

PULNiX

**TM-1010
PROGRESSIVE SCANNING
HIGH RESOLUTION CAMERA**

(REV. 2)

**OPERATIONS &
MAINTENANCE MANUAL**

JUN 1996

1.1 Features and Applications

The TM-1010 is a state-of-the-art CCD camera which uses a 1 inch 1K x 1K progressive scan interline transfer CCD imager.

This CCD camera offers outstanding compactness, high resolution, built-in frame memory, asynchronous reset and electronic shutter, 10-bit digital output as well as analog video and a number of technical innovations. The camera's various features allow for versatile applications, such as high resolution image capturing, machine vision, computer graphics, gauging, avionics, microscopy, medical imaging, character and fine pattern recognition, document reading and high end surveillance.

Miniaturized and light weight

All PULNiX cameras are built with the same design principles: Solid state technology; miniaturization; application specific such as custom design, remote imagers, special functions for various application needs; robust design even for military applications.

Imager

The TM-1010 uses a 1K x 1K progressive scan interline transfer CCD. The reason of such CCD is,

1. High resolution (1024 x 1024 active pixels)
For very high resolution and image quality.
2. Square pixel (9.0 x 9.0 μm)
Precise dimensional measurement ability.
3. High speed electronic shutter capability
High dynamic resolution of moving object and electronic iris control.
Eliminates a need of mechanical shutter.
4. Progressive scan
Eliminates interlace deterioration of image.
Ease of computer interface.
5. High sensitivity and low noise at fast scanning
Can drive faster than 20 MHz x 2 pixel clock rate. (40 MHz output clock)
Excellent S/N ratio (>50 dB).
Micro lens built-in.

Asynchronous reset

The TM-1010 can be reset with external reset pulse (VINIT). When VINIT is enabled at Async mode, the camera keeps discharging from CCD and with VINIT leading edge (negative going pulse), it resets the internal timing and starts integrating the image for the preset period of shutter timing and outputs the async shutter video.

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

Frame memory and Digital output

The TM-1010 has a built-in frame grabber and a frame memory.

The 10-bit A/D converter provides 1024 gray levels with maximized signal-to-noise ratio. The output can be real time digital output or captured image (frozen picture).

The digital output format is always progressive scan at the maximum rate of 15 frames / sec. and is RS-422 differential output.

Variable clock rate

The standard pixel clock frequency is 20 MHz but TM-1010 can be programmed to operate at 10 MHz and 5 MHz in order to adapt various higher bit frame grabbers which normally runs at slower speed for 10-bit processing. Also, lower speed reduces the system noise to degree and increase sensitivity due to longer integration at the speed.

Async image capturing

The TM-1010 captures async reset image and provides continuous video output of the same image. It makes simpler for an ordinary frame grabber to capture the async reset images.

Integration

The TM-1010 is capable of capturing high resolution integration images. The integration can last from 1/15 sec to a few seconds. For uniform and low noise integration, PULNiX offers a peltier cooled CCD option.

Analog output (interlace)

Since 1K x 1K cameras are no longer in TV format, the display of the video signal is only achieved by using a frame grabber and computer or special monitor.

The TM-1010 has a feature of analog display output for signal monitoring purpose from BNC connector but the signal is not processed for the scan conversion in order to maintain good S/N ratio. While the digital is 10-bit non-interlace, the analog is 8-bit non-interlace output. If analog display is important, PULNiX offers TM-1040.

A/D reference voltage and dynamic range control

10-bit A/D converter's reference voltage can be controlled by back panel switches or RS-232C. The high reference and low reference variation provides A/D or signal processing dynamic range to maximize CCD characteristics.

Remote RS-232C control

The back panel mode switch, gain control, shutter speed, A/D reference functions and the data preset are controlled by RS-232C communication.

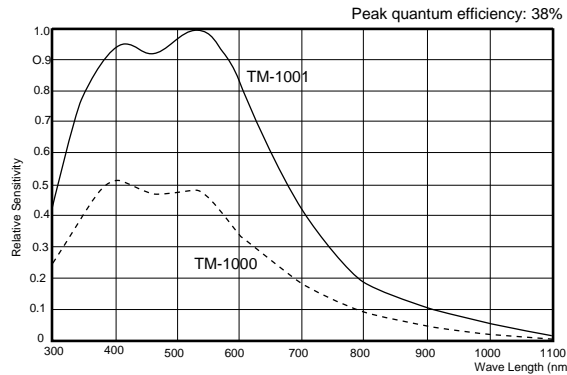
NOTE: TM-1010 has a microlens CCD.

2. SPECIFICATIONS

Imager

Imager	1" Progressive scan interline transfer CCD		
Total pixels	1024 (H) x 1024 (V)		
Photosensitive pixels	1008 (H) x 1018 (V)	6 + 10 ob(H), 4 + 2 ob (V)	
Photosensitive area	9.1 (H) x 9.2 (V) mm		
Pixel size	9.0 (H) x 9.0 (V) μ m		
Output sensitivity	12 μ V/e-		
Micro lens	Built-in		

Blemish	Point defect	Cluster	Column
Class 0	No defect	0	0
Class 1	<5	0	0
Class 2	<10	<4	<2
Class 3	<20	<8	<4



TM-1001 SPECTRAL RESPONSE

Camera

Scanning	1024 lines 15 Hz (Single channel output from CCD, single channel output for read out)		
Sync	Internal / External auto switch HD / VD, 4.0 Vp-p impedance 4.7 K Ω fHD = 15.75 KHz fVD = 15 Hz		
Pixel clock	20.034 MHz, output clock: selectable 20 MHz, 10 MHz and 5 MHz		
TV resolution	Analog :700 (H) x 800 (V) , Digital: 1008 (H) x 1018 (V) pixel resolution		
Minimum illumination	2.0 lux, f = 1.4 without IR cut filter		
S/N ratio	50 dB min. AGC = Off		
Video output	Analog	1.0 Vp-p composite video, 75 Ω , sync negative	
	Digital	10-bit RS-422 differential output Data clock = 20.034 MHz (10 MHz, 5 MHz)	
Display mode video	Analog only fHD = 15.75 KHz, fVD = 15 Hz, Non-interlace		
AGC	Off		
MGC	Manual gain adjustable (6 dB to 26 dB)		
Gamma	1.0		
Lens mount	C-mount.....1" lens format		
Power requirement	12 V DC 500 mA (700 mA for driving RS-422)		
Operating temperature	-10° C to 50° C		
Vibration and shock	Vibration: 7G (200Hz to 2000Hz), shock: 70G		
Size	51mm (H) x 67 (W)mm x 152mm (L) (2.01" x 2.64" x 5.98")		
Weight	330 grams (11.6 oz)		
Power cable	12P-02		
Digital cable	30DG-02-10 (10-bit cable)		
Power supply	K25-12V or PD-12		

TM-1010 1K X 1K HIGH RESOLUTION ASYNCHRONOUS RESET FULL FRAME SHUTTER CAMERA

The TM-1010 is designed to accommodate a high resolution, ON-LINE inspection reset mechanism with full frame shutter. It takes external horizontal sync to lock the camera and VINIT pulse for resetting the camera asynchronously.

