
PI411MC-A7

400DPI CIS Module

Engineering Data Sheet

Key Features

- Low power-Single Power Supply at 5.0Volts
- Light source, lens, and sensor are integrated into a single module
- 15.7 dpm resolution, 89 mm scanning length
- High Speed Page Scan - up to 282 μ sec/line @ 5MHz pixel rate
- Wide dynamic range
- Analog output
- 660 nm LED light source
- Compact size \cong 13 mm x 25.6 mm x 102 mm
- Light weight

General Description

The PI411MC-A7 is a contact imaging sensor, CIS, module that can operate from a single 5.0 Volts supply. It is a linear scanning array composed of 11 PI3022 imaging sensor chips. The PI3022 is a 400 DPI solid-state line imaging sensor chip with 128 photo sensitive elements, also, a product of Peripheral Imaging Corporation. Eleven of these devices are sequentially cascaded to form the linear scanning array with a total photo sensing elements of 1408. This imaging device is fabricated using MOS imaging sensor technology for its high-speed performance and high sensitivity. It is designed for scanning A7 size (89 mm) documents with 400 dots per inch resolution. Applications include ticket, check and card scanners, variety of mark readers, and other automation equipment.

Functional Description

The PI411MC-A7 consists of 11 imaging array sensors that are cascaded to provide 1408 photo-detectors. Each sensor has their associated multiplex switches, and a digital shift register that controls its sequential readout. Each also contains a chip select switch so that each following chip is accessed sequentially as its predecessor chip completes its scan. These chips are mounted on a PCB board along with clock buffers and video signal amplifier. See Figure 1. PI411MC-A7 module block diagram.

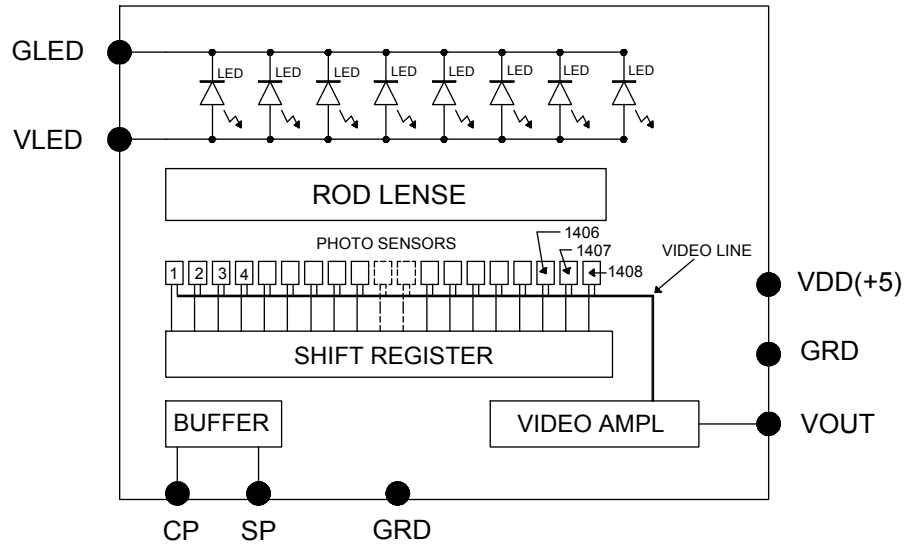


Figure 1. PI411MC-A7 module block diagram.

The PCB containing the imaging array is enclosed in a module housing, along with a one-to-one graded indexed micro lens array that focuses the scanned documents' image onto the sensing line of the sensor chips. The document is illuminated with a LED light source, which is also mounted in the housing. See Figure 2. PI411MC-A7 Cross Sectional View.

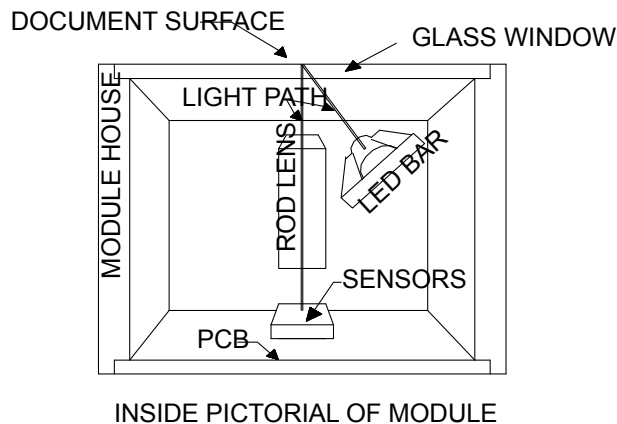


Figure 2. PI411MC-A7 Cross Sectional View

This pictorial cross section shows the LED Bar light source and its illumination path. The light on the document reflects images on the document. The reflected images focus through the micro lens onto the chips' image sensing line where images are converted to proportional electrical charges. An on board amplifier processes these signal charges into proportional video signal voltages, which is sent out to the output video port.

