

**RETICON<sup>®</sup>**

# LC1917 Series Cameras

## Low-Profile Analog Line Scan Camera



### Description

In the LC1917 analog line scan camera, PerkinElmer has combined the best features of photodiode array detection, high-speed charge-coupled scanning, and analog line scan camera technology to offer an uncompromising solution to the increasing demands of advanced imaging applications.

The LC1917 is a low profile analog line scan camera. The LC1917 features a single channel differential analog video output format, with a resolution of 1024 pixels, which can achieve data rates of up to 5 MHz with exceptional noise immunity. It is designed for volume applications where a small profile is required.

One feature of typical line scan cameras is a square profile face. While this shape is unavoidable for area scan cameras, it does not take advantage of the long, thin active area of linear arrays. The LC1917's flat faceplate measures 0.75" high by 2" wide. This size allows

the user to install multiple LC1917s into an area scarcely big enough for even the smallest square front profile line scan camera.

The LC1917 converts light imaged during a scene into an analog video signal. The amplitude of the video signal is a linear function of the incident illumination taken from the scene. Antiblooming structures within the sensor ensure superior performance over a wide range of lighting conditions. User-defined control is possible for line rate, integration time and video data rate.

LC1917 cameras may be interfaced to most frame grabber cards, allowing for a tested, plug and play solution. Typical high performance line scan applications include position monitoring, edge and spot tracking, and acquisition of any image generated by shadows, light beams, or external optics.

### Features

- 5 MHz output rate
- Geometrically precise 14  $\mu$ m square pixel CCD
- Small size: 0.75"H x 2"W x 3.077"L
- High dynamic range (2500:1)
- Antiblooming control
- CE Mark
- Adjustable gain and dark offset levels
- Line scan rates to 4.7 kHz
- Differential digital I/O signals for electrical noise immunity

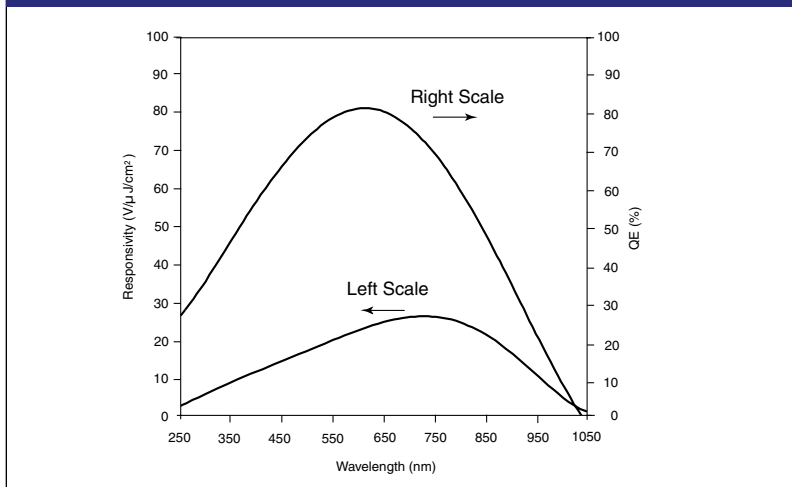


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## The Sensor

LC1917-series cameras contain a high-performance, high-resolution line scan image sensor (PerkinElmer Optoelectronics parts RL1024PAG) featuring a pinned photodiode pixel. Each photodiode converts incident light into discrete charge packets. Advantages of pinned photodiode pixels include linear exposure control, the elimination of image lag, and the reduction of photo response non-uniformity (PRNU). For more specific sensor specifications and information, please consult the appropriate sensor datasheet, available by contacting PerkinElmer. Figure 1a details the spectral sensitivity of the sensor, while Figure 1b details the sensor's glass window light transmission curve.

