EG&G RETICON

RA3812P
Solid State Image Sensor Array

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Introduction

The Reticon RA3812P is a two-dimensional self-scanned optical sensor array consisting of 456 silicon photodiodes in a 38 x 12 matrix. This device is a functional equivalent to low resolution vidicon camera tubes, but with the advantages of higher geometric accuracy, high sensitivity, small size, low voltage, low power, and all-solid-state ruggedness and reliability. The RA3812P is designed for applications in the areas of pattern recognition, character recognition, and guidance.

Key Features

- 456 light sensitive elements
- 4-mil element centers in both X and Y directions
- Frame storage–each diode integrates photo-current for the entire frame time
- Self-scanned in both X and Y directions by on-chip shift registers and multiplexers to provide a single serial video output
- Nonburning sensors
- Solid state reliability
- Low power dissipation
- 16-pin ceramic dual-inline package (0.3 inch x 0.8 inch) with scratch-resistant glass window

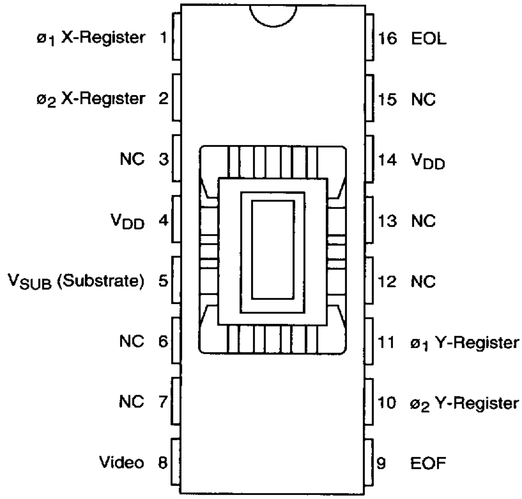

Figure 1. Pinout Configuration

General Description

The RA3812P is housed in a 16-lead integrated circuit package (0.8 inch x 0.3 inch outline) with a ground and polished window (see Figure 8). The devices are fabricated on a monolithic silicon chip containing the photodiode matrix, as well as access switches and two integrated MOS shift registers for scanning in the X and Y directions. Each shift register is driven by a two-phase clock. The diode-to-diode sample rate is set by the X-register clock frequency, while the line rate is set by the Y-register clock frequency.

A basic circuit for driving the RA3812P is shown in Figure 3. This circuit supplies clock signals for both the X and Y registers and provides first-stage video amplification which has a video output similar to that shown in Figure 4.

Clock and Start Requirements

This array is self-starting, with no external start pulse required. The X-register should be driven by complementary square wave clock phases $ø_1$ and $ø_2$ as shown in Figure 4. These two phases can be generated from an input TTL clock run at the desired data rate which supplies the basic timing. The Y-register is driven by complementary square wave clocks run at the desired line rate. Keep crossovers on clock phases close to 50% to minimize odd/even fixed pattern noise.

