Software

To operate your Zebra GevIQ, you can use one or more Zebra software products that support the board. These are MIL and its derivatives (for example, MIL-Lite and Matrox Capture Works). MIL is supported under Windows and Linux when using Zebra GevIQ. 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 camera 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 for both normal and dot-matrix text, feature-based), code reading and grading (1D, 2D and composite code types), bead (continuous strips of material) inspection, 3D reconstruction, 3D processing, 3D analysis, classification, and color analysis.

MIL applications are easily ported to new Zebra 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 Capture
Works

Matrox Capture Works is a utility that allows you to rapidly evaluate the performance and functionality of virtually any GenICam-compliant camera, 3D sensor, or other device that is compatible with GigE Vision, USB3 Vision, CXP, or GenTL. Matrox Capture Works will list all detected GigE Vision-compliant devices connected to each allocated board. It can start or stop capturing images, display acquired images, save the last grabbed image, send a software trigger, as well as browse and control the selected device's features. You can view and change acquisition properties, and view acquisition statistics. Matrox Capture Works is distributed with MIL; it is also available with MIL-Lite.

Matrox Gecho

Matrox Gecho is an event logging application that is used to help debug and troubleshoot MIL applications and driver issues. Matrox Gecho is run in the background while other MIL applications are running, and can generate RAW, CSV, or JSON files that can be used to track the detected events.

Essentials to get started

To begin using your Zebra GevIQ, you must have a computer with the following:

- An available PCIe slot that is at least version 3.0 and has x8 lanes, if you want to operate at the maximum available bandwidth[*].

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

- MIL or one of its derivatives.

  Compatibility is not guaranteed with all computers that have the above specifications. Please consult with your local Zebra representative, local Zebra sales office, the Zebra web site, or the Zebra 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).

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[*]. Note that you can install Zebra GevIQ in any mechanical PCIe slot that fits your board (for example, connecting to an open-ended connector). Be aware that if you install it in a PCIe slot that has less PCIe lanes or is of an earlier version than the capabilities of the board, then the maximum bandwidth transfer rate will be affected. For example, you can install a x8 board in a PCIe x4 slot that has a mechanical x8 connector; however, the maximum transfer rate between Zebra GevIQ and the Host is reduced by 50%.

Inspecting the Zebra GevIQ package

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

Standard items
You should receive the following items:

- The Zebra GevIQ board.

Zebra GevIQ board
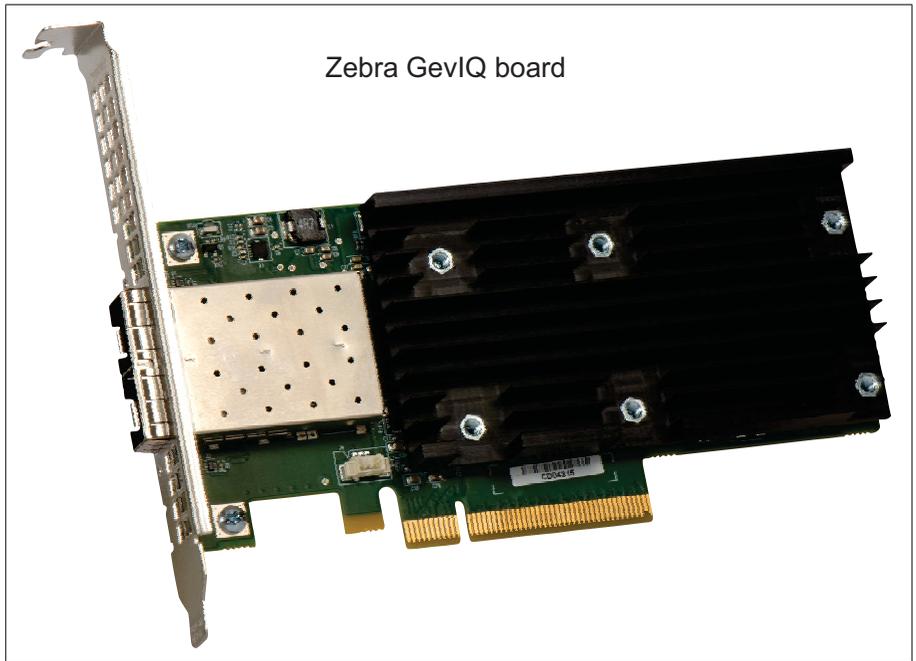
Available separately
You might have also ordered one or more of the following:

