Datasheet

ADVACAM
Imaging the Unseen

AdvaPIX QUAD

Version 1.0 - Datasheet

WITH CENTRAL OPENING

ADVACAM
Imaging the Unseen

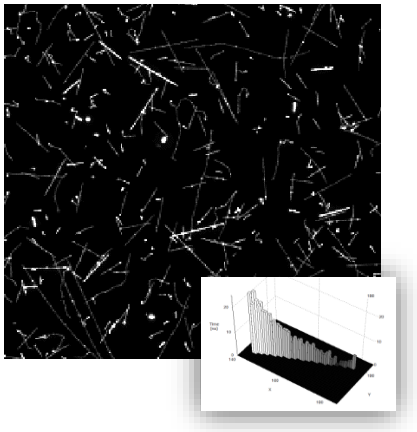


Illustration of single particle sensitivity of Timepix device. The tracks of different particles of radiation background (mostly muons and few protons) were recorded in 5 minutes on board of airplane. No noise (clean zero) is seen in dark regions. Inset shows the time profile along one muon track.

The **ADVA*PIX* QUAD** camera contains four single Timepix devices with fast parallel readout with a 4 mm^2 central opening to allow the beam pass through the device uninterrupted. The AdvaPIX QUAD allows a sustainable frame rate of up to 1300 frames per second. Each Timepix device has an independent USB 3.0 communication channel. That assures fast read-out of the complete system. All modules in the system are operated synchronously or triggered independently. The sensor type and thickness can be customised.

The fast modules with Si or CdTe pixel detectors Timepix can be also used in different configurations such as stack of many 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 **ADVA*PIX* QUAD** is specially designed for combined Wide Angle X-ray Scattering (WAXS) and Small Angle X-ray Scattering (SAXS). The open space in the center of the camera eliminates completely the need to use a beam stop in front of the camera.

Main Features:

- Readout chip type..... Timepix
- Pixel size .....55 x 55 µm
- Sensor resolution.....256 x 256 pixels
- Dynamic range in one frame……11 810[1]
- Time resolution…….. .....20 ns
- Sensor material……..100,300,500 µm Si or 1000 µm CdTe
- Power……..... External or via second USB 3.0
- Interface.....USB 3.0 (Super-Speed)
- Maximum readout speed.....1300 fps
- Dimensions .....260 x 250 x 35 mm
- Weight ..... 1500 g

[1] 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	Min	Typ	Max	Units	Comment
TA	Temperature Range	0	50	70	°C	
Φ	Humidity			60	%	Not condensing

Electrical Specification

T_A = 25°C, USB voltage V_{CC} = 4.8V

Symbol	Parameter	Min	Typ	Max	Units	Comment
V_{CC}	**Supply Voltage**	28	24	20	V	
I_{CC}	**Supply Current**					
I_{CC1}	Chip active			1000	mA	
P1	**Power Dissipation**			24	W	
BNC Inputs						
V_{INL}	**Voltage Low**	0		0.7	V	
V_{INH}	**Voltage High**	1.7		5.0	V	
BNC Outputs						
V_{OUTL}	**Output Voltage Low**	0		0	V	
V_{OUTH}	**Output Voltage High**		4.5	5.0	V	
Bias Voltage Source for Sensor Diode						
V_{BIAS}	Bias Voltage	0		±450	V	Polarity is sensor dependent

