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# ADVAPIX

## Datasheet

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Model No.: APXMDE-Xxx170208  
APXMDE-Xxx170714



## General features

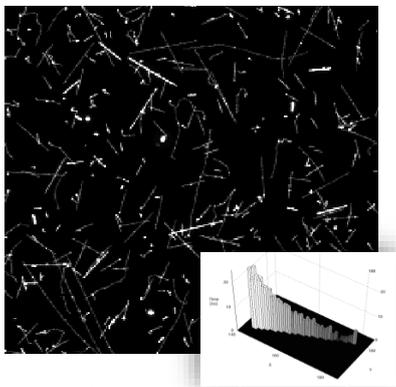


Illustration of single particle sensitivity of Timepix device. The tracks of different particles of radiation background (mostly muons and few protons) were recorded in 5 minutes on board of airplane. No noise (clean zero) is seen in dark regions. Inset shows the time profile along one muon track. Inset shows the time profile along one muon track.

**AdvAPIX** modules were designed with special emphasis to performance and versatility which is often required in a scientific experimental work. The fast modules with Si or CdTe pixel detectors Timepix can be used in different configurations such as stack of several layers or tiling to cover larger area or combination of both. Each module contains single Timepix device with fast parallel readout up to per second independent of frame occupancy. A separate USB 3.0 communication channel for each device assures fast read-out of the whole modular system. All modules in the system can be operated synchronously or triggered independently. The sensor type and thickness is of customer's choice.

The **AdvAPIX** can be used in a variety of applications such as fast radiography (X-rays, neutrons, ions), spectroscopic imaging (each pixel records the energy spectrum), particle tracking, time-of-flight imaging, multilayer Compton camera (thin top sensor, thick bottom sensor) and many other. The sensors can be adapted for neutron imaging by deposition of converter layers<sup>1</sup>. The spatial resolution in some applications (slow neutrons) can reach units of microns or even sub-micrometric level (ions).

## Main Features

- Readout chip type ..... TimePIX
- Pixel size ..... 55 x 55  $\mu\text{m}$
- Sensor resolution ..... 256 x 256 pixels
- Dynamic range in one frame ..... 11 810<sup>2</sup>
- Time resolution ..... 20 ns
- Sensor material ..... 100, 300, 500  $\mu\text{m}$  Si, 1000  $\mu\text{m}$  CdTe
- Power ..... External or via second USB 3.0
- Interface ..... USB 3.0 (Super-Speed)
- Maximum readout speed ..... 1700 fps
- Dimensions ..... 125 x 79 x 25.5 mm
- Weight ..... 503 g

<sup>1</sup> Convertors based on 6LiF or 10B4C for slow neutrons (efficiency up to 4%) or PE for fast neutrons.

<sup>2</sup> A final picture can be created as sum of individual images. The dynamic range is limited only by the measurement time.



## Device parameters

### Operating conditions

Symbol	Parameter	Value	Units	Comment
TA	Ambient Temperature Range	0-50	°C	
Φ	Humidity	<80	%	Not condensing
	Altitude*	<2000	m	Above sea level
IP	IP rating	IP40		With cover

\*for use in vacuum chamber, operate only with air pressure lower than  $10^{-3}$ Pa. **Warning:** Disconnect the device from power during pumping down or venting the vacuum chamber!

Location: Intended for indoor use, dust free.

