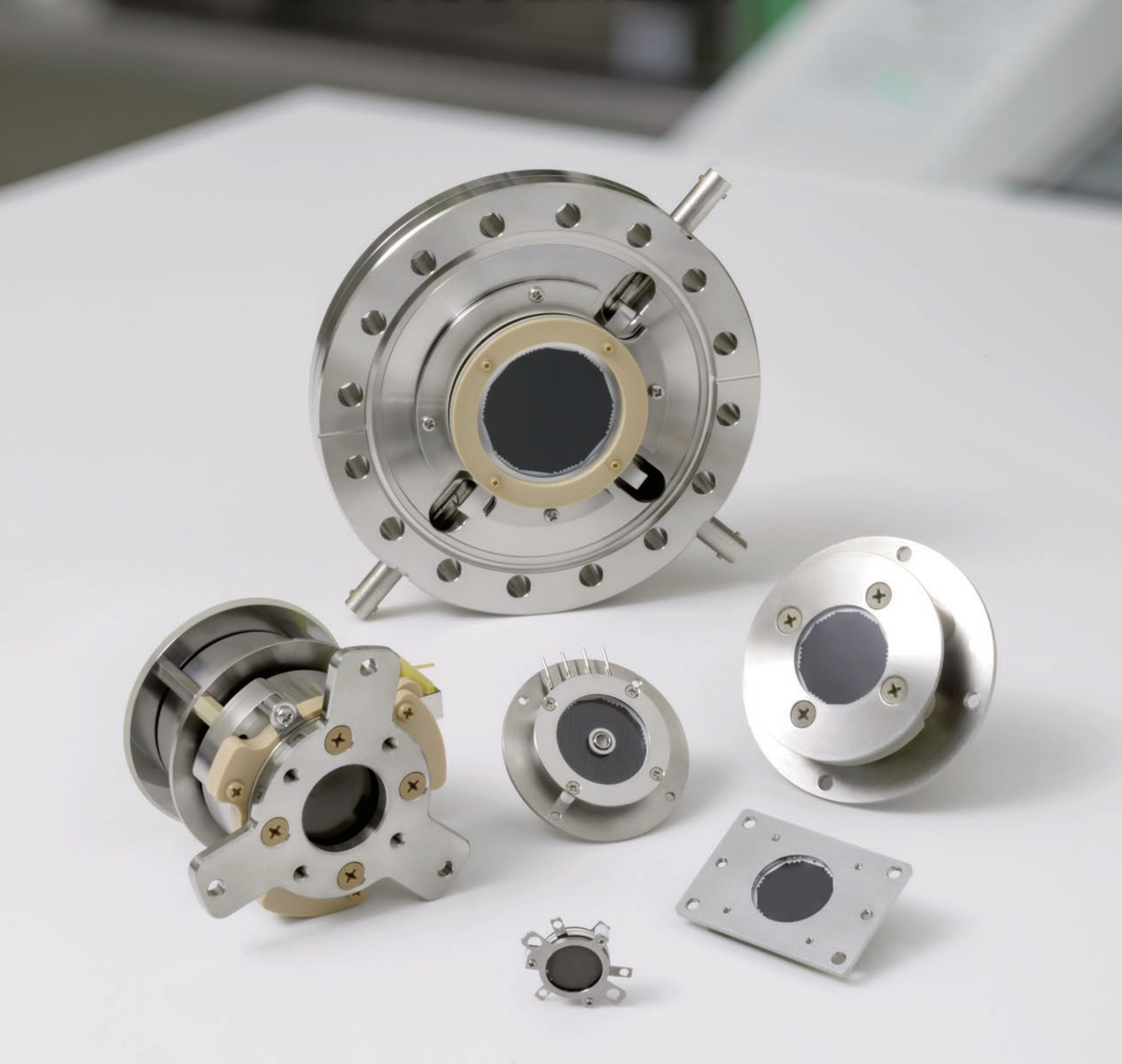
HAMAMATSU

PHOTON IS OUR BUSINESS

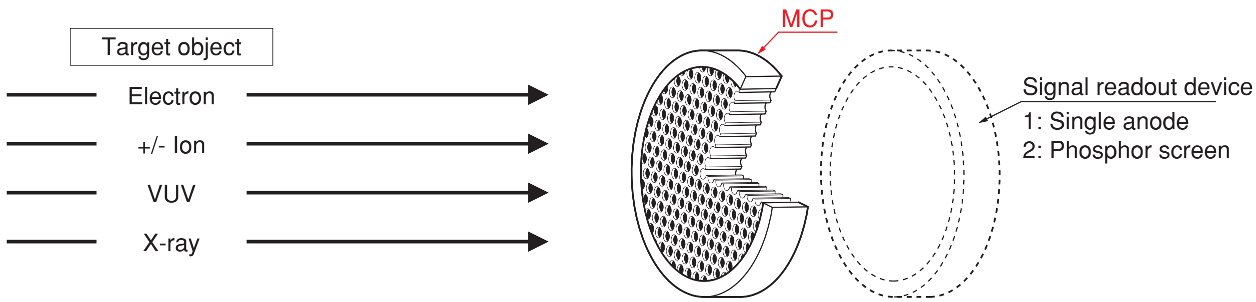
MCP (MICROCHANNEL PLATE) ASSEMBLY



HAMAMATSU PHOTONICS K.K.

OVERVIEW

Microchannel plate (MCP) is a two-dimensional sensor that detects electrons, ions, VUV rays, X-rays and gamma rays in a vacuum, and amplifies the detected signals. 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 two different readout devices to meet application needs. The devices are of: (1) single anode (electrical signal output), and (2) phosphor screen (visible light output). Select the ideal output device for 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 hits 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 hit 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 α ($\alpha=L/d$), and this α and the secondary emission factor inherent to the channel wall material determine the gain of the MCP. Standard MCPs are fabricated so that α is 40 to 60. The MCP thickness is therefore determined by the required channel diameter and the design value of this α.

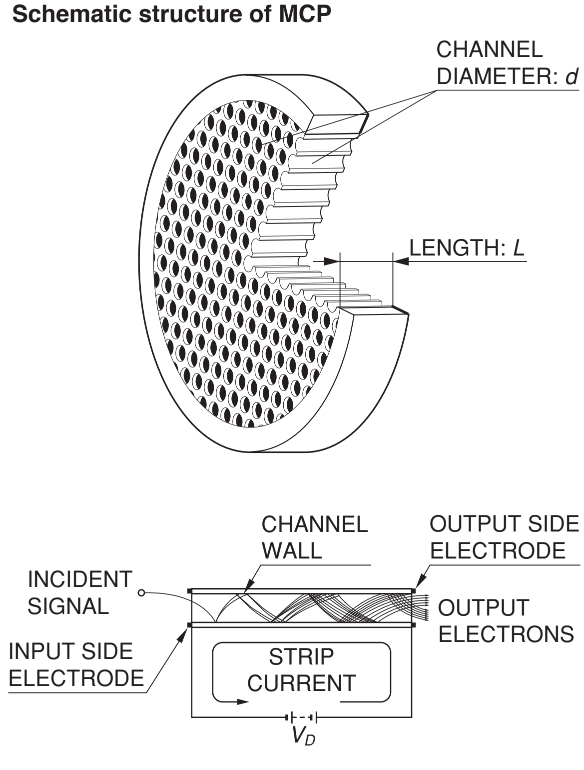
Open Area Ratio: OAR

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

Bias angle

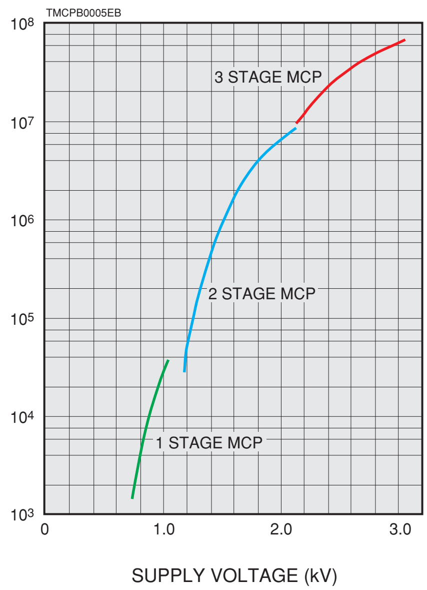
The bias angle is formed by the channel axis and the axis perpendicular to the plate surface. This bias angle is chosen by considering the detection efficiency and spatial resolution as well as the prevention of input signals from passing through the channels without colliding with the channel walls.

