# GEViCAM OPERATIONS MANUAL

**Preliminary**

# GP-GEV SERIES
## GigE Vision Compliant Models
## Supplemental Manual


**GP-3360 GEV  GP-3780GEV  GP-2360GEV**
**GP-21400GEV  GP-151400GEV**

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***A GigE Vision Camera Company***

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## 1.1 GigE Vision (GEV) compliant models

GEViCAM GigE cameras are designed to accommodate various GigE platforms with different SDK and camera firmware. Mainly Pleora iPort SDK supports high performance driver and is proven the full functionality of Ethernet interface, frame grabber functions and camera control functions including PLC and the advanced controls. It also supports various OS including Windows NT (2000), some Linux and third party APIs. On the other hand GigE Vision version is industry standard for all vendors of camera, API software, driver and interface device manufacturers. The compliant devices can be hooked up on Gigabit Ethernet and communicate each other. However, the compliance to the standard may limit the functionality of each device.
Therefore, GEViCAM maintains both version of firmware and SDK. GigE Vision standard models are marked "GEV" (i.e. GP3360C-GEV). The latest version of SDK is 2.3.1 (or 2.3.0), in which the application software (Coyote) can select iPort application or GenApi (GigE Vision application). The camera for GEV must have GEV firmware inside camera. The firmware can be uploaded but not suggested to do so unless the operator is qualified. This manual is supplement to standard GP series cameras to accommodate GigE Vision standard (GEV) models. Please make sure your model must carry model name of "GEV" when you place order.

## 1.2 SDK selection for GEV (GigE Vision)

GgiE Vision version must use e-Bus driver (Universal or Optimal) or Window Stack. The latest SDK is 2.3.1. Ver. 2.3.0 works in general but may have some functional limitations. The 2.2.1 or legacy iPort SDK cannot support GEV.

**GigE Vision** is open frame work for transferring imaging data and control signals between cameras and PCs over standard GigE connections. The four major elements are;

1. Device Discovery
    - Defines how compliant devices obtain IP addresses and are identified on the network
2. GigE Vision Control Protocol (GVCP)
    - Defines how to specify stream channels and control / configure compliant devices.
3. GigE Vision Stream Protocol (GVSP)
    - Defines how images are packetized and provides mechanism for cameras to send image data and other information to host computers.
4. XML Camera Description File
    - Computer-readable data sheet of features in compliant devices
    - Must be based on schema in EMVA's GenICam standard.
    - Seven mandatory features required for compliance.

GigE Vision standard requires 7 mandatory features to be compatible.
These features are;

- Width Image width
- Height Image height
- PixelFormat Pixel format defined in GVSP
- PayloadSize Number of bytes transferred for each image on the stream channel
- AcquisitionMode Manner in which images are sequenced from the camera
- AcquisitionStart Starts image acquisition in the specified mode
- AcquisitionStop Stops image acquisition in the specified mode

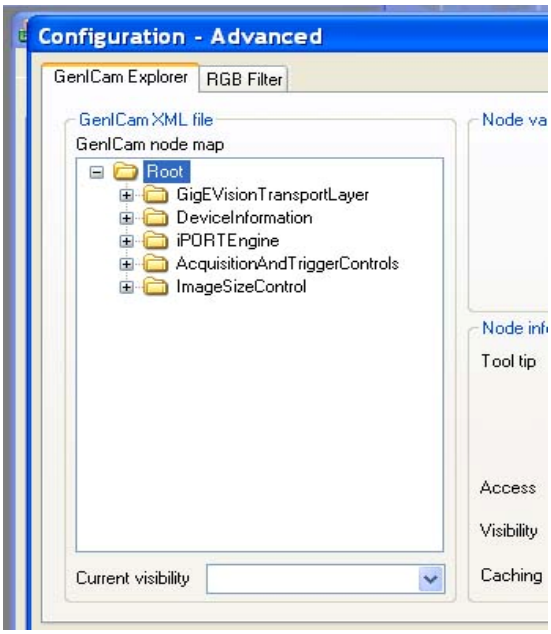
As you can see these functions may be fine for interoperability test but not enough for real applications. GEViCAM GP series provides far more functions in GEV format and they are accessible from majority of API suppliers. In GenApi of Gevicam SDK (Coyote), all of these functions are supported.

