# ΛDVΛCΛM
## Imaging the Unseen

# W<small>IDE</small>*PIX* L®<sub>2(1)x10 - MPX3</sub>
## Datasheet

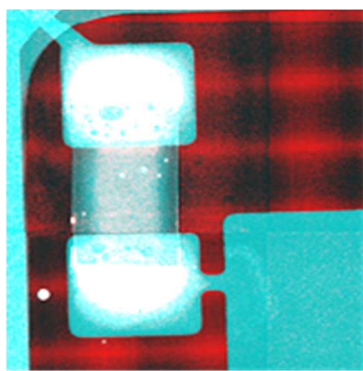| Model No.: | W2CMX3-Xxx1906dd |
| | WUCMX3-Xxx1906dd |
| | WLCMX3-Xxx1906dd |

# General features

Illustration of multichannel "color" radiographs where different materials are identified and imaged in different colors

The large area imaging detector **WIDEPIX L$_{2(1)x10 - MPX3}$** with resolution of 512 (256) x 2560 pixels is composed of Medipix3 hybrid detector electronics tiles. Each tile (256 x 256 pixels) is attached to a silicon or CdTe sensor. Therefore, the whole area of the **WIDEPIX L$_{2(1)x10 - MPX3}$** device is fully sensitive and there are no gaps between sensor tiles. Each pixel has two integrated 12-bit digital counters and two energy discrimination thresholds. The counters store number of registered particles, e.g. X-ray photons, with energy above the appropriate threshold. Both counters can be joined to a single 24-bit counter providing enhanced dynamic range. The particle counting principle eliminates any additional noise generated by the sensor or electronic readout. It allows acquiring X-ray images with very high contrast and wide dynamic range. Therefore, even low contrast structures such as plastic or soft tissue are easily detectable in X-ray images.

Both devices are suitable for CT scanners, which can take advantage of large sensitive area without any gaps. The **WIDEPIX L$_{1x10 - MPX3}$** variant moreover supports a hardware-based Time-Delayed-Integration mode for online (continuous) scanning applications.

The energy discrimination thresholds of Medipix3 technology allow spectral X-ray imaging. Different materials in an inspected sample could be then identified based on their spectral X-ray attenuation properties. Energy spectra could be measured typically from 5 keV upwards.

The Charge Summing Mode implemented in the pixel electronics provides hardware-based correction of signal cross talk between pixels. This further considerably improves the detector spectral response and therefore also quality of spectra measured in individual pixels.

The camera is connected to a computer via three ethernet cables.

# Main Features

- Readout chip type .................................... Medipix3
- Pixel size ................................................ 55 x 55 µm
- Sensor resolution .................................... 512 (256) x 2560 pixels
- Dynamic range in one frame .................... 12-bit / 24-bit[1]
- Dark current ........................................... none
- Interface ................................................ 2x RJ45 1Gbit/s ethernet
- Maximum frame rate .............................. up to 80 (170) fps[1]
- Dimensions ............................................. 280 x 153 x 42 mm
- Weight .................................................... 3000 g

[1] Depends on operation mode.

# Device parameters

## Operating conditions

| Symbol | Parameter | Min | Typ | Max | Units | Comment |
|--------|-----------|-----|-----|-----|-------|---------|
| $T_A$ | Temperature Range | 0 | 30 | 40 | °C | |
| Φ | Humidity | | 55 | 60 | % | Not condensing |
| | IP Code | | IP50 | | | |
| | Pressure range | | >80 | | kPa | Atmospheric operation |
| | | | <1 | | Pa | Vacuum operation |

*Warning: Disconnect the device from power during pumping down or venting the vacuum chamber!
Location: Intended for indoor use, dust free.