Schematic structure of MCP

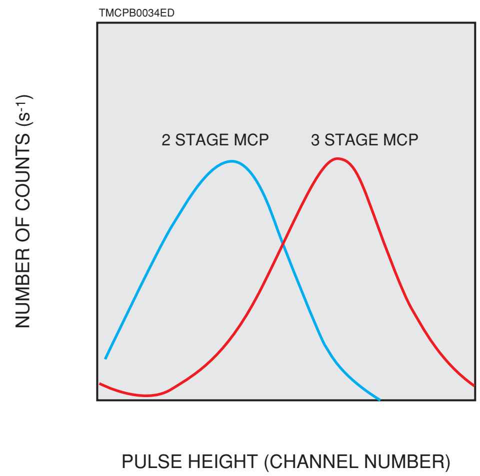


CHARACTERISTICS

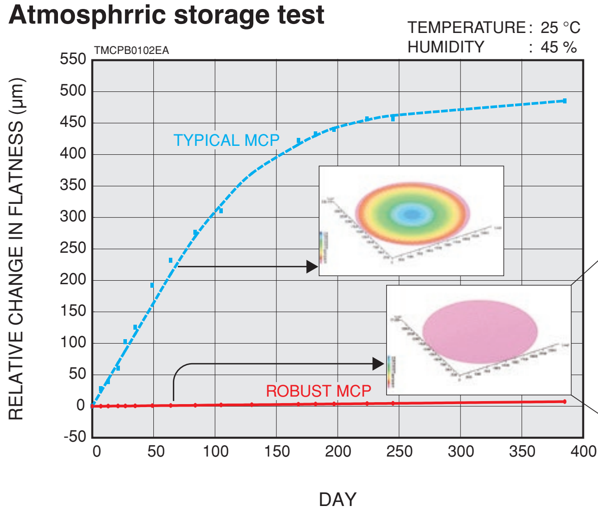
MCP gain characteristics

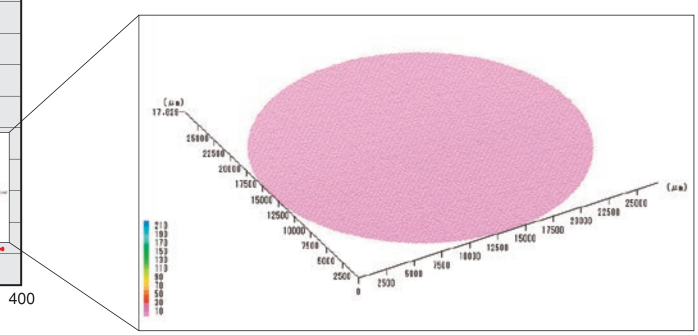


Pulse height distribution (PHD)



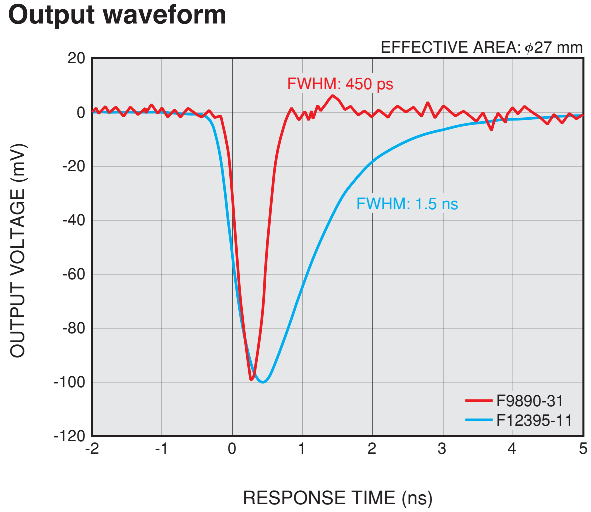
Atmosphrric storage test





Robust MCPs have durability against various environmental conditions. They are less likely to warp or crack and are very stable in shape even when exposed to air and humidity for long time, minimizing the time jitter that affects the mass resolution of TOF-MS (Time-of-flight mass spectrometry).

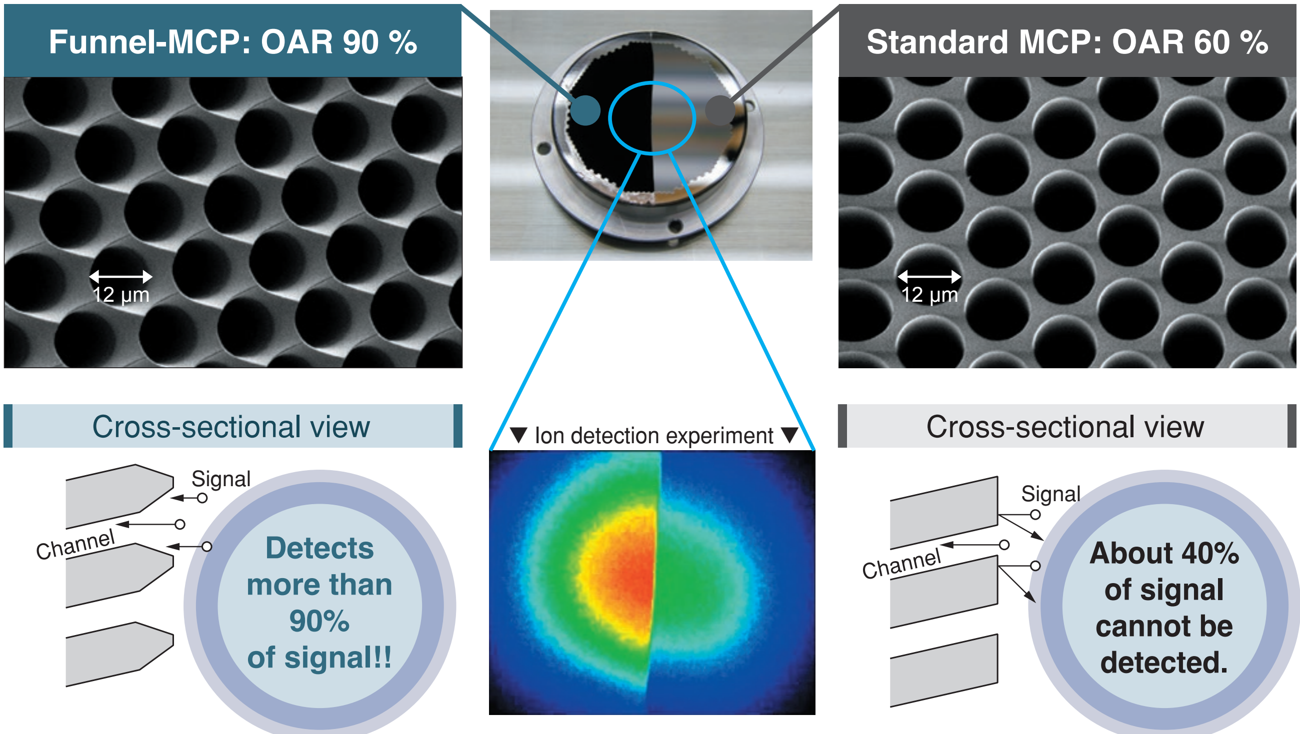
Output waveform



MCP assemblies for TOF measurement are available with a fast response time ranging from 450 ps to 1.5 ns (FWHM). Select according to your application.

