

A microchannel plate (MCP) is a secondary electron multiplier consisting of an array of glass capillaries (channels) fused into the form of a thin plate. Each channel has an internal diameter of $6\ \mu\text{m}$ to $25\ \mu\text{m}$ and works as an independent electron multiplier, making possible the detection and amplification of two-dimensional information.

In addition to previously available circular-type MCPs, Hamamatsu has available seven types of rectangular MCPs. Of these, three standard types include demountable assemblies which have electrode leads and read-out devices. Using these, it is possible to alleviate dimensional limitations encountered when building the MCPs into instruments as compared with circular types, greatly facilitating the effective use of these devices. The demountable assembly can be selected as combinations of MCPs (1 to 3 stage) and a read-out device (single-anode, multi-anode or phosphor screen). Making possible the selection of the most suitable configuration for your application, while facilitating replacement as well.

FEATURES

- Convenience of use due to fewer leads
- Choice and interchangeability of MCP and read-out devices
- High gain and low noise
- Two-dimensional image intensification
- Fast time response
- Immunity to magnetic fields
- Sensitive to electrons, ions, VUV lights, X-rays and γ -rays
- Stable in air
- Low power consumption
- Small size and light weight
- Can be baked in vacuum at up to 350°C

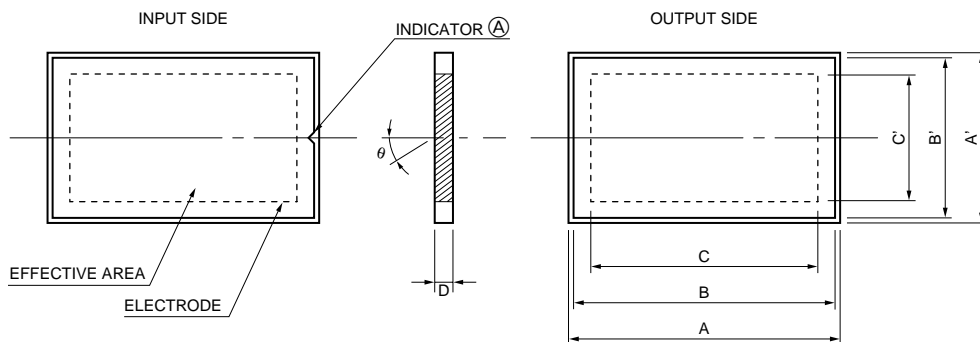
APPLICATIONS

Detection and imaging of electrons, ions, VUV lights, X-rays and γ -rays

- Mass spectroscopy
- Energy spectroscopy
- High-speed response CRTs

RECTANGULAR MCP AND ASSEMBLY SERIES

MCP DIMENSIONAL OUTLINES (Unit: mm)



TMCPA0028EB

| Parameters \ Type | F6492 | F2370-01 | F4772-01 | F2806-01 | F1943-02 | F2805-03 | F2396-04 | Unit |
|---------------------------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|---------|
| Outer dimensions 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 dimensions B × B' | 138 × 8 | 15 × 8.5 | 61 × 9.4 | 49 × 39 | 87 × 37 | 58 × 58 | 95.6 × 77.3 | mm |
| MCP Effective dimensions 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 | | | | – |

ELECTRICAL CHARACTERISTICS

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

| | | | | | | |
|---------------------------|--|------------|-----------|-----------|-------------------|----|
| Current Gain | More than 10^4 | | | | – | |
| Plate Resistance | 10 to 100 | 100 to 500 | 20 to 200 | 20 to 120 | 10 to 50 | MΩ |
| Dark Current | Less than 5×10^{-13} | | | | A/cm ² | |
| Max. Linear Output Signal | Up to 7% of the strip current [Ⓐ] | | | | – | |

MAXIMUM RATINGS

| | | | | |
|-----------------------------|------------|------|------------|----|
| Supply Voltage [Ⓒ] | 1000 | 1100 | 1200 | V |
| Ambient Temperature | –50 to +70 | | –50 to +50 | °C |

Ⓐ This indicator shows the MCP input side and the direction of channel bias.

