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Single Photon Position Sensitive Detector

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July 2020

U.S. DEPARTMENT OF ENERGY

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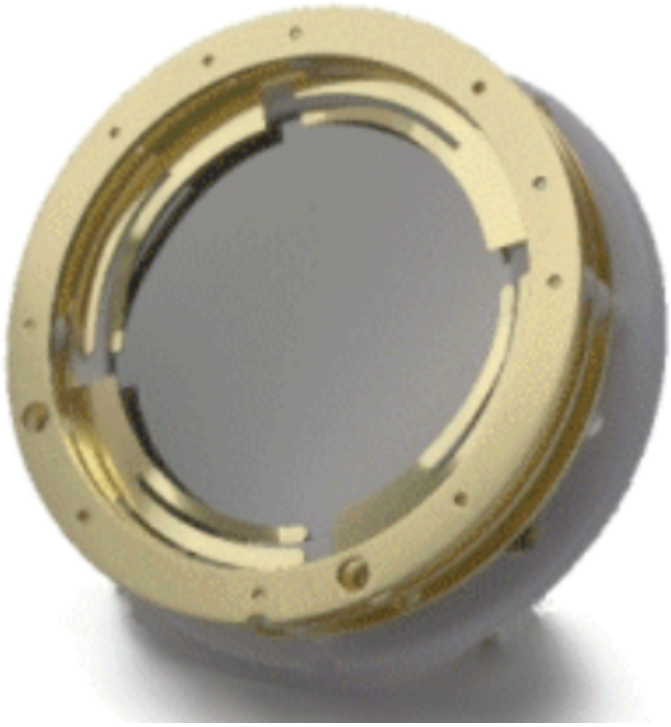
Quantar Technology Inc.

- http://www.quantar.com/pages/QTI/ofs.htm
- 3300 Series
  - Open-face, MCP-based
  - Resistive Anode Encoder (RAE) position sensitive detector
  - standard or coated (e.g. CsI, KBr) MCP surface
  - operating in vacuum (fully UHV-compatible), P<1e-6 Torr required
  - MCPs operate in a gain-saturated mode to ensure a relatively constant gain to optimize the spatial resolution



  - Charge packet disperses linearly to the four corners of resistive anode
  - Four pulse signals are processed by separate charge-sensitive preamplifiers, shaper amplifiers and discriminators.
  - X and Y coordinates of each detected event, corresponding to a single incoming particle or photon, are then computed from the ratio of charge pulse amplitudes.

Quantar Technology Inc. -3300 Series (continue)

- Standard and high spatial-resolution versions are available.
  - Standard resolution - 100 resolution elements (1/100 of active dimension) across each axis.
  - High-resolution versions achieve 400 resolution elements (1/400 of active dimension)
- Spatial position linearity is typically within 5% of true position (of sensor active dimension).
  - Background count rate are typically less than 10 events per second integrated over the entire image area.
  - Coincidences of true and background events can be additionally discriminated by referencing signals to the revolution marker
  - Bias voltages for the microchannel plates by external 2-3 kV (3-4 kV for high resolution versions) power supply and resistive divider
- Options we do not need
  - Electrically Isolated Front Rings (option 001/SE)
    - Can be used for support
  - Coated MCP Options
  - CsI, KBr or similar coatings can be applied to input MCP surface to enhance detection efficiency for soft x-ray and vacuum uv applications.

