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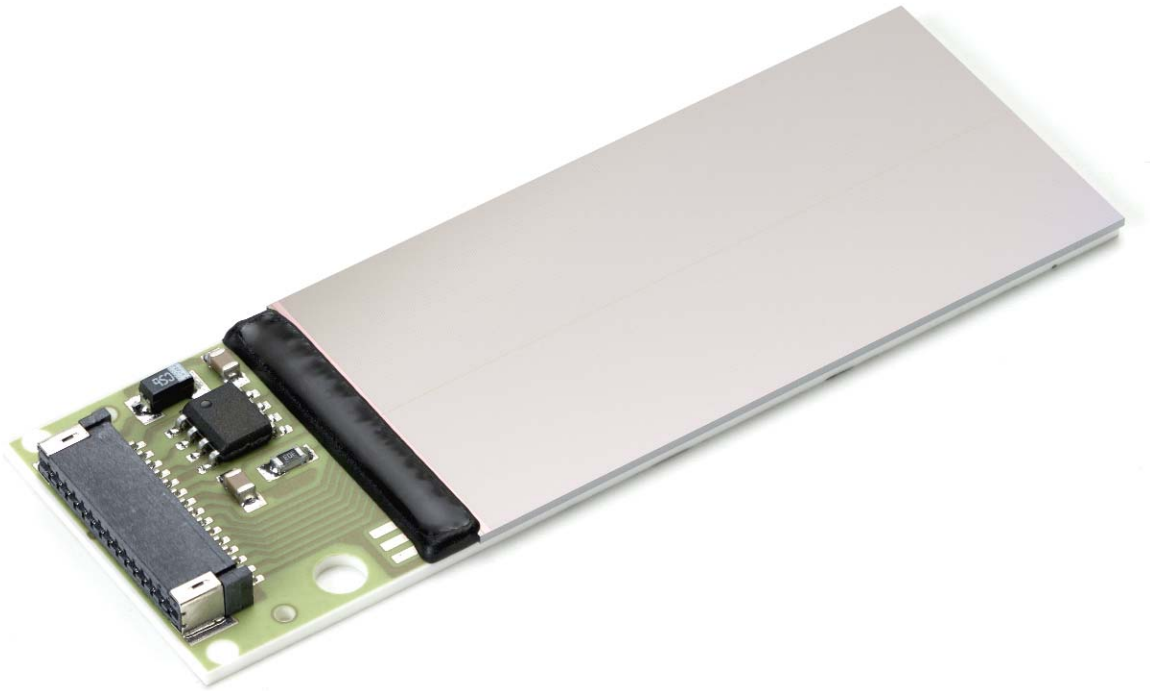
RadEye™1

Large Area Image Sensor



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
- Simple +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.

