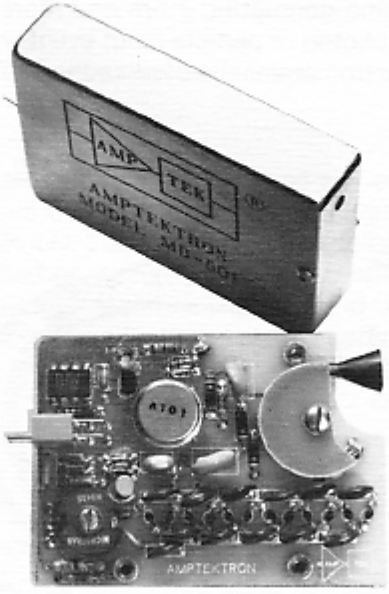
AMPTEKTRON®

MD-501

THE CHANNEL ELECTRON MULTIPLIER (CEM) COMES OF AGE!!!



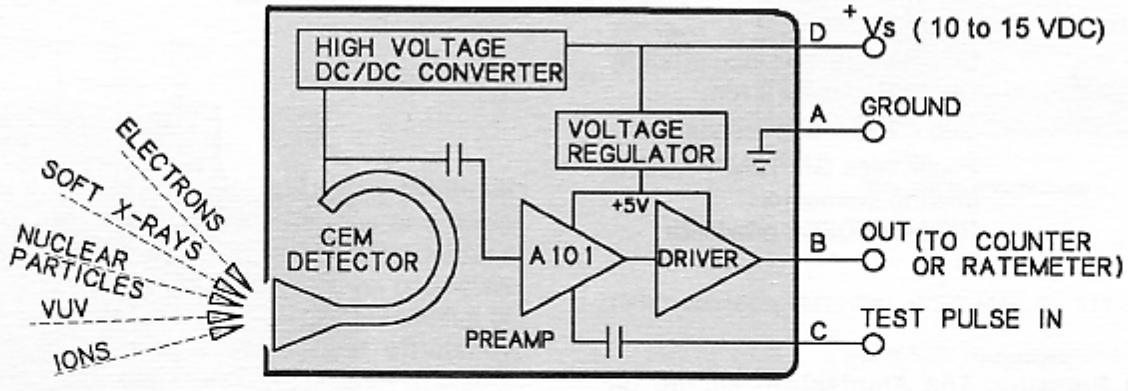
A COMPLETE CEM DETECTOR SYSTEM FOR VACUUM USE

It Contains:

- CEM
- High Voltage Supply
- Charge Sensitive Preamplifier & Discriminator
- Line Driver
- Fully Packaged Electronics

The AMPTEKTRON is a compact, easy to use electron multiplier system capable of detecting Electrons, Ions, VUV, Soft X-rays, and other Nuclear Particles at rates greater than one million events per second. It is configured in a pulse counting mode and operates from a single low voltage supply.

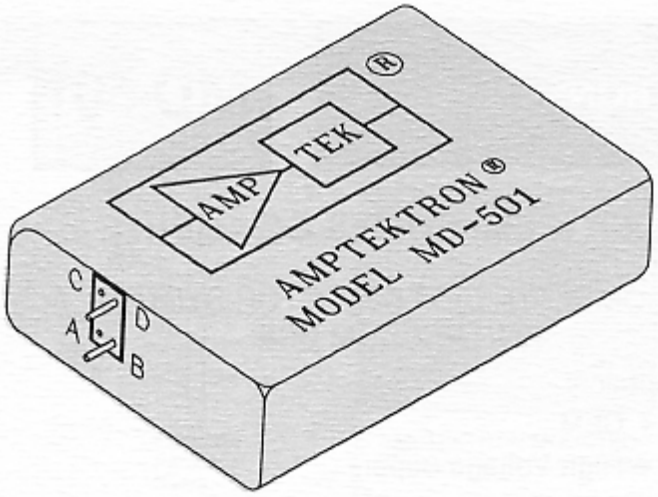
The AMPTEKTRON is designed for direct applications in the field of aerospace instrumentation, mass spectrometer, laboratory and research experiments, vacuum process monitoring and beam diagnosis.



