PULNiX

# TM-6702

## Progressive Scan Full Frame Shutter Camera

## Operation Manual


69-0060
Rev. A

## Notice

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## Warranty

All of our solid state cameras have a full three-year warranty. If any such product proves defective during this warranty period, PULNiX America, Inc. will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product. This warranty shall not apply to any damage, defect or failure caused by improper use or inadequate maintenance and use.

## Certifications

**CE Compliance**

The TM-6702 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:

| | |
|---|---|
| Immunity: | EN500082-2/1995 |
| Emissions: | EN55022:1995 Class A / CISPR 22:1993 |

All PULNiX 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 prohibit use of the CE mark. Please note that the use of interconnect cables that are not properly grounded and shielded may affect CE compliance.

Contact the PULNiX 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 is likely to 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-6702 Operation Manual
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**PULNiX America, Inc.**
1330 Orleans Drive
Sunnyvale, CA 94089
Tel: (408) 747-0300
Tel: (800) 445-5444
Fax: (408) 747-0880
E-mail: pulnix@pulnix.com
www.pulnix.com

PULNiX

# TM-6702 Progressive Scan Full Frame Shutter Camera

## Operation Manual

# 1 INTRODUCTION

## 1.1 Product Description

The TM-6702 is a high performance progressive scan camera with a state-of-the art 1/2" interline transfer CCD imager for high resolution imaging. Double speed scan, asynchronous reset and electronic shutter, and non-interlace 60 Hz analog video (VGA) are just some of the features of this highly functional, compact CCD camera.

This camera offers solutions to a wide variety of application requirements, such as high speed image capturing, machine vision, computer graphics, gauging, avionics, microscopy, character and fine pattern recognition, document reading and high end surveillance.

## 1.2 Features

- **1/2" progressive scan interline transfer CCD**

  The advantages of this CCD are:

  - 648H x 484V active pixels for very high resolution and superior image quality
  - Square pixels (9.0 x 9.0 μm for precise dimensional measurement)
  - Double speed scan mode: selectable 60Hz VGA and 30Hz normal speed scan
  - High speed electronic shutter capability results in high dynamic resolution of moving objects
  - Progressive scanning eliminates interlace image deterioration
  - High sensitivity and low noise at fast scanning, excellent S/N ratio (>50db)

- **Asynchronous reset**

  The TM-6702 resets with an external reset pulse (VINIT). This feature is especially important for capturing moving objects at a precise location in the field of view, for applications such as a conveyer belt process, fast event observation, and still picture capturing.

- **Integration**

  The TM-6702 is capable of capturing high resolution integration images. Integration can last from 1/60 sec. to several seconds.

- **VGA display output**

  The TM-6702 has VGA output which scans out at 60Hz non-interlace. PULNiX PVM-1200 series monitors or equivalent B/W multi-sync monitors can display the non-interlace images. Please contact your PULNiX representative for display monitor information.

- **Sync input (external sync) or output (clock and sync) selection (optional, OP7-2))**

  Rear board jumpers enable sync input/output selection. When the jumpers are set to internal sync, the camera accepts HD and VD sync and video output from pin #4 of the 12-pin connector. If the jumpers are set to OP7-2, then HD,VD and clock output are provided for a frame grabber to take the data.

- **"One shot sync" (optional, OP51-2)**

  The composite sync of the video output can be selectable with the rear panel jumper resistor location. Continuous V-sync mode outputs the V-sync at all times regardless of async reset or normal rate V-sync during async mode stand-by. Async V-sync mode outputs the V-sync once only at async reset (at Vinit trigger) and no V-sync during the stand-by period (H-sync only in video composite sync) until the next Vinit comes in. These modes can be selected based on a frame grabber's sync capability for async reset.

- **Three-Year Warranty**

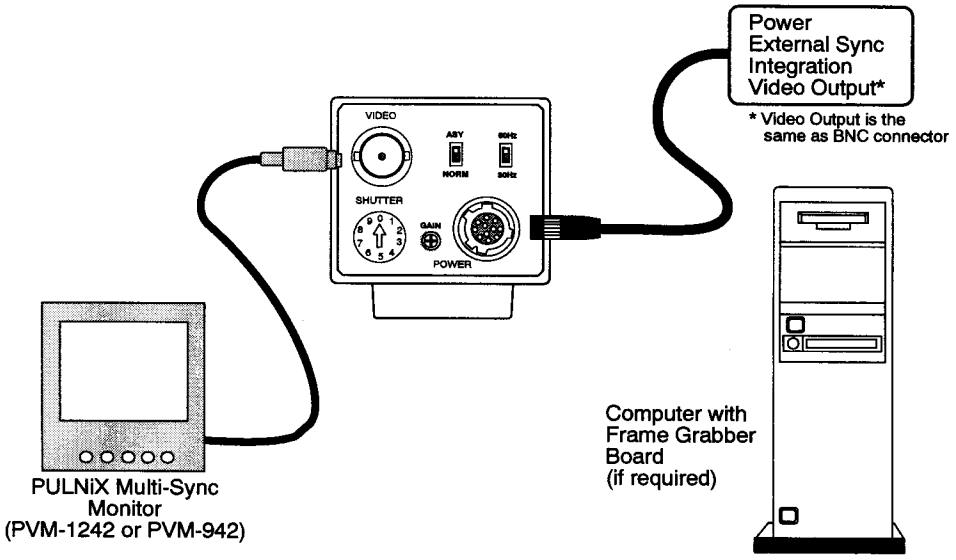
  The CCD solid state image sensor allows the camera to maintain a superior performance level indefinitely while requiring virtually no maintenance. PULNiX backs all of the TM Series cameras with a three-year warranty.

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

## 1.3 Functional Options

- Optical Filter Removal (OP3-2)
- Glassless CCD Imager (OP21)
- Internal IR Filter (OP3-1)
- Pixel Clock, HD, and VD output (OP7-2)
- One Shot Sync (OP51-2)
- Remote Head (OP10-1)

FIGURE 1. **TM-6702 System Configuration**




*NOTE: Additional cable interface may be required from the frame grabber board manufacturer.*

# 2 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.

## 2.1 Getting Started

### 2.1.1 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.

### 2.1.2 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 PULNiX representative immediately.

- TM-6702 camera
- PD-12P power supply (650mA)
- TM-6702 data sheet
- TM-6702 manual (by request)

### 2.1.3 Accessories

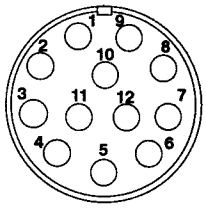
Following is a list of additional accessories or equipment that may be recommended or required for your particular application. Please check with your PULNiX representative prior to the installation of your video system to determine what you might need.

- Cable (power/video) 12P-02
- PVM-1242 or PVM-942 multi-sync monitor
- Power supply PD-12P

## 2.2 Camera Setup

### 2.2.1 Connector Pin Configurations

#### 2.2.1 (a) 12-Pin Connector




The TM-6702 has a 12-pin connector for power input. Pin #1 is Ground and Pin #2 is +12V DC. The other pins handle a number of other input and output functions as detailed below.

