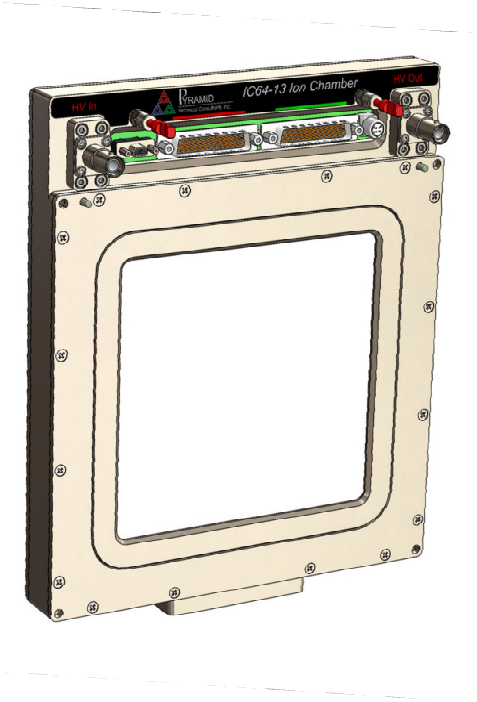
Datasheet **IC64-13**

High-Resolution Single Axis Position Sensing Transmission Ionization Chamber with Integral Plane

Features

- 12.8 cm x 12.8 cm sensitive area
- Ionization chamber with 64 strip readout for position and shape monitoring in one axis
- Integral plane electrode for total beam current measurement
- Minimum scattering due to thin films of low-Z material
- Small beamline length (22 mm)
- Small electrode gaps for low recombination
- Polyimide film electrode substrates for radiation hardness
- Gold plated foil for readout electrodes for extended lifetime (revision B and later)
- 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



Applications	• Particle therapy beam monitoring • On-line beam trajectory monitoring • General high energy ion beam diagnostics
Options	• Non-multiplexed environmental sensor signals.

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)

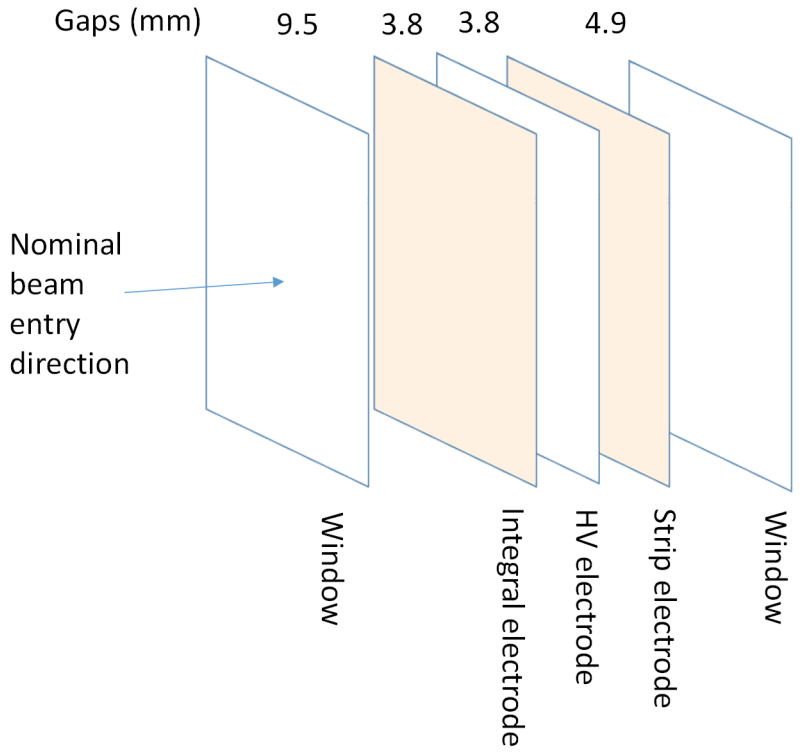
Sensor	
Type	Parallel plate dual ionization chamber with multi-strip cathode and integral plane cathode.
High voltage	500-1000 V nominal (1300 to 2600 V cm^{-1}); maximum 1500 V
Sensitive area	128 mm by 128 mm