- MIL or MIL-Lite. Matrox Capture Works and Matrox Gecho are included with these software packages.

- SFP+/SFP28 transceiver modules.

Handling components

The electronic circuits in your computer and the circuits on your Zebra GevIQ 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. You must have a MIL GevIQ driver installed to use Zebra GevIQ with MIL.

More information   For information on using multiple Zebra GevIQ boards, refer to *Chapter 3: Using multiple Zebra GevIQ boards*.

For in-depth hardware information, as well as environmental and electrical specifications, 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, you can refer to the support page on the Zebra website: https://supportcommunity.zebra.com/s/contactsupport?brand=matrox. The support page provides information on how to contact technical support.

To request support, you should first complete and submit the online Technical Support Request Form, accessible from the above-mentioned web page. Once you have submitted the information, a support agent will contact you shortly thereafter by email or phone, depending on the problem.

Vision Academy

The Vision Academy online training resource is also available to help customers visualize the steps involved in using various products. For access to these videos, visit https://imaging.matrox.com/en/imaging/apps/vision_academy/mil.

Chapter

2

Hardware installation

This chapter explains how to install your Zebra GevlQ board in your computer.

Installing your Zebra GevIQ board

Before you install your Zebra GevIQ 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).

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 PCIe slot in which to install your board. For maximum available bandwidth, use a PCIe slot that is at least version 3.0 and has x8 lanes[*].

3. If there is a metal plate at the back of the selected slot, remove it. Keep the screw from the top of the plate to anchor your board once it is installed.

4. Position your Zebra GevIQ 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.

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[*]. Note that you can install Zebra GevIQ in any mechanical PCIe slot that fits your board (for example, connecting to open-ended connectors). Be aware that if you install it in a PCIe slot that has less PCIe lanes or is of an earlier version than the capabilities of the board, then the maximum bandwidth transfer rate will be affected. For example, you can install a x8 board in a PCIe x4 slot that has a mechanical x8 connector; however, the maximum transfer rate between Zebra GevIQ and the Host is reduced by 50%.

Important

When installing your Zebra GevIQ board in a PCIe x16 slot, special care must be taken to avoid damaging the board. Some PCIe x16 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.

PCIe x16 solder-side latch

PCIe x16 component-side latch
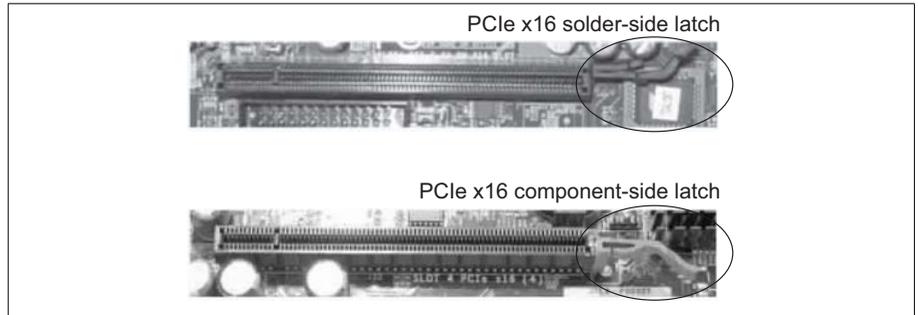
5. Once the input connectors are in the opening of the chassis, press the board firmly but carefully straight down into the connector of the slot.

