

PHILIPS

Data handbook



Electronic
components
and materials

Electron tubes

Part 6

July 1980

Geiger-Müller tubes

ELECTRON TUBES

PART 6 — JULY 1980

GEIGER-MÜLLER TUBES

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of four series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS	RED
INTEGRATED CIRCUITS	PURPLE
COMPONENTS AND MATERIALS	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

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May 1980

ELECTRON TUBES (BLUE SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	February 1980	T1 02-80 (ET1a 12-75)	Tubes for r.f. heating
Part 2	April 1980	T2 04-80 (ET1b 08-77)	Transmitting tubes for communications
Part 2b	May 1978	ET2b 05-78	Microwave semiconductors and components Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	June 1980	T3 06-80 (ET2a 11-77)	Klystrons, travelling-wave tubes, microwave diodes
ET3 01-75			Special Quality tubes, miscellaneous devices
Part 5a	October 1979	ET5a 10-79	Cathode-ray tubes Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	December 1978	ET5b 12-78	Camera tubes and accessories, image intensifiers
Part 6	July 1980	T6 07-80 (ET6 01-77)	Geiger-Müller tubes
Part 7a	March 1977	ET7a 03-77	Gas-filled tubes Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	May 1979	ET7b 05-79	Gas-filled tubes Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	July 1979	ET8 07-79	Picture tubes and components Colour TV picture tubes, black and white TV picture tubes, monitor tubes, components for colour television, components for black and white television.
Part 9	June 1980	T9 06-80 (ET9 03-78)	Photo and electron multipliers Photomultiplier tubes, phototubes, single channel electron multipliers, channel electron multiplier plates.

SEMICONDUCTORS (RED SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	March 1980	S1 03-80 (SC1b 05-77)	Diodes Small-signal germanium diodes, small-signal silicon diodes, special diodes, voltage regulator diodes ($< 1,5 \text{ W}$), voltage reference diodes, tuner diodes, rectifier diodes
Part 2	May 1980	S2 05-80 (SC1a 08-78)	Power diodes, thyristors, triacs Rectifier diodes, voltage regulator diodes ($> 1,5 \text{ W}$), rectifier stacks, thyristors, triacs
Part 2	June 1979	SC2 06-79	Low-frequency power transistors
Part 3	January 1978	SC3 01-78	High-frequency, switching and field-effect transistors*
Part 3	April 1980	S3 04-80 (SC2 11-77, partly) (SC3 01-78, partly)	Small-signal transistors
Part 4a	December 1978	SC4a 12-78	Transmitting transistors and modules
Part 4b	September 1978	SC4b 09-78	Devices for optoelectronics Photosensitive diodes and transistors, light-emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	July 1978	SC4c 07-78	Discrete semiconductors for hybrid thick and thin-film circuits

* Field-effect transistors and wideband transistors will be transferred to S5 and SC3c respectively. The old book SC3 01-78 should be kept until then.

INTEGRATED CIRCUITS (PURPLE SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code. Books with the purple cover will replace existing red covered editions as each is revised.

Part 1	May 1980	IC1 04-80 (SC5b 03-77)	Bipolar ICs for radio and audio equipment
Part 2	May 1980	IC2 04-80 (SC5b 03-77)	Bipolar ICs for video equipment
Part 5a	November 1976	SC5a 11-76	Professional analogue integrated circuits
Part 6	October 1977	SC6 10-77	Digital integrated circuits LOCMOS HE4000B family
Part 6b	August 1979	SC6b 08-79	ICs for digital systems in radio and television receivers
Signetics integrated circuits			Bipolar and MOS memories 1979 Bipolar and MOS microprocessors 1978 Analogue circuits 1979 Logic - TTL 1978

COMPONENTS AND MATERIALS (GREEN SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	July 1979	CM1 07-79	Assemblies for industrial use PLC modules, high noise immunity logic FZ/30 series, NORbits 60-series, 61-series, 90-series, input devices, hybrid integrated circuits, peripheral devices
Part 3a	September 1978	CM3a 09-78	FM tuners, television tuners, surface acoustic wave filters
Part 3b	October 1978	CM3b 10-78	Loudspeakers
Part 4a	November 1978	CM4a 11-78	Soft Ferrites Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	February 1979	CM4b 02-79	Piezoelectric ceramics, permanent magnet materials
Part 6	April 1977	CM6 04-77	Electric motors and accessories Small synchronous motors, stepper motors, miniature direct current motors
Part 7	September 1971	CM7 09-71	Circuit blocks Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 7a	January 1979	CM7a 01-79	Assemblies Circuit blocks 40-series and CSA70 (L), counter modules 50-series, input/output devices
Part 8	June 1979	CM8 06-79	Variable mains transformers
Part 9	August 1979	CM9 08-79	Piezoelectric quartz devices Quartz crystal units, temperature compensated crystal oscillators
Part 10	April 1978	CM10 04-78	Connectors
Part 11	December 1979	CM11 12-79	Non-linear resistors Voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)
Part 12	November 1979	CM12 11-79	Variable resistors and test switches
Part 13	December 1979	CM13 12-79	Fixed resistors
Part 14	April 1980	C14 04-80 (CM2b 02-78)	Electrolytic and solid capacitors
Part 15	May 1980	C15 05-80 (CM2b 02-78)	Film capacitors, ceramic capacitors, variable capacitors

SELECTION GUIDE

cylinder types

	application	γ counting rate		sensitive length	plateau threshold voltage	plateau length	max. plateau slope	max. dead time	max. background
		count/s at R/h		mm	V	V	%/V	μ s	(shielded) count/min
ZP1200	γ	210	10^{-2}	40	400	200	0,04	90	10
ZP1210	γ	1000	10^{-2}	140	400	100	0,15	200	50
ZP1220	γ	1600	10^{-2}	240	400	100	0,1	200	90
ZP1300	$(\beta), \gamma$	350	1	8	500	100	0,3	11	1
ZP1310	$(\beta), \gamma$	1400	1	16	500	150	0,15	15	2
ZP1311*	γ	1400	1	16	500	150	0,15	15	2
ZP1320	β, γ	7400	1	28	500	150	0,08	45	12
ZP1330	β, γ	900	10^{-2}	75	450	350	0,02	70	30

window types

				window					
				ϕ (mm)	th**				
ZP1400	β, γ	210	10^{-2}	9	(3)	400	200	0,04	90 10
ZP1410	$\alpha, \beta, (\gamma)$	320	10^{-2}	19,8	(1)	450	250	0,02	175 15
ZP1430	$\alpha, \beta, (\gamma)$	450	10^{-2}	27,8	(1)	450	250	0,04	190 25
ZP1431	$\beta, (\gamma)$	450	10^{-2}	27,8	(5)	450	250	0,04	190 25
ZP1441	$\alpha, \beta, (\gamma)$	160	10^{-2}	19,8	(1)	500	200	0,09	65 5
ZP1442	$\beta, (\gamma)$	160	10^{-2}	19,8	(3)	500	200	0,09	65 8
ZP1451	$\alpha, \beta, (\gamma)$	330	10^{-2}	27,8	(1)	500	250	0,07	60 9
ZP1452	$\beta, (\gamma)$	330	10^{-2}	27,8	(3)	500	250	0,07	60 18
ZP1460	$\beta, (\gamma)$	930	10^{-2}	51	(6)	700	400	0,04	45 45
ZP1480	β, γ	—	—	17	(4)	400	100	0,2	120 30
ZP1481	β, γ	—	—	17	(4)	400	100	0,2	120 30

X-ray types

ZP1600	6 to 20 keV	600	10^{-2}	ϕ 19,8	(5)	1600	400	0,07	110 25
ZP1610	2,5 to 40 keV	—		7 x 18	(2)	1900	working voltage 1460 to 1850 V		

cosmic-ray guard tube

ZP1700	anti coincidence	1300	10^{-2}	—	—	800	400	0,03	1000 70
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* With Sn filter.

** Window thickness in mg/cm² (1) = 1,5 to 2,0; (2) = 2,0 to 2,5; (3) = 2,0 to 3,0; (4) = 2,5 to 3,0; (5) = 2,5 to 3,5; (6) = 3,5 to 4,0.

CONVERSION LIST

current type no.	obsolete type no.
ZP1200	18503
ZP1210	18520
ZP1220	18545
ZP1300	18529
ZP1310	18509
ZP1311	ZP1100
ZP1320	18550
ZP1330	18555
ZP1400	18504
ZP1410	18505
ZP1430	18526
ZP1431	18506
ZP1441	18515
ZP1451	18536
ZP1460	18546/01
ZP1480	MX168/02
ZP1481	MX168
ZP1600	18507
ZP1610	18511
ZP1700	18518

GEIGER-MÜLLER TUBES

GENERAL OPERATIONAL RECOMMENDATIONS
GEIGER-MÜLLER TUBES

Where appropriate, the terminology used conforms to the following publications:— IEC50-531, IEC100, IEC151-25.

1. **GENERAL**

- 1.1 **Geiger-Müller radiation counter tubes (G.M. tubes)** are intended to detect alpha particles, beta particles, gamma or X-radiation.
- 1.2 A G.M. tube is a gas-filled device which reacts to individual ionizing events, thus enabling them to be counted.
- 1.3 A G.M. tube consists basically of an electrode at a positive potential (anode) surrounded by a metal cylinder at a negative potential (cathode). The cathode forms part of the envelope or is enclosed in a glass envelope. Ionizing events are initiated by quanta or particles entering the tube either through the window or through the cathode and colliding with the gas molecules.
- 1.4 The **gas filling** consists of a mixture of one or more rare gases and a quenching agent.
- 1.5 **Quenching** is the process of terminating a pulse ionizing current in a G.M. tube. Optimum quenching in our tubes is obtained by the quenching gases used in conjunction with the recommended anode resistor.
2. The **capacitance** of a G.M. tube is that between anode and cathode, ignoring the capacitive effects of external connections.

3. **OPERATING CHARACTERISTICS**

3.1. **Starting voltage**

This is the lowest voltage applied to a G.M. tube at which pulses of 1 V amplitude appear across the tube. See fig.1.

3.2 **Plateau**

This is the section of the counting rate versus voltage characteristic (with constant irradiation), over which the counting rate is substantially independent of the applied voltage. Unless otherwise stated, the plateau is measured at a counting rate of approximately 100 count/s.

3.3 **Plateau threshold voltage**

This is the lowest voltage applied which corresponds to the start of the plateau for the stated sensitivity of the measuring circuit. See fig.1.

3.4 **Plateau length**

This is the range of applied voltage over which the plateau extends. See fig.1.

3.5 **Plateau slope**

This is the change in counting rate over the plateau length, expressed in % per volt. See fig.1.

3.6 **Recommended supply voltage**

This is the supply voltage at which the G.M. tube should preferably be used. This voltage is normally chosen to be in the middle of the plateau. See fig.1.

OPERATING CHARACTERISTICS (continued)

3.7 Background

This is the counting rate in the absence of the radiation which the G.M. tube is intended to measure.

3.8 Dead time

This is the time interval, after the initiation of a discharge resulting in a normal pulse, during which the G.M. tube is insensitive to further ionizing events. See fig.4.

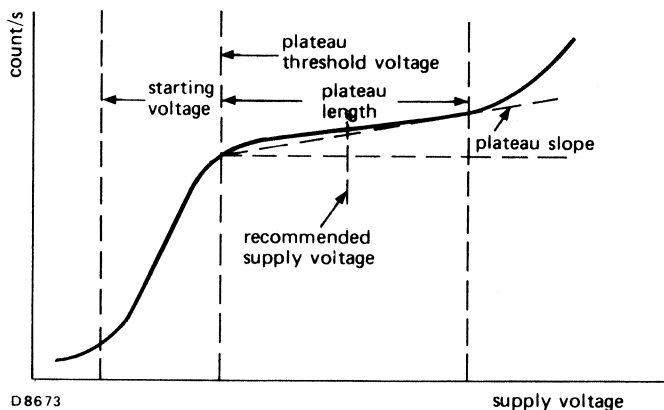


Fig.1

4 MEASURING CIRCUITS

4.1 Measuring circuit A

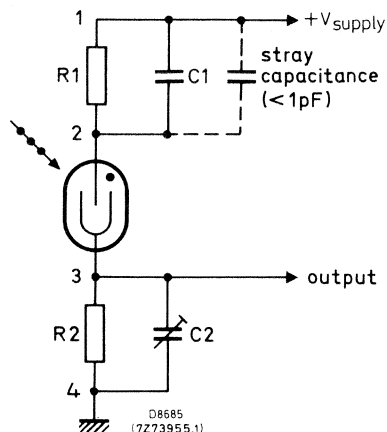


Fig.2

Notes:

1. The input resistance and capacitance of the measuring equipment are represented by R2 and C2 respectively.
2. R1 is specified by the manufacturer and should be mounted as near as possible to the anode connector.
3. When applying a rectangular pulse at 1 with the tube inserted but short-circuited, C2 should be adjusted to give an undistorted pulse at 3. Under these conditions $R1 \times (C1 + \text{stray capacitance}) = R2 \times C2$.
4. The measuring equipment consists of an emitter follower with a pulse shaper, a limiting amplifier and a scaler. Unless otherwise stated, the tube is measured with the circuit given in the data, with a ^{60}Co source and at the recommended supply voltage (mid-plateau).

4.2 Measuring circuit B

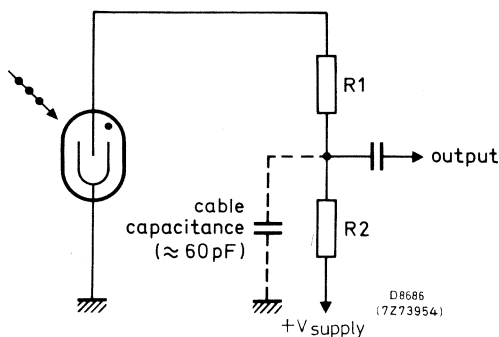


Fig.3

Note: The value of the anode resistor R₁ should not be less than that specified under LIMITING VALUES in the data.

5. NOTES

5.1 Resolution time (of a counting system)

This is the minimum time interval between two distinct ionizing events which enables both to be counted.

5.2 Recovery time

This is the minimum time interval between the initiation of a normal size pulse and the initiation of the next pulse of normal size. See fig.4.

5.3 Pulse amplitude

The pulse amplitude of a G.M. tube may be approximated by the equation:

$$P = b \times (V_{\text{supply}} - V_{\text{starting}})$$

where P = pulse amplitude

V_{supply} = anode supply voltage

V_{starting} = starting voltage

$$b = \frac{R_2}{R_1 + R_2} \quad (\text{See measuring circuit})$$

The tap on the load resistor minimizes the influence of a capacitive load.

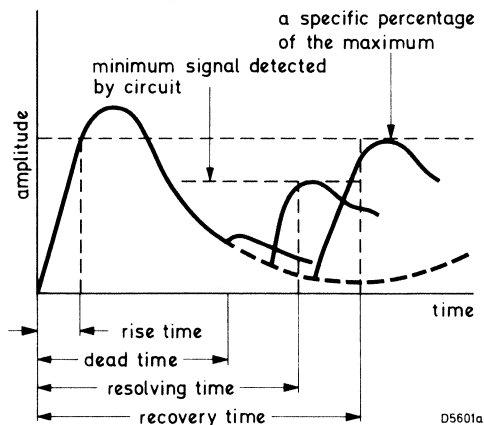


Fig.4

5.4 Anode resistor

Normally the tube should be operated with an anode resistor of the value indicated in the measuring circuit, or higher. Decreasing the value of the anode resistor not only decreases the dead time but also the plateau length. A decrease in resistance below the limiting value may affect tube life and lead to its early **destruction**.

The anode resistor should be connected direct to the anode connector of the tube to ensure that parasitic capacitances of leads will not increase too greatly the capacitive load on the tube. An increase in capacitive load has the tendency to increase the pulse amplitude, the pulse duration, the dead time, and the plateau slope. In addition the plateau length will be shortened appreciably. Shunt capacitances of more than 20 pF may **destroy** the tube.

5.5 Maximum counting rate

The maximum counting rate is approximately $1/\tau$ (τ = dead time). For continuous stable operation it is recommended that the counting rate is adjusted to a value in the linear part of the counting rate/dose rate curve.

5.6 Dead time losses

After every pulse, the tube is temporarily insensitive during a period known as the dead time (τ). Consequently, the pulses that occur during this period are not counted. At a counting rate of N count/s the tube will be dead during $100 \times N \times \tau\%$ of the time, so that approximately $100 \times N \times \tau\%$ of the counts will be lost.

If, in an experiment, the inaccuracy must be $< 1\%$, N should be less than $1/100\tau$ count/s.

Example: If $\tau = 20 \mu\text{s}$, an inaccuracy of 1% is reached at a counting rate of approximately 500 count/s.

5.7 Background

See definition under 3.7. The most important sources of background are:

1. Gamma radiation from the environment and from cosmic radiation.
2. Mesons from cosmic radiation.
3. Beta particles from contamination and impurities of the materials from which the detector itself is made.
4. Spontaneous discharge or pulses in the detector and the counting circuit that do not originate from radiation.

From published experimental data the gamma contribution accounts for approximately 70% of the background and a further 25% (approximately) is due to cosmic mesons. For the majority of G.M. tube applications, the background may be reduced to an acceptable level by shielding the tube with lead or steel. Thus most of the gamma contribution is eliminated.

5.8 Counting rate/dose rate curves

These are measured with, or corrected for, a ^{60}Co source perpendicular to the tube axis, at the recommended supply voltage, unless otherwise stated. The curves shown are typical. Deviation of up to approximately $\pm 10\%$ may occur.

5.9 Current/dose rate curves

These are measured with, or corrected for, a ^{60}Co source perpendicular to the tube axis, unless otherwise stated. The curves shown are typical. Deviation of up to approximately $\pm 20\%$ may occur.

5.10 Dead time curves

These represent the dead time (see 3.8 and fig.4) as a function of the supply voltage, measured with pulsed X-radiation in the recommended circuit, unless otherwise stated. The curves shown are typical. The maximum value is stated under OPERATING CHARACTERISTICS. Note that a higher anode resistor results in a higher dead time.

5.11 Energy response curves

These represent the energy sensitivity (in count/R) as a function of the radiation energy (in keV), measured in the recommended circuit and in the linear part of the counting rate/dose rate curve. The curves shown are typical. Deviation depends on energy and construction.

NOTES (continued)

5.12 **Polar response curves**

These represent the relative sensitivity as a function of the angle of irradiation (as defined in the drawing), measured in the recommended circuit. The curves shown are typical. Deviation depends on energy and construction.

6. **LIMITING VALUES**

The limiting values of G.M. tubes are given in the Absolute Maximum Rating System in accordance with IEC Publication 134.

Absolute maximum ratings are limiting values of operating and environmental conditions, applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

7. **MOUNTING**

G.M. tubes must not be clamped tightly in the vicinity of glass-metal seals. Great care must be taken in handling and fixing thin walled glass and thin metal tubes. Mica windows are extremely fragile and must never be touched.

Low capacitance between anode and cathode is essential, i.e. the **shortest possible** connections between anode terminal and load resistor must be made.

Soldering to the anode pin or to the cathode wall will **destroy** the tube. Most types are provided with a cathode lead or strap. This lead should be used for connection to the cathode. Tubes with an anode pin are supplied with an anode connector (see drawing). Only this connector should be used for connection to the anode.

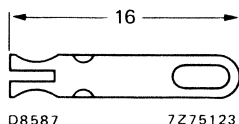


Fig.5

8. STORAGE AND HANDLING

The tube should not be stored at ambient temperatures outside the limits given under the heading LIMITING VALUES on the data sheets.

To prevent leakage between the anode and the cathode, the tube should be dry and clean. Condensation of water vapour may cause a short-circuit between anode and cathode.

9. OUTSIDE PRESSURE

In tubes provided with a mica window, the gas pressure outside the tube should neither be lower than 35 kPa ($\approx$ 25 cm Hg) nor higher than the atmospheric pressure (unless otherwise stated) and changes in pressure should be gradual.

