PULNiX

TM-1040
PROGRESSIVE SCANNING
HIGH RESOLUTION CAMERA

(REV. 3)

OPERATIONS &
MAINTENANCE MANUAL

Jan. 1996

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1.1 Features and Applications

The TM-1040 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, 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-1040 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-1040 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-1040 has two sets of built-in frame grabber and 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 rate of 30 frames / sec. and is RS-422 differential output. Due to the speed limitation of CCD readout, it keeps two horizontal channel outputs in two sets of frame memory at 20 MHz and combined the readout into 40 MHz single (10-bit) output.

Async image capturing
The TM-1040 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-1040 is capable of capturing high resolution integration images. The integration can last from 1/30 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-1040 has a feature of analog display mode which scans the frame memory read out into two fields per 30 Hz frame (60 field / sec). This way it converts the progressive scan into interlace 30 frame/sec display mode for RS-343 or RS-170 (switchable).
Electrohome EVM900 or EVM1200 series monitors or equivalent B/W monitor can display 1000 by 1000 pixel counts.
Consult PULNiX for display monitor information.
This output can be recorded by RS-343 equivalent video recorders or RS-170 standard recorders.
Since the TM-1040 has two sets of frame memory in the digital and analog processing, the output is independent to each other. While the digital is 10-bit non-interlace, the analog is 8-bit conversion interlace output.

NOTE
1. PLEASE ALLOW 10 SEC. DELAY BEFORE RESTARTING THE CAMERA.

2. TM-1040 HAS A BUILT-IN MICRO LENS CCD.

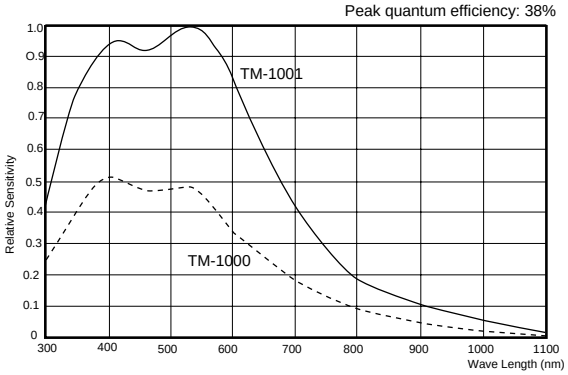
2. SPECIFICATIONS

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) µm
Output sensitivity	12 µV/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 30 Hz (Dual channel output from CCD, single channel output for read out)
Sync	Internal / External auto switch HD / VD, 4.0 Vp-p impedance 4.7 KΩ fHD = 31.50 KHz fVD = 30 Hz
Pixel clock	20.034 MHz, output clock 40.068 MHz
TV resolution	Analog :700 (H) x 800 (V)..RS-343 , 700 (H) x 350 (V)..RS-170 Digital: 1008 (H) x 1009 (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 = 40.068 MHz
Display mode video	Analog only RS-343: fHD = 31.50 KHz, fVD = 60 Hz, Interlace RS-170: fHD = 15.75 KHz, fVD = 60 Hz, Interlace Progressive: fHD = 31.50KHz, fVD = 30 Hz, Non-interlace
AGC	Off
MGC	Manual gain adjustable (6 dB to 28 dB)
Gamma	1.0
Lens mount	C-mount.....1" lens format
Power requirement	12 V DC 600 mA (800 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 160mm (L) (2.01" x 2.64" x 6.30")
Weight	330 grams (11.6 oz)
Power cable	12P-02
Digital cable	30DG-02 (8-bit), 30DG-02-10/40 (10-bit)
Power supply	K25-12V or PD-12

