DATASHEET

Remote RadEye Product Family

Key Features

- Sensor module weighs 1kg or less
- Choose from 5 different sensor modules that provide up to 100 x 100mm active image area
- Choose from 3 different electronic modules: digital frame grabber, USB or Ethernet interface
- Choose from 3 different resolution options: 20µm, 48µm and 96µm
- Supports x-ray energies as low as 5keV and up to 160kVp
- 12 or 14-bit digital video output
- Ready-to-run software and drivers

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Overview

The Remote RadEye™ x-ray camera provides the ultimate flexibility in design and product options for your complex imaging applications. Our unique camera design separates the x-ray sensor module from its supporting electronics: the module is mounted on a detachable cable enabling easy installation into tight spaces or on gantry systems. While other imaging solutions can be bulky and difficult to implement, the Remote RadEye is slim, lightweight, and housed in a rugged stainless steel package. The Remote RadEye is suitable for industrial inspection applications where images are taken in tight or difficult-to-reach spaces. In addition, system integrators gain flexibility in building cabinet systems or portable inspection applications. This revolutionary x-ray camera is a cost-effective imaging solution for NDT/industrial inspection, scientific research such as x-ray crystallography, and general radiography applications.

Description

The Remote RadEye™ x-ray camera is a flexible, rugged and cost-effective solution for high-resolution radiation imaging. End users can choose between five different sensor modules, each of which contains a two-dimensional CMOS photodiode array featuring up to 2 million pixels with pixel spacing ranging from 20µm to 96µm. A Gd_2O_2S scintillator screen, placed in direct contact with the photodiode array, converts incident x-ray photons to light, which in turn is detected by the photodiodes. An EV option is available for operation in high-dose environments or with x-ray energies up to 160kVp, and models featuring a Beryllium entrance window can be used in low-energy applications down to 5keV.

Each sensor module features a rugged steel or aluminum enclosure with a stainless steel cover and a carbon-fiber or Beryllium window that shields the sensor against ambient light and protects the sensitive electronics from accidental damage. A shielded cable connects the sensor head to a separate camera electronics module. Here the analog video signal is processed, digitized to 12- or 14-bit resolution, and prepared for transmission to a PC.

There are three camera module options: the Shad-o-Box module offers a high-speed parallel LVDS interface, the Shad-o-Snap module offers a plug-and-play USB connection, and the GigE module offers a gigabit Ethernet interface for connection to a PC or laptop. The Shad-o-Box camera module also requires a compatible frame grabber and data cable. We recommend using a dedicated LAN adapter for use with the Ethernet camera module. Please refer to our Shad-o-Box and Shad-o-Snap datasheets for additional product information. All three interface modules are compatible with our ShadoCam image acquisition software, and are available with programming examples and SDKs for custom application software development.

The Remote RadEye x-ray camera delivers a typical dynamic range (defined as the maximum signal divided by the read noise) of 4000:1 at frame rates as high as 2.7 frames per second. The conversion gain in the detector is largely dependent on pixel size and varies from sensor to sensor. Our standard camera has an electronics gain of 5x, but a high-gain 10x electronics gain option is available for applications requiring higher sensitivity. All models operate from a standard desktop power supply and consume less than five Watts of power. An optional battery pack is available for use in portable x-ray imaging applications.

Remote RadEye Sensor Options

Remote RadEye sensor modules are available in five sizes. Each sensor module can be paired with any one of the camera electronics modules. The RadEye1 attaches via a 1m analog cable with custom LEMO connectors. The RadEye2, 4, and 200 sensor modules attach via a 2m DVI cable, with longer options also available. The RadEye HR has a direct USB interface with 2m cable, and does not require a separate camera module.

