Datasheet **IC128-25LC-2I**

Integrated Dosimetry and Position Sensing Ionization Chamber with Dual Redundant Dose Measurement

Features

- 25 cm x 25 cm sensitive area
- Ionization chamber with dual integral plane readout for dosimetry and 128 by 128 strip readout for position and shape tracking can provide all sensing necessary for a proton therapy nozzle (depending on specific system risk analysis)
- Low scattering due to thin film electrodes
- Small insertion length
- Two-gap integral plane sections for optimum sensitivity and speed of response
- Polyimide film electrode substrates for radiation hardness and high geometric precision
- Operable with atmospheric pressure air chamber gas or flow-through gas
- Integrated temperature, pressure and humidity sensing
- Integrated desiccant system for fill gas
- High voltage sense loopback

Applications	• Particle therapy scanned beam tracking and dosimetry • Pencil beam scanning control • General high energy ion beam diagnostics
Options	• Gold electrode metallization in place of aluminium

Specifications

Beam compatibility	
Species	Protons, deuterons, helium ions, fully-stripped carbon
Energy range	30 MeV /nucleon to 500 MeV / nucleon
Beam current density range	Up to 30 nA cm^{-2} (proton particle current) limited ultimately by recombination losses and stability
Sensor	
Type	Parallel plate dual ionization chamber with multi-strip cathodes and dual-gap integral plane cathodes.
High voltage bias	2000 V maximum operating.
Sensitive area	250 mm by 250 mm.

Sensor (cont)	
Sensitive volumes	Active volume 1: Dual 5 mm gap integral plane section Active volume 2: 7 mm gap X strip section Active volume 3: 7 mm gap Y strip section Active volume 4: Dual 5 mm gap integral plane section
Strip geometry	Equal width 1.89 mm on 2.00 mm pitch (effective sampling width 2.00 mm).

Chamber gas	
Operating gas	Atmospheric air, or flow of any clean ionization chamber gas (N_2, Ar/CO_2 etc)
Flow gas connections	To suit 1/8” tube push fit
Desiccant	For use when chamber is operated with atmospheric gas fill and optionally for flow gas operation. Four silca gel sachets. Sachets can be changed with chamber in situ.

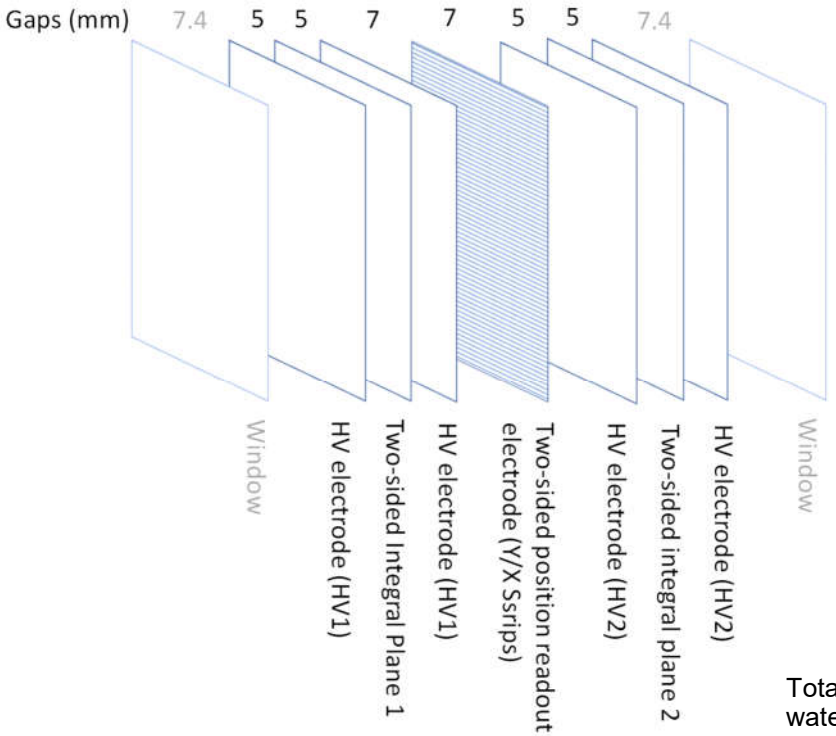
Mechanical	
Insertion length	49.0 mm window to window, 55.7 mm face to face (including decal)
Orientation	Operable in any orientation, and with beam entering in either direction
Overall size	425 mm by 425 mm by 56 mm approx. excluding mating connectors (see figures)
Weight	6.0 kg (12.5 lb)
Operating environment	Clean and dust-free, Temperature 10 to 35 C (15 to 25 C recommended) Humidity < 70% humidity, non-condensing Vibration < 0.1g all axes (1 to 100 Hz) Ambient sound in < 300 Hz range should be minimised to prevent micro-phonic pickup
Shipping and storage environment	-10 to 50 C, < 80% humidity, non-condensing, vibration < 1g all axes, 1 to 100 Hz A dedicated shipping container is included.