Performance Characteristics for Timepix

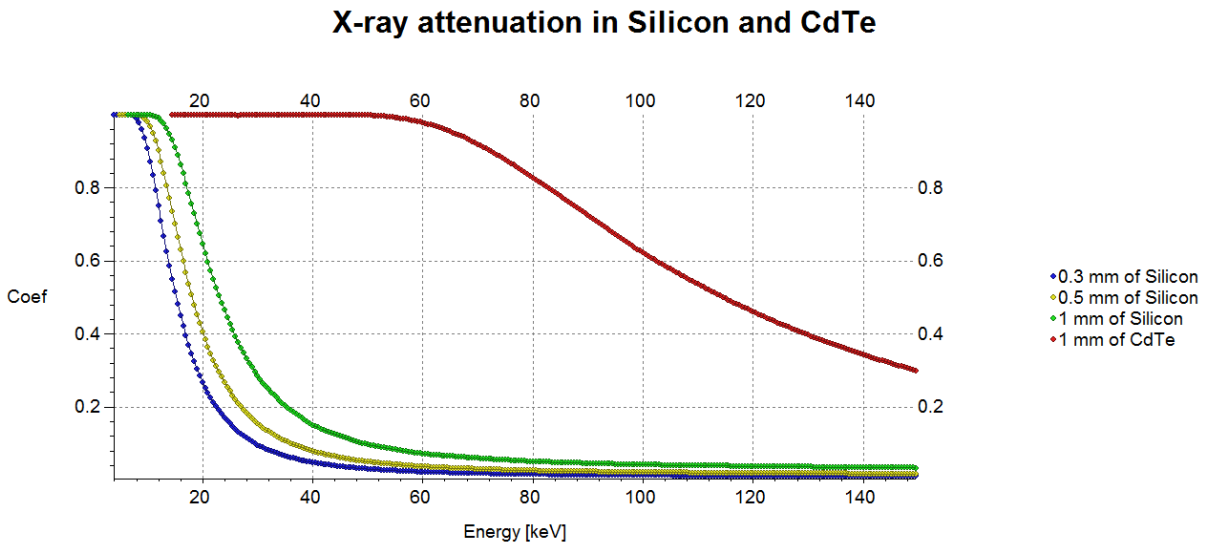
Symbol	Parameter	Min	Typ	Max	Units	Comment
f	Frame Rate			1300	fps	with USB 3.0 cable
T_{READ}	Frame Readout Time[2]		588		µs	with USB 3.0 cable
dT	Time resolution	20	100		ns	

