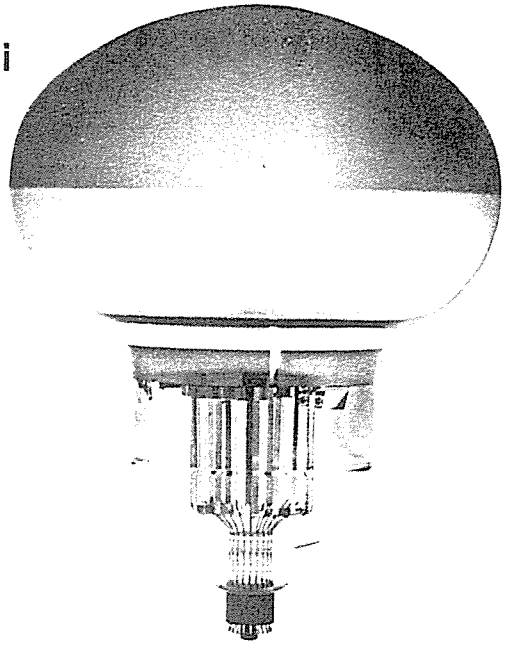
HAMAMATSU

TECHNICAL DATA SHEET

R1449

PHOTOMULTIPLIER TUBE 20 INCH HEMISPHERICAL

For High Energy Physics Research Applications (Especially For Proton Decay, Neutrino and Muon Detector) 20" Diameter, 13 Stage, Head-On, Bialkali Hemispherical Photocathode



FEATURES:

- **Ultra-Large Size with 20" Dia. Hemispherical Photocathode**
- **High Current Amplification (Note 1) ..... 1×10^7**
- **Quantum Efficiency at 390 nm (Note 16) ..... 23 %**
- **Time Response (Note 1)**
  - **Anode Pulse Rise Time (Note 2) ..... 18 ns**
  - **Anode Pulse Fall Time (Note 3) ..... 46 ns**
  - **Anode Pulse Width (FWHM) ..... 29 ns**
  - **Electron Transit Time (Note 4) ..... 90 ns**
  - **Transit Time Spread (Note 5) ..... 7.7 ns**
- **Dark Pulse Count (Note 13) ..... 40 kcps typical**
  100 kcps maximum

GENERAL:

Spectral Response ..... 300～650 nm (see Figure 1)
Wavelength of Maximum Response ..... 420 ± 30 nm
Photocathode Material ..... Bialkali
Window
  Material ..... Low expansion borosilicate glass
  Index of Refraction at 420 nm ..... 1.473 ± 0.001
  Thermal Expansion Coefficient ..... 32×10^{-7}/°C
  Shape ..... Hemispherical
Dynode
  Structure ..... Venetian blind
  Number of Stages 13
Direct Interelectrode Capacitances (approx.)
  Anode to Last Dynode ..... 36 pF
  Anode to All Other Electrodes ..... 40 pF
Base ..... JEDEC No. B20-102
Weight ..... 13 kg
Suitable Socket ..... Hamamatsu E678-20A (supplied)

MAXIMUM RATINGS (Absolute Maximum Values):

Supply Voltage
  Between Anode and Cathode ..... 2800 Vdc
  Between Anode and Last Dynode ..... 300 Vdc
Average Anode Current (Note 6) ..... 0.1 mA
Average Cathode Current (Note 7) ..... 100 nA
Ambient Temperature ..... 0～+50°C

CHARACTERISTICS (at 25°C):

	Min.	Typ.	Max.	Units
Anode Sensitivity				
Luminous (Note 1, 8)	—	400	—	A/lm
Blue (Note 1, 9)	—	65	—	A/lm-blue
Cathode Sensitivity				
Luminous (Note 10)	—	40	—	μA/lm
Blue (Note 11)	4.0	6.5	—	μA/lm-blue
Current Amplification (Note 1)	—	1×10^7	—	
Anode Dark Current (Note 1, 12)	—	200	1000	nA

FIGURE 1
Typical Spectral Response

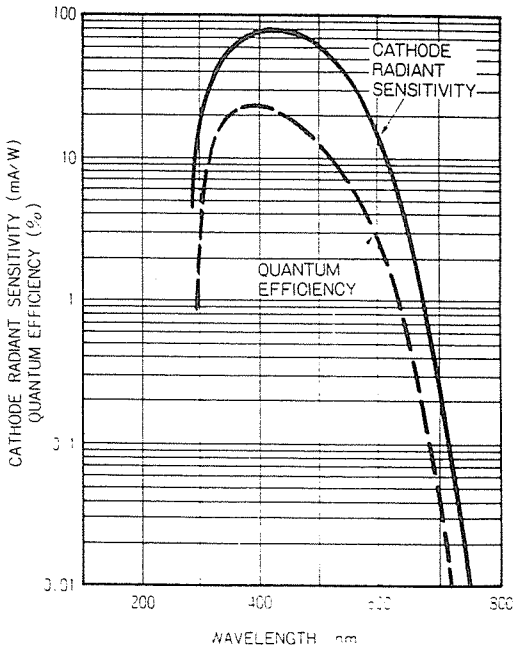


FIGURE 2
Anode Sensitivity, Current Amplification And Dark Current Characteristics

