

# 25 mm (1") encapsulated photomultiplier

## 9110V15 series data sheet

### 1 description

The 9110V15 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 100 V at 175°C.**

### 2 applications

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

### 3 features

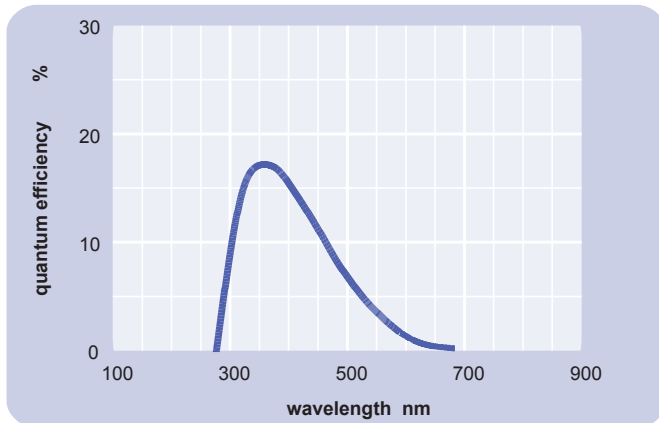
- rugged
- high temperature operation
- encapsulated in a mu-metal sleeve with an integral voltage divider

### 4 window characteristics

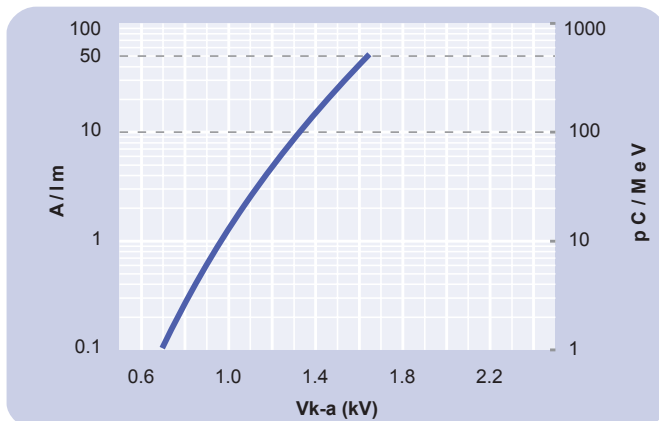
	9110V15 borosilicate
spectral range* (nm)	280 - 630
refractive index ( $n_d$ )	1.49
K (ppm)	300
Th (ppb)	250
U (ppb)	100

\* 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
<b>photocathode:</b>				
<b>high temperature bialkali</b>				
active diameter	mm		22	
quantum efficiency at peak	%		17	
luminous sensitivity	$\propto$ A/lm		50	
with CB filter		4	6	
with CR filter			5	
<b>dynodes: 10CFBeCu</b>				
<b>anode sensitivity:</b>				
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	$\times 10^6$		0.2	
<b>dark current at 20 °C:</b>				
DC at nominal A/lm	nA		0.1	1
DC at max. rated A/lm	nA		0.5	
<b>pulsed linearity (-5 % deviation):</b>				
divider A	mA		20	
<b>resolution:</b>				
<sup>137</sup> Cs with 1.0 " dia x 1.5 " NaI(Tl)			10	
<b>temperature coefficient:</b>				
	% °C <sup>-1</sup>		-0.5	
<b>timing:</b>				
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	
<b>maximum ratings:</b>				
anode current	$\propto$ A			100
cathode current	nA			20
gain	$\times 10^6$			1
sensitivity	A/lm			50
	pC/MeV			500
temperature	°C	-55		175
V (k-a) <sup>(1)</sup>	V			2300
V (k-d1)	V			450
V (d-d) <sup>(2)</sup>	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)

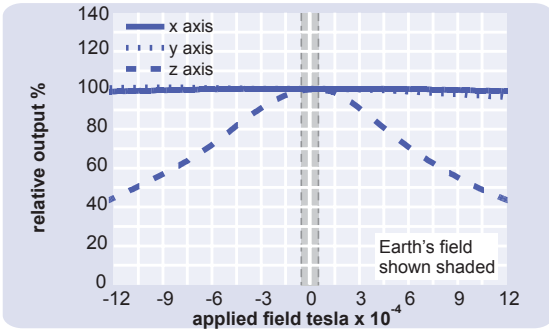
#### qualification shock & vibration levels (all 3 axes, non-operating)

<b>random vibration:</b>	
5 Hz to 100 Hz roll on	6 dB/octave
50 Hz to 500 Hz	0.89 g <sup>2</sup> /Hz
500 Hz to 1000 Hz roll off	6 dB/octave
composite	25 g rms
duration	60 mins/axis
<b>sine vibration:</b>	
amplitude	30 g peak
frequency range	50 Hz to 2000 Hz
sweep rate	2 octaves/min
duration	60 mins/axis
<b>shock (half sine wave):</b>	
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)

