PULNiX

TM-7200 / TM-6200

High Resolution Digital CCD Camera

Operation Manual

69-0046
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

UL

CE

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-7200/TM-6200 Operation Manual
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TM-7200/TM-6200 High Resolution Digital CCD Camera

Operation Manual

1 INTRODUCTION

1.1 Product Description

The PULNiX TM-7200/TM-6200 CCD camera is a high resolution monochrome shutter camera with asynchronous reset capability and a built-in video frame memory. The TM-7200/TM-6200 is designed as a basic machine vision or automated inspection imaging sensor that provides low cost image capture and storage functions right in the camera.

1.2 Features

- High resolution 1/2" imager
  - TM-7200 (EIA): 768 (H) x 494 (V)
  - TM-6200 (CCIR): 752(H) x 582(V)
- 8-bit RS-422 digital output
- Built-in asynchronous video memory
- Asynchronous reset with external shutter control
- Low light sensitivity (0.5 lux) with on-chip lenses
- Eight shutter speeds to 1/31,000 sec. selectable via a convenient rotary selector switch

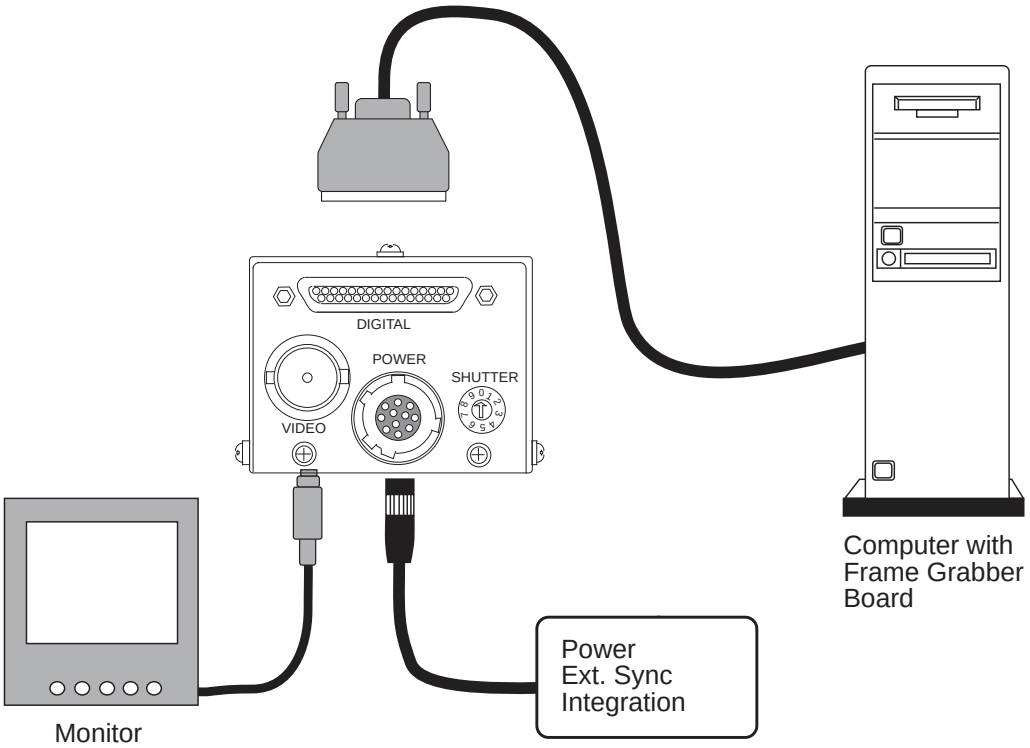
1.3 Functional Options

- Frame mode setting for full frame integration (OP60)
- Continuous sync output during reset (OP51)
- Remoted imager (OP10-1)
- AGC Enable (OP1-2)
- Internal IR cut filter (OP3-1)
- Optical Filter Removal (OP3-2)
- Gamma Adjust to 0.45 (OP4-1)
- Glassless CCD Imager (OP21)

1.4 Applications

The TM-7200/TM-6200 is designed as a basic machine vision or automated inspection imaging sensor. It is excellent for applications such as on-line, high speed automated inspection, bar code and label reading, and process inspection.

1.5 TM-7200/TM-6200 System Configuration



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-7200/TM-6200 (EIA) or TM-6200 (CCIR) camera
- TM-7200/TM-6200 / TM-6200 Data sheet
- PULNiX Camera Installation and Setup instructions
- TM-7200/TM-6200 / TM-6200 Operation Manual

2.1.3 Accessories

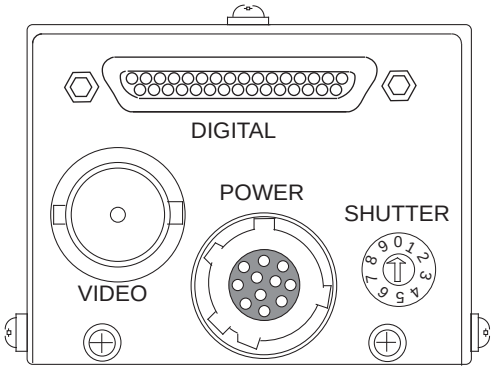
Following is a list of additional accessories or equipment that may be recommended or required for your particular application. Please check with your PULNiX representative prior to the installation of your video system to determine what you might need.

- Digital Cable: 30DG-02-7200
- Power Cable: 12P-02
- Power Supply: PD-12, DC-12N or K25-12V
- B/W monitor
- Lens

2.2 Camera Setup

2.2.1 Rear Panel

FIGURE 1. **TM-7200/TM-6200 Rear Panel Configuration**

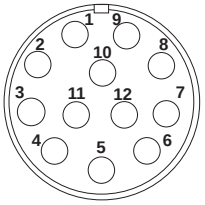


- 12-pin connector (power)
- 31-pin connector (digital output)
- Video connector
- Shutter control switch

2.2.2 Connector Pin Configurations

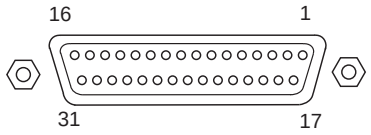
2.2.2 (a) 12-Pin Connector

The TM-7200/TM-6200 has a 12-pin connector for power input.



Pin#	Description	Pin#	Description
1	GND	7	VD Input
2	+12V DC	8	GND
3	GND	9	HD Input
4	Video Out	10	GND
5	GND	11	INT. CONT.
6	VINIT	12	GND

2.2.2 (b) 31-Pin Connector



The TM-7200/TM-6200 has a 31-pin connector for digital output.

Pin#	Description	I/O	Pin#	Description	I/O
1	CLK+	O	17	CLK-	O
2	LDV+	O	18	LDV-	O
3	FDV+	O	19	FDV-	O
4	GND		20	VINIT	I
5	FI+	O	21	FI-	O
6	INTEG	I	22	ENINT	I
7	LPULSE	O	23	GND	
8	D0+	O	24	D0-	O
9	D1+	O	25	D1-	O
10	D2+	O	26	D2-	O
11	D3+	O	27	D3-	O
12	D4+	O	28	D4-	O
13	D5+	O	29	D5-	O
14	D6+	O	30	D6-	O
15	D7+	O	31	D7-	O
16	GND				

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.

