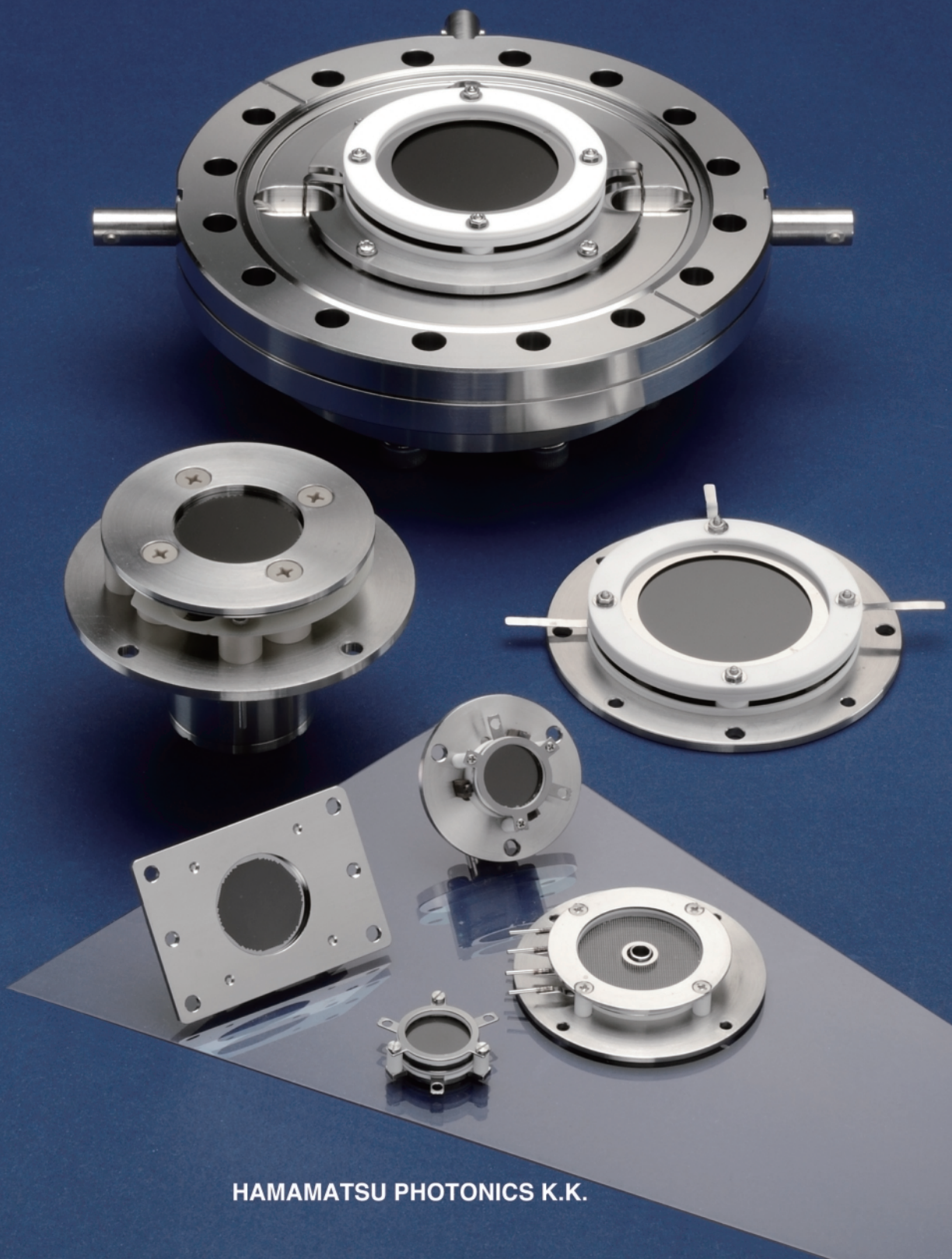
HAMAMATSU

PHOTON IS OUR BUSINESS

# MCP (MICROCHANNEL PLATE) AND MCP ASSEMBLY



HAMAMATSU PHOTONICS K.K.

# OVERVIEW

MCP (microchannel plate) is a two-dimensional sensor that detects electrons, ions, vacuum UV rays, X-rays and gamma rays in a Vacuum, and amplifies the detected signals. Circular and rectangular MCPs are available in various dimensions, including easy-to-use MCP assemblies with pre-mounted electrode leads and supports. These MCPs are widely used in many types of analytical equipment such as for "mass spectroscopy", "semiconductor inspection" and "surface analysis".
The MCP assemblies are available with three different readout devices to meet application needs. The devices are of: (1) single anode (electrical output signal measurement within effective area), (2) multianode (electrical output signal measurement corresponding to signal input positions), and (3) phosphor screen (optical imaging of output signal). Select the output device that best matches your application.
From one to three stage MCPs can be selected for the assembly to obtain necessary gain, allowing uses in the analog mode (the output signal is measured as a continuous electrical current) or the counting mode (the low level signal can be measured by a binary processing).

# OPERATING PRINCIPLE

As shown in the figure on the lower right, a potential gradient is established along the channel when the voltage $V_D$ is applied between the input and output sides of the MCP. Multiple secondary electrons are emitted when an electron enters a channel from the input side and strikes its inner wall. These secondary electrons are accelerated by the potential gradient to draw parabolic trajectories that are determined by their initial velocities. They then strike the opposite wall in the channel causing further secondary electrons to be emitted. The electrons in this way travel towards the output end while striking the inner wall of the channel repeatedly. As a result, a large number of exponentially increased electrons are extracted from the output side.

## ■Thickness

The thickness of an MCP is nearly equal to the channel length. The ratio of the channel length (L) to the channel diameter (d) is referred to as $\alpha$ ($\alpha$=L/d), and this $\alpha$ and the secondary emission factor inherent to the channel wall material determine the gain of the MCP. Standard MCPs are fabricated so that $\alpha$ is 40 to 60. The MCP thickness is therefore determined by the required channel diameter and the design value of this $\alpha$.

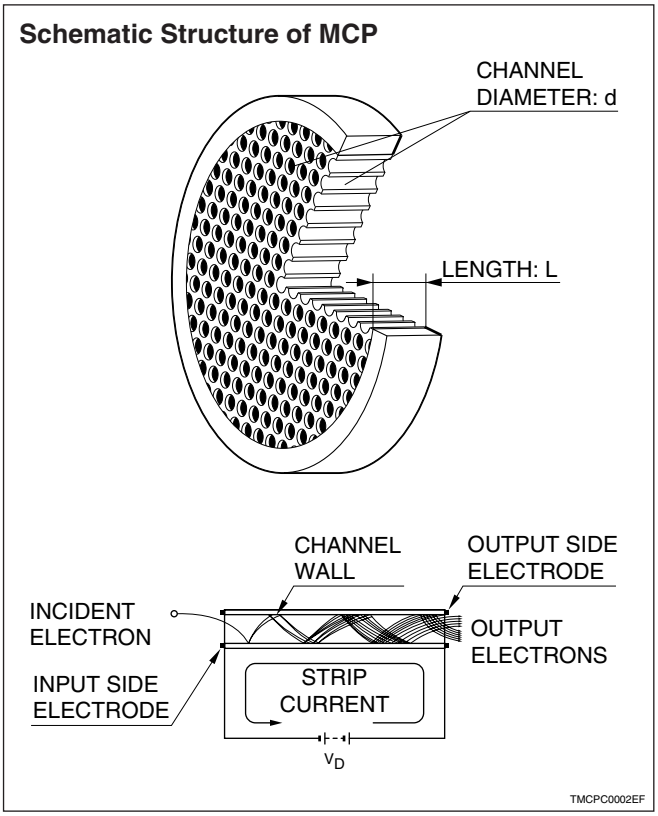
## ■Open Area Ratio: OAR

The OAR indicates the ratio of the channel open area to the entire effective area of  and MCP.

## ■Bias angle

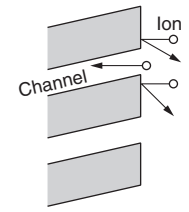
The bias angle is an angle formed by the channel axis and the axis perpendicular to the plate surface. This angle is chosen by considering the detection efficiency and spatial resolution as well as the prevention of input signals from passing through the channels without colliding with the channel walls. The optimum value is usually from 5° to 15°.

**Schematic Structure of MCP**

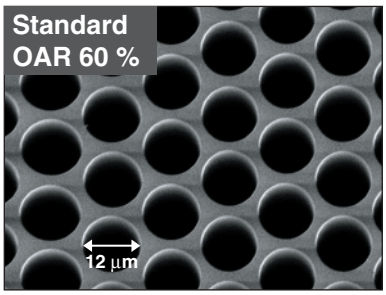


# LARGE OAR: FUNNEL TYPE (OPTION)

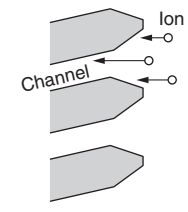
The open area ratio (OAR) of standard MCPs is normally set to about 60 %, but we also provide "funnel type" MCPs whose open area ratio is improved up to 90 % in order to guide more signals into each channel. Please contact us if you are interested in funnel type MCPs.