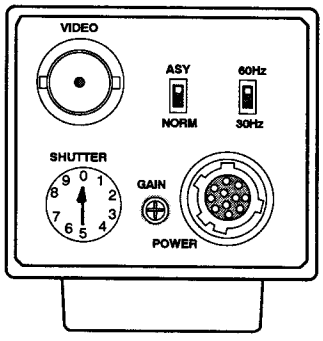
| Pin# | Description | Pin# | Description |
|---|---|---|---|
| 1 | GND | 7 | VD in (out OP7-2) |
| 2 | +12V DC | 8 | GND |
| 3 | GND | 9 | HD in (out OP7-2) |
| 4 | Video Out (clk out OP7-2) | 10 | N/C |
| 5 | GND | 11 | Integration |
| 6 | VINIT In | 12 | GND |

### 2.2.2 Rear Panel

Functions and controls located on the camera rear panel:

- 12-pin connector (power, I/Os)
- BNC video cable connector
- ASY/NRM switch (asynchronous shutter and manual shutter switch)
- 60Hz/30Hz switch
- Manual gain control adjustment

FIGURE 2. **TM-6702 Rear Panel**



## 2.2.3 Power Supply and Power Cable Setup

### 2.2.3 (a) Power Supplies

PULNiX recommends the following power supplies:

| | | |
|---|---|---|
| K25-12 | 110V AC/12V DC | 2.1A power supply |
| P-15-12 | 220V AC/12V DC | 2.1A power supply |
| K50-12 | 110V AC/12V DC | 4.2A power supply |
| PD-12P | 110V AC/12V DC | 0.5A power supply |

For users providing power through the 12-pin connector, the PD-12P power supply is available with the 12-pin mating connector already attached to the leads from the power supply. The PD-12 power supply can be connected to the PULNiX power cable via a terminal strip or directly.

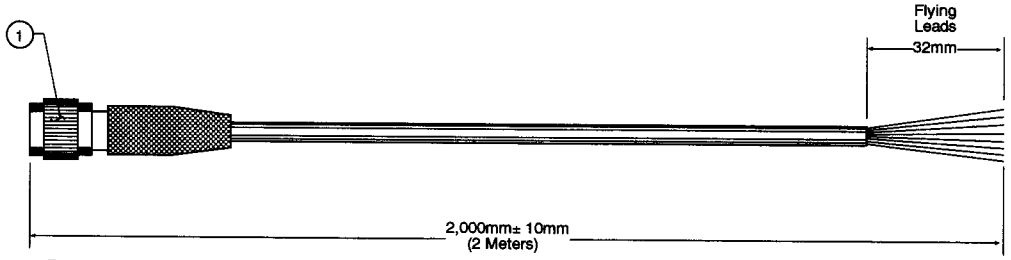
If wiring the PD-12 power supply directly, please note the following:

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

### 2.2.3 (b) Using PULNiX Power/Video Cables

If you are using PULNiX power cables, such as the 12P-02, KC-10, etc., please refer to the pin-out diagram. The color coded leads use Grey for Ground and Yellow for +12V DC.

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




1 PC-12P (Hirose Part #10A-10P-12S/PC12P)

**12P-02 Interface Cable**

| Pin# | Lead Color | Function | Pin# | Lead Color | Function |
|---|---|---|---|---|---|
| 1 | Gray | GND | 7 | Black coax | VD Input |
| 2 | Yellow | +12VCD | 8 | White coax shield | GND |
| 3 | Red coax shield | GND | 9 | White coax | HD Input |

**12P-02 Interface Cable**

| Pin# | Lead Color | Function | Pin# | Lead Color | Function |
|---|---|---|---|---|---|
| 4 | Red coax | Video | 10 | Brown | N/C |
| 5 | Orange coax shield | GND | 11 | Blue | Integration |
| 6 | Orange coax | N/C | 12 | Black coax shield | N/C |

*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.*

### 2.2.3 (c) Using the "K" Series Power Supplies

Attach the 110V line cord to the two terminals marked "AC". Do not plug the cord into a 110V AC socket until later in the procedure. Next, attach the Grey and Yellow leads of the power cable to the Ground and 12V DC terminals respectively. Be sure to replace the plastic terminal guard on the power supply at this time.

*NOTE: The "K" series power supplies are designed primarily for OEM users who will be mounting the power supply inside a protective enclosure. For use in exposed situations, the DC-12N and PD-12 are recommended.*

### 2.2.3 (d) Building Your Own Power Cables

If you are building your own power cables, consult the pin-out for the camera purchased and connect the Ground and +12V power leads of the PC-12P power connector to Pin #1 and Pin #2, respectively (power must be DC regulated, and of sufficient current to properly power the camera).

### 2.2.3 (e) Attaching the Power Cable to the Connector

The 12-pin connector is keyed and will only fit in one orientation. Rotate the connector while applying slight pressure until the keyways line up. Press the connector into place until firmly seated.

The power cord may now be plugged into the 100V AC socket, and the camera powered up.

## 2.2.4 Attaching the Video Output

Most users utilize the BNC connector for video output from the camera. Connect the output from the camera to the input of your monitor, VCR or switching device. The input of the monitor should be balanced for 75Ω termination. Standard RG-59 type coaxial cable should carry a full video signal for up to 500 feet.

Users wishing to output the video and input the power and sync to a camera over a single cable can use the PULNiX multi-conductor cables, such as the 12P-02, the KC-10, etc. The mini coaxial leads in PULNiX multi-conductor cables are designed for short runs of no longer than 100 feet.

*NOTE: Make sure that no extraneous wires are visible which could cause a short.*

### 2.2.5 Attaching the Camera Lens

The TM-6702 camera accepts standard 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.

### 2.2.6 Back Focusing the Lens

To backfocus the TM-6702 camera, first attach a C-mount lens in the lens mount. Be sure that the lens is properly mounted.

Set the lens focus to infinity (if the lens is a manual iris, set the iris to a high f-stop while still retaining a well-illuminated image). Obtain the best focus possible at this setting, then loosen the two miniature hex head set screws (hex socket size: 0.89mm) locking the focus ring in place. Now turn the entire lens and focus ring assembly back and forth until the best image is obtained. Tighten the focus ring set screws. Your backfocus is now set.

### 2.2.7 Auto Iris Lens Setup

Auto-iris lenses with full video input can be used with the PULNiX TM-6702, 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.*

To install the auto-iris lens in a PULNiX camera for which the auto-iris output is not supplied, wire the signal (video) on the lens into the terminal 1 Vp to peak video output on the camera (pin 4 of 12 pin connector).

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 OPERATION

## 3.1 Modes of Operation

The TM-6702 is designed to accommodate a high resolution, on-line inspection reset mechanism with full frame shutter. It accepts external horizontal sync (HD, TTL Levels) to lock the camera and VINIT pulse for resetting the camera asynchronously. HD is not required for asynchronous reset of the camera. The shutter speed is controlled by setting the 10-position shutter speed dial switch on the back panel.

### 3.1.1 Asynchronous Reset Mode

Select ASY on the back panel of the camera to set the asynchronous reset mode.