Device	Pixels	Active Area	Resolution	Connection
RadEye1	512 x 1024	24.6 x 49.2 mm	48 µm	LEMO, 1m
RadEye2	1024 x 1024	49.3 x 49.2 mm	48 µm	DVI, 2m
RadEye4	2048 x 1024	98.6 x 49.2 mm	48 µm	DVI, 2m
RadEye HR	1650 x 1246	33.0 x 24.9 mm	20 µm	Direct USB, 2m
RadEye200	1024 x 1000	98.4 x 96.0 mm	96 µm	DVI, 2m

Specifications

Sensor Module	RadEye1/2/4	RadEye200	RadEye HR	Units
Avg. dark current (23°C) [1]	8	15	6	ADU/s[2]
Read noise (rms)	<1	<1	2	ADU
Dynamic range	4000:1	4000:1	2000:1	
Digitization		12 [3]		bits
Conversion gain	500 [4]	1400 [4]	155	elec/ADU

Camera Module – LVDS or GigE				
Sensor data rate	1500	750	n/a	kHz
Readout period [5]	370	740	n/a	ms
Max. frame rate	2.7	0.75	n/a	fps

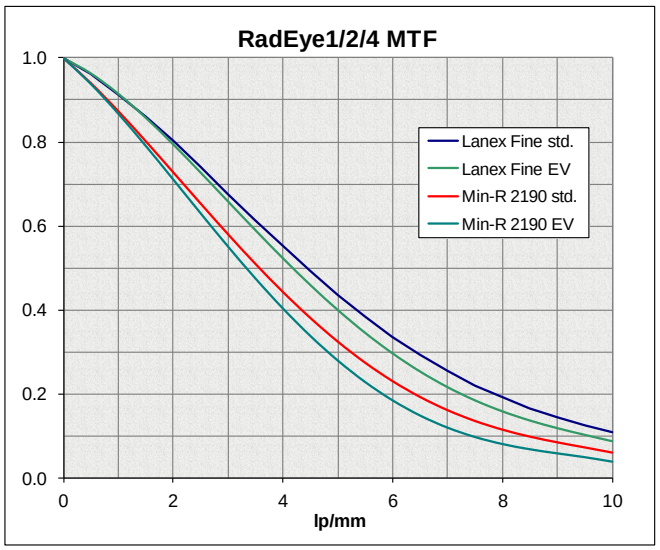
Camera Module – USB			
Sensor data rate	1000	5000	kHz
Readout period [5]	540	680	ms
Image transfer to PC	3-4	0.7	sec

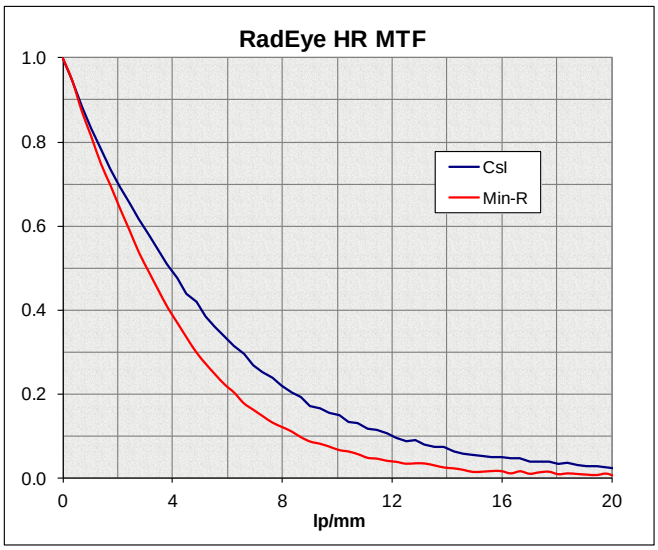
General				
Weight of sensor head [6]	0.3/0.8/1.0	1.0	0.2	kg
Weight of camera module	1.7	1.7	n/a	kg
Operating temperature		0 to 50		°C
Storage temperature		-10 to +65		°C
Humidity (non-condensing)		10 to 80		% R.H.