Features:

- Small size [3.25 x 2.25 x 0.75 inches] [8.3 x 5.7 x 1.9 cm]
- Eliminates detector system design
- Single low voltage supply operation (+ 10 to + 15 VDC)
- Low voltage interface eliminates high voltage vacuum feed through
- Power required is typically 0.3 Watts
- + 5 volt logic output interface directly with CMOS and TTL
- Rugged design simplifies handling and use

AMPTEK INC. 6 DE ANGELO DRIVE, BEDFORD, MA 01730 U.S.A. TEL: (617) 275-2242 FAX: (617) 275-3470



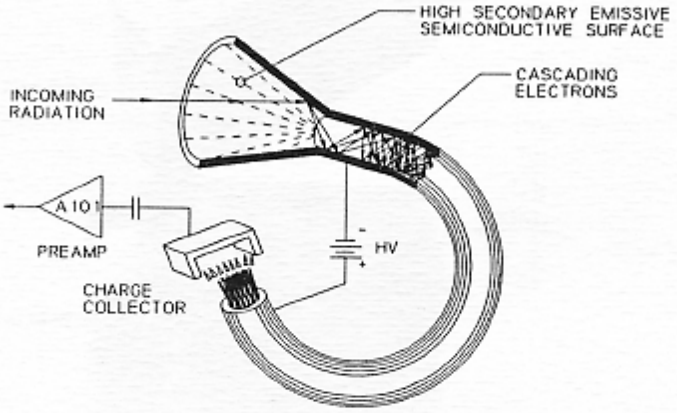
A — Ground (Power and Signal)
B — Pulse Output
C — Test Pulse Input
D — Vs (+ 10 to + 15 VDC)

SPECIFICATIONS

Count Rate:	0–1.0x10⁶ cps random
Pulse Pair Resolution:	250 ns
Dark Current:	< 0.1 cps typical
Output Pulse:	+ 5 V: 220 ns wide, nominal
Operating Voltage:	+ 10 to + 15 VDC
Operating Current:	30 mA typical (depends on supply voltage)
Temperature:	– 55° to + 70°C operational
Weight:	3 ounces (85 grams)
CEM Cone Size:	10mm Diameter
Aperture:	Shipped with .141 inch (3.6mm) Dia. hole, Area = 0.1cm²
Dimensions:	3.25 x 2.25 x 0.75 inches
Connector:	Positronics GFPL2M2FACORV (mating connector GF2M2FBDSCL provided)

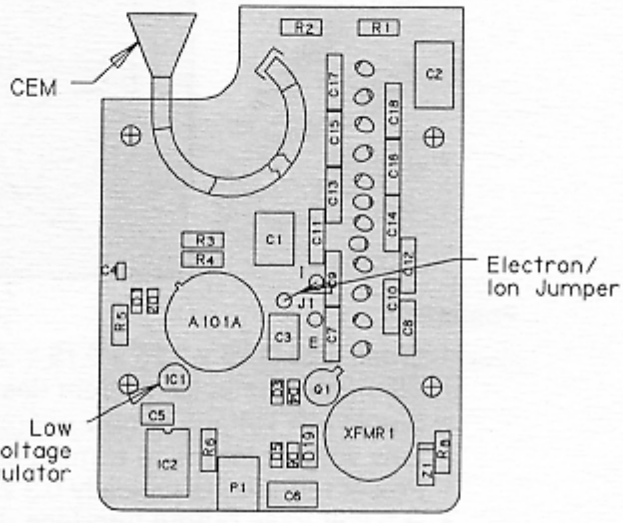
Operational Pressure: The Amptektron should be operated in pressures $\leq 1.0 \times 10^{-4}$ Torr. Prior to shipment the Amptektron is "burnt in" for 28 hours of continuous operation resulting in 2×10^9 total accumulated counts. The pressure during "burn in" is typically 4×10^{-8} Torr.

