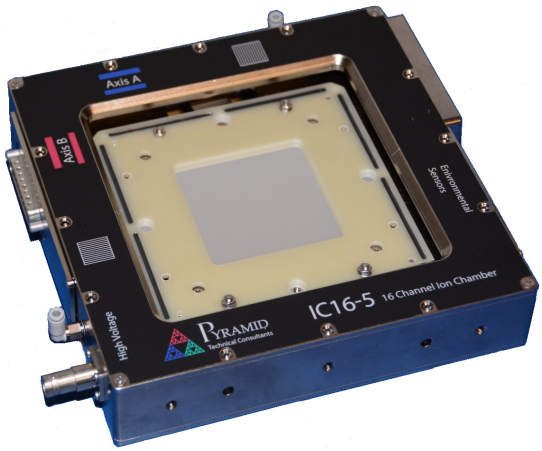
Compact Position Sensing Transmission Ionization Chamber

Features



- 48 mm x 48 mm sensitive area
- Ionization chamber with 16 by 16 strip readout for position and shape monitoring
- Minimum scattering due to thin films of low-Z material
- Small beamline length (32 mm)
- Small electrode gaps for low recombination
- Polyimide film electrode substrates for radiation hardness
- Electrode patterns laser-cut for high geometric precision
- Operable with atmospheric pressure air chamber gas or flow-through gas
- Integrated temperature, pressure and humidity sensing
- Integrated desiccant for fill gas
- Compatible with I3200 or I6400 readout electronics

Applications	• Particle therapy beam monitoring • On-line beam trajectory monitoring • General high energy ion beam diagnostics
Options	• Integral plane electrode.

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 dual ionization chamber with multistrip cathodes
High voltage	500-1000 V nominal (1660 to 3330 V cm^{-1}); maximum 1500 V
Sensitive area	48 mm by 48 mm

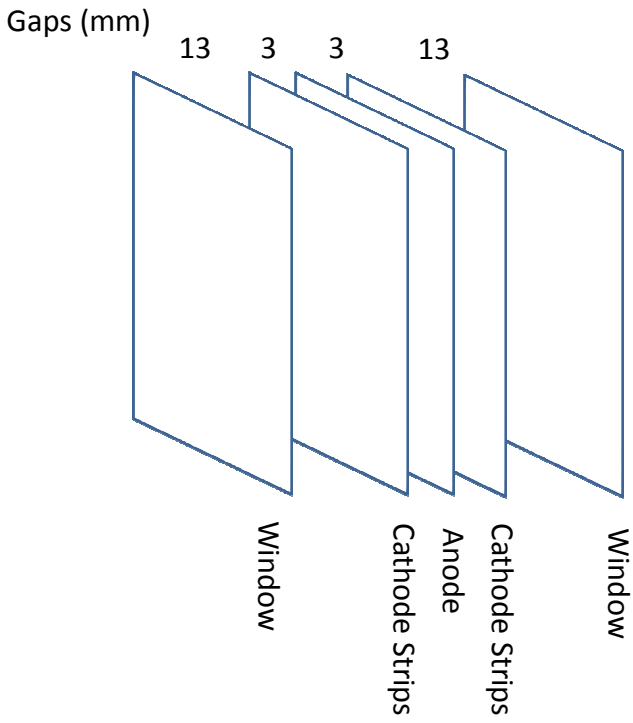
Sensor (cont)	
Sensitive volume	Active volume 1: Strip cathode 1 to anode. 3mm spacing. Active volume 2: Anode to strip cathode 2. 3mm spacing.
Strip geometry	16 strips 3.00 mm pitch (50 µm inter-strip gaps typical)
Gain uniformity	Better than +/-2% for beams within the sensitive area.
Position accuracy	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 strips tolerance build-up relative to fiducial features on body +/- 0.3 mm nominal, < +/- 0.1 mm typical .

Chamber gas	
Operating gas	Dry atmospheric air, or flow of any clean ionization chamber gas (Ar/CO_2, N_2 etc)
Flow gas connections	To suit 1/8" tube push fit
Desiccant	For use when chamber is closed to atmosphere. Silca gel sachet. Sachet can be changed with chamber in situ.