## Family parameters
$T_A$ = 25°C, $V_{CC}$ = 24V

| Symbol | Parameter | WidePIX L 1x10 - MPX3 | WidePIX L 2x10 - MPX3 | Units | Comment |
|--------|-----------|------------------------|------------------------|-------|---------|
| $V_{CC}$ | Supply Voltage | 20/24/26 | | V | Min/Typ/Max |
| $I_{CC}$ | Supply Current ($V_{CC}$ = 24V) | 0.7/1.34 | 1.6/3.2 | A | Typ/Max |
| P | Power dissipation | 18/36 | 32/64 | W | Typ/Max |
| A | Sensor Area | 141 x 14.1 | 141 x 28.2 | mm | |
| | Detector Resolution | 2560 x 256 | 2560 x 512 | Pixels | |
| f | Frame Rate[1] | 50 | 20 | fps | |
| $T_{READ}$ | Readout Time[2] | 20 | 50 | ms | |
| m | Weight | 3300 | 3500 | g | |

## Modes of readout chip operation

| Type | Mode | Bit depth | Description |
|------|------|-----------|-------------|
| Frame (reading all pixels) | SPM-1CH | 12/24 bit/frame | Single Pixel Mode using one counter: Every pixel works independently of its neighbors. One energy threshold (energy channel) is available. 1 output image: Number of events per pixel |
| | SPM-2CH | 12 bit/frame | Single Pixel Mode using both counters: Every pixel works independently of its neighbors. Two energy thresholds (energy channels) are available. 2 output images: Number of events per pixel |
| | CSM | 12/24 bit/frame | Charge Summing Mode: The charge from 4 adjacent pixels is summed and is assigned to the pixel with the largest charge deposition. The event is counted only if the sum of signals exceeds the energy threshold. 1 output image: Number of events per pixel |

[1] Operating parameters: Shutter time=1ms, Mode = CSM or SPM-1Ch 12bit resolution.

[2] During Readout time (or Dead time), no charge is collected from the sensor.

[3] Except CSM mode Silicon sensor.

# Energy range and resolution

Typical values for 300 µm Silicon sensor, $T_A$ = 20°C.

| Range | Mode | Min Energy [keV] | Max Energy [keV] |
|---|---|---|---|
| Super Narrow | SPM | 2.5 - 4.0 | 100 - 110 |
| Narrow | SPM | 2.5 – 4.0 | 160 - 180 |
| | CSM | 6.0 | - |
| Broad | SPM | 5.0 – 6.5 | 260 - 290 |
| | CSM | 8.0 | - |

Typical values for 1000 µm CdTe sensor, $T_A$ = 20°C

| Range | Mode | Min Energy [keV] | Max Energy [keV] |
|---|---|---|---|
| Super Narrow | SPM | 5 – 10 | 150 – 170 |
| | CSM | 5 – 10 | 150 – 160 |
| Narrow | SPM | 5 – 10 | 170 – 190 |
| | CSM | 5 – 10 | 260 – 270 |
| Broad | SPM | 5 – 10 | 220 – 240 |
| | CSM | 5 – 10 | 460 – 470 |

* resolution in Sigma of gaussian fit.

# Sensor parameters

Sensor material

| Symbol | Parameter | Si | | CdTe | Units | Comment |
|---|---|---|---|---|---|---|
| | Thickness | 300 | 500 | 1000 | µm | |
| $V_{bias}$ | Bias Voltage | 200 | 300 | -450 | V | Max |
| | Typical detectable energy range for X-rays* | up to 60 | | up to 600 | keV | See chart below |
| | Pixel size | 55 x 55** | | | µm² | |

* to get true detector response, detectable energy and quantum efficiency of sensor chip has to be combined with energy range of readout chip (see chapter "Energy range and resolution")
** Pixels on tile borders are 2.5 times larger in one direction. The corner tile pixels are 2.5 times larger in both directions.