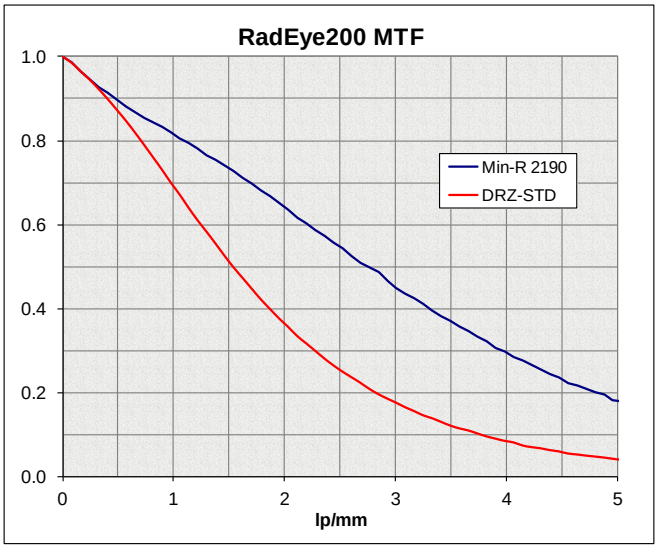
[1] dark current doubles approx. every 8°C
[2] ADU = Analog-Digital Unit = 1 LSB (Least Significant Bit)
[3] 14-bit option available (LVDS & Ethernet interface only)
[4] high-gain option (2x) available
[5] time required to transfer image from sensor to camera memory
[6] not including sensor cable

Resolution

The intrinsic resolution of the detector within the Remote RadEye camera is determined by the pixel size of the individual sensor module that is chosen. The actual Modulation Transfer Function (MTF) for various scintillator options is shown in the following charts. A thicker phosphor screen will produce more signal, but at the expense of high-frequency contrast. Please refer to our application note AN07 for more information on scintillator performance and tradeoffs.







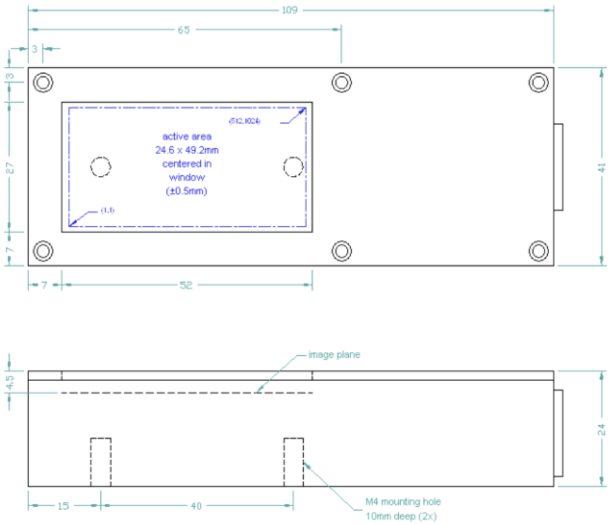
Ordering Information

All Remote RadEye detectors – except for the RadEye HR – can be ordered in two image quality grades: Premium grade (specify -01 option) and Standard grade (specify -02 option). The default scintillator option is Kodak Min-R® 2190 for the 20µm and 48µm pixel sizes, and Mitsubishi Chemical DRZ-Std for the RadEye200. Additional scintillator options may be available on request. Most models are sold in a low-energy/low-dose configuration (typ. 10-50kV) and an extended 10-160kV energy range (high dose) "EV" version. The camera modules ship with a universal input power supply (90-264V, 50-60Hz). Please specify the type of power cord you require.