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

7. Attach your video sources.

8. 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 Zebra GevIQ software. You will require a GevIQ driver for MIL to use Zebra GevIQ.

Important

If you install both the GevIQ and GigE drivers, your cameras will appear under both systems. If you allocate a camera to the GigE system, then you can acquire images, but all of the processing will be offloaded to the host system. To use the full capabilities of the Zebra GevIQ, it is important to allocate your cameras to the GevIQ system.

9. Disable active state power management (ASPM) for PCIe devices, to maximize the performance of Zebra GevIQ. 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 10, 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**.

10. Under Microsoft Windows, set the power plan option to high performance to maximize the performance of Zebra GevIQ and minimize the possibility of dropped frames. For example, under Microsoft Windows 10, open the **Power Options** dialog box from the Windows Control Panel and set the power plan option to **High Performance**.

Providing adequate ventilation

It is important to provide proper ventilation to the Zebra GevIQ board and your setup as a whole. Operating with elevated temperatures reduces the life expectancy of your overall computer and any boards that are installed. Zebra GevIQ is equipped with a heat sink to help provide proper cooling for the board, but this cannot be relied on as the only source of cooling. A properly ventilated computer should be set up so that a longer life span and more reliable operating environment can be expected. For information on temperature specifications, see the *Dimensions and environmental specifications* section in *Appendix B: Technical information*.

Ventilation guidelines

These are some recommended guidelines for proper ventilation:

- Choose an appropriate, well-ventilated slot for Zebra GevIQ to guarantee good airflow. This will ensure that the heat sink will have enough airflow to efficiently cool the board.

- Position intake fans so that they force air onto the PCIe add-on boards. Ensure that the airflow of these fans isn't blocked by disk bays or other physical components.

- Inspect and clean any accumulated dust.

- When appropriate, use perforated brackets for empty slots in the computer to encourage additional air flow.

Connecting to the SFP cages

Zebra GevIQ comes with two SFP cages to which you must connect SFP+ or SFP28 transceivers. The SFP+ and SFP28 form factors are identical; however, SFP+ supports 10 Gbits/sec speeds and SFP28 supports 25 Gbits/sec speeds. Zebra GevIQ supports RJ45, direct-attach copper, and multi-mode fiber SFP+/SFP28 transceivers.

Zebra GevIQ SFP cages support the following types of transceivers and cables. Be aware that this table only lists the compatible transceivers for 10 and 25 Gbits/sec connections and is only provided for reference and is liable to change:

Standard	Description	Supported distance
10GBASE-T SFP+ Copper RJ-45	10 Gbits/sec Short Reach SFP+ Transceiver	Up to 30 m over CAT6a/CAT7 cables
10GBASE-SR	10 Gbits/sec Short Reach SFP+ Transceiver	Up to 300 m over OM3 multi-mode fiber
10GBASE-LR	10 Gbits/sec Long Reach SFP+ Transceiver	Up to 10 km over single-mode fiber
25GBASE-SR	25 Gbits/sec Short Reach SFP28 Transceiver	Up to 70 m over parallel OM3 multi-mode fiber and 100 m over parallel OM4 multi-mode fiber
25GBASE-LR	25 Gbits/sec Long Reach SFP28 Transceiver	Up to 10 km over single-mode fiber
25GBASE-AOC	25 Gbits/sec SFP28 to SFP28 Active Optical Cable (AOC)	Up to 30 m pre-terminated 25 Gbits/sec SFP active optical cable
25GBASE-CR	25 Gbits/sec SFP28 to SFP28 Direct Attach Twinax Copper Cable (DAC)	Up to 5 m pre-terminated 25 Gbits/sec SFP28 twinax copper cable
25GBASE-CR-S	25 Gbits/sec SFP28 to SFP28 Direct Attach Twinax Copper Cable (DAC)	Up to 3 m pre-terminated 25 Gbits/sec SFP28 twinax copper cable

❖ Note that both the supported speed and the supported cable length vary by module manufacturer. Confirm with the manufacturer of the module whether it supports the speed and cable length that you expect to use.