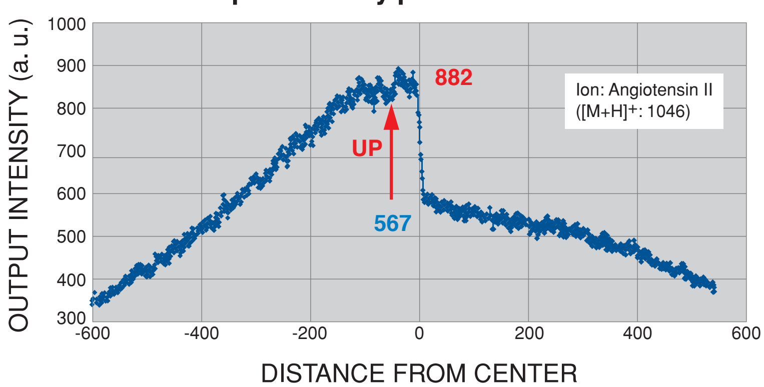
LARGE OAR: FUNNEL TYPE

Funnel MCPs have a large open area ratio (OAR) by making the input side of each channel into the shape of a funnel. This allows more signals to enter each channel than before, enabling effective and accurate signal detection.



Fluorescence output intensity image
(pseudo color display)

Fluorescence output intensity profile



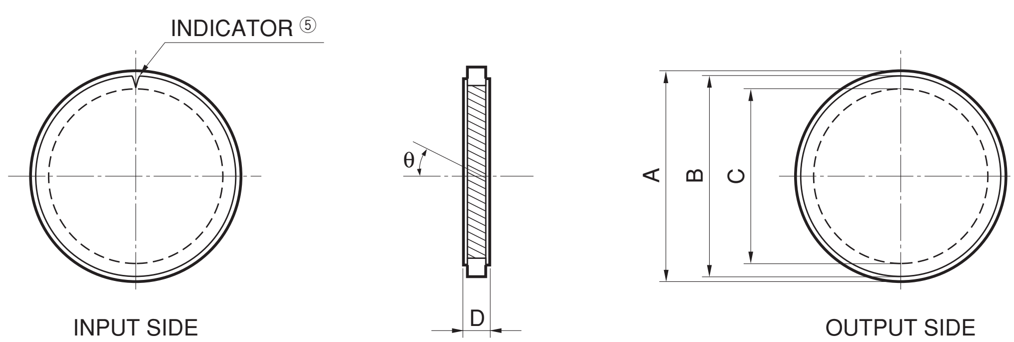
Line-up

Parameter / Type No.	F1551-011F	F1094-011F	F1552-011F	F1217-011F	Unit
Channel diameter	12				μm
Effective area	ϕ14.5	ϕ20	ϕ27	ϕ42	mm
Bias angle	12				°
Thickness	0.48				mm

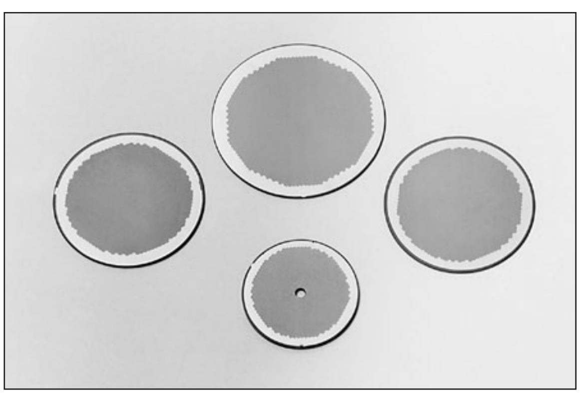
MCP SPECIFICATIONS AND DIMENSIONAL OUTLINES

Parameter \ Type No.	F1551 -01①	F1551 -011	F1551 -074	F1094 -01①	F1094 -011	F1094 -074	F1552 -01①	F1552 -011	F1552 -074	F1208-01	F1217 -01①	F1217 -011	F1942-04	Unit
Outer size A	ϕ17.9			ϕ24.8			ϕ32.8			ϕ38.4	ϕ49.9		ϕ86.7	mm
Electrode area B	ϕ17			ϕ23.9			ϕ31.8			ϕ36.5	ϕ49		ϕ84.7	mm
Effective area C	ϕ14.5		ϕ14	ϕ20			ϕ27			ϕ32	ϕ42		ϕ79	mm
Thickness D	0.48		0.3	0.48		0.3	0.48		0.3	0.48	0.48		1	mm
Channel diameter	12		6	12		6	12		6	12	12		25	μm
Channel pitch	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	°
Open area ratio	60													%
Electrode material	Inconel													—
Gain (Min.) ②	10^4		5×10^3	10^4		5×10^3	10^4		5×10^3	10^4				—
Resistance ②	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	MΩ
Dark current (Max.) ②	0.5													$pA\cdot cm^{-2}$
Maximum linear output ②	7 % of strip current ④													—
Supply voltage ③	1.0													kV
Operating ambient temperature ③	-50 to +70													°C

NOTE: ①The F1551-01, F1094-01, F1552-01, F1208-01 and F1217-01 are also available with a center through-hole (6 mm diameter).
②Supply voltage: 1.0 kV, vacuum: 1.3×10^{-4} Pa, operating ambient temperature: +25 °C
③Vacuum: 1.3×10^{-4} Pa
④Strip 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.
⑤Indicates MCP input side. Shape varies depending on product type.



TMCPA0056EA



MCPF0006

MCP ASSEMBLY SELECTION GUIDE BY PURPOSE

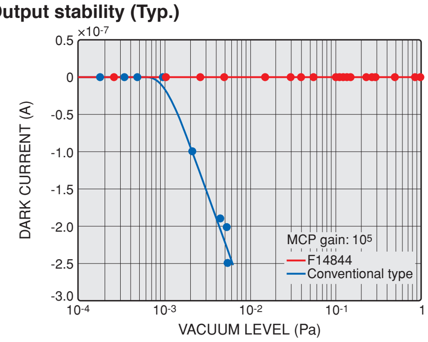
Higher pressure New

Higher pressure measurement

- Miniature mass spectrometer (explosive / drug trace detection)
- Portable devices

Ion detection at higher pressure

Output stability (Typ.)



This MCP assembly with triode structure supresses ion feedback noise and ensures stable operation even in a higher presuure environment of 1 Pa. This is an innovative ion detectors that can be mounted in compact desktop mass spectrometers where installing large vacuum pumping systems is difficult or impractical.

Operating principle video

Compact F14844

Signal measurement

Measures the amount of signal

- Very small amount ion detection
- Electron detection
- VUV detection
- Soft X-ray detection

Standard

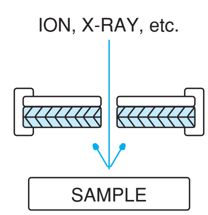
These MCP assemblies are used to detect signals in general-purpose applications where high-speed response in the order of nanoseconds is not required. Various types are provided including circular type and compact type.

Demountable

Compact F4655-14

- Scanning electron microscope (SEM)
- Mask aligner
- Surface analysis

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.

F2223-21SH

Page	Compact F14844	Demountable	Compact F4655-14	F2223-21SH
Page	p.7	p.8	p.8	p.9

Time-of-flight (TOF) measurement

Measures the difference between the arrival times

Two-dimensional detection

Measures two-dimensional distribution and incident position of signals

- Mass spectrometry (TOF-MS, MALDI-TOF)
- Observation of high-speed phenomena

- Mass spectrometry (TOF-MS, imaging MS)

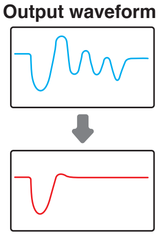
- Electron spectroscopy for chemical analysis (ESCA)
- Acceleration beam monitor
- Velocity map imaging (VMI)

less than 1 ns

1 ns or more

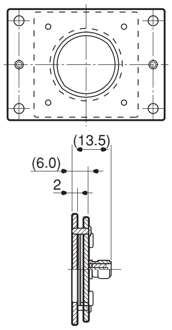
Fast response

Output waveform



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

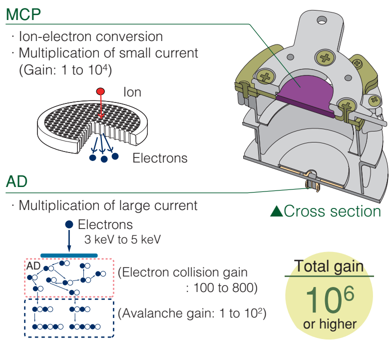
Thin



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.