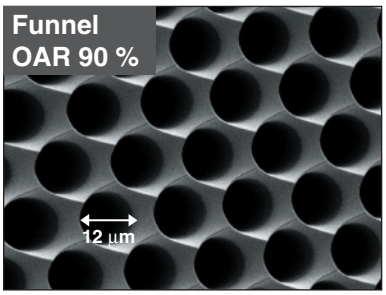

Cross-sectional view




▲Shape of channel entrance (SEM image)



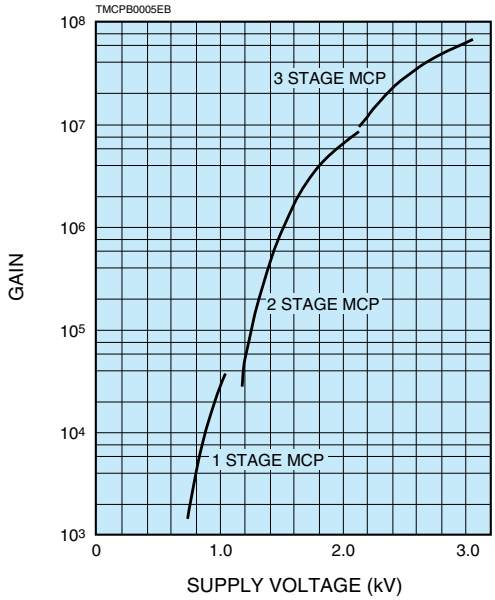

Cross-sectional view



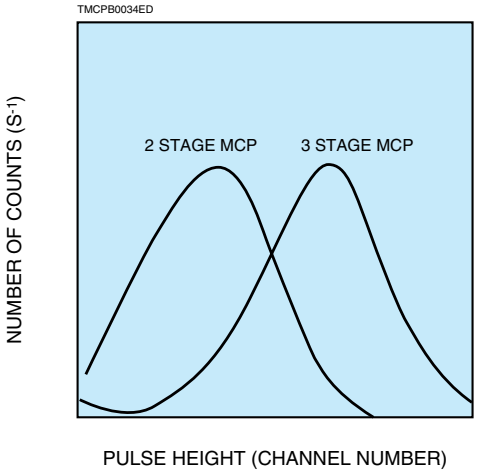

▲Shape of channel entrance (SEM image)

# CHARACTERISTICS

## ■MCP gain characteristics

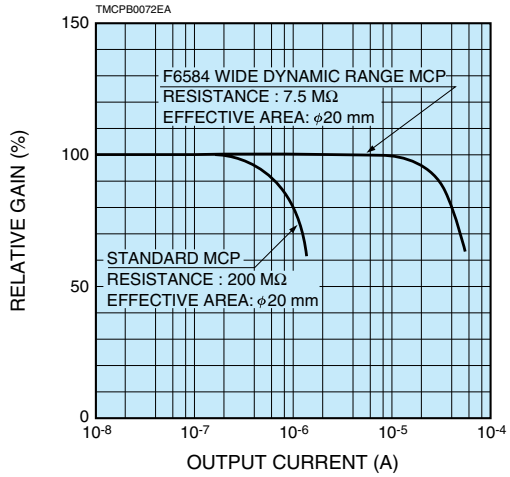



## ■Pulse height distribution (PHD)

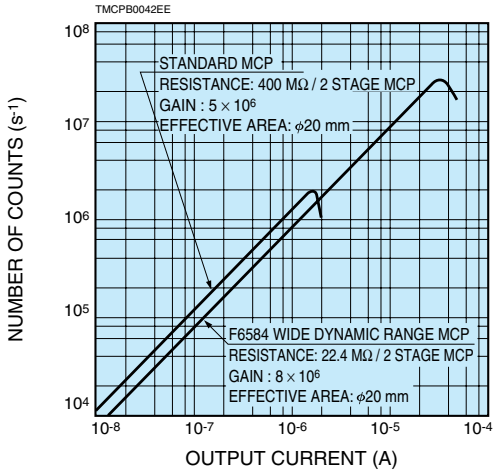



## ■MCP saturation characteristics (output linearity)

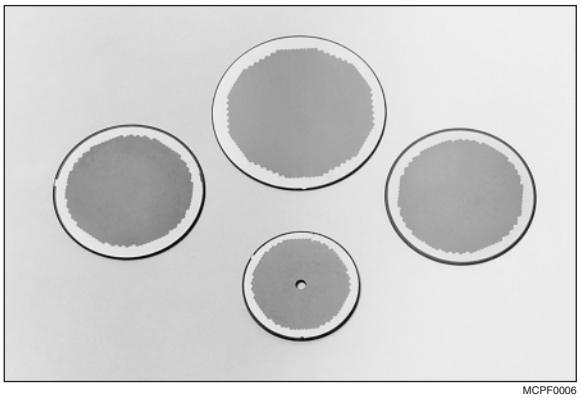
Analog mode



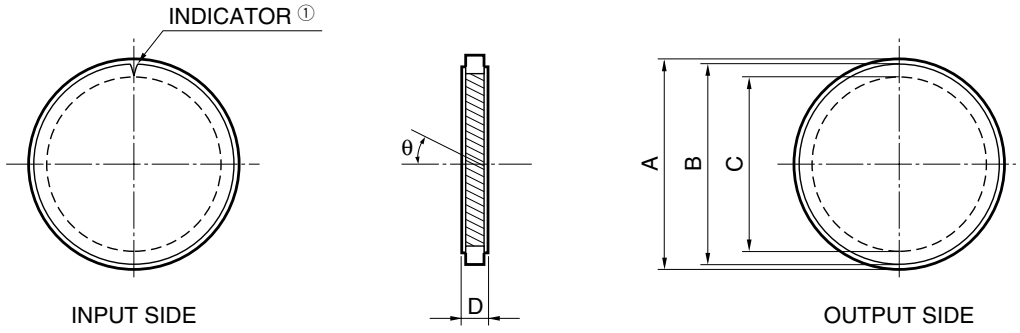

Counting mode



## Circular MCP



MCPF0006



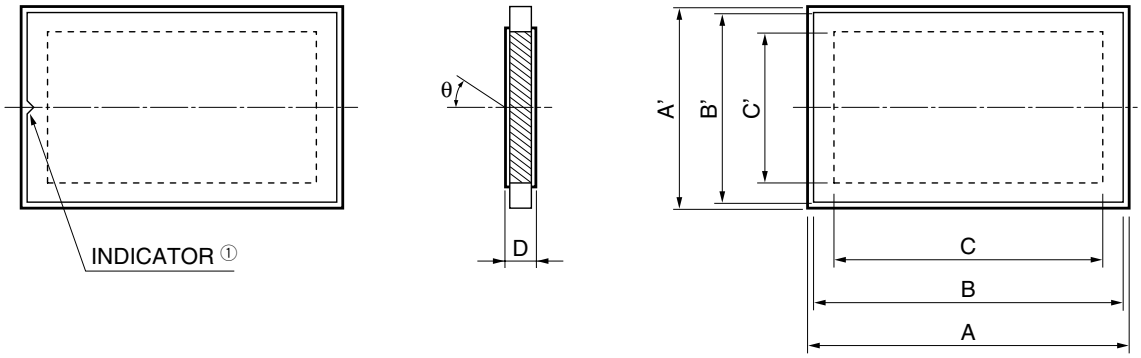

TMCPA0056EA

| Parameter \ Type | F1551 | | | | F1094 | | | F1552 | | | F1208-01 | F1217 | | F1942-04 | F2395-04 | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -01⑤ | -06 | -011 | -074 | -01⑤ | -011 | -074 | -01⑤ | -011 | -074 | | -01⑤ | -011 | | | |
| Outer Size A | $\phi$17.9 | | | | $\phi$24.8 | | | $\phi$32.8 | | | $\phi$38.4 | $\phi$49.9 | | $\phi$86.7 | $\phi$113.9 | mm |
| Electrode Area B | $\phi$17 | | | | $\phi$23.9 | | | $\phi$31.8 | | | $\phi$36.5 | $\phi$49 | | $\phi$84.7 | $\phi$112 | mm |
| Effective Area C | $\phi$14.5 | | | | $\phi$20 | | | $\phi$27 | | | $\phi$32 | $\phi$42 | | $\phi$77 | $\phi$105 | mm |
| Thickness D | 0.48 | 0.2 | 0.48 | 0.3 | 0.48 | | 0.3 | 0.48 | | 0.3 | 0.48 | 0.48 | | 1 | | mm |
| Channel Diameter | 12 | 4 | 12 | 6 | 12 | | 6 | 12 | | 6 | 12 | 12 | | 25 | | μm |
| Channel Pitch | 15 | 5 | 15 | 7.5 | 15 | | 7.5 | 15 | | 7.5 | 15 | 15 | | 31 | | μm |
| Bias Angle θ | 8 | 12 | | | 8 | 12 | | 8 | 12 | | 8 | 8 | 12 | 8 | | degrees |
| Open Area Ratio | 60 | 55 | 60 | | | | | | | | | | | | | % |
| Electrode Material | Inconel | | | | | | | | | | | | | | | — |
| Gain (Min.) ③ | $10^4$ | | $5\times10^3$ | | $10^4$ | | $5\times10^3$ | $10^4$ | | $5\times10^3$ | $10^4$ | | | | | — |
| Resistance ③ | 100 to 700 | 10 to 100 | 20 to 100 | 20 to 200 | 50 to 500 | 10 to 50 | 10 to 100 | 15 to 200 | 6.7 to 33.3 | 6.7 to 66 | 20 to 100 | 10 to 200 | 4 to 20 | 10 to 100 | 5 to 50 | MΩ |
| Dark Current (Max.) ③ | 0.5 | | | | | | | | | | | | | | | pA·cm$^{-2}$ |
| Maximum Linear Output ③ | 7 % of Strip Current ② | | | | | | | | | | | | | | | — |
| Supply Voltage ④ | 1.0 | | | | | | | | | | | | | | | kV |
| Operating Ambient Temperature ④ | -50 to +70 | | | | | | | | | | | | | | | °C |

**NOTE:** ①Indicates MCP input side. Shape varies depending on product type.
②Strip current is the current that flows through channel walls when a voltage is applied between MCP IN and OUT. It is given by dividing the applied voltage by the MCP resistance.
③Supply voltage: 1.0 kV, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
④Vacuum: $1.3\times10^{-4}$ Pa
⑤The F1551-01, F1094-01, F1552-01, F1208-01 and F1217-01 are also available with a center through-hole (6 mm diameter).

