

1.0 General Description

The AMIS-710330 (PI330MC-DR) is a contact image sensor (CIS) module with an additional on board circuit, which digitizes the analog pixels from the CIS image sensor to a “background-tracking”, two-level digital output signal. The module uses MOS image sensor technology to gain high-speed performance and high sensitivity. The AMIS-710330 is suitable for scanning documents with widths of 89mm and resolutions of 11.8 dots per millimeter (dpm). It has broad applications but is specifically 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-710330 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
- 11.8dpm resolution, 89mm scanning length
- Up to 423µsec/line scanning speed, with 2.5MHz pixel rate (see Table 3, Note 3)
- Wide dynamic range
- Two-level tracking digital output (“dynamic threshold digitizer”)
- Infrared light source 880nm (other colors are available)
- Compact size \cong 13mm x 25.6mm x 102mm
- Low power
- Light weight

3.0 Module Description

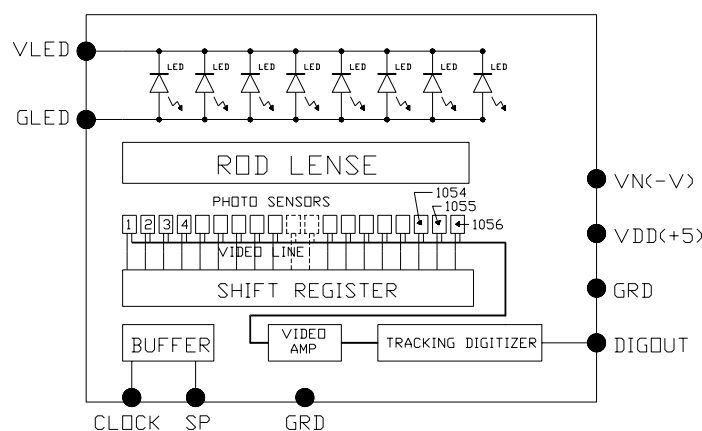
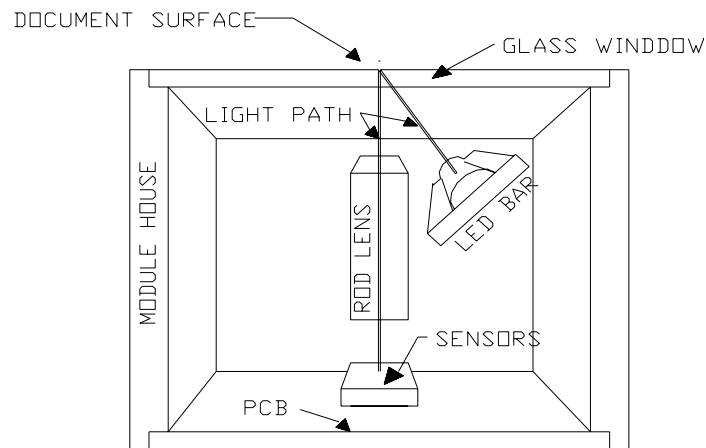


FIGURE 1. BLOCK DIAGRAM OF PI3010MC-DR

Figure 1: Block Diagram

The AMIS-710330 module consists of 11 sensors, which are cascaded to provide 1056 photo-detectors with their associated multiplex switches and a digital shift register, which controls its sequential readout. Mounted in the module is a one-to-one graded-indexed micro lens array, which 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 an analog digitizing circuit, where the video pixels are converted to a digital signal and passed to the 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 with a cover glass, which acts as the focal point for the object being scanned and protects the imaging array, the micro lens assembly and the LED light source from dust. The pictorial of AMIS-710330 cross section is shown in Figure 2.



INSIDE PICTORIAL
OF THE MODULE
FIGURE 2

Figure 2: Inside Pictorial of the Module

I/O to the module is an 8-pin flex cable connector (see I/O Connector, in Section 5.0) located on one end of the module. The connector is on the top of the module with the glass window facing down and it is located on the opposite side of the module (see the Mechanical Housing in Section 9.0).

4.0 Circuit Description and Operation

Figure 3 is a simplified block diagram of the analog tracking digitizer. Fundamentally, the tracking digitizer transforms the signal output from a CIS module, which exists on the market today. It takes the analog signal from the CIS section of AMIS-710330 and derives a tracking background reference signal. Then this reference is compared against the output signals from the CIS section. The resulting signal from this comparison produces a two-level digital signal, which 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.