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.

Materials	

Materials in beam path

1	12.5 µm polyimide window with 0.1 µm Al both sides
	7.4 mm fill gas
2	12.5 µm polyimide anode electrode with 0.1 µm Al both sides, HV1
	5.0 mm fill gas (active volume for IP1)
3	25 µm polyimide IP1 electrode with 0.1 µm Al both sides
	5.0 mm fill gas (active volume for IP1)
4	12.5 µm polyimide anode electrode with 0.1 µm Al both sides, HV1
	7.0 mm fill gas (active volume for Y strips)
5	25 µm polyimide strip electrode with 0.1 µm Al both sides
	7.0 mm fill gas (active volume for X strips)
6	12.5 µm polyimide anode electrode with 0.1 µm Al both sides, HV2
	5.0 mm fill gas (active volume for IP2)
7	25 µm polyimide IP1 electrode with 0.1 µm Al both sides
	5.0 mm fill gas (active volume for IP2)
8	12.5 µm polyimide anode electrode with 0.1 µm Al both sides, HV2
	7.4 mm fill gas
9	12.5 µm polyimide window with 0.1 µm Al both sides



Total effective thickness < 255 µm
water equivalent including air filling

Connectors

Strip readout

High density DSub male 44 pin.

Eight connectors color-coded (four per axis for strips Red 1-32, Green 33-64, Blue 65-96, White 97-128)

1	Strip 29 I_28	16	Strip 31 I_30	31	Strip 32 I_31
2	Strip 28 I_27	17	Strip 30 I_29	32	Shield
3	Strip 26 I_25	18	Strip 27 I_26	33	KGnd
4	Strip 24 I_23	19	Strip 25 I_24	34	KGnd
5	Strip 22 I_21	20	Strip 23 I_22	35	KGnd
6	Strip 20 I_19	21	Strip 21 I_20	36	KGnd
7	Strip 18 I_17	22	Strip 19 I_18	37	KGnd
8	Strip 16 I_15	23	Strip 17 I_16	38	KGnd
9	Strip 14 I_13	24	Strip 15 I_14	39	KGnd
10	Strip 12 I_11	25	Strip 13 I_12	40	KGnd
11	Strip 10 I_09	26	Strip 11 I_10	41	KGnd
12	Strip 8 I_07	27	Strip 9 I_08	42	KGnd
13	Strip 6 I_05	28	Strip 7 I_06	43	Shield
14	Strip 4 I_03	29	Strip 5 I_04	44	Strip 3 I_02
15	Strip 2 I_01	30	Strip 1 I_00		

The table shows the connections for the first bank of 32 signals for either axis (connector J1). The same connection pattern is repeated for the remaining three connectors on each axis:

J2: Strips 33 to 64 (I_33 to I_63)

J3: Strips 65 to 96 (I_64 to I_95)

J4: Strips 97 to 128 (I_96 to I_127).

I_xx numbers are circuit schematic references.

