

X-ray Line-Scan Camera Series



Hawk XID Dual Energy

The X-Scan Imaging XID8800 series of dual-energy linear array x-ray cameras offer high performance and capability to differentiate materials in a variety of applications. At the heart of a XID8800 camera are X-Scan Imaging's CMOS silicon imaging detector diode array chips providing wide dynamic range and solid-state reliability. A wide selection of filter and scintillation materials select and convert x-rays for detection by the diode array and optimizes x-ray energy

discrimination, sensitivity, and resolution. The proximity of the analog-to-digital converters (ADC) to the detector chips and the use of low-voltage-differential-signal (LVDS) technology minimize interference noise. A collection of hardware for interfacing to computers and software including drivers, an intuitive application programming interface (API), and example code software expedite developments of x-ray scanning systems.

Key Features

Extract material of a target from dual-energy image data

Incorporates X-Scan Imaging's proprietary XB8800 Photodiode Detectors

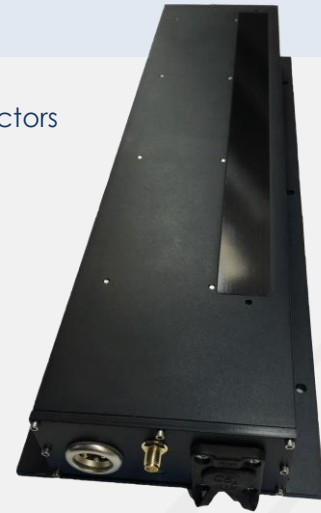
- High resolution with varieties of filters and scintillators
- Low noise, wide dynamic range, high sensitivity, high x-ray energy contrast
- X-ray energy range options for:
 - Low x-ray energy range (25 – 100 KeV)
 - High x-ray energy range (45 – 160 KeV)

Variable scan speed with position synchronization

16-bit analog-to-digital conversion

Software development kit

- Device drivers, libraries, standard API



Applications

Food and industrial inspection requiring high contrast
 Composite material sorting and inspection
 Security and cargo screening
 Waste sorting and recycling
 Rare metal or mineral detection
 Drug detection and control

Filter Material

Copper 0.250, 0.400, 0.800mm standard
 Filter material can be customized.

Adjustable low energy/high energy integration times

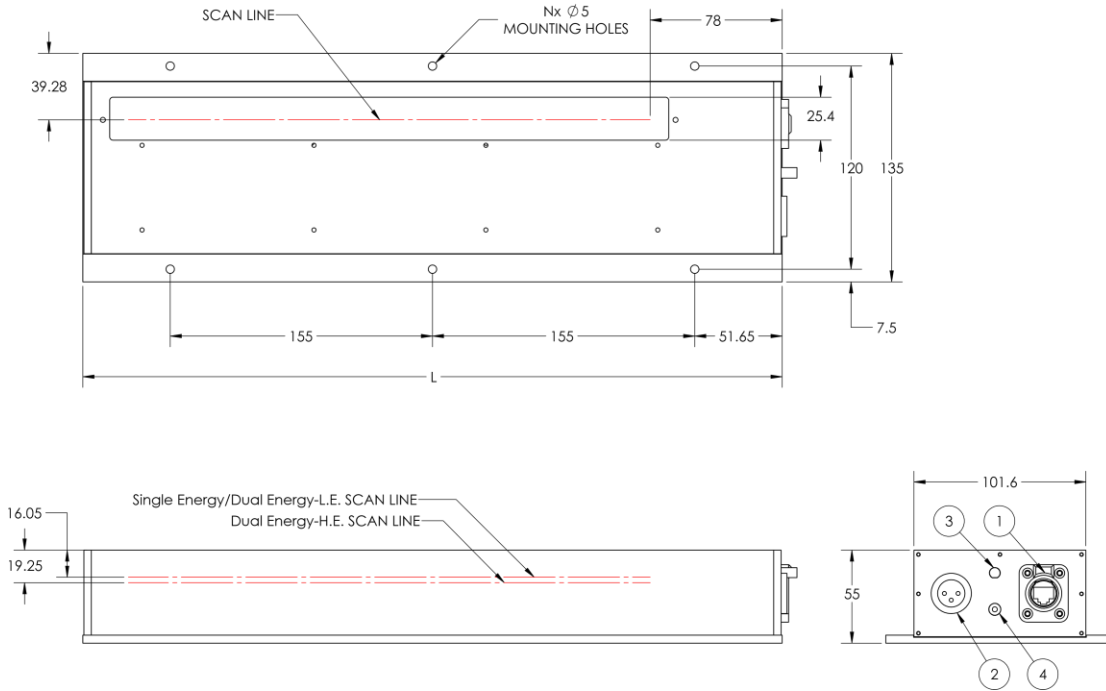
Model	Active length ⁱ	Number of pixels		
		XID8804 Series	XID8808 Series	XID8816 Series
XID88 _{LE} -12	307 mm	768 × 2	384 × 2	192 × 2
XID88 _{LE} -18	461 mm	1152 × 2	576 × 2	288 × 2
XID88 _{LE} -24	614 mm	1536 × 2	768 × 2	384 × 2
XID88 _{LE} -36	922 mm	2304 × 2	1152 × 2	576 × 2
XID88 _{LE} -48	1229 mm	3072 × 2	1536 × 2	768 × 2

ⁱ Other detector lengths are available upon request. Minimum active length is 154mm.

