

**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

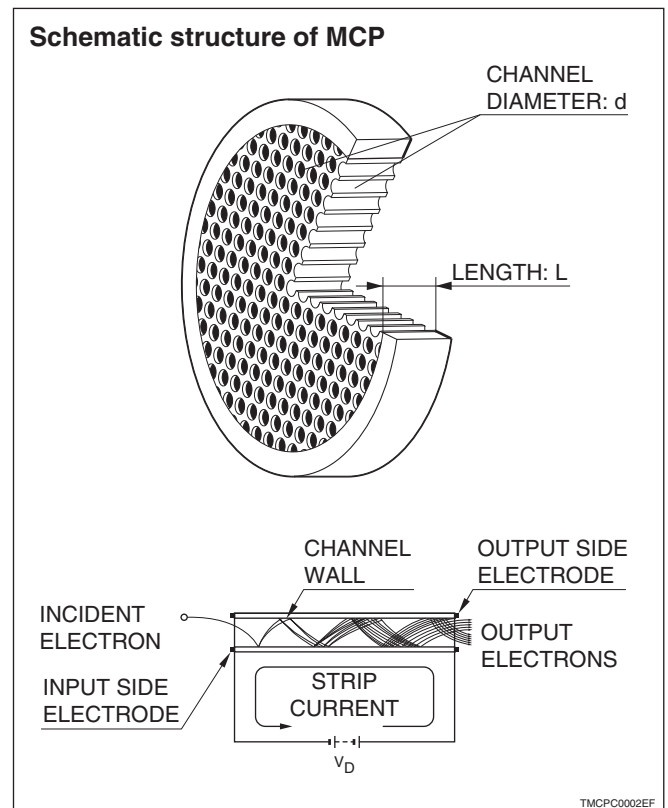
The thickness of an MCP is nearly equal to the channel length. The ratio of the channel length ( $L$ ) to the channel diameter ( $d$ ) is referred to as  $\alpha$  ( $\alpha=L/d$ ), and this  $\alpha$  and the secondary emission factor inherent to the channel wall material determine the gain of the MCP. 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 MCP.

## ■ Bias angle

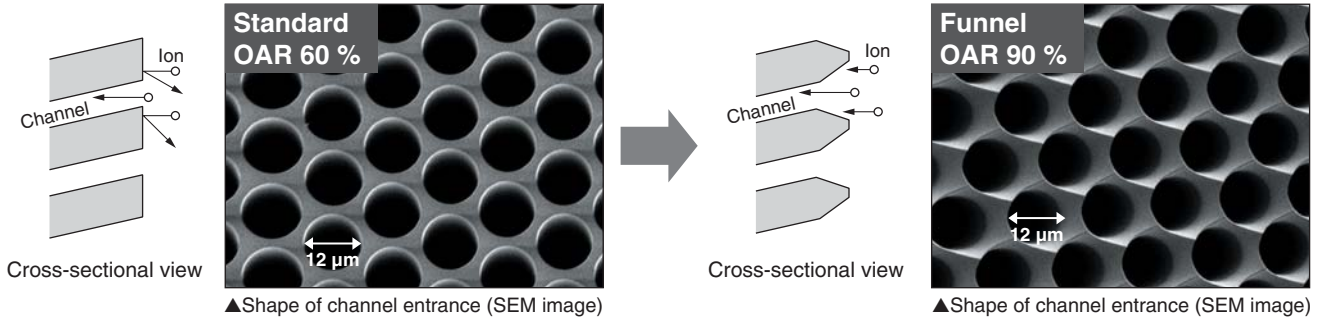
The bias angle is an angle formed by the channel axis and the axis perpendicular to the plate surface. This angle is chosen by considering the detection efficiency and spatial resolution as well as the prevention of input signals from passing through the channels without colliding with the channel walls.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



TMPC0002EF

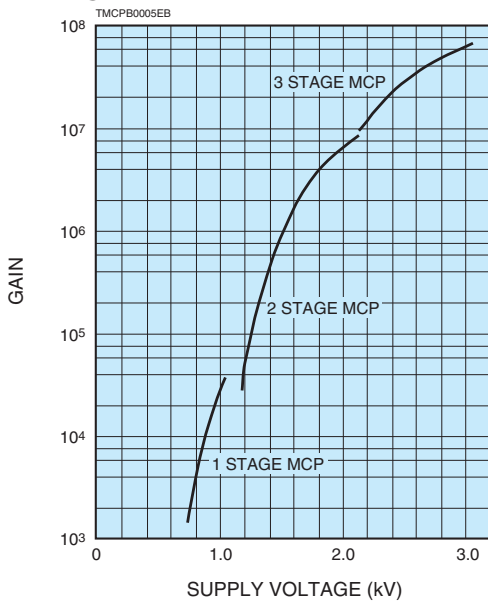
# LARGE OAR: FUNNEL TYPE (OPTION)

The open area ratio (OAR) of standard MCPs is normally set to 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.