Changing SFP transceivers

If you need to change your transmission speed, you might also need to physically change your transceiver to one that supports your required speed. Each brand of SFP transceiver will vary both in size and specific installation instructions, but as a general rule, you should hear a small click sound after the SFP makes proper contact with the connector. Also, be aware of the orientation of the SFP connector and ensure that you are installing it according to the instructions from the manufacturer. The SFP transceiver is connected as follows:
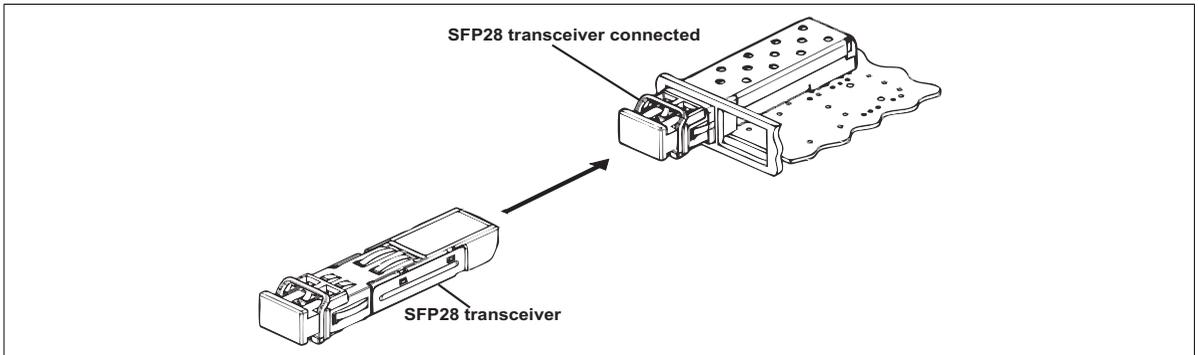
SFP28 transceiver connected

SFP28 transceiver

Warning

To reduce unnecessary wear, only plug and unplug the SFP+/SFP28 transceivers when absolutely required. The SFP cages are rated for a maximum of 250 module insertions.

Once the transceiver is connected to the board, Link Speed Auto negotiation will automatically establish the speed of any newly connected transceiver. You can now also remove any dust cap that might be covering the connector and plug a cable into the connector like any other Ethernet port.

❖ Note that you can install different transceivers to each port (for example, one port can use a Fiber SFP transceiver and the other can use an RJ45 SFP transceiver).

Chapter

3

Using multiple Zebra GevIQ boards

This chapter explains how to use multiple Zebra GevIQ boards.

Installation of multiple boards

You can install and use multiple Zebra GevIQ boards in one computer.

Install each additional Zebra GevIQ board as you installed the first board (refer to *Chapter 2: Hardware installation*). The number of Zebra GevIQ 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_GEVIQ** in the MIL Reference.

Simultaneous image capture from different boards

In addition to capturing images from multiple video sources with a single Zebra GevIQ board, you can also simultaneously capture images from video sources attached to multiple Zebra GevIQ boards. Note that the number of Zebra GevIQ boards from which you can simultaneously capture images is limited by the number of PCIe lanes available. Ideally, Zebra GevIQ should use at least a PCIe 3.x x8 slot. Using the correct PCIe speed will optimize the speed of data transmission and will minimize data loss.

To measure the effective available bandwidth of the PCIe slot in your computer with the Zebra GevIQ board, you can use the Zebra GevIQ Bench tool, accessible using 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[*].

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[*]. This is true as long as the allocated buffer type in MIL is the same as the acquisition camera.

Chapter

4

Zebra GevIQ hardware reference

This chapter explains the architecture, features, and modes of the Zebra GevIQ hardware.