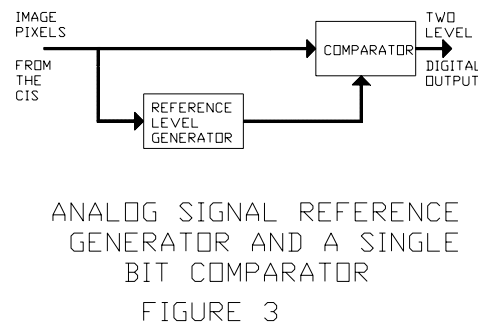


Figure 3: Analog Signal Reference Generator and a Single Bit Comparator

Figure 1 depicts the two basic circuits, the CIS (image sensors and video amplifier) and the tracking digitizer. In the CIS section, the module has 11 serially concatenated AMIS-720230 (PI3030) image sensors, accordingly, the image sensors will span one scanning-read line width, which is 11 sensor times 96 pixel elements/sensor, or 1056 pixel elements.

In operation, the module produces the analog image pixel signals, which are proportional to the 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 inputs 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 value of "1" represents the analog image pixel that is brighter than the background and a digital pixel level value of "0" represents the image pixel that is darker than background.

5.0 Specifications

5.1 I/O Connector

The table of pins and their functions are listed in Table 1.

Table 1: Pin Configuration

| Pin Number | Symbol | Names and Functions |
|------------|-----------------|------------------------------------|
| 1 | DIGOUT | Digital video output |
| 2 | Vdd (+5V) | Ground; 0V |
| 3 | Vn (-10 to -5V) | Negative power supply |
| 4 | SP | Start pulse for the shift register |
| 5 | GRD | Ground; 0V |
| 6 | CLOCK | Clock for the shift register |
| 7 | GLED | Return for the LED light source |
| 8 | VLED | Power in for the LED light source |

The connector is an 8-pin 1mm surface mount flex input, Molex 52207-0890.

5.2 Inputs

There are five inputs:

- Clock is on Pin 6 of the I/O connector. This is the main clock input into the CIS module.
- SP is on Pin 4. This is the start clock input to the CIS module.
- VDD is on Pin 2. This is a + 5V supply.
- VN is on Pin 3. This is a -10 to -5V supply.
- VLED is on Pin 8. This is a +24V supply for the LED light source.

Note: The power return for the LED light source is GLED on Pin 7 and the ground return for the CIS modules is Pin 5.

5.3 Video Output

DIGOUT is on Pin 1 of the I/O connector. This 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 “1”. 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 | | 1056 | Elements | |
| Pixel-to-pixel spacing | | 84.7 | µm | |
| Line scanning rate | Tint ⁽¹⁾ | 528 | µsec | @ 2.0MHz clock frequency |
| Clock frequency | f | 2.0 | MHz | |
| Bright output | Digital video output signal | >3.2 | V | |
| Dark output | | <0.8 | V | |

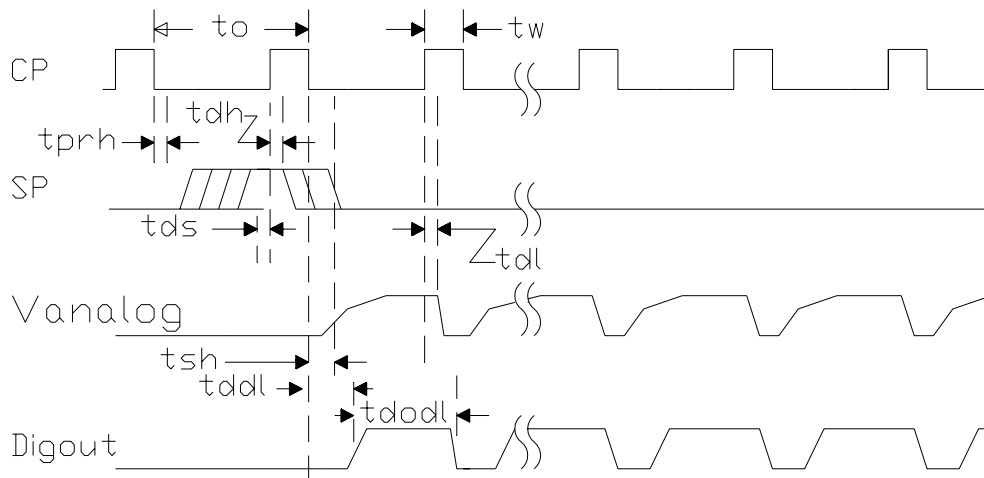
Note:
 (1) The tint is specified with a 2.0MHz clock frequency. In operation, the time constants in the reference generator are set to match the initial exposure time, hence the time constant will determine the optimum integration time. Note that the integration time is also a function of the clock frequency. Accordingly, it is highly recommended that the parameters be factory adjusted for the specific applications.