Channel Electron Multiplier: The following figure shows schematically the process that occurs inside the Amptektron to detect energetic particles or photons. The primary incoming radiation passes through the Amptektron inlet aperture and strikes the surface of the channel electron multiplier. If the energy of the collision is sufficient, at least one electron is ejected from the CEM wall. The ejected electrons are accelerated into the interior of the CEM by the local electric field developed by the bias voltage. If the magnitude of the bias voltage is sufficient, the accelerated electrons acquire enough energy to trigger more secondaries when they strike the CEM surface again. This process continues down the length of the CEM, striking the CEM surface many times, each time generating more and more secondaries. A single photon or particle input event will trigger an output electron avalanche of more than 10^7 electrons!



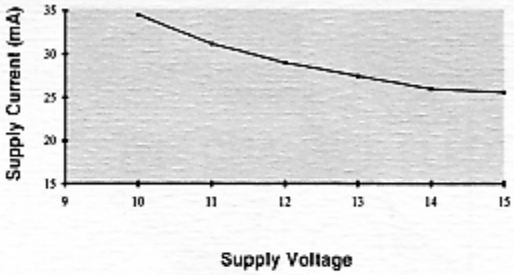
CHANNEL ELECTRON MULTIPLIER (CEM)

Power Requirements: The Amptektron is intended to operate from a range of low voltage supplies. (10 to 15 VDC). To allow this range of operation there is a series voltage regulator that supplies a stable 5 VDC to the charge amplifier/discriminator (A101A) and the output driver.

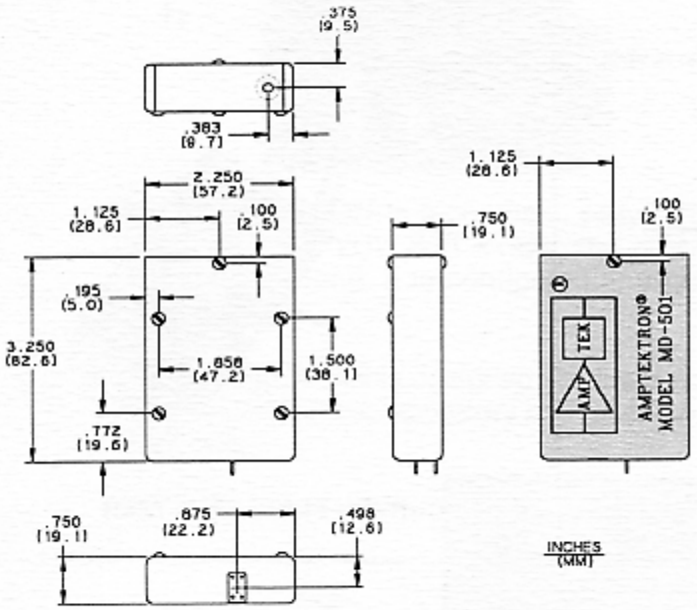


The Amptektron current requirements vary somewhat as a function of the supply voltage. The following figure gives a typical power consumption for low counting rates.

Nominal Amptektron Power Consumption



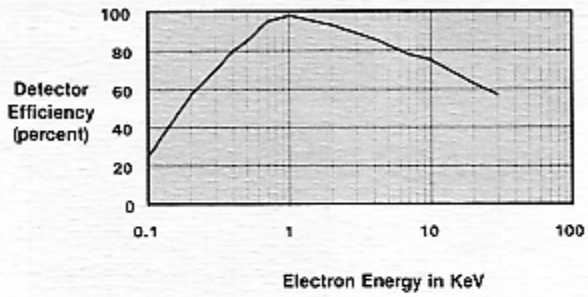
Mounting: Mechanical mounting may use any or all of the six 4-40 screws that retain the printed circuit card and aperture assembly. The aperture plate block may be removed and drilled or tapped for custom attachment. The aperture plate has been nickel plated and the surface will be difficult to drill until the plating surface has been penetrated. Amptektron dimensions are as follows:



CEM Efficiency: A CEM responds to a variety of stimuli in various degrees. The absolute efficiency of a given CEM to a specified input will depend on the surface cleanliness of the CEM, any pre-acceleration potentials that may exist, and the energy/mass characteristics of the input. There have been many CEM efficiency estimates published in scientific literature, not all in consistent agreement. Following are some typical curves that have been extracted from that literature. They should provide an order of magnitude estimate of the sensitivity of an Amptektron.

