# WidePIX

## CHROMATIC 15
## CHROMATIC 30

former name: WIDE*PIX L* 2(1)x15 - MPX3
Model No.: WxCM3x-Xxx210721



Datasheet

**∧DVACAM**
Imaging the Unseen
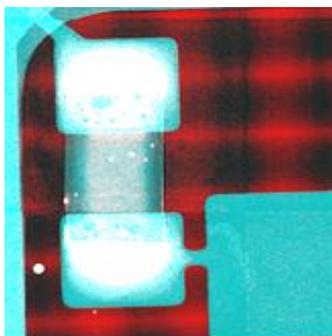
## General features





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

The large area imaging detectors **WidePIX CHROMATIC 30** (Double Row) with resolution of 512 x 3840 pixels and **WidePIX CHROMATIC 15** (Single Row) with resolution of 256 x 3840 pixels are 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 CHROMATIC** 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 CHROMATIC 15** (Single Row) 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's spectral response and therefore also quality of spectra measured in individual pixels.

The camera is connected to a computer via an ethernet cable.

## Main Features

- Readout chip type......................................Medipix3
- Pixel size[1]......................................................55 x 55 µm$^2$
- Sensor resolution........................................512 (256) x 3840 pixels
- Dynamic range in one frame[2].................12-bit / 24-bit
- Dark current.................................................none
- Interface........................................................3 x RJ45 1Gb/s ethernet
- Maximum frame rate[2]................................up to 90 (170) fps
- Dimensions...................................................170 x 280 x 42 mm
- Weight............................................................3300 g

[1] 55 x 110 µm$^2$ at the edges and 110 x 110 µm$^2$ at the corners
[2] Depends on operation mode.

# Device parameters

## Operation conditions

| Symbol | Parameter | Value | Units | Comment |
|--------|-----------|-------|-------|---------|
| $T_a$ | Operating ambient temperature range[1] | 0-40 | °C | |
| Φ | Humidity | < 60 | % | Not condensing |
| IP | IP rating | IP50 | | |

[1] With temperature stabilization – see the paragraph below.

## Water cooling interface

Temperature stabilization of the device required when in operation. **WidePIX CHROMATIC** uses water connectors that allow for quick disconnection/reconnection. Mating connector is included as standard accessories and must be attached to 4x6 mm plastic hose.

| ⚠️ | Temperature of the cooling water must be within range 21 ± 4 °C.<br>Max. pressure in the water-cooling system: 1,2 bar.<br>The device will automatically shut down after chip or CPU temperature exceeds 55 °C.<br>Intended for dust free indoor use. |
|----|----|

## Device specification

$T_a$ = 22 °C, $V_{CC}$ = 12 V

| Symbol | Parameter | WidePIX CHROMATIC 15 (Single Row) | WidePIX CHROMATIC 30 (Double Row) | Units | Comment |
|--------|-----------|-----------------------------------|-----------------------------------|-------|---------|
| $V_{CC}$ | Supply Voltage | 12 ±10 % | | V | |
| $I_{CC}$ | Supply Current | 2/4 | 4,8/9,6 | A | Typ/Max |
| P | Power dissipation | 24/48 | 58/115 | W | Typ/Max |
| m | Weight | 3300 | 3500 | g | |

## Chip parameters

| Symbol | Parameter | WidePIX CHROMATIC 15 (Single Row) | WidePIX CHROMATIC 30 (Double Row) | Units | Comment |
|--------|-----------|-----------------------------------|-----------------------------------|-------|---------|
| A | Sensitive area | 211,5 × 14,1 | 211,5 × 28,2 | mm² | |
| | Detector resolution | 3840 × 256 | 3840 × 512 | Pixels | |
| | Pixel size[1] | 55 x 55 | 55 x 55 | μm² | |
| f | Frame rate[2] | 170 | 90 | fps | |
| $T_{READ}$ | Readout time[3] | 6 | 11 | ms | |

[1] 55 x 110 μm² at the edges and 110 x 110 μm² at the corners.
[2] Operating parameters: Shutter time = 1 ms, Mode = CSM or SPM-1CH 12bit resolution.
[3] During Readout time (or Dead time), no charge is collected from the sensor.