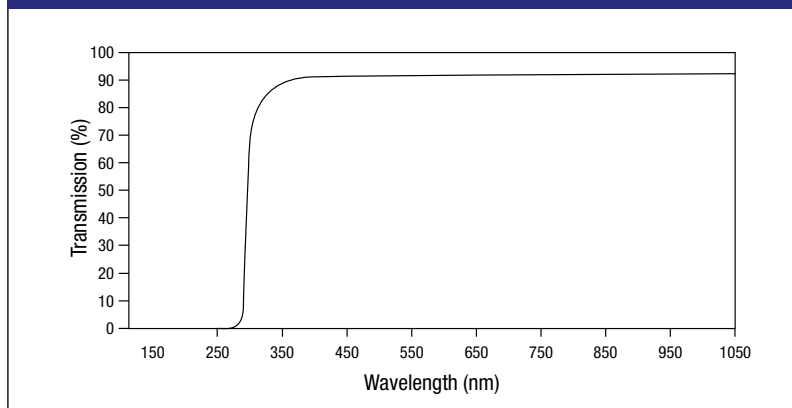
Figure 1a. Spectral Sensitivity Curve (1X Gain)



## Functional Description

The video signal from the sensor is processed through a single channel of sampled-and-held, raster order, analog video data. The video channel signal processing circuitry offers both adjustable gain and dark offset levels to allow customization of the camera to unique lighting applications. An operational amplifier in a differential configuration is recommended to receive the video signal. Figure 2 details the camera video processing.

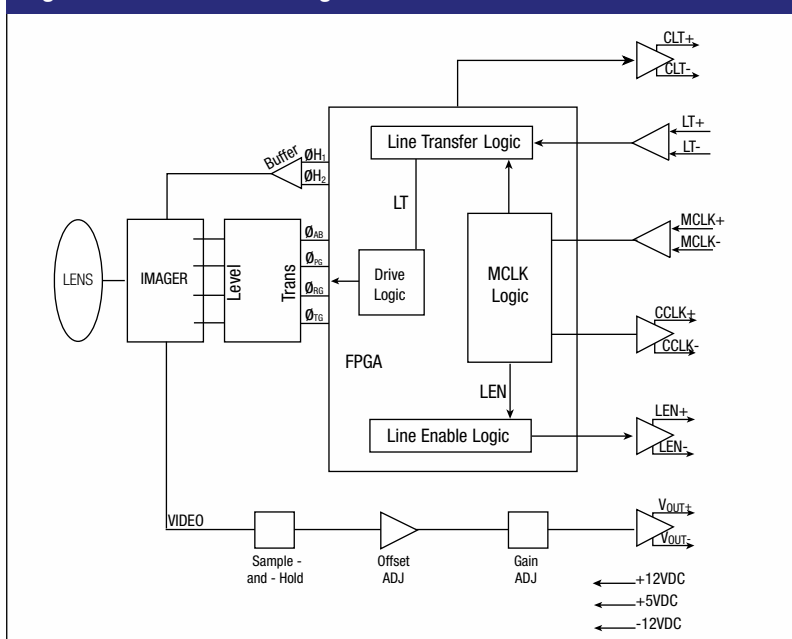
Figure 1b. Sensor Window Transmission Curve



## Input Signals

The LC1917 camera requires DC supply voltages of +12 VDC, -12 VDC, and +5 VDC for operation. Table 3 further describes power requirements and voltages, along with tolerances. By default, the camera will operate at its maximum line rate of 4700 scans per second. The camera is controlled by two externally generated differential input signals: Master Clock (MCLK) and Line Transfer (LT).

Figure 2. Camera Block Diagram



The Master Clock input determines the data rate frequency for values up to maximum clock of the camera (5 MHz). The data rate may be run from 1 MHz to camera's maximum clock rate.

The LT input signal transfers the charge from each photosite to the readout registers. The readout registers, in turn, transport the charge from each photodiode in succession to the video outputs. The LT input from the user must remain in the ON state for at least one and a half MCLK cycles to initiate the internal line transfer and may remain ON until one

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## Input Signals (contd.)

and a half clock cycles prior to the end of read out. Because there are extra stages in the CCD sensors readout register, a minimum number of MCLK cycles (the number of elements on the CCD sensor plus 41) must exist between successive LT commands.

The maximum line-scan period is 20 milliseconds. Integration times longer than 20 ms can introduce higher levels of dark current, which reduces the dynamic range of the sensor. Longer integration times are possible, however, if the camera is cooled, which reduces dark current. Specific application characteristics, such as light level and rate of object motion, will determine the optimum setting. Timing details are shown in Figure 3.

## Output Signals

The LC1917-series camera provides three output synchronization signals: Camera Clock (CCLK), Line Enable (LEN), and Camera Line Transfer (CLT).

The Camera Clock (CCLK) operates at the MCLK frequency and is synchronized to the analog video. The output of the CCLK signal can be used to capture analog video data by a frame grabber or digitizer.

