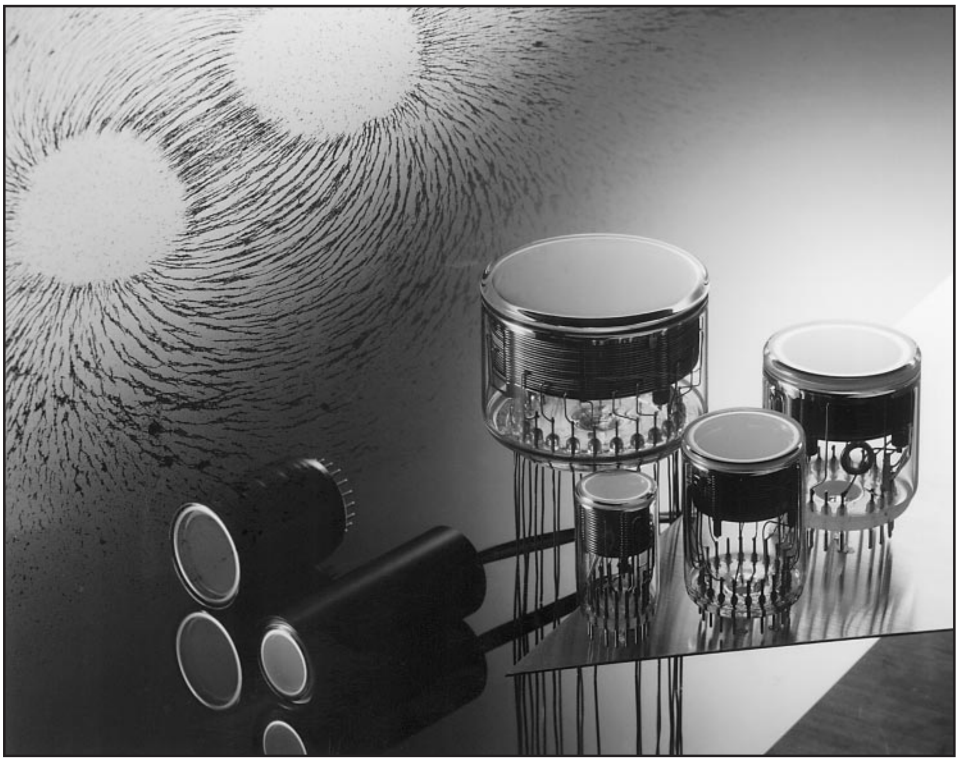
# FINE MESH PMT SERIES for HIGH MAGNETIC FIELD ENVIRONMENTS

HAMAMATSU

## PMT's for THE OPERATION in HIGH MAGNETIC FIELDS over 1 TESLA



In recent years, the demand for photodetectors, that can be operated in strong magnetic fields has increased, especially in the field of high energy physics. Conventional PMT's electrons trajectories are affected by magnetic fields. The gain of these PMT's is decreased under such conditions. Therefore, it is necessary for these PMT's to either use a light guide to send signal light to a region outside the magnetic field or to use a magnetic shield. The light guide and its coupling to a PMT, cause loss of light and deterioration of the timing characteristics of the signal light. The use of magnetic shield adds cost and energy loss for the next particle detector.

PMT's using fine mesh dynodes (Fine Mesh PMT's) make it possible to operate PMT's even in strong magnetic fields over 1.0 tesla. Depending on your needs, you can select from the Fine Mesh PMT series.
In addition, socket assemblies and hybrid assemblies can be supplied to avoid troublesome design and manufacturing of voltage dividers.

### APPLICATION

- TOF COUNTER
- CALORIMETER
- OTHER DETECTORS IN HIGH ENERGY PHYSICS AND NUCLEAR PHYSICS EXPERIMENTS

# FINE MESH PMT SERIES for HIGH MAGNETIC FIELD ENVIRONMENTS

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| Tube Diameter | Type Number | Spectral Response Range (nm) | ① Outline No. | ② Socket | No. of Stages | Cathode Sensitivity: Luminous Typ. (µA/Lm) | Cathode Sensitivity: Blue Typ. (µA/Lm-b) | Cathode Sensitivity: Q.E at Peak Typ. (%) | Anode Sensitivity: Anode to Cathode Voltage (Vdc) ③ | Current Amplification ④ (at 0 Tesla) Typ. | Current Amplification ④ (at 0.5 Tesla) Typ. | Current Amplification ④ (at 1 Tesla) Typ. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25mm (1") | R5505 | 300 to 650 | ① | E678-17A | 15 | 80 | 9.5 | 23 | 2000 | $5\times10^5$ | $2.3\times10^5$ | $1.8\times10^4$ |
| 38mm (1.5") | R5946 | 300 to 650 | ② | E678-19D | 16 | 80 | 9.5 | 23 | 2000 | $1\times10^6$ | $4.3\times10^5$ | $2.9\times10^4$ |
| 51mm (2") | R5924 | 300 to 650 | ③ | – | 19 | 70 | 9.0 | 22 | 2000 | $1\times10^7$ | $4.1\times10^6$ | $2.0\times10^5$ |
| 64mm (2.5") | R6504 | 300 to 650 | ④ | – | 19 | 70 | 9.0 | 22 | 2000 | $1\times10^7$ | $4.1\times10^6$ | $2.0\times10^5$ |
| 76mm (3") | R5542 | 300 to 650 | ⑤ | – | 19 | 70 | 9.0 | 22 | 2000 | $1\times10^7$ | $3.0\times10^6$ | $1.7\times10^5$ |