Sensor (cont)	
Sensitive volume	Active volume 1: Integral cathode to anode. 3.8 mm spacing. Active volume 2: Anode to strip cathode. 3.8 mm spacing.
Strip geometry	64 strips 2.00 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 sen-
Position resolution	Depends on signal to noise ratio; 10's of µm achievable provided beam co-vers 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" (3.18 mm) tube push fit
Desiccant	Desiccant sachet. Sachet can be changed with chamber in situ.
Mechanical	
Insertion length	22 mm window to window, 28.4 mm housing face to face.
Overall size	208 mm by 262 mm by 52 mm approx (see figures)
Weight	1.3 kg (2.9 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 per-formed.
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	9.5 mm	Fill gas (non-active gap)
3a	0.03 µm	Gold plating (ground plane)
3b	25.0 µm	Polyimide foil
3c	0.03 µm	Gold plating (integral plane electrode)
4	3.8 mm	Fill gas (active gap)
5	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (anode)
6	3.8 mm	Fill gas (active gap)
7a	0.03 µm	Gold plating (strip readout electrode)
7b	25.0 µm	Polyimide foil
7c	0.03 µm	Gold plating (ground plane)
8	4.9 mm	Fill gas (non-active gap)
9	12.5 µm	Polyimide foil aluminized both sides 0.1 µm (window)



Total effective thickness < 150 µm water equivalent including air filling

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	
Strip readout	DSub male high density 44 pin. Two identical connectors for channels 1-32 and 33-64

1	Strip 29 (61)	16	Strip 31 (63)	31	Strip 32 (64)
2	Strip 28 (60)	17	Strip 30 (62)	32	Chassis
3	Strip 26 (58)	18	Strip 27 (59)	33	AGnd / KGnd
4	Strip 24 (56)	19	Strip 25 (57)	34	AGnd / KGnd
5	Strip 22 (54)	20	Strip 23 (55)	35	AGnd / KGnd
6	Strip 20 (52)	21	Strip 21 (53)	36	AGnd / KGnd
7	Strip 18 (50)	22	Strip 19 (51)	37	AGnd / KGnd
8	Strip 16 (48)	23	Strip 17 (49)	38	AGnd / KGnd
9	Strip 14 (46)	24	Strip 15 (47)	39	AGnd / KGnd
10	Strip 12 (44)	25	Strip 13 (45)	40	AGnd / KGnd
11	Strip 10 (42)	26	Strip 11 (43)	41	AGnd / KGnd
12	Strip 8 (40)	27	Strip 9 (41)	42	AGnd / KGnd
13	Strip 6 (38)	28	Strip 7 (39)	43	Chassis
14	Strip 4 (36)	29	Strip 5 (37)	44	Strip 3 (35)
15	Strip 2 (34)	30	Strip 1 (33)	-	-

Connector shell is common with cable screen 1.

The pin arrangement is compatible with a pin to pin (M-F) 44-way cable connection to an I6400 electrometer.

Integral plane	Lemo 0B.304 four-pin female

1	Integral plane signal
2	AGnd
3	n/c
4	Chassis

HV in	SHV
HV out	SHV

Connectors (cont)

Monitor (default, multiplexed)

Micro 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		

Readout MUX

Digital bit pattern (TTL levels) to select analog sensor voltage that is switched to pins 6, 2 of monitor connector (default option)

Bit 1	*Bit 0*	*Selected sensor*
0	0	Temperature (V_{measT})
0	1	Pressure (V_{measP})
1	0	Relative humidity (V_{measH})
1	1	Reference voltage (V_{ref})

Monitor (-NMX option)