Mechanical	
Insertion length	32 mm window to window, 37 mm housing face to face.
Overall size	190 mm by 190 mm by 37 mm 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	13 mm	Fill gas (non-active gap)
3a	0.1 µm	Aluminization (ground plane)
3b	25 µm	Polyimide foil
3c	0.1 µm	Aluminization (strip cathode)
4	3 mm	Fill gas (active gap)
5	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (anode)
6	3 mm	Fill gas (active gap)
7a	0.1 µm	Aluminization (strip cathode)
7b	25 µm	Polyimide foil
7c	0.1 µm	Aluminization (ground plane)
8	13 mm	Fill gas (non-active gap)
9	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (window)



Total effective thickness < 130 µm water equivalent.

Connectors	
Strip readout	DSub male 25 pin. Two identical connectors (one per axis, 16 strips per axis)

1	Strip 02	14	Strip 01
2	Strip 03	15	n/c
3	Strip 04	16	AGnd
4	Strip 05	17	AGnd
5	Strip 06	18	AGnd
6	Strip 07	19	AGnd
7	Strip 08	20	AGnd
8	Strip 09	21	AGnd
9	Strip 10	22	AGnd
10	Strip 11	23	AGnd
11	Strip 12	24	Strip 16
12	Strip 13	25	Strip 15
13	Strip 14		

Connector shell is common with cable screen 1.

The pin arrangement is compatible with a pin to pin (M-F) 25-way cable connection to an I3200 electrometer. One axis will read out on I3200 channels 1-16, the other on channels 17-32.

HV in	SHV
Monitor	DSub male 9-pin

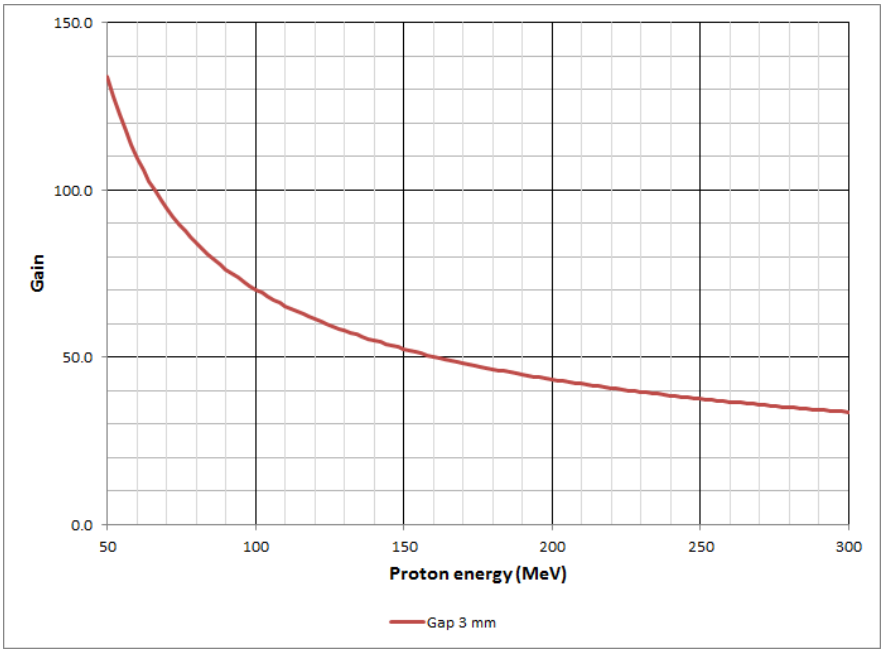
1	Chassis	6	Analog out +
2	Analog out -	7	Signal select bit 0
3	Signal select bit 1	8	Device ID2
4	Device ID1	9	+5V in
5	DGnd		