| Anode Sensitivity: Luminous Typ. (A/Lm) | Dark Current Typ. (nA) | Dark Current Max. (nA) | Maximum Rating ⑤: Anode to Cathode Voltage (Vdc) ⑥ | Maximum Rating ⑤: Average Anode Current (mA) ⑦ | Typical Time Response ⑧: Rise Time Typ. (ns) | Typical Time Response ⑧: Transit Time Typ. (ns) | Typical Time Response ⑧: T.T.S. Typ. (ns) | ⑨ Long Term Stability (%) | Pulse Linearity ⑩: ±2% Typ. (mA) | Pulse Linearity ⑩: ±5% Typ. (mA) | Notes | Type Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 5 | 30 | 2300 | 0.01 | 1.5 | 5.6 | 0.35 | 2.0 | 180 | 250 | UV type (R5506) | R5505 |
| 80 | 5 | 30 | 2300 | 0.01 | 1.9 | 7.2 | 0.35 | 2.0 | 350 | 500 | UV type (R6148)<br>Synthetic Silica Type (R6149) | R5946 |
| 700 | 30 | 200 | 2300 | 0.1 | 2.5 | 9.5 | 0.44 | 2.0 | 500 | 700 | UV type (R6608)<br>Synthetic Silica Type (R6609)<br>Glass Base type (R5924-01) | R5924 |
| 700 | 50 | 300 | 2300 | 0.1 | 2.7 | 11.0 | 0.47 | 2.0 | 700 | 1000 | UV type (R6505) | R6504 |
| 700 | 80 | 400 | 2300 | 0.1 | 2.9 | 12.3 | 0.50 | 2.0 | 1000 | 1500 | UV type (R5543) | R5542 |

## < NOTE >

① Basing Diagram Symbols
K : Photocathode    P : Anode    DY : Dynode
IC :Internal Connection ( Don't use )

② A socket will be supplied with a PMT.

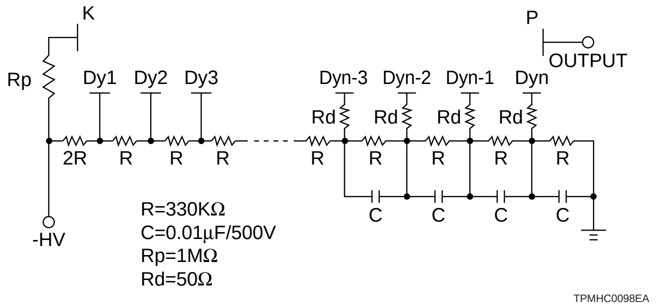
③ The voltage indicates a standard applied voltage used to measure anode characteristics. The voltage distribution ratio are shown below.

**The Voltage Distribution Ratio**

| Electrodes | K | Dy1 | Dy2 | Dy3 | ··· | Dyn-1 | Dyn | P |
|---|---|---|---|---|---|---|---|---|
| Ratio | | 2 | 1 | 1 | 1 | 1 | 1 | 1 |

Where n corresponds to a number of dynode stages of each PMT.

The circuit drawing of recommended voltage divider is shown below.




In this drawing, Rp is a protection resistor which prevents damages to the signal readout unit when the PMT generates a large output pulse, and Rd is a damping resistor which reduces ringings of output pulses.

④ Only these items are defined as a value measured with magnetic fields, and other items are defined without magnetic fields.
The direction of magnetic fields is pallarel to the tube axis.

⑤ The maximum ambient temperature range is-80°C to +50°C. When a PMT is operated below -20°C, please consult our sales office.

⑥ The maximum anode to cathode voltage is limited by the internal structure of the PMT. Excessive voltage causes electrical breakdown.

⑦ This indicates the maximum averaged current over any interval of 30 seconds.

⑧ Time Response

**Rise Time**
The time for the anode output pulse to rise from 10% to 90% of the peak amplitude.

**Electron Transit Time**
The time interval between the arrival of a delta function light pulse at the photocathode and the instant when the anode output pulse reaches its peak amplitude.

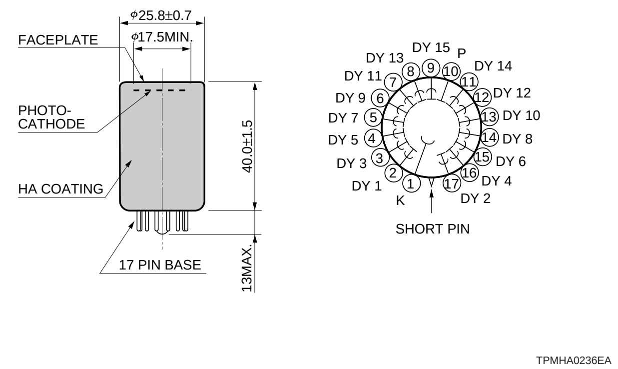
**T.T.S. (Transit Time Spread)**
This is the fluctuation in transit time among individual pulses, and is defined as the FWHM of the frequency distribution of transit time. T.T.S. depends on the number of incident photons. The values in this catalog are measured in the single photoelectron state.

