1.0 General Description

The AMIS-710214 (PI214MC-DR) is a contact image sensor (CIS) module with an additional on-board circuit that digitizes the analog pixels from the CIS image sensor to a “background-tracking”, two-level digital output signal. It is based on AMI Semiconductor’s CIS module that employs MOS image sensor technology to gain its high-speed performance and high sensitivity. The AMIS-710214 is suitable for scanning documents with width of 216mm and with resolution of 8 dots per millimeter (dpm). It has broad applications, but is specially designed for the following areas:

- Where data compression is required, such as in data transmissions.
- Where component pin-out count must be kept to a minimum.

The background-tracking-digitizing circuits in the AMIS-710214 have been referred to as the “dynamic threshold” two-level A/D converter. For the purpose of describing the module’s characteristics this “dynamic threshold” processing circuit shall herein be referred to as the “tracking digitizer”.

2.0 Key Features

- Light source, lens and sensor are integrated into a single module
- 8dpm resolution, 216mm scanning length
- Up to 440µsec/line scanning speed, with 4.0MHz pixel rate (See Table 3, Note 2)
- Wide dynamic range
- Two-level tracking digital output (“Dynamic Threshold Digitizer”)
- Red (660nm) light source (other colors are available)
- Compact size ≅ 19.5mm x 21.5mm x 232mm
- Low power
- Light weight

3.0 Module Description

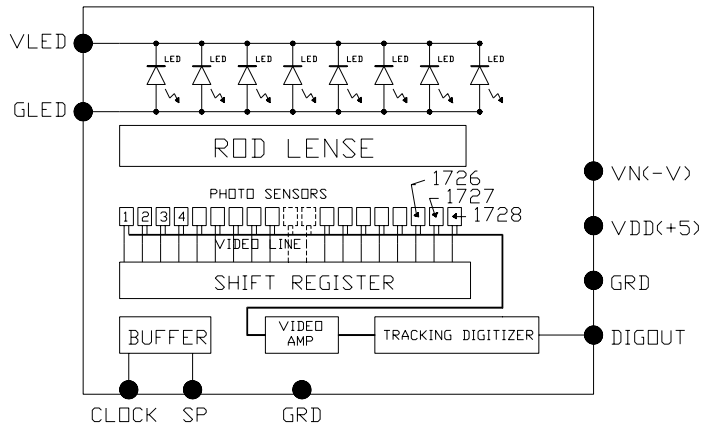

FIGURE 1. BLOCK DIAGRAM OF PI214MC-DR

Figure 1: Block Diagram of AMIS-710214

The AMIS-710214 module consists of 27 sensors that are cascaded to provide 1728 photo-detectors with their associated multiplex switches and a digital shift register that controls its sequential readout. Mounted in the module is a one-to-one graded-indexed micro lens array that focuses the scanned documents to image onto its sensing plane. A buffer amplifier amplifies the video pixels from the image sensors and passes them to analog digitizing circuit, where video pixels are converted to digital signal and passed to output of the module. See Figure 1.

Illumination is accomplished by means of an integrated LED light source. All components are housed in a small plastic housing, which has a cover glass, which acts as the focal point for the object being scanned and protects the imaging array, micro lens assembly and LED light source from dust. The pictorial of AMIS-710214 cross section is shown in Figure 2.

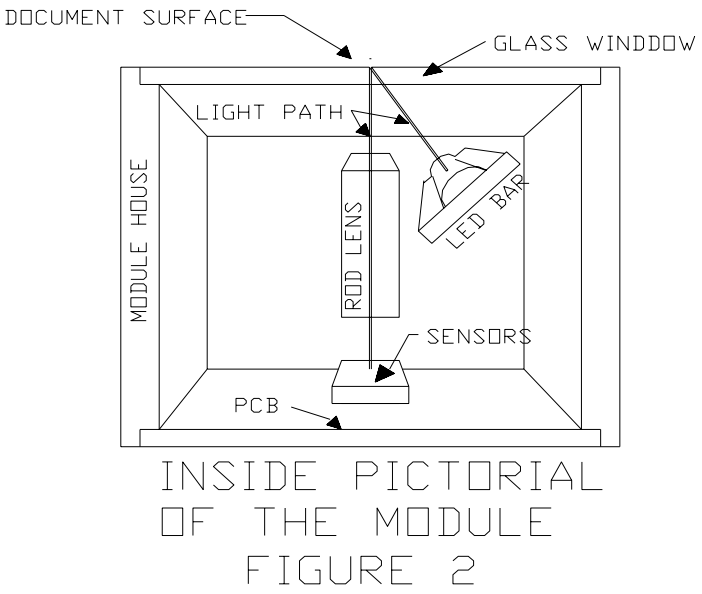

Figure 2: Inside Pictorial of the Module

I/O to the module is a 2 x 2mm 16-pin unshrouded connector (see I/O pin assignment, under Specifications) located on one end of the module (see module drawing).

