

# 25 mm (1") photomultiplier

## 9110FLB series data sheet

### 1 description

The 9110FLB is a 25 mm (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 for fast timing and extended linearity.

This type is supplied in flying lead format and will operate up to 150°C.

### 2 applications

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

### 3 features

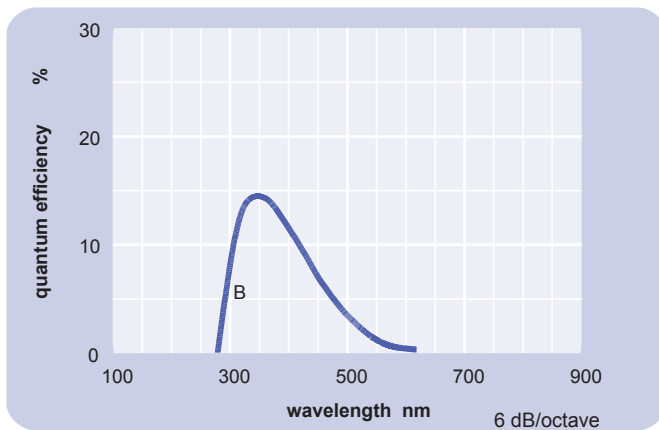
- rugged
- high temperature operation

### 4 window characteristics

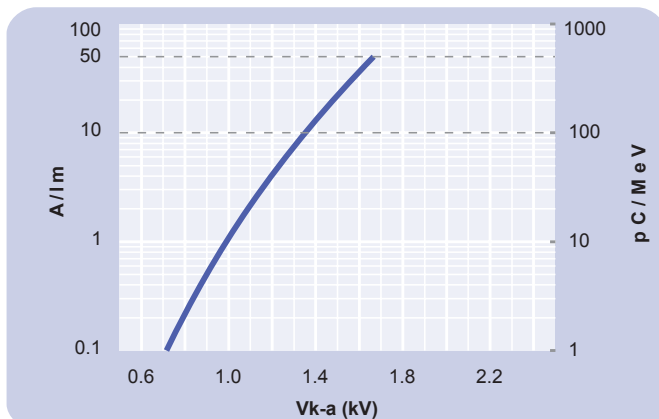
	9110FLB borosilicate
spectral range* (nm)	280 - 630
refractive index (n <sub>e</sub> )	1.49
K (ppm)	300
Th (ppb)	250
U (ppb)	100

\* 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	μA/lm		50	
with CB filter		4	6	
with CR filter			5	
<b>dynodes: 10CFBeCu</b>				
nominal anode sensitivity	A/lm		10	
	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 <sup>6</sup>		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 0.75" x 1" 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	
single electron fwhm	ns		3.1	
single electron jitter (fwhm)	ns		1.2	
transit time	g		15	
	g		64	
<b>weight:</b>				
<b>maximum ratings:</b>				
anode current	μA			100
cathode current	nA			20
gain	x 10 <sup>6</sup>			1
sensitivity	A/lm			100
	pC/MeV			150
temperature	°C	-55		150
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			

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

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

##### random vibration:

10 to 100 Hz roll on  
100 Hz to 400 Hz  
400 to 500 Hz roll off

6 dB/octave  
0.89 g<sup>2</sup>/Hz  
6 dB/octave

composite  
duration

20 g rms  
60 mins/axis

##### sine vibration:

amplitude  
frequency range  
sweep rate  
duration

6 dB/octave  
30 g  
50 Hz to 2000 Hz  
2 octaves/min  
60 mins/axis

##### shock (half sine wave):

0.5 ms duration  
4 ms duration  
shocks per axis

1000 g peak  
250 g peak  
3 up, 3 down

#### microphony under random vibration (all 3 axes, operating)

##### random vibration:

20 to 100 Hz roll on  
100 to 400 Hz  
400 to 500 Hz roll off

6 dB/octave  
0.103 g<sup>2</sup>/Hz  
6 dB/octave

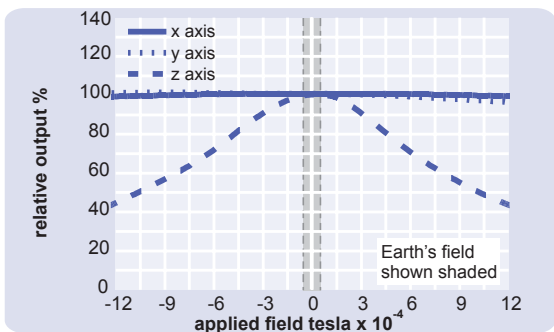
composite  
duration

6.5 g rms  
5 mins/axis

microphony at 100 pC/MeV above a threshold of 5.5 pC (55 keV)