## 2.1 Accsess to GEViCAM (GEV version)

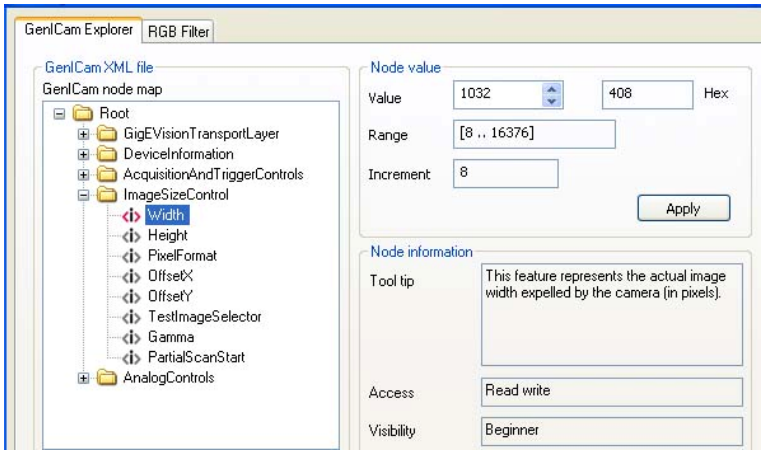
Since GEV version is GigE Vision compliant, it can be accessed from any GigE Vision compliant drivers and PC software. In order to capture images from the camera the receiver side (PC) must have GigE driver software and image display dialog.
Once the device (camera) is found, the API software will be showing the connection and device information via XML file.
When image acquisition is activated, you will be able to see the image in your display. The output format of GP series is raw data (default is 8-bit) and even color model will be displayed in monochrome at first until the Bayer color interpolation is processed in PC.
Here we will explain how GenApi works.

## 2.2 GenApi Explorer

In Coyote application of version 2.3.1 or 2.3.0, the dialog guides through the same process as standard GP series models.
After “Detect” is done, look for GenApi marking box and mark it. The driver will perform GigE Vision protocol for connecting to the device. Press “Connect”. Normal Coyote application dialog appears.
Next, you can open up device configuration button. Typical GigE Vision application software will show device configuration explorer (feature browser) window.




In GenApi application of Coyote SDK 2.3.1, the dialog looks like one shown left.
Top three files of GigEVisionTransportLayer, GevicInformation and iPortEngine are set by manufacturer.

