MiniPIX
Miniaturized and low power radiation camera

Key features	
Readout chip type	Timepix
Pixel size	55 x 55 μm
Sensor resolution	256 x 256 pixels
Dynamic range in one frame	11 082
Dark current	none
Interface	USB 2.0 (Full-Speed)
Maximum frame rate	55 fps
Dimensions	88.9 x 21 x 10 mm
Weight	30 g

The MINIPIX is miniaturized and low power solution of radiation camera with single particle counting (or particle tracking) detector Timepix. The standard MINIPIX system incorporates single Timepix detector (256 x 256 pixels with pitch of 55 μm) with sensor according to customer preference (standardly 300 μm thick silicon). It uses USB 2.0 interface capable to read up to 45 frames per second (with exposure time of 1 ms). The Timepix detector is energy sensitive which brings a new dimension to radiographic images.

The MINIPIX device is controlled via USB interface. The major operating systems are supported (MS Windows, Mac OS and LINUX). The complex software PIXET PRO used for detector operation is provided for free.

Several MINIPIX devices connected to single or several computers can be opera- ted together forming the radiation monitoring network. The whole group is accessed using advanced application allowing setting of alarm levels for different radiation types, performing data logging and calculating various statistics, protocols and charts. Such network can serve as long time monitor of environment[1]. Several other devices developed in IEAP CTU in Prague and produced by ADVACAM s.r.o. company can be also integrated into such monitoring network.

Example of the radiation monitoring network based on the first version of MINIPIX is operated in ISS (International Space Station). This network was installed by common effort of NASA, University of Houston and IEAP CTU in Prague. Devices and software was developed by IEAP CTU in Prague.
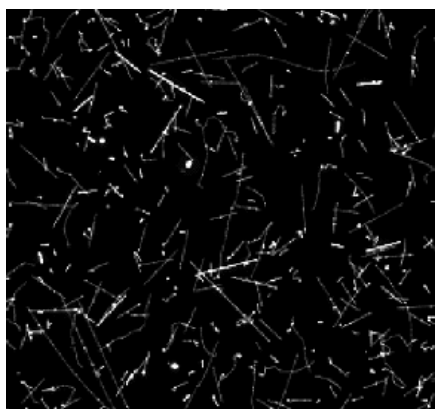

Illustration of single particle sensitivity of Timepix3 device. The tracks of different particles of radiation background (mostly muons and few protons) were recorded in 5 minutes on board of airplane. No noise (clean zero) is seen in dark regions.

[1] MINIPIX is not certified dosimetric device. It serves as the first level indicator and monitor of radiation fields allowing identification of a radiation type. Radiation protection of people cannot be based on measurements of MINIPIX.

[2] Dynamic range of final picture is theoretically unlimited; the only limiting factor is exposure time.

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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
Location: Intended for indoor use, dust free.

Electrical specification
T_A = 25 °C, USB voltage V_{CC} = 4.8V

Symbol	Parameter	Min	Typ	Max	Units	Comment
V_{CC}	Supply Voltage	4.0	5.0	5.5	V	Comply with USB 2.0
I_{CC2}	Chip active			500	mA	Comply with USB 2.0
P1	Power Dissipation			2.5	W	
Bias Voltage Source for Sensor Diode						
V_{BIAS}	Bias Voltage	3		200	V	

Performance characteristics of Timepix3

Symbol	Parameter	Min	Typ	Max	Units	Comment
f	Frame-rate			55	fps	with USB 2.0 Host
T_{READ}	Frame readout time[3]		19		ms	

