See the possibilities

User's Manual

TM-700
TM-705 NIR

High resolution Interline Transfer CCD

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Warranty

Please contact your factory representative for details about the warranty.

Certifications

CE Compliance

The TM-700 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-700 series Operation Manual

JAI Inc.
625 River Oaks Parkway
San Jose, CA 95134
Tel:(408) 383-0300
Tel:(800) 445-5444
Fax:(408) 383-0301
www.jai.com

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1.TM-700 series Camera Control Software

1 Introduction

The TM-700 series are high resolution, interline transfer CCD scan cameras. This software opens the RS-232 serial port (COM). This document addresses the JAI TM-700 series Camera software available for download at www.jai.com.

1.1 Software Installation

Following are instructions to install the TM-700 series Camera Software on a PC.

1.1.1 Before Installing the Camera-Control Software

Before installing the Camera-Control Software, please note the following.

- The TM-700 series camera-control software is tested for Microsoft Windows 2000 and XP operating systems.
- We recommend that you use small fonts for the Display Properties dialog box in the control panel.
- The TM-700 series camera-control software requires one free communication port that is not in conflict with other peripherals such as the mouse or modem.

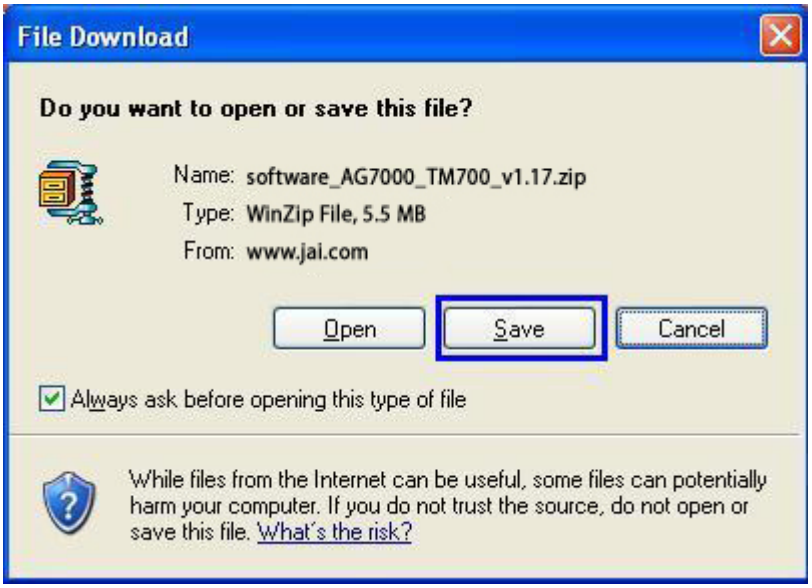
1.1.2 Installing the Software

To install the TM-700 series camera-control software, follow the steps below.

1. Download the TM-700 series software from the JAI, Inc. web site at www.jai.com.
2. Locate the software by going to the camera description (TM-700) and clicking on the Software link, or searching using the site search feature.
3. Click on the “Save” button to save a compressed copy of the software to the hard drive of your system.

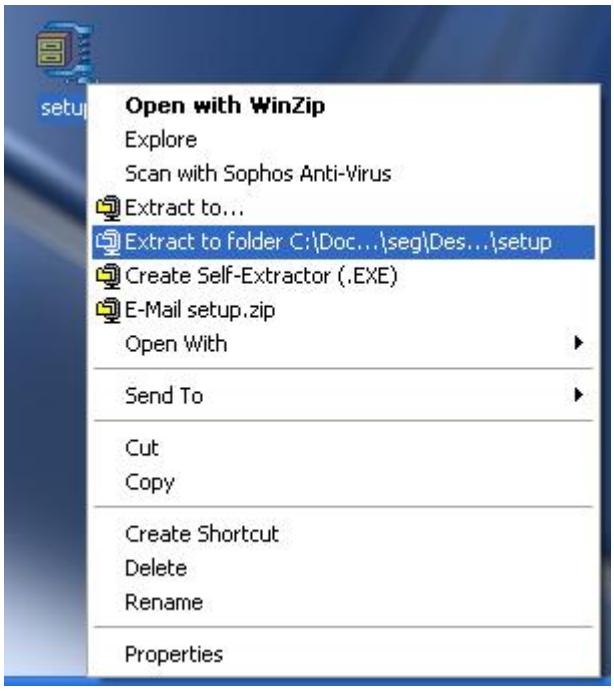
Note: If you go to software and download based on the camera description, for example, TM-700, the software download is the correct, and latest released version.

Figure 1. Use Save to download a copy of the software.



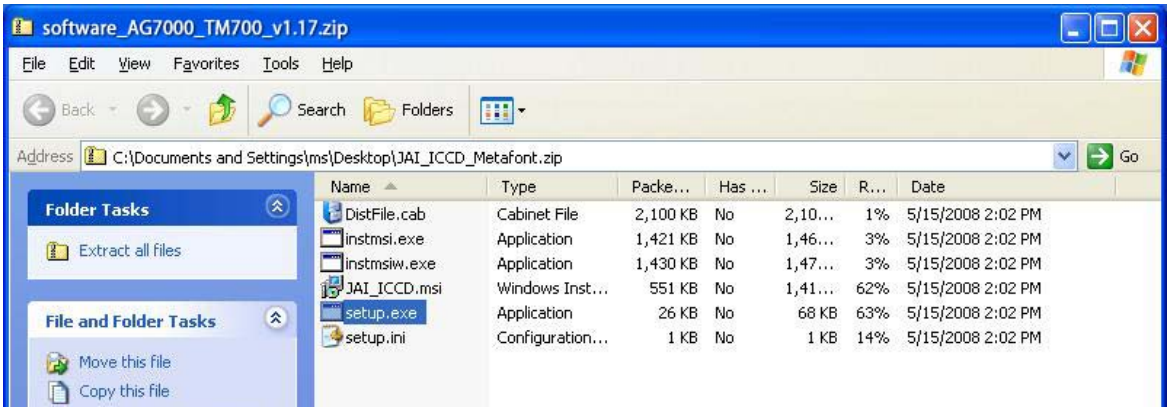
The software is compressed, use decompression software to create the installation directory.

Figure 2. Right click to extract the compressed files.



By choosing to "Extract to folder..." (C: normally indicates the hard drive that includes the desktop) the directory is in the same place as the download, and can be easily moved to any desired location.

Figure 3. The extraction directory has the same name as the zip file.



3.Open the directory and double-click on setup to begin the TM-700 series software install.

4.Follow the installation instructions.

Note: You can change the installation directory if you want.

1.1.2.1 Uninstalling Previous TM-700 series JAI, Inc. Software

- If you already have TM-700 series software on the hard drive, the installer asks to uninstall the software.
- Accepting the uninstall allows the existing software to be removed. The installer then closes.
- To initiate a new installation it is necessary to click “Setup” again.

Figure 4. Uninstall Existing TM-700 Series Software

1.1.3 Fresh Installation of the TM-700 series Software

- Start by clicking on the Setup icon in the software folder.
- Click Next to begin a clean install.

Figure 5. Clean Install of TM-700 series Software

- Accept the default installation path by clicking Next, if there is room on the hard drive. Use the browse button if you wish to set a different installation path.
- Click the Next button twice to begin the actual software installation.

Figure 6. Accept the default install path.

Figure 7. A bar indicates installation progress.

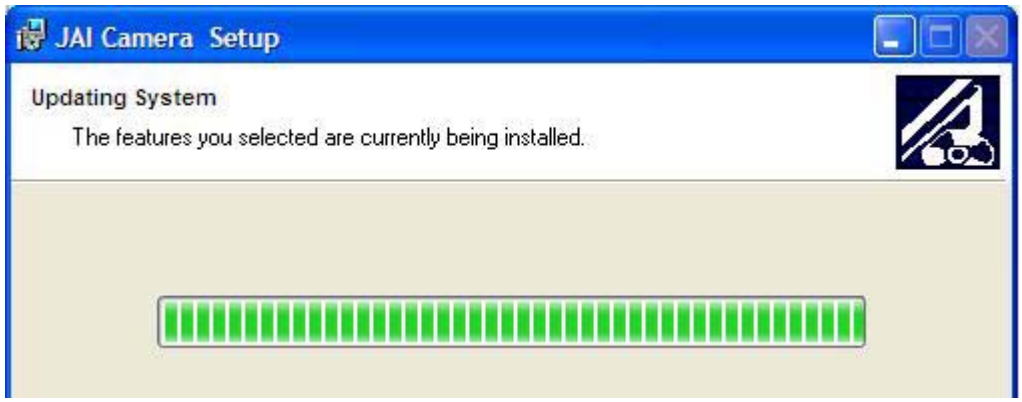


Figure 8. The installer asks to close.

- It is not necessary to restart the computer after installing the TM-700 series software.
- Click on the Windows Start menu to access a shortcut to the TM-700 series software.
- Click on the JAI_TM-700 series icon to start the software.

Figure 9. A shortcut provides easy access to the TM-700 series software.

1.2 Using the TM-700 series Software

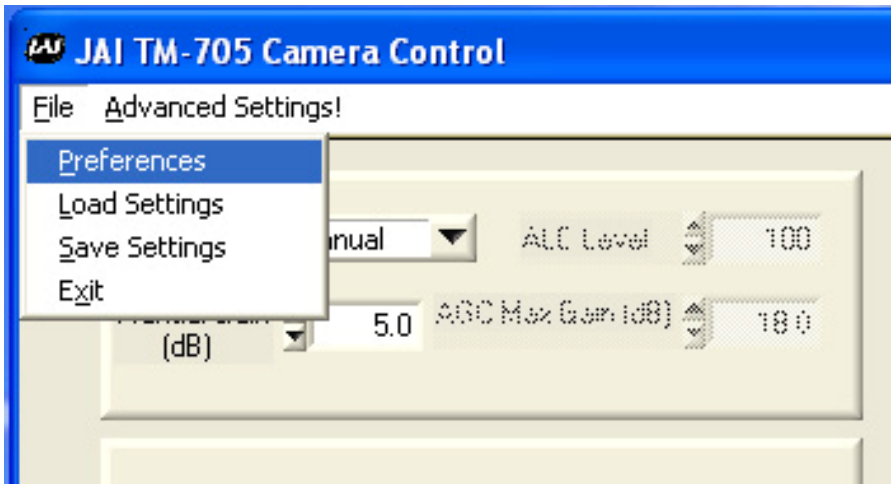
You must connect a camera via an RS-232 cable to the computer and power it up before starting the camera control software.