4.0 Circuit Description and Operation

See Figure 3, which is a simplified block diagram of the analog tracking digitizer. Fundamentally, the tracking digitizer transforms the signal output from a CIS module existing on the market today.

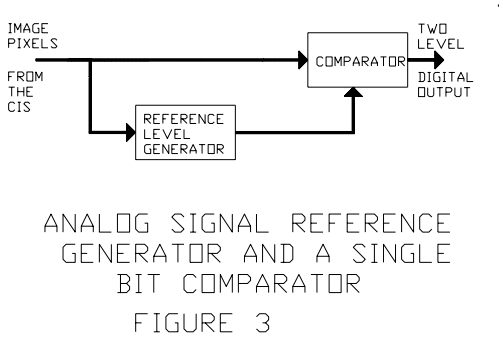

Figure 3: Analog Signal Reference Generator and a Single-bit Comparator

It takes the analog signal from the CIS section of AMIS-710214 and derives a tracking background reference signal. Then this reference is compared against the output signals from the CIS section. The resulting signal from comparison produces a two-level digital signal that is high when the pixel signal is brighter than the background and remains at zero as long as the signal is darker than the background signal.

Figure 1, AMIS-710214 block diagram depicts the two basic circuits, the CIS (image sensors and video amplifier) and the tracking digitizer. In the CIS section, the module has 27 serially concatenated PI3004B image sensors, accordingly, the image sensors will span one scanning-read line width that is 27 sensor times 64 pixel elements/sensor, or 1728 pixel elements.

In operation, the module produces the analog image pixel signals that are proportional to exposure on the corresponding picture element on the document (the video signal) then passes the signal to the tracking digitizer. In turn, the digitizer processes the analog image pixels to digital image pixels. The analog image pixels, at test point TV, are separated into two signals. One generates the reference signal and the other remains unmodified. These unmodified image pixels are applied to one of the input of the comparator. The reference signal is applied to the second input of the comparator. The results of the comparison are the digital image pixels. This digital output is produced in two levels, determined by the difference between the background reference signal and the analog image pixels. A digital pixel output of value “one” represents the analog image pixel that is brighter than the background and digital pixel level of value “zero” represents the image pixel that is darker than background.

5.0 Specifications

The I/O Connector is a Molex connector, part number 87049-1616, and its pin numbers and their functions are listed in Table 1.

Table 1: Pin Configuration

Pin Number	Symbol	Names and Functions
1 ,2, 4, & 8	GRD	Ground; 0V
3	DIGOUT	Digital video output
5 & 6	VDD	Positive power supply
7	SP	Start Pulse for the shift register
9 & 10	Vn	Negative power supply
11 & 12	Clock (CP)	Clock for the shift register
13 & 14	GLED	Return for the LED light source
15 & 16	VLED	Power in for the LED light source

5.1 Inputs

There are five inputs:

- Clock (CP): This is the input for the main sampling clock.
- SP: This is the start pulse input for initiating the scan.
- VDD: This is an input for the + 5V positive supply.
- VN: This is the input for the -5V negative supply.
- VLED: This is the input for the +5V power supply for the LED light source.

Note: Power return for the LED light source is GLED on Pin 13 &14, where as the rest of ground returns are on Pins 1, 2, 4, & 8.

5.2 Video Output

DIGOUT on Pin 3 of the I/O connector is the only output I/O. Pin 3 is the digital video output from the CIS module. Reflection off the dark target produces a digital signal of “0” level, while the white reflection off the white target produces a digital level of “one”. The amplitudes of the white and dark are listed in the table below:

6.0 Electro-Optical Characteristics at 25°C

Table 2: Electro-Optical Characteristics at 25°C

Parameter	Symbol	Parameter	Units	Note
Number of photo detectors		1728	Elements	
Pixel-to-pixel spacing		125	µm	
Line scanning rate	Tint[1]	440	µsec	@ 4.0MHz clock frequency
Clock frequency	f	4.0	MHz	
Bright output Dark output	Digital video output signal	>3.2 <0.8	V V	

Note:

1. The tint is specified with a 4.0MHz clock frequency. In operation the time constants in the reference generator are set to match the initial exposure time, hence the generator’s time constant will determine the optimum integration time. Note, the integration time is also a function of the clock frequency. Accordingly it is highly recommended that the parameters be factory adjust for the specific applications.

Table 3: Recommended Operating Conditions (25°C)

Item	Symbol	Min.	Mean	Max.	Units
Power supply	Vdd		5.0		V
	Vn.		-5.0		V
	VLED		5.0		V
	Idd		350		mA
	Ivn		20		mA
	ILED		390	450	mA
Input voltage at digital high	Vih	Vdd-1.0	Vdd-0.5	Vdd	V
Input voltage at digital low	Vil	0		0.8	V
Clock frequency	f			4.0	MHz
Clock pulse high duty cycle		25			%
Clock pulse high duration	Clock	62.5 (1)			ns
Integration time	Tint	0.440(2)			ms
Operating temperature	Top		25	50	°C

Notes:

1. Clock pulse high is specified at 4.0MHz at 25 percent duty.
2. The tint is specified with a 4.0MHz clock frequency. In operation the time constants in the reference generator are set to match the initial exposure time, hence the time constant of the reference generator will determine the optimum integration time. Accordingly it is highly recommended that the parameters be factory adjust for the specific applications.

