TM-6300 Progressive Scan Full Frame Shutter Camera

Operation Manual

69-0095
Rev.A

PULNiX
Imaging Products

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Certifications

CE Compliance

The TM-6300 camera has been certified to conform to the requirements of Council Directive 89/336/EEC for electromagnetic compatibility and to comply with the following European Standards:

Immunity: EN50082-2/1997
Emissions: CISPR22: 1997/EN55011: 1998 Class B

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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-6300 Operation Manual
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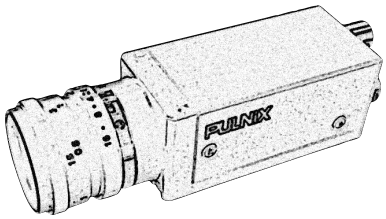


1 Introduction

1.1 Product Description

The TM-6300 is a high-performance progressive scan camera with a state-of-the-art 1/3" 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

- **1/3" 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 (7.4 x 7.4 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-6300 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-6300 is capable of capturing high-resolution integration images. Integration can last from 1/60 sec. to several seconds.

- **VGA display output**

  The TM-6300 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.

- **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.

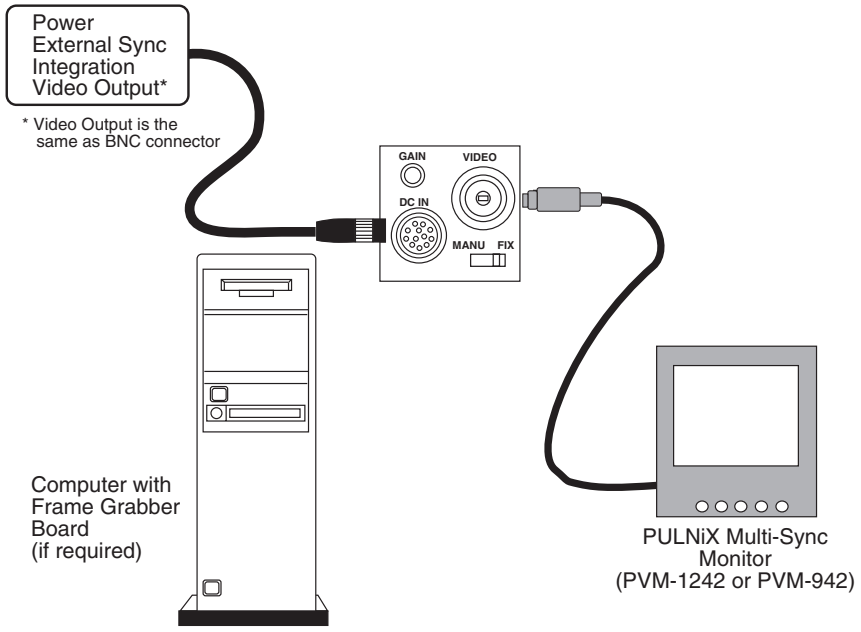
1.3 Applications

Designed for speed and functional versatility, the TM-6300 is ideal for applications such as high-speed image capturing, machine vision, computer graphics, gauging, avionics, microscopy, character and fine pattern recognition, document reading and high-end surveillance.

1.4 System Configuration

Figure 1 below presents a typical configuration for the TM-6300 camera.

FIGURE 1. TM-6300 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. We suggest that you read through these instructions prior to unpacking and setting up your camera system.

2.1 Getting Started

2.1.1 Unpacking Instructions

We recommend that you save the original packing cartons for the cameras and lenses in case you need to return or exchange an item.

We also recommend 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-6300 camera
- TM-6300 data sheet
- TM-6300 manual (by request)

2.1.3 Accessories

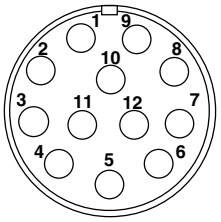
Following is a list of additional accessories or equipment that may be recommended or required for your particular application. Please check with your PULNiX representative prior to the installation of your video system to determine what you might need.

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

2.2 Camera Setup

2.2.1 Connector Pin Configurations

2.2.1 (a) 12-Pin Connector



The TM-6300 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.

Note: Internal-Sync and External-Sync modes are selected by an internal switch. If external HD is not present, the camera operates in Internal-Sync mode.

Refer to Section 3 on page 9 for selection.

