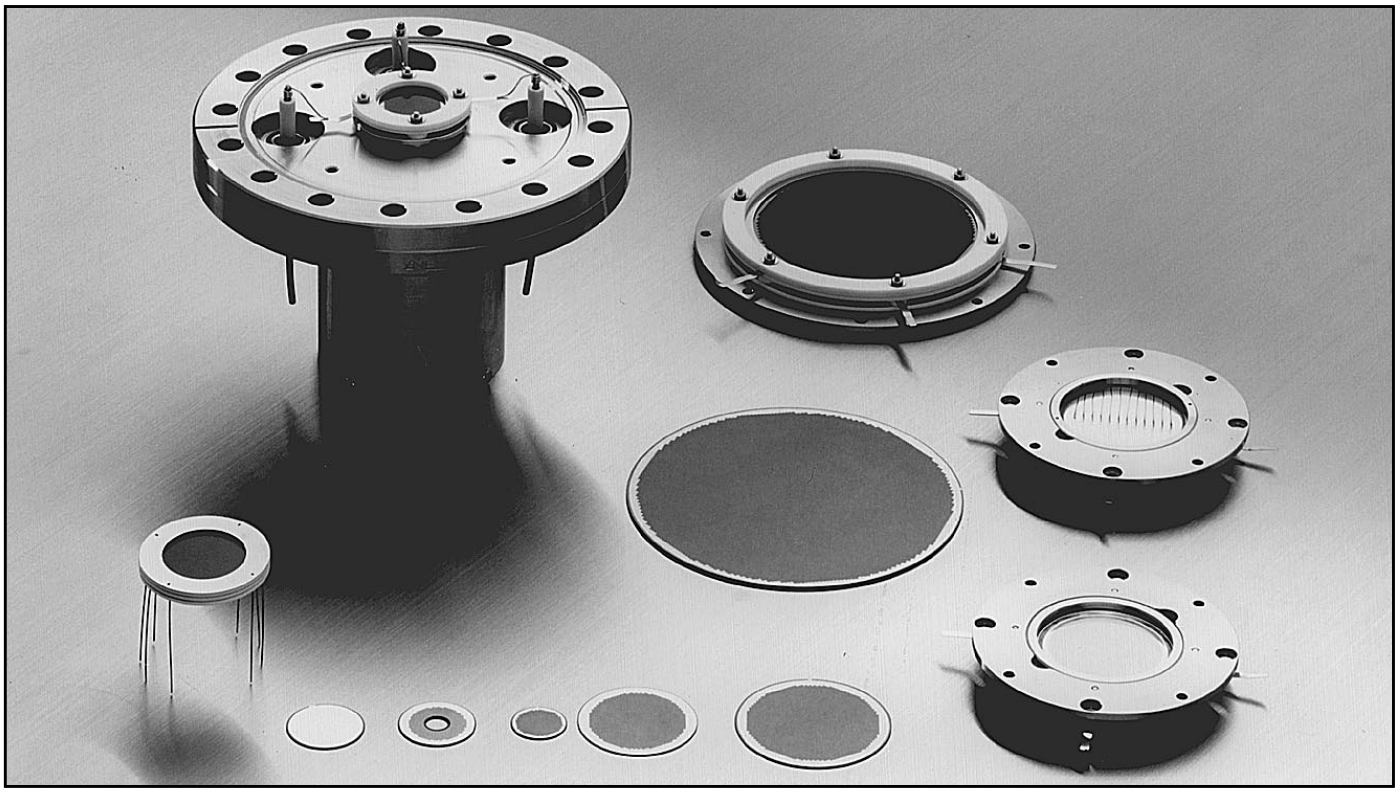
HAMAMATSU

CIRCULAR MCP AND ASSEMBLY SERIES



A microchannel plate (MCP) is a secondary-electron multiplier which detects and amplifies electrons in two-dimensions. The MCP is sensitive not only to electrons but to ions, vacuum ultraviolet light, X-rays and γ-rays, making it useful in a wide range of detection applications.

Hamamatsu has available seven types of circular MCPs, ranging in outer diameter from 18mm to 114mm. MCP assemblies with electrode leads are also available to facilitate use of the MCPs. These MCP assemblies offer three types of read-out devices; a phosphor screen (optical image conversion), a multi-anode (electrical output signals responding to the position of the incident signals), and a single-anode (an electrical output signal within the effective area), providing a variety of readout functions to handle a range of applications. From one to three MCPs can be selected as required to provide the necessary electron gain.