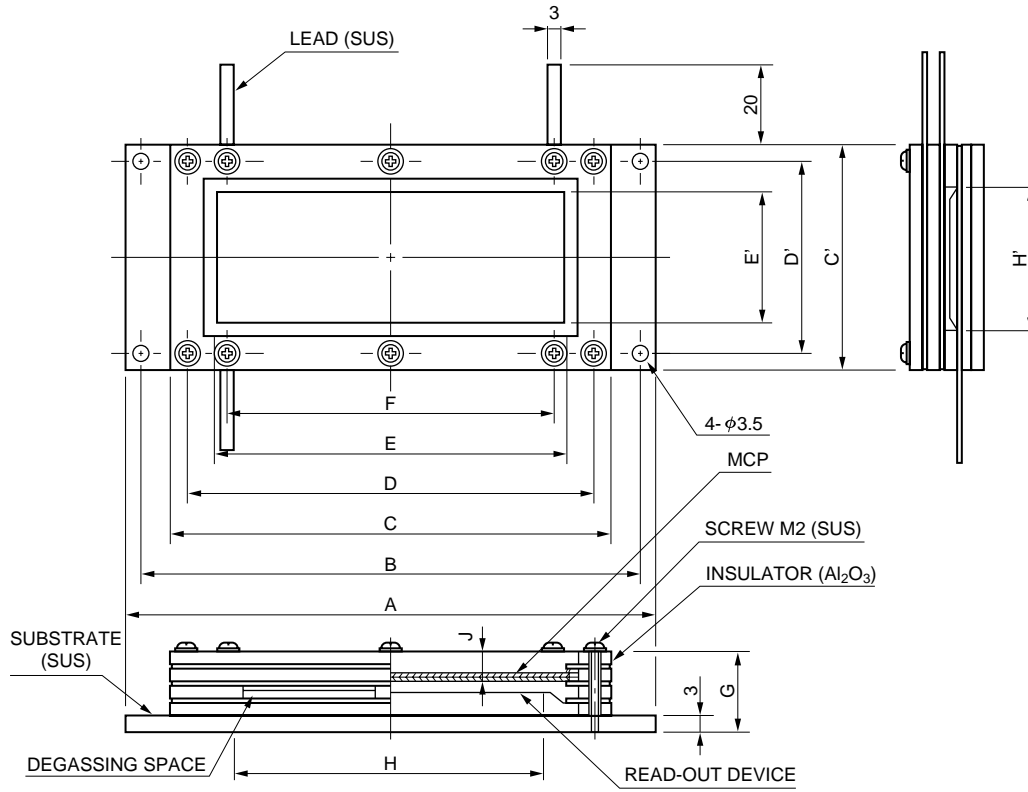
The F2806-01 has bias angle of opposite direction against the perpendicular line shown in the figure.

Ⓑ The strip current is the current which flows along the channel wall when a voltage is supplied between the MCP input and output and is given by Supply voltage/Plate resistance.

Ⓒ At a vacuum of 1.3×10^{-4} Pa (1×10^{-6} Torr) or less.

Comment: Consult us for other dimensions, details on MCP resistance ranges and other information.