Zebra GevIQ hardware reference

This chapter provides information on the Zebra GevIQ hardware. It covers the architecture, features, and modes of the board's acquisition capabilities. In addition, the chapter covers the Zebra GevIQ hardware related to the formatting and transfer of data. A summary of the features of Zebra GevIQ 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 transport single or multiple streams 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 adapter. Depending on how your video sources are configured/connected to your Zebra GevIQ (for example, using a switch), an SFP connector could have multiple acquisition paths.

Digitizer

MIL-Lite uses the concept of a MIL digitizer to represent the acquisition path(s) with which to grab from an video source of the specified type.

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 Capture Works utility to adjust the DCF file.

Zebra GevIQ

On-board memory
(DDR4 SDRAM)
4 GB

SFP
cage*

MAC
controller
10G/25G

64-bits

64-bits

Decoder

128-bits

128-bits

Video
stream
offload

256-bits

Arbiter
(MUX)

256-bits

19 GB/s

Memory
Controller

128-bits

128-bits

Control
packet
WDMA

256-bits

SFP
cage*

MAC
controller
10G/25G

64-bits

64-bits

Control
packet
RDMA

256-bits

8 GB/s

Host Interface

Pixel unpacking

Bayer decoder

MIL license
fingerprint
and supplemental
MIL license storage

Color space
converter &
pixel formatter

8 GB/s

DMA Write

* SFP+/SFP28 transceiver modules are not included.

Host PCIe 3.0 x8 bus

Zebra GevIQ acquisition

Zebra GevIQ is a network adapter that supports digital video sources compliant with the GigE Vision 2.2 standard. Zebra GevIQ can grab monochrome, RGB color, and Bayer color-encoded data. The board can also perform pixel unpacking, image sub-sampling, and color-conversion.

Performance

Zebra GevIQ can send data to the Host at a maximum theoretical transfer rate of 8 Gbytes/sec using scatter-gather DMA transfers if installed in a PCIe 3.0 x8 slot.

Effect of the type of PCIe slot

Both the version and number of active lanes of your PCIe slot are important to consider. A PCIe 3.x slot supports a higher data transmission rate than a 2.x slot; furthermore, a PCIe x8 slot will double the data rate, when compared to a PCIe x4 slot of the same base specification (3.x or 2.x). The Zebra GevIQ requires a 3.x slot to operate at the maximum available bandwidth. While transferring data to the Host, these factors will reduce the maximum transmission rate as follows.

PCIe slot base specifications	Theoretical transmission rate per lane	Estimated maximum practical transmission rate	
		x4	x8
PCIe 2.x	500 Mbytes/sec	1.75 Gbytes/sec	3.5 Gbytes/sec
PCIe 3.x	985 Mbytes/sec	3.5 Gbytes/sec	7 Gbytes/sec

On-board memory

Zebra GevIQ is equipped with on-board memory. This memory is accessed through the memory controller, and is used to store acquired images and images for or resulting from processing. The theoretical transfer rate on Zebra GevIQ is 19 Gbytes/sec.

Zebra GevIQ has a default of 128 Mbytes of on-board 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

Data can be modified as it is being transferred to the Host. Depending on the image payload data types, some types of data processing might not be available.

Pixel unpacking

By default, the data block is written into on-board memory and this payload can be unpacked during DMA transfer. Pixel unpacking happens automatically on-board to help minimize the use of host resources (for example, the CPU usage).

Bayer color decoder

As data from on-board memory is transmitted to the Host, it can pass through the Bayer color decoder. The Bayer color decoder converts Bayer color encoded images (GB, BG, GR, and RG pattern support) to multi-band RGB images using a 2x2 average demosaicing algorithm. The maximum line width for Bayer color conversion is 32 Kbytes.

Color space converter and image formatter

As data from on-board memory or the Bayer color decoder is transmitted to the Host, it passes through the color space converter and image formatter. 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** and the subsampling factor.