### Electrical Specification

T<sub>A</sub> = 25°C, USB voltage V<sub>CC</sub> = 4.8V

Symbol	Parameter	Min	Typ	Max	Units	Comment
V <sub>CC</sub>	Supply Voltage	4.0	5.0	5.5	V	
I <sub>CC</sub>	Supply Current					
I <sub>CC1</sub>	Chip active		800	1500	mA	
P1	Power Dissipation			7.5	W	
<b>I/O Conn. Input CMOS 0-2.5 (pin 4,6)</b>						
V <sub>INL</sub>	Voltage Low	0		0.9	V	
V <sub>INH</sub>	Voltage High	1.6		2.5	V	
<b>I/O Conn. Output CMOS 0-2.5 (pin 3,5)</b>						
V <sub>OUTL</sub>	Voltage Low	0		0.45	V	
V <sub>OUTH</sub>	Voltage High	2.05		2.5	V	
<b>I/O Conn. Input CMOS 0-3.3V (pin 8,10)</b>						
V <sub>INL</sub>	Voltage Low	0		1.15	V	
V <sub>INH</sub>	Voltage High	2.15		3.3	mV	
<b>I/O Conn. +5V (pin 2)</b>						
I <sub>MAX</sub>	Maximum current	0		0.5	A	
V <sub>+5V</sub>	Pin Voltage		4.5		V	V <sub>CC</sub> – 0.5V
<b>Bias Voltage Source for Sensor Diode</b>						
V <sub>BIAS</sub>	Bias Voltage	0		±450	V	Polarity is sensor dependent

### Performance characteristics of Timepix

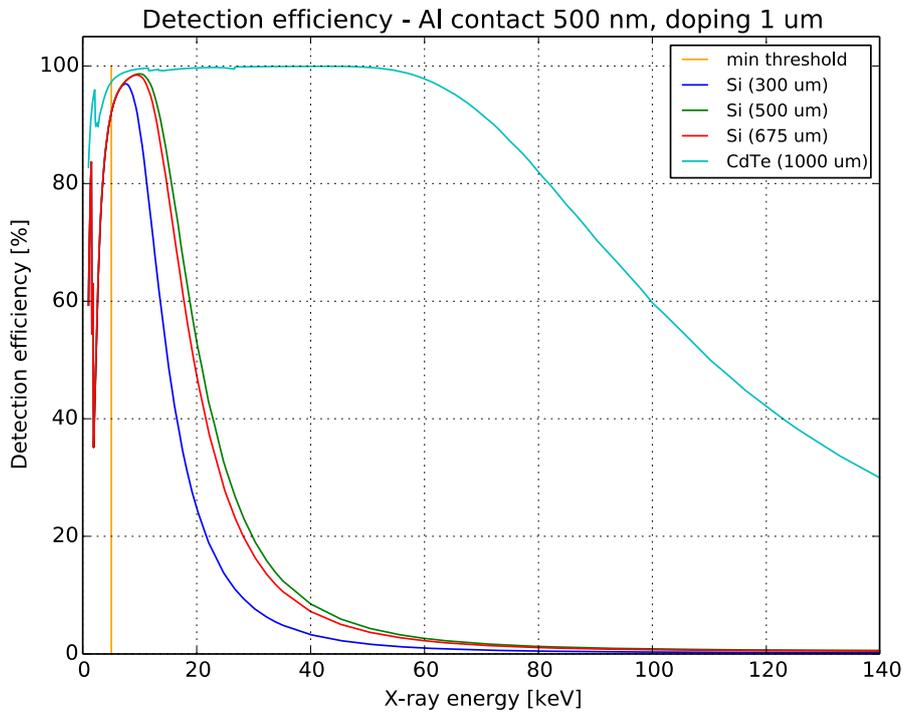
Symbol	Parameter	Min	Typ	Max	Units	Comment
F <sub>READ</sub>	Read-out frequency			1700	MHz	with USB 3.0 cable
T <sub>READ</sub>	Frame Readout Time		588		µs	with USB 3.0 cable
dT	Time resolution	20	100		ns	



## Sensor parameters

T<sub>A</sub> = 25°C

Symbol	Parameter	Si			CdTe	Units	Comment
		100	300	500			
	Thickness	100	300	500	1000	μm	
σ	Energy resolution of energy discrimination threshold (σ @ 23 keV)	0.5			1.1	keV	
σ	Energy resolution of energy discrimination threshold (σ @ 60 keV)	0.6			1.5	keV	
σ	Energy resolution in full spectral mode (σ @ 23 keV)	0.7			3.0	keV	
σ	Energy resolution in full spectral mode (σ @ 60 keV)	1.0			3.6	keV	
	Typical detectable energy range for X-rays <sup>4</sup>	5 to 60			5 to 500	keV	See chart below
	Pixel size	55			55	μm	