Care should be taken not to expose tubes with very thin envelopes to pressures substantially higher than atmospheric.

10. ENERGY DEPENDENCE

The sensitivity of G.M. tubes to gamma radiation is influenced considerably by the energy of the radiation.

At energies above about 300 to 400 keV, the action of the tube is due to emission of electrons from the cathode and the higher the atomic number of the cathode material the greater will be the electron emission. Radiation with an energy of less than 300 to 400 keV is absorbed by the gas filling, the absorption increasing as the energy decreases. This gives rise to the characteristic peak in sensitivity which occurs at about 60 keV, below which the sensitivity decreases rapidly due to cut-off by the thickness or density of the cathode wall. By using an external filter a near linear sensitivity can be obtained.

11. LIFE

11.1 Storage life

If stored in a cool dry place, free from continuous or severe vibration, there is hardly any deterioration in the tube's characteristics. A storage life of years is not unusual.

11.2 Operational life

The operational life of a G.M. tube is expressed in counts (discharges). Theoretically the quenching gas, ionized during a discharge, should be re-combined between discharges. However, minute quantities will be chemically bound, no longer taking part in the quenching process. This will lead to a gradual shortening of the plateau length, and, for a given working voltage, to an increased counting rate. This will cumulate in a continuous state of discharge of the tube, rendering it useless.

Apart from the accumulated number of counts registered, the ambient temperature during operation is of prime importance to the life of the tube. At temperatures above 50 °C, changes in the gas mixture may occur, possibly reducing the total number of counts attainable. Short periods of operation (not exceeding 1 h) up to approximately 70 °C should not prove harmful, but life will progressively decrease with increasing temperature.

Thus, depending on application and circumstances, the quenching gas could be exhausted in as little as a few hours or theoretically last for many years.

For these reasons G.M. tubes cannot be guaranteed unconditionally for a specified period of time.

NEVER

1. Exceed the LIMITING VALUES
2. Solder to the tube
3. Bend the anode pin
4. Touch the mica window

MAXIMUM BETA ABSORPTION (percentages)

source	max. β energy MeV	in mica window (mg/cm ²)			in metal envelope (mg/cm ²)		
		2	3	4	40	60	100
⁴² K	3,55	1	1	2	13	20	30
⁹⁰ Y + ⁹⁰ Sr	2,27	1	3	3	23	32	48
³² P	1,71	3	4	5	33	44	63
⁸⁹ Sr	1,46	3	4	5	40	51	70
²⁴ Na	1,39	3	5	6	41	53	73
¹⁰⁹ Pd	1,00	4	6	8	54	68	85
³⁶ Cl	0,71	7	10	13	72	84	95
¹³¹ I	0,61	8	11	15	77	90	97
²² Na	0,54	8	13	17	81	92	98
⁴⁶ Sc	0,36	15	22	27	94	99	100
⁶⁰ Co	0,31	20	26	34	97	100	100
⁹⁹ Tc	0,29	21	30	37	99	100	100
⁴⁵ Ca	0,25	24	33	42	100	100	100
³⁵ S	0,17	36	49	59	100	100	100
¹⁴ C	0,16	39	51	62	100	100	100
³ H	0,02	100	100	100	100	100	100
Geiger-Müller tubes		ZP1410 ZP1430 ZP1441 ZP1451	ZP1400 ZP1442 ZP1452 ZP1480 ZP1481	ZP1460	ZP1320	ZP1330	ZP1300 ZP1310

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA

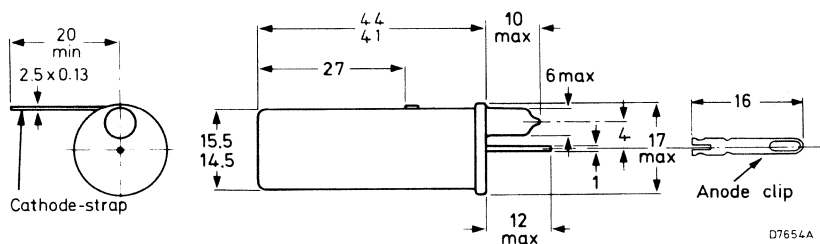
Dose rate range	10^{-4} to 1	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

CATHODE

Thickness	250	mg/cm ²
Sensitive length	40	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	2.0	pF
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OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	325	V
Plateau threshold voltage	max.	400	V
Plateau length		200	V
Recommended supply voltage		500	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	10	count/min
Dead time, at recommended supply voltage	max.	90	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	600	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

$R_1 = 10\text{ M}\Omega$

$R_2 = 220\text{ k}\Omega$

$C_1 = 1\text{ pF}$

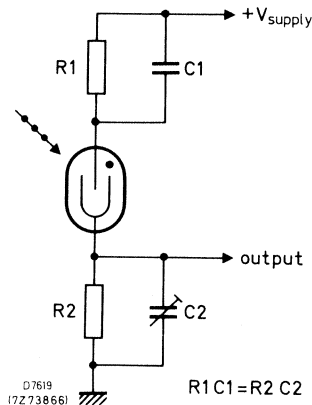
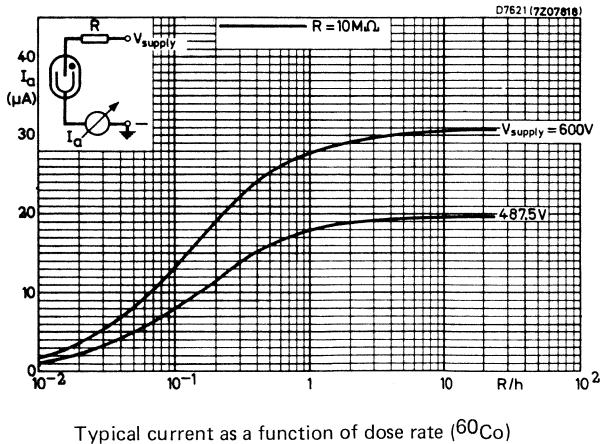
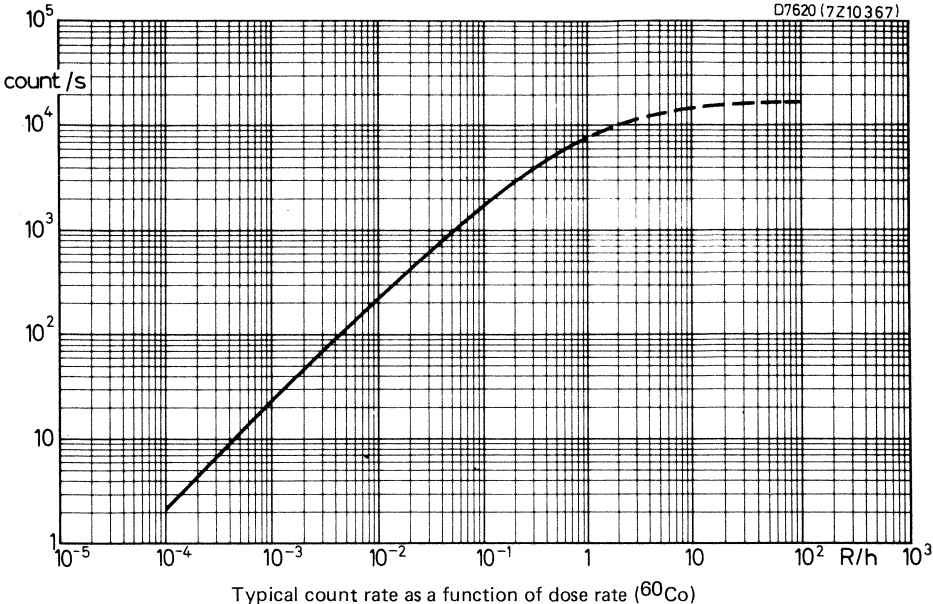
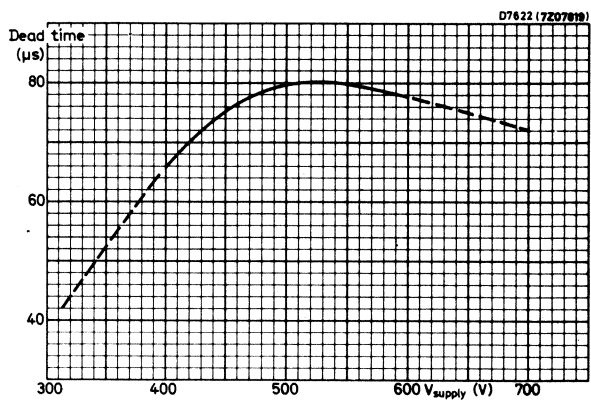


Fig.2





Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA

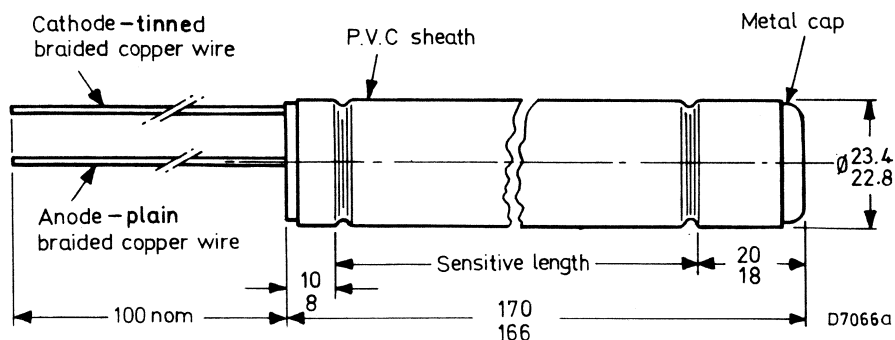
Dose rate range	4×10^{-4} to 2×10^{-1}	R/h
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	525	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Tube must not be clamped within 30 mm of either end.

CATHODE

Thickness	525	mg/cm ²
Sensitive length	140	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	4.5	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	400	V
Plateau length		100	V
Recommended supply voltage		450	V
Plateau slope	max.	0.15	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	50	count/min.
Dead time, at recommended supply voltage	max.	200	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.7	$\text{M}\Omega$
Anode voltage	max.	500	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

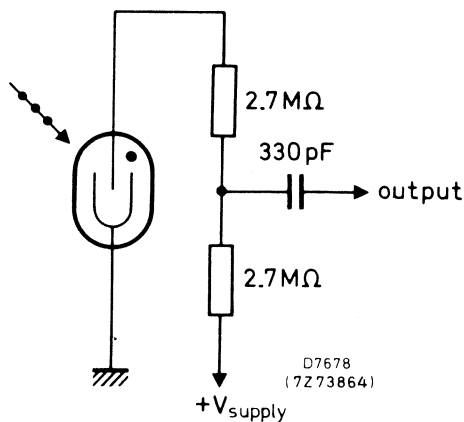
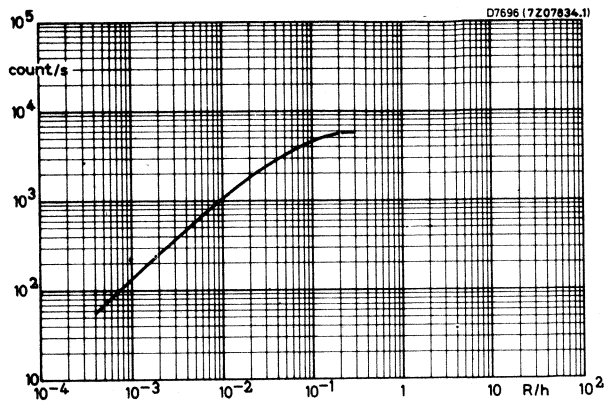
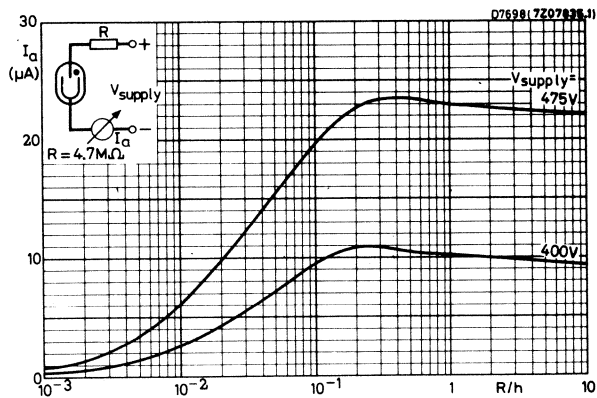


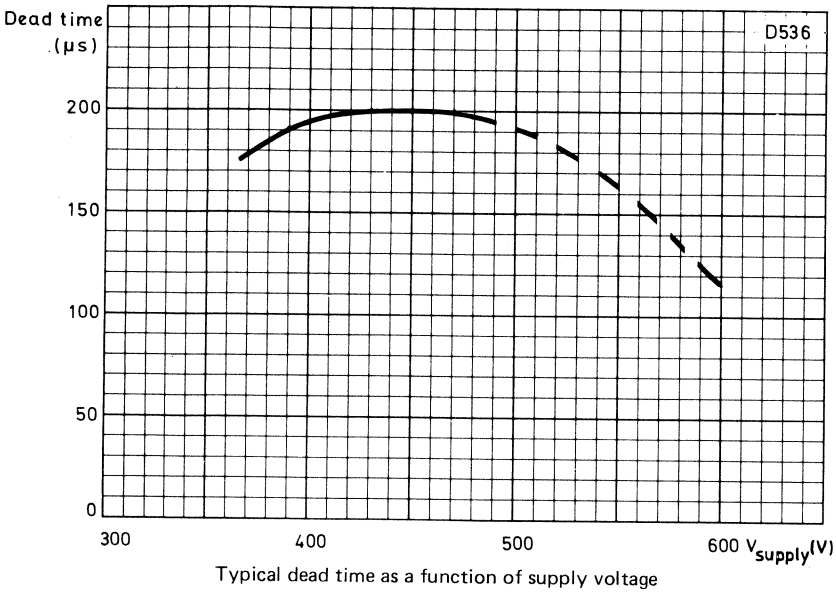
Fig.2



Typical count rate as a function of dose rate (^{60}Co)



Typical current as a function of dose rate (^{60}Co)



GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA

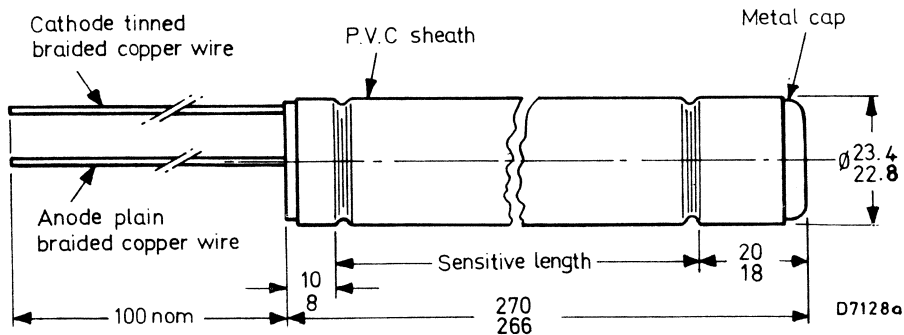
Dose rate range	10^{-4} to 10^{-1}	R/h
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	525	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Tube must not be clamped within 30 mm of either end.

CATHODE

Thickness	525	mg/cm ²
Sensitive length	240	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	10	pF
------------------	----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	400	V
Plateau length		100	V
Recommended supply voltage		450	V
Plateau slope	max.	0.15	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	90	count/min.
Dead time, at recommended supply voltage	max.	210	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.7	$\text{M}\Omega$
Anode voltage	max.	500	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$ 5×10^{10} count

MEASURING CIRCUIT

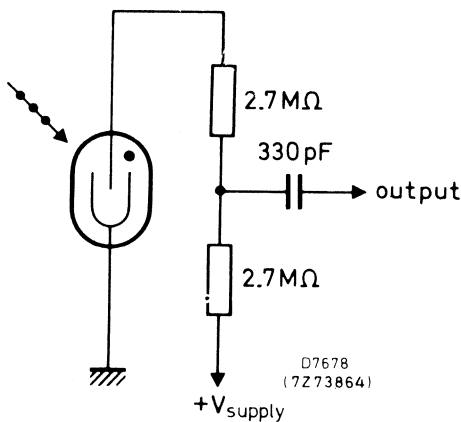
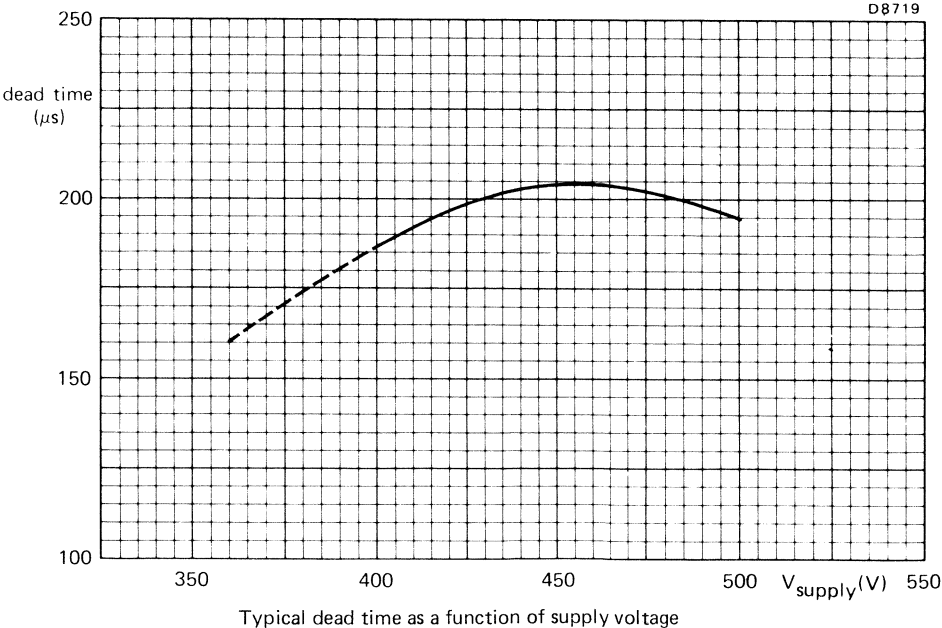
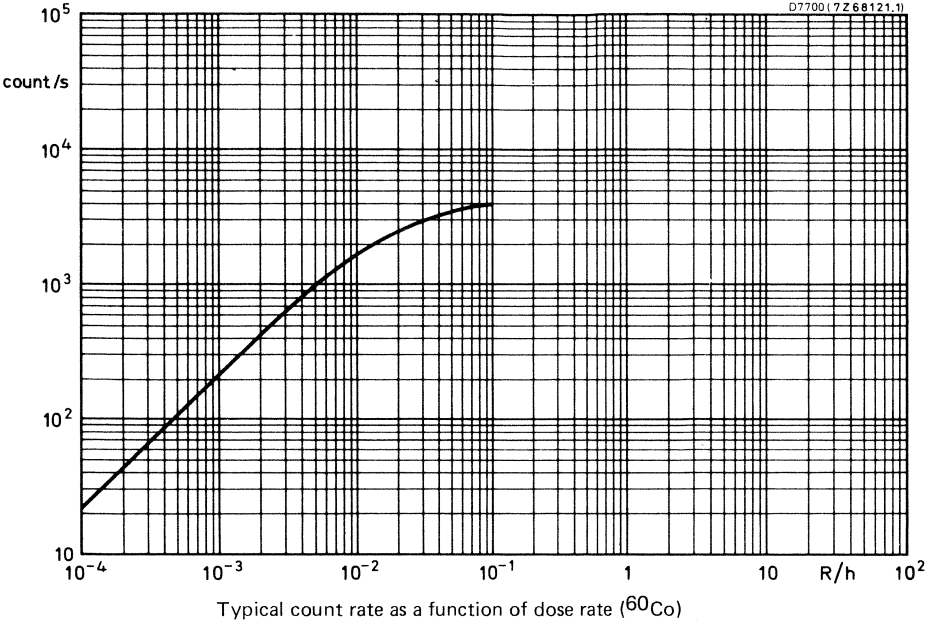


Fig.2



GEIGER-MÜLLER TUBE

Halogen quenched γ and high energy β (> 0.5 MeV) radiation counter tube.