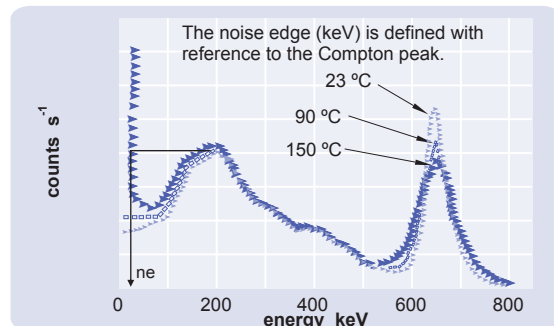
< 1 cps

## 8 magnetic field sensitivity



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

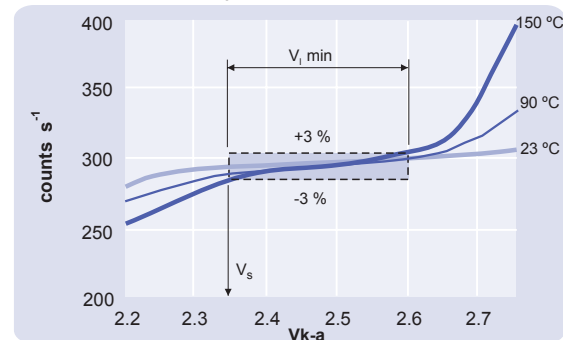
This pmt is tested for resolution at room temperature & at high temperature.



spectral data	unit	20 °C		150 °C
		typ	max	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 <sup>137</sup>Cs illustrating the definition of the start of the plateau  $V_s$  and the length of the plateau  $V_l$ .



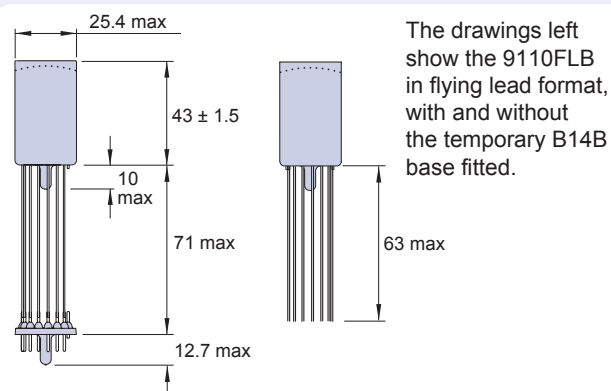
plateau data	unit	150 °C		
		min	typ	max
<b>combined 20 °C / 150 °C:</b>				
plateau start (5.5 pC threshold)	V		1200	1500
plateau length ±3 %	V	100		

## 11 voltage divider distribution

k	d <sub>1</sub>	d <sub>2</sub>	.....	d <sub>6</sub>	d <sub>7</sub>	d <sub>8</sub>	d <sub>9</sub>	d <sub>10</sub>	a	
3R	R	.....		R	R	R	R	R	R	Standard
3R	R	.....		R	R	R	2R	4R		High Pulsed Linearity

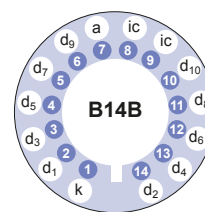
Characteristics contained in this data sheet refer to divider A unless stated otherwise.

## 12 external dimensions mm

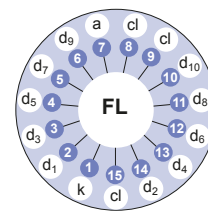


The drawings left show the 9110FLB in flying lead format, with and without the temporary B14B base fitted.

## 13 base configuration (viewed from below)



temporary B14B hardpin base (for 9110FLB)  
'ic' indicates an internal connection



flying lead base (for 9110FLB) after removal of temporary B14B base  
'cl' indicates a cut lead

A wide range of B14B sockets is available to suit the temporary B14B hardpin base.

## 14 ordering information

The 9110FLB meets the specification given in this data sheet. You may order product with **specification options** by discussing your requirements with us. If your selection option is for one-off order, then the product will be referred to as 9110FLA. For a repeat order, ET Enterprises will give the product a two digit suffix after the letter B, for example B21.

options	9110FL
<b>M</b> supplied with spectral response calibration	
specification options	
<b>B</b> as given in data sheet	
<b>A</b> single order to selected specification	
<b>Bnn</b> repeat order to selected specification	

## 15 voltage dividers

The standard voltage divider available for the 9110FLB is tabulated below:

	k	d <sub>1</sub>	d <sub>2</sub>	.....	d <sub>6</sub>	d <sub>7</sub>	d <sub>8</sub>	d <sub>9</sub>	d <sub>10</sub>	a
C651A	3R	R	.....		R	R	R	R	R	
C651B	3R	R	.....		R	R	R	2R	4R	
C651C	150 V	R	.....		R	R	R	R	R	
C651D	150 V	R	.....		R	R	R	2R	4R	

R = 4.3 MΩ

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