Detection efficiency - Al contact 500 nm, doping 1 um
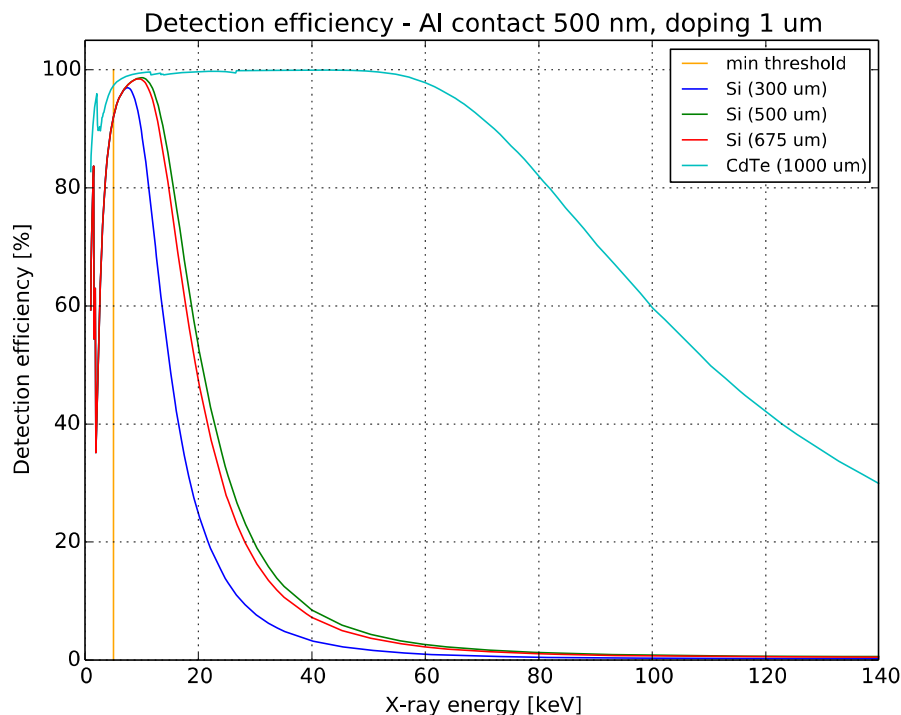
# Device description
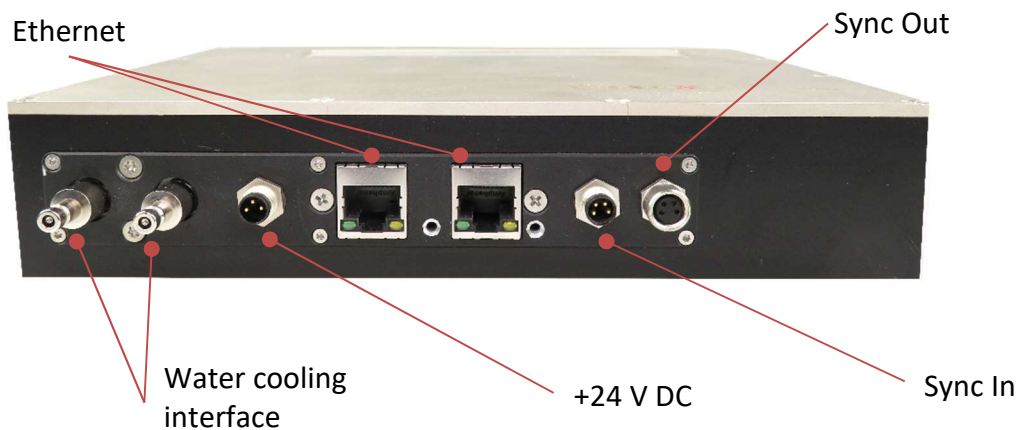


## Ethernet connectors
2x RJ45 1Gbit/s ethernet connectors.

## +24 V DC connector
Main power supply (via standard M8 connector with 3 female contacts) Connect after plugging USB connector.

# Water cooling interface

It is mandatory to cool down detector when in operation. **WIDE*PIX* L$_{2(1)x10 - MPX3}$** uses water connectors that allow for quick disconnection/reconnection. Mating connector is included as standard accessories and has to be attached to 4x6 mm plastic hose.