-NMX purchase option - direct signals, no multiplex

1	Chassis	6	Relative humidity (V_{measH})
2	Pressure (V_{measP})	7	+5 V in
3	Temperature (V_{measT})	8	Device ID2
4	Device ID1	9	+5 V in
5	DGnd		

Temperature

Temperature(centigrade) = $100*V_{measT}$

Temperature(Kelvin) = Temperature(centigrade) + 273.2

Pressure

Pressure(psi) = $18.75 * (V_{measP} / V_{ref} - 0.1)$

Pressure(mbar) = Pressure(psi) * 68.95

Pressure(Pa) = Pressure(psi) * 6895

Humidity

Relative humidity (%) = $157 * (V_{measH} / V_{ref}) - 23.8$

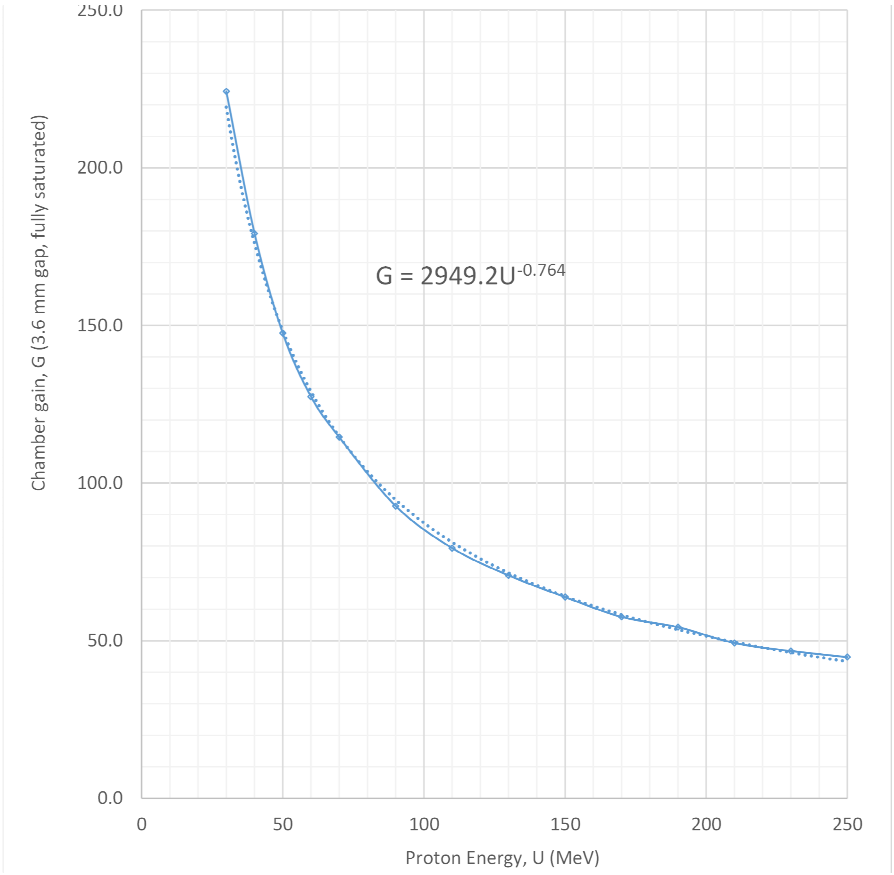
Gain correction

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:

