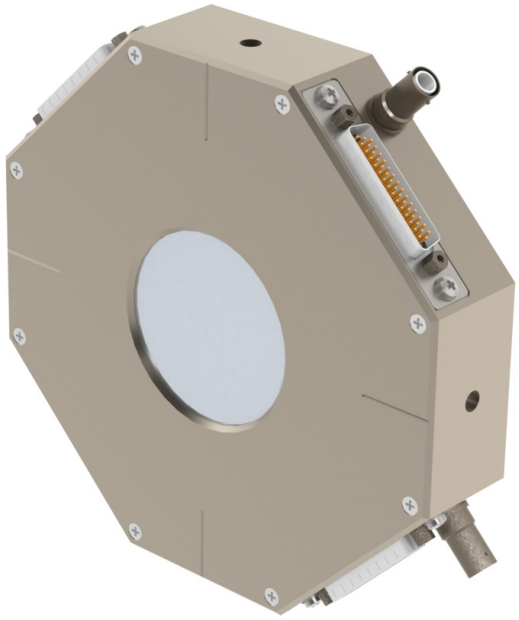
Datasheet PX-2

Pixelated 2D-Sensing Ionization Chamber

Features

- 42 mm diameter sensitive area
- Compact package
- Ionization chamber with 120 pixel readout for position and shape monitoring
- Robust thin FR4 electrodes
- HV loopback
- Compatible with I128 and I6400 readout electronics



Applications	• Particle therapy isocenter diagnostic systems • Beam shape, position and trajectory monitoring • General high energy ion beam diagnostics
Options	• Thin film electrode version available (PX-1)

Specifications

Beam compatibility	
Species	Protons, deuterons, fully-stripped carbon
Energy range	30 MeV/nucleon to 500 MeV / nucleon
Beam current density range	Up to 20 nA cm^{-2} (particle current)

Sensor	
Type	Parallel plate single-gap ionization chamber with pixelated cathode
High voltage	500-1000 V nominal (1660 to 3330 V cm^{-1}); maximum 1500 V
Sensitive area	42 mm nominal diameter

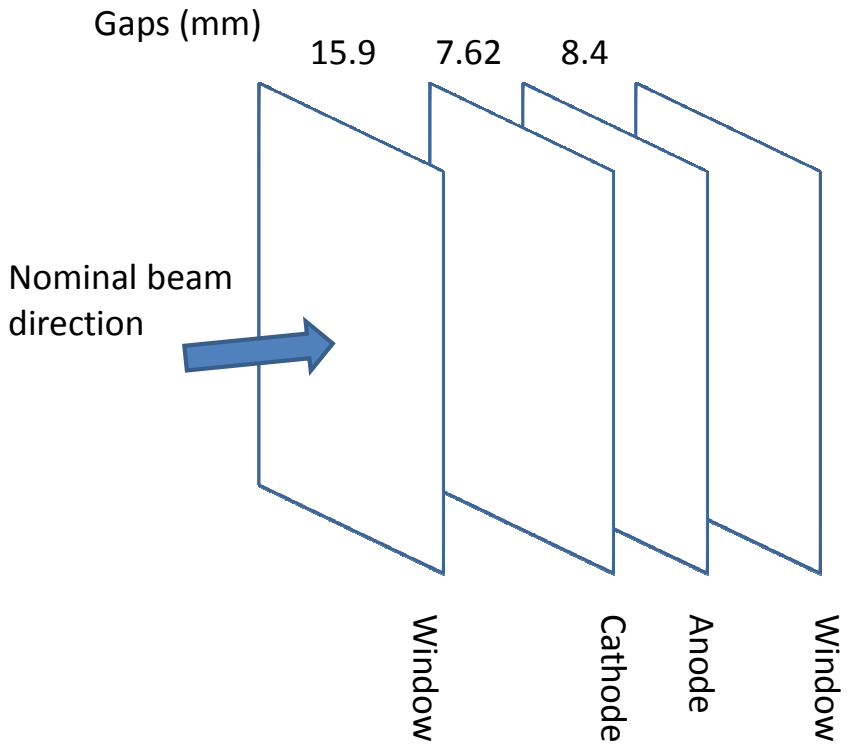
Sensor (cont)	
Sensitive volume	Active volume: Pixelated cathode to anode. 7.62 mm spacing.
Pixel geometry	120 pixels 3.80 mm pitch (50 µm inter-pixel gaps typical)
Gain uniformity	Better than +/-2% for beams within the sensitive area.
Position accuracy	Integral linearity better than 50 µm maximum deviation relative over the sensitive area.
Position resolution	Depends on signal to noise ratio; 10's of µm achievable provided beam covers more than one strip.
Fiducials	Electrode pixel position tolerance build-up relative to fiducial features on body +/- 0.3 mm nominal, < +/- 0.1 mm typical .