The TM-6702's asynchronous reset is flexible and takes external HD for phase locking (if required). Applying a VINIT pulse resets the camera's scanning and purging of the CCD. Do not supply VD if the asynchronous reset is used. Instead, use HD to synchronize the camera to the external device.

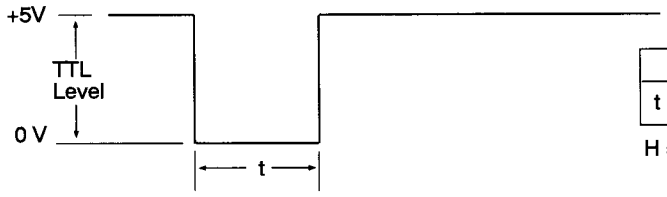
When external VINIT is high (5V), the TM-6702 expects the async pulse input, and the video output will be black video. It resets at the negative going pulse edge and captures the frame regardless of the shutter speed (fast or slow mode). The video output is kept disabled as the CCD is discharged continuously during VINIT high. When the first VINIT pulse comes in, it resets the timing and outputs the image. If the switch is set to NRM (normal mode), the video output will be real time with manual shutter.

### 3.1.2 Driving /VINIT

The TM-6702 VINIT input circuit equivalently has 10K ohm input resistance (Figure 4, "VINIT (Vertical Initialization) Trigger Specification," on page 9). To drive this circuit, at least 2mA of current is required to drive the camera.

*NOTE: The VINIT signal must be a defined, clean pulse for the asynchronous reset function to work properly. Some triggering systems (e.g., optical isolators, mechanical relays, noisy electrical devices, etc.) have bounce or rapid transition between high and low states. It is highly recommended that the input VINIT pulse be analyzed by test equipment to insure proper signal characteristics. If an unspecified signal is used, improper camera performance may result.*

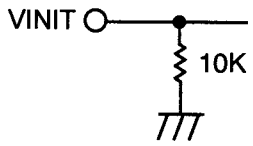
FIGURE 4. **VINIT (Vertical Initialization) Trigger Specification**




| | Min. | Max. |
|---|---|---|
| t | 2H | 500H |

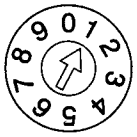
H = 31.8µs (60Hz mode)
63.6µs (30Hz mode)

FIGURE 5. **Equivalent Circuit**




### 3.1.3 Shutter Control Switch

The shutter control switch is located on the rear panel of the camera. The dial can be set from 0 to 9. The settings are detailed below:




Shutter Control Switch

TABLE 1. **Shutter Control Settings (60Hz)**

| Position | Manual Shutter Mode | Async Reset Mode | |
|---|---|---|---|
| 0 | No Shutter | No Shutter | |
| 1 | 1/125 | 1.0H | 1/32,000 |
| 2 | 1/250 | 2.0H | 1/16,000 |
| 3 | 1/500 | 4.0H | 1/8,000 |
| 4 | 1/1,000 | 8.0H | 1/4,000 |
| 5 | 1/2,000 | 16.0H | 1/2,000 |
| 6 | 1/4,000 | 32.0H | 1/1,000 |
| 7 | 1/8,000 | 64.0H | 1/500 |
| 8 | 1/16,000 | 128.0H | 1/250 |
| 9 | 1/32,000 | Shutter determined by pulse width | |

Mode 0: Normal Mode
Mode 1-4: Fast Mode
Mode 5-8: Slow Mode
Mode 9: Pulse Width Mode

*NOTE: 1H = 31.75μs. At 30Hz, the shutter speed is 1/2 of what it would be at 60Hz. For example, when set to switch #4 in the manual shutter mode, the shutter speed will be 1/500 sec. at 30Hz (as compared to 1/1,000 sec.at 60Hz).*

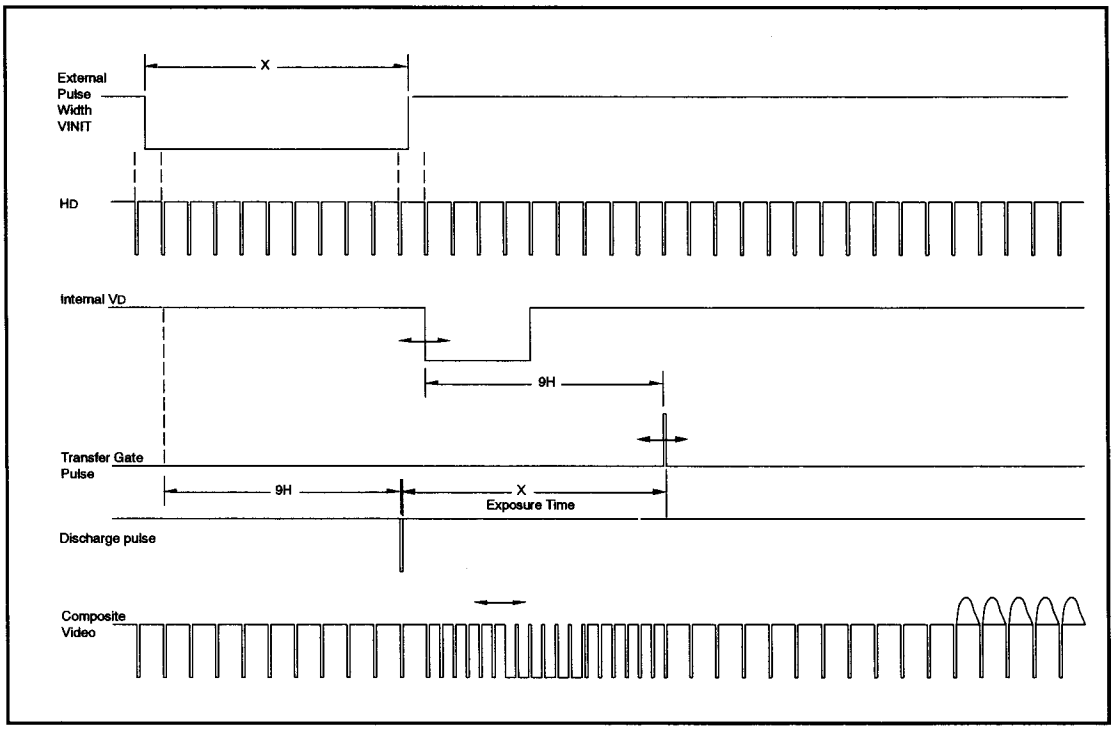
### 3.1.3 (a) External Pulse Width Control Mode

To select the External Pulse Width Control mode, set the shutter speed dial switch to "9". Apply a pulse width control VINIT signal to the camera via an external event trigger. The internal reset pulse will be latched to HD. At the 9th HD timing from the external pulse leading edge (negative going edge), the CCD discharge pulse will be generated to clear the images. The internal VD is generated at the following edge (positive going edge) of the external pulse, and resets the internal timing, including the video sync.

The shutter speed will be the same as the external pulse width, but the integration delays 9H from the leading edge of the external pulse width. For the immediate reset option, please contact PULNiX.