These MCPs and MCP assemblies are finding wide application in fields including image intensifiers, fast time response photomultiplier tubes, and analytical instruments.

FEATURES

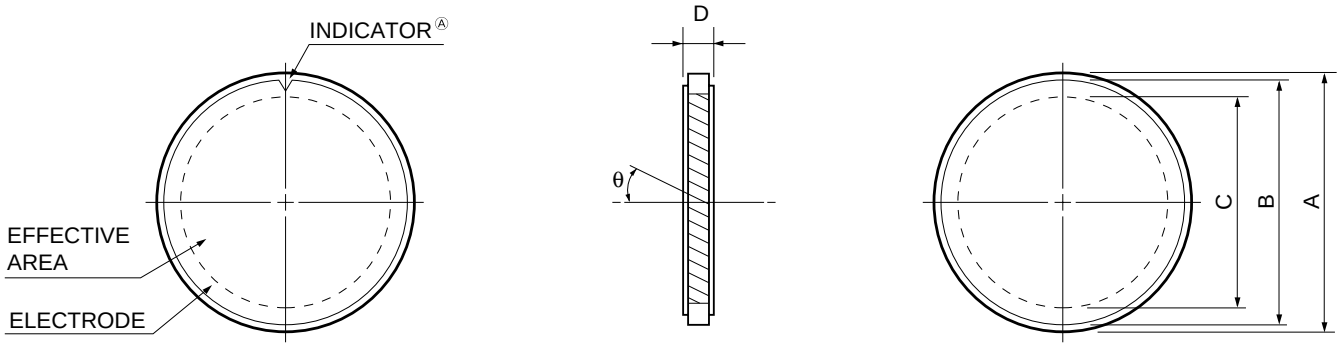
- **Sensitive to electrons, ions, VUV lights, X-rays and γ-rays**
- **Two-dimensional image intensification**
- **Fast time response**
- **Immunity to magnetic fields**
- **Small size and lightweight**

APPLICATIONS

- **Analytical Instruments**
  - **Electron Beam Measuring System (EBMS)**
  - **FIM, AP-FIM**
  - **ESCA**
  - **Mass Spectrometer (MS)**
  - **TOF-MS**
  - **LEED, MEED, etc.**
- **Electron Tube**
  - **Image Intensifier**
  - **Fast Time Response PMT**
  - **Streak Camera**
- **Cosmic Measurement**
  - **Detection of Plasma Ions, Soft X-rays and VUV lights**
- **High Energy Physics**
  - **Detection of Ions, Electrons, Positrons, High Energy Particles and X-rays**

CIRCULAR MCP SERIES

MCP DIMENSIONAL OUTLINES (Unit: mm)



INPUT SIDE **OUTPUT SIDE**

TMCPA0025EB

Parameter \ Type No.		F1551	F1094			F1552		F1208	F1217	F1942	F2395	Unit
		-01	-07	-09	-01	-09	-01	-01		-04		
Outer Diameter	A	17.9	24.8			32.8		38.5	49.9	86.7	114	mm
Electrode Diameter	B	17	23.9			31.8		36.5	49	84.7	112	mm
Effective Diameter	C	14.5	20			27		32	42	77	105	mm
Thickness	D	0.48	0.24	0.41	0.48	0.41	0.48	0.48		1.00		mm
Channel Diameter		12	6	10	12	10	12	12		25		μm
Channel Pitch		15	7.5	12	15	12	15	15		31		μm
Bias Angle	θ	8	13	5,15	5,8,15	8,12		8		8		degrees
Open Area Ratio		60										%
Electrode Material		Inconel										—

ELECTRICAL CHARACTERISTICS

(Supply Voltage: 1000V, Vacuum: 1.3×10^{-4} Pa (1×10^{-6} Torr), Ambient Temperature: +25°C)

Gain	More than 10^4							—
Plate Resistance	100 to 700	50 to 500	30 to 300	20 to 200	10 to 200	10 to 100	5 to 50	MΩ
Dark Current	Less than 5×10^{-13}							A/cm^3
Max. Linear Output Signal	Up to 7% of the strip current Ⓑ							—