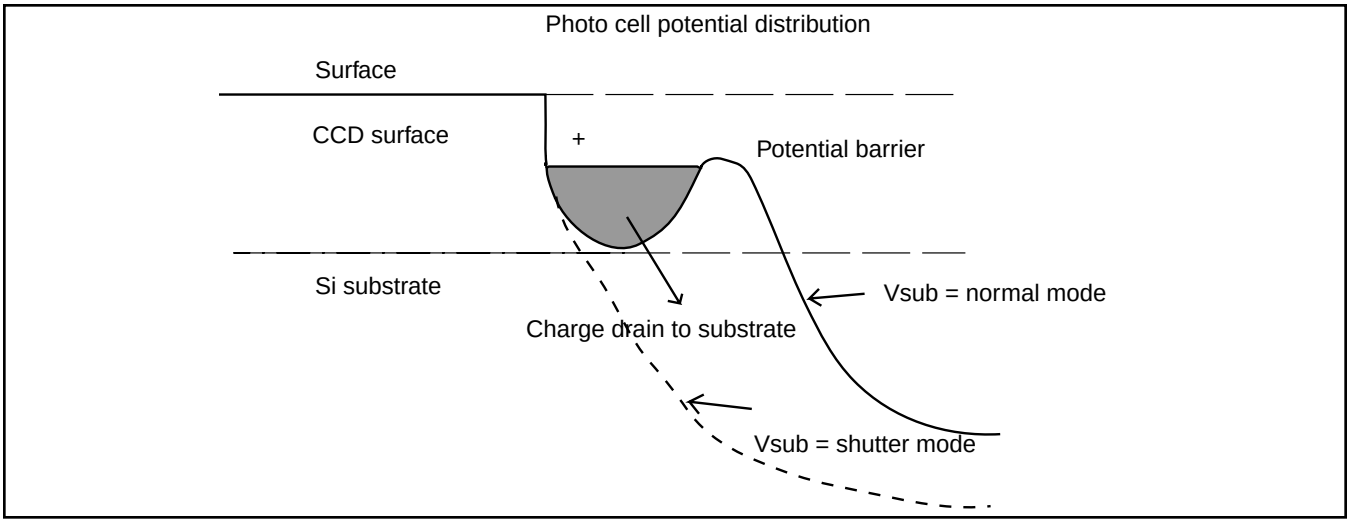
TM-1040 1K X 1K HIGH RESOLUTION ASYNCHRONOUS RESET FULL FRAME SHUTTER CAMERA

The TM-1040 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**

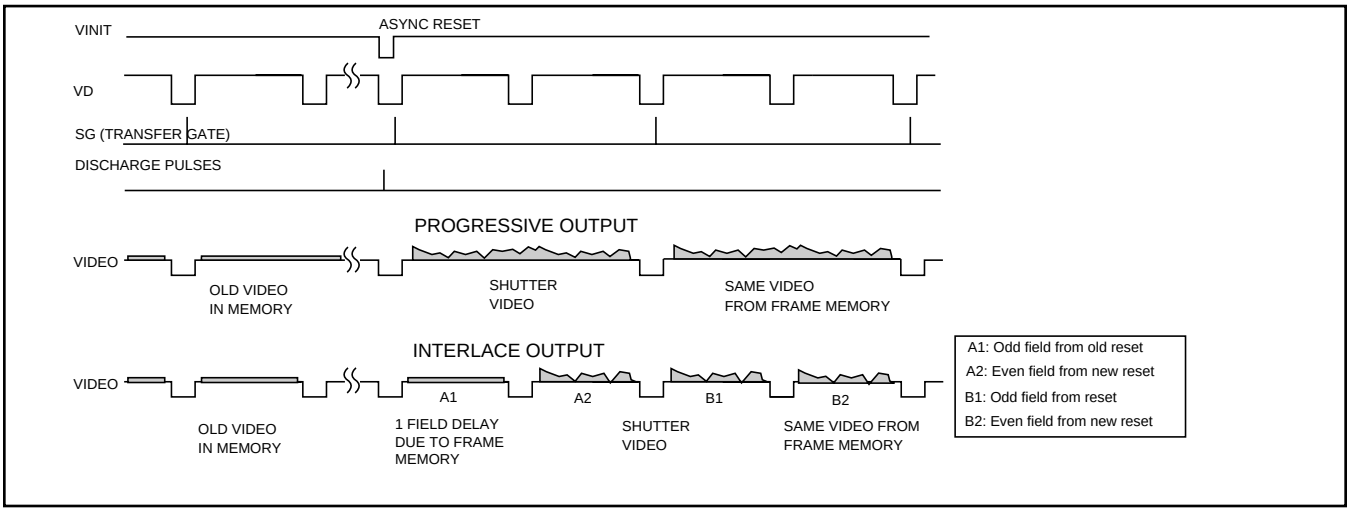
1.1 **Substrate Drain Shutter Mechanism**

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.



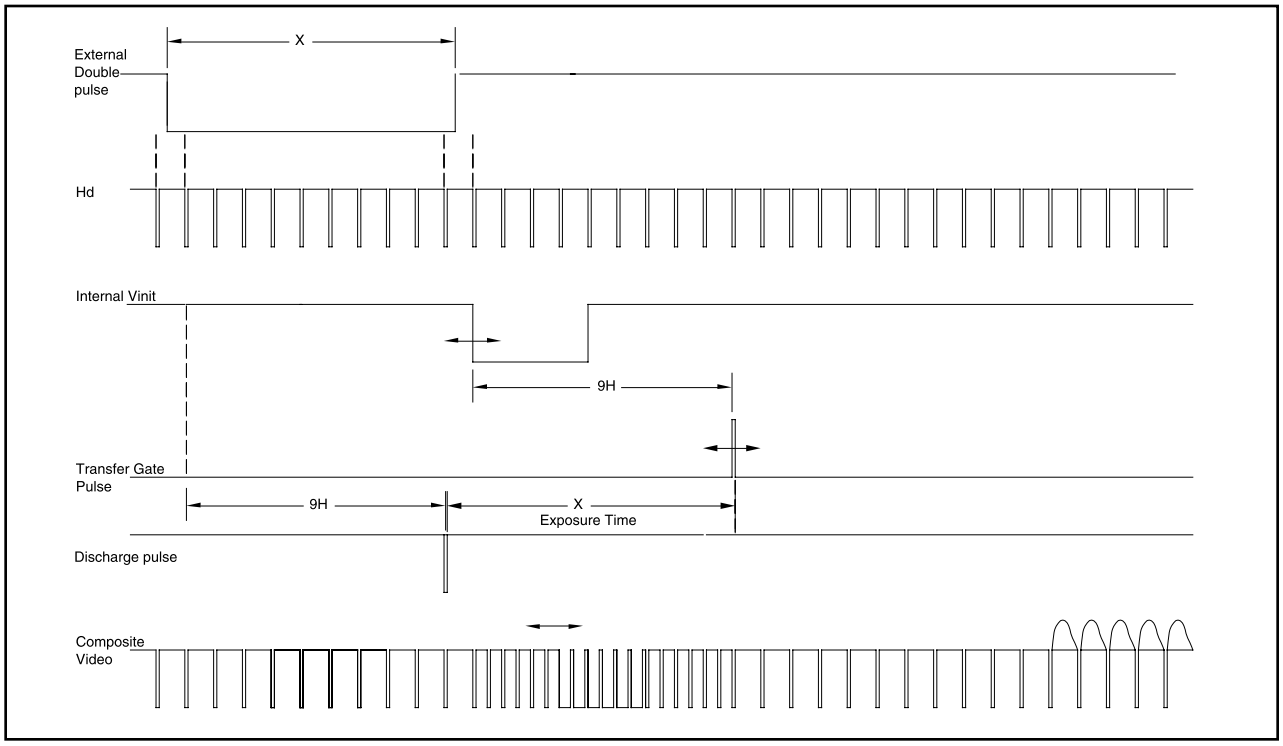
1.2 **Asynchronous shutter**

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-1040 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. The same full frame image (two fields) is output from interlace analog signal with one field of delay.