MIGHTION™

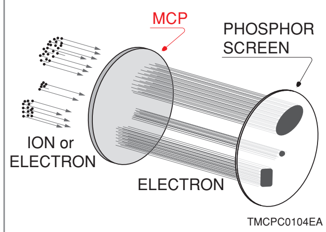
New



An ion detector consisting of a MCP (microchannel plate) and an AD (avalanche diode). It has various unique features as a hybrid type detector, such as fast time response, wide dynamic range and long life time.

Operating principle video

Phosphor screen output



The output electrons from the MCP are converted into a visible light on the phosphor-coated glass plate. One-stage MCPs offer a spatial resolution of 40 μm to 50 μm, and two-stage MCPs a resolution of 80 μm to 100 μm. The standard phosphor is P43 (peak emission wavelength: 545 nm, decay time: 1 ms).

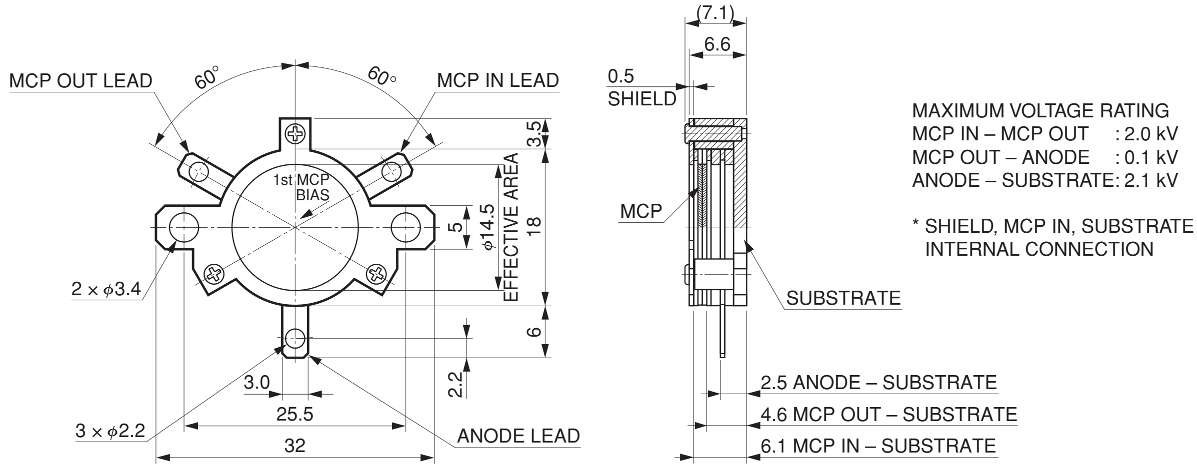
Anode ground	Floating	Compact	Vacuum flange	Fast time response	Fast time response Hybrid type	Vacuum flange
F9890-13/-14 F9892-13/-14	F9890-31/-32 F9892-31/-32	F4655-10	F4655-11	F12334-11 F12395-11 F12396-11 F13446-11 F13447-11	F14845	F2225-21PGF F6959
p.10	p.10	p.11	p.11	p.12	p.7	p.13

Please consult us for product specifications not listed in this catalog.

MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

F14844

Max. operating pressure (pa)	Gain (Min.)	Effective area (mm)	Resistance (MΩ)	Dark count (Max.) ($s^{-1}\cdot cm^{-2}$)
1	1×10^6	ϕ14.5	300 ~ 600	3

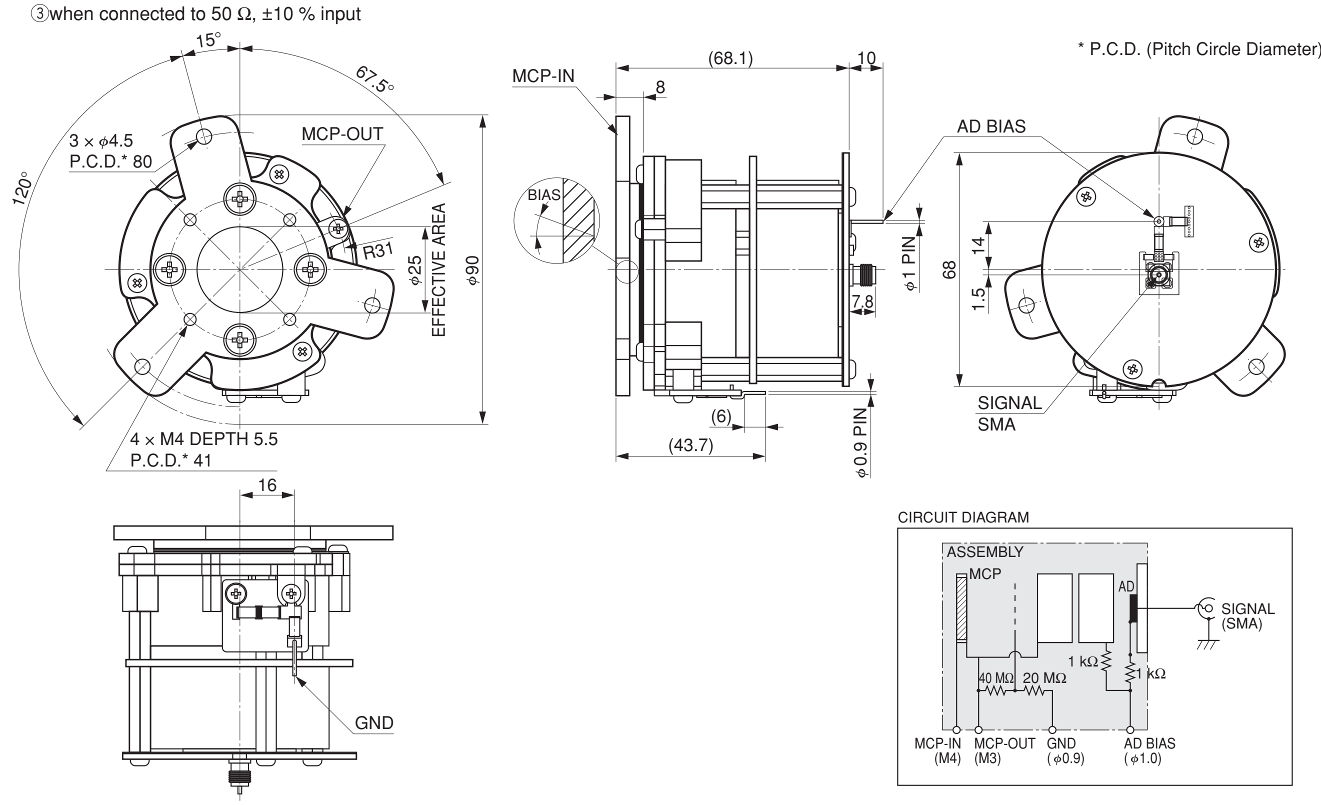


TMCPA0088EA

F14845-11

Pulse width (FWHM) (Typ.) (ps)	Gain ① (Min.)	Effective area (mm)	DC output ② (Max.) (μA)	Pulse linearity ③ (Max.) (V)
550	1×10^6	ϕ25	200	3.2

NOTE: ①MCP-in: -6 kV, MCP: 600 V, AD: -350 V
②±10 %
③when connected to 50 Ω, ±10 % input

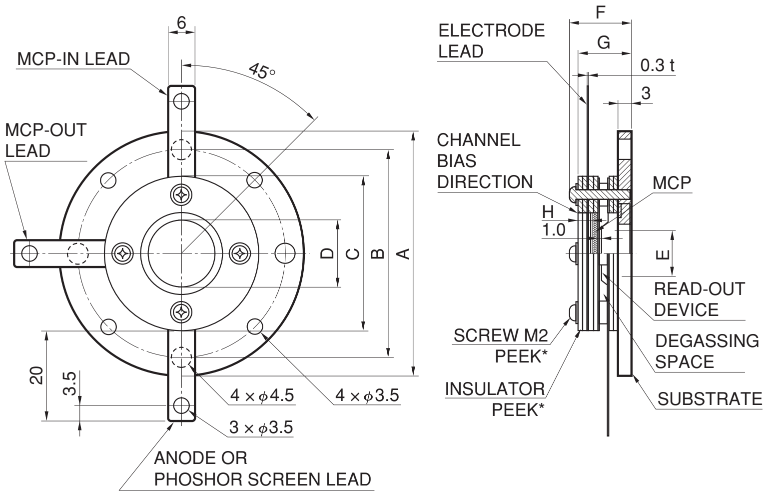


TMCPA0089EA

Demountable

Type No.	Channel diameter (μm)	Number of MCPs	Gain ① (Min.)	Pulse height resolution ① (Max.) (%)	Dark count ① (Max.) ($s^{-1}\cdot cm^{-2}$)	MCP ② supply voltage (kV)	MCP-OUT to anode ② supply voltage (kV)
F2221	12	Refer to “Anode type” below	1 stage MCP : 1×10^4 2 stage MCP : 1×10^6 3 stage MCP : 1×10^7	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 Phosphor screen : 3.0 to 4.0
F2222							
F2223							
F2224							
F2225							
F2226	25						

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



* PEEK: Polyetheretherketone
F2226 has leads every 60 degrees.

