

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)

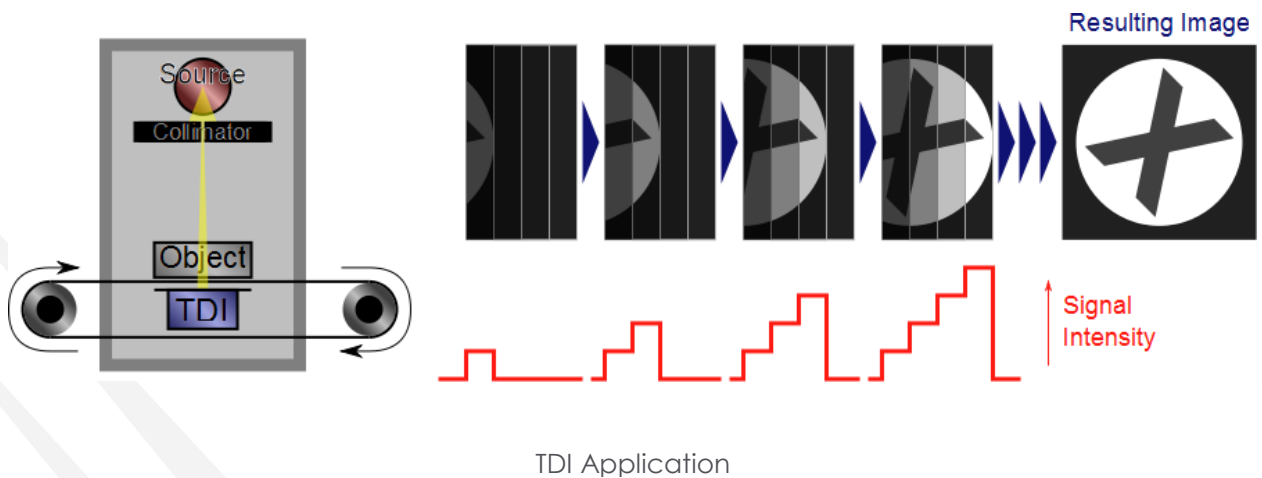
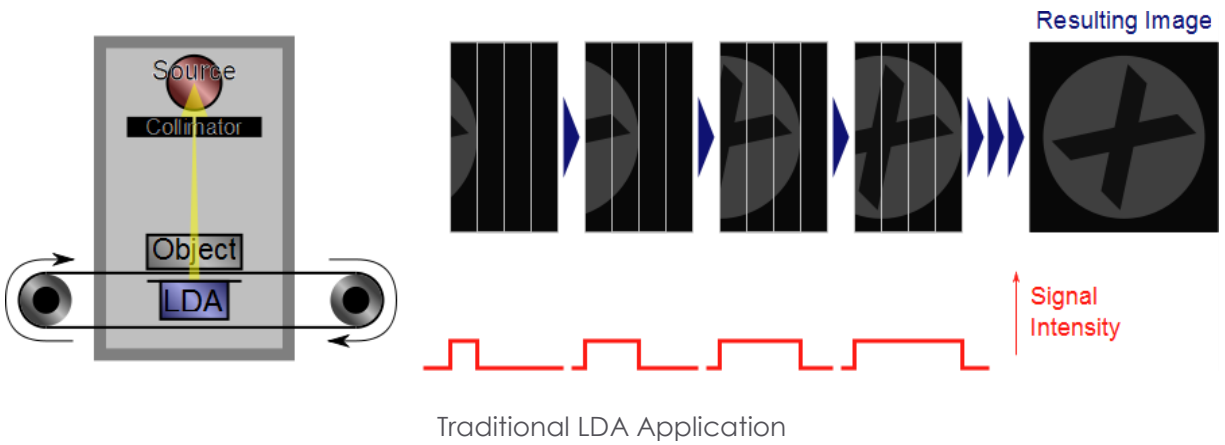