All components are housed in a small plastic housing and covered with a glass window. This cover glass not only serves to protect all of the critical components within the housing from dust, but, along with micro lens, it determines the depth-of-focus because it lies in the optical path.

Pin Out Description

There is a connector located at the end of the module. The outline of the module of Figure 4 of the mechanical section illustrates the connector location. With the module window facing down on flat surface, with the viewer looking down on backside of the module, and with the connector's pins facing viewer, the connector is located on the right hand end of the module. The connector is a surface-mount-flex input, Molex 52207-0890, 1 mm single 10-pin row. Its I/O designation is provided in Table 1. I/O Designation. Pin number 1 location is the pin closest to end of the module.

Pin Number	Symbol	Names and Functions
1	Vout	Analog Video Output
2	Gnd	Ground; 0V
3	Vdd (+5V)	Positive power supply
4	NA	Not used
5	Gnd	Ground; 0V
6	SP	Shift register start pulse
7	Gnd	Ground; 0V
8	CP	Sampling clock pulse
9	GLED	Ground for the light source
10	VLED	Supply for the light source

Table 1. I/O Designation

Absolute Maximum Rating:

The following is a table of absolute maximum parameters. These parameters should not be used in prolonged operation.

Parameter	Symbols	Maximum Rating	Units
Power Supply	Vdd	7.0	V
	Idd	50	mA
	VLED	5.7	V
	ILED	300	mA
Input Clock Pulse (high)	Vih	Vdd	V
Input Clock Pulse (low)	Vil	-0.5	V

Table 2. Absolute Maximum Rating

Operating Environment

Operating temperature	Top	0 to 50	°C
Operating humidity	Hop	10 to 85	%
Storage temperature	Tstg	-25 to 85	°C
Storage humidity	Hstg	5 to 95	%

Table 3. Operating Environment

Electro-Optical Characteristics (25° C)

Parameter	Symbol	Parameter	Units	Note
Number of photo detectors		1408	elements	
Pixel to pixel spacing		62	μm	
Line scanning rate ⁽¹⁾	Tint	423	μsec	@ 3.33 MHz clock frequency
Clock frequency ⁽²⁾	Fclk	3.33	MHz	See note 2 for 5.0 MHz operation.
Bright output voltage ⁽³⁾	Video Output	1.2 +/-0.05	V	Specified for Tint = 423μsec.
Bright output nonuniformity ⁽⁴⁾	Up	<+/-30	%	

Adjacent pixel nonuniformity ⁽⁵⁾	Uadj	<25	%	
Dark nonuniformity ⁽⁶⁾	Ud	<75	mV	
Dark output voltage	Vd	200<Vd<300	mV	
Modulation transfer function ⁽⁷⁾	MTF	>40	%	See note 7 for MTF & DOF.

Table 4. Electro-optical characteristics at 25° C.

Definition:

- (1) Tint: Line scanning rate or integration time. Tint is determined by the interval of two SP, start pulses. See note 2 for the high scanning speed operation.
- (2) Fclk: main clock frequency. The call out is at 3.3 MHz, but electrically, the module reliably operates to 5.0 MHz. This modification will require adjusting the LED light level and gain adjust.
- (3) $V_{pavg} = \sum V_p(n)/1804$
- (4) $U_p = [(V_{pmax} - V_p) / V_p] \times 100\%$ or $[(V_p - V_{pmin}) / V_p] \times 100\%$
- (5) $U_{p adj} = \text{MAX}[| (V_p(n) - V_p(n+1)) | / V_p(n)] \times 100\%$
U_{p adj} is the nonuniformity percentage pixel to pixel
- (6) $U_d = V_{dmax} - V_{dmin}$
V_{dmin} is the minimum output on a black document
V_{dmax}: maximum output voltage of black document
- (7) $MTF = [(V_{max} - V_{min}) / (V_{max} + V_{min})] \times 100 [\%]$. Depth of focus, DOF, range is defined with the MTF. MTF is measure at glass surface.
V_{max}: maximum output voltage at 100 lp/inch (At 1/2 of the optical Nyquist Frequency)
V_{min}: minimum output voltage at 100 lp/inch
- (8) lp / inch: line pair per inch

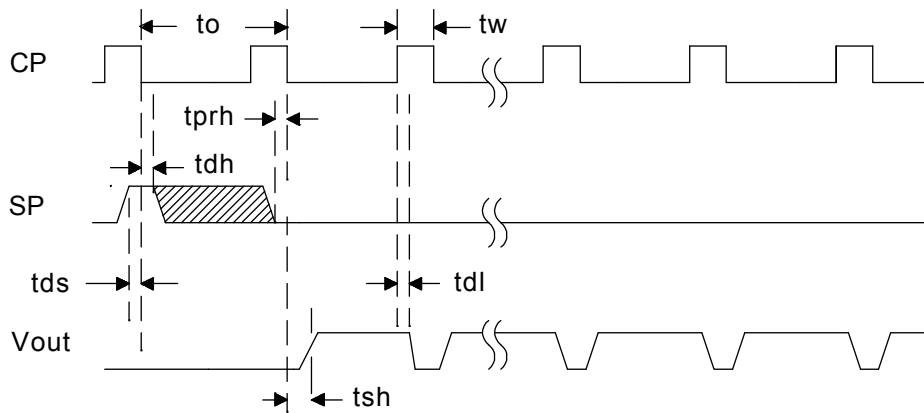
Table 5. Recommended Operating Conditions (25 °C)

