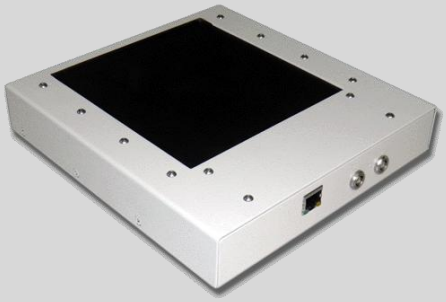
DATASHEET

Shad-o-Box HS Product Family



Key Features

- Large active area up to 10x15 cm
- Up to 10 lp/mm resolution
- Gigabit Ethernet interface (Camera Link optional)
- 14-bit digital video output
- Energy range from 10 to 225 kV
- Ready-to-run software and drivers

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Overview

Teledyne Rad-icon's Shad-o-Box HS product family of digital x-ray cameras offers users a high-speed, high-performance x-ray imaging detector with a fast, reliable Gigabit Ethernet interface. The cameras in this product line are capable of frame rates up to 40 fps, and communicate via a standard Cat6e data cable over lengths up to 100m. The detectors are available with different scintillator options to address a range of resolution and sensitivity requirements, making this camera an ideal choice for industrial inspection, biomedical and scientific x-ray imaging applications.

The Shad-o-Box HS product line leverages Teledyne DALSA's advanced CMOS image sensing technology, which enables the delivery of low-dose x-ray images and yields higher image quality than a-Si flat panels and image intensifier devices. Camera features include: (1) large active area of up to 10 x 15 cm; (2) several different resolution (pixel size) options; (3) fast, real-time image transfer via Gigabit Ethernet interface; (4) 14-bit digitization of images; and (5) SDK's, drivers and programming support. The camera interface allows easy access to features such as adjusting the frame rate, single and multiple frame acquisitions, and control of advanced timing modes. Each camera ships with our ShadoCam Imaging application and Teledyne DALSA's CamExpert software, which provide simple, user-friendly tools for communicating with the camera and acquiring images.

Description

Shad-o-Box HS cameras contain a large-area, high-resolution CMOS detector with a photodiode pixel array featuring three standard size options of approximately 3x4, 4x6 and 5x5 inches. The cameras are available in different resolution models featuring either a 135µm, 99/100µm or 49.5µm pixel size. All detectors are capable of real-time, full-resolution imaging at frame rates of 30 fps or higher.

The detector array consists of a single CMOS die (no tiling) that contains multiple output taps to enable high frame rates. The video signal is digitized to 14 bits, reassembled (deinterlaced) within the camera's FPGA, and then transferred directly to the host memory via a high-speed Gigabit Ethernet interface. An optional Camera Link interface is also available (contact your sales representative for details).

The CMOS sensor inside the Shad-o-Box HS camera contains a direct-contact Gd_2O_2S scintillator such as Kodak Min-R® 2190 or Mitsubishi Chemical DRZ-Std. The scintillator converts x-ray photons into visible light that is sensed by the CMOS photodiodes. A thin graphite cover protects the sensor from accidental damage as well as ambient light. The Shad-o-Box HS camera also contains lead and steel shielding to protect the camera electronics from the x-ray radiation. The cameras are optimized for the 40-160 kV energy range, but may be used with x-ray energies as high as 225 kV. Please refer to our application notes for additional information.

Shad-o-Box HS Camera Options

Device	Pixels	Active Area	Resolution	Frame Rate
Shad-o-Box 512 HS	768 x 512	10.4 x 6.9 cm	135 µm	35 fps
Shad-o-Box 1024 HS	768 x 1024	10.4 x 13.8 cm	135 µm	35 fps
Shad-o-Box 1280 HS	1280 x 1280	12.8 x 12.8 cm	100 µm	30 fps
Shad-o-Box 688 HS	1032 x 688	10.2 x 6.8 cm	99 µm	40 fps
Shad-o-Box 1548 HS	1032 x 1548	10.2 x 15.3 cm	99 µm	20 fps
Shad-o-Box 3K HS	2304 x 1300	11.4 x 6.4 cm	49.5 µm	10 fps
Shad-o-Box 6K HS	2304 x 2940	11.4 x 14.6 cm	49.5 µm	5 fps

Specifications

Detector Specifications		Units
Typ. dark current (23°C) (1)(4)	12	ADU/s(2)
Read noise (rms)	4-8	ADU
Typ. dynamic range	3000:1	
Digitization	14	bits
Image lag	<0.1	%
Non-linearity (10..90% FS)	<1.5	%
Readout period (3)(4)	22	ms
Max. frame rate (full res.)	30	fps
Output data rate	40	MHz

