Mini*PIX*
Miniaturized and low power radiation camera

Quantum Design
EUROPE

Quantum Design GmbH
Breitwieserweg 9
D-64319 Pfungstadt
www.qd-europe.com

Jennifer Kraus: +49 6157 80710-692
jkraus@qd-europe.com

ADVACAM
Imaging the Unseen

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Main features	
Readout chip type	Timepix
Pixel size[1]	55 x 55 µm
Sensor resolution	256 x 256 pixels
Dynamic range in one frame[2]	11 082
Sensor material	100, 300, 500 µm Si, 1 mm CdTe
Dark current	none
Interface	USB 2.0 (High-Speed)
Maximum frame rate	55 fps
Dimensions	88.9 x 21 x 10 mm
Weight	30 g

[1] 55 x 110 µm at the edges and 110 x 110 µm at the corners

[2] i.e., counter depth. Dynamic range of integrated picture is theoretically unlimited. Maximal counting freq. per pixel is 1 MHz.

The Mini*PIX* is miniaturized and low power solution of radiation camera with single particle counting (or particle tracking) detector Timepix. The standard Mini*PIX* 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 55 frames per second (with exposure time of 1 ms). The Timepix detector is energy sensitive which brings a new dimension to radiographic images.

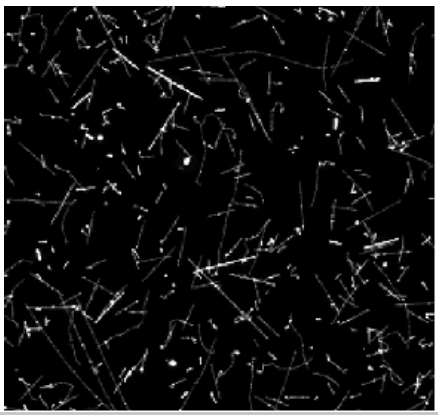

Illustration of single particle sensitivity of Timepix3 device. The tracks of different particles of radiation background (mostly muons and few protons) were recorded in 5 minutes on board of airplane. No noise (clean zero) is seen in dark regions.

The Mini*PIX* 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 Mini*PIX* devices connected to single, or several computers can be operated 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 tatistics, protocols and charts. Such network can serve as long time monitor of environment[3]. 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 Mini*PIX* 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.

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

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Device parameters

Operating conditions				
Symbol	**Parameter**	**Value**	**Units**	
T_a	Operating ambient temperature range [1]	0-50	°C	
Φ	Humidity	<85	%	Not condensing
IP	IP rating with cover	IP40		
IP	IP rating without cover	IP10		
[1] With temperature stabilization – see the paragraph below.				

Vacuum operation

Advacam detectors can be vacuum compatible on request. Contact us for more information.

- In case of vacuum operation, operate only with air pressure lower than 10^{-3} Pa.
- Intended for dust free indoor use.
- Make sure to disconnect the device from power during pumping down or venting the vacuum chamber!
- The device will automatically shut down after chip or CPU temperature exceeds 55 °C.
- A direct connection to the host device is required for maximum performance. Connecting via a USB hub may negatively affect the performance and stability of the device.

External temperature stabilization

Temperature stabilization of the required. Connect the water cooler hoses to the device connectors. The temperature should be set to 22 °C.

Electrical specification

T_{dev} = 22 °C, USB voltage V_{CC} = 4,8 V

Symbol	Parameter	Min	Typical	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	

Typical bias voltage source for sensor diode	**Si**				**CdTe**		**Units**
Thickness	100	300	500	1000[1]	1000	2000[1]	µm
V_{BIAS}	50	150	150	200	-300 to -500	-500	V

[1] Customized product

[2] Positive for Si sensors, negative for CdTe. Typical values

Performance characteristics of Timepix

Symbol	Parameter	Min	Typical	Max	Units	Comment
f	Frame-rate			55	fps	with USB 2.0 Host
T_{READ}	Frame Readout time[1]		19		ms	
[1] During Readout time (or Dead time), no signal is collected from the sensor.						