Start the TM-700 series software by clicking on the Start menu, and then selecting JAI_TM-700 series and clicking the JAI_TM-700 series shortcut on the right (Figure 9 on page 15).

1.2.1 The Main Screen

The main screen offers several menus. Click on File in the menu bar to access the following:

Figure 10. Main Screen File Menu

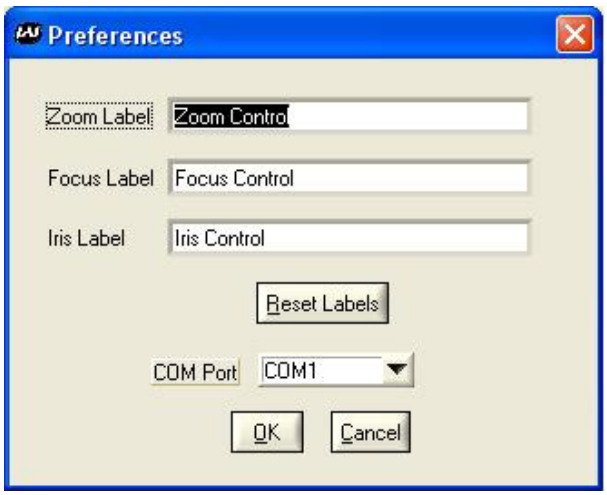


1.2.1 (a) Preferences

Selecting Preferences opens a separate window that allows the user to set the COM port the camera will use to interface with the computer. Set the port number by selecting it in the COM Port drop down list box. The system defaults to the COM port number where the camera is attached.

In addition, the label names (i.e. Zoom Control, Focus Control, Iris Control) can be renamed to suit user preferences in this window.

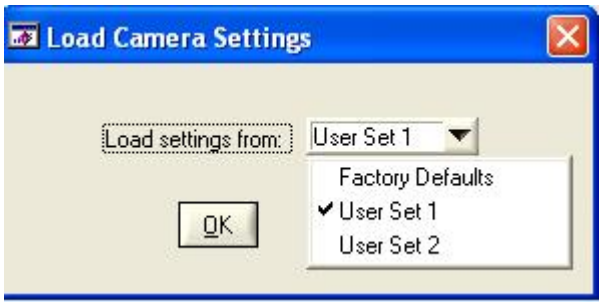
Figure 11. Set the COM Port



1.2.1 (b) Load Settings

Selecting Load Settings causes the camera to open a separate window that allows the user to select the camera settings they will use to interface with the computer. The factory defaults are saved in the camera. Users can access UserSet1 and UserSet2 once settings have been saved into the camera.

Figure 12. Load Settings Selections



1.2.1 (c) Save Settings

Selecting Save Settings causes the camera to open a separate window that allows the user to save their currently configured camera settings. As a user you can create UserSet1 and UserSet2 by selecting the appropriate line of the drop down menu. Factory Defaults cannot be overwritten.

Figure 13. Saving Settings

1.2.1 (d) Exit

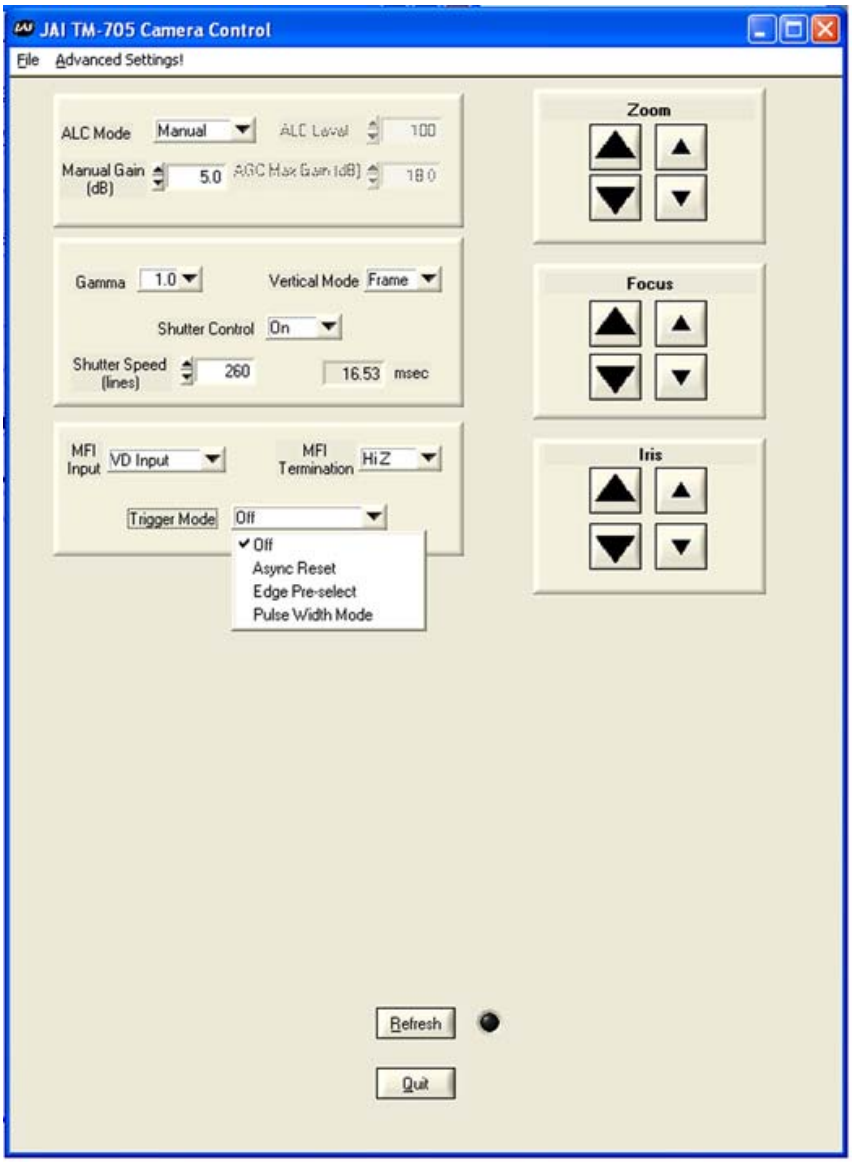
Selecting Exit closes the JAI TM-700 series Camera Control program.

1.3 Camera Control Main Window

The camera is configured using the main window.

The main window has these controls from left to right:

- ALC
  - ALC Mode
  - ALC Level
  - ALC Gain
  - ALC Max Gain
- Gamma
  - Gamma
  - Vertical Mode
  - Shutter Control
  - Shutter Speed
- MFI
  - MFI Input
  - MFI Termination
  - Trigger Mode
- Zoom Control
  - Zoom In Coarse
  - Zoom In Fine
  - Zoom Out Coarse
  - Zoom Out Fine
- Focus Control
  - Focus In Coarse
  - Focus In Fine
  - Focus Out Coarse
  - Focus Out Fine
- Iris Control
  - Iris Open Coarse
  - Iris Open Fine
  - Iris Closed Coarse
  - Iris Closed Fine



1.4 Control Details

Figure 14. AEC Controls Set

1.4.1 ALC

The automatic level control determines how the camera responds to incoming light. In automatic mode, the camera varies its internal gain and shutter speed to get a consistent exposure based on the setting of the other ALC parameters. In manual mode the Manual Gain setting and Shutter Speed control may be adjusted to get the desired exposure.

- Manual Gain

The Manual Gain allows you to set the system gain. The range is from 5dB to 32dB. The Manual Gain control is only operative when the ALC Mode is set to Manual.

- ALC Level

The ALC Level setting determines the desired exposure level when the ALC Mode is set to Automatic. The units are arbitrary and vary from 0 to 255. A higher Level setting will result in a brighter image.

- ALC Max Gain

The ALC Max Gain setting specifies the maximum system gain that will be applied when ALE Mode is set to Automatic.

- ALC Mode

In Automatic Mode the system will automatically adjust the gain and shutter speed to maintain a consistent exposure level. In Manual Mode the user may adjust the Manual Gain and Shutter Speed setting to obtain the desired exposure level.

1.4.2 Video

Figure 15. Video Control Set

- Video Pedestal

The Video Pedestal sets the black level reference for the video output.

- Video White Clip

The Video White Clip sets the maximum level for the analog signal at saturation.

- Vertical Mode

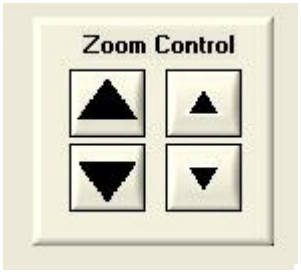
The frame mode is the standard interlaced method of horizontal line transfer. In the first field the odd lines are transferred, in the second field the even lines are transferred. This is the normal mode of operation, each pixel is integrated for an entire field. Vertical resolution is good but there is a tendency to show vertical Moire when compared with field mode.

In field mode, during each transfer, two adjacent lines are summed together and shifted out. This increases the sensitivity by a factor of two but reduces vertical resolution.

1.4.3 Zoom Control

The zoon control allows you to remotely focus the camera lens on a motorized zoom lens when properly wired to the 15-=pin connector.

Figure 16. Zoom Control Set



- Zoom In Coarse

Pressing and holding this button causes the lens to “zoom in” in a rapid fashion. Releasing the button causes the zoom to stop. The speed of the zoom may be set using the Advanced Setting Menu (see section 1.4.12)

- Zoom In Fine

Pressing and holding this button causes the lens to “zoom in” in a slow fashion. Releasing the button causes the zoom to stop. The speed of the zoom may be set using the Advanced Setting Menu (see section 1.4.12)

- Zoom Out Coarse

Pressing and holding this button causes the lens to “zoom out” in a rapid fashion. Releasing the button causes the zoom to stop. The speed of the zoom may be set using the Advanced Setting Menu (see section 1.4.12)

- Zoom Out Fine

Pressing and holding this button causes the lens to “zoom out” in a slow fashion. Releasing the button causes the zoom to stop. The speed of the zoom may be set using the Advanced Setting Menu (see section 1.4.12)

Note: This capability requires a lens with a motorized zoom control.