One frame of video output will start from the rising edge of the pulse width control for progressive format. The camera will output the same video from memory when VINIT is kept high (5V), and update the image upon receiving the next pulse. At async mode, with external pulse input high, the video output is disabled as the camera keeps discharging the CCD image and only will provide black video.

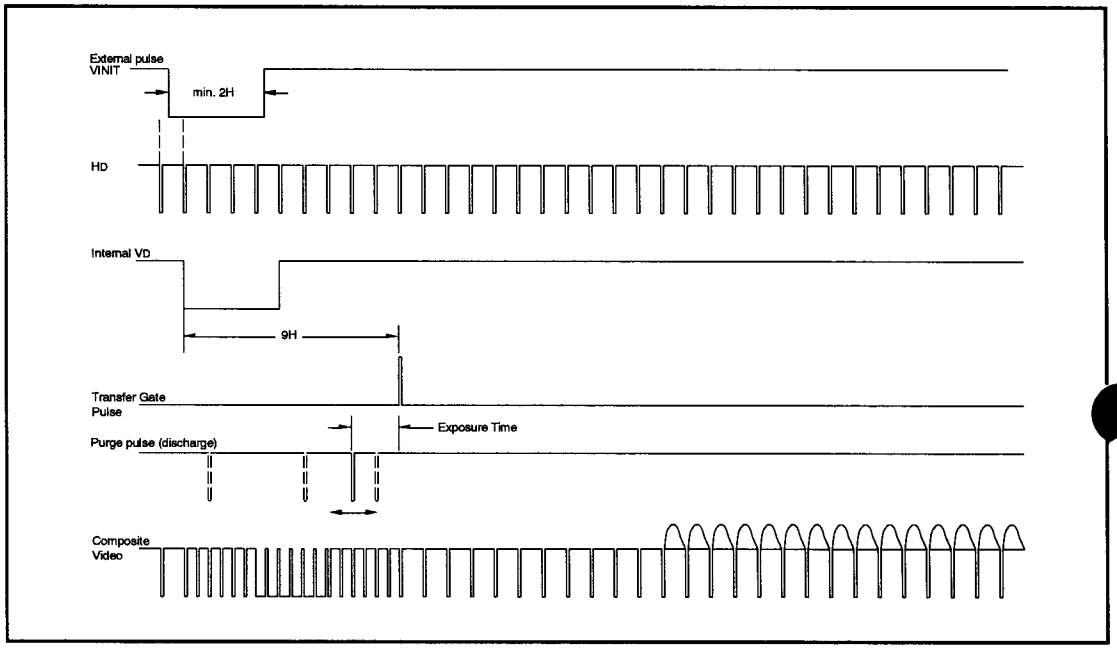
**FIGURE 6.** **External Pulse Width Control (Async Mode)**



### 3.1.3 (b) Internal Fast Reset Mode (Async Mode)

For Internal Reset Mode, set the 10-position dial switch from "1" to "4". When this mode is selected, the camera resets with internal VD timing, which is latched to HD, and video output is also synchronized with internal VD timing without further delay. The shutter speed is controlled by the dial switch.

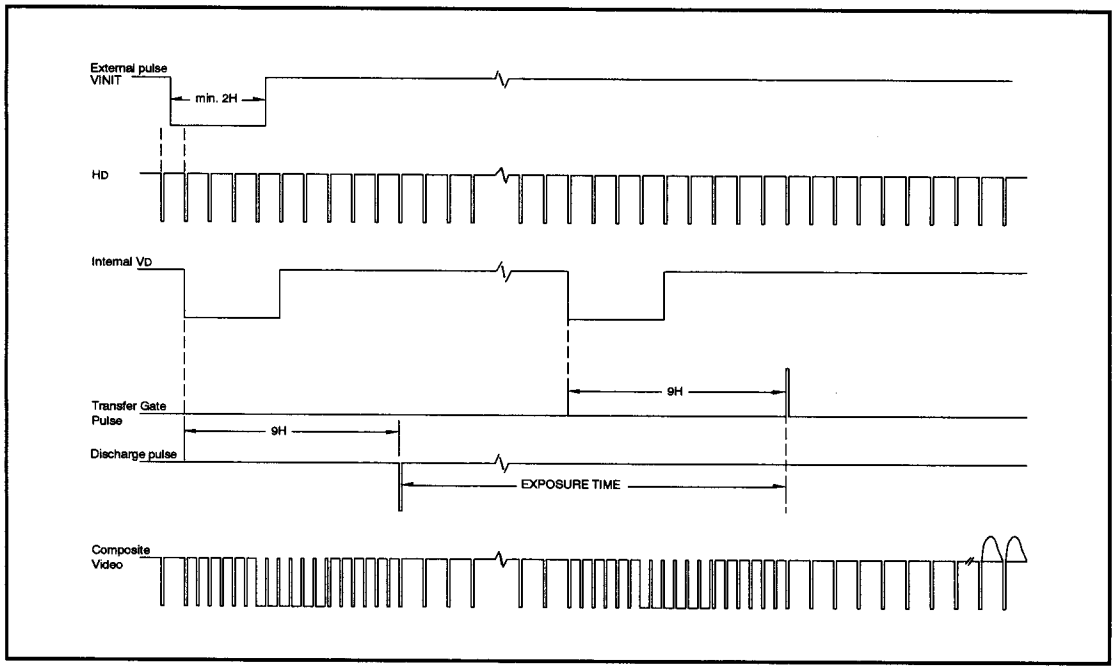
**FIGURE 7.** **Internal Fast Reset**



### 3.1.3 (c) Internal Slow Reset Mode (Async Mode)

For Internal Slow Reset Mode, set the 10-position shutter speed dial switch from "5" to "8". When the external VINIT pulse is applied, internal VD is latched to HD and a second internal VD signal is generated to set up the shutter speed period. Video output timing starts right after the second internal VINIT.

**FIGURE 8.** **Internal Slow Reset**



### 3.1.4 Progressive Scanning

The TM-6702 uses a state-of-the-art CCD called a "Progressive scanning interline transfer CCD" which scans all lines sequentially from top to bottom at one frame rate (60 Hz). Like a non-interlace computer screen, it generates a stable crisp image without alternating lines and provides full vertical TV resolution of 484 lines. 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-6702 outputs the progressive scanned image with an electronic shutter in two standard and one optional format:

1. **Progressive scanning double speed output**

   On the rear panel of the camera, select NORM (normal mode) and 60Hz. This produces straight forward signal output equivalent to non-interlace VGA format (60Hz). Real-time double speed CCD output is converted through normal analog video processing into 75Ω 1Vp-p output format.

2. **Progressive scanning 30Hz output**

   On the rear panel of the camera, select NORM (normal mode) and 30Hz. The TM-6702 scanning clock is reduced to half of normal speed so that the frame rate is 30Hz. All other functions, such as Hd, VD, pixel clock and external sync, are also twice that of normal speed.