Anode type	Number of MCPs
Single anode	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		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. of MCPs 1	10.9					12.9	mm
		2	11.9					14.4	
		3	11.9					15.9	
H	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	

Shape may differ depending on product type number.

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

Type number designation

F2224-21P

Type No. : Assembly type

Readout device
- S: Single anode
- P: Phosphor screen (P43 peak emission wavelength: 545 nm, 10 % decay time: 1 ms)

Channel diameter
- 1: 12 μm
- 4: 25 μm (Only circular type)

Number of MCPs
- 1: 1-stage
- 2: 2-stage

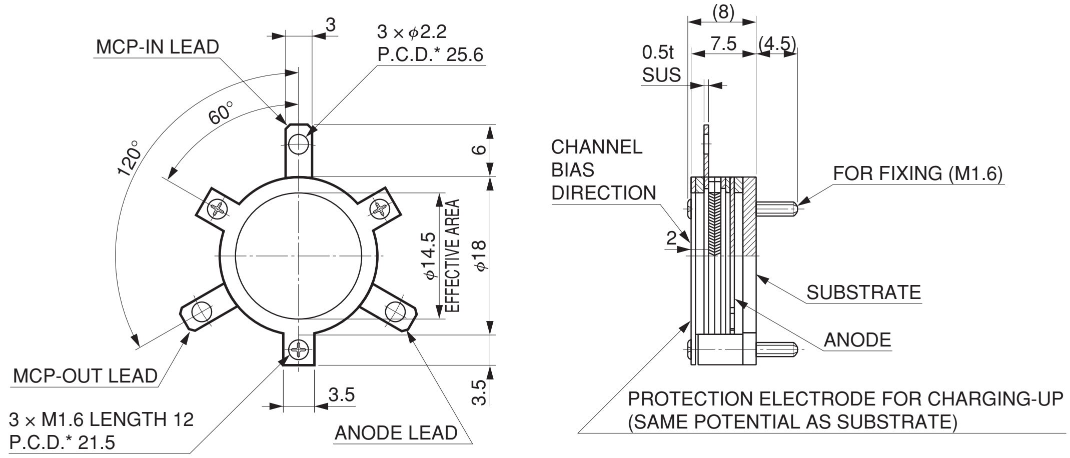
MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

Type No.	Channel diameter (μm)	Number of MCPs	MCP center dead area (mm)	Gain ① (Min.)	Pulse height resolution ① (Max.) (%)	Dark count ① (Max.) ($s^{-1} \cdot cm^{-2}$)	MCP ② supply voltage (kV)	MCP-OUT to anode ② supply voltage (kV)
F4655-14	12	2	—	5×10^7	50	3	2.5	0.5
F2223-21SH			ϕ8	1×10^6	—		2.0	

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

F4655-14

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

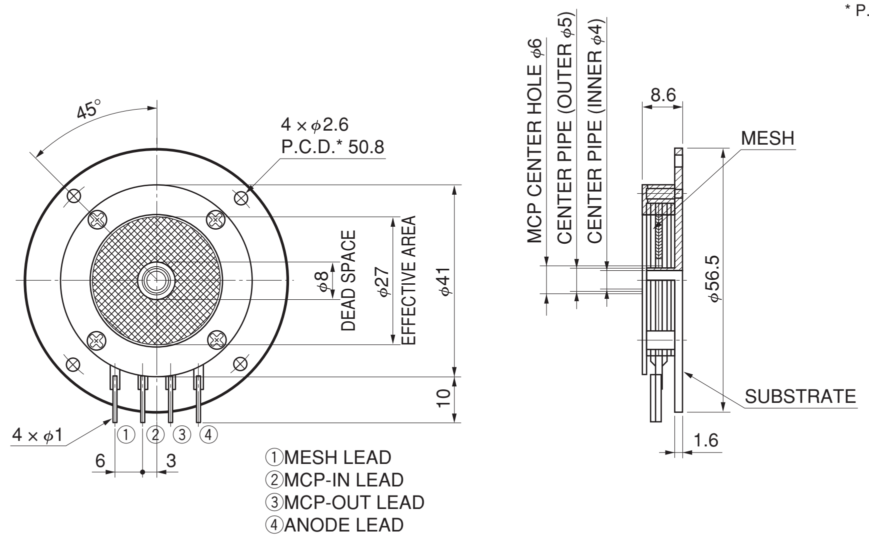


TMCPA0086ED

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

F2223-21SH

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



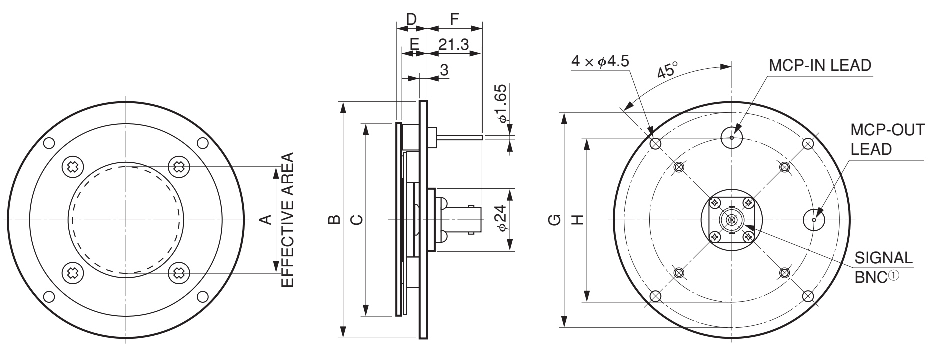
TMCPA0002EI

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

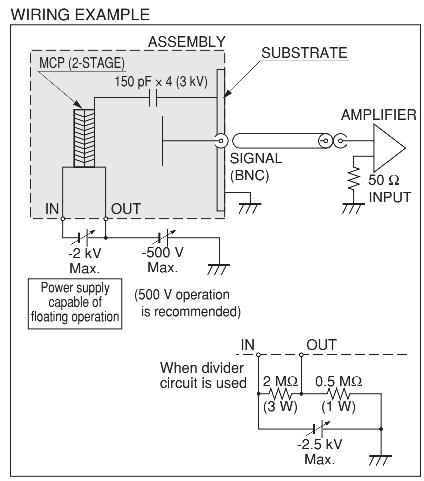
<table>
<tr><th>Type No.</th><th>Channel diameter (μm)</th><th>Number of MCPs</th><th>Pulse width (FWHM) (ps)</th><th>Gain ① (Min.)</th><th>Pulse height ① resolution (Max.) (%)</th><th>Dark count ① (Max.) ($s^{-1}\cdot cm^{-2}$)</th><th>MCP ② supply voltage (kV)</th><th>MCP-OUT to anode ② supply voltage (kV)</th></tr>
<tr><td>F9890-13</td><td>12</td><td rowspan="8">2</td><td rowspan="2">900</td><td rowspan="8">1×10^6</td><td rowspan="8">150</td><td rowspan="8">3</td><td rowspan="8">2.0</td><td rowspan="8">0.5</td></tr>
<tr><td>F9890-14</td><td>6</td></tr>
<tr><td>F9890-31</td><td>12</td><td rowspan="2">450</td></tr>
<tr><td>F9890-32</td><td>6</td></tr>
<tr><td>F9892-13</td><td>12</td><td rowspan="2">1200</td></tr>
<tr><td>F9892-14</td><td>6</td></tr>
<tr><td>F9892-31</td><td>12</td><td rowspan="2">700</td></tr>
<tr><td>F9892-32</td><td>6</td></tr>
</table>

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

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



①SMA connector type is also available.