1.4.4 Focus Control

The focus control allows you to remotely focus the camera lens when properly wired to the 15-pin connector.

Figure 17. Focus Control Set

- Focus In Coarse

Pressing and holding this button causes the lens to “focus in” in a rapid fashion. Releasing the button causes the focus to stop. The speed of the focus may be set using the Advanced Setting Menu (see section 1.4.13)

- Focus In Fine

Pressing and holding this button causes the lens to “focus in” in a slow fashion. Releasing the button causes the focus to stop. The speed of the focus may be set using the Advanced Setting Menu (see section 1.4.13)

- Focus Out Coarse

Pressing and holding this button causes the lens to “focus out” in a rapid fashion. Releasing the button causes the focus to stop. The speed of the focus may be set using the Advanced Setting Menu (see section 1.4.13)

- Focus Out Fine

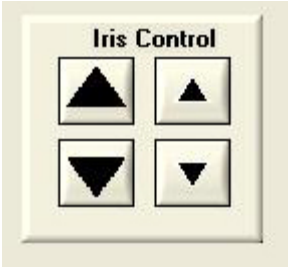
Pressing and holding this button causes the lens to “focus out” in a slow fashion. Releasing the button causes the focus to stop. The speed of the focus may be set using the Advanced Setting Menu (see section 1.4.13)

Note: *This capability requires a lens with a motorized focus control.*

1.4.5 Iris Control

The iris control allows you to remotely change the aperture of the lens when properly wired to the 15-pin connector.

Figure 18. Iris Control Set



- Iris Open Coarse

Pressing and holding this button causes the iris to open in a rapid fashion. Releasing the button causes the iris to stop. The speed of the iris control may be set using the Advanced Setting Menu (see section 1.4.14)

- Iris Open Fine

Pressing and holding this button causes the iris to open in a slow fashion. Releasing the button causes the iris to stop. The speed of the iris control may be set using the Advanced Setting Menu (see section 1.4.14)

- Iris Close Coarse

Pressing and holding this button causes the iris to close in a rapid fashion. Releasing the button causes the iris to stop. The speed of the iris control may be set using the Advanced Setting Menu (see section 1.4.14)

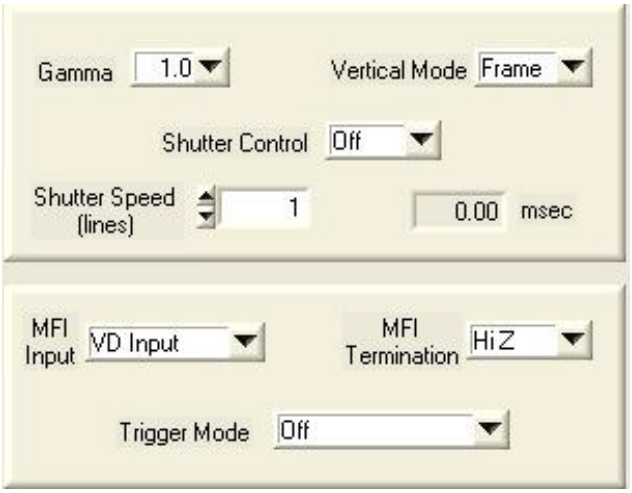
- Iris Close Fine

Pressing and holding this button causes the iris to close in a slow fashion. Releasing the button causes the iris to stop. The speed of the iris control may be set using the Advanced Setting Menu (see section 1.4.14)

Note: *This capability requires a lens with a motorized iris control.*

1.4.6 Shutter

Figure 19. Shutter Control Set



- Shutter Speed

The TM-700 can be set for a range of shutter speeds by selecting the desired speed from the drop down list box. The speed is adjustable in increments of one horizontal line time (~63.56 us), from 1 to 260 lines.

1.4.7 Trigger Mode

- Off: No triggering
- Vreset: A single pulse on the trigger input causes the video timing to reset to the start of a video frame.
- Areset Edge Mode
- Areset One-Shot Mode

1.4.8 Gamma

Gamma adjustment affects the linearity of the video signal with respect to the incoming light. The software offers to two gamma options, 1.0 and 0.45. The 1.0 setting captures an image while maintaining a linear relationship between incoming light and output video level. The 0.45 setting creates a nonlinear relationship that corrects for the nonlinear manner in which most video monitors display an image. The 0.45 setting is typically used when an image will be viewed on a video monitor. The 1.0 setting is typically used when the image will be captured by a frame grabber and undergo subsequent image processing.

1.4.9 MFI Input (Multi-Function Input)

One of the inputs available on the rear panel, DB15 connector serves multiple functions. The MFI Input selection allows the operator to choose the one that best serves the application.

HD & VD Input are used for genlocking to a vertical drive input
CSYNC is used for genlocking to a composite sync input
Trigger Input is used for one of several trigger modes

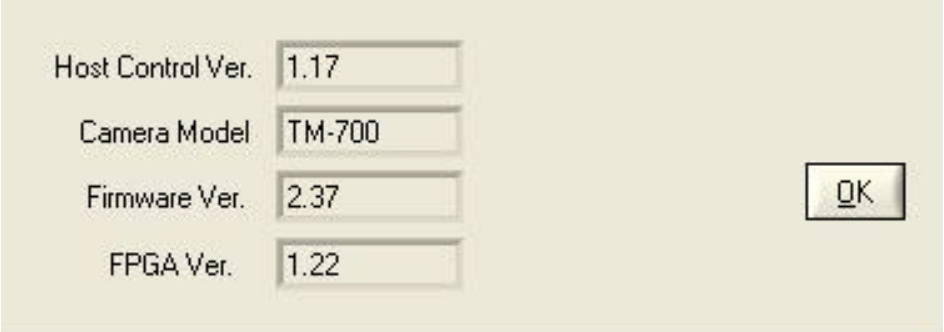
- MFI Termination

This option allows the option of terminating the MFI in either 75 ohms, or a high impedance.

- HiZ setting terminates in a high impedance.
- 75 ohm terminates in 75 ohms.

1.4.10 Software/Hardware Details

Figure 20. Firmware and Hardware Detail Boxes



- Host Control Ver.

The host software version is displayed.

- Camera Model

The JAI camera model number is displayed.

- Firmware Ver.

The camera firmware version is displayed.

- FPGA Ver.

The camera FPGA version is displayed

1.4.11 Video

Figure 21. Video Controls

- Video Pedestal

The Video Pedestal sets the black level reference for the video output. It is adjustable from 0mV to 100mV in approximately 17mV steps.

- Video White Clip

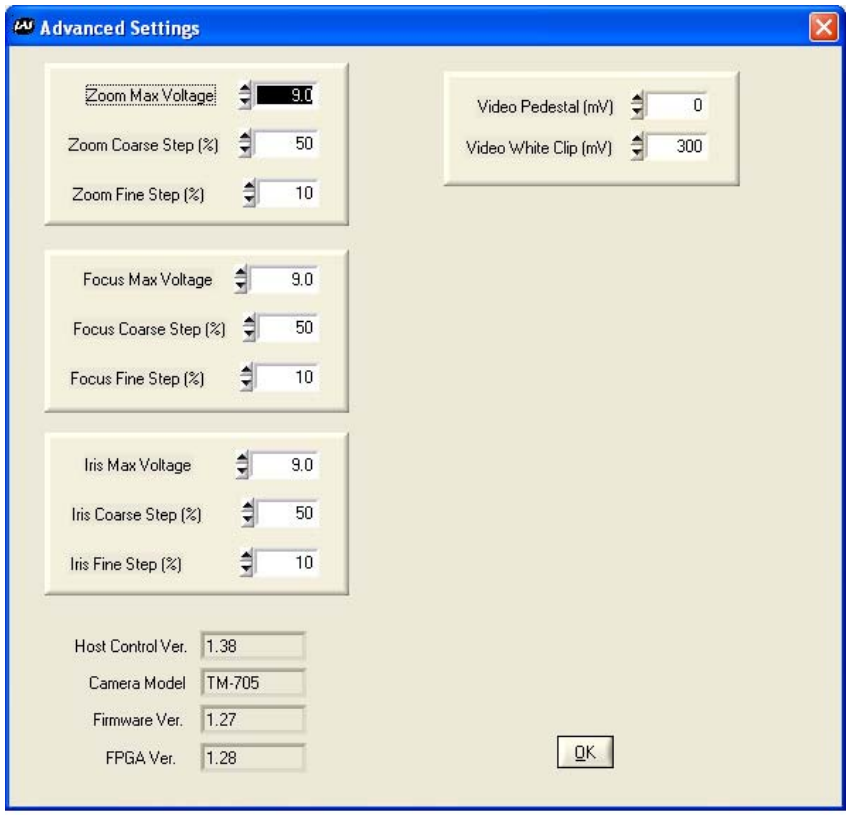
The Video White Clip sets the video output saturation level. It is adjustable from 300mV to 1000mV in approximately 17mV steps

1.5 Advanced Control Settings

The advanced settings for the camera configuration are set from this screen.

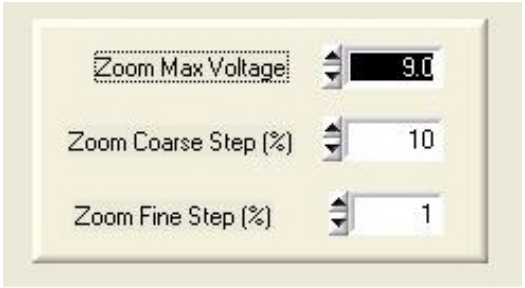
The window has these controls from top to bottom, left to right:

- Zoom
  - Max Voltage
  - Coarse Step
  - Fine Step
- Focus
  - Max Voltage
  - Coarse Step
  - Fine Step
- Iris
  - Max Voltage
  - Coarse Step
  - Fine Step
- Video
  - Pedestal
  - White Clip



1.5.1 Advanced Zoom Controls

Figure 22. Zoom Controls



- Zoom Max Voltage

This sets the maximum voltage that will be applied to the zoom motor. The range is 0V to 9V.