MAXIMUM RATINGS

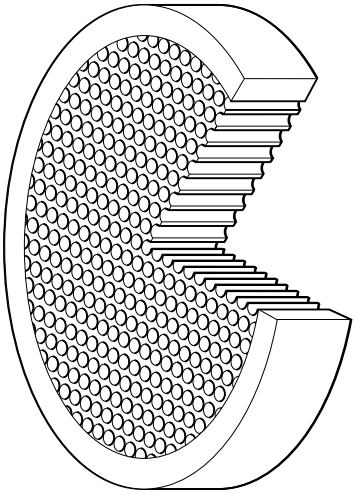
Supply Voltage Ⓒ	1000 (Channel Diameter: 6μm, 10μm, 12μm): 1200 (Channel Diameter: 25μm)		V
Ambient Temperature	-50 to +70	-50 to +30	°C
Baking Temperature	400		°C

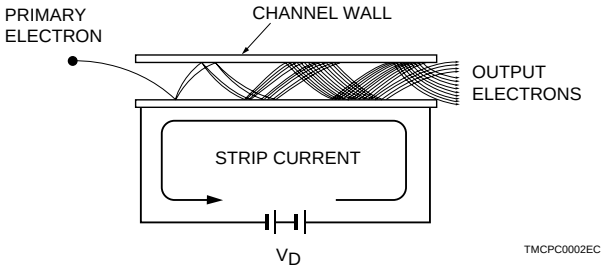
Ⓐ This indicator shows the MCP input side and the direction of channel bias.
Ⓑ The strip current is the current which flows along the channel wall when a voltage is applied between the MCP input and output and is given by applied voltage/plate resistance.
Ⓒ At a vacuum of 1.3×10^{-4} Pa (1×10^{-6} Torr) or less.
Consult us for more details on MCP dimensions and tolerances.

OPERATING PRINCIPLE

As shown in the figure, when a voltage V_D is applied across the input-side and output-side electrodes of the MCP, a potential gradient is built up along the channel direction. If an incident electron strikes an inner wall on the input side, a number of secondary electrons are emitted. These secondary electrons are accelerated by the potential gradient and travel along a parabolic path determined by the initial velocity. They then collide with the opposing wall surface, causing secondary electrons to be emitted again. In this manner, the electrons collide repeatedly within the channel as they pass towards the output side. The result is a large multiplication of the incident electron.