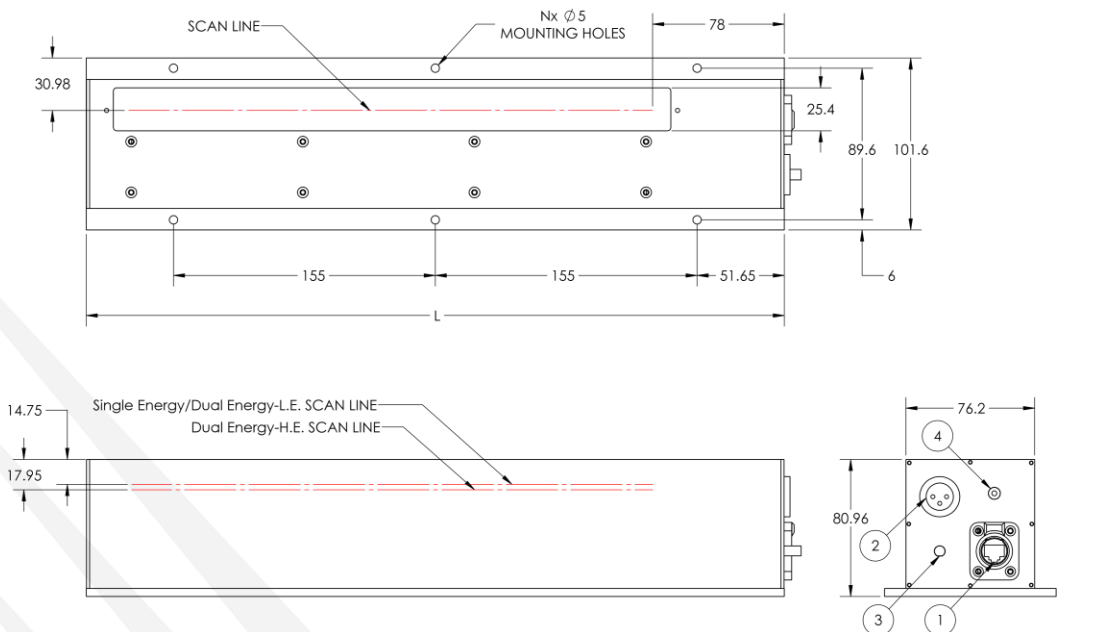
Mechanical Configurations

X-Scan Imaging housings are available in two form factors. The DR housing is a low profile, wider detector to fit under conveyor systems or other tight spaces. The DS housing is a taller, narrower profile. The standard X-Scan Imaging detectors, Single Energy, Dual Energy, and CMOS TDI all share the same mounting hole pattern.

DR:

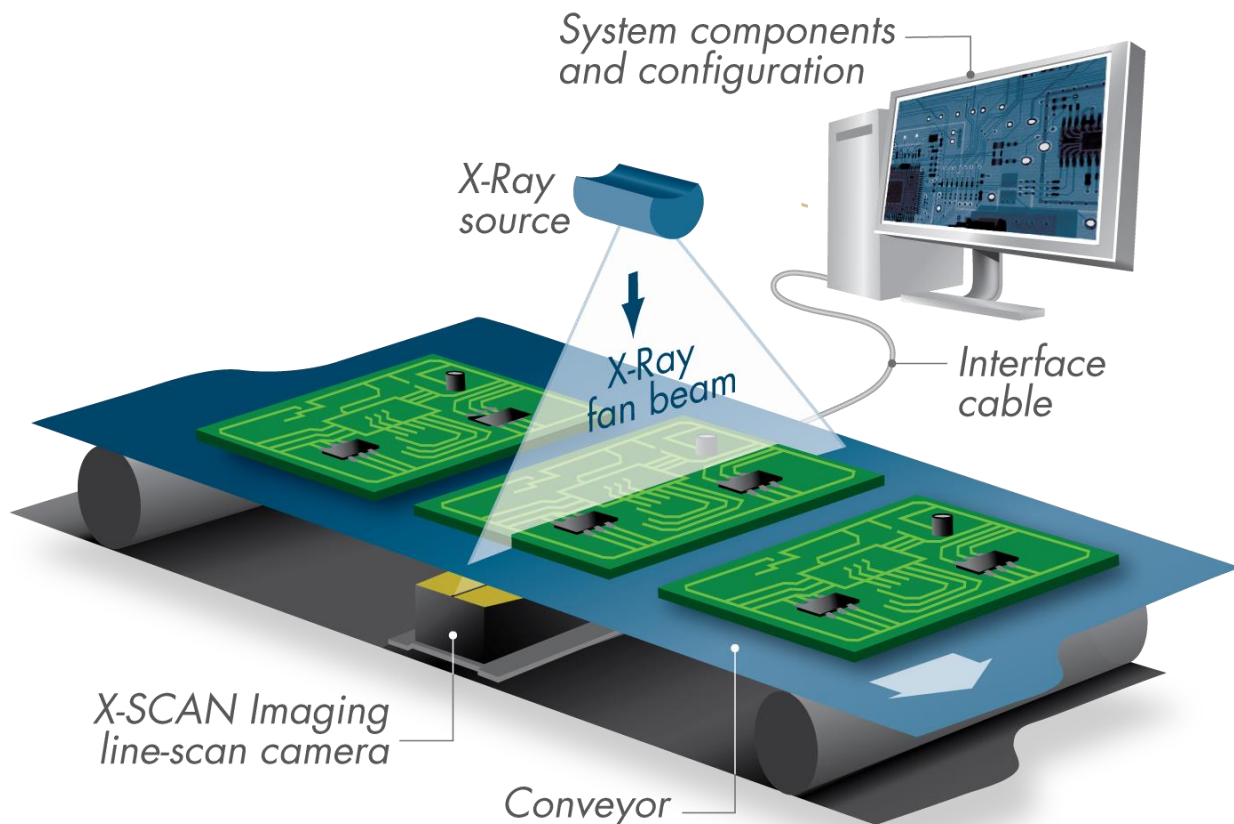


DS:



Setup

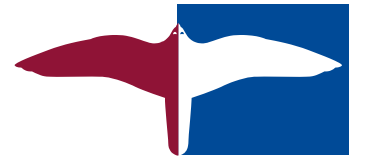
The XID8800 series camera system includes a camera unit, a software development kit, power adapter and cabling. The frame-grabber to be installed in the computer is provided optionally. The objects to be scanned should be passed between the x-ray source and the camera.



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X-ray Line-Scan Camera Series



Falcon Single Energy LDA

The X-Scan Imaging XI8800 series of linear array x-ray cameras offer high performance for x-ray scanning applications at extra long lengths. At the heart of a XI8800 camera are X-Scan Imaging's CMOS silicon imaging detector array chips providing wide dynamic range and solid-state reliability. A wide selection of scintillation material converts x-rays into visible light for detection by the imaging array and optimizes both sensitivity

and resolution. The close proximity of the analog-to-digital converters (ADC) to the detector chips and the use of low-voltage-differential-signal (LVDS) technology minimize interference noise. A collection of hardware for interfacing to computers and software including drivers, an intuitive application programming interface (API), and example code software expedite developments of x-ray scanning system.

Key Features

Wide range of resolutions & selection of lengths

Compact form factor

Incorporates X-Scan Imaging's proprietary XB8800 Photodiode Detectors

- Selectable resolution for 0.1/0.2mm and 0.4/0.8mm
- Low noise, wide dynamic range, high sensitivity
- High MTF