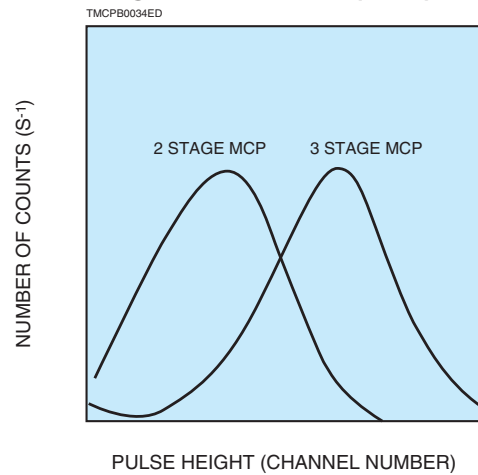


# CHARACTERISTICS

## MCP gain characteristics

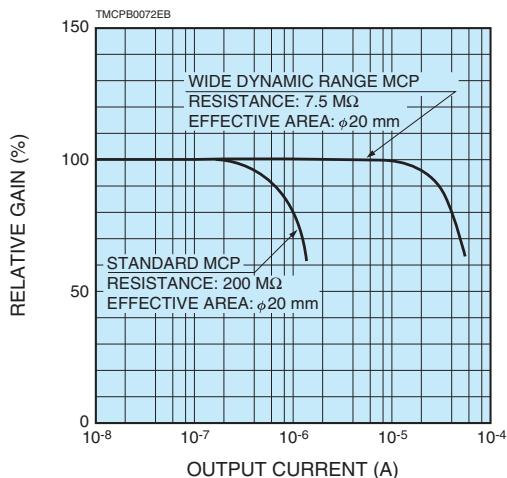


## Pulse height distribution (PHD)

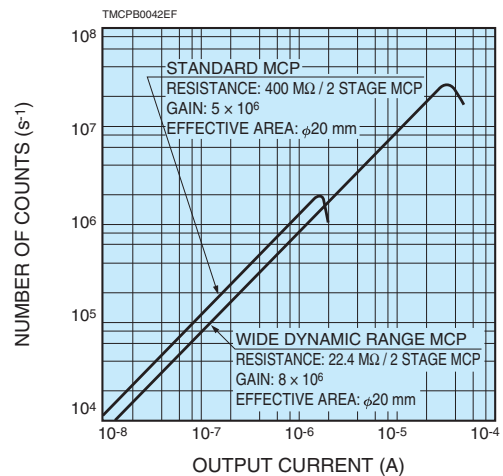


## MCP saturation characteristics (output linearity)

Analog mode

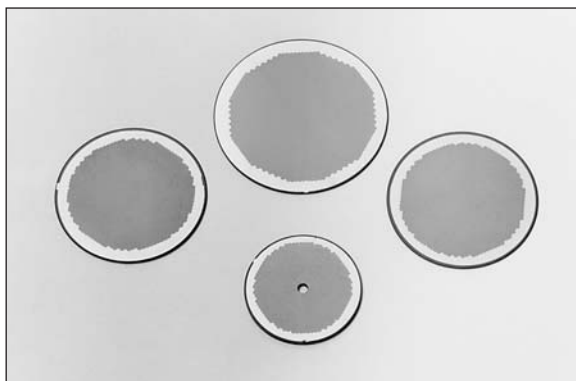


Counting mode

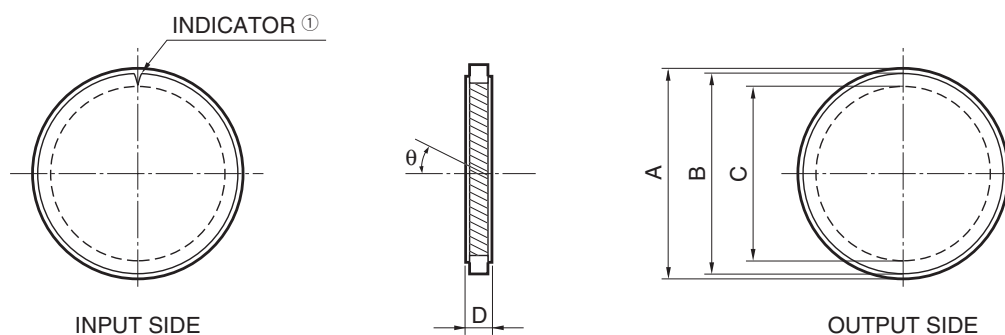


# MCP SPECIFICATIONS AND DIMENSIONAL OUTLINES

## Circular MCP



MCPF0006



TMCPA0056EA

Parameter	Type	F1551			F1094			F1552			F1208-01	F1217		F1942-04	F2395-04	Unit		
		-01 <sup>⑤</sup>	-011	-074	-01 <sup>⑤</sup>	-011	-074	-01 <sup>⑤</sup>	-011	-074		-01 <sup>⑤</sup>	-011					
Outer size A		φ17.9			φ24.8			φ32.8			φ38.4	φ49.9		φ86.7	φ113.9	mm		
Electrode area B		φ17			φ23.9			φ31.8			φ36.5	φ49		φ84.7	φ112	mm		
Effective area C		φ14.5			φ20			φ27			φ32	φ42		φ77	φ105	mm		
Thickness D		0.48	0.48	0.3	0.48		0.3	0.48		0.3	0.48	0.48		1		mm		
Channel diameter		12	12	6	12		6	12		6	12	12		25		μm		
Channel pitch		15	15	7.5	15		7.5	15		7.5	15	15		31		μm		
Bias angle θ		8		12		8		12		8		8		12		8		degrees
Open area ratio		60		60														%
Electrode material		Inconel														—		
Gain (Min.) <sup>③</sup>		10 <sup>4</sup>		5×10 <sup>3</sup>		10 <sup>4</sup>		5×10 <sup>3</sup>		10 <sup>4</sup>		5×10 <sup>3</sup>		10 <sup>4</sup>				—
Resistance <sup>③</sup>		100 to 700	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 200	10 to 200	4 to 20	10 to 100	5 to 50	MΩ		
Dark current (Max.) <sup>③</sup>		0.5														pA·cm <sup>2</sup>		
Maximum linear output <sup>③</sup>		7 % of strip current <sup>②</sup>														—		
Supply voltage <sup>④</sup>		1.0														kV		
Operating ambient temperature <sup>④</sup>		-50 to +70														°C		

**NOTE:** ① Indicates MCP input side. Shape varies depending on product type.

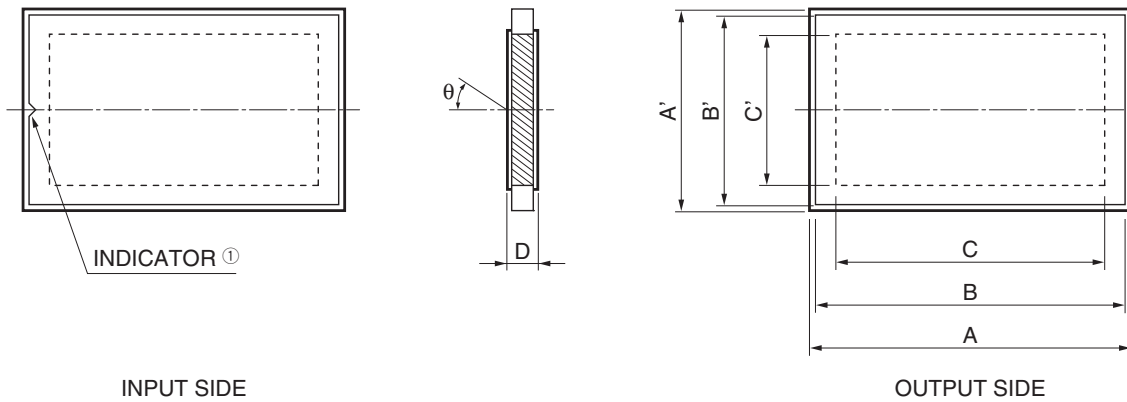
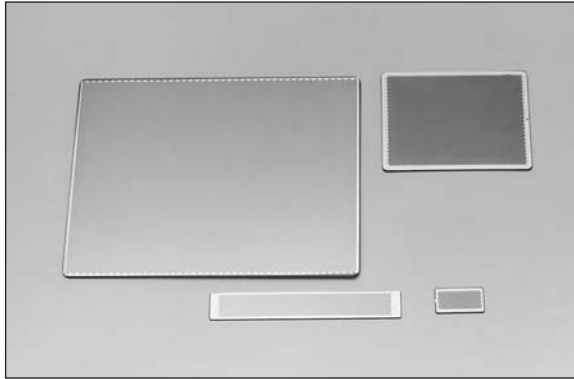
② Strip current is the current that flows through channel walls when a voltage is applied between MCP IN and OUT. It is given by dividing the applied voltage by the MCP resistance.

③ Supply voltage: 1.0 kV, vacuum:  $1.3 \times 10^{-4}$  Pa, operating ambient temperature: +25 °C

④ Vacuum:  $1.3 \times 10^{-4}$  Pa

⑤ The F1551-01, F1094-01, F1552-01, F1208-01 and F1217-01 are also available with a center through-hole (6 mm diameter).

## Rectangular MCP



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	81×32.5	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.) <sup>③</sup>		10 <sup>4</sup>						—
Resistance <sup>③</sup>		100 to 500	20 to 200			20 to 120	10 to 50	MΩ
Dark current (Max.) <sup>③</sup>		0.5						pA·cm <sup>-2</sup>
Maximum linear output <sup>③</sup>		7 % of strip current <sup>②</sup>						—
Supply voltage <sup>④</sup>		1.0						kV
Operating ambient temperature <sup>④</sup>		-50 to +70						°C

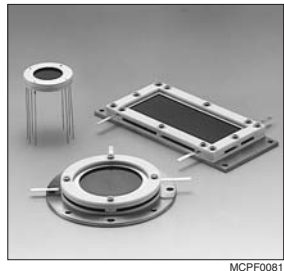
# MCP ASSEMBLY SELECTION GUIDE BY PURPOSE

## Target object

- Electron →
- +/- Ion →
- VUV →
- X-ray →

### Signal Amount Measurement

Measures the signal amount



MCPF0081

### TOF (Time of Flight) Detection

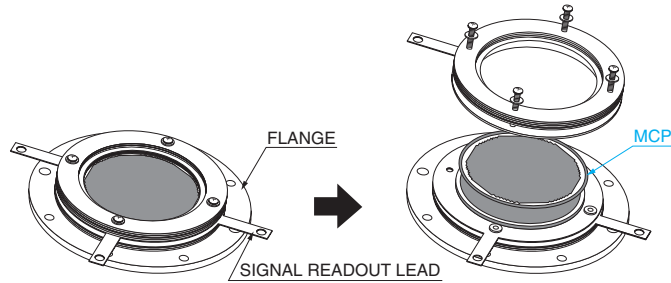
Measures the difference in the arrival time



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.