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

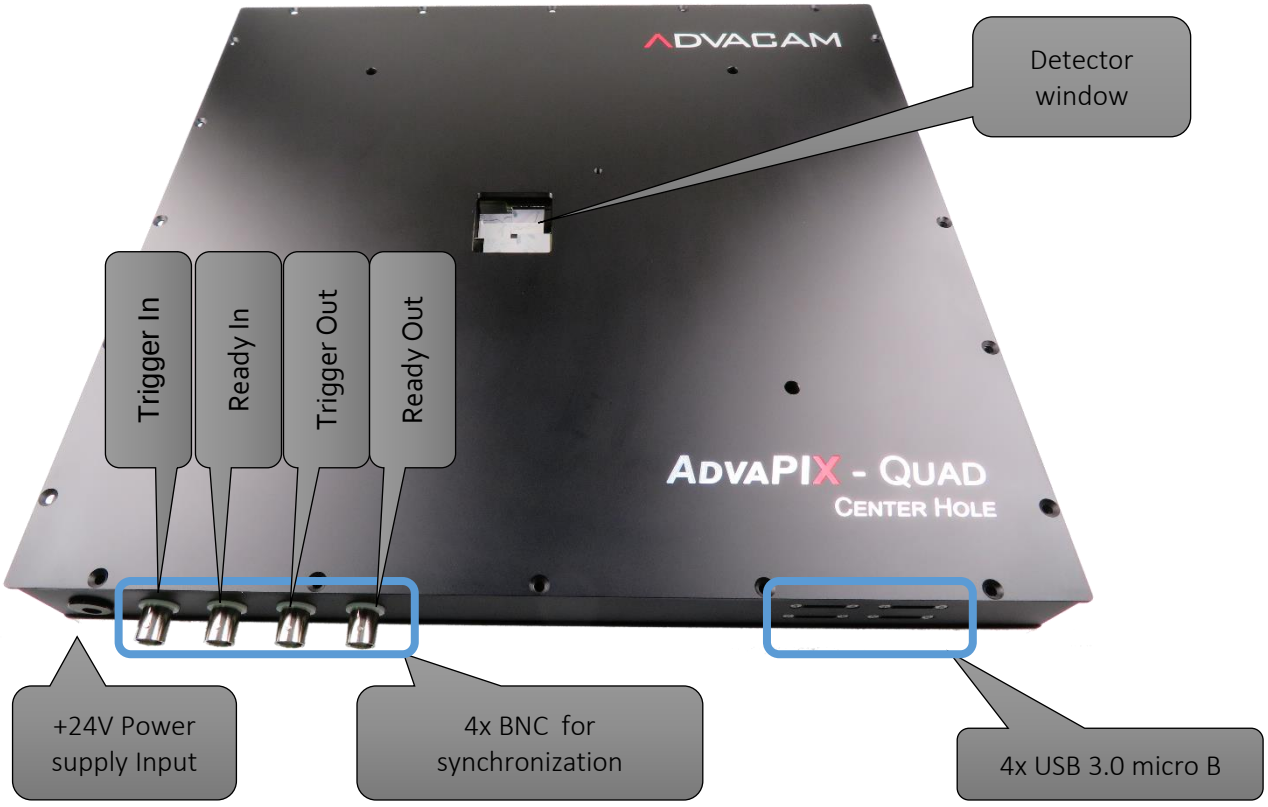
Sensor parameters

T_A = 25°C

Symbol	Parameter	Si				CdTe	Units	Comment
	Thickness	100	300	500	675	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				1.3	keV	
σ	Energy resolution in full spectral mode (σ @ 60 keV)	1.0				1.5	keV	
	Typical detectable energy range for X-rays[3]	5 to 60				5 to 600	keV	See chart below
	Pixel size	55				55	µm	



[3] The maximum detectable energy is limited only by sensitivity of the selected sensor for the given radiation type. The maximum measured energy can reach several MeV in case of heavy charged particles



+24VDC connector

Main power supply (via standard 2.1 mm barrel connector).

USB connector

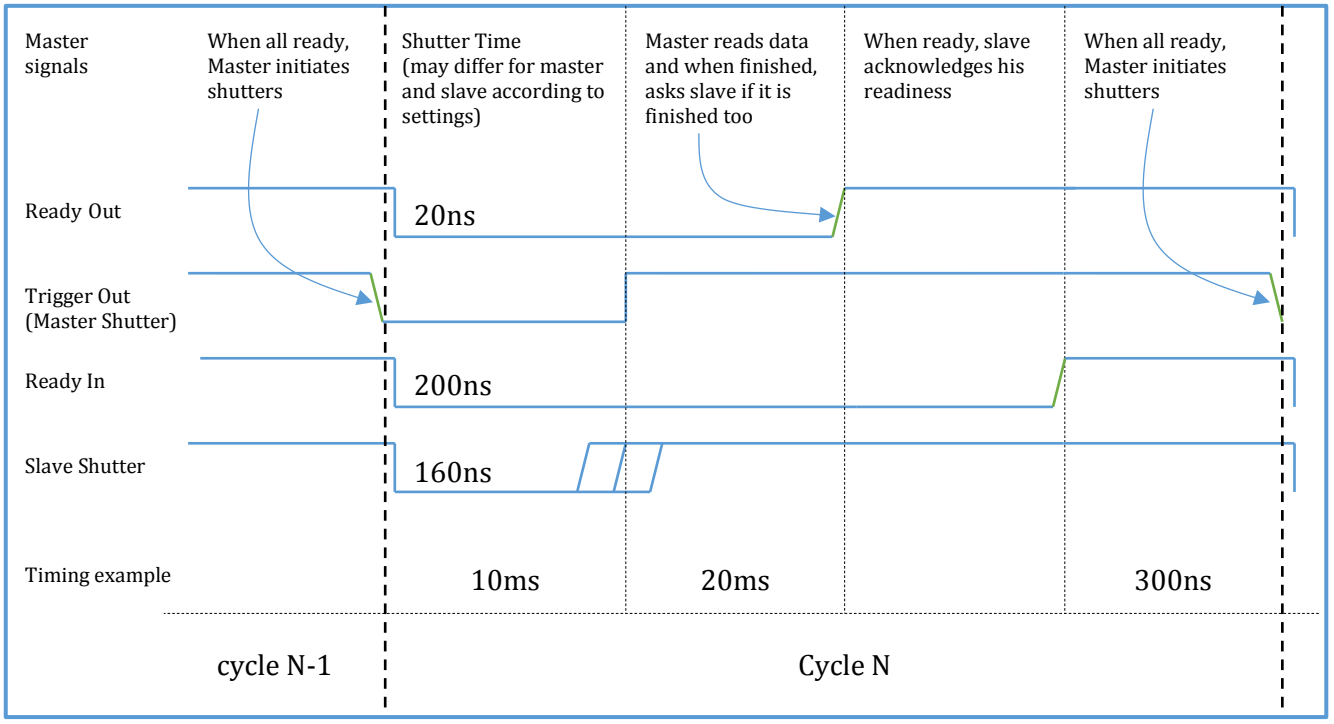
USB 3.0 type micro B, Standard USB 3.0 Super-Speed. All USBs must be connected to the computer.

BNC synchronization connectors

All the BNC input signals (if not used) are tight to its neutral state, where the offered feature is disabled.