Quantar Technology Inc. -3300 Series (continue)

Model	Active Area Diameter	# of MCPs	Spatial Resolution (resolvable elements)	Spatial Resoluton (approximate mm)	Overall sensor diameter
3390	25mm	2	100	0.25 mm	2.0 inch (50.8 mm)
3391-010	25mm	3	400	0.063 mm	2.0 inch (50.8 mm)
3394	40mm	2	100	0.40 mm	2.9 inch (73.7 mm)
3395-010	40mm	3	400	0.10mm	2.9 inch (73.7 mm)
3392	75mm	2	100	0.75 mm	5.5 inch (139.7 mm)
3398	80x100mm	2 or 3	100	0.79 mm	5.8 inch (147.4 mm)

- 3391-010 looks as a preferable choice for image of the beam
  - With 2 times optical amplification the sensitive area referenced to the beam is ±6 mm, resolution is 32 μm
  - Should be the first choice
  - Further optical amplification is not expected to improve resolution which is still limited by diffraction
- 3395-010 looks as preferable choice for direct photon registration
  - 1/γ angle yields 20 mm radius at 6 m distance for 150 MeV beam

Quantar Technology Inc.– Technical Implementation

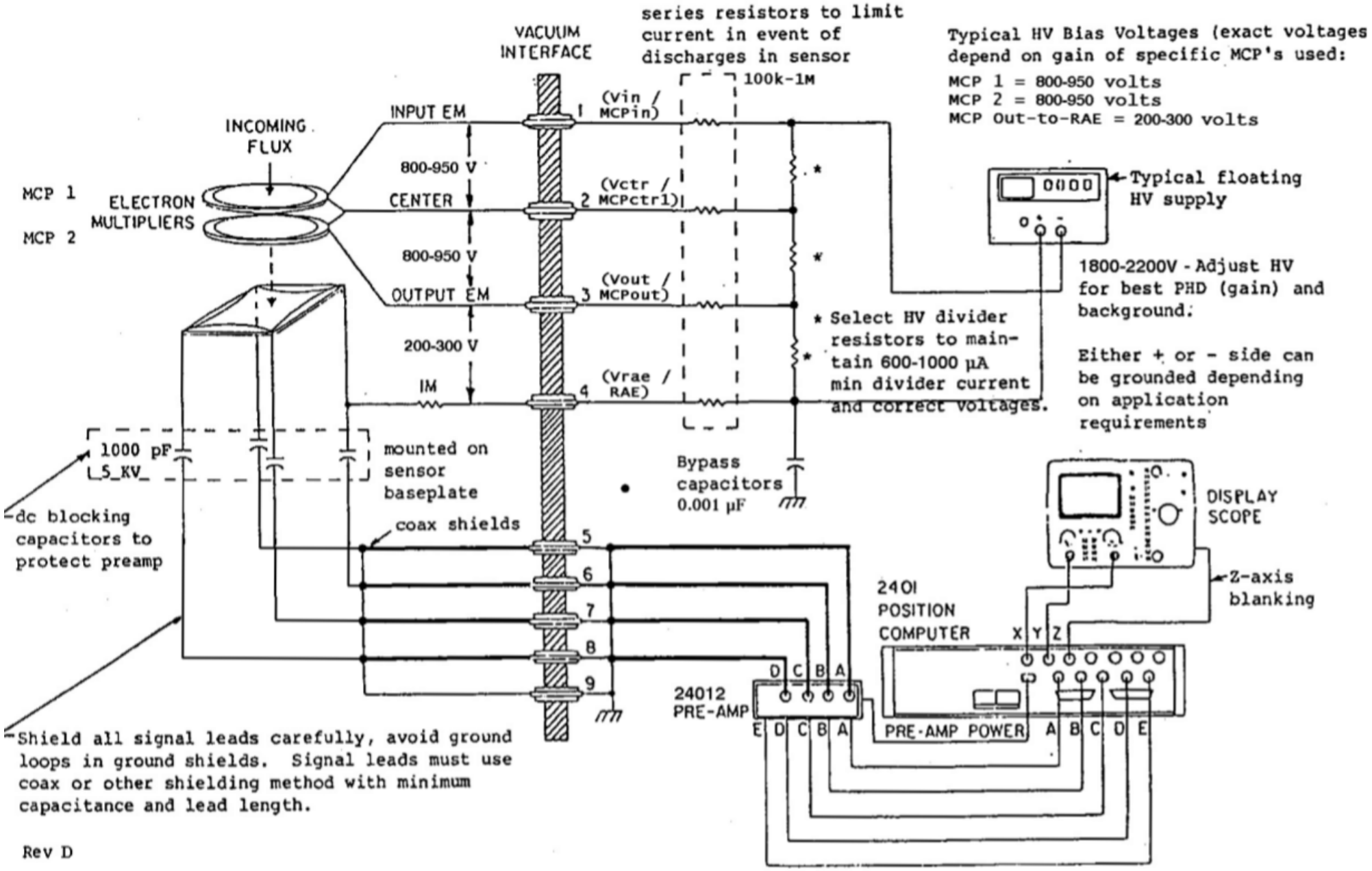
- Typical electron gain of
  - 2 MCPs stack is 5×10^6
  - 5 MCP stack is 5×10^7
- Resistive noise (Johnson noise) produced by the resistive nature of resistive anode and preamplifier noise are fixed for a given design
- MCP gain determines the S/N ratio and thus the spatial resolution