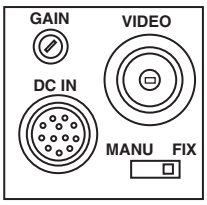
TABLE 1. 12-Pin Connector Assignments

	Internal	External Sync Mode	
Pin No.	Sync Mode	HD/VD	HD/VINIT
1	GND	GND	GND
2	+12V	+12V	+12V
3	GND	GND	GND
4	Video out	Video out	Video out
5	GND	GND	GND
6	HD out	HD in	HD in
7	VD out	VD in	—
8	GND	GND	GND
9	—	—	—
10	GND	GND	GND
11	—	—	VINIT
12	GND	GND	GND

2.2.2 Rear Panel

Functions and controls located on the camera rear panel:

FIGURE 2. TM-6300 Rear Panel



- 12-pin connector (power, I/Os)
- BNC video cable connector
- Manual gain control adjustment
- Manual/Fix Gain switch

2.2.3 Power Supply and Power Cable Setup

2.2.3 (a) Power Supplies

PULNiX recommends the following power supplies:

K25-12V	110V AC/12V DC	2.1A power supply (requires 12P-02S power cable)
K50-12V	110V AC/12V DC	4.2A power supply (requires 12P-02S power cable)
PD-12UU	100-240V AC/12V DC	1.2A universal voltage power supply with US plug
PD-12UUP	100-240V	1.2A universal voltage power supply with US plug and 12-pin connector
PD-12UE	100-240V/12V DC	1.2A universal power supply with European plug
PD-12UEP	PD-12UU with 12-pin connector	1.2A universal power supply with European plug and 12-pin connector

If you are providing power through the 12-pin connector, the PD-12UUP and PD-12UEP power supplies are available with the 12-pin mating connector already attached to the leads from the power supply. The PD-12UU or PD-12UE power supply can be connected to the PULNiX power cable via a terminal strip or directly.

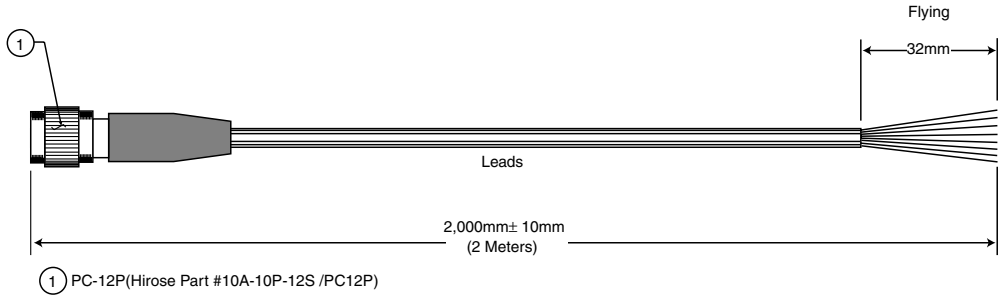
If wiring the PD-12UU power supply directly, please note the following:

- 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-02S, etc., please refer to the pin-out diagram. The color-coded leads use Gray for Ground and Yellow for +12V DC. Refer to Figure 3.

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



12P-02S 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	—
4	Red coax	Video	10	Brown	GND
5	Orange coax shield	GND	11	Blue	VINIT
6	Orange coax	HD	12	Black coax shield	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.*

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 Gray 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 PD-12UU is 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 PULNiX multi-conductor cables, such as the 12P-02S, 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-6300 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 Auto Iris Lens Setup

Auto-iris lenses with full video input can be used with the PULNiX TM-6300, 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-p 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

3.0.1 Progressive Scanning

The TM-6300 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, as well as providing 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-6300 outputs the progressive scanned image with an electronic shutter in two standard and one optional format:

1. **Progressive scanning double speed output**

   This produces straightforward 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**

   The TM-6300 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.

3.1 Modes of Operation

The TM-6300 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. Refer to Figure 4, Figure 5, and Figure 6. HD is not required for asynchronous reset of the camera. The shutter speed is set by the internal top board DIP switch, positions 5 to 9. Refer to Table 3.