⑨ This is defined as the mean gain deviation for 16 hours operation.

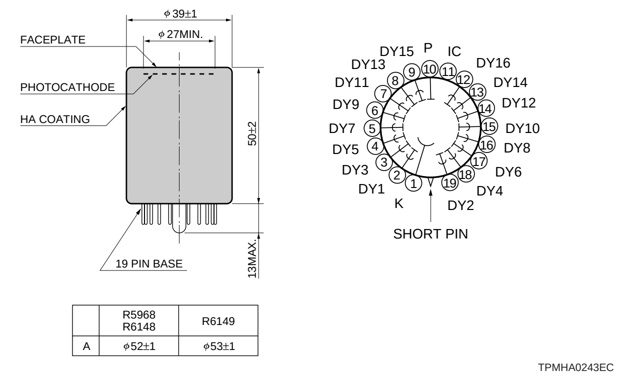
⑩ The definition of the pulse linearity is proportionality between the input light amount and the output current in the pulse operation mode.
Typical values of pulse linearity are specified at two deviation points of ±2% and ±5% from linear proportionality.

Unit: mm

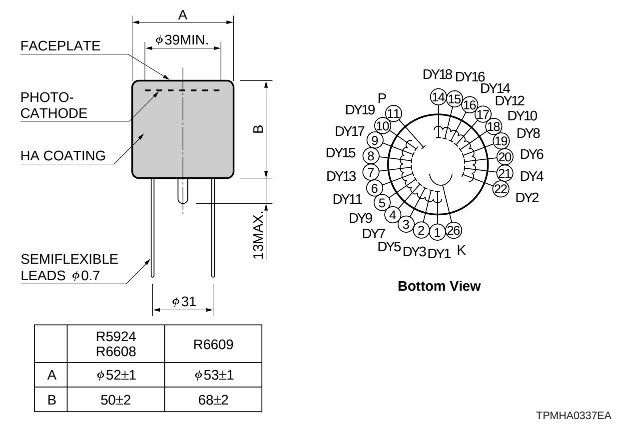
## ① R5505, R5506



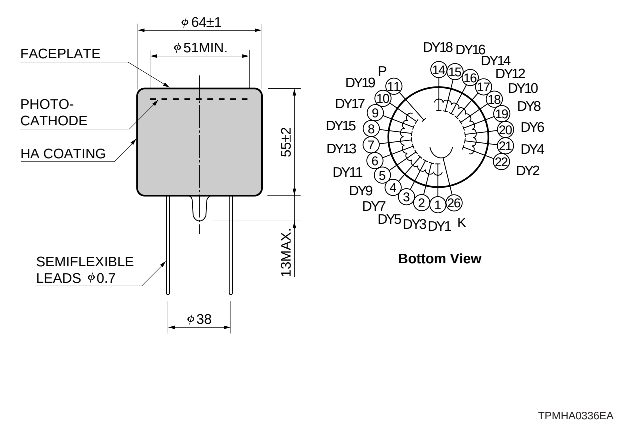

## ② R5946, R6148, R6149



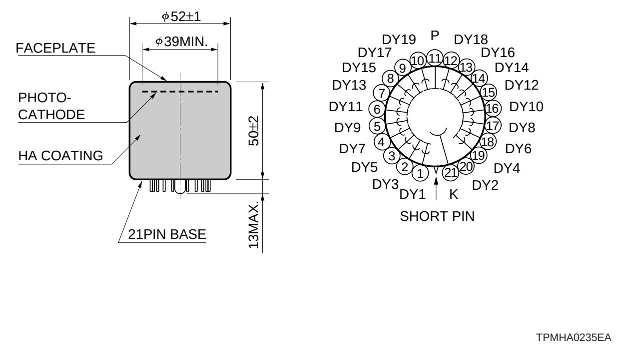

## ③ R5924/-01, R6608, R6609



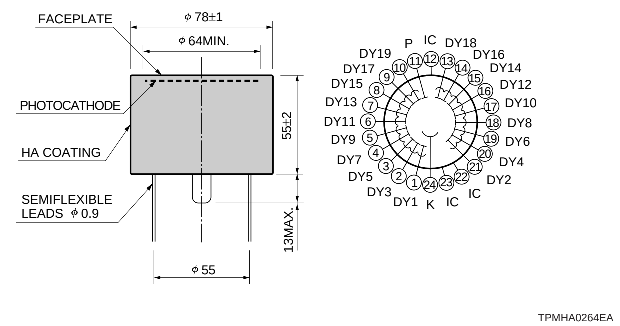

## ④ R6504, R6505




## R5924-01 (Glass Base Type)




## ⑤ R5542, R5543



# FINE MESH PMT SERIES for HIGH MAGNETIC FIELD ENVIRONMENTS

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**Fig.1: Typical Spectral Response**