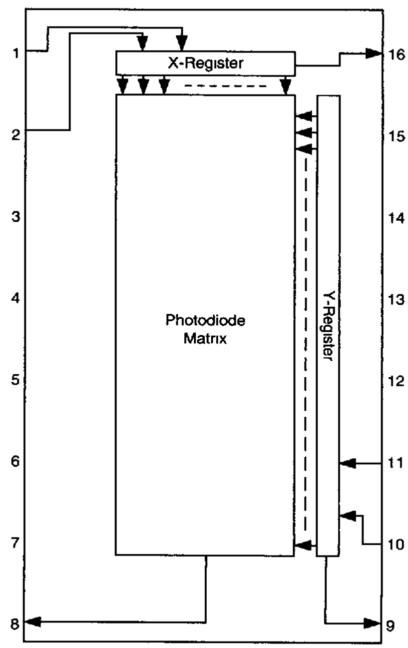

Figure 2. Block Diagram

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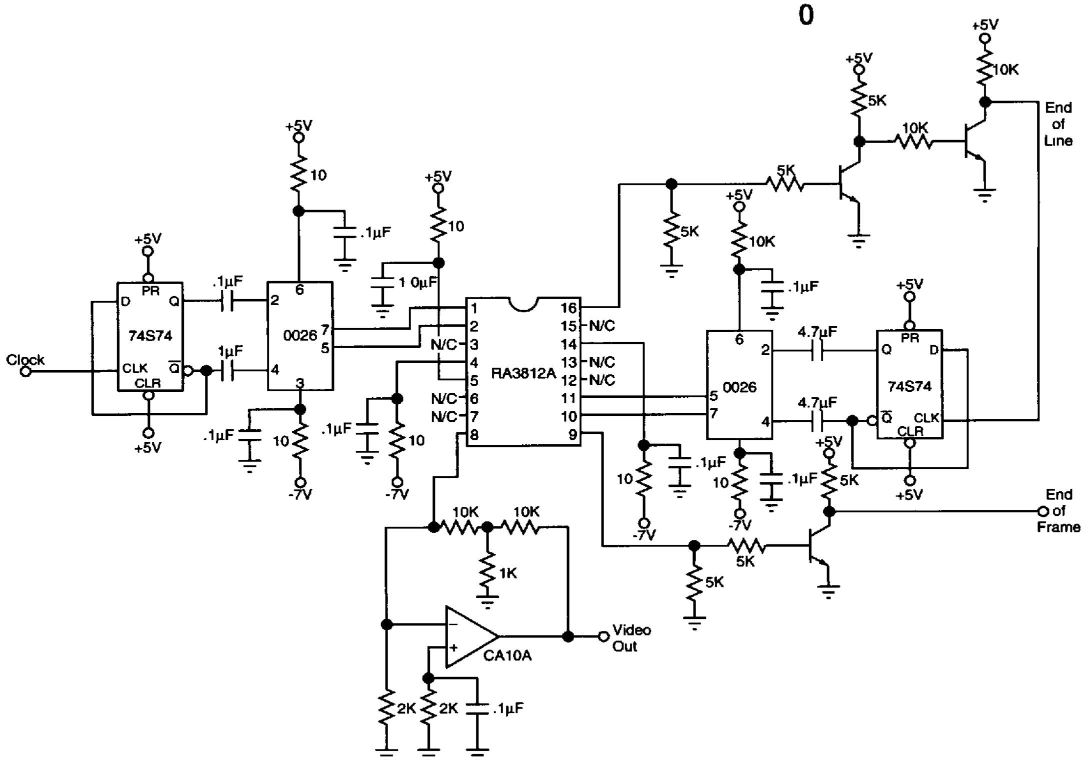

Figure 3. Basic Circuit for Operation of RA3812P Photodiode Array

Signal Extraction

The video output appears on pin 8 and consists of a train of current pulses each containing a charge equal to the photocurrent in the corresponding photodiode integrated over a frame time. To obtain good signal-to-noise or dynamic range, these pulses should be processed by a resettable integrator which may be followed by a sample-and-hold circuit. Switching transients will be superimposed on the current pulses, but the effect of these is essentially eliminated by the integrator circuit which integrates the current flow in each sample period including both the signal and the switching transients. Since the switching transients must integrate to zero, even low-level signals can be recovered.

End-of-Line and End-of-Frame

End-of-line pulses appear one sample period after the last element in each line (see Figure 4). The end-of-line output can be used to time the Y-register clocks so that the next line can be scanned. After the last line is scanned, a new bit is automatically loaded into the Y-register to start a new frame. If more sophisticated scanning is required, the Y-register should be timed by an externally-generated TTL pulse train with an appropriate repetition rate. For example, an interlace pattern where only the odd lines are scanned in one frame and only the even lines in the next frame can be produced by clocking the Y-register at twice the line rate and adding one step at the end of each frame.

An end-of-frame output (see Figure 5) appears on pin 9 during the last and first line of each frame. This output can be used for frame synchronization purposes.

Sensitivity and Spectral Response

The RA3812P operates in the frame storage mode. This means that each diode integrates photocurrent for an entire frame time and empties the integrated charge onto the video line when it is sampled once each frame time. The sensitivity of each diode is, therefore, over 456 times the sensitivity of an individual diode of equal size operated in the photoconductive mode. The output of each diode (below saturation) is proportional to the light intensity times the frame time and can be specified in terms of charge out per unit of exposure. A plot of output versus exposure is shown in Figure 6. Spectral response is typical of high-quality diffused silicon photodiodes, covering the range from the near UV to the near IR with peak response at 750 nm. Typical spectral response is shown in Figure 7.

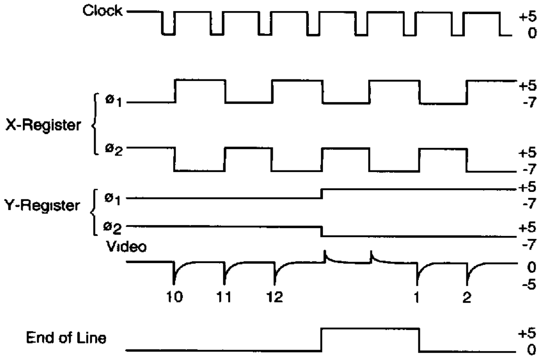

Figure 4. Timing Diagram

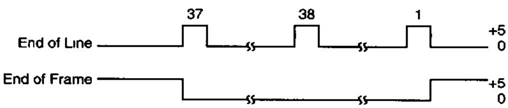

Figure 5. Timing Diagram for End-of-Frame Output

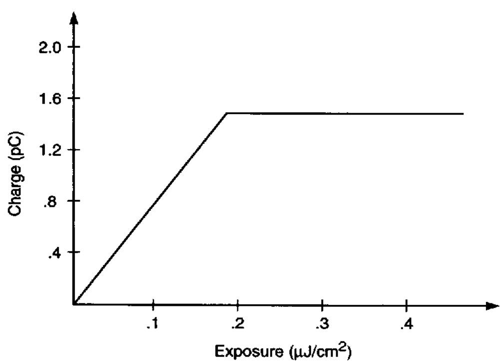

Figure 6. Charge Output per Cell Versus Exposure where Exposure Equals Light Intensity Times Frame Time