Integral plane readout

Two connectors, Lemo 0B four pin female

1	Signal current	4	Chassis
2	AGnd	3	Aux signal current

1 and 3 are connected internally

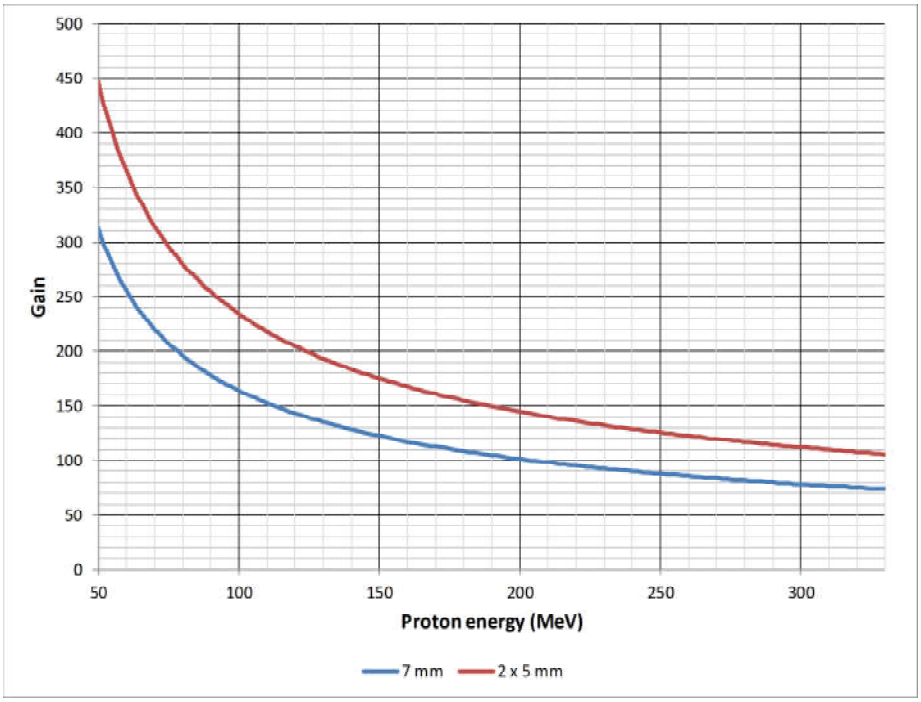
All connectors allow connection to Pyramid I128 and I6400 electrometers via pin to pin cables.

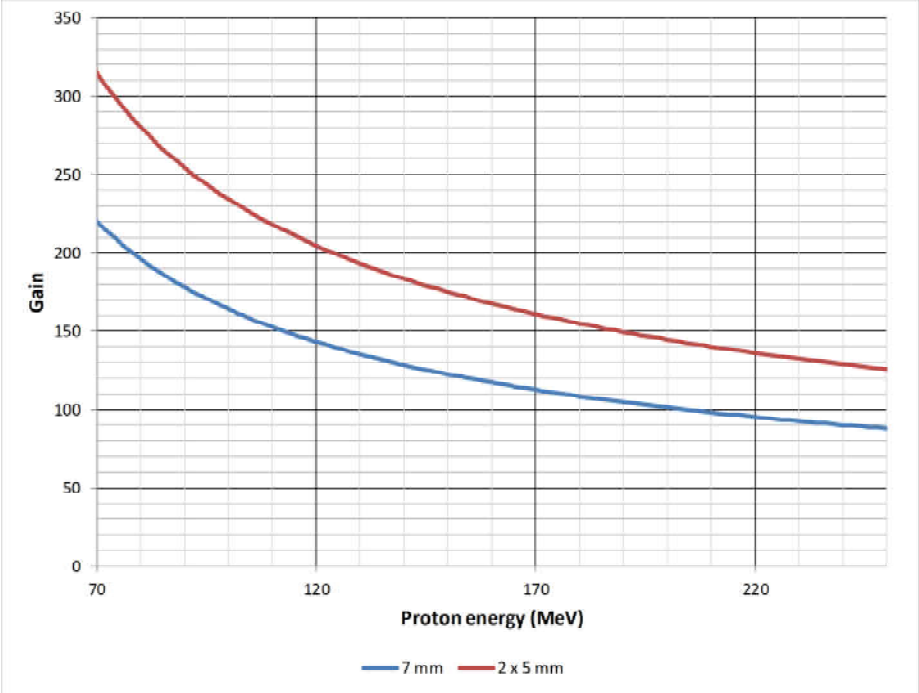
Connectors (cont)	
HV in / out	SHV Four connectors for anode voltages - two (HV1 in and HV1 sense out) for IP1 integral section and X strip readout section - two (HV2 in and HV2 sense out) for IP2 integral plane section and Y strip readout section HV1 and HV2 are nominally expected to be at the same voltage, but a differential voltage of up to 2000 V can be tolerated.
Monitor	DSub male 9-pin, two connectors with redundant functions.