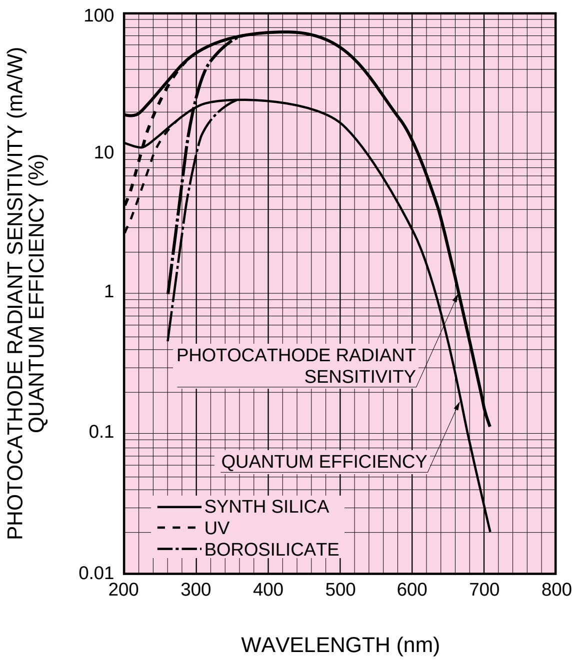


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**Fig.2: Typical Current Amplification**

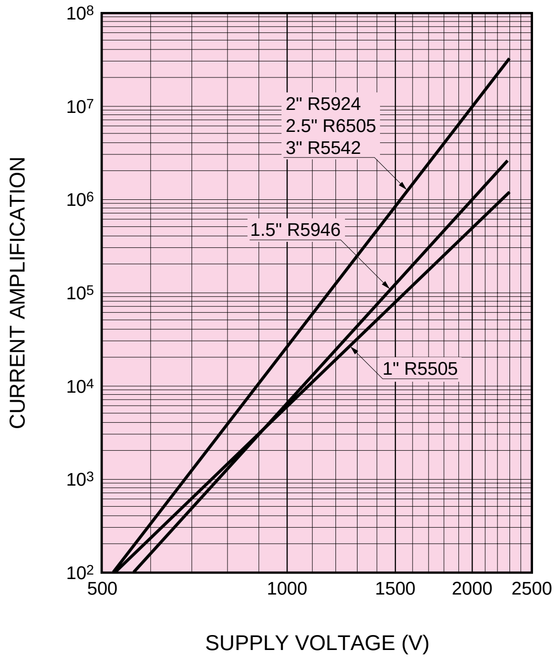


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**Fig.5: R5505 Typical Current Amplification in Magnetic Fields**

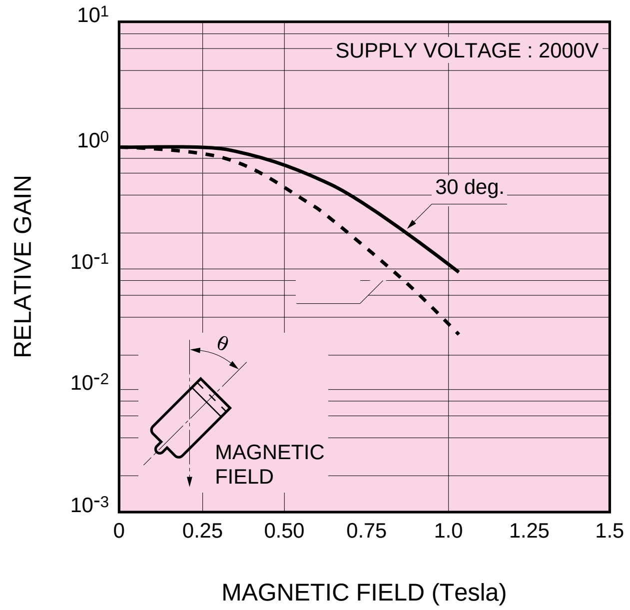


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**Fig.6: R5946 Typical Current Amplification in Magnetic Fields**

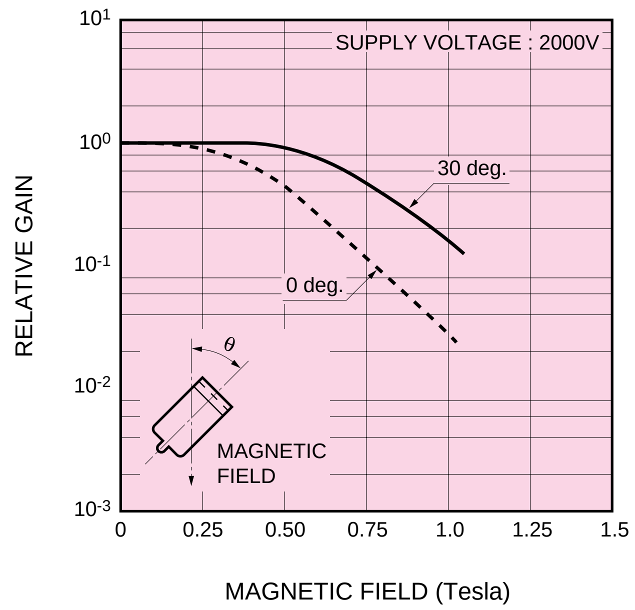


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**Fig.3: Typical Time Response**