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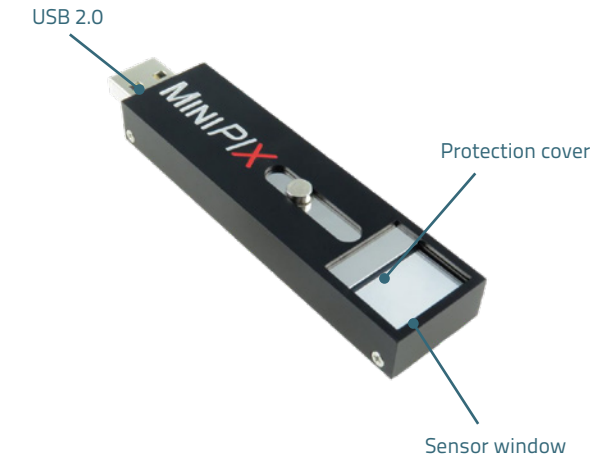
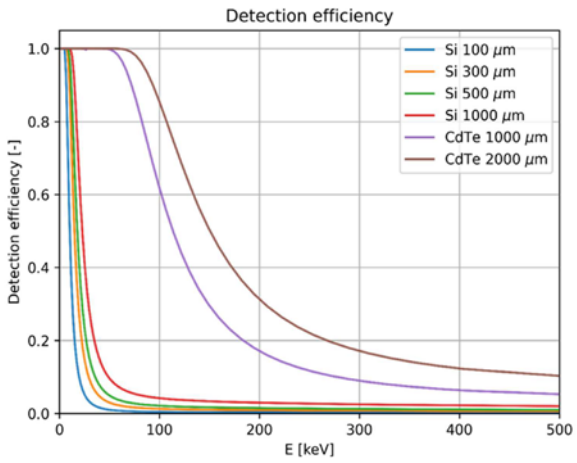
Sensor parameters T_A = 25 °C						
Symbol	**Parameter**	**Si**			**Units**	**Comment**
	Thickness	100	300	500	µm	
σ	Energy resolution of energy discrimination threshold (σ@ 23 keV)	0.5			keV	
σ	Energy resolution of energy discrimination threshold (σ @ 60 keV)	0.6			keV	
σ	Energy resolution in full spectral mode (σ @ 23 keV)	0.7			keV	
σ	Energy resolution in full spectral mode (σ @ 60 keV)	1.0			keV	
	Typical detectable energy range for X-rays	5 to 60			keV	See chart below
	Pixel size[1]	55			µm	
[1] 55 x 110 µm at the edges and 110 x 110 µm at the corners						

Device description





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

Modes of readout chip operation			
Type	**Mode**	**Dynamic range**	**Description**
Frame (reading all pixels)	Event	11810/frame	1 output image: Number of Events per pixel
	ToT	11810/frame	1 output image: Sum of all Energies deposited in given pixel (Time Over Threshold)
	ToA	11810/frame	1 output image: Time of arrival of first event in given pixel

Certificates

Mini*PIX* 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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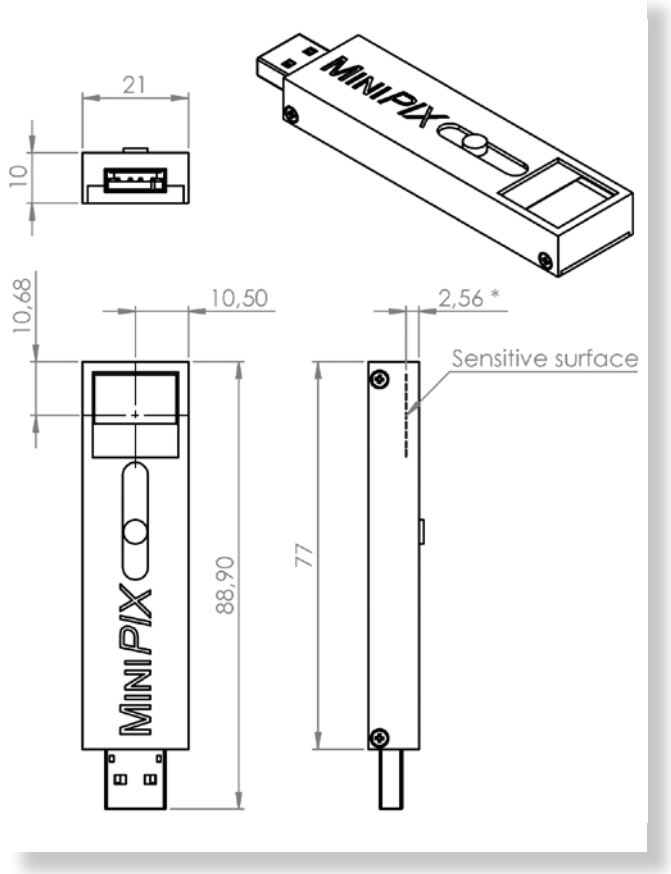
Mechanical dimensions



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 Mini*PIX* without the protecting cover. Warranty does not apply to mechanical damage of the sensor and wire-bonds.

Model number codes

MNX	TXS	X	P	3	XXXXXXXX
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	Device build version:

Instructions for safe use

Do not touch sensor surface!

To avoid malfunction or damage to your Mini*PIX* 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.
- The maximum USB cable length is 2 m.
- Thermal stabilization of the device is necessary. Recommended temperature is 22 °C.
- A direct connection to the host device is required for maximum performance. Connecting via a USB hub may negatively affect the performance and stability of the device.
- 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.

Release history		
Date (YY/MM/DD)	Changes	Changed by
21/08/12	New version	
23/02/22	Updated	
24/07/01	Datasheet revision, new graphic style of the document	J. Baborák, P. Bloudek
24/07/22	Minor format changes	J. Baborak

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