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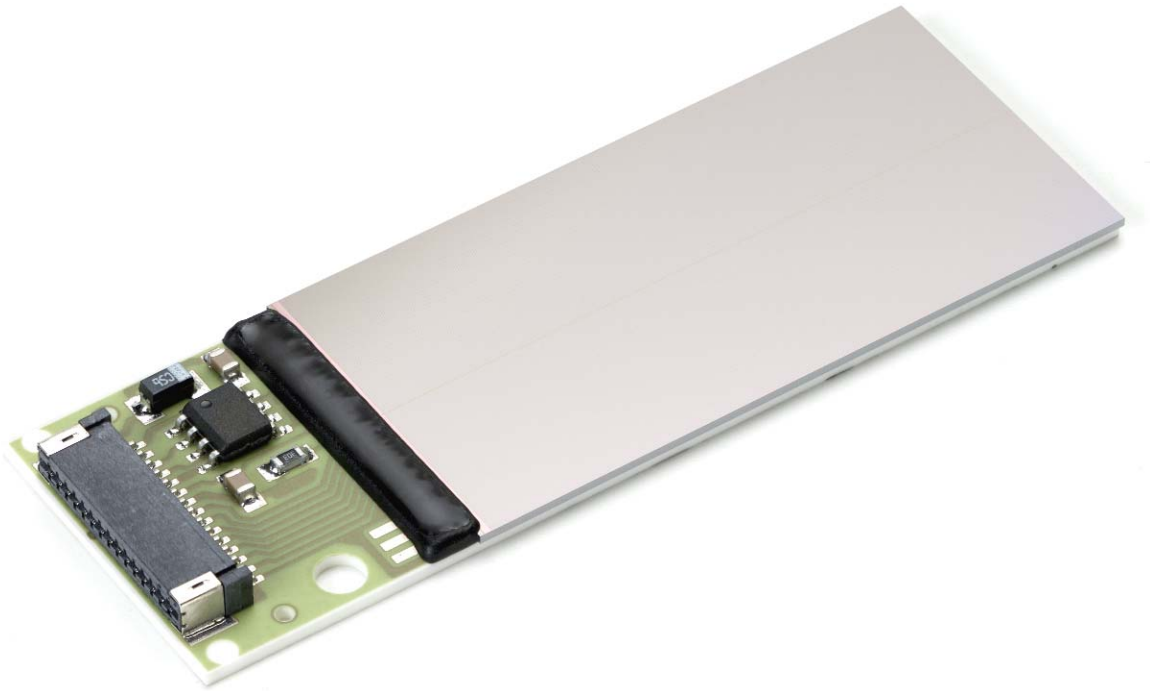
RadEye™1

Large Area Imager



Key Features:

- 25 by 50 mm active area
- 524,288 pixels
- 10 lp/mm resolution
- Three-side buttable
- Variable frame rate (0.01 – 4.5 Hz)
- Single differential video output
- Fully integrated timing control
- Runs off single +5V power supply

The RadEye™1 large-area image sensor is a three-side buttable, fully integrated CMOS photodiode array designed for both visible and high-energy radiation imaging. The large 24.6 mm by 49.2 mm active area consists of a 512 by 1024 matrix of silicon photodiodes on 48 µm centers. Used directly to detect visible light, or with a scintillator to detect x-rays and other energetic radiation, the RadEye™ is the perfect solution for applications ranging from medical diagnostics to industrial inspection (NDT) and scientific imaging.

Rev. 04/09-04

Description:

The *RadEye1* large-area image sensor consists of a two-dimensional array of photodiodes along with CMOS structures for scanning and readout. All support and control functions are integrated on-chip to minimize the amount of external circuitry needed to run the imager. The *RadEye1* offers several imaging modes. In *continuous* mode (START=*high*) only an external pixel clock is required to run the device. In *frame* mode (START=*pulsed*) the frame rate and integration time can be controlled externally. Adjusting the START frequency controls the integration time or synchronizes the imager to an external trigger such as the firing of an x-ray source (see timing diagrams on next page).

Each frame consists of 1024 lines of pixel data. A line consists of 512 pixels (one CLOCK cycle per pixel) plus a blanking period. A *rising edge* on the START input triggers the beginning of each frame readout. START must return to a *low* level before the readout cycle ends. If START remains *high*, the next readout cycle begins immediately following the last line of the previous frame. The maximum CLOCK frequency is 2.5 MHz, which corresponds to a maximum frame rate of 4.5 frames per second (fps). In *continuous* mode, it is also possible to control the frame rate by adjusting the CLOCK frequency.