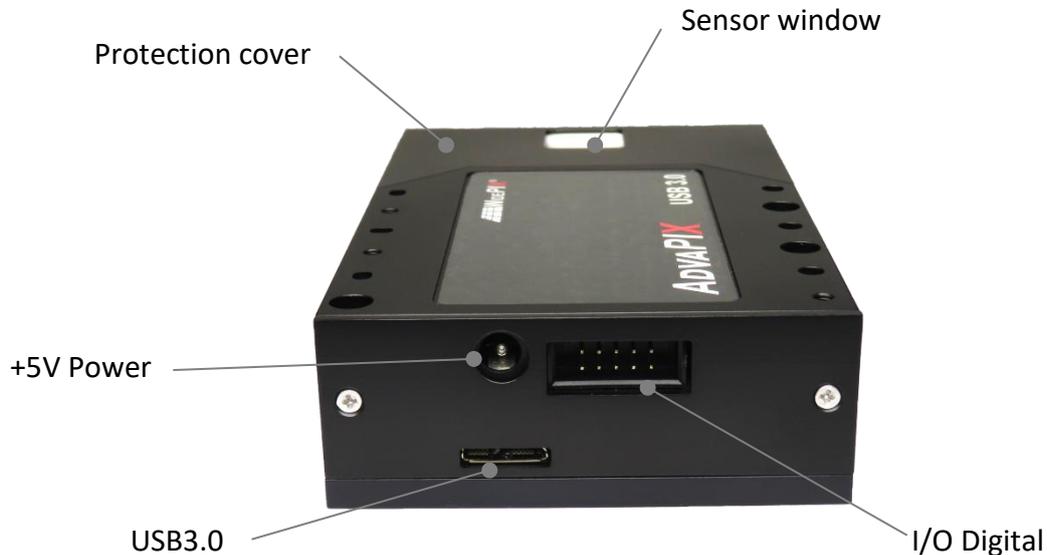


## Modes of readout chip operation

Type	Mode	Precision	Description
Frame (reading all pixels)	Event	13bit/frame	1 output image: Number of Events per pixel
	ToT	13bit/frame	1 output image: Sum of all Energies deposited in given pixel(Time Over Threshold)
	ToA	13bit/frame	1 output image: Time of arrival of first event in given pixel



## Device description



### +5VDC connector

Main power supply (via standard 5.5/2.1mm barrel connector). Connect after plugging USB connector.

### USB 3.0 connector

USB type micro B, Standard USB 3.0 Super-Speed.

### I/O Digital connector

Signals on I/O Digital connector are used for synchronization purposes. For details see Synchronization guide for TPX. Input pins are **NOT** +5V compatible. Pin 2 (+5V) may be used for power of external circuitry. It is taken directly from +5VDC connector, protected by schottky diode (0.5A max)

Pin	Signal	Signal logic	Pin	Signal	Signal logic
1	GND	Power Ground	2	+5V	Power Output
3	Ready Out	CMOS 0-2.5V	4	Ready In	CMOS 0-2.5V
5	Trigger Out	CMOS 0-2.5V	6	Trigger In	CMOS 0-2.5V
7	Reserved	-	8	Ready Out	CMOS 0-3.3V
9	Reserved	-	10	Trigger Out	CMOS 0-3.3V