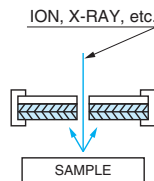


### Standard

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

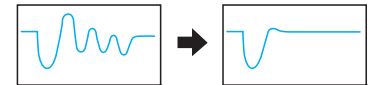
### Center hole

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

OUTPUT WAVEFORM



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

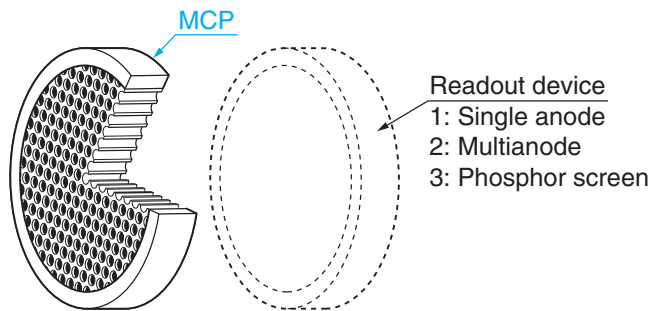
Fast time response

Anode ground

Floating

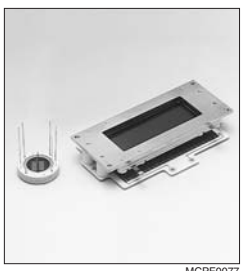
Compact

Compact and 4 μm MCP



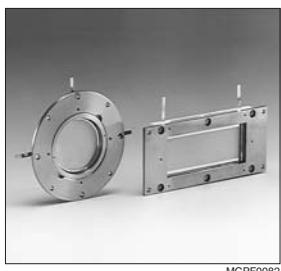
## Position Detection

**Measures the signal amount and position distribution**



## Image Readout

**Captures a signal distribution as an image**



### Thin

(15.1)  
(5.6)

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

ION, X-RAY, etc.

MCP

MULTI-ANODE

SIGNAL

**Features**

- Wide room for choice of readout patterns in one dimension (1xn) or two dimensions (axn)
- Simultaneous counting (parallel counting)
- High counting efficiency
- Anode pitch: 3 mm or more

### Phosphor screen output

MCP

PHOSPHOR SCREEN

ION or ELECTRON

ELECTRON

TMCP0104EA

The phosphor screen coated on the glass plate converts the output charge distribution from the MCP into a visible image. A resolution of 40  $\mu\text{m}$  to 50  $\mu\text{m}$  can be obtained with a one-stage MCP, and that of 80  $\mu\text{m}$  to 100  $\mu\text{m}$  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**

**P.15**

**P.8**

**P.8**

**P.9**

**P.10**

**P.9**

**P.10**

**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. Please 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	Mass spectroscopy										Semiconductor inspection					Surface analysis									
	Application	Time-of-flight mass spectroscopy (TOF-MS) (MALDI-MS)	Time-of-flight mass spectroscopy (TOF-MS) (LC-MS)	Quadrupole mass spectroscopy (Q-MS)	Double focusing mass spectroscopy (Sector-MS)	Gas or liquid chromatographic 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)	Transmission 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															○		⊙	⊙	○	○	○	○	○	○	



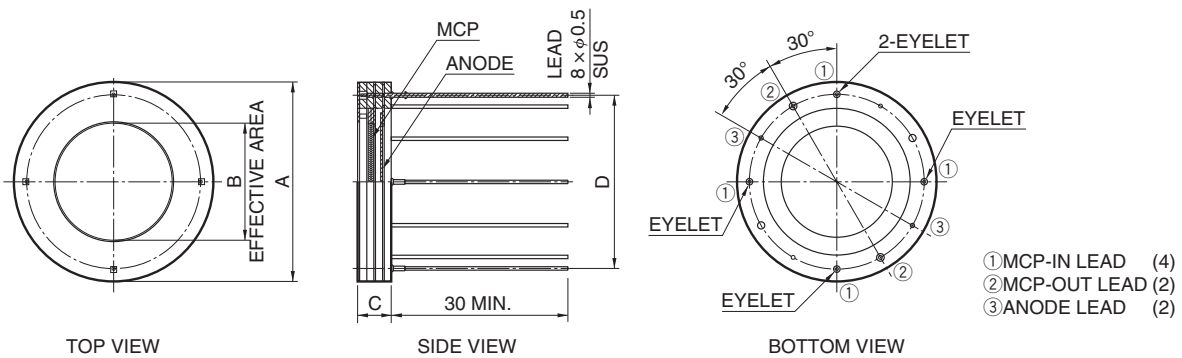
# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

Type No.	Channel diameter (μm)	Number of MCPs	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F1551	12	1 to 3	1 stage MCP : 1 × 10 <sup>4</sup>	2 stage MCP: 120 3 stage MCP: 80	3 (2 or 3 stage MCP)	1 stage MCP: 1.0 2 stage MCP: 2.0 3 stage MCP: 3.0	Single anode: 0.5 Multianode: 0.5
F1094			2 stage MCP : 1 × 10 <sup>6</sup>				
F1552			3 stage MCP : 1 × 10 <sup>7</sup>				
F1208							
F1217							

NOTE: ①Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C  
②Vacuum: 1.3 × 10<sup>-4</sup> Pa

## Circular (Non-demountable)

Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> Pa.



TMCPA0027EG

Anode type	Number of MCPs
Without readout device	1 to 3
Single anode	
Multianode	

Phosphor output type are not available.

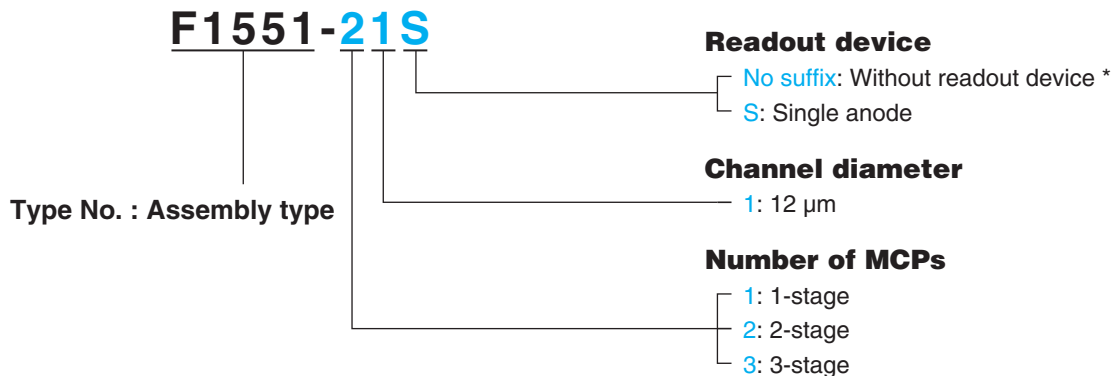
Symbol	Description	F1551	F1094	F1552	F1208	F1217	Unit
A	Assembly outer size	φ27	φ34	φ42	φ49	φ62	mm
B	Effective area	φ14.5	φ20	φ27	φ32	φ42	mm
C	Assembly height	No. of MCPs	1	4.5			mm
			2	5.7			
			3	5.7			
D	Lead pin circle diameter	22.5	29.5	37.5	44	56	mm

\* 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 MCP assemblies (non-demountable type). When you order other MCPs (non-assembled MCPs) and MCP assemblies, we use their type numbers as listed.

\* When customers prepare a read-out device, we supply MCP assemblies without readout devices.