1	Chassis	6	Analog out +
2	Analog out -	7	Signal select bit 1
3	Signal select bit 2	8	Device ID bit 2
4	Device ID bit 1	9	Vref in (+5 V in)
5	DGnd		

Grounding	Multiple ground options that may be connected or isolated, depending on whether control and readout electronics (integral plane readout, strip readout, environmental sensor control and readout, high voltage bias) are integrated or independent. **AGnd** is the primary signal reference ground. The guard areas on the integral and strip electrode planes are connected to AGnd. **KGnd** is an auxiliary signal ground for strip readout electronics. Used if the strip readout electronics are independent. Optional connection to AGnd via internal 0 ohm resistors R4 (normally fitted). **Chassis** is the cable screen for Lemo and SHV connectors. Optional connection to the IC128 body via internal 0 ohm resistor R7. Optional connection to shield via internal 0 ohm resistors R5 (normally fitted). Optional connection to SHV screens via internal 0 ohm resistors R6 (normally fitted). **Case** is the metal shell of the IC. Optional connection to chassis via internal 0 ohm resistors R7 (normally fitted). **Shield** is a special ground associated with the I128 readout electronics. May be ignored for other readout electronics. Optional connection to chassis via IC128-25 internal 0 ohm resistors R3 (normally fitted). **DGnd** is the reference ground for the environmental sensors control and readout.
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 if the electrodes are not grounded.

Calibration	
Gain curves	Approximate gain curve at standard temperature and pressure for protons, dual 5 mm and single 7 mm gaps.





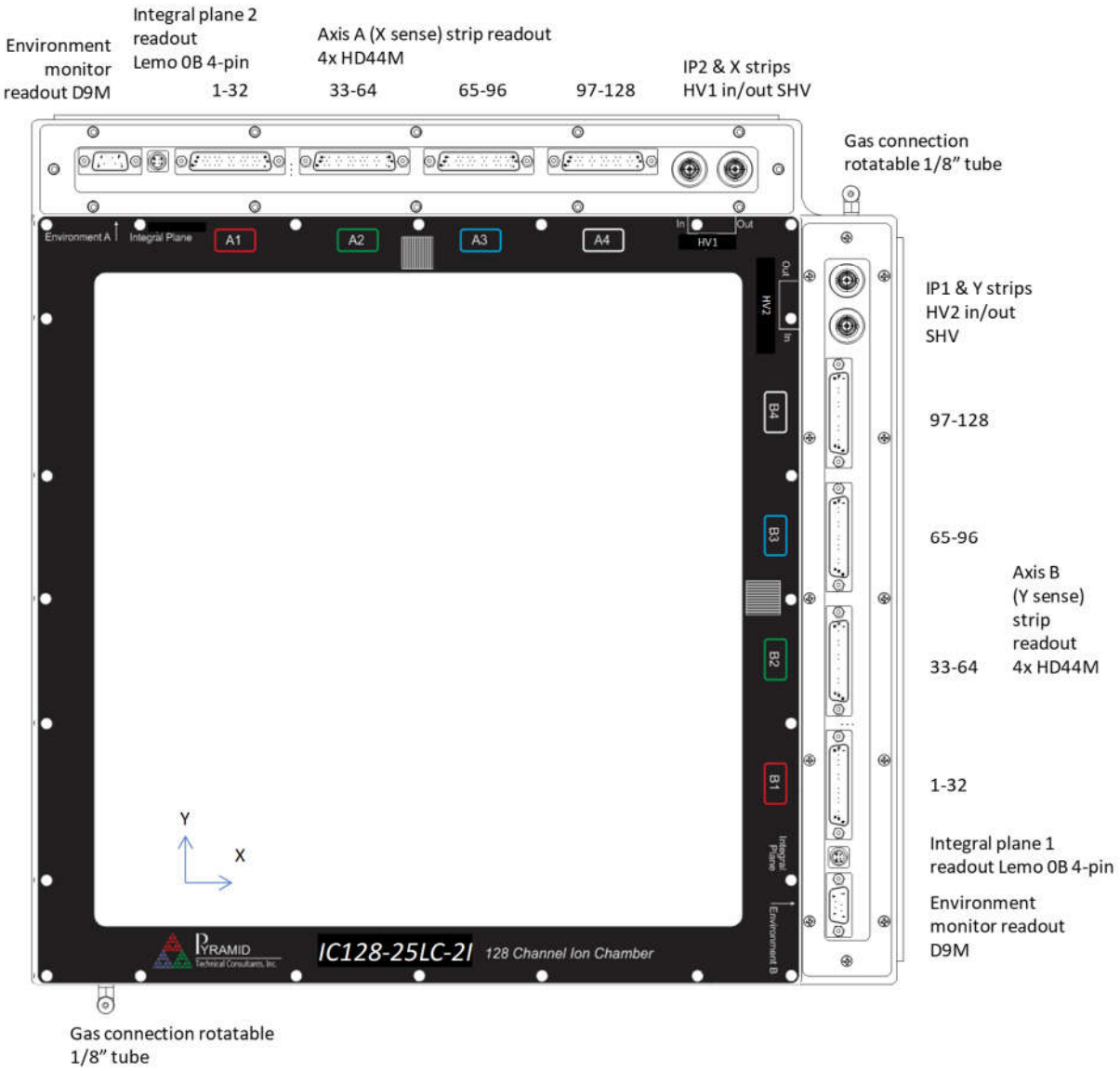
Note: Critical dosimetry measurements must use accurate gain values corrected for temperature and pressure, referenced to traceable standards. The values must be regularly validated.

