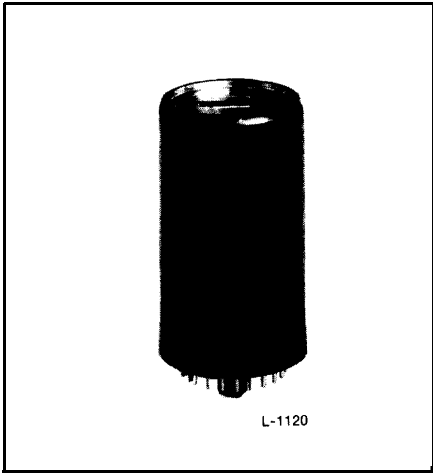


C31034 Series Photomultipliers



51-mm (2-inch) Diameter 11-Stage, End Window Quantacon[®] PMTs

- Typical Cathode Responsivity - Luminous -
C31034 : 440 uA/lm
C31034A : 720 uA/lm
- Radiant -
C31034: 52 mA/W at 860 nm
C31034A: 81 mA/W at 860 nm
- Broad Spectral Response
Range 185 to 930 nm
- Small Photocathode Area (Projected) -
4 mm x 10 mm minimum
- Low Dark Noise at -30 °C -
Maximum Dark Pulse Summation
C31034, C31034A : 50 cps
C31034-06, C31034A-05: 25 cps
C31034-02, C31034A-02: 12 cps

The BURLE C31034 Series are 51 -mm (2-inch) diameter end-window, 11 -stage Quantacon photomultipliers. They have GaAs:Cs-0 photocathodes, ultraviolet-transmitting glass windows, and in-line copper beryllium dynode structures. The C31034A is a variant of the C31034 Series which exhibits higher photocathode responsivity.

The C31034 Series is designed specifically for use at reduced temperatures, e.g., -30° C. When cooled to such temperatures, these tubes are highly useful in photon counting applications such as Raman and fluorescence spectroscopy and astronomy. Cooling reduces dark noise to a minimal value and allows taking full advantage of the performance capabilities of the tube.

Variants with lower dark pulse summations are shown under Performance Data.

Absolute-Maximum Ratings¹

	Limiting Values
Average Anode Current:	
Averaged over any 30 second interval	100 ² nA
DC Supply Voltage:	
Between anode and cathode	2200 V
Between anode and dynode No.11	250 V
Between adjacent dynodes	250 V
Between dynode No.1 and cathode	200 V
Temperature Range ³ :	
Storage	-80 to +50 °C
Operating	-80 to +30 °C

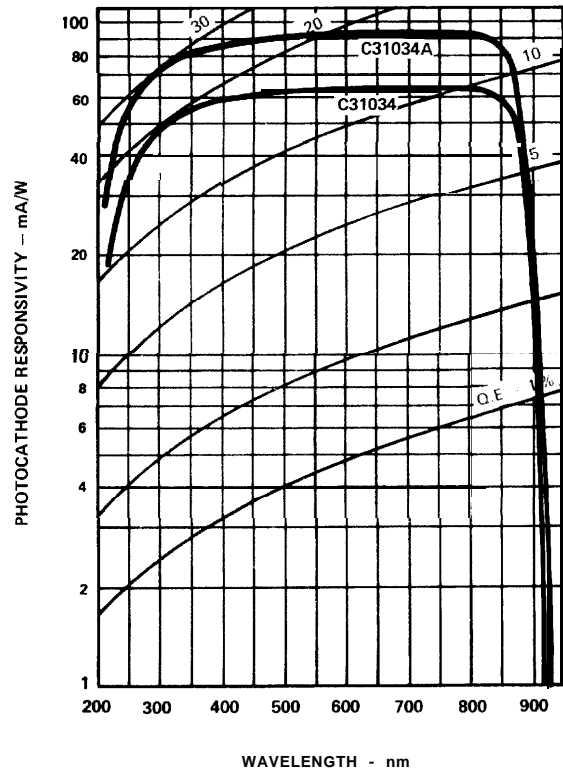


Figure 1 - Typical Photocathode Spectral Response Characteristics

Performance Data

With the voltage distribution of Table 1, an anode-to-cathode supply voltage of 1500 volts, a tungsten light source at a color temperature of 2856K, and an ambient operating temperature of 22 °C, unless otherwise indicated.