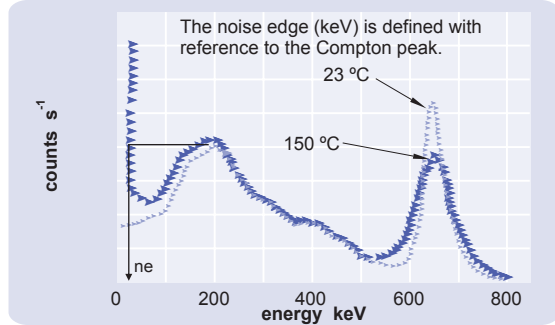
<b>random vibration:</b>	
20 to 100 Hz roll on	6 dB/octave
100 to 400 Hz	0.103 g <sup>2</sup> /Hz
400 to 500 Hz roll off	6 dB/octave
composite	6.5 g rms
duration	5 mins/axis
microphony at 100 pC/MeV above a threshold of 5.5 pC (55 keV)	< 1 cps

## 8 magnetic field sensitivity



## 9 pulse height resolution with NaI(Tl) crystal

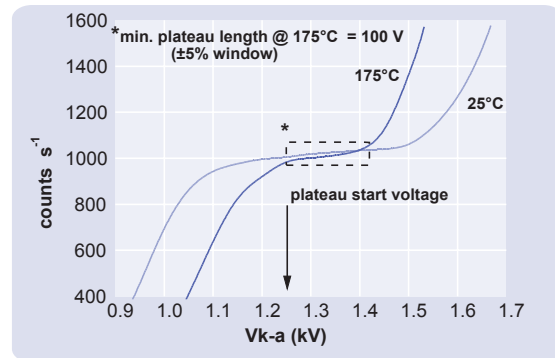
This pmt is tested for resolution at room temperature & at high temperature.



spectral data	unit	20 °C			150 °C typ
		typ	max	typ	
operating voltage for 13 pC/MeV	V	1050	1200	1200	
operating voltage for 100 pC/MeV	V	1350	1500	1500	
pulse height resolution	%	10		14	
noise edge	keV	<10		35	

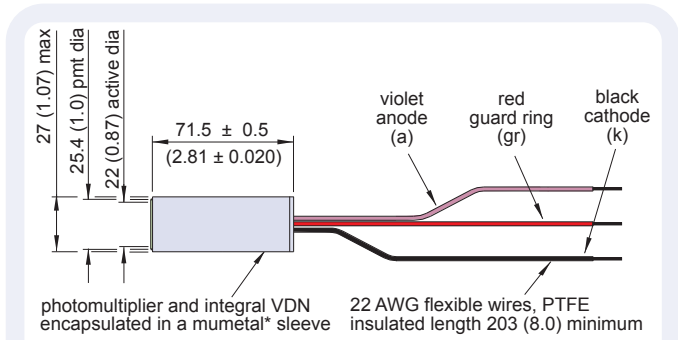
## 10 pulse counting with NaI(Tl) crystal

Pulse counting plateau with <sup>137</sup>Cs and NaI(Tl) crystal (1.0" dia. x 1.5")

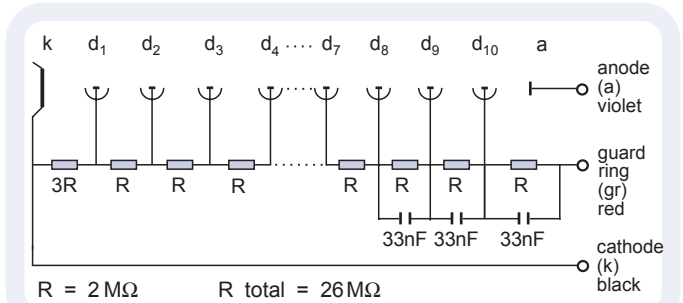


plateau data	unit	150°C		
		min	typ	max
combined 25 °C / 175 °C: plateau start (1.5 pC threshold)	V		1250	1500
plateau length ±5 %	V	100		

## 11 external dimensions in mm (inches)



## 12 voltage divider distribution

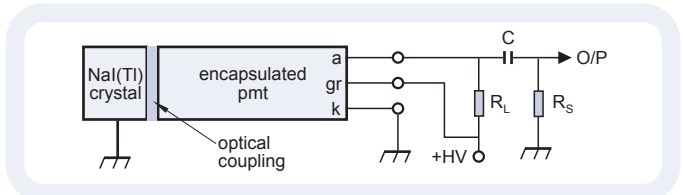


## 13 ordering information

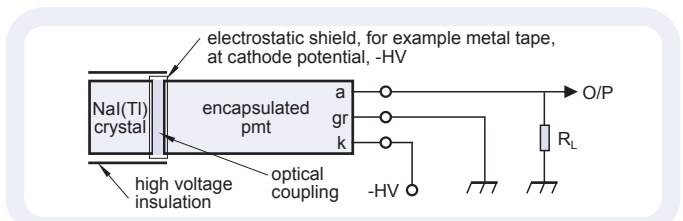
The 9110V15 meets the specification contained in this data sheet. If you want a different specification then discuss your requirements with us. For customer specific requirements, **ET Enterprises** will change the 2 digit numeric suffix to indicate additional tests and selection.

## 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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