QUICK REFERENCE DATA

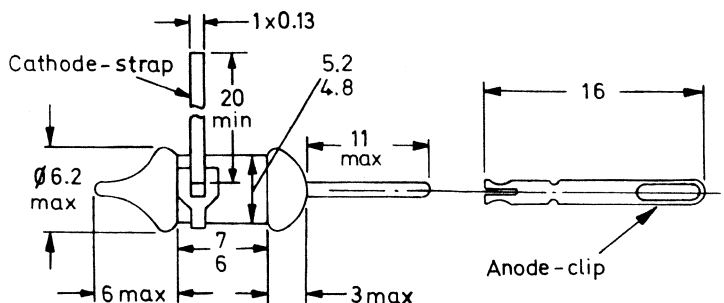
Dose rate range	10^{-2} to 2×10^3	R/h
Plateau threshold voltage	500	V
Plateau length	100	V
Recommended supply voltage	550	V
Chrome-iron cathode	80 to 100	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

D7076

CATHODE

Thickness	80 to 100	mg/cm ²
Sensitive length	8	mm
Material	chrome-iron	

FILLING

neon, helium, halogen

CAPACITANCE

Anode to cathode	0.7	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	400	V
Plateau threshold voltage	max.	500	V
Plateau length		100	V
Recommended supply voltage		550	V
Plateau slope	max.	0.3	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	1	count/min
Dead time, at recommended supply voltage	max.	11	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	600	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	10^{10}	count
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MEASURING CIRCUIT

$R_1 = 2.2\text{ M}\Omega$
 $R_2 = 47\text{ k}\Omega$
 $C_1 = 1\text{ pF}$

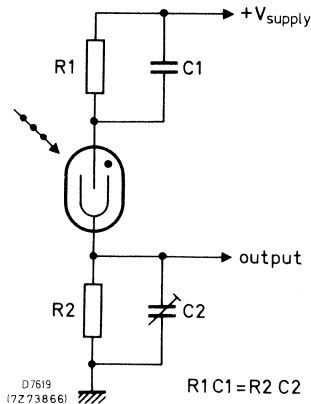
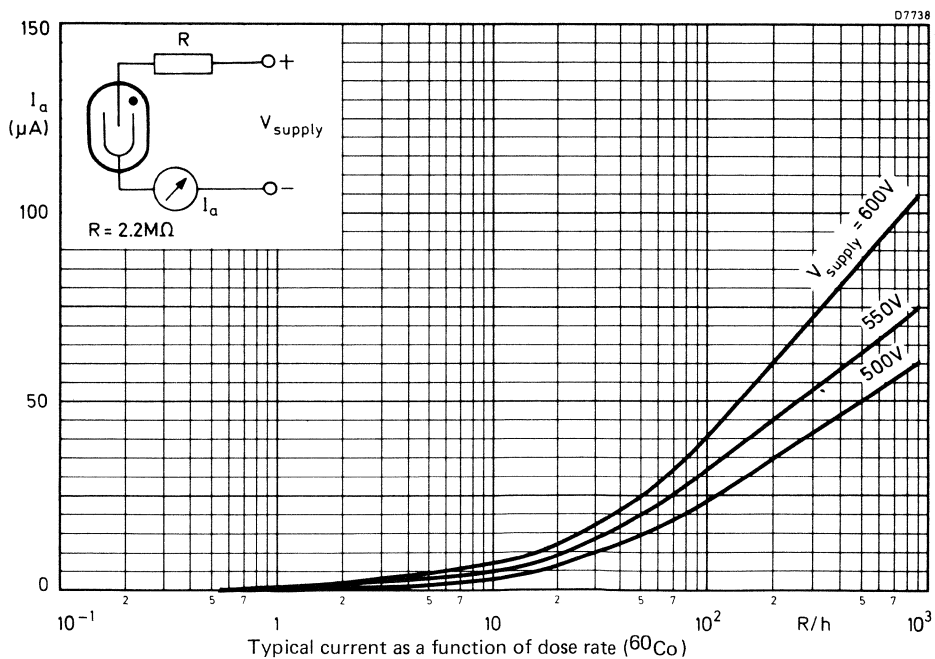
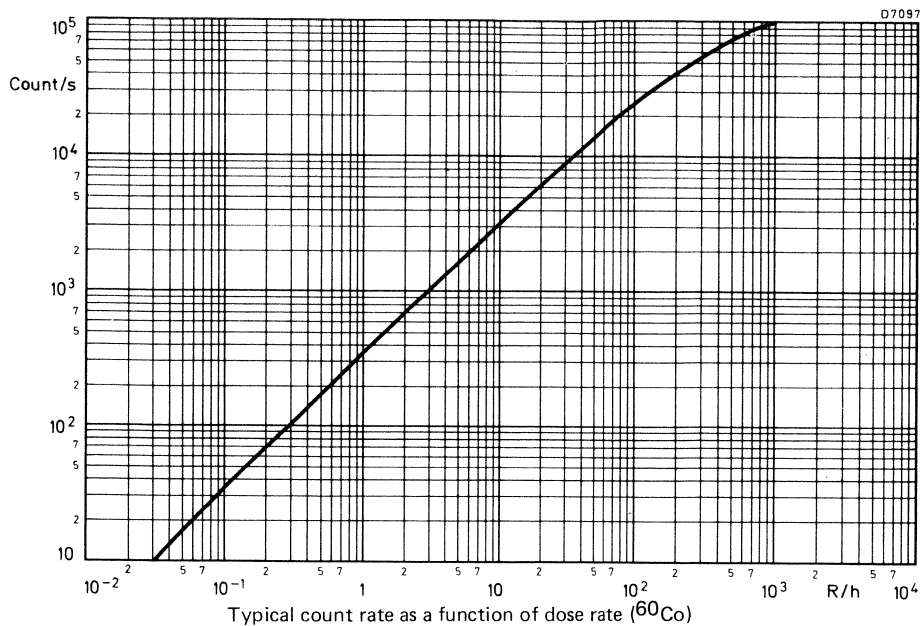


Fig.2



GEIGER-MÜLLER TUBE

Halogen quenched γ and high energy β (> 0.5 MeV) radiation counter tube

QUICK REFERENCE DATA

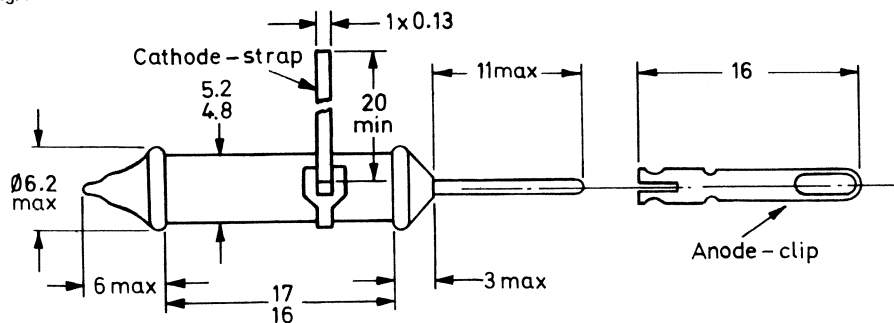
Dose rate range	10^{-3} to 3×10^2	R/h
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	80 to 100	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



D7073

Use only anode connector supplied with tube.

CATHODE

Thickness	80 to 100	mg/cm ²
Sensitive length	16	mm
Material	chrome-iron	

FILLING

neon, helium, halogen

CAPACITANCE

Anode to cathode	1.2	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	380	V
Plateau threshold voltage	max.	500	V
Plateau length		150	V
Recommended supply voltage		575	V
Plateau slope	max.	0.15	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	2	count/min
Dead time, at recommended supply voltage	max.	15	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	650	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

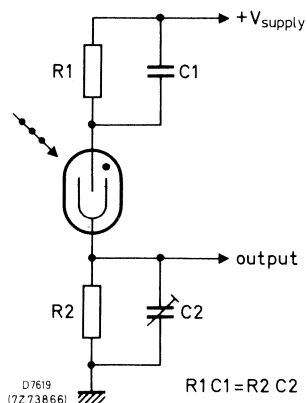
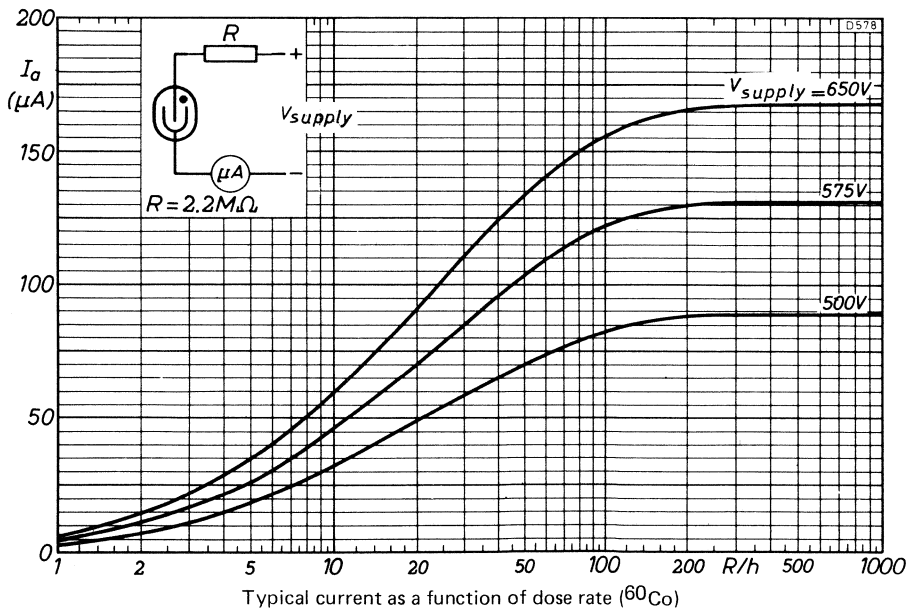
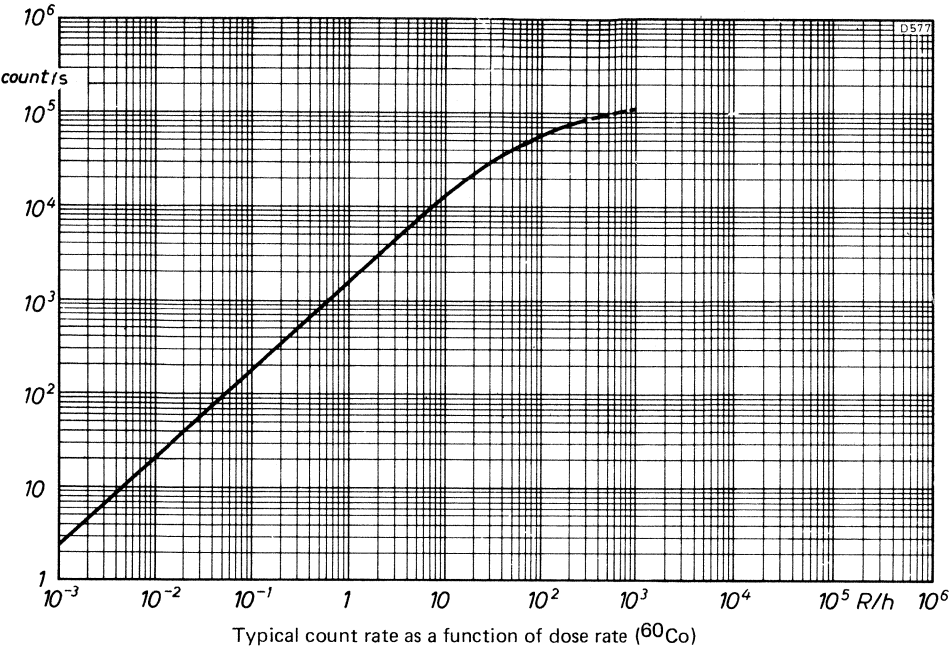
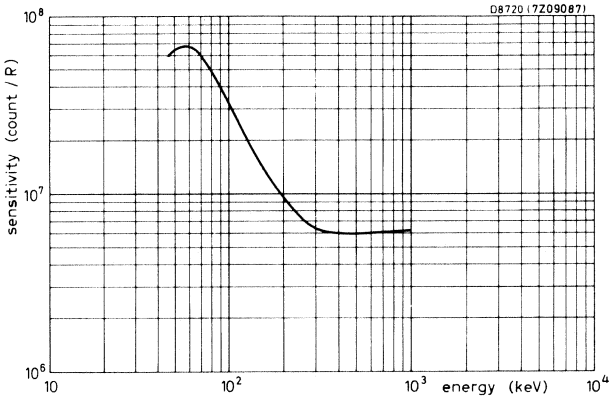
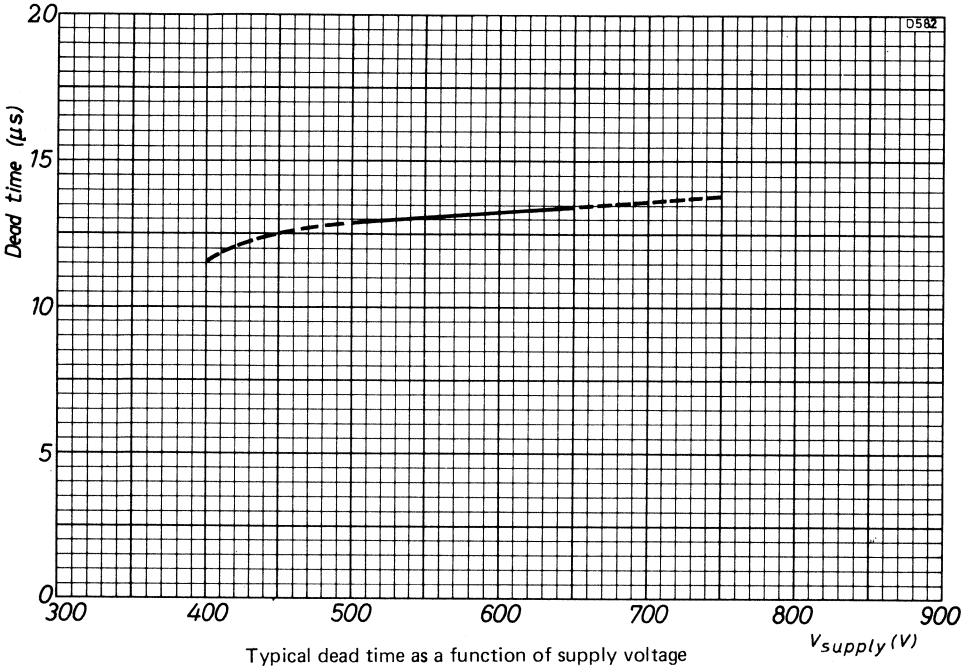
LIFE EXPECTANCYLife expectancy at $\approx 25\text{ }^{\circ}\text{C}$ 5×10^{10} count**MEASURING CIRCUIT** $R_1 = 2.2\text{ M}\Omega$ $R_2 = 47\text{ k}\Omega$ $C_1 = 1\text{ pF}$ 

Fig.2





Typical energy response curve (side response)

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube fitted in a filter. The energy response is flat to within 15% referred to the 1.33 MeV point.

QUICK REFERENCE DATA

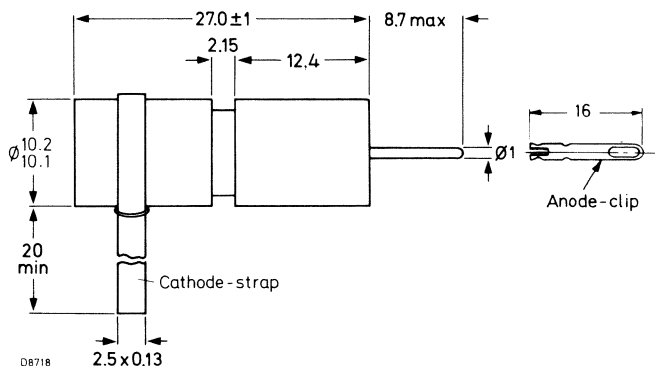
Dose rate range	10^{-3} to 3×10^2	R/h
Energy range	40 to 3000	keV
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	80 to 100	mg/cm ²
Sn filter	2	mm