	C31034 Series			C31034A Series			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Anode Responsivity:							
Radiant at 860 nm	-	2.6 x 10 ⁴	-	-	4.9x10 ⁴	-	AW
Luminous (1 x 10 ⁵ lm)	100	210	-	100	430	-	A/lm
Cathode Responsivity:							
Radiant at 860 nm ⁴	25	52	-	70	81	-	mA/W
Luminous (1 x 10 ⁻⁴ lm, 200 volts between cathode and all other electrodes connected as anode)	210	440	-	560	720	-	uA/lm
Current Amplification (Gain)	-	0.5 x 10 ⁶	-	-	0.6x10 ⁶	-	
Rise Time	-	2.5	-	-	2.5	-	ns
Transit Time	-	33	-	-	33	-	ns
Anode Dark Current ⁵	-	15	40	-	15	40	nA
Equivalent Anode Dark Current Input:							
at a Current Amplification of 10 ⁶	-	3.4 x 10 ⁻¹¹	-	-	2.1 x 10 ⁻¹¹	-	lm
at 860 nm	-	2.9 x 10 ⁻¹³	-	-	1.9x10 ⁻¹³	-	W
Dark Pulse Summation: ⁶							
C31034	-	-	50	-	-	-	cps
C31034-02	-	-	12	-	-	-	cps
C31034-06	-	-	25	-	-	-	cps
C31034A	-	-	-	-	-	50	cps
C31034A-02	-	-	-	-	-	12	cps
C31034A-05	-	-	-	-	-	25	cps

- In accordance with the Absolute Maximum rating system as defined by the Electronic Industries Association Standard RS-239A, formulated by the JEDEC Electron Tube Council.
- The gallium arsenide photocathode of the C31034 Series is highly susceptible to a permanent loss in photocathode responsivity when high levels of **average** anode current are used. Accordingly, this maximum rating must never be exceeded. To obtain best long-term stability and life, the tube should be operated at **average** anode current values well below the specified maximum of 100 nanoamperes.
- The use or storage of these tubes with attached teflon sockets, such as the AJ2144A or AJ2145A, at temperatures below -50° C can destroy the tube. When tube operation below -50° C is desired, the teflon body of the socket should be removed and only socket-contact to circuit-element connections should be used.
- Measured using a calibrated narrow bandpass filter having a center wavelength at 860 nanometers and a bandpass (FWHM) of approximately 10 nanometers. The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2856 K and the value of light flux incident on the filter is 1 x 10⁻⁴ lumen. 200 volts are applied between cathode and all other electrodes connected **as** anode.
- The supply voltage is adjusted so that the tube is operating at a current amplification of 10⁶. The dark current is recorded. Dark current caused by thermionic emission may be reduced by cooling.
- Maximum dark count summation made between 1/8 pe and 16 pe at -30° C and a Gain of 10⁶ (See **Figure 4**).

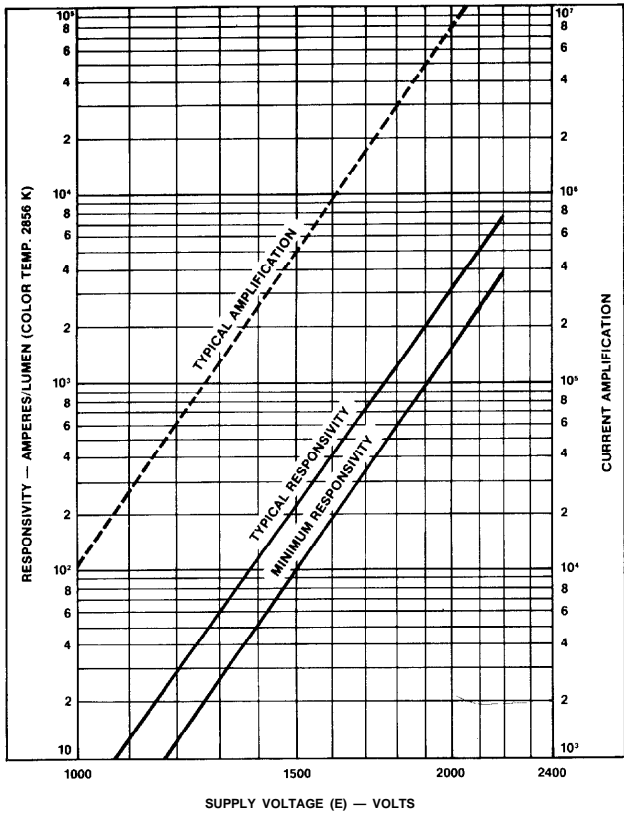
A Multichannel Pulse Height Analyzer having 256 channels is employed. The anode load is a 100 ± 5% kilohm resistor in parallel with a total capacitance of 100 ± 3% pF. The tube is measured in complete darkness. The pulse height for the single photoelectron equivalent is determined by using a light source operated at a low color temperature to assure the high probability of single photoelec-