Table 3: Recommended Operating Conditions

| Item | Symbol | Min. | Mean | Max. | Units |
|-------------------------------|--------|----------------------|-------------------|------|-------|
| Power supply | Vdd | | 5.0 | | V |
| | Vn. | -10 | | -5 | V |
| | VLED | | 24 ⁽¹⁾ | | V |
| | Idd | | 25 | | mA |
| | Ivn | | 15 | | mA |
| | ILED | | 60 | | 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 | | | 2.5 | MHz |
| Clock pulse high duty cycle | | 25 | | | % |
| Clock pulse high duration | Clock | 100 ⁽²⁾ | | | ns |
| Integration time | Tint | 0.423 ⁽³⁾ | | | ms |
| Operating temperature | Top | | 25 | 50 | °C |

- Notes:**
- (1) VLED sources are also available in 5V.
 - (2) Clock pulse high is specified at 2.5MHz at 25 percent duty.
 - (3) The tint is specified with a 2.5MHz clock frequency. In operation, the time constants in the reference generator are set to match the initial exposure time, hence the time constant will determine the optimum integration time. Accordingly, it is highly recommended that the parameters be factory adjusted for the specific applications.

7.0 Switching Characteristics at 25°C



MODULE TIMING DIAGRAM
FIGURE 4

Figure 4: Module Timing Diagram

Table 4: Switching Parameter and Timing Symbol Definition

| | Symbol | Min. | Typ. | Max. | Units |
|---------------------------------------|--------|------|------|------|-------|
| Clock cycle time | to | | 0.50 | | μs |
| Clock pulse width | tw | 100 | | | ns |
| Clock duty cycle | | 25 | | 50 | % |
| Prohibit crossing time of start pulse | tprh | 15 | | | ns |
| Data setup time | tds | 20 | | | ns |
| Data hold time | tdh | 20 | | | ns |
| Signal delay time | t dl | 50 | | | ns |
| Signal settling time | tsh | 120 | | | ns |
| Digital signal delay | tddl | | 60 | | ns |
| Digital signal off delay | tdodl | | 300 | | ns |

Table 5: Absolute Maximum Rating

| Parameter | Symbols | Maximum Rating | Units |
|--------------------------------|---------|----------------|-------|
| Power supply voltage | Vdd | 10 | V |
| | Idd | 50 | mA |
| | Vn | -15 | V |
| | In | 30 | mA |
| | VLED | 25 | V |
| | ILED | 80 | 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 | % |

8.0 Setup and Adjustments

8.1 The Clock Rate and Integration Time

This was factory set to a specific application. See Note 1 under Table 2.

- The clock frequency was set to 2.4MHz.
- The total integration time was set to 560μsec.

8.2 The Required Power

The required power is slightly greater than the specified values in Table 3.

8.2.1. Circuit Power

- Positive supply: +5V @ 25mA
- Negative supply: -10V @ 15mA
- LED power: +24V @ 60mA