16-bit analog-to-digital conversion

Supports variable scan speed with position synchronization

Software development kit

Device drivers, libraries, standard API

With x-ray tube voltages 15 – 160 kV

GigE/Camera Link/USB3 interface



Applications

Food and industrial inspection

Package content inspection

Security and cargo screening

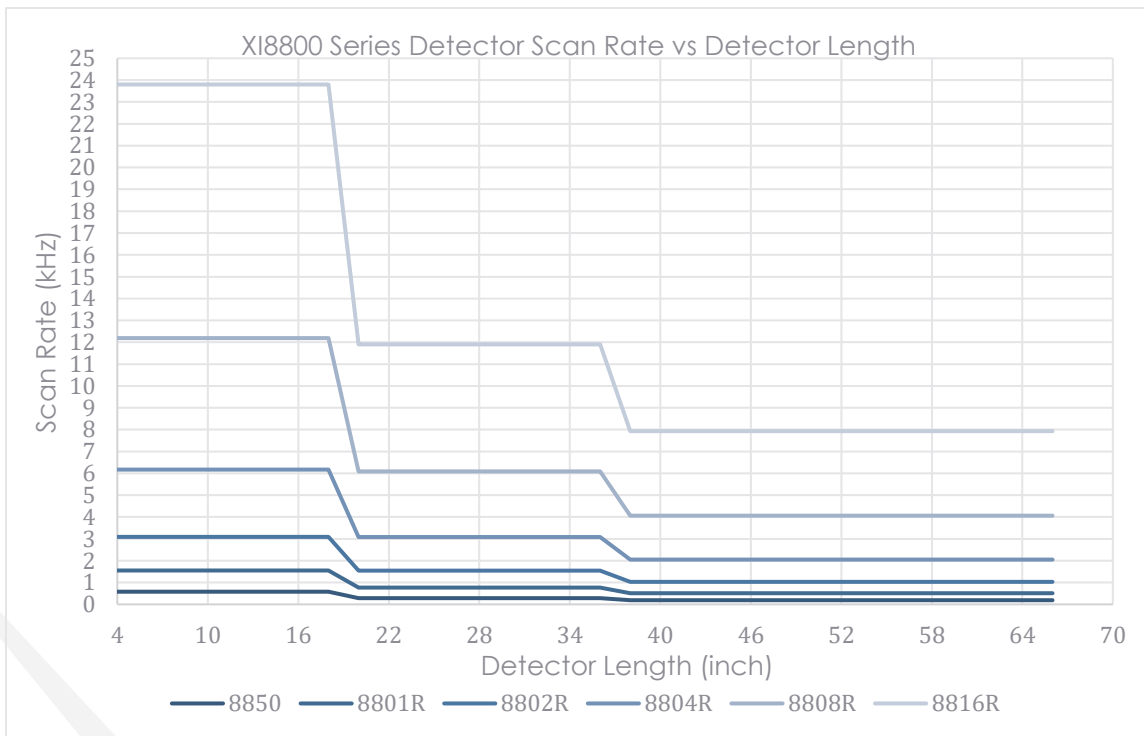
Industrial non-destructive testing (NDT)

Model : XI88_{LLL}-[LLL]¹

Model series	XI8850	XI8801	XI8802	XI8804	XI8808	XI8816
Resolution	50 μm	0.1 mm	0.2 mm	0.4 mm	0.8 mm	1.6 mm
Number of pixels	LLL × 512	LLL × 256	LLL × 128	LLL × 64	LLL × 32	LLL × 16
Maximum line rate up to 18 inches	550 Hz	1500 Hz	3 KHz	6 KHz	12 KHz	23 KHz

ⁱ Active Length is (25.6 mm × LLL) where LLL is the detector length and a multiple of 2 and LLL ≥ 8 (minimum length is 205 mm and no maximum length limit).
 The maximum line rate is available for LLL ≤ 18 (461 mm). Also depending in scintillator choice, image quality may be degraded at line rates greater than 1 KHz.

Scan Rate



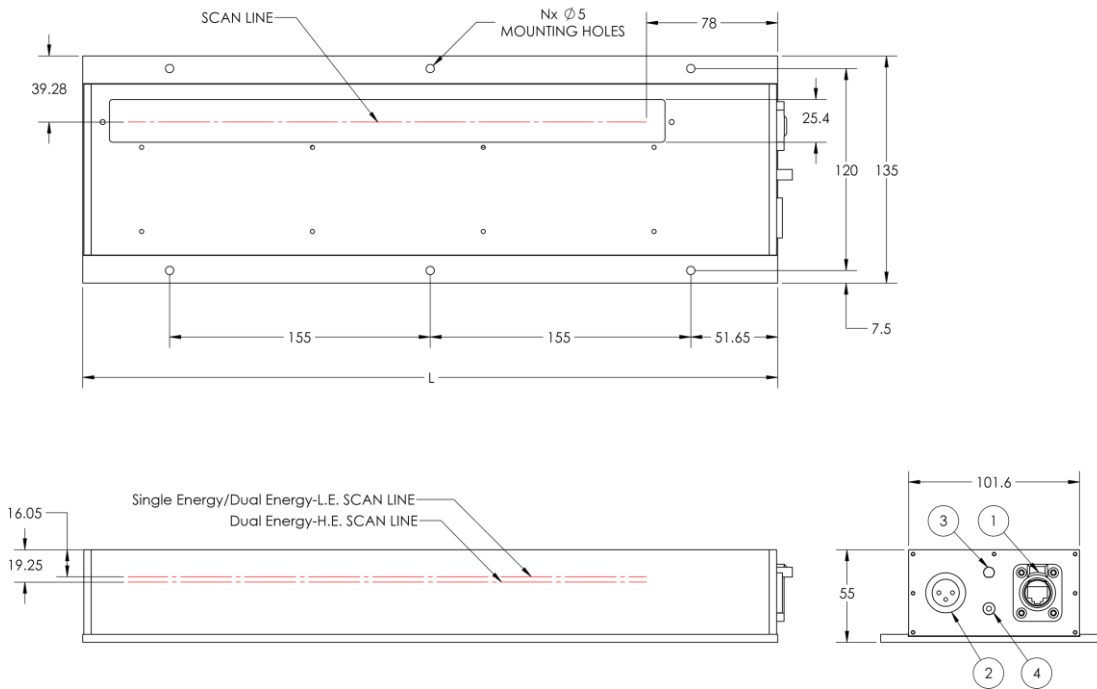
Calculate conveyor speed or object velocity by multiplying (Resolution * Scan Rate)
 Example XI8804 16 inches long, Maximum velocity is (0.4mm * 6kHz) = 2.4m/s

Magnification may also need to be considered using the source to object and source to detector distances.

