MCP & MCP ASSEMBLY

SELECTION GUIDE

HAMAMATSU

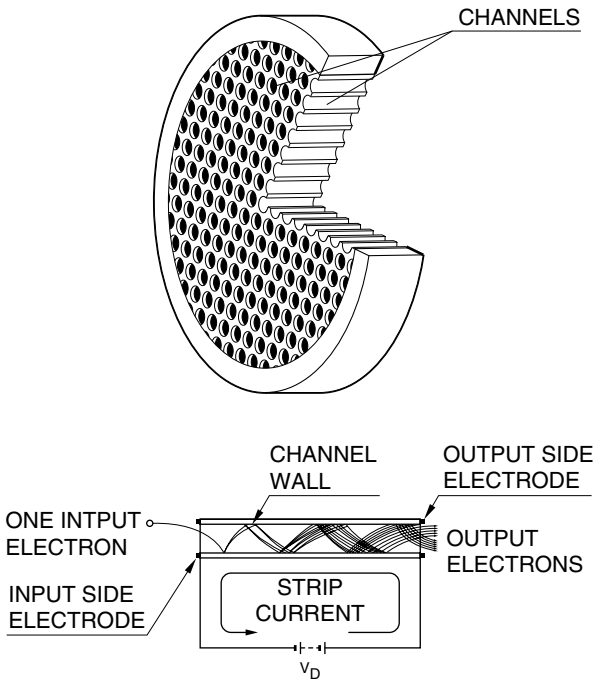
OVERVIEW

MCP (microchannel plate) is a two-dimensional sensor that detects electrons, ions, vacuum UV rays, X-rays and gamma rays, 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 region), (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

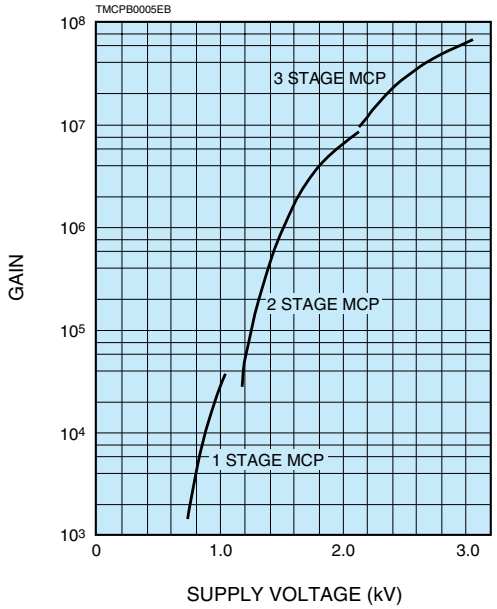
As shown in the figure on the right, a potential gradient is established along the channel when the voltage V_D is applied between the input and output sides of the MCP. Multiple secondary electrons are emitted when an electron enters a channel from the input side and strikes its inner wall. These secondary 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.

Schematic Structure of MCP

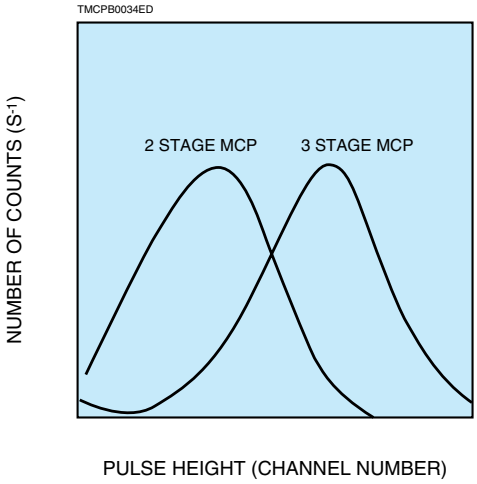


CHARACTERISTCS

■MCP Gain Characteristics

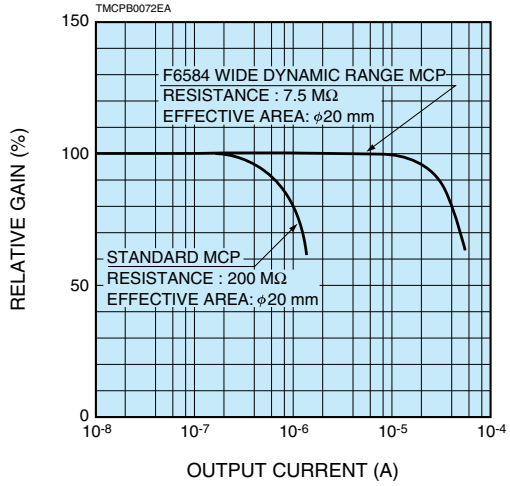


■Pulse Height Distribution (PHD)

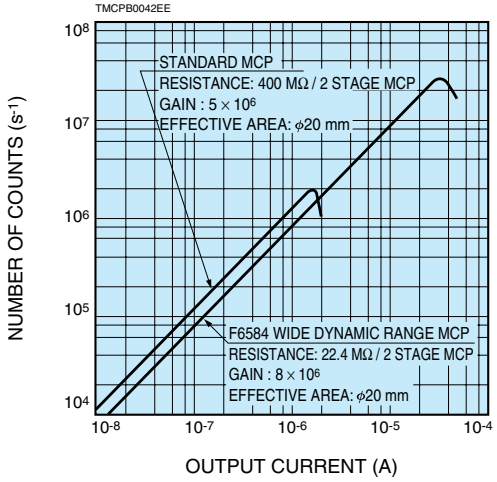


■MCP Saturation Characteristics (Output Linearity)