Calibration (cont)	
Readout MUX	Digital bit pattern (TTL levels(to select analog sensor voltage that is switched to pins 6, 2 of monitor connector.

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})

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 = 1/ [$Gain_{SATP}$ * ($Pressure_{SATP}$ / Pressure(Pa)) * (Temperature(Kelvin) / $Temperature_{SATP}$)] For nominal gains established at other reference temperature and pressure, substitute the appropriate reference values in the equation.

Layout

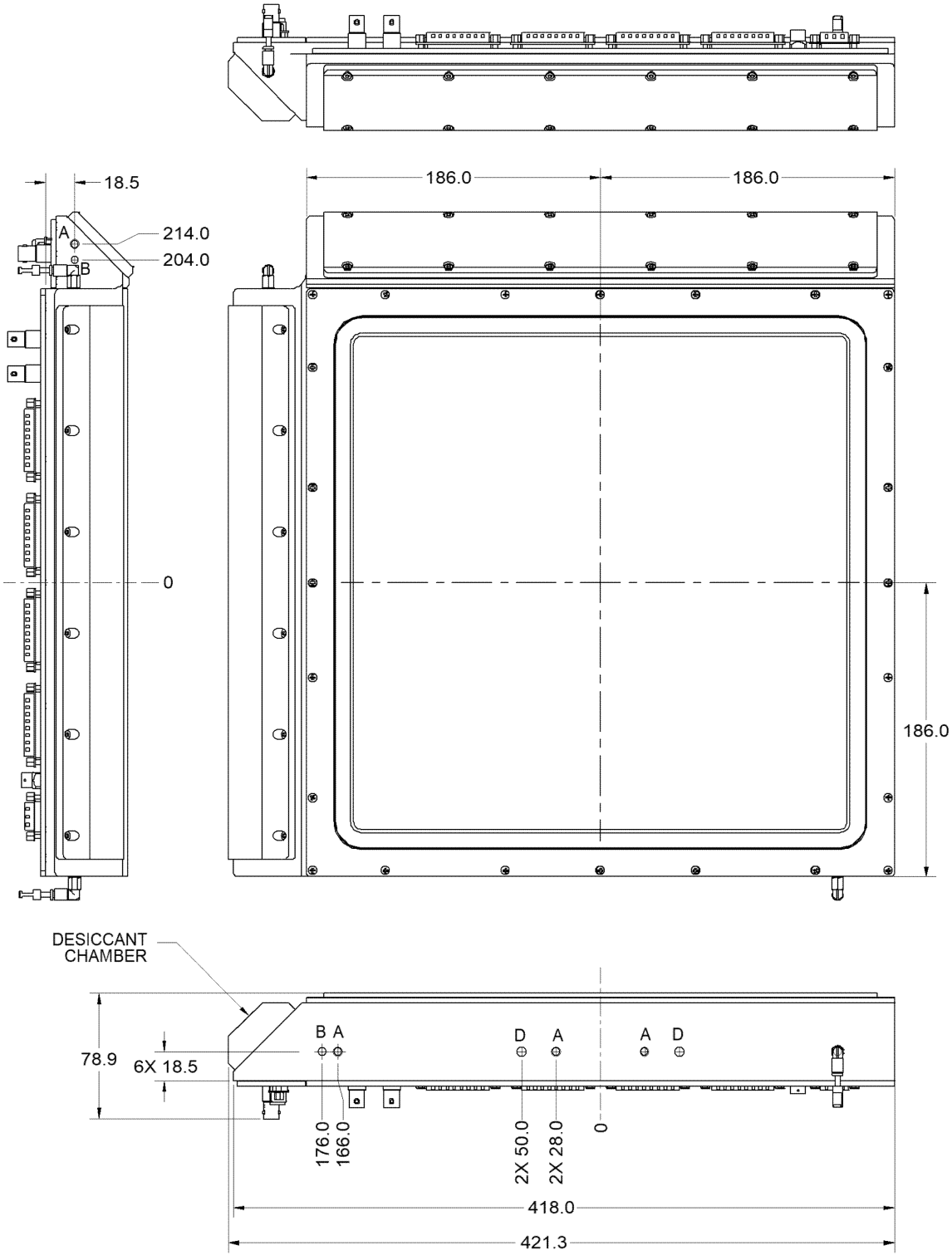


Designation of axes as X /Y, or horizontal / vertical is arbitrary, as it depends upon the orientation of the IC with respect to the beamline.

