

Mixed Mode - Pixel Array Detector



Applications

- Ptychography
- X-ray Photon Correlation Spectroscopy (XPCS)
- Coherent Diffractive Imaging (CDI)
- Total Scatter (SAXS & WAXS)

Features

- $> 4.7 \times 10^7$ photons/pixel single frame dynamic range or an equivalent sustained count rate of 5×10^8 photons/pixel/second
- Frame rates up to 1.1 kHz
- Silicon (Si) sensor for up to 20 keV energies or CdTe sensor for greater than 20 keV energies
- Includes EPICS control interface and/or proprietary Sydor control interface

The Sydor MM-PAD is a single photon sensitive, direct x-ray imaging detector with an ultra-wide dynamic range. It has an unprecedented full well capacity and a dynamic range that is orders of magnitude higher than commercially available, active gain detectors. These properties make the MM-PAD ideal for x-ray scatter applications such as: ptychography, Coherent Diffractive Image (CDI), Small Angle X-ray Scattering (SAXS) and Wide Angle X-ray Scattering (WAXS).

The “mixed mode” operation of this device results in a full well capacity of greater than 4.7×10^7 photons/pixel/frame and a sustained count rate of 5×10^8 photons/pixel/second. Taking advantage of analog and digital data management techniques, in-pixel electronics sense when a pixel is nearing saturation, removes the charge, and simultaneously stores the number of times this occurs during each exposure. Unlike simpler photon counting detectors, there is no “dead” time where a photon could be missed due to detector processing architecture.

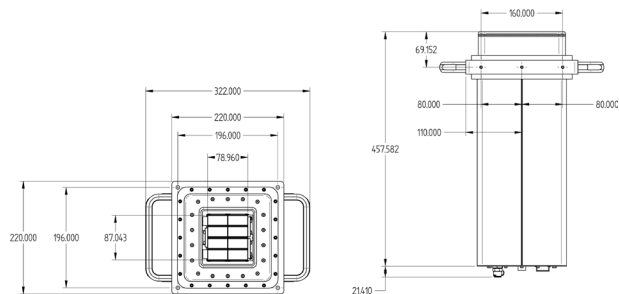
The standard detector head configuration is 512 x 512 pixels and is formed by a 2 x 4 array of submodules, each submodule having 256 x 128 pixels, at a pixel pitch of 150 μm . For experiments with x-ray energies at 20 keV or below, submodules based on silicon (Si) sensor substrates are available. For experiments expecting x-ray energies above 20 keV, submodules are available with a cadmium telluride (CdTe) sensor substrate.

The MM-PAD has a minimum inter-frame time of 0.86 ms, frame rates of up to 1.1 kHz, and sustained photon count rates of 5×10^8 photon/pixel/second. At 8 keV, read noise is ~ 0.5 photons/pixel and dark currents are 2 photons/pixel/second. A thermoelectric cooling system is integrated with the MM-PAD to maintain low dark current. Cooling and general detector functions are controlled via ethernet connection to the user’s PC and support the EPICS control interface or a proprietary Sydor control interface.

Product Specifications

- **Sensor Material:** 500 μm thick Si or 750 μm CdTe
- **Sensor Format:** Eight submodules of 256 x 128 pixels. Standard detector array is a 512 x 512 pixel format
- **Pixel Pitch:** 150 μm
- **Full Well Capacity:** 4.7×10^7 photons/pixel/frame at 8 keV
- **Sustained Count Rate:** $\sim 5 \times 10^8$ photons/pixel/second
- **Read Noise:** ~ 0.5 photons/pixel @ 8 keV
- **Dark Current:** 2 photons/pixel/sec @ 8 keV
- **Frame Rate:** up to 1.1 kHz
- **Spectral Range:** up to 20 keV with Si sensor or greater than 20 keV with CdTe sensor
- **Cooling Method:** Thermoelectric Cooler (TEC) with water waste heat removal
- **Physical Dimensions:** 220 x 220 x 460 mm, < 8 kg
- **User Interface:** EPICS and/or proprietary Sydor Control Interface

Typical 512 x 512 Array Head



QE Curve for Si and CdTe Options

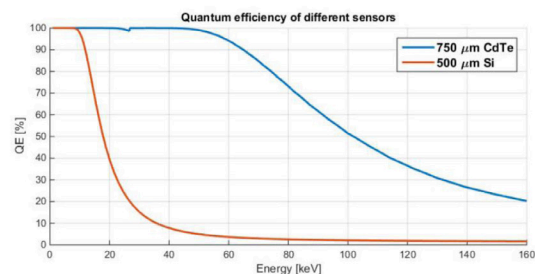


Figure 1. Quantum efficiency of 750 μm CdTe and 500 μm silicon sensors.