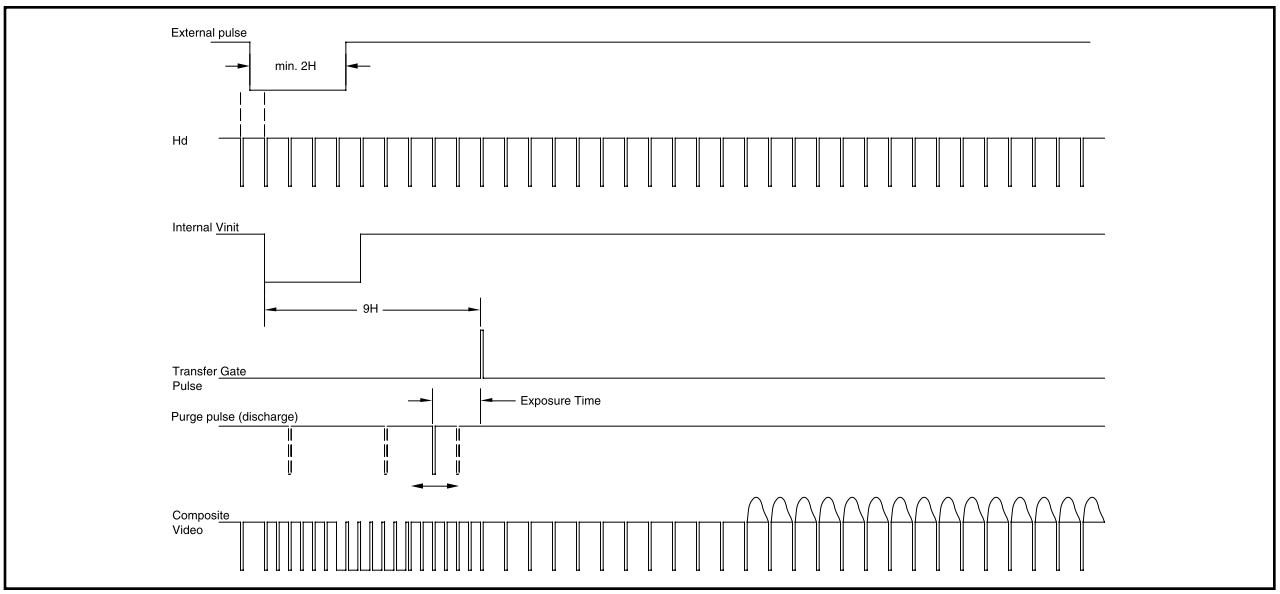
2. Shutter Speed Control

2.1 External pulse width control mode



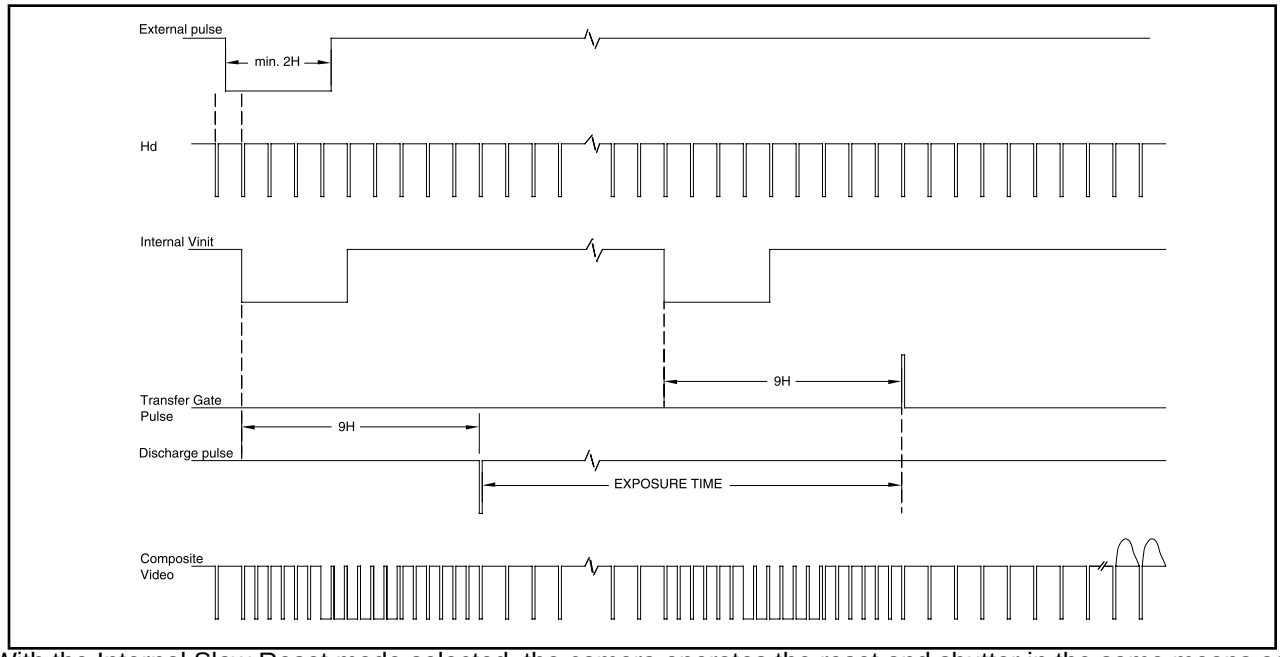
For External Pulse Mode, set dial switch to "9". Apply a pulse width control VINIT signal, which can be generated from an external event trigger, to the camera. Internal reset pulse will be latched to Hd and at 9th HD timing from external pulse leading edge (negative going edge), CCD discharge pulse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