- Ready In – input signal (gate-in signal that disables the measurement when at logical zero).
- Ready Out – equals one if the **ready in** signal is in logical one and at the same time the Device has finished current cycle (is ready for a new cycle). This signal may be used as **Busy out signal** commonly used in other systems.
- Trigger In – initiates shutter according to **TriggerStg** value. Use only when Master not connected.
- Trigger Out – mirroring shutter of the Device.

Synchronization waveform example

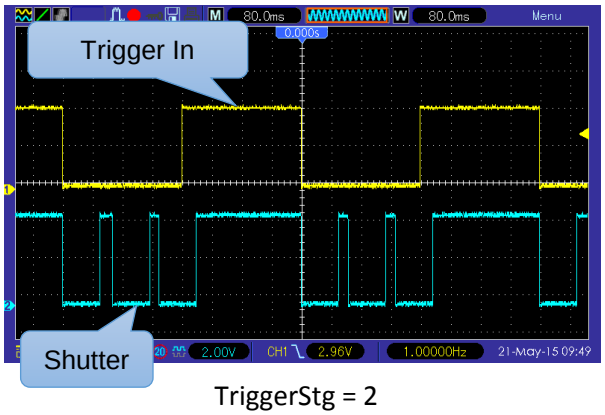


Note1: the decisive leading edges are indicated in orange color.
Note2: WidePIX 2x2 is Master, cooperating device is Slave

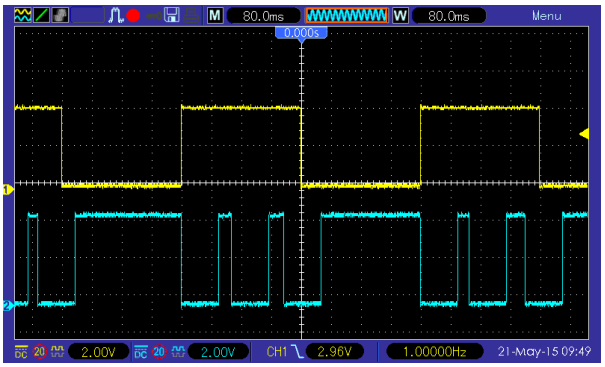
Depending on the TriggerStg value, the behavior of shutter signal is following (see figure below for graphical visualization of described behavior).

TriggerStg value	Detector performs measurement (activated shutter), when:
0 (log 0)	**Trigger-In** signal is logical zero => the camera starts measurement and keeps measuring frames as long as the trigger-in signal is in logical zero.
1 (log 1)	**Trigger-In** signal is logical one => the camera starts measurement and keeps measuring frames as long as the trigger-in signal is in logical one.
2 (rising edge)	**Trigger-In** signal is changing from zero to one => the camera measures only one frame.
3 (falling edge)	**Trigger-In** signal is changing from one to zero => the camera measures only one frame.