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

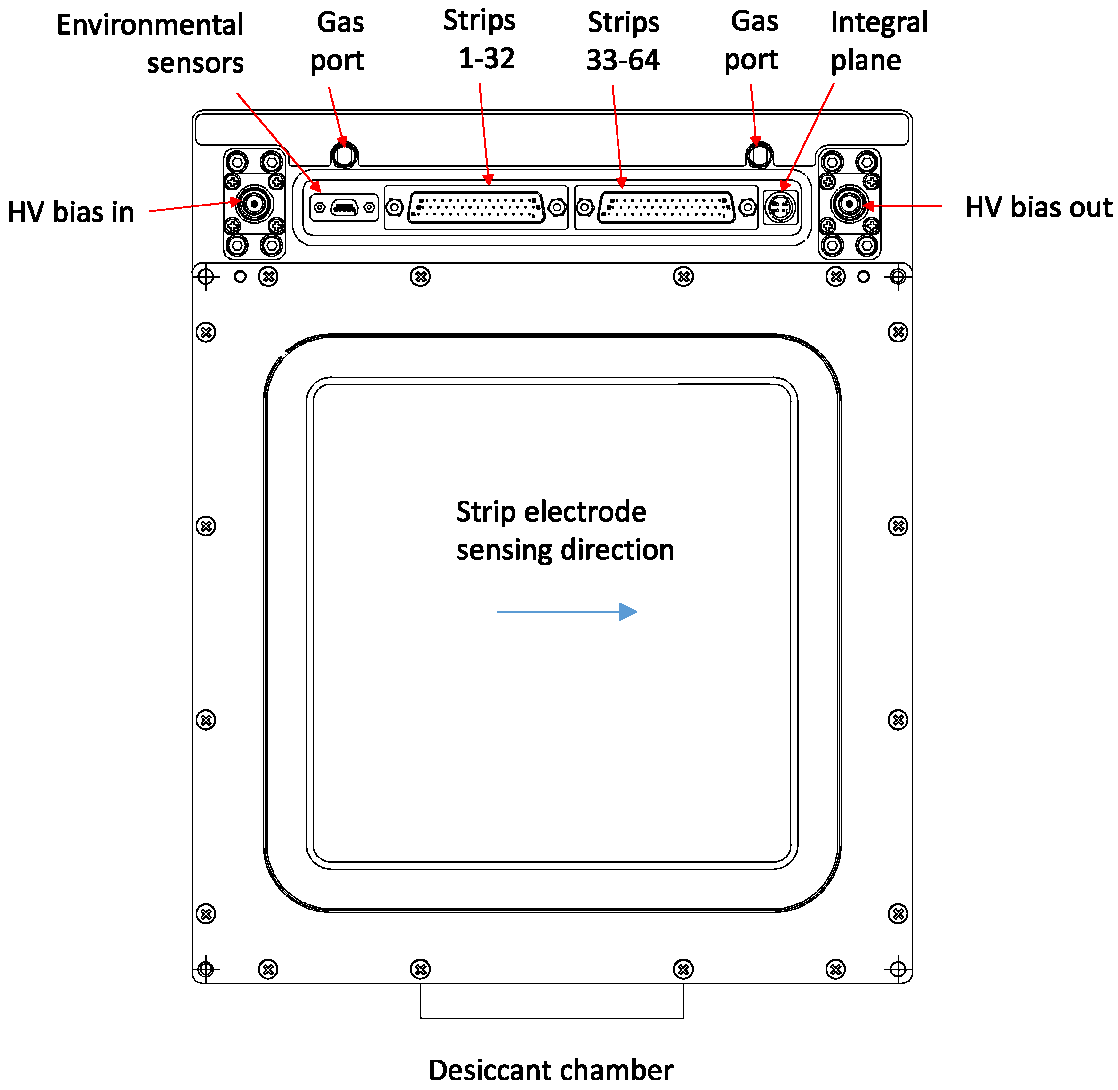
For nominal gains established at other reference temperature and pressure, substitute the appropriate reference values in the equation.

Calibration	
Gain curve	Approximate gain curves for air at standard ambient temperature and pressure for protons calculated by Geant4. The fitting curve is approximate.