Applications

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

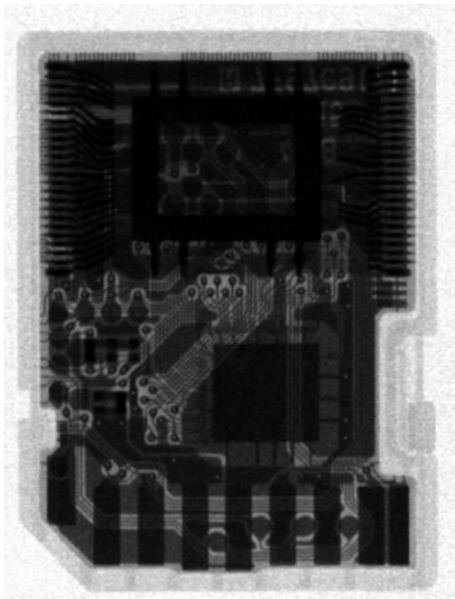
Principal of operation

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.

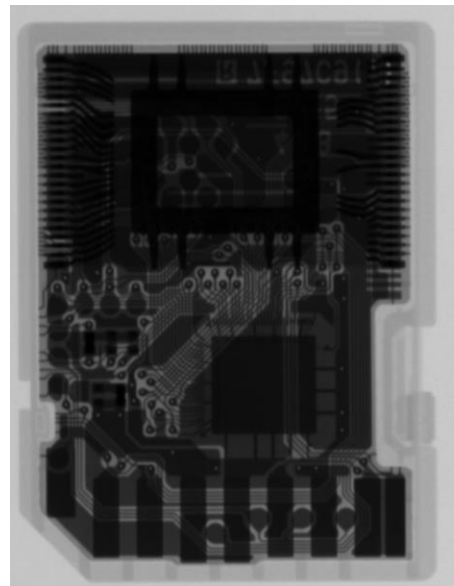


Comparison images

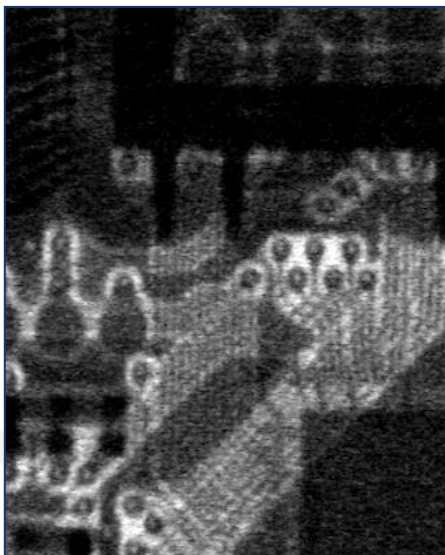
Radiographs of SD card using traditional LDA and XT112848 TDI
Sensor board with photodiode locations [This drawing to be updated]



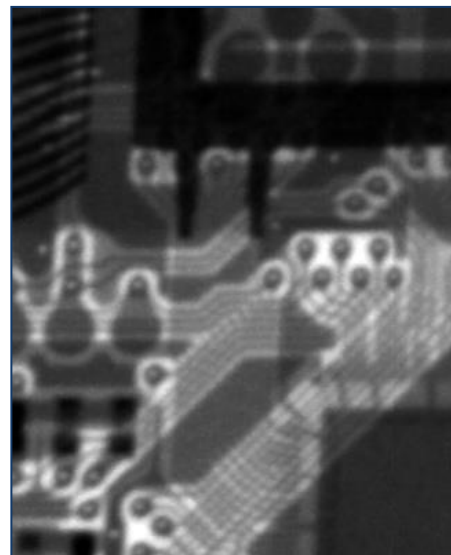
Traditional LDA (50um)



TDI (48um)