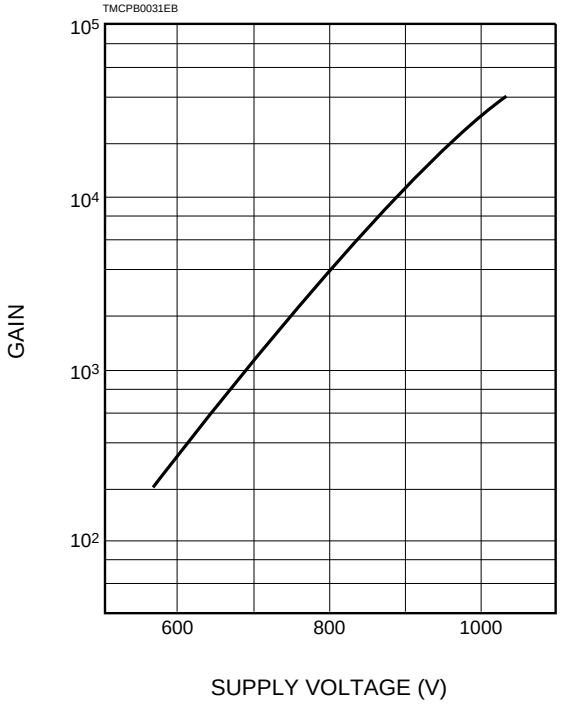
MCP CONFIGURATION



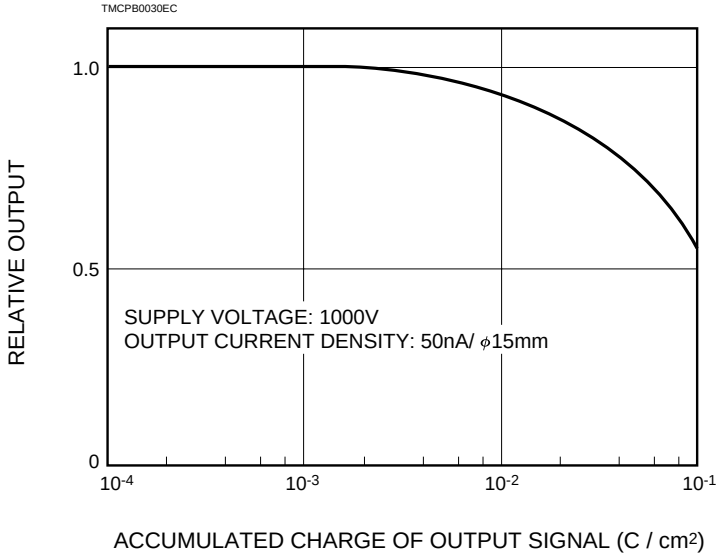


GAIN AND LIFE CHARACTERISTICS

• Gain vs. Supply Voltage



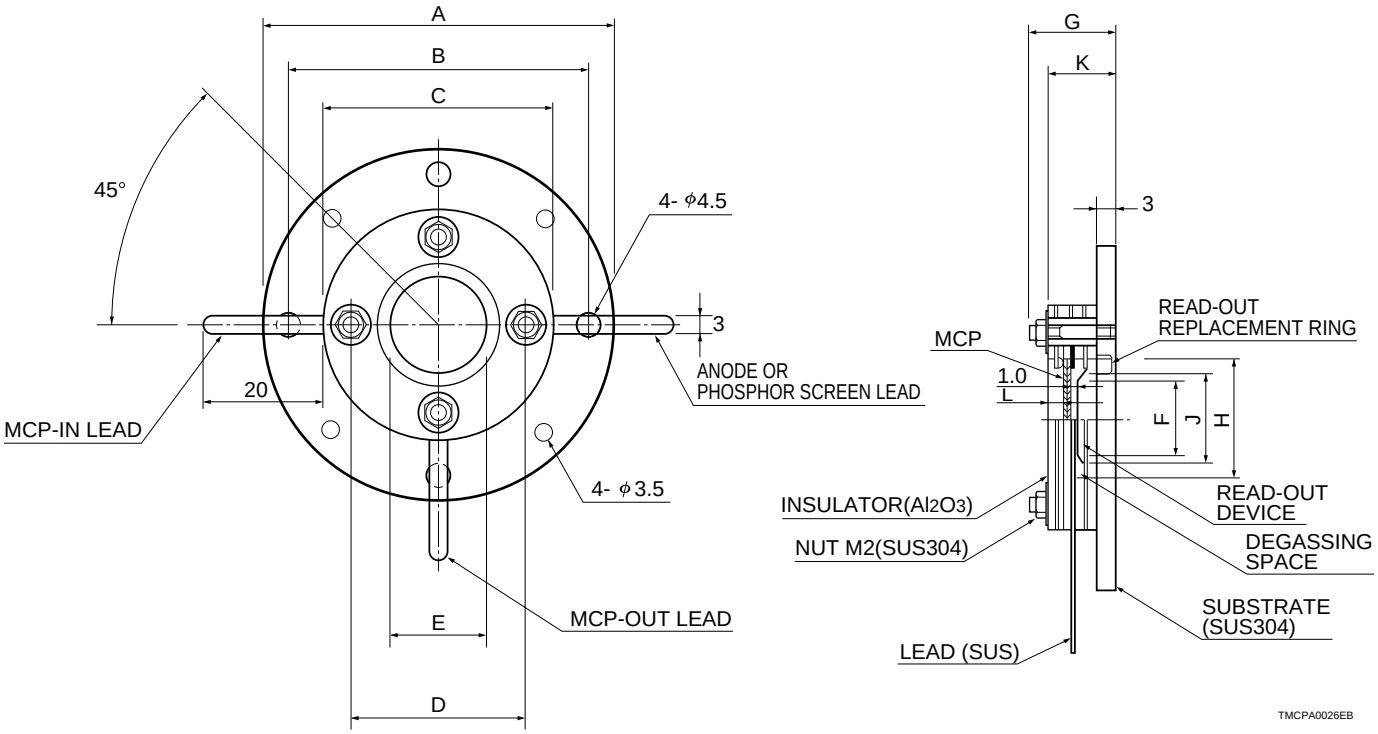
• Life



MCP ASSEMBLIES

Demountable Type Series (The MCP and the Read-Out Device Can be Easily Replaced)

ASSEMBLY DIMENSIONS (Unit: mm)