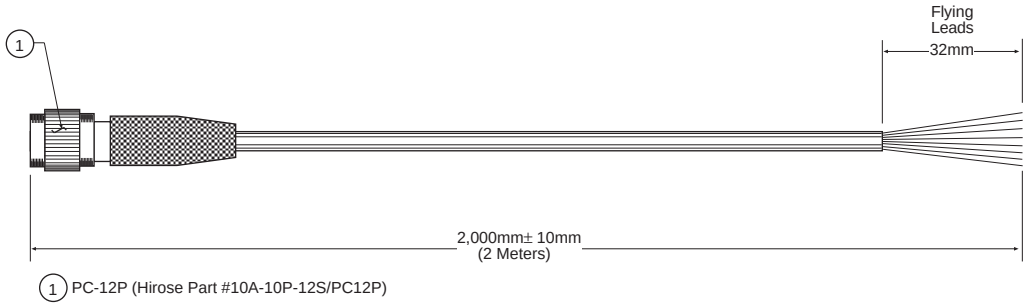
When wiring the PD-12 power supply directly, please note the following:

- 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) PULNiX Power 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 2. **12P-02 Interface Cable (optional)**



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
4	Red coax	Video	10	Brown	GND
5	Orange coax shield	GND	11	Blue	Int. Cont.
6	Orange coax	VINIT	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) "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 Cable

Consult the pin-out for the camera purchased. 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).

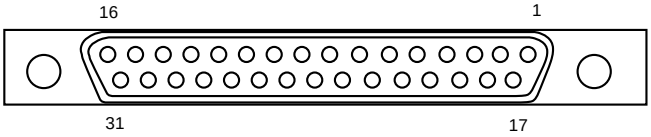
2.2.3 (e) Attaching the Power Cable to the Connector

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.

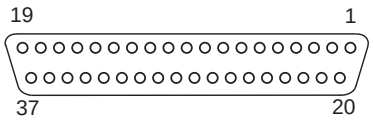
2.2.4 Digital Cable Assembly

2.2.4 (a) 31-Pin Connector (MP211-031-113-4300)



Pin#	Signal	Cable	Pin#	Signal	Cable
1	CLK+	OR 1 RED	17	CLK-	OR 1 BLUE
2	LDV+	GRY 1 RED	18	LDV-	GRY 1 BLUE
3	FDV+	WHT 1 RED	19	FDV-	WHT 1 BLUE
4	GND	YLW 1 RED	20	VINIT	YLW 1 BLUE
5	FI+	PINK 1 RED	21	FI-	PINK 1 BLUE
6	INTEG	OR 2 RED	22	EN INTEG	OR 2 BLUE
7	L PULSE	WHT 2 RED	23	GND	GRY 2 BLUE
8	D0+	WHT 2 RED	24	D0-	WHT 2 BLUE
9	D1+	YLW 2 RED	25	D1-	YLW 2 BLUE
10	D2+	PINK 2 RED	26	D2-	PINK 2 BLUE
11	D3+	OR 3 RED	27	D3-	OR 3 BLUE
12	D4+	GRY 3 RED	28	D4-	GRY 3 BLUE
13	D5+	WHT 3 RED	29	D5-	WHT 3 BLUE
14	D6+	YLW 3 RED	30	D6-	YLW 3 BLUE
15	D7+	PINK 3 RED	31	D7-	PINK 3 BLUE
16	N/C				

2.2.4 (b) 37-Pin D-Sub Connector



Pin#	Signal	Cable	Pin#	Signal	Cable
1	CLK+	OR 1 RED	20	CLK-	OR 1 BLUE
2	LDV+	GRY 1 RED	21	LDV-	GRY 1 BLUE
3	FDV+	WHT 1 RED	22	FDV-	WHT 1 BLUE
4	N/C		23	GND	GRY 2 BLUE
5	FI+	PNK 1 RED	24	FI-	PINK 1 BLUE
6	N/C		25	N/C	
7	N/C		26	N/C	
8	D0+	WHT 2 RED	27	D0-	WHT 2 BLUE
9	D1+	YLW 2 RED	28	D1-	YLW 2 BLUE
10	D2+	PINK 2 RED	29	D2-	PINK 2 BLUE
11	D3+	OR 3 RED	30	D3-	OR 3 BLUE
12	D4+	GRY 3 RED	31	D4-	GRY 3 BLUE
13	D5+	WHT 3 RED	32	D5-	WHT 3 BLUE
14	D6+	YLW 3 RED	33	D6-	YLW 3 BLUE
15	D7+	PINK 3 RED	34	D7-	PINK 3 BLUE
16	GND	YLW 1 RED	35	GND	SHIELD
17	VINIT	YLW 1 BLUE	36	N/C	
18	EN INTEG	OR 2 BLUE	37	INTEG	OR 2 RED
19	N/C				

2.2.5 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.

2.2.6 Attaching the Camera Lens

The TM-7200/TM-6200 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.

2.2.7 Back Focusing the Lens

To backfocus the TM-7200/TM-6200 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 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.

2.2.8 Auto-Iris Lens Setup

Auto-iris lenses with full video input can be used with the PULNiX TM-7200/TM-6200, 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 PULNiX 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.

2.2.9 Monitor Display Mode

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

2.2.10 Connectors and Cables

12-pin connector and cable: Standard cable is 12P-02 (2m, 8 conductor cable) for power and external controls.

3 OPERATION

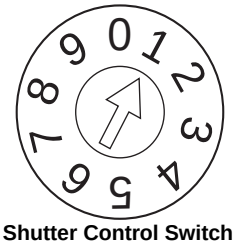
3.1 Modes of Operation

3.1.1 Shutter Operation

The TM-7200/TM-6200 has a substrate drain type shutter mechanism which provides a superb picture at various speeds without smearing. Manual shutter speed control can be selected at 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, or 1/10,000 sec. rate.

3.1.2 Asynchronous Reset with Shutter

The TM-7200/TM-6200's asynchronous reset is flexible and takes external HD for phase locking. Applying a VINIT pulse resets the camera's scanning and purging of the CCD.



Shutter Control Switch

When async reset pulse (VINIT) is applied to High state (+5V) with dial switch select from1 to 9, the TM-7200/TM-6200 asynchronous camera discharges the photo charges into the substrate drain although the camera is still running on its sync timing and only outputs captured video. When the negative going reset pulse is applied, the camera will latch the falling edge to its next horizontal drive and reset vertical sync timing immediately. Then it starts integrating for the period of shutter control set by either an external pulse width pulse or internal shutter control. Therefore the horizontal phase will not be interrupted. The TM-7200/TM-6200 asynchronous camera will output one field of shuttered video after reset.