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

FILTER

Thickness	2	mm
Material	tin	

CATHODE

Thickness	80 to 100	mg/cm ²
Sensitive length	16	mm
Material	chrome-iron	

FILLING

neon, helium, halogen

CAPACITANCE

Anode to cathode	2.0	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^\circ\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	380	V
Plateau threshold voltage	max.	500	V
Plateau length		150	V
Recommended supply voltage		575	V
Plateau slope	max.	0.15	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	2	count/min
Dead time, at recommended supply voltage	max.	15	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	M Ω
Anode voltage	max.	650	V
Ambient temperature	max.	+70	$^\circ\text{C}$
continuous operating	min.	-40	$^\circ\text{C}$
storage	max.	+75	$^\circ\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25^\circ\text{C}$	5×10^{10}	count
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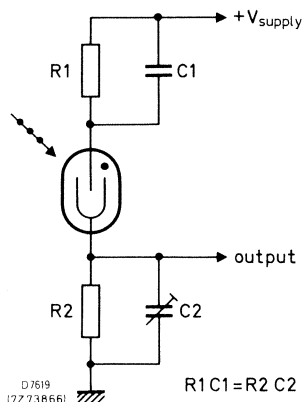
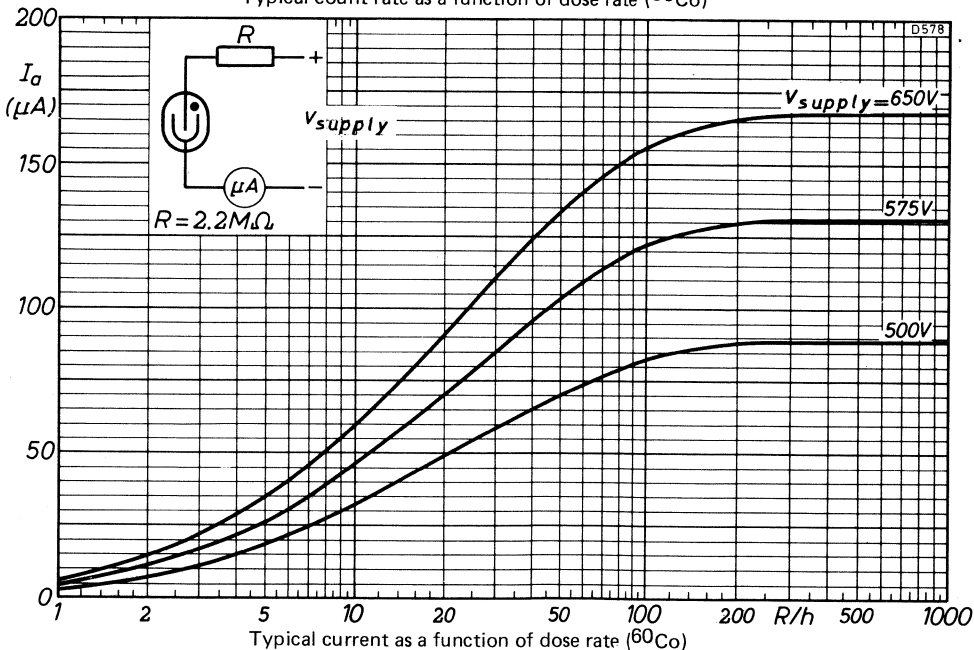
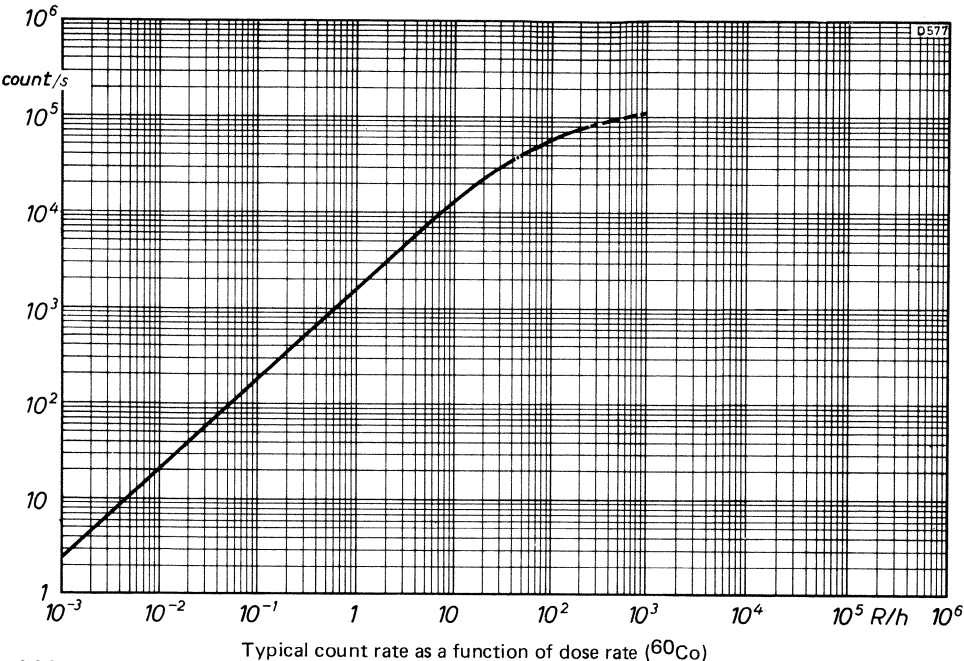
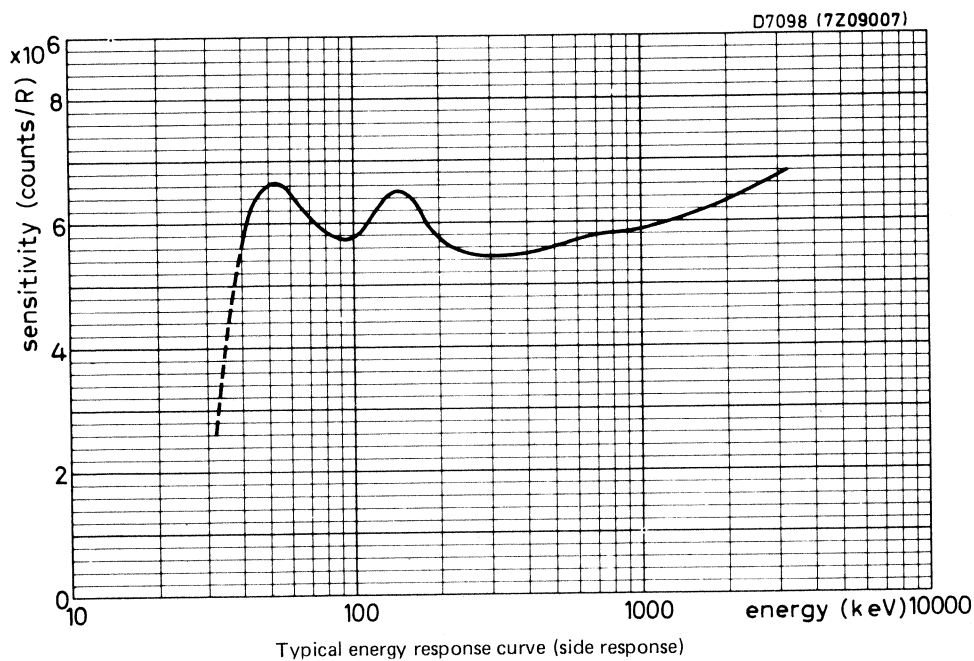
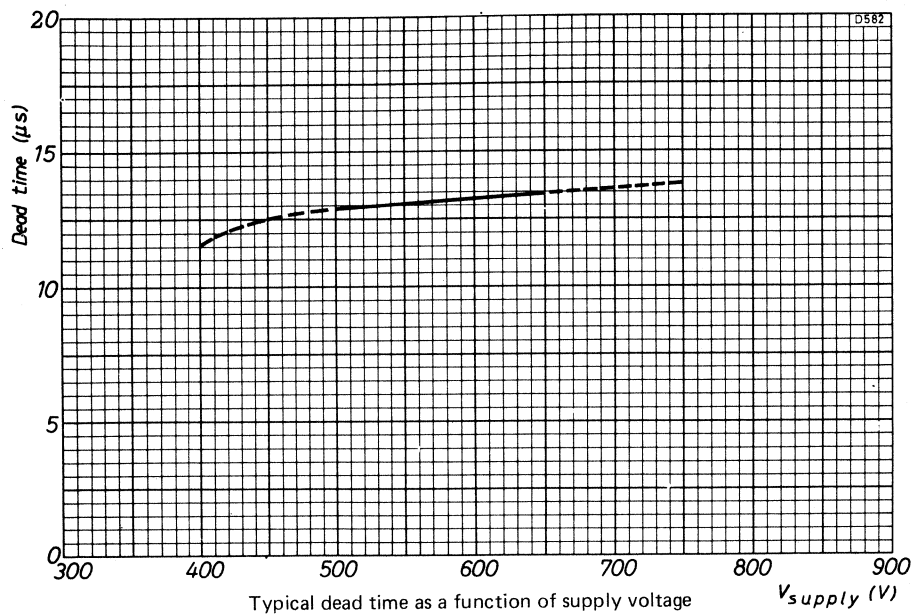
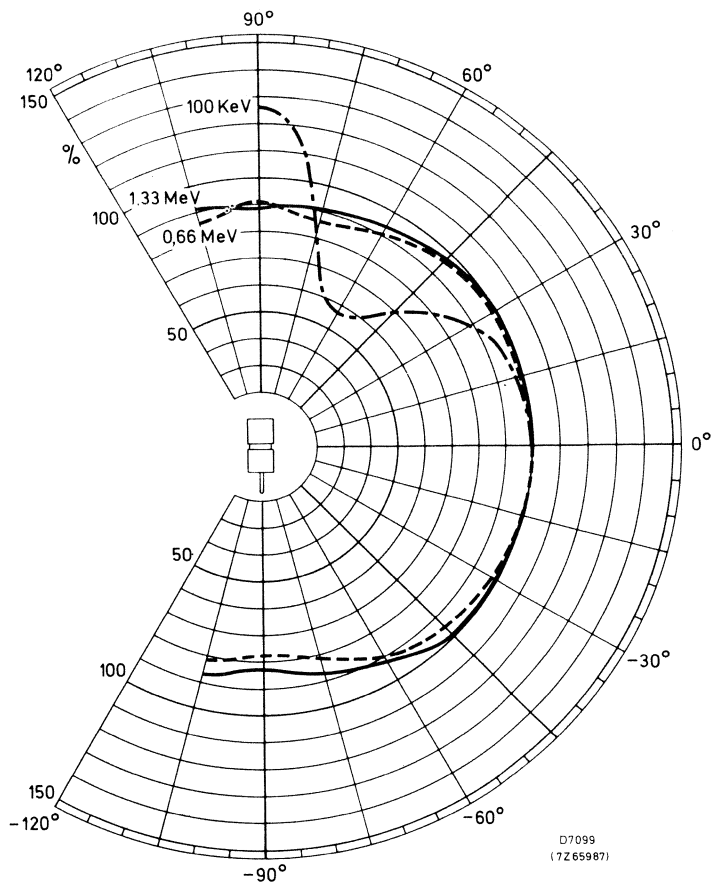
MEASURING CIRCUIT $R_1 = 2.2 \text{ M}\Omega$ $R_2 = 47 \text{ k}\Omega$ $C_1 = 1 \text{ pF}$ 

Fig.2







Typical polar diagram

GEIGER-MÜLLER TUBE

Halogen quenched γ and β (> 0.25 MeV) radiation counter tube.

QUICK REFERENCE DATA

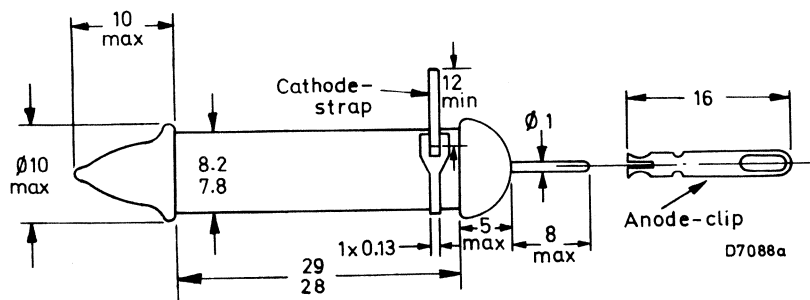
Dose rate range	10^{-3} to 10^2	R/h
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	32 to 40	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig. 1



Use only anode connector supplied with tube.

CATHODE

Thickness	32 to 40	mg/cm ²
Sensitive length	28	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.1	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	380	V
Plateau threshold voltage	max.	500	V
Plateau length		150	V
Recommended supply voltage		575	V
Plateau slope	max.	0.08	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	12	count/min
Dead time, at recommended supply voltage	max.	45	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	650	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

$R_1 = 4.7\text{ M}\Omega$

$R_2 = 100\text{ k}\Omega$

$C_1 = 1\text{ pF}$

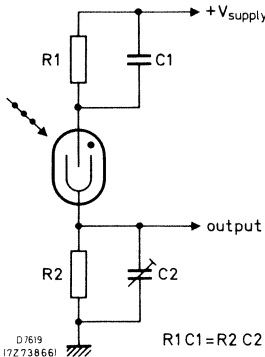
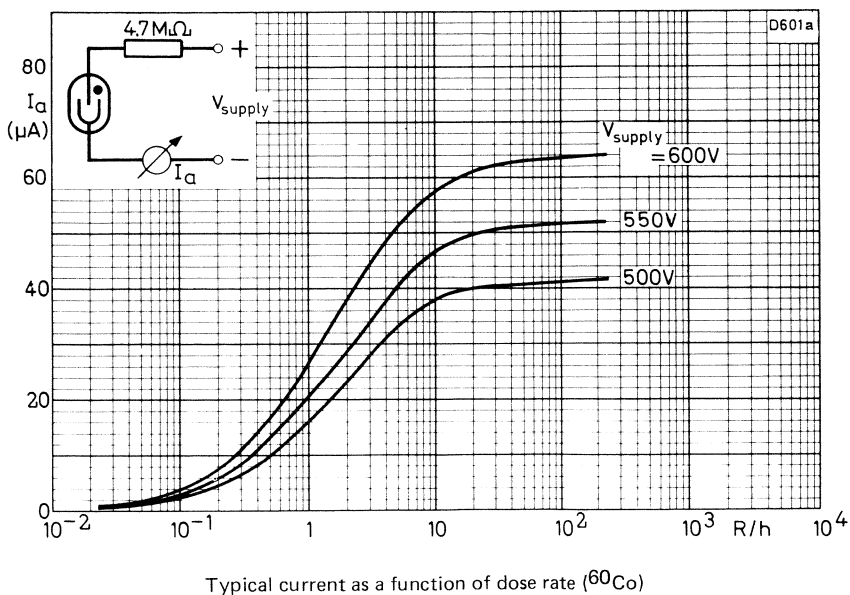
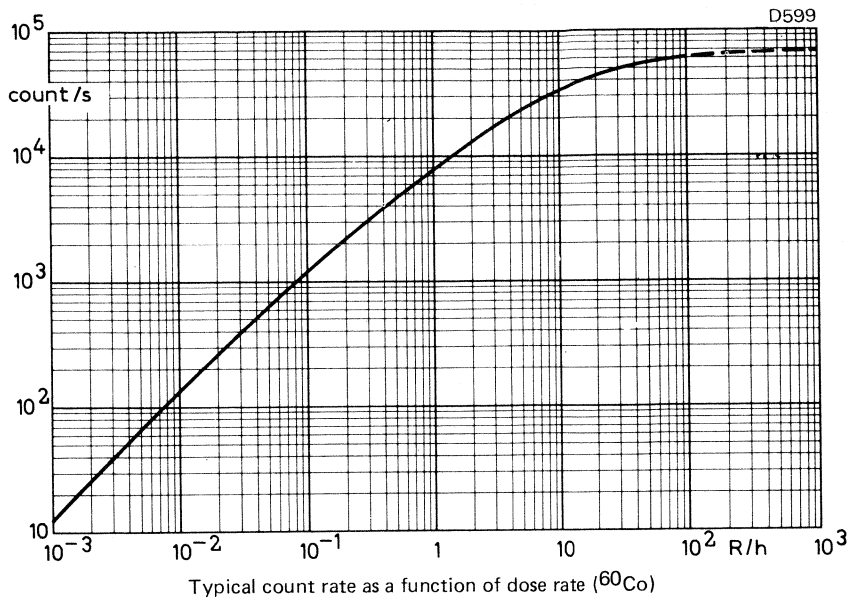
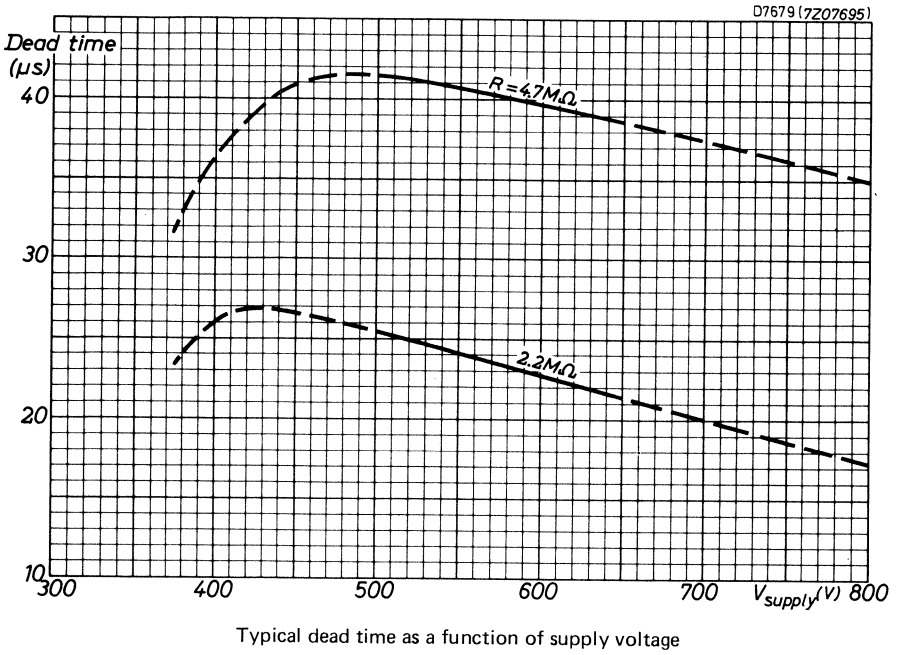


Fig.2





GEIGER-MÜLLER TUBE

Halogen quenched γ and β (>0.3 MeV) radiation counter tube for use in damp and/or saline atmosphere.

QUICK REFERENCE DATA

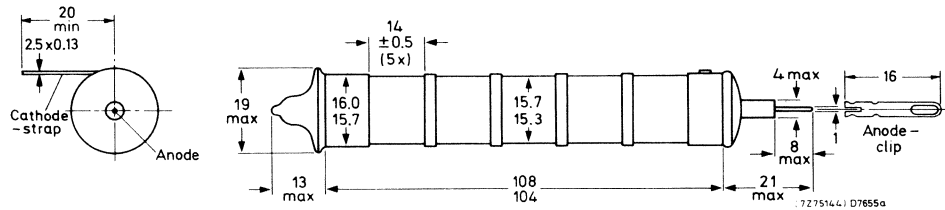
Dose rate range	10^{-3} to 10	R/h
Plateau threshold voltage	450	V
Plateau length	350	V
Recommended supply voltage	625	V
Chrome-iron cathode	40 to 60	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig. 1



The cathode is covered with a corrosion resistant coating.

Use only anode connector supplied with tube.

CATHODE

Construction	cylindrical wall with strengthening ribs	
Thickness between strengthening ribs	40 to 60	mg/cm ²
Sensitive length	75	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	4.0	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	400	V
Plateau threshold voltage	max.	450	V
Plateau length		350	V
Recommended supply voltage		625	V
Plateau slope	max.	0.02	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	30	count/min
Dead time, at recommended supply voltage	max.	70	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	800	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

$R = 2.2\text{ M}\Omega$

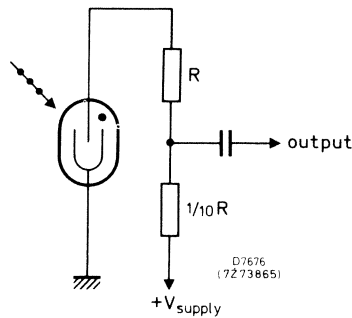
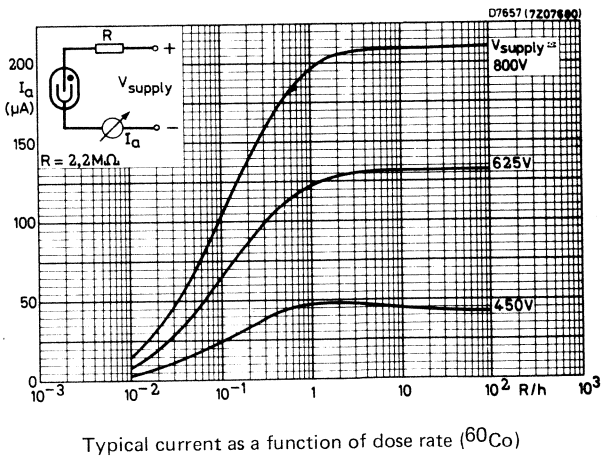
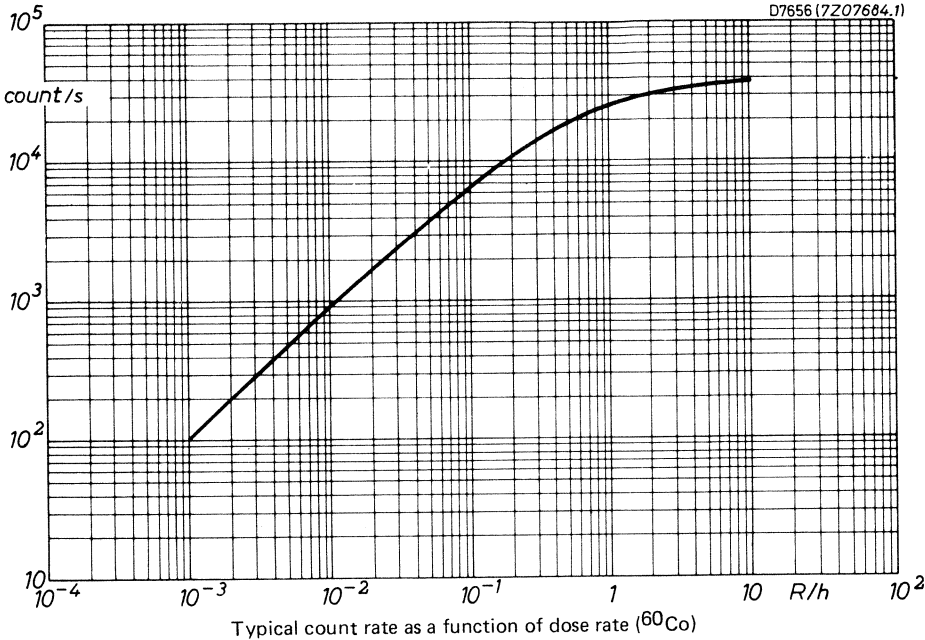
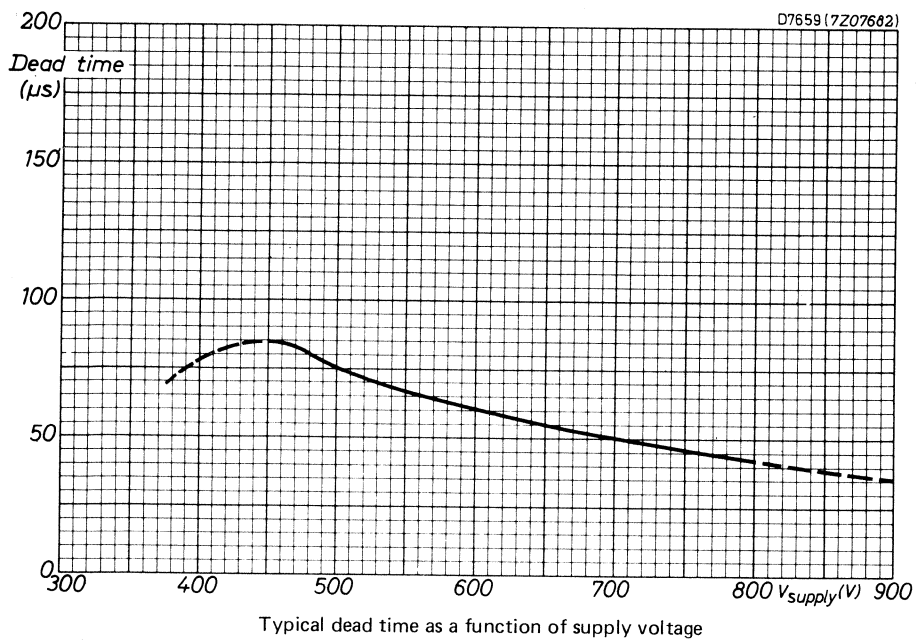


Fig.2





OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	325	V
Plateau threshold voltage	max.	400	V
Plateau length		200	V
Recommended supply voltage		500	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage			
	max.	10	count/min
Dead time, at recommended supply voltage	max.	90	μs

LIMITING VALUES (Absolute max. rating system).