(1) dark current doubles approx. every 8°C
(2) ADU = Analog-Digital Unit = 1 LSB (Least Significant Bit)
(3) time required to transfer image from sensor to camera memory

Camera Specifications	1280 HS	All Others	Units
Typical supply voltage	12.0	6.5	Volts
Supply voltage range	11 to 13	6.0 to 8.0	Volts
Maximum supply current (4)	1.0	1.5	Amps
Typical power dissipation	< 10		Watts
Camera interface	Gigabit Ethernet		
Trigger connector	TTL		

General Specifications		Units
Operating temperature	0 to 40	°C
Storage temperature	-10 to +55	°C
Humidity (non-condensing)	10 to 80	% R.H.
Weight (4)	< 3.5	kg

(4) depends on camera model

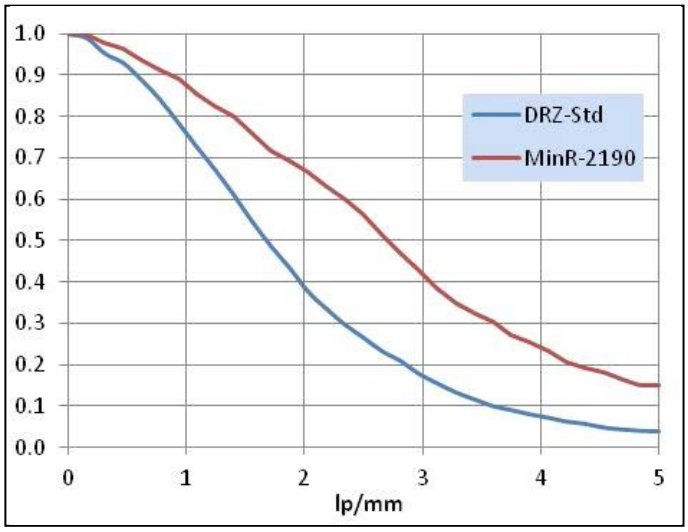
Resolution & Sensitivity

The Shad-o-Box HS cameras are designed to work with x-ray sources operating at a wide range of kVp settings. X-ray energies as low as 10-15 keV can be detected. The cameras can be used with x-ray energies as high as 225kV, although we recommend the use of additional shielding and/or collimation at higher energies in order to protect the sensor element and electronics from damage.

The pixel spacing of each camera model determines the limiting resolution of the sensor. The actual Modulation Transfer Function (MTF) of the detector depends on the type of scintillator that is installed. A thicker phosphor screen will produce more signal, but at the expense of high-frequency contrast. Typical MTF curves for the two standard scintillator options are shown in the graph below.

Scintillator	Typical Sensitivity (1)
Min-R 2190	4.1 ADU/µR @ 50kVp 5.2 ADU/µR @ 80kVp
DRZ-Std	10.5 ADU/µR @ 50kVp 14.5 ADU/µR @ 80kVp