Analog Mode

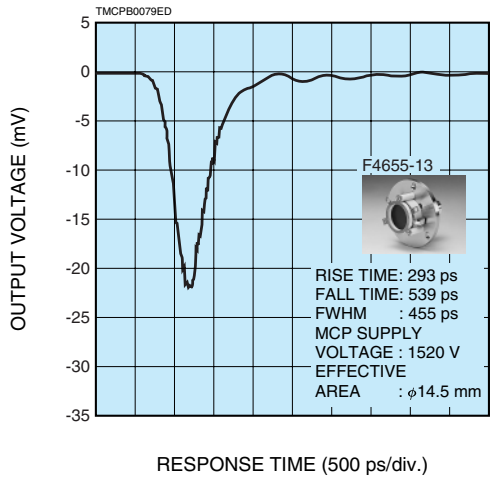


Counting Mode



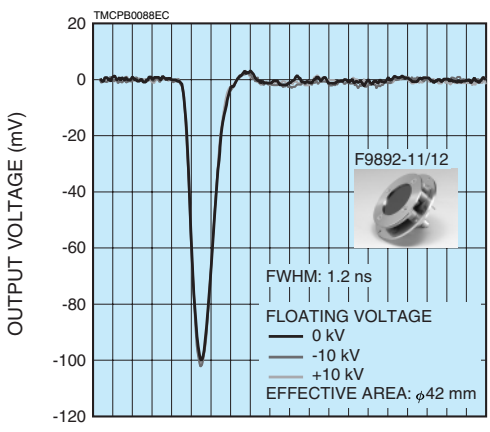
■Output Waveform

Anode Ground



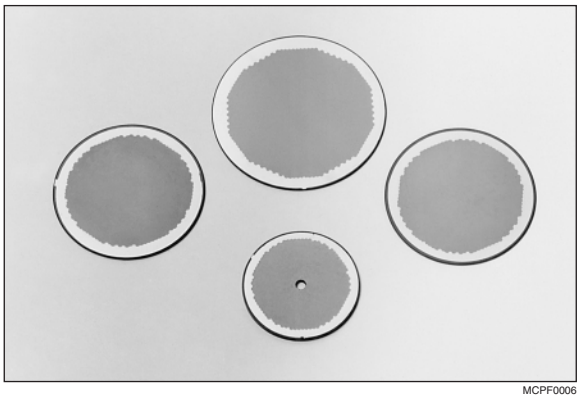
RESPONSE TIME (500 ps/div.)

MCP Input Side Floating at ±10 kV

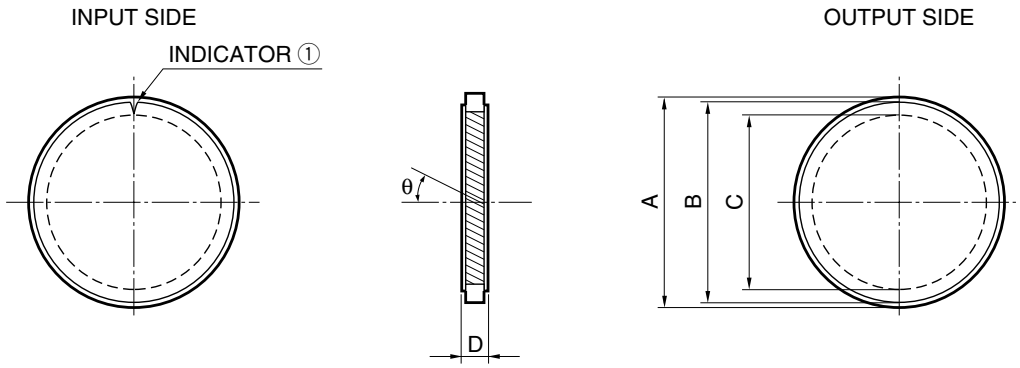


RESPONSE TIME (1 ns/div.)

Circular MCP (Bare MCP)



MCPF0006



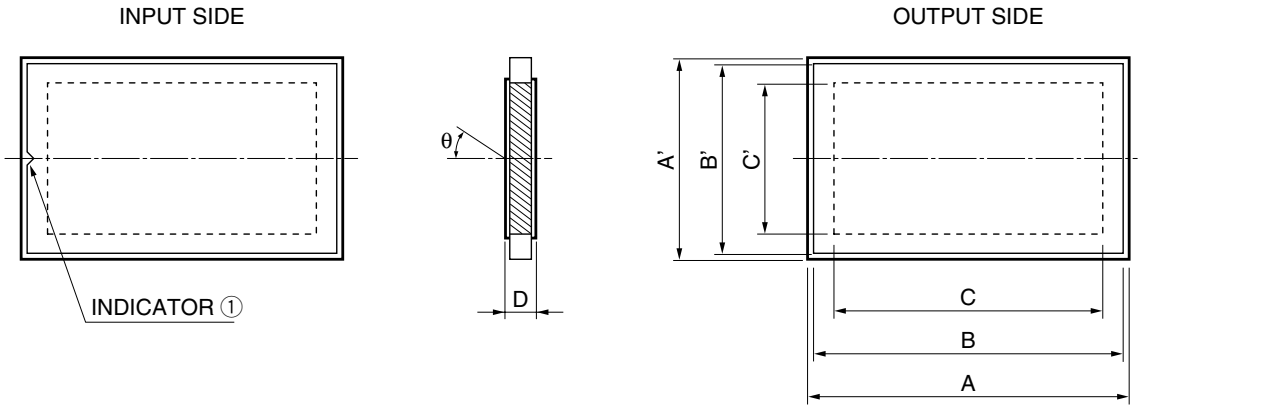
TMCPA0056EA

Parameter \ Type	F1551-01	F1094 ② -01	F1094 ② -09	F6584-01 ③	F1552 ② -01	F1552 ② -09	F1208-01	F1217-01 ②	F1942-04	F2395-04	Unit
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	0.41	0.48	0.48	0.41	0.48		1.00		mm
Channel Diameter	12	12	10	12	12	10	12		25		µm
Channel Pitch	15	15	12	15	15	12	15		31		µm
Bias Angle θ	8	8	5	8	8, 12		8				degrees
Open Area Ratio	60										%
Electrode Material	Inconel										—
Gain (Min.) ⑤	10^4										—
Resistance ⑤	100 to 700	50 to 500		2 to 30	30 to 300		20 to 200	10 to 200	10 to 100	5 to 50	MΩ
Dark Current (Max.) ⑤	0.5										pA·cm^{-2}
Maximum Linear Output ⑤	7 % of Strip Current ④										—
Supply Voltage ⑥	1.0										kV
Operating Ambient Temperature ⑥	-50 to +70										°C

NOTE: ①This mark indicates the MCP input side.
②Variant types with 6 µm channel diameter are also available.
③Wide dynamic range type designed to obtain high output current. (See the graph "MCP Saturation Characteristics" on page 2.)
④The strip current is an electric one that flows along channel walls when a voltage is applied between MCP IN and OUT. This is obtained by dividing the applied voltage by the MCP plate resistance.
⑤Supply voltage: 1.0 kV, vacuum: 1.3×10^{-4} Pa, operating ambient temperature: +25 °C
⑥Vacuum: 1.3×10^{-4} Pa

Rectangular MCP (Bare MCP)