# Rectangular MCP

MCPF0011




INPUT SIDE

OUTPUT SIDE

TMCPA0057EA

| Parameter \ Type | F2370-01 | F4772-01 | F2806-01 | F1943-02 | F2805-03 | F2396-04 | Unit |
|---|---|---|---|---|---|---|---|
| Outer Size A×A' | 15.9×9.4 | 61.9×13.9 | 49.9×39.9 | 87.9×37.9 | 59.9×59.9 | 96.9×78.9 | mm |
| Electrode Size B×B' | 15×8.5 | 61×13 | 49×39 | 87×37 | 58×58 | 95.6×77.3 | mm |
| Effective Area C×C' | 13×6.5 | 55×8 | 45×35 | 81×31 | 53×53 | 90×72 | mm |
| Thickness D | 0.48 | | | 0.60 | 0.80 | 1.00 | mm |
| Channel Diameter | 12 | | | 15 | 20 | 25 | μm |
| Channel Pitch | 15 | | | 19 | 25 | 31 | μm |
| Bias Angle θ | 8 | | | | | | degrees |
| Open Area Ratio | 60 | | | | | | % |
| Electrode Material | Inconel | | | | | | — |
| Gain (Min.) ③ | $10^4$ | | | | | | — |
| Resistance ③ | 100 to 500 | 20 to 200 | | | 20 to 120 | 10 to 50 | MΩ |
| Dark Current (Max.) ③ | 0.5 | | | | | | $pA \cdot cm^{-2}$ |
| Maximum Linear Output ③ | 7 % of Strip Current ② | | | | | | — |
| Supply Voltage ④ | 1.0 | | | | | | kV |
| Operating Ambient Temperature ④ | -50 to +70 | | | | | | °C |

# MCP ASSEMBLY SELECTION GUIDE BY PURPOSE

Target object

Electron

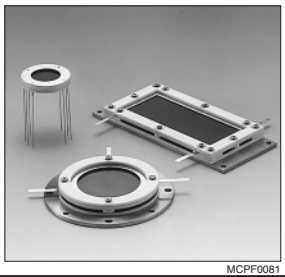
+/- Ion

VUV

X-ray

## Signal Amount Measurement

**Measures the signal amount**



MCPF0081

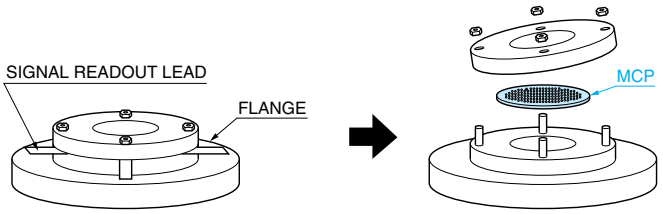
## TOF (Time of Flight) Detection

**Measures the difference in the arrival time**

MCPF0088

## Demountable

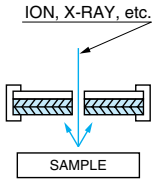
Up to 3 MCPs can be added according to level of X-rays or electrons to be detected. The screw mount allows easy replacement of the MCP and readout device.




## Standard

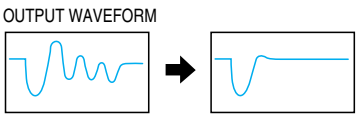
Circular and rectangular types are provided.
The circular type also includes an even smaller device.

## Center hole




This type of MCP assembly has a through-hole in the center that allows ions, X-rays and so on to pass through it to irradiate a sample. The signal from the sample can then be detected effectively.

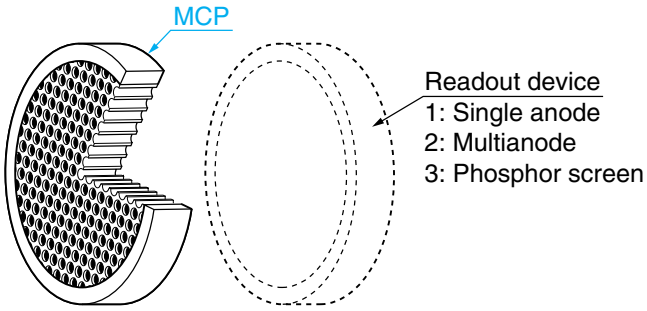
## Fast response




Using an anode specially designed for the high-speed signal readout, this type of MCP assembly eliminates signal distortions called "ringing" and ensures an accurate signal output.

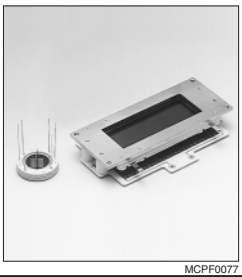
| Circular | Rectangular | Compact | Standard | Fast time response | Anode ground | Floating | Compact | Compact and 4 μm MCP |
|---|---|---|---|---|---|---|---|---|
| P9 | P.10 | P.11 | P.12 | P.12 | P.13 | P.13 | P.14 | P.14 |

Page



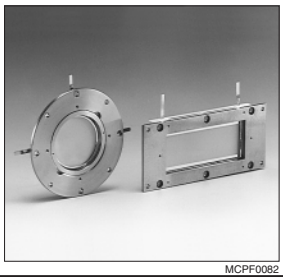

## Position Detection

**Measures the signal amount and position distribution**

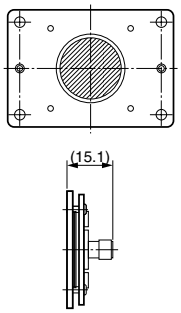



## Image Readout

**Captures a signal distribution as an image**

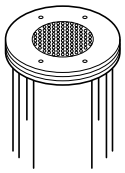



### Thin



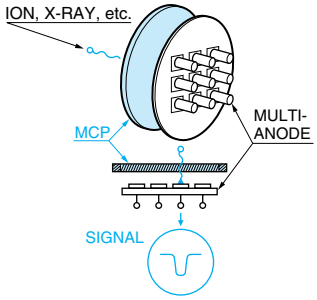

Its thin and flat shape permits installation in minimum spaces as add on parts. Maintenance and servicing of this MCP assembly are quite easy since there are only 2 wiring connections.

### Non-demountable



This type is compact, light in weight and economical. Unlike the demountable type, however, the assembled MCP cannot be replaced.

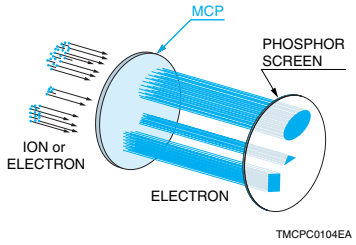
### Multianode




**Features**

- Wide room for choice of readout patterns in one dimension (1×n) or two dimensions (a×n)
- Simultaneous counting (parallel counting)
- High counting efficiency
- Anode pitch: 0.5 mm or more

### Phosphor screen output




The phosphor screen coated on the glass plate converts the output charge distribution from the MCP into a visible image. A resolution of 40 µm to 50 µm can be obtained with a one-stage MCP, and that of 80 µm to 100 µm can be done with a two-stage MCP. Select the desired phosphor screen among three types of P43, P46 and P47. (See page 9 for detailed specifications.)

| Fast response | Non-demountable | Non-demountable | Circular | Rectangular | Circular | Rectangular | Vacuum flange | Vacuum flange |
|---|---|---|---|---|---|---|---|---|
| P.15 | P.8 | P.8 | P.9 | P.10 | P.9 | P.10 | P.16 | P.16 |

# MCP ASSEMBLY SELECTION GUIDE BY APPLICATIONS

Major applications of MCP assemblies include "mass spectroscopy", "semiconductor inspection" and "surface analysis". The table below gives you a quick reference for selecting the best MCP assembly in these major application fields. This table shows only typical applications. Feel free to contact our sales office in your area if you do not find your specific application here.

◎: Best suited ○: Applicable

| Detection method | Field / Application / MCP assembly | Mass spectroscopy | | | | | | | Semiconductor inspection | | | | | | Surface analysis | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time-of-flight mass spectroscopy (TOF-MS) (MALDI) | Time-of-flight mass spectroscopy (TOF-MS) (LC-MS) | Quadrupole mass spectroscopy (Q-MS) | Double focusing mass spectroscopy (Sector-MS) | Gas or liquidchromatographic mass spectroscopy (GC/LC-MS) | Inductive-coupled plasma mass spectroscopy (ICP-MS) | Secondary ion mass spectroscopy (SIMS) | Scanning electron microscope (SEM) | Scanning ion microscope (SIM) | Electron beam measuring system (EBMS) | Electron or ion beam lithography | Mask aligner | FIB system | Auger electron spectroscopy (AES) | Ion scattering spectroscopy (ISS) | Electron spectroscopy for chemical analysis (ESCA) | Rutherford backscattering spectroscopy (RBS) | Vacuum UV spectroscopy (VUVS) | Soft X-ray spectroscopy (SXS) | Reflection medium energy electron diffraction (RMEED) | Low energy electron diffraction (LEED) | Field ion microscope (FIM) | Tranmission electron microscope (TEM) | Soft X-ray microscope (SXM) | Positron detector |
| Total Amount measurement, TOF | Demountable, circular MCP assembly (single anode) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | | | | | | | | | | |
| | Demountable, rectangular MCP assembly (single anode) | ○ | ○ | ○ | ○ | | | | | | | | | | ○ | ○ | | | | | | | | | | |
| | Non-demountable, circular MCP assembly (single anode) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | ○ | ○ | | | | | | | | | | |
| | F2223-21SH | ○ | ○ | | | | | | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | | | | | | | | | | |
| | F4294-09 | ◎ | ◎ | | | | | | | ◎ | ◎ | | | ◎ | ◎ | ◎ | | | | | | | | | | |
| | F4655/-14 | | | | | | | | | | | | | | ○ | ○ | | | | | | | | | | |
| | F4655-10/-11 | ○ | ○ | ◎ | ○ | ○ | ◎ | ○ | | | | | | | ○ | ○ | | | | | | | | | | |
| | F4655-13 | ◎ | ◎ | ○ | ○ | | | ○ | | | | | | | ○ | ○ | | | | | | | | | | |
| | F9890-31/-32, F9892-31/-32 | ○ | ◎ | ◎ | ○ | ◎ | ◎ | ○ | | | | | | | ○ | ○ | | | | | | | | | | |
| | F9890-13/-14, F9892-13/-14 | ◎ | ○ | ◎ | ○ | ○ | ○ | ○ | | | | | | | ○ | ○ | | | | | | | | | | |
| | F12334-11, F12395-11, F12396-11 | ◎ | ○ | ◎ | ○ | ○ | ○ | ○ | | | | | | | ○ | ○ | | | | | | | | | | |
| Position detection | Demountable, circular MCP assembly (multi-anode) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | | | | | | ◎ | | ○ | ○ | | | | | | |
| | Demountable, rectangular MCP assembly (multi-anode) | ○ | ○ | | ○ | | | ○ | | | | | | | | | ◎ | ○ | ○ | ○ | | | | | | |
| | Non-demountable, circular MCP assembly (multi-anode) | | | | ○ | | | ○ | | | | | | | | | ◎ | | ○ | ○ | | | | | | |
| Image readout | Demountable, circular MCP assembly (phosphor screen) | | | | ○ | | | ○ | | | | | | | | | | | ◎ | ◎ | ◎ | ◎ | ◎ | ○ | ○ | ○ |
| | Demountable, rectangular MCP assembly (phosphor screen) | | | | | | | | | | | | | | | | | | ◎ | ◎ | ○ | ○ | ◎ | ○ | ○ | ○ |
| | F2225-21PGF | | | | | | | | | | | | | | | | | | ◎ | ◎ | ○ | ○ | ◎ | ○ | ○ | ○ |
| | F6959 | | | | | | | | | | | | | | | | | | ◎ | ◎ | ○ | ○ | ○ | ○ | ○ | ○ |