Traditional LDA zoomed-in view



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

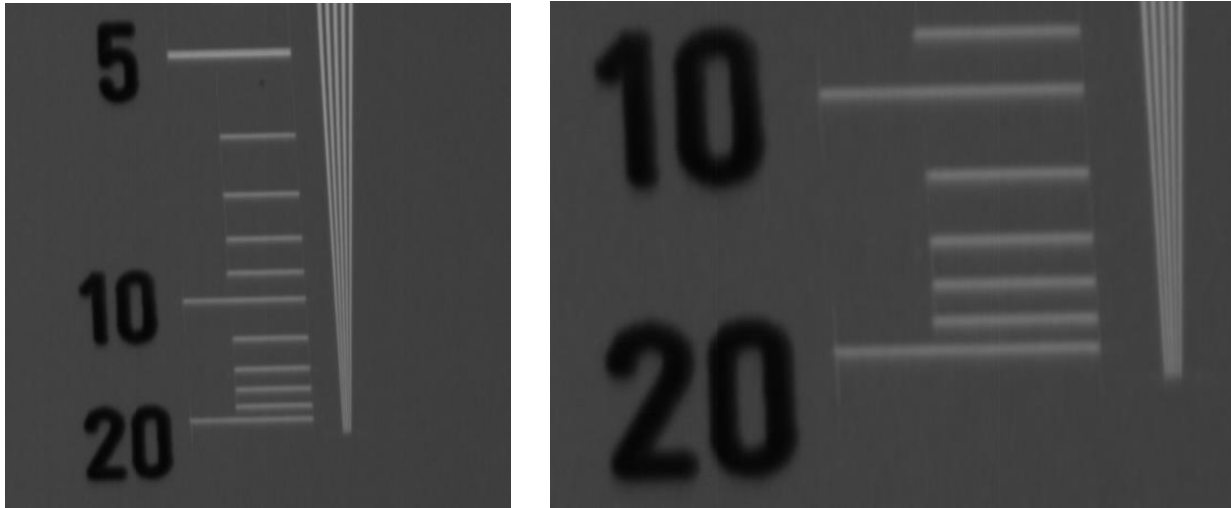
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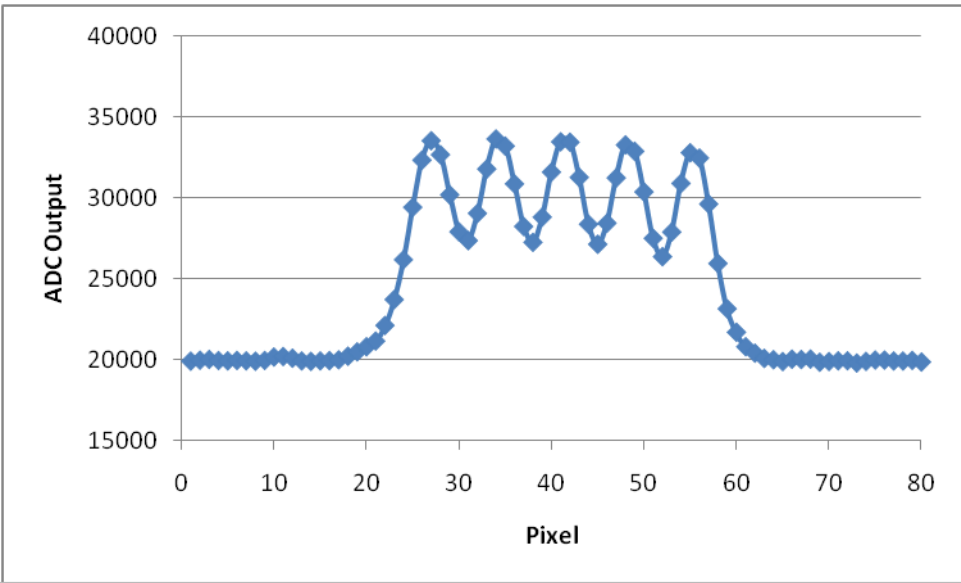
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Resolution



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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