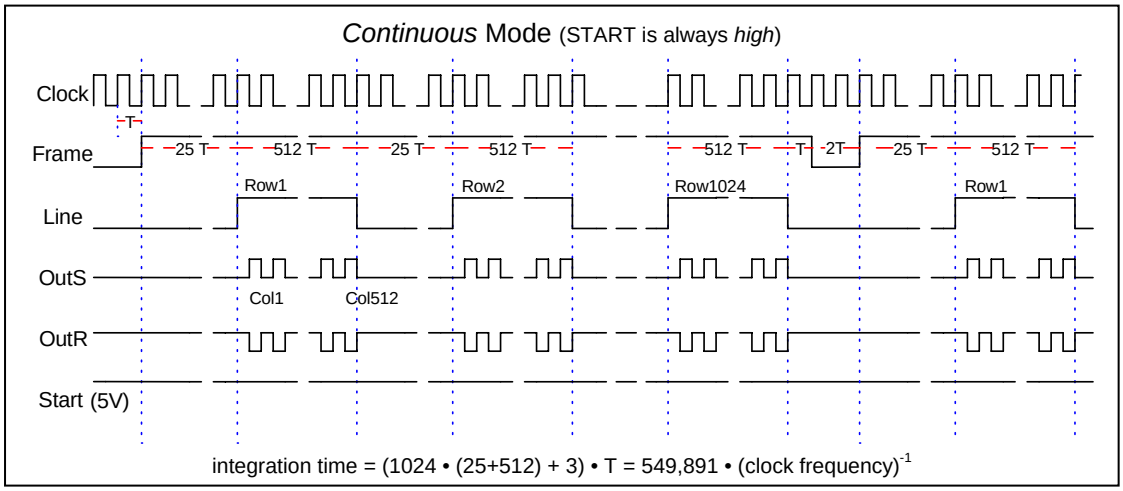
Rev. 05/02-07

Specifications	*Minimum*	*Typical*	*Maximum*	*Units*
Avg. dark current (at 23°C)*	-	4,000	10,000	electrons/sec
Read noise (rms, at 1 fps)	-	150	-	electrons
Saturation	-	2,800,000	-	electrons
Dynamic range	-	85	-	dB
Frame rate	0.01	-	4.5	fps
Data rate (CLOCK)	0.01	-	2.5	MHz
Conversion gain	-	0.5	-	µV/electron
Response linearity (average)	-	± 1	± 2	% of sat.
Quantum efficiency (500-700nm)	-	> 30	-	%
Supply voltage (VDD)	4.5	5.0	5.1	V
Supply current (IDD)	-	20	-	mA
Reference voltage (VD)	2.5	3.8	4.3	V
Analog output + (VD = 3.8 V)	-	2 (dark)	2.7 (sat)	V
Analog output – (VD = 3.8 V)	1.3 (sat)	2 (dark)	-	V
Digital “low” voltage in	-0.1	0	0.5	V
Digital “high” voltage in	4.5	5	5.1	V
Operating temperature	0	-	50	°C
Storage temperature	-25	-	85	°C

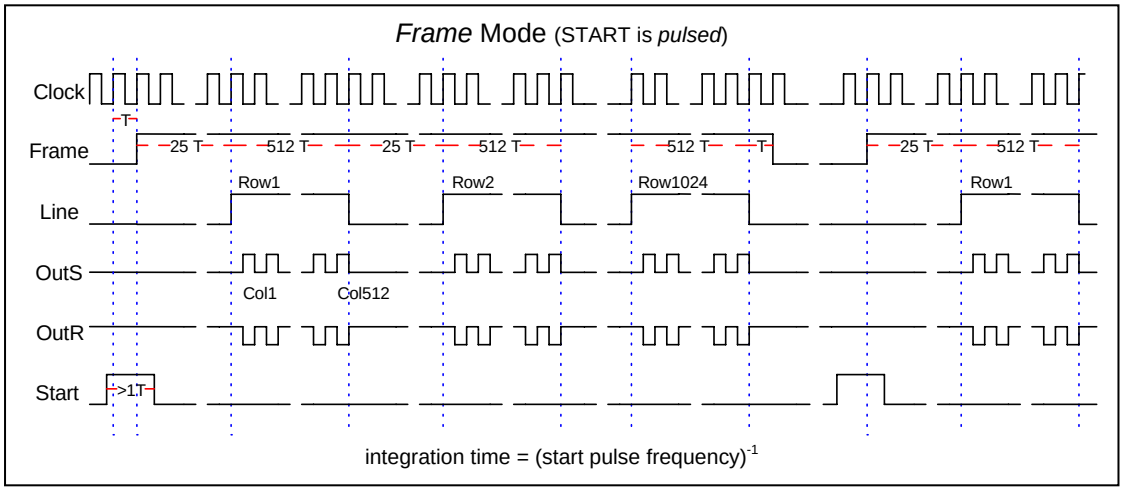
* dark current doubles approx. every 8°C

Description & Timing Diagrams:

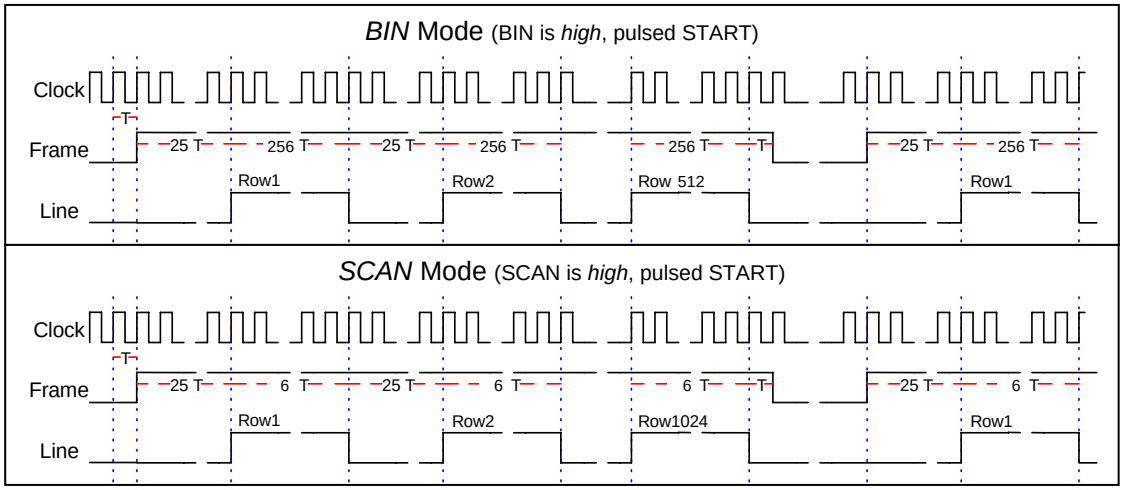
The *RadEye1* large-area image sensor consists of a two-dimensional array of photodiodes along with CMOS structures for scanning and readout. All support and control functions are integrated on-chip to minimize the amount of external circuitry needed to run the imager. The *RadEye1* offers several imaging 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 this page and next).