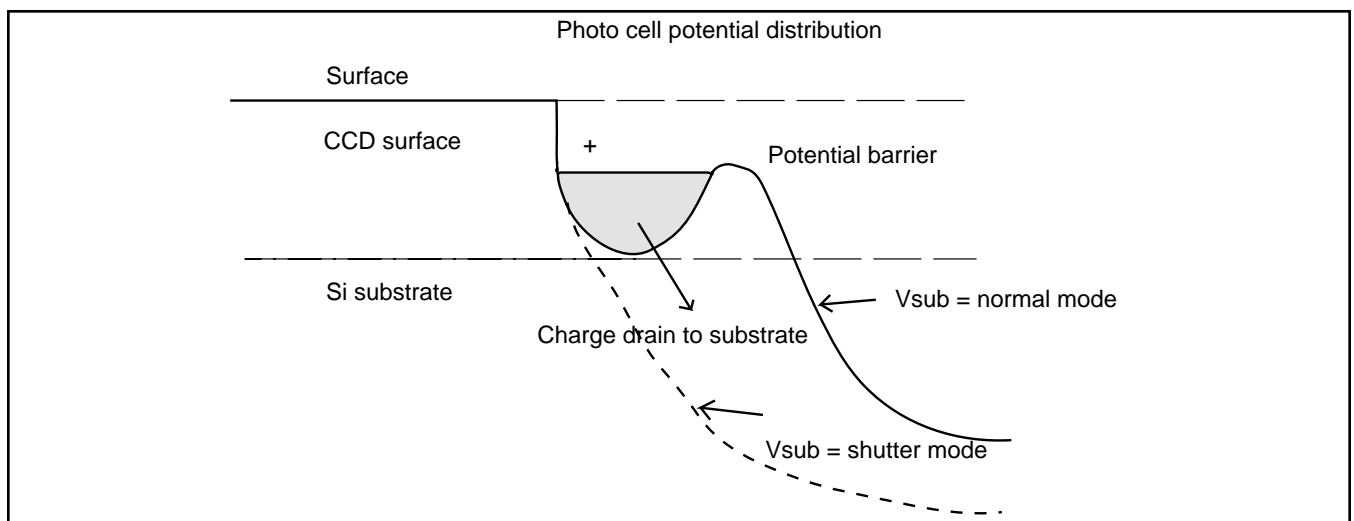
The shutter speed can be controlled by either an external double pulse or internal shutter speed control with a 10-position dial switch on the back panel.

1. Discharge Principle of CCD

1.1 Substrate Drain Shutter Mechanism

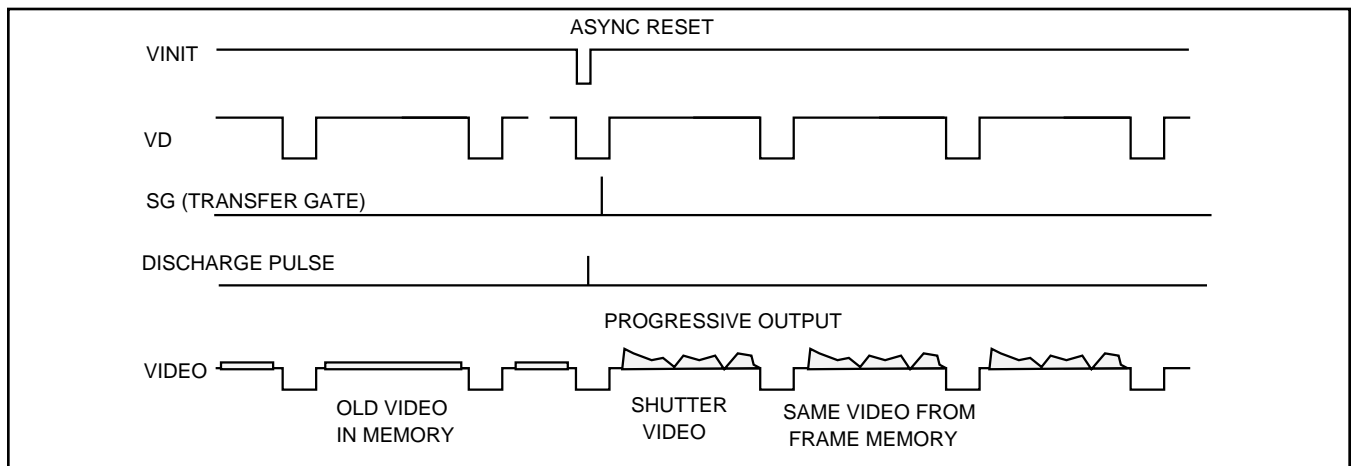
Normal operation requires the CCD chip to construct an individual potential well at each image cell. The potential wells are separated from each other by a barrier. The barrier is sequentially removed to transfer the charge from one cell to another by pixel clock. This is the basic principle of the CCD operation for charge transfer.

The substrate drain vertically moves the charges. When excess potential is applied to substrate underneath each cell, a potential barrier is pulled down to release the charge into the drain. This can happen to all the cells simultaneously, whereas normal CCD shuttering is achieved with a horizontal charge shift to the drain area by interline transferring or reverse transferring of the frame transfer chip.



