



*See the possibilities*

# *User's Manual*

## **RM/TM-6740GE** **RMC/TMC-6740GE**

*Digital Monochrome/Color  
Progressive Scan, Interline-Transfer GE Camera*



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## Warranty

Please contact your factory representative for details about the warranty.

## Certifications

### CE Compliance

The TM-6740GE series of cameras has been certified to conform to the requirements of Council Directive 89/336/EC for electromagnetic compatibility and to comply with the following European Standards:

EMCEN55022: 1998 + A1: 2000 CLASS A  
EN55024: 1998 + A1: 2001

All JAI Inc. products bearing the CE mark have been declared to be in conformance with the applicable EEC Council Directives. However, certain factory-installed options or customer-requested modifications may compromise electromagnetic compatibility and affect CE compliance. Please note that the use of interconnect cables that are not properly grounded and shielded may affect CE compliance.

Contact the JAI Inc. Applications Engineering Department for further information regarding CE compliance.

### FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, 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 this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his own expense.

**WARNING**

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

**TM-6740 Series Operation Manual**

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# 1. TM-6740GE Series Hardware Operation Manual

## 1 Hardware Introduction

### 1.1 Product Description

The JAI TM-6740GE is a dual-tap output, high-speed progressive scan CCD camera. The interline-type CCD permits full vertical and horizontal resolution of very high speed shutter images and applications. The electronic shutter, which has speeds to 1/64,000 sec., can be reset asynchronously by external pulse control. The frame rate for a full image is 200 fps, with partial scan mode of up to 3205 fps. A 4:3 ratio imager format with uniform square pixels provides superior image definition in any orientation. On-chip micro lenses provide increased sensitivity.

The TM-6740GE has a full dynamic range control function, which can be set via software selectable look-up table (LUT) knee slopes to convert 10-bit input to 8-bit output, thereby optimizing the CCD's full dynamic range in the normal output signal range. As a dual-tap output camera, the TM-6740GE has semi-auto-gain balancing functions.

Applications for the TM-6740GE include machine vision, medical imaging, intelligent transportation systems, high-definition graphics, on-line inspection, gauging, character reading, archiving, and high security surveillance.

The TM-6740GE series consists of the TM-6740GE (monochrome) and the TMC-6740GE (color), as well as the RoHS-compliant versions RM-6740GE and RMC-6740GE. Unless otherwise noted, all information contained in this manual is relevant to all 6740GE models.

### 1.2 Features

- Miniature size and light weight  
The printed circuit boards in the TM-6740GE have been arranged to create modular electronics, giving the camera flexibility. In addition, the use of miniature solid-state components results in a compact, lightweight camera that is 50.8mm x 50.8mm x 84.3mm in dimensions, and weighs only 194 grams.
- Imager  
The TM-6740GE uses a dual-tap progressive scan interline transfer CCD that has the following features:
  - Resolution of 640 x 480 active pixels for excellent image quality.
  - 7.4 x 7.4  $\mu\text{m}$  square pixels for precise dimensional measurement.
  - High-speed electronic shutter capability for high dynamic resolution of moving objects that eliminates the need for a mechanical shutter.
  - Progressive scan CCD eliminates interlace deterioration of image and increases ease of computer interface.
  - High sensitivity and low noise at fast scanning. The CCD has an excellent S/N ratio at the default setting that is greater than 50dB.
  - The CCD has built-in microlenses for increased quantum efficiency.

- **Electronic shutter**  
The TM-6740GE has a substrate drain-type shutter mechanism which provides superb pictures at various speeds without smearing.
- **Asynchronous reset**  
The TM-6740GE captures async reset images and provides single-shot video output with single FDV. This makes it simpler for an ordinary frame grabber to capture the async reset images. The TM-6740GE's asynchronous reset is flexible and accepts external horizontal drive (HD) for phase locking. When the VINIT (5V) pulse is applied to CC1, it resets the camera's scanning and purging of the CCD.

The TM-6740GE has four modes to control the asynchronous reset and shutter speed:

- Async, no shutter. The video signal and FDV are reset by external VINIT.
  - Async Programmable shutter. The shutter speed control depends on the number of horizontal lines defined by the user.
  - Internal shutter speed control. The speed control varies from 1/200 to 1/64,000 sec. The video signal and FDV starts with internal V reset timing related to shutter speed.
  - External VINIT with pulse width. The duration between pulse edges controls the shutter speed externally.
- **Output**  
The TM-6740GE has a 10-bit/8-bit Gigabit Ethernet output. The analog output is 714 mVp-p composite video (75 ohms) on all models.
  - **Dual-channel auto black level balancing and semi-auto gain balancing**  
The TM-6740GE, as a dual-tap output camera, has auto black level balancing and semi-auto gain balancing functions.
  - **Integration**  
The TM-6740GE is capable of capturing high-resolution integration images. Its CCD imager can be exposed for longer than the normal scan timing of 1/200 sec. This integration feature provides extra sensitivity for applications in dark environments. The progressive scan imager permits a full frame of resolution in non-interlace format. Integration is achieved by applying INTEG signal to CC2 control of Gigabit Ethernet or by feeding VINIT pulse width control up to 1 sec of the pulse width in async pulse width control mode for the frames to be integrated.
  - **Warranty**  
Contact your factory representative for details about the warranty.

## 2 Installation

The following instructions will help you set up your camera quickly and easily. JAI suggests that you read through these instructions first, before you unpack and set up your camera system.

### 2.1 Getting Started

#### 2.1.1 Unpacking Instructions

JAI recommends that you save the original packing cartons for the cameras and accessories in case you need to return or exchange an item. We also recommend that you bench-test any equipment being sent to another location for field installation to assure that everything is fully operational as a system.

#### 2.1.2 Components

When you receive your TM-6740GE camera from JAI, the contents of the shipping box should include the camera and a document download card. If either of these items is missing, please contact your JAI representative immediately. The document download card includes instructions and web locations for downloading the datasheet, manual, and camera-control software. If you do not have Internet access, please contact JAI to receive this material on a CD-ROM.

#### 2.1.3 Accessories and Options

Following is a list of additional accessories and options that may be required for your application. Please check with your JAI representative before you install your camera to determine what you might need.

- PD-12U series power supply
- 12P-02S power cable
- Cat5e or Cat6 shielded Ethernet cable (not supplied by JAI)
- Tripod Mounting Kit: TP-20  
(for dimensions go to: [www.jai.com/EN/CameraSolutions/Products/Accessories/Pages/Home.aspx](http://www.jai.com/EN/CameraSolutions/Products/Accessories/Pages/Home.aspx))

### 2.2 Camera Setup

#### 2.2.1 Heat Dissipation

The TM-6740GE is a compact 640 by 480 camera. Since all the electronics have been packed in a compact package, the outer case of the camera can become hot due to heat dissipation. For optimal performance, JAI recommends using a cooling fan to set up a positive air flow around the camera and following the precautions below.

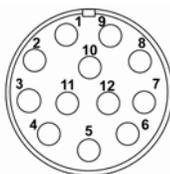
- Mount the camera on a large heat sink (camera bracket) made out of heat-conductive material like aluminum.
- Make sure the flow of heat from the camera case to the bracket is not blocked by a non-conductive material like plastic. • Make sure the camera has enough open space around it to facilitate the free flow of air.

## 2.2.2 Connector Pin Configurations

### 2.2.2.1 12-Pin Connector

The TM-6740GE has a 12-pin Hirose connector for power input and signal integration. Pin #1 is Ground and pin #2 is +12V DC. The pin-out table is shown in Table 1.

**Figure 1. 12-Pin Connector Pinouts.**



Pin #1 is Ground and pin #2 is +12V DC. Table 1 shows the pin-out table.

**Table 1 12-Pin Connector**

Pin	Description	Pin	Description
1	GND	7	VD in (CC4 equiv)
2	+12V DC	8	Strobe
3	GND (analog)	9	HD in (CC3 equiv)
4	Video out	10	Reserved
5	GND (digital)	11	Integration/ROI (CC2 equiv)
6	VINIT in (CC1 equiv)	12	Reserved

### 2.2.2.2 Ethernet Connector

The GigE socket, marked on the camera’s back panel as “GigE,” is a standard RJ-45 Ethernet socket as shown in Figure 2.

**Figure 2. GigE Ethernet Connector**



Use at least Cat5e UTP cables (Cat6 cables are preferred). JAI recommends the use of shielded cables to reduce emissions and for CE/FCC compliance. Double-shielded cables further reduce emissions.

## 2.2.3 Power Supplies and Power Cable Setup

### 2.2.3.1 Power Supplies

The TM-6740GE camera requires 12V DC power obtained through the 12-pin connector located on the rear panel of the camera. JAI, Inc. power supplies feature a 100-240V AC/12V DC 1.2A universal voltage power supply. JAI recommends the following power supplies:

PD-12UU	PD-12UU (no 12-pin connector)	US plug
PD-12UUP	PD-12UU with 12-pin connector	US plug
PD-12UE	PD-12UU (no 12-pin connector)	European plug
PD-12UEP	PD-12UU with 12-pin connector	European plug

If you are providing power through the 12-pin connector, the PD-12P, PD-12UEP and PD-12UUP power supplies are available with the 12-pin mating connector already attached to the leads from the power supply. You can connect the PD-12UU and PD-12UE power supplies to the JAI power cable either directly or using a terminal strip.

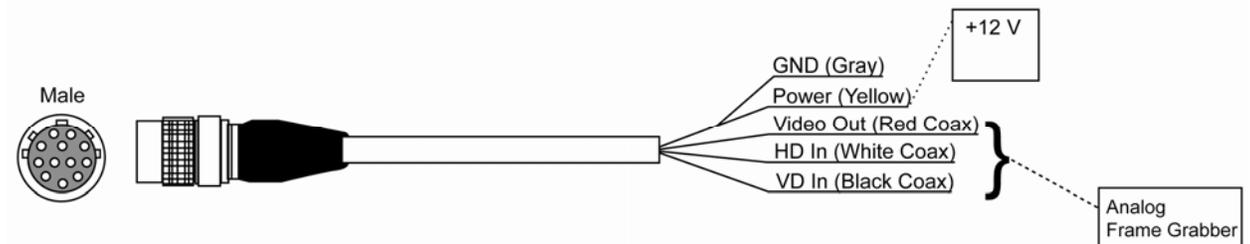
When wiring the PD-12UU and PD-12UE power supplies directly, note the following:

- Twist the lead ends together and tin-solder them for strength and electrical continuity.
- Use shrink tubing or a similar insulator to prevent exposed leads from touching and shorting.
- The +12V lead is marked with a red stripe or white lettering; be sure not to reverse the leads.
- All connections must be properly insulated to prevent shorting.

**2.2.3.2 JAI Power Cables**

If you are using JAI power cables such as the 12P-02S, refer to Figure 3 which shows the cable pin-out diagram and pin-outs. The color-coded leads use Gray for Ground and Yellow for +12V.

**Figure 3. 12P-02S Interface Cable (optional)**



12P-02S Interface Cable					
Pin #	Lead Color	Function	Pin #	Lead Color	Function
1	Gray	GND (Power Ground)	7	Black coax	TTL IN (External_VD)
2	Yellow	+12V DC (Power In)	8	White coax shield	TTL OUT (STROBE)
3	Red coax shield	AGND (Analog Ground)	9	White coax	TTL IN (External_HD)
4	Red coax	VIDEO (Analog Out)	10	Brown	RESV
5	Orange coax shield	shield GND (TTL- Digital)	11	Blue	TTL IN (External_INT) (integration signal)
6	Orange coax	TTL IN (External_Trigger)	12	Black coax shield	RESV

*Note: Make sure that the unused leads are not touching and that there is no possibility that exposed wires could cause the leads to short.*

### 2.2.3.3 Building Your Own Power Cable

Refer to the 12-pin connector pin-out in Table 1 on page 12. Connect the Ground lead to pin #1, and the +12V DC lead to pin #2 of the 12-pin connector. Power must be DC-regulated, and of sufficient current to properly power the camera.

### 2.2.3.4 Attaching the Power Cable to the Connector

The 12-pin connector is keyed and will only fit in one orientation. To properly attach the power cable to the camera connector, use the following steps:

1. Rotate the connector while applying slight pressure until the keyways line up.
2. Press the connector into place until firmly seated.
3. Plug the power cord into the 100V AC socket. This powers up the camera.

*Note: If using a power supply other than the standard PD-12U Series from JAI, certain characteristics are required of the power supply and the wiring in order to properly power the camera. The camera requires 12V immediately upon start-up; no slow ramps. Once power is applied, the power supply must be able to support a 2A to 2.5A in-rush current for approximately 200 $\mu$ s to prevent the voltage at the camera from dropping below the 10.8V minimum required. Dropping below this will result in the camera's internal power supply lowering its impedance in an attempt to draw more current. Since no more current will be available, the voltage at the camera will drop instead. This will result in a steady state hang-up which will damage the camera's power supply and cause the camera to cease operating or to operate in an unstable manner.*

### 2.2.4 Attaching the Camera Lens

The TM-6740GE camera accepts 1/3" or larger format size C-mount lenses. To attach the C-mount lens to the camera, carefully engage the threads and rotate the lens clockwise until it firmly seats on the mounting ring. Do not force the lens if it does not seat properly.

*Note: Some lenses with extremely long flangebacks may exceed the mounting depth of the camera.*

C-mount to F-mount and C-mount to K-mount adapters are available for larger format lenses (35mm). Check with local photography dealers for these lens adapters.

### 2.2.5 Adjustable Back-Focus

Before cameras are shipped, back focus is carefully set using a collimator, oscilloscope and other specialized equipment. While the factory-set focus serves well in most cases, an adjustable back focus makes it possible to improve image sharpness when using lower-cost zoom lenses, custom optics, or in unusual parameters.

There should be an obvious need to refocus the lens before attempting to change the back focus. This is a very exacting task. Some cameras have been returned to the factory to reset the back focus after failed attempts to change the focus by customers. It might be wise to label cameras whose back focus was adjusted

The camera must be connected to a monitor before attempting to adjust the back focus.

1. To back focus the camera, first attach a C-mount lens in the mount. Be certain that the lens is properly seated.
2. Next set the lens focus to infinity (if the lens is a manual iris, set the iris to a high f number while still retaining a well illuminated image).
3. Loosen the three miniature hex set-screws (use a 0.9 mm hex wrench) that lock the focus ring in place (two screws for a CS-mount). Slowly turn the lens and focus ring assembly back and forth until you obtain the best image of the desired object. This sets the back focus. Once the best image is obtained, tighten the focus ring set-screws until they are snug. Do not over-tighten the screws. Note: Mini-bayonet cameras adapted to C-mount do not have the back focus feature.

Figure 4. Back-Focus Set-Screw Locations



Loosen the three 2mm screws around the perimeter of the C-mount lens collar (two 2mm screws for a CS-mount) to adjust the back focus. Unless you absolutely must, do not attempt to adjust this focus.

### 3 Operation

#### 3.1 Progressive Scanning

The TM-6740GE uses a state-of-the-art progressive scanning interline transfer CCD which scans all lines sequentially from top to bottom at one frame rate. Like a non-interlace computer screen, it generates a stable, crisp image without alternating lines and provides full vertical TV resolution of 480 lines. Due to the TM-6740GE's extremely high frame rate, however, it will not synchronize to most monitors.

The interline transfer architecture is also important to generate simultaneous shuttering. This is different from full frame transfer architecture, which requires a mechanical shutter or strobe light in order to freeze the object motion.

The TM-6740GE outputs the progressive scanned image with an electronic shutter in thirty-six different formats. See Table 2 on page 17 for more information.

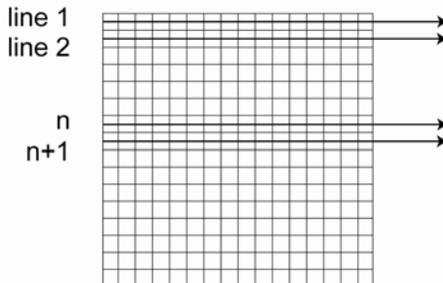
##### Progressive scanning digital and analog output

The CCD signal goes through A/D converters 10-bit in, 10-bit/8-bit out. The digital output is available via the Gigabit Ethernet connector.

The analog output is the same as 75 ohms, 714mV format available from BNC and 12-pin connector. Full Progressive Scan

Normal scanning mode for the TM-6740GE is 640 x 480 pixels. The standard speed with dual-channel output is 200 frame/sec at the pixel clock rate of 40 MHz. The progressive scan reads every line from top to bottom and all lines are exposed with a single electronic shutter.

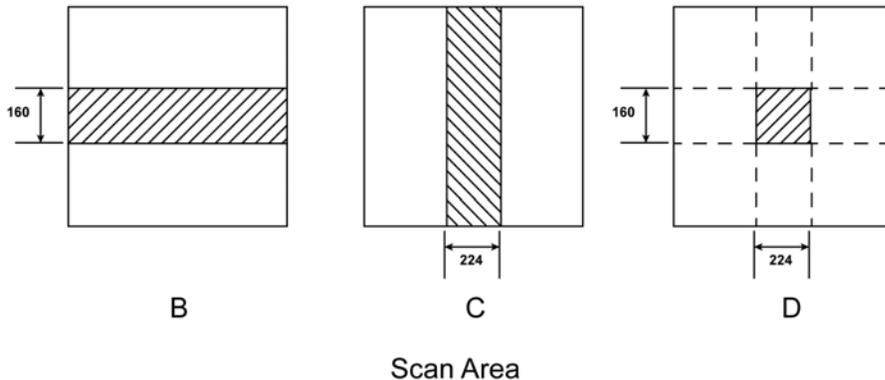
Figure 5. Full Progressive Scan Mode (A)



##### Partial Scan Mode

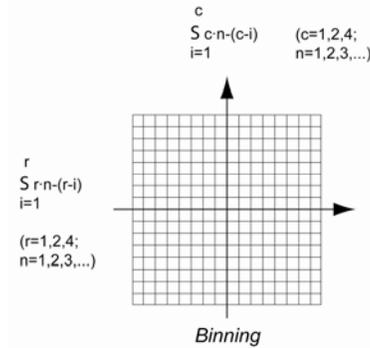
By selection, the camera has three partial scan modes: centered 160 lines, centered 224 columns, and centered 224 x 160 area.

Figure 6. Partial Scan Mode (B, C, and D)



**Binning Mode**

The TM-6740GE series has horizontal and vertical binning. By selection, the camera has 1x2, 1x4, 2x1, 2x2, 2x4, 4x1, 4x2, and 4x4 binning.



**Table 2 TM-6740GE Scan Modes**

Scan Mode		Active Pixels	Vertical Frequency (Hz)	Horizontal Frequency (KHz)	Output Clock	
Binning	Scan Area				Digital (MHz)	Analog (MHz)
No binning	A	640x480	200	100	40	80
	B	640x160	540	100		
	C	224x480	500	250		
	D	224x160	1250	250		
1x2	A	640x240	400	100		
	B	640x80	1000	100		
	C	224x240	1000	250		
	D	224x80	2315	250		
1x4	A	640x120	712	100		
	B	640x40	1596	100		
	C	224x120	1602	250		
	D	224x40	3205	250		
2x1	A	320x480	200	100	20	40
	B	320x160	540	100		
	C	112x480	500	250		
	D	112x160	1250	250		
2x2	A	320x240	400	100		
	B	320x80	1000	100		
	C	112x240	1000	250		
	D	112x80	2315	250		
2x4	A	320x120	712	100		
	B	320x40	1596	100		
	C	112x120	1602	250		
	D	112x40	3205	250		
4x1	A	160x480	200	92.59	10	20
	B	160x160	540	92.59		
	C	56x480	500	208.33		
	D	56x160	1250	208.33		

Scan Mode		Active Pixels	Vertical Frequency (Hz)	Horizontal Frequency (KHz)	Output Clock	
Binning	Scan Area				Digital (MHz)	Analog (MHz)
4x2	A	160x240	400	92.59		
	B	160x80	1000	92.59		
	C	56x240	1000	208.33		
	D	56x80	2315	208.33		
4x4	A	160x120	712	92.59		
	B	160x40	1596	92.59		
	C	56x120	1602	208.33		
	D	56x40	3205	208.33		

### 3.2 Bayer Color Filter (Color Versions)

JAI AccuPiXEL series color cameras are high-resolution, high-speed progressive scan CCD cameras. The interline transfer, progressive scan CCD permits full vertical and horizontal resolution of images acquired at very high shutter speeds. Uniform square pixels provide superior image definition in any orientation. On-chip micro lenses mean increased sensitivity.