Chamber gas	
Operating gas	Dry atmospheric air

Mechanical	
Insertion length	32 mm window to window, 37 mm housing face to face.
Overall size	170 mm by 170 mm by 37mm approx (see figures)
Weight	1.3 kg (2.8 lb) excluding any added mounting brackets.
Operating environment	Clean and dust-free, 0 to 35 C (15 to 25 C recommended , < 70% humidity, non-condensing, vibration < 0.1g all axes (1 to 50 Hz) Temperature and pressure compensation of chamber gain must be performed.
Shipping and storage environment	-10 to 50 C, < 80% humidity, non-condensing, vibration < 1g all axes, 1 to 20 Hz

Beam scattering	
Layers in beam path	

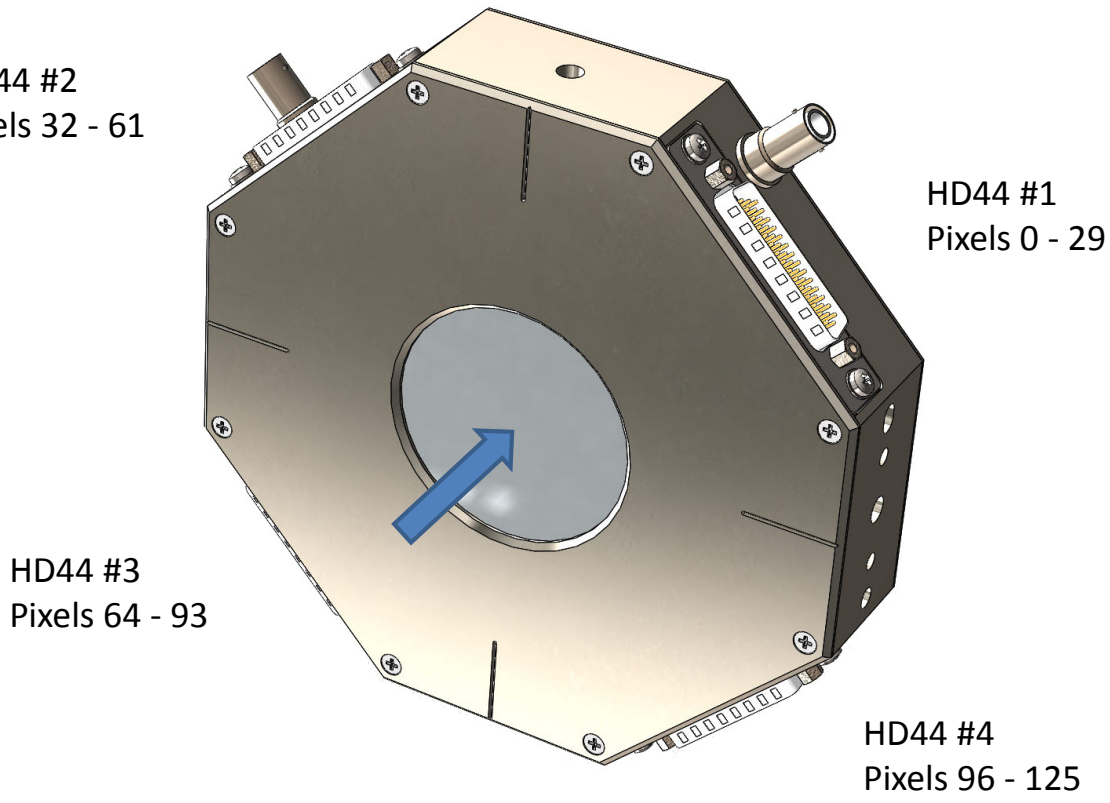
1	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (window)
2	15.9 mm	Air (non-active gap)
3	152 µm	FR4 with copper patterning 5 µm both sides (cathode)
4	7.62 mm	Air (active gap)
5	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (anode)
6	8.4mm	Air (non-active gap)
7	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (window)