The Line Enable (LEN) signal brackets the valid analog video. The signal becomes high two CCLK periods before the first valid pixel and goes low two CCLK periods before the last valid pixel. The video output is a contiguous pixel data stream with a dynamic range (defined as peak video divided by rms pixel noise) of greater than 2500:1.

The Camera Line Transfer (CLT) output signal is an internally generated sync signal. Its falling edge indicates the start of a line readout sequence. This signal may be used for controlling strobes, shutters or other accessories of the users system.

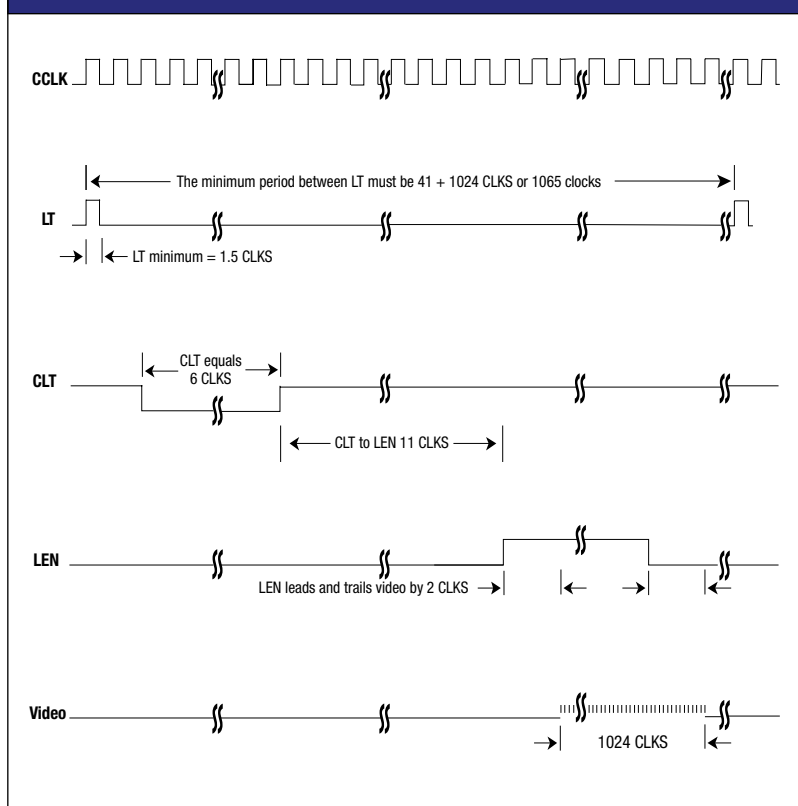
## Video Signals

The LC1917 camera features an adjustable DC offset. This offset is controlled by a potentiometer, located underneath the set screw on the body side of the camera adjacent to active

**Table 2. Camera Description**

Parameter	Variable	Description
Physical	Optical Lens	No lens adaptor - optical
	Sensor Alignment	Within $\pm 0.005"$ of $\Phi$ of mounting hole
Connector	Dimensions	2" x 3.077" x 0.75"
	Type	Amp C-216297
Power Requirements	Cable Length	26-pin High Density Male
	Operating Voltages	Maximum 10 meters
Output	Connection	+12 VDC, +5 VDC, -12 VDC
	Data Rate	Through 26-pin connector
Control Signals	Type	1 - 5 MHz
	Connection	Analog Differential Video
Sensor	User Supplied	Through 26-pin connector
	User Communications	Master Clock (MCLK)
Operational	Camera Supplied	Line Transfer (LT)
	Connection	RS-422 Control Signals
Operational	Type	Camera Clock (CCLK)
	Window	Line Enable (LEN)
Operational	Gain Adjustment	Camera Line Transfer (CLT)
	Dark Offset Adjustment	Through 26-pin connector
Operational	Type	PerkinElmer RL1024PAG
	Window	Glass

**Figure 3. Camera Timing Diagram**



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## Video Signals (contd.)

pixel 1024. This dark offset allows the user to adjust the standard 0 V signal  $\pm 100$  mV.

Additionally, the LC1917 camera features a user-adjustable video gain, allowing for video gains of up to 2.5X. Video gain is adjustable using the potentiometer, located underneath the set screw on the body side adjacent to the active pixel 1 side of the camera.

Both the gain and offset potentiometers can also be adjusted by removing the bottom plate of the camera. This is accomplished by removing the two lower screws on both the faceplate and rear body of the camera. The camera bottom is not attached to any internal circuitry.