tron emission from the photocathode of the tube. The light is removed before the dark pulse summation is measured. The supply voltage is adjusted so that the peak of the single electron distribution lies in channel No.8. This corresponds to a tube gain of approximately 10⁶.

Table 1

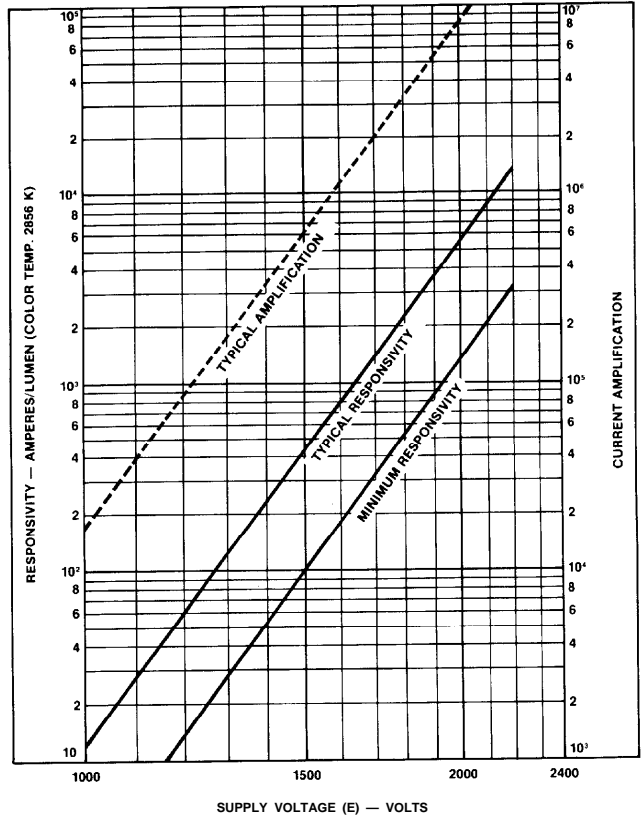
Voltage to be Provided by Divider	
Voltage (E) Between	8.06% of Supply Multiplied By:
Cathode and Dynode No.1	1.0
Dynode No.1 and Dynode No.2	1.4
Dynode No.2 and Dynode No.3	1.0
Dynode No.3 and Dynode No.4	1.0
Dynode No.4 and Dynode No.5	1.0
Dynode No.5 and Dynode No.6	1.0
Dynode No.6 and Dynode No.7	1.0
Dynode No.7 and Dynode No.8	1.0
Dynode No.8 and Dynode No.9	1.0
Dynode No.9 and Dynode No.10	1.0
Dynode No.10 and Dynode No.1	1.0
Dynode No.1 1 and Anode	1.0
Anode and Cathode	12.4

Aperture plate (pin No. 17) is connected to photocathode (pin No. 1).



LM-3912R2

Figure 2 - Responsivity and Current Amplification Characteristics - C31034 Series



LM-3994R3

Figure 3 - Responsivity and Current Amplification Characteristics - C31034A Series

Operating Considerations

Anode Current

The operating stability of the tube is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 100 nanoamperes is recommended when stability of operation is important. This maximum rating should never be exceeded because operation at higher average output currents may cause a permanent decrease in responsivity and a consequent decrease in the tube life.

Anode Dark Current and Noise

Operation of this tube at room temperature is not recommended. The tube is intended for use at reduced temperatures (below 22° C) where low anode dark current and low anode dark current count rates are readily achieved. Operation at room temperature can produce anode dark current values that approach the maximum rated average anode current value of 100 nA.

Because the tube is designed especially to provide low anode current dark noise rates, care should be taken to insure that the tube socket is never allowed to become contaminated by handling. Such contamination can produce leakage and dark current noise.