FIGURE 4. Sync Mode Selection

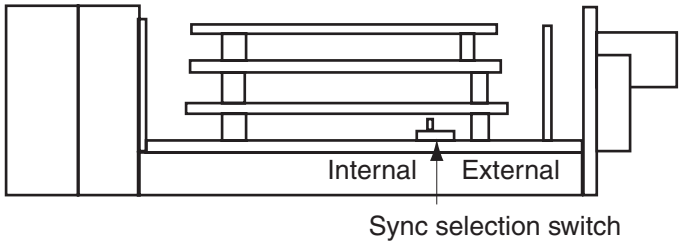


FIGURE 5. Mode Selection Switch (DIP Switch)

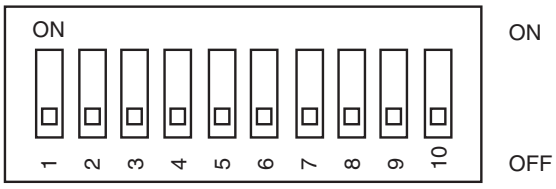


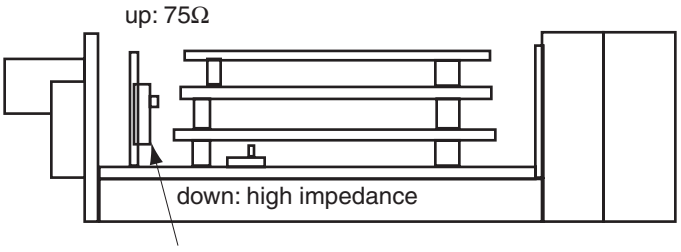
TABLE 2. Mode Selection Switch Settings

Function Description	Switch Number					
	1	2	3	4	5-9	10
2:1 interlace-scan 60 field/s	OFF		OFF			
2:1 interlace-scan 30 field/s	OFF		ON			
Progressive scan 60 frame/s	ON		OFF			
Progressive scan 30 frame/s	ON		ON			
External Shutter Control mode single pulse (width)		OFF			not used	OFF
External Shutter Control mode double pulse (width)		OFF			not used	ON
Internal shutter control mode		ON			table 3	X
AGC (Auto Gain Control)				OFF		
MGC (Manual Gain Control				ON		

TABLE 3. Shutter Speed Setting

Switch number					Shutter speed	
5	6	7	8	9	30 fps	60 fps
OFF	OFF	OFF	OFF	OFF	no shutter	
ON	ON	OFF	OFF	OFF	1/100	1/200
ON	OFF	ON	OFF	OFF	1/125	1/250
ON	OFF	OFF	ON	OFF	1/250	1/500
ON	OFF	ON	ON	OFF	1/500	1/1000
ON	OFF	OFF	OFF	ON	1/1000	1/2000
ON	OFF	ON	OFF	ON	1/2000	1/4000
ON	OFF	OFF	ON	ON	1/4000	1/8000
ON	OFF	ON	ON	ON	1/10000	1/20000

FIGURE 6. Input Signal Impedance Selection



Up position is 75 Ω for HD and VD inputs.

Down position is high impedance. When VINIT is used for async pulse width shutter control, the input impedance selection must be “high impedance” position.

3.1.1 Asynchronous Reset with Internal Shutter Control

Select DIP switch #2 to OFF to select Internal Shutter Control mode.

The TM-6300'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.

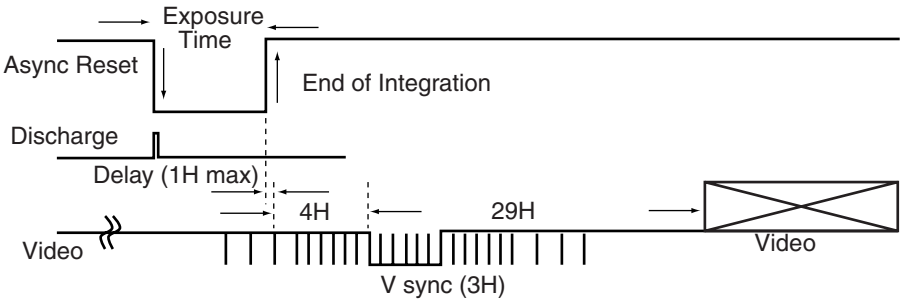
When external VINIT is high (5V), the TM-6300 expects the async pulse input, and the video output will be black video. It resets at the negative going pulse edge and captures the frame regardless of the shutter speed (fast or slow mode). The video output is kept disabled as the CCD is discharged continuously 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 Async Pulse Width Shutter Control

A VINIT pulse can control async reset and shutter speed. To select the External Pulse Width Control mode, set switch #2 to “OFF” position. Apply a pulse width control VINIT signal to the camera via an external event trigger. Refer to Figure 7 and Figure 8. The leading edge (negative going edge) resets camera and the pulse width (between falling edge and rising edge) controls the shutter speed. At leading edge of the VINIT pulse, CCD is discharged and start integrating. At the trailing edge of the pulse, it transfers the charges to vertical shift registers to output the image. This async operation can be implemented with or without external HD. However, for majority of applications, we recommend locking the camera with external HD.