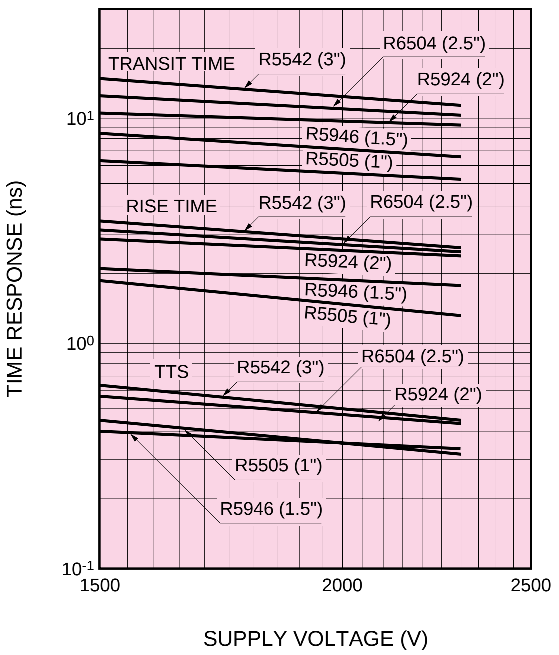


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**Fig.4: Typical Pulse Linearity**

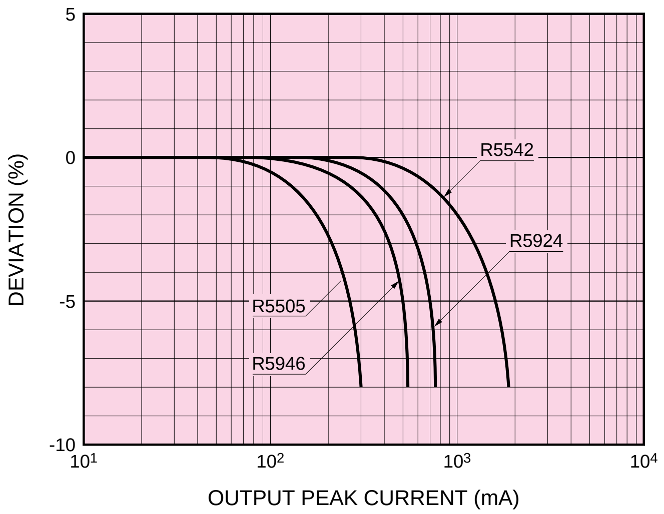


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**Fig.7: R5924 & R6504 Typical Current Amplification in Magnetic Fields**

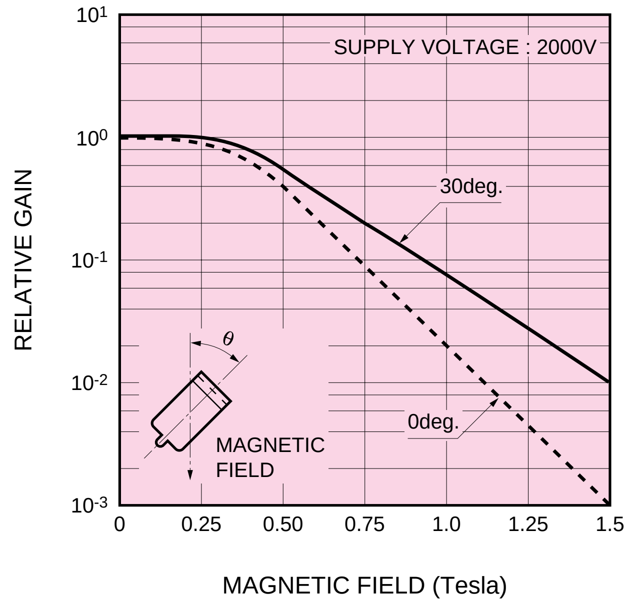


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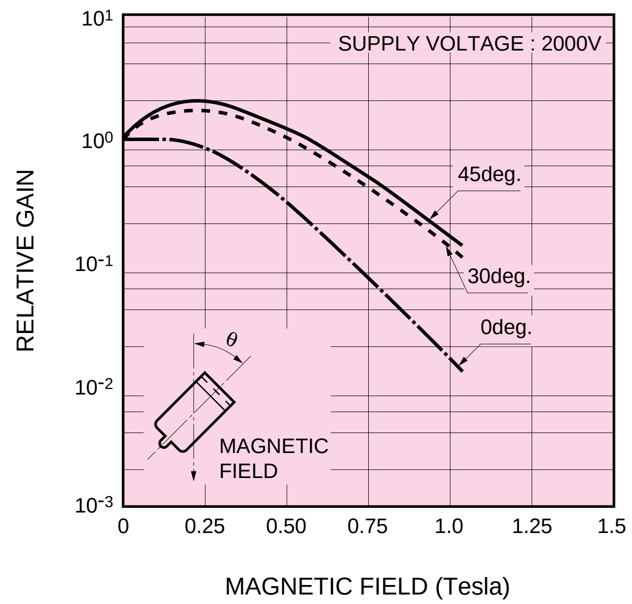
**Fig.8: R5542 Typical Current Amplification in Magnetic Fields**