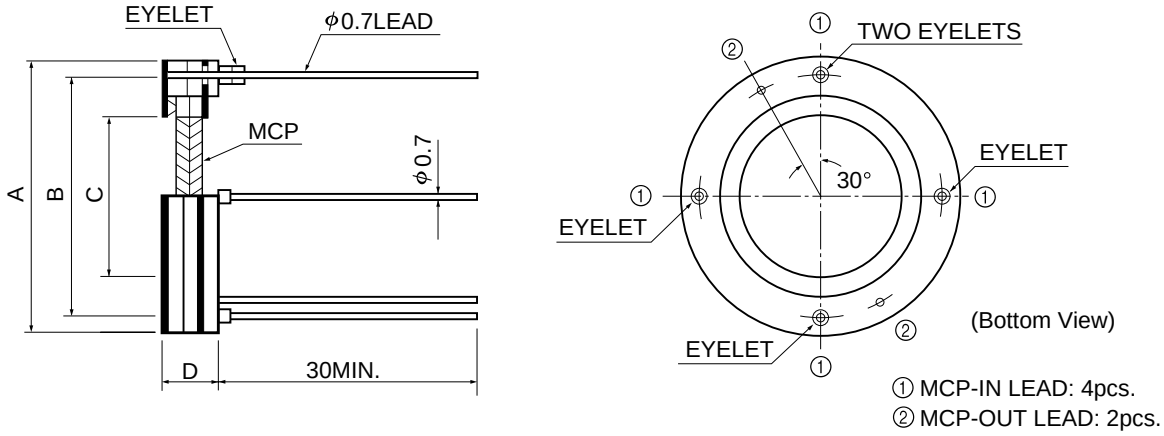
Note: SUS and SUS304 are stainless steels of Japanese Industrial Standards (JIS) code.

Code	Parameter	F2221	F2222	F2223	F2224	F2225	F2226	Unit
A	Assembly Outer Diameter	ϕ54	ϕ61	ϕ69	ϕ75	ϕ86	ϕ123	mm
B	Mounting Screw Hole Pitch	ϕ46	ϕ53	ϕ61	ϕ67	ϕ78	ϕ115	mm
C	Insulator Outer Diameter	ϕ34	ϕ41	ϕ49	ϕ55	ϕ66	ϕ103	mm
D	Assembly Screw Pitch	ϕ26	ϕ33	ϕ41	ϕ47	ϕ58	ϕ95	mm
E	MCP Effective Diameter	ϕ14.5	ϕ20	ϕ27	ϕ32	ϕ42	ϕ77	mm
F	Readout Device Effective Diameter	ϕ10	ϕ17	ϕ24	ϕ30	ϕ40	ϕ75	mm
G	Maximum Height	15	15	15	15	15	17	mm
H	Replacement Ring Screw Diameter for Readout Device	M19	M26	M33.8	M39.5	M51	M88	—
J	Replacement Ring Inside Diameter for Readout Device	ϕ13	ϕ20	ϕ27	ϕ33	ϕ44	ϕ78	mm
K	Distance from Bottom of Substrate to Insulator Surface	(Number of MCP stages)						—
		Single-stage: 10.9					12.9	mm
		Two-stage : 11.9					14.4	mm
		Three-stage : 11.9					15.9	mm
L	Distance from MCP Input Surface to Insulator Surface	(Number of MCP stages)			(Channel diameter)			—
					10μm	12μm	25μm	—
		Single-stage:			2.9	2.8	3.8	mm
		Two-stage :			3.5	3.3	4.3	mm
		Three-stage :			3.1	2.9	4.8	mm

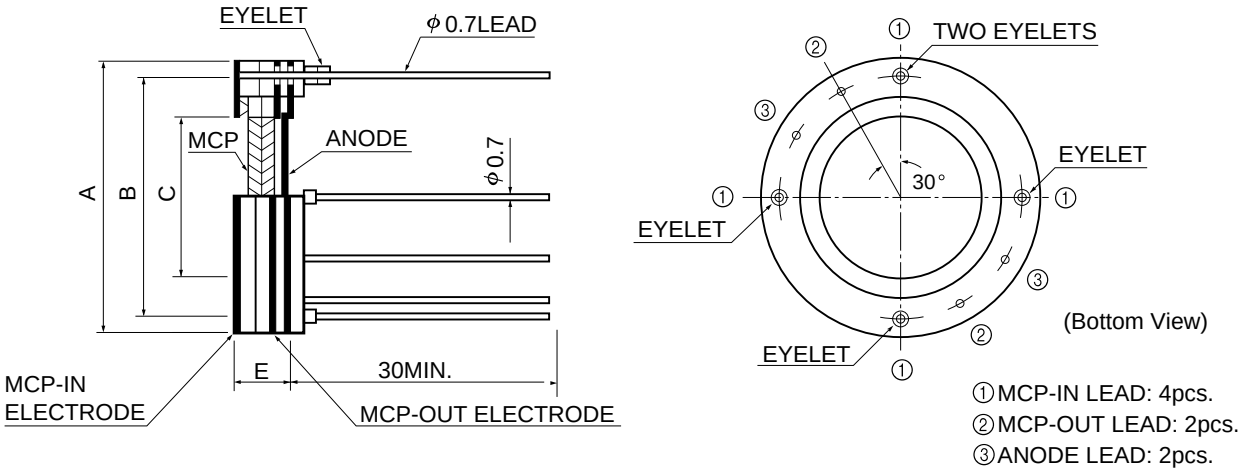
Non-Demountable Type Series (Compact and Lightweight)