MCPF0011



TMCPA0057EA

Parameter \ Type	F6492	F2370-01	F4772-01	F2806-01	F1943-02	F2805-03	F2396-04	Unit
Outer Size A×A'	139.9×8.9	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'	138×8	15×8.5	61×13	49×39	87×37	58×58	95.6×77.3	mm
Effective Area C×C'	127×4	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.) ⑤	10^4							—
Resistance ⑤	5 to 50	20 to 120	20 to 200				100 to 500	MΩ
Dark Current (Max.) ⑤	0.5							pA·cm^{-2}
Maximum Linear Output ⑤	7 % of Strip Current ④							—
Supply Voltage ⑥	1.0							kV
Operating Ambient Temperature ⑥	-50 to +70							°C

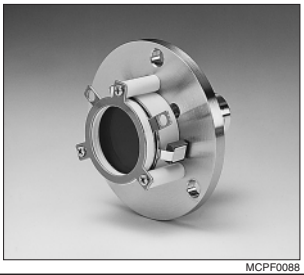
MCP ASSEMBLY SELECTION GUIDE BY PURPOSE

MCP is a two-dimensional sensor that detects electrons, ions, X-rays and so on, and multiplies the detected signals with high efficiency, high speed and thus resulting high temporal resolution. This selection guide would help you choose the best MCP assembly that has a suitable readout configuration for your application.

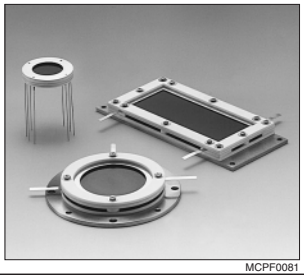
What do you want to detect?

- +/- Ion ▶
- Electron ▶
- X-ray ▶
- High energy particle ▶

TOF (Time of Flight)



Total Amount Measurement

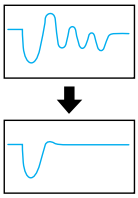


Demountable Type

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.

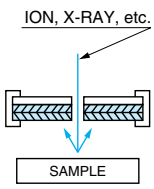
Fast Response Type

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.



Center Hole Type

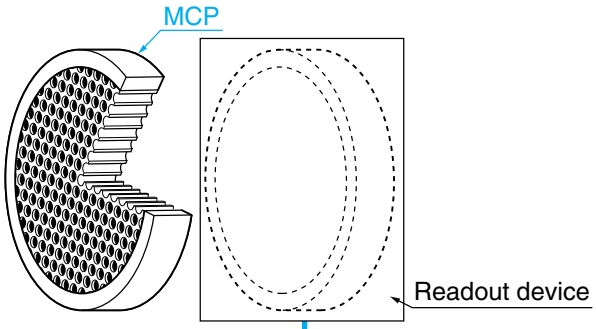
This type of MCP assembly has a through-hole in the center that allows ions, X-rays and so on to pass through it to irradiate a sample. The signal from the sample can then be detected effectively.



Standard Type

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

Compact	Compact and 4 µm MCP	Floating	Anode Ground	Center Hole and Fast Time Response	Standard	Circular	Rectangular	Compact
•PHR: 50 % •Positive Ion detection •Mountable on vacuum flange •No. of MCPs: 2 •BNC output connector •Rise time: 350 ps •Fall time: 750 ps	•Positive Ion detection •Mountable on vacuum flange •No. of MCPs (4 µm): 2 •BNC output connector •Rise time: 293 ps •Fall time: 539 ps	•Ringing: 5 % •Both positive/ negative mode detection •No. of MCPs: 2 •BNC output connector	•Ringing: 5 % •Both positive/ negative mode detection •No. of MCPs: 2 •BNC output connector	•Positive Ion detection •SMA output connector •No. of MCPs: 2 •Rise time: 330 ps •Fall time: 630 ps	•Thickness : 8.6 mm •No. of MCPs: 2	•Effective area : ϕ10 mm to ϕ75 mm •Outer size : ϕ54 mm to ϕ123 mm •No. of MCPs : 1 to 3	•Effective area : 55 mm×8 mm to 81 mm×31 mm •Outer size : 78 mm×29.5 mm to 128 mm×54 mm •No. of MCPs : 1 to 3	•Effective area : ϕ14.5 mm •Outer size : 18 mm •PHR : 50 % •No. of MCPs: 2
Type F4655-10	F4655-13	F9890-11 F9890-12 F9892-11 F9892-12	F9890-13 F9890-14 F9892-13 F9892-14	F4294-09	F2223-21SH	F2221 F2222 F2223 F2224 F2225 F2226	F2813 F2814 F3490	F4655



Position Detection

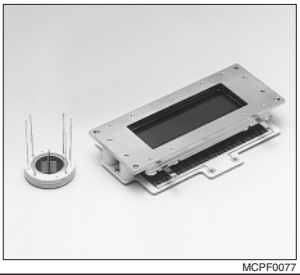
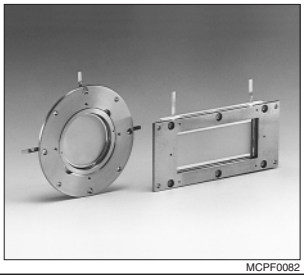
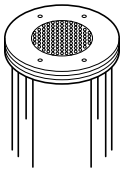


Image Readout



Non-demountable Type

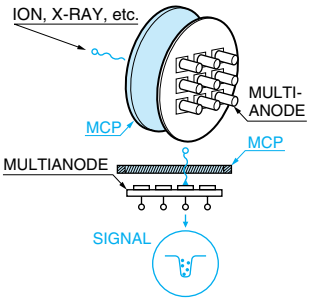


This type is compact, light in weight and economical. Unlike the demountable type, however, the assembled MCP cannot be replaced.

- **Non-demountable**
  - Effective area : ϕ14.5 mm to ϕ42 mm
  - Outer size : ϕ27 mm to ϕ62 mm
  - No. of MCPs : 1 to 3

F1551
F1094
F1552
F1208
F1217

Multianode Type



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

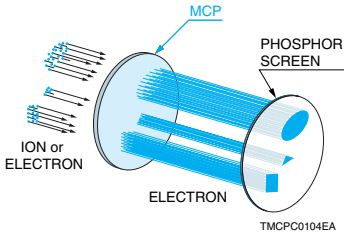
- **Circular**
  - Effective area : ϕ10 mm to ϕ75 mm
  - Outer size : ϕ54 mm to ϕ123 mm
  - No. of MCPs : 1 to 3
- **Rectangular**
  - Effective area : 55 mm×8 mm to 81 mm×31 mm
  - Outer size : 78 mm×29.5 mm to 128 mm×54 mm
  - No. of MCPs : 1 to 3
- **Non-demountable**
  - Effective area : ϕ14.5 mm to ϕ40 mm
  - Outer size : ϕ27 mm to ϕ62 mm
  - No. of MCPs : 1 to 3

F2221
F2222
F2223
F2224
F2225
F2226

F2813
F2814
F3490

F1551
F1094
F1552
F1208
F1217

Phosphor Screen Output Type



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 8 for detailed specifications.)