## Sensor parameters

| Parameter | Si | CdTe | Units | Comment |
|---|---|---|---|---|
| Thickness | 500 | 1000 | µm | |
| Bias Voltage | 150 | – 450 | V | Max |
| Minimum energy threshold | 5,0 | 8,0 | keV | Typical, $T_A$=22 °C |
| Typical detectable energy range for X-rays[1] | up to 60 | up to 600 | keV | See chart below |

[1] To get true detector response, detectable energy and quantum efficiency of sensor chip must be combined with energy range of readout chip.

### Single row
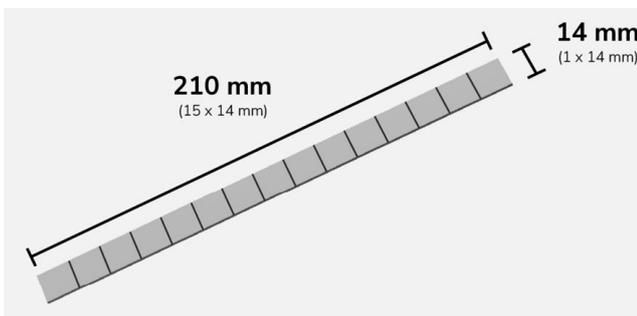


WidePIX CHROMATIC 15 (Single Row)

### Double row
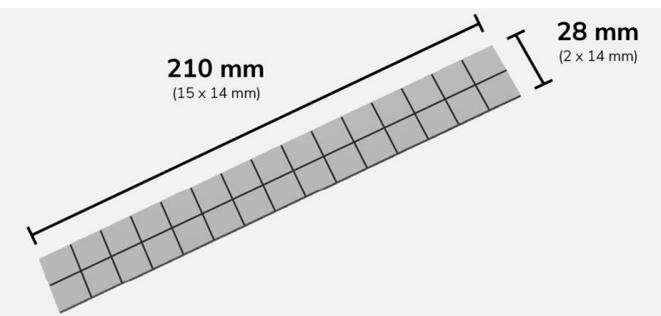


WidePIX CHROMATIC 30 (Double Row)

The detector is built from configurable arrays of 14 × 14 mm readout chips bump-bonded to the sensor layer:
**Silicon sensors** are monolithic up to 70 × 28 mm. Larger areas use multiple monolithic pieces.
**CdTe sensors** are composed of individual 14 × 14 mm tiles assembled into the final area.

## Threshold setting

Energy threshold is the minimum photon energy a pixel must receive in order to be counted as an event.

Typical values for 500 µm **silicon sensor**, $T_a$ = 22 °C.

| Range | | Mode | Energy threshold [keV] |
|---|---|---|---|
| Super Narrow[2] | Very narrow range, low-energy optimized. | SPM | 5,0 up to ~ 60 |
| | | CSM | Not supported |
| Narrow | Standard calibration mode | SPM | 5,0 up to ~ 120 |
| | | CSM | 5,0 up to ~ 300 |

Typical values for 1000 µm **CdTe sensor**, $T_a$ = 22 °C

| Range | | Mode | Energy threshold [keV] |
|---|---|---|---|
| Super Narrow[2] | Very narrow range, low-energy optimized. | SPM | 8,0 up to ~ 60 |
| | | CSM | 8,0 up to ~ 60 |
| Narrow | Standard calibration mode | SPM | 8,0 up to ~ 150 |
| | | CSM | 8,0 up to ~ 300 |
| Broad[2] | Used for higher-energy photons; wider usable range. | SPM | 8,0 up to ~ 250 |
| | | CSM | 8,0 up to ~ 500 |