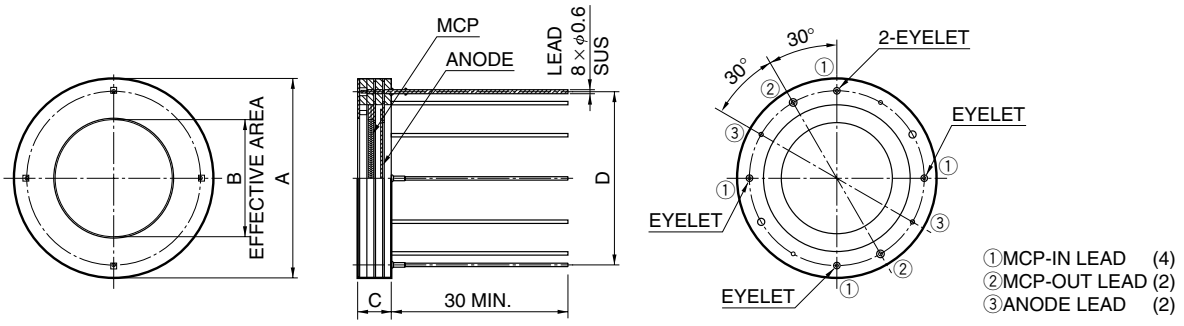
# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}\cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F1551 | 12 | 1 to 3 | 1 stage MCP : $1 \times 10^4$<br>2 stage MCP : $1 \times 10^6$<br>3 stage MCP : $1 \times 10^7$ | 2 stage MCP: 120<br>3 stage MCP: 80 | 3<br>(2 or 3 stage MCP) | 1 stage MCP: 1.0<br>2 stage MCP: 2.0<br>3 stage MCP: 3.0 | Single anode: 0.5<br>Multianode: 0.5 |
| F1094 | | | | | | | |
| F1552 | | | | | | | |
| F1208 | | | | | | | |
| F1217 | | | | | | | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

## Circular (Non-demountable)

Phosphor output type are not available.
Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.




TMCPA0027EF

| Anode Type | Number of MCPs |
|---|---|
| Without readout device | 1 to 3 |
| Single anode | |
| Multianode | |

| Symbol | Description | | F1551 | F1094 | F1552 | F1208 | F1217 | Unit |
|---|---|---|---|---|---|---|---|---|
| A | Assembly outer size | | φ27 | φ34 | φ42 | φ49 | φ62 | mm |
| B | Effective area | | φ14.5 | φ20 | φ27 | φ32 | φ42 | mm |
| C | Assembly height | No. of MCPs 1 | 4.5 | | | | | mm |
| | | No. of MCPs 2 | 5.7 | | | | | |
| | | No. of MCPs 3 | 5.7 | | | | | |
| D | Lead pin circle | | φ22.5 | φ29.5 | φ37.5 | φ44 | φ56 | mm |

* Multianode types have different dimensions.
Types with no anode are also available.

# TYPE NUMBER DESIGNATION FOR NON-DEMOUNTABLE TYPE

The following ordering information applies only to circular/rectangular MCP assemblies (demountable type) listed on page 9 and circular MCP assemblies (non-demountable type) listed on page 8. When ordering other MCP assemblies and bare MCPs (non-assembled MCPs), use their type numbers as listed.

**F1551-21S**

**Type No. : Assembly type**

**Third suffix: Readout device**
- No suffix: Without readout device
- S: Single anode

**Second suffix: Channel diameter**
- 1: 12 μm

**First suffix: Number of MCPs**
- 1: 1-stage
- 2: 2-stage
- 3: 3-stage

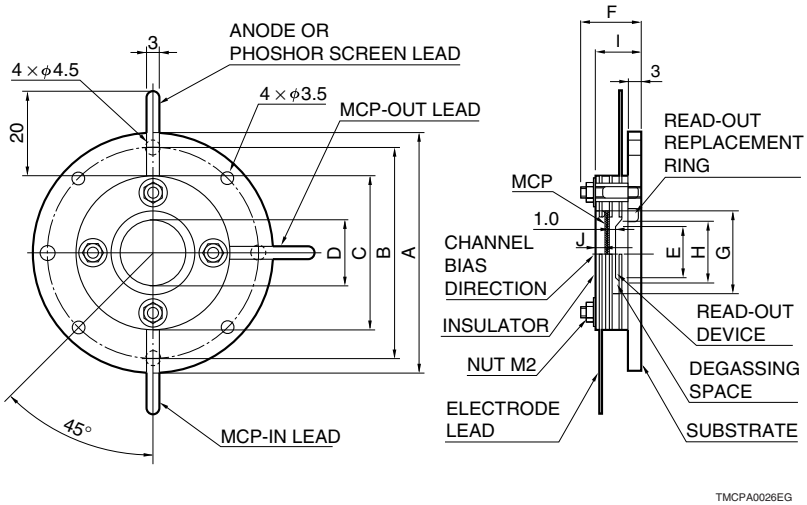
# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}\cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F2221 | 12 | Refer to "Anode Type" below | 1 stage MCP : $1 \times 10^4$<br>2 stage MCP : $1 \times 10^6$<br>3 stage MCP : $1 \times 10^7$ | 2 stage MCP: 120<br>3 stage MCP: 80 | 3<br>(2 or 3 stage MCP) | 1 stage MCP: 1.0<br>2 stage MCP: 2.0<br>3 stage MCP: 3.0 | Single anode: 0.5<br>Multianode: 0.5<br>Phosphor screen : 3.0 to 4.0 |
| F2222 | | | | | | | |
| F2223 | | | | | | | |
| F2224 | | | | | | | |
| F2225 | | | | | | | |
| F2226 | 25 | | | | | | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

## Circular (Demountable)

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.




| Anode Type | Number of MCPs |
|---|---|
| Without readout device | 1 to 3 |
| Single anode | |
| Multianode | |
| Phosphor screen | 1 to 2 |

| Symbol | Description | | F2221 | F2222 | F2223 | F2224 | F2225 | F2226 | Unit |
|---|---|---|---|---|---|---|---|---|---|
| A | Assembly outer size | | ϕ54 | ϕ61 | ϕ69 | ϕ75 | ϕ86 | ϕ123 | mm |
| B | Mounting screw hole pitch | | ϕ46 | ϕ53 | ϕ61 | ϕ67 | ϕ78 | ϕ115 | mm |
| C | Insulator outer size | | ϕ34 | ϕ41 | ϕ49 | ϕ55 | ϕ66 | ϕ103 | mm |
| D | Effective area | | ϕ14.5 | ϕ20 | ϕ27 | ϕ32 | ϕ42 | ϕ77 | mm |
| E | Effective area of readout device | | ϕ10 | ϕ17 | ϕ24 | ϕ30 | ϕ40 | ϕ75 | mm |
| F | Maximum height | | 15 | 15 | 15 | 15 | 15 | 17 | mm |
| G | Replacement ring screw size for readout device | | M21 | M28 | M35 | M42 | M52 | M89 | — |
| H | Replacement ring inside size for readout device | | ϕ13 | ϕ20 | ϕ27 | ϕ33 | ϕ44 | ϕ78 | mm |
| I | Distance from bottom of substrate to insulator surface | No. of MCPs 1 | 10.9 | | | | | 12.9 | mm |
| | | No. of MCPs 2 | 11.9 | | | | | 14.4 | |
| | | No. of MCPs 3 | 11.9 | | | | | 15.9 | |
| J | Distance from MCP input surface to insulator surface | No. of MCPs 1 | 2.8 | | | | | 3.8 | mm |
| | | No. of MCPs 2 | 3.3 | | | | | 4.3 | |
| | | No. of MCPs 3 | 2.9 | | | | | 4.8 | |

Shape may differ depending on product type number.

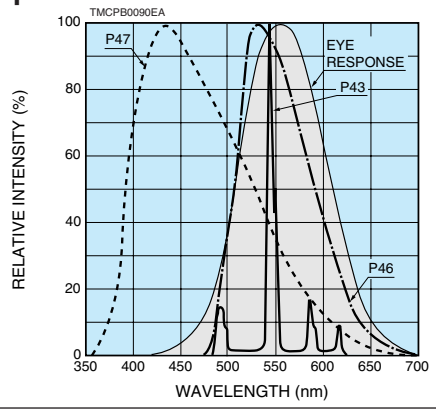
# PHOSPHOR SCREEN

Select the desired phosphor screen by taking into account the decay time according to the readout method and application, and the emission wavelength according to the readout device sensitivity.

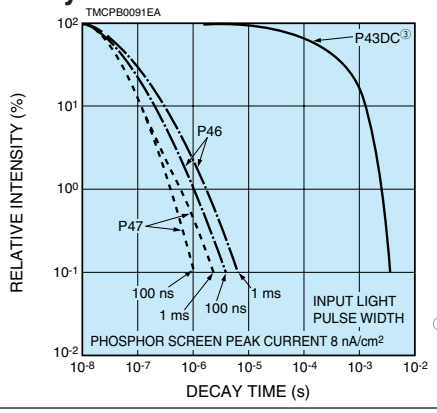
| Phosphor Screen Type | Peak Emission Wavelength (nm) | Emission Color | Relative Energy Efficiency ① | 10 % Decay Time | Remarks |
|---|---|---|---|---|---|
| P43 | 545 | Yellowish Green | 1 | 1 ms | Standard Type |
| P46 | 510 | Yellowish Green | 0.3 | 0.2 μs to 0.4 μs ② | Short Decay |
| P47 | 430 | Purplish Blue | 0.3 | 0.11 μs | Very Short Decay |

**NOTE:** ①Supply voltage: 6 kV. Value relative to P43 which is specified as 1. ②Varies depending on the input pulse width.