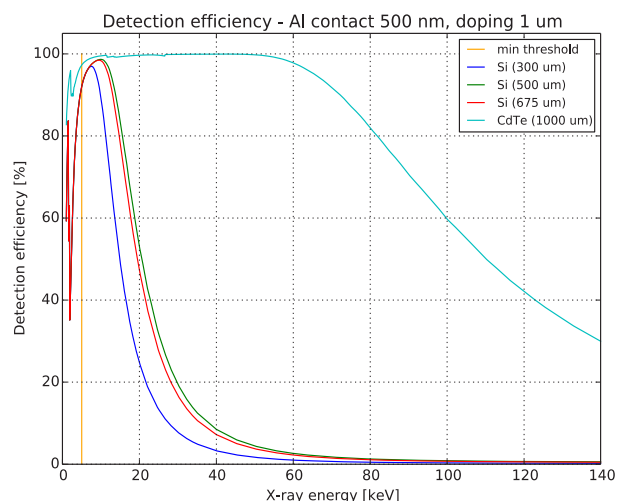[3] During Readout time (or Dead time), no signal is collected from the sensor.

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

Standard number	Name
EN 61000-6-2:05	Electromagnetic compatibility (EMC) - Immunity standard for industrial environments
EN 61000-6-4:07+A1:11	Electromagnetic compatibility (EMC) - Emission standard for industrial environments

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Sensor parameters $T_A = 25\,°C$						
Symbol	**Parameter**	**Si**			**Units**	**Comment**
	Thickness	100	300	500	µm	
σ		0.5				
σ	Energy resolution of energy discrimination threshold (σ @ 60 keV)	0.6			keV	
σ	Energy resolution in full spectral mode (σ @ 23 keV)	0.7			keV	
σ	Energy resolution in full spectral mode (σ @ 60 keV)	1.0				
	Typical detectable energy range for X-rays	5.0 - 60			keV	See chart below
	Pixel size	55			µm	

Device description

USB

Protection cover

Sensor window

Detection efficiency - Al contact 500 nm, doping 1 um

USB connector
USB type A, Standard USB 2.0 Full-Speed.

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

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Mechanical dimensions
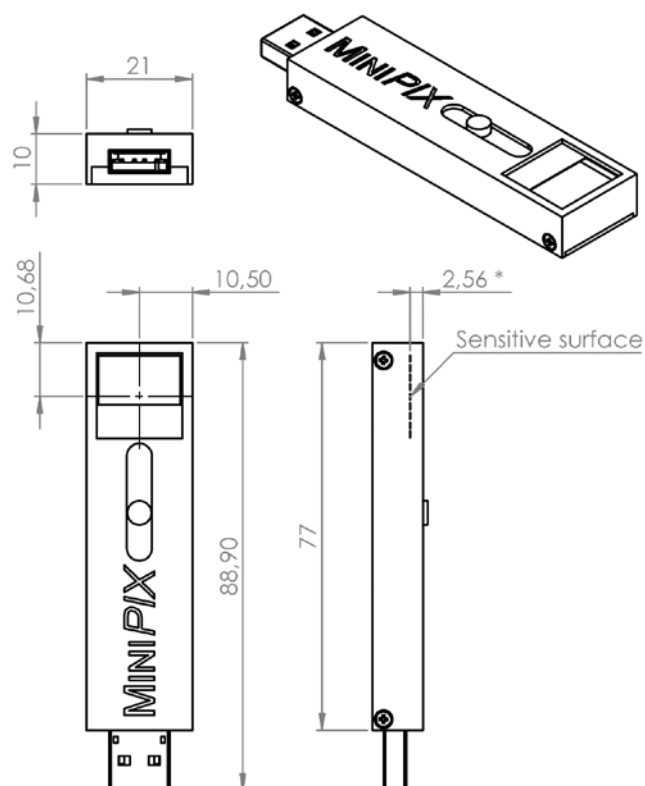
All dimensions are in mm.
* Sensitive surface distance from top of the box is for 300 μm sensor thickness.

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

Do not touch sensor surface!

Instructions for safe use

To avoid malfunction or damage to your MINIEPIX please obey 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.

- Maximum USB cable length is 3 m

- 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

Model number codes (example)

MNX	TXS	X	P	3	181116
Device name MNX – MiniPIX	Device modification TXS Timepix standard		Sensor type P-Planar silicon	Sensor thickness 1 – 100 μm 3 – 300 μm 5 – 500 μm	YY MM DD