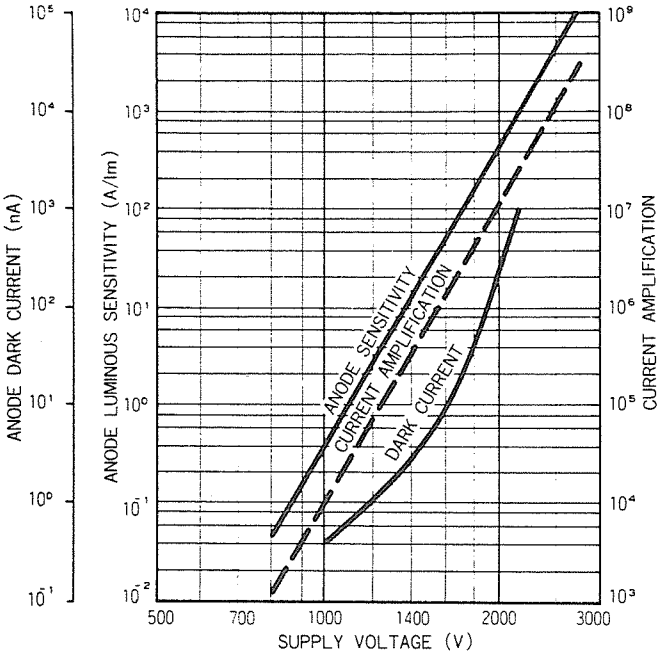


FIGURE 3
Typical Time Response

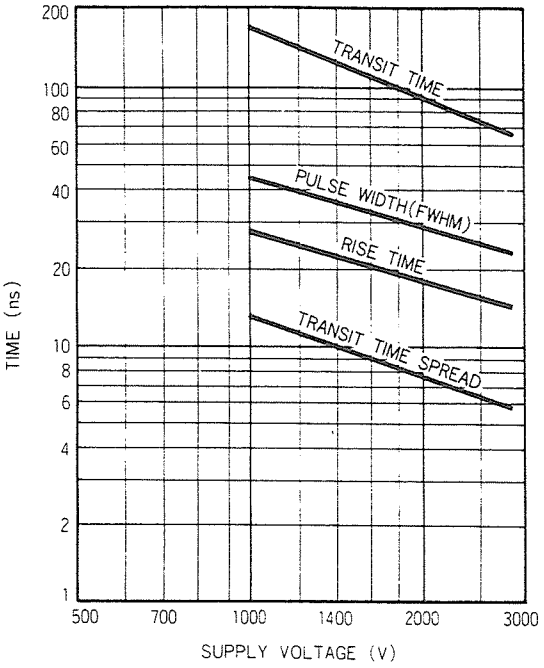


FIGURE 4
Typical Temperature Coefficient of Anode Sensitivity

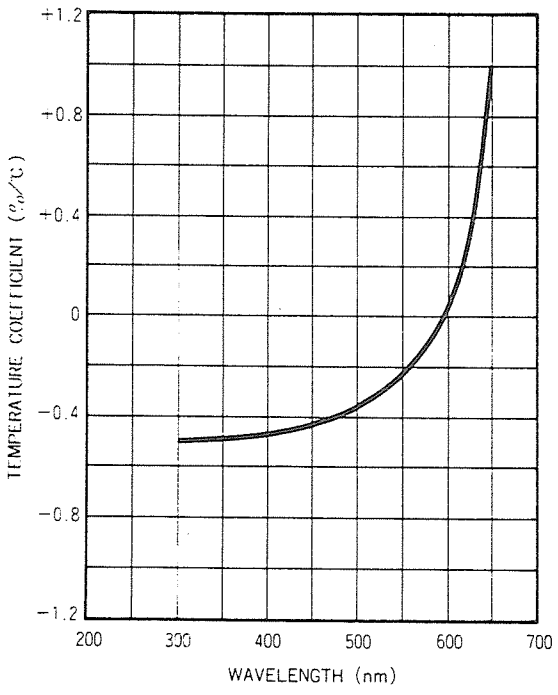


FIGURE 5
Typical Temperature Characteristic of Dark Count