[2] The detector is calibrated for Narrow Gain Mode by default; other gain modes are available on request

## Detector efficiency
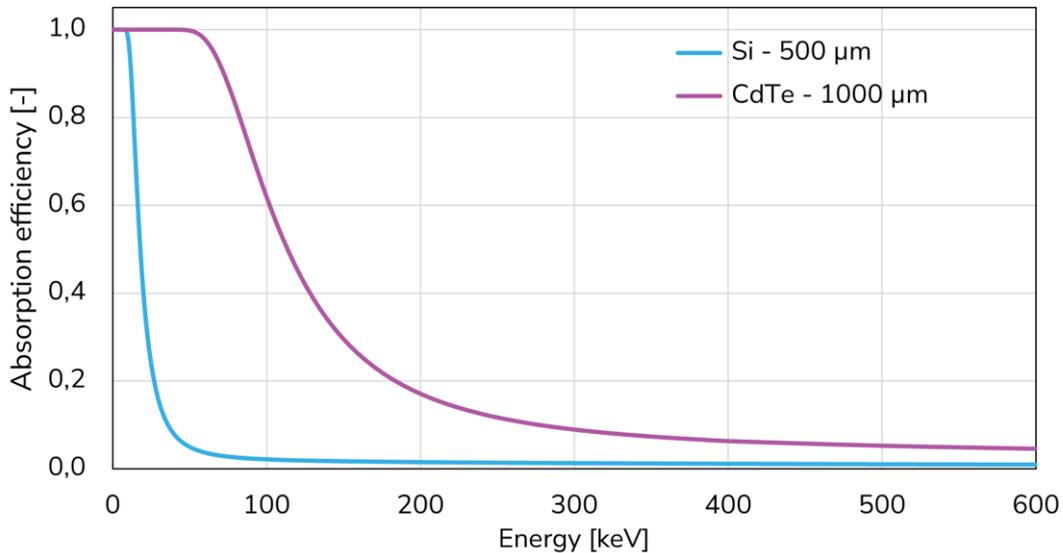


## Basic principles, measurement types and operational modes

The ionizing radiation particle interacts with the sensor material creating an electric charge. This charge is collected by electric field and brought to pixel preamplifier where it is amplified and shaped forming triangular voltage pulse. The amplitude and duration of this pulse is proportional to energy deposited by particle within the pixel. The situation when the voltage pulse amplitude in particular pixel exceeds preselected threshold value is called "event" or "hit".

Each pixel contains two digital counters (12 and 12 bits). These counters are used differently according to measurement type and mode. List of operational modes and their description is provided in the table below.

| 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 second energy threshold. 1 output image: Number of events per pixel |

All modes can be operated at three ranges: Broad / Narrow / Super Narrow (Except Broad range and combination of Super narrow mode with CSM with silicon detectors).

# Device description



Water cooling interface    +12 V    Ethernet    IP reset    Sync. In    Sync. out    GND M3
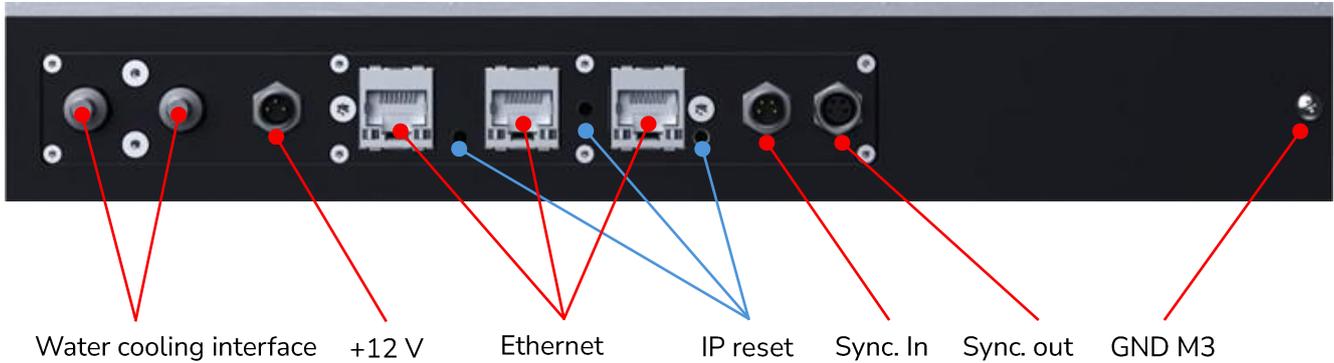
## Ethernet connector