# Synchronization interface (optional)

Two 4-pin M8 connectors (female for outputs and male for input) serve as synchronization interface, allowing to synchronize **WIDE*PIX* L$_{2(1)x10 - MPX3}$** detector with external processes. Four signals are available:

- **Ready in** – measurement is not possible, when signal at logical zero
- **Trigger in** – logical zero starts shutter (measurement)
- **Ready out** – logical one if device is ready to for new shutter
- **Trigger out** – mirrors shutter (logical zero when shutter is active)

All signals are TTL compatible and 5V tolerant. For detailed description see **Synchronization Guide**.

| Sync. Outputs (M8-4Female) | | Sync. Inputs (M8-4Male) | |
|---|---|---|---|
| Pin | Signal | Pin | Signal |
| 1 | Gnd | 1 | Gnd |
| 2 | Trigger Out | 2 | Trigger In |
| 3 | Ready Out | 3 | Ready In |
| 4 | Reserved | 4 | Reserved |

# Mechanical dimensions
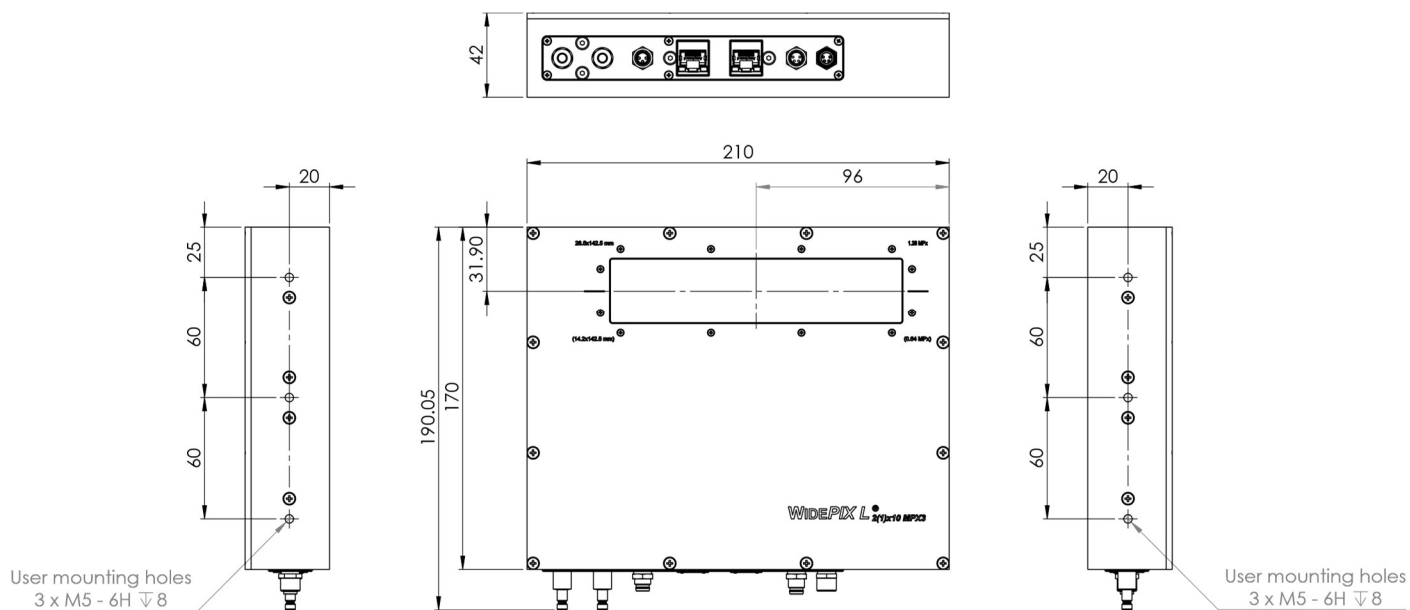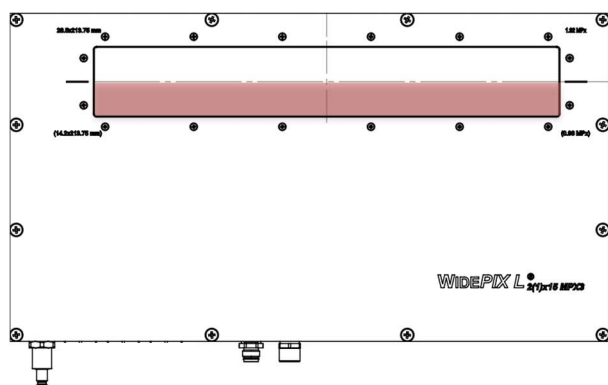


All dimensions are in mm.
* Sensitive surface distance from top of the box may vary depending on actual sensor thickness.
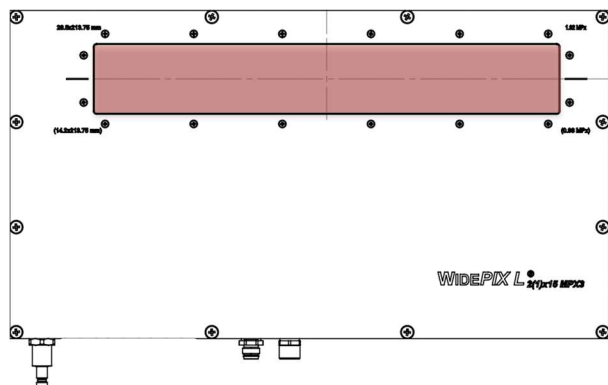
# Sensitive area

## Sensitive area for models **WUCMX3**-XxxYYMMDD (single upper row)
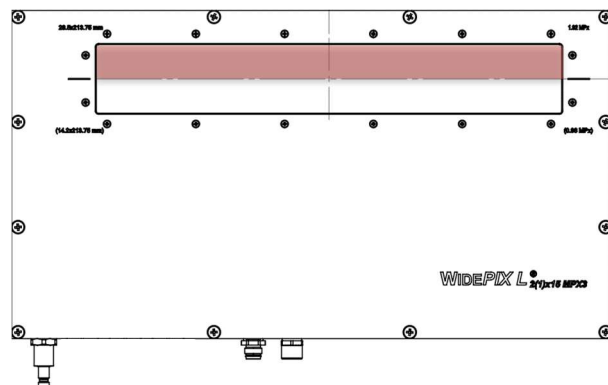