TABLE 1. Shutter Control

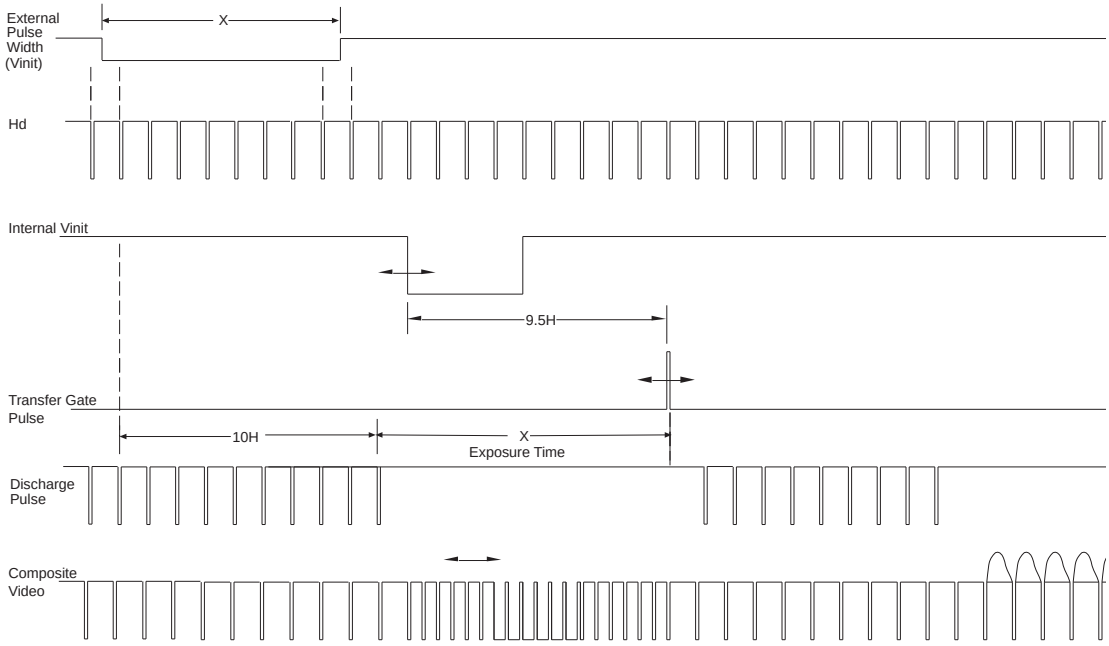
	Manual Mode	Async Reset Mode	
Set	**TM-7200/TM-6200**	**TM-7200**	**TM-6200**
0	1/60	normal 1/60	normal 1/50
1	1/125	0.5H 1/31,000	1/31,000
2	1/250	1.5H 1/10,000	1/10,000
3	1/500	3.5H 1/4,500	1/4,500
4	1/1,000	6.5H 1/2,400	1/2,400
5	1/2,000	16.5H 1/950	1/950
6	1/4,000	32.5H 1/480	1/480
7	1/10,000	64.5H 1/245	1/245
8	N/C	128.5H 1/120	1/120
9	N/C	Shutter determined by pulse width	

There are three modes to control the asynchronous reset and shutter speed, External Pulse Width Mode, Internal Fast Reset Mode and Internal Slow Reset Mode.

3.1.2 (a) External Pulse Width Mode

The TM-7200/TM-6200 can be reset with external reset pulse (VINIT). Set the dial switch to “9”. Apply a pulse width control VINIT signal generated from an external event trigger to the camera The internal reset pulse will be latched to HD and at 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 VINIT will be generated at the following edge (positive going edge) of the external pulse, resetting the internal timing including the video sync. The shutter speed is the same as the external pulse width, but the integration delays 9H from the leading edge.

FIGURE 3. **External Pulse Width Mode**



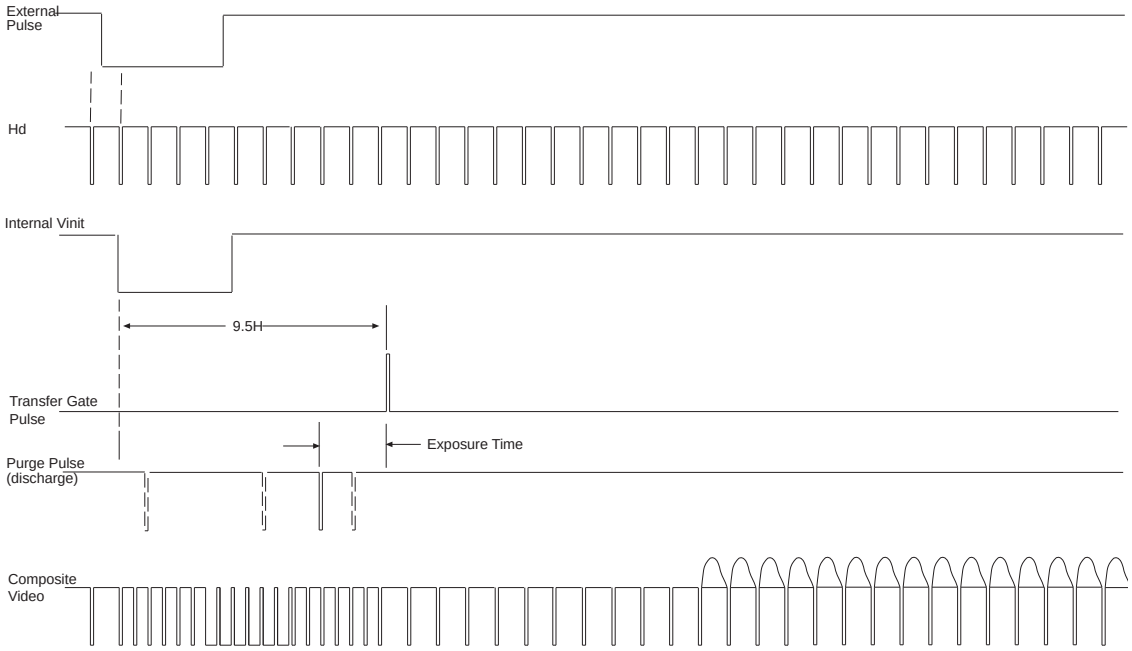
For the progressive format, one frame of video output will start from the rising edge of the pulse width control. The camera will output the same video from memory when VINIT is kept high (5V), then update the image upon receiving the next pulse. At async mode with external pulse input high, the video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

This feature is especially important in capturing moving objects at the precise location of the field of view, such as belt conveyer, fast event observation and still image capturing.

3.1.2 (b) Internal Fast Reset Mode

The video signal has no delay from the reset timing. Shutter speed range is 1/2400 to 1/31,000 sec. Select a dial switch setting from "1" to "4". When the fast reset mode is selected, the camera resets with internal VINIT timing, which is latched to Hd, and video output is also synchronized with internal VINIT timing without further delay. The shutter speed is controlled by the dial switch on the camera's rear panel.