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<tr><td colspan="2">A</td><td colspan="2">φ27</td><td colspan="2">φ42</td></tr>
<tr><td colspan="2">B</td><td colspan="2">φ81</td><td colspan="2">φ92</td></tr>
<tr><td colspan="2">C</td><td colspan="2">φ63</td><td colspan="2">φ75</td></tr>
<tr><td colspan="2">D</td><td>12</td><td>11.6</td><td>12</td><td>11.6</td></tr>
<tr><td colspan="2">E</td><td>10</td><td>9.6</td><td>10</td><td>9.6</td></tr>
<tr><td rowspan="2">F</td><td>MCP-IN LEAD</td><td colspan="2">22.0</td><td colspan="2">22.0</td></tr>
<tr><td>MCP-OUT LEAD</td><td colspan="2">24.0</td><td colspan="2">24.0</td></tr>
<tr><td colspan="2">G</td><td colspan="2">φ72</td><td colspan="2">φ84</td></tr>
<tr><td colspan="2">H</td><td colspan="2">φ52</td><td colspan="2">φ64</td></tr>
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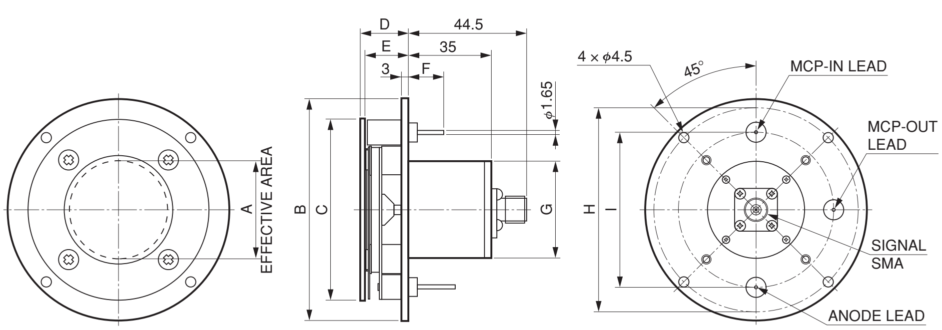
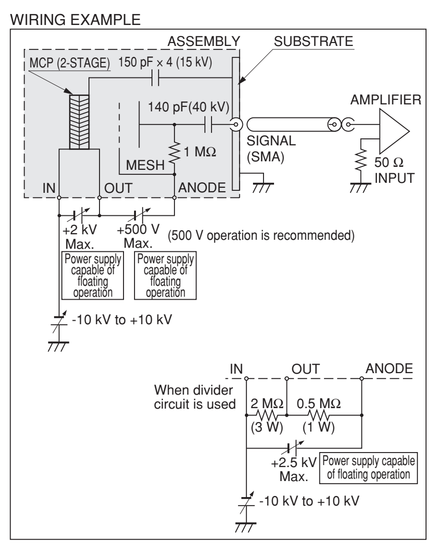
TMCPA0075ED

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





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<tr><td colspan="2">B</td><td colspan="2">φ81</td><td colspan="2">φ92</td></tr>
<tr><td colspan="2">C</td><td colspan="2">φ63</td><td colspan="2">φ75</td></tr>
<tr><td colspan="2">D</td><td>20.2</td><td>19.9</td><td>20.2</td><td>19.9</td></tr>
<tr><td colspan="2">E</td><td>18.2</td><td>17.9</td><td>18.2</td><td>17.9</td></tr>
<tr><td rowspan="3">F</td><td>MCP-IN LEAD</td><td>13.5</td><td>13.9</td><td>13.5</td><td>13.9</td></tr>
<tr><td>MCP-OUT LEAD</td><td colspan="2">15.2</td><td colspan="2">15.2</td></tr>
<tr><td>ANODE LEAD</td><td colspan="2">19.4</td><td colspan="2">19.4</td></tr>
<tr><td colspan="2">G</td><td colspan="2">φ35</td><td colspan="2">φ40</td></tr>
<tr><td colspan="2">H</td><td colspan="2">φ72</td><td colspan="2">φ84</td></tr>
<tr><td colspan="2">I</td><td colspan="2">φ52</td><td colspan="2">φ64</td></tr>
</table>

TMCPA0082EF

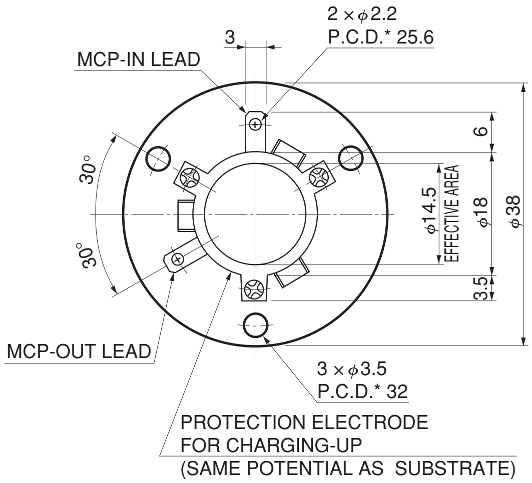
MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

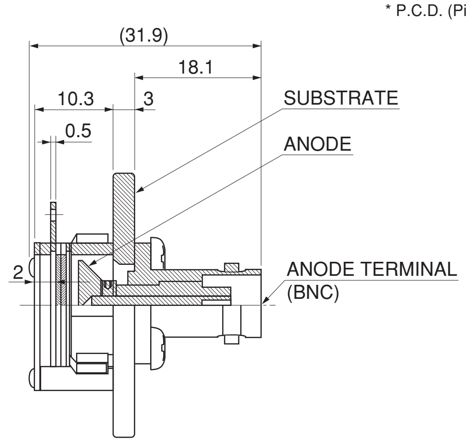
Type No.	Channel diameter (μm)	Number of MCPs	Pulse width (FWHM) (ps)	Gain ① (Min.)	Pulse height resolution ① (Max.) (%)	Dark count ① (Max.) ($s^{-1}\cdot cm^{-2}$)	MCP ② supply voltage (kV)	MCP-OUT to anode ② supply voltage (kV)
F4655-10	12	2	600	5×10^7	50	3	2.5	0.5
F4655-11								

NOTE: ①Supply voltage: 1.2 kV/MCP, vacuum: 1.3 ± 10^{-4} Pa, operating ambient temperature: +25 °C
②Vacuum: 1.3 × 10^{-4} Pa

F4655-10

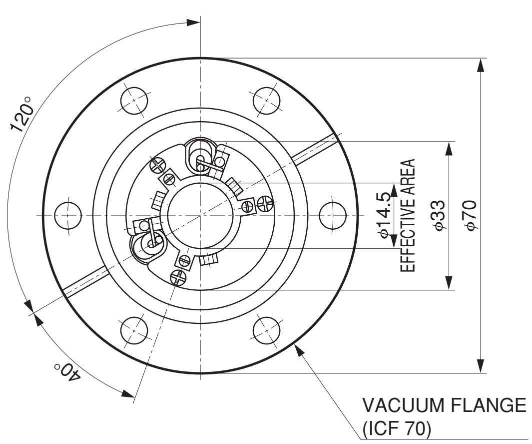
* P.C.D. (Pitch Circle Diameter)