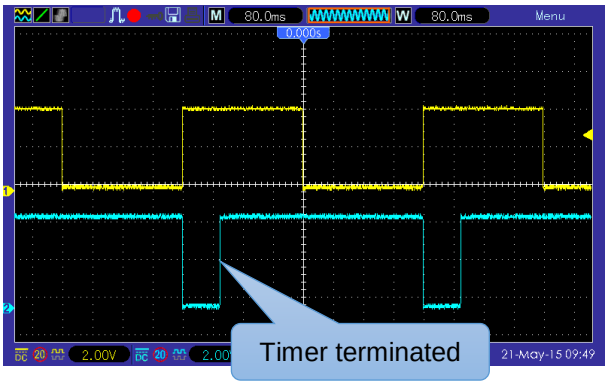
TriggerStg = 0



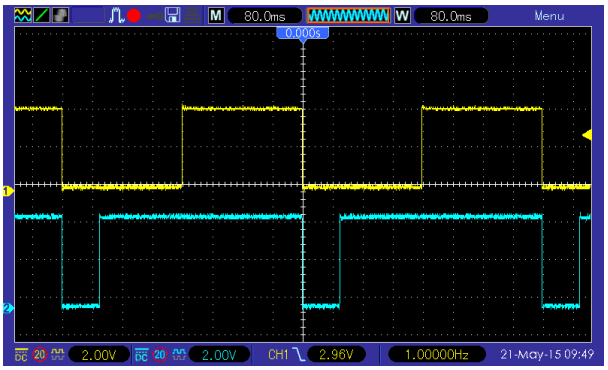
TriggerStg = 1



TriggerStg = 2

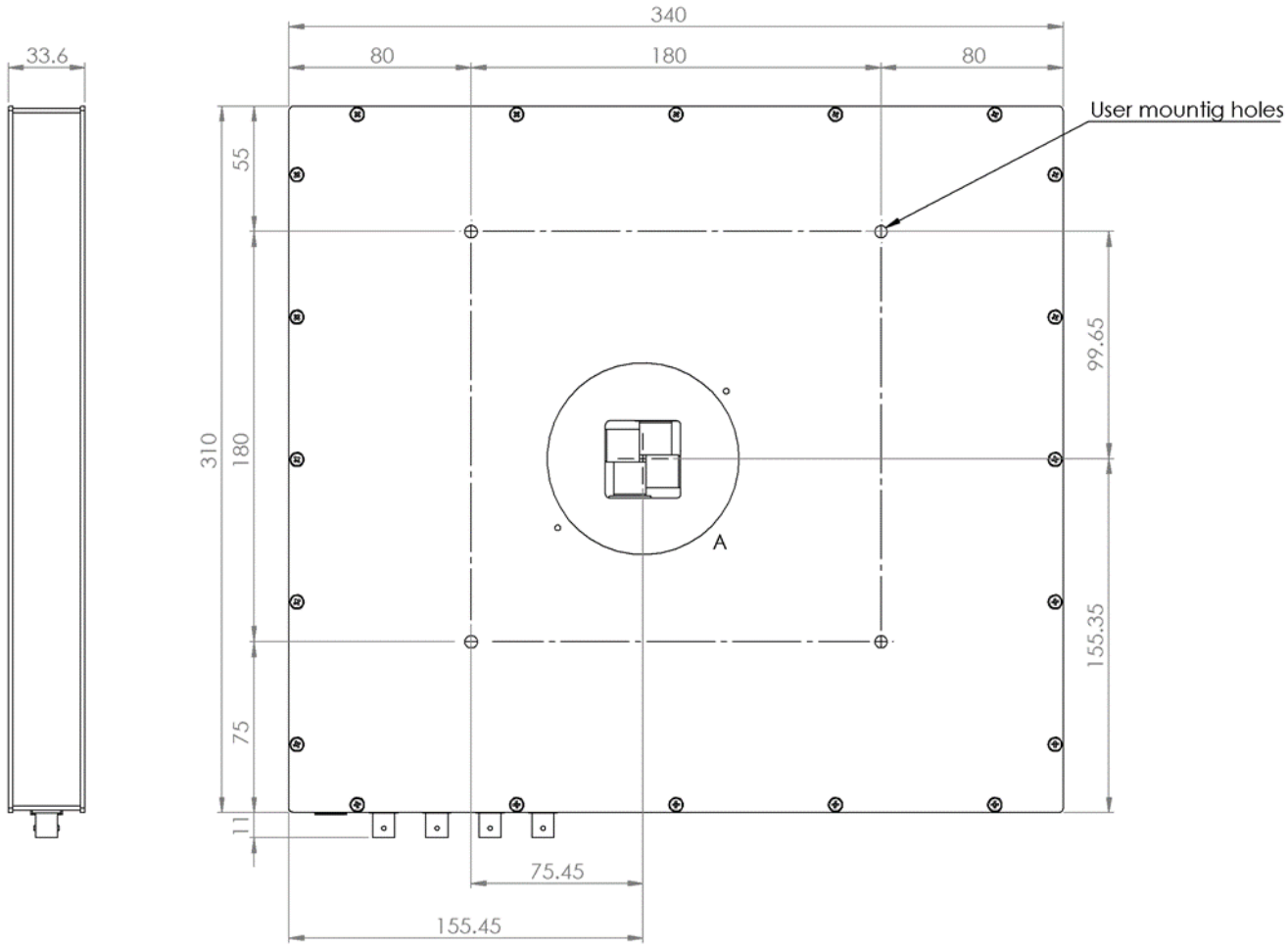


TriggerStg = 3



Mechanical Dimensions

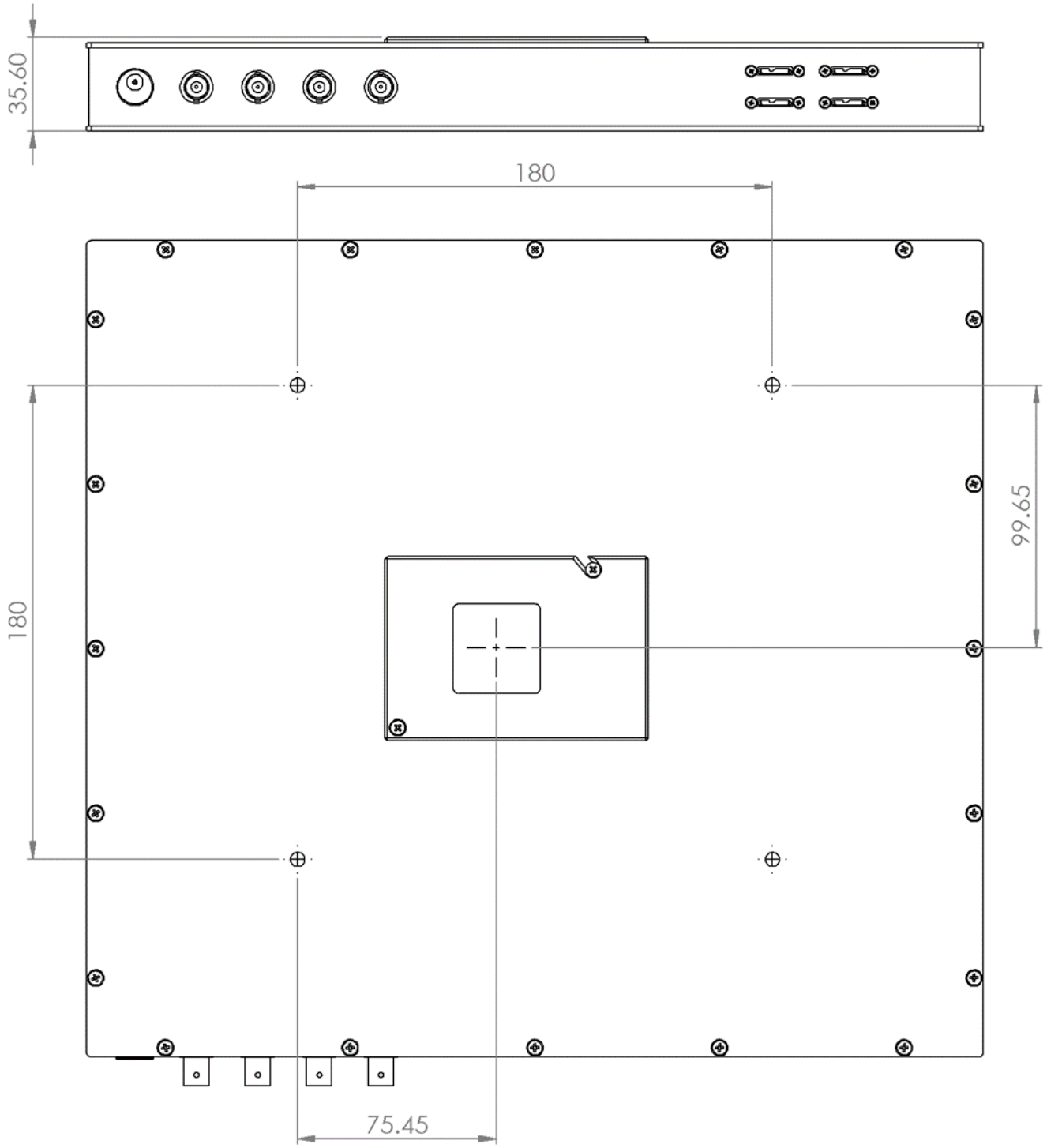
Without protecting cover



All dimensions are in mm.

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

With protecting cover



All dimensions are in mm.

Configuration Examples

WAXS/SAXS (Wide/Small angle X-ray scattering)

Combination of MiniPIX and AdvaPIX Quad - compact WAXS and SAXS system:

Configuration Examples

Single detector
(Single layer of 256 x 256 pixels, speed of 1700 frames per second)

Quad detector or
Quad detector with central hole
(Single layer of 512 x 512 pixels, speed of 1300 frames per second with optional hole in the middle, up to 2mm square)

Stacked detector
(Arbitrary number of layers of 256 x 256 pixels, speed of 1700 frames per second)

Row detector
(Single layer 256 x 1024 pixels, speed of 1700 frames per second)

Warning

Do not touch sensor surface!

Instructions for safe use.
To avoid malfunction or damage to your **ADVA*PIX* QUAD** please observe the following:

- Do not expose to water, moisture.
- Do not disassemble. Wire-bonding connection may be irreversibly damaged.
- Do not insert any object into the sensor window.

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