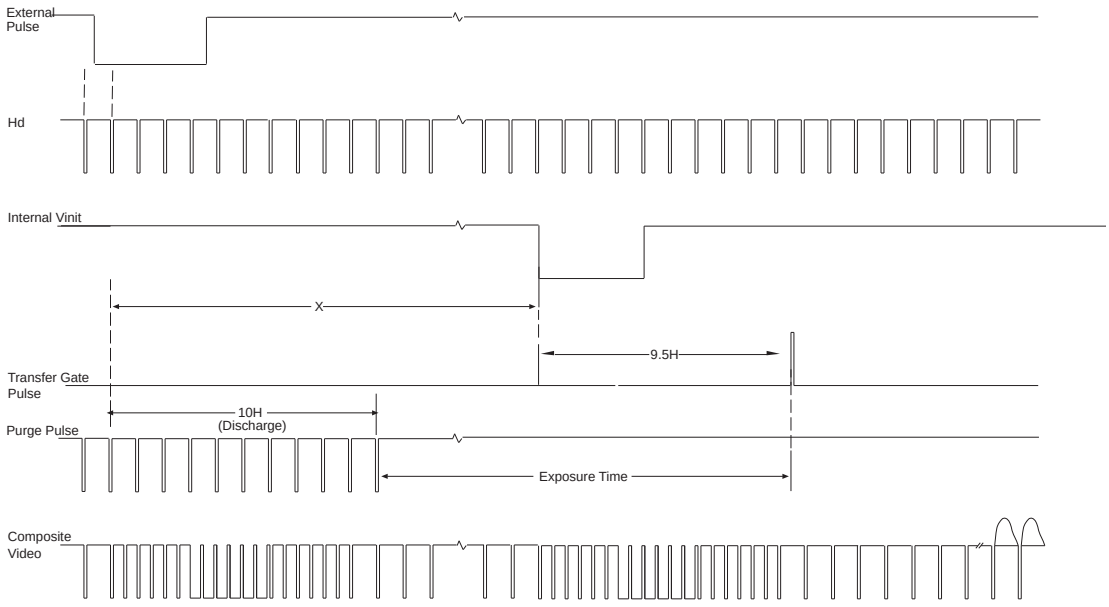
FIGURE 4. **Internal Fast Reset Mode**



3.1.2 (c) Internal Slow Reset Mode

The speed control ranges from 1/120 to 1/950 sec. The video signal starts with internal V. Select a dial switch setting from "1" to "4". With the internal slow reset mode selected, the camera operates the reset and shutter in the same way as the external double pulse control mode. When the external VINIT pulse is applied, internal VINIT is latched to Hd and the second internal VINIT signal is delayed to set up the shutter speed period. The shutter speed is controlled by the dial switch from "5" to "8". Video output timing starts right after the second internal VINIT.

FIGURE 5. **Internal Slow Reset Mode**



3.1.3 Integration

The CCD imager of the TM-7200/TM-6200 can be exposed longer than normal TV timing (16.7 msec.). Because the TM-7200/TM-6200 has an interline transfer chip, a full frame of resolution is achievable with the Frame Mode option (OP60).This feature provides high sensitivity for dark environment applications.

Note: A full frame is not available in the shutter mode.

Integration is achieved by controlling pin #11 of the 12-pin connector to Low (GND). Integration also can be controlled by VINIT with the pulse width more than one field.

During integration, the signal processing keeps optical black levels as the reference black video to clamp video levels. This results in cancelling out thermal noise during the integration period.

3.1.4 Field Mode and Frame Mode

The standard factory setting for the TM-7200/TM-6200 cameras is FIELD MODE. The mode selection is by solder jumper on the process board and should only be changed by a PULNiX factory authorized representative. If FRAME MODE is required, please contact PULNiX for this setting. The differences between the two modes is explained below.

3.1.4 (a) Field Mode

In Field Mode, two horizontal rows are scanned together, changing the pair at each interlace scan (Fig.). 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: Field Mode cannot provide full frame resolution with strobe lighting applications.

3.1.4 (b) Frame Mode

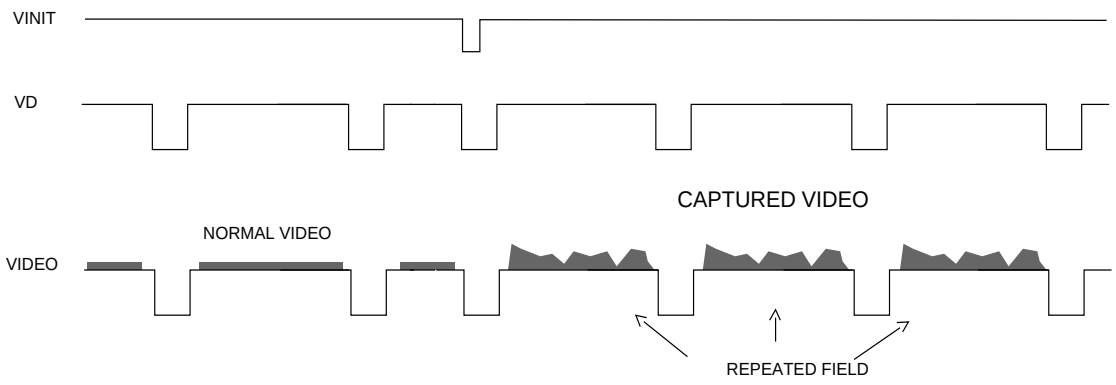
In Frame Mode, each horizontal row is scanned as interlace scanning. The integration of each pixel is one frame period. Vertical pixel resolution is good, and exact location is obtained. A disadvantage as compared with Field Mode is the tendency to show vertical Moire. For strobe lighting, Frame Mode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

3.1.5 Video Output

3.1.5 (a) Async Reset Image Capture

With built-in memory, an image can be captured when VINIT pulse is applied. The captured image will be continuously scanned out until the next VINIT pulse occurs.

FIGURE 6. **Async Reset Image Capture**

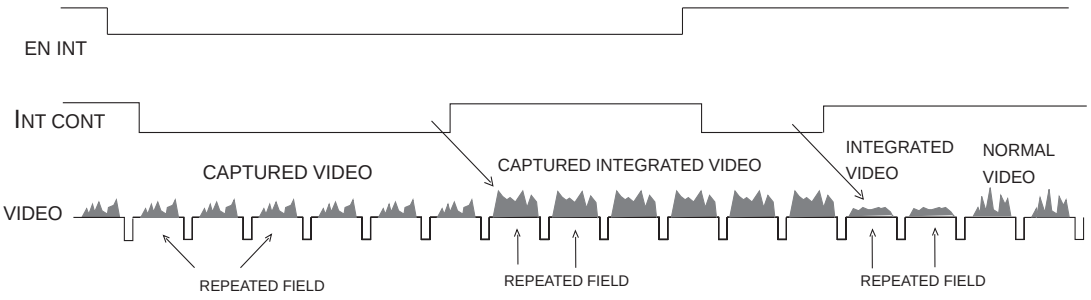


3.1.5 (b) Built-in Memory for Integration Image Capture

With EN INT high (enable integration, pin #10), set the integration control (pin #11) to low for integration. Integrated video can be captured once integration control goes back to high. All captured fields in this case are the same fields.