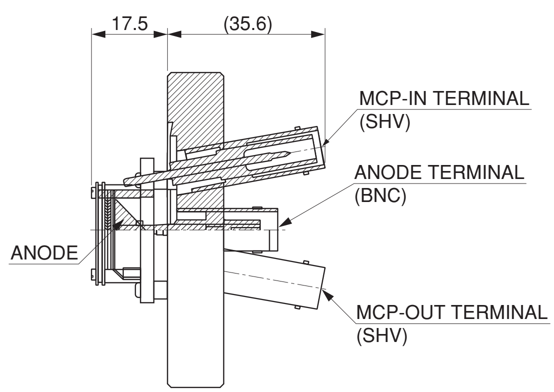




TMCPA0021EH

F4655-11



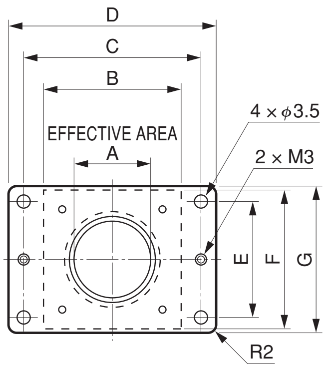


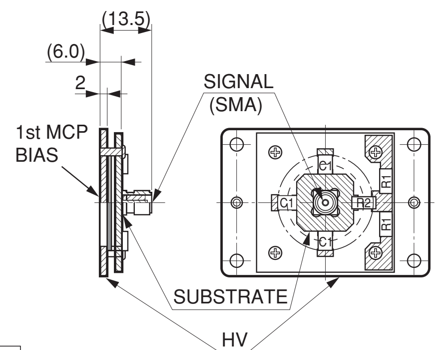
TMCPA0085EC

Type No.	Channel diameter (μm)	Number of MCPs	Pulse width ① (FWHM) (ps)	Gain ② (Min.)	Pulse height ② resolution (Max.) (%)	Dark count ② (Max.) ($s^{-1} \cdot cm^{-2}$)	MCP ③ supply voltage (kV)	MCP-OUT to anode ③ supply voltage (kV)
F12334-11	12	2	1500	1×10^6	—	3 ④	— ④	0.1
F12395-11								
F12396-11								
F13446-11			1300					
F13447-11			1500					

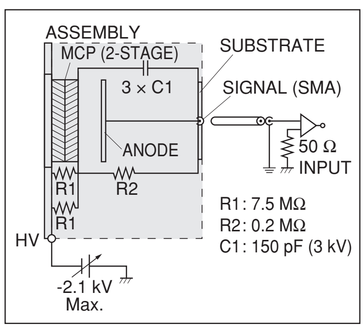
NOTE: ①FWHM at output peak value 20 mV, 50 Ω input
②Supply voltage: 1.0 kV/MCP, vacuum: 1.3×10^{-4} Pa, operating ambient temperature: +25 °C
③Vacuum: 1.3×10^{-4} Pa
④A maximum of -2.1 kV is supplied to the HV electrode, depending on the built-in bleeder resistors.

F12334-11, F12395-11, F12396-11





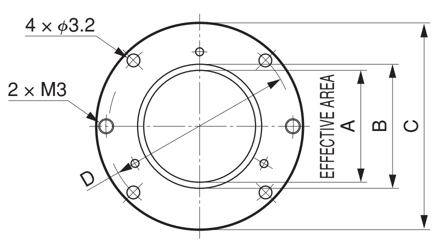
WIRING EXAMPLE

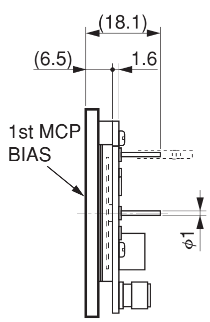


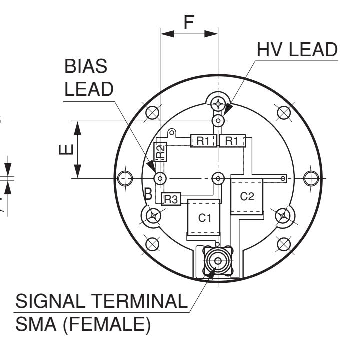
	F12334-11	F12395-11	F12396-11
A	φ20	φ27	φ42
B	36	40	51
C	46	51	62
D	54	61	72
E	30	30	40
F	36	40	51
G	38	41	52

TMCPA0084EE

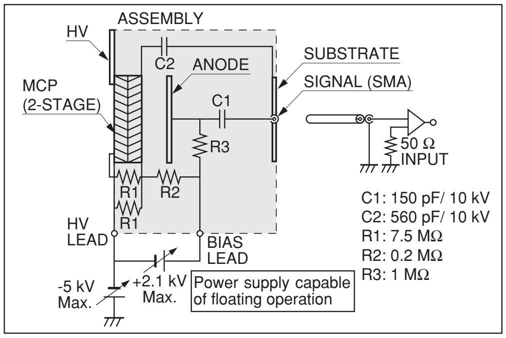
F13446-11, F13447-11







WIRING EXAMPLE



	F13446-11	F13447-11
A	φ27	φ42
B	φ30	φ46
C	φ50	φ70
D	φ45	φ65
E	14	16
F	14	18

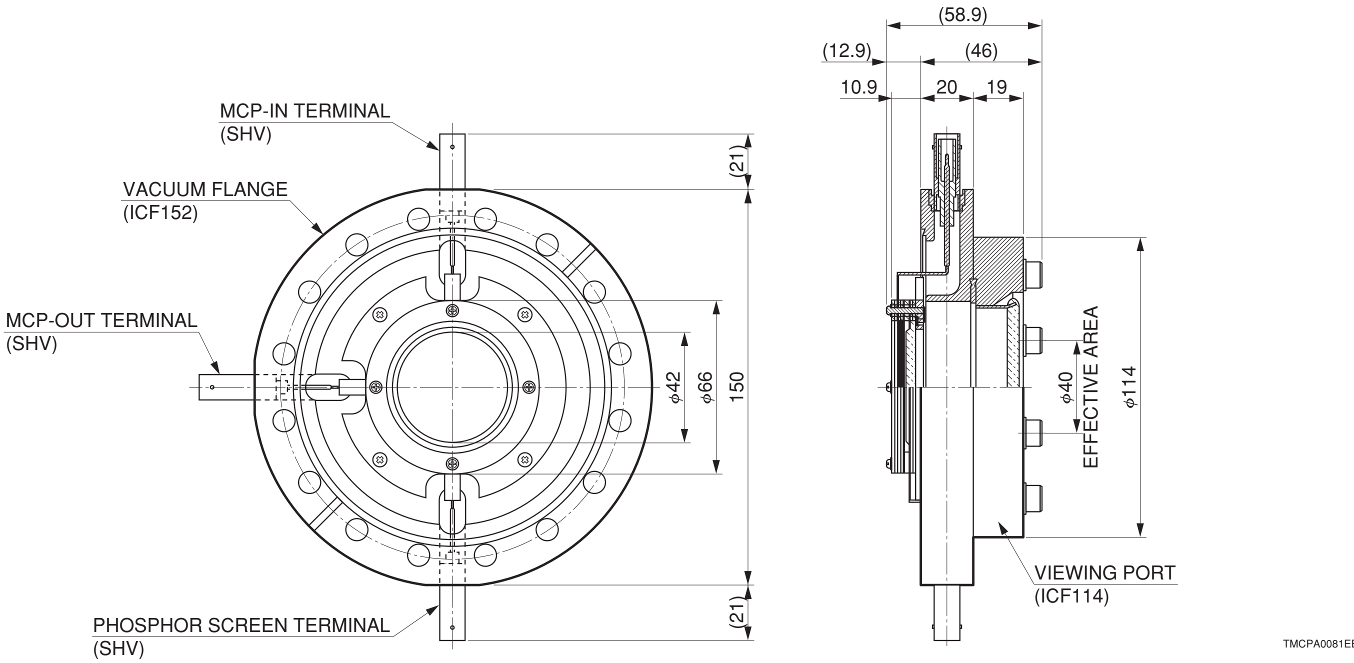
TMCPA0087EE

MCP ASSEMBLY SPECIFICATIONS AND DIMENSIONAL OUTLINES (Unit: mm)

Type No.	Channel diameter (μm)	Number of MCPs	Gain ① (Min.)	Pulse height resolution ① (Max.) (%)	Dark count ① (Max.) ($s^{-1}\cdot cm^{-2}$)	MCP ② supply voltage (kV)	MCP-OUT to anode ② supply voltage (kV)
F2225-21PGF	12	2	1×10^6	—	3	2.0	4.0
F6959							3.0