ASSEMBLY DIMENSIONS (Unit: mm)

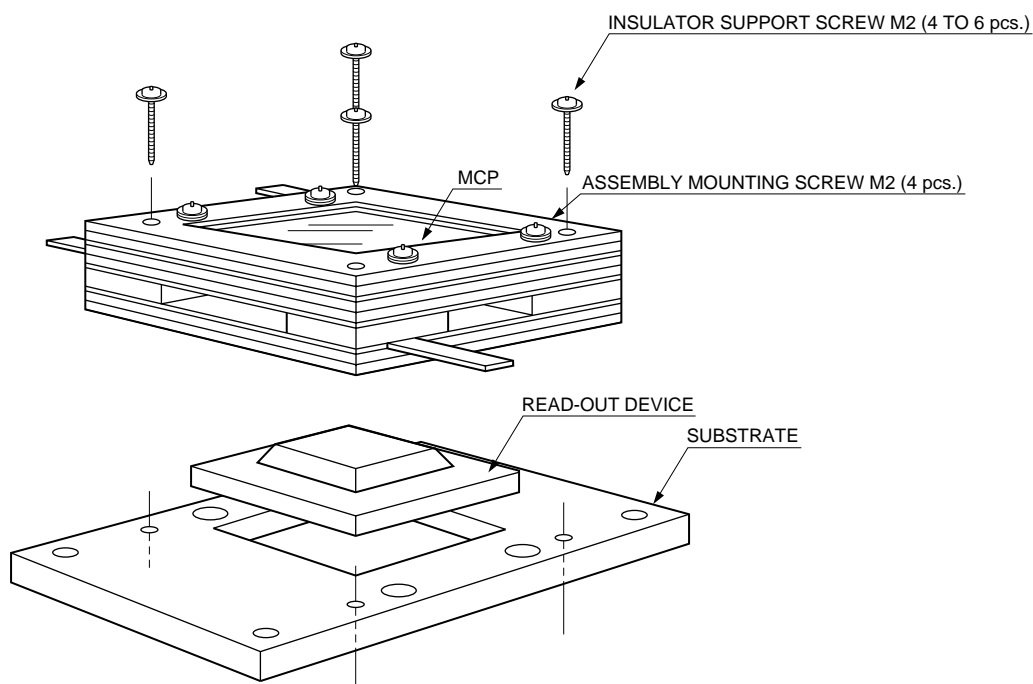


TMCPA0029EB

ASSEMBLY DIMENSIONS TABLE

| Symbol | Description | | F2813 | F2814 | F3490 | Unit | |
|--------|--|------------|----------|---------|-----------|------|----|
| A × C' | Assembly outer dimensions | | 128 × 54 | 96 × 76 | 78 × 29.5 | mm | |
| B × D' | Mounting screw hole pitch | | 120 × 46 | 86 × 68 | 72 × 18 | mm | |
| C × C' | Insulator outer dimensions | | 104 × 54 | 76 × 76 | 66 × 29.5 | mm | |
| D × D' | Insulator support screw pitch | | 96 × 46 | 68 × 68 | 56 × 24 | mm | |
| E × E' | MCP effective dimensions | | 81 × 31 | 53 × 53 | 55 × 8 | mm | |
| F × D' | Assembly screw spacing | | 79 × 46 | 51 × 68 | 56 × 24 | mm | |
| H × H' | Effective dimensions of readout device | | 80 × 30 | 50 × 50 | 52 × 7 | mm | |
| G | Distance from bottom of substrate to insulator surface | No. of MCP | 1 | 10.9 | 10.9 | 11.9 | mm |
| | | | 2 | 11.9 | 11.9 | | |
| | | | 3 | 11.9 | 12.9 | | |
| J | Distance from MCP input surface to insulator surface | No. of MCP | 1 | 2.7 | 2.5 | 3.8 | mm |
| | | | 2 | 3.1 | 2.7 | 3.3 | |
| | | | 3 | 2.5 | 2.9 | 2.9 | |