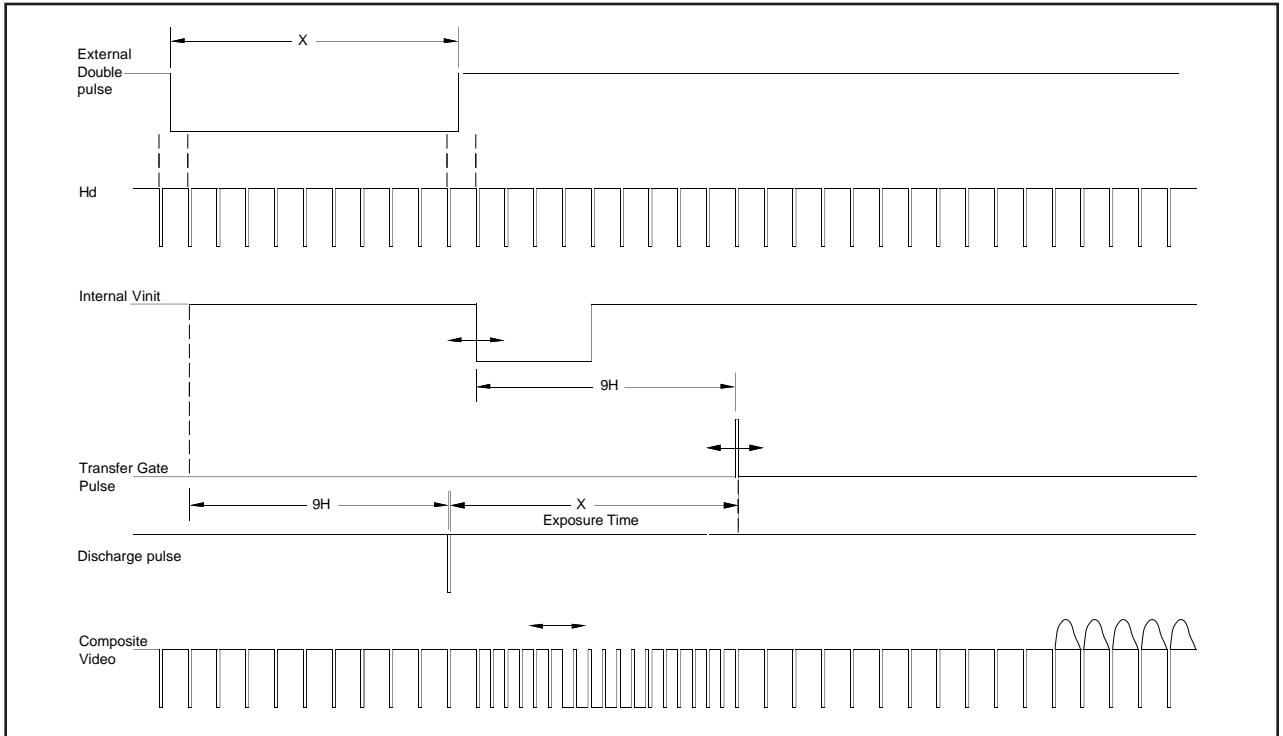
1.2 Asynchronous shutter

For Async Shutter mode, set jumper W5 of bottom board open and provide external Hd for phase locking. 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. Therefore, the horizontal phase won't be interrupted. The TM-1010 asynchronous camera outputs a full frame of shuttered video in progressive scanning format from a frame buffer. The frame buffer is updated upon receiving negative reset pulse.



2. Shutter Speed Control

2.1 External pulse width control mode



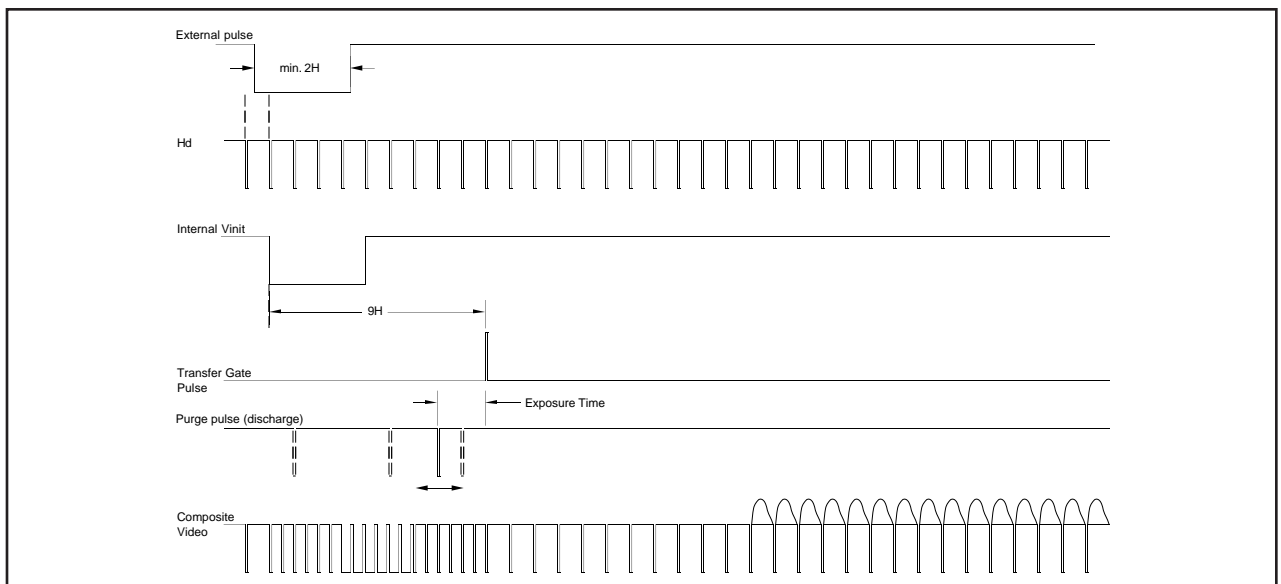
For External Pulse Mode, set dial switch to "9". Apply a pulse width control VINIT signal, which can be generated from an external event trigger, to the camera. Internal reset pulse will be latched to Hd and at 9th HD timing from external pulse leading edge (negative going edge), CCD discharge pulse is generated to clear the images. The internal VINIT is generated at the following edge (positive going edge) of the external pulse and it resets 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. For 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.

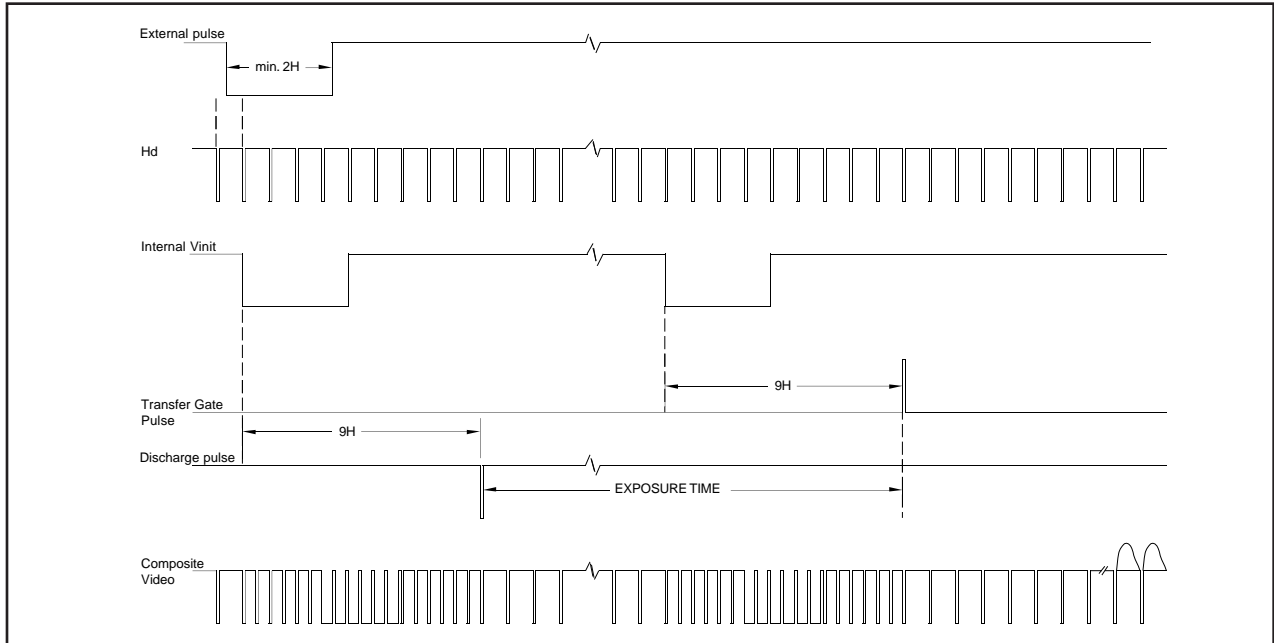
The camera will output the same video from memory when VINIT is kept high (5V) and update the image upon receiving next pulse. At async mode, with external pulse input high, the video output is disabled as the camera keeps discharging CCD image and only provides black video.

