25 mm (1") encapsulated photomultiplier
9110V02 series data sheet

ET Enterprises electron tubes

1 description

The 9110V02 encapsulated photomultiplier comprises a 25mm (1") diameter, compact, rugged, end window photomultiplier with a plano-concave window, high temperature blue-green sensitive bialkali photocathode and 10 BeCu dynodes of circular focused design.

The photomultiplier is encapsulated, together with a voltage divider, in a mumetal* sleeve.

This type will operate up to 175°C and has a minimum plateau length of 150 V at 150°C.

2 applications

- oil well logging including measuring while drilling (MWD)
- x-ray and gamma ray spectroscopy in harsh environments

3 features

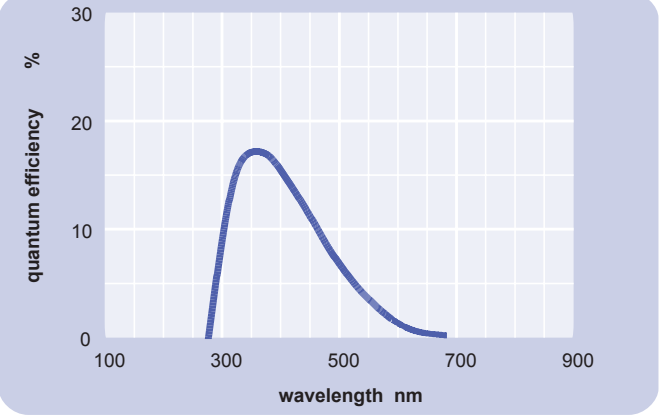
- rugged
- high temperature operation
- encapsulated in a mu-metal sleeve with an integral voltage divider

4 window characteristics

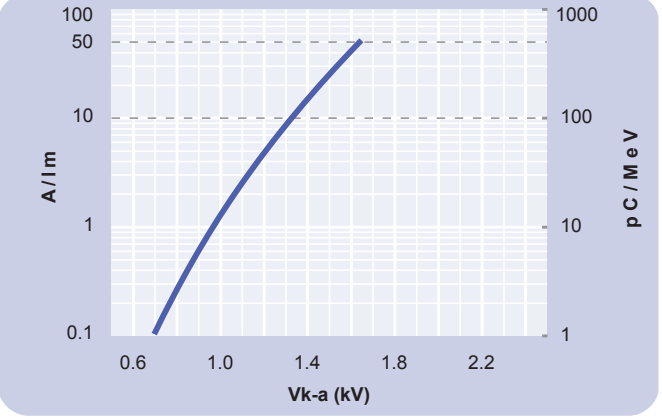
	9110V02 borosilicate
spectral range* (nm)	280 - 630
refractive index (n_d)	1.49
K (ppm)	300
Th (ppb)	250
U (ppb)	100

* wavelength range over which quantum efficiency exceeds 1 % of peak

5 typical spectral response curves



7 typical voltage gain characteristics



6 characteristics

	unit	min	typ	max
photocathode:				
high temperature bialkali				
active diameter	mm		22	
quantum efficiency at peak	%		17	
luminous sensitivity	∝A/lm		50	
with CB filter		4	6	
with CR filter			5	
dynodes: 10CFBeCu				
anode sensitivity:				
nominal anode sensitivity	A/lm		10	
max. rated anode sensitivity	A/lm		50	
overall voltage for nominal A/lm	V		1350	1500
overall voltage for max. rated A/lm	V		1650	
gain at nominal A/lm	x 10^6		0.2	
dark current at 20 °C:				
DC at nominal A/lm	nA		0.1	1
DC at max. rated A/lm	nA		0.5	
pulsed linearity (-5 % deviation):				
divider A	mA		20	
resolution:				
^{137}Cs with 1.0 " dia x 1.5 " NaI(Tl)			10	
temperature coefficient:	% °C^{-1}		-0.5	
timing:				
multi-electron rise time	ns		2	
multi-electron fwhm	ns		4	
single electron rise time	ns		1.8	
transit time	ns		15	
weight:	g		64	
maximum ratings:				
anode current	∝A			100
cathode current	nA			20
gain	x 10^6			1
sensitivity	A/lm			50
	pC/MeV			500
temperature	°C	-55		175
V (k-a)[1]	V			2300
V (k-d1)	V			450
V (d-d)[2]	V			300
ambient pressure (absolute)	kPa			202

(1) subject to not exceeding max. rated sensitivity (2) subject to not exceeding max rated V(k-a)

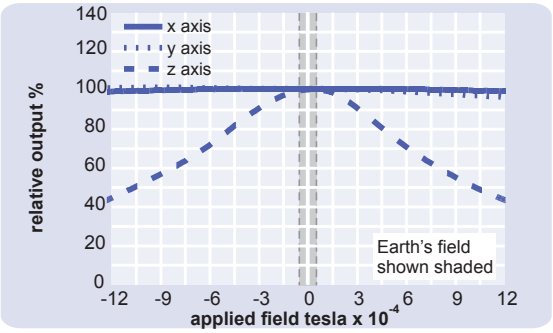
qualification shock & vibration levels (all 3 axes, non-operating)

random vibration:	
5 Hz to 100 Hz roll on	6 dB/octave
50 Hz to 500 Hz	0.89 g^2/Hz
500 Hz to 1000 Hz roll off	6 dB/octave
composite	25 g rms
duration	60 mins/axis
sine vibration:	
amplitude	30 g
frequency range	50 Hz to 2000 Hz
sweep rate	2 octaves/min
duration	60 mins/axis
shock (half sine wave):	
0.5 ms duration	1000 g peak
4 ms duration	250 g peak
shocks per axis	3 up, 3 down

microphony under random vibration (all 3 axes, operating)