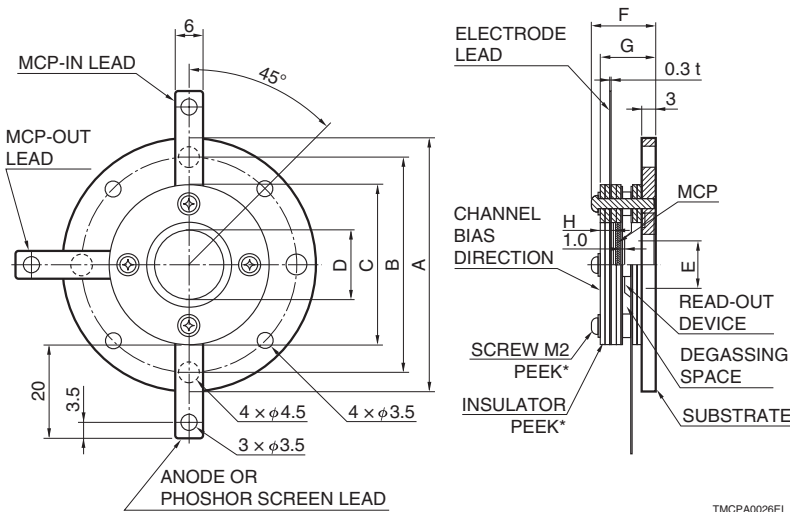
# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

Type No.	Channel diameter (μm)	Number of MCPs	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> .cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F2221	12	Refer to "Anode Type" below	1 stage MCP : 1 × 10 <sup>4</sup>	2 stage MCP: 120 3 stage MCP: 80	3 (2 or 3 stage MCP)	1 stage MCP: 1.0 2 stage MCP: 2.0 3 stage MCP: 3.0	Single anode: 0.5 Multianode: 0.5 Phosphor screen : 3.0 to 4.0
F2222			2 stage MCP : 1 × 10 <sup>6</sup>				
F2223			3 stage MCP : 1 × 10 <sup>7</sup>				
F2224							
F2225							
F2226	25						

NOTE: ①Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C  
②Vacuum: 1.3 × 10<sup>-4</sup> Pa

## Circular (Demountable)

Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> 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	Distance from bottom of substrate to insulator surface	No. 1	10.9				12.9	mm
		No. 2	11.9				14.4	
H	Distance from MCP input surface to insulator surface	MCPs 3	11.9				15.9	mm
		No. 1	2.8				3.8	
		No. 2	3.3				4.3	
H	Distance from MCP input surface to insulator surface	MCPs 3	2.9				4.8	mm

Shape may differ depending on product type number.

\* PEEK: Polyetheretherketone  
F2226 has leads every 60 degrees.

## PHOSPHOR SCREEN

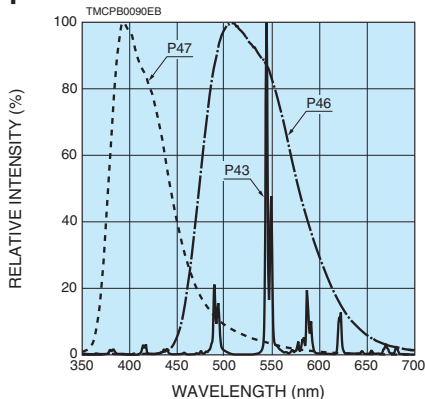
Select the desired phosphor screen by taking into account the decay time according to the readout method and application, and the emission wavelength according to the readout device sensitivity.

Phosphor screen type	Peak emission wavelength (nm)	Emission color	Relative energy efficiency <sup>①</sup>	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 <sup>②</sup>	Short decay
P47	400	Purplish blue	0.3	0.11 μs	Very short decay

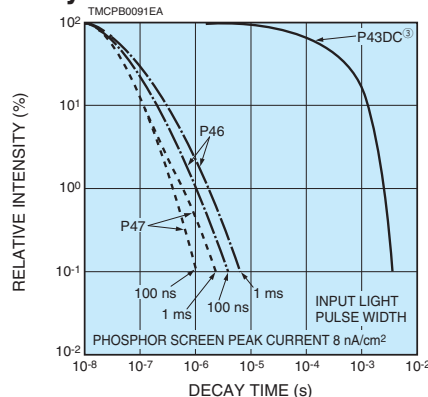
NOTE: ①Supply voltage: 6 kV. Value relative to P43 which is specified as 1.

②Varies depending on the input pulse width.

### ■Spectral emission characteristics



### ■Decay characteristics



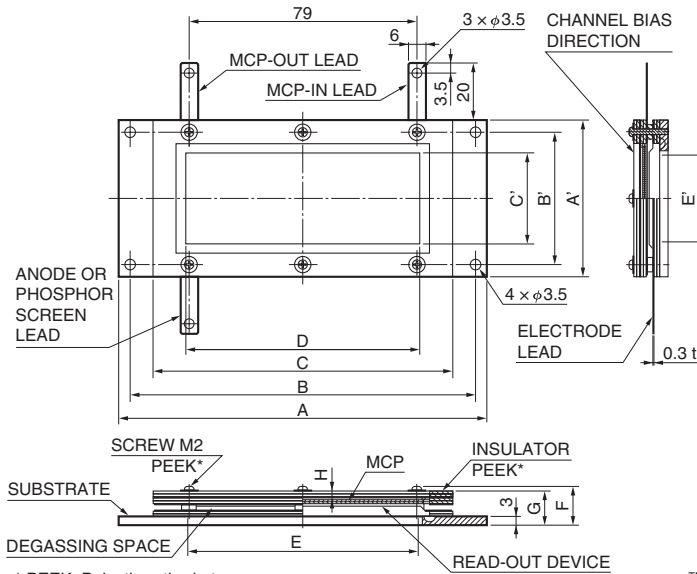
③ Decay characteristics after removal of continuous light input

Type No.	Channel diameter (μm)	Number of MCPs	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode Supply voltage (kV) <sup>②</sup>
F2813	15	Refer to "Anode type" below	1 stage MCP : 1 × 10 <sup>4</sup>	2 stage MCP: 120 3 stage MCP: 80	3 (2 or 3 stage MCP)	1 stage MCP: 1.0 2 stage MCP: 2.0 3 stage MCP: 3.0	Single anode: 0.5 Multianode: 0.5 Phosphor screen : 3.0 to 4.0
F2814	20		2 stage MCP : 1 × 10 <sup>6</sup>				
F3490	12		3 stage MCP : 1 × 10 <sup>7</sup>				

NOTE: ①Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C  
②Vacuum: 1.3 × 10<sup>-4</sup> Pa

## Rectangular (Demountable)

Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> Pa.



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

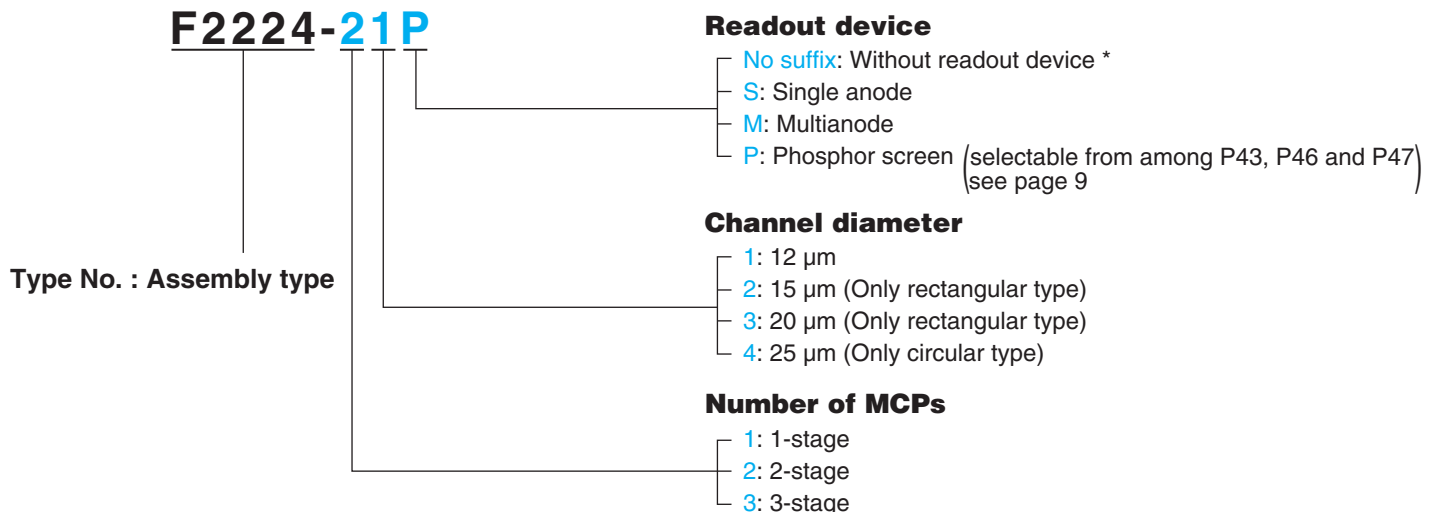
Symbol	Description	F2813	F2814	F3490	Unit	
Ax A'	Assembly outer size	128x54	96x76	78x29.5	mm	
Bx B'	Mounting screw hole pitch	120x46	86x68	72x18	mm	
Cx A'	Insulator outer size	104x54	76x76	66x29.5	mm	
DxD'	Effective area	81x31	53x53	55x8	mm	
Ex E'	Effective area of readout device	80x30	50x50	52x7	mm	
F	Distance from bottom of substrate to insulator surface	No. of MCPs	1	10.9	10.9	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
			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). When you order other MCPs (non-assembled MCPs) and MCP assemblies, we use their type numbers as listed.