#### 3.2.1 Color Filter Array

JAI AccuPiXEL cameras use Bayer CFA (color filter array) as their standard primary color filter. This filter provides the most popular color interpolation supported by numerous software suppliers.

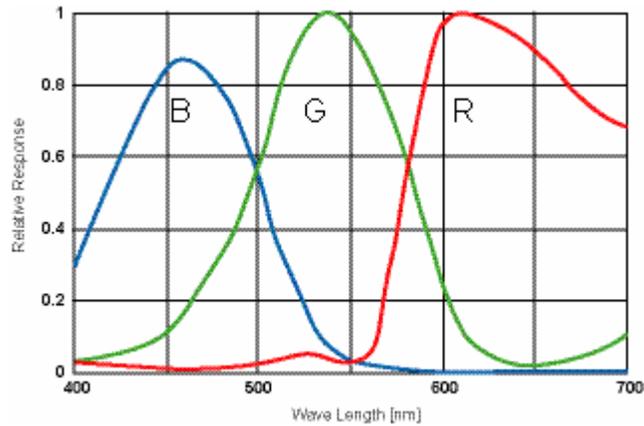
The digital format allows the camera to output accurate pixel data, including the color information. When the data is stored in the frame buffer of a frame grabber or computer, the color information is easily manipulated to restore the original color images. Because the color filter array contains only a single R, G or B color in each pixel, the restored image has to fill in the missing color information in each pixel location. The software uses neighboring pixel information to “guess” the missing colors to make smooth, clear images. This is called “color interpolation.” Today's high-speed computers allow such color interpolation to be done almost in real time. Because these cameras do not contain internal color processing circuitry, they are smaller and less expensive than full-function color cameras.

#### 3.2.2 Bayer Color Filter Array (CFA)

The Bayer CFA is an R, G, B primary color filter array. This is the most widely accepted CFA for the single-chip CCD progressive scan format. This type of array layout has a specific order for each color's pixels. Since the human eye's resolution and color recognition are highest at green, the CFA contains two greens per each red and blue.

It is critical for the frame grabber and color interpolation to know where the individual color pixels exist relative to sync (LDV and FDV) timing.

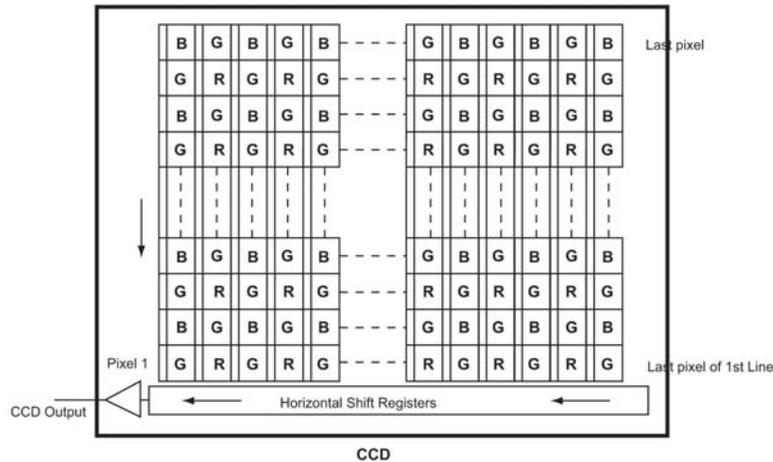
This requirement makes digital output the preferred choice, because the timing relationships are very accurate.



### 3.2.3 Starting Pixel Configuration

All manufacturers produce identical Bayer CFAs, but there are slight differences between the CCDs produced by different manufacturers. The first line is generally R and G. The camera timing can be adjusted to start with either G or R by skipping the very first pixel in each line. The majority of color interpolation software can select between a variety of pixel relations, such as R/G start or G/R start, as well as G/B start and B/G start. Once the correct scanning is configured, the rest of the interpolation will be exactly the same. Please contact JAI for further information regarding CCD manufacturers.

Figure 7. Example of Color CCD CFA Pattern



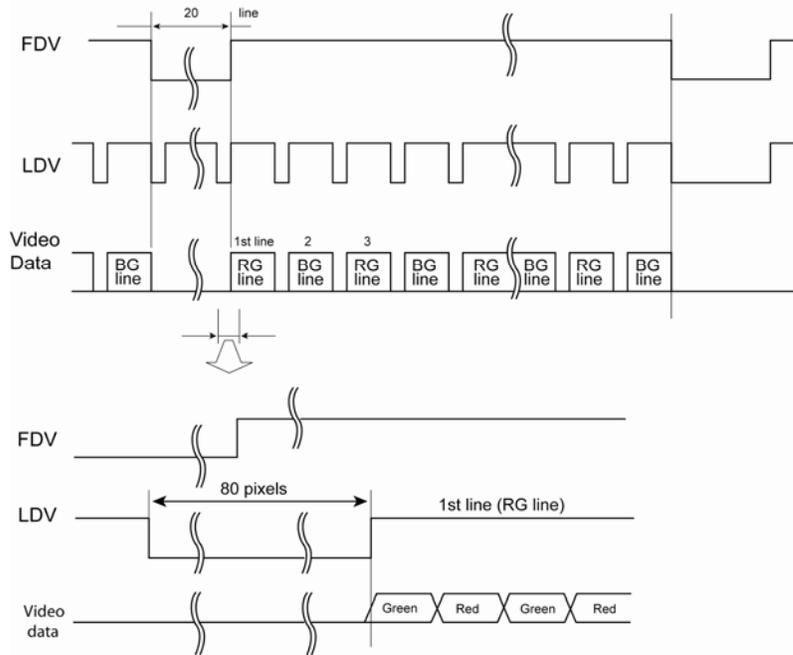
### 3.2.4 Sync and Data

The individual color data is exactly the same as the pixel data. This means that the timing relationships of the color cameras are also the same as of the B/W cameras.

For a detailed timing chart, please refer to each B/W camera's data sheet and manual.

The following diagram is an example of the TMC-6740GE default mode. FDV and LDV are used internally for the GigE interface.

Figure 8. Example of TMC-6740GE in Default Mode.



It is important to meet the exact starting pixel at the line, and the starting line in frame. If the starting pixel or line is shifted due to the image capture configuration, then the interpolation software can be adjusted for the correct starting point.

**3.2.5 Camera Functions**

AccuPiXEL color cameras perform all functions the same way as B/W cameras. However, because of color characteristics, the LUT (Look-up Table) is different. The LUT is a powerful tool to adjust the dynamic range, as well as the color dynamic range. Since human color perception is non-linear, LUT selection can help optimize color contrast by selecting the LUT value. Gamma 0.45 is logarithmic and is close to human perception.

When LUT is selected, black-level adjustment must be more accurate than for B/W cameras.

**3.2.6 Interpolation Software**

The color interpolation can be performed in the frame grabber or by using the host computer’s CPU. Most major frame grabbers with processing capability provide tools for color interpolation. Software vision packages also provide color interpolation capability, but speed and performance may be determined by the PC’s resources and by the complexity of the interpolation routine.

**3.2.7 Color Interpolation**

The Bayer pattern color filter array (CFA) consists of R, G, and B primary colors. Each pixel represents one of three colors. In order to display or print color images, the signal has to be converted to RGB output, which has three independent channels (outputs) and sync signals.

Color interpolation software or firmware performs the color preprocessing by filling the missing color pixels with neighboring pixels. It then separates the stream of data, (8-bit or 10-bit) into 3 (RGB) data (8-bit x 3) and adds the color matrix to adjust and balance each of the R,G, and B channels (white balance or color balance).

The image quality depends on the camera’s own pixel data (including pixel data independency from neighboring pixels, noise and color filter), and interpolation of the software algorithm such as 3 x 3 interpolation, 2 x 2 interpolation, color matrix, white balance capability, etc.

Green	Red	Green
Blue	Green	Blue
Green	Red	Green

All AccuPiXEL color cameras are carefully designed for maximum color performance. JAI strongly suggests that you use digital output for the best performance.

Some software is used on board (FPGA or DSP) to perform the interpolation. Other software simply uses the host computer’s memory and CPU. The processing speed may vary depending on the architecture and speed of the computer.

### 3.3 Electronic Shutter

The TM-6740GE has a substrate drain-type shutter mechanism which provides a superb picture at various speeds without smearing. A built-in fixed shutter speed control selects the electronic shutter rate from 1/250 to 1/64,000.

**Table 3 Electronic Shutter Speeds**

Shutter Speed Number	Manual	Async.
0	1/frame rate	Async No Shutter
1	1/250 sec	1/64,000 sec
2	1/500 sec	1/32,000 sec
3	1/1,000 sec	1/16,000 sec
4	1/2,000 sec	1/8,000 sec
5	1/4,000 sec	1/4,000 sec
6	1/8,000 sec	1/2,000 sec
7	1/16,000 sec	1/1,000 sec
8	1/32,000 sec	1/500 sec
9	1/64,000 sec	PWC (pulse width control)

With VINIT high (CC1), the CCD keeps discharging. With an active low pulse to VINIT, the camera resets and purges the charge momentarily. Then it starts integrating for the period of shutter control set by either an external pulse width or internal shutter control. Progressive scanning in the TM-6740GE permits a full 480 lines of vertical resolution, as compared to an interlaced CCD camera which captures only half the vertical lines per shutter.

### 3.4 Integration

The CCD imager of the TM-6740GE can be exposed for longer than the normal scan timing of 1/200 sec. This integration feature provides extra sensitivity for dark-environment applications. The progressive scan imager permits a full frame of resolution in non-interlace format. Integration is achieved by controlling CC2 Camera Control line through the Gigabit Ethernet cable to low (GND) or providing pulse-width control up to 1 sec. Please refer to Figure 3, “12P-02S Interface Cable (optional),” on page 13 for pin-out information on the 12-pin connector.

### 3.5 External Sync

The TM-6740GE accepts an external sync of standard HD and VD on CC3 and CC4 of the 12pin connector for general locking to an external source. The frequency requirement is shown in Table 2 on page 17. The tolerance is ±2% horizontal frequency.

### 3.6 Asynchronous Reset

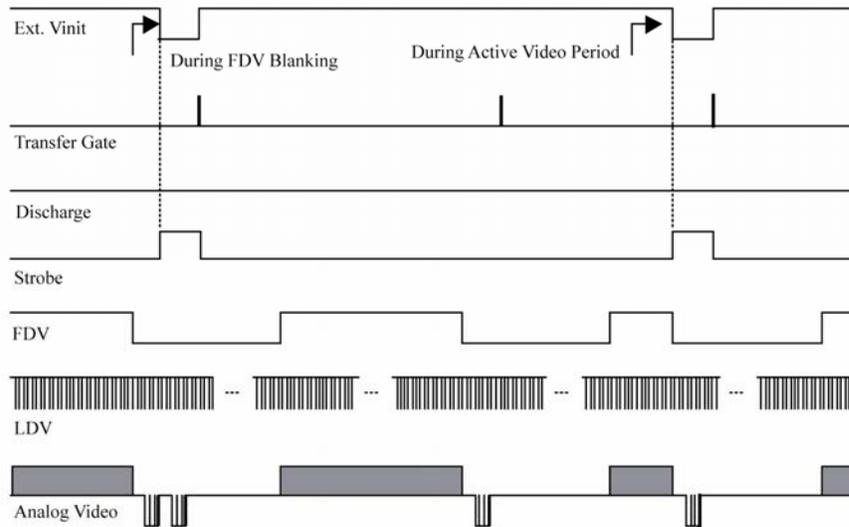
The TM-6740GE camera includes four modes to control the asynchronous reset and shutter speed:

- Async No Shutter (recommended for strobe applications)
- Async Programmable Shutter
- External VINIT with Pulse Width (No-Delay Shutter) and ROI (read-out-inhibit)

3.6.1 Async No Shutter

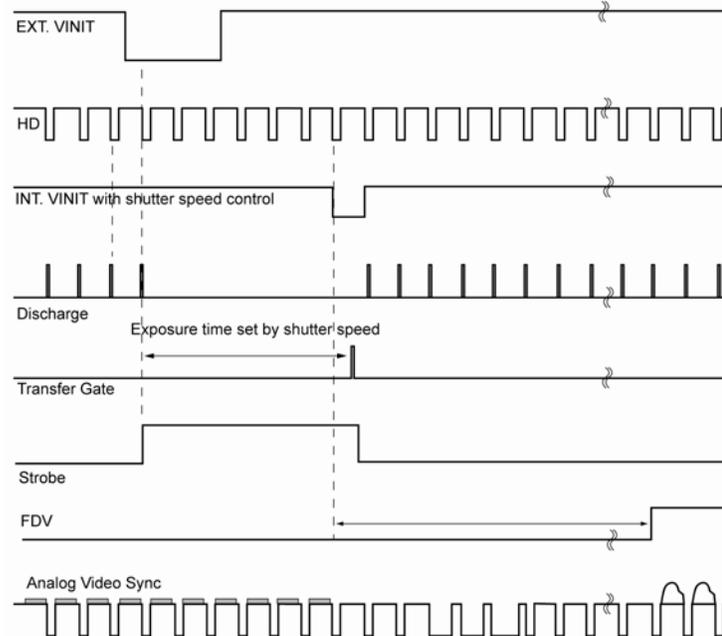
Async No Shutter allows for strobe and back-to-back strobing (strobing both before the transfer gate and right after) applications as shown in Figure 9. This mode is meant to be used in a dark environment in conjunction with a strobe light.

Figure 9. Async No Shutter



Vinit trigger starts the first exposure period within one line (1H = 10  $\mu$ sec.) and transfers the frame after a 43  $\mu$ sec. exposure. After the first transfer, a new full frame exposure period (5msec.) begins. Please see Camera Timing Charts below.

3.6.2 Async Programmable Shutter

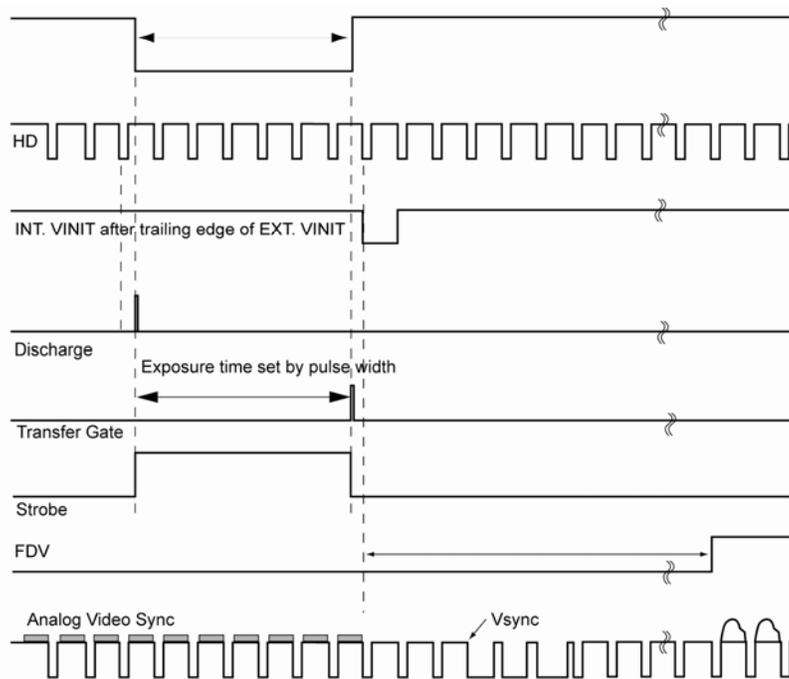


The video signal starts with internal VINIT. When the external VINIT pulse is applied, internal VINIT is latched to HD and the internal VINIT is delayed to set up the shutter speed period. The shutter speed is controllable by the user via communication software. Video output timing starts right after the internal VINIT and single shots, FDV is output at the internal VINIT timing.

**3.6.3 External VINIT With Pulse Width (No-Delay Shutter) and ROI (Read-out Inhibit)**

For multiple-camera applications such as 2D or 3D measurement and multi-angle inspection, simultaneous image capturing at an exact shutter timing for all cameras is a critical requirement. The TM-6740's asynchronous pulse-width control mode provides no-delay shutter (Figure 10, "Pulse Width Control No-Delay Shutter" on page 23) as standard. Regardless of the internal pulse timing, the camera discharges at the VINIT leading edge and transfers charges at the trailing edge of the pulse. Even though each camera runs with slightly different H and data clock timing, the image capturing is exactly simultaneous.

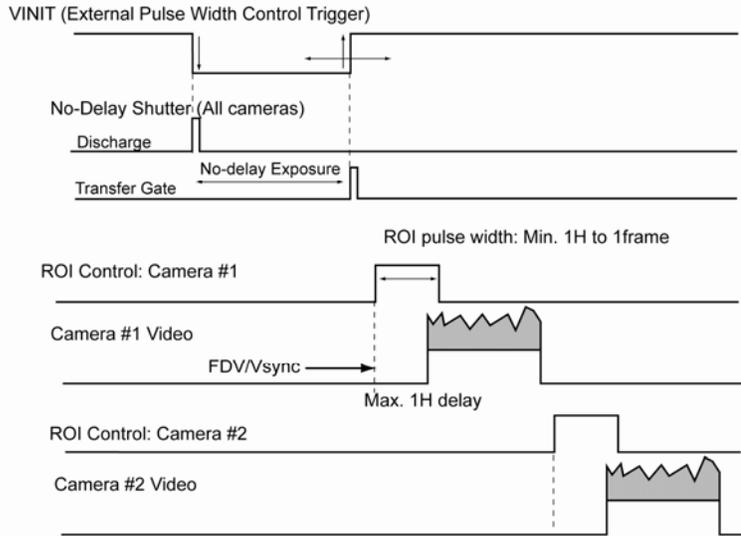
**Figure 10. Pulse Width Control (No-Delay Shutter)**



The TM-6740GE camera also has read-out-inhibit control (ROI) to control the vertical clock start (Pulse Width Control mode). The ROI signal is fed in via the Integration Signal pin (External\_INT\_In). When ROI is low, V-clock is stopped and the transferred charges remain in the vertical shift registers, which work like CCD memory. When the ROI is high, it clocks out the CCD data. This helps a single frame grabber process multiple images in pipeline processing (sequential process).

