

Standard very fast, 12-stage, 51 mm (2") round tube

Applications : High and medium energy physics where the number of photons to be detected is very low and where utmost time characteristics are required. This tube features a good linearity, a very low background noise and extremely good time characteristics and good single electron spectrum			
Description :	Window :	Material :	borosilicate glass
		Photocathode :	bi-alkali
		Refr. index at 420 nm :	1.48
	Multiplier :	Structure :	linear focused
		Nb of stages :	12
	Mass :	240 g	

Photocathode characteristics

Spectral range :	270-650	nm
Maximum sensitivity at :	420	nm
Sensitivity ① :	Luminous :	70 $\mu\text{A}/\text{lm}$
<input checked="" type="checkbox"/> Blue :	min.: 7.5 typ.: 10	$\mu\text{A}/\text{lmF}$
	Radiant, at 420 nm :	typ.: 80 mA/W

Characteristics with voltage divider A

Gain slope (vs supp. volt., log/log) :	9	
For a gain of :	3×10^7	
<input checked="" type="checkbox"/> Supply voltage :	max.: 2600 typ.: 2000	V
	min.: 1750	
<input checked="" type="checkbox"/> Anode dark current ② :	max.: 100 typ.: 10	nA
<input checked="" type="checkbox"/> Background noise ③ :	max.: 2500 typ.: 900	c/s
Single electron spectrum ④ :		
	resolution :	typ.: 70 %
	peak to valley ratio :	typ.: 2.5
Pulse amplitude resolution for ^{137}Cs ⑤ :		7.2 %
Gain halved for a magnetic field of :		
	perpendicular to axis "n" :	0.15 mT
	parallel with axis "n" :	0.12 mT

Characteristics with voltage divider C ⑥ :

	C	B	A	
For a supply voltage of :	2500	2800	2000	V
Gain :	4×10^7	4×10^6	3×10^7	
Linearity (2%) of anode current up to :	70	280	25	mA
Anode pulse ⑦ :				
	Rise time :	1.5	1.7	1.6 ns
	Duration at half height :	2.4	2.7	3.7 ns
	Transit Time :	30	31	28 ns
	Transit Time Spread :			
	Standard deviation :	0.25		ns
Capacitance				
	anode to all :	7		pF
	grid to K + D1 + D5 :		20	pF

Recommended voltage divider

Type A for maximum gain

K	G	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	A	
1.2	2.8	1.2	1.8	1	1	1	1	1	1	1	1	1	1	1	(total :17)

Type B for best timing / linearity compromise

K	G	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	A	
1.2	2.8	1.2	1.8	1	1.25	1.5	1.5	1.75	2.5	3.5	4.5	8	10		(total :42.5)

Type C for timing/ linearity / gain compromise

K	G	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	A	
1.2	2.8	1.2	1.8	1	1	1	1	1	1	1.5	1.5	3	2.5		(total :21.5)

K: photocathode G: focusing electrode Dn: dynode A: anode

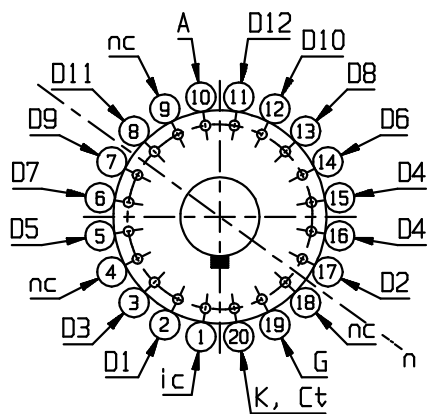
Limiting values

Gain :			max.: 2×10^8	
Supply voltage :			max.: 3000	V
Continuous anode current :			max.: 0.2	mA
Voltage between :	G and photocathode :		max.: 300	V
	first dynode and PK :	min.: 210	max.: 800	V
	consecutive dynodes (except 11&12) :		max.: 400	V
	dynodes D11 and D12 :		max.: 600	V
	anode and last dynode :	min.: 80	max.: 700	V
Ambient temperature :	short operation (< 30 mn) :	min.: -30	max.: +80	°C
	continuous operation & storage :	min.: -30	max.: +50	°C

Notes ☒ Characteristic measured and mentioned on the test ticket of each tube.

- ① Luminous sensitivity is measured with a tungsten filament lamp with a colour temperature of 2856 ± 5 K. The blue sensitivity, expressed in A/lmF ("F" as in Filtered) is measured with a tungsten filament lamp with a colour temperature of 2856 ± 5 K. Light is transmitted through a blue filter Corning CS no.5-58, polished to half stock thickness. The radiant sensitivity is measured with a tungsten filament lamp with a colour temperature of 2856 ± 5 K. Light is transmitted through an interference filter. Radiant sensitivity at 420 nm, expressed in mA/W, can be estimated by multiplying the blue sensitivity, expressed in $\mu\text{A/lmF}$, by 7.5 for this type of tube.
- ② Dark current is measured at ambient temperature, after the tube has been in darkness for approximately 1 min. Lower value can be obtained after a longer stabilisation period in darkness (approx. 30 min.).
- ③ Noise is measured at ambient temperature, after the tube has been stored with its protection hood, the tube is placed in darkness with V_d set at a value to give a gain of 3×10^7 . After a 30 mn stabilisation period, noise pulses with a threshold of 1 pC (corresponding to 0.2 PE) are recorded.
- ④ The peak to valley ratio is defined as the single electron peak value divided by the minimum value at the left of the peak.
- ⑤ Pulse amplitude resolution for ^{137}Cs is measured with NaI(Tl) cylindrical scintillator with a diameter of 51 mm and a height of 51 mm. the count rate used is $\sim 10^4$ c/s.
- ⑥ To obtain a peak pulse current greater than that obtainable with divider A, it is necessary to increase the inter-dynode voltage progressively. Divider circuit C is an example of a progressive divider, giving a compromise between gain, speed and linearity. Other dividers can be conceived to achieve other compromises. It is generally recommended that the voltage ratio between two successive stages is less than 2.
- ⑦ Measured with a pulse light source, with a pulse duration (FWHM) of approximately 1 ns., the cathode being completely illuminated. The rise time is determined between 10 % and 90 % of the anode pulse amplitude. The signal transit time is measured between the instant at which the illuminating pulse of the cathode becomes maximum, and the instant at which the anode pulse reaches its maximum. Rise time, pulse duration and transit time vary with respect to high tension supply voltage V_{ht} as $(V_{ht})^{-1/2}$.

Note : The envelope of the tube is covered with a conductive coating connected to the photocathode on top of which a black paint is applied. This paint is neither guaranteed to be light-tight nor electrically insulating. Care should be taken to avoid electrical shock.



K: cathode Dn: dynode
A: anode Ct : coating

Figure 1 is a log-linear plot showing the spectral sensitivity S_k (mA/W) versus Wavelength (nm) for the photodiode. The x-axis represents Wavelength (nm) from 200 to 800 nm, and the y-axis represents S_k (mA/W) on a logarithmic scale from 1 to 100. The curve shows a peak sensitivity of approximately 80 mA/W at 400 nm.

Wavelength (nm)	S_k (mA/W)
280	1
300	20
320	40
340	60
360	70
380	75
400	80
420	78
440	75
460	70
480	60
500	50
520	30
540	15
560	8
580	4
600	2
620	1

Socket : FE1120
Mu-metal shield : MS172
Voltage divider : VD124K