\* When customers prepare a read-out device, we supply MCP assemblies without readout devices. In the case of using a phosphor screen as the readout device, there is a need to change several points, so please consult us in advance.



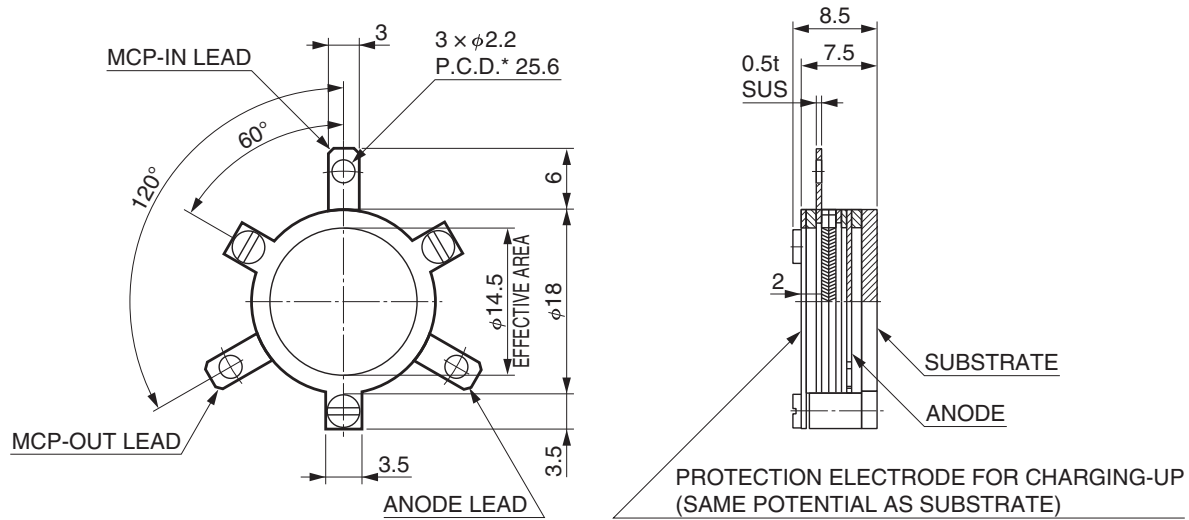
# MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

Type No.	Channel diameter (μm)	Number of MCPs	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F4655	12	2	5 × 10 <sup>7</sup>	50	3	2.5	0.5
F4655-14							

NOTE: ① Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C  
 ② Vacuum: 1.3 × 10<sup>-4</sup> Pa

## F4655

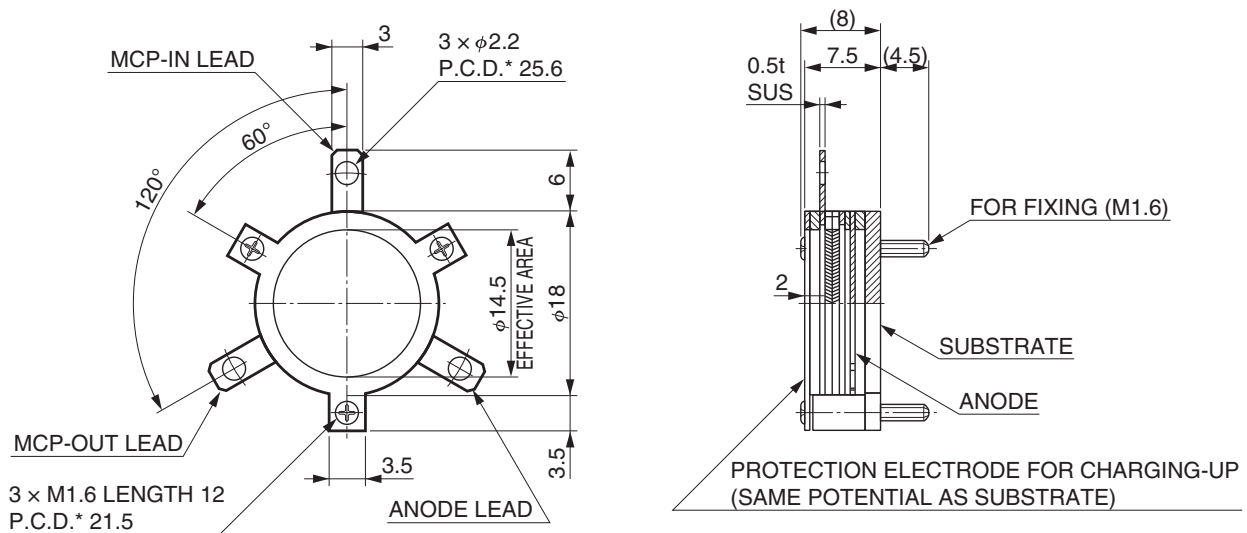
Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> Pa. \* P.C.D. (Pitch Circle Diameter)



TMCPA0001EK

## F4655-14

Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> Pa. \* P.C.D. (Pitch Circle Diameter)



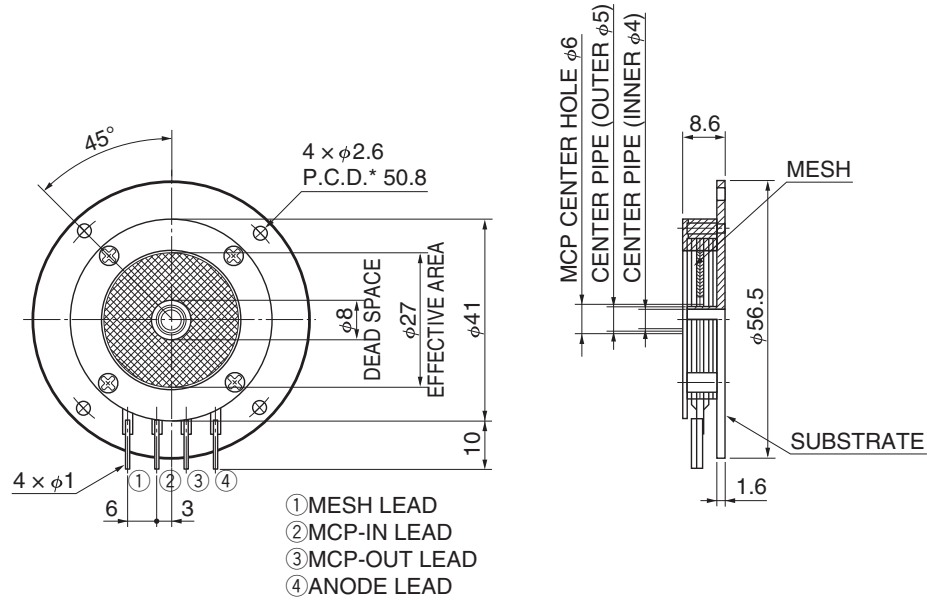
TMCPA0008EC

Type No.	Channel diameter (μm)	Number of MCPs	MCP center dead area (mm)	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F2223-21SH	12	2	φ8	1 × 10 <sup>6</sup>	—	3	2.0	0.5
F4294-09			φ12					

