

# Remote RadEye X-Ray Camera

## DATASHEET



### Key Features

- Sensor module weighs 1kg or less
- Choose from 4 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: 22.5 $\mu$ m, 48 $\mu$ m and 96 $\mu$ m
- 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



In partnership with:




### 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 four different sensor modules, each of which contains a two-dimensional CMOS photodiode array featuring up to 1200 by 1600 pixels with pixel spacing ranging from 22.5 $\mu$ m to 96 $\mu$ m. A Gd<sub>2</sub>O<sub>2</sub>S 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 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. The electronics module features either a high-speed parallel digital frame grabber interface, or a USB connection for use with a PC or laptop. Please refer to our Shad-o-Box™ and Shad-o-Snap™ data sheets for additional details, or contact us for information about our new Ethernet frame grabber option.

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 four sizes, ranging from the Remote RadEye1 (25x50mm with 48µm pixel size) to the Remote RadEye200 (100x100mm with 96µm pixel size). Each sensor module can be paired with any one of the electronics modules. The RadEye1, 2 and HR modules attach via a 1m analog cable with custom LEMO connectors. The RadEye200 sensor module attaches via a 2m DVI cable, with longer options also available.

Device	Pixels	Active Area	Resolution	Interface/Cable
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	LEMO (2x), 1m
RadEye HR	1200 x 1600	27 x 36 mm	22.5 µm	LEMO, 1m
RadEye200	1024 x 1000	98.4 x 96.0 mm	96 µm	DVI, up to 5m
RadEye4 (coming soon)	2048 x 1024	98.6 x 49.2 mm	48 µm	DVI, up to 5m

## Remote RadEye Camera Specifications

	RadEye 1 & 2	RadEye HR	RadEye 200	Units
Avg. dark current (23°C) <sup>(1)</sup>	8	25	15	ADU/s <sup>(2)</sup>
Read noise (rms)		<1		ADU
Dynamic range		4000:1		
Digitization <sup>(3)</sup>		12		bits
Conversion gain <sup>(4)</sup>	500	120	1400	elec/ADU
<b>Shad-o-Box (LVDS) Interface</b>				
Sensor data rate	1500	1500	750	kHz
Readout period <sup>(5)</sup>	370	1320	740	ms
Max. frame rate	2.7	0.75	1.35	Hz
<b>Shad-o-Snap (USB) Interface</b>				
Sensor data rate	1000	1000	1000	kHz
Readout period	540	1980	540	ms
Image transfer to PC	3-4	7-8	3-4	sec
<b>General</b>				
Weight of sensor head <sup>(6)</sup>	0.3/0.8	0.5	1.0	kg
Weight of electronics module		1.7		kg
Operating temperature		0 to 50		°C
Storage temperature		-25 to +85		°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 (Shad-o-Box only)

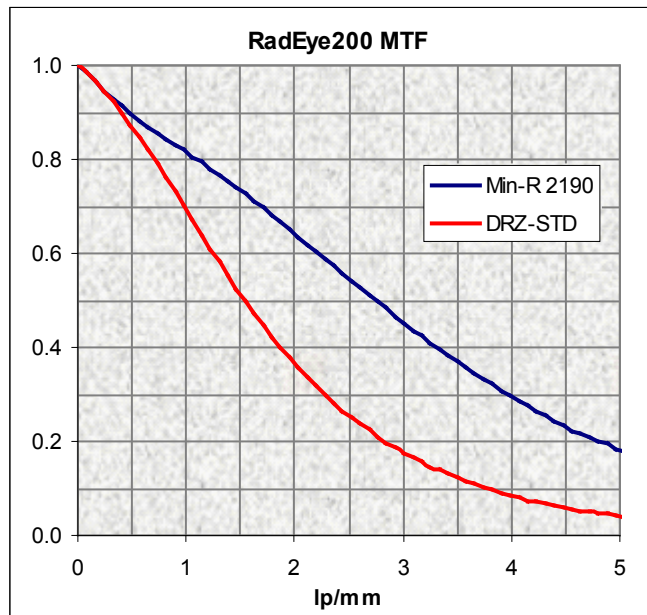
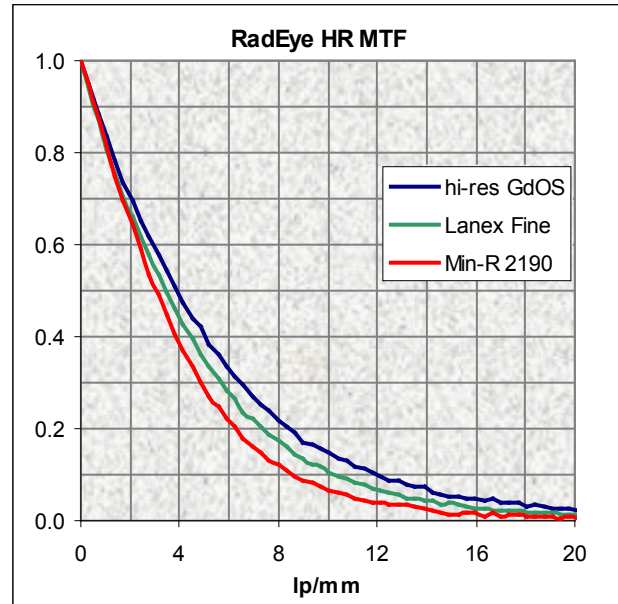
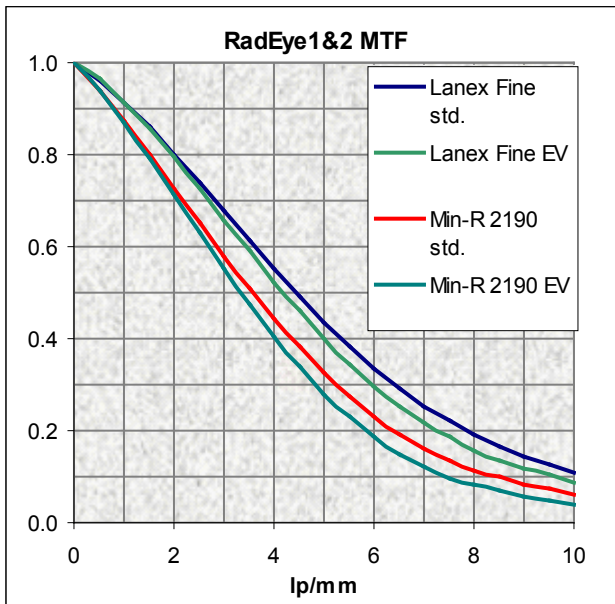
(4) high-gain option (2x) available

