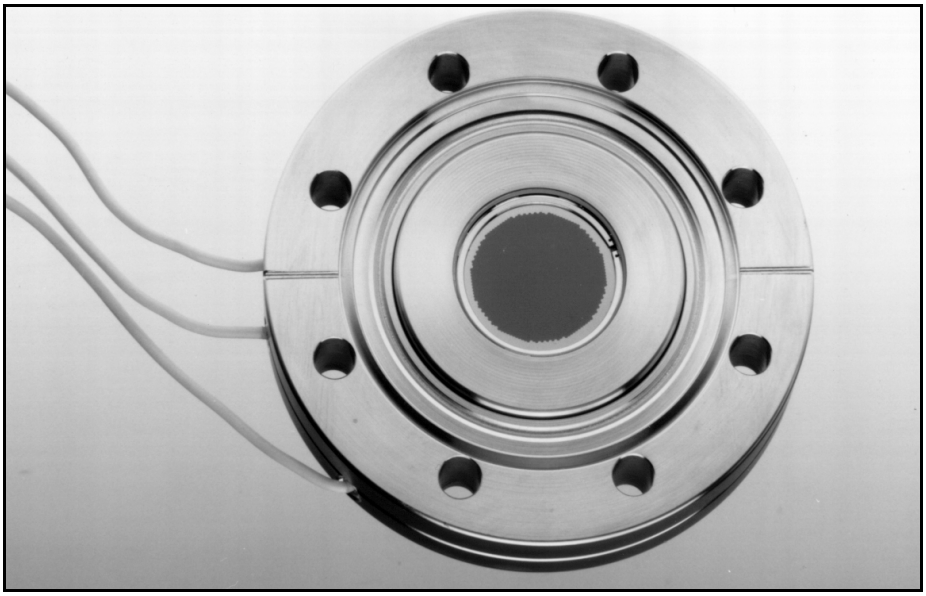
Open, high vacuum imaging

MCP Detector Systems



Open MCP detector system type OD 2562 Z

Applications

- Mass Spectrometer
- Electron detection
- X-Ray Detection
- UV Detection
- Heavy Ion detection
- Time of flight measurements
- Short time particle beam adjustment

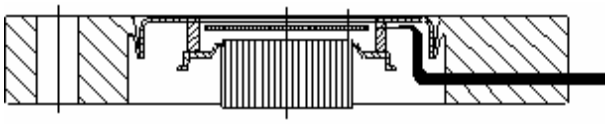
Features

- Single, double and triple MCP versions
- Coating of first MCP with CsI, MgF2, MgO or CuI alternativly possible
- Use of special MCPs possible for example MCPs with center holes (∅ 2-10 mm) or cutted segments
- Screens with P43, P46, P47, P20 and other Scintillators
- Taper coupling to CCD possible
- Fiber optic- or glass output window
- Version with metal anode or metallized multi anode available
- Magnetic free MCP detectors available
- Low cost version available

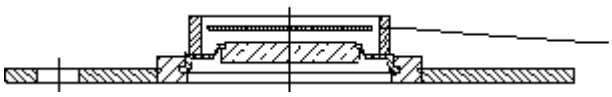
Open MCP Detectors

As manufacturer of 25 mm and 40 mm proximity focused MCP image intensifiers, PROXITRONIC also offers a broad variety of open detector systems. When using these systems, a two-dimensional image of electrons, ionized particles, X-rays and UV-radiation is possible. Open MCP detector systems are specially suitable for the energy range from 10 eV ... 1000 eV (approx. 120 nm ... 1 nm).

In addition to a large number of special designs according to the needs of our customers, 2 standard types exist for 25 mm and 40 mm microchannel plates.



The open detector systems OD 25... and OD 40... with precisely closed up CF-flanges that can be used as a vacuum window. The electrical connections are led to the atmospheric side.



The demountable detector systems DD 25... and DD 40... that can be used within a high vacuum container. The supports of the luminous screen and the MCP are designed in such a manner that all components can be individually assembled and dismounted.

Each standard type is available with 1, 2, or 3 microchannel plates. Clear glass or fiber optic plates are used as a substrate for the screen that can be covered with P43, P46, P47 or P20 phosphor alternatively. At the vacuum side, only mounting components made of glass, metal or ceramics are used. The maximum heating temperature of the OD types is limited to 100°C because of the isolation material while the DD types can be even used in UHV applications with bake temperatures up to 350°C.