*Note: When the ROI function is not used, make sure that the INTEG/ROI input is kept logic high during Async. Pulse Width control mode. This done via the Programmable Logic Controller (See IP Engine Examples section 5.8.8).*

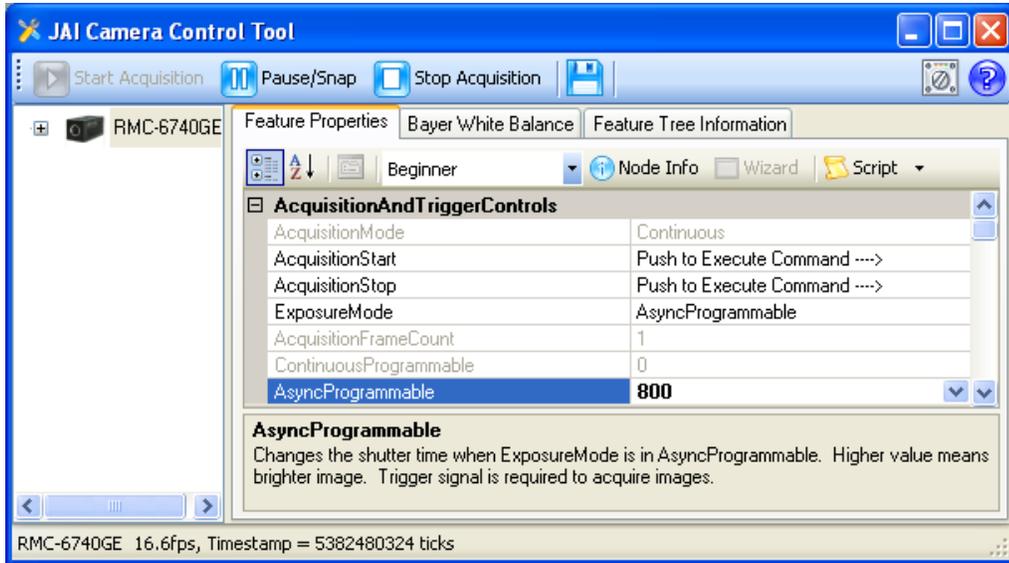
Figure 11. Read-Out Inhibit



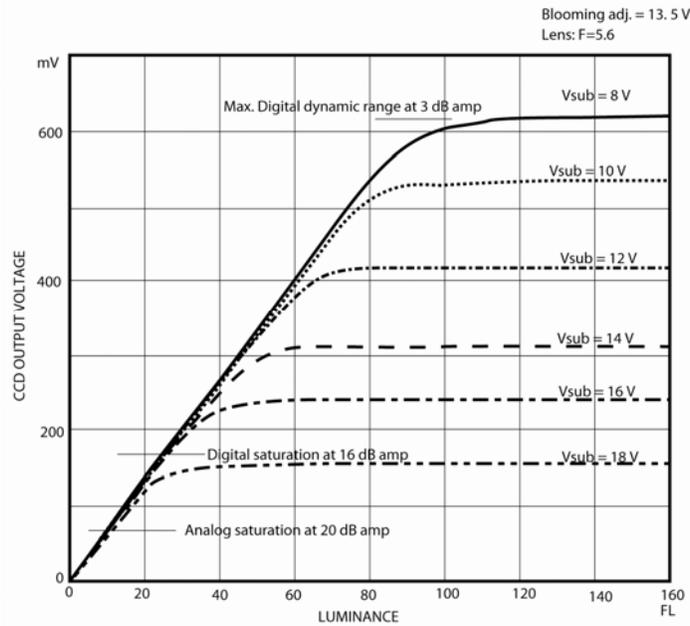
### 3.6.4 Async Programmable Exposure Mode

Async Programmable exposure is determined by a shutter value entered from 0 to 2079. The shutter value equals 1H (horizontal line time) or 10  $\mu$ sec for each increment. The Async Programmable exposure timing functions exactly the same as the internal shutter speed control. Async Programmable value is user controlled via GigE camera acquisition software. The GUI interface that controls Async Direct Shutter exposure is illustrated in Figure 12 below.

Figure 12. Async Programmable



### 3.7 Dynamic Range Control



The typical interline transfer CCD has fixed noise levels based on dark current (thermal or KT noise), pattern noise, and the operating clock speed. In general, the level of the 40 MHz pixel clock CCD at room temperature is around 20 to 30 electrons. The maximum capacity of CCD charges is limited by the well capacity at saturation. The range is limited by the structure and the pixel size.

The TM-6740GE uses a CCD with 7.4 μm x 7.4 μm pixels and a two-phase vertical shift register structure. The well capacity is 20,000 electrons. The theoretical dynamic range is 20,000:30 = 666:1 (56 dB).

A typical CCD camera does not use the full dynamic range due to the nominal gain and the output specification such as RS-170. The typical CCD camera's gain is set between 16 and 22 dB and the RS-170 video level is 714 mV. Using 20 dB gain for the calculation, CCD output is limited to 714/10 = 71.4 mV. Since the CCD's saturation voltage is 400 mV to 500 mV, it uses less than 1/5 of the full dynamic range.

Machine vision and outdoor applications cannot afford to miss image information behind the saturation, which is why the dynamic range adaptation is critical.

#### 3.7.1 Programmable Look-Up Table (LUT) and Knee Control

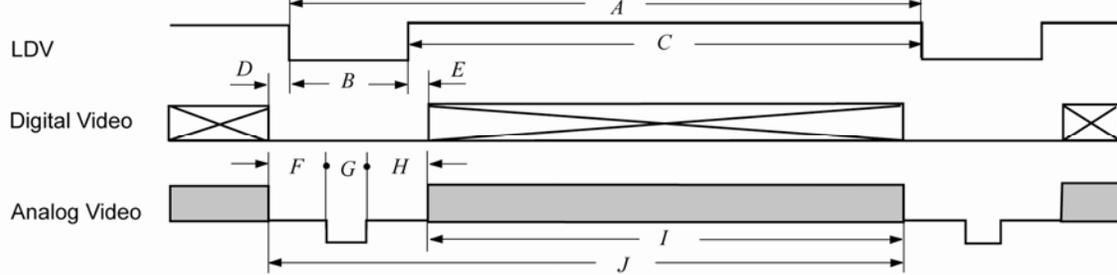
The TM-6740GE has a built-in LUT (look-up table) for dynamic range control. At a specific gain setting, the offset (minimum level.... dark point) and A/D reference top voltage (maximum level... saturation point) are set to 10-bit A/D input so that the full dynamic range of the CCD is utilized at 10-bit references as the input and the LUT output is converted into 8-bit to adjust the gamma correction. Notice that the LUT (look-up table) is not available in the 10-bit grayscale mode.

The look-up table has two knee points (variable gamma selection) that allow the 10-bit input to be segmented into three regions. The look-up table selection can be made by knee curve direct input.

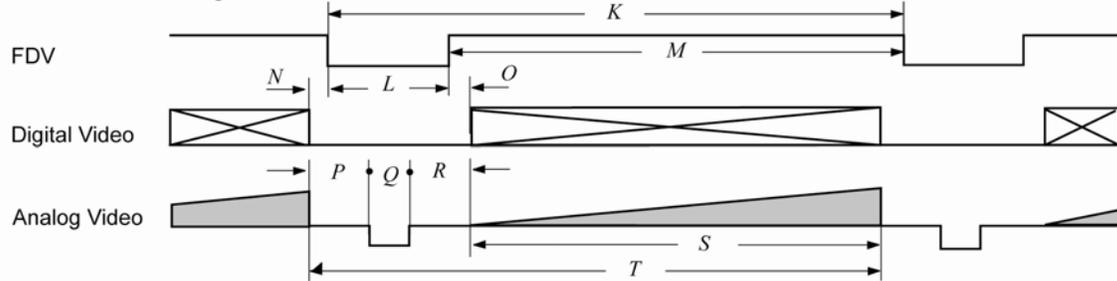
### 3.8 Camera Timing Charts

#### 1. Video Output

##### >> Line Video Timing

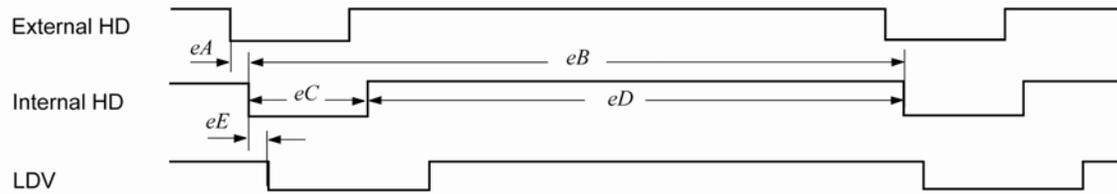


##### >> Field Video Timing

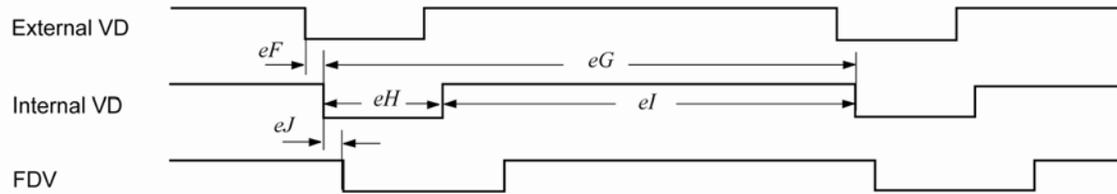


#### 2. External HD Locking & External VD Reset

##### >> External HD Locking

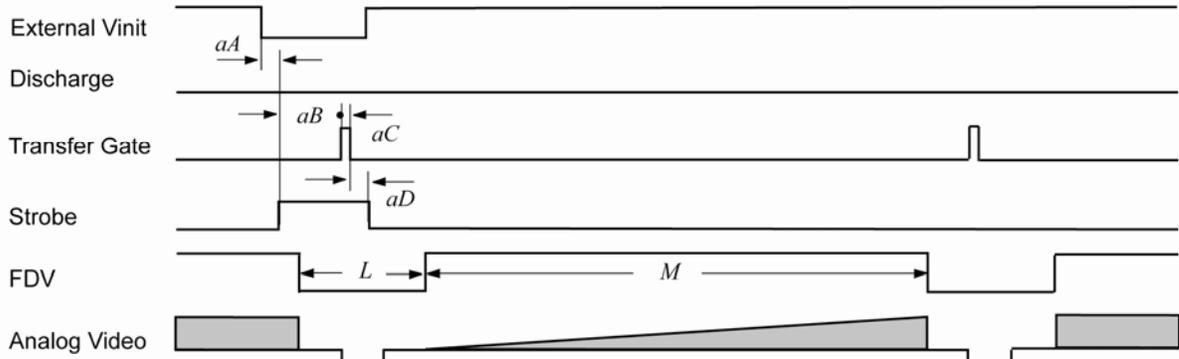


##### >> External VD Reset

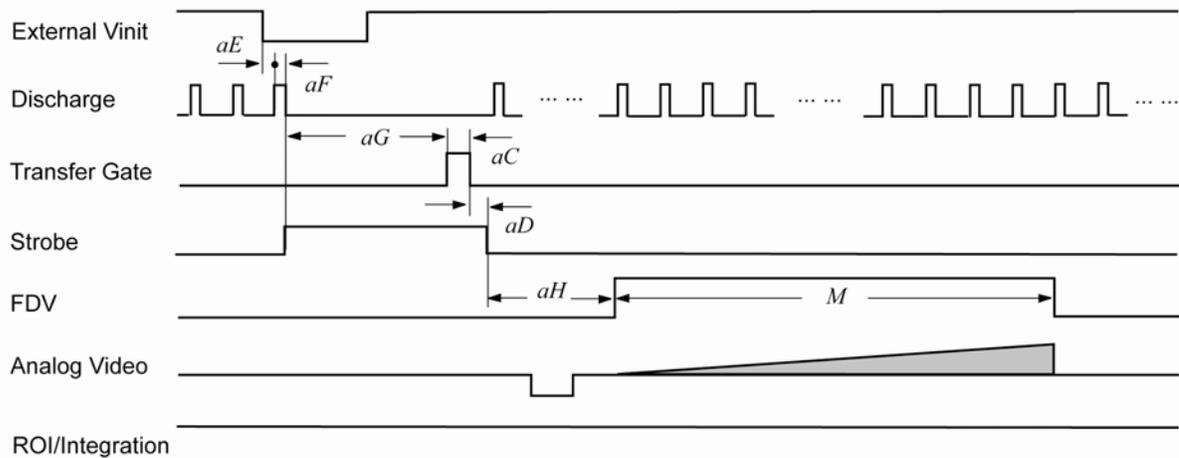


### 3. Async Reset

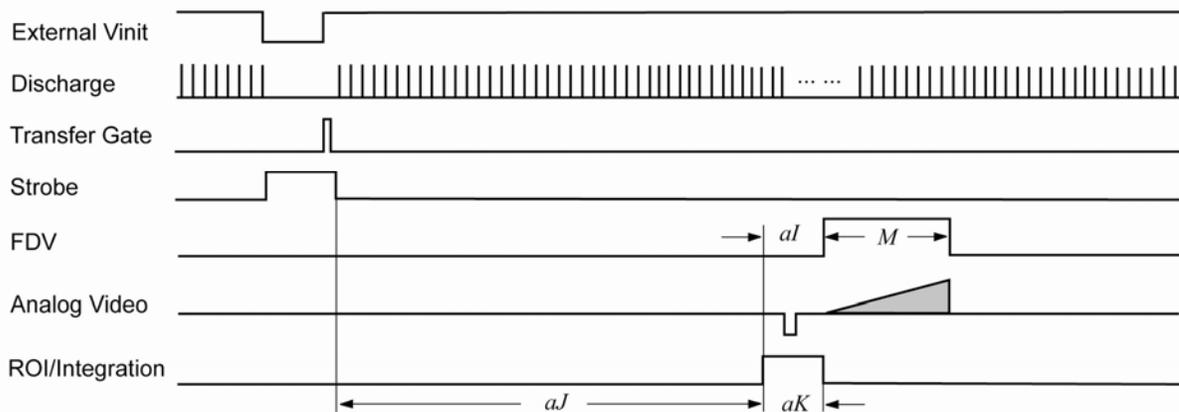
>> Async No Shutter (async shutter 0)



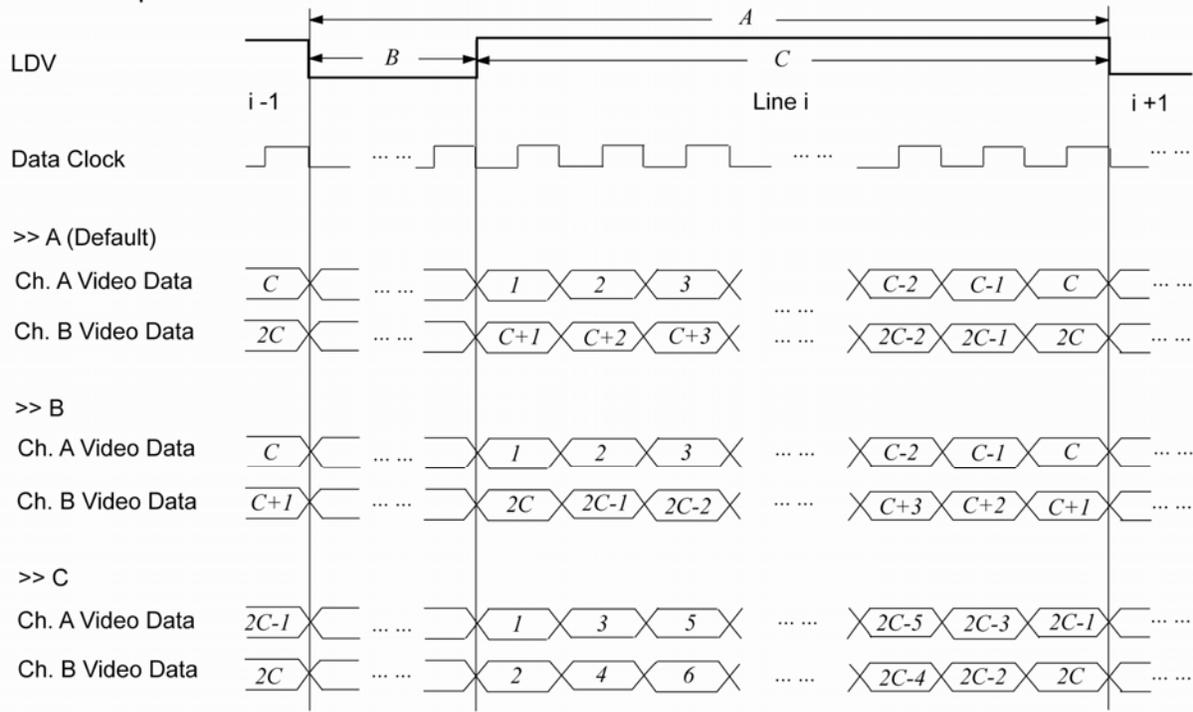
>> Async Normal Shutter (async shutter 1-8) & Async No-delay Shutter (async shutter 9)



>> Read-Out Inhibit (ROI, async shutter 9)



4. Video Output Order



3.9 Video Output

Table 4 Video Output (A to J)

Scan Mode		Output		Horizontal (Pixels)												
Binning	Scan Area	Digital	Analog	Digital			Analog									
				A	B	C	F	G	H	I	J					
No binning	A	40MHz 25ns	80MHz 12.5ns	400	80	320	58	16	86	640	800					
	B			400	80	320				640	800					
	C			160	48	112				224	320					
	D			160	48	112				224	320					
1x2	A			400	80	320				640	800					
	B			400	80	320				640	800					
	C			160	48	112				224	320					
	D			160	48	112				224	320					
1x4	A			432	112	320				640	864					
	B			432	112	320				640	864					
	C			192	80	112				224	384					
	D			192	80	112				224	384					
2x1	A			20MHz 50ns	40MHz 25ns	200				40	160	20	8	52	320	400
	B					200				40	160	20		52	320	400
	C					80				24	56	22		50	112	160
	D					80				24	56	22		50	112	160
2x2	A	200	40			180	20	52	320	400						
	B	200	40			180	20	52	320	400						
	C	80	24			56	22	50	112	160						
	D	80	24			56	22	50	112	160						
2x4	A	216	56			160	20	52	320	432						
	B	216	56			160	20	52	320	432						
	C	96	40			56	22	50	112	192						
	D	96	40			56	22	50	112	192						
4x1	A	10MHz 100ns	20MHz 50ns			100	20	80	10	4	26	160		200		
	B					100	20	80				160		200		
	C					40	12	28				56		80		
	D					40	12	28				56		80		
4x2	A			100	20	80	160	200								
	B			100	20	80	160	200								
	C			40	12	28	56	80								
	D			40	12	28	56	80								
4x4	A			108	28	80	160	216								
	B			108	28	80	160	216								
	C			48	20	28	56	96								
	D			48	20	28	56	96								

\*. D, E=0 pixels.

Table 5 Video Output (K to T)

Scan Mode		Output		Vertical (Pixels)							
Binning	Scan Area	Digital	Analog	Digital			Analog				
				K	L	M*	P‡	R	S	T	
No binning	A	40Mhz 25ns	80Mhz 12.5ns	500	20	480	3	14	480	500	
	B			185	25	160	9	13	160	185	
	C			500	20	480	3	14	480	500	
	D			200	40	160	9	28	160	200	
1x2	A			250	10	240	3	4	240	250	
	B			100	20	80	6	11	80	100	
	C			250	10	240	3	4	240	250	
	D			108	28	80	4	21	80	108	
1x4	A		130	10	120	3	4	120	130		
	B		58	18	40	5	10	40	58		
	C		130	10	120	3	4	120	130		
	D		65	25	40	4	18	40	65		
2x1	A		20MHz 50ns	40Mhz 25ns	500	20	480	3	14	480	500
	B				185	25	160	9	13	160	185
	C				500	20	480	3	14	480	500
	D				200	40	160	9	28	160	200
2x2	A	250			10	240	3	4	240	250	
	B	100			20	80	6	11	80	100	
	C	250			10	240	3	4	240	250	
	D	108			28	80	4	21	80	108	
2x4	A	130		10	120	3	4	120	130		
	B	58		18	40	5	10	40	58		
	C	130		10	120	3	4	120	130		
	D	65		25	40	4	18	40	65		
4x1	A	10MHz 100ns		20MHz 50ns	500	20	480	3	14	480	500
	B				185	25	160	9	13	160	185
	C				500	20	480	3	14	480	500
	D				200	40	160	9	28	160	200
4x2	A		250		10	240	3	4	240	250	
	B		100		20	80	6	11	80	100	
	C		250		10	240	3	4	240	250	
	D		108		28	80	4	21	80	108	
4x4	A		130	10	120	3	4	120	130		
	B		58	18	40	5	10	40	58		
	C		130	10	120	3	4	120	130		
	D		65	25	40	4	18	40	65		

\*. N, O=0 pixels. †. Q=3 lines.