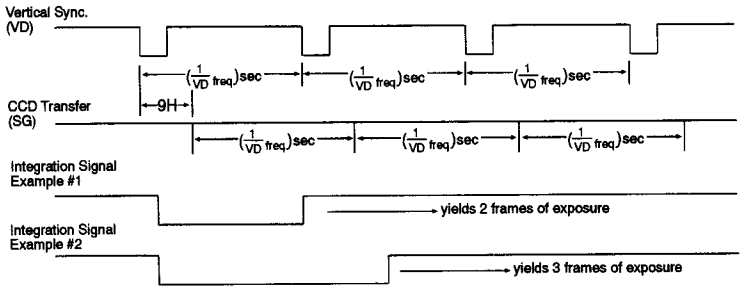
3. **Option 7-2**

   In order to connect the TM-6702 camera to various frame grabbers, the internal jumper settings allow the TM-6702 to accept external HD and VD sync at double speed (fH = 31.468 KHz) or normal speed (fH = 15.734 KHz), or to output HD, VD and pixel clock for variable scan frame grabbers. Please contact your PULNiX representative to order this option.

### 3.1.5 Integration

Integration times can vary depending on the specific application. Pin #11 of the 12-pin connector is integration control. It accepts standard TTL inputs. High is considered 5 volts, and Low is considered 0 volts. When a low is applied to pin #11, the integration process begins. Integration blocks the transfer gate of the image data out of the CCD array. Upon returning the signal back to high (which is required to end the process), the image is output upon the next regular transfer.

**FIGURE 9.** **Integration Timing**




NOTE: Integration may be controlled in increments of frame times only.
H = 1/horizontal frequency.

When the integration signal is set back to high (5 volts), the image data will not move out of the CCD array until the transfer gate occurs. Sg's occur 9H after the start of the VD. For example if the camera is set to expose for 1.5 frame times, the actual exposure is for 2 frame times because the array is still accumulating light until the sg of that field (or frame if field mode). The remaining image data acquired before the start of the integration also may be output.

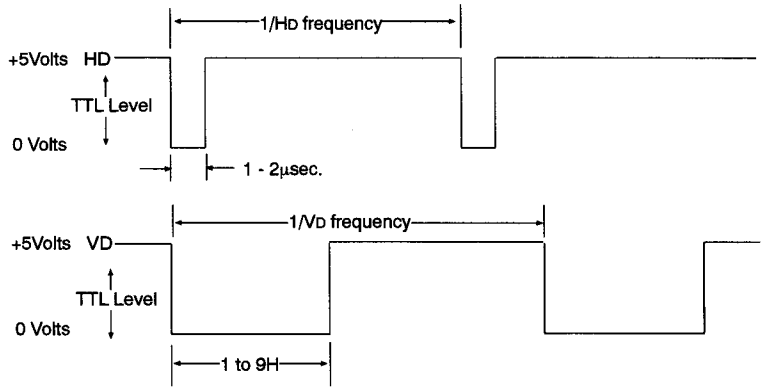
*NOTE: The camera should be in normal mode during integration.*

### 3.1.6 V-Sync Output Selection for Async Mode (OP51-2)

At async image capturing, some frame grabbers cannot take the specific frame when continuous video sync presents. The TM-6702 video output is normally composite sync with frame rate V-sync regardless of the actual image or blank image.When it is asynchronously reset, the newly reset V-sync may be random to normal sync rate and can be very close to the regular rate V-sync. This may be problematic to the frame grabber in capturing the correct image.By selecting the rear plate board jumper, the V-sync output occurs only at the async reset, and no V-sync occurs until the next Vinit (async trigger) comes in. The frame grabber can then look for this V-sync and capture the correct timing.

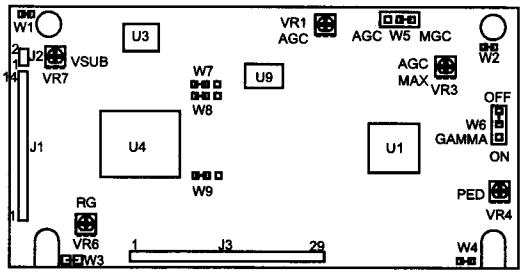
### 3.1.7 External Input Signals

**FIGURE 10.** **External Input Signals**



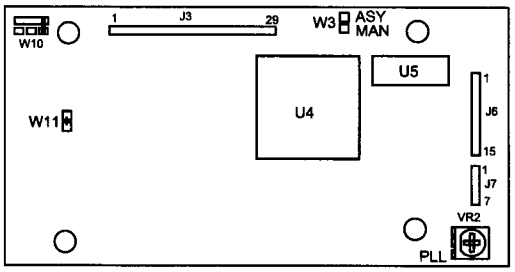
## 3.2 Board Layout and Adjustment

### 3.2.1 Top Board (Top Side)




| | | |
|---|---|---|
| W5 | AGC/MGC | Left: AGC<br>Right: MGC |
| W6 | Gamma | Down: On (0.45)<br>Up: Off (1.0) |
| W7-W9 | CDS pulse delay adjustment | |
| VR1 | AGC | Set at 2.0V |
| VR2 | MGC | Controlled from back plate |
| VR3 | AGC MAX | Set at 2.5V |
| VR4 | PED | Set at 50 mV of video |
| VR5 | RG | Factory adjustment only |
| VR7 | Vsub | Factory adjustment only |

### 3.2.2 Bottom Board (Bottom Side)

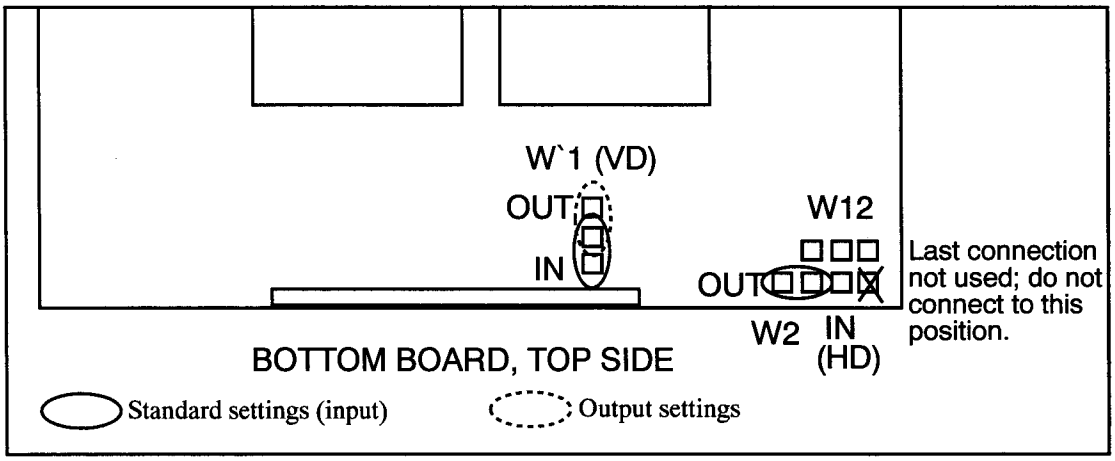



| | |
|---|---|
| VR2 | PLL adjustment |
| W1 (VD), W2 (HD) | HD and VD input/output selection |