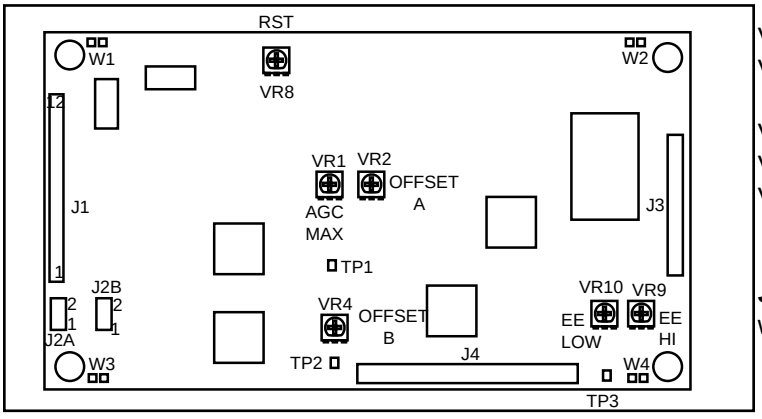
For Internal Fast Reset Mode, set the 10-position dial switch from "1" to "4". When fast reset mode is selected, the camera resets with internal VINIT timing, which is latched to Hd, and video output is also synchronized with internal VINIT timing without further delay. The shutter speed is controlled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

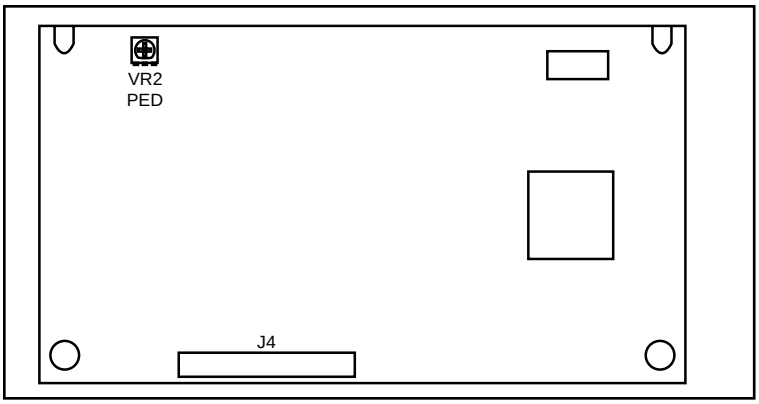
2.3 Internal Slow reset mode



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





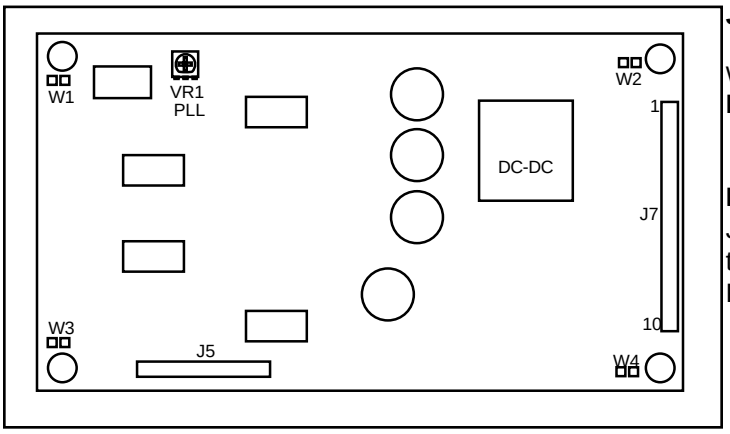
Preset

VR1	AGC MAX	4.0 V (28 dB)
VR2	PED	Set pedestal at 50 mV of video (analog)
VR8	Reset	-6.0 V
VR9	EE high	3.85 V (with no light)
VR10	EE low	3.70 V

Jumpers

w1 - W4 for chassis GND

4. Bottom board



Jumper

W1 - W4 for chassis GND

Potentiometer

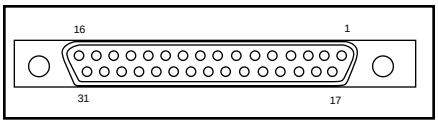
VR1 PLL 2.6 V (with Ext.Sync input)

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).