A transparent and highly conductive ITO layer also known as NESA coating is applied onto the screen substrate in order to avoid electrostatic charges.

Special Types

- Taper coupling of the OD types onto a CCD or a row of diodes.
- Aluminum reflection layer on top of the phosphor screen.
- Special coating of the MCP, e.g. with CsI in order to increase the efficiency.
- Central circular hole within the MCP and metal anode for the DD types.
- Magnetic free MCP detectors available made completely out of ceramics and copper contacts.
- Metallized anode or metallized multi anode availabe.

Nomenclature

MCP Detector	with precisely closed up CF-flange	OD				
	demountable	DD				
Useful Diameter	25 mm		25			
	40 mm		40			
Output Window	clear glass			61		
	fiber optic			62		
	metal anode			60		
Phosphor Screens	P 43				Z	
	P 46				X	
	P 47				Y	
	P 20				G	
	P 11				B	
Special Types	double MCP					-V
	triple MCP					-Z
	high resolution MCP´s					-HR
	extended dynamic range MCP´s					-EDR
	CsI coating of MCP input					-CsI

Type Nomenclature Example

OD 2562 Z-V

OD 25	Open MCP detector system with 25 mm useful diameter
62	Fiber optic output window
Z	P 43 phosphor screen
-V-EDR	Double MCP in V-stack-assembly with extended dynamic range MCP´s

Efficiency

The efficiency of particles and radiation to release electrons from the MCP depends on the energy and the wavelength, respectively.

	Energy / Wavelength	**Efficiency**
Electrons	100 eV ... 500 eV 500 eV ... 4 keV 4 keV ... 100 keV	10 % ... 50 % 50 % ... 75 % ... 50 % 50 % ... 10 %
Ions	500 eV ... 3 keV 3 keV ... 10 keV 10 keV ... 50 keV 50 keV ... 200 keV	5 % ... 40 % 40 % ... 70 % 70 % ... 80 % ... 70 % 70 % ... 40 %
Soft X-ray / UV-Radiation	0.2 nm ... 30 nm 30 nm ... 115 nm 115 nm ... 150 nm	3 % ... 16 % 16 % ... 8 % 8 % ... 2 %

If highly energetic particles are to be detected, an energy discriminating foil or layer may be applied between the beam and the MCP detector system in order to increase the MCP´s sensitivity to these highly energetic particles.

MCP Electron Multiplication

MCP Voltage (V)	Single MCP (el/el)	Double MCP (el/el)
500	6	
600	12	
700	90	
800	350	
900	1500	
1000	5500	
1300		$3 \cdot 10^3$
1400		$9.5 \cdot 10^3$
1500		$3 \cdot 10^4$
1600		$9.5 \cdot 10^4$
1700		$3 \cdot 10^5$

Quantum Efficiency of Phosphor Screens for 6 keV Electrons

Phosphor Type	P 43	P 46	P 47	P 20	P 11	
On Fiber Optic Window	95	45	105	120	100	photons/electron

A roughly 40% higher efficiency is obtained with clear glass output screens.

In general the MCP detector screen consists of ITO layer and phosphor layer.
The efficiency can be increased max. 30% at 6 kV screen voltage with an aluminum reflection layer on top of the phosphor . But such an aluminum layer is only advisable if clean room conditions can be guaranteed in the vacuum chamber. Be aware that one particle may destroy the aluminum reflection layer and may cause a short circuit to the MCP. This may destroy the MCP detector or a part of it.

Power Supplies

Suitable high voltage power supplies are available for safe operation of the open MCP detector systems.

Transport, Storage and Operation

The open MCP-detector systems are assembled and tested under clean room conditions. We place the MCP-detector systems into the transportation container in a laminar-flow-box. Then we evacuate the container, vent with N_2 and evacuate once more to 10^{-4} Torr. A test for coarse leaks is done and is passed successfully. Nevertheless, it is necessary that you immediately check the vacuum condition after receipt of the open MCP-detector system.

MCP-glass is very hygroscopic. Therefore, storage of the open MCP-detector systems in air results in mechanic deformation of the MCP after a short period of time and finally leads to cracks.