2.2 Internal Fast reset mode



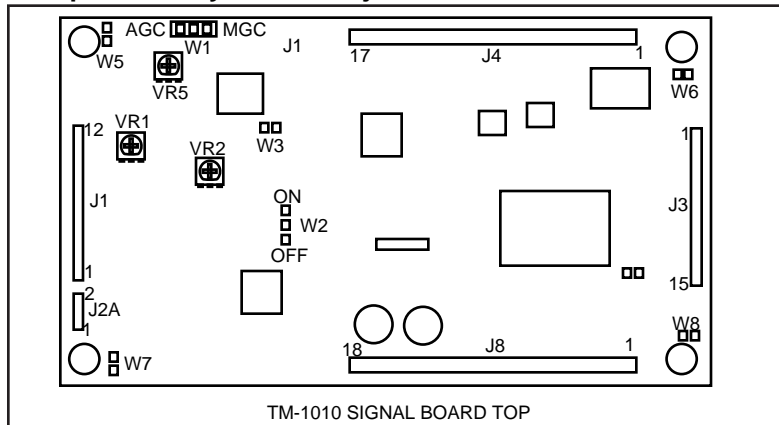
For Internal Fast Reset Mode, set the 10-position dial switch from "1" to "4". When fast reset mode is selected, the camera resets with internal VINIT timing, which is latched to Hd, and video output is also synchronized with internal VINIT timing without further delay. The shutter speed is controlled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

2.3 Internal Slow reset mode



With the Internal Slow Reset mode selected, the camera operates the reset and shutter in the same means as the external Double Pulse mode. When external VINIT pulse is applied, internal VINIT is latched to Hd and the second internal VINIT signal is generated to set up the shutter speed period. The shutter speed is controlled by setting the dial switch from "5" to "8". Video output timing starts right after the second internal VINIT. For the timing of the second internal reset, LPULSE output of 31-pin connector can be used.

3. Top Board Layout and Adjustment

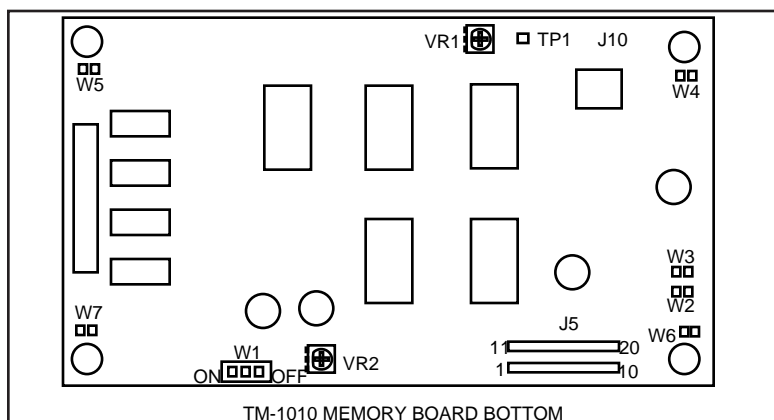


Preset

VR1	AGC	2.0 V
VR2	AGC MAX	1.5 V (22 dB)
VR3	No mount	
VR4	No mount	
VR5	VR	mechanical center

Jumpers

W1	AGC/MGC	MGC
W2	Gamma	Set to 1.0 (OFF)
W3	Down load	Open
W4	CAL	
w5 - W8		for chassis GND



Middle boards Layout and Adjustment

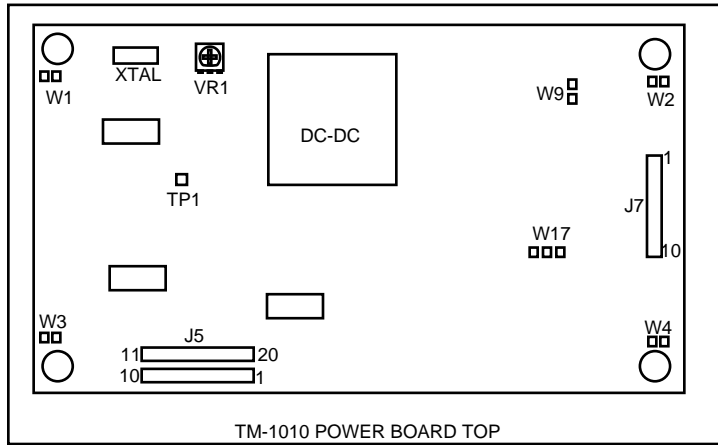
Preset

VR2	PED	Set pedestal at 50 mV of video (analog)
VR1	D/A reference	TBD (Vin = V out)

Jumpers

W1	Gamma	Set to OFF
W2	DL	
W3	ER	
W4 - W7		Chassis GND

4. Bottom board



Jumper

W1 - W4 for chassis GND
 W9 5VDR Keep short
 W17 +10V adj Keep I side

Power supply selection

Select internal jumper W10 through W16 (back side) for power supply optimization.

Potentiometer

VR1 PLL Set at mechanical center

Ext. sync input impedance

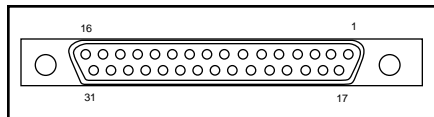
Jumpers W5 and W6 (back side) select for 75 Ω

termination. When it is open (factory set), it is 4.7 KΩ (high impedance).

5. Digital output connector

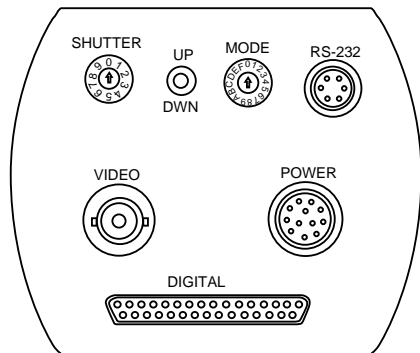
An EIA-422 digital output is available from 31-pin high-rel, micro-miniature connector (Airborn MP221-031-243-2200). The mating connector can be firmly secured to the receptacle for vibration and shock environments.

A common D-sub connector was not used to prevent any vibration problems.