3 x RJ45 1 Gbit/s ethernet connector

## Power supply: +12 V DC connector

Main power supply is connected via standard M8 connector with 3 female contacts. Connect after plugging ethernet cable. Connect the power adapter to the device first, then to the wall socket.

## Synchronization interface (optional)

Two 4-pin M8 connectors (female for outputs and male for input) serve as synchronization interface, allowing to synchronize **WidePIX CHROMATIC** 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 5 V tolerant. For a detailed description see **Synchronization Guide for WidePIX Chromatic** in the WidePIX Chromatic Manual.

| 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

The following drawings illustrate the standard connection setup of **WidePIX CHROMATIC 30** (Double Row) and **WidePIX CHROMATIC 15** (Single Row).
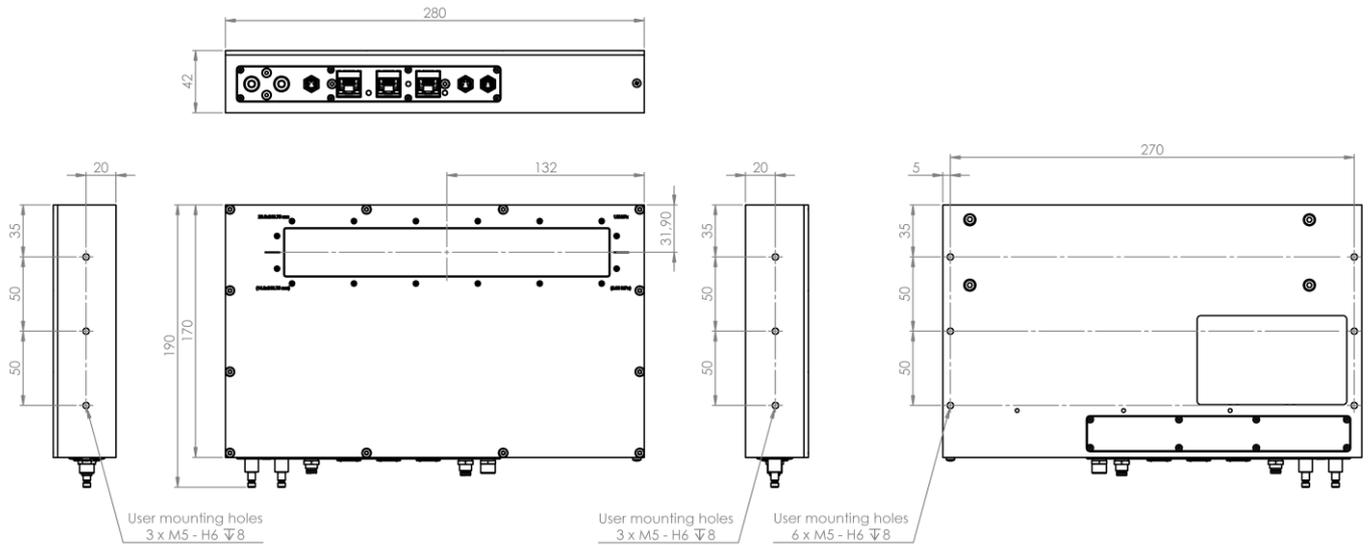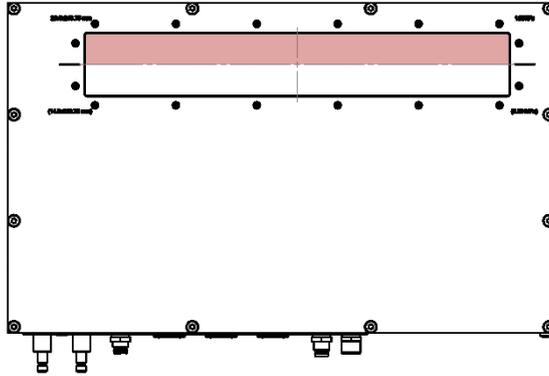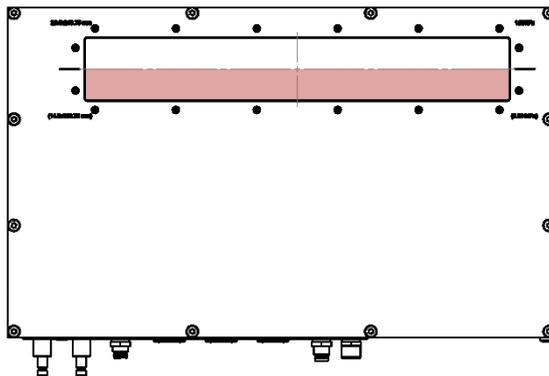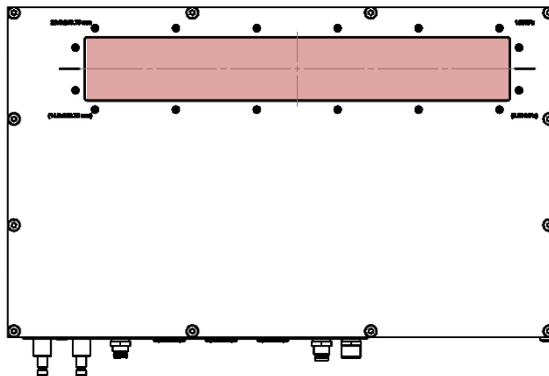