- Zoom Coarse Step

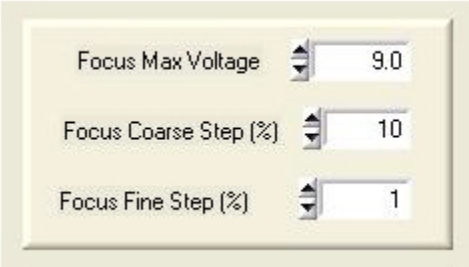
This sets the voltage that gets applied to the zoom motor when the coarse Zoom control is activated. It is specified as a percentage of the Zoom Maximum Voltage

- Zoom Fine Step

This sets the voltage that gets applied to the zoom motor when the fine Zoom control is activated. It is specified as a percentage of the Zoom Maximum Voltage

1.5.2 Advanced Focus Controls

Figure 23. Focus Controls



- Focus Max Voltage

This sets the maximum voltage that will be applied to the focus motor. The range is 0V to 9V.

- Focus Coarse Step

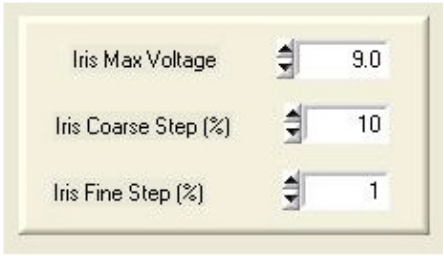
This sets the voltage that gets applied to the focus motor when the coarse Focus control is activated. It is specified as a percentage of the Focus Maximum Voltage

- Focus Fine Step

This sets the voltage that gets applied to the focus motor when the fine Focus control is activated. It is specified as a percentage of the Focus Maximum Voltage

1.5.3 Advanced Iris Controls

Figure 24. Iris Controls



- Iris Max Voltage

This sets the maximum voltage that will be applied to the iris motor. The range is 0V to 9V.

- Iris Coarse Step

This sets the voltage that gets applied to the iris motor when the coarse Iris control is activated. It is specified as a percentage of the Iris Maximum Voltage

- Iris Fine Step

This sets the voltage that gets applied to the iris motor when the fine Iris control is activated. It is specified as a percentage of the Iris Maximum Voltage

1.6 TM-700 series Camera Control Software Troubleshooting

1.6.1 Problem: Camera is not recognized

After adjusting some software settings, and closing the program, the TM-700 series software will not recognize the camera when attempting to open it at a later time.

1.6.2 Solution:

- Close and reopen the program.
- Uninstall and reinstall the TM-700 series software.

1.6.3 Problem: Program Controls are Grayed Out

After opening the program, all boxes are grayed out.

1.6.4 Solution:

The connection the camera is not correct. Check the cable and all other connections.

2.TM-700 series Hardware Instructions

2 Hardware Introduction

2.1 Product description

The TM-700 series is designed to be simple, yet high quality cameras capable of meeting a variety of application requirements. Featuring an advanced Had-type interline transfer 2/3" CCD imager, this miniaturized high resolution camera offers many standard and optional features at a very affordable price. It is available in the EIA formats.

2.2 Features

- Variable electronic shutter and random CCD integration.

The substrate drain-type shutter mechanism provides a superb picture at various speeds without smearing. The electronic shutter rate can be externally adjusted, from 1/60 to 1/10,000 in discrete steps, by means of an RS-232 communication port.

- Miniaturized and lightweight.

The use of a CCD image sensor in the video camera module and the development of special mini C-mount lenses makes it possible to produce a very compact, lightweight and robust camera small enough to operate just like a remoted head.

- High sensitivity.

The TM-700 series camera is one of the most low light sensitive 2/3" CCD cameras available today. This feature is especially important when using the faster shutter speeds. The CCD detects images into the near infrared. It requires only 1.0 lux of minimum illumination and 0.5 lux minimum illumination at maximum gain. In general, this allows use of a higher lens f-value while providing greater depth of field and sharper images.

- Precise image geometry.

On the CCD image sensor, the photo sensor elements form exact rows both horizontally and vertically so that a very precise image geometry may be obtained.

- Low lag/high resistance to image burning.

Since the CCD is highly resistant to image burning, the camera may be exposed to bright objects for a long period of time. Because a "smear" phenomena may occur when shooting a very bright object, an infrared cutoff filter is recommended to obtain a clear picture.

- Integrated Lens Control

The TM-700 series camera provides external signals which can be used to control motorized lenses. Features such as Zoom, Focus, and Iris are controllable by means of the RS-232 communication port. The control signals can support a variety of lenses. See the appendix for further details.

- AGC selection, manual gain control and gamma adjustment.

These adjustments, which are particularly important in vision system applications, are externally adjustable by means of the RS-232 communication port.

- Genlock circuit.

An genlock circuit is built in to accept external sync for applications in which external sync is required.

- High resistance to magnetic field and vibration/mechanical shock.

Due to its ruggedized design, the CCD imager can withstand strong vibration and shock with little or no noise appearing in the picture. Since the TM-700 series is not influenced by a magnetic field, it will produce stable images even when placed next to objects such as electric furnaces, welding machines or NMR scanners.

- Quick start-up and low power consumption.

No more than 2 seconds is needed for the TM-700 series to warm up, and shooting can begin within a second after turning on the camera. The power consumption is only 3.0W. This makes the camera excellent for use with battery operated systems.

- Three Year Warranty

The CCD solid state image sensor allows the camera to maintain a superior performance level indefinitely while requiring virtually no maintenance. JAI, Inc. backs all of the TM Series cameras with a three-year warranty.

Warning:
Unscrewing the camera cover or opening the camera in any way will void this warranty.

2.3 Functional Options

- Internal IR Cut Filter (OP3-1)

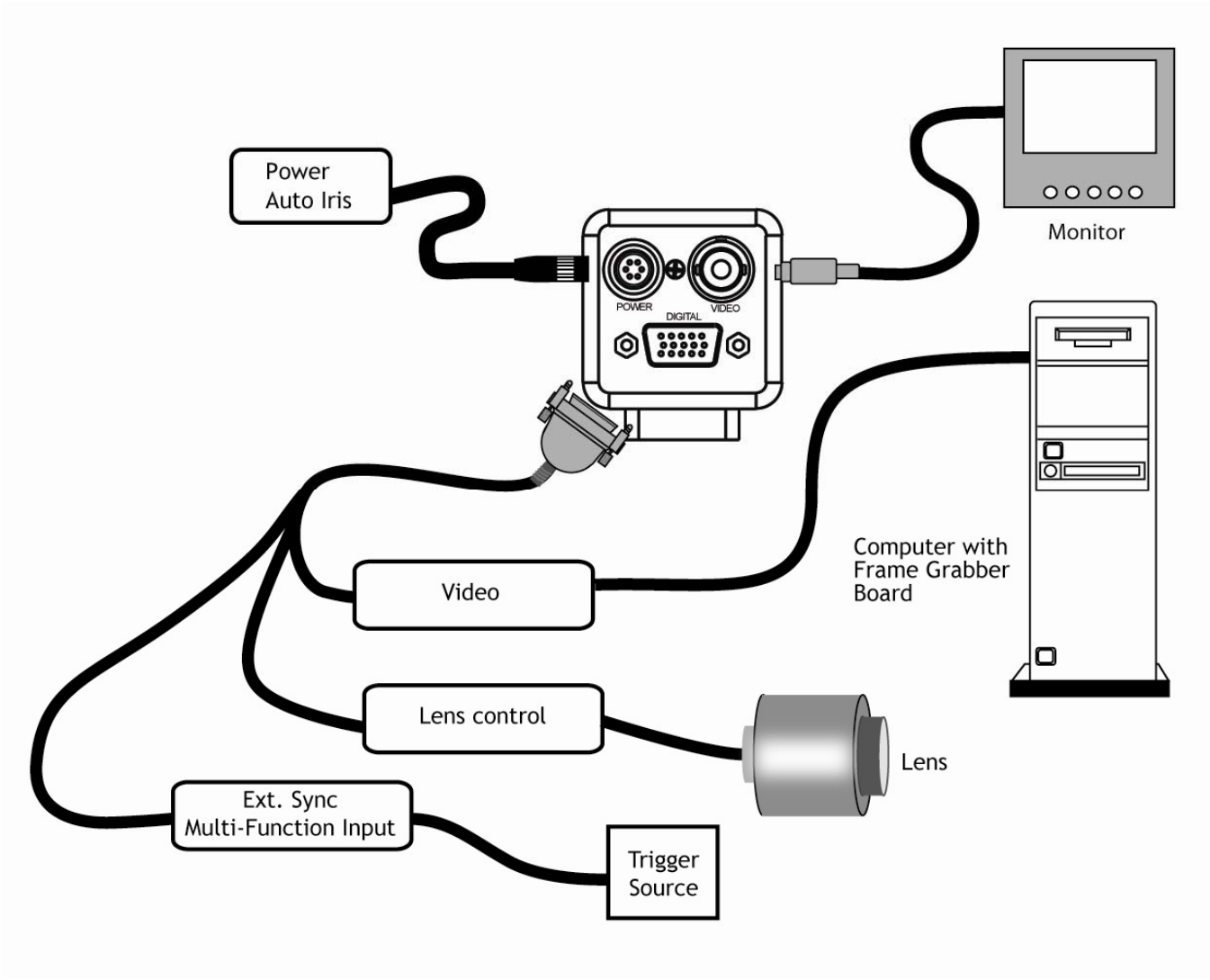
2.4 Applications

The miniature size of the TM-700 series camera eliminates the need for a remoted imager camera in all but the most confined spaces. This camera fits easily, both physically and functionally, into all types of machine vision, automated inspection, and related applications. Other uses include remotely piloted vehicles, miniature inspection devices, surveillance, microscopes and medical equipment.

2.5 System Configuration

Figure 1 (below) presents a typical system configuration in which a computer and frame grabber board are used. A computer and frame grabber board are not required for operation of the TM-700 series camera. The RS-232 com port is not required for operation, but it is needed to configure the cameras and other control functions.

Figure 25. TM-700 series System Configuration



3 Installation

The following instructions are provided to help you to set up your video camera system quickly and easily. It is suggested that you read through these instructions prior to unpacking and setting up your camera system

3.1 Getting Started

3.1.1 Unpacking Instructions

It is recommended that the original packing cartons for the cameras and lenses be saved in case there is a need to return or exchange an item. It is also recommended that any equipment being sent to another location for field installation be bench tested to assure that everything is fully operational as a system.