3.10 External HD Locking and External VD Reset

Table 6 External HD Locking and External VD Reset (eA to eE)

Scan Mode		Pixel Clock	Horizontal		External HD Locking Timing (Pixels)								
Binning	Scan Area		Freq. (kHz)	Time (μsec)	eA	eB	eC	eD	eE				
No binning	A	40MHz 25ns	100	10	<20ns	400	32	368	13				
	B		100	10		400		368					
	C		250	4		160		128					
	D		250	4		160		128					
1x2	A		100	10		400		368					
	B		100	10		400		368					
	C		250	4		160		128					
	D		250	4		160		128					
1x4	A		92.6	10.8		432		400					
	B		92.6	10.8		432		400					
	C		208.3	4.8		192		160					
	D		208.3	4.8		192		160					
2x1	A		20MHz 50ns	100		10		<20ns		200	26	184	12
	B			100		10				200		184	12
	C			250		4				80		64	11
	D			250		4				80		64	11
2x2	A	100		10	200	184	12						
	B	100		10	200	184	12						
	C	250		4	80	64	11						
	D	250		4	80	64	11						
2x4	A	92.6		10.8	216	200	12						
	B	92.6		10.8	216	200	12						
	C	208.3		4.8	96	80	11						
	D	208.3		4.8	96	80	11						
4x1	A	10MHz 100ns		100	10	<20ns	100		16	84		15	
	B			100	10		100			84			
	C			250	4		40			24			
	D			250	4		40			24			
4x2	A		100	10	100		84						
	B		100	10	100		84						
	C		250	4	40		24						
	D		250	4	40		24						
4x4	A		92.6	10.8	108		92						
	B		92.6	10.8	108		92						
	C		208.3	4.8	48		32						
	D		208.3	4.8	48		32						

## TM-6740GE Series

**Table 7 External HD Locking (eF to eJ)**

Scan Mode		Pixel Clock	Vertical		External HD Locking Timing (Pixels)							
Binning	Scan Area		Freq. (kHz)	Time (μsec)	eF	eG	eH	eI	eJ			
No binning	A	40MHz 25ns	200	5000	<20ns	500	9	500	500			
	B		540	1850		185		185	185			
	C		500	2000		500		500	500			
	D		1250	800		200		200	200			
1x2	A		400	2500		250		250	250			
	B		1000	1000		100		100	100			
	C		1000	1000		250		250	250			
	D		2315	432		108		108	108			
1x4	A		712	1404		130		130	130			
	B		1596	626.4		58		58	58			
	C		1602	624		130		130	130			
	D		3205	312		65		65	65			
2x1	A		20MHz 50ns	200		5000		<20ns	500	9	500	500
	B			540		1850			185		185	185
	C			500		2000			500		500	500
	D			1250		800			200		200	200
2x2	A	400		2500	250	250	250					
	B	1000		1000	100	100	100					
	C	1000		1000	250	250	250					
	D	2315		432	108	108	108					
2x4	A	712		1404	130	130	130					
	B	1596		626.	458	458	458					
	C	1602		624	130	130	130					
	D	3205		312	65	65	65					
4x1	A	10MHz 100ns		200	10	<20ns	500		9		500	500
	B			540	10		185				185	185
	C			500	4		500				500	500
	D			1250	4		200				200	200
4x2	A		400	10	250		250	250				
	B		1000	10	100		100	100				
	C		1000	4	250		250	250				
	D		2315	4	108		108	108				
4x4	A		712	10.8	130		130	130				
	B		1596	10.8	58		58	58				
	C		1602	4.8	130		130	130				
	D		3205	4.8	65		65	65				

3.11 Asynchronous Reset

Table 8 Async Reset

Scan Mode		Async Reset Timing								
Binning	Scan Area	aA (no lines)	aB (μsec)	aC (μsec)	aD (μsec)	aE	aG (no lines)	aH (lines)		aI (lines)*
								s1-8†	s9‡	
No binning	A	>1 & <2	43.2	4.8	1.9	s1-8: >1 line	s1=1 s2=2 s3=5 s4=12 s5=24 s6=49 s7=99 s8=199 s9=PW	20	> aH (s8) & < aH (s8) + 1	> aH (s8) + 1 & < aH (s8) + 2
	B		43.2	4.8	1.9			19		
	C		16.0	4.0	3.8			18		
	D		16.0	4.0	3.8			32		
1x2	A		43.2	4.8	1.9			10		
	B		43.2	4.8	1.9			17		
	C		16.0	4.0	3.8			8		
	D		16.0	4.0	3.8			25		
1x4	A		46.4	4.8	2.7			10		
	B		46.4	4.8	2.7			16		
	C		19.2	4.0	4.6			8		
	D		19.2	4.0	4.6			22		
2x1	A		43.2	4.8	1.9			20		
	B		43.2	4.8	1.9			19		
	C		16.0	4.0	3.8			18		
	D		16.0	4.0	3.8			32		
2x2	A	43.2	4.8	1.9	10					
	B	43.2	4.8	1.9	17					
	C	16.0	4.0	3.8	8					
	D	16.0	4.0	3.8	25					
2x4	A	46.4	4.8	2.7	10					
	B	46.4	4.8	2.7	16					
	C	19.2	4.0	4.6	8					
	D	19.2	4.0	4.6	22					
4x1	A	43.2	4.8	1.9	20					
	B	43.2	4.8	1.9	19					
	C	16.0	4.0	3.8	18					
	D	16.0	4.0	3.8	32					
4x2	A	43.2	4.8	1.9	10					
	B	43.2	4.8	1.9	17					
	C	16.0	4.0	3.8	8					
	D	16.0	4.0	3.8	25					
4x4	A	46.4	4.8	2.7	10					
	B	46.4	4.8	2.7	16					
	C	19.2	4.0	4.6	8					
	D	19.2	4.0	4.6	22					

\*. aJ < 1 sec (recommended value)

aK = > 1 line

†. s1-9 means async shutter 1-9.

PW means pulse width of external vinit.

‡. aE = s1-8 < 1 line. s9 < 125 nsec.

aF = 500 nsec.



## 4 Functions and Operations

### 4.1 GigE Vision Standard Interface

The TM-6740GE series cameras are designed in accordance with the GigE Vision standard. Digital images are transmitted over Cat5e or Cat6 Ethernet cables. All camera functions are also controlled via the GigE Vision interface.

The camera can operate in continuous mode, providing an endless stream of images. For capturing individual images, related to a specific event, the camera can also be triggered. For precise triggering, it is recommended to use a hardware trigger applied to the Hirose 12-pin connector. It is also possible to initiate a software trigger through the GigE Vision interface. However, when using software trigger, certain latency inherent to the GigE interface must be anticipated. This latency, that manifests itself as jitter, greatly depends on the general conditions and traffic on the GigE connection. The frame rate described in this manual is for the ideal case and may deteriorate depending on conditions.

When using multiple cameras (going through a switch and/or a single path) or when operating in a system with limited transmission bandwidth the Delayed Readout Mode and Inter-Packet Delay functions can be useful.

### 4.2 GigE Vision-Aware Software

A GigE Vision camera can be controlled by any software that understands the protocol. At JAI we provide the JAI GigE Vision SDK and Control Tool to interface with our cameras. The remainder of the manual will show screenshots of the JAI Control Tool but other 3rd party software will provide similar functionalities.

### 4.3 Recommended Network Configurations

Although the TM-6740GE series cameras conform to Gigabit Ethernet (IEEE 802.3) not all combinations of network interface cards (NICs) and switches/routers are suitable for use with the GigE Vision compliant camera.

#### 4.3.1 Verified Network Interface Cards (NICs)

At the time of publishing this document these combinations have been verified:

NIC: Intel Pro/1000MT, Pro/1000GT, Pro/1000PT.

CPU: Intel Core 2 Duo 1.84Ghz.

Memory: 2 GB

Video Card: video card on PCI Express bus with at least 256MB of VRAM.

Functions such as screen saver and power save should not be used. Unnecessary applications such as Word, Excel or others should not be used.

#### 4.3.2 Video data rate (network bandwidth)

The video bit rate for TM-6740GE series cameras at the continuous mode is:

Model	Pixel Type	Frame Rate	Packet data volume (In case the Packet size is 4040)
TM-6740GE	Mono8	200 fps	511 Mbit/s @ Packet Size of 1428 Bytes
	Mono10	200 fps	989 Mbit/s @ Packet Size of 8124 Bytes
	Mono10Packed	200 fps	743 Mbit/s @ Packet Size of 8124 Bytes
TMC-6740GE	BayerGR8	200 fps	498 Mbit/s @ 4040PacketSize
	BayerGR10	200 fps	987 Mbit/s @ 16260 PacketSize

*Note: The Mono10 and BayerGR10 settings at full frame rate will exceed GigE bandwidth. It is recommended to use Mono8, Mono10Packed, or BayerGR8 for max frame rate.*

For TM-6740GE series cameras, the jumbo frame can be set at a maximum 16260 Bytes (Factory setting is 1428 Bytes). To set Jumbo Frames, refer to section 4.3.4.

To ensure the integrity of packets transmitted from the camera it is recommended that these simple guidelines be followed:

1. Whenever possible use a peer-to-peer network.
2. When connecting several cameras going through a network switch, make sure it is capable of handling jumbo packets and that it has sufficient memory capacity.
3. Configure inter-packet delay to avoid congestion in network switches.
4. Disable screen saver and power save functions on computers.
5. Use high performance computers with multi-CPU, hyper-thread and 64-bit CPU, etc.
6. Only use Gigabit Ethernet equipment and components together with the camera.
7. Use at least Cat5e or preferably Cat6 Ethernet cables.
8. Whenever possible, limit the camera output to Mono8 or Mono10Packed for Monochrome cameras and BayerGR8 for color.

### 4.3.3 Disable Firewalls

To ensure proper operation of the JAI SDK & Control Tool, all firewalls must be disabled. This also includes the Windows firewall.

Click [Start], [Control Panel] for accessing the Windows firewall configuration.

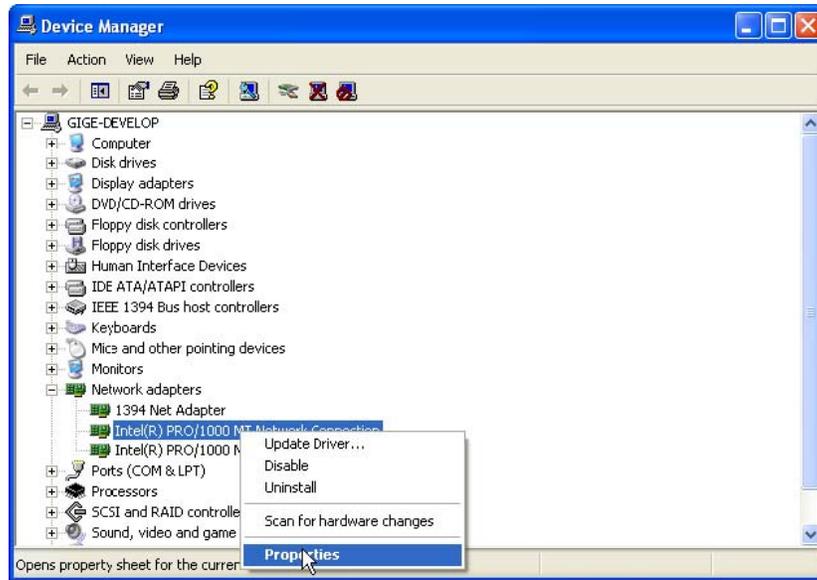


### 4.3.4 Enabling Jumbo Frames

- (1) Click [Start] and click [Control Panel].
- (2) Click [Performance and Maintenance].
- (3) Click [System].
- (4) Click [Hardware] tab.
- (5) Click [Device Manager]

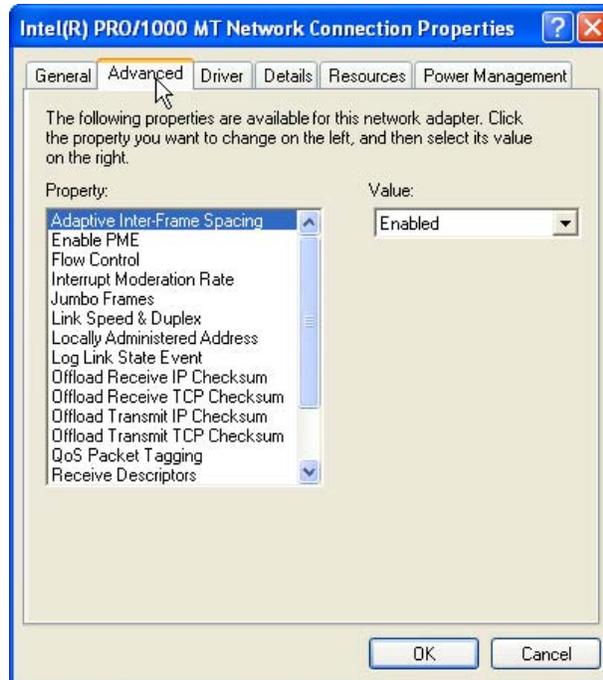


- (6) Expand [Network adapters].
- (7) Select target NIC, right-click, and click [Properties].

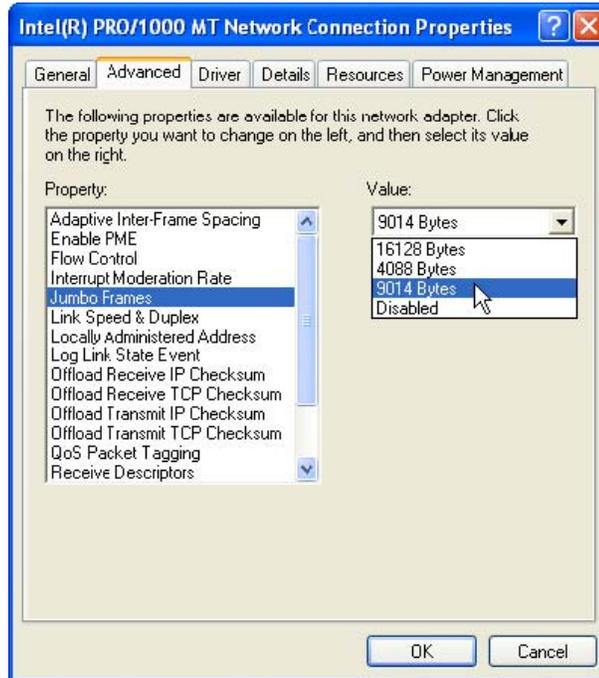


*Note: The following procedure uses the Intel® PRO/1000 as an example. If a different NIC is used, the setup tabs will likely be different. In that case, set the item in a manner similar to what is described here.*

- (8) Click [Advanced] tab.



(9) Select Jumbo Frames under Property, and select the desired Value. This setting defines the maximum GevSCPS Packet Size the camera can use.



(10)Click [OK].

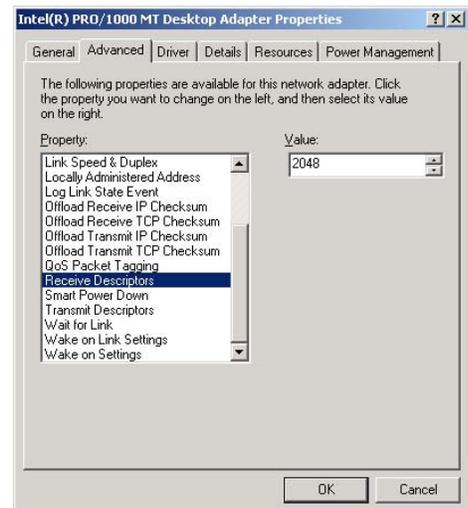
(11)Close [Device Manager].

(12)Close [System Properties] clicking [OK].

### 4.3.5 Setting Receive Descriptors

If the Network Connection Properties list contains a property called Receive Descriptors, then change its property to the maximum value supported by the NIC installed in the computer.

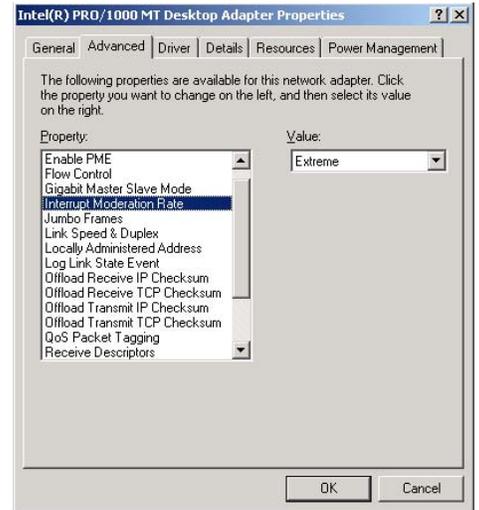
Click "OK" to save the property.



**4.3.6 Interrupt Moderation rate**

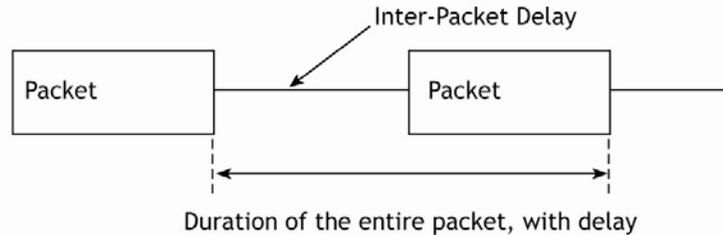
If the Network Connection Properties list contains a property called Interrupt Moderation Rate, then it is possible to set the preferred value. When it is changed from Minimal, M High and Extreme, number of interruption is decreased to get better performance. Set it to “Extreme.”

Click “OK“ to save the property.



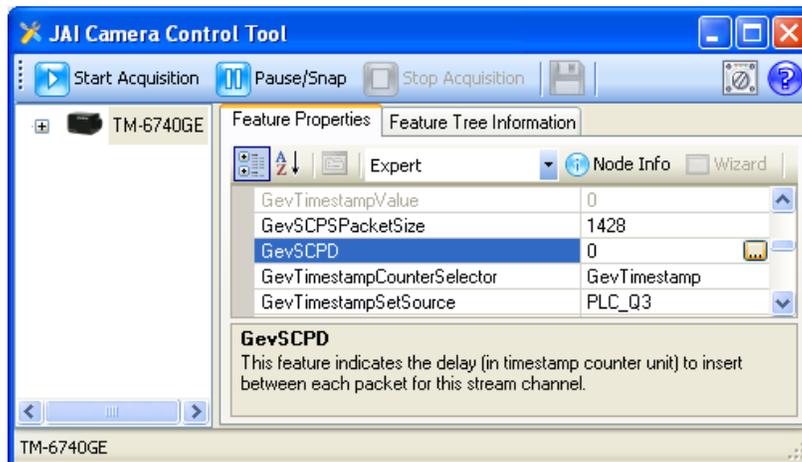
**4.3.7 Calculating and setting Inter-Packet Delay**

When connecting several cameras to one network interface card via a switching hub, it is important to optimize the Inter-Packet Delay of the cameras to avoid congestion in the switch. A sure sign of congestion is the loss of packets.

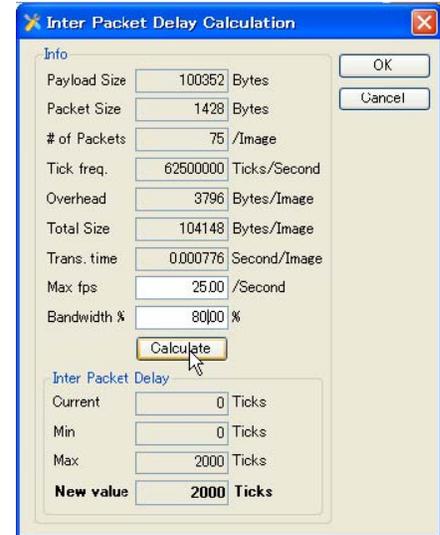


Since increasing the inter-packet delay also adds overhead to the data transfer it is important to calculate the optimal setting in order to make best use of the video bandwidth.

JAI Control Tool has a built in wizard for calculating Inter-Packet Delay. When the Inter-Packet Delay function is activated, a button appears on the right hand side of the bar. Click the button to open the calculation wizard window.