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

Layout



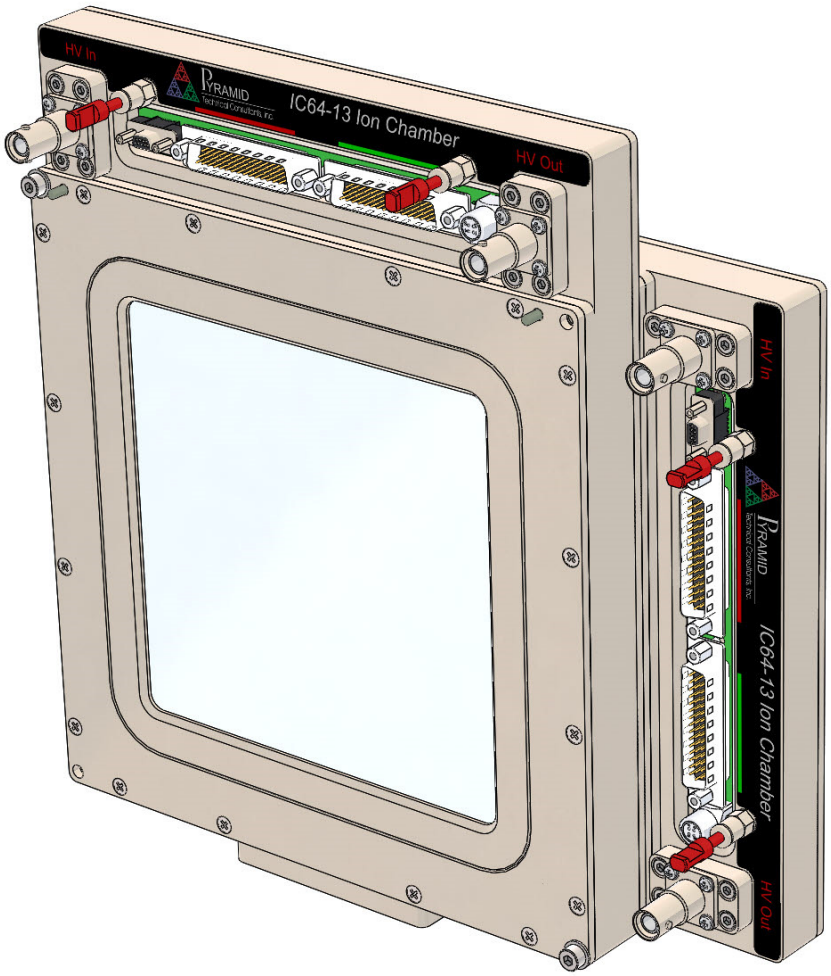
View on nominal beam entrance face. The IC64-13 in fact has no preferred beam entrance side (the beam can enter in either direction). Designation of the sensing axis as X / Y, or horizontal / vertical is also arbitrary, as it depends upon the orientation of the IC with respect to the beamline, and of the beamline relative to any other reference coordinate system.

Strips/channel numbering is shown assuming that the axes are connected to I6400 readout electronics with pin to pin cables.