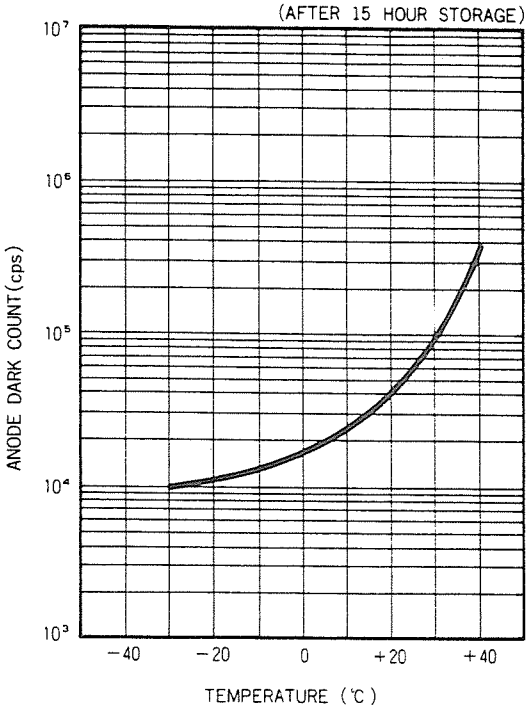


FIGURE 6
Typical Effect of Terrestrial Magnetism (Note 14)

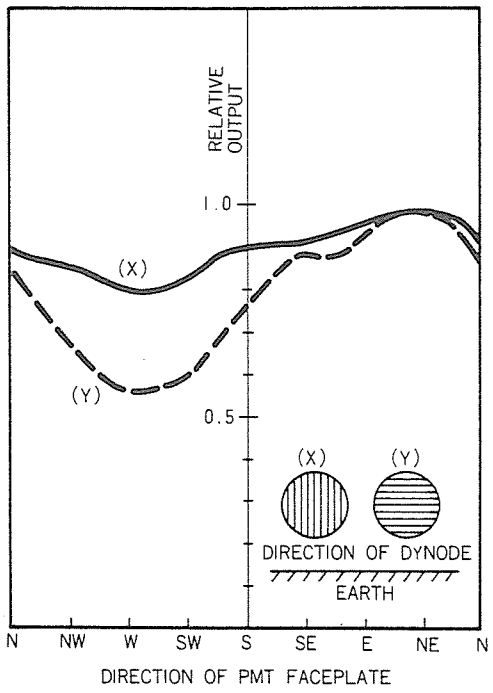


FIGURE 7
Typical Anode Uniformity

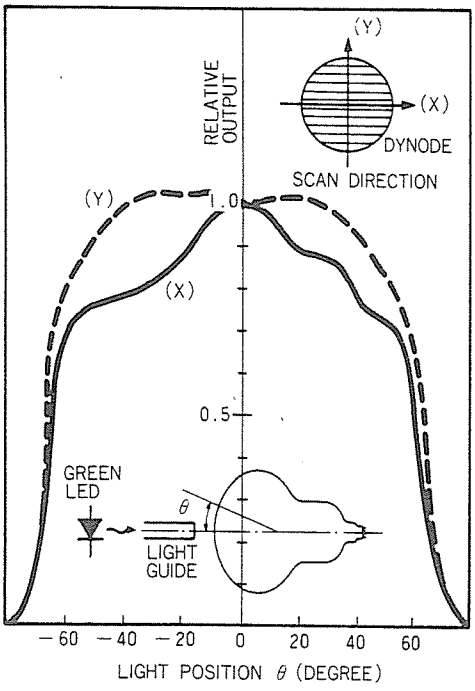
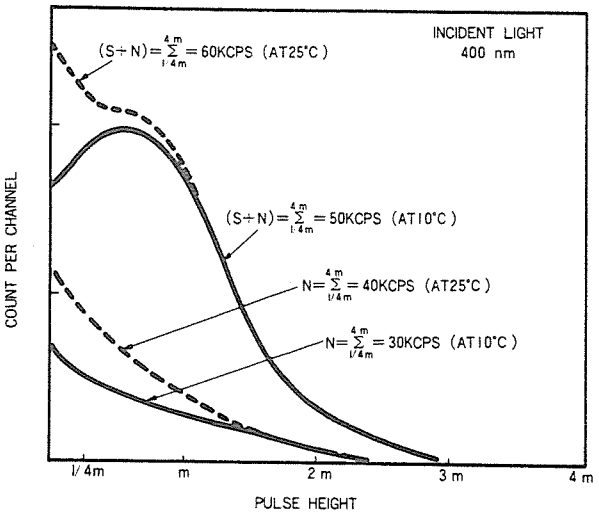
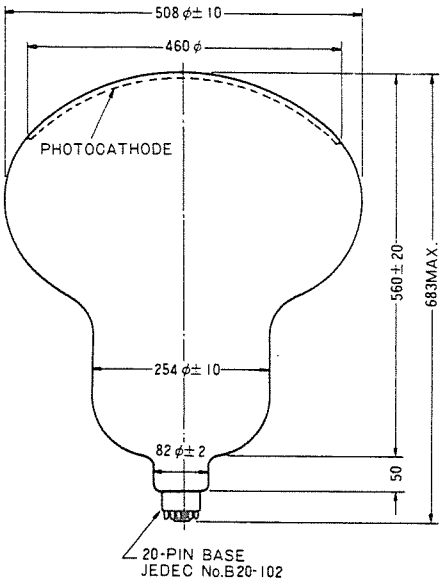