## Certificates

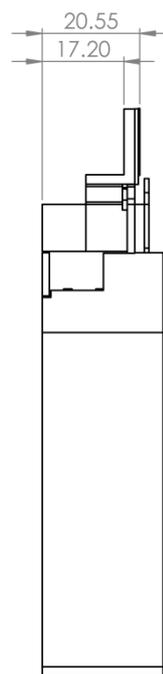
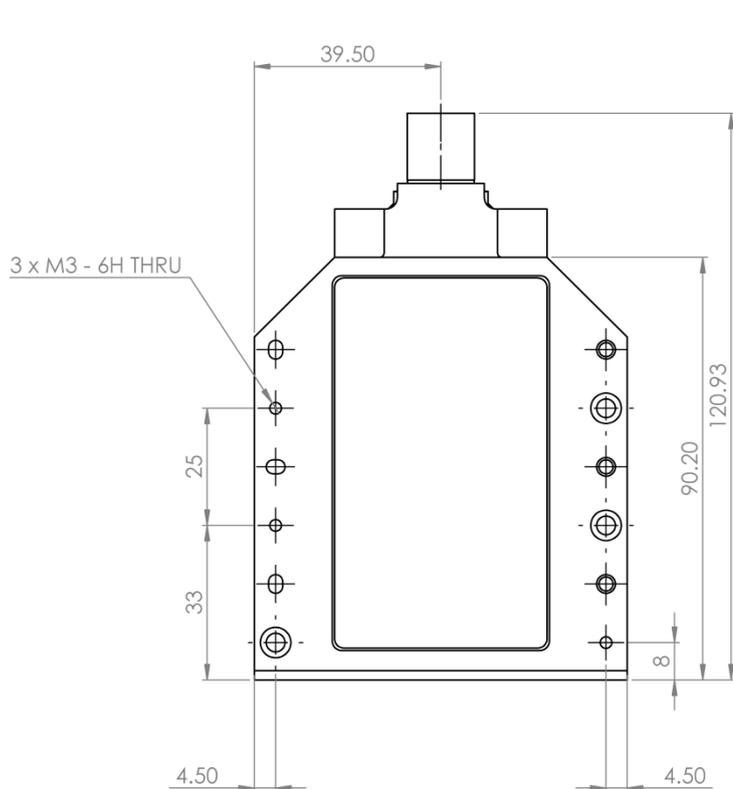
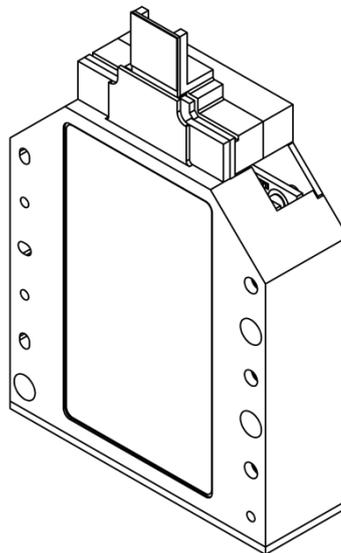
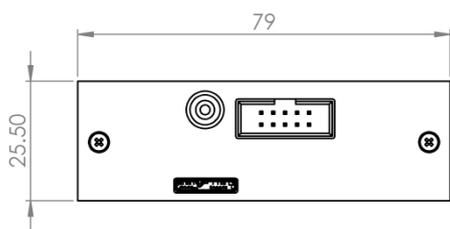
**ADVAPIX** has been tested by certification authority (Electrotechnical testing institute EZÚ) according to following standards:

Standard number	Name
EN 61010-1:2010	Safety Requirements For Electrical Equipment For Measurement, Control, And Laboratory Use
EN 61326-1:13	Electrical Equipment For Measurement, Control And Laboratory Use - EMC Requirements

## Mechanical dimensions

Without protection cover

**Do not operate without protection cover!**

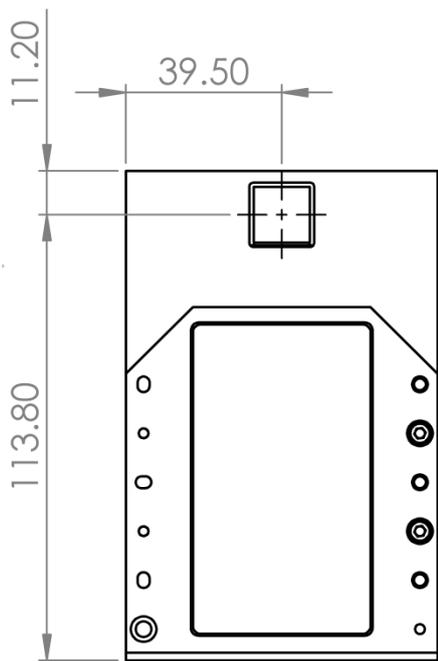
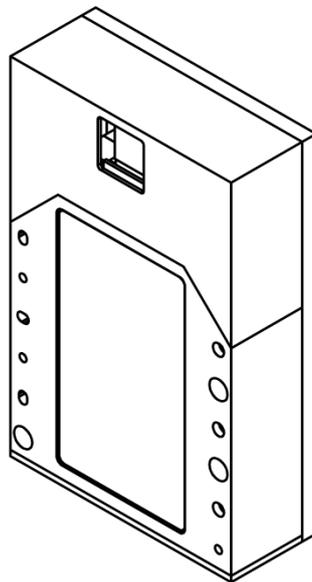
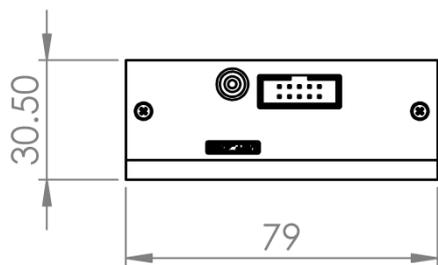