1. At first, type in the frame rate of the connected camera. TM-6740GE series cameras are 200 fps.
2. Set the bandwidth at 80%.
3. Click the calculation tab.
4. New value is calculated.
5. Click OK. This shown value is automatically transferred to the Packet Delay column of the Control Tool.

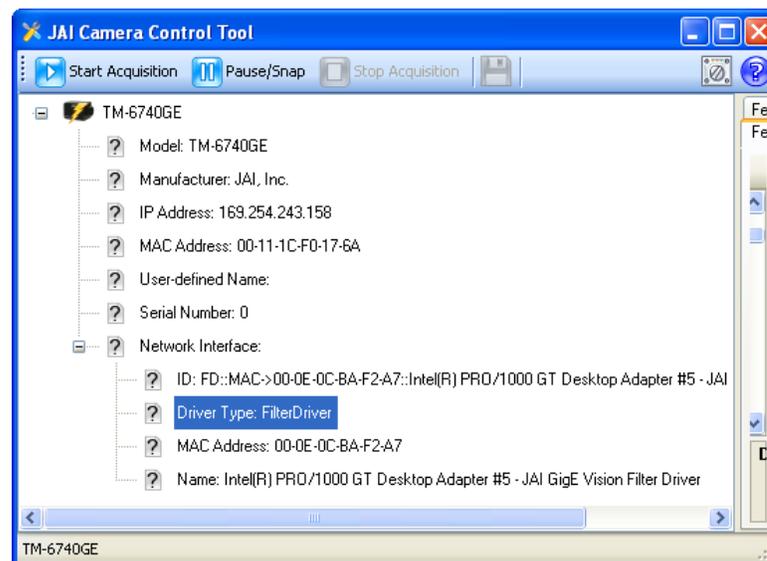


### 4.3.8 Confirm the Filter Driver is used

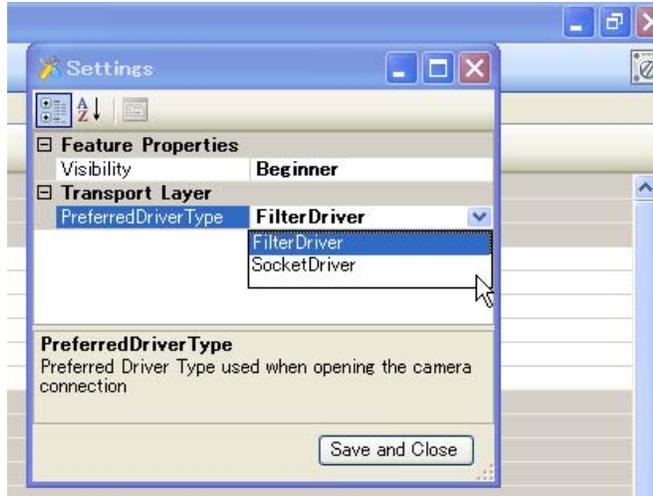
The filter driver is installed as an optional function when JAI SDK is installed. If the filter driver is not installed at that time, it can be installed from, All Programs ⇒ JAI SDK ⇒ GigE Vision Filter Driver ⇒ Install GigE Vision Filter Driver.



If the Filter Driver is installed properly, the Camera Control Tool indicates “ Driver Type Filter Driver “ in the Network Interface.



If it is not shown, confirm the setting in the “Settings” window. Access the “settings” window by clicking on the “Control Knob” icon in the upper right corner of the window. Refer to the “Getting Started Guide” provided with the JAI GigE Vision SDK and Control Tool for more information about controls in the “Settings” window.



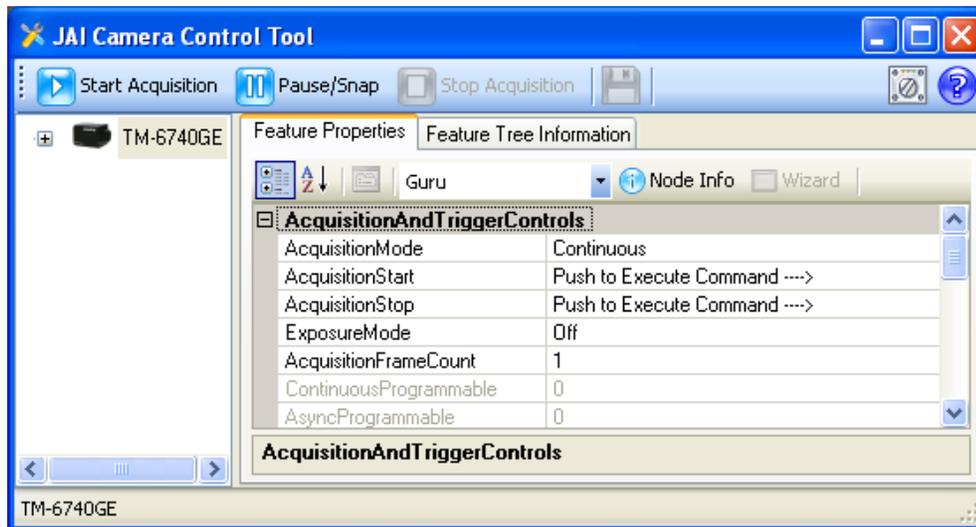
## 5 Configuring the Camera

The following sections describe the various features of the camera.

### 5.1 Acquisition and Trigger Controls

These controls affect exposure mode, exposure time, and image acquisition operations.

Figure 13. Acquisition And Trigger Controls Category



*AcquisitionMode*: controls how the camera behaves during image acquisition. The possible options are:

- Continuous: Images will be acquired continuously.
- SingleFrame: A single image will be acquired.
- MultiFrame: the camera acquires the number of images as specified by AcquisitionFrameCount feature (see below).
- ContinuousRecording: The camera will continuously acquire and store images onto the onboard memory. Acquisition is stopped when the onboard memory capacity is reached. Images can be read from the camera using either ContinuousReadout or SingleFrameReadout.
- ContinuousReadout: Images will be read continuously from the camera's onboard memory. When no more images are available, timeouts will occur.
- SingleFrameRecording: Acquire a single image and store onto the onboard memory. Images can be read from the camera using SingleFrameReadout.
- SingleFrameReadout: A single image will be read from the onboard memory. If no frames are available, a timeout will occur.

*AcquisitionStart*: tells the camera to start acquiring images in the mode as specified by AcquisitionMode.

*AcquisitionStop*: tells the camera to stop acquiring images.

*AcquisitionFrameCount*: specifies the number of frames to be acquired in the MultiFrame Acquisition mode. Valid range is from 1 to 255.

*ExposureMode*: specifies mode of operation for the exposure control (or shutter). All Async modes, and PulseWidthControl require a trigger signal. The possible options are:

- Off: 1/frame rate.

- ContinuousPreset1: 1 / 250 sec
- ContinuousPreset2: 1 / 500 sec
- ContinuousPreset3: 1 / 1,000 sec
- ContinuousPreset4: 1 / 2,000 sec
- ContinuousPreset5: 1 / 4,000 sec
- ContinuousPreset6: 1 / 8,000 sec
- ContinuousPreset7: 1 / 16,000 sec
- ContinuousPreset8: 1 / 32,000 sec
- ContinuousPreset9: 1 / 64,000 sec
- ContinuousProgrammable: Puts the camera into ContinuousProgrammable mode and enable ContinuousProgrammable value feature below.
- AsyncNoShutter: this mode is meant to be used in a dark environment in conjunction with strobe light.
- AsyncPreset1: 1 / 64,000
- AsyncPreset2: 1 / 32,000 sec
- AsyncPreset3: 1 / 16,000 sec
- AsyncPreset4: 1 / 8,000 sec
- AsyncPreset5: 1 / 4,000 sec
- AsyncPreset6: 1 / 2,000 sec
- AsyncPreset7: 1 / 1,000 sec
- AsyncPreset8: 1 / 500 sec
- PulseWidthControl
- AsyncProgrammable: Puts the camera into AsyncProgrammable mode and enable AsyncProgrammable value feature below.

*ContinuousProgrammable*: user defined shutter time in unit of scan lines. Available only when ExposureMode is in ContinuousProgrammable.

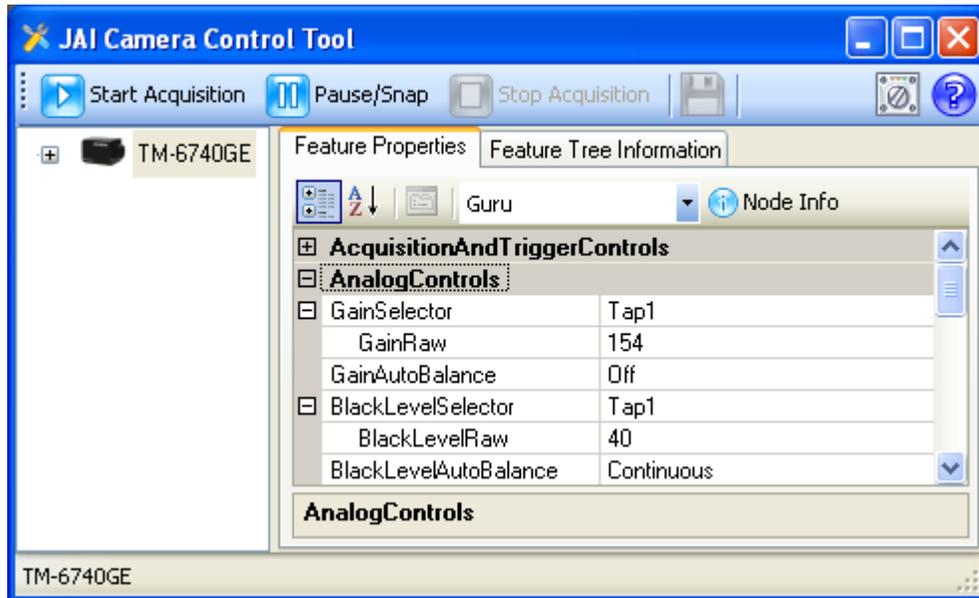
*AsyncProgrammable*: user defined shutter time in unit of scan lines. Available only when ExposureMode is in AsyncProgrammable. Requires trigger signal.

## 5.2 AnalogControls

These controls allow you to make adjustment to image intensities (Gain), Black Level, and channel balancing.

The camera image sensor is read out via two channels called Taps. Each channel's Gain, and Black Level can be independently adjusted.

Figure 14. AnalogControls Category



*GainSelector*: select the video channel that GainRaw will affect.

Available choices:

- Tap1: left channel.
- Tap2: right channel.

*GainRaw*: controls the Gain value.

*GainAutoBalance*: use this feature to balance the left and right channel's Gain values. Make sure the camera is pointing at a uniform light source. The balance is done once and may be repeated if needed.

*BlackLevelSelector*: select the video channel that BlackLevelRaw will affect.

Available choices:

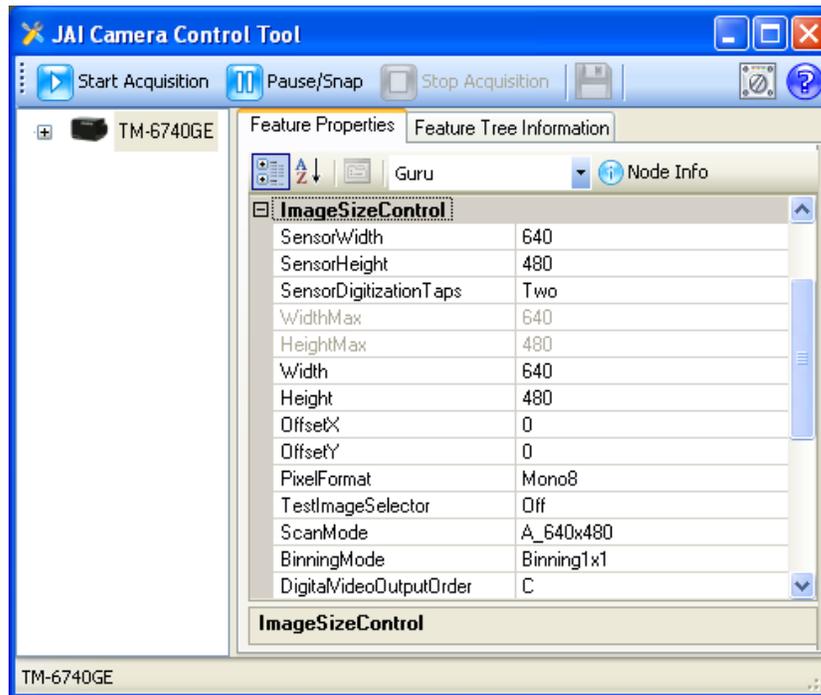
- Tap1: left channel.
- Tap2: right channel.

*BlackLevelAutoBalance*: use this feature to continuously auto balance the channels' Black Level. When set to Continuous, Tap2 is balanced to Tap1.

### 5.3 Image Size Controls

These controls allow you to make adjustment to the image's size, scan mode, and binning. Please see section 3.1 for a table of possible image sizes and modes.

Figure 15. ImageSizeControl category



*SensorDigitizationTaps*: the image sensor is read out via two channels. This feature is read only and shows that the camera is always in DualTap mode.

*WidthMax*: shows the current valid maximum value for Width.

*HeightMax*: shows the current valid maximum value for Height.

*Width*: sets the width of the output image. When ScanMode is changed it is necessary to set this value to equal to or less than WidthMax.

*Height*: sets the height of the output image. When ScanMode is changed it is necessary to set this value to equal to or less than HeightMax.

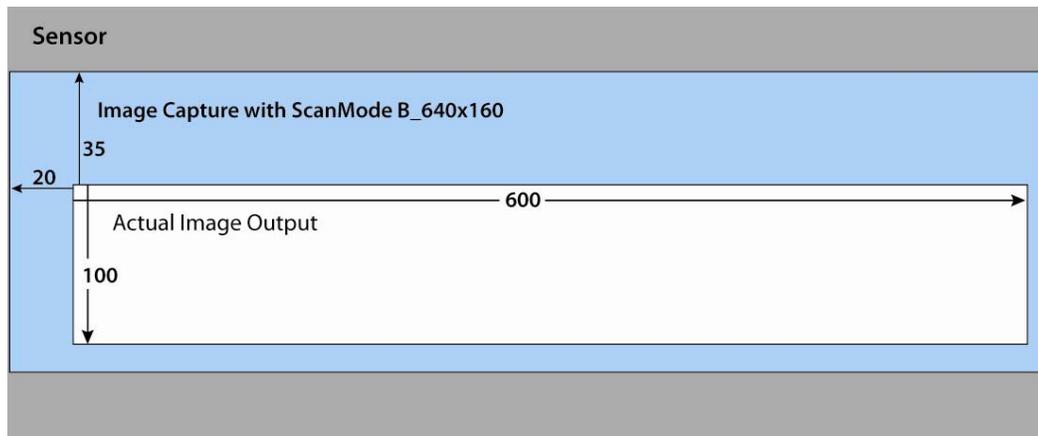
*OffsetX*: specify the offset from the left edge of the image captured by the sensor to be sent out of the camera. Width must be set lower than WidthMax before this value can be increased.

*OffsetY*: specify the offset from the top of the image captured by the sensor to be sent out of the camera. Height must be set lower than HeightMax before this value can be increased.

Offset Example:

- ScanMode is set to B\_640x160
- Width to 600 and Height to 100.
- OffsetX can have a range of 0 to 40. OffsetX is then set to 20.
- OffsetY can have a range to 0 to 80. OffsetY is then set to 35.
- The resulting image is of size 600x480 with the upper left pixel offset by 20 pixels horizontally and 35 vertically

Figure 16. Image Output Example



*ScanMode*: controls the image size captured by the image sensor. By changing to a smaller size you can achieve a faster frame rate. After changing ScanMode it is necessary to adjust the Width and Height value to a valid value. Available options (expressed in unit of Width x Height pixels):

- A\_640x480
- B\_640x160
- C\_224x480
- D\_224x160

*BinningMode*: the 6740's Binning Mode can group the image sensor pixels together to make a larger pixel. The larger pixel will have all the light from the 4 original pixels. This mode can be used for application in low light level. Since the pixels are grouped, the image size is also affected. Available options are:

- Binning1x1: results in image size of 640x480.
- Binning1x2: results in image size of 640x240.
- Binning1x4: results in image size of 640x120.
- Binning2x1: results in image size of 320x480.
- Binning2x2: results in image size of 320x240.
- Binning2x4: results in image size of 320x120.
- Binning4x1: results in image size of 160x480.
- Binning4x2: results in image size of 160x240.
- Binning4x4: results in image size of 160x120.

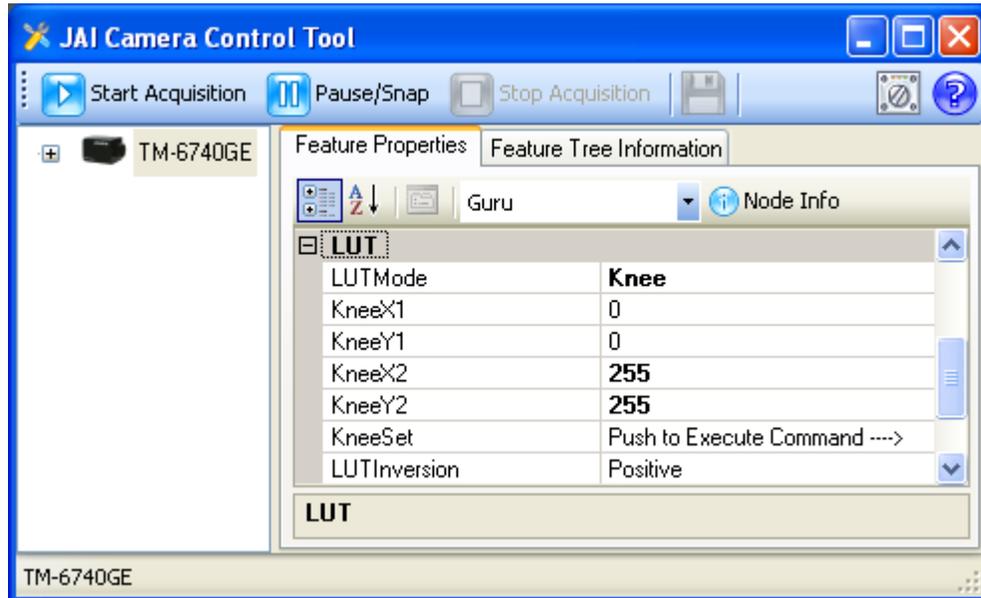
*TestImageSelector*: shows a software generated test pattern. Use this feature for debugging purposes. Available options are:

- Off: turn off test pattern generator and resume normal operation.
- DeviceSpecific: shows diagonal lines on black background. Generated by the camera's CPU.
- IPEngineTestPattern: shows horizontal striped gradients running right to left.

#### 5.4 LUT (Look Up Table)

The camera's LUT is used for dynamic range control when the camera is in 8-bit output mode (Mono8 or BayerGR8). This allows for the full utilization of the image sensor's 10-bit output as it is mapped to the 8-bit output.

Figure 17. LookUp Table



*LUTMode*: controls which LUT table to use. There are 2 predefined tables and 1 user configurable table. Available options:

- Linear: a linear mapping
- Gamma45: also known as Gamma 0.45.
- Knee: you can specify the curve by controlling two points.

*KneeX1*: controls the X value of first Knee point.

*KneeY1*: controls the Y value of first Knee point.

*KneeX2*: controls the X value of second Knee point. This value must be greater than KneeX1.

*KneeY2*: controls the Y value of second Knee point.