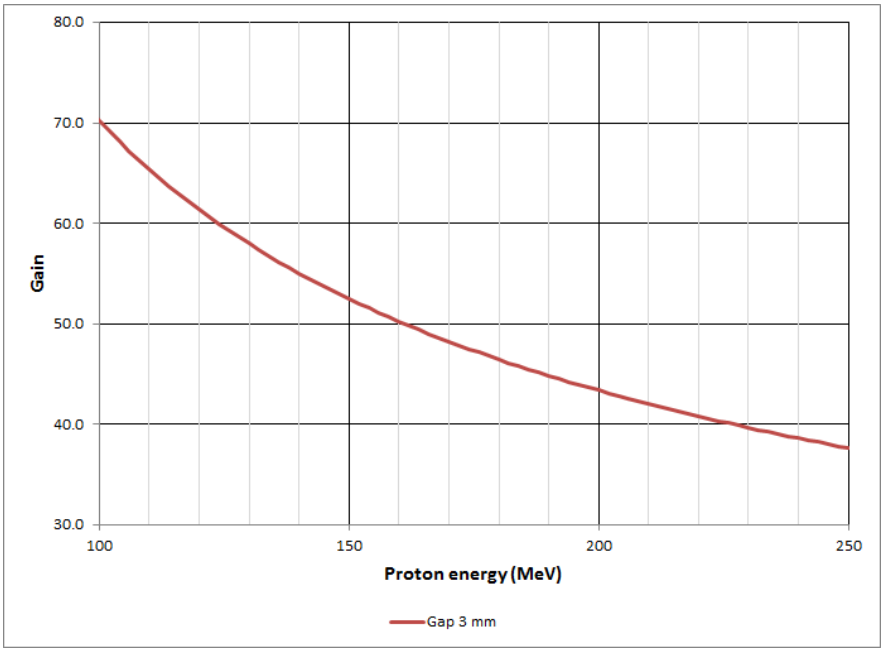
Device ID for the I16-5 is 3 (ID1 & ID2 set).

DGnd is isolated from AGnd.

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.

Calibration	
Gain curves	Approximate gain curves at standard ambient temperature and pressure for protons, 3mm gaps.





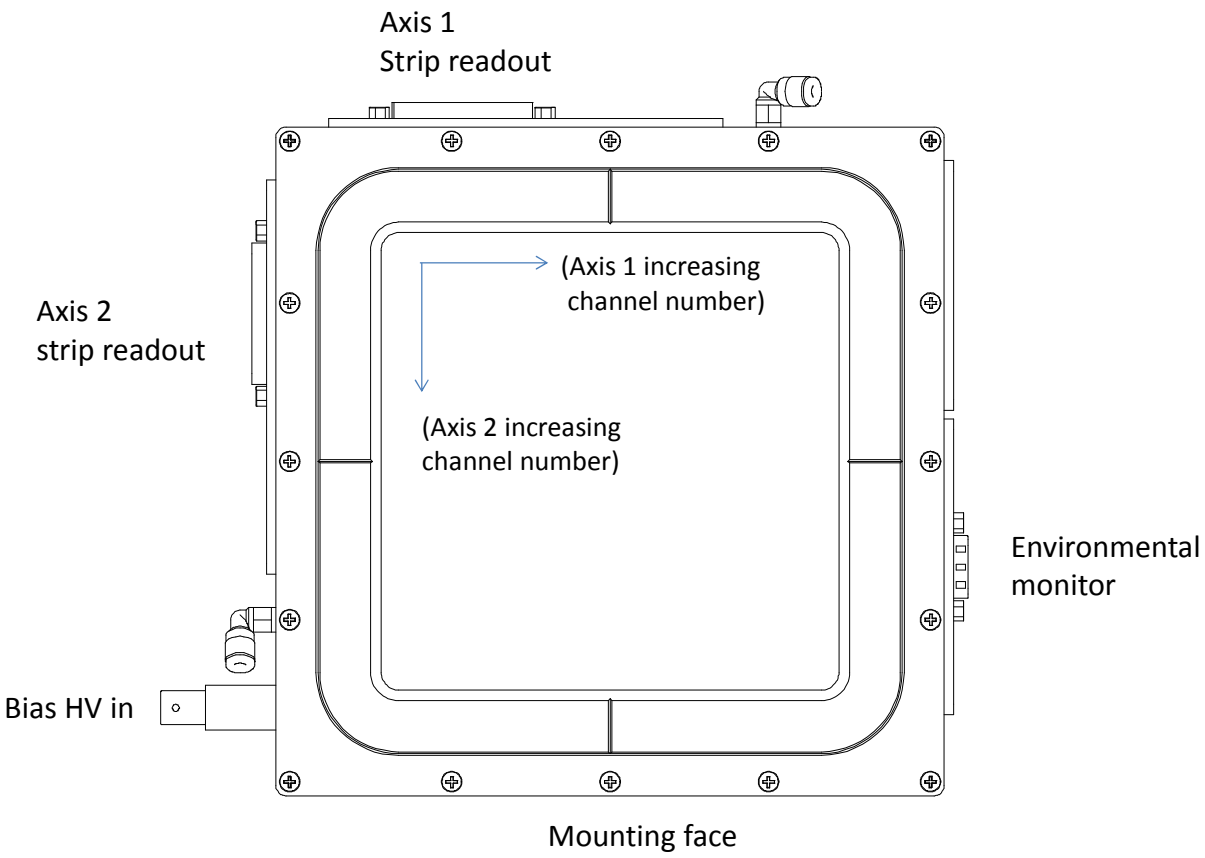
Note: Critical dosimetry measurements must use accurate gain values referenced to traceable standards, and regularly validated.