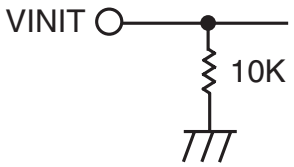
With this mode, video Vsync appears only once per trigger.

FIGURE 7. VINIT (Vertical Initialization) Trigger Specification



1H = 32 µsec (60 fps), 64 µsec (30 fps)

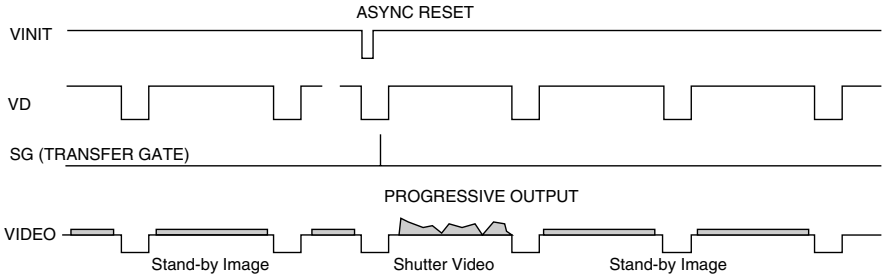
FIGURE 8. Equivalent Circuit



3.1.3 Asynchronous Reset at 0 Shutter

This resets the camera without shutter function. This is useful for conventional strobe applications.

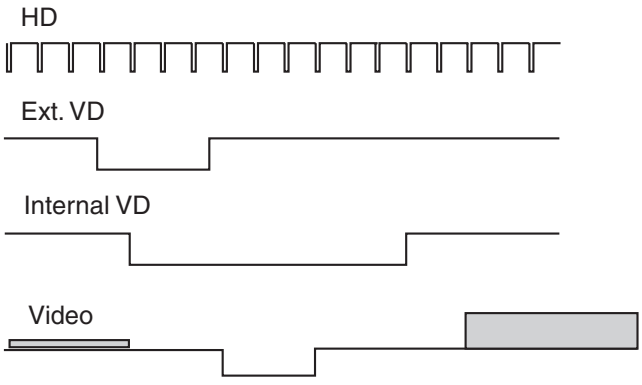
FIGURE 9. Asynchronous Reset at 0 Shutter



3.1.3 (a) Vertical Reset Mode

With external HD, VD reset mode, single VD can be applied at random timing (async timing) to generate single shot video output. In progressive scan mode, it outputs one full frame image and in interlace scan mode, it outputs one field image (ODD or EVEN field depending on VD and HD timing relationship).

FIGURE 10. Vertical Reset Timing Diagram



3.1.4 External Sync and VINIT Signals

Refer to Figure 11.

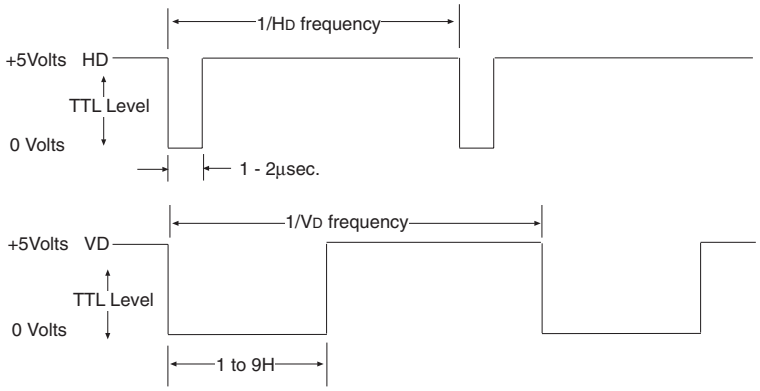
External sync— HD and VD signal level is TTL, negative going pulse. It must be 2.0 V to 5.0 V for high level to both high impedance or 75Ω drive.