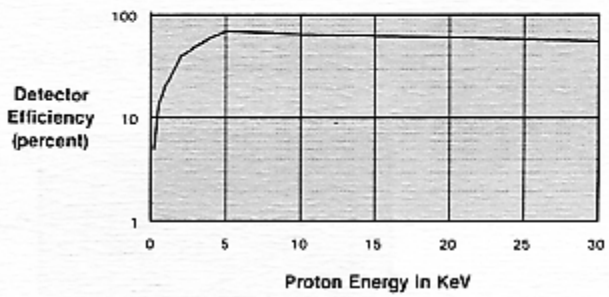
The MD-501 circuitry places a bias voltage on the CEM input funnel to provide an acceleration potential to incoming low energy particles. For ions the funnel is set to -400 volts and for electrons it is set to +100 volts. A jumper on the printed circuit card is used to select the mode. Note that this pre-acceleration potential provides rejection for low energy particles of the opposite polarity.

CEM Electron Response



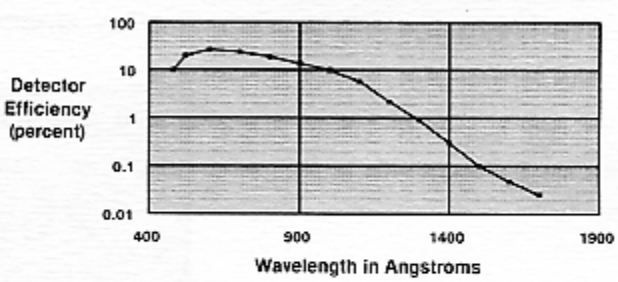
From: Pashman, G., et al., Rev. of Sci. Inst., 41, 1706 (1970)

CEM Proton Efficiency



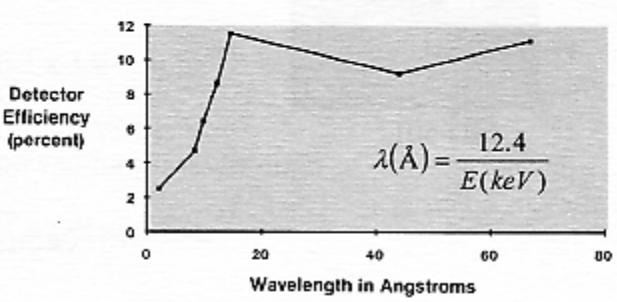
From Egidi, Rev. of Sci. Inst., 40, 88 (1969)

Absolute Vacuum Ultraviole CEM Detection Efficiency



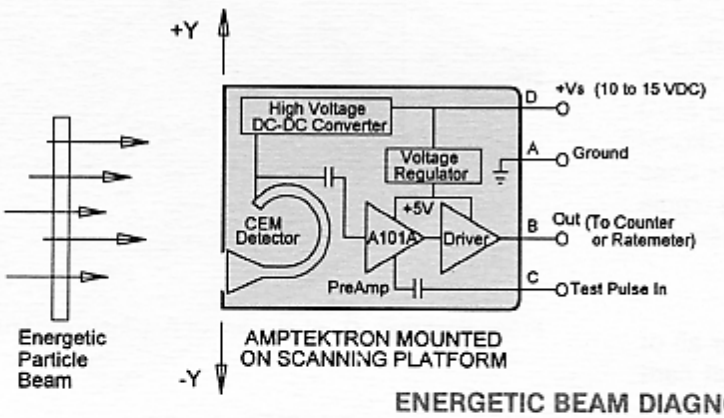
From: Johnson, M.C., Rev. of Sci. Inst., 40, 311 (1969)