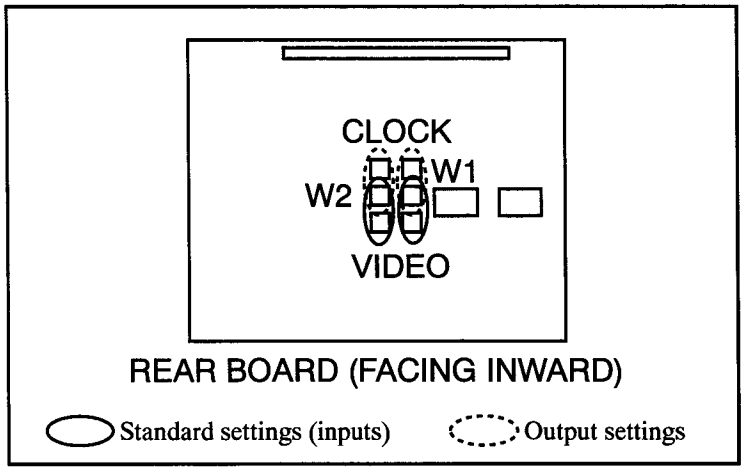
### 3.2.3 Option 7-2 Board Adjustments (Bottom Board, Top Side)

Internal jumper settings allow the TM-6702 to accept HD and VD sync at double speed (60Hz) or normal speed (30Hz), or to output HD, VD and pixel clock for variable scan frame grabbers.

#### 3.2.3 (a) HD (W2) and VD (W1) Input / Output Selection




#### 3.2.3 (b) Video / Clock Output Selection



# 4 TROUBLESHOOTING

## 4.1 Problems and Solutions

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

### 4.1.1 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

### 4.1.2 Symptom: Dark Video

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

- Shutter selection
- Iris opening on the lens
- Async mode with 5 volt level on "VINIT" (Pin #6)

### 4.1.3 Symptom: Non-synchronized Video

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

- Proper mode output
- Frame grabber software camera selection

## 4.2 Information and Support Resources

For further information and support:

| | |
|---|---|
| Phone: | (408) 747-0300 |
| | (800) 445-5444 |
| | (800) 3-PULNIX (24-hour message access) |
| Fax: | (408) 747-0660 |
| E-mail: | pulnix@pulnix.com |
| Mail: | PULNiX America Inc.<br>Sales Department<br>1330 Orleans Drive<br>Sunnyvale, CA 94089<br>ATTN: Video Applications |
| Web Site: | www.pulnix.com |

# 5 APPENDIX

## 5.1 Specifications

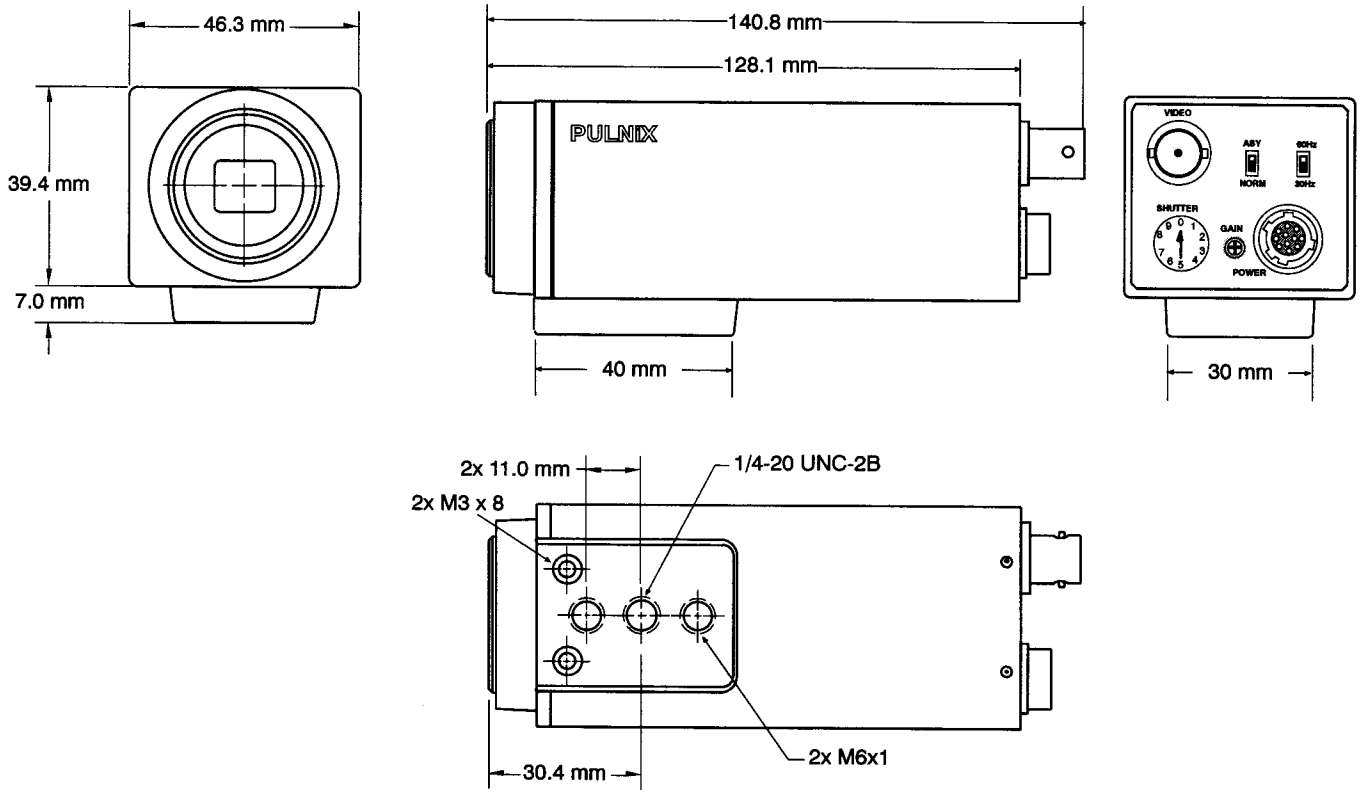
### 5.1.1 Product Specifications

**TABLE 2. Product Specifications Table**

| | |
|---|---|
| **Imager** | 1/2" progressive scan interline transfer CCD with on-chip microlens |
| **Pixels** | 694 H x 496 V |
| **Cell size** | 9.0 H x 9.0 V μm |
| **Photosensitive Pixels** | 648 H x 484 V |
| **Output sensitivity** | 12μV/e- |
| **Microlens** | Standard |
| **Scanning** | 525 lines at 60Hz (double speed mode), 30Hz (normal speed) |
| **Sync** | Internal/External auto switch<br>HD/VD, 4.0 Vp-p impedance 4.7KΩ<br>fHD = 31.468KHz / 15.734KHz, fVD = 60Hz / 30Hz |
| **Pixel clock** | 25.49MHz / 12.745MHz |
| **TV resolution** | 500 H x 484 V |
| **Video output** | Analog 1.0 Vp-p composite video, 75Ω, sync negative non-interlace |
| **Display mode video** | Analog only fHD=31.468KHz, fVD=60Hz (VGA) |
| **S/N ratio** | 50dB min AGC = OFF, 56dB typical |
| **AGC** | On / Off (off = std) |
| **MGC** | Manual gain adjustable (6dB to 26dB) |
| **Gamma** | 0.45 or 1.0 (1.0=std) |
| **Lens mount** | C-mount |
| **Power requirement** | 12 V DC 500 mA |
| **Operating temp.** | -10°C to +50°C |
| **Vibration & Shock** | Vibration: 7Grms (10Hz to 2000Hz), Shock: 70G |
| **Size** | 46.3mm x 39.4mm x 140.8mm (1.78" x 1.52" x 5.41") |
| **Weight** | 240 grams (9.0 oz.) |
| **Power cable** | 12P-02 |
| **Power supply** | K25-12V or PD-12 |