HD frequency requirement for PLL is 31.468 KHz ±5% for 60 fps and 15.734 KHz ±5% for 30 fps.

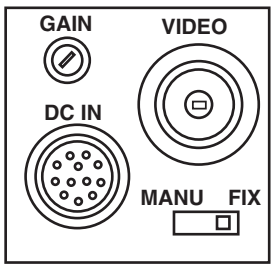
VD is 59.94 Hz ±5% for 60 fps reset and 29.97 ±5% for 30 fps reset.

Async pulse width shutter control— VINIT trigger is high-impedance input. The high level is 4V to 5V TTL

FIGURE 11. External Input Signals



3.1.5 Gain Control



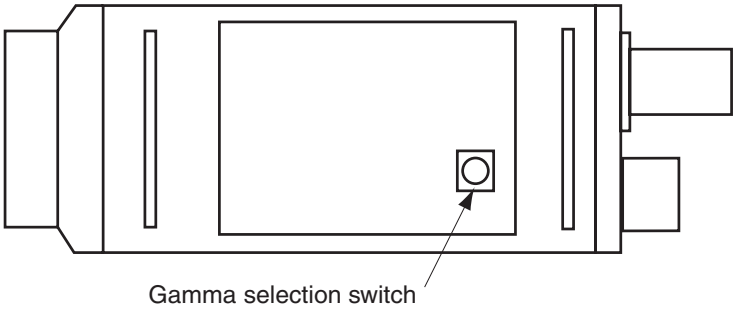
Fixed gain is factory set at 17 dB.

Manual gain is variable from 6 dB to 25 dB.

Automatic gain control (AGC) is selected by DIP SW #4.

3.1.5 (a) Gamma Selection

Set the Gamma selection switch to the desired Gamma setting.



Gamma = 0.45

Gamma = 1

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 #11)