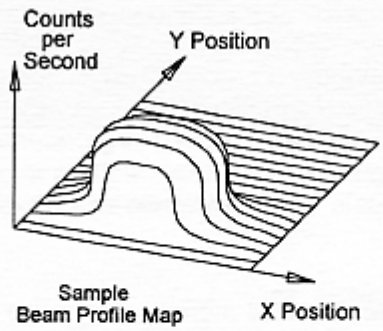
CEM X-RAY Response



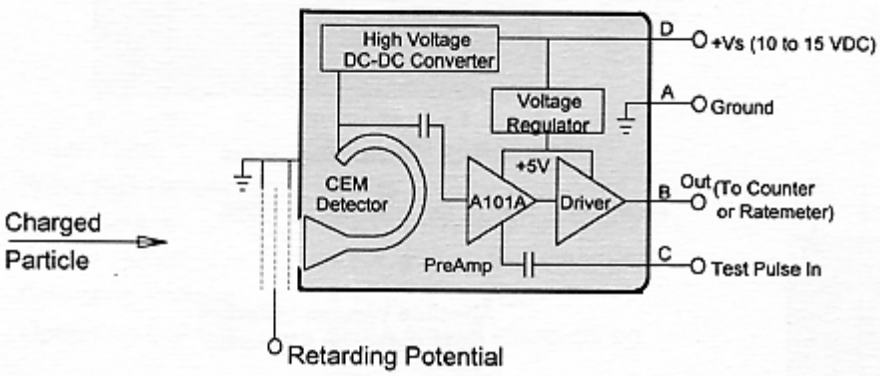
From: Smith, D.G., et al., Trans. of the IEEE, NS-15, 541 (1968)

TYPICAL APPLICATIONS

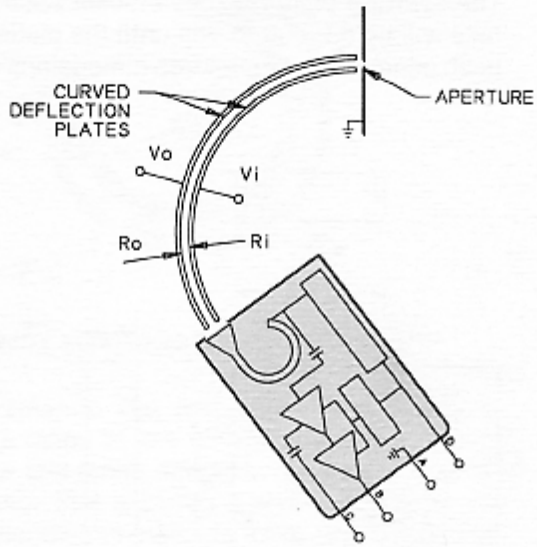




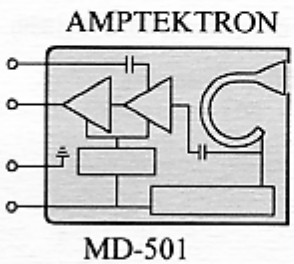
ENERGETIC BEAM DIAGNOSTIC

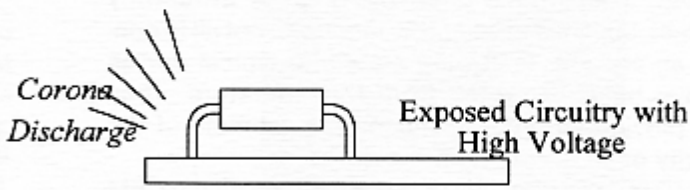


RETARDING POTENTIAL ANALYZER



CURVED PLATE ANALYZER





VACUUM PROCESS MONITORING

AMPTEK INC. 6 DE ANGELO DRIVE, BEDFORD, MA 01730 U.S.A. TEL: (617) 275-2242 FAX: (617) 275-3470

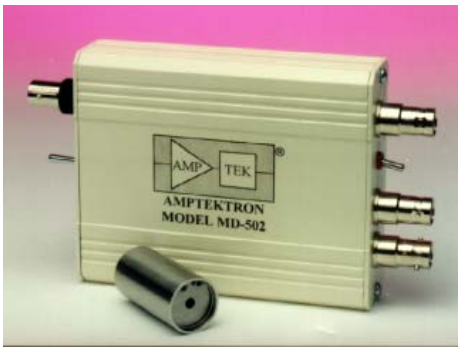
ELECTRON AND ION DETECTOR FOR ULTRA-HIGH VACUUM