## ■Spectral Emission Characteristics




## ■Decay Characteristics



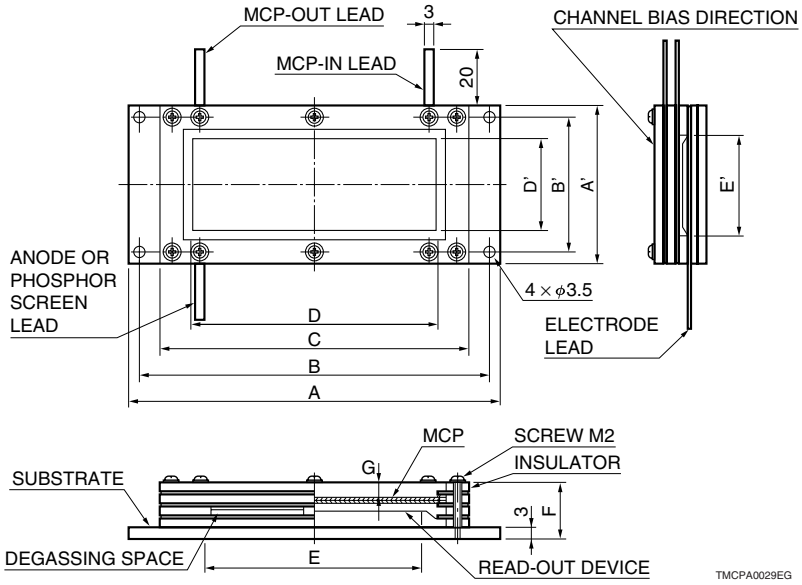

③ Decay characteristics after removal of continuous light input

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}$·$cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F2813 | 15 | Refer to "Anode Type" below | 1 stage MCP : $1 \times 10^4$<br>2 stage MCP : $1 \times 10^6$<br>3 stage MCP : $1 \times 10^7$ | 2 stage MCP: 120<br>3 stage MCP: 80 | 3<br>(2 or 3 stage MCP) | 1 stage MCP: 1.0<br>2 stage MCP: 2.0<br>3 stage MCP: 3.0 | Single anode: 0.5<br>Multianode: 0.5<br>Phosphor screen : 3.0 to 4.0 |
| F2814 | 20 | | | | | | |
| F3490 | 12 | | | | | | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

## Rectangular (Demountable)

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.




| Anode Type | Number of MCPs |
|---|---|
| Without readout device | 1 to 3 |
| Single anode | |
| Multianode | |
| Phosphor screen | 1 to 2 |

| Symbol | Description | | | F2813 | F2814 | F3490 | Unit |
|---|---|---|---|---|---|---|---|
| A×A' | Assembly outer size | | | 128×54 | 96×76 | 78×29.5 | mm |
| B×B' | Mounting screw hole pitch | | | 120×46 | 86×68 | 72×18 | mm |
| C×A' | Insulator outer size | | | 104×54 | 76×76 | 66×29.5 | mm |
| D×D' | Effective area | | | 81×31 | 53×53 | 55×8 | mm |
| E×E' | Effective area of readout device | | | 80×30 | 50×50 | 52×7 | mm |
| F | Distance from bottom of substrate to insulator surface | No. of MCPs | 1 | 10.9 | 10.9 | 11.9 | mm |
| | | | 2 | 11.9 | 11.9 | | |
| | | | 3 | 11.9 | 12.9 | | |
| G | Distance from MCP input surface to insulator surface | No. of MCPs | 1 | 2.7 | 2.5 | 3.8 | mm |
| | | | 2 | 3.1 | 2.7 | 3.3 | |
| | | | 3 | 2.5 | 2.9 | 2.9 | |

Shape may differ depending on product type number.

# TYPE NUMBER DESIGNATION FOR DEMOUNTABLE TYPE

The following ordering information applies only to circular/rectangular MCP assemblies (demountable type) listed on page 9 and circular MCP assemblies (non-demountable type) listed on page 8. When ordering other MCP assemblies and bare MCPs (non-assembled MCPs), use their type numbers as listed. * When the customer prepares a read-out device, we supply MCP assemblies without readout devices. If using a phosphor screen as the readout device, there is a need to change some points, so please consult us in advance.

**F2224-21P**

**Type No. : Assembly type**

**Third suffix: Readout device**
- No suffix: Without readout device *
- S: Single anode
- M: Multianode
- P: Phosphor screen (selectable from among P43, P46 and P47)

**Second suffix: Channel diameter**
- 1: 12 μm
- 2: 15 μm (Only rectangular type)
- 3: 20 μm (Only rectangular type)
- 4: 25 μm (Only circular type)

**First suffix: Number of MCPs**
- 1: 1-stage
- 2: 2-stage
- 3: 3-stage

# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

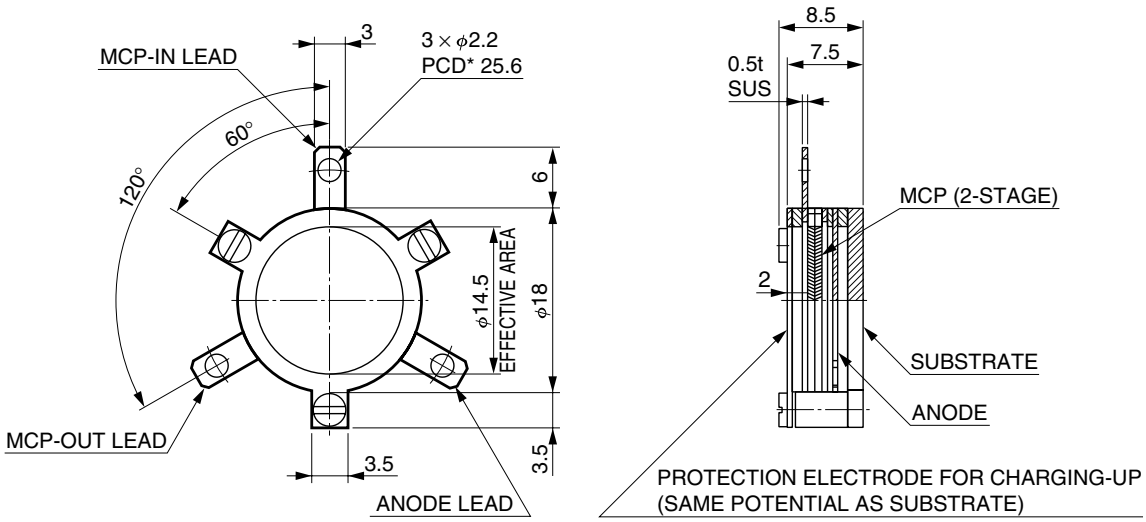
| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}\cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F4655<br>F4655-14 | 12 | 2 | $5 \times 10^7$ | 50 | 3 | 2.5 | 0.5 |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

## F4655

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.

* PCD (Pitch Circle Diameter)

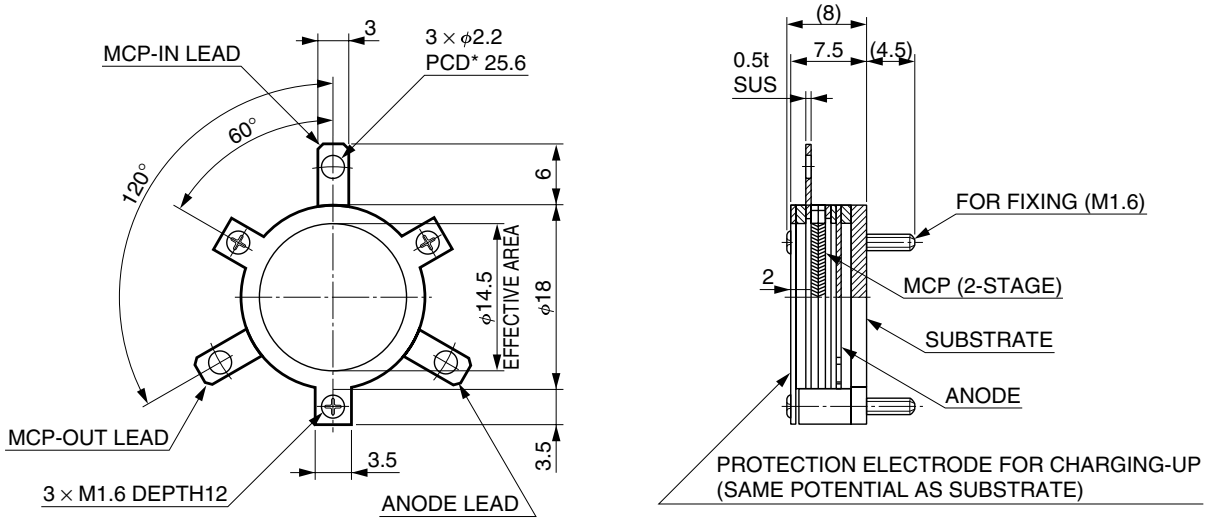



TMCPA0001EJ

## F4655-14

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.

* PCD (Pitch Circle Diameter)




TMCPA0086EA

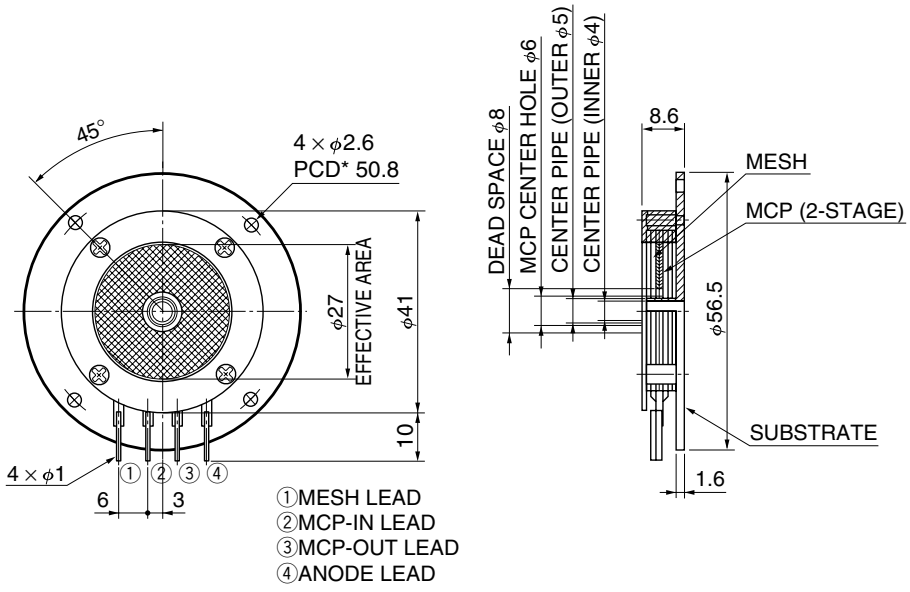
| Type No. | Channel Diameter (μm) | Number of MCPs (–) | MCP Center Dead Area (mm) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}$·$cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|---|
| F2223-21SH | 12 | 2 | φ8 | $1 \times 10^6$ | — | 3 | 2.0 | 0.5 |
| F4294-09 | | | φ12 | | | | | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3 \times 10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3 \times 10^{-4}$ Pa

## F2223-21SH

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.