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

## F2223-21SH

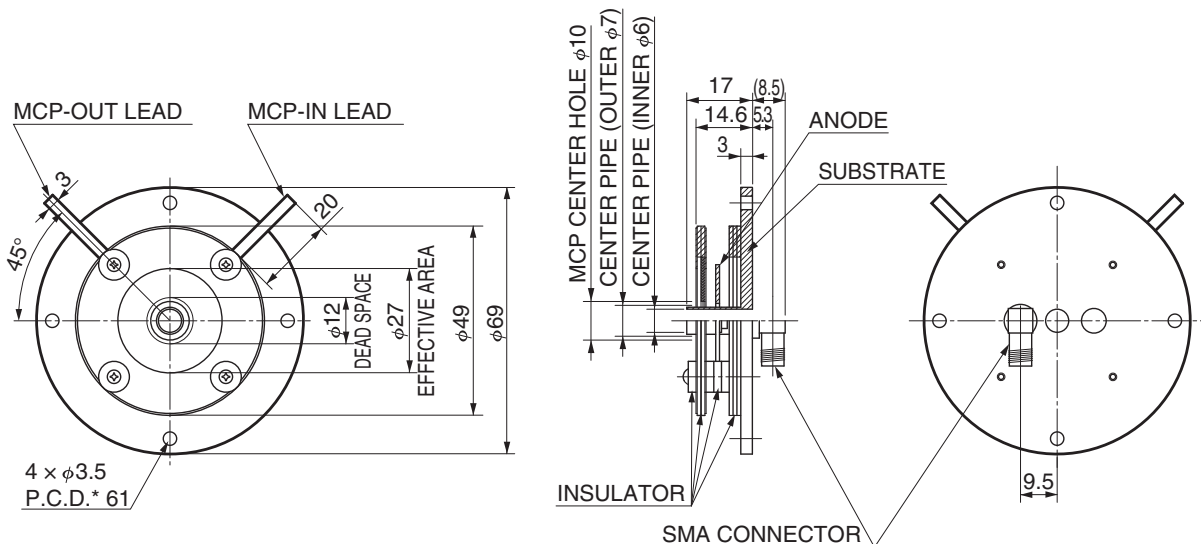
Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below  $1.3 \times 10^{-4}$  Pa. \* P.C.D. (Pitch Circle Diameter)



TMCPA0002E1

## F4294-09

\* P.C.D. (Pitch Circle Diameter)



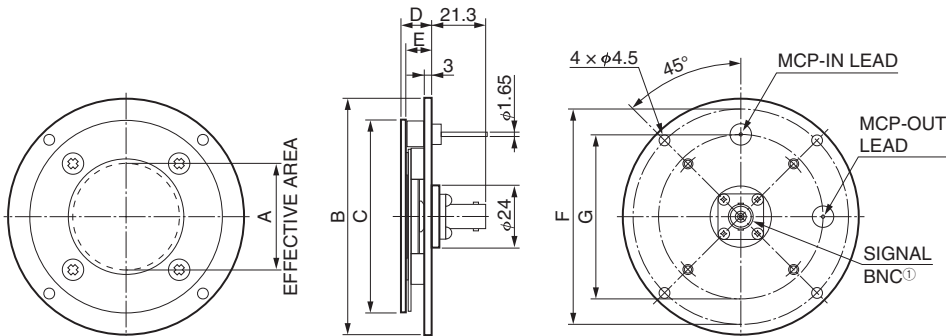
TMCPA0042EG

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

Type No.	Channel diameter (μm)	Number of MCPs	Pulse width (FWHM) (ps)	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F9890-13	12	2	900	1 × 10 <sup>6</sup>	150	3	2.0	0.5
F9890-14	6							
F9890-31	12							
F9890-32	6							
F9892-13	12							
F9892-14	6							
F9892-31	12							
F9892-32	6							

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

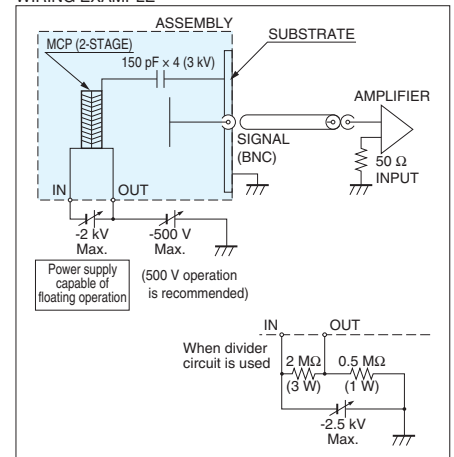
## F9890-13/14, F9892-13/14



①SMA connector type is also available.

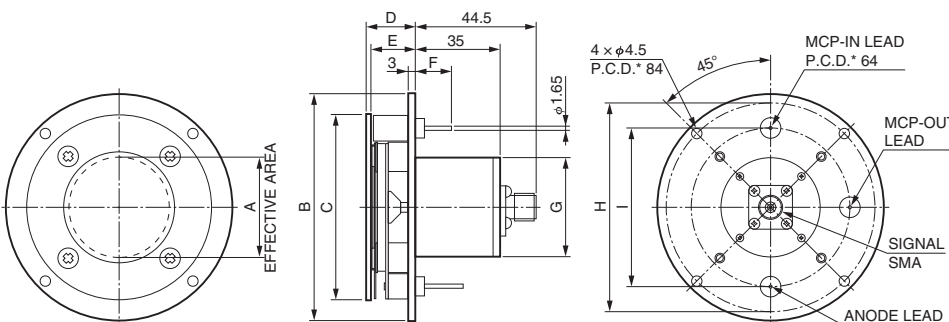
	F9890-13	F9890-14	F9892-13	F9892-14
A	φ27		φ42	
B	φ81		φ92	
C	φ63		φ75	
D	12	11.6	12	11.6
E	10	9.6	10	9.6
F	φ72		φ84	
G	φ52		φ64	

### WIRING EXAMPLE



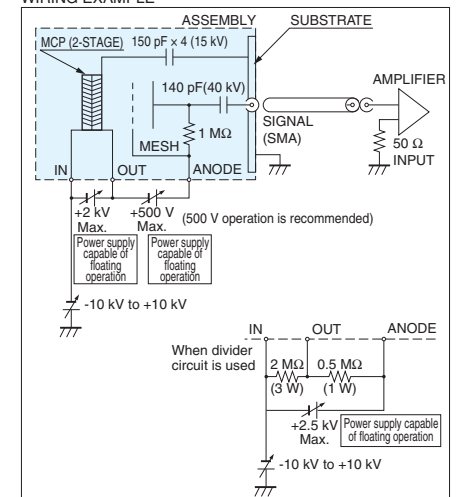
TMCPA0075EC

## 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
	MCP-OUT LEAD	15.2		15.2
	ANODE LEAD	19.4		19.4
G		φ35		φ40
H		φ72		φ84
I		φ52		φ64

### WIRING EXAMPLE



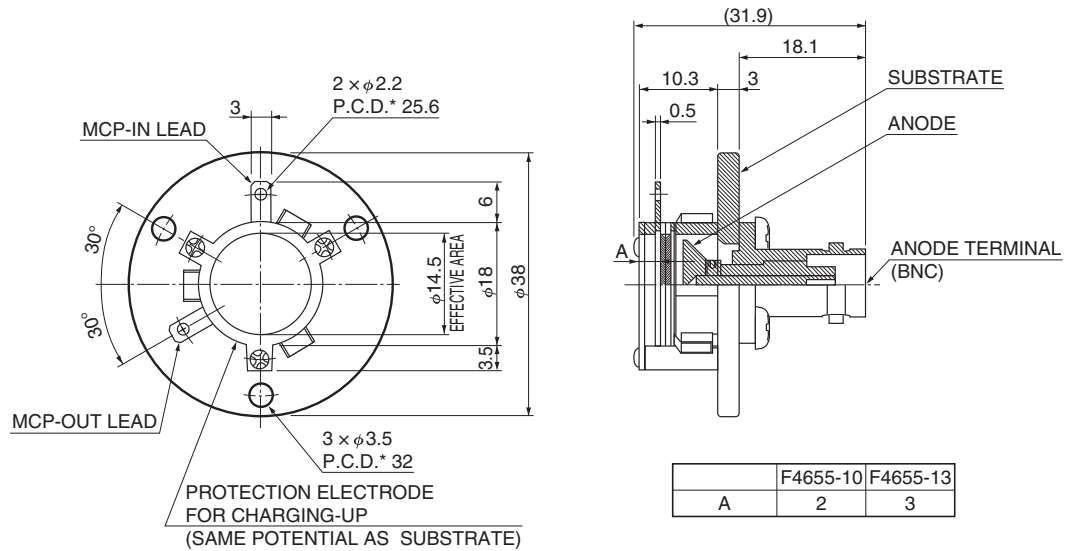
TMCPA0082EE

Type No.	Channel diameter (μm)	Number of MCPs	Pulse width (FWHM) (ps)	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F4655-10	12	2	600	5 × 10 <sup>7</sup>	50	3	2.5	0.5
F4655-11				1 × 10 <sup>6</sup>	120	5	2.0	
F4655-13	4							