Total effective thickness < 400 µm water equivalent.

Cathode pixel pattern faces the anode.

Orientation and pixel pattern



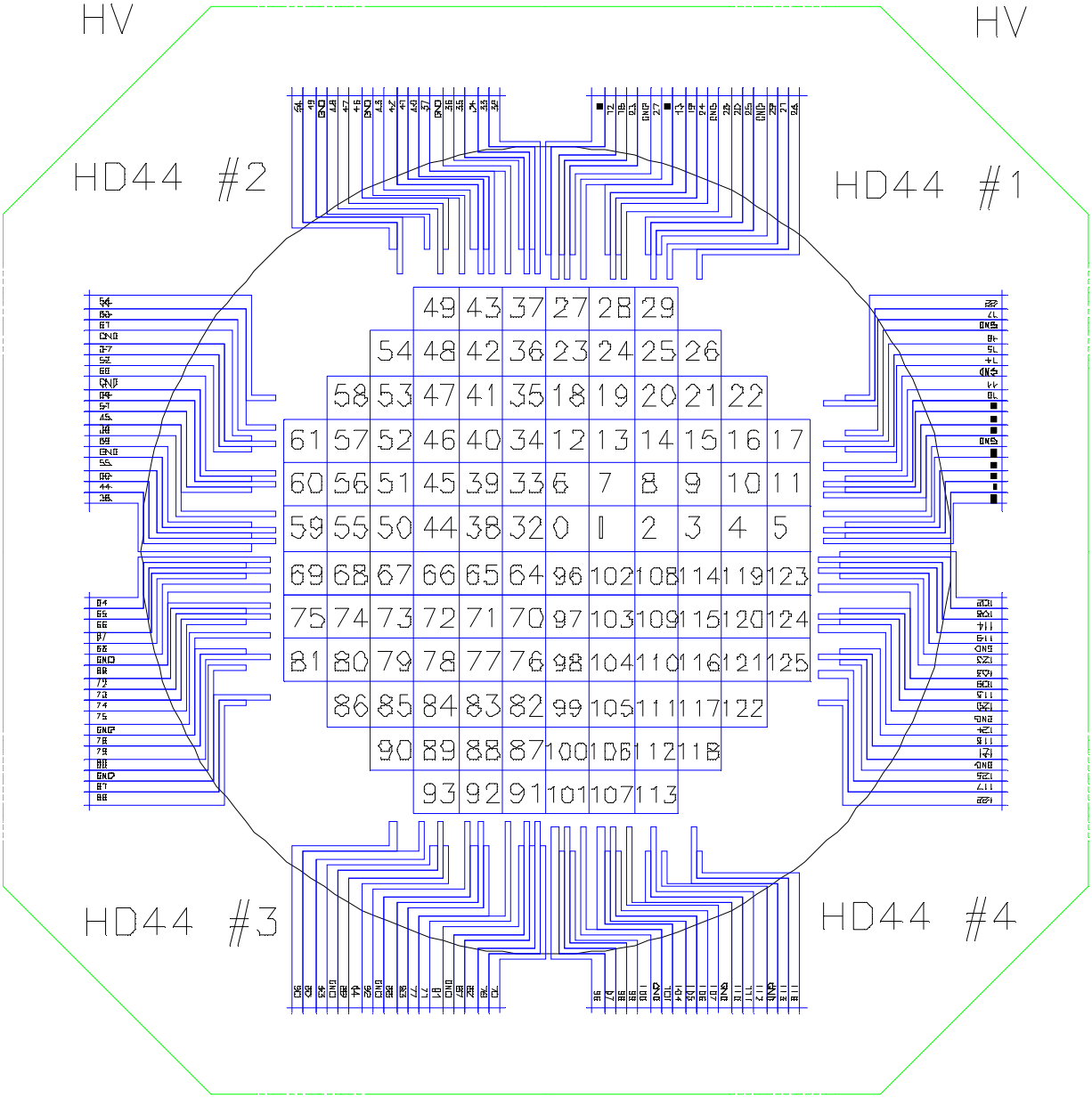
The nominal beam entry face for pixel identification is indicated, although the beam can pass through in other direction also.