- **Circular**
  - Effective area : ϕ10 mm to ϕ75 mm
  - Outer size : ϕ54 mm to ϕ123 mm
  - No. of MCPs : 1 to 2
- **Rectangular**
  - Effective area : 55 mm×8 mm to 81 mm×31 mm
  - Outer size : 78 mm×29.5 mm to 128 mm×54 mm
  - No. of MCPs : 1 to 2
- **Vacuum Flange**
  - Effective area : ϕ28 mm
  - Flange size : ICF152
  - Direct fiber coupling to CCD
  - No. of MCPs: 2
  - SHV connector

F2221
F2222
F2223
F2224
F2225
F2226

F2813
F2814
F3490

F6959

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														○	○										
	F4655-10	○	○	◎	○	○	◎	○							○	○										
	F4655-13	◎	◎	○	○			○							○	○										
	F9890-11/-12, F9892-11/-12	○	◎	◎	○	◎	◎	○							○	○										
	F9890-13/-14, F9892-13/-14	◎	○	◎	○	○	○	○							○	○										
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)																		◎	◎	○	○	○	○	○	○
	F6959																		◎	◎	○	○	○	○	○	○

MCP ASSEMBLY SPECIFICATIONS

Assembly Type / Type No.	Circular (Demountable)	Rectangular (Demountable)	Circular (② Non-demountable)	Center Hole	Fast Response with Center Hole ①	Thin with Center Hole ①	Compact	Compact, Fast Response ①	Compact, Fast Response, 4 µm MCP ①	Fast Response for ± Mode Detection, Floating ①		Fast Response for ± Mode Detection, Anode Ground ①		Phosphor Screen Output with Vacuum Flange ①	Unit
				F2223-21SH	F4294-09	F6589	F4655	F4655-10	F4655-13	F9890-11 F9892-11	F9890-12 F9892-12	F9890-13 F9892-13	F9890-14 F9892-14	F6959	
Outer Size	φ54 to φ123	78×29.5 to 128×54	φ27 to φ62	φ56.5	φ69	φ28	φ18	φ38		F9890 series: φ81 F9892 series: φ92				φ152	mm
Effective Area	φ10 to φ75	55×8 to 81×31	φ14.5 to φ42	φ27		φ11	φ14.5			F9890 series: φ27 F9892 series: φ42				φ28	mm
Height	15 to 17	10.9 to 12.9	4.5 to 5.7	8.6	17	2.5	8.5	31.9		54.1	53.7	33.3	32.9	36.1	mm
Number of MCPs	1 to 3 With Phosphor Screen: 1 to 2			2											—
MCP Center Dead Area	—			φ8	φ12	φ4	—								mm
Gain ③	1 stage MCP: 10^4 Min. 2 stage MCP: 10^6 Min. 3 stage MCP: 10^7 to 10^8			10^6 Min.			5×10^7 Min.		10^6 Min.						—
Pulse Height Resolution ③ (FWHM) (Max.)	2 stage MCP: 120 3 stage MCP: 80			—			50		120	150				120	%
Dark Count (Max.) ③	3 (2 or 3 stage MCP)			3					5	3					$s^{-1} \cdot cm^{-2}$
MCP Supply Voltage ④	1 stage MCP: 1.0 2 stage MCP: 2.0 3 stage MCP: 3.0			2.0			2.5		2.0						kV
MCP-OUT to Anode Supply Voltage ④	Single anode : 0.5 Multianode : 0.5 Phosphor screen: 3.0 to 4.0			0.5		0.4	0.5							3.0	kV

NOTE: ①Vacuum baking cannot be performed on these MCP assemblies.
②Phosphor screen type is not available.
③Supply voltage: 1.0 kV/MCP, vacuum: 1.3×10^{-4} Pa, operating ambient temperature: +25 °C
④Vacuum: 1.3×10^{-4} Pa

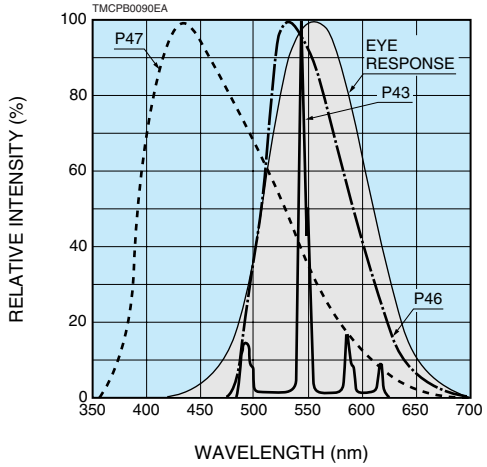
PHOSPHOR SCREEN

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

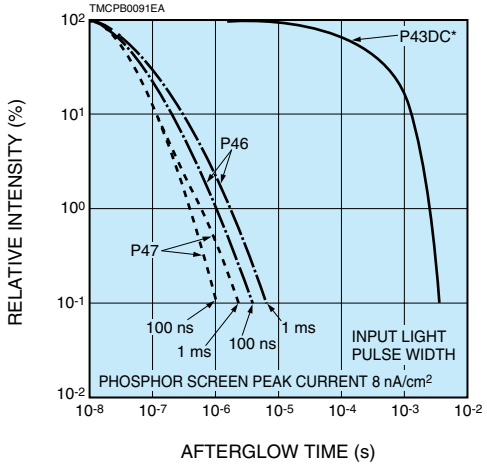
Phosphor Screen Type	Peak Emission Wavelength (nm)	Emission Color	Relative Energy Efficiency ⑤	10 % Afterglow Time	Remarks
P43	545	Yellowish Green	1	1 ms	Standard Type
P46	530	Yellowish Green	0.3	0.2 µs to 0.4 µs ⑥	Short Afterglow
P47	430	Purplish Blue	0.3	0.11 µs	Very Short Afterglow

NOTE: ⑤Supply voltage: 6 kV. Value relative to P43 which is specified as 1.
⑥Varies depending on the input pulse width.