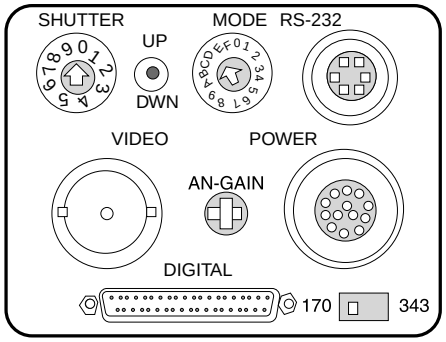
5. Digital output connector

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(40.068MHz) 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



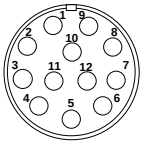
TM-1040 Back plate

6-1. Mode control switch

0 Normal mode

1	MGC control (A&B channel)	Up/Down
2	Async / Manual shutter	Up: Manual Down: Async
3	Gain selection	Up: 9 dB Down: 16 dB
4	Gain selection	Up: 22 dB Down: 28 dB
5	Offset adjustment (A&B)	Up/Down
6	Offset (B only)	up/Down
7	EE / Normal shutter	Up: Normal Down: EE
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 data Down: Recall data

6-2. 12-PIN Connector pin configurations



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

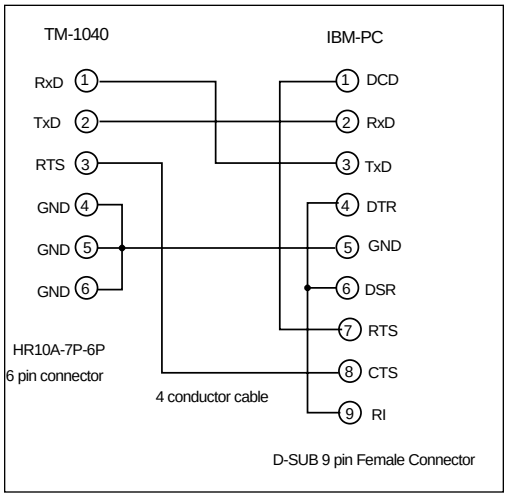
NOTE: TM-9700, TM-540, TM-720, TM-745, TM-840N pin compatible.

6-3. 6-pin RS-232C Connector (HR10A-7P-6P)

RS-232

PC-6P

1	RXD
2	TXD
3	RTS
4-6	GND



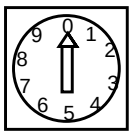
6-4. Analog gain control

TM-1040 has a potentiomaeter on the back panel to control D/A output gain for analog output. In order to achieve the bast dynamic range for the digital output, normal A/D input range is kept for wide range and the digital information has wide dynamic range to process. However this feature shows differnt output level between digital and analog display is compared due to narrow range of analog which is limited by the maximum 714 mV (100 IRE) video level. This analog level can be adjusted to match the digital display.

6-5. RS-343 and RS-170 selection

For analog output, user can select its format betweem RS-343 and RS-170.
The default is RS-343 and when remote control (RS232C) is used, this switch must be kept on RS-343 side.

6-6. 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

7. Monitor display mode

One of the advantages of the TM-1040 is the built-in scan conversion circuit so that even though the progressive scan frequency can not be displayed or recorded by conventional video equipment,RS-343 video signal (an interlace analog video format at 31.50 KHz horizontal and 1050 line, 30 Hz frame frequency) or RS-170 video signal (525 scanning lines) is available. RS-343 or RS-170 is switch selectable at the rear panel and by RS-232C communication.
For the monitoring, connect BNC output to RS-343 or RS-170 equivalent video equipment.
The interlace output is intended for analog signal monitoring or recording and 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 multi-sync type non-interlace monitors (9” and 12”).
Electrohome EVM942 /1242 or equivalent model can be used for TM-1040 display mode.
Some of these monitor may not accept multi-frequency vertical sync. Please contact PULNiX for the modification or information.

8. Frame Memory
The TM-1040 has two sets of built-in frame memory which output progressive scan images at 30 Hz rate (30 frames per sec) and analog interlace images independently. 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-1040 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-1040 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 normal mode....(manual shutter mode), the video output is real time with manual shutter.
B. Integration
Activate Freeze mode then input INTEG control(#6) as active low (TTL). While it is low, the TM-1040 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 Freeze mode is Real, 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 fame). 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-1040 uses a state-of-the-art CCD called a "Progressive scan interline transfer CCD" which scans all lines sequentially from top to bottom at one frame rate (30 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-1040 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. Interlace scan analog output (RS-343 / RS-170)
The TM-1040 outputs interlace video for monitor display. It combines two channel outputs from CCD to generate 60 Hz field rate.
The internal scan conversion provides RS-170 video output also when it is selected. It skips horizontal lines to generate 525 lines and due to the dual channel conversion, it may show minor artifact of vertical resolution. It scans two rows out of 1024 sequentially then skips two rows.

9. 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 of two channel can be controlled together by up/down switch. The minimum gain is 8 dB and the maximum gain is set internally (factory set is 28 dB)

-2. Async / Manual shutter selection
The electronic shutter mode is selected by up (manual) and down (async) switch.
When it is in 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 & -4. Gain selection
Fixed specific gain is recalled by selecting 3 and 4 by pressing up/down switch up or down.

3 - up	9 dB,	3 - down	16 dB
4 - up	22 dB,	4 - down	28 dB

-5. Offset adjustment
Black level offset is adjustable by pressing up/down switch. Two channels move together.

-6. Offset adjustment
Offset of B channel moves up/down in order to calibrate black level banding (or flickering with interlace output).

-7. EE/Normal Shutter
Auto electronic shutter can be selected by pressing the UP/DWN switch to DWN position.
Normal shutter can be achieved by pressing UP/DWN switch to UP position.

-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-1040 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
The factory default data is stored in page #9.
When an user needs the original calibration data, select #9 and press up/down switch to recall.
This factory data can not be altered by user.

-A. User default data page
The page #A is user default page which camera sees this data to load at the power up unless user set a specific page (B through F at power up).
The last data can be stored in the page #A and it will be kept for next operation. **Note**: Data cannot be saved unless save process is implemented.

-B through F. User data pages
By selecting these pages, user can store and recall various data. Press up/down switch up to save and press down to load the data.