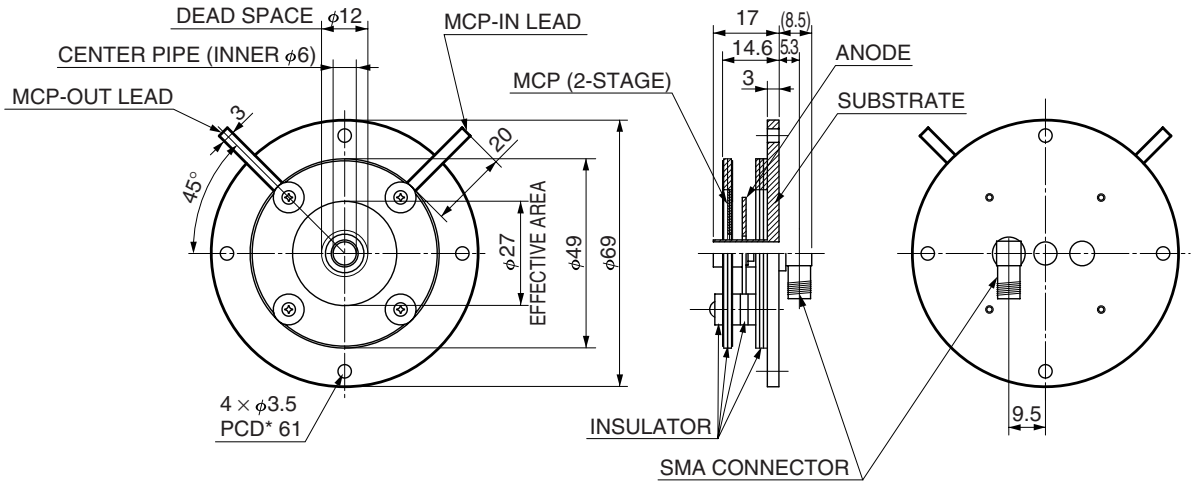
* PCD (Pitch Circle Diameter)




TMCPA0002EH

## F4294-09

* PCD (Pitch Circle Diameter)



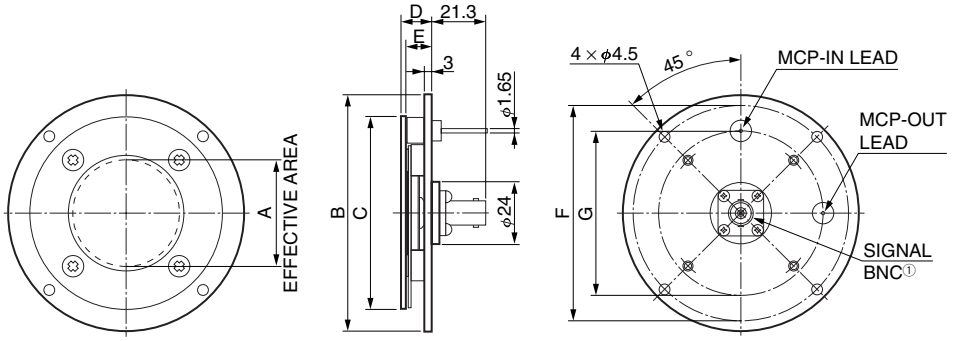

TMCPA0042EF

# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Pulse Width (FWHM) (ps) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}\cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|---|
| F9890-13 | 12 | 2 | 900 | $1 \times 10^6$ | 150 | 3 | 2.0 | 0.5 |
| F9890-14 | 6 | | | | | | | |
| F9890-31 | 12 | | 450 | | | | | |
| F9890-32 | 6 | | | | | | | |
| F9892-13 | 12 | | 1200 | | | | | |
| F9892-14 | 6 | | | | | | | |
| F9892-31 | 12 | | 700 | | | | | |
| F9892-32 | 6 | | | | | | | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

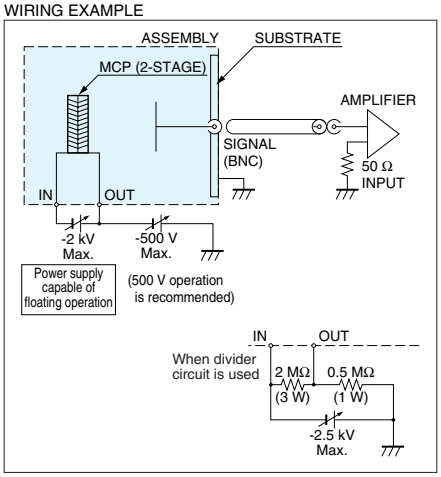
## F9890-13/-14, F9892-13/-14




①SMA connector type is also available.

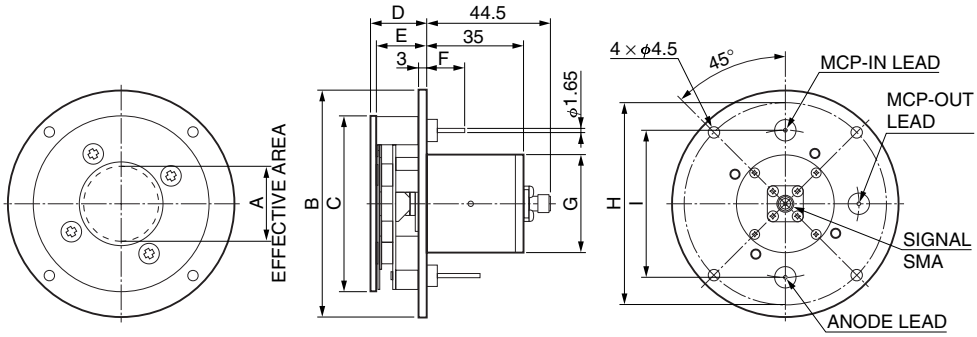
| | F9890-13 | F9890-14 | F9892-13 | F9892-14 |
|---|---|---|---|---|
| A | ϕ27 | | ϕ42 | |
| B | ϕ81 | | ϕ92 | |
| C | ϕ63 | | ϕ75 | |
| D | 12 | 11.6 | 12 | 11.6 |
| E | 10 | 9.6 | 10 | 9.6 |
| F | ϕ72 | | ϕ84 | |
| G | ϕ52 | | ϕ64 | |

WIRING EXAMPLE



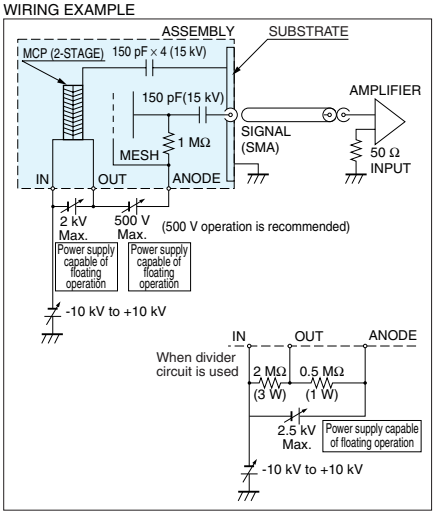

TMCPA0075EC

## F9890-31/-32, F9892-31/-32




| | | F9890-31 | F9890-32 | F9892-31 | F9892-32 |
|---|---|---|---|---|---|
| A | | ϕ27 | | ϕ42 | |
| B | | ϕ81 | | ϕ92 | |
| C | | ϕ63 | | ϕ75 | |
| D | | 20.2 | 19.9 | 20.2 | 19.9 |
| E | | 18.2 | 17.9 | 18.2 | 17.9 |
| F | MCP-IN LEAD | 13.5 | 13.9 | 13.5 | 13.9 |
| | MCP-OUT LEAD | 15.2 | | 15.2 | |
| | ANODE LEAD | 19.4 | | 19.4 | |
| G | | ϕ35 | | ϕ40 | |
| H | | ϕ72 | | ϕ84 | |
| I | | ϕ52 | | ϕ64 | |

WIRING EXAMPLE



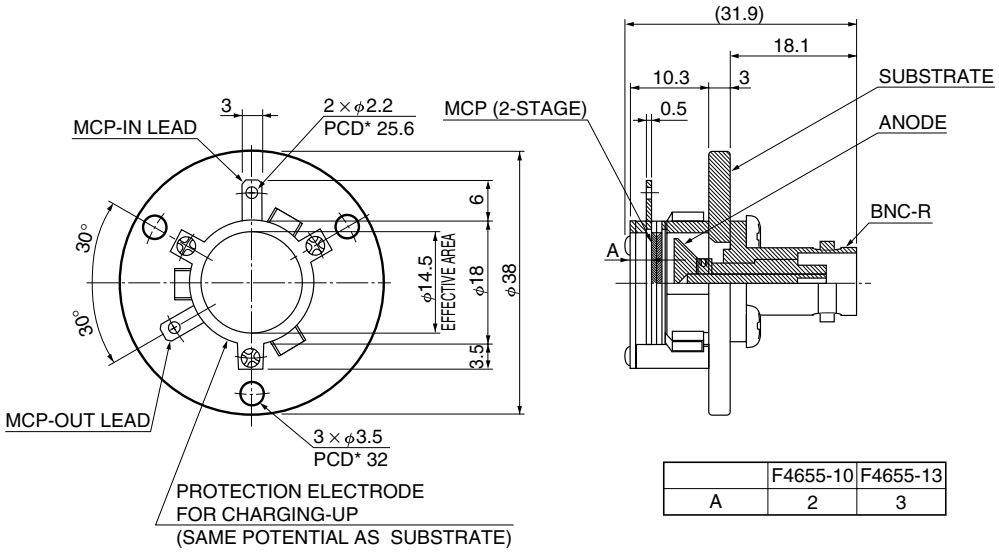

TMCPA0082EC

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Pulse Width (FWHM) (ps) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}$·$cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|---|
| F4655-10 | 12 | 2 | 600 | $5 \times 10^7$ | 50 | 3 | 2.5 | 0.5 |
| F4655-11 | | | | | | | | |
| F4655-13 | 4 | | | $1 \times 10^6$ | 120 | 5 | 2.0 | |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3 \times 10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3 \times 10^{-4}$ Pa