In the orientation shown the beam passes through the cathode then the anode. The view of the cathode pixel pattern on the next page is looking in the direction of the arrow. The pattern is on the downstream side of the cathode, facing the anode.

Orientation and pixel pattern

View along nominal beam direction as shown in the previous figure. View through the cathode to the pixel pattern on the downstream side.

Note: there are 120 pixels, numbered from 0 upwards. Some numbers (30, 31, 62, 63, 94, 95) are absent.



Connectors

Pixel readout

Four DSub male high density 44 pin.
HD44 #1.

1	Pixel 28	16	n/c	31	Test pixel
2	Pixel 27	17	Pixel 29	32	n/c
3	Pixel 25	18	Pixel 26	33	AGnd / KGnd
4	Pixel 23	19	Pixel 24	34	AGnd / KGnd
5	Pixel 21	20	Pixel 22	35	AGnd / KGnd
6	Pixel 19	21	Pixel 20	36	AGnd / KGnd
7	Pixel 17	22	Pixel 18	37	AGnd / KGnd
8	Pixel 15	23	Pixel 16	38	AGnd / KGnd
9	Pixel 13	24	Pixel 14	39	AGnd / KGnd
10	Pixel 11	25	Pixel 12	40	AGnd / KGnd
11	Pixel 9	26	Pixel 10	41	AGnd / KGnd
12	Pixel 7	27	Pixel 8	42	AGnd / KGnd
13	Pixel 5	28	Pixel 6	43	n/c
14	Pixel 3	29	Pixel 4	44	Pixel 2
15	Pixel 1	30	Pixel 0	-	-

Connector shell is common with ionization chamber body.

The pin arrangement is compatible with a pin to pin (M-F) 44-way cable connection to an I6400 or I128 electrometer, with pixel 0 connecting to channel 1 and so on.

Test pixels are outside the sensitive area and are available for background noise checks.

AGnd is the signal ground designation in the I6400 electrometer. KGnd is the signal ground designation in the I128 electrometer.

CAUTION

Do not expose the device to ionizing radiation beams unless all connections to readout electronics and bias supplies are made, or otherwise grounded. Charge build-up and subsequent arcing damage can occur.

Connectors (cont)

Pixel readout (cont)

HD44 #2.