Pin No	Signal	Description
1	CLK+	Pixel clock(20.034MHz) output
17	CLK-	"
2	LDV+	Line data valid
18	LDV-	"
3	FDV+	Field data valid
19	FDV-	"
4	GND	
20	VINIT/VD	External Vinit input or VD (TTL)
5	EXT. HD	Ext. HD sync input (TTL)
21	INTEG. CONT	Integration control input (TTL), active low
6 - 15	DO0+ - DO9+	Digital video output (10-bit)
22 - 31	DO0- - DO9-	"
16	GND	

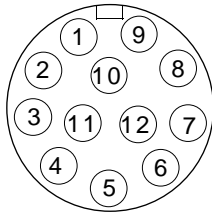
6. Connector Pin Configurations



TM-1010 Back plate

6-1. Mode control switch

0	Normal mode	
1	MGC gain control	Up/Down (6 to 22 dB)
2	Async / Manual shutter	Up: Manual Down: Async
3	Gain selection (6 dB)	Up to set
	" (9 dB)	Down
4	" (12 dB)	Up
	" (16 dB)	Down
5	Clock selection (20,10,5MHz)	Up/down
6	A/D Vref low	Up/Down
7	A/D Vref high	Up/Down
8	Freeze (ENINT) enable	Up: Real time Down: Freeze
9	Factory default recall	Up/down: recall factory default
A	User default (Default page at power up) Press Up and power on	Up: save data (latest data) Down: Load user default data Calibration mode
B - F	User page storage	Up: save Down: Recall

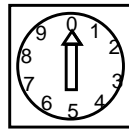


12-PIN Connector

- | | |
|--------------|-------------------------|
| 1. GND | 7. V _D In |
| 2. +12V DC | 8. GND |
| 3. GND | 9. H _D In |
| 4. Video Out | 10. GND |
| 5. GND | 11. Integration Control |
| 6. VINIT In | 12. GND |

NOTE: TM-9700, TM-540, TM-720, TM-745, TM-1001 pin compatible.

SH CONTROL



Shutter Control Switch

	Manual shutter mode	Async reset mode
0	no shutter	no shutter
1	1/60	1.0H 1/16000
2	1/125	2.0H 1/8000
3	1/250	4.0H 1/4000
4	1/500	8.0H 1/2000
5	1/1000	16 H 1/1000
6	1/2000	32 H 1/500
7	1/4000	64 H 1/250
8	1/8000	128H 1/125
9	1/16000	Shutter determined by pulse width

- Mode 0: Normal mode
 Mode1-4: Fast mode
 Mode5-8: Slow mode
 Mode 9: Pulse width mode

3.4.4 6-pin RS-232C Connector (HR10A-7P-6P)

RS-232



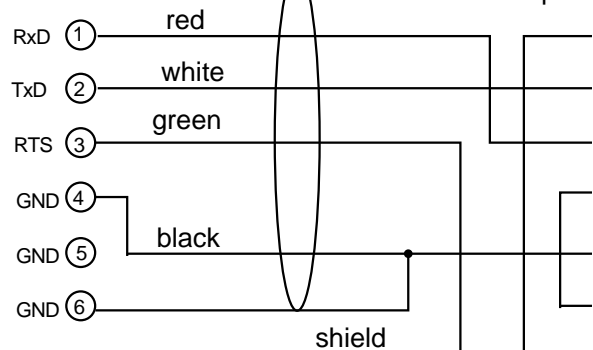
PC-6P

- | | |
|-----|-----|
| 1 | RXD |
| 2 | TXD |
| 3 | RTS |
| 4-6 | GND |

TM-1040
 TM-1010
 TMC-9700

RS-232
 CABLE

IBM-PC
 9-pin c



HR10A-7P-6P
 6 pin connector

7. Monitor display mode

For the monitor information connect BNC output to multiscan or equivalent video equipment. Since the frame rate is 15 Hz, it is not easy to see the detail on a monitor. The analog output of TM-1010 is more likely to be monitored by oscilloscope for the waveform analysis. Analog signal monitoring is not using the full advantage of 10-bit signal processing. For digital output application, use the digital output connector.

Multi-sync black and white monitors

PULNiX offers slow decay phosphor CRT type non-interlace monitor (42-5001). Electrohome EVM942 /1242 or equivalent model can be used for TM-1010 display mode. Some of these monitor may not accept 15 Hz vertical sync. Please contact PULNiX for the modification or information.

8. Frame Memory

The TM-1010 has a built-in frame memory which outputs progressive scanning images at 15 Hz rate (15 frames per sec). This feature provides the following advantages:

1. Asynchronously captured images are output as standard continuous video signals so that a monitor or frame grabber can display or process without a special asynchronous video grabber.
2. Integration video is continuously output until the next capture. Normally, the camera cannot output the video signal during the integration, and the periodic integration causes a blinking video signal. The TM-1010 memory keeps the stored image until the next image is completed so that there is no blank interval during integration.
3. Digital format of the video output can be used as direct interface with the computer. The format is progressive.

How to activate the frame memory?

A. Asynchronous reset mode (Select switch of the back panel for ASY...async)

When External VINIT is high (5V), the TM-1010 expects the async pulse input. 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 captures the image. The captured image is kept until next pulse is applied for new image.

If the switch is NRM (normal mode....manual shutter mode), the video output is real time with manual shutter.

B. Integration

Activate EN INT (Enable Integration) of 31-pin connector (#22) by connecting to GND then input INTEG control(#6) as active low (TTL). When it is low, the TM-1010 keeps integrating and, upon the rising edge of the INTEG control pulse, it captures the frame and keeps it until next end of integration. When EN INT is high (open), video output is in real time without freezing and one frame of the integrated image appears upon ending of INTEG control pulse (during INTEG control low, it keeps the previous image but when INTEG is high it only holds one frame).

FDV(Field Data Valid) is disabled during the integration and the vertical pulse starts when the image is output.

9. Progressive scanning

Standard TV system scanning is 525 line interlace scanning as specified in RS170. Every other horizontal line (ODD lines and EVEN lines) is scanned at a 60 Hz rate per field, and completes scanning with two fields (one Frame) at 30 Hz rate.

Because of the interlace scanning, vertical resolution of CCD cameras is limited at 350 TV lines regardless of horizontal resolution. When electronic shutter is applied, the CCD can only hold one field of charges at each exposure. Therefore, the vertical resolution of the electronic shutter camera is only 244 TV lines.

This is the same situation for HDTV format camera since it is interlaced scanning and the vertical resolution of shuttered image is 500 lines.

The TM-1010 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 (15 Hz). Like a non-interlace computer screen, it generates a stable crisp image without alternating lines and provides full vertical TV resolution of 1000 lines (a monitor display may not be able to show 1000 lines due to monitor resolution and interlace scanning of the analog output). 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-1010 outputs the progressive scanned image with an electronic shutter in two different formats:

1. Progressive scanning digital output

The CCD signal goes through A/D and D/A converters. The frame memory is capable of capturing async and integration video without having special frame grabbers.

10-bit digital output is available from 31-pin connector with EIA-422 format (40 MHz clock rate).

2. Non-interlace scan analog output

The TM-1010 outputs non-interlace video for monitor display. The digital output of 31-pin connector is also at 15 Hz with a 20 MHz pixel clock but it is not interlace scan (progressive scan).

Mode control functions

-0. Normal mode

Camera outputs real time normal video signal without electronic shutter or asynchronous functions.