## F4655-10/-13

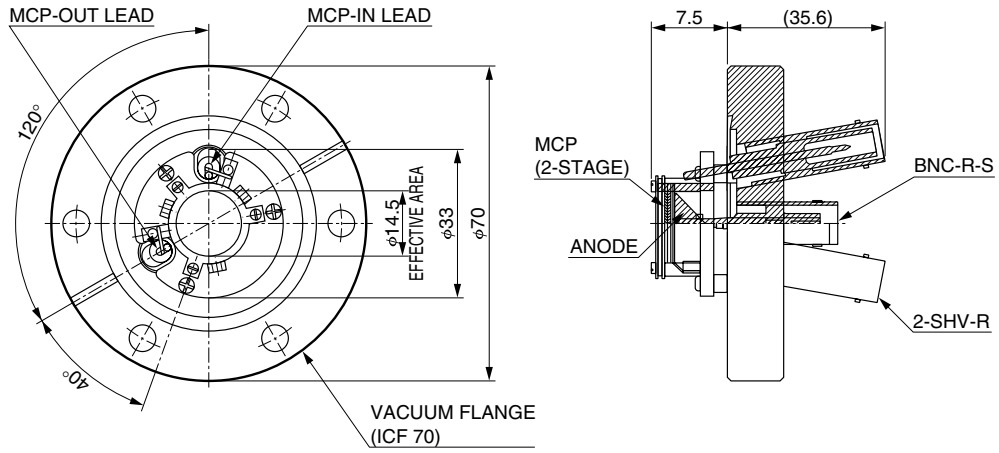
* PCD (Pitch Circle Diameter)




| | F4655-10 | F4655-13 |
|---|---|---|
| A | 2 | 3 |

TMCPA0021EG

## F4655-11



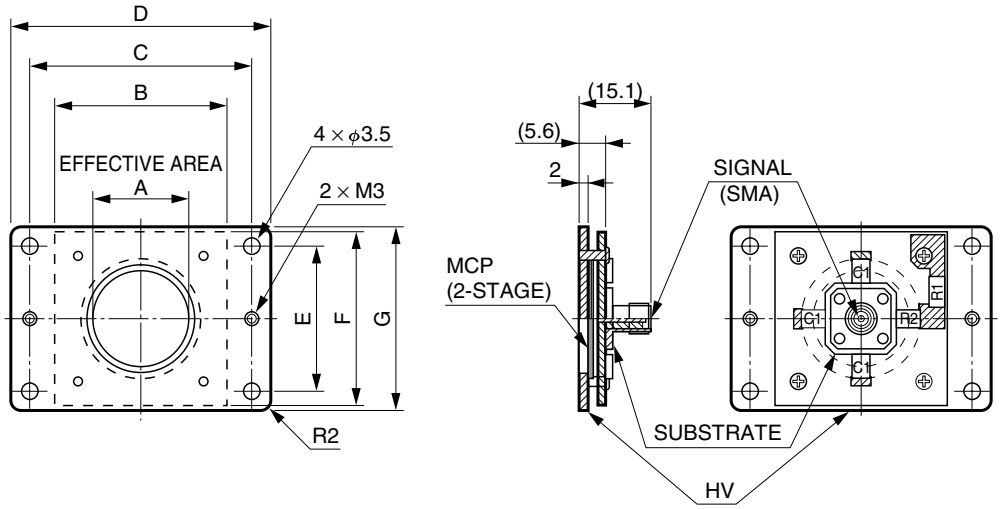

TMCPA0085EA

# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1} \cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F12334-11 | 12 | 2 | $1 \times 10^6$ | 3 | — ③ | — ③ | 0.5 |
| F12395-11 | | | | | | | |
| F12396-11 | | | | | | | |

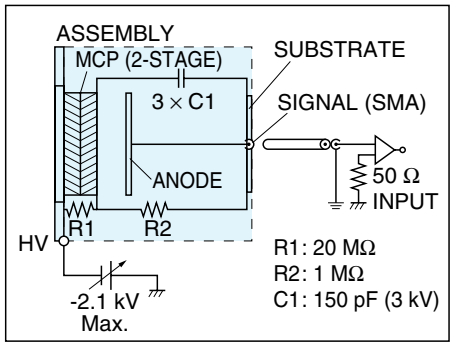
**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3 \times 10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3 \times 10^{-4}$ Pa
③A maximum of -2.1 kV is supplied to the HV electrode, depending on the built-in bleeder resistors.

## F12334-11, F12395-11, F12396-11




| | F12334-11 | F12395-11 | F12396-11 |
|---|---|---|---|
| A | 20 | 27 | 42 |
| B | 36 | 40 | 51 |
| C | 46 | 51 | 62 |
| D | 54 | 61 | 72 |
| E | 30 | 30 | 40 |
| F | 36 | 40 | 51 |
| G | 38 | 41 | 52 |

WIRING EXAMPLE




TMCPA0084EC

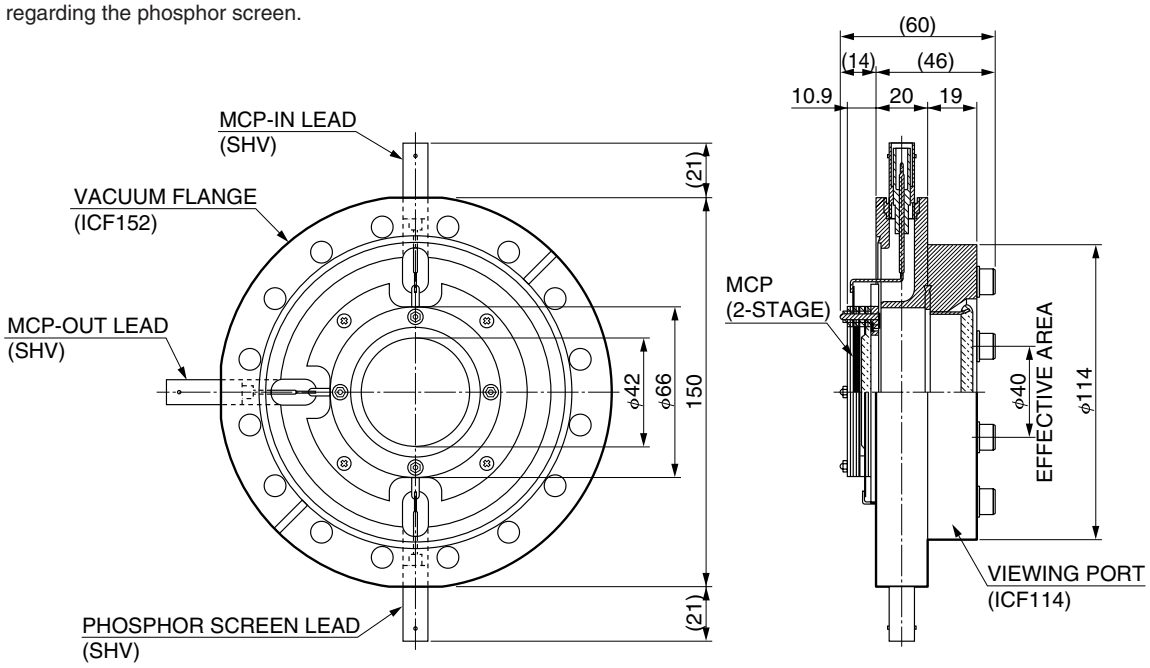
| Type No. | Channel Diameter (μm) | Number of MCPs (–) | Gain (Min.) (–) ① | Puls Height Resolution (Max.) (%) ① | Dark Count (Max.) ($s^{-1}\cdot cm^{-2}$) ① | MCP Supply Voltage (kV) ② | MCP-OUT to Anode Supply Voltage (kV) ② |
|---|---|---|---|---|---|---|---|
| F2225-21PGF | 12 | 2 | $1 \times 10^6$ | — | 3 | 2.0 | 4.0 |
| F6959 | | | | | | | 3.0 |

**NOTE:** ①Supply voltage: 1.0 kV/MCP, vacuum: $1.3\times10^{-4}$ Pa, operating ambient temperature: +25 °C
②Vacuum: $1.3\times10^{-4}$ Pa

## F2225-21PGF

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.
See page 9 regarding the phosphor screen.