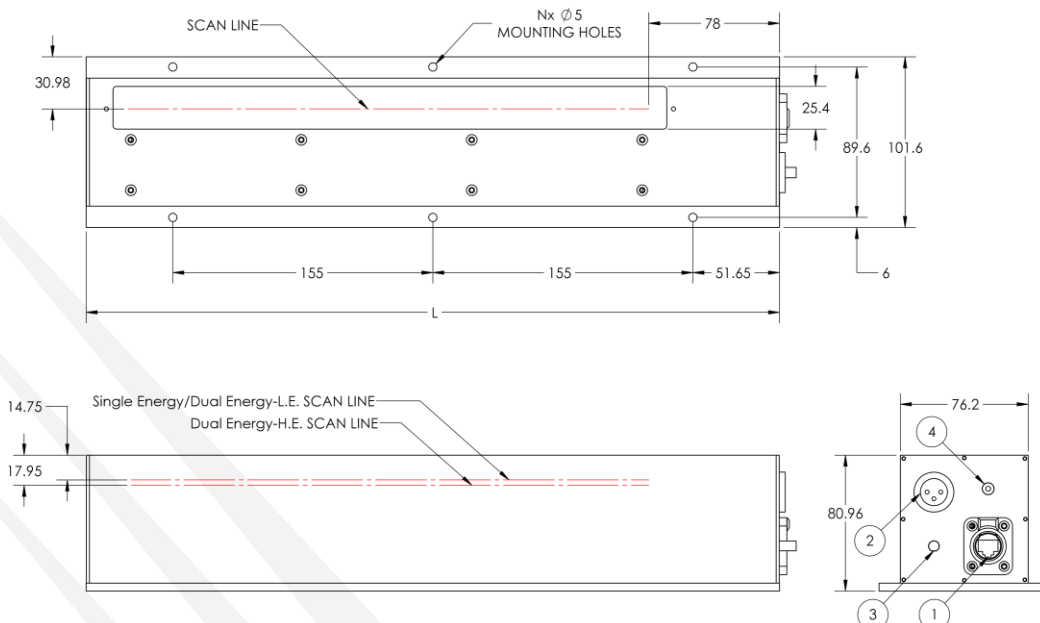
Mechanical Configurations

X-Scan Imaging housings are available in two form factors. The DR housing is a low profile, wider detector to fit under conveyor systems or other tight spaces. The DS housing is a taller, narrower profile. The standard X-Scan Imaging detectors, Single Energy, Dual Energy, and CMOS TDI all share the same mounting hole pattern.

DR:

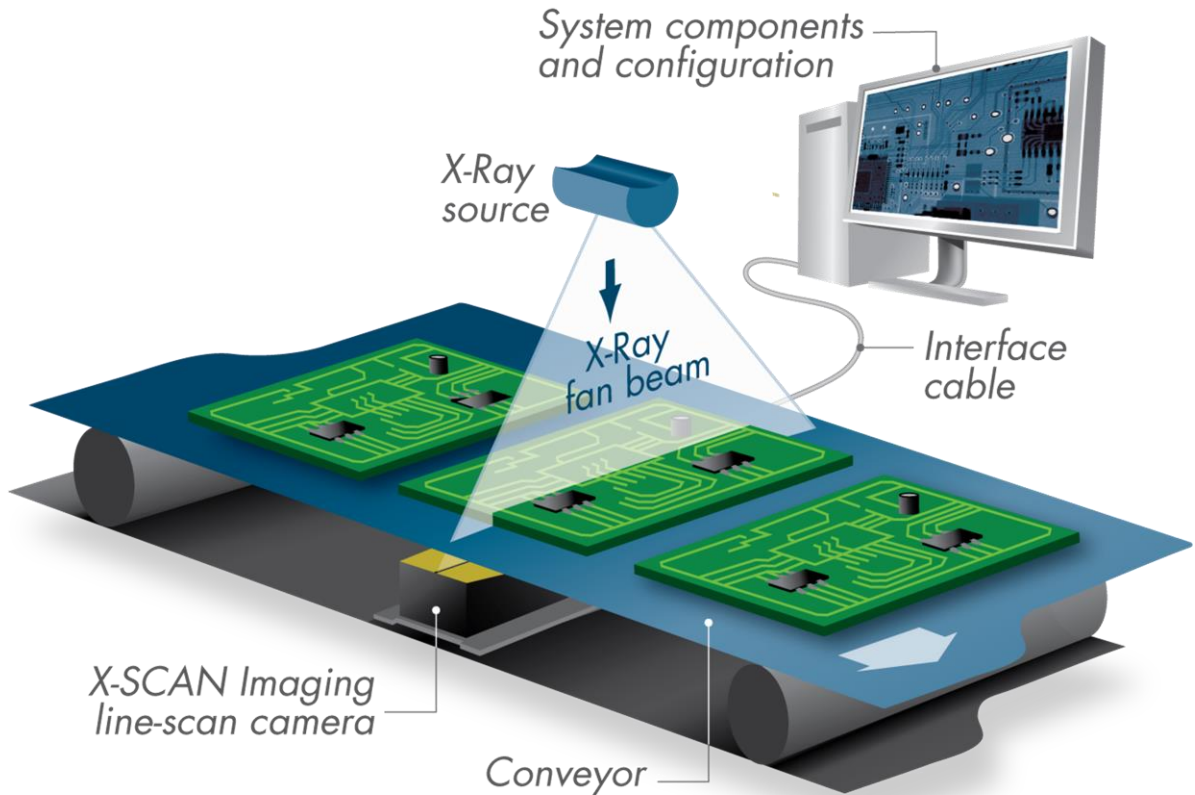


DS:



Setup

The XI8800 series camera system includes a camera unit, a software development kit, power adapter and cabling. The frame-grabber to be installed in the computer is provided optionally. Interfaces available include GigE, Camera Link, and USB3.0.



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X-ray Line-Scan Camera Series



Crane XIRH High Energy Detector

The X-Scan Imaging XIRH8800 series of linear array x-ray cameras offer high performance for high-energy x-ray and gamma-ray scanning applications in a compact form factor. A heavy-metal housing shields diode arrays and electronics ensuring long-life reliability under extreme radiation conditions. A wide selection of scintillation material converts high-energy photons into visible light, fiber optics convey the visible light to a shielded, off-axis CMOS imaging linear diode array (LDA) while providing a wide dynamic

range, optimization of sensitivity and resolution, and solid-state reliability. The close proximity of the analog-to-digital converters (ADC) to the detector chips and the use of low-voltage-differential-signal technology minimize interference noise. A collection of hardware for interfacing to computers and software including drivers, an intuitive application programming interface (API), and example code software expedite developments of x-ray scanning systems.

Key Features

- Off-axis, fiber-optic design for high-energy reliability in a compact form factor
- 50 KeV to 15 MeV energy range
- Choice of scintillators: GOS:Tb, CsI:TI, CWO
- Wide range of resolutions & selection of lengths
- Incorporates X-Scan Imaging's proprietary photodiode arrays
 - Selectable resolution
 - Low noise, wide dynamic range, high sensitivity
 - High MTF
- 16-bit analog-to-digital conversion
- Supports variable scan speed with position synchronization
- Software development kit
 - Device drivers, libraries, standard API
- GigE/Camera Link/USB3 interface



Applications

- Industrial non-destructive testing (NDT)
- Weld and corrosion inspection
- Fan-beam computed tomography (CT)

Model: XIRH88_{LL}-[LLL]ⁱ

Model series	XIRH8850	XIRH8801	XIRH8802	XIRH8804	XIRH8808	XIRH8816
Resolution	50 µm	0.1 mm	0.2 mm	0.4 mm	0.8 mm	1.6 mm
Number of pixels	LLL × 512	LLL × 256	LLL × 128	LLL × 64	LLL × 32	LLL × 16
Maximum line rate	550 Hz	1500 Hz	3 KHz	6 KHz	12 KHz	23 KHz

ⁱ Active Length is (25.6 mm × LLL) where LLL is a multiple of 6 and LLL ≥ 12 (minimum length is 308 mm and no maximum length limit).
 The maximum line rate is available for LLL ≤ 18 (461 mm). Also depending in scintillator choice, image quality may be degraded at line rates greater than 1 KHz.