Proper ESD precautions should be taken when removing the bottom plate of the camera. Failure to do so can result in camera failure.

## User Connections

The connector on the LC1917-series camera is a 26-pin high density male AMP C-216297. All user connections are via this connector. It contains all communications, output, and power connections needed for camera operation. Refer to Table 1 for pinout locations and details. Connector pin locations are shown in Figure 4.

## Optical Interface and Mounting

The LC1917 is to be mounted to the user's optics via 4 M3 threaded screws, located on the front panel of the camera, adjacent to the sensor.

The optical surface of the sensor is located 2.7mm ( $\pm 10\%$ ) from the surface face of the camera. The sensor has a maximum angular error of  $\pm 15$  milliradians.

## Camera Performance

The camera head is housed in a rugged aluminum case, measuring 0.75"H x 2"W x 3.077"L (excluding connector extensions) specifically designed for close-proximity harsh industrial applications. The sensor is mounted on an aluminum plate that efficiently transfers heat to the camera case. The conductive cooling of this surface is useful in minimizing thermally generated dark current and noise of the camera system.

**Table 1. Pin Assignments**

Pin	Sym	Description
1	+12 VDC	12 VDC Input
2	+12 VDC	12 VDC Input
3	GND	Power Supply Ground
4	GND	Power Supply Ground
5	GND	Power Supply Ground
6	GND	Power Supply Ground
7	GND	Power Supply Ground
8	-12 VDC	-12 VDC Input
9	-12 VDC	-12 VDC Input
10	LT+	Line Transfer +
11	MCLK+	Master Clock +
12	CCLK+	Camera Clock +
13	LEN+	Line Enable +
14	CLT+	Camera Line Transfer +
15	+5VDC	5 VDC Input
16	GND	Power Supply Ground
17	GND	Power Supply Ground
18	VIDEO+	Video Out +
19	LT-	Line Transfer -
20	MCLK-	Master Clock -
21	CCLK-	Camera Clock -
22	LEN-	Line Enable -
23	CLT-	Camera Line Transfer -
24	+5 VDC	+5 VDC Input
25	GND	Power Supply Ground
26	VIDEO-	Video Out -

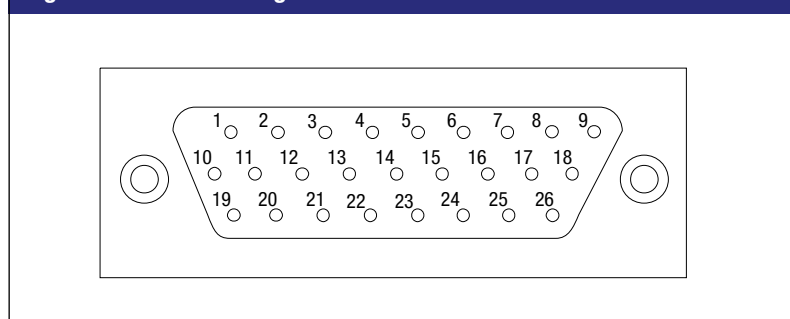
**Table 3. Power Requirements**

Pin	Voltage	Tolerance	Power Requirement
1	+12 VDC	$\pm 0.5$ V	100 mA max
2	+12 VDC	$\pm 0.5$ V	100 mA max
8	-12 VDC	$\pm 0.5$ V	100 mA max
9	-12 VDC	$\pm 0.5$ V	100 mA max
15	+5 VDC	$\pm 0.2$ V	200 mA max
24	+5 VDC	$\pm 0.2$ V	200 mA max