ASSEMBLY DIMENSIONS (Unit: mm)

WITHOUT ANODE



WITH ANODE



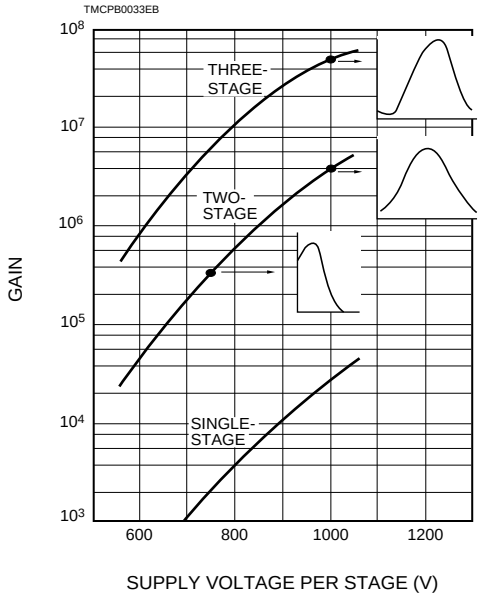
TMCPA0027EB

Parameter \ Type No.		F1551	F1094	F1552	F1208	F1217	Unit
Assembly Outer Diameter	A	φ 27	φ 34	φ 42	φ49	φ62	mm
Lead Pin Circle	B	φ22.5	φ29.5	φ37.5	φ44	φ56	mm
MCP Effective Diameter	C	φ14.5	φ 20	φ 27	φ32	φ40	mm
Assembly Height	D without anode	(Number of MCP stages) Single-stage: 3 Two-stage : 4.2 Three-stage : 4.2					mm
	E with anode	(Number of MCP stages) Single-stage: 4.5 Two-stage : 5.7 Three-stage : 5.7					mm

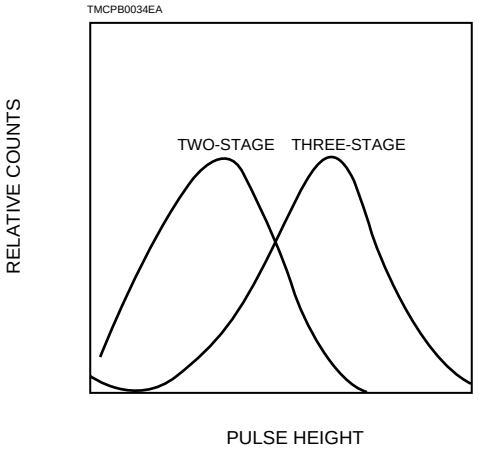
MCP ASSEMBLIES

Characteristics of MCP Assemblies

• Typical Gain and Pulse Height Distribution Characteristics Comparision for Different Stage MCP



• Typical Pulse Height Distributions for Two-and Three-Stage MCP



GENERAL

Parameter \ MCP	Single-Stage	Two-Stage	Three-Stage
Channel Diameter (μm)	10 to 25 (Refer to the table on page 2.)		
Read-Out Device	Without read-out device, with single anode, multianode or phosphor screen (P-11, P-20, P-47) Ⓐ		

Ⓐ The phosphor screen read-out type is not available for non-demountable type or three-stage series.

ELECTRICAL CHARACTERISTICS

(Supply Voltage: 1000V per stage, Vacuum: In the order of 1.3×10^{-5} Pa (1×10^{-7} Torr), Ambient Temperature: +25°C)

Gain	10^4	10^6	10^7 to 10^8
Dark Noise	Less than 5×10^{-13} A/cm^2	Less than 3 s^{-1}/cm^2 (cps/cm^2) Ⓑ	Less than 3 s^{-1}/cm^2 (cps/cm^2) Ⓑ
Pulse Height Resolution (%)	—	Less than 120	Less than 80
Max. Linear Output Signal	Up to 7% of the strip current		

Ⓑ Dark noise lower than the valley of pulse height distribution for the signal is not taken into account.