Standard Options

Part Numbering:

Example: XIRH8802W15/600-024-GX-FGE

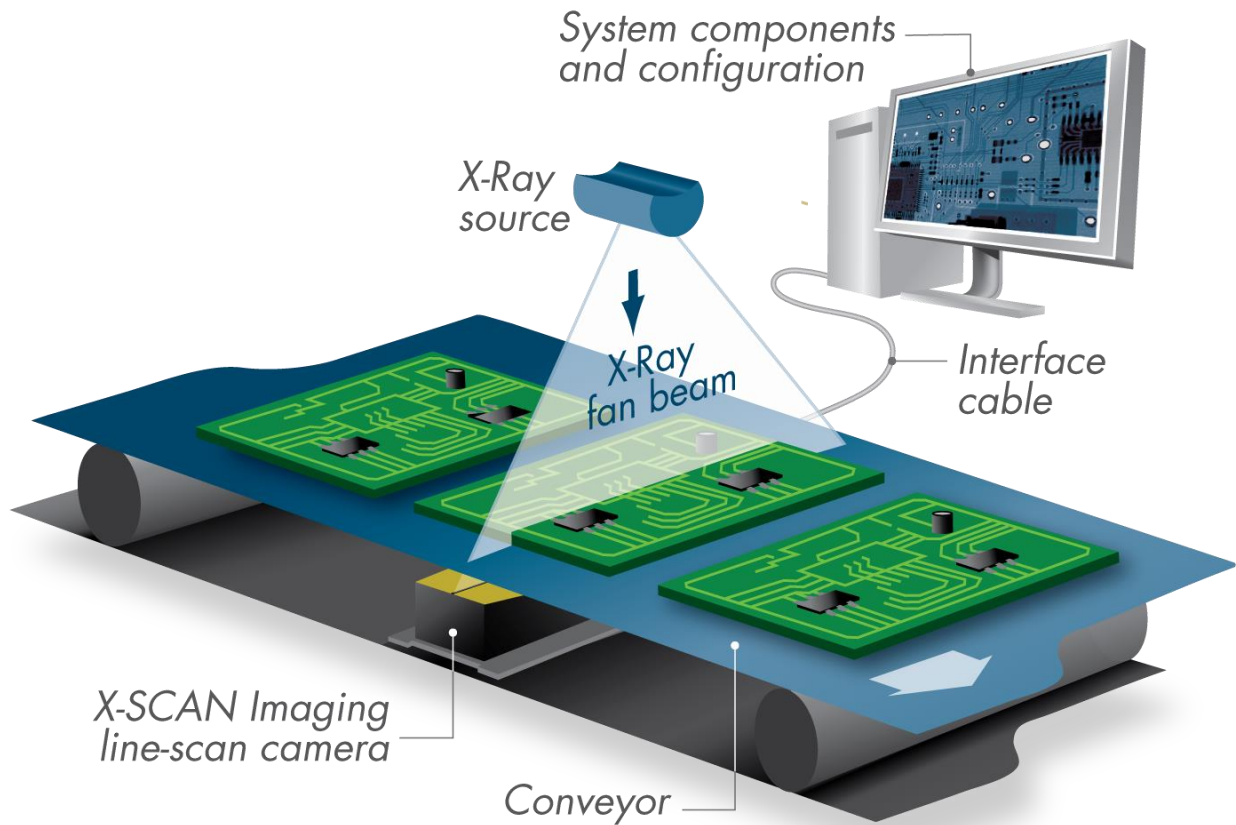
Definitions:

X I RH 88 02 W15 / 600 - 024 - DS - GX - FGE
 [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12]

Position	Description	Position	Description
[1]	Product Family	[7]	Scintillator Code
[2]	Array Type	[8]	Energy Rating
[3]	Shape	[9]	Detector Length (Inches)
[4]	Energy Option H= With FOP	[10]	Housing Aspect
[5]	Array Series	[11]	Interface G=GigE C=CameraLink U=USB
[6]	Pixel Pitch 02=200um, 04=400um, etc	[12]	PC Frame Grabber Card

Setup

The XIRH8800 series camera system includes a camera unit, a software development kit, power adapter and cabling. The frame-grabber to be installed in the computer is provided optionally. The objects to be scanned should be passed between the x-ray source and the camera.



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X-ray L-shape Line-Scan Camera Series

XL8800 Series

The X-Scan Imaging XL8800 series of x-ray L-shape line-scan cameras offer high performance for x-ray scanning applications using panoramic x-ray sources. At the heart of a XL8800 camera are X-Scan Imaging's CMOS silicon imaging detector array chips providing wide dynamic range and solid-state reliability. A wide selection of scintillation material converts x-rays into visible light for detection by the imaging array and optimizes both sensitivity and resolution. The close proximity of the analog-to-digital converters (ADC) to the detector chips minimizes interference noise. A collection of hardware for interfacing to computers and software including drivers and an intuitive application programming interface (API) with sample code expedites development of x-ray scanning systems. **The L-shape camera is ideal for X-ray wheel inspection applications.**

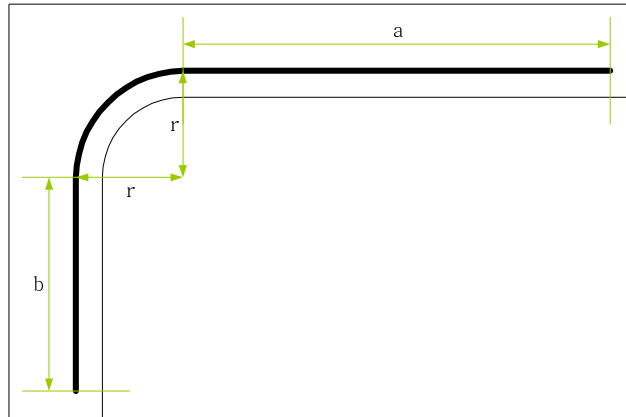
Key Features

- L-shape optimized for wheel inspection
- Rounded corners for reduced corner distortions
- Integrated X-Scan proprietary detectors
 - Standard energy range of 40–160 KV
 - Wide selection of resolutions from 0.05 mm to 1.6 mm
 - Software selectable resolution
 - Low noise
 - Wide dynamic range
 - High x-ray sensitivity
 - High MTF
- 16-bit analog-to-digital conversion
- Scan rates over 2000 lines/second
- Variable scan speeds with position synchronization
- Software development kit: device drivers, libraries, standard API
- X-ray inspection software with standard features
- Compact & rugged housing with minimal cabling
- Modular design for expeditious customization of length and shape



X-ray L-shape Line-Scan Camera XL8800 Series

Models



Model	Resolution (mm)	Dimensions (mm)			Total Detector Length (mm)	Minimum Line Period (ms)	Maximum Scan Velocity (m/s)
		a	b	r*			
XL8804-16-12-1x4	0.4	411	308	73	822	0.70	0.6
	0.8					0.35	1.8
XL8804-16-14-1x4	0.4	411	360	73	873	0.90	0.45
	0.8					0.45	1.4
XL8804-18-14-1x4	0.4	463	360	73	925	0.90	0.45
	0.8					0.45	1.4
XL8804-20-16-1x4	0.4	514	411	73	1028	0.90	0.45
	0.8					0.45	1.4
XL8804-28-18-1x4	0.4	719	463	73	1234	0.90	0.45
	0.8					0.45	1.4

Note: Other geometries available upon request.