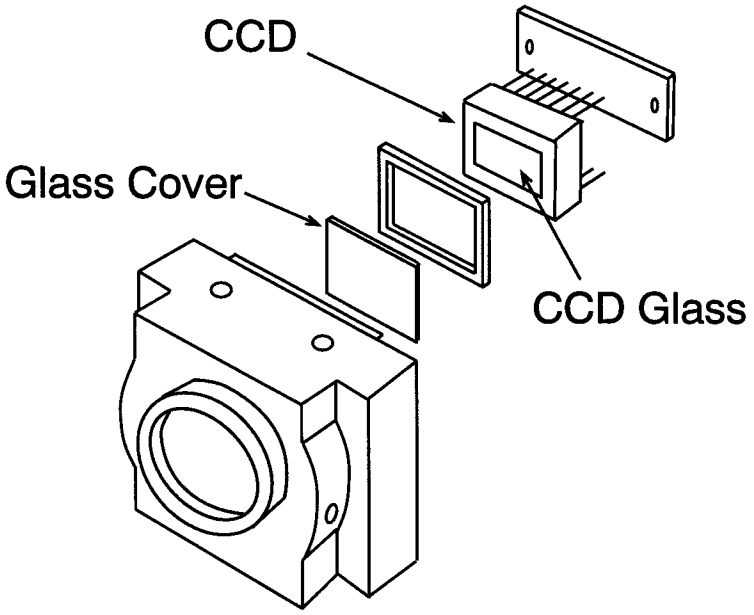
## 5.1.2 Physical Dimensions

FIGURE 11. **Physical Dimensions**



### 5.1.3 Glass Specifications

FIGURE 12. **Camera Front End - Glass Specifications**



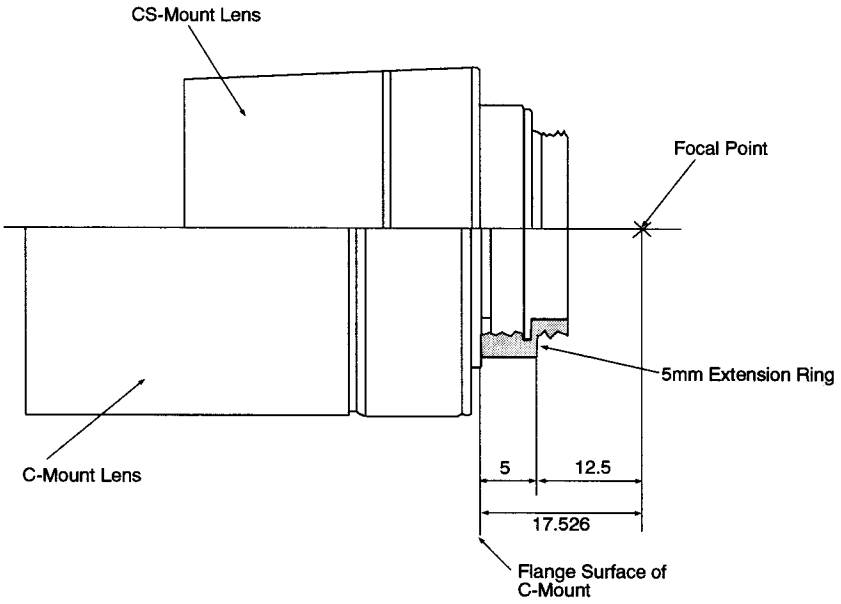

CCD Glass (BK-7) 0.75mm thickness
Refractive Index = 1.5

Glass Cover (BD-65) 1.0mm thickness
Refractive Index = 1.51

### 5.1.4 C-Mount Specifications

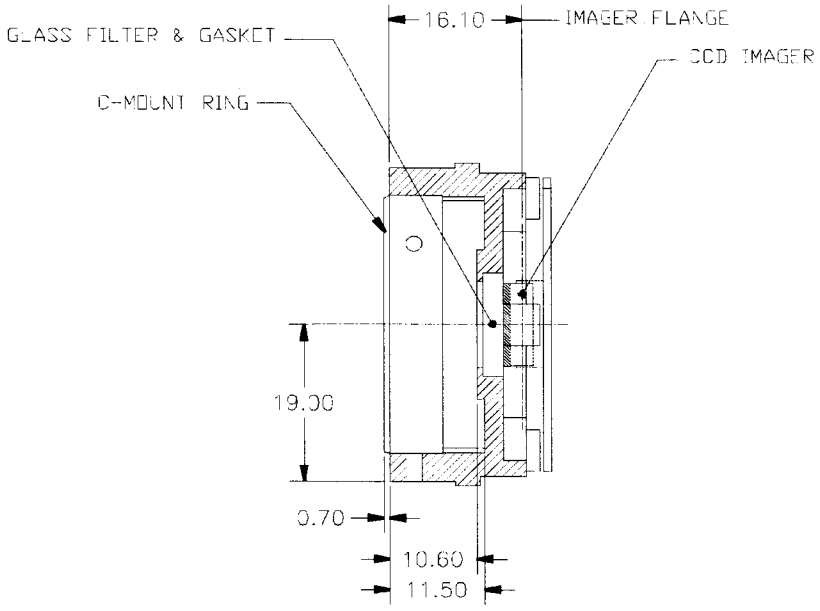
The Flange Back Length of the "CS-Mount" is 12.5mm versus 17.526 of the "C-Mount". The shorter Flange Back Length of the "CS-Mount" allows room for the stripe filter incorporated in the color camera. Additionally, the shorter Flange Back Length allows for reduction of the effective diameter of the first lens and reduces the number of lens elements. The common C-Mount lens is completely compatible with a CS-Mount camera when a 5mm extension ring is inserted between the lens and the camera.