NOTE: ① Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C  
 ② Vacuum: 1.3 × 10<sup>-4</sup> Pa

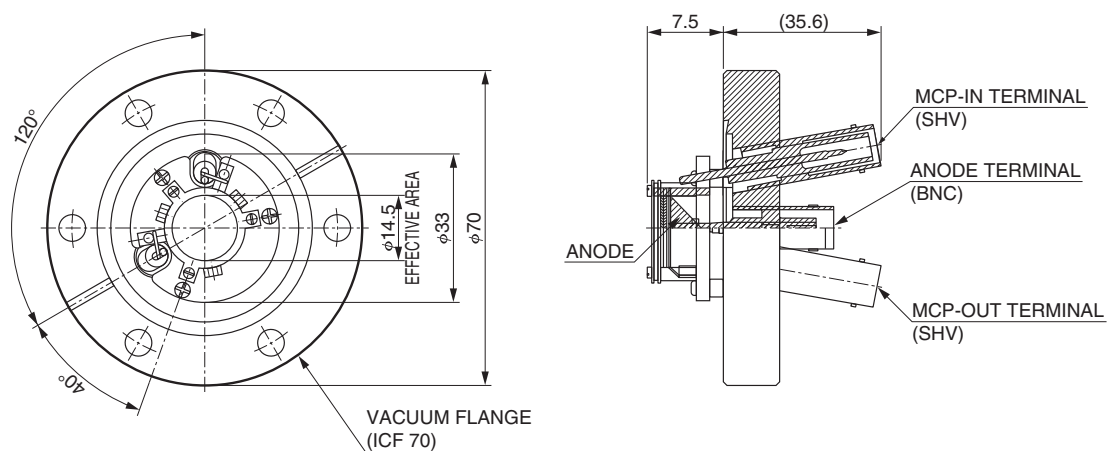
## F4655-10/13

\* P.C.D. (Pitch Circle Diameter)



TMCPA0021EH

## F4655-11



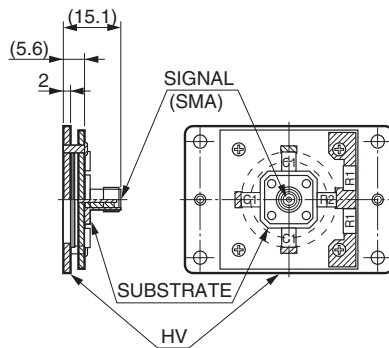
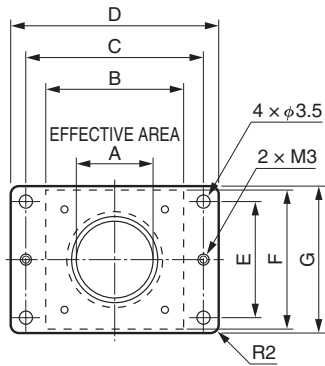
TMCPA0085EC

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

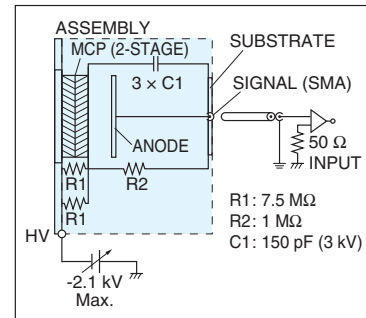
Type No.	Channel diameter (μm)	Number of MCPs	Pulse width (FWHM) (ns)	Gain (Min.)	Puls height resolution (Max.) (%)	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> )	MCP supply voltage (kV)	MCP-OUT to anode supply voltage (kV)
F12334-11	12	2	1.5	1 × 10 <sup>6</sup>	—	3 <sup>③</sup>	— <sup>③</sup>	0.5
F12395-11								
F12396-11								
F13446-11								

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

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



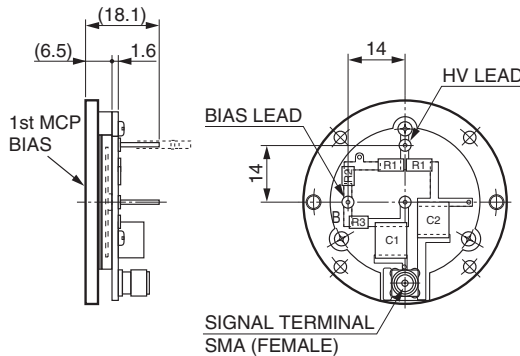
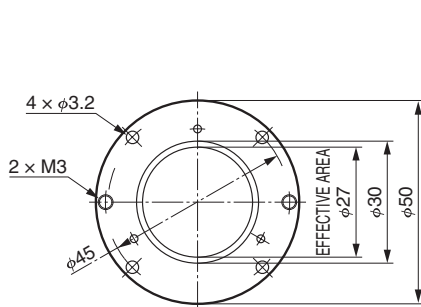
### WIRING EXAMPLE



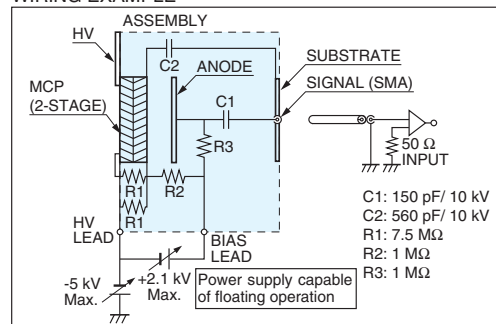
	F12334-11	F12395-11	F12396-11
A	φ20	φ27	φ42
B	36	40	51
C	46	51	62
D	54	61	72
E	30	30	40
F	36	40	51
G	38	41	52

TMCPA0084ED

## F13446-11



### WIRING EXAMPLE



TMCPA0087EC



Type No.	Channel diameter (μm)	Number of MCPs	Gain (Min.) <sup>①</sup>	Puls height resolution (Max.) (%) <sup>①</sup>	Dark count (Max.) (s <sup>-1</sup> ·cm <sup>-2</sup> ) <sup>①</sup>	MCP supply voltage (kV) <sup>②</sup>	MCP-OUT to anode supply voltage (kV) <sup>②</sup>
F2225-21PGF	12	2	1 × 10 <sup>6</sup>	—	3	2.0	4.0
F6959							3.0

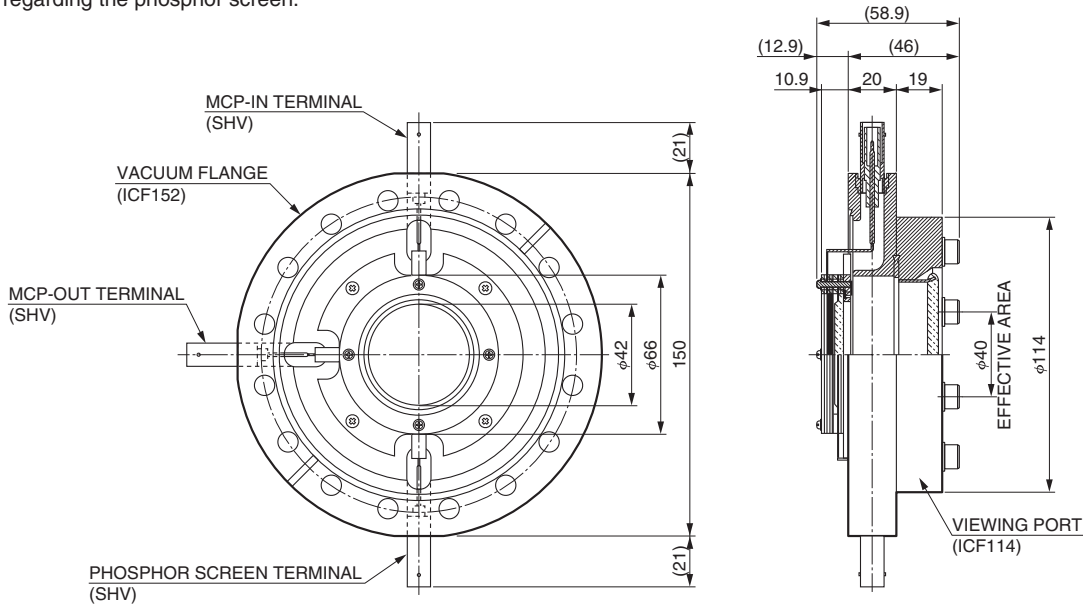
NOTE: ①Supply voltage: 1.0 kV/MCP, vacuum: 1.3 × 10<sup>-4</sup> Pa, operating ambient temperature: +25 °C

②Vacuum: 1.3 × 10<sup>-4</sup> Pa

## F2225-21PGF

Perform the vacuum baking under 150 °C while keeping the evacuation system at a vacuum pressure below 1.3 × 10<sup>-4</sup> Pa.