■Spectral Emission Characteristics



■Afterglow Characteristics

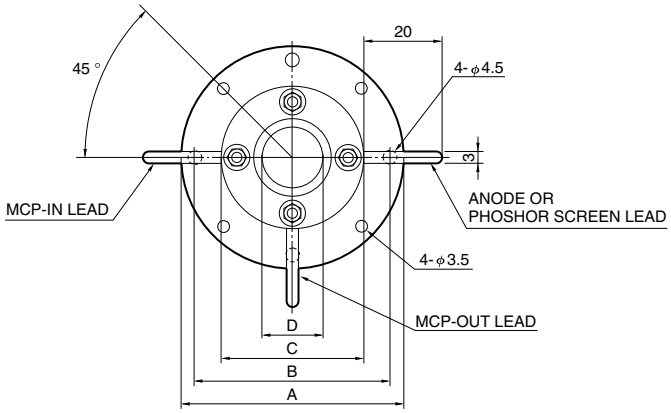


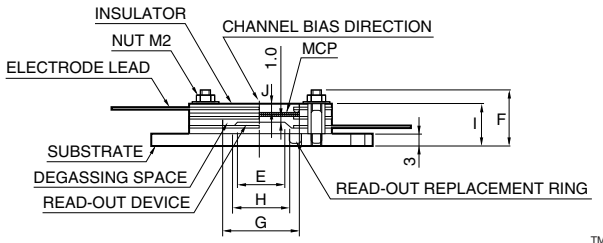
* Afterglow characteristics after removal of continuous light input

MCP ASSEMBLY DIMENSIONAL OUTLINES

Total Amount Measurement | Position Detection | Image

Circular MCP Assembly (Demountable)





TMCPA0026EF

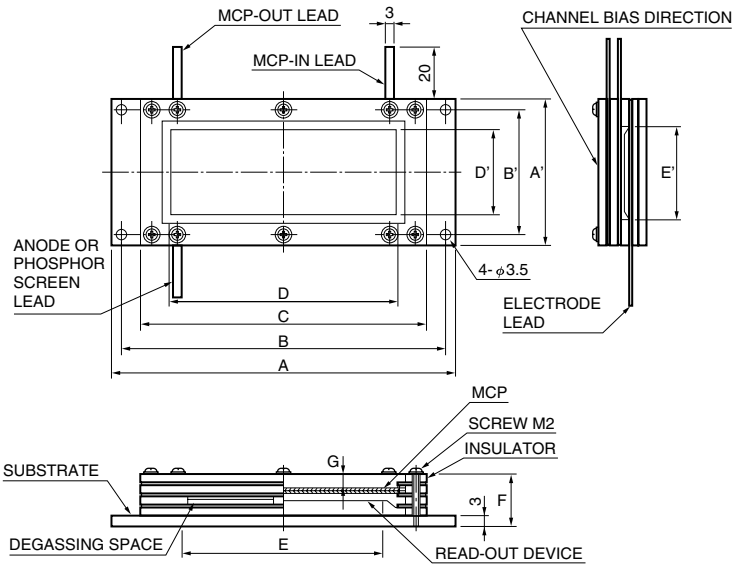
Anode Type	No. of MCPs
Single anode	1 to 3
Multianode	1 to 3
Phosphor screen	1 to 2

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 of MCP			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
			2	11.9					14.4	
			3	11.9					15.9	
J	Distance from MCP input surface to insulator surface	No. of MCPs	1	2.8					3.8	mm
			2	3.3					4.3	
			3	2.9					4.8	

* This dimension shows for a Phosphor read out type. Other read out type may have a different dimension from it.
(For further details, please consult with us.)

Total Amount Measurement | Position Detection | Image

Rectangular MCP Assembly (Demountable)



TMCPA0029EF

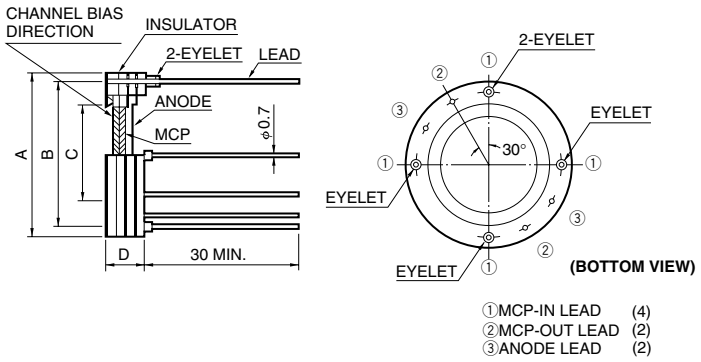
Anode Type	No. of MCPs
Single anode	1 to 3
Multianode	1 to 3
Phosphor screen	1 to 2

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 of MCP			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	

* This dimension shows for a Phosphor read out type. Other read out type may have a different dimension from it.
(For further details, please consult with us.)

Total Amount Measurement | Position Detection

Circular MCP Assembly (Non-demountable)



Anode Type	No. of MCPs
Single anode	1 to 3
Multianode	1 to 3

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

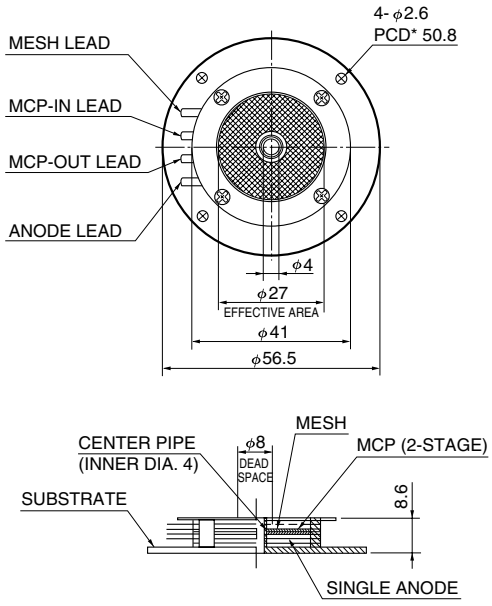
* The dimensions of multianode types may differ.
No anode type is also available.