7.0 Switching Characteristics (25°C)

The switching characteristics for the I/O clocks are shown in Figure 4. The timing parametric values and their symbols are given in Table 4.

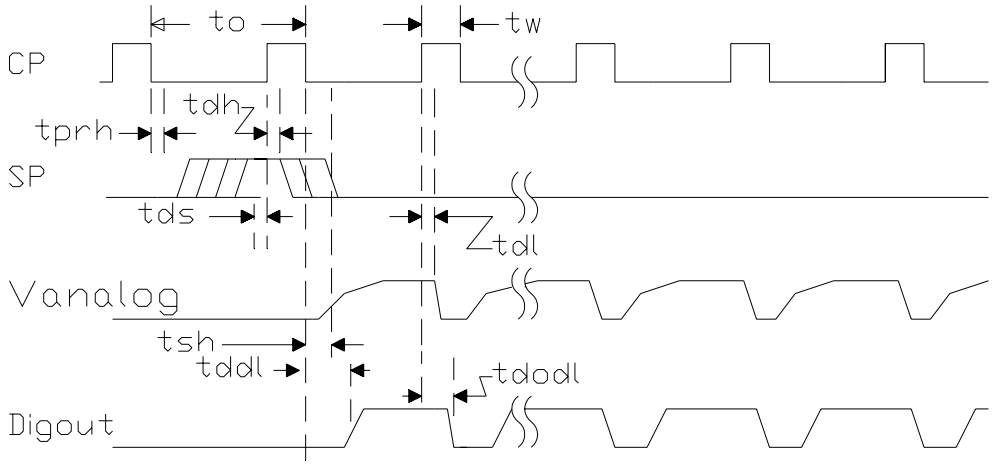

Figure 4: Module Timing Diagram

Table 4: Switching Parameters and Timing Symbol Definitions

Parameter	Symbol	Min.	Typ.	Max.	Units
Clock cycle time	to	250			ns
Clock pulse width	tw	62.5			ns
Clock duty cycle		25		50	%
Prohibit crossing time of SP	tprh	15			ns
Data setup time	tds	20			ns
Data hold time	tdh	20			ns
Signal delay time	tdl	50			ns
Signal settling time	tsh	120			ns
Digital signal delay	tddl		50		ns
Digital signal off delay	tdodl		20		ns

8.0 Absolute Maximum Rating

Table 5: Absolute Maximum Rating

Parameter	Symbols	Maximum Rating	Units
Power supply voltage	Vdd	10	V
	Idd	375	mA
	Vn	-10	V
	Ivn	30	mA
	VLED	5.5	V
	ILED	450	mA
Input clock pulse (high level)	Vih	Vdd – 0.5	V
Input clock pulse (low level)	Vil	-0.8	V

Table 6: Operating Environment

Parameter	Symbols	Maximum Rating	Units
Operating temperature	Top	0 to 50	˚C
Operating humidity	Hop	10 to 85	%
Storage temperature	Tstg	-25 to +75	˚C
Storage humidity	Hstg	5 to 95	%

9.0 Mechanical Structure

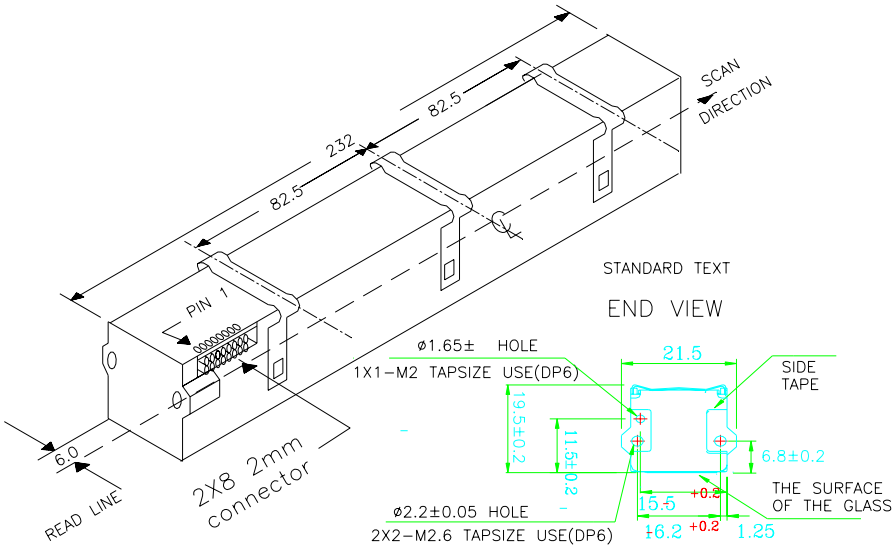

Figure 5: Mechanical Structure

10.0 Company or Product Inquiries

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