  - **MbufTransfer**() with **M_COPY + M_SCALE** and setting the destination buffer size smaller than the original image.

  Note that Zebra GevIQ 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.**

- **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

❖ Note that, this is not an exclusive list of all the supported formats.

  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 Zebra GevIQ PCIe 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. For best results, install Zebra GevIQ in a PCIe 3.x with 8 lanes.

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

Appendix A: Glossary

This appendix defines some of the specialized terms used in the Zebra GevIQ documentation.

Glossary

- **Acquisition path.**

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

- **Arbiter.**

  An arbiter is a multiplexer that also includes a mechanism that controls which inputs are forwarded to the memory controller.

- **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.

- **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 DDR4 SDRAM clock frequency).

- **Contiguous memory.**

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

- **DDR4 SDRAM.**

  Double-data-rate type 4 synchronous dynamic random-access memory. A type of general purpose consumer RAM. DDR4 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.

- **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.

- **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.

- **PCIe.**

  Peripheral Component Interconnect Express. The standard used for the computer bus that acts as an interface between hardware devices, such as Zebra GevIQ, and your Host.

- **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.

- **SFP transceiver module.**

  Small form-factor pluggable transceiver module. This is a hot-pluggable network interface module that allows for fiber-optic or copper cables to be connected to networking hardware. The module can be used in both telecommunication and data communication applications.

Appendix B: Technical information

This appendix contains information that might be useful when installing your Zebra GevIQ board.

Board summary

Global information

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

- Minimum computer requirements:

  - An available PCIe slot that is at least version 3.0 and has x8 lanes[*].

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

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

❖ Note that compatibility is not guaranteed with all computers that have the above specifications. Please consult with your local Zebra representative, local Zebra sales office, the Zebra web site, or the Zebra Customer Support Group at headquarters before using a specific computer.

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[*]. Note that you can install Zebra GevIQ in any mechanical PCIe slot that fits your board (for example, connecting to open-ended connectors). Be aware that if you install it in a PCIe slot that has less PCIe lanes or is of an earlier version than the capabilities of the board, then the maximum bandwidth transfer rate will be affected. For example, you can install a x8 board in a PCIe x4 slot that has a mechanical x8 connector; however, the maximum transfer rate between Zebra GevIQ and the Host is reduced by 50%.

Technical features

- 2 SFP cages. Depending on the installed transceiver and the selected configuration, acquisition speed can be 10/25 Gbits/sec per transceiver.

Warning

To reduce unnecessary wear, only plug and unplug the SFP+/SFP28 transceivers when absolutely required. The SFP cages are rated for a maximum of 250 module insertions.

- Support for up to two GigE Vision-compliant cameras connected directly to the Zebra GevIQ board, or up to 32[*] when connected behind a switch.

- Supports video sources with a Bayer color filter. Bayer color encoded images (GRBG, GBRG, BGGR, and RGGB pattern support) are converted to multi-band RGB images using a 2x2 average demosaicing algorithm. The maximum line width for Bayer color conversion is 32 Kbytes.

- Can convert 8- or 16-bit monochrome data or 24- or 48-bit packed BGR data to monochrome, packed BGR, packed BGRa, planar RGB, or YUV (YUYV) format.

- Has 4 Gbytes of DDR4 SDRAM and a total memory bandwidth of up to 19 Gbytes/sec.

- Acts as a smart network adapter.

- Fanless design[†].

- Support for MIL license fingerprint and storage.

_____

[*]. In the initial release of the Zebra GevIQ, there is support for only 8 GigE Vision cameras to be connected behind a switch.

[†]. If your configuration does not meet the heat dissipation requirements, contact your Zebra sales representative.

Electrical specifications

The following table describes electrical specifications for Zebra GevIQ.