3.1.2 Components List

Please begin by checking your order against the Components List (below) to assure that you have received everything as ordered, and that nothing has been overlooked in the packing materials. If any item is missing, please contact your JAI, Inc. representative immediately.

- TM-700 series camera
- TM-700 series data sheet
- TM-700 series operations manual

3.1.3 Accessories

Following is a list of additional accessories or equipment that may be recommended or required for your particular application. Please check with your JAI, Inc. representative prior to the installation of your video system to determine what you might need.

- Power Cable:
- Power Supply:
- Tripod Mounting Kit: TP-30
  (for dimensions go to:
  www.jai.com/EN/CameraSolutions/Products/Accessories/Pages/Home.aspx)

3.2 Camera Setup

3.2.1 Connector Pin Configurations

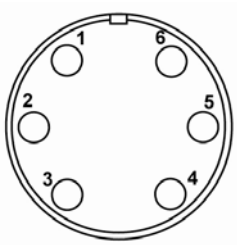
3.2.1 (a) 6-Pin Connector

The TM-700 series has a 6-pin connector for power input. Generally, Pin #1 is Ground and Pin #2 is +12V DC. The other pins handle a number of other input and output functions, which will be discussed further in other sections.

Table 1 Pin Description

Pin	Description
1	GND
2	+12V DC
3	GND
4	Auto Iris
5	GND
6	+12V Iris

Figure 26. Six Pin Connector

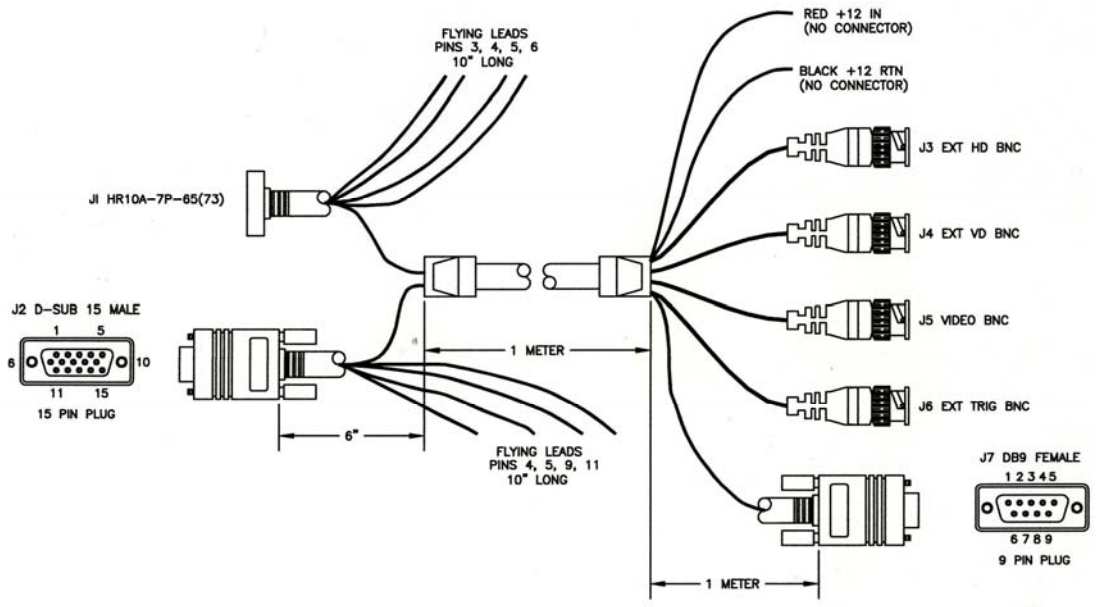


3.2.2 Power Supply and Power Cable Setup

The TM-700 series cameras require a100-240V AC/12V DC 1.3A universal voltage power supply with a US plug. The JAI cable for this series of cameras is part number is PD-12UU6PF-AG.

3.2.2 (b) JAI, Inc. Control Cables

Figure 27. Control Cable (15P-02-9P-AG)



Pin	Description	Pin	Description
1	RX	9	LENS CONT2
2	VIDEO	10	GND
3	TX	11	LENS CONT3
4	LENS CONT1	12	EXT TRIG/MULTI-FUNC
5	GND	13	EXT HD
6	GND	14	EXT VD/CSYNC
7	GND	15	NC
8	GND		

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

3.2.3 Attaching the Camera Lens

The TM-700 series camera accepts 1/2" 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. Please note that some lenses with extremely long flangebacks may exceed the mounting depth of the camera.

3.2.4 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 an 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 is wise to label cameras whose back focus was adjusted.

1. The camera must be connected to a monitor before attempting to adjust the back focus.
2. To back focus the camera, first attach a C-mount lens in the mount. Be certain that the lens is properly seated.
3. 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).
4. 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 28. Back Focus Set-Screw Locations

Loosen the three 2mm screws around the perimeter of the C0mount 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.

3.2.5 Auto-Iris Lens Setup

Auto-iris lenses with full video input can be used with the JAI, Inc. TM-700 series, although this camera model does not come equipped with auto-iris output.

Note: Make sure that the power is removed from the camera before connecting or disconnecting the auto-iris lens. There is a small chance that damage could occur to the auto-iris lens by plugging or unplugging it while the camera is powered up.

Power down the camera before installing the auto-iris lens. To install the auto-iris lens in a JAI, Inc. camera for which the auto-iris input is not supplied, wire the signal (video) on the lens into the terminal 1 Vp to peak video output on the camera.

Point the camera at a light area and then quickly towards a darker area. If everything is working properly, the iris should adjust for the light change.

3.2.6 Monitor Display Mode

For monitoring real time video, connect the video output to a video monitor or other device.

3.2.7 Connectors and Cables

6-pin connector and cable: Standard cable is 15P-02-9P-AG, cable for AG-7000/TM-700/TM-705NIR.

4 Functions and Operations

Apart from the standard continuous operation, the TM-700 series features three external asynchronous trigger modes (edge pre-select, pulse width controlled and vRESET).

4.1 Input of Ext HD/VD Signals

In the default setting the camera will accept external HD/VD signals on pin 13 and 14 of the 15 pin connector. If external HD/VD is applied, the camera will synchronize to it. If no external sync signals are applied, the camera will operate with its internal x-tal controlled sync. The time requirements to the relation between VD and HD are shown in Fig. 36.

To use this mode:

Input:	Ext. VD in or int. VD out on pin 14 on 15 pin connector.
	Ext. HD in or int. HD out on pin 13 on 15 pin connector.

Note: External sync system should follow the camera scanning system.

4.1.1 External Sync

The TM-700 series can accept external sync from an external sync generator or frame grabber. Input specifications:

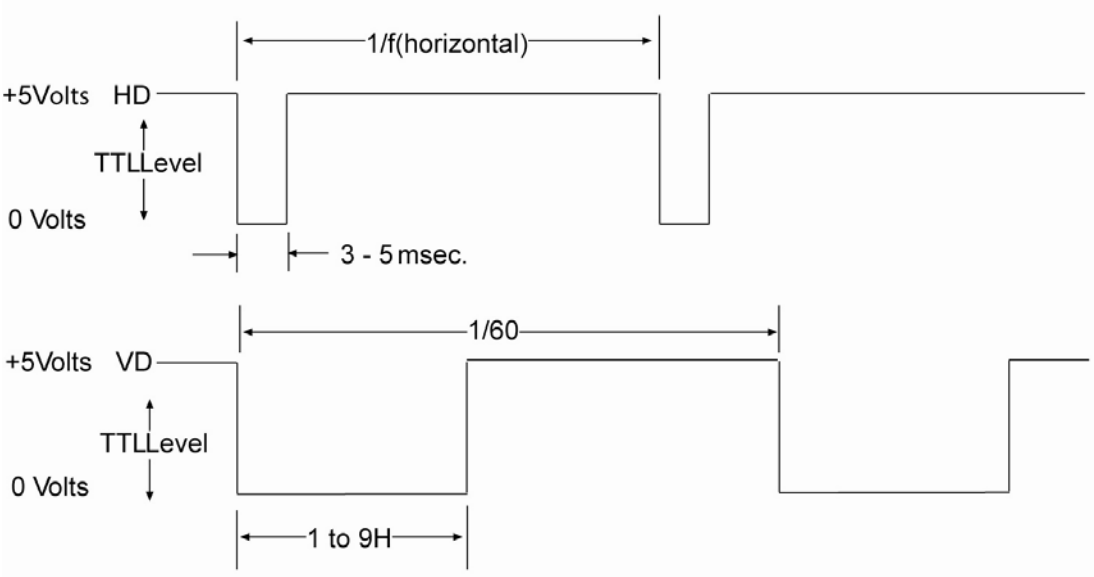
Internal/External auto switch

fH+15.734 KHz ± 5%, fV +59.95 Hz ± 5%

Min signal amplitude 3.5 Vp-p

Note: The TM-700 series has a one (1) horizontal line delay between the input VD signal and the output video. If external vertical drive (VD) is applied to the camera, it may cause the video output to be delayed 1 HD (1 H = ~64.0 µ s). If the imaging system is capable of automatically detecting the start of video (within a few HD), then no problem will exist. Otherwise, reconfigure the video capturing sequence to delay video acquisition of 1H.

Figure 29. Input Signals



4.2 Modes of Operation

4.2.1 Continuous Operation (Non triggered)

For applications that do not require asynchronous external trigger (continuous operation). This is the factory default setting of the camera.