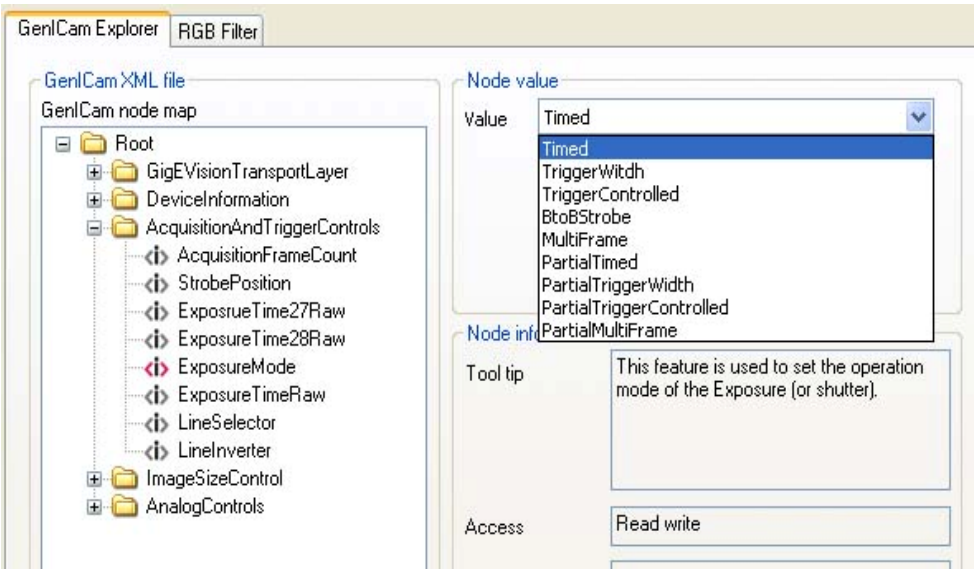



In “ImageSizeControl”, there are two mandatory required features among others.
For example, the Image width for XGA (GP3780GEV) is 1032, height is 779.
In ImageSizeControl the PixelFormat is mandatory and for this camera the Bayer is RG8. The Bayer selection can be modified by shifting the Offset too. The Bayer can be GR8 if OffestX=1. However, some API only take multiple of 4 or 8 for Width. If you have OffsetX, the total number have to be reduced. In this case Width=1024 for multiples of 8 and OffsetX=1.
Please note some API may not be bale to take offset function. Therefore in GP series OffsetX and Y are not user accessible.

Click OK and go back to image acquisition. You will see the continuous images.
Above example is part of Coyote application but it will be similar process to work with other API software.

## 2.3 Advanced Functions

As mentioned before, the mandatory features are not sufficient for real applications. GP series provide far more important functions for various applications. Some of the key elements are trigger functions, gain changes, and exposure controls. GenIcam standard features are not necessarily convenient to actual camera functions to describe some combined functions. However GenApi can display even custom functions so that unique functions can be implemented. GP series have added functions as shown in the explorer.




### 2.3.1 AcquisitionAndTriggerControls

**1. ExposureMode**

The mode selections are tied to trigger mode selection.

A. **Timed**: Non-trigger operation with internal exposure control (ExposureTimeRaw). The image output is streamed video at the maximum frame rate. The exposure is limited to the one frame.

B. **TirggerWidth**: It requires external TTL trigger or PLC self trigger. The exposure time is controlled by the pulse width.

C. **TriggerControlled**: Typical async trigger with shutter control. It requires external trigger and the exposure time can be 1H to 65000H (FFFF).

D. **BtoBStrobe**: Back-to-back strobe mode and unique to GP series. Double pulses for strobe are output. The second pulse location can be controlled with StrobePosition.

E. **MultiFrame**: ITS mode for multiple (3 frames) image capturing and independent exposure control. In GenApi, the multiple frame number is set at 3 consecutive frames. Each shutter speed is set by ExposureTimeRaw (#1 frame), ExposureTime27Raw (#2 frame) and ExposureTime28Raw (#3 frame).

F. **PartialTimed**: This mode sets the scanning to partial scan. The ImageSize must be changed for correct Height. The exposure is the same way as mode A. The partial scan starting position can be adjusted vertically by PatialScanPosition in ImageSizeControl file. (see below)

G. **PartialTriggerWidth**: Same mode as B in partial scan.

H. **PartialTriggerControlled**: Same mode as C in partial scan

I. **PartialMultiFrame**: Same mode as E in partial scan.

**2. ExposureTimeRaw**

Exposure (shutter) control by numerical number input. The unit is 1H (horizontal clock period).
1H varies based on models

| Models | 1H (µs) | Clocks/1H | Max H per Frame | Partial Scan H |
|---|---|---|---|---|
| GP3360/2360 | 19.5 | 780 | 512 | 240 |
| GP3780 | 38.1 | 1270 | 790 | 400 |
| GP21400 | 40.8 | 1634 | 1056 | 720 |
| GP151400 | 43.5 | 1742 | 1056 | 720 |