Item	Symbol	Min	Mean	Max	Units
Power Supply	Vdd	4.5	5.0	5.5	V
	VLED	4.5	5.0	5.5	V
	Idd	28	32	36	ma
	ILED	130	180	235	ma
Input voltage at digital high	Vih	Vdd-1.0	Vdd-0.5	Vdd	V
Input voltage at digital low	Vil	0		0.6	V
Clock frequency	Fclk		3.33	5.0	MHz
Clock pulse high duty cycle		25			%
Clock pulse high duration ⁽¹⁾		50			ns
Integration time ⁽²⁾	Tint	0.282		5.0	ms
Operating temperature	Top		25	50	°C

Table 5. Recommended Operating Conditions (25 °C)

- (1) The clock high duration are at 5.0 MHz maximum clock rate.
- (2) Tint (Min) is the minimum line integration time available at 5.0 MHz clock rate.
See note 2 under Table 4.

Switching Characteristics (25°C)



MODULE TIMING DIAGRAM

Figure 3. Clock and Start pulse Timing Diagram

The switching characteristics for the I/O clocks are shown in Figure 3. Its corresponding timing symbol definitions are given in Table 6, below.

Item	Symbol	Min.	Typical	Max.	Units
Clock cycle time	t_o	0.2		4.0	μs
Clock pulse width	t_w	50			ns
Clock duty cycle		25		75	%
Prohibit crossing time of Start Pulse	t_{prh}	15			ns
Data setup time	t_{ds}	20			ns
Data hold time	t_{dh}	20			ns
Signal fall delay time	t_{dl}	50			ns
Signal sampling time	t_{sh}	120			ns

Table 6. Symbol Definition for the Above Timing Diagram

Module and Its Mechanical Dimensions

The sketch of this module is to provide a pictorial of the module size and structure. A detailed drawing is available upon request.

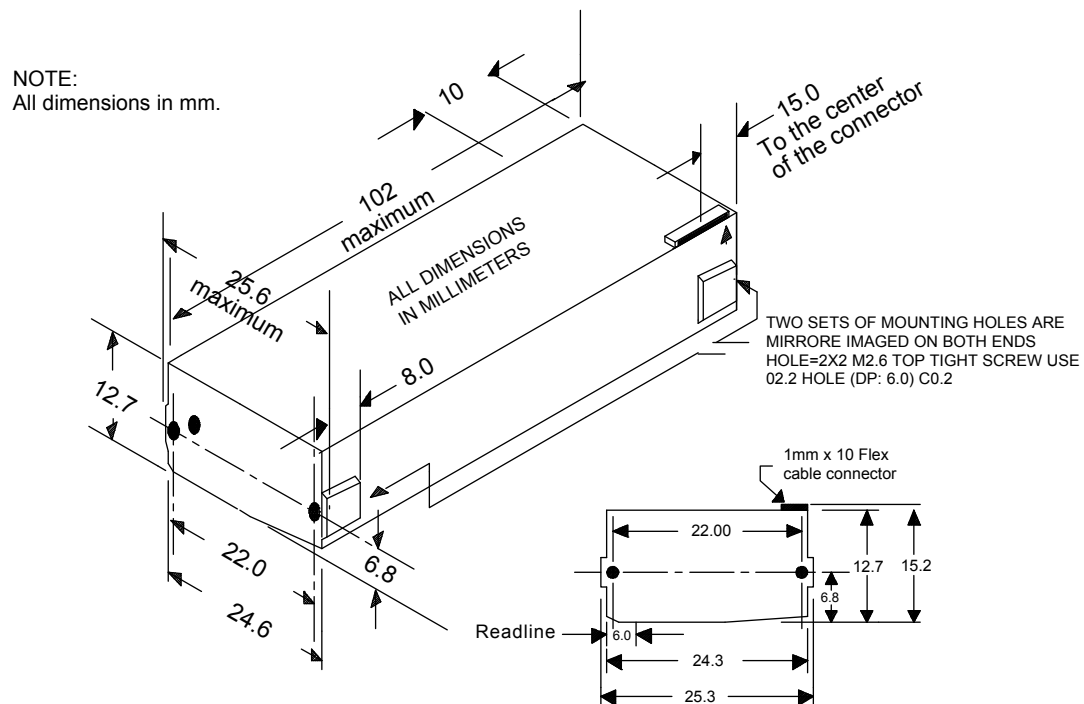


Figure 4. PI411MC-A7 Module Mechanical Outline

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