Anode resistor	min.	4.7	MΩ
Anode voltage	max.	600	V
Ambient temperature			
continuous operating	max.	+70	°C
	min.	-40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C	5×10^{10}	count
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MEASURING CIRCUIT

- $R_1 = 10\text{ M}\Omega$
- $R_2 = 220\text{ k}\Omega$
- $C_1 = 1\text{ pF}$

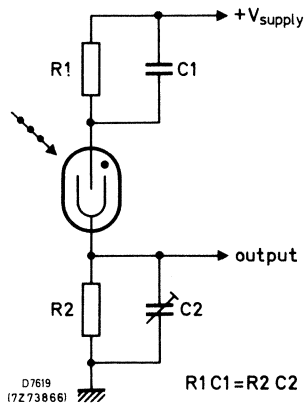
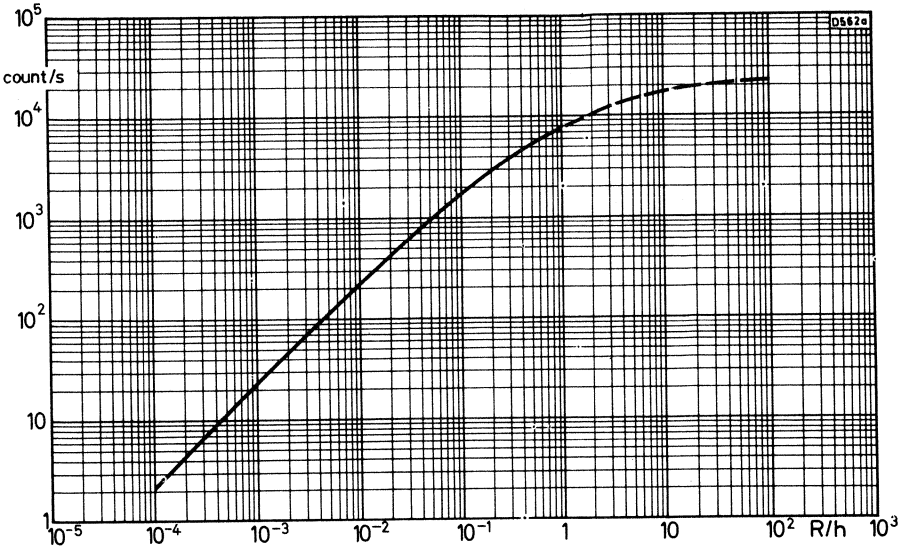
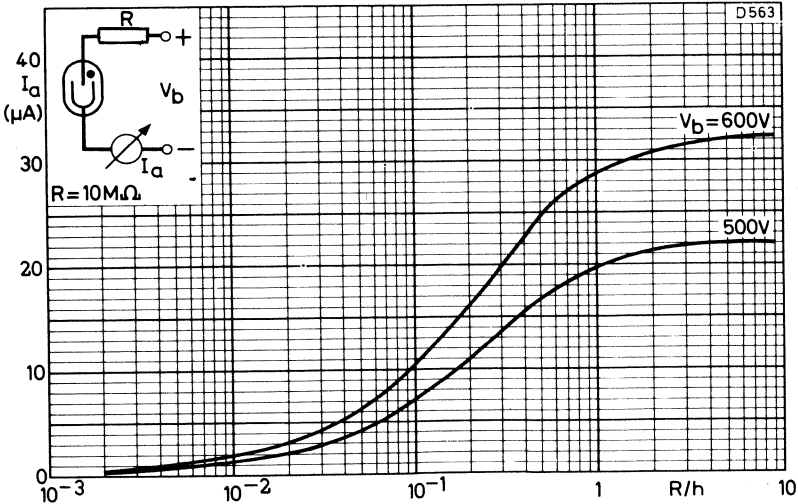


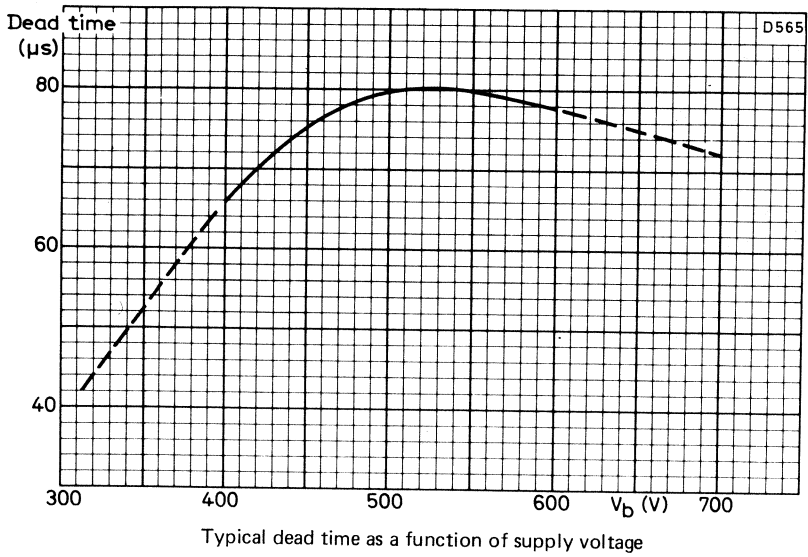
Fig.2



Typical count rate as a function of dose rate (⁶⁰Co)
(through the side wall)



Typical current as a function of dose rate (⁶⁰Co)



GEIGER-MÜLLER TUBE

End window halogen quenched α , β and γ radiation counter tube.

QUICK REFERENCE DATA

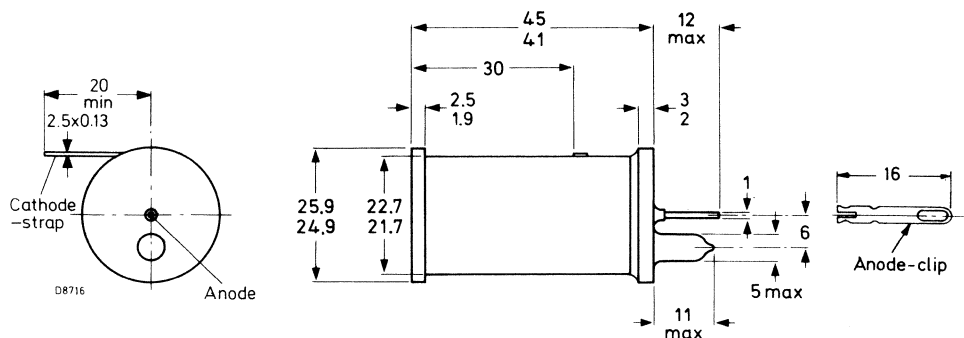
Dose rate range	10^{-4} to 3	R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	910	mg/cm ²
Mica window (19.8 mm diameter)	1.5 to 2.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	1.5 to 2.0	mg/cm ²
Useful diameter	19.8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm ²
Sensitive length	37	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode 2.5 pF

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.02	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	15	count/min.
Dead time, at recommended supply voltage	max.	175	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	700	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$ 5×10^{10} count

MEASURING CIRCUIT

$R = 10\text{ M}\Omega$

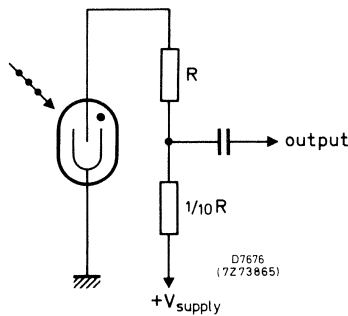
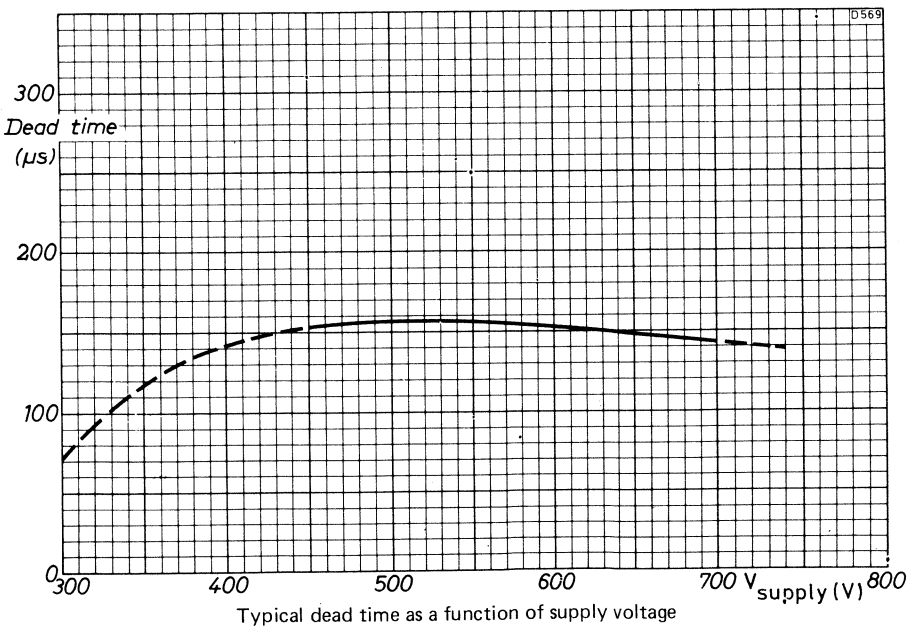
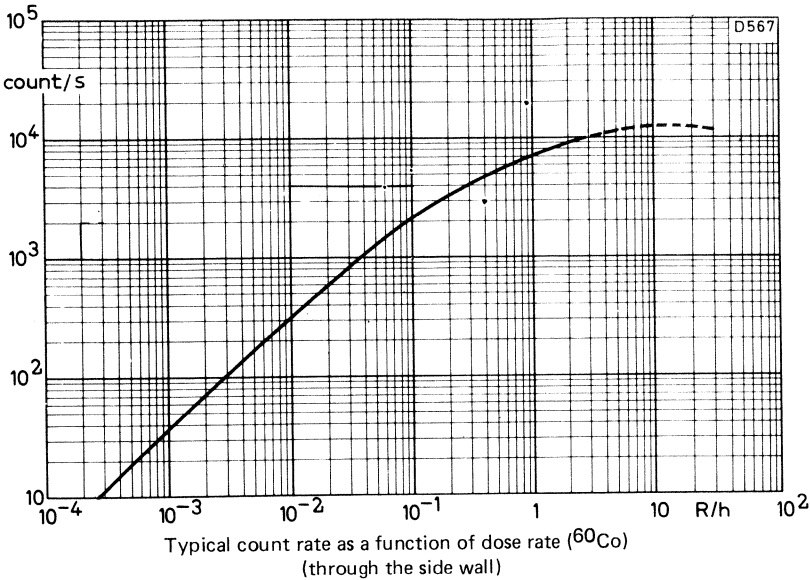


Fig.2



GEIGER-MÜLLER TUBE

End window halogen quenched α , β and γ radiation counter tube.

QUICK REFERENCE DATA

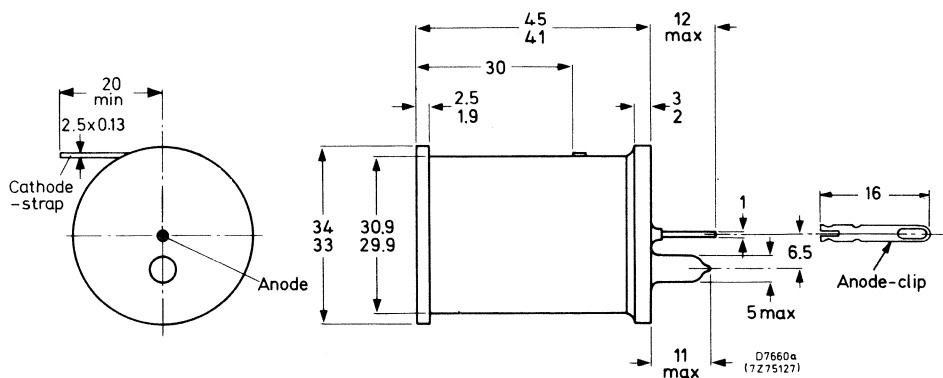
Dose rate range	10^{-4} to 2	R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	980	mg/cm ²
Mica window (27.8 mm diameter)	1.5 to 2.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	1.5 to 2.0	mg/cm ²
Useful diameter	27.8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm ²
Sensitive length	37	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode 3.5 pF

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	375	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	25	count/min
Dead time, at recommended supply voltage	max.	190	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	700	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$ 5×10^{10} count

MEASURING CIRCUIT

$R_1 = 10\text{ M}\Omega$
 $R_2 = 220\text{ k}\Omega$
 $C_1 = 1\text{ pF}$

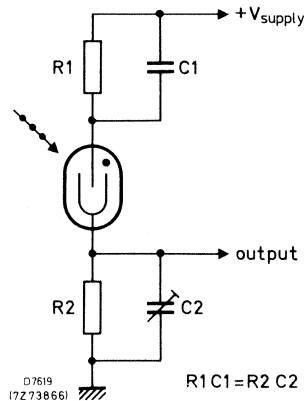
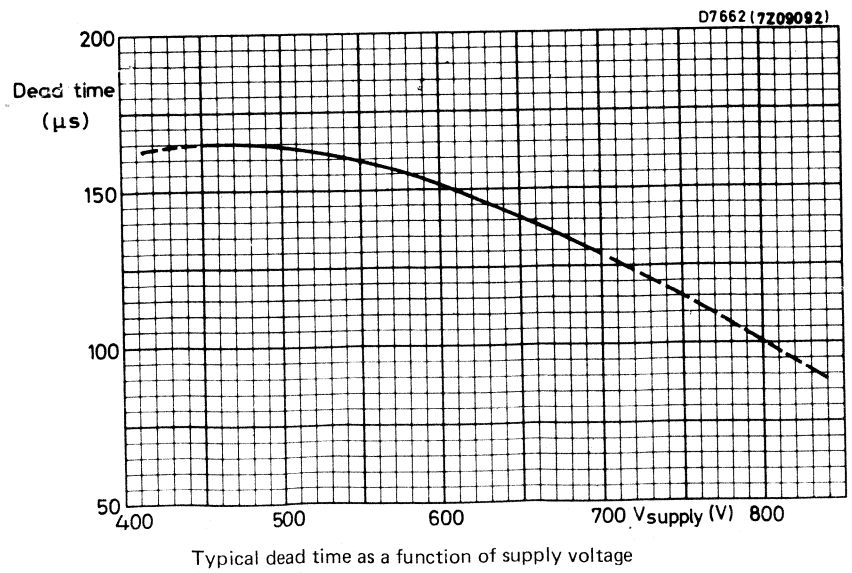
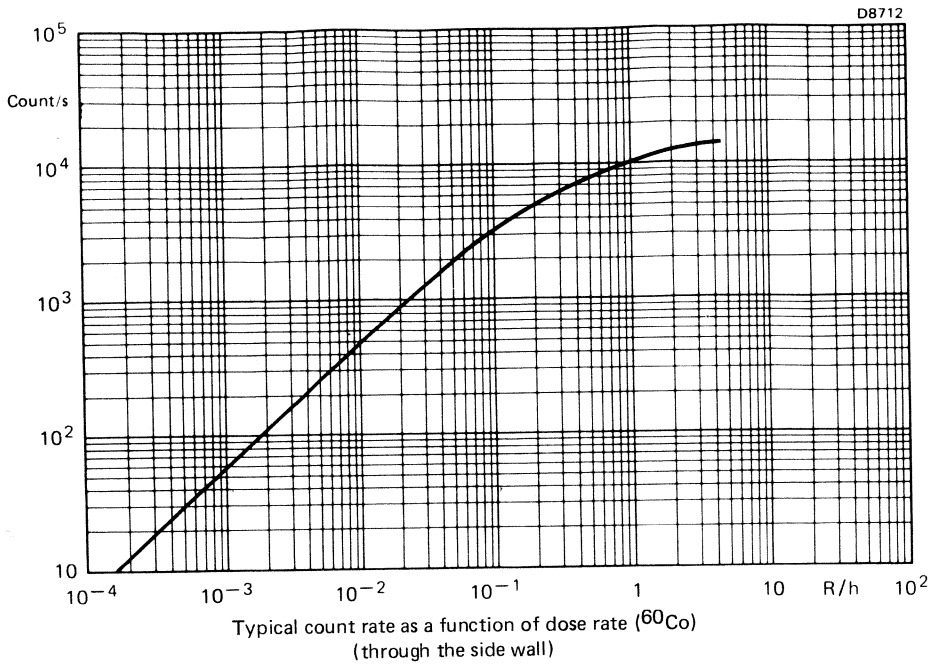
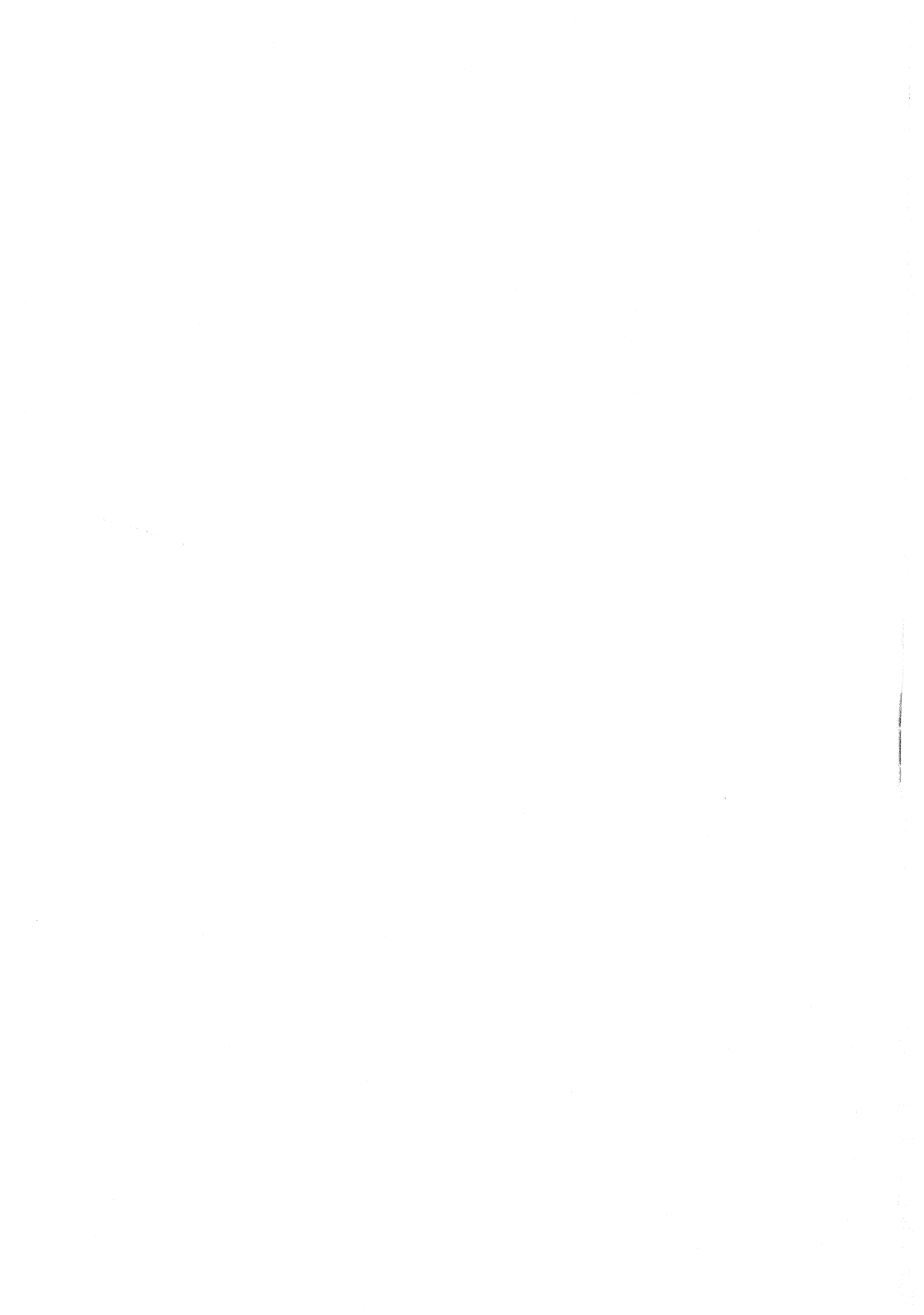