MD-502

A complete CEM detector system for ultra-high vacuum use

ULTRA-HIGH VACUUM PACKAGED CEM FEATURES:

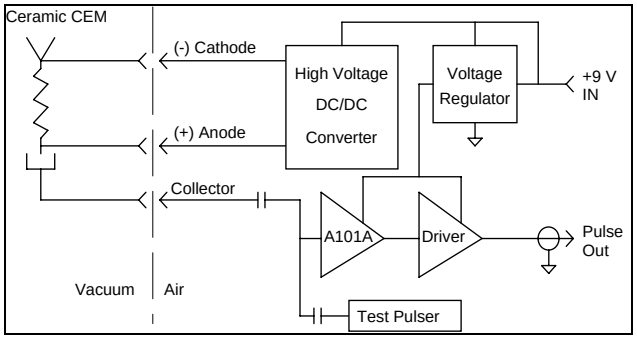
- Ceramic channel electron multiplier
- Stainless steel faraday housing
- Bakeable to +300 °C
- Operational from cryogenic to +200 °C
- Ceramic and gold UHV connector



REMOTE ELECTRONIC SYSTEM FEATURES:

- Low voltage supply (AC/DC converter)
- High voltage supply
- Charge sensitive preamplifier & discriminator
- Test pulse
- Line driver

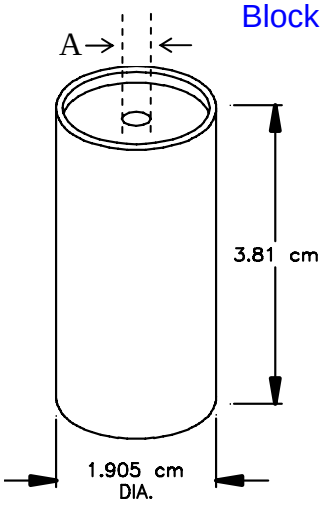
The **AMPTEKTRON MD-502** is a compact, easy to use electron multiplier system capable of detecting electrons, ions, vacuum ultra-violet, soft x-rays, and other nuclear particles at rates greater than 10^6 events per second. It is configured in a pulse counting mode and operates from a single low voltage supply.



Block Diagram

The **AMPTEKTRON MD-502** is designed for direct applications in the field of mass spectrometer, laboratory and research experiments, vacuum process monitoring and beam diagnosis, particularly in systems requiring ultra-high vacuum operation. It requires three high voltage connections to the UHV CEM.

The aperture (A) is normally 3.6 mm diameter, which can be increased up to 10 mm diameter.



MD-502 CEM Housing

	Ion mode	Electron mode
Cathode	-2400 VDC	+500 VDC
Anode	Ground	+2900 VDC
Collector	Virtual ground	+2900 VDC

The three CEM electrical connections are supplied via SHV connectors on the MD-502 electronics box. The CEM contains a self-biasing resistive strip that creates a +100 VDC potential between the output of the CEM charge cloud and the collector. This ensures efficient collection of the charge cloud output. The voltage of the bias potentials depends upon the mode selected for the MD-502. The cathode potential appears on the CEM cone and serves as a rejection potential for deselected species and an acceleration field for the selected species. Thus, thermal ions will be strongly attracted to the -2400 VDC in the ion mode, but will be repelled by the +500 volts encountered in electron mode. Electrons experience the opposite effects, being attracted by the +500 volts and strongly repelled by the -2400 volts in the ion mode. Particles with energies in excess to these rejection fields will be able to penetrate and be counted.

Refer also to specifications for MD-501.

AMPTEK, INC. 14 DEANGELO DRIVE, BEDFORD, MA 01730 U.S.A.
TEL: (781) 275-2242 FAX: (781) 275-3470 email: sales@amptek.com http://www.amptek.com