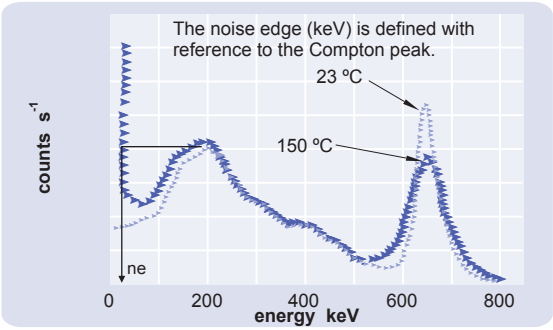
random vibration:	
20 to 100 Hz roll on	6 dB/octave
100 to 400 Hz	0.103 g^2/Hz
400 to 500 Hz roll off	6 dB/octave
composite	6.5 g rms
duration	5 mins/axis
microphony at 100 pC/MeV above a threshold of 5.5 pC (55 keV)	< 1 cps

8 magnetic field sensitivity



9 pulse height resolution with NaI(Tl) crystal

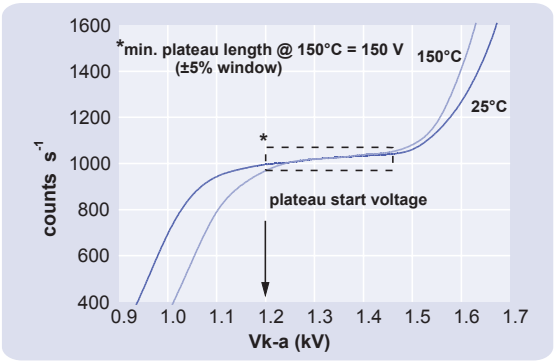
This pmt is tested for resolution at room temperature & at high temperature.



spectral data	unit	20 °C typ	20 °C max	150 °C typ
operating voltage for 13 pC/MeV	V	1050	1200	1150
operating voltage for 100 pC/MeV	V	1350	1500	1450
pulse height resolution	%	10		13
noise edge	keV	<10		25

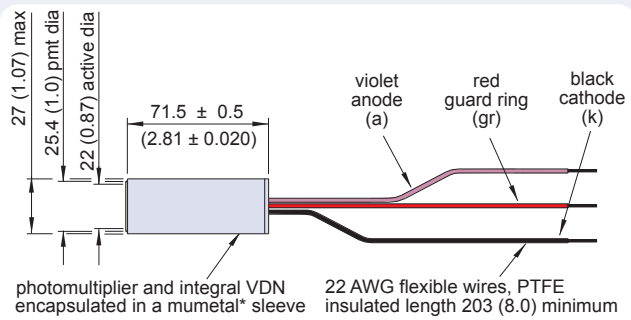
10 pulse counting with NaI(Tl) crystal

Pulse counting plateau with ^{137}Cs and NaI(Tl) crystal (1.0" dia. x 1.5")

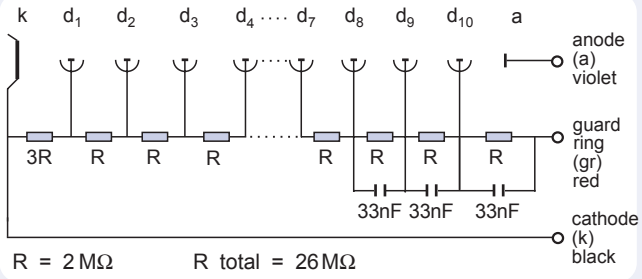


plateau data	unit	150°C min	150°C typ	150°C max
combined 25 °C / 150 °C:				
plateau start (1.5 pC threshold)	V		1200	1500
plateau length ±5 %	V	150		

11 external dimensions in mm (inches)



12 voltage divider distribution

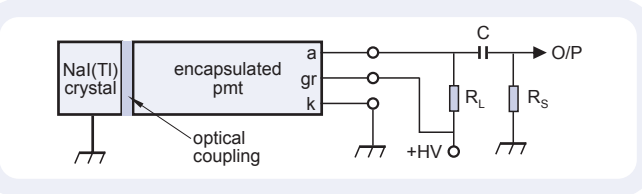


13 ordering information

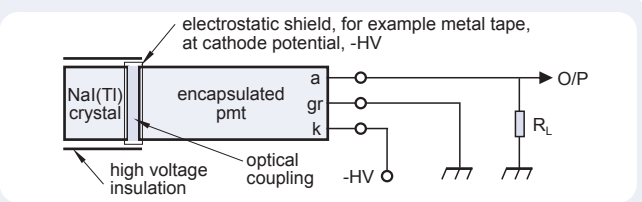
The 9110V02 meets the specification contained in this data sheet. If you want a different specification then discuss your requirements with us. For customer specific requirements, **ET Enterprises** will change the 2 digit numeric suffix to indicate additional tests and selection.

14 applications with NaI(Tl) crystals

The use with positive HV is recommended, as shown in the diagram below:



With negative HV, as shown in the next diagram, any material in contact with the window, for example the NaI(Tl) crystal, **must** be maintained at cathode potential and insulated for safety. The interface between the NaI(Tl) crystal and the pmt window **must** be shielded along the body of the housing.



These precautions are essential to prevent erratic behaviour.

*mumetal is a registered trademark of Magnetic Shield Corporation

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