With the full frame integration option, the TM-7200/TM-6200 provides one full frame (two fields) of integrated image. This option requires additional frame memory inside the camera.

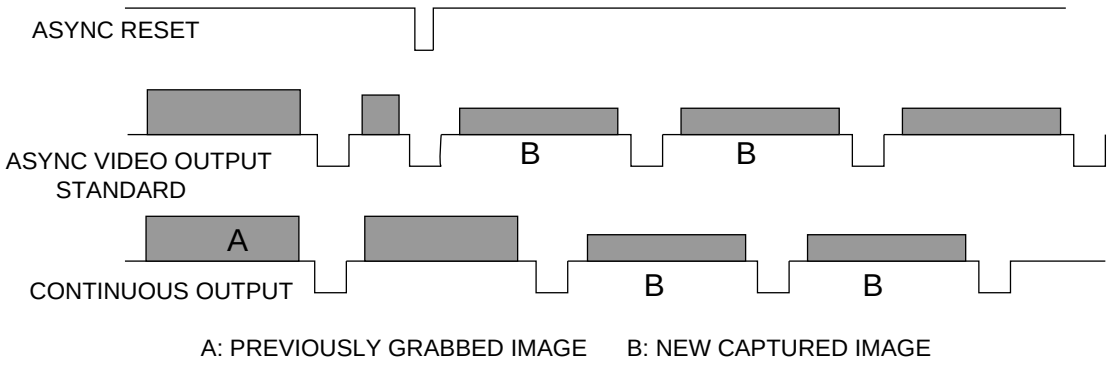
FIGURE 7. **Integrated Image Capture Timing**



3.1.5 (c) Continuous Sync Output Option (OP51))

When async reset is applied, video sync is also reset asynchronously. This phenomenon causes video picture rolling or bouncing on the monitor. With this option, a continuous output (no more bouncing or rolling pictures) will be achieved at async reset.

FIGURE 8. **Continuous Sync Output**



3.1.6 Timing

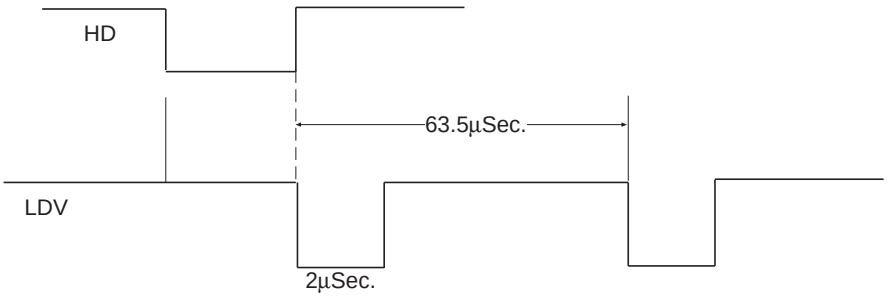
3.1.6 (a) Digital Video

Differential line-driven, 10-bit parallel signal with EIA-422 format. 100Ω output termination impedance. Output from 31-pin connector. Mating connector: Airborne MP211-031-113-4300. Please consult digital cable information, e.g., 50-13-1-01, 30DG-02 (8-bit) or 30DG-02-10 (10-bit), 2m cable.

3.1.6 (b) Line Data Valid

This is differential line-driven signal with EIA-422 format. It is active high (+ side is higher than - side) during the transfer of each line of data, producting horizontal line readout.

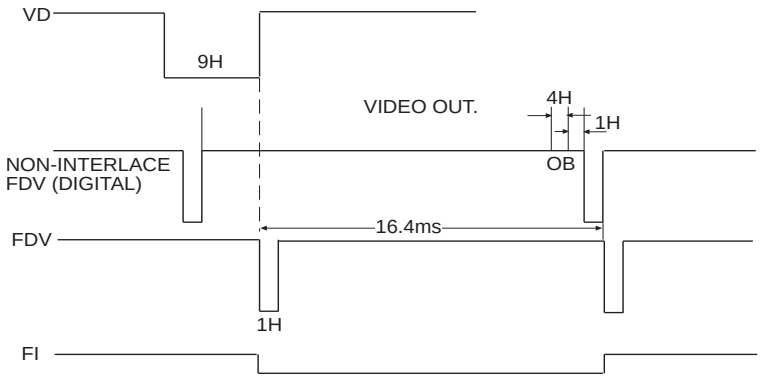
FIGURE 9. **Line Data Valid**



3.1.6 (c) Frame Data Valid and Odd/Even Field Valid

This is differential line-driven signal with EIA-422 format. It is active high during the transfer of each frame data. During integration, both LDV (Line Data Valid) and FDV (Frame Data Valid) are kept low and restart upon the completion of integration. When F1 is kept high, the camera outputs odd field data; otherwise, even field data is output.

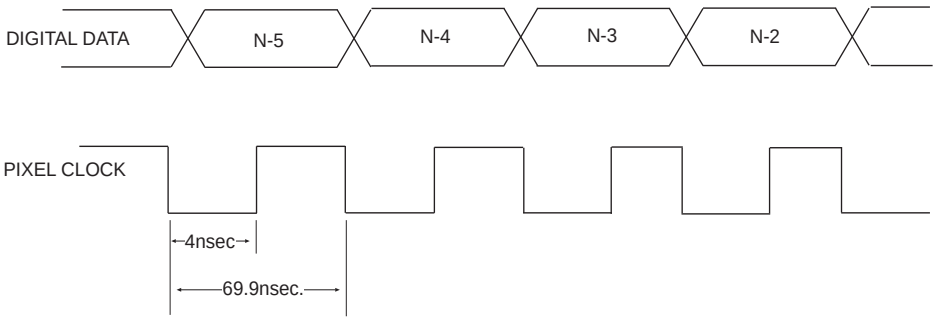
FIGURE 10. **Frame Data Valid**



3.1.6 (d) Pixel Clock

Differential line-driven signal with EIA-422 format. The frequency is 40.068 MHz (standard).