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 SCAN 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 of the sensor to 17.4 fps (at 2.5 MHz). A *high* level on the SCAN input puts the sensor into a rapid-readout mode in which only the first six pixels of each row are read. In this mode it is possible to scan all 1024 rows of the sensor in just 12.7 ms. This feature can be used to rapidly reset the dark signal prior to an exposure, or to quickly sample the exposure level in NDR mode (see below).



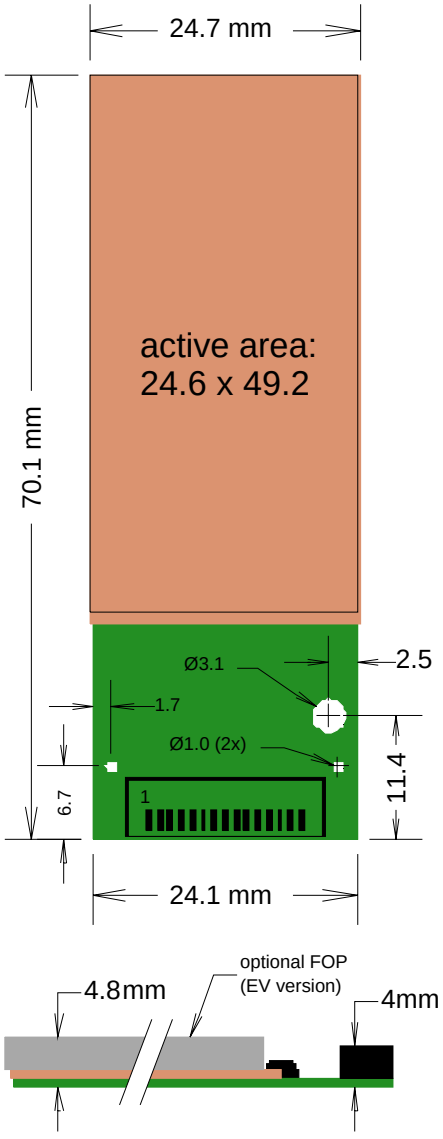
The *RadEye1* also features a non-destructive readout (NDR) mode that is activated by setting the NDR input to a *high* level. In this mode, the voltage at each pixel is sampled without resetting the photodiode. This feature can be used to monitor the exposure level in the device, or to implement a low-noise 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.

Mechanical Dimensions:

The RadEye1 array is “tileable” on three sides, meaning that larger sensors can be formed by tiling two or more devices together in a mosaic. The physical die area includes a ~50µm border zone surrounding the active area.

The ceramic substrate is sized slightly smaller than the RadEye1 die. The silicon die overhangs the substrate and is extremely fragile. Special care must be taken to prevent chipping of the die edges or scratching of the die surface! We strongly recommend mounting the sensor in a protective housing, and exercising extreme caution when bonding a scintillator screen to the active surface.

The EV version of the RadEye1 sensor includes a fiber-optic faceplate that is permanently attached to the active area of the die. The FOP provides a robust and easily cleanable interface that helps protect the sensor from accidental damage. Its dimensions are 26.0 mm by 50.4 mm by 3.0 mm.



Connector: Samtec P/N FC1-15-02-T-WT
(mates with 15-conductor flex cable,
Samtec P/N FJ-15-D-x.xx-4)

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	SCAN	Scan Mode 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

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)
RE1139-01	RadEye1 EV Sensor, Premium Grade
RE1139-02	RadEye1 EV Sensor, Standard Grade