TMCPA0027ED

Center Hole | Total Amount Measurement | TOF

* PCD (Pitch Circle Diameter)

MCP Assembly with Center Hole F2223-21SH

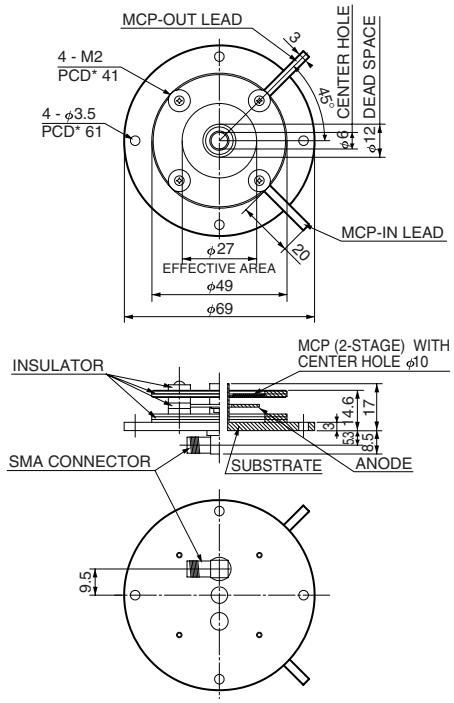


TMCPA0002EF

Center Hole | Total Amount Measurement | TOF

* PCD (Pitch Circle Diameter)

Fast Response MCP Assembly with Center Hole F4294-09

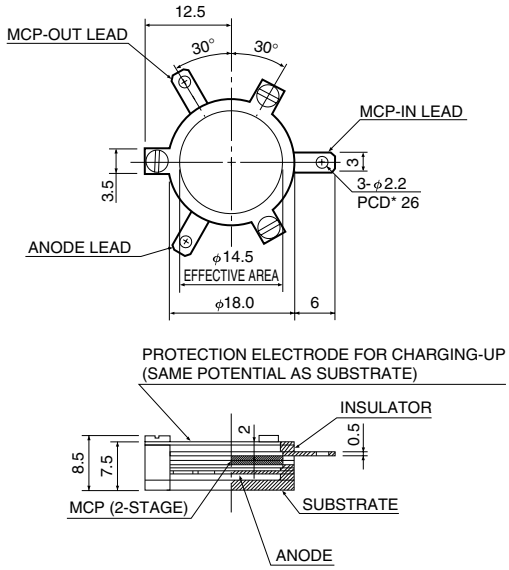


TMCPA0042ED

Compact | Total Amount Measurement | TOF

* PCD (Pitch Circle Diameter)

Compact MCP Assembly F4655

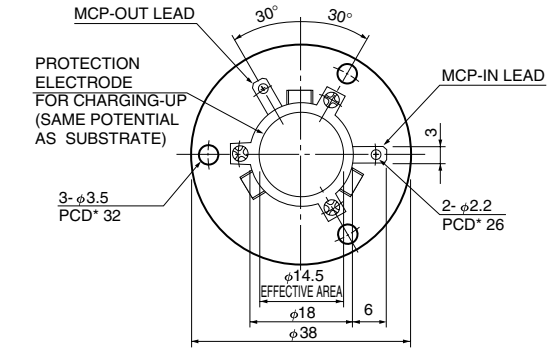


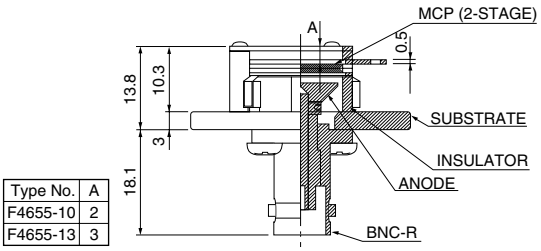
TMCPA0001EH

Compact | Fast Response | TOF | Anode Ground

Compact, Fast Response MCP Assembly F4655-10
Compact, Fast Response 4 μm MCP Assembly F4655-13

* PCD (Pitch Circle Diameter)





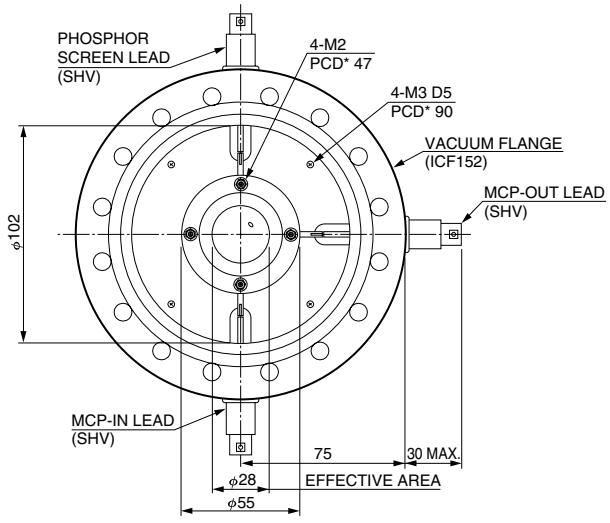
Type No.	A
F4655-10	2
F4655-13	3

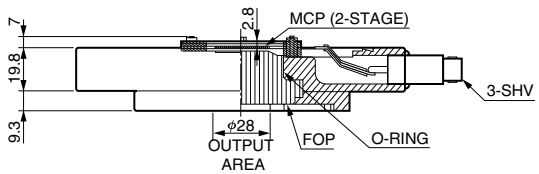
TMCPA0021EF

Fiber Coupling | Image

* PCD (Pitch Circle Diameter)

Phosphor Screen Output MCP Assembly with Vacuum Flange F6959



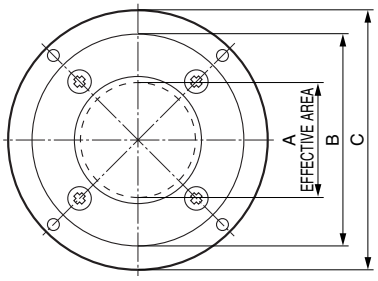


TMCPA0038EC

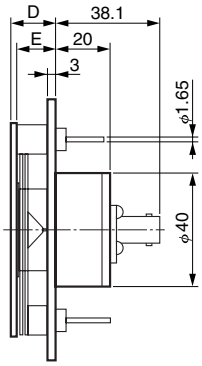
+/- Ions | Fast Response | TOF for LC-MS | Floating

* PCD (Pitch Circle Diameter)

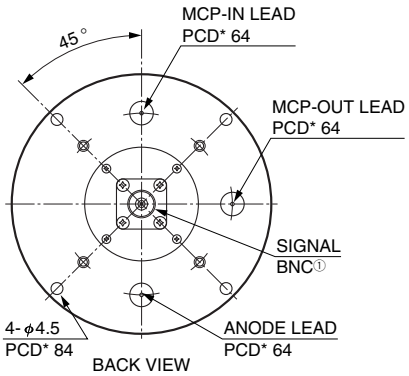
Fast Response for +/-Mode Detection MCP Assembly F9890-11/-12, F9892-11/-12



FRONT VIEW



SIDE VIEW

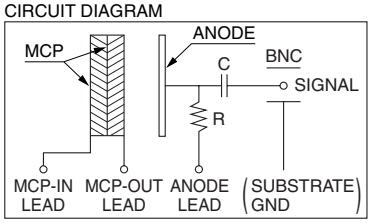


BACK VIEW

①SMA Connector type is also available.