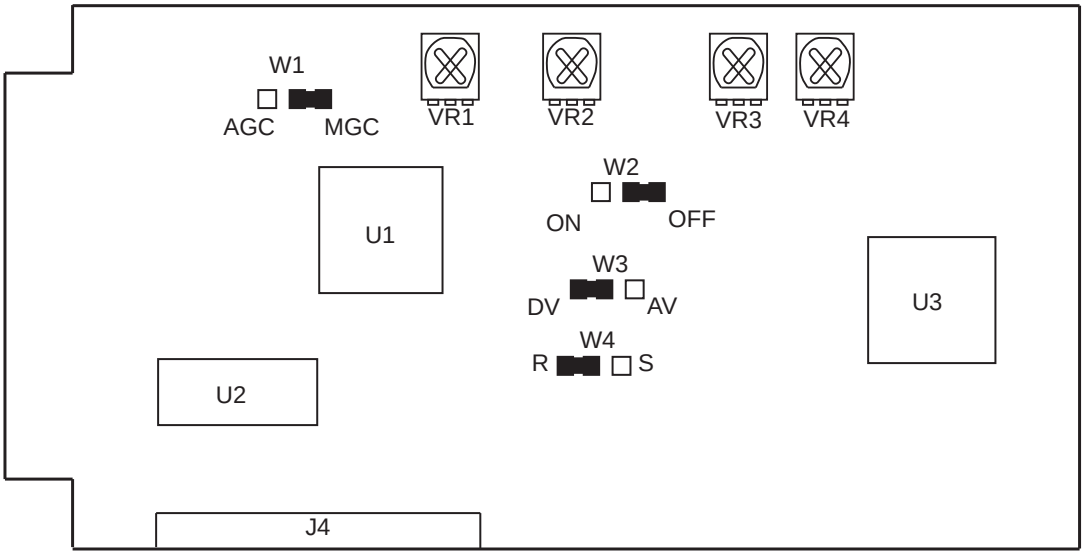
FIGURE 11. **Pixel Clock**



3.2 Adjustment Procedures

3.2.1 Signal Board

FIGURE 12. **Signal Board (top side)**

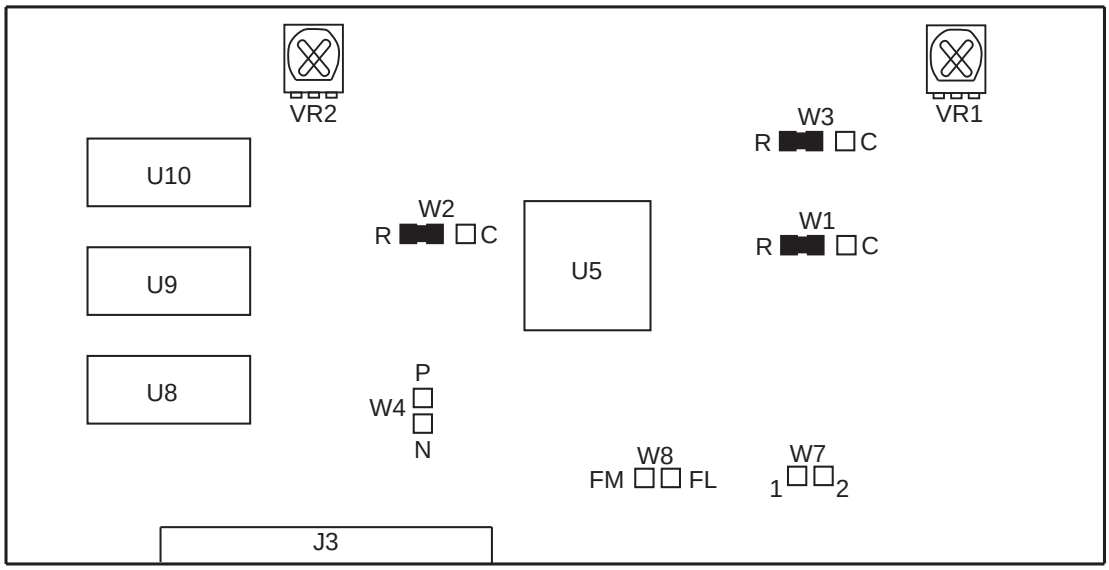


Set	W1(AGC/MGC)	Right (MGC) Manual Gain
Set	W2(GAMMA)	Left(1) Gamma = 1.0
Set	W3(DV/AV)	Left(DV) Direct analog (right)
Set	W4(Video R/S)	Left(R)
Set	W5(N/P)	Open(N)
Set	W6(FRM/FLD)	Open(FLD)
Set	W7(SMD2)	Open

VR1	AGC
VR2	MGC
VR3	AGC MAX
VR4	Pedestal

3.2.2 Memory Board

FIGURE 13. **Memory Board (bottom side)**

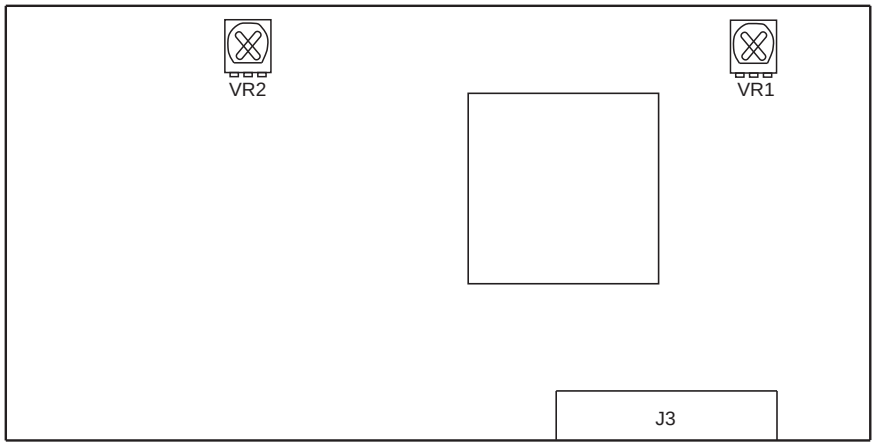


Set	W1(FLD)	Left(R)
Set	W2(HD)	Left(R)
Set	W3(VD)	Left(R)
Set	W4(P/N)	Open(N)
Set	W7(MFM1/2)	Open(2)
Set	W8(FM/FL)	Open(FL)

VR1 A/D VREF
VR2 D/A VREF

3.2.3 Power Board

FIGURE 14. **Power Board**



VR1 EXT. VD PHASE
VR2 PLL

4 TROUBLESHOOTING

4.1 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 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