Fig.2





GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA

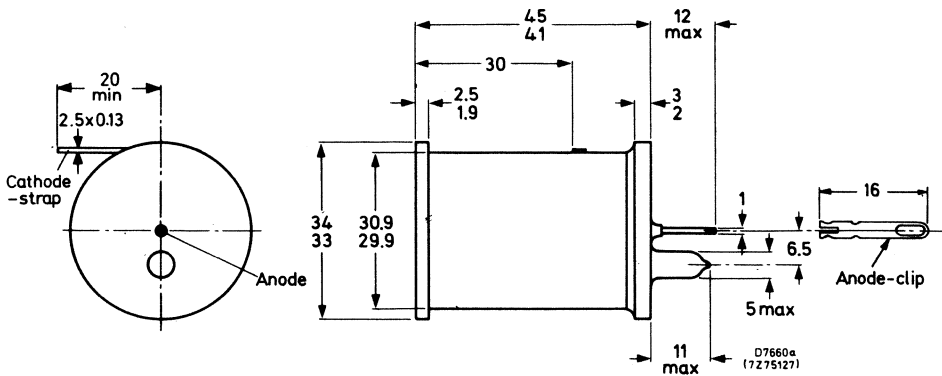
Dose rate range	10^{-4} to 2	R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	980	mg/cm ²
Mica window (27.8 mm diameter)	2.5 to 3.5	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	2.5 to 3.5	mg/cm ²
Useful diameter	27.8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm ²
Sensitive length	37	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	3.5	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	375	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	25	count/min
Dead time, at recommended supply voltage	max.	190	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	700	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

$R_1 = 10\text{ M}\Omega$

$R_2 = 220\text{ k}\Omega$

$C_1 = 1\text{ pF}$

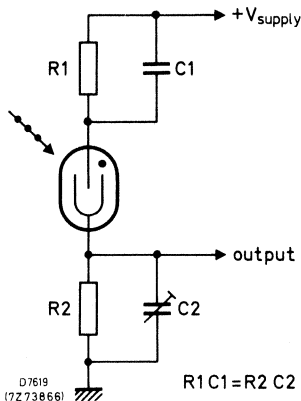
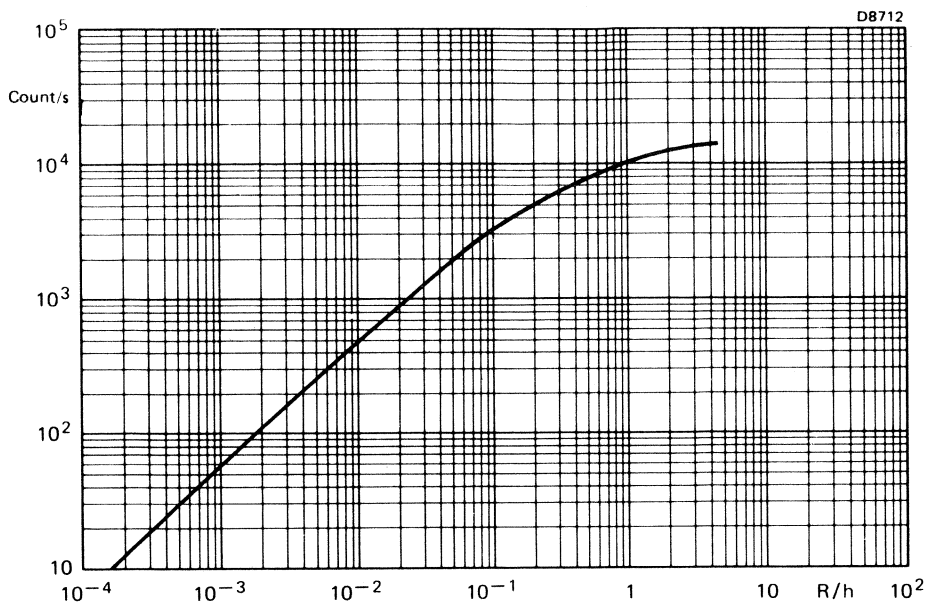
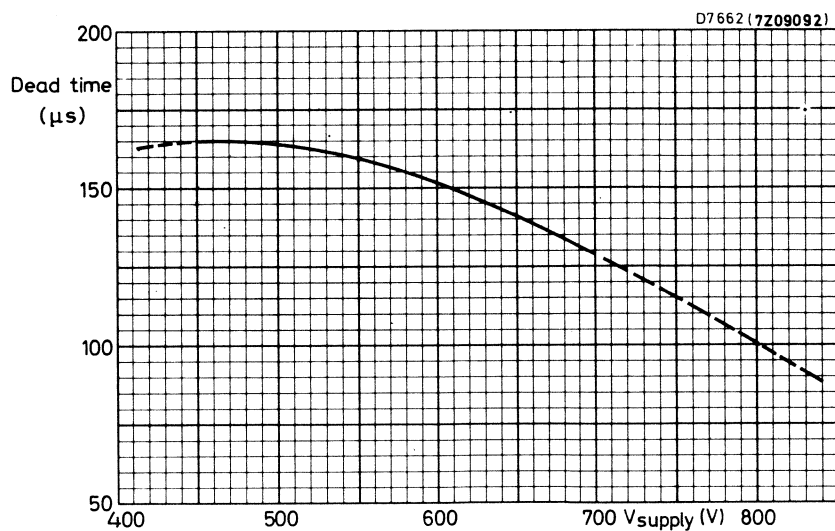


Fig.2



Typical count rate as a function of dose rate (⁶⁰Co)
(through the side wall)



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

End window halogen quenched α , β and γ radiation counter tube for measurement of low levels of radiation in combination with a guard counter tube, e.g. ZP1700.

QUICK REFERENCE DATA

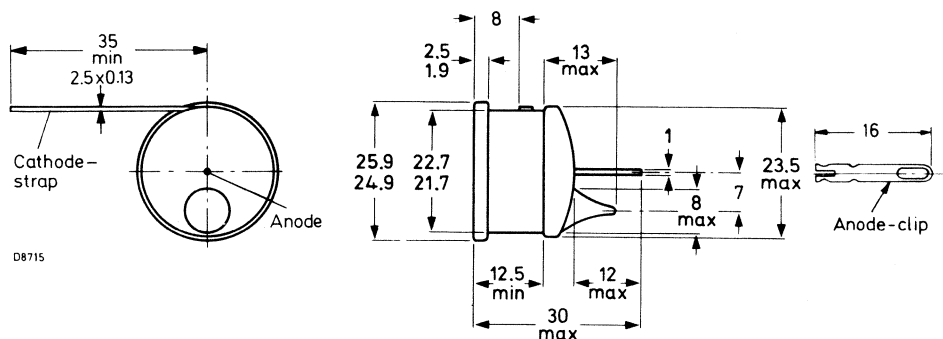
Dose rate range	10^{-2} to 10	R/h
Plateau threshold voltage	500	V
Plateau length	200	V
Recommended supply voltage	600	V
Chrome-iron cathode	910	mg/cm ²
Mica window (19.8 mm diameter)	1.5 to 2.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	1.5 to 2.0	mg/cm ²
Useful diameter	19.8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm ²
Sensitive length	12	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.0	pF
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OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	500	V
Plateau length		200	V
Recommended supply voltage		600	V
Plateau slope	max.	0.09	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	5	count/min
Background in anti-coincidence circuit with guard counter tube ZP1700 (shielded with 100 mm Fe and 30 mm Pb), at recommended supply voltage, Fe outside	max.	1.2	count/min
Dead time, at recommended supply voltage	max.	65	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	M Ω
Anode voltage	max.	700	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$

MEASURING CIRCUIT

- $R_1 = 4.7\text{ M}\Omega$
- $R_2 = 100\text{ k}\Omega$
- $C_1 = 1\text{ pF}$

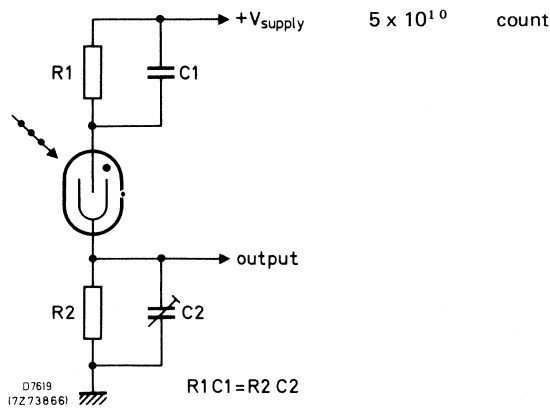
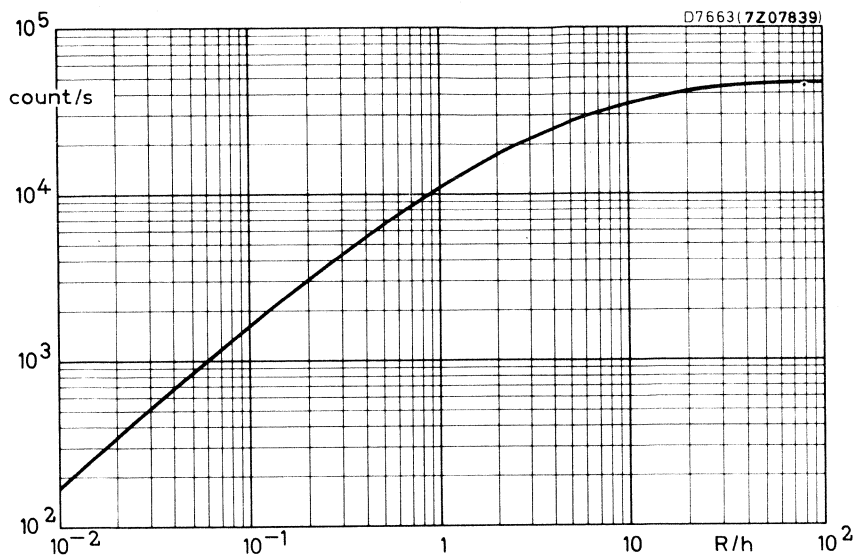
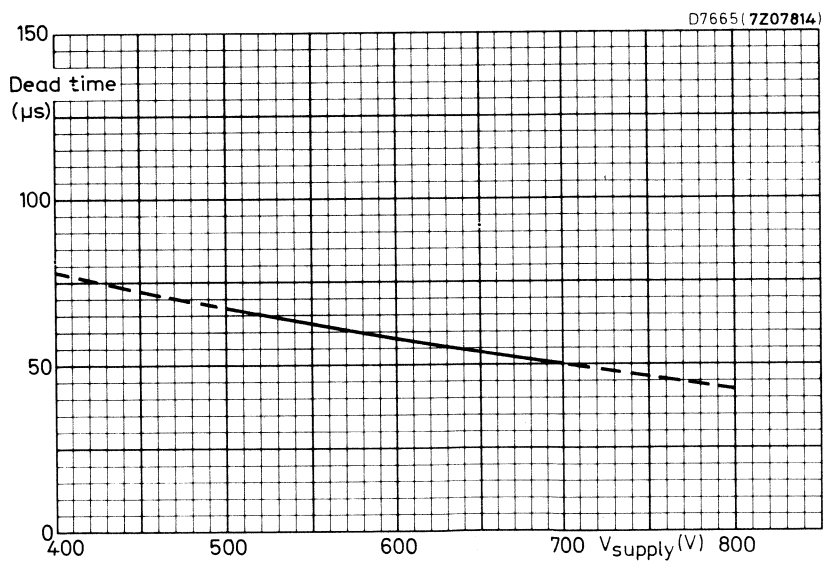


Fig.2

Typical count rate as a function of dose rate (^{60}Co)

Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA

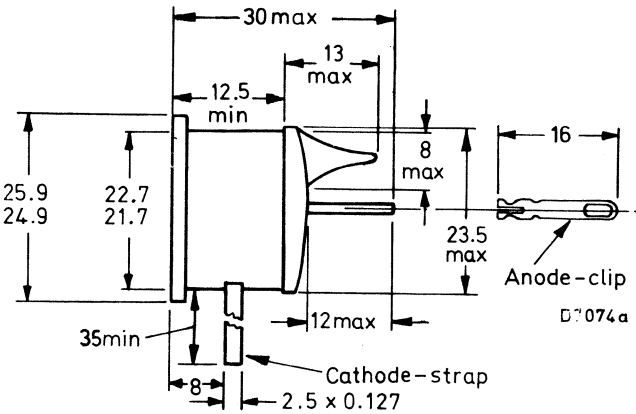
Dose rate range	10^{-2} to 10	R/h
Plateau threshold voltage	500	V
Plateau length	200	V
Recommended supply voltage	600	V
Chrome-iron cathode	910	mg/cm ²
Mica window (19.8 mm diameter)	2.0 to 3.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	2.0 to 3.0	mg/cm ²
Useful diameter	19.8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm ²
Sensitive length	12	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.0	pF
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OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^\circ\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	500	V
Plateau length		200	V
Recommended supply voltage		600	V
Plateau slope	max.	0.09	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	8	count/min
Dead time, at recommended supply voltage	max.	65	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	$\text{M}\Omega$
Anode voltage	max.	700	V
Ambient temperature continuous operating	max.	+70	$^\circ\text{C}$
	min.	-40	$^\circ\text{C}$
storage	max.	+75	$^\circ\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25^\circ\text{C}$	5×10^{10}	count
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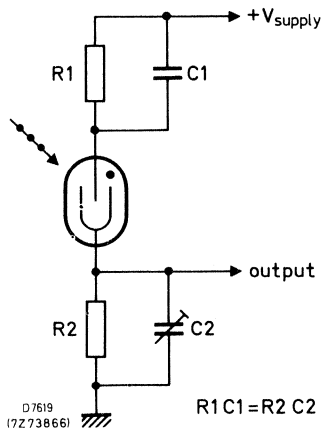
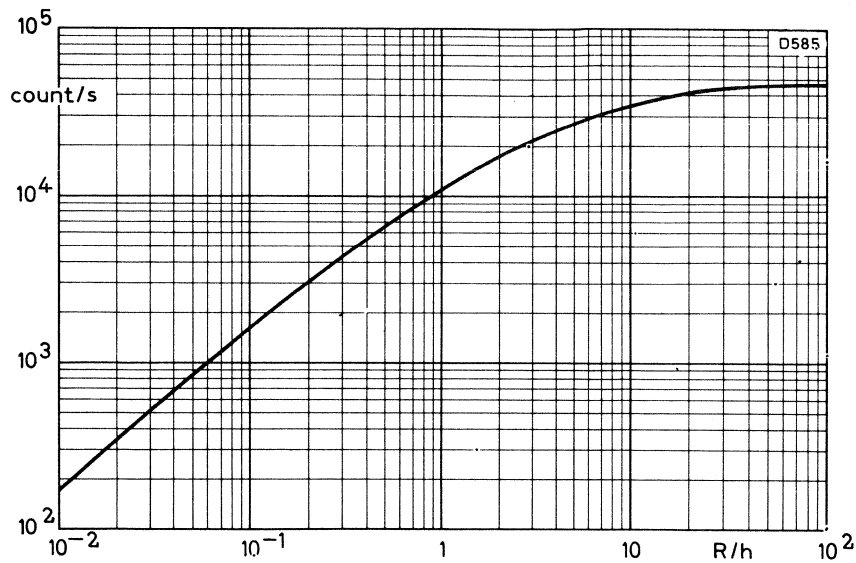
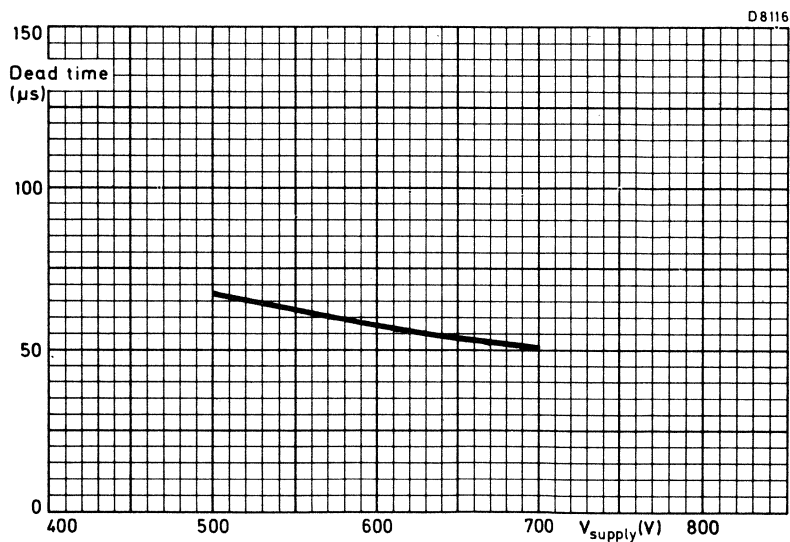
MEASURING CIRCUIT $R_1 = 4.7 \text{ M}\Omega$ $R_2 = 100 \text{ k}\Omega$ $C_1 = 1 \text{ pF}$ 

Fig.2

Typical count rate as a function of dose rate (^{60}Co)

Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

End window halogen quenched α , β and γ radiation counter tube for measurement of low levels of radiation in combination with a guard counter tube, e.g. ZP1700.