8.3 Adjustments

8.3.1. General Location of Test, Adjustment and Monitor Points

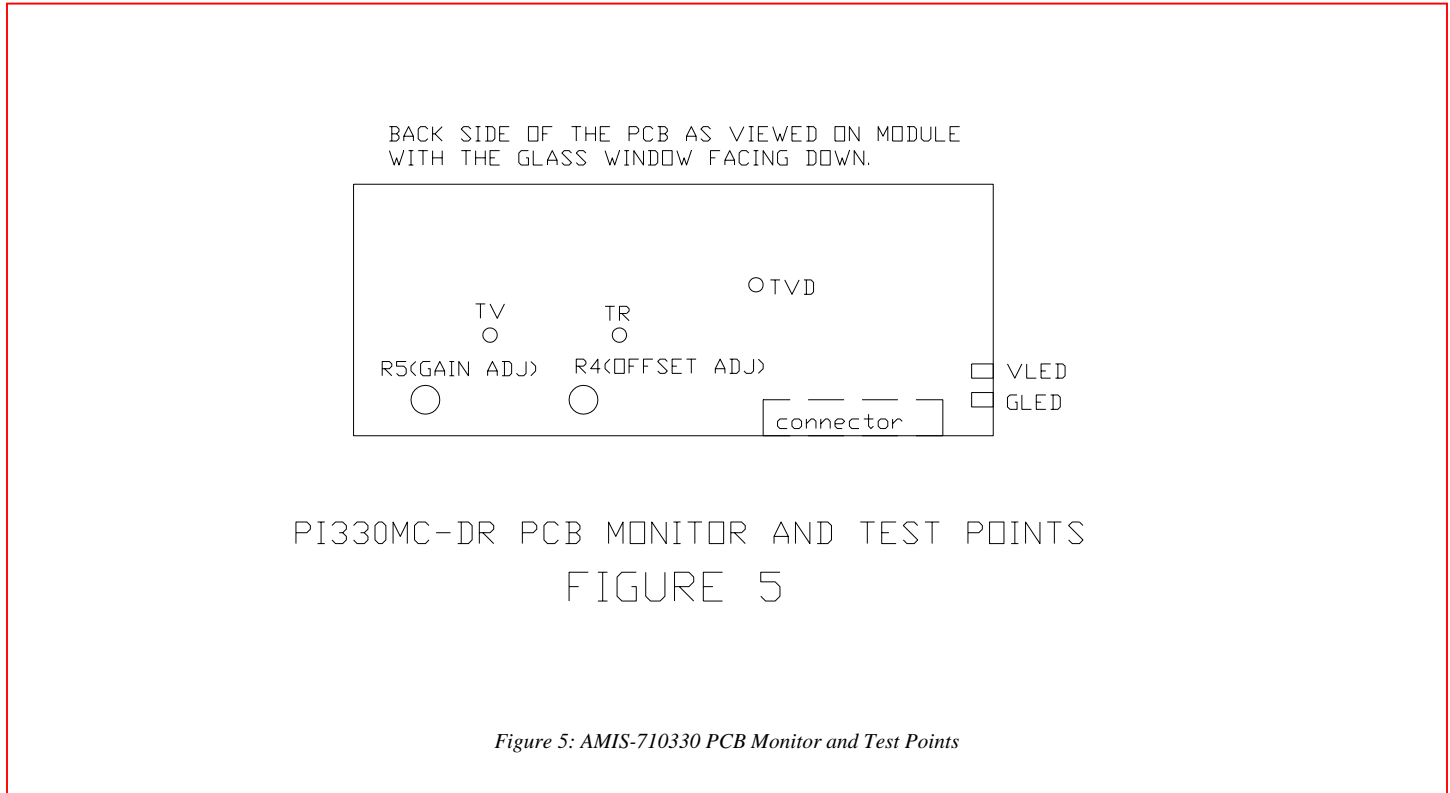


Figure 5 shows the pictorial layout of the controls and the test points. These adjustment potentiometers and the test points are shown relative to the connector and to the output pads for LED light power. This is a bird's eye view of the PCB's backside with the glass window of the module facing down on the documents.

The test point labeled TV is for the analog image pixels, just as it is produced at the output of the CIS array section and prior to its entry into the tracking digitizer circuit.

The test point labeled TR is the output of the tracking reference level from the tracking digitizer circuit.

The test point labeled TVD is the digital output from the comparator.

Offset adjust, R4, is a screw driver adjustment potentiometer, which is accessed through the adjustment hole as it viewed in Figure 5.

Gain adjust, R5, is a screw driver adjustment potentiometer, which is accessed through the hole as it is viewed in Figure 5.

8.3.2. There are Only Two Adjustments

These adjustments will be pre-adjusted at the factory, to the specific application of the customer, thus generally will not require adjustments by the user.

The gain is adjusted by monitoring the test point TV with a scope, adjusting the gain potentiometer, R5, until the analog image pixel levels are set to approximately a 2.0V peak with the module imaged on the a standard white target, similar to the standard white copy or typing paper. (The probe should be grounded as close to the CIS module as possible. The ideal method for grounding would be to place the probe right on the ground input lead, Pin 5, of the I/O connector.)

10.0 Company or Product Inquiries

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