10. Banding Calibration Mode (gain and offset)

Set MODE switch to #A while holding UP/DWN switch to UP position, and then power on the camera. (**NOTE**: In calibration mode, the last calibration data is automatically saved in the page.
To exit the calibration mode, turn off power once, then power up with the same page ...#A.)

1. MGC mode calibration (in calibration mode)
1-1. Select mode switch #1 and adjust the gain level first.
1-2. Then close lens to see offset uniformity.
If the offset is to high or too low, select #5 to move up or down both channel together.
1-3. Select #6 and adjust channel B only to obtain the best balancing between channel A and channel B.
1-4. Open lens and set the light intensity and adjust the channel variance by selecting #2 and up/down switch. The channel B is calibrated to match channel A.
1-5. Repeat 1-2 through 1-4 if necessary.
1-6. Turn off power to exit calibration mode. then power up again to see calibrated result.

2. Starting from specific gain selection (in calibration mode)
2-1. Select #3 or #4 up or down to chose the specific gain setting (9, 16, 22, 28 dB)
2-2. Select #0 and press up/down switch up. This stores the gain memory to an RAM data and saves following changes to the same memory page automatically.
2-3. Adjust offset by closing lens and calibrate step 1-2 through 1-3.
2-4. Calibrate gain balance by following step 1-4.
2-5. Repeat 2-1 through 2-4 at different gain selection. All four gain setting with the individual variation can be stored.
2-5. Turn off power and restart to see calibrated operation.

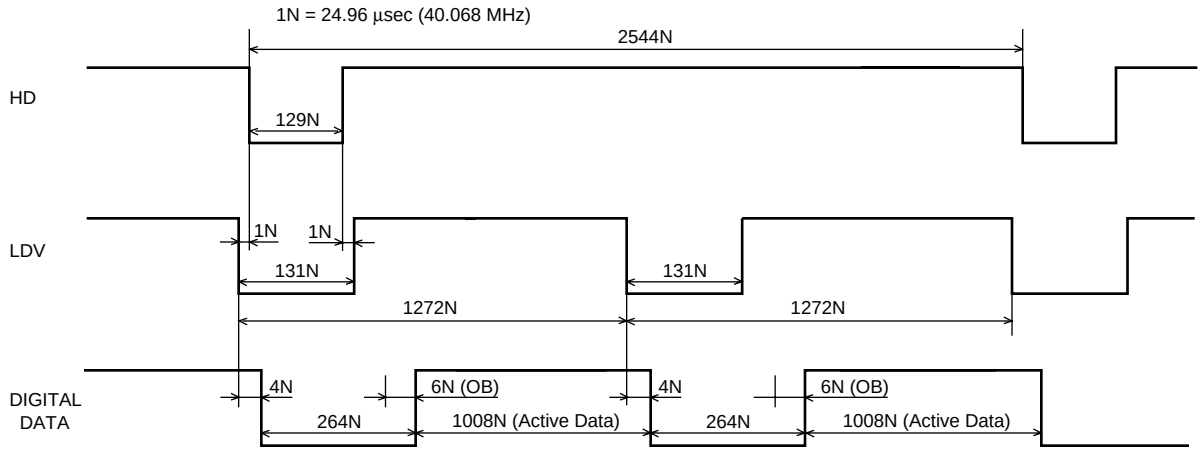
11. Digital output pulses

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. 50-1301-01, 30DG-02 (8-bit) or 30DG-02-10 (10-bit), 2m cable

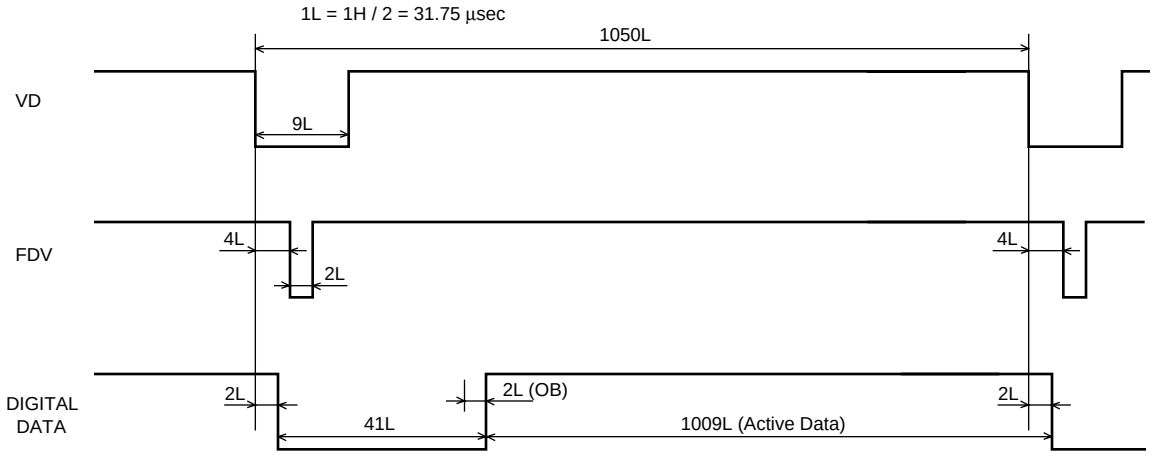
Line Data Valid

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.



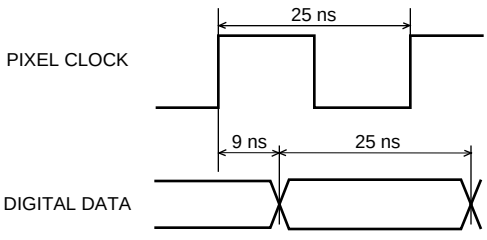
Frame Data Valid

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 40.068 MHz (standard).Noti



12. Connector and cable

Digital output connector is optional.