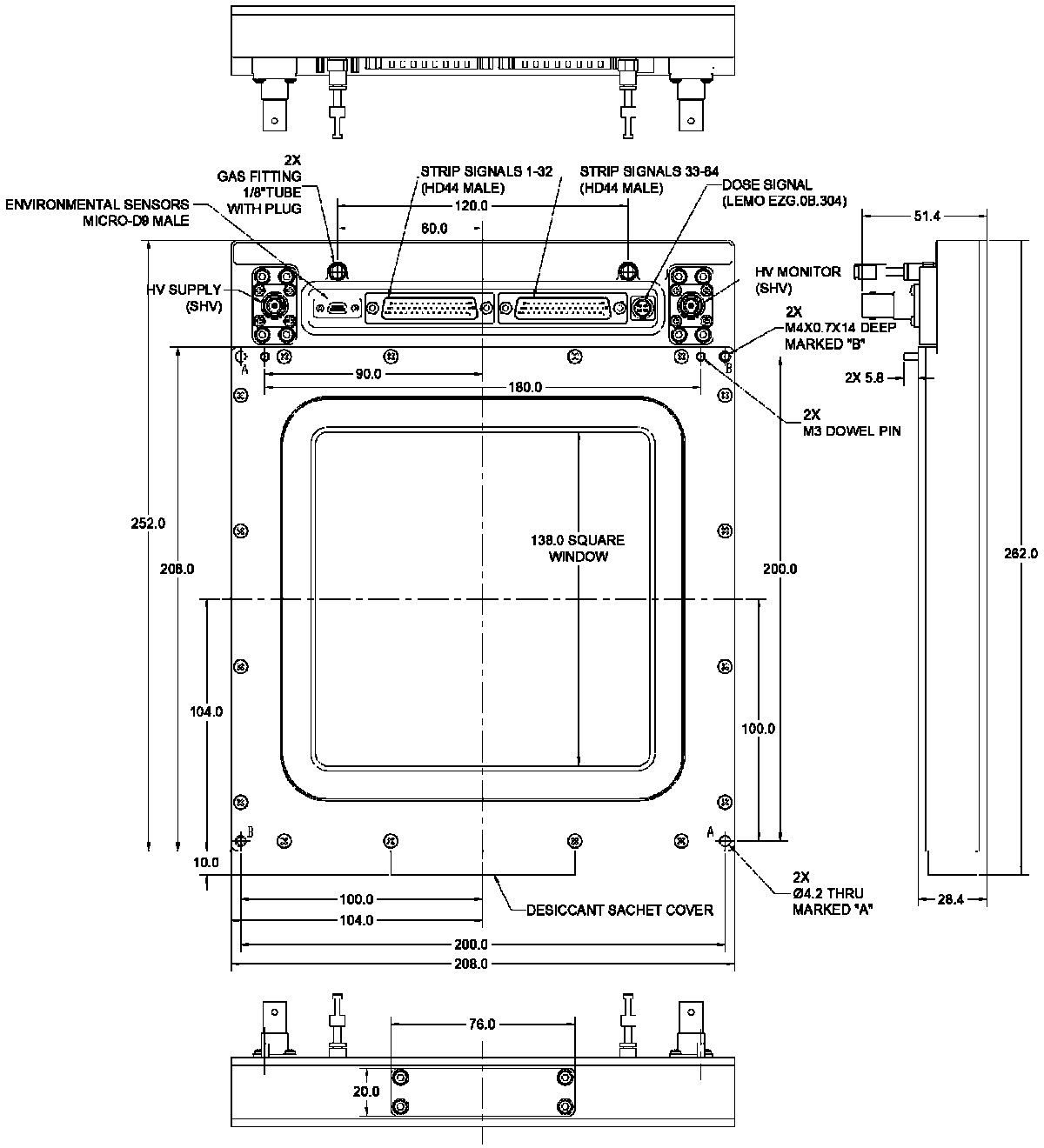
Assuming that the chamber is standing vertically as shown, a beam entering into the page on the figure passes first through the integral plane sensing gap, and second through the strip readout sensing gap.

The HV in and out designation is arbitrary and can be reversed with no effect on the function.

Two-axis arrangement



A pair of IC64-13 can be arranged rotated at 90 degrees relative to each other as shown to provide a two axis readout system with full redundancy on the integral plane readout for dose measurement..


2X
GAS FITTING
1/8"TUBE
WITH PLUG
ENVIRONMENTAL SENSORS
MICRO-D9 MALE
STRIP SIGNALS 1-32
(HD44 MALE)
STRIP SIGNALS 33-64
(HD44 MALE)
DOSE SIGNAL
(LEMO EZG.0B.304)
120.0
60.0
51.4
HV SUPPLY
(SHV)
HV MONITOR
(SHV)
2X
M4X0.7X14 DEEP
MARKED "B"
2X 5.8
90.0
180.0
2X
M3 DOWEL PIN
252.0
208.0
138.0 SQUARE
WINDOW
200.0
262.0
104.0
100.0
10.0
2X
Ø4.2 THRU
MARKED "A"
28.4
100.0
104.0
DESICCANT SACHET COVER
200.0
208.0
76.0
20.0