<table>
<tr><td>Calibration (cont)</td><td></td></tr>
<tr><td>Readout MUX</td><td>Digital bit pattern (TTL levels(to select analog sensor voltage that is switched to pins 6, 2 of monitor connector.
<table>
<tr><th>Bit 1</th><th>Bit 0</th><th>Selected sensor</th></tr>
<tr><td>0</td><td>0</td><td>Temperature (V_{measT})</td></tr>
<tr><td>0</td><td>1</td><td>Pressure (V_{measP})</td></tr>
<tr><td>1</td><td>0</td><td>Relative humidity (V_{measH})</td></tr>
<tr><td>1</td><td>1</td><td>Reference voltage (V_{ref})</td></tr>
</table></td></tr>
<tr><td>Temperature</td><td>Temperature(centigrade) = 100*V_{measT}
Temperature(Kelvin) = Temperature(centigrade) + 273.2</td></tr>
<tr><td>Pressure</td><td>Pressure(psi) = 18.75 * (V_{measP} / V_{ref} - 0.1)
Pressure(mbar) = Pressure(psi) * 68.95
Pressure(Pa) = Pressure(psi) * 6895</td></tr>
<tr><td>Humidity</td><td>Relative humidity (%) = 157 * (V_{measH} / V_{ref}) - 23.8</td></tr>
<tr><td>Gain correction</td><td>Nominal gain at standard ambient temperature and pressure (Temperature$_{SATP}$ = 298.15 K, Pressure$_{SATP}$ = 100000 Pa), must be corrected for measured temperature and pressure:

Gain = Gain$_{SATP}$ / [(Pressure$_{SATP}$ / Pressure(Pa)) * (Temperature(Kelvin) / Temperature$_{SATP}$)]

For nominal gains established at other reference temperature and pressure, substitute the appropriate reference values in the equation.</td></tr>
</table>