Operating voltage and current for Zebra GevIQ
Typical: 3.3 V, 0.9 A mA (3 W)
Typical 12.0 V, 1.3 A (16 W)
Total power consumption (including power drawn by SFP28 modules): 23 W
Zebra GevIQ is designed to accommodate up to two class III SFP28 modules, each using a maximum of up to 2 W each from the PCIe 12 V supply. The total maximum combined power for both SFP28 modules must not exceed a total of 4 W.

Dimensions and environmental specifications

- Dimensions with standard bracket: 169.55 mm (L) x 68.9 mm (H) (6.67" x 2.71") from bottom edge of goldfinger to top edge of board.
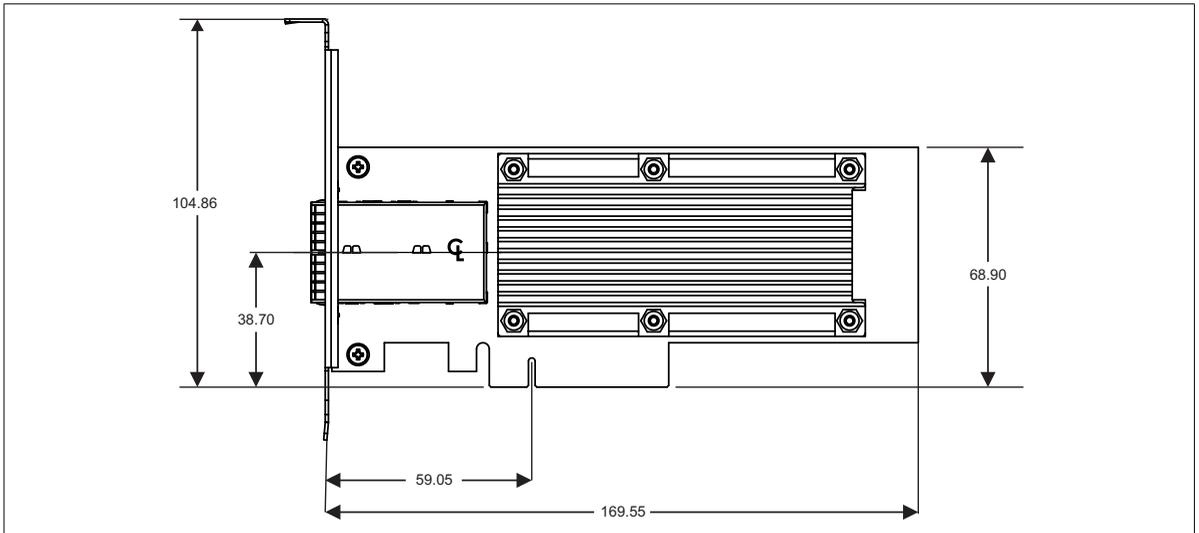
- Ventilation: 150 LFM over board(s) (through the heat sink) in a single board configuration. More ventilation might be required in multiple-board configurations.

- Minimum/maximum ambient operating temperature[*]:

  - 0°C to 55°C (32°F to 131°F) for SKU without fan.

- Minimum/maximum storage temperature: -40°C to 65°C (-40°F to 149°F).

- Operating relative humidity: 20% to 80% relative humidity (non-condensing).

- Storage humidity: 10% to 90% relative humidity (non-condensing).

[*]. In the vicinity of the board.

Transceiver temperatures

As per SFF-8679, transceivers must operate within one or more of the following temperature ranges:

Transceiver class	Temperature range
Standard	0 to 70°C
Extended	-5 to 85°C
Industrial	-40 to 85°C

Connectors on the Zebra GevIQ board

On the Zebra GevIQ board, there are two SFP cages. When installing transceivers and cables, make sure that they are compatible with Zebra GevIQ.