All dimensions are in mm.

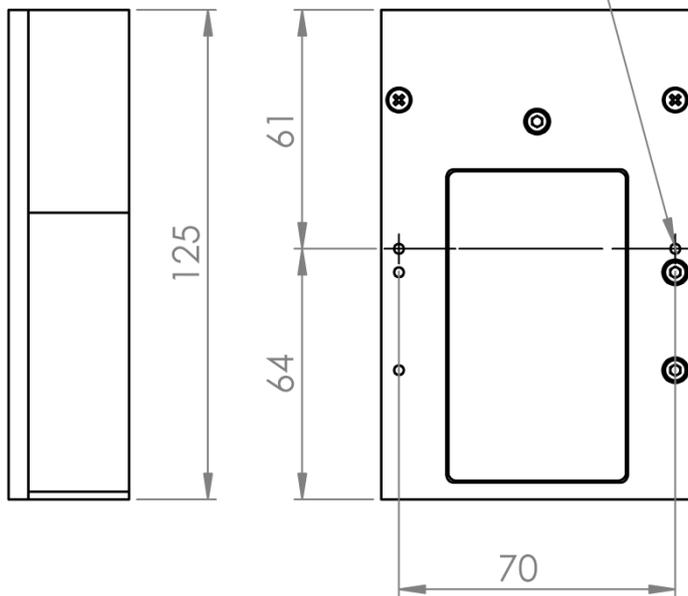
Extreme care must be taken when removing protecting cover and handling the **ADVAPIX** without the protecting cover. Warranty does not apply to mechanical damage of the sensor and wirebonds.



With protection cover



User mounting holes  
2 x M3 - 6H  $\nabla$  5



All dimensions are in mm.



## Model Number Codes

Example:

APX MDE - X P 3 170714

**Device name:**

APX – AdvaPIX

**Device modification:**

MDE – Timepix Module

**Sensor type:**

- P – Planar silicon
- E – Edgless silicon
- C – CdTe

**Sensor thickness:**

- 1 – 100 µm
- 3 – 300 µm
- 5 – 500 µm
- A – 1000 µm
- B – 2000 µm

**Device version date:**

YY MM DD

## Release history

Date	Changes
17/11/02	Model number codes added, new datasheet version
18/08/13	Synchronization connector corrected pinout and voltage levels
18/11/22	Temperature, and warning updated
19/08/30	EMC certificate numbers added



# Warning

**Do not touch sensor surface!**

## Instructions for safe use

To avoid malfunction or damage to your **ADVAPIX** please observe the following:

- Do not expose to water or moisture.
- Do not disassemble. Wire-bonding connection may be irreversibly damaged.
- Do not insert any object into the sensor window.
- Extreme care must be taken when removing the protecting cover or handling the **ADVAPIX** without the protecting cover. Warranty does not apply to mechanical damage of the sensor and wirebonds
- 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 these instruments as unsorted municipal waste. Please use separate collection facility to contact the supplier from which the instrument was purchased. Please make sure discarded electrical waste is properly recycled to reduce environment impact

## Copyright

ADVACAM s.r.o.  
U Pergamenky 1145/12  
170 00 Praha  
Czech Republic

Tel: +420 603 444 112  
Email:  
[info@advacam.com](mailto:info@advacam.com)  
[www.advacam.com](http://www.advacam.com)