Detailed specifications

Model Number	Active Diameter	Number of MCP's	Spatial Resolution*	Spatial Resolution
3390A	25 mm	2	1/100	250 μm
3391A/010	25 mm	3	1/400	62.5 μm
3391A	25 mm	5	1/400	62.5 μm
3392A	75 mm	2	1/100	750 μm
3394A	40 mm	2	1/100	400 μm
3395A/010	40 mm	3	1/400	100 μm
3395A	40 mm	5	1/400	100 μm

*

Typical Background Count Rate: at 10^{-6} torr pressure (sea level):	5-10 counts per sec (25mm and 40mm) 100-125 counts per sec (75 mm) (background counts at higher altitudes may be slightly higher due to higher rate of cosmic rays)
Maximum Bakeout Temperature:	200 degrees C without Teflon lead set 150 degrees C with Teflon lead set
Decoupling capacitor voltage rating:	5000 V DC maximum.
Net Weight:	Models 3390A, 3391A (25 mm): 3.5 oz (100 grams) Models 3394A, 3395A (40 mm): 6.2 oz (180 grams)
Shipping Weight:	Approximately 5 lbs (2.27 kg)
Mechanical Dimensions:	25 mm: see drawing in this Manual 40 mm: see drawing in this Manu


series resistors to limit current in event of discharges in sensor
VACUUM INTERFACE
100k-1M
Typical HV Bias Voltages (exact voltages depend on gain of specific MCP's used:
MCP 1 = 800-950 volts
MCP 2 = 800-950 volts
MCP Out-to-RAE = 200-300 volts
INPUT EM
(Vin / MCPin)
INCOMING FLUX
800-950 V
CENTER
(Vctr / MCPctr1)
MCP 1
ELECTRON MULTIPLIERS
MCP 2
800-950 V
OUTPUT EM
(Vout / MCPout)
Typical floating HV supply
1800-2200V - Adjust HV for best PHD (gain) and background.
200-300 V
IM
(Vrae / RAE)
* Select HV divider resistors to maintain 600-1000 µA min divider current and correct voltages.
Either + or - side can be grounded depending on application requirements
1000 pF 5 KV
mounted on sensor baseplate
Bypass capacitors 0.001 µF
DISPLAY SCOPE
dc blocking capacitors to protect preamp
coax shields
Z-axis blanking
2401 POSITION COMPUTER
X Y Z
D C B A
24012 PRE-AMP
E D C B A
PRE-AMP POWER
A B C D E
Shield all signal leads carefully, avoid ground loops in ground shields. Signal leads must use coax or other shielding method with minimum capacitance and lead length.
Rev D

RorntDec Handels GmbH (D-65779 Kelkheim, Germany)

- https://www.roentdek.com/products/detectors/
- https://www.roentdek.com/info/Novel_particle.pdf
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