1	Pixel 60	16	n/c	31	Test pixel 2
2	Pixel 59	17	Pixel 61	32	n/c
3	Pixel 57	18	Pixel 58	33	AGnd / KGnd
4	Pixel 55	19	Pixel 56	34	AGnd / KGnd
5	Pixel 53	20	Pixel 54	35	AGnd / KGnd
6	Pixel 51	21	Pixel 52	36	AGnd / KGnd
7	Pixel 49	22	Pixel 50	37	AGnd / KGnd
8	Pixel 47	23	Pixel 48	38	AGnd / KGnd
9	Pixel 45	24	Pixel 46	39	AGnd / KGnd
10	Pixel 43	25	Pixel 44	40	AGnd / KGnd
11	Pixel 41	26	Pixel 42	41	AGnd / KGnd
12	Pixel 39	27	Pixel 40	42	AGnd / KGnd
13	Pixel 37	28	Pixel 38	43	n/c
14	Pixel 35	29	Pixel 36	44	Pixel 34
15	Pixel 33	30	Pixel 32	-	-

HD44 #3

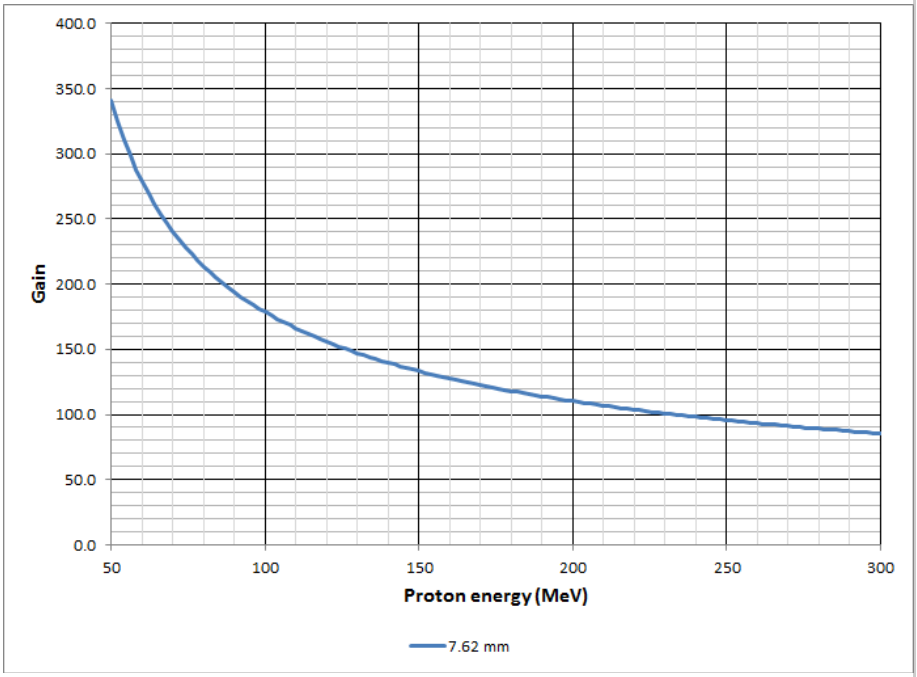
1	Pixel 92	16	n/c	31	Test pixel 3
2	Pixel 91	17	Pixel 93	32	n/c
3	Pixel 89	18	Pixel 90	33	AGnd / KGnd
4	Pixel 87	19	Pixel 88	34	AGnd / KGnd
5	Pixel 85	20	Pixel 86	35	AGnd / KGnd
6	Pixel 83	21	Pixel 84	36	AGnd / KGnd
7	Pixel 81	22	Pixel 82	37	AGnd / KGnd
8	Pixel 79	23	Pixel 80	38	AGnd / KGnd
9	Pixel 77	24	Pixel 78	39	AGnd / KGnd
10	Pixel 75	25	Pixel 76	40	AGnd / KGnd
11	Pixel 73	26	Pixel 74	41	AGnd / KGnd
12	Pixel 71	27	Pixel 72	42	AGnd / KGnd
13	Pixel 69	28	Pixel 70	43	n/c
14	Pixel 67	29	Pixel 68	44	Pixel 66
15	Pixel 65	30	Pixel 64	-	-