The BIN and RESET inputs offer additional control over the readout functions. The BIN input, when *high*, causes the readout to skip every other row and column. This shortens the readout time and raises the maximum frame rate to 17.4 fps. A *high* level on the RESET input causes an asynchronous reset of all photodiodes in the active area. This feature can be used to reset the dark signal prior to an exposure.

The *RadEye1* also features a non-destructive readout (NDR) mode that is activated by setting the NDR input to a *high* level. In this mode, the voltage at each pixel is sampled without resetting the photodiode. This feature can be used to monitor the exposure level in the device, or to implement a low-noise readout mode by reading out and subtracting two images before and after an exposure. Both analog outputs (OUTS and OUTR) carry the same signal when NDR is turned on. There is a slight increase in fixed-pattern noise when the NDR mode is activated, which can be compensated for by performing the appropriate offset correction in software. Please refer to *Rad-icon Application Note AN04* for more information on RadEye sensor timing and using the NDR mode.

The RadEye imager provides a fully differential high-speed video signal through two video output pins. The dark level on each output lies approximately 1.8 V below the reference voltage VD. At saturation, the two outputs will swing approximately 0.7 V above and below the dark level.

Specifications:

Avg. dark current (at 23°C) ...4000 electrons/sec*
Read noise (rms, at 1 fps).....150 electrons
Saturation.....2,800,000 electrons
Dynamic range.....85 dB (>14 bits)
Frame rate.....0.01 to 4.5 fps
Max. data rate .....2.5 MHz
Conversion gain .....0.5 µV/electron

Supply voltage (VDD).....5 V (±0.25 V)
Supply current.....25 mA (typ)
Reference voltage (VD) .....3.8 V (±0.5 V)
Analog output +.....2 V (dark) to 2.7 V (sat)
Analog output –.....2 V (dark) to 1.3 V (sat)
Digital “low” voltage.....0.5 V max.
Digital “high” voltage .....4.5 V min.

Operating temperature.....0 to 50 °C
Storage temperature .....-25 to +85 °C

* dark current doubles approx. every 8°C

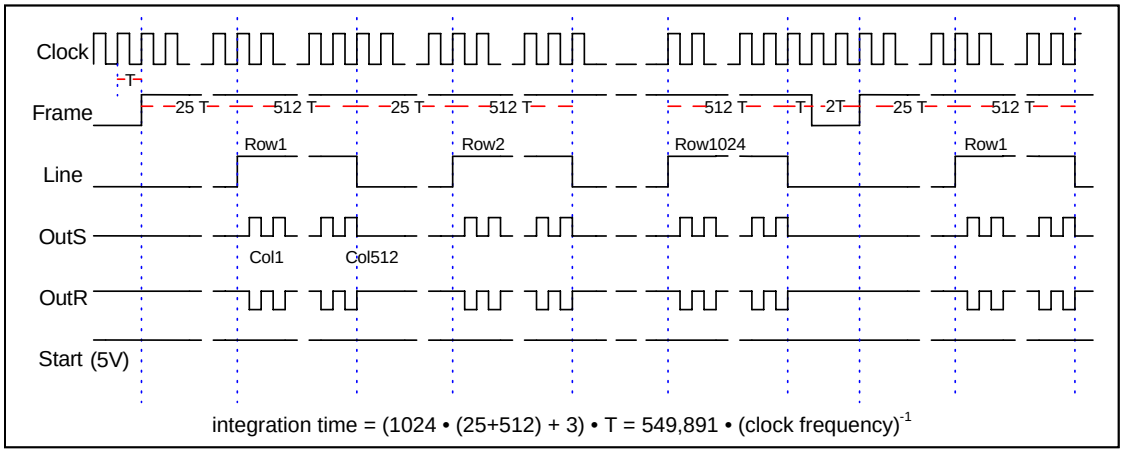
Connector Pinout:

Pin	Type	Signal	Description
1		VDD	Power (+5V)
2		GND	Ground
3	A	OUTS	Video Output +
4	A	OUTR	Video Output -
5		GND	Ground
6	A	VD	Reference In
7		GND	Ground
8	D	RESET	Array Reset In
9	D	START	Frame Start In
10	D	CLOCK	Master Clock In
11	D	BIN	Binning Select In
12	D	NDR	NDR Select In
13	D	FRAME	Frame Sync Out
14	D	LINE	Line Sync Out
15		GND	Ground

Type: A = Analog Signal D = Digital Signal

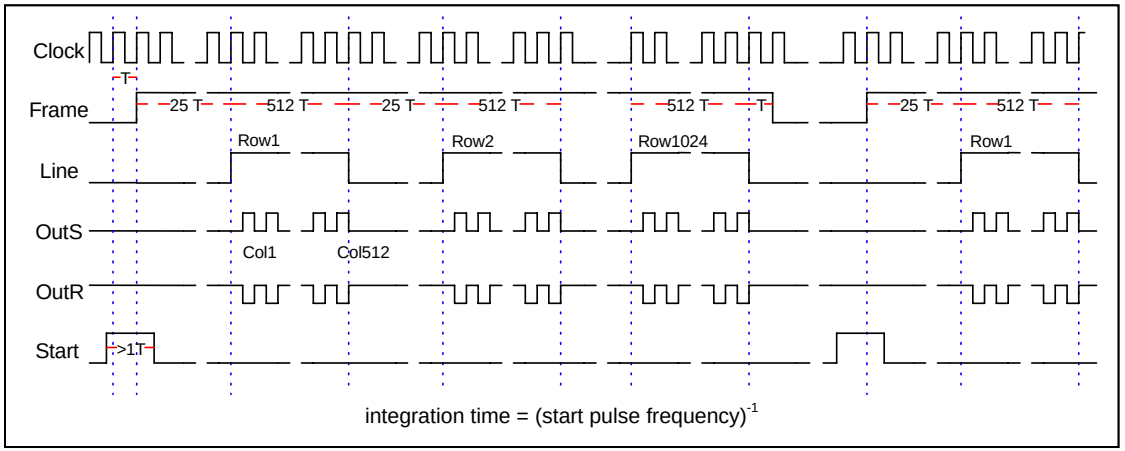
Timing Diagrams:

1. *Continuous* Mode (START is always *high*)



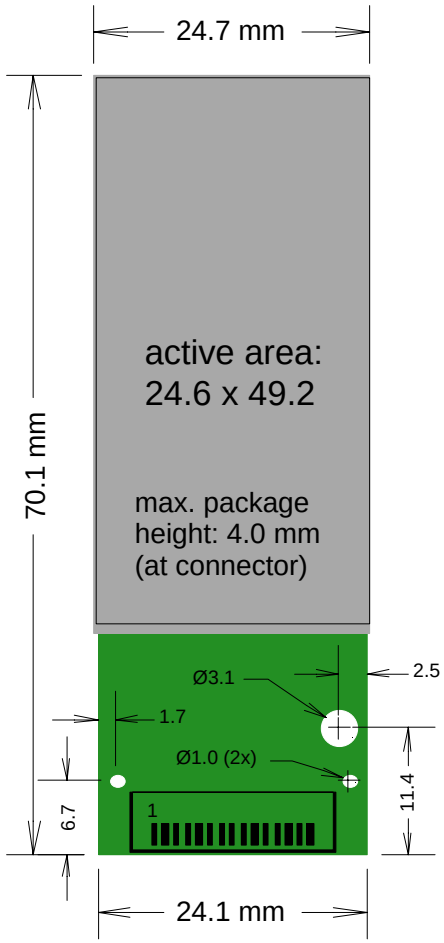
integration time = (1024 • (25+512) + 3) • T = 549,891 • (clock frequency)$^{-1}$

2. *Frame* Mode (START is *pulsed*)



integration time = (start pulse frequency)$^{-1}$

Mechanical Dimensions:



Connector: Samtec P/N FC1-15-02-T-WT

Ordering Information:

Rad-icon P/N	Description
RE1002-01	RadEye1 Image Sensor, Premium Grade (no line defects)
RE1002-02	RadEye1 Image Sensor, Standard Grade (up to three line defects)

The RadEye1 array is “buttable” on three sides, meaning that larger sensors can be formed by tiling two or more devices together in a mosaic. A gap approximately two pixels (100 µm) wide separates the devices in this case.