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

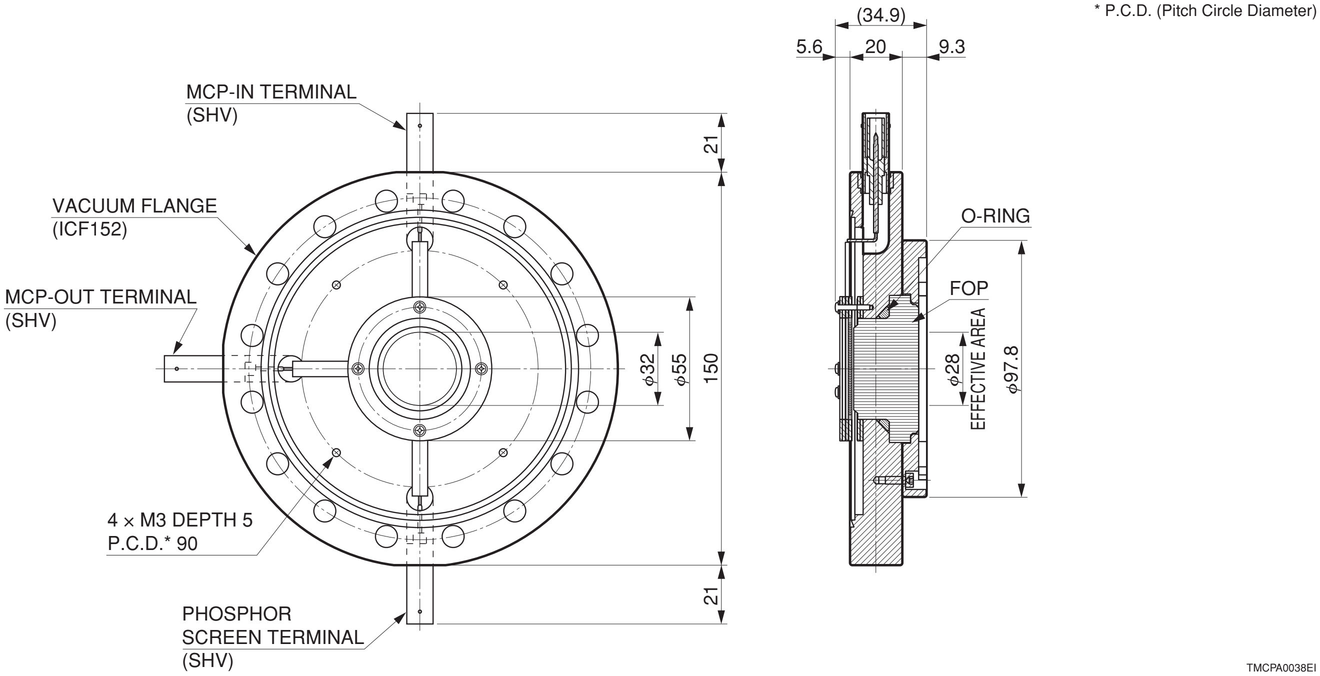
F2225-21PGF



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

F6959

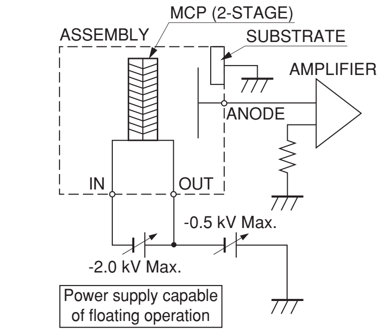
* P.C.D. (Pitch Circle Diameter)

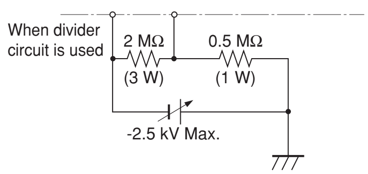


MCP ASSEMBLY WIRING EXAMPLE

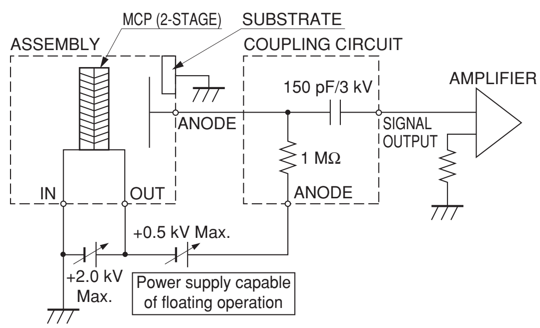
Signal measurement (electrical signal output)

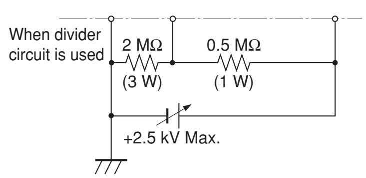
Positive ion detection: Anode grounded



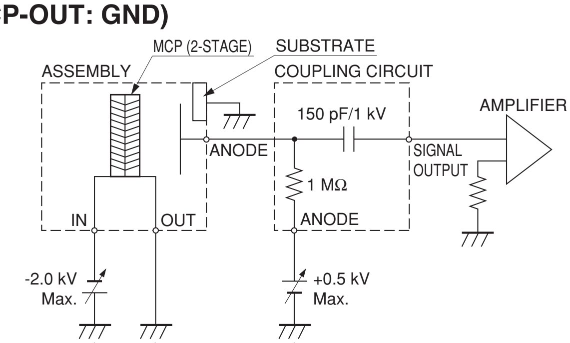


Electron or negative ion detection: Anode floating (MCP-IN: GND)





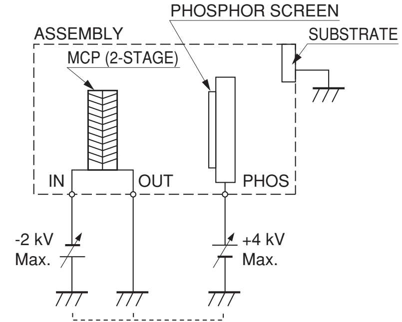
Positive ion detection: Anode floating (MCP-OUT: GND)



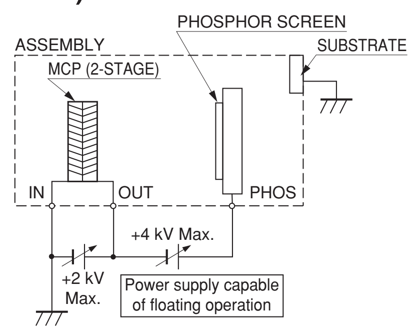
TMCPC0005JI

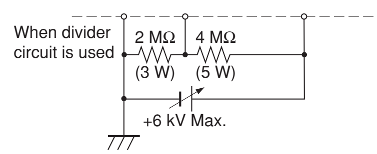
Two-dimensional detection (visible light output)

Positive ion detection (MCP-OUT: GND)

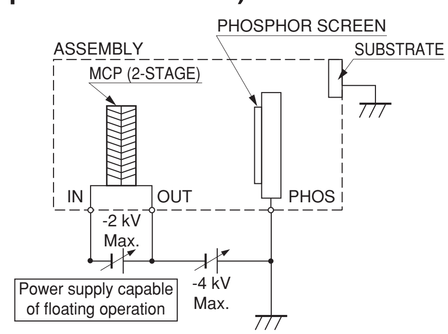


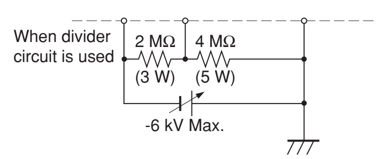
Electron or positive ion detection (MCP-IN: GND)





Positive ion detection (Phosphor screen: GND)





TMCPC0007JF

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.
There can be some exceptions.

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 1.3×10^{-4} Pa for more than 24 h 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 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. (1 Pa or less for the F14844 series)

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 sec per 100 V).

7. MEASUREMENT OF MCP RESISTANCE

Because MCP is made of lead glass, the resistance of MCP cannot be measured correctly if placed in the atmosphere due to the humidity. The resistance can be measured correctly only when the MCP is placed in a vacuum and its electrodes are securely in contact with the measuring device. The MCP resistance has a negative temperature characteristics (resistance deceases as temperature increases), so it may take several minutes for the resistance value to become stable.

WARRANTY

This product is warranted for 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.

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.

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