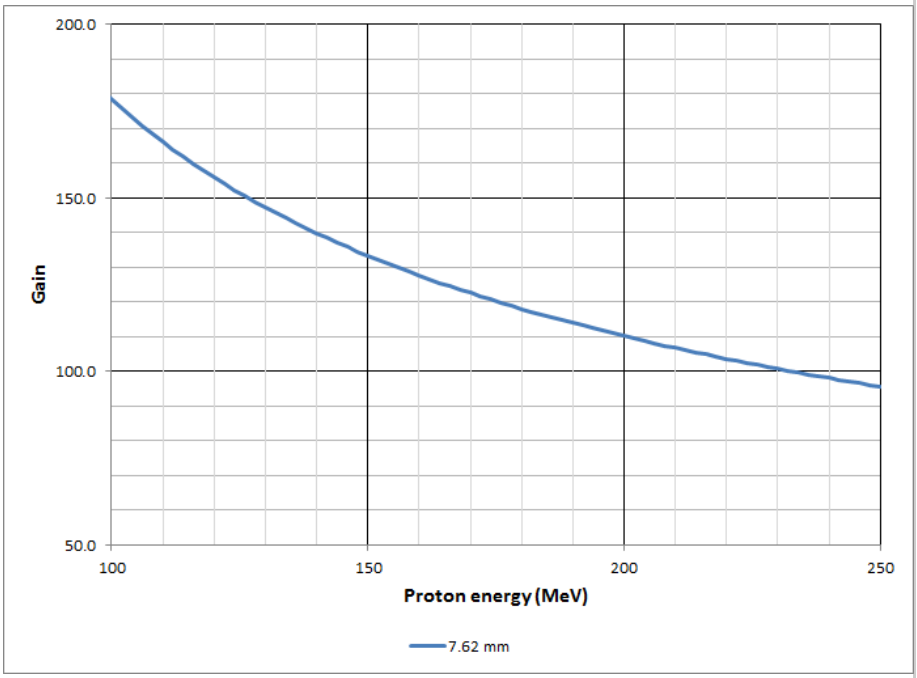
Connectors (cont)	
Pixel readout (cont)	HD44 #4.

1	Pixel 124	16	n/c	31	Test pixel 4
2	Pixel 123	17	Pixel 125	32	n/c
3	Pixel 121	18	Pixel 122	33	AGnd / KGnd
4	Pixel 119	19	Pixel 120	34	AGnd / KGnd
5	Pixel 117	20	Pixel 118	35	AGnd / KGnd
6	Pixel 115	21	Pixel 116	36	AGnd / KGnd
7	Pixel 113	22	Pixel 114	37	AGnd / KGnd
8	Pixel 111	23	Pixel 112	38	AGnd / KGnd
9	Pixel 109	24	Pixel 110	39	AGnd / KGnd
10	Pixel 107	25	Pixel 108	40	AGnd / KGnd
11	Pixel 105	26	Pixel 106	41	AGnd / KGnd
12	Pixel 103	27	Pixel 104	42	AGnd / KGnd
13	Pixel 101	28	Pixel 102	43	n/c
14	Pixel 99	29	Pixel 100	44	Pixel 98
15	Pixel 97	30	Pixel 96	-	-