FIGURE 8
Typical Single Photoelectron Pulse Height Distribution and Cooling Effect (Note 15)

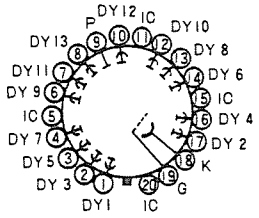


Warning—Personal Safety Hazards
Electrical Shock—Operating voltages applied to this device present a shock hazard.

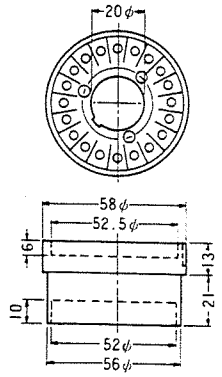
FIGURE 10
Dimensional Outlines



Basing Diagram
(Bottom View)

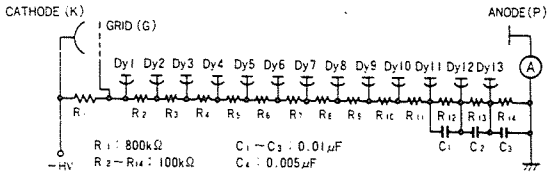


Socket E678-20A
(Supplied)



NOTES

1. Supply voltage of 2000 Vdc is applied using a voltage divider shown below.



2. The rise time is the time for the output pulse to rise from 10% to 90% of the peak amplitude when the entire photocathode is illuminated by a delta function light pulse.
3. The anode pulse fall time is defined as the time required to fall from 90% to 10% of the peak amplitude under the same conditions as Note 2.
4. The electron transit time is the interval between the arrival of a delta function light pulse at the entrance window of the tube and the time the output pulse reaches the peak amplitude. In measurement the entire photocathode is illuminated.
5. Also called transit time jitter. This is the fluctuation in transit time between individual pulses, and may be defined as the FWHM of the mean distribution of the transit time. The photocathode is fully illuminated in the single photoelectron state.
6. Averaged over any interval of 30 seconds maximum.
7. Same as Note 6 and the whole photocathode is illuminated.
8. The light source is a tungsten filament lamp operated at a distribution temperature of 2856K. The light input is 0.1 micro-lumen. The light spot is 400 millimeters in diameter.
9. The value is anode output current when a blue filter (Corning CS No. 5-58 polished to 1/2 stock thickness) is interposed between the light source and the tube under the same condition as Note 8.
10. Under the same conditions as Note 8 except that the light input is 0.1 lumen and 150 volts are applied between the cathode and all other electrodes connected together as anode.
11. The value is cathode output current when a blue filter (Corning CS No. 5-58 polished to 1/2 stock thickness) is interposed between the light source and the tube under the same condition as Note 10.
12. Measured after 5 second storage in darkness.
13. Measured after 15 hour storage in darkness at 20°C.
14. The maximum value of terrestrial magnetism is 0.34 guausses when the photocathode faceplate faces north.
15. The single photoelectron pulse height distribution can be improved by cooling the tube since cooling reduces the noise component. m is determined to satisfy the following equation.

$$\sum_{1/4m}^{m} (\text{counts per channel}) = \sum_{m}^{4m} (\text{counts per channel})$$

16. Measured with a 40 millimeter diameter light spot falling on the center of the photocathode.

PRECAUTIONS FOR USE

1. **Do not give a mechanical shock to tube.**
2. **Do not give a quick change of temperature around tube.**
3. **Do not expose tube to the sun or a strong light source.**
4. **When using tube in water, operate the tube with the anode at high voltage and the cathode at ground potential.**

HAMAMATSU

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