The transport container should be removed under conditions as dust free as possible. Dust particles which get into the system can be accelerated by high electric fields. An impact of these particles onto the luminescent screen or MCP can cause serious defects.

Before incorporating the system into an experiment, the inner side of the flange and especially the MCP surface should be examined for dust particles with inclined incident light. Observed dust particles may be removed by blowing them off with N_2.

"Burn-in-process" of the phosphor screen: Before starting operation, the system has to be evacuated to a pressure of at least 10^{-6} Torr. It is advantageous to begin by connecting both MCP contacts to ground and then raising the voltage of the luninescent screen slowly to the recommended operating value of 6 kV (in relation to MCP output). The slower this is done, the better; you may even extend this procedure over a whole day in steps of ca. 50 V. Meanwhile, the luminescent screen has to be monitored. If single bright spots appear, it is not permitted to raise the voltage any more. These events originate in general from dust particles which are stimulated to field emission. In such a case we recommend to send the system back to us to avoid further damage and let the contamination be removed.

If the nominal voltage is achieved, you should operate the system for a few minutes and pay attention to fluctuations of the voltage.

After this, switch off the high voltage and connect the MCP(s) to its / their voltage source:

- MCP input: 0 V
- MCP output: 0 … + 1 kV (single MCP)
  0 … + 2 kV (Chevron-MCP)

It is recommended to connect a µA-meter to the input side of the MCP. The applied MCP voltage is increased slowly (the slower, the better; see above) up to the maximum value and meanwhile the current flowing through the plates is observed. The current should rise approximately proportional to the voltage. Jumps and breaks indicate problems with the contact or gas discharges. If such irregularities happen, the MCP voltage has to be switched off / disconnected immediately, and the system together with its cabling and the vacuum have to be examined.

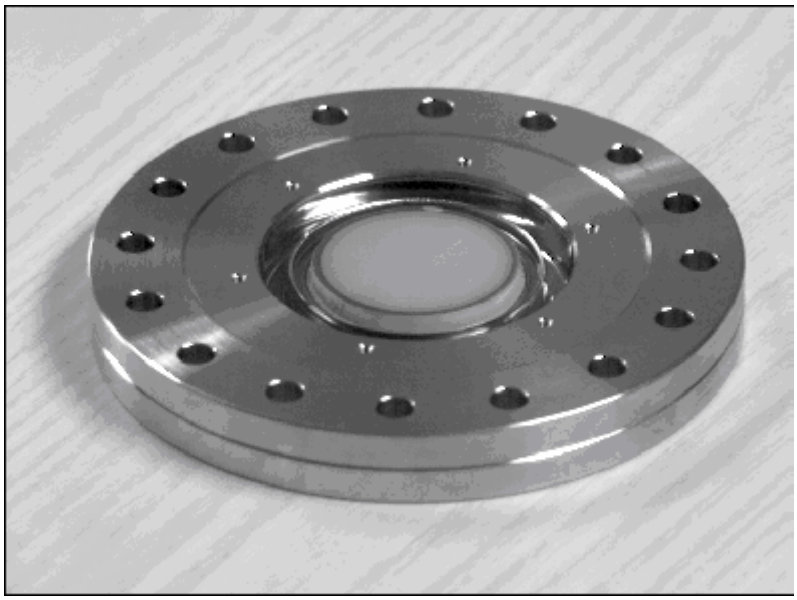
A similar test procedure is recommended after each aeration of the system.

After successful test, the system can be set into operation.

The following voltages should not be exceeded:

- MCP output to ground (= MCP input): + 1 kV (single MCP)
  + 2 kV (Chevron-MCP)
- luminescent screen to MCP output: + 6 kV
- luminescent screen to ground: + 7 kV (single MCP)
  + 8 kV (Chevron-MCP)

Fiber Optic Windows



Fiber optic vacuum window type VF 40

The open MCP detectors OD 2562 and OD 4062 with fiberoptic output windows are also available without microchannel plate and phosphor screen as fiber optic vacuum windows types VF 25 (useful diameter 25 mm) and VF 40 (useful diameter 40 mm). They can be used for example to lead optical fibers out of a vacuum chamber.

It is also possible to coat the fiber optic window with a phosphor for the direct detection of X-ray´s, UV-light and electrons. If a CCD camera is fiber optically coupled to the window you are able to use that setup as camera System for electron microscope.

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