ASSEMBLY EXPLODED VIEW



TMCP0029EA

GENERAL

| Parameter | MCP | Single-Stage | Two-Stage | Three-Stage | Unit |
|------------------|-----|---|-----------|-------------|------|
| Channel Diameter | | F3490 type: 12, F2813 type: 15, F2814 type: 20 | | | μm |
| 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: 1000 V per stage, Vacuum: In the order of 1.3×10^{-5} Pa (10^{-7} Torr) , Ambient Temperature: 25 °C)

| | | | | |
|---------------------------|---|--|--|---|
| Current Gain | 10^4 | 10^6 | 10^7 to 10^8 | — |
| Dark Noise | Less than 5×10^{-13} A/cm ² | Less than $3 \text{ s}^{-1}/\text{cm}^2$ (cps/cm ²) [Ⓑ] | Less than $3 \text{ s}^{-1}/\text{cm}^2$ (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 | 1000 | 2000 | 3000 | V |
| MCP-Out—Anode Voltage | | 1000 | | V |
| MCP-Out—Phosphor Screen Voltage | | 4000 | | V |
| Substrate—Other Terminals Voltage | | 6000 | | V |
| Baking Temperature | | 350 | | °C |

Ⓒ 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).

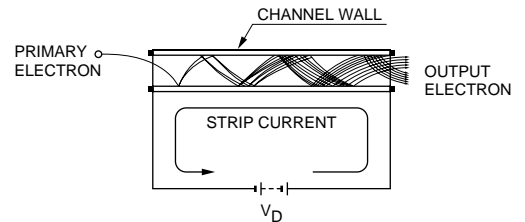
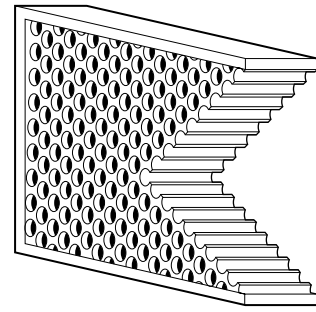
PHOSPHOR SCREEN EMISSION CHARACTERISTICS

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

OPERATING PRINCIPLE

As shown in the figure, when a voltage V_D is supplied 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 logarithmic multiplication of the electron current appearing at the output.