Dims mm

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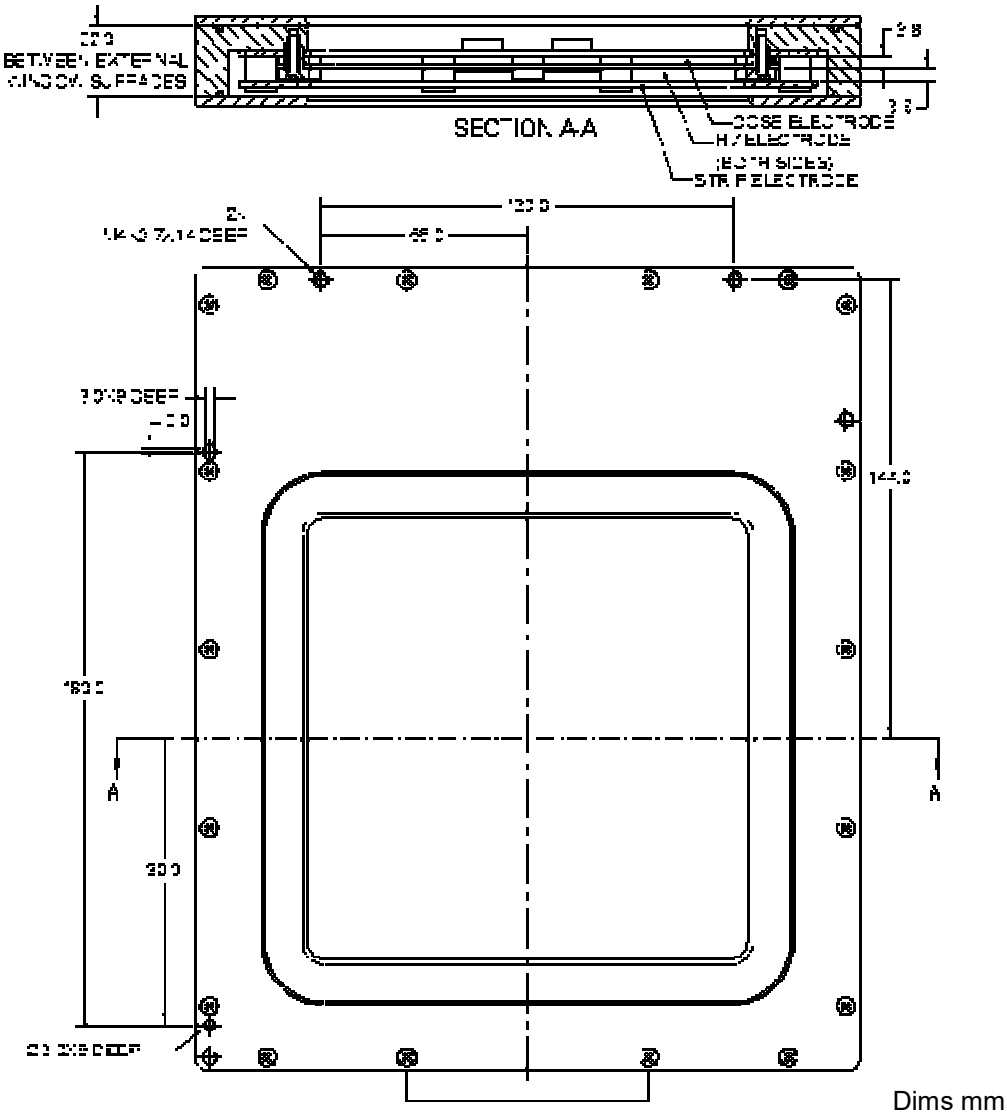

Dims mm

Ordering information

IC64-13	Thin film ionization chamber with 12.8 by 12.8 cm sensitive area, single axis 64 strip cathode readout, integral plane electrode. Gold plating on integral and strip electrodes.
-NMX	Option - environmental sensor signals not multiplexed (default is multiplexed signals)

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IC64-13_DS_190625