*Rounded corners approximated by one or two straight segments.

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Camera Link® is a registered trademark of the Automated Imaging Association, Ann Arbor, Mich.

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X-ray Time Delay Integration (TDI) CCD camera



Harrier

Time Delay Integration (TDI) is a special image acquisition method that is used for in-line inspection application that requires high-speed, high sensitivity and high resolution. XT112848 TDI camera is designed for long life with a Fiber Optic Plate that separates the

sensor from the X-Ray path. X-Scan Imaging can help users select the scintillator for specific applications. Pixels are $48 \mu\text{m} \times 48 \mu\text{m}$. Binning modes 2×2 , 4×4 , 8×8 , etc. allow for imaging at higher speed with lower resolutions.

Key Features

High speed, resolution & sensitivity
Imaging with off-axis, fiber-optic design
User-select X-ray scintillating material GOS, CsI(Tl), CdWO₄, etc.
A selection of lengths:

- 4 inches (2048 pixels)
- 9 inches (4608 pixels)
- 12 inches (6144 pixels)

Highly extended lifetimes
Camera Link (Base configuration) and GigE Vision interfaces
16-bit digitization and data output
100-240-V, 50-60-Hz power
Software development kit (SDK) with application programming interface (API)

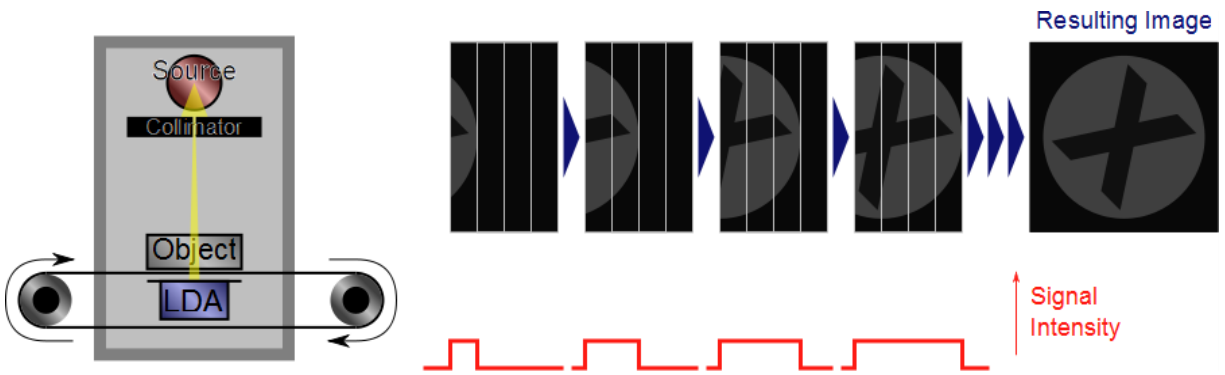


Applications

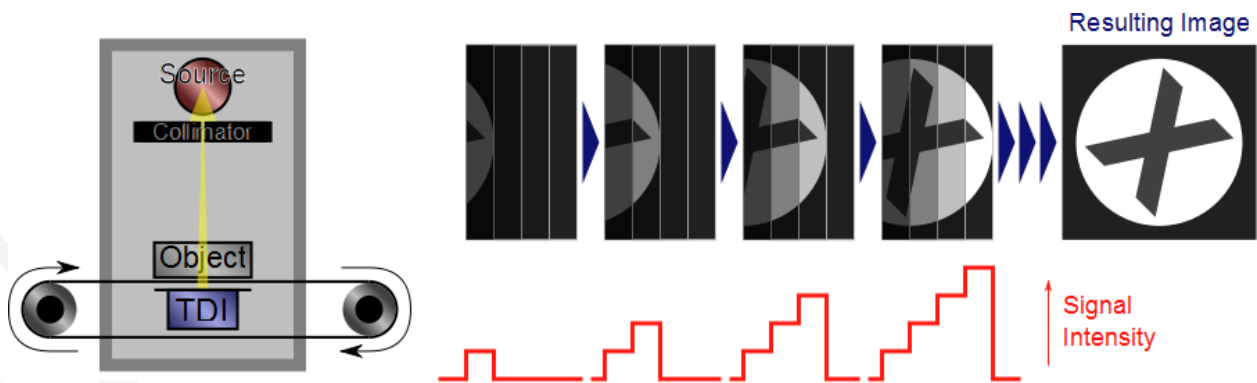
PCB/SMT inspection
In-line Non-Destructive Testing (NDT)
High-energy x-ray, gamma-ray, betatron and neutron imaging

Principal of operation

In the operation of both traditional Linear Diode Array (LDA) and TDI detectors, objects must be moving relative to the detectors. In an LDA, a single line of diodes collect signal. Once the object has past the diode line, no more signal is collected. A TDI device has multiple diode lines and the signal for each line can be passed to the next line. As the object passes over each line, each line collects signal and then passes the signal to the following line. After the object passes the final line, the full integrated signal is read out. When the TDI device is synchronized to the moving object, an image with higher resolution at lower light level is achieved. As a result, signal-to-noise ratio in TDI camera is much higher than that in a line-scan camera.



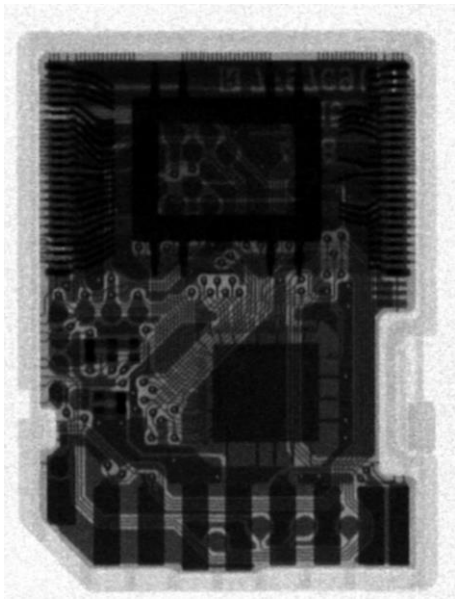
Traditional LDA Application



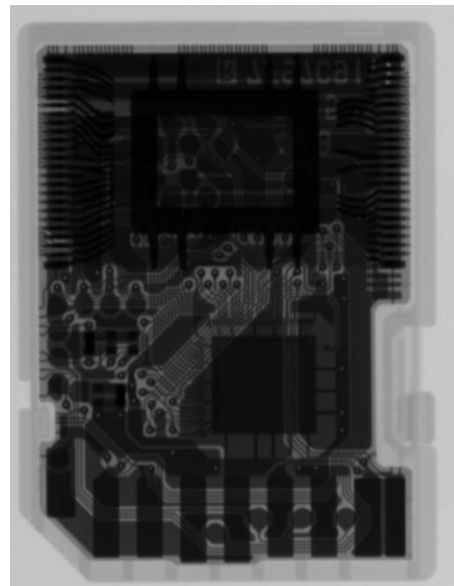
TDI Application

Comparison images

Radiographs of SD card using traditional LDA and XT112848 TDI
Sensor board with photodiode locations [This drawing to be updated]