(1) Shad-o-Box 1280 HS, W target, 2mm glass window, no filtration

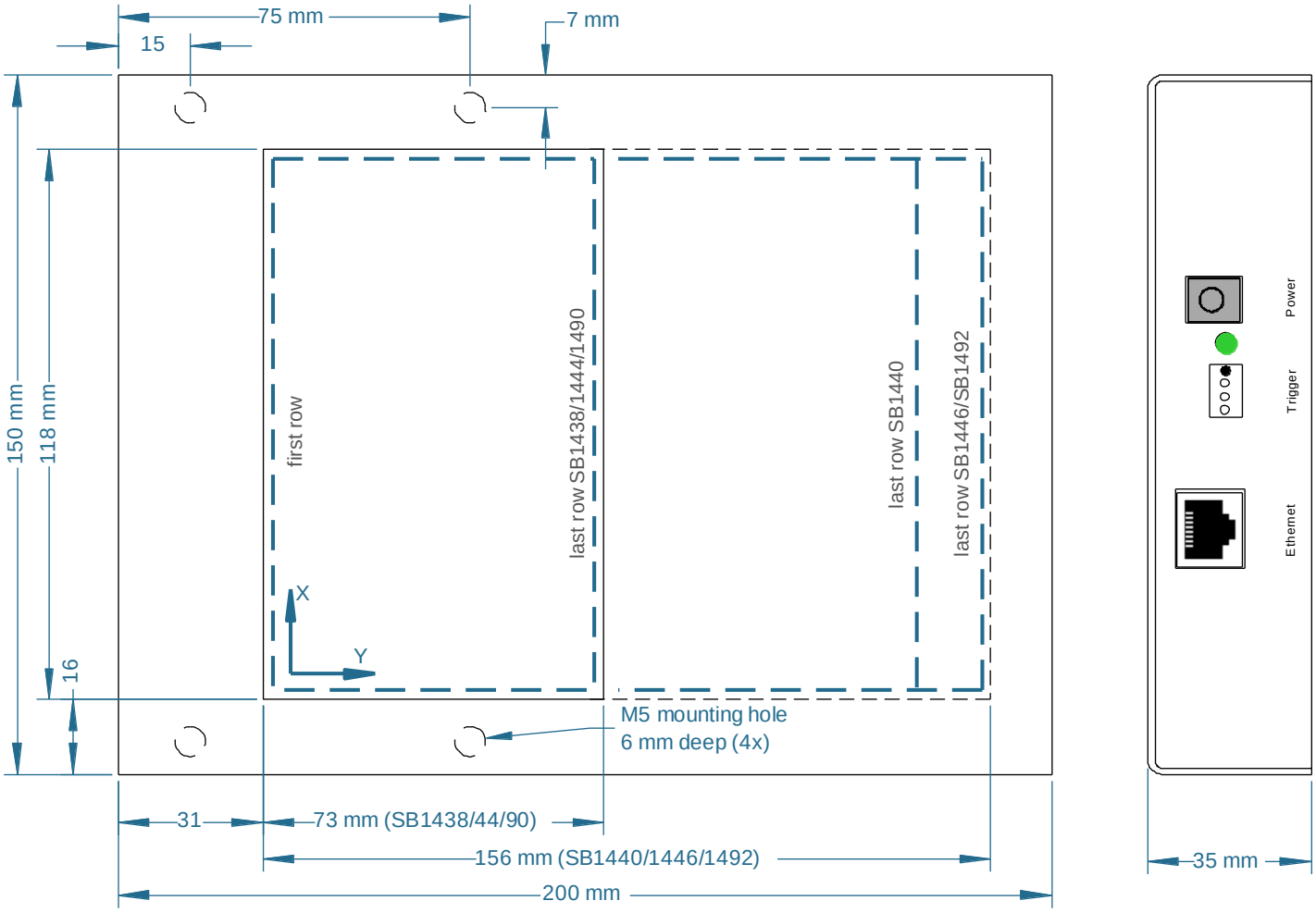


Software

Each Shad-o-Box HS camera ships with Teledyne Rad-icon's ShadoCam Imaging application, Teledyne DALSA's CamExpert software and a Gigabit Ethernet driver. The software is compatible with Windows® XP, VISTA, Windows 7 and 8. Check with your sales representative for compatibility with other Windows versions or with the Linux operating system. The camera can be connected on a network, but for optimal performance a dedicated network adapter is highly recommended.

For writing custom applications to acquire images from the camera, we recommend using Teledyne DALSA's Sapera LT or Sapera Essentials SDK (sold separately).

Mechanical Drawing: *3x4" and 4x6" Models*



Data Connector:

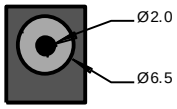
RJ45 HALO HFJ11-1G16E-L12RL

Power Connector:

DC power jack, 2 mm center pin

center pin:
6.5 VDC

outside:
ground



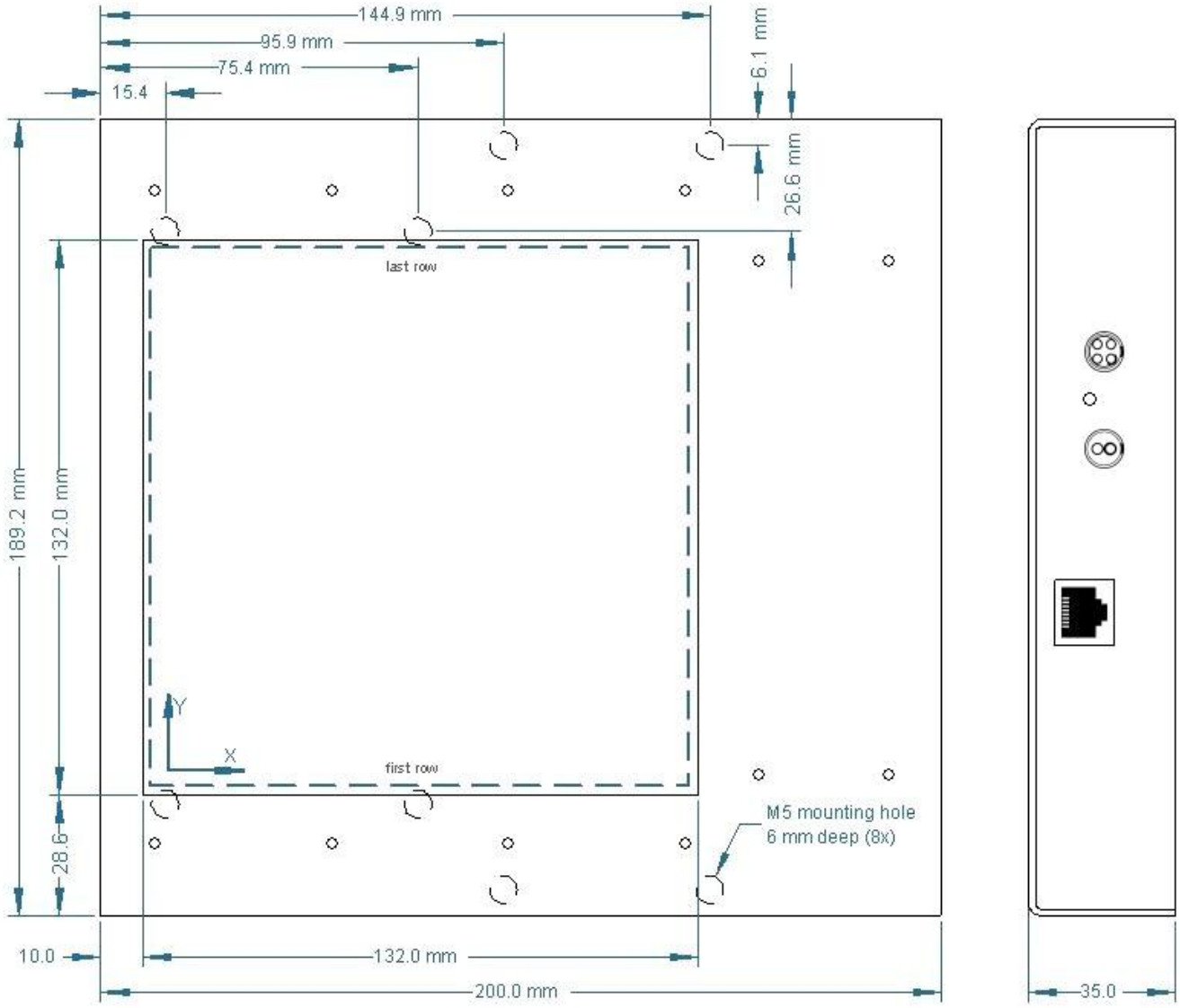
Trigger I/O Connector:

4-pin FCI 78208-104HLF
Mates with FCI 78211-004LF

TTL (open collector), opto-isolated

Pin 1 Trig out+
Pin 2 Trig out–
Pin 3 Trig in+
Pin 4 Trig in–

Mechanical Drawing: *Shad-o-Box 1280 HS*



Data Connector:

RJ45 HALO HFJ11-1G16E-L12RL

Power Connector:

2-pin LEMO EGG.0B.0302

Pin 1 +12 VDC
Pin 2 ground

Trigger I/O Connector:

4-pin LEMO EGG.0B.0304

TTL (open collector), opto-isolated

Pin 1 Trig out+
Pin 2 Trig out–
Pin 3 Trig in+
Pin 4 Trig in–

Ordering Information

Shad-o-Box HS cameras are available in a single, industrial image quality grade (up to 25 correctable line defects). Specify option -01 for the Kodak Min-R® 2190 scintillator, or option -02 for a Mitsubishi Chemical DRZ-Std scintillator. Additional scintillator options may be available by request.

All cameras ship with a universal input power supply (90-264V, 50-60Hz), power cord, Ethernet cable, software CD and User's Manual. For international orders, please specify the type of power cord you require.

P/N	Description
SB1438	Shad-o-Box 512 HS Camera (7x10cm, 135µm pixel)
SB1440	Shad-o-Box 1024 HS Camera (10x14cm, 135µm pixel)
SB1350	Shad-o-Box 1280 HS Camera (13x13cm, 100µm pixel)
SB1444	Shad-o-Box 688 HS Camera (7x10cm, 99µm pixel)
SB1446	Shad-o-Box 1548 HS Camera (10x15cm, 99µm pixel)
SB1490	Shad-o-Box 3K HS Camera (7x11cm, 49.5µm pixel)
SB1492	Shad-o-Box 6K HS Camera (11x15cm, 49.5µm pixel)

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.