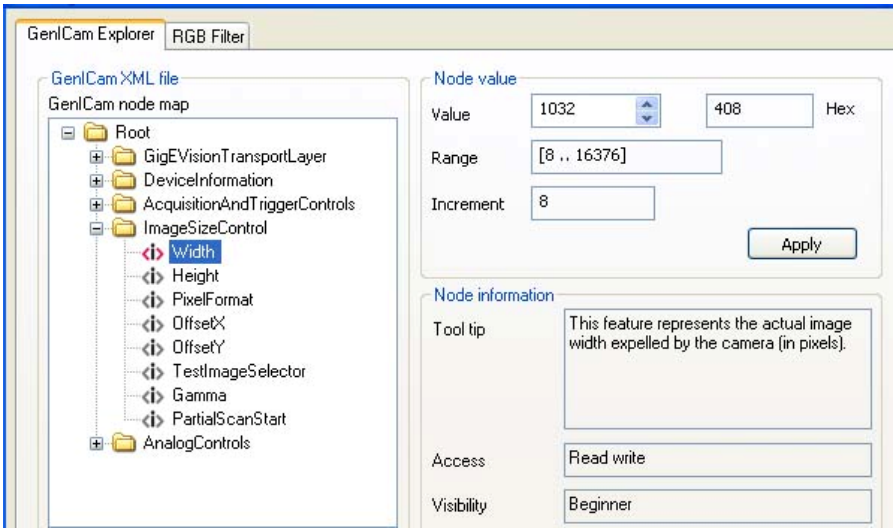
**3. LineSelector**

Select external input lines. The default is DirectTTL (direct TTL input to GPIO connector pin-9). When PLC functions are available another mode can be chosen.

**4. LineInverter**

The default trigger input is negative going pulse (falling edge). By choosing the LineInverter, it accepts rising edge triggering.

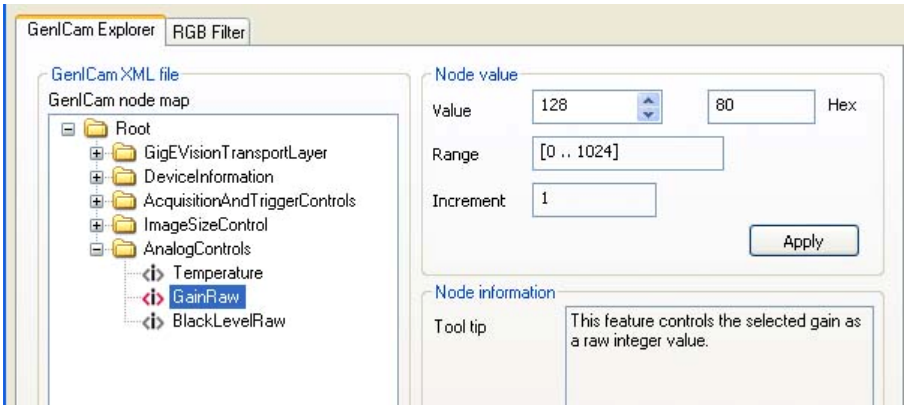
### 2.3.2 ImageSizeControl




**Width, Height and PixelFormat** are mandatory requirement.
**OffsetX and Y** controls image shift for frame grabber function. When Offset value is added, image size (Width and Height) must be adjusted to include the shift amount. If OffsetX is added by 1, Width has to reduced by 1 in theory. However, API only takes the Width change by specific multiples such a 4 or 8. In case of 8, Width in this example will be 1024 (1032-8).
As noted before generic version of GP series firmware is not user adjustable due to some API's compatibility issue.

A. **TestImageSelector**: Select test pattern images. The default is OFF. There are two test patterns for GP series. One is GrayHorizontalRamp which is generated in camera head. Another is running gray pattern (IPORTTest) which is generated in GigE engine. These two test patterns are useful tool to identify communication and image capture diagnostics.
B. **Gamma**: In 8-bit PixelFormat, Gamma function is enabled ($\gamma$=0.45) or disabled (linear).
C. **PartialScanStart**: In conjunction with partial scan mode (ExposureMode), the scan start position is programmable. The unit is H (horizontal lines).

### 2.3.3 AnalogControls




Analog control is serial control command for analog values. In GP series Gain control, Black level control and temperature reading are activated.

A. **Temperature**: It reads inside temperature. The value is twice of the actual reading.
˚C = n/2
In order to update the value, you have to activate the item manually (click "Apply" or other parameter such as GainRaw and click back Temperature.

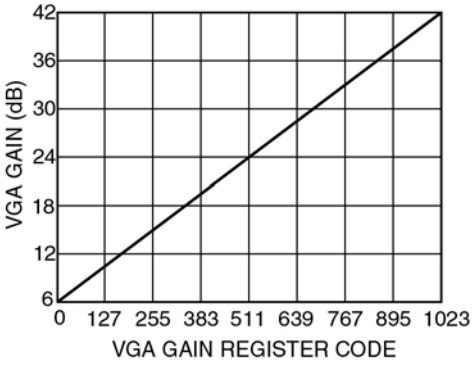
B. **GainRaw**: Gain control value is displayed in decimal value.
The actual Gain vs. control value is shown below and in the chart.