MAXIMUM RATINGS Ⓒ

MCP Supply Voltage (V)	1000	2000	3000
MCP-OUT — Anode Voltage (V)	1000		
MCP-OUT — Phosphor Screen Voltage (V)	4000		
Substrate — Other Terminals Voltage (V)	7000		
Baking Temperature (°C)	350		

Ⓒ At a vacuum of 1.3×10^{-5} Pa (1×10^{-7} Torr) and an ambient temperature of +25°C.
The phosphor screen read-out type assemblies should be operated in a vacuum below 2.6×10^{-5} Pa (2×10^{-7} Torr).

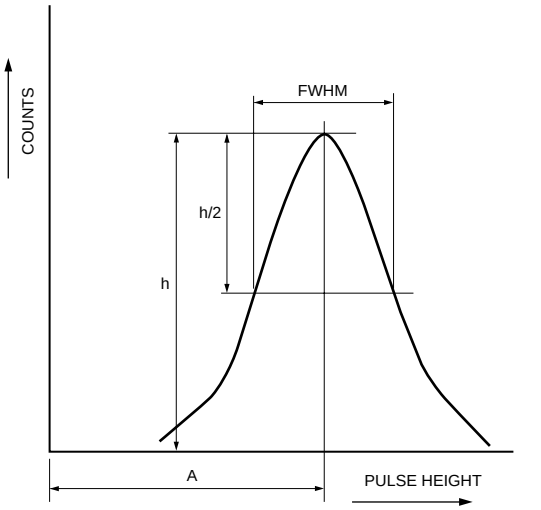
PHOSPHOR SCREEN EMISSION CHARACTERISTICS

Parameter \ Phosphor type	P-11	P-20	P-47
Wavelength at Peak Emission (nm)	450	530 to 560	410
Decay Time <10%> (μs)	460	50 to 2000	0.08

• Pulse Height Resolution

The pulse height resolution is defined as follows.

$$\text{Pulse Height Resolution} = \frac{\text{FWHM (Full Width at Half Maximum)}}{\text{Pulse Height Peak: A}} \times 100\ (\%)$$



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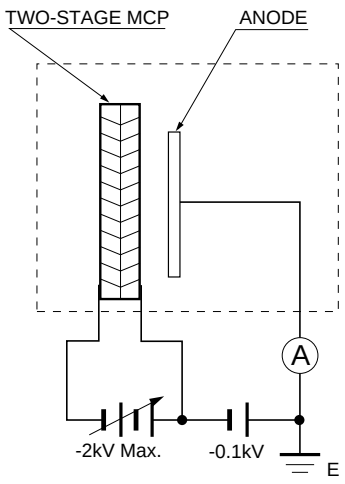
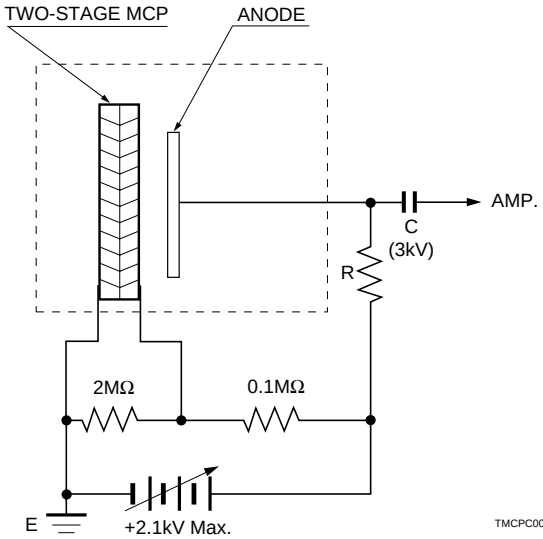
WIRING EXAMPLES

(For assembly types, either MCP-IN, MCP-OUT, anode or phosphor screen can be ground potential)