Condensation or handling may cause a contamination between pins on the stem that could produce leakage and dark current. When this is suspected, use the following stem cleaning procedure:

Wash the base with a solution of alkaline cleanser and de-ionized or distilled water having a temperature not exceeding 60 degrees C. Use a soft brush to clean between pins. After cleaning, the stem should be rinsed in de-ionized or distilled water (<60 degrees C) for several minutes and then air-blown dry. If the socket is suspected of being contaminated, follow the cooler manufacturer's recommendation for cleaning the socket.

Ambient Atmosphere

Operation or storage of this tube in environments where excessive helium is present should be avoided. Helium may permeate the tube envelope and may lead to eventual tube destruction.

Warning - Personal Safety Hazards

Electrical Shock - Operating voltages applied to these devices present a shock hazard. Appropriate precautions should be taken.

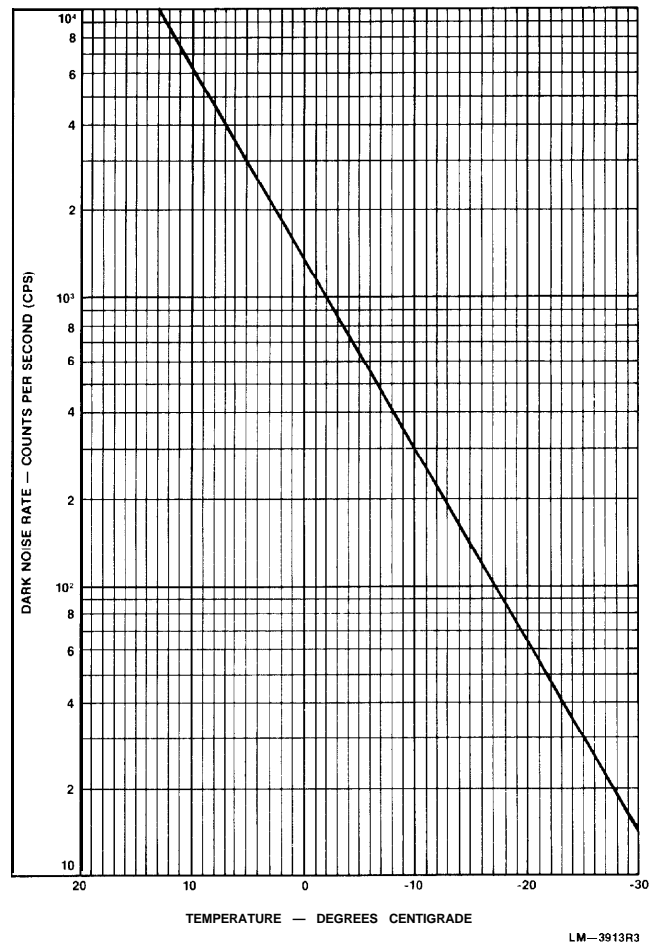
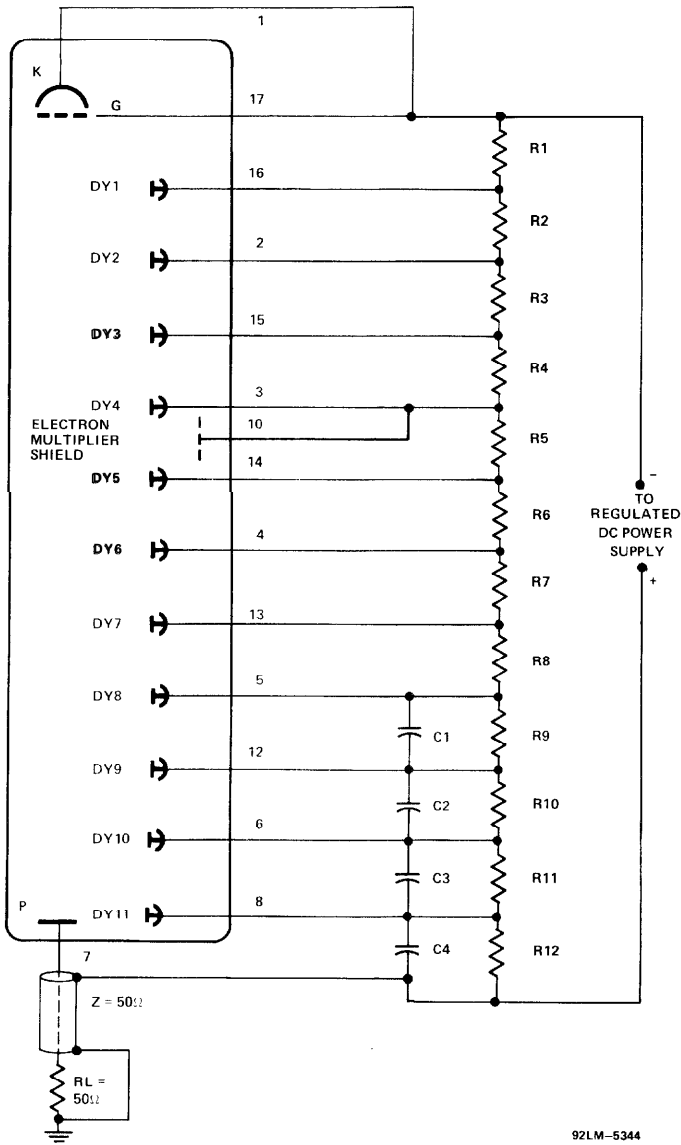