*VGA Gain (dB) = (VGA code x 0.035 dB) + 5.3 dB*

(VGA: Variable Gain Amplifier)

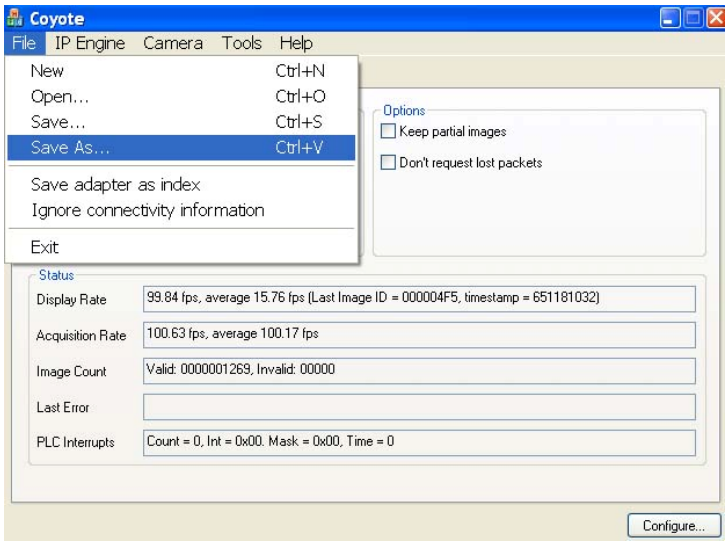
The default shown in the explorer is 128 and the gain is 9.78 dB.
Typical monochrome cameras are set at 80 (50 in Hex) = 8 dB.

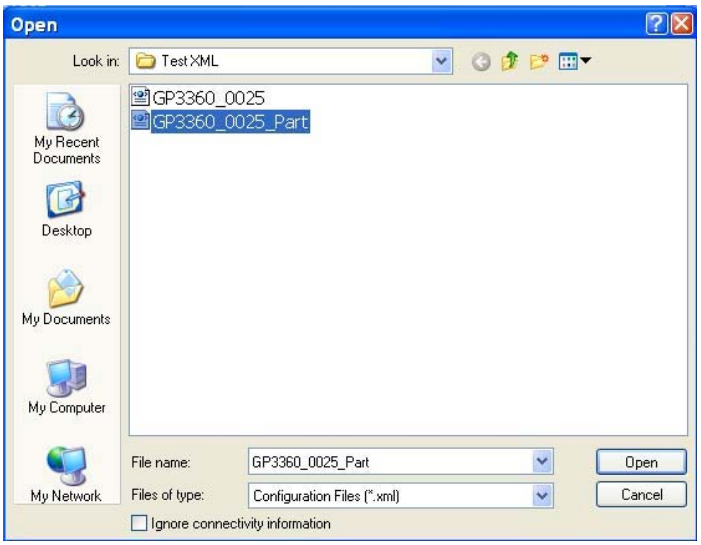
C. **BlackLevelRaw**: Black level (pedestal level) is controlled for 0 to 255. The typical default is 72 (48 in Hex) which generates value 4.0 of black level out of 255 in 8-bit data. Total variables in black level control is from 0 to 16 in 8-bit.



## 2.4 Save XML and Open from XML file

GigE Vision standard uses GenIcam standard features. The critical part of the standards is use of XML file, which is machine readable file. Coyote application and its SDK allows “Save” XML of current settings and opens the file for nest power up without going through “Detect”, “Connect” and set parameters.