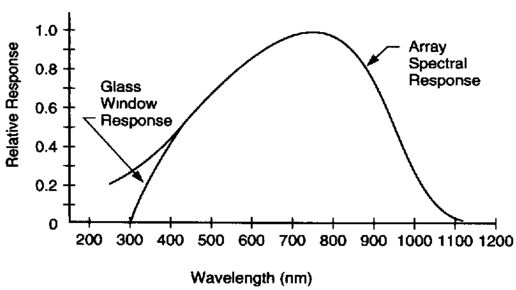

Figure 7. Relative Spectral Response as a Function of Wavelength

Table 1. Electrical Characteristics (25°C) (Voltages with respect to substrate (pin 5); substrate typically held at +5V)

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	Min	Typ	Max	Units
Video output line bias		-5	-8	V
Supply voltage V_{DD}	-11	-12	-13	V
Clock pulse amplitude	-11	-12	-13	V
End of line/frame output resistance		5		KΩ
End of line output pulse width [1]		2/f		s
Video line capacitance (at -5V with respect to substrate)		40		pF
Diode sample rate (f)	10^4		4×10^6	Hz
Frame rate [2]	19		7500	fps
Power dissipation (DC)		10		mW

Notes:
1 f = diode sample rate
2 fps = frames per second

Table 2. Electro-Optical Characteristics (25°C)

	Typ	Max	Units
Photodiode sensitivity [1]	9		pC/μJ/cm^2
Uniformity of sensitivity [1,2]	±8	±12	%
Saturation exposure [1]	.18		μJ/cm^2
Saturation charge (with typical input and bias voltages)	1.6		pC

Notes:
1 2870°K tungsten source
2 Neglects first and last elements of each line

Table 3. Mechanical Characteristics

	Typ	Units
Number of diodes	456	
Number of rows	12	
Number of columns	38	
Spacing (row and column)	4	mils
Diode sensing area	8	mils^2
Package size (16-pin DIP)	.31 x .8	inch

Absolute Maximum Rating

	Min	Max	Units
Voltage with respect to substrate	0	-20	V
Storage temperature	-55	+85	°C
Temperature under bias	-55	+85	°C

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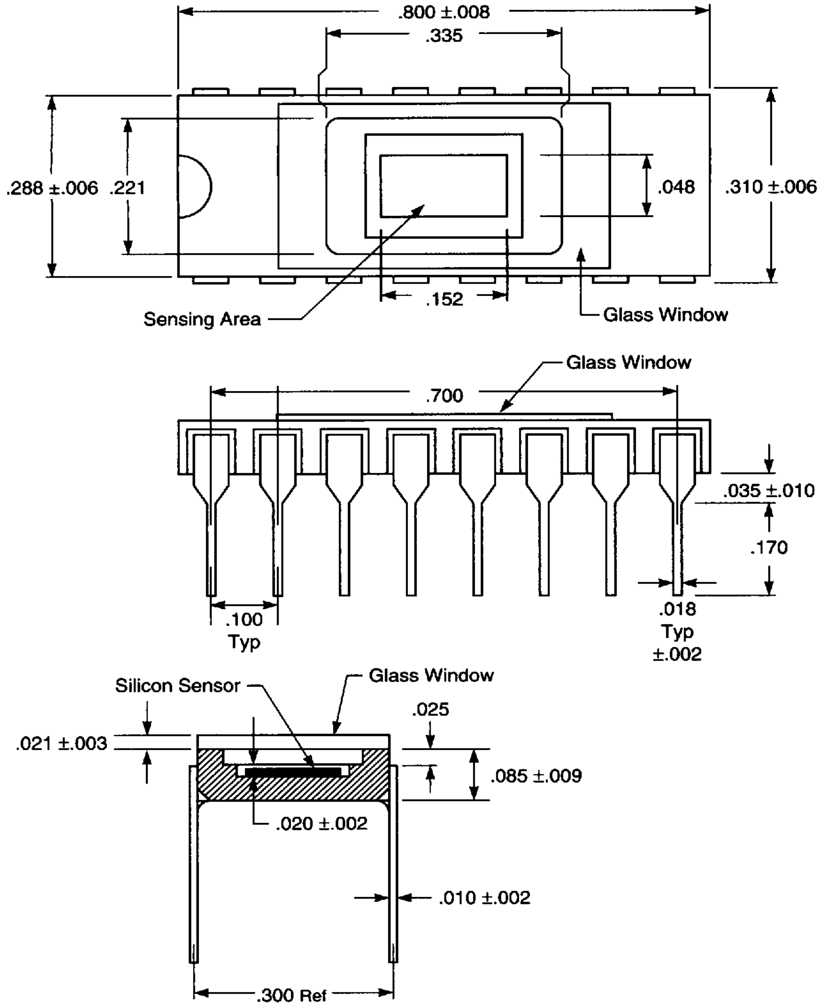

Figure 8. Package Dimensions

Ordering Information

Part Number
RA3812PAG-011

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