QUICK REFERENCE DATA

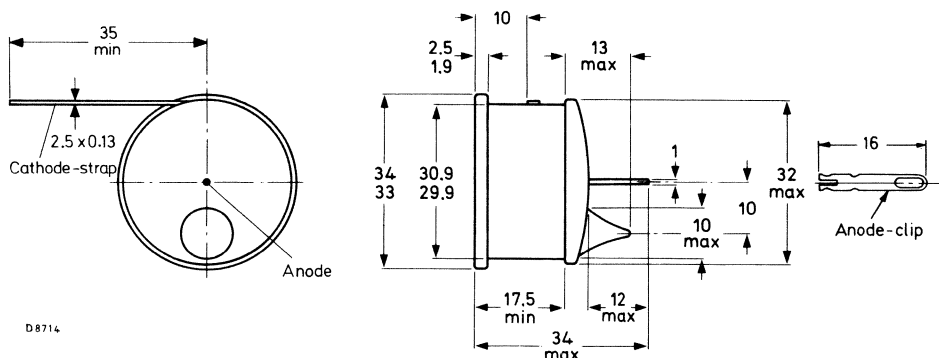
Dose rate range	10^{-4} to 3	R/h
Plateau threshold voltage	500	V
Plateau length	250	V
Recommended supply voltage	625	V
Chrome-iron cathode	980	mg/cm ²
Mica window (27.8 mm diameter)	1.5 to 2.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	1.5 to 2.0	mg/cm ²
Useful diameter	27.8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm ²
Sensitive length	16	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode 1.4 pF

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^\circ\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	375	V
Plateau threshold voltage	max.	500	V
Plateau length		250	V
Recommended supply voltage		625	V
Plateau slope	max.	0.07	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	9	count/min
Background in anti-coincidence circuit with guard counter tube ZP1700 (shielded with 100 mm Fe and 30 mm Pb), at recommended supply voltage, Fe outside	max.	2	count/min
Dead time, at recommended supply voltage	max.	60	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	750	V
Ambient temperature continuous operating	max.	+70	$^\circ\text{C}$
	min.	-40	$^\circ\text{C}$
storage	max.	+75	$^\circ\text{C}$

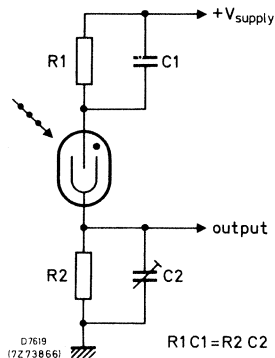
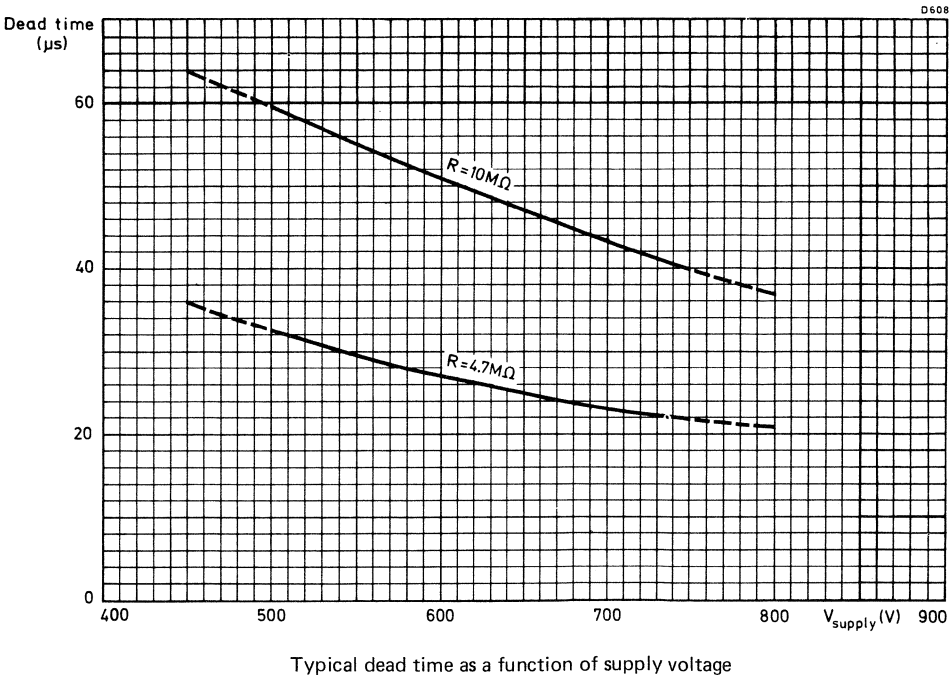
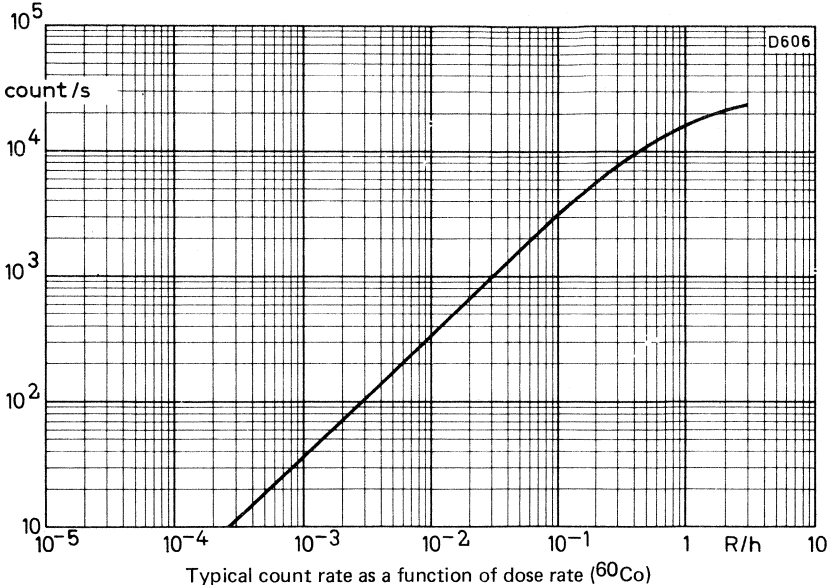
LIFE EXPECTANCYLife expectancy at $\approx 25^\circ\text{C}$ 5×10^{10} count**MEASURING CIRCUIT** $R_1 = 10 \text{ M}\Omega$ $R_2 = 220 \text{ k}\Omega$ $C_1 = 1 \text{ pF}$ 

Fig.2



GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA

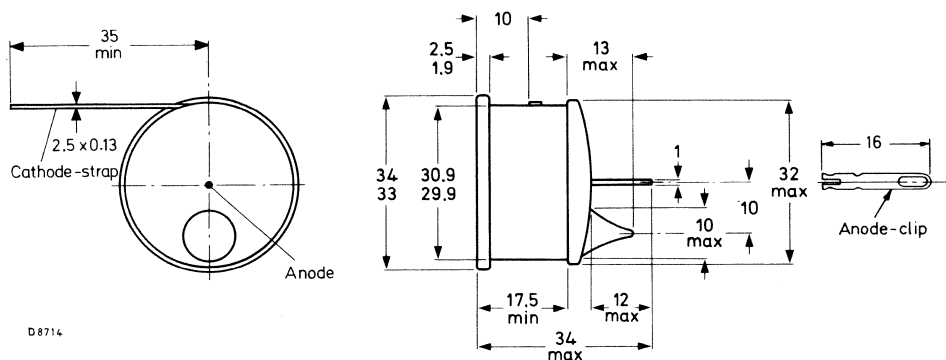
Dose rate range	10^{-4} to 3	R/h
Plateau threshold voltage	500	V
Plateau length	250	V
Recommended supply voltage	625	V
Chrome-iron cathode	980	mg/cm ²
Mica window (27.8 mm diameter)	2.0 to 3.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig. 1



Use only anode connector supplied with tube.

WINDOW

Thickness	2.0 to 3.0	mg/cm ²
Useful diameter	27.8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm ²
Sensitive length	16	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.4	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	375	V
Plateau threshold voltage	max.	500	V
Plateau length		250	V
Recommended supply voltage		625	V
Plateau slope	max.	0.07	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	18	count/min
Dead time, at recommended supply voltage	max.	60	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	750	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

- $R_1 = 10\text{ M}\Omega$
- $R_2 = 220\text{ k}\Omega$
- $C_1 = 1\text{ pF}$

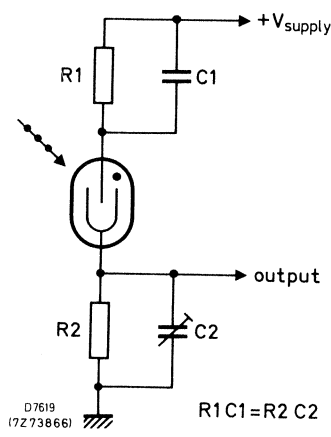
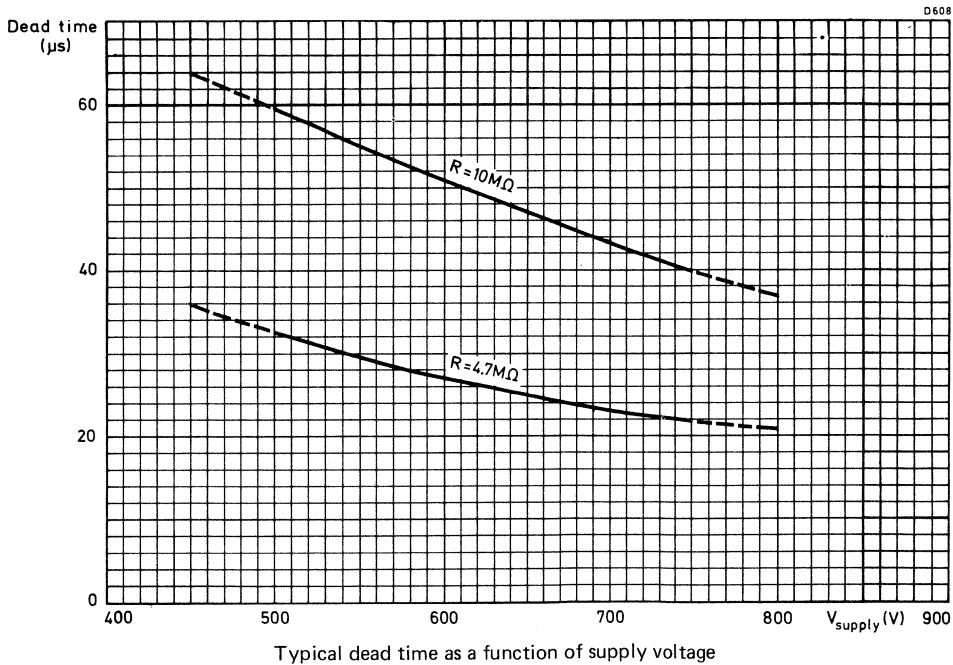
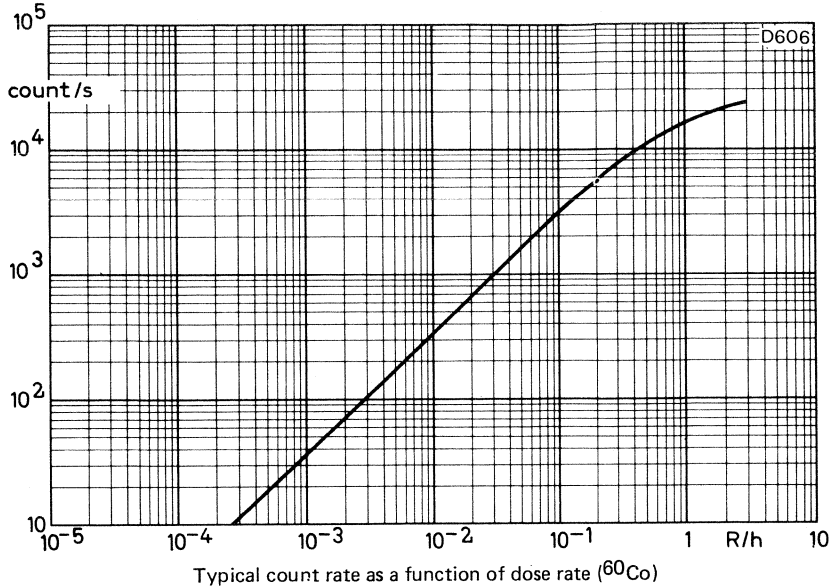


Fig.2



GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA

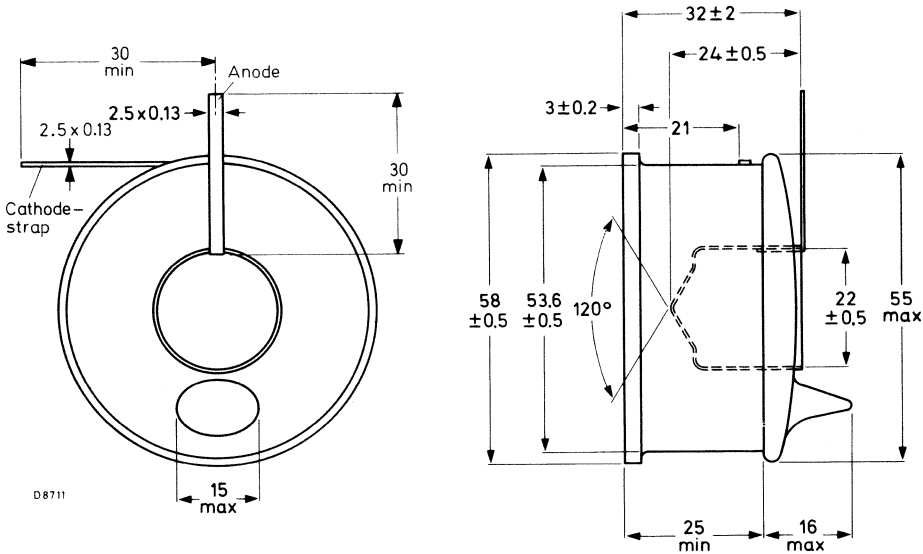
Dose rate range	3×10^{-2} to 10^2	mR/h
Plateau threshold voltage	700	V
Plateau length	400	V
Recommended supply voltage	900	V
Chrome-iron cathode	950	mg/cm ²
Mica window (51 mm diameter)	3.5 to 4.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	3.5 to 4.0	mg/cm ²
Useful diameter	51	mm
Material	mica	

CATHODE

Thickness	950	mg/cm ²
Sensitive length	22	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	5.0	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^\circ\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	400	V
Plateau threshold voltage	max.	700	V
Plateau length		400	V
Recommended supply voltage		900	V
Plateau slope	max.	0.04	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage			
	max.	45	count/min
Dead time, at recommended supply voltage	max.	45	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	3.9	M Ω
Anode voltage	max.	1100	V
Ambient temperature			
continuous operating	max.	+70	$^\circ\text{C}$
	min.	-70	$^\circ\text{C}$
storage	max.	+75	$^\circ\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25^\circ\text{C}$	5×10^{10}	count
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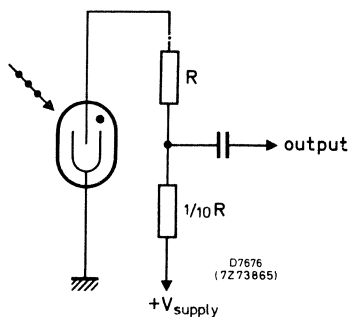
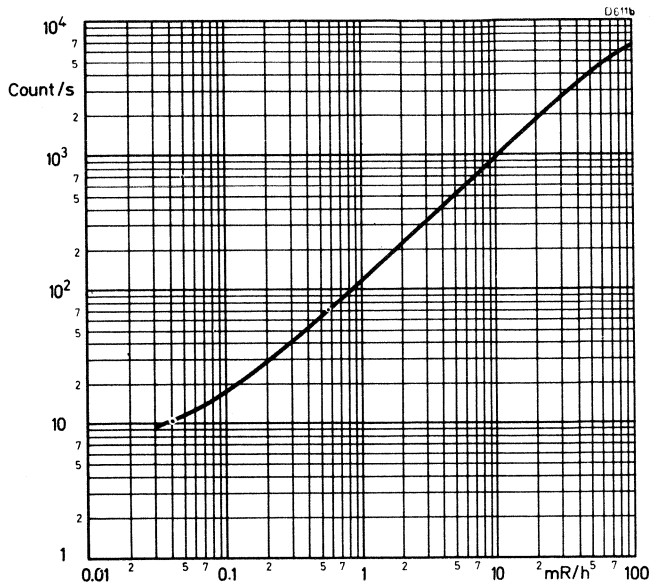
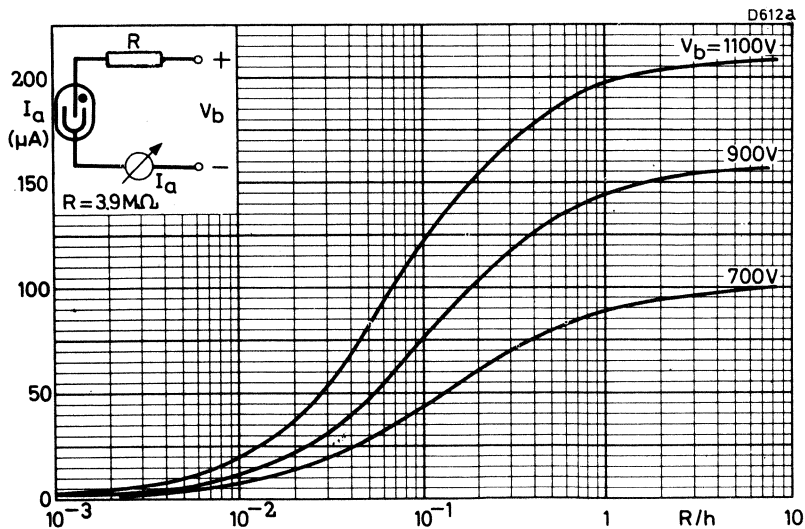
MEASURING CIRCUITR = 4.7 M Ω 

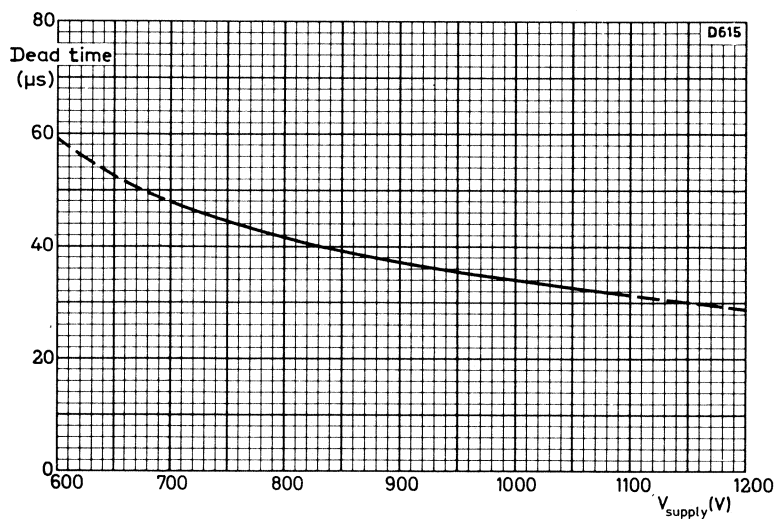
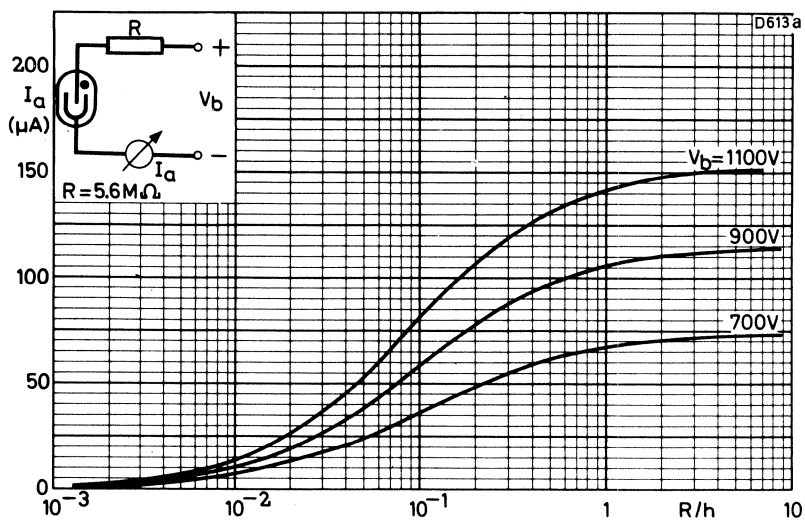
Fig.2



Typical count rate as a function of dose rate (⁶⁰Co)



Typical current as a function of dose rate (⁶⁰Co)



GEIGER-MÜLLER TUBES

End window halogen quenched β and γ radiation counter tubes.