-1. MGC gain control

CDS amplifier gain can be controlled by up/down switch. The minimum gain is 6 dB and the maximum gain is set internally (factory set is 22 dB)

-2. Async / Manual shutter selection

The electronic shutter mode is selected by up (manual) and down (async) switch. When it is manual mode, the shutter speed is programmed by shutter speed switch and when async shutter is selected, the shutter timing works with VINIT (async reset pulse). If VINIT is kept high, it keeps discharging CCD and when negative going pulse comes in, it resets the timing and captures a image and holds until next pulse comes. The async shutter speed is also selected by the shutter selection switch.

-3 and -4. Gain selection

Fixed specific gain is recalled by selecting 3 or 4 and pressing up/down switch up or down.

3 - up	6 dB
3 - down	9 dB
4 - up	12 dB
4 - down	16 dB

-5. Clock frequency selection

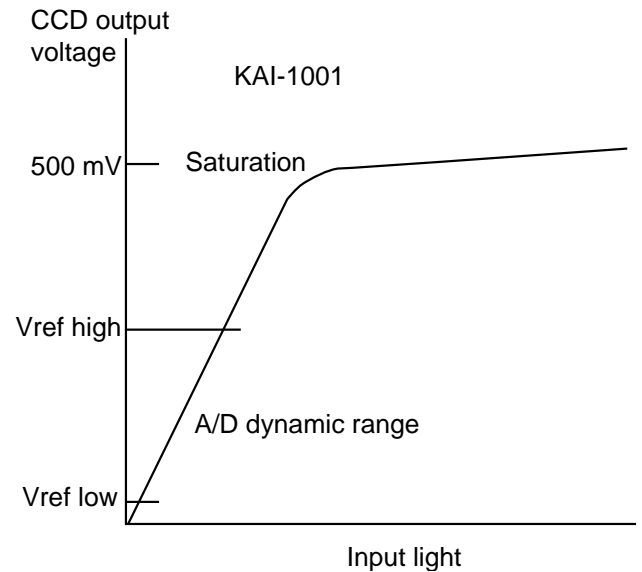
Three different frequency is selectable by up and down switch. The standard frequency is 20 MHz and 1/2 (10 MHz) and 1/4 (5.0 MHz) of standard frequency is selected. Since TM-1010 is 10-bit output and many frame grabbers with 10-bit or 12-bit input may not have 20 MHz capability, it is convenient to have such frequency selectable feature.

-6 and -7. A/D reference voltage control

CCD output itself has over 60 dB of dynamic range. However, signal normally used to display or capture is not such wide range. For instance, if amp gain is set at 12 dB (4X) and the display is 100 IRE which saturation is 714 mV, actual signal from CCD is $714/4 = 178$ mV. This is 1/3 of KAI-1001 imager saturation. By adjusting Vref, the full dynamic range at a specific gain can be obtained.

When low light and high sensitivity is required, the reference can be set at narrow range so that small signal can be digitally amplified and also the gray level can be shifted to middle region for easy observation and processing.

The input signal to A/D is from 2.2 V to 3.7 V and typical factory set is $V_L = 2.2$ V and $V_H = 3.2$ V.



-8. Freeze (ENINT) enable

The internal frame buffer can freeze the image by selecting this function. When up/down switch is pushed up, it is real time image. When it is down, it freezes the final image. This freeze mode is also used for integration control. At freeze mode, TM-1010 can be used to integrate (log exposure) by controlling INTEG control input on 12-pin connector (pin #11). It keeps integrating as long as the pin #11 is low and grab a image upon the integration is over.

-9. Factory default recall

When this mode 9 is selected at power up, camera starts with the factory set parameter. When camera is already powered, select the switch #9 and press up/down switch up to recall factory default. (User cannot change this parameter)

-A. User default page

This page is default page for camera to start up. When camera is powered up, it start operating with parameters stored in page #A except switch positions of #9 (factory set), #B through #F (user set specific pages).

The last changes during optimization should be stored in the page #A so that the default will be recalled upon next power up.

-B through -F User pages

User can store its specific parameters in pages from B through F.

10. Digital output pulses

Digital Video

Differential line-driven, 10-bit parallel signal with EIA-422 format.

100Ω output termination impedance.

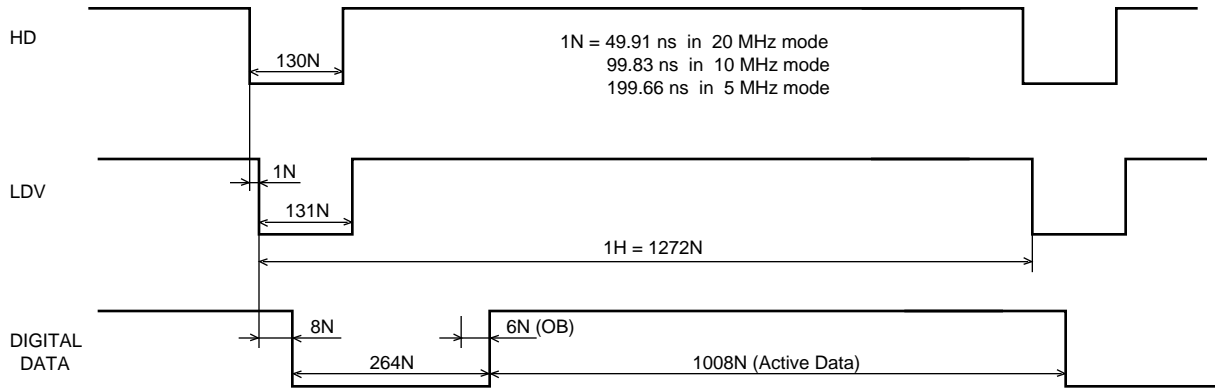
Output from 31-pin connector. The mating connector: Airborne MP211-031-113-4300

Please consult digital cable information. eg. 50-1301, 30DG-02-10 (10-bit), 2m cable

Line Data Valid (preliminary)

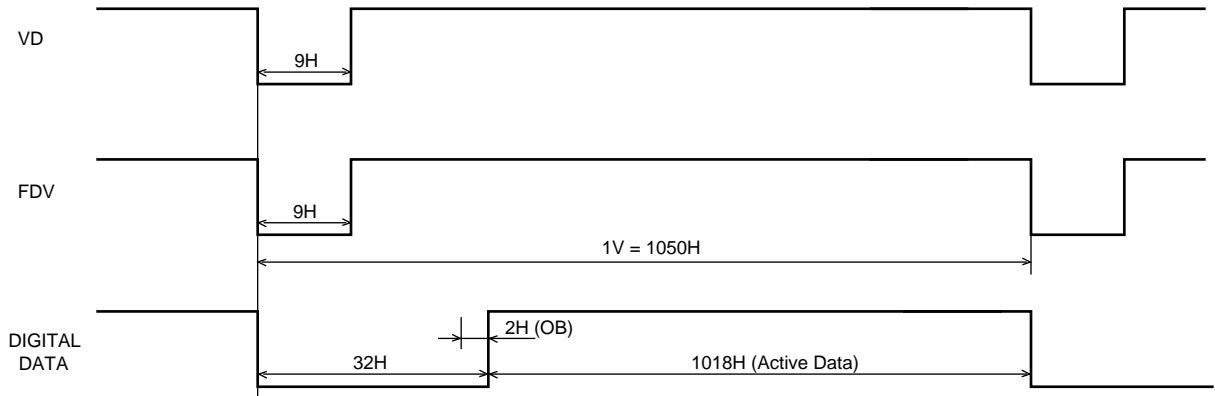
Differential line-driven signal with EIA-422 format.