FIGURE 13. **Combination With "CS-Mount" Camera**



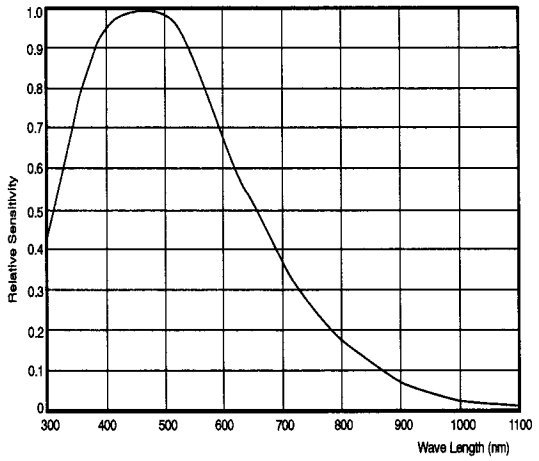

## 5.1.5 Front End Detail

FIGURE 14. **TM-6702 Imager Location**



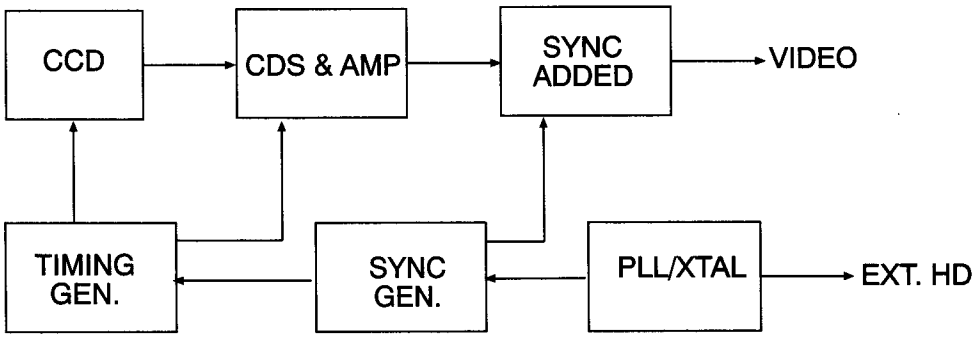
## 5.2 Spectral Response

FIGURE 15. **Spectral Response**




## 5.3 Block Diagram

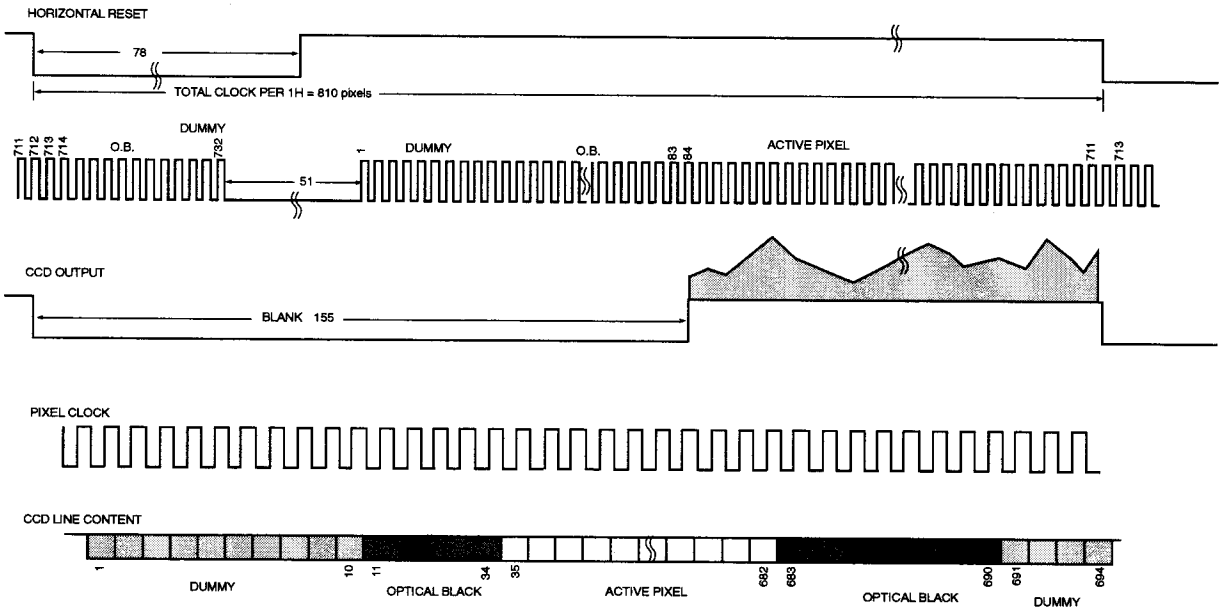
FIGURE 16. **TM-6702 Block Diagram**



## 5.4 Timing

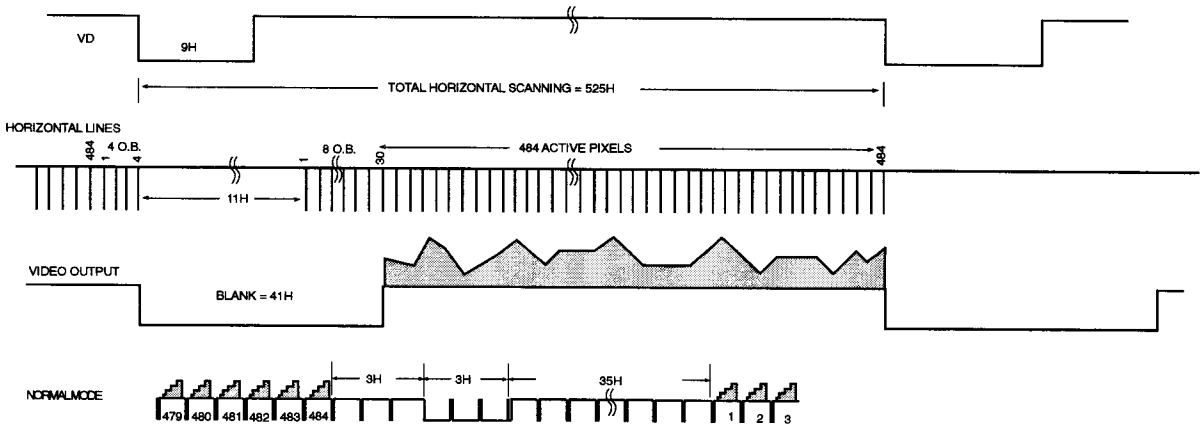
### 5.4.1 Pixel Mapping (Horizontal)

FIGURE 17. Pixel Mapping (Horizontal)




### 5.4.2 Vertical Frame Output Timing

FIGURE 18. Vertical Frame Output Timing



## Industrial Products Division


**PULNiX America, Inc.**
**1330 Orleans Drive**
**Sunnyvale, CA 94089**

**Tel: 408-747-0300**
**Tel: 800-445-5444**
**Fax: 408-747-0660**

**Email: pulnix@pulnix.com**


# www.pulnix.com


**In Japan**
PULNiX America, Inc.
1-11-14 Hongo
Bunkyo-ku, Tokyo 113-0033
Tel: 03-5805-2455
Fax: 03-5805-8082
*Kyoto Office*:
Tel: 075-594-6688
Fax: 075-591-2333

**In Australia**
PULNiX America, Inc.
Unit 16, #35 Garden Road
Clayton, Vic 3168
Tel: 3-9546-0222
Fax: 3-9562-4892

**In the U.K.**
PULNiX Europe, Ltd.
Aviary Court, Wade Road
Basingstoke, Hants RG24 8PE
Tel: 01256-475555
Fax: 02156-466268

**In Germany**
PULNiX America, Inc.
Steinbruch 5
63755 Alzenau
Tel: 06023-9625-0
Fax: 06023-4667