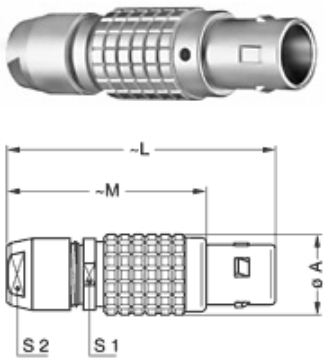
P/N	Description	Notes
	Camera Modules	
RM1158-01	Shad-o-Box (LVDS) – 1 ch.	Single channel for RadEye1
RM1159-02	Shad-o-Box (LVDS) – 2 ch.	Dual channel for RadEye2 & 200
RM1159-04	Shad-o-Box (LVDS) – 4 ch.	Quad channel for RadEye4
RM1160-01	Shad-o-Snap (USB) – 1 ch.	
RM1161-02	Shad-o-Snap (USB) – 2 ch.	
RM1263-01	Gigabit Ethernet – 1 ch.	
RM1263-02	Gigabit Ethernet – 2 ch.	
RM1263-04	Gigabit Ethernet – 4 ch.	
	Sensor Modules	
RM1163-01, -02	RadEye1 EV	no low-dose model available
RM1164-01, -02	RadEye2	low dose (10-50 kV energy range)
RM1165-01, -02	RadEye2 EV	high dose (up to 160kV)
RM1298-01, -02	RadEye4	low dose (10-50 kV energy range)
RM1299-01, -02	RadEye4 EV	high dose (up to 160kV)
RM1426-02	RadEye HR	10-90 kV energy range
RM1426-06	RadEye HR	Be window for low energy apps
RM1244-01, -02	RadEye200	low dose (10-50 kV energy range)
RM1244-03, -04	RadEye200 EV	high dose (up to 160kV)
RM1244-05, -06	RadEye200 EV	Be window for low energy apps

Mechanical Drawings

Each Remote RadEye sensor module features a rugged, stainless steel housing that is optimized for each sensor size. The LEMO cable socket for the RadEye1 is located at the short end of the enclosure opposite the sensor, whereas the DVI cable for the RadEye2, RadEye4, and RadEye200 attaches on the long side of the sensor module. Mounting holes for M4 screws are located on the back of each housing assembly.