It is active high (+ side is higher than - side) during the transfer of each line of data.....Horizontal line read out.



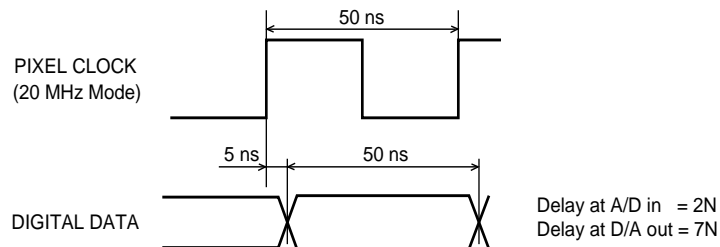
Frame Data Valid (preliminary)

Differential line-driven signal with EIA-422 format. It is active high during the transfer of each frame data. During integration, both LDV and FDV are kept low and restart upon the completion of integration.



Pixel clock

Differential line-driven signal with EIA-422 format. The frequency is 20.034 MHz (standard)



11. Connector and cable

Digital output connector is optional.

Mating connector ordering information: PULNiX part No. 15-1623

Airborn P/N: MP211-031-113-3400

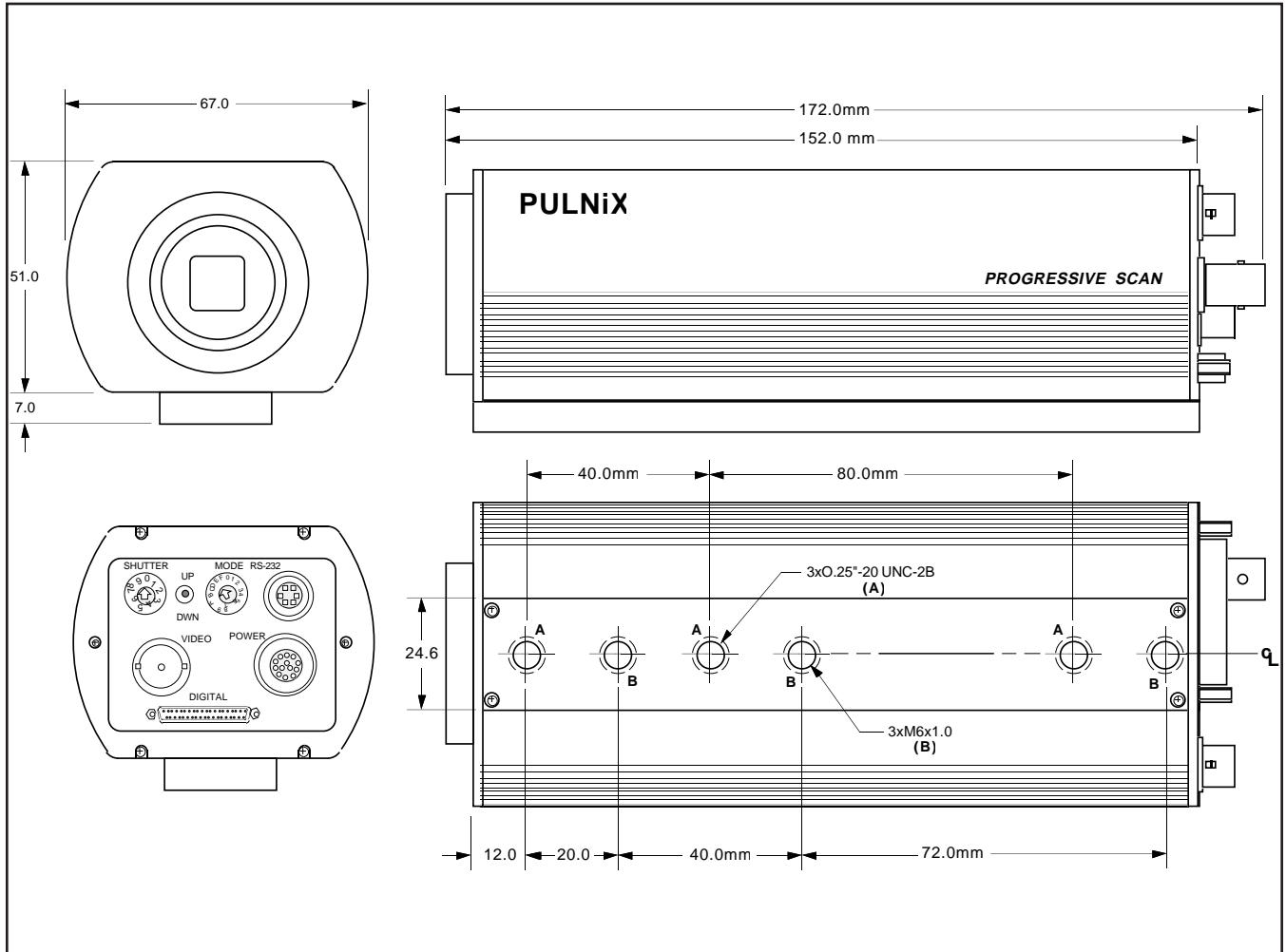
Straight Backshell (cover): 15-1624

MM254-031-000-0000

Cable assembly: Digital cable 30DG-02-10 50-1301-05

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

12. Physical Dimensions

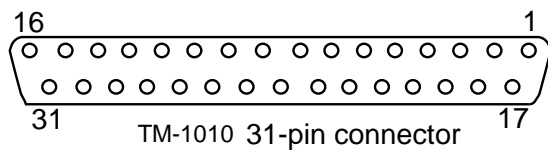


13. DIGITAL CABLE ASSEMBLY

30DG-02-10 (10-bit cable)

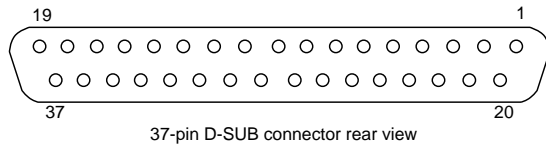
P/N 50-1301-10 for TM-1010 Full function cable

TM-1010 PIN CONFIGURATIONS



Pin	Signal	Cable	Pin	Signal	Cable
1	CLK+	OR 1RED	17	CLK-	OR 1BLUE
2	LDV+	GRY 1RED	18	LDV-	GRY 1BLUE
3	FDV+	WHT 1RED	19	FDV-	WHT 1BLUE
4	GND	YLW 1RED	20	VINIT/VD	YLW 1BLUE
5	HD	PINK1RED	21	INTEG	PINK1BLUE
6	D0+	OR 2RED	22	D0-	OR 2BLUE
7	D1+	GRY 2RED	23	D1-	GRY 2BLUE
8	D2+	WHT 2RED	24	D2-	WHT 2BLUE
9	D3+	YLW 2RED	25	D3-	YLW 2BLUE
10	D4+	PINK2RED	26	D4-	PINK2BLUE
11	D5+	OR 3RED	27	D5-	OR 3BLUE
12	D6+	GRY 3RED	28	D6-	GRY 3BLUE
13	D7+	WHT 3RED	29	D7-	WHT 3BLUE
14	D8+	YLW 3RED	30	D8-	YLW 3BLUE
15	D9+	PINK3RED	31	D9-	PINK3BLUE
16	GND	SHIELD			