Figure 30. Timing Chart

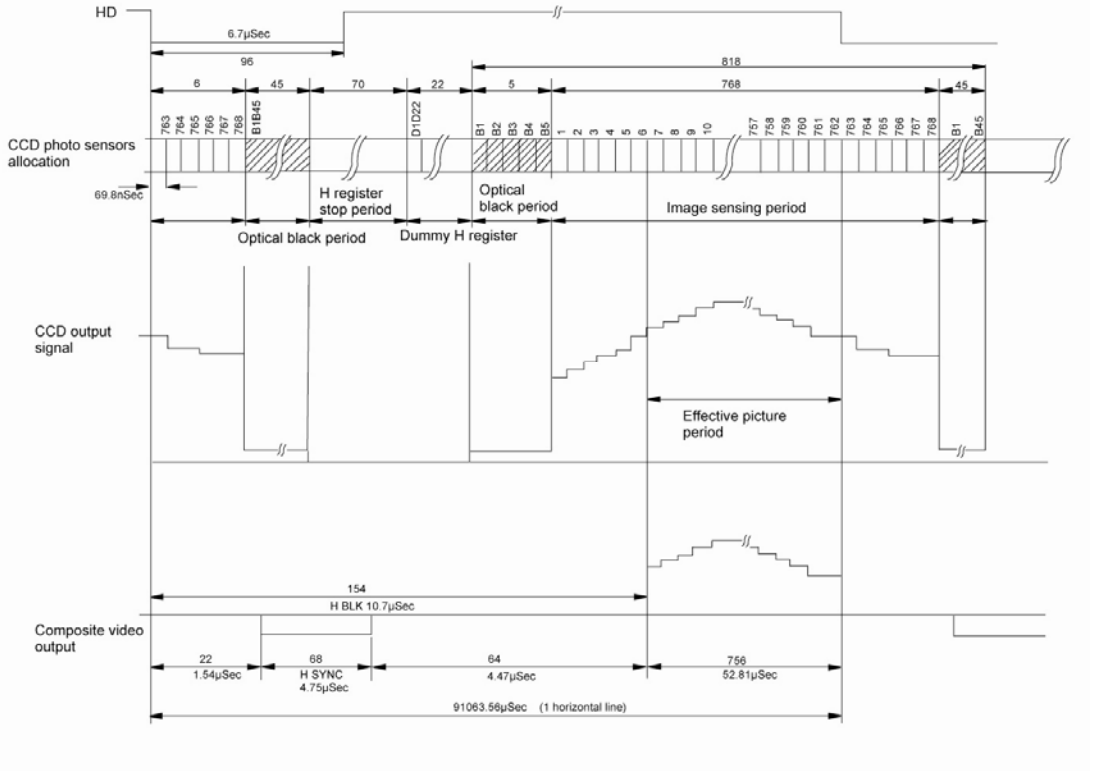


Figure 31. Horizontal timing details and pixel numbering for the CCD array. EIA

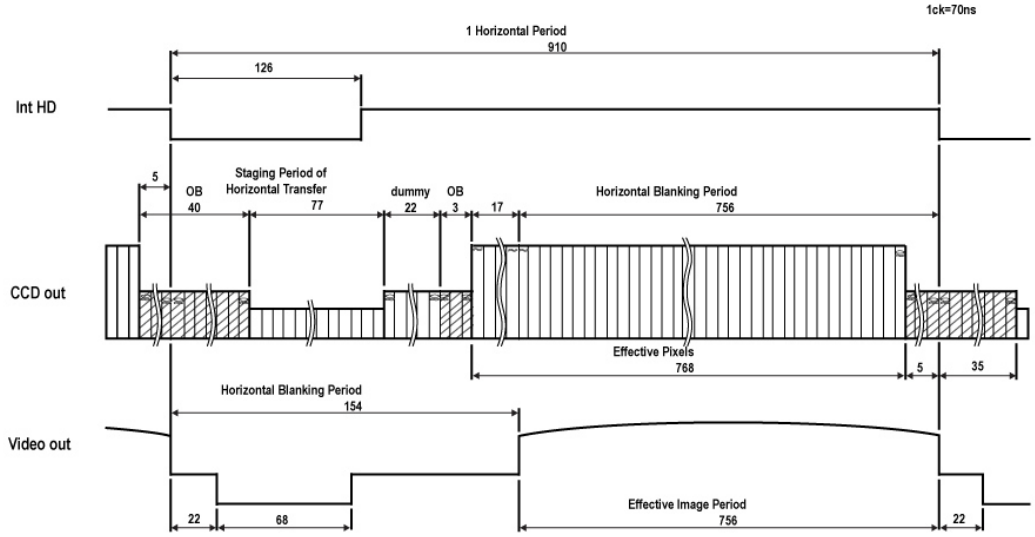
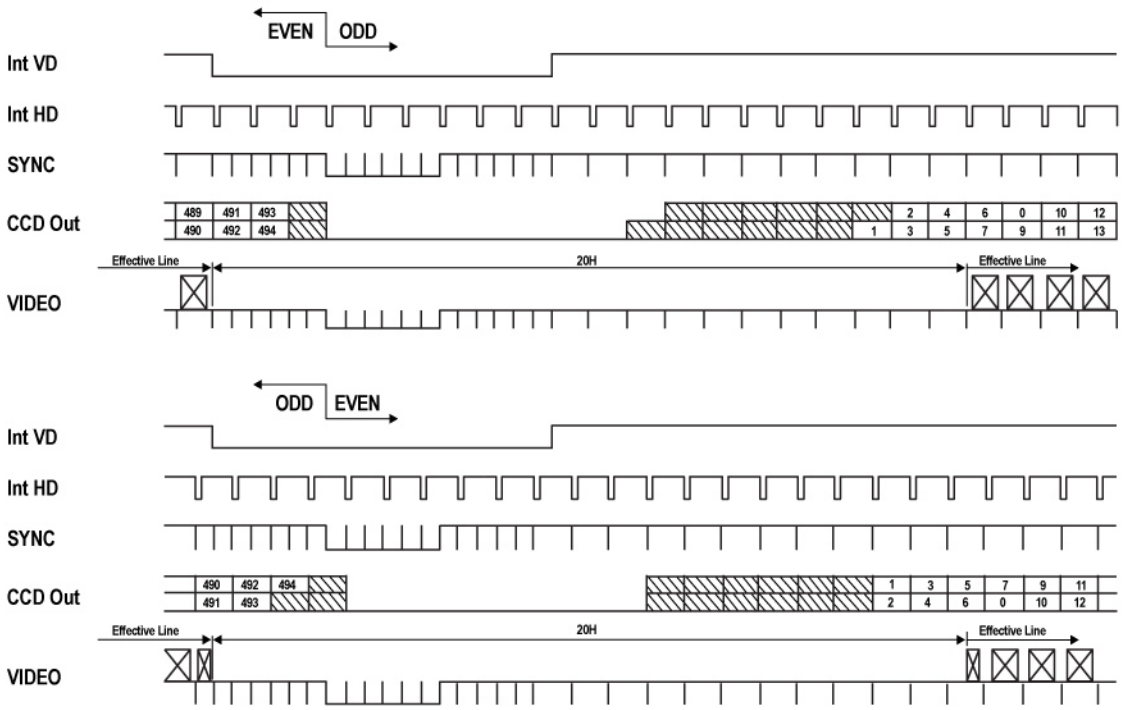


Figure 32. Vertical timing details for interlaced. EIA



Note: Fig. 29 through fig.31 on the following pages shows horizontal and vertical timing details for interlaced and non-interlaced.

4.2.2 External Trigger Modes

This camera has 3 external asynchronous trigger modes, which can be set by RS-232C commands.

0.	Vreset	Trig resets start frame
1.	Edge Pre-select Mode.	Pre-selected exposure through shutter speed
2.	Pulse Width Control Mode.	Pulse width controlled exposure through Pin 12 Trig In.

An external trigger pulse initiates the capture (input on pin 12 of the 15-pin connector). The falling edge of the trigger pulse initiates the exposure and the duration of the pulse governs the exposure (accumulation) time.

The duration of the external trigger pulse must be greater than 1H. It is recommended to make this longer, typically 9H.

4.2.2.1 Vreset Mode

The falling edge of the trigger pulse resets the image readout and initiates the start of a new frame. It then operates in continuous mode until the trigger comes again.

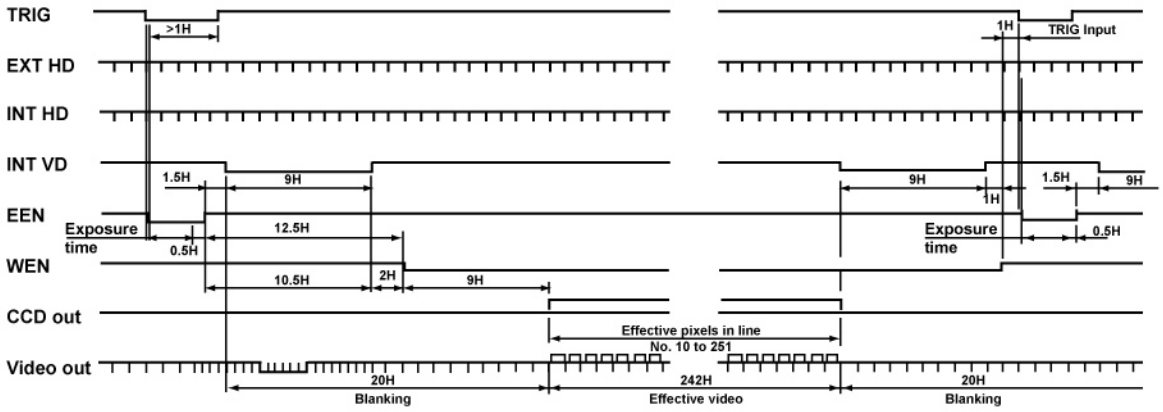
4.2.2.2 Edge Pre-select Mode

The falling edge of the trigger pulse initiates the exposure. The exposure time (accumulation time) is governed by the pre-defined shutter speed set by RS-232C. (see section 1.4.5)

To use this mode:

Input: Ext. trigger to pin 12 on 15 pin connector. Shutter exposure time determined by line time from 1 (64µs) to 260 lines.

Figure 33. Edge pre-select EIA



Note:

• The duration of the external trigger pulse must be greater than 1H. It is recommended to make this longer, typically 9H.