	F9890-11	F9890-12	F9892-11	F9892-12
A	ϕ27		ϕ42	
B	ϕ63		ϕ75	
C	ϕ81		ϕ92	
D	16	15.6	16	15.6
E	14	13.6	14	13.6

CIRCUIT DIAGRAM

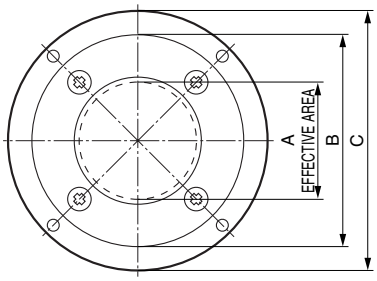


TMCPA0054EB

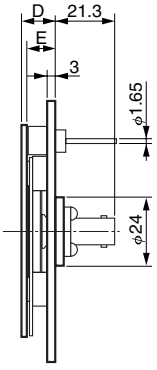
+/- Ions | Fast Response | TOF for LC-MS | Anode Ground

* PCD (Pitch Circle Diameter)

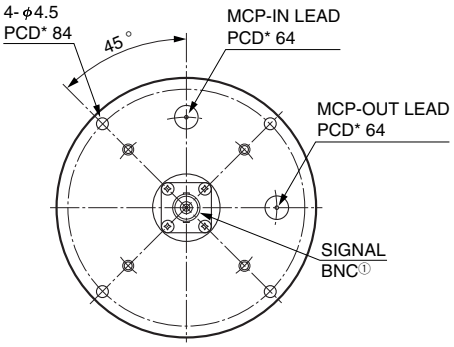
Fast Response for +/-Mode Detection MCP Assembly F9890-13/-14, F9892-13/-14



FRONT VIEW



SIDE VIEW

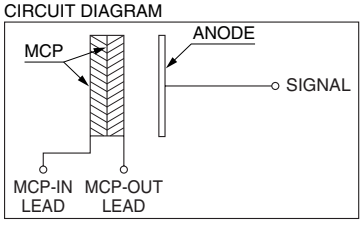


BACK VIEW

①SMA Connector type is also available.

	F9890-13	F9890-14	F9892-13	F9892-14
A	ϕ27		ϕ42	
B	ϕ63		ϕ75	
C	ϕ81		ϕ92	
D	12	11.6	12	11.6
E	10	9.6	10	9.6

CIRCUIT DIAGRAM



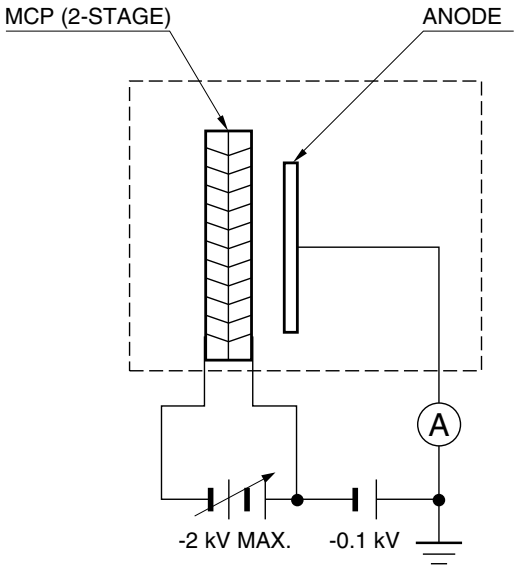
TMCPA0075EA

MCP ASSEMBLY WIRING EXAMPLES

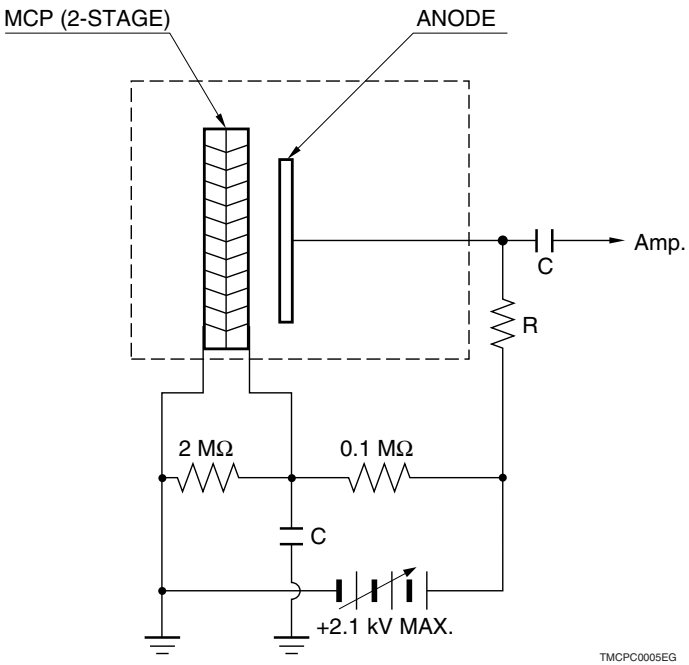
Any of the MCP-IN, MCP-OUT, anode and phosphor screen can be at ground potential.

Signal Detection

●Positive ion detection
(Used with high-voltage power supply only)



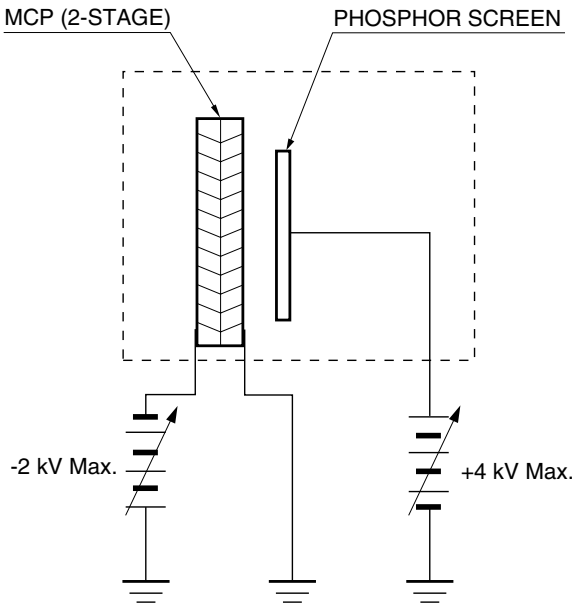
●Electron or negative ion detection
(Used with high-voltage power supply and divider circuit)