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

5 Appendix

5.1 Specifications

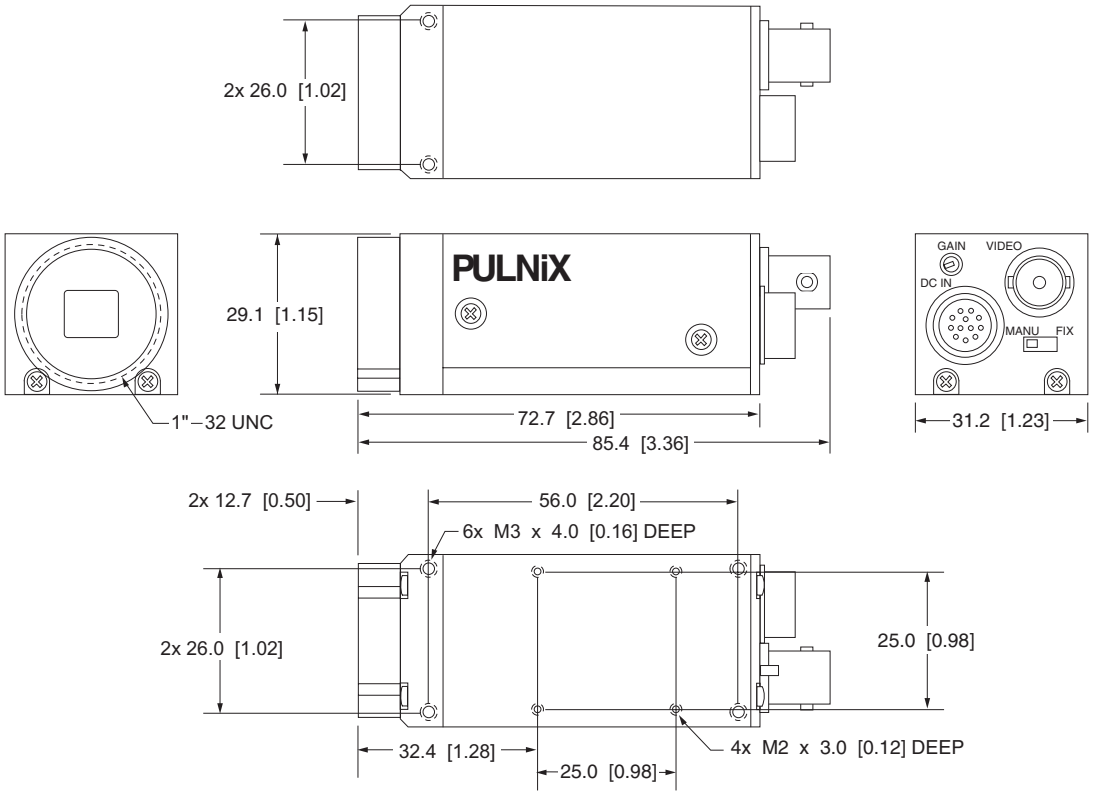
5.1.1 Product Specifications

TABLE 4. Product Specifications Table

Image Sensor	1/3” Progressive interline transfer CCD
Pixels	659 (H) x 494 (V)
Cell Size	7.4µm x 7.4µm square pixels
Scanning	30 or 60 frames/sec. with single channel output (VGA output)
Scanning Area	4.88 mm (H) x 3.66 mm (V)
Sync	Internal/external auto switch HD=31.468 KHz, (15.734 KHz) ±5% Vertical async reset or VD=60 or 30 Hz (non-interlace)
Asynchronous Reset	Ext. Vinit (Trigger) for async reset
Pixel clock	24.5454 MHz or 12.2727 MHz
Resolution	500 (H) x 494 (V) TV lines
S/N ratio	56dB min (at 30fps)
Minimum illumination	1 Lux at 30 fps, 2 Lux at 60 fps, F=1.4
Video output	1.0 Vp-p composite, 75Ω non-interlace
AGC	Manual/Factory preset/AGC switchable
Gamma	0.45 or 1.0 (standard)
Electronic shutter	Asynchronous electronic shutter (60fps or 30 fps) Mode A: 1/120,000 or 1/110,000 Max (manual speed) Mode B: Async pulse width control (500/100 µsec to 8.3/16.7 µsec) Full frame resolution per shutter
Lens mount	C-mount
Power requirements	12V DC, 210 mA
Operating temperature	-10°C to 50°C
Vibration, Random	7Grms 10-2000 Hz
Shock	70G 10-11 msec
Size (W x H x L)	31.2mm (W) x 29.1mm (H) x 72.7mm (L) (1.23” x 1.15” x 2.86”)
Weight	85 g
Auto Iris Connector	None
Functional Options	
I/O accessories **Power cable** **Power supply**	 12P-02S K25-125 or PD-12UUP

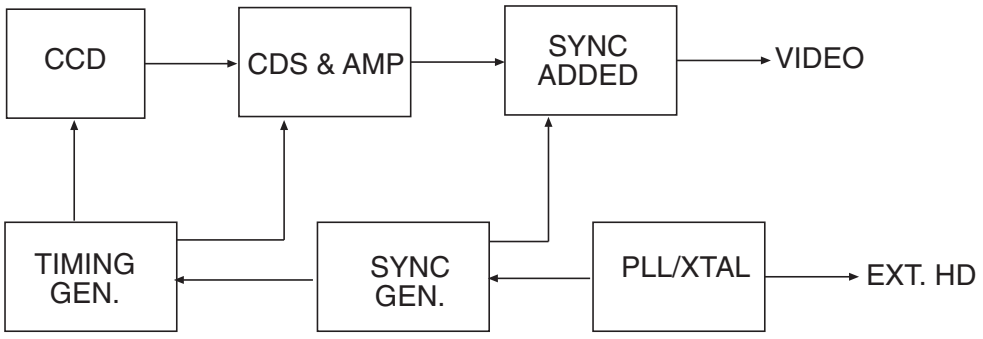
5.1.2 Physical Dimensions

FIGURE 12. Physical Dimensions



5.2 Block Diagram

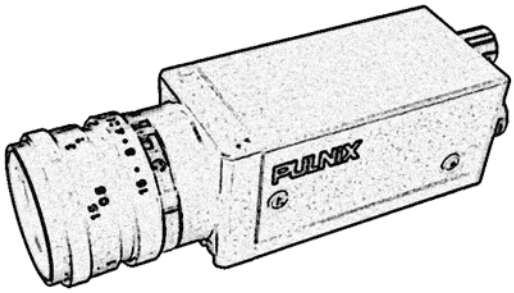
FIGURE 13. TM-6300 Block Diagram



5.3 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:	imaging@pulnix.com
Mail:	PULNiX America Inc. Sales Department 1330 Orleans Drive Sunnyvale, CA 94089 ATTN: Video Applications
Web Site:	www.pulnix.com



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