(5) time required to transfer image from sensor to memory

(6) not including sensor cable(s)

## 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.



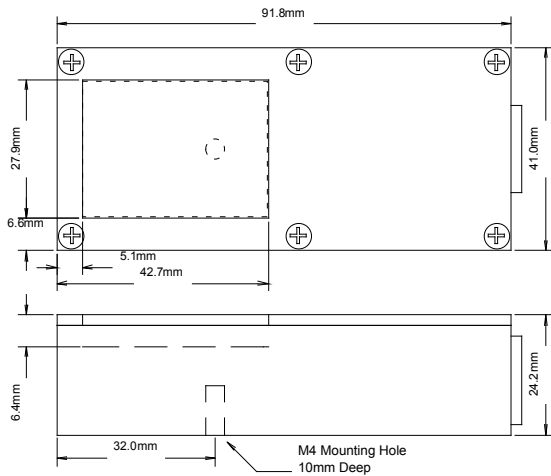
## Ordering Information

All Remote RadEye detectors can be ordered in two image quality grades - Standard and Premium. The default scintillator option is Kodak Min-R® 2190. Additional scintillators are available on request. Except for the Remote RadEye HR (10-90kV only), options for the 10-50kV energy range and for the 10-160kV range are available for all models. The camera modules are available with either a Shad-o-Box digital frame grabber interface or a Shad-o-Snap USB interface. Electronics modules ship with a universal input power supply (90-264V, 50-60Hz). Please specify the type of power cord you require.

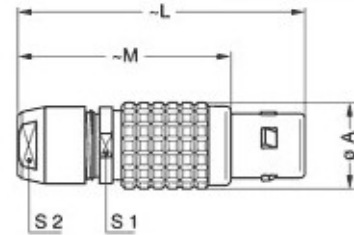
P/N	Description	Notes
RM1158	<b>Shad-o-Box 512 Remote Camera</b>	Single channel for RadEye1 & HR
RM1159	<b>Shad-o-Box 1024 Remote Camera</b>	Dual channel for RadEye2 & 200
RM1160	<b>Shad-o-Snap 512 Remote Camera</b>	Single channel for RadEye1 & HR
RM1161	<b>Shad-o-Snap 1024 Remote Camera</b>	Dual channel for RadEye2 & 200
RM1162	<b>RadEye1 Remote Sensor Module</b>	10-50kV energy range
RM1163	<b>RadEye1 EV Remote Sensor Module</b>	10-160kV energy range
RM1164	<b>RadEye2 Remote Sensor Module</b>	10-50kV energy range
RM1165	<b>RadEye2 EV Remote Sensor Module</b>	10-160kV energy range
-01	Premium Grade, Min-R 2190	no line defects
-02	Standard Grade, Min-R 2190	up to three line defects
RM1180	<b>RadEye HR Remote Sensor Module</b>	10-90kV energy range
-01	Premium Grade, Min-R 2190	up to three line defects
-02	Standard Grade, Min-R 2190	up to ten line defects
-05	Premium Grade, hi-res GdOS	high-resolution scintillator
-06	Standard Grade, hi-res GdOS	
-07	Premium Grade, Be Window	for low-energy applications (5-20kV)
-08	Standard Grade, Be Window	
RM1244	<b>RadEye200 Remote Sensor Module</b>	10-50kV energy range
-01	Premium Grade, Min-R 2190	no line defects
-02	Standard Grade, Min-R 2190	up to three line defects
-03	Premium Grade, EV Model	10-160kV energy range
-04	Standard Grade, EV Model	
-05	Premium Grade, Be Window	for low-energy applications (5-20kV)
-06	Standard Grade, Be Window	