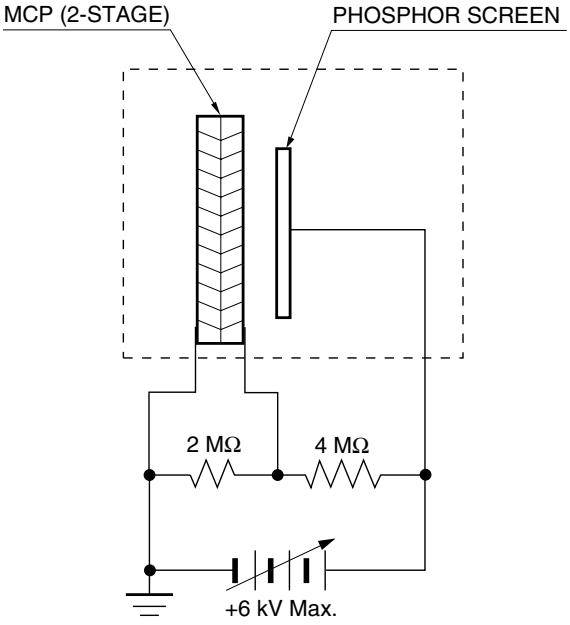
TMCPC0005EG

Image Detection

●Positive ion detection
(Used with high-voltage power supply only)

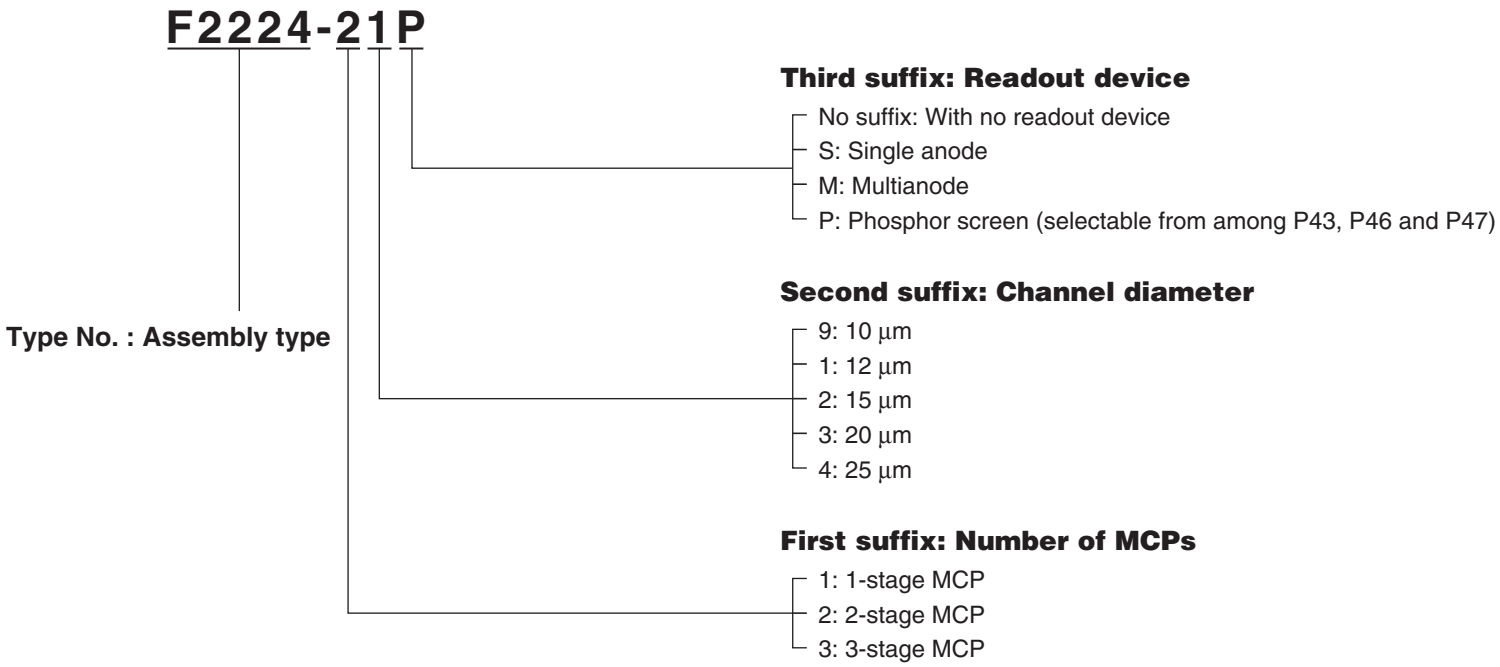


●Electron or negative ion detection
(Used with high-voltage power supply and divider circuit)



TMCPC0007ED

TYPE NUMBER DESIGNATION FOR PLACING ORDER *



* This ordering information applies ONLY to circular/rectangular MCP assemblies (demountable type) listed in the page 9 and circular/rectangular MCP assemblies (non-demountable type) listed in the page 10. Use their type numbers as listed when ordering other MCP assemblies and bare MCPs (non-assembled MCPs).

When the MCP assembly doesn't have the 3rd digit on the suffix, it means no signal collection anode as a factory set-up. In case of using a phosphor as an anode for the image or position detection, the special parts and treatment must be supplied. Please contact our office shown on the back cover at first.

CUSTOM DEVICES

- 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.

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.

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 1.3×10^{-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 1.3×10^{-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 1.3×10^{-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.

HAMAMATSU WEB SITE www.hamamatsu.com
HAMAMATSU PHOTONICS K.K., Electron Tube Division
314-5, Shimokanzo, Iwata City, Shizuoka Pref., 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P. O. Box 6910, Bridgewater. N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: usa@hamamatsu.com
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658 E-mail: info@hamamatsu.de
France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10 E-mail: infos@hamamatsu.fr
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road Welwyn Garden City Hertfordshire AL7 1BW, United Kingdom, Telephone: 44-(0)1707-294888, Fax: 44(0)1707-325777 E-mail: info@hamamatsu.co.uk
North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171-41 SOLNA, Sweden, Telephone: (46)8-509-031-00, Fax: (46)8-509-031-01 E-mail: info@hamamatsu.se
Italy: Hamamatsu Photonics Italia: S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39)02-935 81 733, Fax: (39)02-935 81 741 E-mail: info@hamamatsu.it

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