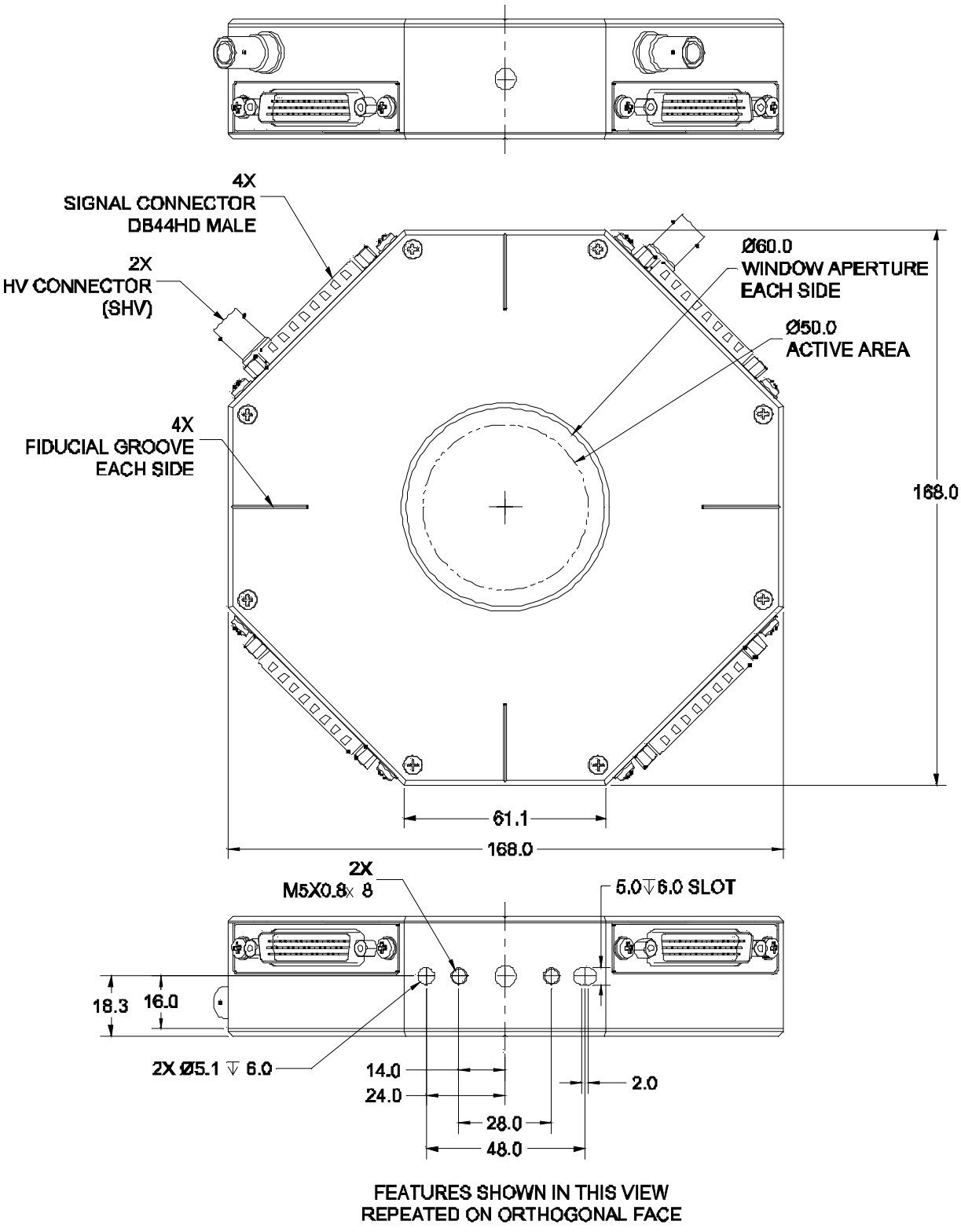
HV in	SHV
HV out	SHV HV in and out are interchangeable.

Calibration	
Gain curves	Approximate gain curves at standard ambient temperature and pressure for protons, 7.62 mm gap.





Note: Critical dosimetry measurements must use accurate gain values referenced to traceable standards, and regularly validated.