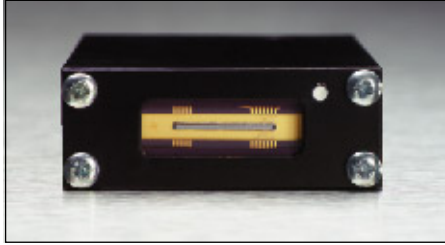
### Notes

1. Cable length should not exceed 10 meters.
2. Noise and ripple  $< 15$  mV p-p.

**Figure 4. Connector Diagram**



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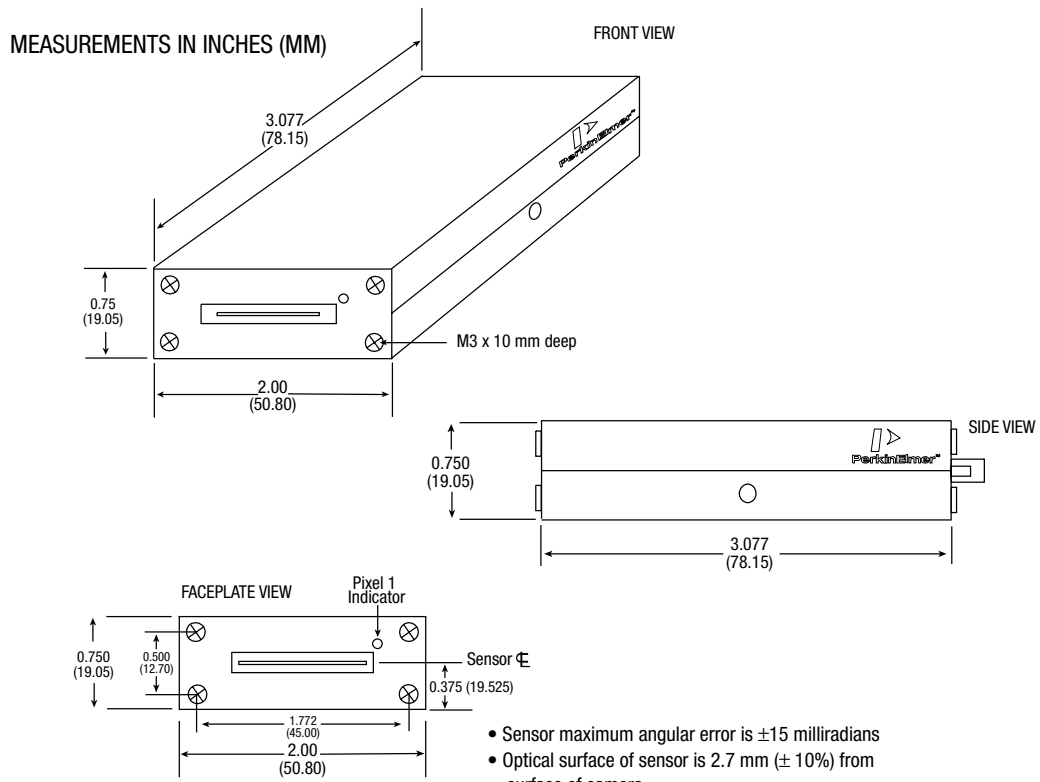
**Table 4. Camera Specifications**

Characteristic	Min	Typ	Max	Unit
Active Pixel Count	-	1024	-	elements
Pixel Size	-	14 x 14	-	µm
Pixel Spacing	-	14	-	µm
Spectral Response	250	-	1000	nm
Dynamic Range <sup>4</sup>	-	2500:1	-	Ratio
Video Data Rate	1	-	5	MHz
Video Saturation Level				
Typical (100Ω)	-	0.75	-	V
Differential (100Ω)	-	1.4	-	V
Gain Control	1	-	2.5	Factor
Dark Offset	-0.1	0	0.1	V
Saturation to FPN Dynamic Range	-	40	-	dB
Light Response Non-Uniformity <sup>1,2</sup>	-	±3	±6	%
Saturation Exposure <sup>3</sup>	-	0.15	-	µJ/cm <sup>2</sup>
Photo Response Non-Uniformity	-	±10	-	%
Weight	-	-	20	ounces
Cable Length	-	-	10	meters
Operating Temperature	0	-	55	°Celsius
Storage Temperature	-40	-	80	°Celsius

**Notes**

1. 635 nm
2. At 50% light saturation
3. 500 nm
4. Dynamic Range =  $V_{SAT}/rms\ noise$ .

**Figure 5. Outline Drawings**



# Analog Line Scan Cameras

## Ordering Information

While the information provided in this data sheet is intended to describe the form, fit and function for this product, PerkinElmer reserves the right to make changes without notice.

**Table 5. Stock Part Numbers**

Camera Model	Resolution	Max Data Rate
LC1917HAN-011	1024	5 MHz

For more information e-mail us at [opto@perkinelmer.com](mailto:opto@perkinelmer.com) or visit our web site at [www.perkinelmer.com/opto](http://www.perkinelmer.com/opto). All values are nominal; specifications subject to change without notice.

**Table 6. Sales Offices**

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