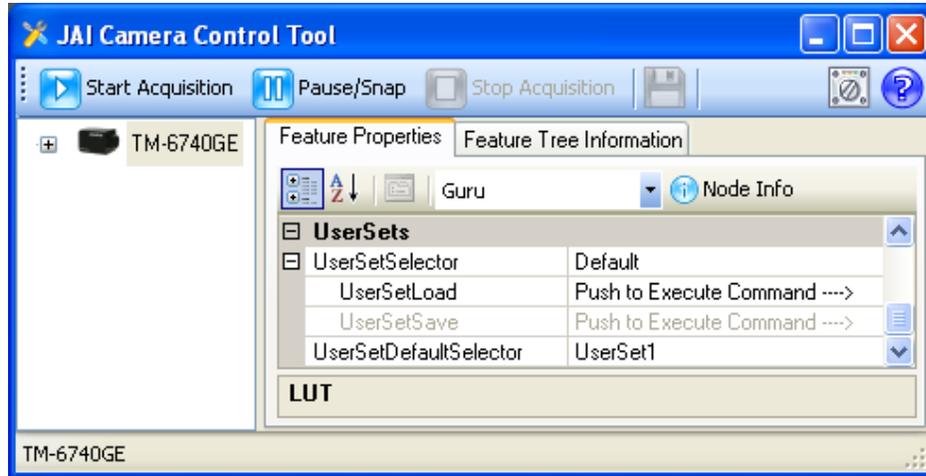
*KneeSet*: after you have changed the values of the knee points click KneeSet to apply the setting. The camera will take a few seconds to calculate the LUT table. If image acquisition is taking place the image will black out for about 1 second.

*LUTInversion*: invert the current LUT table. This creates the negative of image.

### 5.5 UserSets

These controls are for saving camera settings to the onboard memory and selection of which setting will be used during bootup.

Figure 18. UserSets Category



*UserSetSelector*: selects which memory page to load, or save.  
Available options:

- Default: contains factory settings.
- UserSet1: contains saved user settings.

*UserSetSave*: save the camera settings to the currently selected memory page. If Default is selected in UserSetSelector then UserSetSave is grayed out (Default factory settings won't be overwritten).

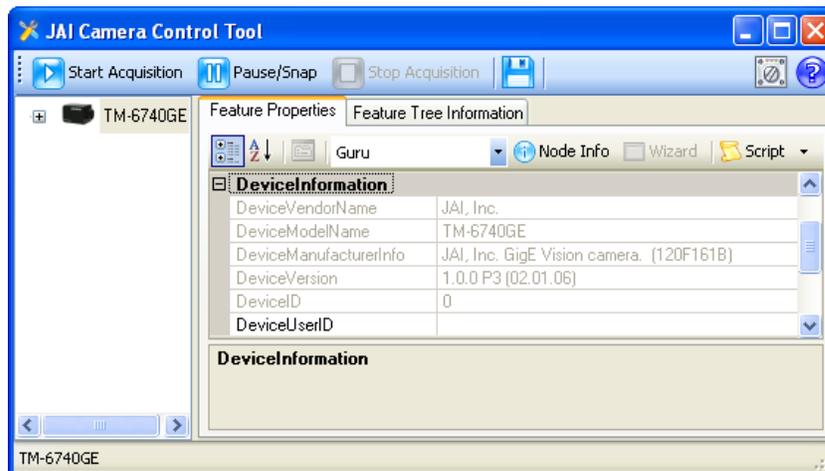
*UserSetLoad*: load the camera settings from the selected memory page.

*UserSetDefaultSelector*: chooses which memory page the camera will use as setting during boot up.

### 5.6 DeviceInformation

Show camera's general information such as version, model, and serial number.

Figure 19. DeviceInformation Category



*DeviceVendorName*: shows JAI, Inc.

*DevicModelName*: shows the camera model name.

*DeviceVersion*: shows the current camera version.

*DeviceID*: the device serial ID. This is set at the factory and only available in Expert and Guru visibility modes.

*DeviceUserID*: User's modifiable ID. You can enter any character string up to a limit of 16 characters.

## 5.7 GigEVisionTransportLayer

More advanced controls for setting IP Address, GigE Vision Stream Channel settings, etc...

A complete explanation of GigE is out of the scope of this manual therefore the user should seek out various online guides about: Persistent/Static IP, DHCP, LLA, IP Address, Subnet Mask, and networking.

### 5.7.1 Persistent IP

When powered up and connected to the network the camera will use the following sequence to obtain an IP Address:

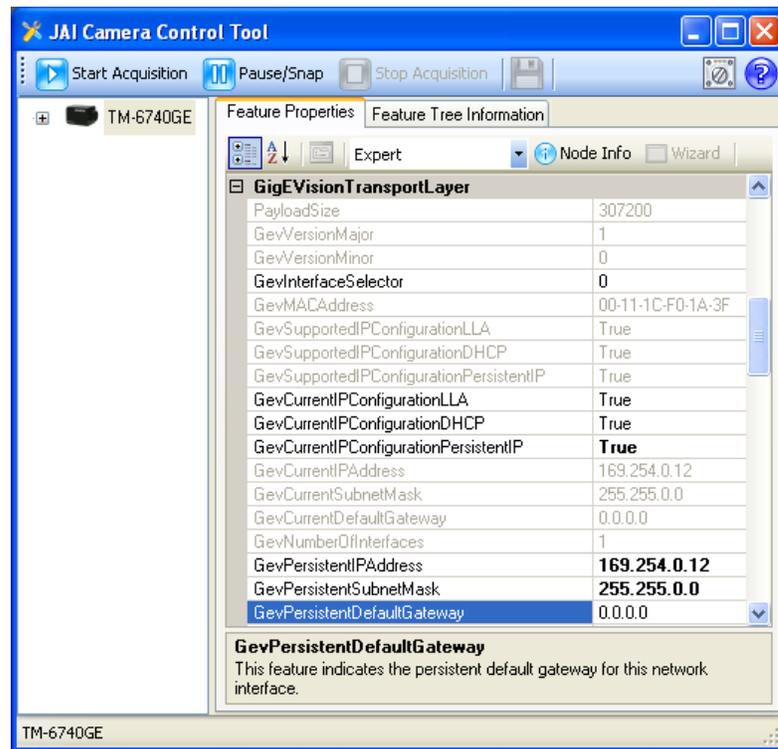
1. Persistent IP
2. DHCP: a DHCP server on the network will assign the camera an IP Address.
3. Link-Local Address (LLA): an IP Address in the 169.254.X.X ranged is assigned.

By default only DHCP and LLA are enabled. LLA will always be enabled. To disable DHCP mode set `GevCurrentIPConfigurationDHCP` to false.

You can also assign a static IP Address to the camera so the camera will always boot up with this IP Address. To do so follow these instructions:

1. Set Visibility to at least Expert.
2. Set `GevCurrentIPConfigurationPersistenIP` to True.
3. Set `GevPersistentIPAddress` to the IP Address of your choosing. (Ex: 169.254.0.11)
4. Set `GevPersistentSubnetMask` to the subnet mask of your choosing. (Ex: 255.255.0.0)
5. Set `GevPersistentDefaultGateway` to the IP Address of your gateway. (Ex: 0.0.0.0)

Figure 20. GigEVisionTransportLayer Persistent IP



### 5.7.2 Stream Channel Packet Size

Images are sent via the StreamChannel in GigE Vision terminology. The camera is able to adjust the size of the data packets sent on this channel. The minimum required value is 576. It is recommended that a value of 1428 is used. If setting to above 1428, the network to which the camera is connected must be able to support Jumbo Packets. To change the stream channel packet size follow these instructions:

1. Stop image acquisition.
2. Switch Visibility to at least Expert.
3. Set GevSCPSPacketSize to a desired value.

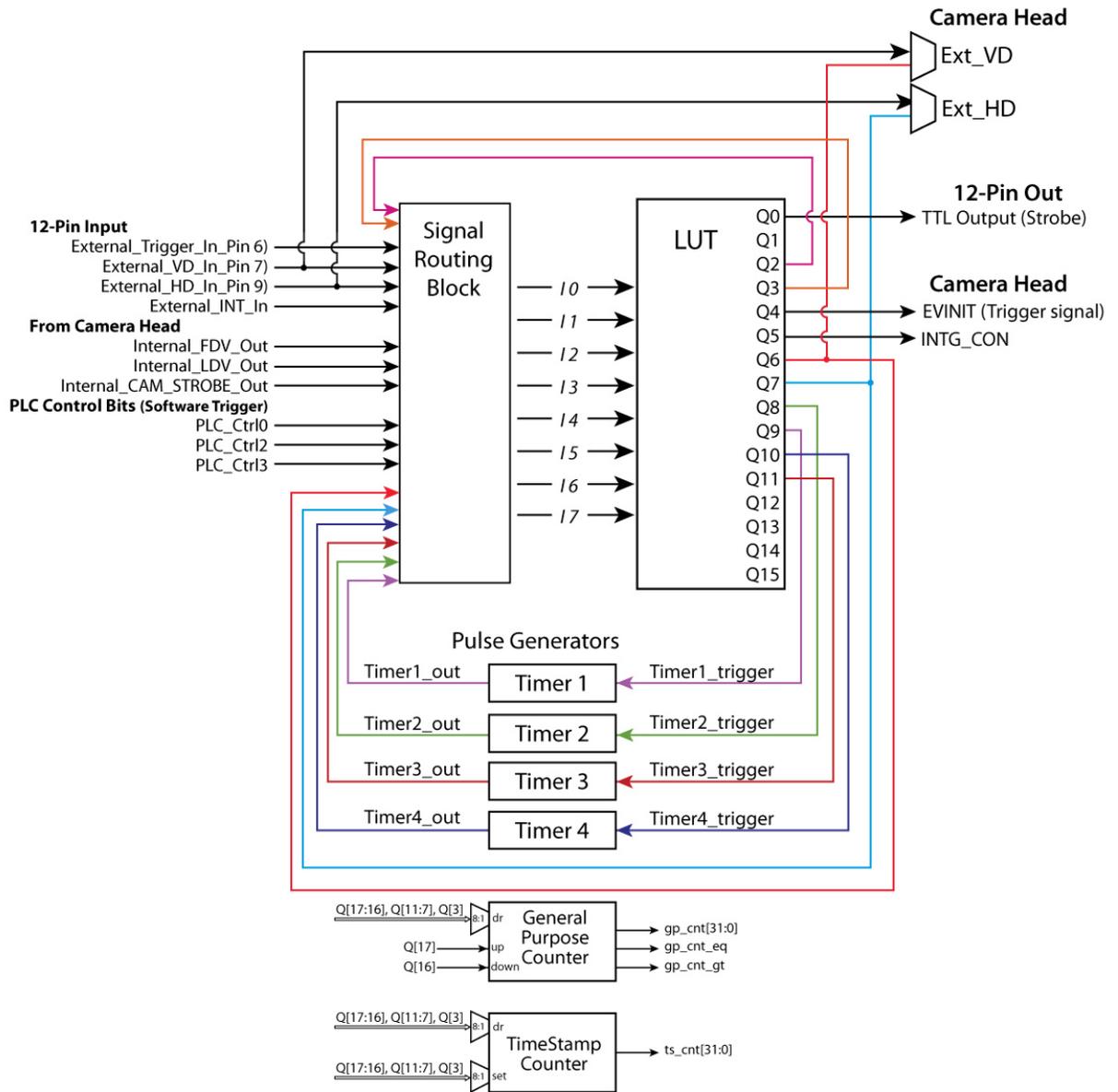
**GevHeartbeatTimeout:** specifies the current heartbeat timeout in milliseconds. Available only in Guru visibility mode. The host software must send at least one command to the camera during this period otherwise it loses control of the camera. This is usually handled by the control tool.

### 5.8 IPEngine

The camera is sectioned into two logical modules: a camera head and the IPEngine. The camera head contains the components to capture images, while the IPEngine takes care of interfacing to the outside world and transmitting captured images. The IPEngine contains the Programmable Logic Controller (PLC) and the Grabber.

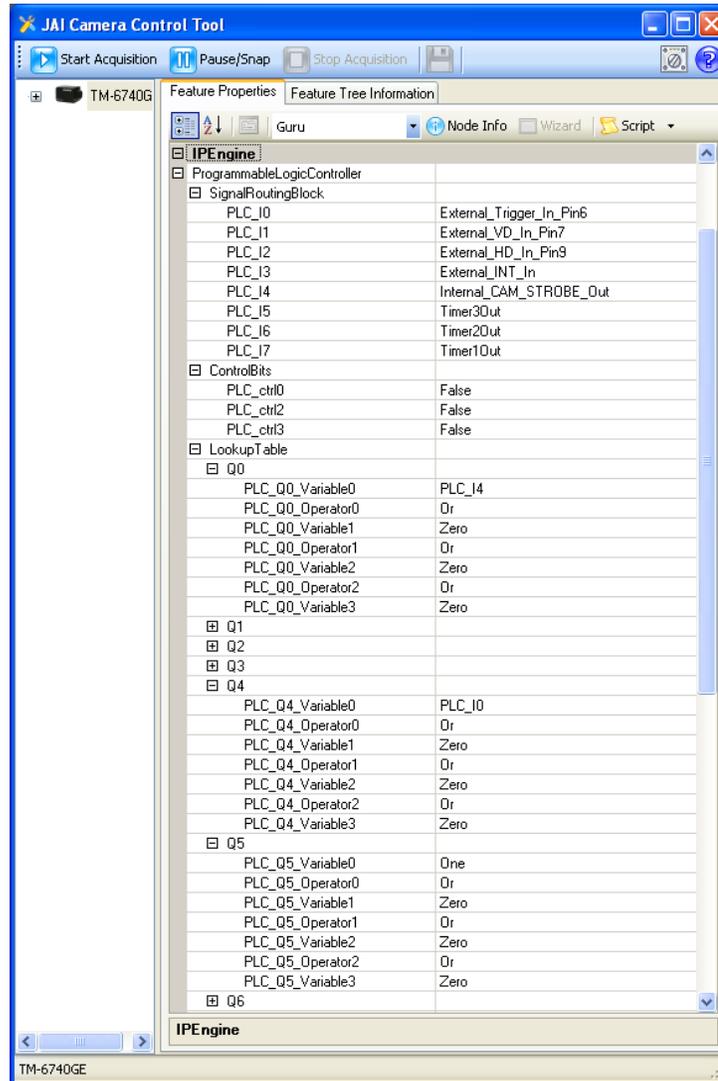
The Grabber is responsible for image transmission. All input and output signals pass through the Programmable Logic Controller (PLC). The PLC contains a Signal Routing Block, Control Bits, and Lookup Table. The PLC also contains 4 Pulse Generators and 1 general purpose counter. By GenICam naming convention the Pulse Generators are called Timers. The Counter and Timers are controlled under the CountersAndTimersControls category, and the other parts are controlled under the IPEngine category.

Figure 21. PLC LUT Diagram



Note: Ext\_VD, EXT\_HD, EVINIT and INTG\_CON all go the camera head. TTL Output (Strobe) goes outside the camera via Pin 8 of the 12-Pin cable.

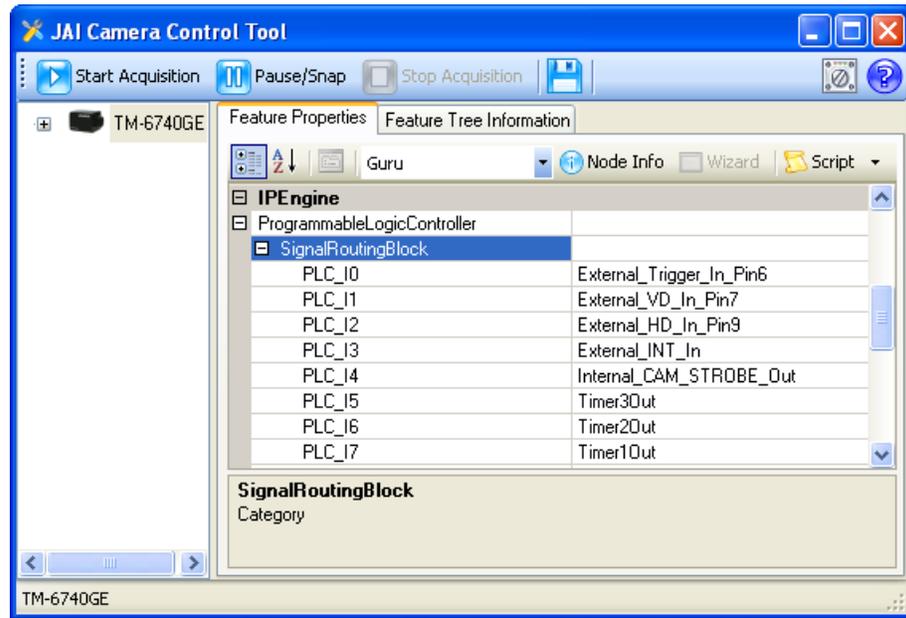
Figure 22. PLC



### 5.8.1 SignalRoutingBlock

The Signal Routing Block is a group of switches that lets you route signals to the PLC Lookup Table. There are a total of 8 input lines, numbered from I0 to I7. Each input line can accept a number of different signals. The input signals can be from the camera head, externally from the 12-Pin cable, or the PLC itself.

Figure 23. SignalRoutingBlock



Here are the possible input signals into the PLC:

Signal Source	Signal Name / Input Pin	Description
12 Pin	External_Trigger_In_Pin6	External trigger signal.
12 Pin	External_VD_In_Pin7	External vertical drive signal.
12 Pin	External_HD_In_Pin9	External horizontal drive signal.
12 Pin	External_INT_In	External Integration Control / Read Out Inhibit signal.
Camera	Internal_FDV_Out	Frame Data Valid output signal generated by camera head.
Camera	Internal_LDV_Out	Line Data Valid output signal generated by camera head.
Camera	Internal_CAM_STROBE_Out	Strobe output signal generated by the camera head.
PLC	PLC_ctrl0	True / False (High/Low) switch used for software trigger. (1)
PLC	PLC_ctrl2	True / False (High/Low) switch used for software trigger. (1)
PLC	PLC_ctrl3	True / False (High/Low) switch used for software trigger. (1)
PLC	PLC_Q2	PLC output that can be routed back to the PLC.
PLC	PLC_Q3	PLC output that can be routed back to the PLC.
PLC	PLC_Q6	PLC output. This signal is also connected to the EXT_VD that goes to the camera head. Please see the PLCSpecialConfigurations section below.
PLC	PLC_Q7	PLC output. This signal is also connected to the EXT_HD that goes to the camera head. Please see the PLCSpecialConfigurations section below.
Counter	Counter1Gt	Counter1's output signaling when the current count value is greater than some user defined value. Please see Counter section below.
Counter	Counter1Eq	Counter1's output signaling when the current count value equal to some user defined value. Please see Counter section below.

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Signal Source	Signal Name / Input Pin	Description
Pulse Generator	Timer1Out	Pulse Generator 1 output signal.
Pulse Generator	Timer2Out	Pulse Generator 2 output signal.
Pulse Generator	Timer3Out	Pulse Generator 3 output signal.
Pulse Generator	Timer4Out	Pulse Generator 4 output signal.