4X
SIGNAL CONNECTOR
DB44HD MALE
2X
HV CONNECTOR
(SHV)
4X
FIDUCIAL GROOVE
EACH SIDE
Ø60.0
WINDOW APERTURE
EACH SIDE
Ø50.0
ACTIVE AREA
168.0
61.1
168.0
2X
M5X0.8↧ 8
5.0↧6.0 SLOT
18.3
16.0
2X Ø5.1 ↧ 6.0
14.0
24.0
28.0
48.0
2.0
FEATURES SHOWN IN THIS VIEW
REPEATED ON ORTHOGONAL FACE

Dims mm

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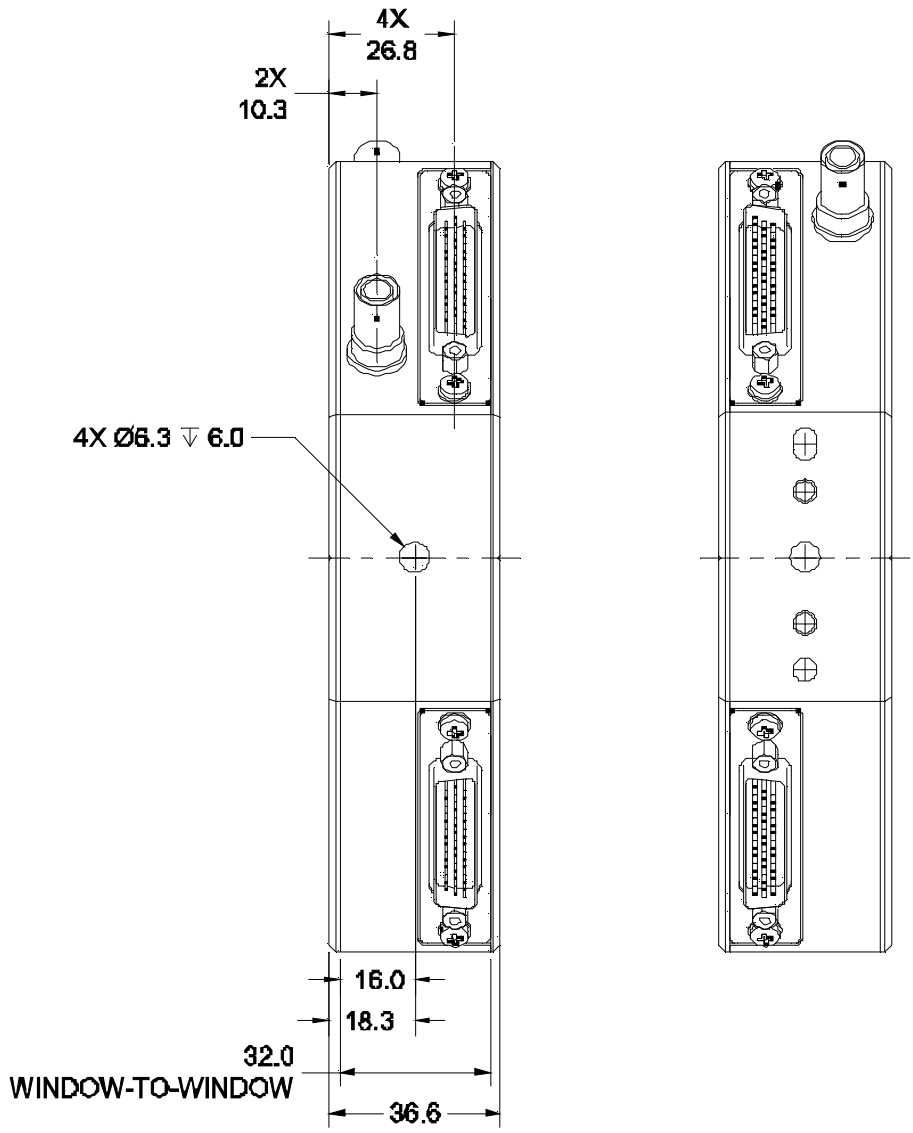

Side elevations

Dims mm

Ordering information

PX-2	Pixelated ionization chamber with 4.2 cm diameter sensitive area, thin FR4 cathode with 120 pixels.

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