4.2.2.3 Pulse Width Control Mode

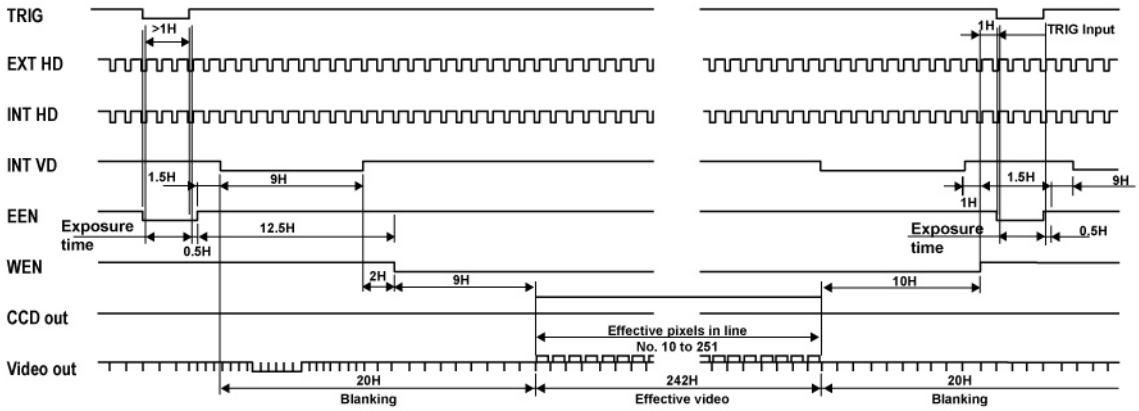
The falling edge of the trigger pulse initiates the exposure. The exposure time (accumulation time) is governed by duration of the trigger pulse.

The exposure time range is 1.5H to 1000H (shortest and longest pulse duration).

To use this mode:

Set function:	Trigger mode to “Pulse Width Control”	TR=2
Input:	Ext. trigger to pin 12 on 15- pin connector.	

Figure 34. Pulse width control EIA.



Note:

• Do not input external VD signal at Pin No. 7 of the 12-pin Hirose connector, as it may disturb the external trigger function.

4.2.3 Field and Frame Modes

The standard factory setting for the TM-700 series camera is FIELD MODE. The mode selection is on the back panel of the camera.

4.2.3.1 Field Mode

In Field Mode, two horizontal rows are scanned together, changing the pair at each interlace scan. The sensitivity of the CCD is doubled for one field of integration, therefore it can obtain the same sensitivity as in Frame Mode in half the period of time. This is an advantage when the shutter is used often. Because of the alternating two row scanning, Moire is almost unnoticeable. While the vertical resolution is not as good as in Frame Mode, it is sufficient to view the full vertical resolution of the TV format. Note: Only odd fields are output in this mode. Field Mode cannot provide full frame resolution with strobe lighting applications.

4.2.3.2 Frame Mode

In Frame Mode, each horizontal row is scanned as interlace scanning. The integration of each pixel is one frame period. Vertical pixel resolution is good, and exact location is obtained. A disadvantage as compared with Field Mode is the tendency to show vertical Moire. For strobe lighting, Frame Mode must be used to achieve full frame resolution.

4.3 RS-232 Commands

The TM-700 series cameras can be controlled by means of RS-232 communications. Commands are sent to the camera as a string of ASCII characters. Each command begins with a start character of ":" and ends with the end character CR (Decimal 10, hex D) which is indicated as <cr> in the table below. The camera will acknowledge successful receipt and processing of the command with the response specified in the table below. If, for any reason, the camera cannot recognize or process a command, it will respond with the Nack response ":e"<cr>.

The camera will generate output only in response to an input command. Commands are not buffered. A new command should not be sent until the camera has responded to the previous command. Any input to the camera will be ignored until processing of the current command has completed and the camera response has been output. Similarly, all characters received after the end character <cr>, but before the receipt of the start character ":" will be ignored.

Figure 35. RS-232C cable diagram

Communication settings

Baud Rate	9600 bps
Data Length	8 bit
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

RS-232C cable diagram

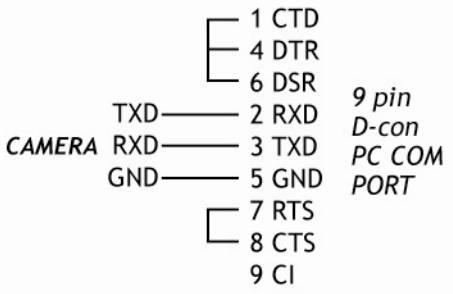


Table 2 TM-700 Series Camera Commands

Command	Parameter	End Cmd	Ack. Response	Description
ALC Level				
:ALV=	XXX	<cr>	:o<cr>	Set the ALC level. XXX is the level value with a range of 0-100
:ALV?		<cr>	:oALV[XXX]<cr>	Enquire current ALC level. XXX is the current value with a range of 0-100
ALC Manual Gain				
:AGN=	XXX	<cr>	:o<cr>	Set the ALC manual gain value. XXX is the gain value with a range of 0-100
:AGN?		<cr>	:oAGN[XXX]<cr>	Enquire current ALC manual gain. XXX is the current gain value with a range of 1-100
ALC Max				
:AMX=	XXX	<cr>	:o<cr>	Set the maximum ALC value. XXX is the max value with a range of 0-100
:AMX?		<cr>	:oAMX[XXX]<cr>	Enquire current ALC max. XXX is the current value with a range of 0-100
ALC Mode				
:AMD=	X	<cr>	:o<cr>	Set the ALC mode. X is the mode parameter. 0 = Manual 1 = Auto
:AMD?		<cr>	:oAMD[X]<cr>	Enquire current ALC Mode. X is the current mode value. 0 = Manual 1 = Auto
Camera Firmware Version				
:VER?		<cr>	:o[XXX]<cr>	Enquire current Camera Firmware Version number. XXX is a string representing the mode number in a *n.nn* format. Maximum length is 10 characters
Camera FPGA Version				
:FPGA?		<cr>	:o[XXX]<cr>	Enquire current Camera Firmware Version number. XXX is a string representing the FPGA version number in a *n.nn* format. Maximum length is 10 characters
Camera Model Number				
:CAM?		<cr>	:o[XXX]<cr>	Enquire current Camera Model. XXX is a string representing the model number. Maximum length is 10 characters
Focus Control				
:FOC=	XXX	<cr>	:o<cr>	Set the Focus Control. XXX is the focus value with a range of -100 — +100
:FOC?		<cr>	:0FOC[XXX]<cr>	Enquire current Focus Control value. XXX is the current values with a range of -100 — +100
Gamma				
:GAM=	X	<cr>	:o<cr>	Sets the Gamma value. X is the gamma flag. 0 = gamma 1.0 1 = gamma 0.45
:GAM?		<cr>	:oGAM[X]<cr>	Enquire the current Gamma setting. X is the current gamma setting. 0 = gamma 1.0

Command	Parameter	End Cmd	Ack. Response	Description
				1 = gamma0.45
Iris Control				
:IRC=	XXX	<cr>	:o<cr>	Set the Iris Control. XXX is the focus value with a range of – 100 — +100
:IRC?		<cr>	:oIRC[XXX]<cr>	Enquire current Iris Control value. XXX is the focus value with a range of – 100 — +100
Multifunction Input				
:MFI=	X	<cr>	:o<cr>	Set the Multifunction Input mode. X is the mode parameter 0 = VD 1= CSYNC 2 = Trigger
:MFI?		<cr>	:oMFI[X]<cr>	Enquire the current Multifunction Input value. X is the current mode value 0 = VD 1= CSYNC 2 = Trigger
Multifunction Input Termination				
:MFT=	X	<cr>	:o<cr>	Set the Multifunction Input termination. X is the termination parameter. 0 = HiZ 1 = 75 Ω
:MFT?		<cr>	:oMFT[X]<cr>	Enquire current Multifunction Input termination. X is the current termination setting 0 = HiZ 1 = 75 Ω
Save/Restore Camera State				
:WSTA=	X	<cr>	:o<cr>	Write the camera state to one of two user state files. X is the file selection. 1 = User_1 2 = User_2
:LSTA?		<cr>	:o<cr>	Load camera state. X is the state file selection. 0 = Factory defaults 1 = User_1 2 = User_2
Shutter Speed				
:SHS=	XXX	<cr>	:o<cr>	Set the integration time (shutter speed) in units of one horizontal line. XXX is the level value with a range of 1-260
:SHS?		<cr>	:oSHS[XXX]<cr>	Enquire current shutter speed. XXX is the current value with a range of 1-260
Trigger Mode				
:TMD=	X	<cr>	:o<cr>	Set the Trigger mode. X is the mode parameter. 0 = Off 2 = Async Edge 1 = Vreset 3 = Async Level
:TMD?		<cr>	:oTMD[X]<cr>	Enquire current Trigger mode. X is the current mode value. 0 = Off 2 = Async Edge 1 = Vreset 3 = Async Level
Vertical Mode				
:VMD=	X	<cr>	:o<cr>	Set the Vertical mode. X is the mode parameter 0 = Field 1 = Frame
:VMD?		<cr>	:oVMD[X]<cr>	Enquire current Vertical mode. X is the current value. 0 = Field 1 = Frame
Video Pedestal				
:VPD=	XXX	<cr>	:o<cr>	Set the Video Pedestal. XXX is the pedestal value with a range of 0-100
:VPD?		<cr>	:oVPD[XXX]<cr>	Enquire current Video Pedestal value. XXX is the

Command	Parameter	End Cmd	Ack. Response	Description
				current value with a range of 1-100
Video White Clip				
:VWC=	XXX	<cr>	:o<cr>	Set the Video White Clip value. XXX is the white clip value with a range of 0-100
:VWC?		<cr>	:oVWC[XXX]<cr>	Enquire current Video White Clip value. XXX is the current white clip value with a range of 0-100
Zoom Control				
:ZMC=	XXX	<cr>	:o<cr>	Set the Zoom Control. XXX is the zoom value with a range of -100 — +100
:ZMC?		<cr>	:oZMC[XXX]<cr>	Enquire current Zoom Control value. XXX is the current value with a range of -100 — +100

5 Troubleshooting

5.1 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, Inc. representative.