* PCD (Pitch Circle Diameter)

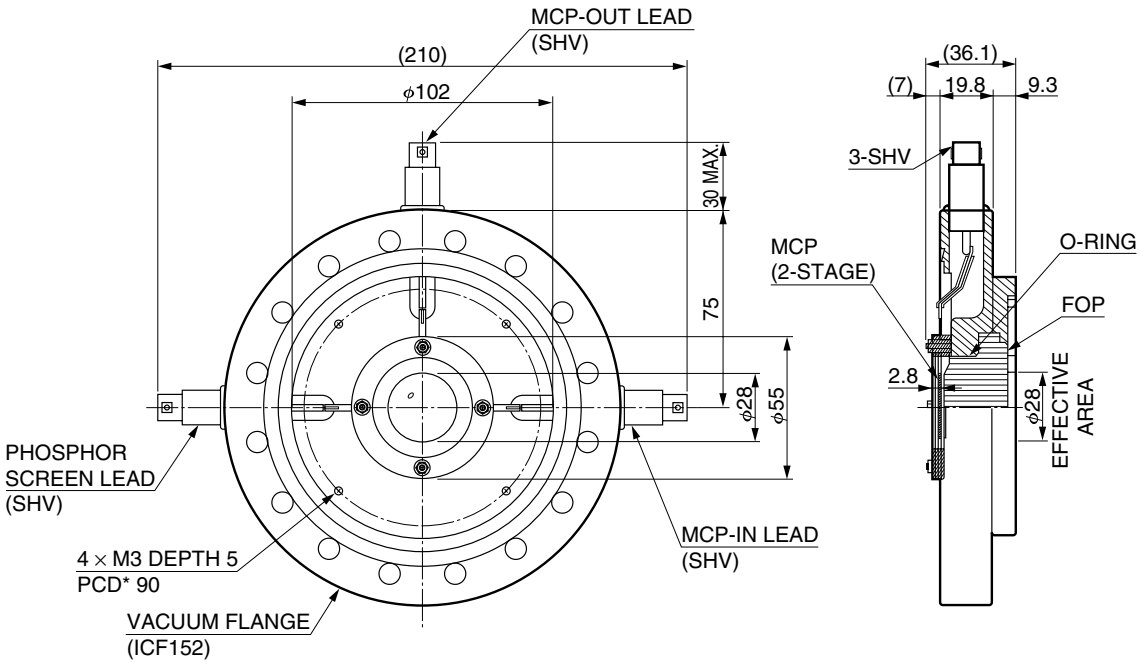



TMCPA0081ED

## F6959

See page 9 regarding the phosphor screen.

* PCD (Pitch Circle Diameter)

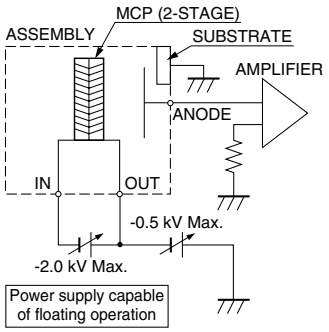


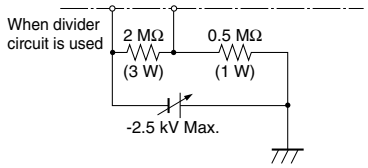

TMCPA0038EF

# MCP ASSEMBLY WIRING EXAMPLES

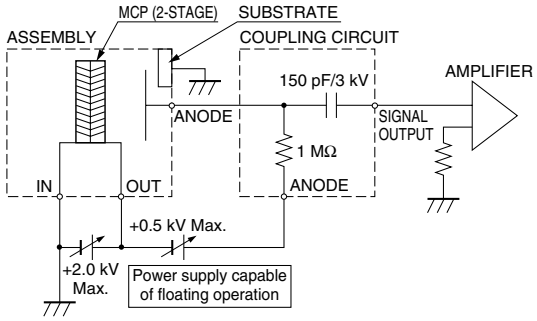
## Signal Detection

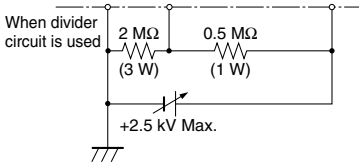
### ●Positive ion detection (Anode Ground)



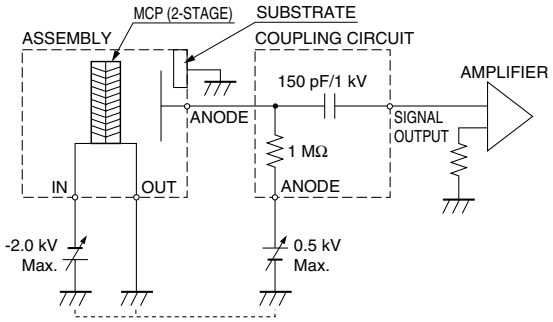




### ●Electron or negative ion detection (Anode Floating (MCP-IN: GND))



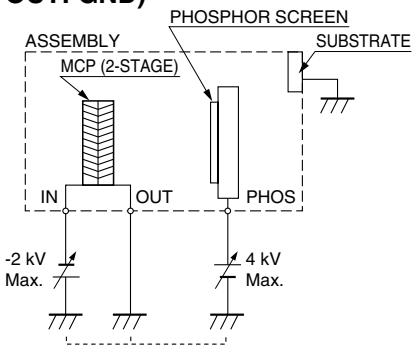

### ●Positive ion detection (Anode Floating (MCP-OUT: GND))



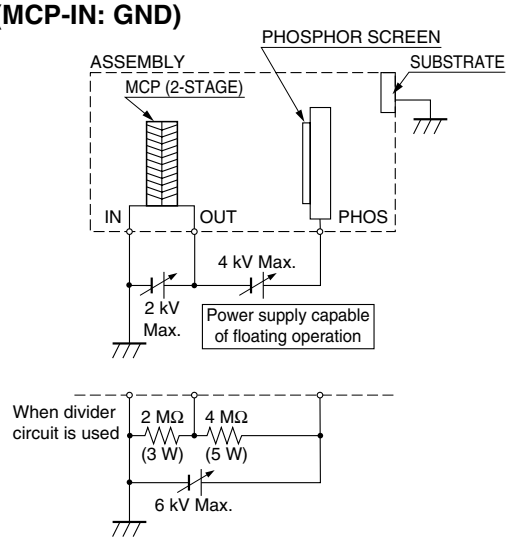

TMCPC0005EH

## Image Detection

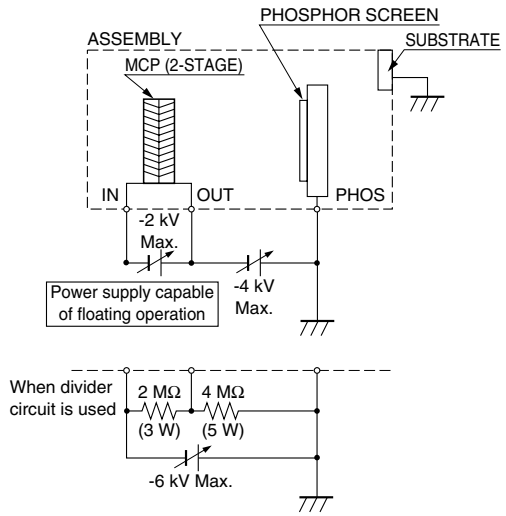
### ●Positive ion detection (MCP-OUT: GND)




### ●Electron or positive ion detection (MCP-IN: GND)




### ●Positive ion detection (Phosphor Screen: GND)




TMCPC0007EE

Using multiple high-voltage power supplies has an advantage that the MCP gain can be independently adjusted.
Using the divider circuit with a single high-voltage power supply offers low cost, but there is a disadvantage that the MCP gain varies as the power supply voltage varies.

# CUSTOMIZATION

- We also manufacture custom-designed MCPs and MCP assemblies not included in the standard product lineup. Please consult us with your specific requirements for outside dimensions, effective dimensions, thickness, etc.
- Feel free to consult us on MCPs with a special aperture or through-hole (for use with reflection electron microscopes), CsI deposition (for higher quantum efficiency in the VUV to X-ray range), aluminum film coating (as a barrier to ions and radiation), MgO coating (for higher gain), electrodes made of Au (gold) and special-purpose MCPs.
- For multianodes, consult us on the desired anode pattern.
- Assemblies with a phosphor-coated fiber optic plate (FOP) are available to enable fiber-coupling to solid state imaging devices (CCD, MOS linear image sensors), etc.
- Assemblies with an MCP, readout device and lead terminals mounted on a special vacuum flange or printed circuit board are also available.
- Please consult us regarding funnel type MCPs with an OAR of 90 %.

# HOW TO HANDLE

**1. STORAGE**

The MCP and the MCP assembly are shipped in packages that are evacuated to a vacuum or filled with dry nitrogen. These packages are intended for use during shipping and not suited for long-term storage. When storing the MCP and MCP assemblies, take them out of their packages and keep them in a clean case under either a) or b) of the following conditions.

a) At vacuum pressure below 13 Pa and no oil diffusion.

b) Under gentle constant flow of dry nitrogen passed through a 0.45 μm or smaller filter (humidity: 20 % or less).

**2. HANDLING**

Avoid touching the MCP and the MCP assembly with bare hand. If handled with bare hand, these might be contaminated by oil and salt from it causing an increase in dark current, a loss of gain and an electrical discharge.

When handling them, always wear clean vinyl or polyethylene gloves. Even when you wear gloves, never touch the effective area of the MCP and the MCP assembly.

**3. ENVIRONMENTS**

The MCP surface is processed to be electrically active and the components used for the assembly are also processed for high vacuum use. So as much as possible, handle them in an environment conforming to clean-room (dust-proof room) specifications where oily vapor, moisture and dust are minimized.

If dusts or debris get on the MCP surface, blow them off with dry clean air or nitrogen gas. When doing this, check the pressure and surrounding area so as not to blow other dust into the air. Never use your own breath to blow off the dust from the MCP surface.

**4. DEGASSING BEFORE USE**

Gas adsorption usually occurs on the surface of an MCP which has not yet been used after delivery or has been stored after use. The MCP must be evacuated in a high vacuum below $1.3 \times 10^{-4}$ Pa for more than 24 hours to perform degassing before using it (before supplying a voltage).

**5. VACUUM BAKING**

Vacuum baking is effective in degassing when the MCP or the MCP assembly is to be used in a high vacuum.

Perform the vacuum baking under 150 °C while keeping the exhaust system at a vacuum pressure below $1.3 \times 10^{-4}$ Pa.

Vacuum baking cannot be performed on some types of MCP assembly. Please consult us for details.

**6. SUPPLY VOLTAGE**

Always maintain the MCP and the MCP assembly high vacuum condition below $1.3 \times 10^{-4}$ Pa in operation.

When supplying a voltage to the MCP or MCP assembly and to the output signal readout device (anode, phosphor screen), slowly increase it at every 100 V step (approx. 5 seconds per 100 V).

**7. THE DISPOSAL METHOD**

The materials in these products contain lead and its compound. Please follow the applicable regulations regarding disposal of hazardous materials and industrial wastes in your country, state, region or province.

# WARRANTY PERIOD AND COVERAGE

This product is warranted for a period of one year from the date of shipment. If you find any failure or defect in the workmanship and notify us within this warranty period, we will repair or replace it free of charge. The warranty is limited to replacement of the defective product.

Even if within the warranty period, this warranty shall not apply to failures or damages that were caused by the product reaching the end of its service life, incorrect operation, or accidents such as natural or man-made disasters.



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