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

5 APPENDIX

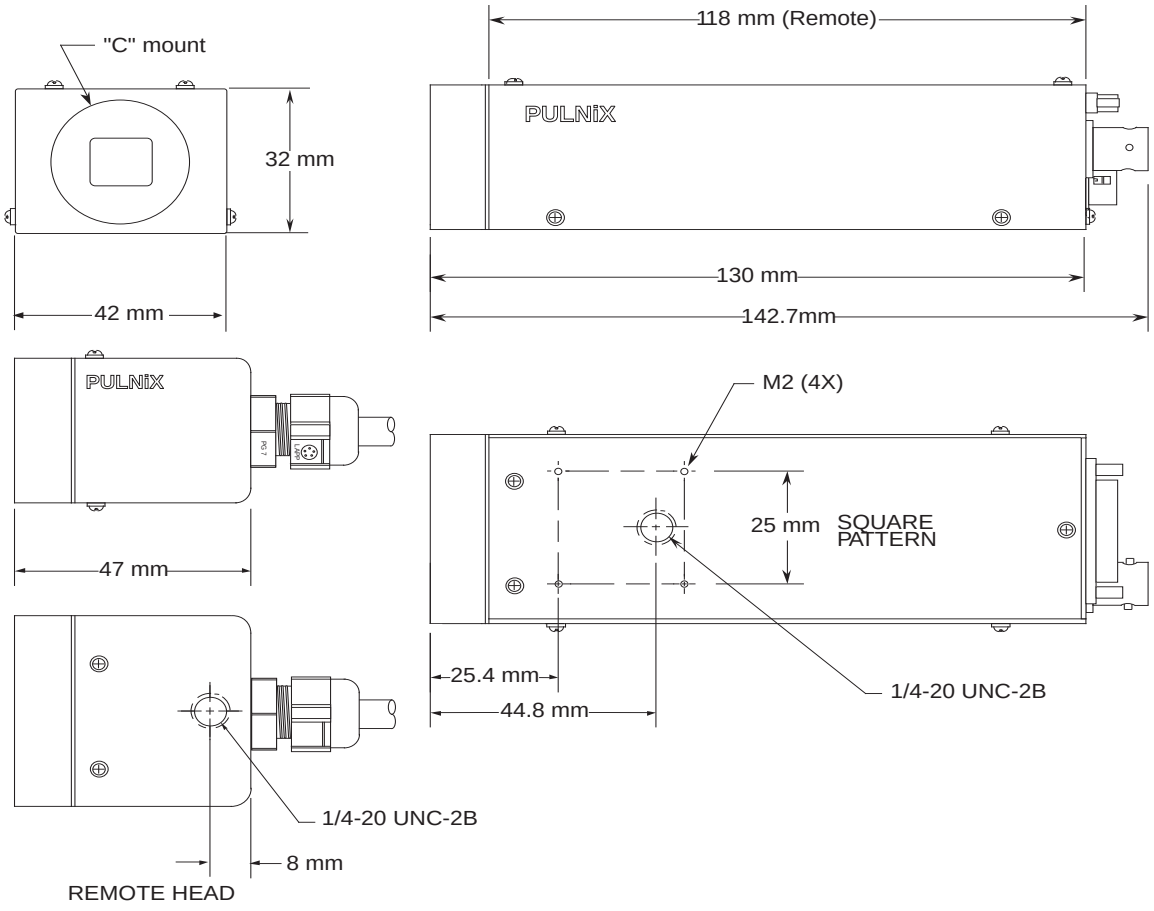
5.1 Specifications

5.1.1 Product Specifications

Model	TM-7200 (EIA)	TM-6200 (CCIR)
Imager	1/2 inch interline transfer CCD	
Pixels	768 (H) x 494 (V)	752 (H) x 582 (V)
Cell size	8.4 (H) x 9.8 (V) microns	8.4 (H) x 8.2 (V) microns
Sensing area	6.41 (H) x 4.89 (V) mm	
Dynamic range	67dB	
Chip size	7.95 mm (H) x 6.45 mm (V)	
Scanning	525 lines, 2:1 interlace	625 lines, 2:1 interlace
Clock	28.6363 MHz	28.3750 MHz
Pixel clock	14.31818 MHz	14.18750 MHz
Horizontal frequency	15.734 KHz	15.725 KHz
Vertical frequency	59.94 Hz	50.00 Hz
TV resolution	570(H) x 485(V) lines	560(H) x 575(V) lines
Video output	Analog: 1.0V p-p composite video, 75Ω	
	Digital: 8-bits RS-422 differential output,	
Data clock	14.3MHz	
S/N ratio:	50 dB min.	
Min. illumination	0.5 lux (F=1.4) without IR cut filter	
AGC	ON/OFF (OFF std.)	
Gamma	1.0 std. (0.45 optional)	
Lens mount	C-mount	
Power requirement	DC 12V, 300 mA	
Operating temperature	-10 °C to +50 °C	
Storage temperature	30 °C to +60 °C	
Operating humidity	Max. 70%	
Storage humidity	Max. 90%	
Vibration & Shock	7 G (11 Hz to 200 Hz), 70 G	
Dimensions:	42mm x 32mm x 130mm	
Weight:	206 grams (6.65 oz.)	

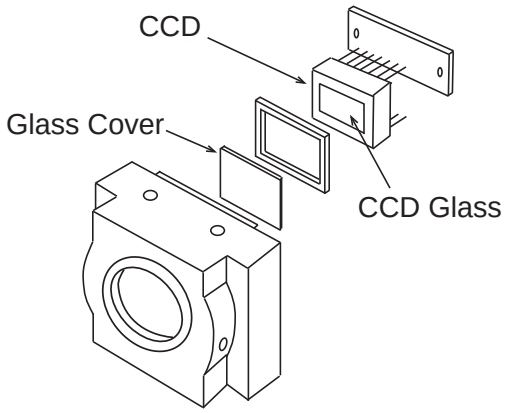
5.1.2 Physical Dimensions

FIGURE 15. **Physical Dimensions**



5.1.3 Glass Specifications

FIGURE 16. **Camera Front End - Glass Specifications**

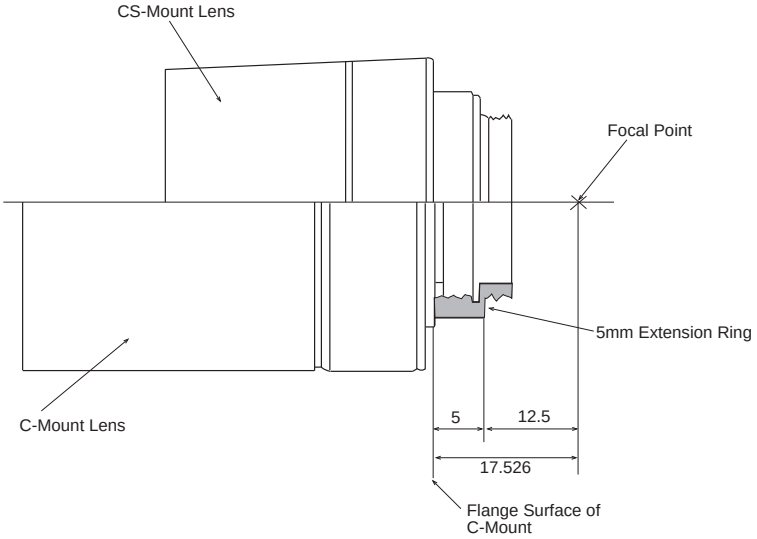


CCD Glass (BK-7) 0.75mm thickness
Refractive Index = 1.5
Glass Cover (BD-65) 1.0mm thickness
Refractive Index = 1.51