*Note: There is no PLC\_ctrl1.*

This table show possible signals each input line can accept (“(D)” specifies factory defaults):

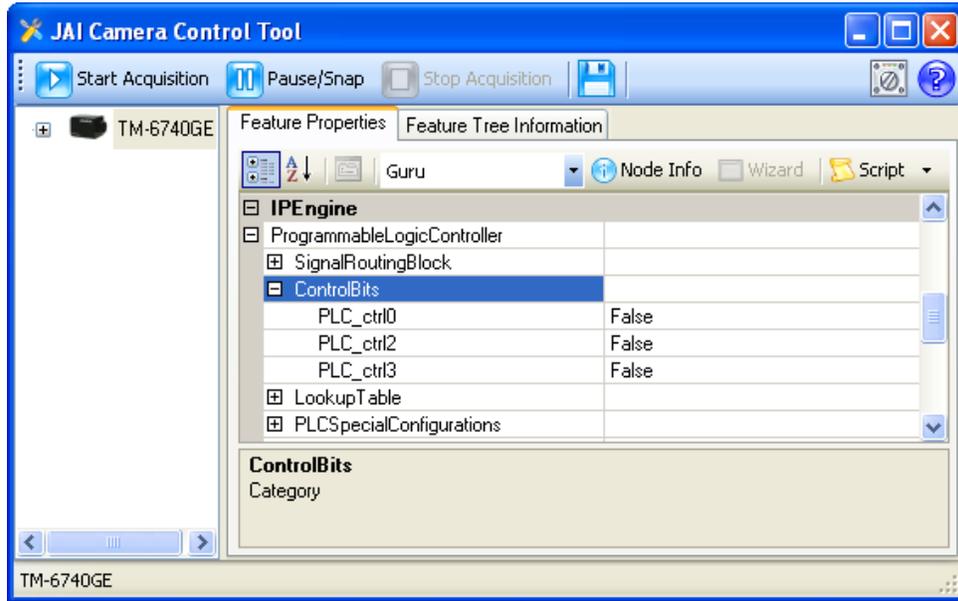
Signal Name / Input Pin	I0	I1	I2	I3	I4	I5	I6	I7
External_Trigger_In_Pin6	X(D)	X	X	X	X	X	X	X
External_VD_In_Pin7	X	X(D)	X	X	X	X	X	X
External_HD_In_Pin9	X		X(D)		X			
External_INT_In		X		X(D)		X		X
Internal_FDV_Out	X	X	X			X	X	X
Internal_LDV_Out	X	X		X	X			X
Internal_CAM_STROBE_Out	X	X	X	X	X(D)		X	X
PLC_ctrl0	X	X	X	X		X		X
PLC_ctrl2	X			X	X		X	
PLC_ctrl3		X	X			X		
PLC_Q2	X		X		X		X	
PLC_Q3		X		X		X		X
PLC_Q6	X		X		X		X	
PLC_Q7		X		X		X		X
Counter1Gt				X		X		X
Counter1Eq			X		X		X	
Timer1Out	X		X		X			X(D)
Timer2Out	X		X		X		X(D)	
Timer3Out		X		X		X(D)		X
Timer4Out		X		X			X	

### 5.8.2 ControlBits

There are 3 Control Bits: PLC\_ctrl0, PLC\_ctrl2, and PLC\_ctrl3. Note that PLC\_ctrl1 is not available. The control bits can be used as software triggers by toggling between two states: True and False. True sets the signal High, while False sets the signal to Low.

When a bit is toggled on the host software, a Write Register command is sent to the camera. The arrival time of the packet depends on current network traffic therefore is varied. These are recommended for testing purposes. For more precise trigger usage please use an external input trigger signal thru the 12-Pin connector. For a constant periodic trigger signal please use the Pulse Generators (Timers).

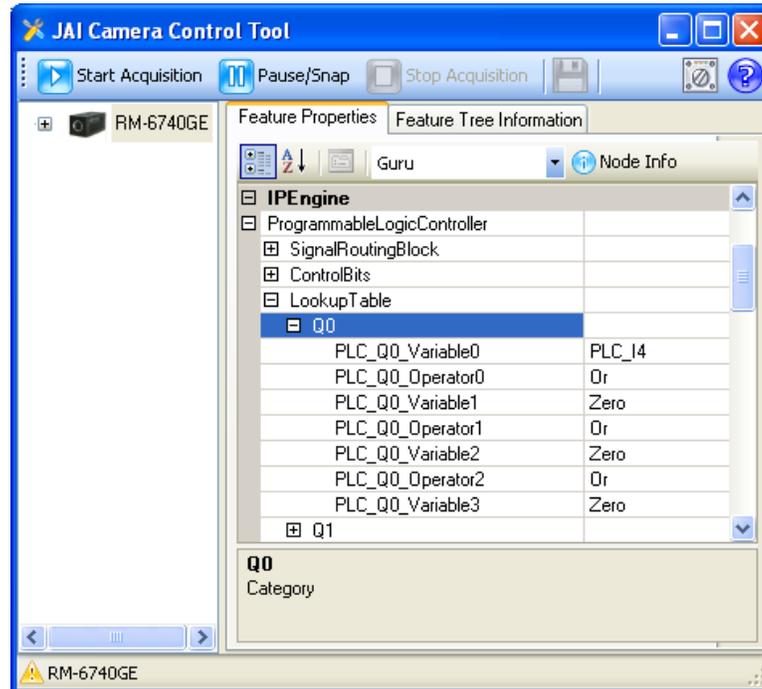
Figure 24. ControlBits



### 5.8.3 PLC LookupTable

The PLC Lookup Table lets you connect any input signal I0-I7 to any Lookup Table output signal Q0-Q17. You can manipulate your inputs using simple or complex Boolean operations. Each Q output results from the Boolean operations of 4 input variables and 3 Boolean operators.

Figure 25. PLC Q Output



The Q output allows the following Boolean operations:

- Variable0 Op0 Variable1 Op1 Variable2 Op2 Variable3
- (Variable0 Op0 Variable1) Op1 Variable2 Op2 Variable3
- Variable0 Op0 Variable1 Op1 (Variable2 Op2 Variable3)
- (Variable0 Op0 Variable1) Op1 (Variable2 Op2 Variable3)

All Q# controls follow this format:

- PLC\_Q#\_Variable0: the first input signal.
- PLC\_Q#\_Operator0: a Boolean operator.
- PLC\_Q#\_Variable1: the second input signal.
- PLC\_Q#\_Operator1: a Boolean operator.
- PLC\_Q#\_Variable2: the third input signal.
- PLC\_Q#\_Operator2: a Boolean operator.
- PLC\_Q#\_Variable3: the fourth input signal.

Each Variable has this selection:

- Zero: low signal.
- One: high signal.
- PLC\_I0
- ...
- PLC\_I7
- PLC\_I0\_Not: a Not operation is applied to the signal.
- ...
- PLC\_I7\_Not: a Not operation is applied to the signal.

Operator0 and Operator2 can have the following Boolean operations:

- And
- Or
- Xor
- AndParenthesis: creates a “(Variable0 & Variable1)”, or “(Variable2 & Variable3)” operation.
- OrParenthesis: creates a “(Variable0 | Variable1)”, or “(Variable2 | Variable3)” operation.
- XorParenthesis: creates a “(Variable0 XOR Variable1)”, or “(Variable2 XOR Variable3)” operation.

Operator1 can have the following Boolean operations:

- And
- Or
- Xor

### 5.8.4 PLCSpecialConfigurations

Switch Visibility mode to at least Expert to get access to these controls. There are two controls of interest in this category: PLC\_Q6\_Configuration and PLC\_Q7\_Configuration. These two controls affect which signal source the EXT\_VD and EXT\_HD come from.

*PLC\_Q6\_Configuration*: affects the EXT\_VD signal.

- Set to Zero to get the signal from the PLC\_Q6 output.
- Set to One to bypass the PLC LUT and get the signal directly from external 12-Pin cable.

*PLC\_Q7\_Configuration*: affects the EXT\_HD signal.

- Set to Zero to get the signal from the PLC\_Q7 output.
- Set to One to bypass the PLC LUT and get the signal directly from external 12-Pin cable.

*Note: If the EXT\_VD and EXT\_HD are not being used set PLC\_Q6\_Configuration and PLC\_Q7\_Configuration to Zero to prevent spurious signals. Improper setting can result in black lines across captured images.*

**Figure 26. PLC Special Configurations**

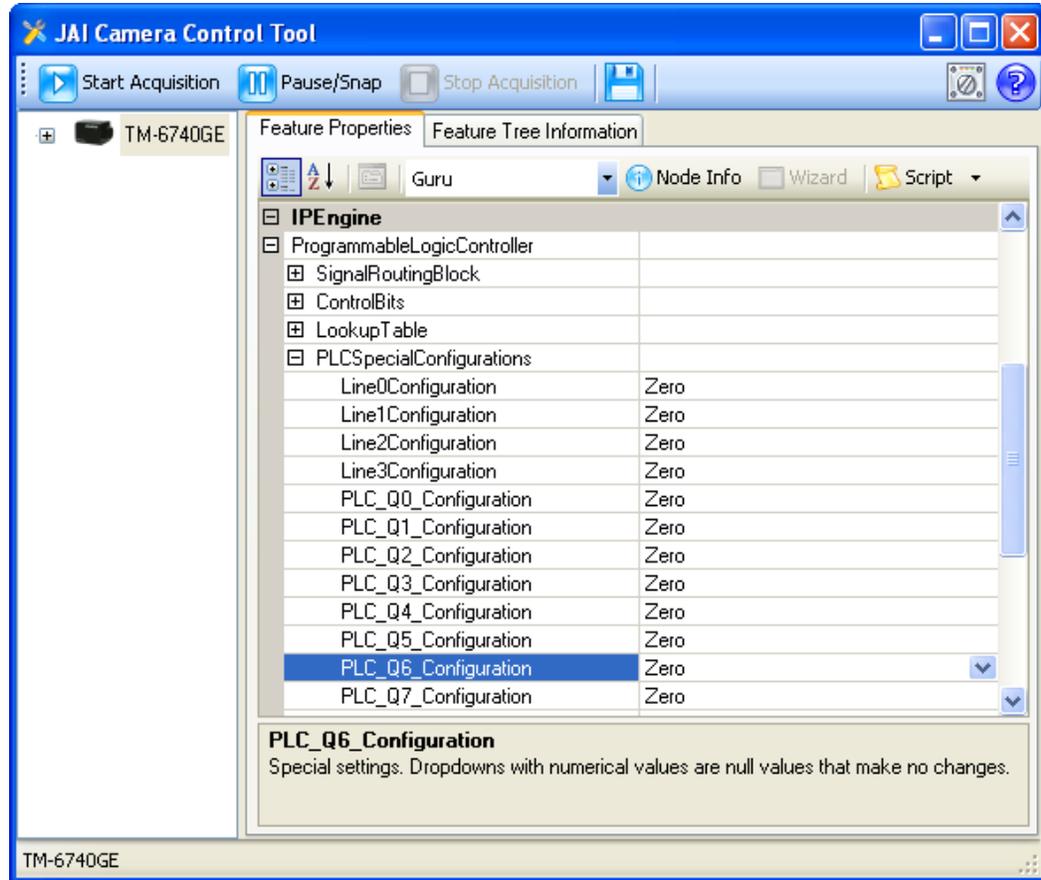
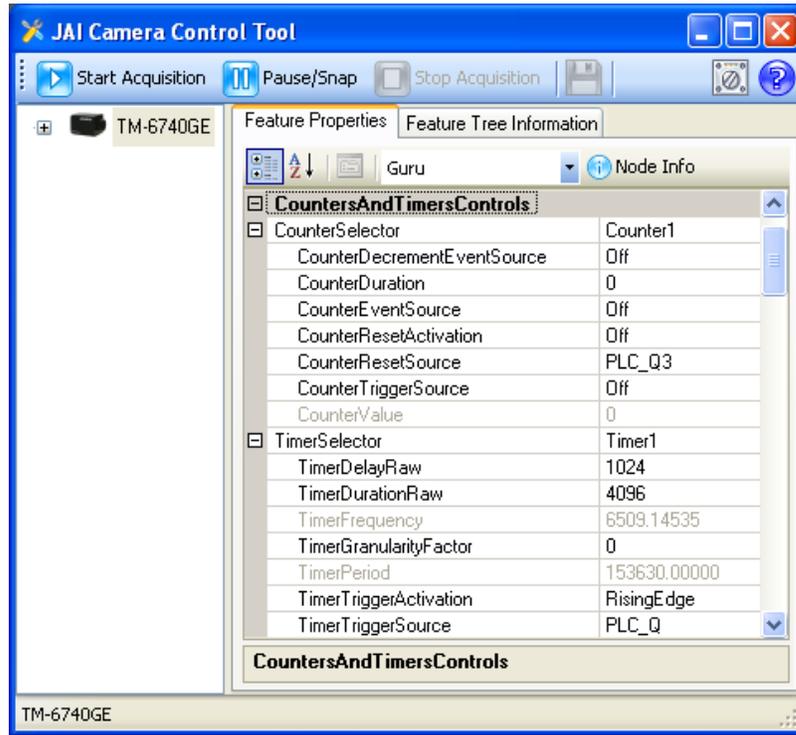
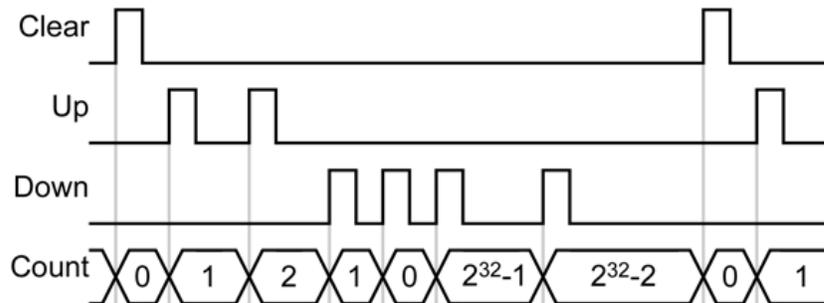


Figure 27. CountersAndTimersControls

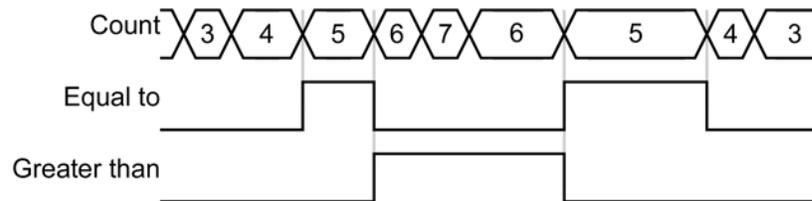


### 5.8.5 Counters

The General Purpose Counter lets you maintain a count between 0 and  $2^{32}-1$  (long integer). You can use different inputs to increment, decrement, or clear the counter value.



The General Purpose Counter outputs two separate signals that indicate when the count is equal to and greater than the compare value that you set: Counter1Gt and Counter1Eq. These signals are available on the Input lines in the Signal Routing Block.



(Compare value of 5)

*CounterSelector*: selects which counter to configure. There is only 1 counter called Counter1.

*CounterDecrementEventSource*: selects the events that will decrement the counter. This signal comes from the Q16 pin of the PLC LUT.

Available options:

- Off: no decrement events
- PLC\_Q16\_RisingEdge: decrement when the signal goes from Low to High
- PLC\_Q16\_FallingEdge: decrement when the signal goes from High to Low.
- PLC\_Q16\_AnyEdge: decrement on any Falling or Rising Edge.
- PLC\_Q16\_LevelHigh: decrement when the signal is at the High section.
- PLC\_Q16\_LevelLow: decrement when the signal is at the Low section.

*CounterDuration*: sets the value that the CounterValue will be compared to. When the CounterValue and CounterDuration are equal, the Counter1Eq signal will go high and stay high as long as the values are equal. When the CounterValue is greater than CounterDuration, the Counter1Gt signal will go high.

*CounterEventSource*: selects the signal event type that will increment the counter. This signal comes from the Q17 pin of the PLC LUT.

Available options:

- Off: no increment events
- PLC\_Q17\_RisingEdge: increment when the signal goes from Low to High
- PLC\_Q17\_FallingEdge: increment when the signal goes from High to Low.
- PLC\_Q17\_AnyEdge: increment on any Falling or Rising Edge.
- PLC\_Q17\_LevelHigh: increment when the signal is at the High section.
- PLC\_Q17\_LevelLow: increment when the signal is at the Low section.

*CounterResetActivation*: select the signal event type that will reset the counter. The counter will be reset to 0.

Available options:

- Off: no decrement events
- RisingEdge: increment when the signal goes from Low to High
- FallingEdge: increment when the signal goes from High to Low.
- AnyEdge: increment on any Falling or Rising Edge.
- LevelHigh: increment when the signal is at the High section.
- LevelLow: increment when the signal is at the Low section.

*CounterResetSource*: selects the source for the reset signal.

Available options:

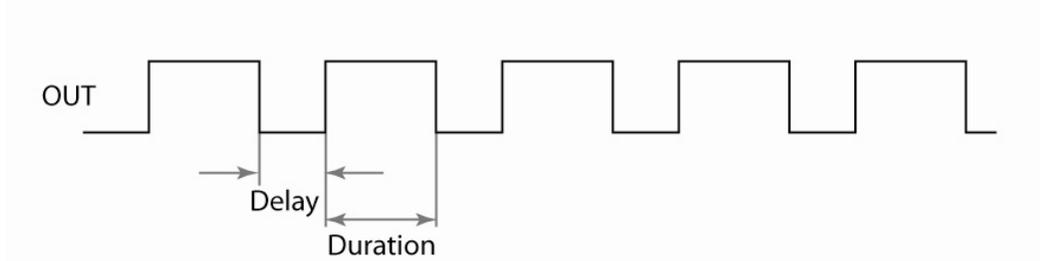
- PLC\_Q3
- PLC\_Q7
- PLC\_Q8
- PLC\_Q9
- PLC\_Q10
- PLC\_Q11
- PLC\_Q16
- PLC\_Q17

*CounterTriggerSource*: select the source signal to start the counter. Currently it is set to Off, meaning always on.

*CounterValue*: the read only value showing the current counter value.

5.8.6 Pulse Generators controls

The Pulse Generator lets you create a pulsed digital signal with a configurable frequency. They can be configured to emit a continuous (periodic) pulse. One use of this feature is to create a periodic trigger signal. The low section of the signal is called Delay, and the high is called Duration.



*TimerSelector*: chooses which Timer to configure.

*TimerDelayRaw*: configures the raw value of the low section of the output signal. The formula to calculate actual time is:

$$\text{Duration of Low (nsec)} = (\text{Granularity} + 1) * (\text{TimerDelayRaw} + 1) * 30$$

*TimerDurationRaw*: configures the raw value of the high section of the output signal. The formula to calculate actual time is:

$$\text{Duration of High (nsec)} = (\text{Granularity} + 1) * \text{TimerDurationRaw} * 30$$

*TimerFrequency*: a read-only field that shows the frequency of the pulse in Hz.

*TimerGranularityFactor*: a multiplier value used to scale the Delay and the Duration in increments of 30 nsec.

*TimerPeriod*: shows the timer's period in units of nsec.

*TimerTriggerActivation*: select the signal state of the TriggerSource to start the Timer.

- RisingEdge: starts when the trigger signal goes from Low to High
- LevelHigh: starts when the trigger signal is at the High state.
- FallingEdge: starts when the trigger signal goes from High to Low.
- AnyEdge: starts on any Falling or Rising Edge.
- LevelLow: starts when the trigger signal is at the Low state.

*TimerTriggerSource*: select the source of trigger to start the Timer.

- PLC\_Q: the trigger source comes from the PLC Q output. Each Timer has their source from different Q output port:
  - Timer1 trigger comes from PLC\_Q9
  - Timer1 trigger comes from PLC\_Q8
  - Timer1 trigger comes from PLC\_Q11
  - Timer1 trigger comes from PLC\_Q10
- Continuous: the Timer is always running.

**5.8.7 PLC Grabber Features**

IPEngine → Grabber → Channel0 → AcquisitionConfiguration

*GrbCh0AcqCfgMemoryWaterLevel*: the camera has 16MB of memory for frame buffering. Water level setting specifies how much of that memory to use with the AcquisitionMode’s recording features. Once the buffer is full no more images will be stored. Possible settings are:

- Level50: 50%
- Level75: 75%
- Level87Point5: 87.5%
- Level100: 100%

*GrbCh0AcqCfgInvertPixelData*: invert pixel data turning the image into a negative image.

- True: turn on pixel inversion.
- False: turn off pixel inversion.

IPEngine → Grabber → Channel0 → TriggerConfiguration

*GrbCh0TrigCfgFrameToSkip*: set the number of images to discard for every one it keeps from the camera head.