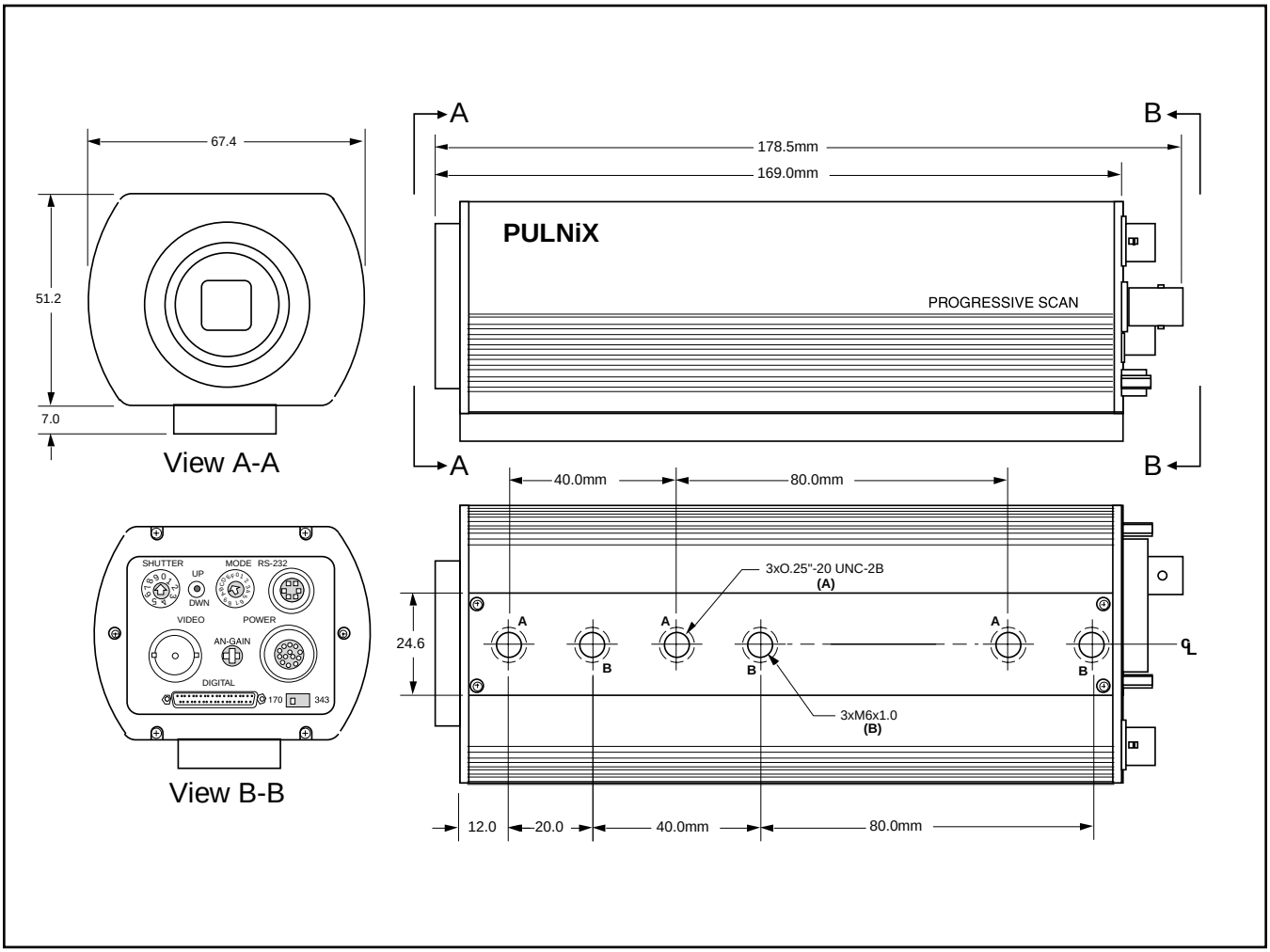
Mating connector ordering information: PULNiX part No. 15-1623 Airborn P/N: MP211-031-113-3400

Straight Back shell (cover): 15-1624 MM254-031-000-0000

Cable assembly: Digital cable 30DG-02 (8-bit) 50-1301-03 or 30DG-02-10/40 (10-bit)

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

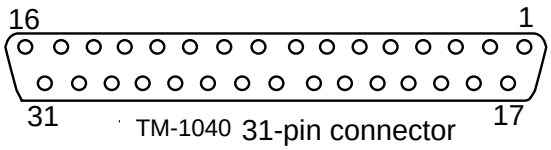
13. Physical Dimensions



DIGITAL CABLE ASSEMBLY

30DG-02-40 P/N 50-1301-40 TM-1040 Full function cable
(consult PULNiX for the frame grabber compatibility)

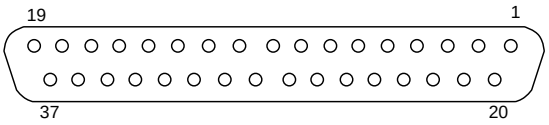
TM-1040 PIN CONFIGURATIONS



TM-1040 31-pin connector

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



37-pin D-SUB connector rear view

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				

Note: TM-1040 digital output is 10-bit and some of frame grabber or a standard 37-DSUB connector cable may not be able to support 10-bit at 40MHz. You can simply use 8-bit output with standard 30DG-02 cable or contact PULNiX for a special interface cable to the specific frame grabber.