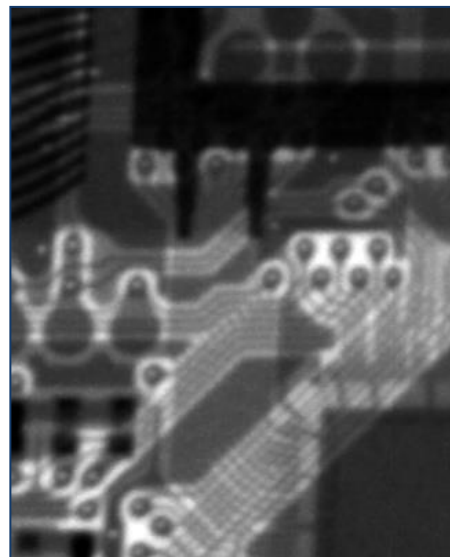
Traditional LDA (50um)



TDI (48um)

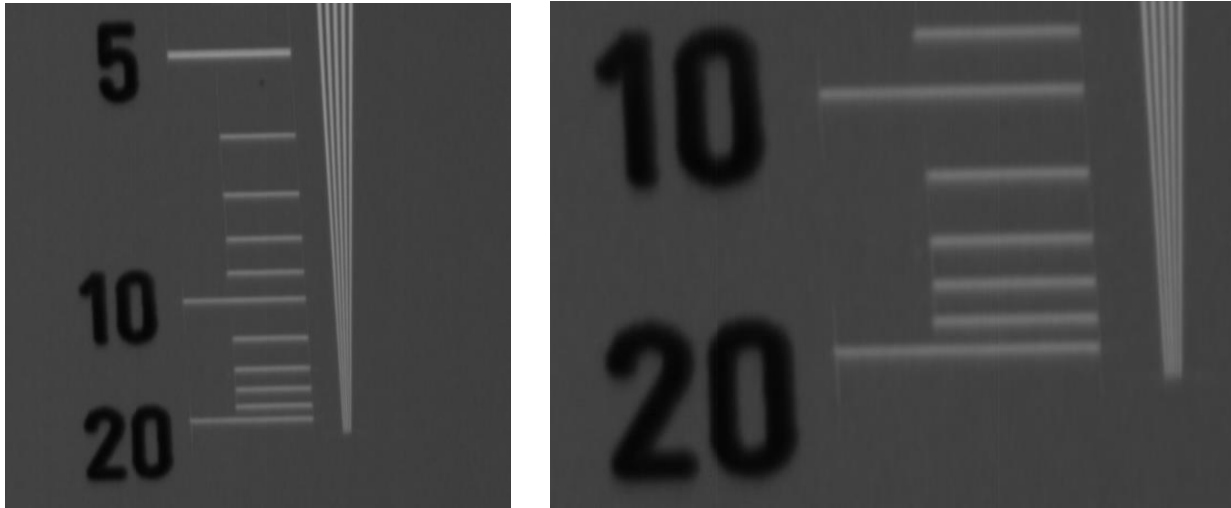


Traditional LDA zoomed-in view

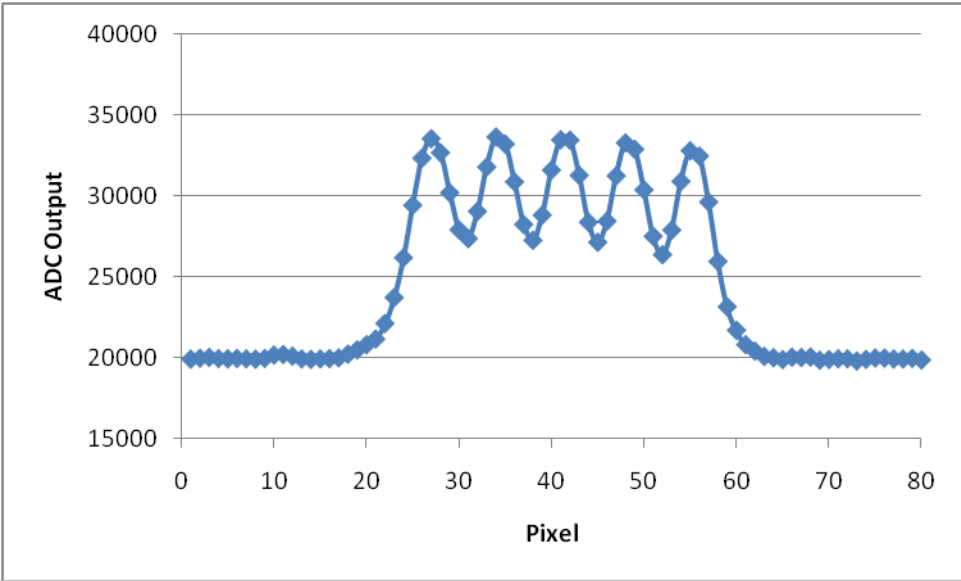


TDI zoomed-in view (S/N improved 9X)

Resolution



TDI camera spatial resolution with 3.4× geometric magnification



TDI camera MTF at 10 lp/mm (with 3.4× geometric magnification)

Specifications			
Model	XTI12848-004	XTI12848-009	XTI12848-012
TDI stages and number of pixels	2048 × 128	4608 × 128	6144 × 128
Pixel size	48 μm × 48 μm		
X-ray sensitive area	98 × 6.1 mm ²	221 × 6.1 mm ²	295 × 6.1 mm ²
Maximum X-ray energy	15 MeV		
CCD pixel clock	3 MHz		
TDI line rate	Up to 10 KHz ⁱ		
A/D converter	16 bit		
Camera Link data rate	48 to 84 MHz ⁱⁱ		
Power requirement	100–240 V, 50–60 Hz		
Power consumption	25 W	63 W	75 W
Readout direction	Bidirectional		
Selectable number of stages	32, 64, 96, 128		

ⁱ Line rate may be limited by scintillator choice or by bandwidth considerations of interface. 10 KHz provided with Csl and Camera Link interface.

20kHz options available on some configurations

ⁱⁱ Camera Link data rate depends on exact camera configuration.