All dimensions are in mm.

# Sensitive area

Sensitive area for models **WUCM3B**-XxxYYMMDD (single upper row)

Sensitive area for models **WLCM3B**-XxxYYMMDD (single lower row)

Sensitive area for models **W2CM3B**-XxxYYMMDD (two rows)

# Instructions for safe use

|  | **Do not touch sensor surface!** |
|---|---|

To avoid malfunction or damage to your **WidePIX CHROMATIC** please obey the following:

- Do not expose to water or moisture **WidePIX CHROMATIC** is dust protected only.
- Do not open **WidePIX CHROMATIC** 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. Recommended temperature is 22 °C.
- The protection provided by this product may be impaired if it is used in a manner not described in this document.

## Disposal

 Do not dispose of these instruments as unsorted municipal waste. Please use separate collection facilities or contact the supplier from whom the instrument was purchased. Ensure discarded electrical waste is properly recycled to reduce environmental impact.

# Release history

| Date (YY/MM/DD) | Changes | Changed by |
|---|---|---|
| 19/07/28 | Preliminary version | |
| 21/06/26 | ETH version | |
| 23/03/14 | New drawings and corrected versions | |
| 23/08/08 | Supply Voltage changed from 24 V to 12 V | |
| 23/09/05 | Default gain mode added | |
| 24/02/15 | Datasheet revision | J. Baborák |
| 24/06/28 | Water cooling details added | J. Baborák |
| 24/07/02 | New graphic style of the document | P. Bloudek |
| 24/07/23 | Minor format changes | J. Baborák |
| 24/10/23 | IP reset pointer added | J. Baborák |
| 26/02/24 | New graphic style of the document, rebranding and revision | P. Bloudek, S. Valtera |