## Mechanical Drawings

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

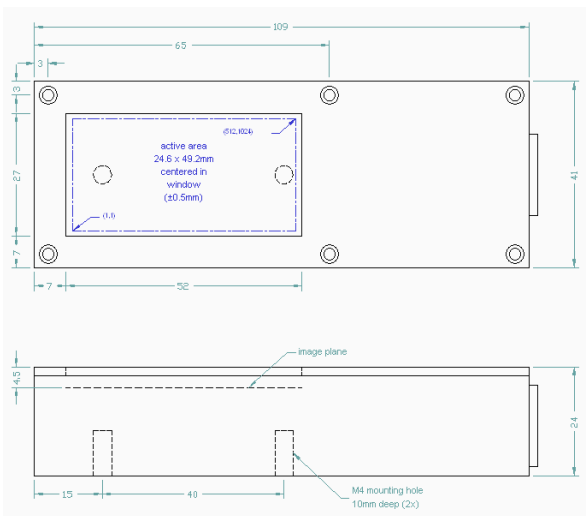


**Remote RadEye HR Sensor Head**

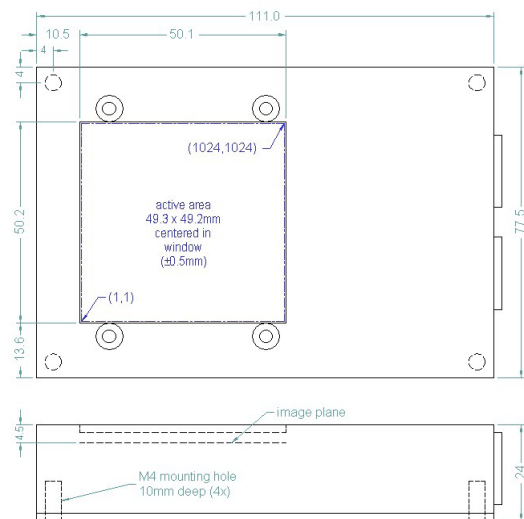


A	L	M	S1	S2
15	50	38	13	12

**LEMO Connector**



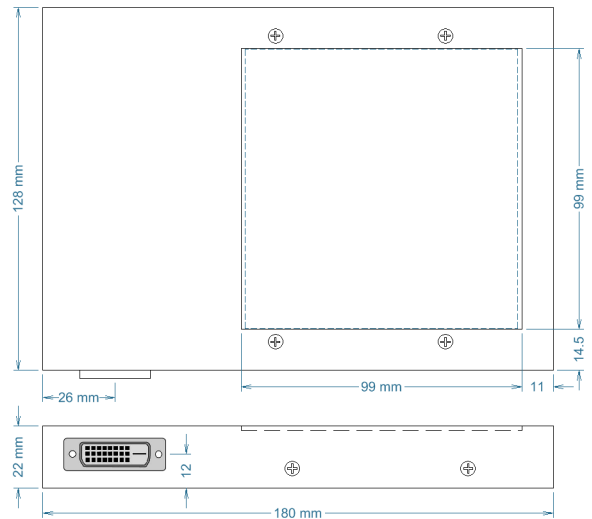
**Remote RadEye1 Sensor Head**



**Remote RadEye2 Sensor Head**

## Remote RadEye200

The Remote RadEye200 sensor module consists of a tiled array of two RadEye100 image sensors in a rugged stainless steel enclosure the size of a paperback novel. Featuring a 1024x1000 pixel image area with 96 $\mu$ m pixel size for a roughly 10x10cm active area, the RadEye200 offers an unsurpassed abundance of silicon real estate in a compact, cost-effective package. The Remote RadEye200 sensor module is available in a base configuration with direct-coupled scintillator for the standard 10-50keV energy range. We also offer the sensor module in an EV model for high-dose applications and x-ray energies up to 160keV. Finally, a Beryllium-window model offers superb sensitivity to low-energy x-rays in the 5-20keV range for x-ray crystallography applications and for imaging low-density materials. All models can be customized with different scintillator options and are available in either premium or standard image quality grades. To connect to the camera electronics module, the Remote RadEye200 features a standard DVI-D cable connection with various lengths up to 5m. In noisy industrial environments we recommend using a shorter cable (1 or 2m) to avoid picking up EMI disturbances in the image. Longer cables work well in laboratory or shielded locations as long as care is taken to avoid creating ground loops between various pieces of equipment.



## About Rad-icon

Rad-icon Imaging Corporation is the 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. Rad-icon Imaging Corporation is a division of DALSA Corporation and based in Santa Clara, CA with integration partners and distributors worldwide. For more information, please visit our website at <http://www.rad-icon.com> or call (408) 486-0886.