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X-ray U-shape Line-scan Camera Series

XU8800 Series

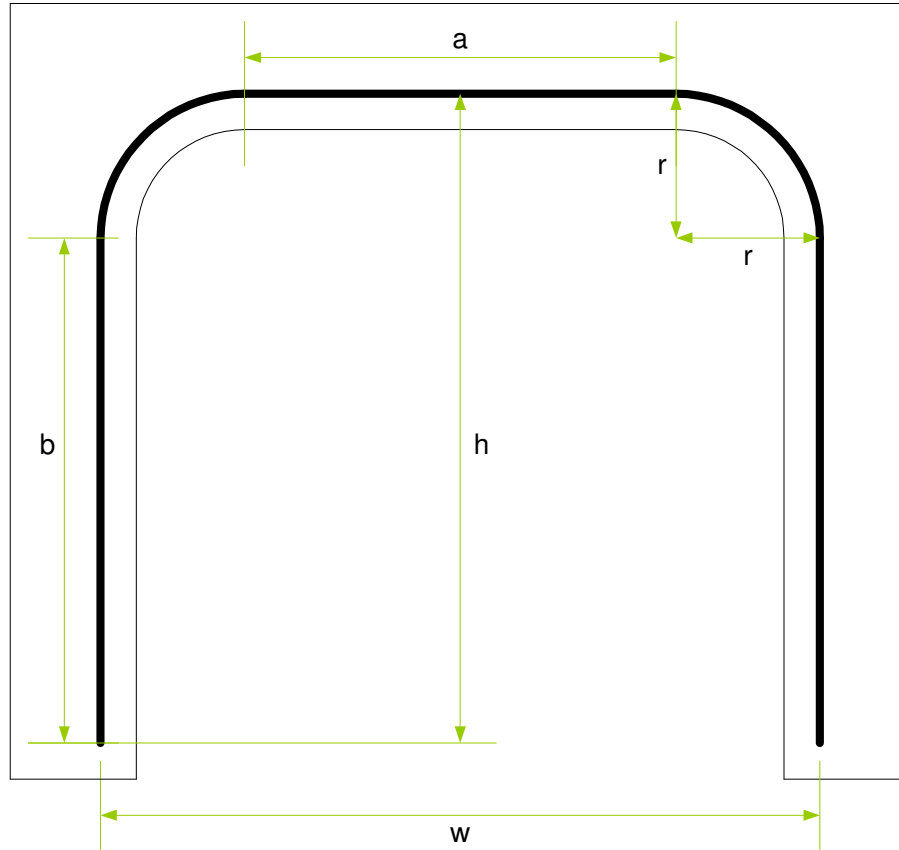
The X-Scan Imaging XU8800 series of x-ray U-shape line-scan cameras offer high performance for x-ray scanning applications using panoramic x-ray sources. The U-shape camera is ideal for tire inspection applications. At the heart of a XU8800 camera are X-Scan Imaging's CMOS silicon imaging detector array chips providing wide dynamic range and solid-state reliability. A wide selection of scintillation material converts x-rays into visible light for detection by the imaging array and optimizes both sensitivity and resolution. The close proximity of the analog-to-digital converters (ADC) to the detector chips minimizes interference noise. A collection of hardware for interfacing to computers and software including drivers and an intuitive application programming interface (API) with sample code expedites development of x-ray scanning systems.

Key Features

- U-shape optimized for tire inspection
- Rounded corners for reduced corner distortions
- Integrated X-Scan proprietary detectors
 - Standard energy range of 40–160 KV
 - High energy versions available
 - Wide selection of resolutions
 - From 0.05 to 1.6 mm
 - Software selectable resolution
 - Low noise
 - Wide dynamic range
 - High x-ray sensitivity
 - High MTF
- 16-bit analog-to-digital conversion
- Scan rates over 2000 lines/second
- Variable scan speeds with position synchronization
- Software development kit: device drivers, libraries, standard API
- X-ray inspection software with standard features
- Compact & rugged housing with minimal cabling
- Modular design for expeditious customization of length and shape



Models



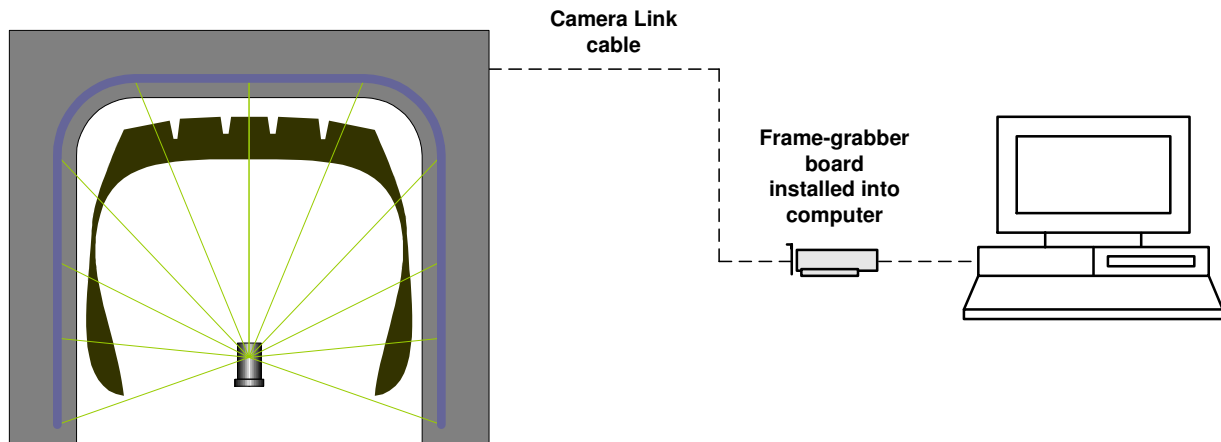
Model	Resolution (mm)	Dimensions (mm)					Total Detector Length (mm)	Minimum Line Period (ms)	Maximum Scan Velocity (m/min)
		a	b	r*	w	h			
XU8804-18-16-1×4	0.4	463	411	73	608	484	1491	0.86	28
	0.8							0.44	109
XU8804-12-18-3×4	0.4	308	463	207	772	670	1850	1.1	22
	0.8							0.54	89
XU8804-18-24-3×4	0.4	463	617	207	877	824	2313	1.1	22
	0.8							0.54	89
XU8804-36-30-3×6	0.4	925	771	311	1546	1082	3392	1.3	18
	0.8							0.65	74
XU8804-68-50-1×6	0.4	1748	1285	109	1966	1394	4626	1.8	13
	0.8							0.87	55

Note: Other geometries available upon request.

* Rounded corners approximated by one to three straight segments.

Setup

The XU8800 series camera system includes a camera body, a software development kit, inspection software, power adapter and cabling. The frame-grabber to be installed in the computer is provided optionally. In a typical tire inspection application, the treads and sidewalls of a rotating tire intersect the x-rays radiating from the x-ray source and directed to the camera body.



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