37-PIN D-SUB CONNECTOR PIN CONFIGURATIONS



Pin	Signal	Cable	Pin	Signal	Cable
1	CLK+	OR 1RED	20	CLK-	OR 1BLUE
2	LDV+	GRY 1RED	21	LDV-	GRY 1BLUE
3	FDV+	WHT 1RED	22	FDV-	WHT 1BLUE
4	N/C		23	N/C	
5	N/C		24	N/C	
6	D0+	OR 2RED	25	D0-	OR 2BLUE
7	D1+	GRY 2RED	26	D1-	GRY 2BLUE
8	D2+	WHT 2RED	27	D2-	WHT 2BLUE
9	D3+	YLW 2RED	28	D3-	YLW 2BLUE
10	D4+	PINK 2RED	29	D4-	PINK 2BLUE
11	D5+	OR 3RED	30	D5-	OR 3BLUE
12	D6+	GRY 3RED	31	D4-	GRY 3BLUE
13	D7+	WHT 3RED	32	D6-	WHT 3BLUE
14	D8+	YLW 3RED	33	D7-	YLW 3BLUE
15	D9+	PINK 3RED	34	D8-	PINK 3BLUE
16	GND	YLW 1RED	35	GND	SHIELD
17	VINIT	YLW 1BLUE	36	N/C	
18	N/C		37	INTEG	PINK 1BLUE
19	N/C				

14 TM-1010 RS-232C CONTROL

The TM-1010 can be controlled its built-in microcomputer chip (CPU) by external RS-232C interface. The internal CPU controls TM-1010 operation mode and DSP parameter changes. (Contact PULNiX for the TM-1040 software disket)

14-1. RS-232C communication default condition

Parity : None
Data : 8 bit
STOP : 2 bit
Baud rate : 9600 bps

(If other communication condition is required, please contact PULNiX.)

14-2. RS-232C command

The TM-1010 command packet starts with STX (Start of Text = 02H) and then followed by Command Code (C.C.one alphabet) , Command option parameter and ETX (End of Text = 03H) to end.

One packet is 8 bit ASCII code.

When a packet is received by TM-1010 (ETX:03H is detected), it reads internal packet of the receiver buffer. If it is the correct packet then it processes the parameters based on the command. When the process is completed, it sends a completion signal (AK packet). If an error is detected, No-go signal (NK packet) is sent back and disregards the packet signal in the buffer. When NK packet is sent from TM-1010, the host must correct the error and resend the packet.

Example: Executing shutter control

In order to set EE mode, The C.C. packet is sent as follows,

STX, "S", "E", ETX
02H,53H,45H,03H
where "S".....Shutter control command mode
"E".....EE (auto-shutter) mode

The TM-1040 will send back

STX,ACK,ETX or STX,NAK,ETX
02H,06H,03H 02H,15H,03H

14.3 Command S

Function: Shutter control command
Shutter mode selection and shutter speed setting.

14-3-1 Manual shutter mode

STX,"SM", "0" -"9" or "S", ETX
02H,53H,4DH, 30H - 39H or 53H,03H

It enables manual shutter operation. Select "0" - "9" shutter speed. It over-rides the back panel setting. When "S" code is selected, the back panel shutter switch is activated for the speed selection.

14-4-2 Async shutter mode

STX, "SA", "0" - "9" or "S", ETX
02H, 53H,41H, 30H - 39H, or 53H ,03H
It enables async shutter mode.

14-3-3 Direct shutter mode

STX, "SX", "1A0", ETX
02H, 53H, 58H, 31H,41H,30H, 03H
It selects a mode for external shutter speed control. Hexadecimal shutter number (3 digit) follows "SX" command. (eg. "1A0" = 416H, shutter speed = (1050-416) = 634H = 20 msec...1/50 sec). It moves shutter discharge pulse at every 1H (32 μsec.) period from 0 (no shutter) to 1049 H (=1/32,000 sec.).

14-4 Command M

Function: Changes memory mode between Freeze and free -run mode

Freeze mode: STX, "M", "0", ETX
02H,4DH, 30H, 03H

Free-run mode: STX, "M", "1", ETX
02H, 4DH, 31H, 03H

14-5. Command G

Function: A/D pre-amp gain control
First value next to "G" command is A channel, second value is B channel.

STX, "G", "FF", "FF", ETX
FFH = gain 255
02H, 47H, 46H,46H, 46H,46H, 03H

STX, "G", "12", "10", ETX
02H, 47H, 31H, 32H, 31H, 30H, 03H
Channel A = gain control value 18
Channel B = gain control value 16

It changes the gain by hexadecimal 2 digit.

$VO = 2/255 \times \text{SET VALUE} + 2.0 \text{ V}$
Value : 0 to 255
 $VO = \text{D/A output voltage}$
(Vo min = 2.0 V...8 dB, V0 max = 4.0V...28 dB)

14-6. Command V

Function: A/D reference voltage control
First value next to "v" command is Vref top, second value is Vref bottom.

STX, "V", "7E", "64", ETX
7EH = Vref top: 126
64H = Vref bottom: 100
02H, 56H, 37H,45H, 36H,34H, 03H

14-7. Command W

Function: Write data to the selected pages or calibration data table.

14-7-1 Saving to page (from page 9 through F)

STX, "W", "A" - "F", ETX

02H, 57H, 41H - 46H, 03H

("page 9" is factory use only)

14-7-2 Saving to calibration table "WU" command

"WU" + [data string 32,byte]

See EEPROM partition table

14-7-3 (Factory set mode "WS" command)

14-8 Command Z

Function: Select and read a memory page and set the pre-programmed data.

STX, "z", "A" - "F", ETX

02H, 5A, 41H - 46H, 03H

It loads the data.

14-9. Command R

(Pulnix software disk is available)

Function: Output data values of camera memory.

14-10-1 Report from RAM "R R" command

Reads out the current setting and the response format from the camera is,

STX, ACK, "R", [data] (20 byte ASCII), ETX

14-9-2 Report from pages "R 9-F" command

Camera responses,

STX, ACK, "A"(page), [data]

14-9-3 Report from user calibration table

"R U" command

Camera response is,

STX, ACK,"U", [data]

14-9-4 Report from factory set

"R S" command

camera response is,

STX, ACK, "S", [data]

For detailed parameter, please contact PULNiX.

Note: When RS-232C is active, back plate switches are over-written and not functioning. In order to activate back plate switches, power off and power up again.