5.1.1 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

5.1.2 Symptom: Dark Video

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

- Shutter selection
- Iris opening on the lens

5.1.3 Symptom: Non-synchronized Video

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

- Proper mode output
- Frame grabber software camera selection

5.2 Information and Support Resources

For further information and support:

Phone: (408) 383-0300
(800) 445-5444
Fax: (408) 383-0301
E-mail: 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

6 Specifications

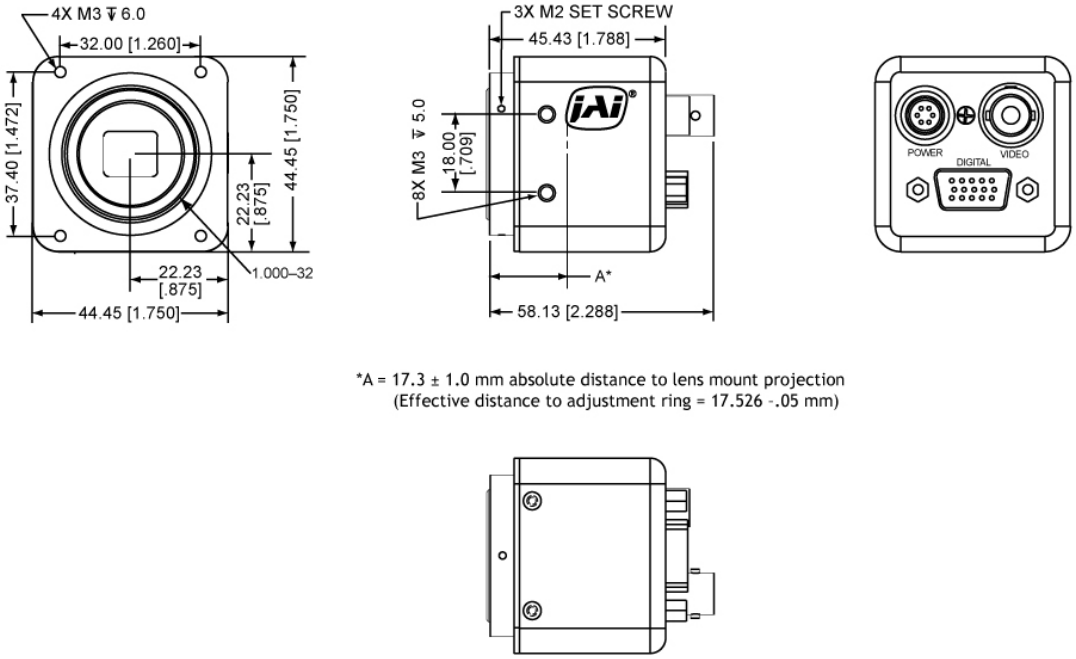
6.1 Product Specifications

Table 3 TM-700 series Product Specifications Table

Model	TM-700 (EIA)	TM-705 (EIA)
Sensor	2/3" Interlace CCD, HAD type IXC 422ALL	½" NIR interlace CCD IXC428ALL
Active pixels	768 (H) x 493(V)	
Cell size	11.6 µm x 13.5 µm	8.4 µm x 9.8 µm
Scanning	525 lines / 60 Hz	
Synchronization	Internal/External auto switch HD/VD 4.0 Vp-p impedance 10 K Ω VD = interlace/non-interlace HD = 15.73 KHz ±00%	
TV resolution	570 (H) x 350 (V)	
S/N ratio	50 dB min. (AGC off)	
Sensitivity	0.20 lux (*f*=1.4)	0.25 lux (*f*=1.4)
Video output	1.0 Vp-p composite video, 75 Ω	
AGC	ON/OFF, (RS-232 controlled)	
Gamma	0.45 / 1.0 (RS-232 controlled)	
Lens mount	C-mount (adjustable)	
Power requirement	12V DC, 150 mA typical at 25° C	
Operating temperature	-10° C to +50° C -40° C to +65° C (configurable option)	
Vibration	7Grms (20 Hz to 2000 Hz) Random	
Shock	70 G, 11 ms, half-sine	
Size	45mm x 45mm x 46mm 1.75" x 1.75" x 1.826"	
Weight	102.4 g (without tripod mount)	
Power supply	PD-12UU6PF-AG	
Optional functions	OP1-5 - Auto level control (EE and AGC) OP22-5-1 – Extended temperature OP22-5-5 – Conformal coat	
Accessories	See current price list	

6.1.1 Physical Dimensions

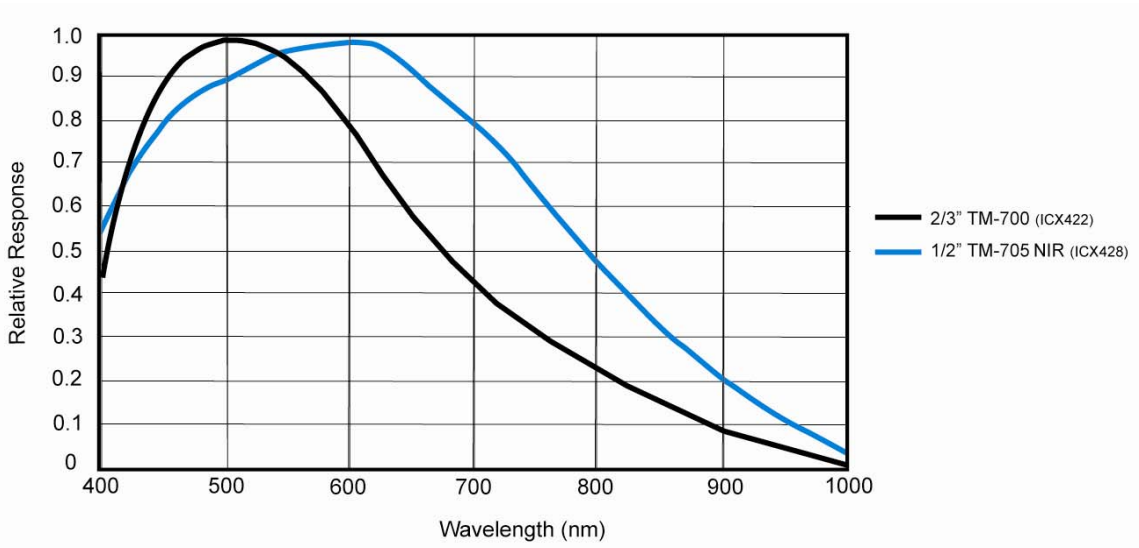
Figure 36. Physical Dimensions



*A = 17.3 ± 1.0 mm absolute distance to lens mount projection
(Effective distance to adjustment ring = 17.526 -.05 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.

Figure 37. Comparative Spectral Response for TM-700 series



7 Appendix

7.1 Front End Detail

Figure 38. Front End Assembly for TM-700

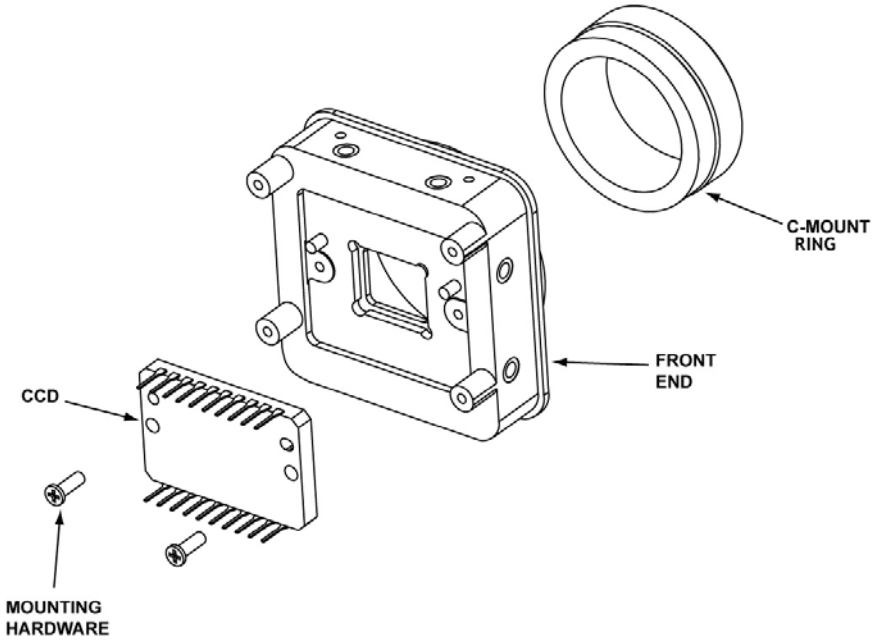
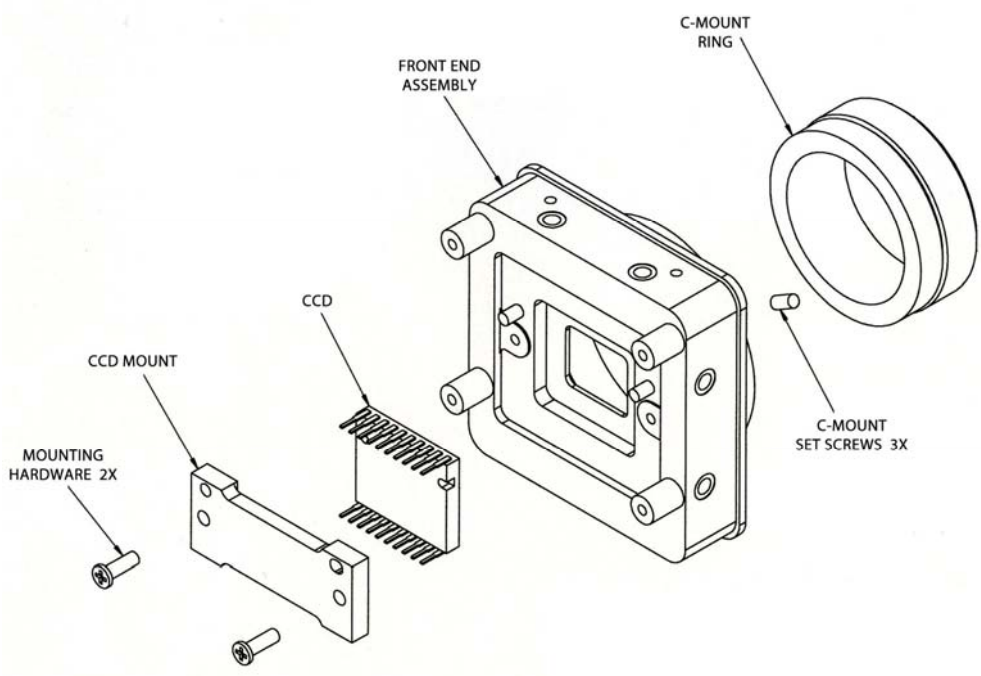


Figure 39. Front End Assembly for TM-705



Europe, Middle East & Africa
Phone +45 4457 8888
Fax +45 4491 8880

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

Americas
Phone (Toll-Free) 1 800 445-5444
Phone +1 408 383-0301

See the possibilities