QUICK REFERENCE DATA

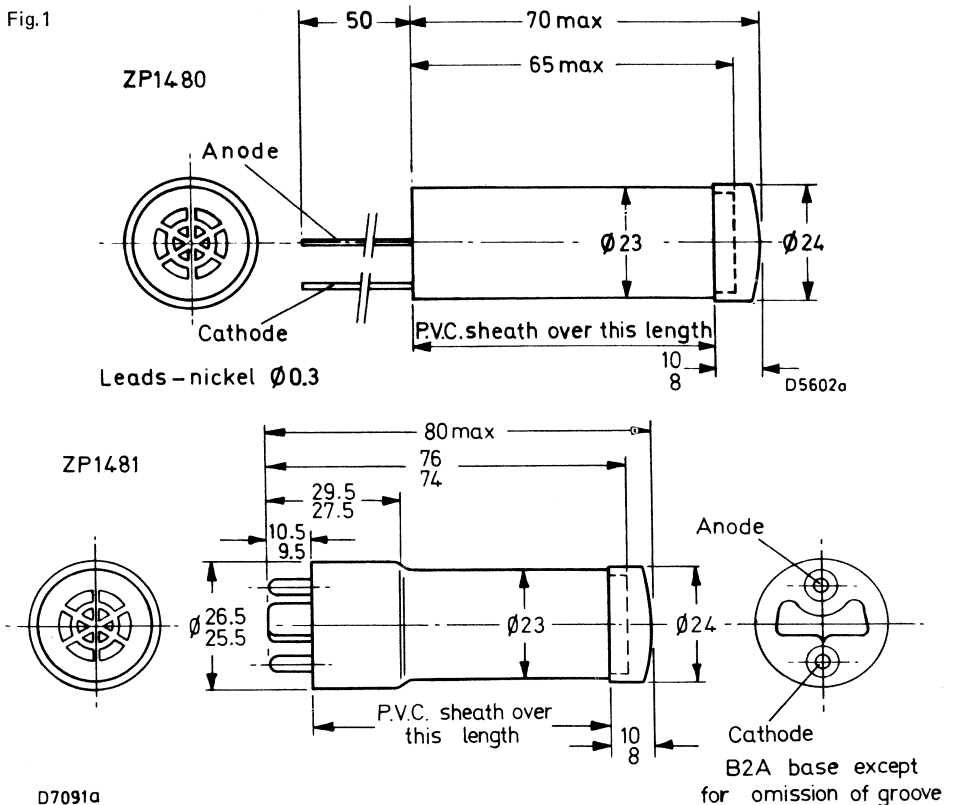
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	1600	mg/cm ²
Mica window (17 mm diameter)	2.5 to 3.0	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



The ZP1481 may be used with socket type number MX199/socket

ZP1480

ZP1481

WINDOW

Thickness	2.5 to 3.0	mg/cm ²
Useful diameter	17	mm
Material	mica	

CATHODE

Thickness	2.6	mm
Sensitive length	38	mm
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	3.5	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	350	V
Plateau threshold voltage	max.	400	V
Plateau length		100	V
Recommended supply voltage		450	V
Plateau slope	max.	0.2	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	30	count/min
Dead time, at recommended supply voltage	max.	120	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.7	M Ω
Anode voltage	max.	500	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUIT

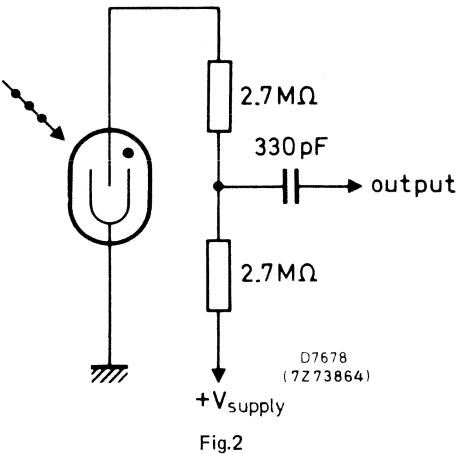
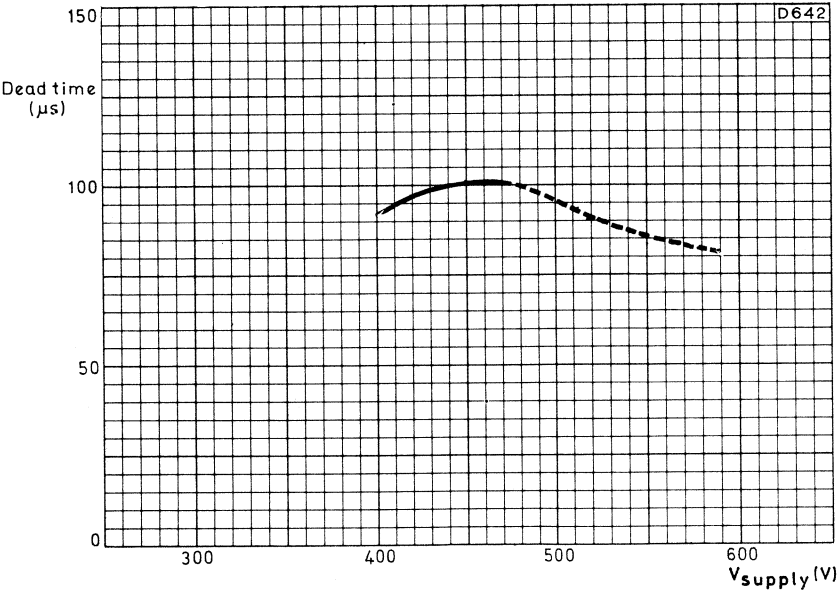


Fig.2



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

End window halogen quenched X-ray counter tube.

QUICK REFERENCE DATA

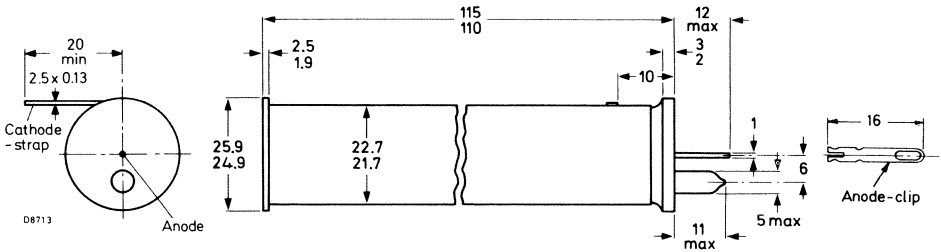
Energy range	6.0 to 20	keV
Wavelength range	0.06 to 0.2	nm
Plateau threshold voltage	1600	V
Plateau length	400	V
Recommended supply voltage	1800	V
Chrome-iron cathode	910	mg/cm ²
Mica window (19.8 mm diameter)	2.5 to 3.5	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	2.5 to 3.5	mg/cm ²
Useful diameter	19.8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm ²
Sensitive length	107	mm
Material	chrome-iron	

FILLING

	neon, halogen	
Gas pressure*	80	kPa

*Caution, transport by air to be in a hermetically sealed container.

CAPACITANCE

Anode to cathode	2.8	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	1450	V
Plateau threshold voltage	max.	1600	V
Plateau length		400	V
Recommended supply voltage		1800	V
Plateau slope	max.	0.07	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al), at recommended supply voltage	max.	25	count/min
Dead time, at recommended supply voltage	max.	110	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	$\text{M}\Omega$
Anode voltage	max.	2000	V
Ambient temperature continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	0	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	10^{10}	count
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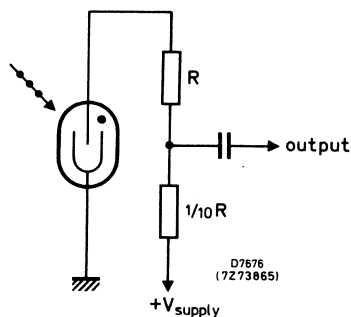
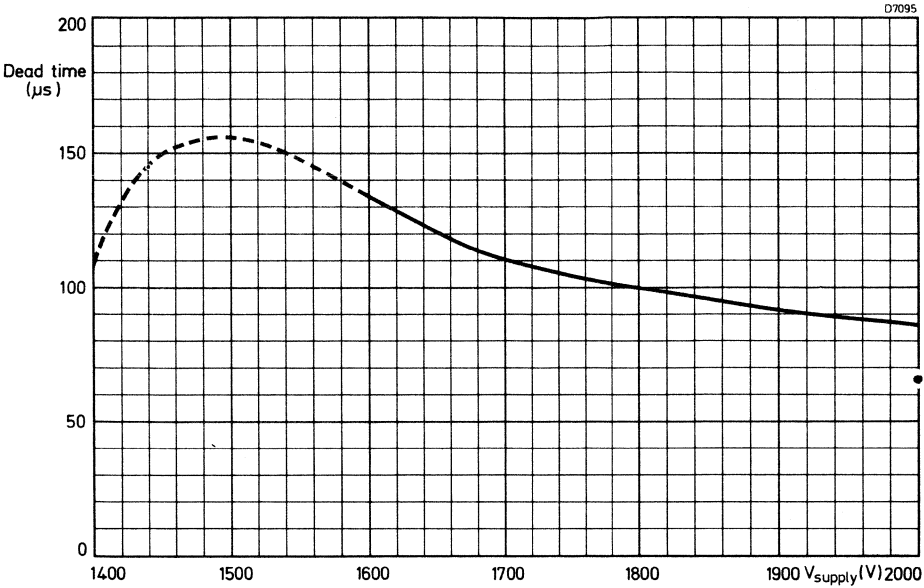
MEASURING CIRCUIT $R = 4.7\text{ M}\Omega$ 

Fig.2



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

Side window organically quenched X-ray counter tube.

QUICK REFERENCE DATA

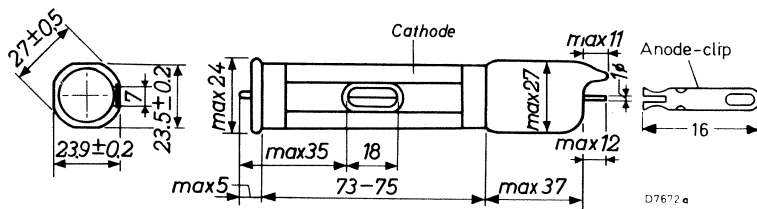
Energy range	2.5 to 40	keV
Wavelength range	0.03 to 0.5	nm
Operating voltage range	1500 to 1800	V
Chrome-iron cathode		
Mica window (7 x 18 mm)	2.0 to 2.5	mg/cm ²

This data must be read in conjunction with 'General operational recommendations — Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



Use only anode connector supplied with tube.

WINDOW

Thickness	2.0 to 2.5	mg/cm ²
Dimensions	7 x 18	mm
Material	mica	

CATHODE

Sensitive length	67	mm
Material	chrome-iron	

FILLING

	xenon and organic vapour	
Gas pressure*	40	kPa

CAPACITANCE

Anode to cathode	2.0	pF
------------------	-----	----

*Caution, transport by air to be in a hermetically sealed container.

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25^\circ\text{C}$)

Measured in circuit of Fig.2

Recommended supply voltage (note 1)	1550	V
Geiger threshold voltage	min. 1900	V
Operating voltage for pulse amplitude where $V_p \approx 1\text{ mV}$ (note 2)	1460 to 1540	V
Operating voltage for pulse amplitude where $V_p \approx 10\text{ mV}$ (note 2)	1690 to 1770	V
Energy resolution (notes 2 and 3) see page 3	22	%

LIMITING VALUES (Absolute max. rating system)

Anode voltage	max. 1850	V
Ambient temperature continuous operating	max. +50 min. -20	$^\circ\text{C}$
storage	max. +50	$^\circ\text{C}$

MEASURING CIRCUIT

$R_1 = 2.2\text{ k}\Omega$

$R_2 = 100\text{ k}\Omega$

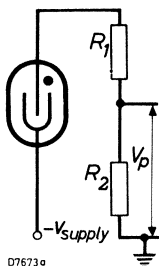
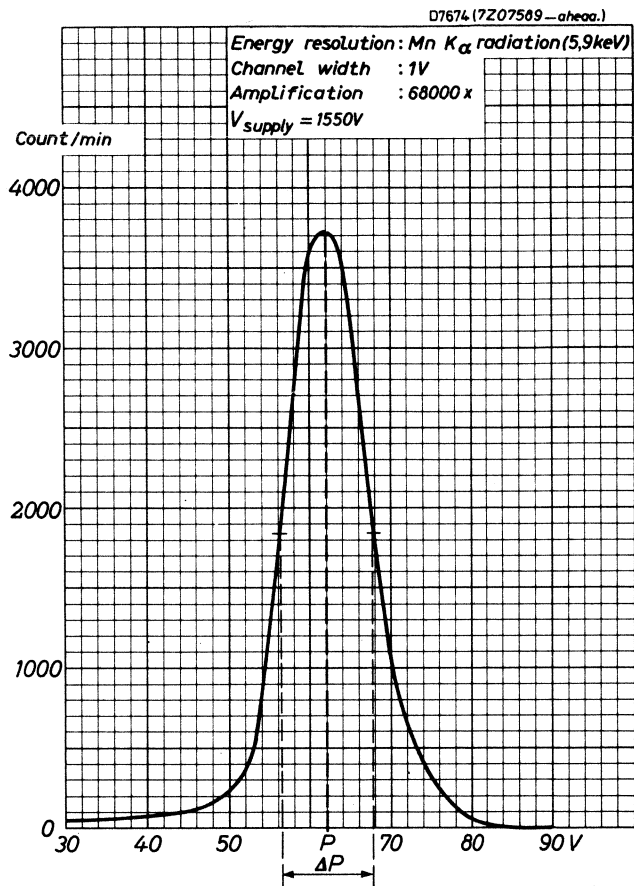


Fig.2

NOTES

1. For maximum tube life, the supply voltage should be kept as low as possible.
2. For Mn $K\alpha$ radiation (5.9 keV)
3. P = average pulse height, ΔP = width of pulse height at half maximum value.



Typical energy resolution curve

GEIGER-MÜLLER TUBE

Halogen quenched cosmic ray guard counter tube for low background measurements in combination with radiation counter tube ZP1441 or ZP1451 in an anti-coincidence circuit.

QUICK REFERENCE DATA

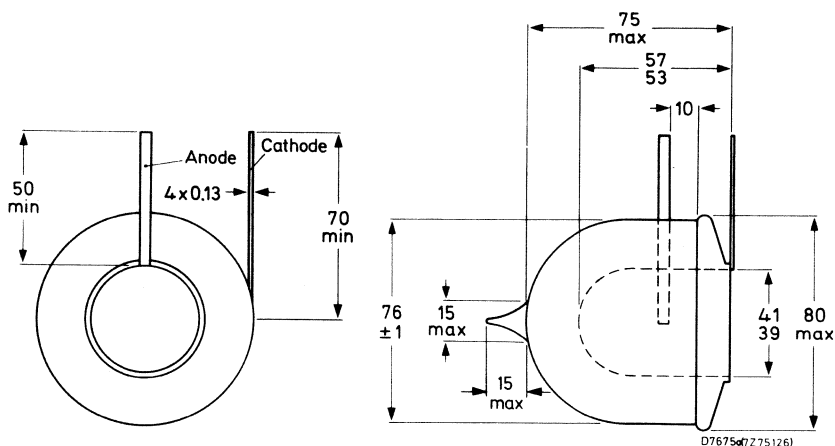
Dose rate range	4×10^{-2} to 10	mR/h
Plateau threshold voltage	800	V
Plateau length	400	V
Recommended supply voltage	1000	V
Chrome-iron cathode	760	mg/cm ²

This data must be read in conjunction with 'General operational recommendations – Geiger-Müller tubes'.

MECHANICAL DATA

Dimensions in mm

Fig.1



CATHODE AND ANODE

Thickness	760	mg/cm ²
Material	chrome-iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	8.0	pF
------------------	-----	----

OPERATING CHARACTERISTICS (Ambient temperature $\approx 25\text{ }^{\circ}\text{C}$)

Measured in circuit of Fig.2

Starting voltage	max.	650	V
Plateau threshold voltage	max.	800	V
Plateau length		400	V
Recommended supply voltage		1000	V
Plateau slope	max.	0.03	%/V
Background (shielded with 100 mm Fe with ari inner liner of 30 mm Pb), at recommended supply voltage, Fe outside	max.	70	count/min
Dead time, at recommended supply voltage	max.	1	ms

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	10	M Ω
Anode voltage	max.	1200	V
Ambient temperature			
continuous operating	max.	+70	$^{\circ}\text{C}$
	min.	-40	$^{\circ}\text{C}$
storage	max.	+75	$^{\circ}\text{C}$

LIFE EXPECTANCY

Life expectancy at $\approx 25\text{ }^{\circ}\text{C}$	5×10^{10}	count
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MEASURING CIRCUITS

For use as a guard counter tube in an anti-coincidence in combination with ZP1441 or ZP1451, see Fig.3.

$R = 10\text{ M}\Omega$

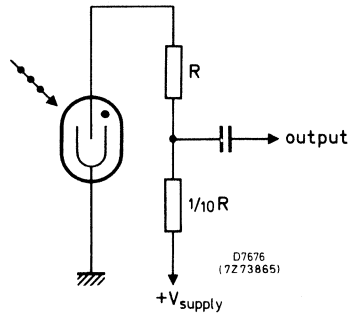


Fig.2

$R_1 = R_2 = 10\text{ M}\Omega$

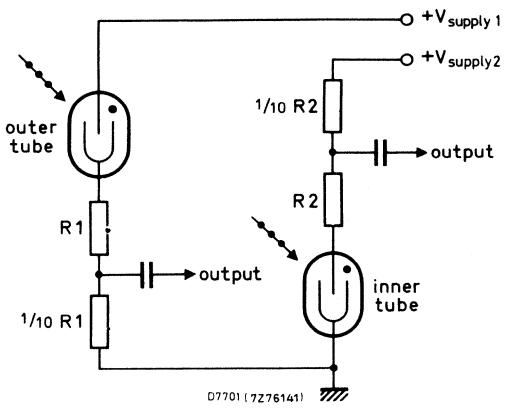
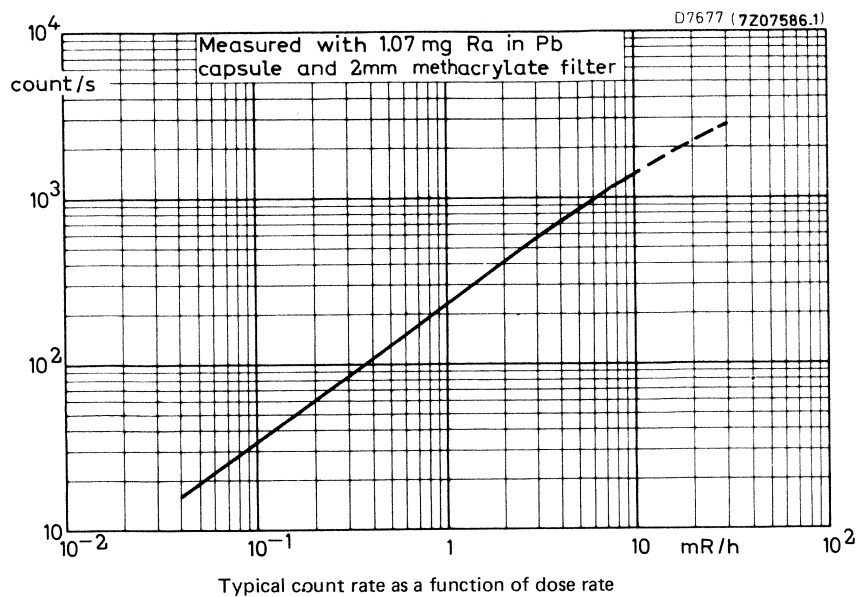


Fig.3



INDEX

Type No.

ZP1200

ZP1210

ZP1220

ZP1300

ZP1310

ZP1311

ZP1320

ZP1330

ZP1400

ZP1410

ZP1430

ZP1431

ZP1441

ZP1442

ZP1451

ZP1452

ZP1460

ZP1480

ZP1481

ZP1600

ZP1610

ZP1700

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