14 TM-1040 RS-232C CONTROL

The TM-1040 can be controlled its built-in microcomputer chip (CPU) by external RS-232C interface. The internal CPU controls TM-1040 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-1040 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-1040 (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-1040, 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 F

Function: Analog output selection command
“0” following “F” command is RS-170
“1” following “F’ command is RS-343
“2” following “F’ command is progressive scan

14.4 Command S

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

14-4-1 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-rules 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.

14-4-3 EE shutter mode
STX,”SE”, ETX
02H, 53H, 45H, 03H

14-4-4 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.).

14-5 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

14-6. 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 = 2.3/255 X SET VALUE + 2.0 V
Value : 0 to 255
VO = D/A output voltage
(Vo min = 2.0 V...8 dB, V0 max = 4.3V...28 dB)

14-7. Command O

Function: A/D pre-amp offset control
First value next to “O” command is A channel, second value is B channel.

STX, “G”, “00”, “00”, ETX
00H = offset o
02H, 47H, 30H,30H, 30H,30H, 03H

STX, “G’, “12”, “10”, ETX
02H, 47H, 31H, 32H, 31H, 30H, 03H
Channel A = offset control value 18
Channel B = offset control value 16
It changes the gain by hexadecimal 2 digit.
Vo = 2.3/255 X SET VALUE + 2.0 V
Value : 0 to 255
Vo = D/A output voltage
Vo min = 2.0 V...Offset = -50 mV,
Vo max = 4.3V...Offset = +360 mV

14-8. Command W
Function: Write data to the selected pages or calibration data table.
14-8-1 Saving to page (from page 9 through F)
STX, “W”, “A” - “F”, ETX
02H, 57H, 41H - 46H , 03H
(“page 9” is factory use only)
14-8-2 Saving to calibration table “WU” command
“WU” + [data string 32,byte]
See EEPROM partition table
Eg. “WU10203040102030400A0A0A0A0D0D0D0D”
Both gains of channel A & B in table A is at set 16
Both gains of channel A & B in table B is at set 32
Both gains in table C is set at 48
Both gains in table D is set at 64
All channel A offsets (table A through D) are set at 10
All channel B offsets (table A through D) are set at 13

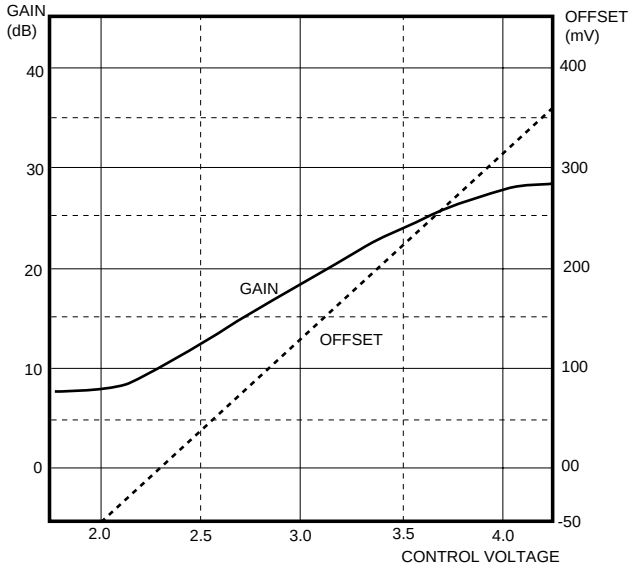
14-8-3 (Factory set mode “WS” command)

14-9 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.

14-10. 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
14-10-2 Report from pages “R 9-F” command
Camera responses,
STX, ACK, “A”(page), [data]

14-10-3 Report from user calibration table
“R U” command
Camera response is,
STX, ACK,”U”, [data]
14-10-4 Report from factory set
“R S” command
camera response is,
STX, ACK, “S”, [data]

For detailed parameter, please contact PULNiX.



TM-1040 gain and offset control

Byte	Data	Partition	Switches
1 and 2	Gain A (value)	A	SW3-UP
3 and 4	Gain A	B	SW3-DOWN
5 and 6	Gain A	C	SW4-UP
7 and 8	Gain A	D	SW4-DOWN
9 and 10	Gain B	A	SW3-UP
11 ann 12	Gain B	B	SW3-DOWN
13 and 14	Gain B	C	SW4-UP
15 and 16	Gain B	D	SW4-DOWN
17 and 18	Offset A	A	SW3-UP
19 and 20	Offset A	B	SW3-DOWN
21 and 22	Offset A	C	SW4-UP
23 and 24	Offset A	D	SW4-DOWN
25 and 26	Offset B	A	SW3-UP
27 and 28	Offset B	B	SW3-DOWN
29 and 30	Offset B	C	SW4-UP
31 and 32	Offset B	D	SW4-DOWN

Report command

Byte	Data
1 and 2:	SHM (shutter and scan mode parameter)
3 and 4:	“00” (reserved)
5 and 6:	RMSW (shutter number specified)
7 and 8:	EXSET (shutter switch control flag)
9 and 10:	HC(H) (direct shutter, H count higher bits)
11 and 12:	HC(L) (direct shutter, H count lower bits)
13 and 14:	Gain A (channel A gain)
15 and 16:	Gain B (channel B gain)
17 and 18:	Offset A (channel A offset)
18 and 20:	Offset B (channel B offset)

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.

Notice

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Warranty

All 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.

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Pulnix America, Inc.

1330 Orleans Drive
Sunnyvale, CA 94089
Tel: (408) 747-0300
(800) 445-5444
Fax: (408) 747-0880