SFP transceiver cage 2

SFP transceiver cage 1

*
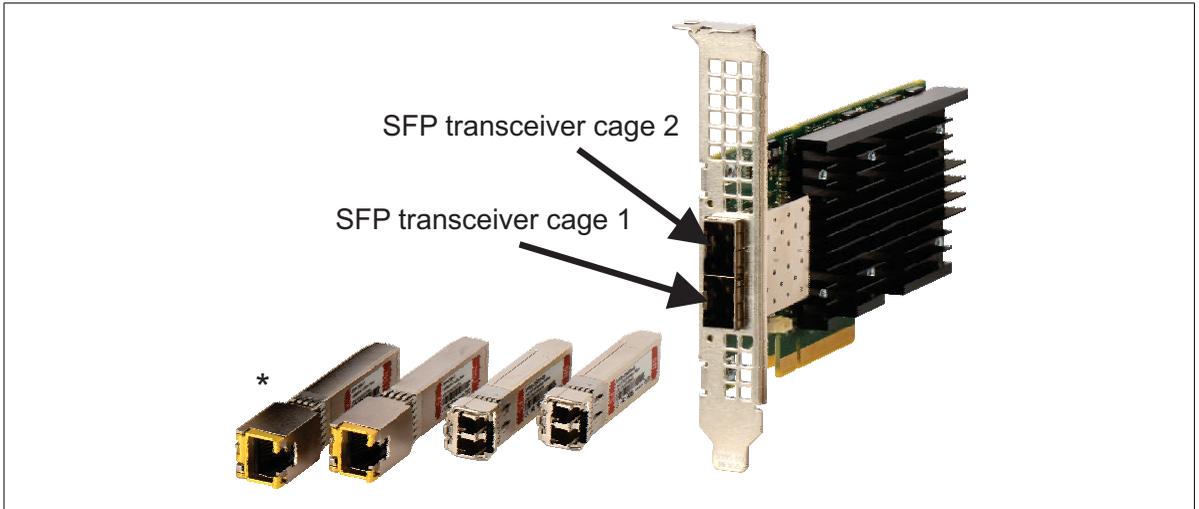
SFP cage connectors

Two SFP cages are available on Zebra GevIQ. Each SFP cage houses a 20-pin connector to which you must connect a transceiver. Each connector supports Ethernet speeds of up to 10 Gbits/sec or 25 Gbits/sec, if using an SFP28 transceiver.
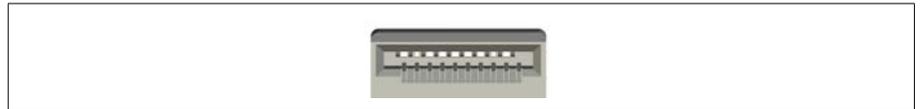
❖ Note that the SFP cages are rated for a maximum of 250 module insertions.

Status LEDs on Zebra GevIQ

Zebra GevIQ has two status LEDs, one for each SFP+/SFP28 transceiver, on the main bracket. These identify the state and activity of connected devices.
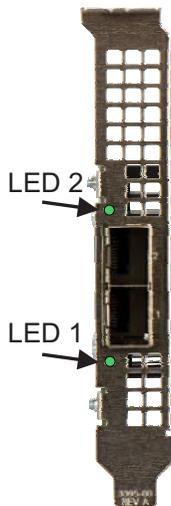
The table below outlines the possible colors for each LED and their definitions.

LED color and state	Description
Off/Red	• Computer is off • Drivers on the Zebra GevIQ are starting. • SFP+/SFP28 transceiver is not present.
Orange	• SFP+/SFP28 transceiver is connected but failed to link.
Green	• SFP+/SFP28 transceiver is connected and successfully linked.

Appendix C: Listing of Zebra GevIQ boards

This appendix lists the key feature changes to the Zebra GevIQ boards.

Key feature changes

Part number	Version	Description
GIQ4G2SF28	000	First shipping version of Zebra GevIQ smart network adapter with 4 Gbytes of DDR4 SDRAM and a passive heatsink.