Figure 4 - Typical Dark Noise Rate as a Function of Temperature



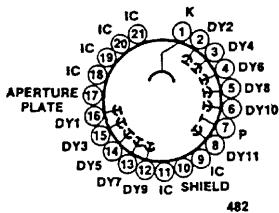
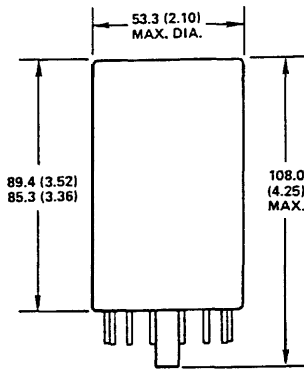
Fast Pulse Response Applications

- C₁: 0.005 uF, 20%, Ceramic Disc, 500 VDC
- C₂: 0.01 uF, 20%, Ceramic Disc, 500 VDC
- C₃: 0.02 uF, 20%, Ceramic Disc, 500 VDC
- C₄: 0.05 uF, 20%, Ceramic Disc, 500 VDC
- R₁: 1 M ohms, 5%, 1/2 W
- R₂: 1.3 M ohms, 5%, 1/2 W
- R₃ through R₁₂: 1 M ohms, 5%, 1/2 W

Note: The use of proper EMI (Electromagnetic Interference) shielding is of extreme importance when the tube is used in fast pulse systems.

Figure 5 - Typical Circuit Arrangement for Fast Pulse Response

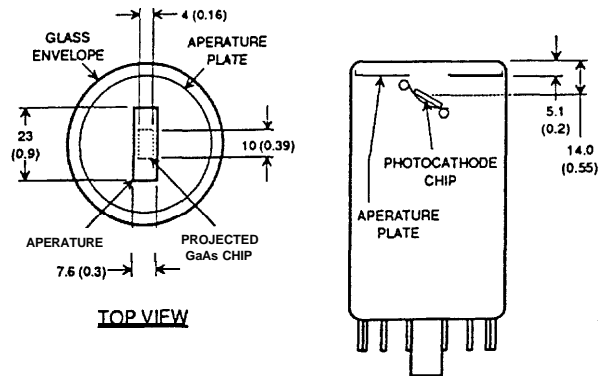
C31034, -06, -02
 C31034A, -05, -02



Socket - BURLE AJ2145A (Supplied)
 BURLE AJ2144A (Optional)

Magnetic Shield - BURLE AJ2250

GaAs Chip Location



Note 1 - Faceplate material is Corning No. 9741, or equivalent. Its index of refraction at 656 nm is 1.46.

Note 2 - Magnetic shielding of the tube is ordinarily required. A typical shield is the BURLE AJ2250.

Note 3 - Typical sockets for use with this base are the BURLE Teflon types AJ2144 and AJ2145A. The AJ2145A is ordinarily supplied with the tube and is designed specifically for chassis mounting. The AJ2144A is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

Warning. The tube should never be operated or stored at temperatures below -50° C with teflon-body sockets attached. See footnote 3 following data tabulation.

Note 4 - To reduce noise generated by the glass envelope, the stem of the tube is potted and the tube's sidewalls are covered with a conductive coating. The conductive coating is connected electrically to the cathode pin. A black protective covering is used over the conductive coating.

Warning. Shock Hazard. Although the black protective covering provides some electrical insulation, the conductive coating/photocathode is normally operated at -HV. Appropriate precautions should be taken.

Dimensions in millimeters. Dimensions in parentheses are in inches.

Figure 6 - Dimensional Outline