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## ASSEMBLIES for FINE MESH PMT SERIES

| Type Number | PMT Tube Diameter | PMT Type Number | Outline Number | Ground Potential | H.V. Input Terminal | Signal Output Terminal | ⓐ Material of Case | Total Resistance (MΩ) | Maximum Rating Overall Voltage (V) | Maximum Rating Divider Current (µA) | Maximum Rating Average Anode Current (µA) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SOCKET ASSEMBLIES** | | | | | | | | | | | | |
| E6133-03 | 25mm (1") | R5505 | ① | ANODE | COAXIAL CABLE (with SHV) | RG-174/U (with BNC) | POM | 5.61 | 2300 | 410 | 10(at 2000V) | |
| E6113-02 | 38mm (1.5") | R5946 | ② | ANODE | COAXIAL CABLE (with SHV) | RG-174/U (with BNC) | POM | 5.94 | 2300 | 390 | 10(at 2000V) | |
| E6132-02 | 51mm (2") | R5924-01 | ③ | ANODE | COAXIAL CABLE (with SHV) | RG-174/U (with BNC) | POM | 6.93 | 2300 | 330 | 17(at 2000V) | |
| **HYBRID ASSEMBLIES (PMT INCLUDED)** | | | | | | | | | | | | |
| H6152-01 | 25mm (1") | R5505 | ④ | ANODE | COAXIAL CABLE | RG-174/U | POM | 5.61 | 2300 | 410 | 10(at 2000V) | |
| H6153-01 | 38mm (1.5") | R5946 | ⑤ | ANODE | COAXIAL CABLE | RG-174/U | POM | 5.94 | 2300 | 390 | 10(at 2000V) | |
| H6614-01 | 51mm (2") | R5924 | ⑥ | ANODE | COAXIAL CABLE | RG-174/U | POM | 6.93 | 2300 | 330 | 17(at 2000V) | |
| H6155-01 | 76mm (3") | R5542 | ⑦ | ANODE | COAXIAL CABLE | RG-174/U | POM | 6.93 | 2300 | 330 | 17(at 2000V) | |