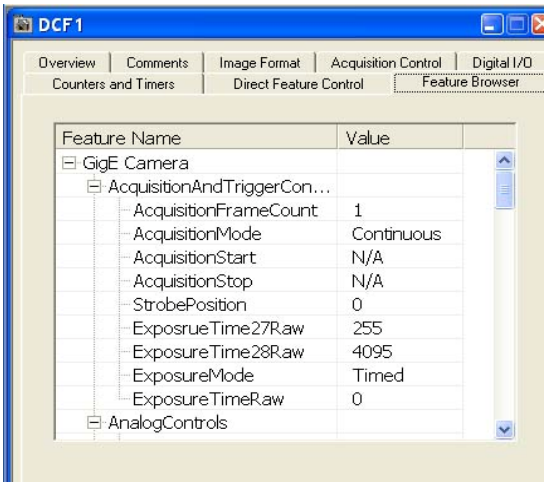




Just like any other document save and open, the application automatically creates the document file as XML. Since XML is machine readable document for command and all settings, when you open the saved file, it follows through routine process of device discovery, communication set up, and last saved parameters.
In above example, there two files saved for GP3360. One is standard setting, another is partial scan special functions. The special function involves PixelFormat selection, ExposureMode selection and other related functions altogether. The XML file contains all these changes and recall when it is opened.

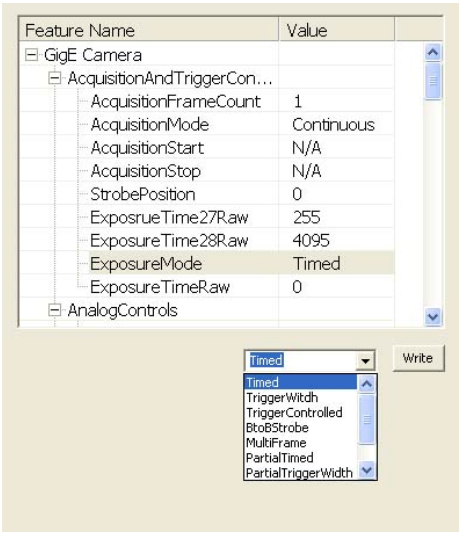
## 3.1 MIL Intellicam and GigE Driver


GigE Vision cameras are compatible to any compliant driver and API. In this section we use Matrox GigE as one of interoperability test. The GigE Vision interface driver is available from Matrox. The installation and the application procedure must follow Matrox instructions. First, MIL software must be installed for the Serial bus driver. Additional GigEVision driver (Milgige) is required to be installed. In this context MIL Lite 8.0 and milgige (m800du14) are used. Once MIL is operable and opens the Intellicam, it shows MIL GigE Vision 0 as the allocated system. The driver should be able to detect the existence of GigE interface when GigE Vision camera is connected. When press continuous grab button, it shows GigE Vision as the digitizer configuration format. When the OK button is pressed, GigE Vision dialog appears and live image should appear. In this stage, both monochrome and color image are displayed in black and white.

### 3.1.1 GenApi Explorer

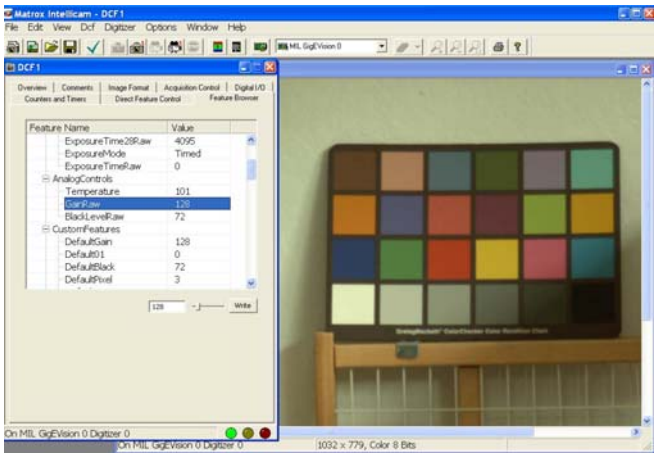



Next, you can open up “Feature Browser” tab. Typical GigE Vision application software will show device configuration explorer window in similar way as Coyote GenApi. The value is visible in the same dialog as features.
When ExposureMode is clicked as the example, the dialog of mode selection appears.