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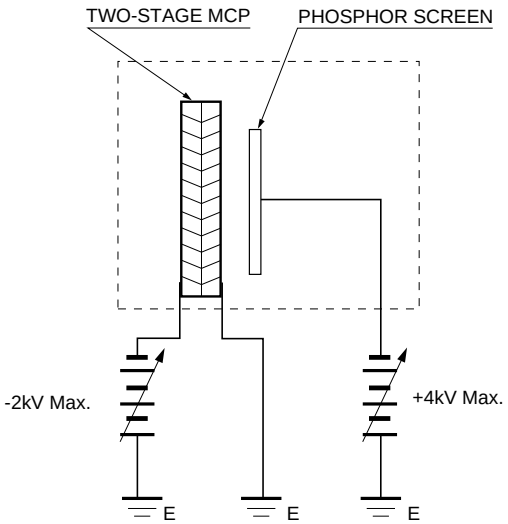
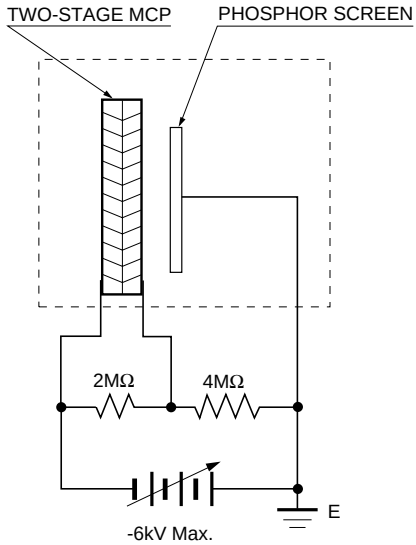
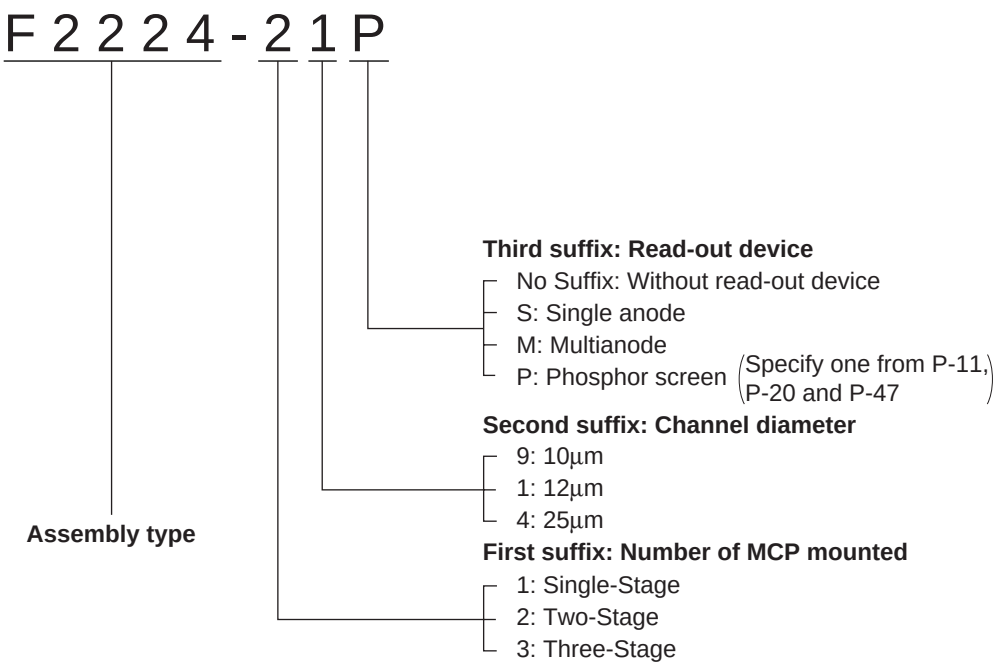




TMCPC0007EC

ORDERING INFORMATION (Type No. Designation)



Note: In ordering the MCP only, specify only the type No. of MCP

SPECIAL MCPs AND ASSEMBLIES

- Hamamatsu accepts order for special MCPs not included in the standard line. Please specify the shape, effective dimensions, thickness and the other parameters.
- Feel free to consult us on MCPs with an aperture (for use with reflecting electron microscopes), Csl coating (to increase quantum efficiency in the VUV to X-ray range), aluminum coating (to prevent ion feedback), MgO coating (to obtain high gain) and other special type MCPs.
- For multianode types, specify the desired anode pattern.
- Assemblies with a phosphor-coated fiber plate are available to enable fiber coupling to solid state imaging devices (CCD and MOS Linear Image Sensor) and position sensitive detectors (PSD).
- Assemblies with the MCP, read-out device and terminals mounted on vacuum flanges are also available.

PRECAUTIONS FOR USE

- Avoid touching the MCP or its assembly parts with bare hands.
- Handle the MCP only in a clean room since dust and humidity may adversely affect MCP characteristics.
- The MCP should be kept in vacuum or nitrogen atmosphere if a long period of storage is contemplated.
- When outgassing from the MCP occurs, baking the MCP at 350°C maximum in an evacuating system is recommended. In addition electron bombarding may be effective.
- The MCP should be operated in vacuum below 1.3×10^{-4} Pa (1×10^{-6} Torr).

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