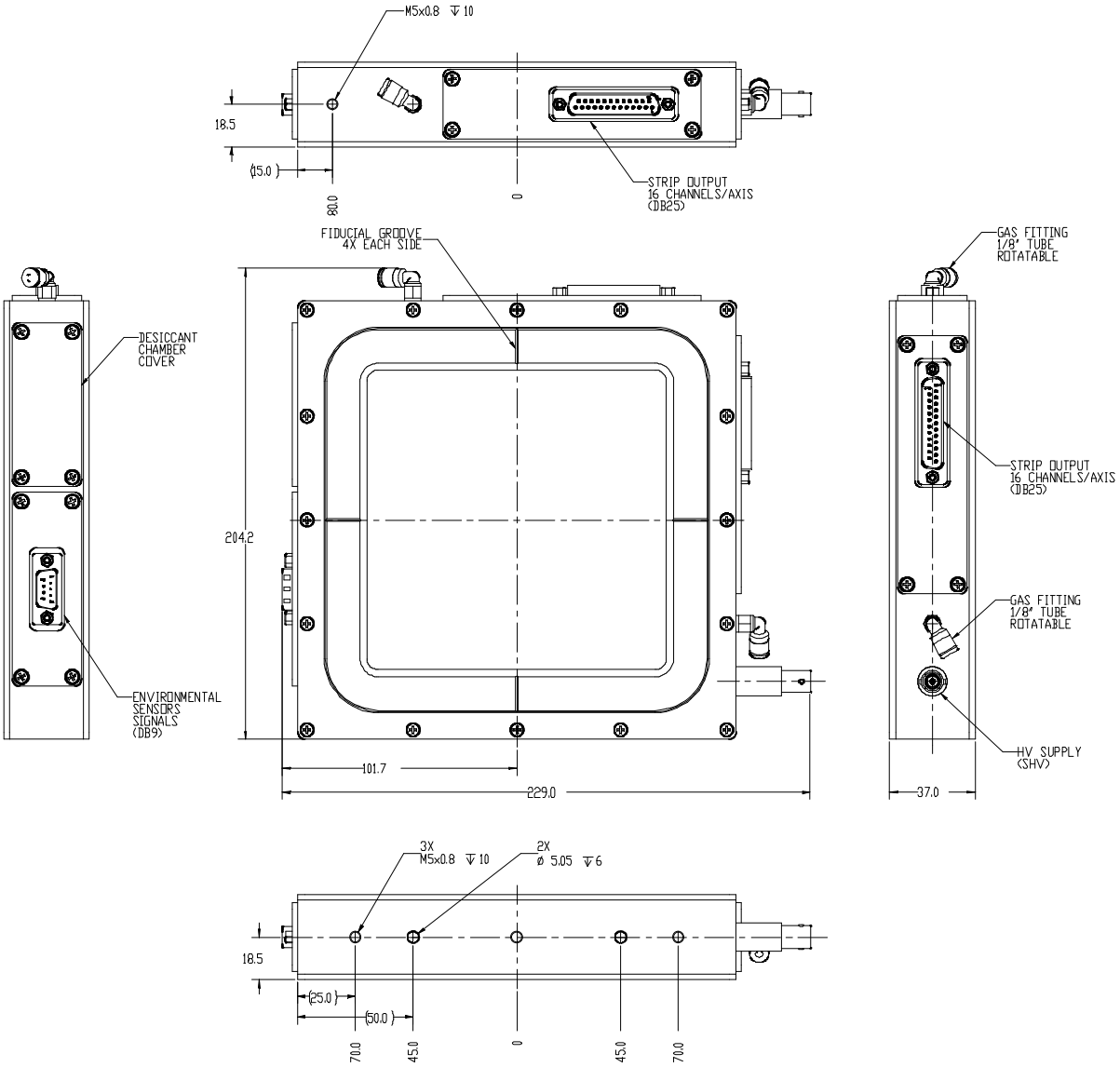
Layout



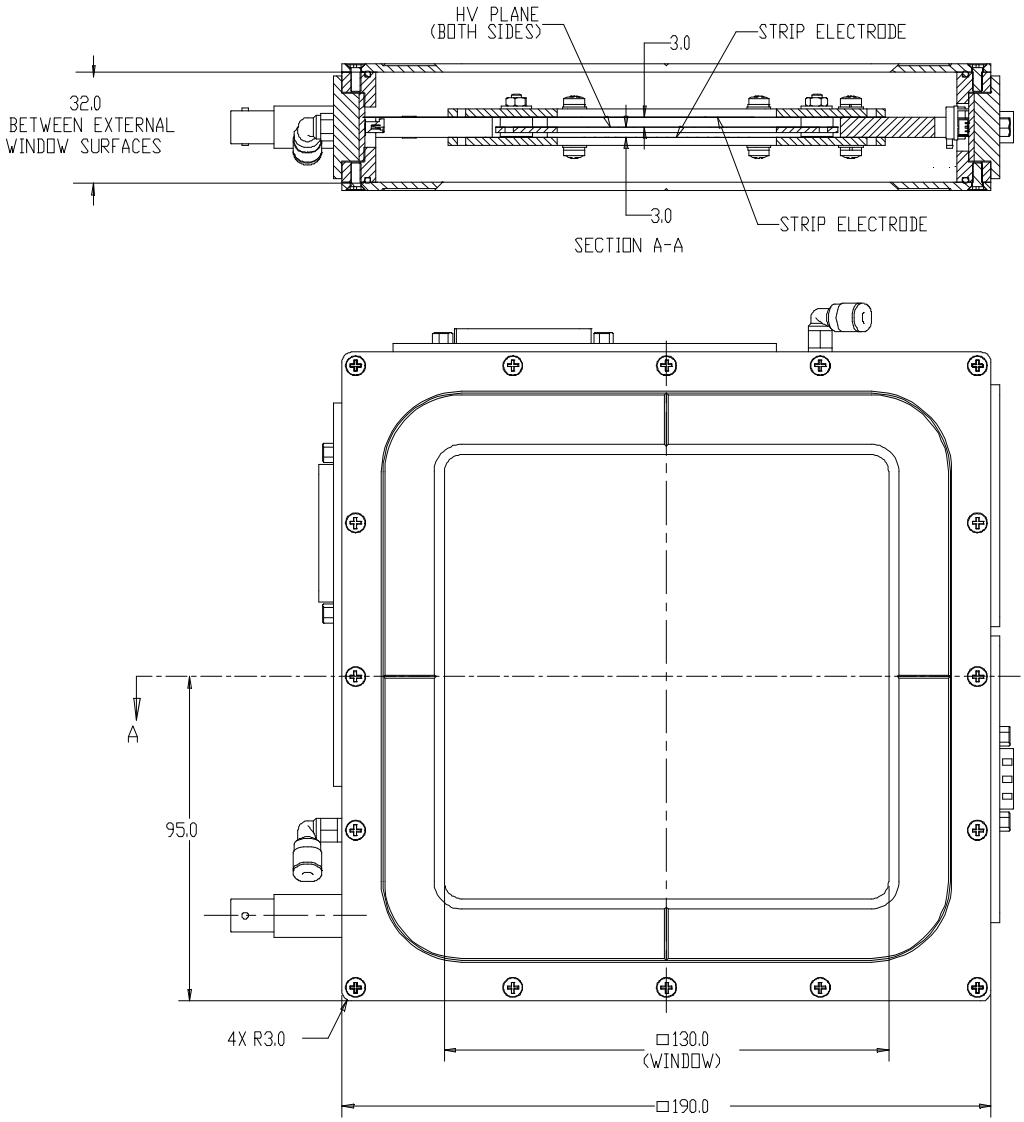
The IC16-5 has no preferred beam entrance side—it is symmetric along the beam path. Designation of axes as X /Y, or horizontal / vertical is arbitrary, as it depends upon the orientation of the IC with respect to the beamline, and of the beamline relative to any other reference coordinate system.

Strips/channel numbering is shown assuming that the axes are connected to I3200 readout electronics with pin to pin cables.

Assuming that the chamber is standing vertically on the mounting face, a beam entering through the face shown passes first through the horizontal sensing gap (axis 1, strips running up and down the page), and second through the vertical sensing gap (axis 2, strips running across the page).


M5x0.8 ↧10
18.5
(15.0)
80.0
0
STRIP OUTPUT
16 CHANNELS/AXIS
(DB25)
FIDUCIAL GROOVE
4X EACH SIDE
DESICCANT
CHAMBER
COVER
ENVIRONMENTAL
SENSORS
SIGNALS
(DB9)
204.2
101.7
229.0
GAS FITTING
1/8" TUBE
ROTATABLE
STRIP OUTPUT
16 CHANNELS/AXIS
(DB25)
GAS FITTING
1/8" TUBE
ROTATABLE
HV SUPPLY
(SHV)
37.0
3X
M5x0.8 ↧10
2X
Ø 5.05 ↧6
18.5
(25.0)
(50.0)
70.0
45.0
0
45.0
70.0

Dims mm



Dims mm

Ordering information

IC16-5	Thin film ionization chamber with 4.8 by 4.8 cm sensitive area, 16 by 16 strip cathode readout.

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IC16-5_DS_150507