### 3.1.2 Controlling Functions

Controlling various functions in GenApi or GigE Vision feature dialog is straight forward. Click the function and adjust the additional windows. For example, GEViCAM GP series has many trigger and exposure functions. Here, you can open up ExposureMode and select one of functions described in AcquisitionAndTriggerControls.
With external trigger input (TTL as default), these advanced functions are controllable from MIL also.
The most common functions are; ExposureTimeRaw (shutter speed control by increment of 1H), GainRaw (gain control up to 42 dB), and Gamma/Linear selection.
The color data is output as individual raw pixel data. In order to reproduce the color from Bayer raw data, color interpolation is done in PC.




**Color Interpolation:**
API must process the color interpolation in PC.
In MIL, there is a color interpolation selection button. By applying the proper Bayer pattern configuration, you will see the color reproduction. MIL has color balance (white balance) feature.

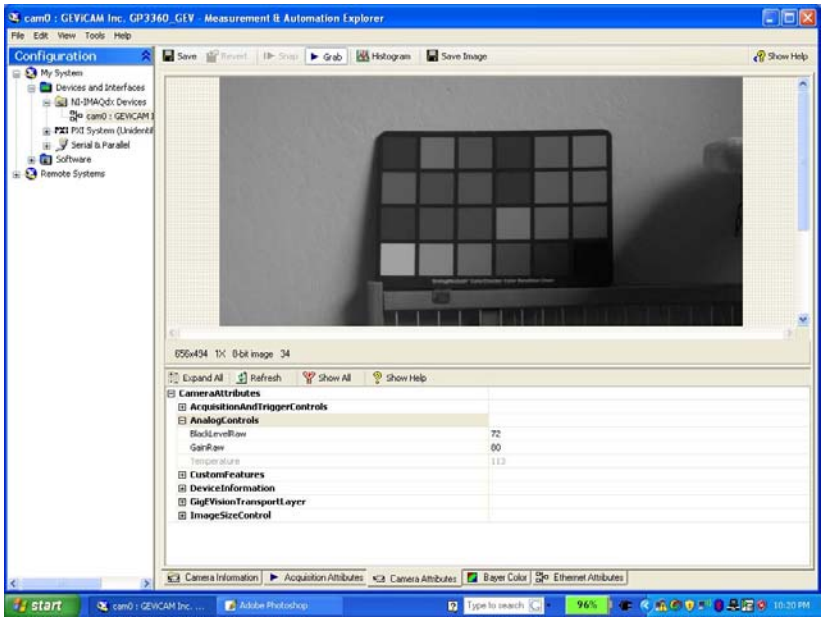
## 4.1 National Instruments Labview and GigE Driver

GEViCAM series work with National Instruments LabView environment also. The simplest way to test the compatibility is to use NI's Measurement & Automation software (MAX). This is a vision acquisition software with built-in device driver for GigE Vision. The latest software is VAS823 (Vision 8.2.3 Acquisition Software). Follow instruction of National Instruments to install the MAX Image acquisition software. The driver installation may have critical conflict with Pleora driver if these two are installed in a computer.
If you have Coyote or Pleora driver already installed, make sure it is changed to the original Windows stack driver prior to installing the MAX driver. You can change the Coyote driver to eBus universal driver after successful installation of MAX.

### 4.1.1 Image Acquisition Software (MAX)

Once the image acquisition software is successfully installed, you can open up the Measurement & Automation application and look for Configuration tree.
The software provides proper interfaces automatically.
Open "Device and interfaces" tree.
When GigE camera is connected and powered up it's icon "NI-IMAQdx Devices" will appear under Device and Interfaces. As GigE driver searches the device, it may take a few moments to appear at the beginning.


### 4.1.2 Controlling Functions




Once a device is discovered, the XML file is loaded and identify the device information and the features, called here, "CameraAttributes". Under Configuration tree cam0: GEViCAMxxxx appears and the Camera Attribute tab shows the same GigE Vision feature items.
Click "Grab" button. You will see continuous images.
Try CameraAttributes by selecting functions to see the camera controls are implemented. Basically all major functions in GP series camera control are accessible.

**Color Interpolation:**

API must process the color interpolation in PC.
In LabView, there is a color interpolation built in and the Bayer pattern is selected in such way as Bayer GR8, RG8, etc. The XML file contains the selected pattern and the interpolation displays the correct color.
It has color balance (white balance) feature. See "Bayer Color" tab to test the function.

# GEViCAM

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