See page 9 regarding the phosphor screen.

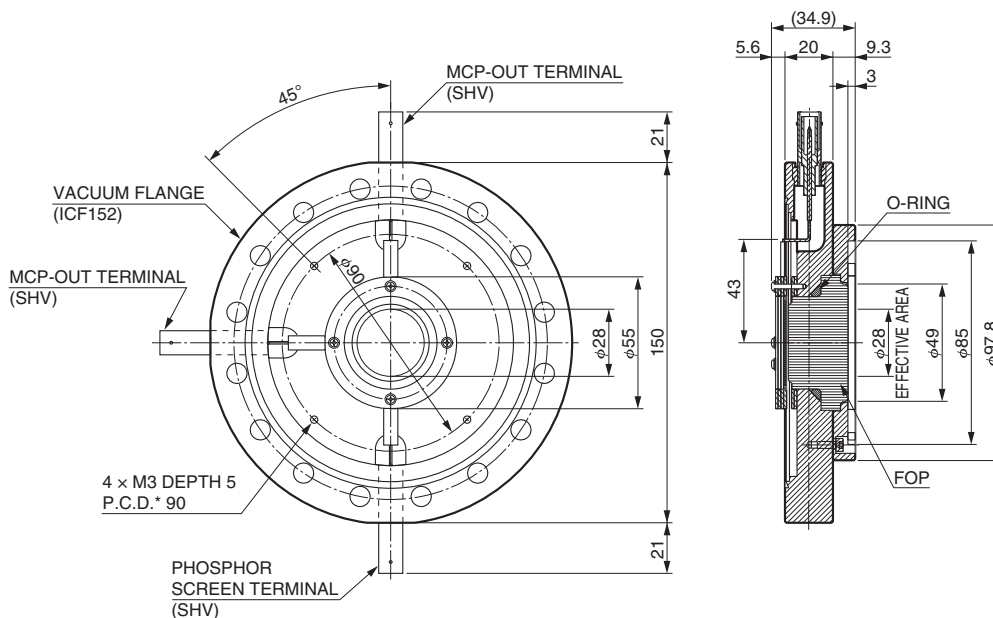


TMCPA0081EE

## F6959

See page 9 regarding the phosphor screen.

\* P.C.D. (Pitch Circle Diameter)

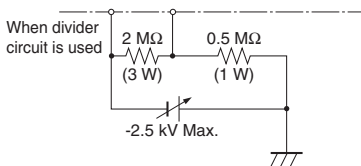
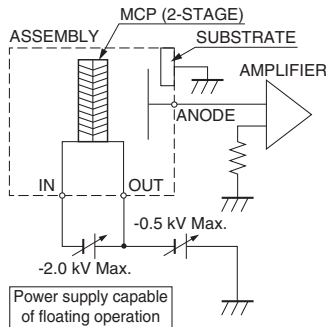


TMCPA0038EG

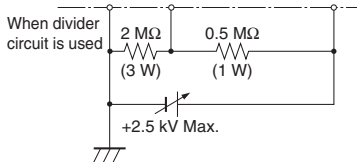
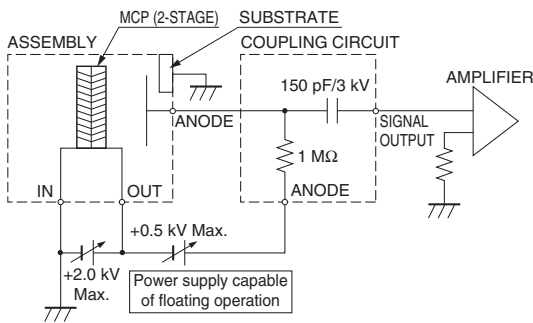
# MCP ASSEMBLY WIRING EXAMPLES

## Signal detection

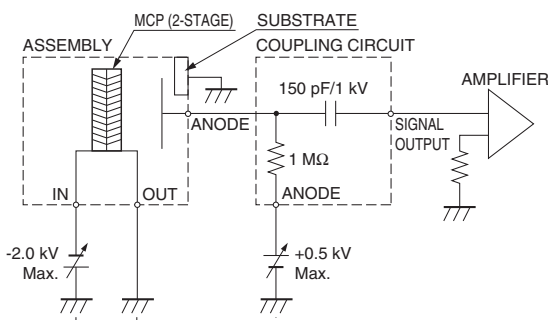
### ● Positive ion detection (Anode ground)



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

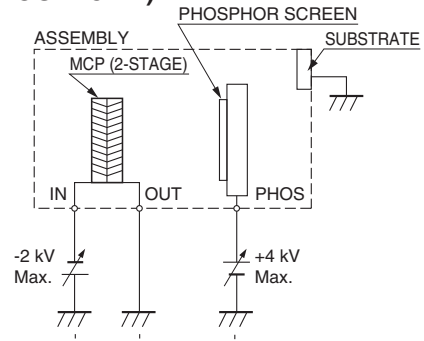


### ● Positive ion detection (Anode floating (MCP-OUT: GND))

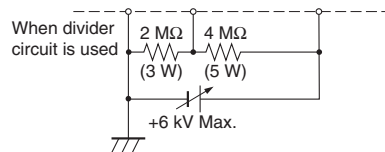
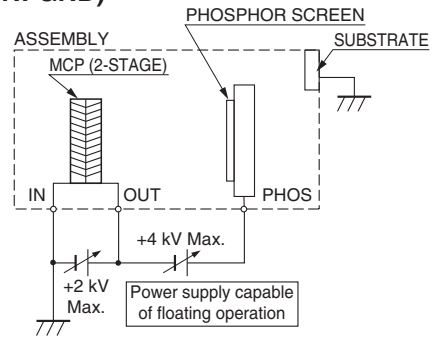


## Image detection

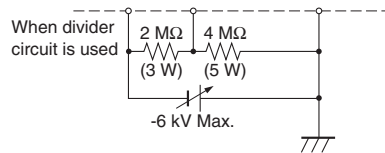
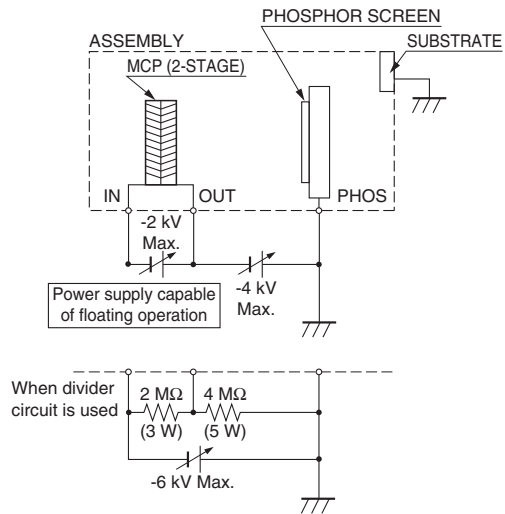
### ● Positive ion detection (MCP-OUT: GND)



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



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



TMCP0005E1

TMCP0007EF

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.
- Please 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, Please consult us on the desired anode pattern.
- 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

MCP and 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. 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 after delivery. 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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