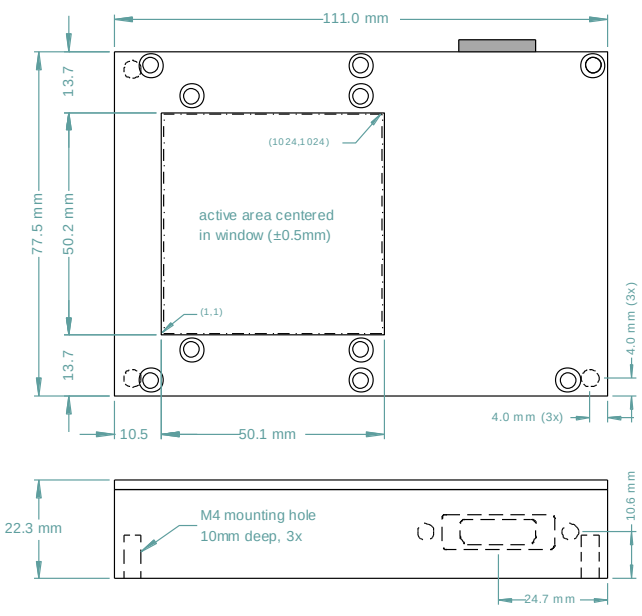


Remote RadEye1 Sensor Head

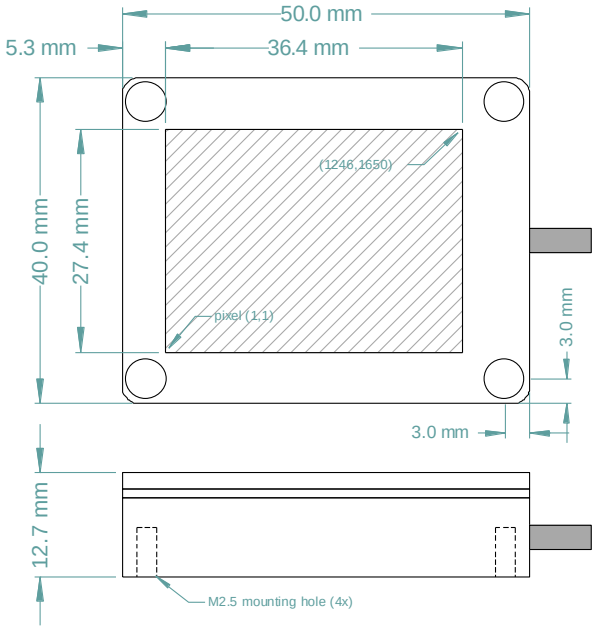


	A	L	M	S1	S2
mm.	12.0	43.0	32.0	10.0	9.0
in.	0.47	1.69	1.26	0.39	0.35

LEMO Connector

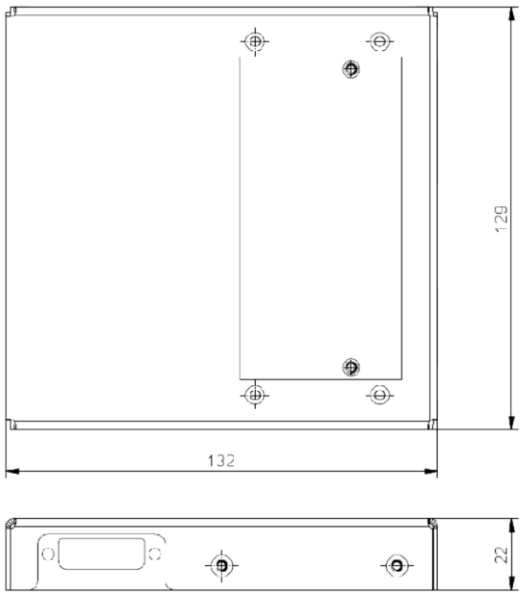


Remote RadEye2 Sensor Head

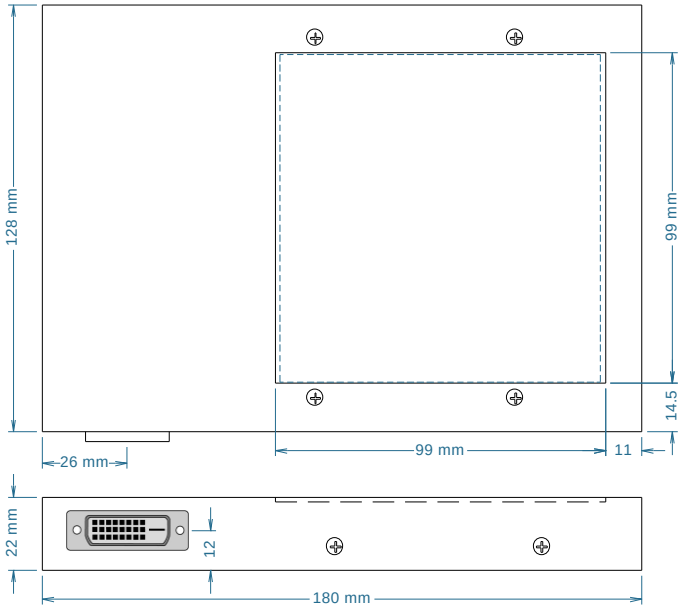


Remote RadEye HR Sensor Head

Mechanical Drawings – continued



Remote RadEye4 Sensor Head



Remote RadEye200 Sensor Head

About Teledyne Rad-icon

Teledyne Rad-icon Imaging is a leading provider of high-performance CMOS image sensors and cameras for the digital radiography market worldwide. Our products enable medical practitioners, industrial manufacturers, and scientific researchers to create superior image quality, high resolution, and large active area images based on our CMOS active pixel sensor (APS) technology. Rad-icon's products address diverse applications such as tissue biopsy, non-destructive testing, circuit board testing, and x-ray crystallography. Our customers are able to implement cost-effective and high-performance digital imaging solutions. Teledyne Rad-icon Imaging is a division of Teledyne DALSA, Inc., a wholly owned subsidiary of Teledyne Technologies Incorporated. Based in Sunnyvale, CA, Teledyne Rad-icon Imaging has integration partners and distributors worldwide.

For more information on our products and technologies, please visit our website at http://www.rad-icon.com or http://www.teledynedalsa.com/imaging/products/x-ray or call us at (408) 736-6000.