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 17. **Combination with “CS-Mount” Camera**



5.1.5 Front End Detail

FIGURE 18. **Front End Detail**

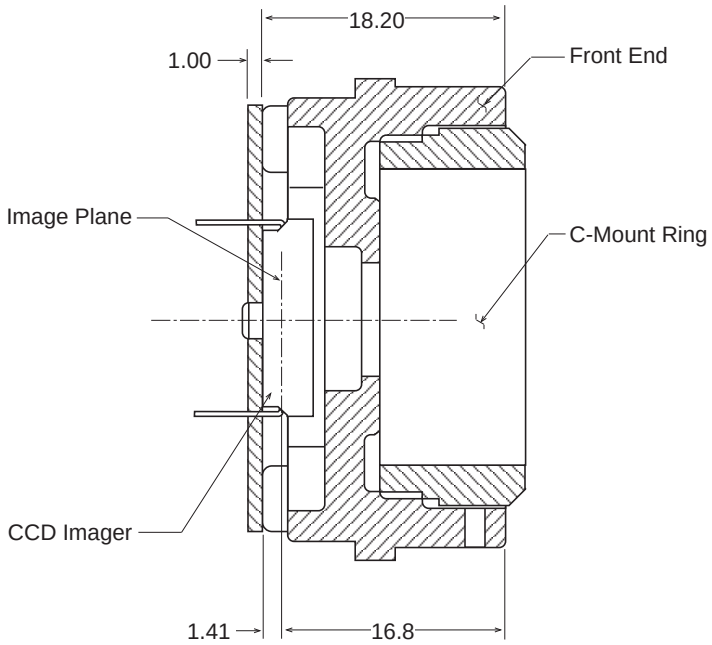
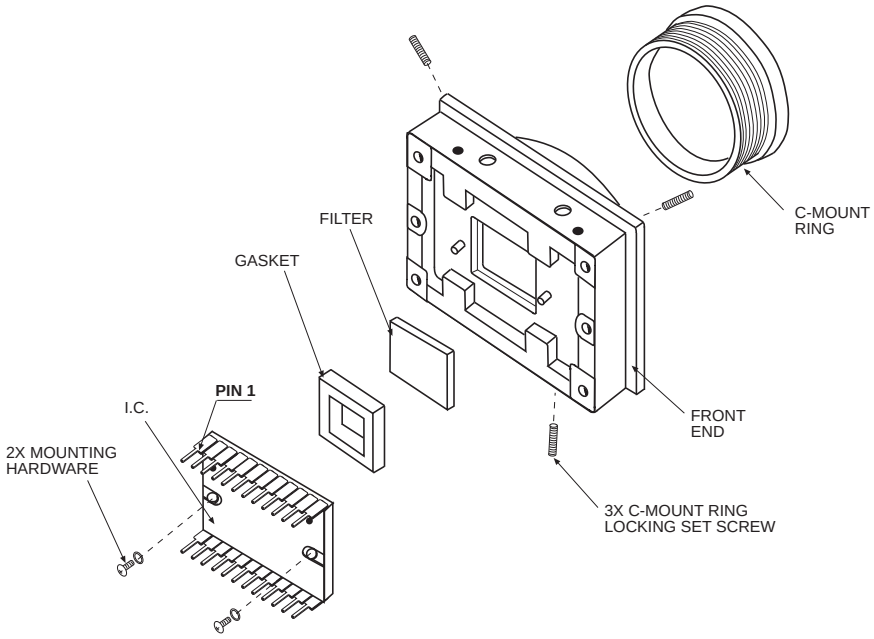
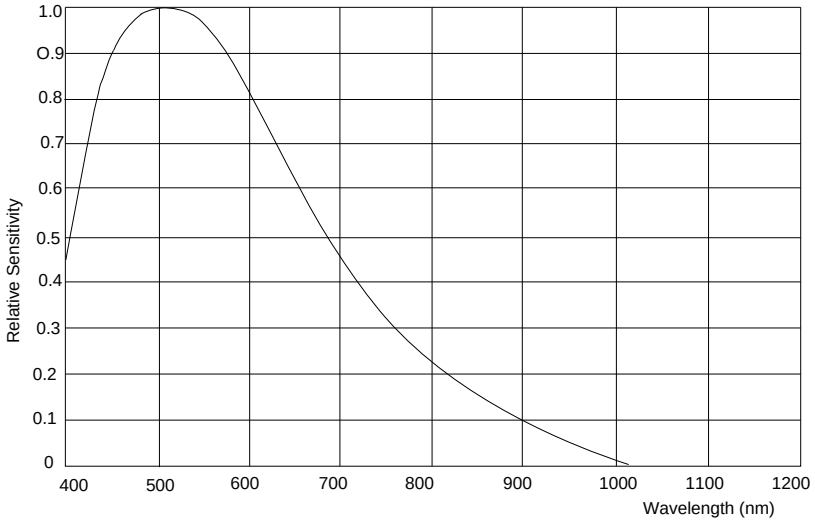


FIGURE 19. **Front End Assembly**



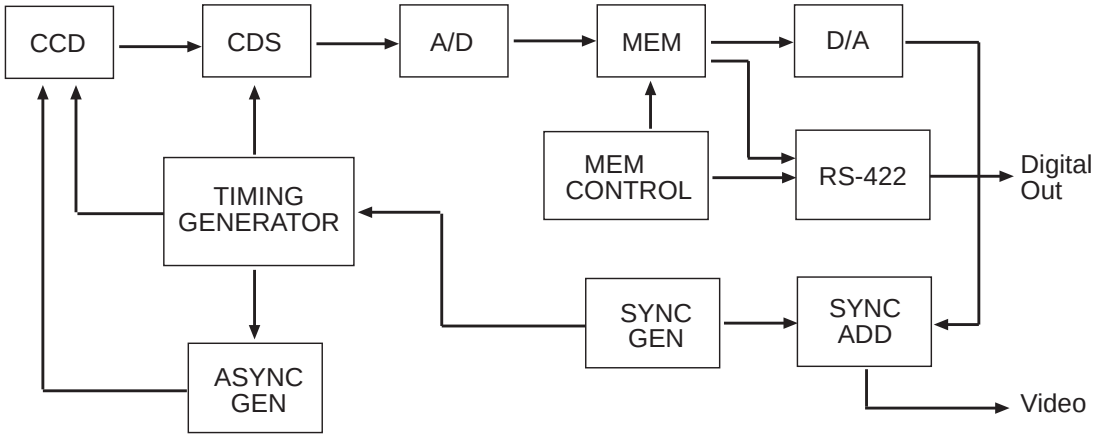
5.2 Spectral Response

FIGURE 20. **Spectral Response**



5.3 Block Diagram

FIGURE 21. **TM-7200/TM-6200 Block Diagram**



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