**5.8.8 IPEngine Examples:**

Example 1: Setting the camera to accept external trigger signal:

1. Set ExposureMode to one of the Asynchronous modes.
2. Setup SignalRoutingBlock
  - a. Goto IPEngine > ProgrammableLogicController > SignalRoutingBlock
  - b. Set Trigger Input line by setting PLC\_I0 to External\_Trigger\_In\_Pin6
  - c. Set Camera Strobe Output by setting PLC\_I4 to “Internal CAM\_STROBE\_Out”.
3. Setup the PLC to route the external trigger signal to the camera’s trigger line.
  - d. Goto IPEngine > ProgrammableLogicController > LookupTable > Q0/Q4/ Q5
    - i Set PLC\_Q0\_Variable0 to PLC\_I4 (Strobe output)
    - ii Set PLC\_Q4\_Variable0 to PLC\_I0 (Trigger Line)
    - iii Set PLC\_Q5\_Variable0 to One. (Integration signal always on.)

Example 2: Setting the camera to accept internal trigger signal generated via Timer 1:

1. Set ExposureMode to one of Asynchronous modes.
2. Setup the Timer (Pulse Generator)
  - a. Set TimerSelector to Timer1.
  - b. Set TimerTriggerSource to Continuous.
  - c. Set TimerDurationRaw, TimerDelayRaw, TimerGranularityFactor according to values below.
    - i These are example values only; other combinations can also be used.
    - ii TimerFrequency tells you the rate of the trigger, hence frame rate.

	<0.5 fps	1 fps	5 fps
TimerDurationRaw	200	200	200
TimerDelayRaw	10000	4550	750
TimerGranularityFactor	7000	7000	7000

3. Setup SignalRoutingBlock
  - a. Goto IPEngine > ProgrammableLogicController > SignalRoutingBlock

- b. Set PLC\_I4 to “Internal CAM\_STROBE\_Out”.
  - c. Set PLC\_I7 to Timer1Out.
4. Setup the ProgrammableLogicController (PLC) to route the Timer1 output to the camera’s trigger line.
- a. Goto IPEngine > ProgrammableLogicController > LookupTable
    - i Set Q4 > PLC\_Q4\_Variable0 to PLC\_I7 (Trigger Line)
    - ii Set Q0 > PLC\_Q0\_Variable0 to PLC\_I4 (Strobe output)
    - iii Set Q5 > PLC\_Q5\_Variable0 to One. (Integration signal always on.)

Example 3: Setting up Integration Signal routing from external source:

1. Goto IPEngine > ProgrammableLogicController > SignalRoutingBlock
2. Set PLC\_I3 to External\_INT\_In
3. Goto IPEngine > ProgrammableLogicController > LookupTable
4. Set Q5 > PLC\_Q5\_Variable0 to PLC\_I3. (Integration signal always on.)

### 5.9 Register Map

Category / Feature	Read/Write	Value Range	Default Value	Visibility Level
<i>AcquisitionAndTriggerControls</i>				
AcquisitionMode	RW	Continuous SingleFrame MultiFrame ContinuousRecording ContinuousReadout SingleFrameRecording SingleFrameReadout	Continuous	Beginner
AcquisitionFrameCount	RW	1-255	1	Beginner
AcquisitionStart	RO	Execute Command		Beginner
AcquisitionStop	RO	Execute Command		Beginner
ExposureMode	RW	Off ContinuousPreset1 ... ContinuousPreset9 ContinuousProgrammable AsyncNoShutter AsyncPreset1            ... AsyncPreset8 AsyncPreset9 AsyncProgrammable	Off	Beginner
AsyncProgrammable	RW	0-2079	Factory Set	Beginner
ContinousProgrammable	RW	499 (ScanMode: A and C) 200 (All other ScanModes)		Beginner
<i>AnalogControls</i>				
GainSelector	RW	Tap1 Tap2	Tap1	Beginner
GainRaw	RW	66-488	Factory Set	Beginner
GainAutoBalance	RW	Off Once	Off	Beginner
BlackLevelSelector	RW	Tap1 Tap2	Tap1	Expert

Category / Feature	Read/Write	Value Range	Default Value	Visibility Level
BlackLevelRaw	RW	0-511	Factory Set	Expert
BlackLevelAutoBalance	RW	Off Continuous	Continuous	Expert
<i>CountersAndTimersControls</i>				
TimerSelector	RW	Timer1 Timer2 Timer3 Timer4	Timer1	Beginner
TimerDelayRaw	RW	1-65535	1024	Beginner
TimerDurationRaw	RW	1-65535	4096	Beginner
TimerGranularityFactor	RW	1-65535	0	Beginner
TimerTriggerActivation	RW	RisingEdge LevelHigh FallingEdge AnyEdge LevelLow	RisingEdge	Beginner
TimerTriggerSource	RW	PLC_Q Continuous	PLC_Q	Beginner
CounterSelector	RW	Counter1	Counter1	Beginner
CounterDecrementEventSource	RW	Off PLC_Q16_RisingEdge PLC_Q16_FallingEdge PLC_Q16_AnyEdge PLC_Q16_LevelHigh PLC_Q16_LevelLow	Off	Beginner
CounterDuration	RW	0-4294967295	0	Beginner
CounterEventSource	RW	Off PLC_Q17_RisingEdge PLC_Q17_FallingEdge PLC_Q17_AnyEdge PLC_Q17_LevelHigh PLC_Q17_LevelLow	Off	Beginner
CounterResetActivation	RW	Off RisingEdge FallingEdge AnyEdge LevelHigh LevelLow	Off	Beginner
CounterResetSource	RW	PLC_Q3 PLC_Q7 PLC_Q8 PLC_Q9 PLC_Q10 PLC_Q11 PLC_Q16 PLC_Q17	PLC_Q3	Beginner
CounterTriggerSource	RW	Off	Off	Beginner
CounterValue	RO	0 - 4294967295		Beginner

## TM-6740GE Series

Category / Feature	Read/Write	Value Range	Default Value	Visibility Level
<i>DeviceInformation</i>				
DeviceVendorName	RO			Beginner
DeviceModelName	RO			Beginner
DeviceManufacturerInfo	RO			Beginner
DeviceVersion	RO			Beginner
DeviceID	RO			Expert
DeviceUserID	RW	User definable string		Beginner
<i>GigEVisionTransportLayer</i>				
GevSCPSPacketSize	RW	72 - 16260	1428	Expert
GevPersistentIPAddress	RW	000.000.000.000 - 255.255.255	000.000.000.000	Expert
GevPersistentSubnetMask	RW	000.000.000.000 - 255.255.255	000.000.000.000	Expert
GevPersistentDefaultGateway	RW	000.000.000.000 - 255.255.255	000.000.000.000	Expert
GevCurrentIPConfigurationPersistenIP	RW	On Off	Off	Beginner
<i>ImageSizeControl</i>				
SensorDigitizationTaps	RW	Two	Two	Expert
WidthMax	RO	0 - 640		
HeightMax	RO	0 - 480		
Width	RW	0 to (WidthMax - OffsetX)		Beginner
Height	RW	0 to (HeightMax - OffsetY)		Beginner
OffsetX	RW	WidthMax - Width		Beginner
OffsetY	RW	HeightMax - Height		Beginner
PixelFormat	RW	Monochrome: Mono8 Mono10 Mono10Packed Bayer: BayerGR8 BayerGR10	Monochrome: Mono8 Bayer: BayerGR8	Beginner
ScanMode	RW	A_640x480 B_640x160 C_224x480 D_224x160 U_UserProgrammable	A_640x480	Beginner
BinningMode	RW	Binning1x1 Binning1x2 Binning1x4 Binning2x2 ... Binning4x4	Binning1x1	Beginner

Category / Feature	Read/Write	Value Range	Default Value	Visibility Level
TestImageSelector	RW	Off DeviceSpecific IPEngineTestPattern	Off	Beginner
<i>LUT</i>				
LUTMode	RW	Linear Gamma45 Knee	Linear	Beginner
KneeX1	RW	0 - 255	255	Beginner
KneeY1	RW	0 - 255	255	Beginner
KneeX2	RW	0 - 255	255	Beginner
KneeY2	RW	0 - 255	255	Beginner
LUTInversion	RW	Execute Command		Beginner
<i>UserSets</i>				
UserSetSelector	RW	Default UserSet1	UserSet1	Beginner
UserSetLoad	RW	Execute Command		Beginner
UserSetSave	RW	Execute Command		Beginner
UserSetDefaultSelector	RW	Default UserSet1	UserSet1	Expert

## 6 Troubleshooting

### 6.1 Problems and Solutions

Following are troubleshooting tips for common problems. Generally, problems can easily be solved by following these instructions. If the following remedies fail to offer a solution to your problems, please contact a JAI representative.

#### 6.1.1 Symptom: No Video

Remedies: Check that the following are properly connected and operational.

- Power supplies
- Power cables
- Main power source
- Shutter control
- Async mode
- Lens
- Digital output cable
- Analog video cable

#### 6.1.2 Symptom: Dark Video

Remedies: Check that the following are properly connected and operational.

- Shutter selection
- Iris opening on the lens

#### 6.1.3 Symptom: Non-Synchronized Video

Remedies: Check that the following are properly connected and operational.

- Proper mode output
- Frame grabber software camera selection

### 6.2 Information and Support Resources

For further information and support:

**Phone:** (408) 383-0300  
(800) 445-5444  
**Fax:** (408) 383-0301  
**Email:** [camerasales.americas@jai.com](mailto:camerasales.americas@jai.com)  
**Mail:** JAI, Inc.  
Sales Department  
625 River Oaks Parkway  
San Jose, CA 95134  
  
ATTN: Video Applications  
**Web site:** [www.jai.com](http://www.jai.com)

## 7 Appendix

### 7.1 Specifications

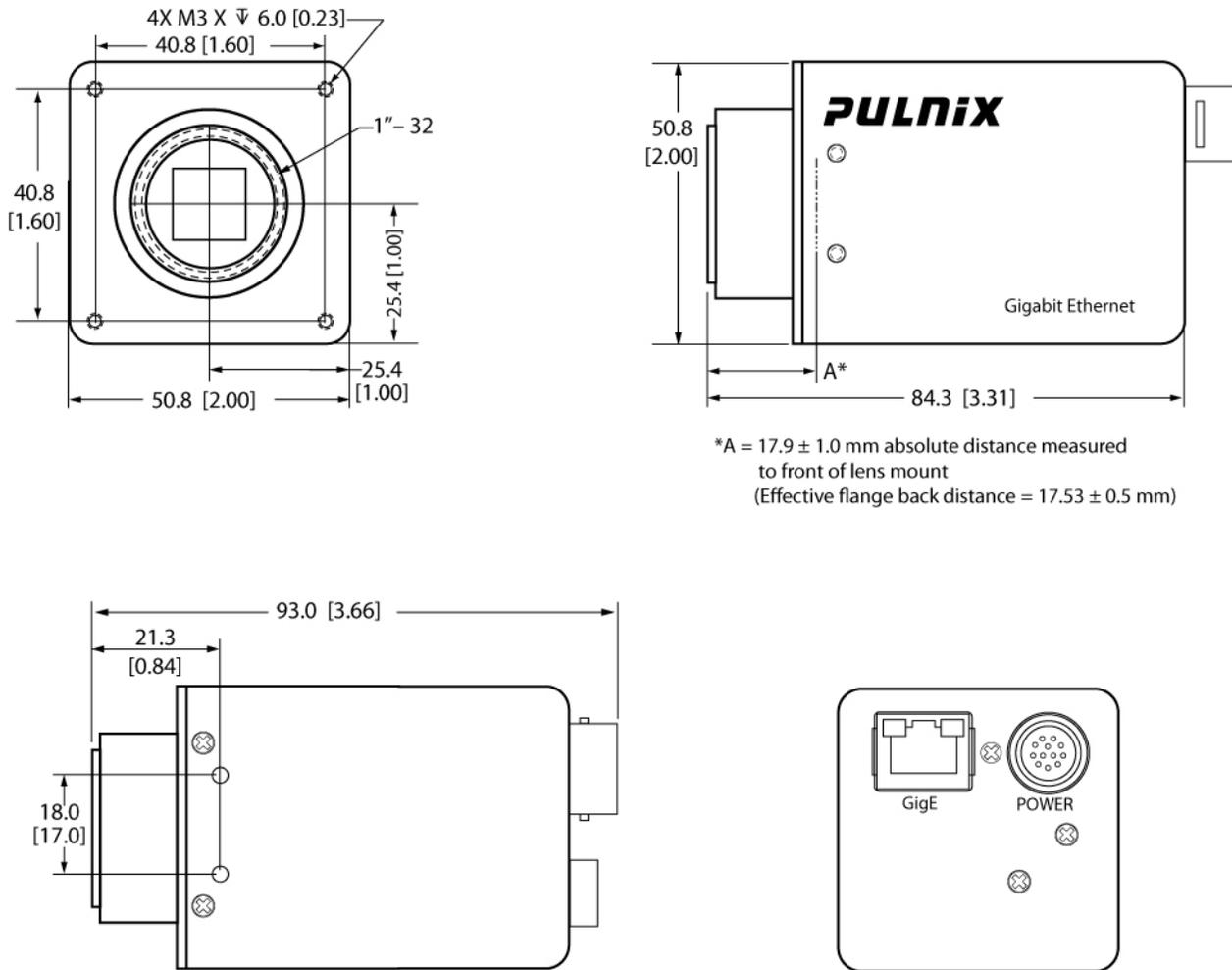
Table 9 TM-6740GE Camera Specifications Table

Feature	TM-6740GE
Imager	1/3" progressive scan interline transfer CCD (KAI-0340)
Active Area	4.74mm x 3.55mm
Active Pixels	640 (H) x 480 (V)
Cell Size	7.4µm x 7.4µm
Display Mode (Active Pixels)	640 (H) x 480 (V) @ 200 Hz (full image) 640 (H) x 160 (V) @ 540Hz (partial scan) 224 (H) x 480 (V) @ 500Hz (partial scan) 224 (H) x 160 (V) @ 1250Hz (partial scan) (1x2, 1x4, 2x1, 2x2, 2x4, 4x1, 4x2, 4x4 binning)
Sync	Internal/External auto switch HD/VD, 4.0 Vp-p impedance 4.7 K ohms VD=frame rates±2%, non-interlace HD=100 kHz ±2%
Data Clock Output	40.00 MHz
Resolution	Digital: 640 (H) x 480 (V), (Analog: over 480 TV lines (H) x 480 TV lines (V))
S/N Ratio	50dB min.
Min. Illumination	Monochrome: 1.4 lux. Color: 11.0 lux. f = 1.4, no shutter, 200 fps. Sensitivity: 30µV/e-
Video Output	Analog: 714 mV, 75 ohms, (750 mV white clip) Digital output: 8-bit / 10-bit Gigabit Ethernet (selectable)
Gamma	Programmable LUT (1.0 std.)
Lens Mount	C-mount (use >1/3" format lenses or larger)
Power Requirement	12V DC, ±10%, 440mA (typical at 25°C)
Operating Temp.	-10°C to 50°C*
Vibration	7 Grms (10Hz to 2000Hz) Random, 11 ms half sine
Shock	70G
Size (W x H x L)	51mm x 51mm x 84mm
Weight	194 grams (6.17 oz.) without tripod
Optional Functions	OP 3-1, internal IR filter; OP 3-2, optical filter removal; OP 21, glassless CCD imager; OP 21-UV, QUV glassless CCD imager with quartz window
Optional Accessories Power Cable Power Supply Tripod Mounting Kit	12P-02S PD-12UUP series (includes power connector) TP-20

\*. Refer to Section 2.2.1 for information on camera heat dissipation. Image quality will degrade with increasing temperature.

7.1.1 TM-6740GE Physical Dimensions

Figure 28. Physical Dimensions



\*A = 17.9 ± 1.0 mm absolute distance measured to front of lens mount  
(Effective flange back distance = 17.53 ± 0.5 mm)

*Caution: When mounting the camera to any fixture, do not use screws that extend more than 5 mm into the camera housing to avoid possible damage to the internal circuitry. For attaching the tripod mounting plate, only the supplied screws should be used.*

7.1.2 Spectral Response

Figure 29. TM-6740 Spectral Response

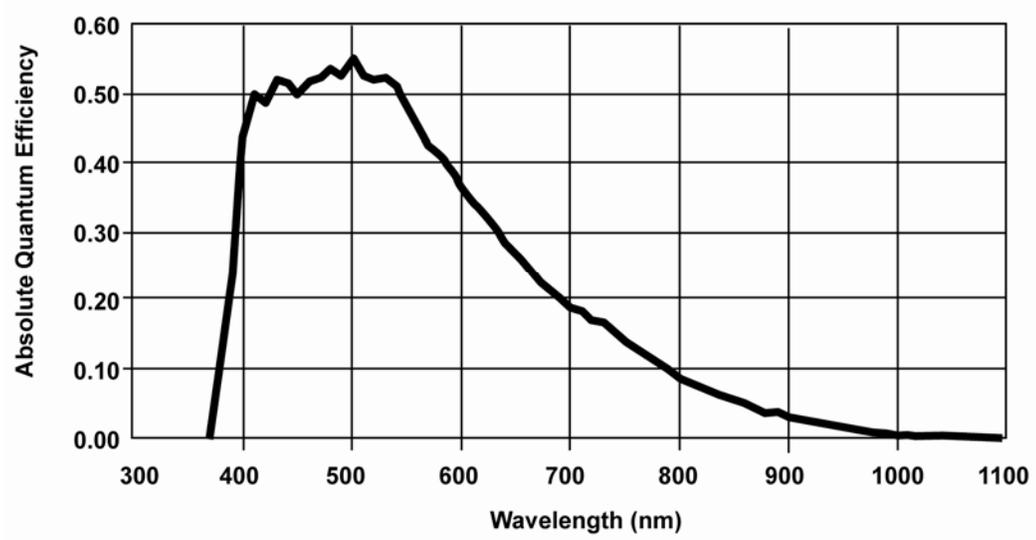
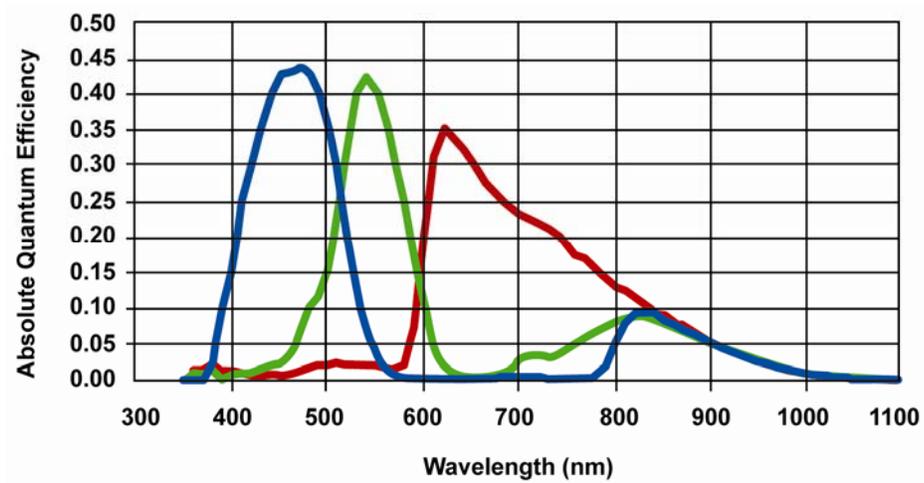


Figure 30. TMC-6740 Spectral Response





# Supplement

This applies to cameras in this manual that are RoHS compliant, which are noted by RM or RMC.

The following statement is related to the regulation on “ Measures for the Administration of the control of Pollution by Electronic Information Products “ , known as “ China RoHS “ . The table shows contained Hazardous Substances in this camera.

 mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

## 重要注意事项

### 有毒，有害物质或元素名称及含量表

根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《有毒，有害物质或元素名称及含量表》如下。

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
外壳	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
.....	.....	.....	.....	.....	.....	.....

○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。  
×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。  
(企业可在此处、根据实际情况对上表中打“×”的技术原因进行进一步说明。)



### 环保使用期限

电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。

数字「15」为期限15年。

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**Europe, Middle East & Africa**  
Phone +45 4457 8888  
Fax +45 4491 3252

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**Asia Pacific**  
Phone +81 45 440 0154  
Fax +81 45 440 0166

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**Americas**  
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Phone +1 408 383-0301

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