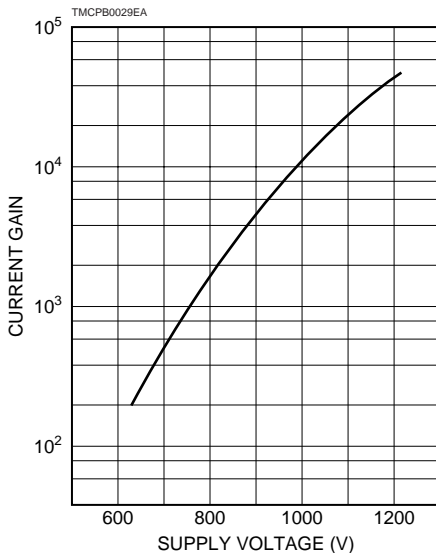
• MCP Configuration



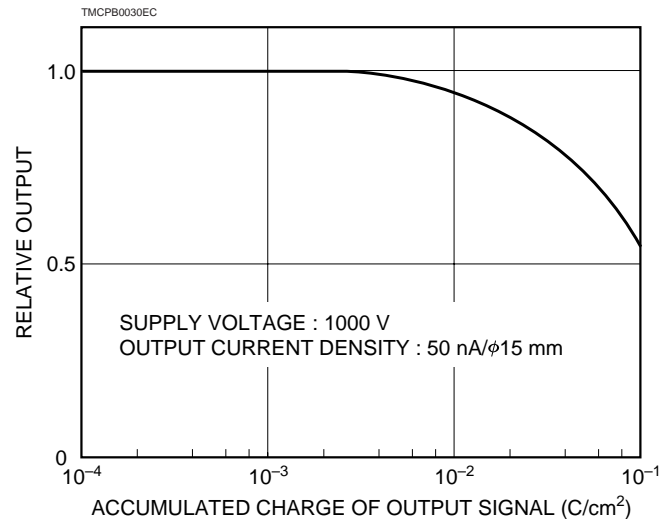
TMCP0030EA

CURRENT GAIN AND LIFE CHARACTERISTICS

• Current Gain vs. Supply Voltage



• Life



■ PRECAUTIONS FOR USE

- Don't touch the MCP and assembly parts with bare hands.
- Always handle the MCP in an area that is maintained at the same level of cleanliness as a clean room since dust and humidity may adversely affect MCP characteristics.
- The MCP should be kept in vacuum or nitrogen atmosphere when storing it after delivery.
- If excessive outgas from the MCP occurs, perform vacuum-baking of the MCP at +350°C maximum in an evacuating system. Alternatively, electron bombarding of the MCP is effective. (Please consult our sales office for details.)
- The MCP and MCP assemblies must be operated in a vacuum below 1.3×10^{-3} Pa (1×10^{-5} Torr). However, phosphor output MCP assemblies and other assemblies using a three-stage MCP should be operated in a vacuum below 1.3×10^{-4} Pa (1×10^{-6} Torr).

RECTANGULAR MCP AND ASSEMBLY SERIES

ORDERING INFORMATION (Type No. Designation)

F 2 8 1 3 - 2 2 S

Assembly type

Third suffix : readout device

- No suffix : without read-out device
- S : Single anode
- M : Multianode
- P : Phosphor screen
(select P-11, 20 or 47)

Second suffix : Channel diameter

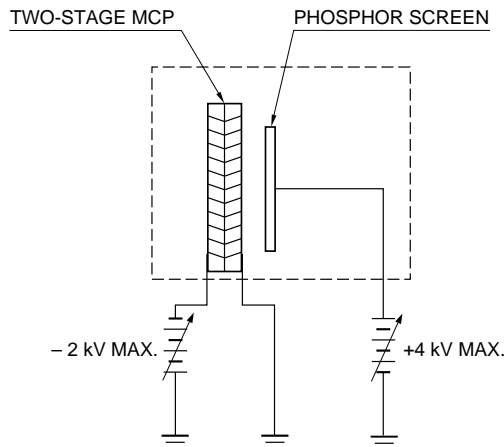
- 1 : 12 μm (F3490 type)
- 2 : 15 μm (F2813 type)
- 3 : 20 μm (F2814 type)

First suffix : Number of MCPs

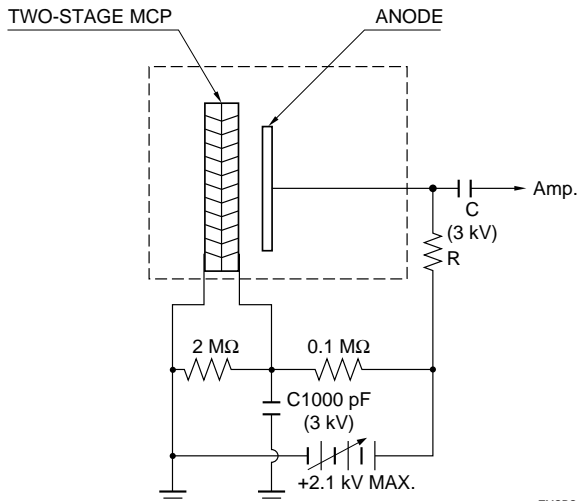
- 1 : Single-stage
- 2 : Two-stage
- 3 : Three-stage

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

WIRING EXAMPLES



TMCP0007EC



TMCP0005EC

SPECIAL MCPs AND ASSEMBLIES

- Hamamatsu Photonics can receive orders for special MCPs and assemblies not included in the standard product line. Please specify the shape, effective dimensions, thickness and other parameters you need.
- Feel free to consult us on MCPs with an aperture (for use with reflecting electron microscopes), CsI deposition (for higher quantum efficiency in the VUV to X-ray range), aluminum film coating (as a barrier to ions or radiation), MgO coating (for higher gain), gold electrode, and other custom 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).
- Assemblies mounted on custom vacuum flanges or substrates are also available.

HAMAMATSU

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