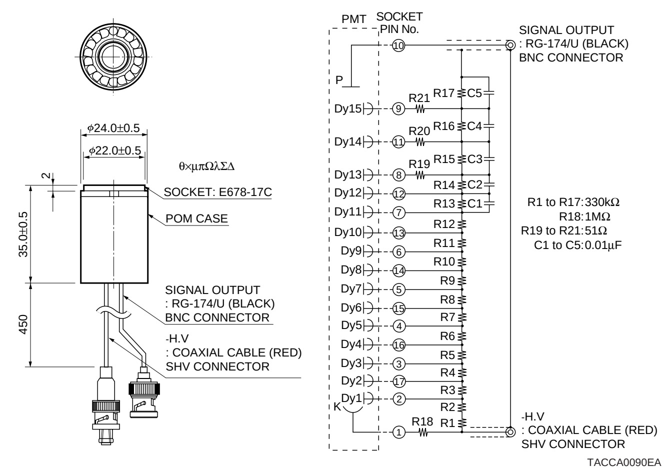
ⓐ POM : Poly Oxy Methylene

## Dimensional Outlines and Circuit Diagrams

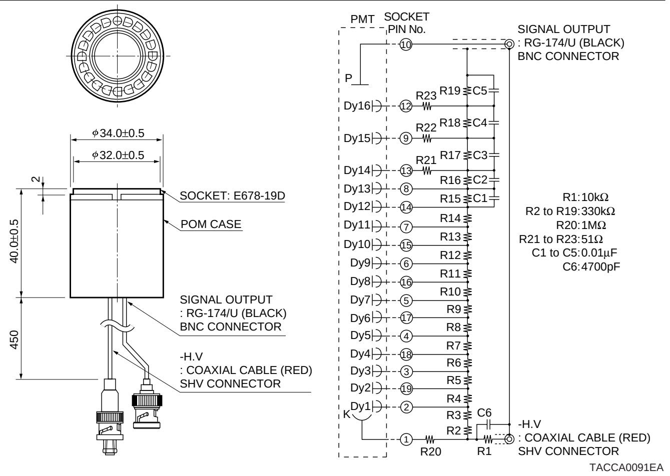
### for PMT Socket Assemblies

Unit: mm

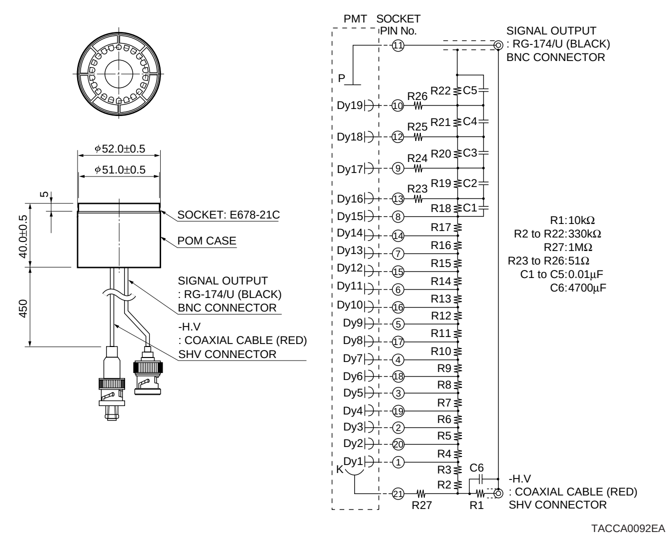
### ① E6133-03




### ② E6113-02




### ③ E6132-02

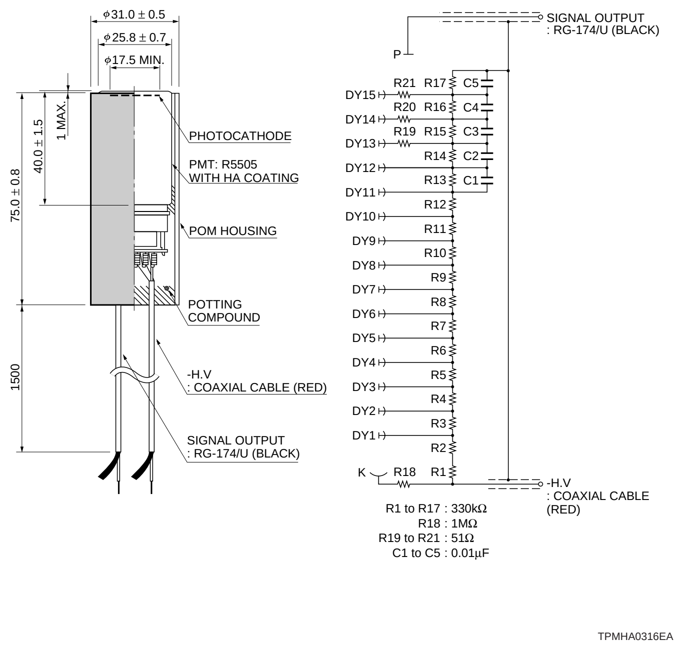



## Dimensional Outlines and Circuit Diagrams

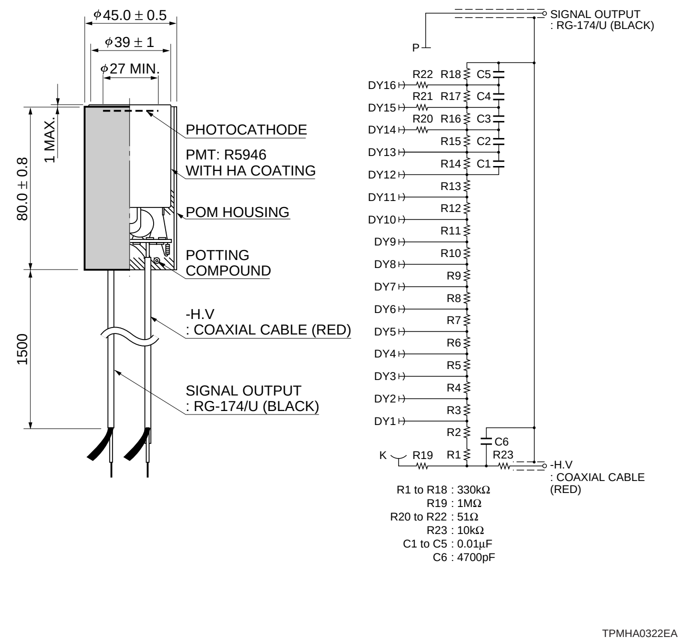
### for PMT Hybrid Assemblies

Unit: mm

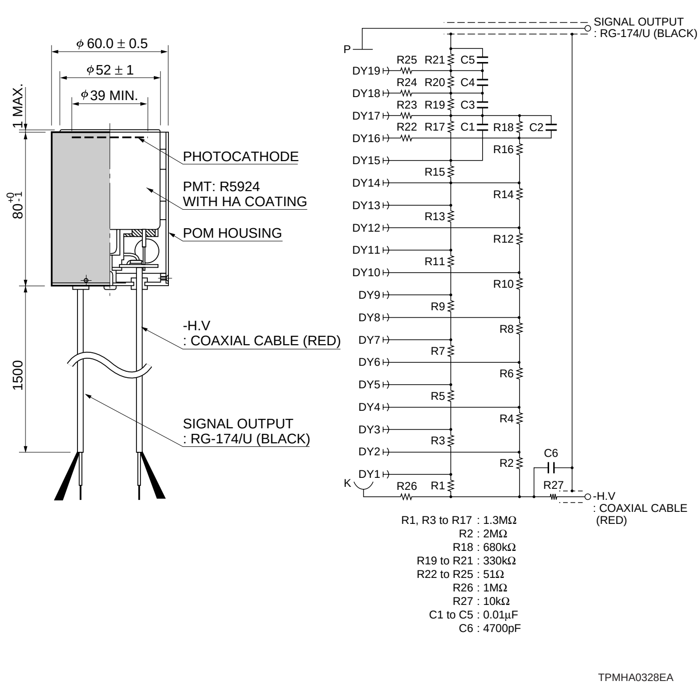
### ④ H6152-01



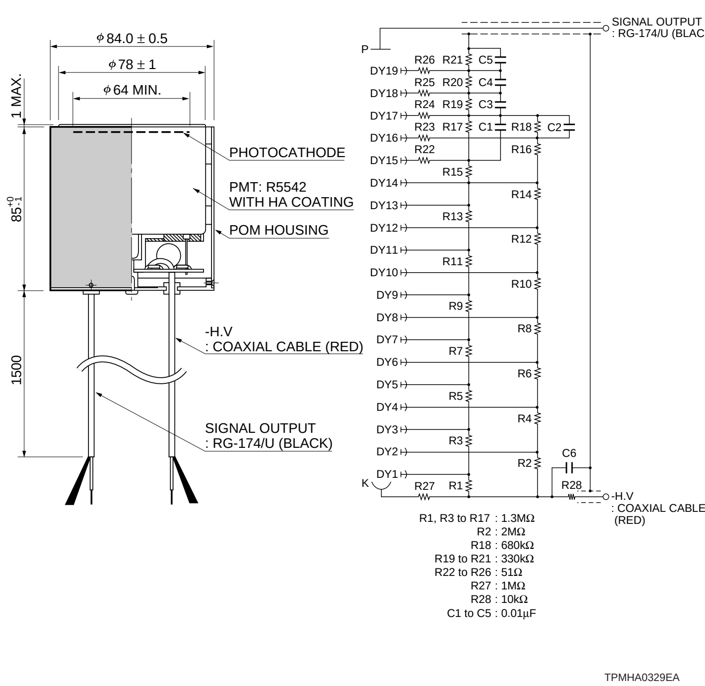

### ⑤ H6153-01




### ⑥ H6614-01




### ⑦ H6155-01

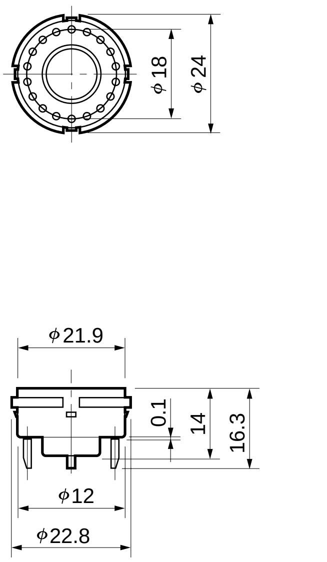


# FINE MESH PMT SERIES for HIGH MAGNETIC FIELD ENVIRONMENTS

## Socket Dimensional Outlines

Unit: mm

**E678-17A**

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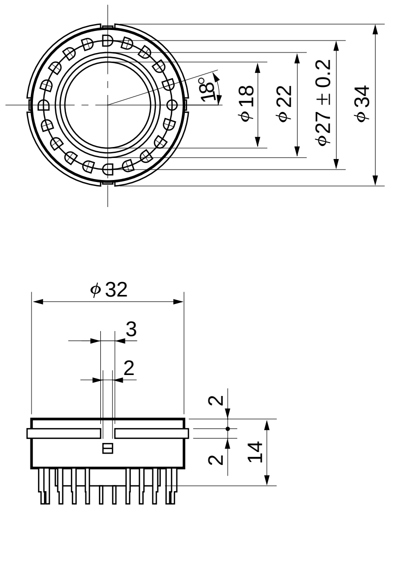
**E678-19D**

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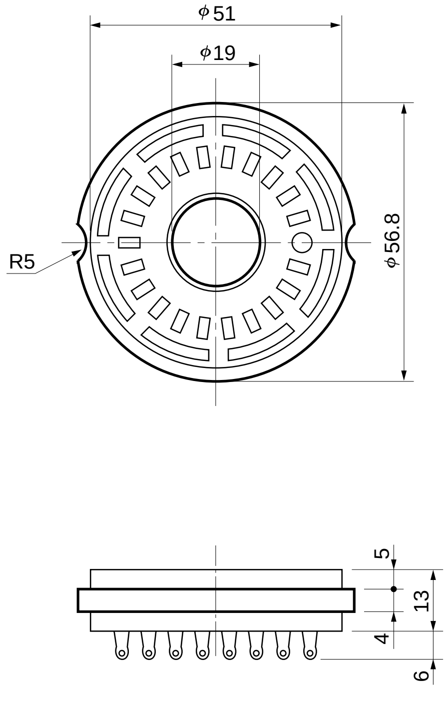
**E678-21A**

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### Warranty

All Hamamatsu photomultiplier tubes are warranted to the original purchaser for a period of 12 months following the date of shipment. The warranty is limited to repair or replacement of any defective material due to defects in workmanship or materials used in manufacture.

A: Any claim for damage of shipment must be made directly to the delivering carrier within five days.

B: Customers must inspect and test all photomultiplier tubes within 30 days after shipment. Failure to accomplish said incoming inspection shall limit all claims to 75% of invoice value.

C: No credit will be issued for broken detectors unless in the opinion of Hamamatsu the damege is due to a bulb crack traceable to a manufacturing defect.

D: No credit will be issued for any photomultiplier tubes which in the judgement of Hamamatsu has been dameged, abused, modified or whose serial number or type number have been obliterated or defaced.

E: No photomultiplier tubes will be accepted for return unless permission has been obtained from Hamamatsu in writing, the shipment has been returned prepaid and insured, the photomultiplier tubes are packed in their original box and accompanied by the original datasheet furnished to the customer with the tube, and a full written explanation of the reason for rejection of each photomultiplier tubes.

F: When photomultiplier tubes are used at the condition which exceeds the specified maximum ratings or which could hardly be grasped, Hamamatsu will not be responsible to the guarantee of photomultiplier tubes.

HAMAMATSU is always in pursuit of improvements and new developments in the field of photodetectors. We can provide various kinds of detectors, emitters and assemblies for use in high energy physics as well as other fields of physics. Please feel free to contact us at any time.


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