## Sensitive area for models **WLCMX3**-XxxYYMMDD (single lower row)



## Sensitive area for models **W2CMX3**-XxxYYMMDD (two rows)

# Model Number Codes

Example:                                    **W2B  MX3  -  X  C  A  180817**

**Device name:**

W2B – WidePIX L 2x10
WUB – WidePIX L 1x10 – upper row
WLB – WidePIX L 1x10 – lower row

**Device modification:**

Medipix3 chips

**Sensor type:**

E – Edgeless silicon
C – CdTe

**Sensor thickness:**

3 – 300 µm
5 – 500 µm
A – 1000 µm

**Device version date:**

YY MM DD

# Release history

| Date | Changes |
|---|---|
| 17/02/22 | 1st release |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

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# Warning

<div style="border: 1px solid red;">
Do not touch sensor surface!
</div>

## Instructions for safe use

To avoid malfunction or damage to your **WIDE*PIX* L$_{2(1)x10 - MPX3}$** please obey the following:

• Do not expose to water or moisture **WIDE*PIX* L$_{2(1)x10 - MPX3}$** is dust protected only.

• Do not open **WIDE*PIX* L$_{2(1)x10 - MPX3}$** case. Detector wire-bonding connections may be irreversibly damaged.

• Do not operate detector when not properly water cooled. Otherwise detector temperature may rise above the specified range.

## Copyright

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|---|---|
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