Strips are numbered sequentially from the lower right corner in the view shown, both axes.

Conventional beam entrance face shown, but beam can enter in either face.

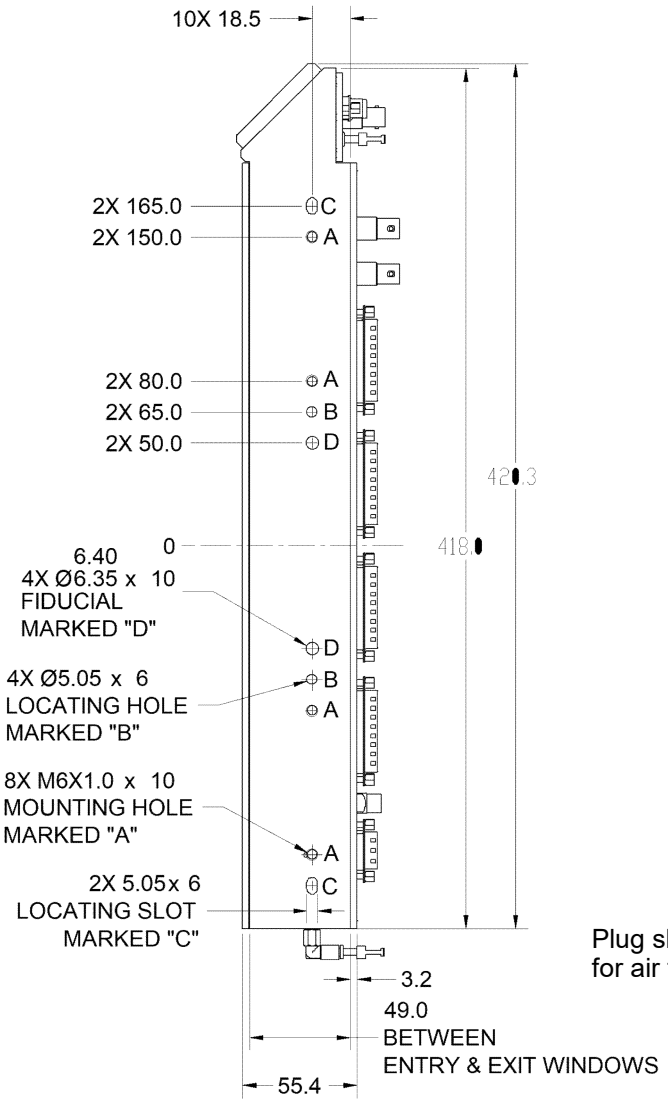
Overall dimensions



Dims mm

Plug shown in gas fitting for air fill operation

Mounting and fiducial details



Plug shown in gas fitting for air fill operation

Dims mm

Ordering information

IC128-25LC-2I	Ionization chamber with 25 by 25 cm sensitive area, 128 by 128 strip cathode readout and two dual-gap integral plane dose readout sections.
-AU	Gold metallization option on readout electrodes

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